



Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

2022 _____ Annual Report

SCIENCE

**EYENZULULWAZI NGEZENDALO
NATUURWETENSKAPPE**

forward together • sonke siya phambili • saam vorentoe



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Value Statement

The Faculty of Science



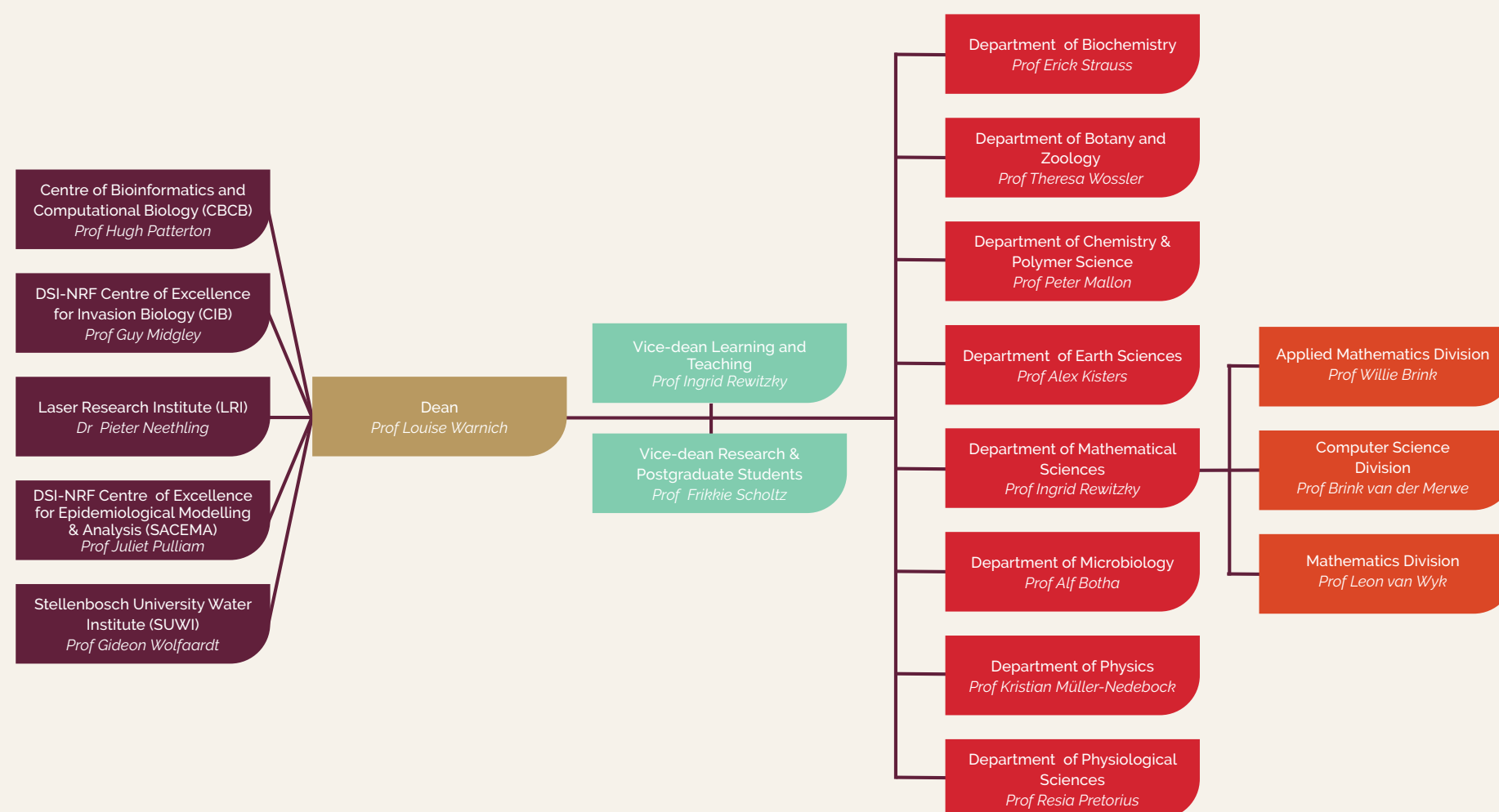
Plays a significant role in positioning SU as a **leading research-intensive university through excellent research outputs with impact**, produced by acclaimed researchers.



Provides **general formative education in the natural sciences to students in Science** and other faculties to prepare our students for the future world of work and research.



Impacts on **societies and communities through various actions and projects related to the expertise in the Faculty**, often in alliance and collaboration with research councils, governmental organisations, and industry partners.



2022 at a glance

Student Profile



Innovation

InnovUS Innovation award for most granted patents and most spinout companies in 2022

- Fluorobiotech
- Nanosense
- Scientia Products

Actual postgraduate student enrolments

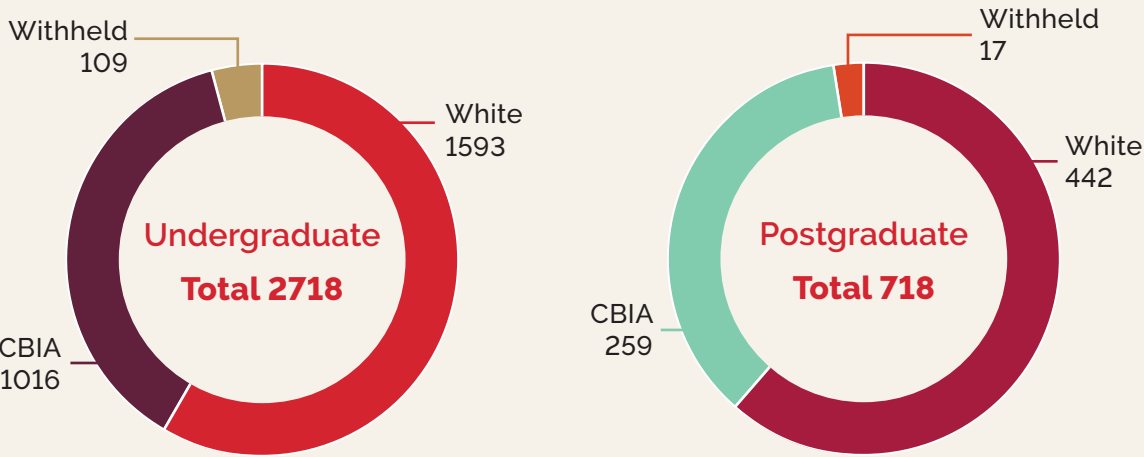
Year	Honours	Master's	Structured Master's (AIMS)	PhD	DSc	Total*
2022	214	264	23	216	1	718

Graduation of Honours, Master's and Doctoral students expressed as percentage of total enrolments in 2022

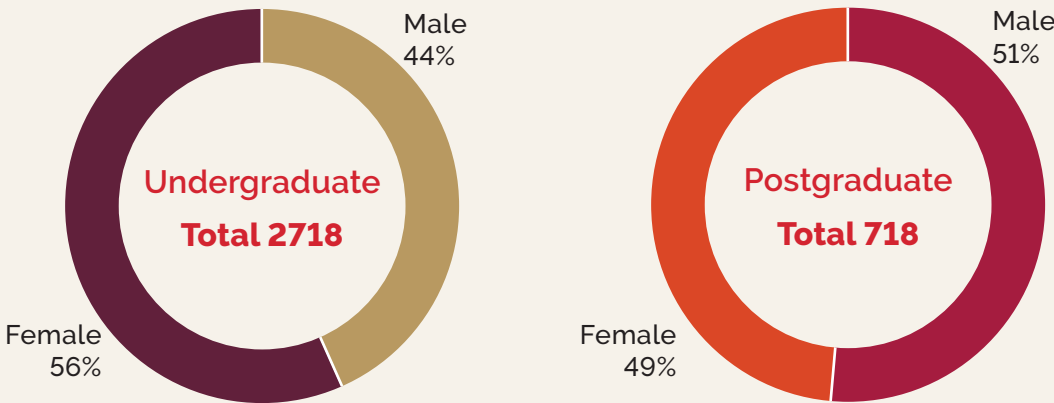
Year	Honours	% of enrolment	Master's	% of enrolment	Doctorate	% of enrolment
2022	175	82%	107	41%	48	21%

2022 Student demographic Profile:

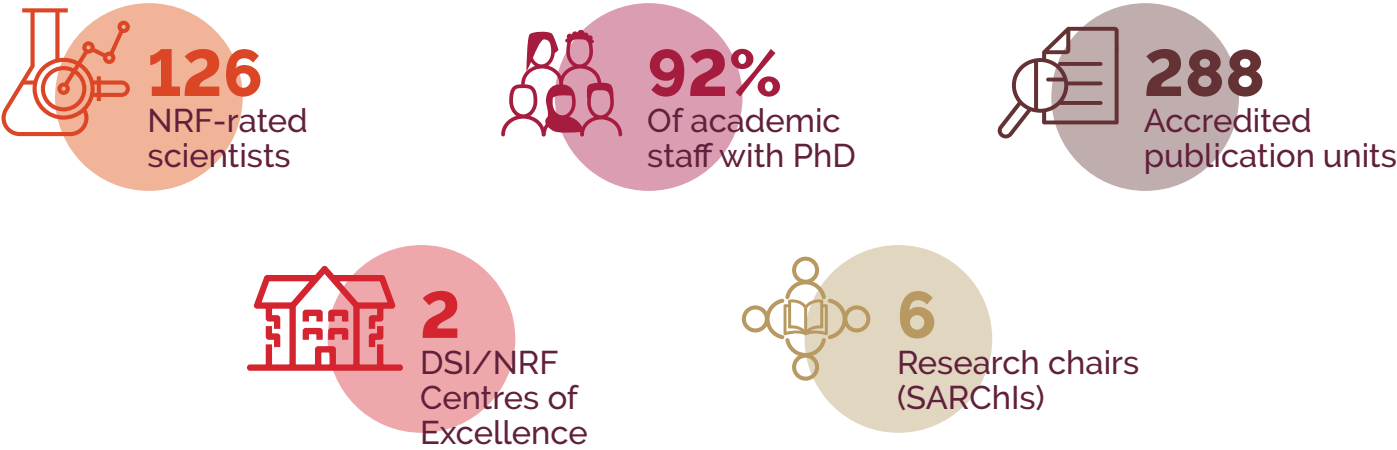
race



gender



Academic Profile



From the Dean's Office



During 2022 the Faculty of Science's staff and students had to find their feet in a post-pandemic world. Albeit off to a careful start, activities picked up quickly and it was a great relieve to see academic and student life returning to our lovely campus.

I am happy to report on some of the highlights from the past year.

Prof Frikkie Scholtz, Vice-Dean of Research, took the initiative to organise the first SU Faculty of Science Postgraduate Research Conference. The conference provided a platform for MSc and PhD students to present their research to a wider audience. This will now become an annual event.

We were pleased to be part of the Nobel in Africa Symposia during October. Nobel in Africa is a STIAS initiative in partnership with Stellenbosch University, under the auspices of the Nobel Foundation and the Royal Swedish Academy of Sciences with funding from the Knut and Alice Wallenberg Foundation. This is the first time, since 1965,

Research and innovation

As always we are grateful for the support of industry partners. The African Rainbow Minerals research chair in Geometallurgy stems from the need for innovative research and training to ensure the sustainability of mining, especially when it comes to mining for precious metals to support the growing demand for renewable energy. The chair will be shared between Dr Bjorn von der Heyden from the Department of Earth Sciences in our faculty and Dr Margreth Thadie from the Department of Process Engineering in the Faculty of Engineering. The research chair in Invasive Species Management in Protected Areas, funded by the Millenium Trust, was established in the Centre for Invasion Biology and is being led by Prof Tammy Robinson-Smythe.

In the aftermath of the COVID-19 pandemic, researchers such as Prof Resia Pretorius are leading the field in unravelling the complexities of long COVID. During 2022 her research efforts have provided further evidence for a link between the severity of the disease and the prevalence of persistent micro blood clots in individuals with acute and long COVID.



Department of Botany and Zoology participated in the **Global Alliance of Universities for Climate's Global Youth Ambassadors programme** on climate change and global climate governance.



From the left, Prof Ingrid Rewitzky (SU), Mariëtta van den Worm (SU); Zinhle Mthombothi (South African Centre for Epidemiological Modelling and Analysis); Prof Karin-Theresa Howell (SU); Prof Louise Warnich (SU); Lezanne Human (co-founder of Bank Zero); Nerina Visser (director and co-owner at etfSA Portfolio Management Company). In front, Jacobie Mouton (MSc student in machine learning); Tarryn Surajpal (MSc student in applied mathematics); Prof Marelle Davel (Faculty of Engineering, North-West University); Helena Conradie (CFA and non-executive director of the Satrix Investments) and Dr Ronalda Benjamin (SU).

that the symposia are held in Africa. As part of the outreach activities, a public lecture by the physicist Sir Michael Berry from the University of Bristol was hosted on our campus.

Special mention should be made of Prof Leon Dicks, who earned his DSc in microbiology. The Faculty of Science also featured at the annual awards function of SU's technology company InnovUS, walking away with the prize for the faculty with the most spinout companies and most granted patents for 2022.

Awards to Staff and Students

The pages of this annual report speak loudly of the achievements of our researchers and postgraduate students. It is, however, extraordinary for two researchers from the same institution to receive the highest possible honour in their respective fields. Emeritus Prof Hendrik Geyer was awarded the De Beers Gold Medal by the South African Institute of Physics. This is the greatest distinction that is conferred in South Africa for achievements in physics. Emeritus Prof Brian van Wilgen was awarded the National Research Foundation's (NRF) Lifetime Achievement Award, the highest honour that is bestowed by the NRF for a deserving South African for their outstanding contribution to the development of science in and for South Africa.

Social impact

The Faculty of Science and its academic departments participate in a wide range of social impact and outreach activities throughout the year, including the National Science Week, the Eskom Expo for Young Scientists, Science Café Stellenbosch, SU Open Day and a series of lectures on the science behind the Nobel Prizes in physics, chemistry and the physiological sciences.

Established in 2016, the faculty continues to build relationships with industry by means of the bi-annual meeting of our advisory board. For the first time, we also hosted a networking luncheon for women mathematicians in business and academia.

On an international level, postgraduate students from the Department of Botany and Zoology for the first time participated in the Global Alliance of Universities for Climate's Global Youth Ambassadors programme on climate change and global climate governance. This is the first time that a university from Africa participated in the programme.

The Faculty of Science also hosted a successful short course in building science communication capacity in the Southern African Development Community (SADC) and Africa, in partnership with SU's Department of Journalism, the Department of Science and Innovation, UNESCO and SADC. More than a hundred science journalists and science communicators from sixteen African countries attended the course in-person and online.

In conclusion, I want to express my deepest gratitude and appreciation for the unwavering commitment and hard work of our academic, administrative and technical staff, contributing to the overall success and reputation of our faculty.

Prof Louise Warnich
Dean: Faculty of Science

Focus on Teaching and Learning



Prof Ingrid Rewitzky
Vice-Dean: Teaching and Learning

With much enthusiasm we returned to in-person teaching and learning in 2022. Some restrictions were in place for the first semester, but students and staff were delighted when these were lifted for the second semester.

Aligned with this change the Science Teaching and Learning Day on 23 May was a Programme Renewal Pitstop – a time to reflect on where we are and where we are going and consider possible futures for teaching, learning, assessment in the Faculty of Science post the Covid-19 pandemic.

It is evident that a hybrid use of different teaching and learning modalities is evolving in many modules. For example, lecturers from the departments of Botany and Ecology, Physics and Chemistry are collaborating on a project that uses virtual reality (VR) in an effort to help students immerse themselves in otherwise 'inaccessible' environments of these basic sciences e.g. the atomic level and the cellular level. This is part of a larger project that is focused on creating embodied learning experiences, supporting the theory of the "embodied mind" – the idea that our cognition and physiology are intimately linked, and that all abstract conceptual thought is ultimately grounded in concrete experience. This contributes to the discussion in a new interdisciplinary research field involving educational theory, cognitive science, and educational technologies.

Some highlights for 2022 are outlined below.

Dr Marnel Mouton from the Department of Botany and Zoology was awarded the SU Teaching Fellowship (2022–2024) for her project "From Access to Success? Evaluating the impact of the Extended Degree Programme (EDP) in STEM at SU". The SU Teaching Fellowship will provide her the opportunity to consolidate and extend her research on and knowledge of academic success and retention of EDP students in STEM. It is a strategic priority of the STEM EDP Programme to increase the pool of students for STEM programmes that require a solid foundation in the fundamental sciences and to provide equity of access with success to STEM disciplines.

Dr Bjorn von der Heyden from the Department of Earth Sciences was selected for the Scholarship of Educational Leadership Short Course. As part of this he led an autoethnographic exploration of teaching and learning during the Covid-19 period.

Dr Marietjie Lutz from the Department of Chemistry and Polymer Science was awarded a teaching and learning grant to develop a prediction model that has the potential to contribute towards understanding various factors that influence student success in chemistry and informing appropriate wrap-around student support addressing also social justice concerns.

The Science Learning Facilitation Training short courses (with three levels LFT1–LFT3) have been developed with the purpose of equipping students for peer-to-peer facilitation. Initially, the training was in-person and then entirely online. However, an analysis by **Drs H Adendorff** and **Ilse Rootman-Le Grange** in 2018 revealed that the courses succeeded in achieving their cognitive, but not their affective, outcomes. To address this challenge, they developed a game titled "Life Happens", tackling challenging peer facilitation scenarios. The game was piloted in the LFT 1 course during the second semester of 2022.

Prof Ingrid Rewitzky from the Department of Mathematical Sciences was invited to present at a SU Learning and Teaching Enhancement Seminar on 12 May 2022 about her research on using complexity theory to guide programme evaluation. This investigation has been the focus of her SU Teaching Fellowship.

At the online international conference on Legitimation Code Theory (LCT 4), Prof **Ingrid Rewitzky**, **Drs Hanelie Adendorff**, **Margaret Blackie**, **Marnel Mouton**, **Ilse Rootman-Le Grange** and **Christine Steenkamp** participated in the LCT Stellenbosch sessions.

Drs Margaret Blackie and Hanelie Adendorff introduced, in 2020, a way of beginning the process of decolonisation in science by recognising that scientists use models to explain situations. This work has led to the book *Decolonising Knowledge and Knowers: Struggles for university transformation in South Africa* co-edited by Drs Blackie and Adendorff, published in 2022.

Science education is not only more important and relevant than ever but is also facing enormous challenges. Many countries have witnessed a decline in the number of students who enroll for degrees in science. Moreover, STEM educators often struggle to find accessible resources to approach teaching in a scholarly manner. Since 2020, three colleagues in the Faculty of Science have been collaborating to compile a book addressing some of the challenges faced by science lecturers using Legitimation Code Theory (LCT).

The book, published in 2022, aims to meet a need for theorised, accessible and discipline-sensitive publications to assist STEM educators in practice and educational research endeavours. LCT is a social realist framework for exploring different aspects of knowledge practices and provides a suite of tools that science educators can employ to elucidate a wide range of challenges and phenomena in higher education, or in practice, to help their students grasp challenging concepts.

The Science Teaching and Learning Hub was established in 2013 for offering capacity-building workshops on teaching, learning and assessment and for promoting a culture of inquiry (through discussions, seminars, a research group, a reading group, and the annual Science Teaching and Learning Day). Drs Adendorff and Rootman-Le Grange and Prof Rewitzky reflected on the Science Teaching and Learning Hub in the paper "A care-full approach to Professional development in a science context" published in the book *Academic Development and its Practitioners: A View from the Inside*. Discussions are underway to strengthen the Faculty of Science's role in Science Education in Higher Education, at SU and beyond, with a view to facilitating the provision of a transformative BSc qualification in service of society.



At the First-year Achievement Awards evening nine of our lecturers were recognised by top-performing first-year students in 2021 as their most inspiring lecturers: Pictured are (from left) students Jean Weight, Danielle Kleyn and Iain le Roux, who all nominated Prof Hugo Touchette (fifth from right). Marelie Bester (fourth from left) is standing next to her nominated lecturer, Dr Rehana Malgas-Enus. From the right are Prof Deresh Ramjugernath (Deputy Vice-Chancellor: Learning and Teaching), lecturer Ms Elizabeth Burger and the student who nominated her, Kyle Louw, and Prof Ingrid Rewitzky, Science's Vice-Dean: Learning and Teaching.

Awards to Staff and Students



Christopher Borrageiro from the *Department of Biochemistry* won the best oral presentation award for his research at the WHO World Antimicrobial Awareness Week International Symposium.



Caitlin Ching-Sent from the *Department of Botany and Zoology* received the Zoological Society of South Africa (ZSSA) award for the best Honours student at Stellenbosch University.



Rutger la Cock from the *Department of Earth Sciences* received the Geological Society of South Africa's Houghton Award for the best Honours thesis in South Africa.



Isabella de Beer from the *Department of Botany and Zoology* received the Zoological Society of South Africa (ZSSA) award for the best third year student at Stellenbosch University.



Alan Eaby from the *Department of Chemistry and Polymer Science* was elected to participate in the 71st Lindau Nobel Laureate Meeting.



Nicola Heathcote received the Zeiss prize for the best micrograph as well as the Scientific Group award for best confocal microscopy presentation during the Microscopy Society of Southern Africa (MSSA) conference.



Jamila Janna from the *Department of Botany and Zoology* won the Best Student Poster award at the South African Marine Science Symposium and the Best Student Presentation award at the Western Indian Ocean Marine Science Symposium.



Logan Smith, MSc student with the Centre for Cardiometabolic Research in Africa (CARMA), won a prize for Most Innovative Method and first prize in the Wyndham Oral competition for his presentation at the PSSA conference.



Yamkela Mapetshana from the *Department of Earth Sciences* won first place in the Honour's level presentations given at the South African Geophysical Association's (SAGA) 17th Biennial Conference.



Dr Tracey Ollewagen from the *Department of Physiological Sciences* won first prize for a Young Scientist in Basic Pharmacology in 2022 at the South African Society for Basic and Clinical Pharmacology 2022 Conference.



Prof Guy Midgley, *interim director of the School for Climate Studies*, received the Green Economy Award at the National Science and Technology Forum (NSTF)-South32 Awards ceremony.



Dr Jacques Rabie from the *Department of Mathematical Sciences* was one of 200 young researchers from more than 50 countries worldwide selected to participate in the Heidelberg Laureate Forum (HLF) in Germany.



Dr Nasreen Peer from the *Department of Botany and Zoology* won the South African Network for Coastal and Oceanic Research (SANCOR) Young Researchers Award.



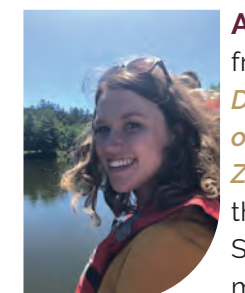
Emeritus Prof Brian van Wilgen from the *Centre for Invasion Biology* was awarded the National Research Foundation's (NRF) Lifetime Achievement Award.



Ryan Rosenfels from the *Department of Earth Sciences* received the Geological Society of South Africa's John Handley Medal for the best MSc thesis in South Africa.



Yann Waku from the *Department of Earth Sciences* won the best MSc poster award at the Prospectors and Developers Association of Canada's (PDAC) conference.



Amoré Malan from the *Department of Botany and Zoology* received the Junior Captain Scott Memorial medal for the best MSc dissertation at a South African university.



Emeritus Prof Hendrik Geyer was awarded the De Beers Gold Medal by the South African Institute of Physics.



Dr Wilma van Rensburg from the *Department of Biochemistry* received an award as one of the top 20 postdoctoral fellows at SU.



Departmental **Reports**

Department of Biochemistry

Photo: Stefan Els

Research Interests

Steroid hormone and receptor function in health and disease; Animal microbiome analysis, pathogen detection and control; Plant pathogen detection and evolution; Antimicrobial peptides and drugs; Mathematical, computational and experimental systems biology; Mechanistic enzymology; Cell stress responses and protein folding

Research Highlights

Complete genome sequenced of third unique mycoplasma species affecting ostriches

Dr Annelise Botes has researched mycoplasma infections in ostriches since the early 2000's. Through her research ostriches were found to be infected with three unique mycoplasma species of which two have been formally described and published. A complete genome of the third species has now been submitted to the internationally accessible public database, GenBank. Access to complete genomes allows further research on the pathogenic potential of this group of bacteria as well as the development of new prevention and treatment strategies. Dr Botes also initiated research to evaluate antibacterial resistance against antibiotics commonly used during ostrich production. The aim of this research is to promote awareness of antimicrobial resistance amongst ostrich producers as well as assist in adapting health management strategies to alter or limit the use of antibiotics during production.



A gaggle of young ostriches

(Struthio camelus). Image: Derek Keats, CC BY 2.0 <<https://creativecommons.org/licenses/by/2.0>>, via Wikimedia Commons

BioSimulators: open-source registry of simulation engines and services

Three colleagues from the department were involved in the development of BioSimulators, an open-source registry of simulation engines and services for computational systems biology. BioSimulators is developed by an international consortium with contributors from 49 affiliations around the world. **Prof Johann Rohwer** contributed to the integration of the PySCeS simulation software, which is developed in his research group. **Prof Jacky Snoep** and **Dr Dawie van Niekerk** contributed to the integration of their JWS Online simulation platform. The BioSimulators registry greatly facilitates checking the reliability and reproducibility of systems biology models and of simulation tools. The results were published in *Nucleic Acids Research*.

Research Activities

Prof Donita Africander served on the editorial board of the *Journal for Ethnopharmacology* and as guest editor for *Frontiers in Immunology* and the *Journal of Steroid Biochemistry and Molecular Biology*. She has active collaborations with Profs Jacky Snoep and Karl Storbeck from this department, Prof Anna-Mart Engelbrecht from the Department of Physiological Sciences, Dr Carmen Pheiffer from the Medical Research Council, Prof Janet Hapgood and Dr Michele Tomasicchio from UCT, Dr Charles Morrison from Family Health International 360 (USA), and Dr Narender Kumar from the Population Council at Rockefeller University, New York City.

Dr Mervyn Beukes has an active collaboration with Dr Daniella Altschuh at the CNRS, University of Strasbourg (France), and the group of Prof H.G. Sahl at the University of Bonn (Germany). He has links with several researchers in Africa, including at the University of Namibia and the University of Dar-Es-Salaam. He also collaborates with local researchers at the CSIR, the University of Pretoria, North-West University and Durban University of Technology. He received a certificate of recognition from the Department of Science and Technology through the National Intellectual Property Management Office, for the proof of concept "Detection method of detecting ketone bodies in the breath of Type II diabetics, as diagnostic tool". He is a member of the American Society for Microbiology and served as a guest editor on their editorial board.

Dr Annelise Botes has an active collaboration with Dr Adriaan Olivier who is the industry veterinarian for the South African Ostrich Business Chamber. She also has links with researchers from the Department of Agriculture, Western Cape Government.

Dr Marianne de Villiers has collaborations with Prof Kevin Saliba and Dr Christina Spry at the Australian National University's Research School of Biology. She also collaborates with Prof Ody Sibon at the University Medical Centre Groningen in The Netherlands. Nationally

she collaborates with Prof Lyn-Marie Birkholtz at the Department of Biochemistry at the University of Pretoria, and Dr Rencia van der Sluis in the focus area for human metabolomics at North-West University. At SU she also collaborates with Prof Karl Storbeck, Prof Erick Strauss, Dr Tawanda Zininga and Prof Dirk Bellstedt at the Department of Biochemistry and Dr Katherine de Villiers at the Department of Chemistry and Polymer Science.

Prof Ann Louw collaborates within her own department with Prof Johann Rohwer and Dr Nicky Verhoog on *Cyclopia*, Rooibos tea and GR dimerization, and with the Agricultural Research Centre (ARC) Infruitec-Nietvoorbij's Dr E Joubert and Prof D de Beer on *Cyclopia* and Rooibos tea; the Vlaams Institute voor Biotechnologie (VIB), and Prof Claude Libert from the University Ghent in Belgium, on GR dimerization; Prof Gunter Volmer and Oliver Zierau from the Technische Universität Dresden (Germany) on *Cyclopia* and breast cancer; and Prof Holger Reichardt from the University of Göttingen (Germany), on GR dimerization. Prof Louw is an associate editor for *Frontiers in Pharmacology's* sub section, Ethnopharmacology.

Prof Marina Rautenbach leads the BIOPEP peptide group that turned 25 in 2022. This quarter century milestone was celebrated by the students from the BIOPEP Peptide group who excelled in 2022. Dr Wilma van Rensburg received an award as one of the top 20 postdoctoral fellows in 2022 at Stellenbosch University for her research on peptide coating and self-sterilising materials. Christopher Borrageiro won the best oral presentation award for his research at the WHO World Antimicrobial Awareness Week International Symposium at the end of 2022. Carmen de Villiers won the best oral presentation award (Biological Sciences) and Gamuchirai Mamhende won the second prize for their research at the SU Faculty of Science Postgraduate Research Conference. Priyata Mithra won the third prize for her research poster presentation (Biological Sciences) at the same conference. Sherwin Bezuidenhout won the People's Poster prize at the Biochemistry Honours Poster Symposium.



Photo: Arrie Arends

From left to right, Dr Wilma van Rensburg, Carmen de Villiers, Prof Marina Rautenbach, Gamuchirai Mamhende, Priyata Mithra, Christopher Borrageiro and Sherwin Bezuidenhout.

Prof Rautenbach serves on the editorial boards of *BBA Biomembranes* and the *Journal of Microbiological Methods* and is a review editor for *Frontiers in Chemistry* and *Frontiers in Microbiology*. She has active collaborations with colleagues in Microbiology, Prof Leon Dicks, Dr Heinrich Volschenk, Prof Wesaal Khan and Prof Alf Botha, in the search for new antibiotics from environmental samples. She also collaborates with Prof Bert Klumperman from the Department of Chemistry and Polymer Science on novel nano-formulations of antimicrobial peptides. She has a long-standing active collaboration with Prof Marietjie Stander from the LC-MS CAF on mass spectrometry of biomolecules. On an international level she collaborates with Prof M-L Mangoni from Sapienza University (Italy), on the application of peptides in self-sterilising materials, specifically to create antiviral materials. Further collaborations are on the biophysical aspects of peptide self-assembly, where she works with Prof B. Bechinger from Strasbourg University (France), Prof H.H. Paradies at Jacobs University in Bremen (Germany), Prof T. Parker from the Science and Technology Council (UK), Dr P. Neethling from SU's Department of Physics, and Dr J.B. Joshi at Dr HS Gour Central University, University in Sagar (India). Prof Rautenbach has licenced her patented innovations with KG Polymer Compounds SA and Sani-touch SA for commercialisation of self-sterilising antimicrobial materials. She is a partner in the Triple-A-Coat consortium funded by an EU Horizon Grant in which the self-sterilising properties of antimicrobial peptides in cellulose films will be assessed in high traffic areas.

Prof Johann Rohwer is a member of the international STRENDa (Standards for Reporting Enzymology Data) Commission and chairs AHASA, the Alexander von Humboldt Association of Southern Africa (South-Western chapter). He currently serves as associate editor for *BMC Bioinformatics* and *Biochemical Society Transactions*. He serves on the editorial advisory board of *In silico Plants*, a new online journal specialising in plant systems biology, and is statistics editor of the *Journal of Experimental Botany*.

Prof Rohwer has active collaborations with a number of groups, both nationally and internationally: with Dr Rencia van der Sluys, North-West University, on studying the kinetics of glycine N-acyltransferases; with Dr Che Pillay, University of KwaZulu-Natal, on the modelling of cellular redoxin networks; with Dr Egils Stalidzans, University of Latvia (Latvia) on bioengineering of the MEP pathway in plants; with Prof Jonathan Gershenzon, Max Planck Institute for Chemical Ecology (Germany), on flux and control analysis of isoprene synthesis in plants; with Dr Brett Olivier, Free University (Netherlands), on the Python Simulator for Cellular Systems software; and with Prof Jürgen Pleiss, University of Stuttgart (Germany), on developing workflows and computational tools for reproducible enzyme kinetics. He also presented an invited lecture at the University of Stuttgart in the context of a research visit to Prof Pleiss.



Photo: Thirdman

Prof Rohwer delivered an oral presentation at the online conference of the SA Society of Biochemistry and Molecular Biology (SASBMB2022) on tools for making enzymology data FAIR (Findable, Accessible, Interoperable and Reusable). He also delivered an oral presentation at the Third EnzymeML Workshop, held in Rüdesheim, Germany, where he presented his work on EnzymeML, a standardised markup language for enzymology data.

Dr Naeem Sheik Abdul is a member of the Society of Toxicology. Dr Sheik Abdul actively collaborates with the group of Prof Jeanine Marnewick at the Applied Microbial and Health Biotechnology Institute, Cape Peninsula University of Technology, on microplastic toxicity and nutraceutical interventions. Other national collaborators include the group of Prof Anil Chuturgoon, University of KwaZulu Natal. On the international front, Dr Sheik Abdul collaborates with Prof Kovacs based at the University of Kaposvar (Hungary), determining molecular mechanisms of mycotoxin toxicity.

Prof Jacky Snoep serves on the editorial boards of *Molecular Systems Biology*, *IET Systems Biology*, *Frontiers in Systems Biology*, and *Metabolomics*. He is involved in the following collaborations: Prof L-M Birkholtz from the University of Pretoria; Prof V Mizrahi from the University of Cape Town; Prof B Bakker from the University of Groningen (Netherlands); Prof C Goble from the University of Manchester (UK); Prof HV Westerhoff and Dr Evelina Tutucci from the Vrije Universiteit Amsterdam (Netherlands); Prof Mattias Goksör and Dr Caroline Adiels from the University of Gothenburg (Sweden); Dr Matthias König from the Humboldt-University Berlin (Germany); Prof Dr Bettina Siebers from the University of Duisburg-Essen (Germany); and Prof Albena Lederer from the Leibniz-Institut für Polymerforschung (Germany) who is the coordinator of the 3D4D2 project on drug administration dynamics for malaria treatment and blocking of transmission ("3D polymer matrix device for dual drug delivery and simultaneous treatment of acute malaria and malaria transmission").

Two of his PhD students conducted research in the labs of collaborators. Joel Fisher spent one month with the group of Prof Bakker, and Morné van Wyk spent one year with the group of Prof Goksör. Prof Snoep and his PhD student Leanie Mocke gave oral presentations at the ISGSB 2022 conference in Austria.

Prof Marietjie Stander is a member of the Chromatography Society of South Africa and is a member of the Food Safety Forum of the Seafood Industry. She is a member of the South African Food Juice Association and OliveSA. Prof Stander has active collaborations within the Department of Biochemistry and is involved in the following collaborations: From SU, Profs. N Makunga, AJ de Villiers and M Rautenbach; from the ARC, Prof D de Beer and L Joubert; from the University of Johannesburg, Prof BE van Wyk.

Prof Karl-Heinz Storbeck serves as an associate editor for the *Journal of Steroid Biochemistry and Molecular Biology* and on the editorial boards of *Steroids*, and *Molecular and Cellular Endocrinology*. He also served on the organising committee for the Steroids, Mass Spectrometry and Endocrinology – Past, Present, Future symposium held in the UK. Nationally, he was elected to serve as the treasurer of the local organising committee for the 27th meeting of the International Union of Biochemistry and Molecular Biology, which will be hosted in Cape Town in 2027.

Prof Storbeck has active collaborations within the Department and with Prof Janet Hapgood from the University of Cape Town on the role of progestins in women's health. His international collaborators include Prof Wiebke Arlt from the University of Birmingham's Institute of Metabolism and Systems Research (UK) on the role of 11-oxygenated androgens in health and disease, and Prof Elahe Mostaghel from the Fred Hutchinson Cancer Research Center, Seattle (USA), on the role of 11-oxygenated androgens in castration resistant prostate cancer.

Prof Erick Strauss has been serving on the editorial advisory board of the journal *ACS Infectious Diseases* since 2017 and joined the editorial advisory board of the ACS journal *Biochemistry* in 2022. He has active collaborations with Prof Valeri Mizrahi at UCT's Molecular Mycobacteriology Research Unit, Prof Ody Sibon from the University Medical Centre Groningen, Department of Cell Biology (Netherlands), Prof Cindy Dowd from George Washington University (USA) and the XChem team at Diamond Light Source (DLS) in the UK under leadership of Prof Frank von Delft from Oxford University. Since 2021 Prof Strauss has been pursuing research focused on countering antimicrobial drug resistance funded from a grant awarded as part of the Grand Challenges Africa (GC Africa) programme's Drug Discovery Initiative. He also has a keen interest in establishing and expanding the capacity for structural biology research in South Africa, and together with Prof Trevor Sewell from UCT, was awarded a follow-up grant from the UKRI in 2022 called START: Health & Biosciences to further support initiatives in this regard.

Prof Amanda Swart currently serves on the editorial board *Scientific Reports - Nature* and as scientific advisor for the South African Rooibos Council. She has collaborations with Profs Stephen Atkin (Royal College of Surgeons in

Ireland); Viroj Boonyaratanakornkit (Bangkok Chulalongkorn University in Thailand); Fabio Faucz (NIH/NICHD, Bethesda, USA); Christa Flück (University of Berne, Switzerland); Irina Budunova (NorthWest University, USA).

Dr Dawie van Niekerk is involved in the following collaborations: Prof L-M Birkholtz from the University of Pretoria; Prof C Goble from the University of Manchester (UK); Dr Evelina Tutucci from the Vrije Universiteit Amsterdam (Netherlands); Prof Mattias Goksör from the University of Gothenburg (Sweden); Dr Matthias König from the Humboldt-University Berlin (Germany); Prof Jacky Snoep (SU) and collaborators, Dr Evelina Tutucci from the Vrije Universiteit Amsterdam (Netherlands), and Prof Albena Lederer (Leibniz-Institut für Polymerforschung Dresden, Germany, as part of the 3D4D2 M-ERA.NET project).

Dr Nicolette Verhoog serves as the social media representative on the South African Society for Biochemistry and Molecular Biology (SASBMB) executive council. Dr Verhoog works closely with Prof Ann Louw on the role of indigenous South African plants such as honeybush and rooibos on steroid receptor signalling, and with the Agricultural Research Centre (ARC) Infruitec-Nietvoorbij's Prof E. Joubert and Dr D. de Beer. Other collaborations include Prof Claude Libert from Ghent University (Belgium), Prof Oliver Zierau and Dr J. Wober from the Technische Universität Dresden (Germany) and Dr N. Salah Ahmed Mostafa from the German University Cairo (Egypt).

Dr Tawanda Zininga collaborates with Dr Prinessa Chellan, Department of Chemistry and Polymer Science at SU and Dr Ofentse Poee at the Department of Biochemistry at the University of KwaZulu Natal; with Prof Karen Sliwa-Hahnle at the Cape Heart Institute and Hatter Institute for Cardiovascular Research in Africa, UCT; with Prof Addmore Shonhai at the Department of Biochemistry, University of Venda; and with Prof Don C. Lamb at the Ludwig Maximilian University of Munich (Germany) and Prof Graham Chakafana at Hampton University (USA).

Academic Affairs

Number of graduates 2022

The department had 86 registered postgraduate students in 2022



Staff Matters

Dr Naeem Sheik Abdul joined the department on 11 July 2022 as a lecturer. **Prof Ann Louw** retired on 31 December 2022. **Dr. Helba Bredell** resigned as senior technical officer at the end of 2022 to take up a position at Afrigen Biologics and Vaccines.

Funding

Global

Bill & Melinda Gates Foundation
M-ERA.NET project: 3D4D2

South Africa

BIOPEP™ Peptide Fund
Cancer Association of South Africa (CANSA)
InnovUS postdoctoral funding
Medical Research Council (MRC)
NRF Competitive Support for Unrated Researchers (CSUR)
NRF Competitive Programme for Rated Researchers (CPRR)
NRF Community of Practice in in Evaluating Malaria Control Interventions
NRF SACEMA/SARCHI research chair in mechanistic modelling of health and epidemiology
South African Centre for Epidemiological Modelling and Analysis (SACEMA)

South African Rooibos Council (SARC)
South African Technology Innovation Agency (TIA)
Stellenbosch University Subcommittee B
Stellenbosch University Faculty of Science

Germany

Beilstein Institute

United Kingdom

GCRF START grant from the STFC/UKRI (UK)

United States of America

National Institutes of Health (NIH)

European Union

EU Horizon 2020

Staff List

Academic

Prof DJ Africander
Dr M Beukes
Dr A Botes
Prof A Louw
Prof M Rautenbach
Prof JM Rohwer
Dr N Sheik Abdul
Prof JL Snoep
Prof K Storbeck
Prof E Strauss (Head of Department)
Prof MA Stander
Dr DD van Niekerk
Dr NJD Verhoog
Dr T Zininga

Extraordinary Professors

Prof Oliver Zierau

Extraordinary senior lecturers

Dr M de Villiers

Emeritus Professors

Prof DU Bellstedt
Prof J-HS Hofmeyr
Prof AC Swart
Prof P Swart

Support staff

Ms W Maart (Secretary)
Mr AP Arends
Mr KD Botha
Mr R Brandt
Dr H Bredell
Mrs L du Toit

Dr Y Engelbrecht
Mrs GD Gerstner
Mr CR Jansen
Dr R Louw-Du Toit
Ms RP Louw
Mrs L Prinsloo

Postdoctoral fellows

Dr Blake Balcomb
Dr Anton Hamman
Dr Hayley Jackson
Dr Theresa Kouril
Dr Nicholas Le Maitre
Dr Konrad Mostert
Dr Deon Neveling
Dr Wiets Roos
Dr Wilma van Rensburg

NRF-rated Researchers

Internationally acclaimed researchers	
Prof Jacky Snoep	Computational systems biology
Prof Johann Rohwer	Computational systems biology
Established researchers	
Prof Dirk Bellstedt	Plant molecular systematics and molecular plant virology
Prof Ann Louw	Steroid receptor signal transduction
Prof Marina Rautenbach	Antimicrobial Peptides, antimicrobial materials
Dr Marietjie Stander	Mass spectrometry and analytical chemistry
Prof Karl Storbeck	Steroid biosynthesis and metabolism
Dr Dawie van Niekerk	Computational systems biology
Promising young researchers	
Dr Marianne de Villiers	Chemical biology, antimalarial drug design and discovery, infectious diseases, mechanistic enzymology
Dr Tawanda Zininga	Cell stress biology, antimalarial drug design and cardiovascular biomarker discovery

Contact Details

Tel: 021 808 5862 | E-mail: welma@sun.ac.za (secretary)
Fax: 021 808 5863 | Web: www.sun.ac.za/biochem

Department of Botany and Zoology

Research Interests

Biotic diversity and ecology of the Cape Region and its coastline; Systematics and molecular ecology; Evolutionary ecology; Physiological ecology; Marine biology; Medicinal plant biology; Global change biology; Invasion biology

Research Highlights

Project Seastore: working towards understanding and reversing seagrass declines in South Africa

Seagrasses are important ecosystem engineers as they provide numerous ecosystem services, including supporting fisheries, improving and maintaining water quality, preventing erosion through binding sediment and helping in the fight against climate change.

Forming part of Vegetated Coastal Ecosystems (along with saltmarshes and mangroves), seagrasses play a critical role in capturing and storing carbon and are of particular interest in the mitigation of and adaptation to climate change. However, in South Africa the major seagrass (*Zostera capensis*) is not only understudied, but like many seagrass species globally, is also on the decline, with a loss of associated ecosystem services.

Zostera capensis is only found in estuaries, which face both marine and terrestrial threats, such as pollution, changes in water flow, habitat destruction and climate change. Through our NRF funded research, Project Seastore aims to better understand some of ecological, physiological and genomic aspects of *Zostera capensis*. Through an integrated and collaborative approach we are investigating the impacts of global change drivers on seagrass persistence, including

for example microplastics and herbicides. An important objective of our project is to initiate the restoration of seagrass meadows: several trials in estuaries around South Africa are already underway to investigate how *Z. capensis* can best be restored. We are building capacity for estimating the carbon contribution of seagrass meadows for inclusion in the National Blue Carbon budget. Since 2019, this project has supported three PhD, five MSc and ten Honours students and built strong collaborations with colleagues from Nelson Mandela University, University of Cape Town, South African National Parks and the University of the Western Cape. – Prof Sophie von der Heyden



Intertidal and subtidal seagrasses adjacent to a saltmarsh at the Berg River Estuary.



Thermoregulatory strategies such as shuttling between microsites and evaporative cooling by panting, as illustrated by the lizard *Agama atra* are likely to not be sufficient to buffer acute thermal stress imposed by intense heat waves

New predictions of temperature effects on animal death rates

Ectothermic animals such as reptiles, amphibians and insects rely on surrounding conditions to regulate body temperature. These organisms have multiple strategies to cope with temperature fluctuations, including behaviours such as thermoregulation and dispersal, but also adaptive physiological changes through acclimation and evolutionary responses. However, the fast increase in the severity, frequency and duration of heat waves associated with climate change means that these organisms are exposed to temperature extremes with potentially severe consequences for their survival.

While changes in average temperature can negatively affect the well-being of ectotherms, by for example reducing their body condition, growth and reproductive rate, extreme temperature events can impose acute stress that results very quickly in death. These fast rates of mortality occurring at extreme temperatures have only recently been assessed quantitatively for many species across large geographic scales. These data revealed that the rates of mortality to acute heat stress are extremely high, and therefore, when ectotherms are exposed to these extremes, there is little room for recovery, typically leading to mass mortality of local populations.

In an invited commentary in the premier journal *Nature*, Prof Susana Clusella-Trullas summarised these results and highlighted priority areas for investigation, such as the processes leading to individual death caused by extreme temperatures. For example, what are the thresholds between mild or permissible temperatures and those that are highly stressful, and therefore leading to fast heat failure, across species? What is the order of cellular and functional breakdown mechanisms that lead to death when acutely exposed to temperature extremes? Are there periods of recovery that can compensate for thermal injury imposed by temperature extremes and do these vary between marine and terrestrial species? These questions are at the heart of better understanding how animals may

respond to intensifying and often stochastic temperature extremes, and therefore, the impact that climate change will have on life on earth. – Prof Susana Clusella-Trullas

Understanding the rise of grassy ecosystems since the Miocene

Frequent fires in savannas limit tree cover and promote grassy vegetation, while forests and thickets form dense canopies that reduce flammable C4-grass fuel loads, leading to a lower probability of fires. However, rare extreme events, such as extreme fires, can cause substantial tree mortality in forests and thickets, making repeat fires more likely. This study, carried out in Hluhluwe iMfolozi Park, analysed whether an extreme fire event could alter species composition, vegetation structure, and fire regimes of closed-canopy ecosystems in an intact savanna-forest-thicket mosaic, or if successive fires were necessary to trigger a biome transition between forest to savanna.

Results showed that forests that only burned once recovered, whereas those that burned again following an initial extreme fire transitioned from closed-canopy forests towards open, grassy savannas. Additionally, the colonisation of the savanna tree community lagged behind the grass community but began to appear in areas that were once forest by the end of the study. These findings suggest that rare extreme fires, followed by repeated burning, can result in savannization in places where savanna and forest represent alternative stable states. This work has implications for our understanding of the rise of grassy ecosystems since the Miocene, particularly in systems where megaherbivores are present, as well as providing insights into the mechanisms behind catastrophic regime shifts in savanna-forest mosaics.

The paper titled "Pathways of savannization in a mesic African savanna-forest mosaic following an extreme fire" by Heath Beckett, Carla Staver, Tristan Charles-Dominique and William Bond has been shortlisted in the Top 10 for the John L. Harper Early Career Researcher Award from the *Journal of Ecology*. – Dr Heath Beckett



Intense fire burning up a slope at night in September 2012 in Hluhluwe iMfolozi Park.

Comparative phylogeography of selected codistributed ectotherms reveals asynchronous cladogenesis

Landscape heterogeneity in conjunction with climatic fluctuations can act as a major driver of speciation. Within the Western Cape, the Cape Fold Mountains have been shown to pose a barrier to gene flow in several individual studies, but a larger comparative review, including multiple species and investigating the relationship between the observed patterns and historical climatic changes, has not yet been conducted.

MSc student Angus Macgregor Myburgh, supervised by Prof Savel Daniels, investigated the impact of the Cape Fold Mountains as a barrier to gene flow, and the synchronicity of species divergence events with respect to historic climatic fluctuations. The results were published in a first author manuscript in *Evolutionary Applications* titled "Between the Cape Fold Mountains and the deep blue sea: comparative phylogeography of selected codistributed ectotherms reveals asynchronous cladogenesis".

It was found that the Cape Fold Mountains do indeed pose a major barrier to the dispersal of ectothermic species, with all study species displaying a clear pattern of isolated eastern and western evolutionary groups. Additionally, it was found that there were three main, shared divergence events between these two groups across thirteen species, indicating a shared response to environmental factors. The estimated times of these divergence events aligned with historical periods of increased glaciation and lowered sea levels, supporting the hypothesis that a periodically accessible land bridge at the southern tip of the Cape Fold Mountains has served as an effective dispersal corridor. Finally, they constructed species distribution models and, using historical climate data, identified areas of relative climatic stability which may have been utilised as refugia and which can be used to guide conservation efforts. – Prof Savel Daniels



Chersina angulata, one of the study taxa used in the study.

Junior Captain Scott Memorial medal for best MSc dissertation

Ms Amoré Malan received the Junior Captain Scott Memorial medal for the best MSc dissertation at a South African university during 2022. For her research she investigated the mechanisms responsible for speciation in the southern hemisphere brown fur seal, *Arctocephalus pusillus*. In terrestrial systems speciation is often correlated with geographic isolation of two or more groups of individuals, but in the marine environment clear barriers to dispersal are often lacking. The results of this study were published in *Biology Letters* in an article titled "Palaeoclimatic changes resulted in range expansion and subsequent divergence in brown fur seals, *Arctocephalus pusillus*". It was clearly shown that the two recognised fur seal subspecies, one restricted to Australia and the other to South Africa, have very limited gene-flow. Her research convincingly showed that the southern African fur seal represent the ancestral population for this species and that the Indian Ocean currently acts as a gene-flow barrier between the two populations. Lower sea levels during the last Glacial Maximum provided more exposed landmasses that allowed the species to colonise Australia approximately 15 000 years before present. The study provided compelling evidence that glacial cycles and oceanic distance are two major forces contributing to speciation in some marine species. – Prof Conrad Matthee

Cluster roots are an adaptation to extreme environments

Plants form the basis of global productivity, by utilising their capacity to convert carbon dioxide into valuable oxygen allows for 95% of all life on earth to exist. One of the key aspects to plants is their need for different nutrients. These are divided into two main groups: macro- and micronutrients, of which macro-nutrients are needed in the largest quantity. Some of the key macro-nutrients, such as phosphorus and nitrogen, comprise of several important factors that enable plant functioning. These two nutrients are, however, the biggest constraints to plant growth and functioning, whereby limitation of either of these two would cause a plant to die. This is especially important from an agricultural perspective, as most fertilisers contain both nutrients.

Nitrogen is one of the most prevalent nutrients on earth. However, due to its triple bond it can only be utilised and converted into usable form by a select few micro-organisms in a process called biological nitrogen fixation. On the other hand, phosphorus is less prevalent and due to its extremely slow regeneration periods it is expected that by 2100 the world would deplete its phosphorus supply, greatly influencing food security.

Certain environments are inherently nitrogen and phosphorus poor, these include South Western Australia, regions of South America and the Fynbos biome endemic to South Africa. Within these environments, plants have a suite of traits that allow for their standing in this environment, namely mycorrhizal fungi, nodules and cluster roots. These

three adaptations are represented in 99.5% of all species that occur natively in these environments. Through symbiosis with mycorrhizal fungi, plants can enlarge their sphere of influence in the soil by increasing soil exploration for both phosphorus and nitrogen. The bean family (*Fabaceae*) is renowned for its symbiosis with micro-organisms housed in nodules, where atmospheric nitrogen is converted into usable forms.

The last adaptation that plants in this environment have is cluster roots. Cluster roots are a term given for a bottlebrush root structure, where the rootlets are highly compacted and in close to each other. These roots are a specialised adaptation to increase phosphorus mobilisation and recycling in the soil and in the plant itself. The release of various different compounds such as organic acids, protons and enzymes from plant roots in these environments, are effective biochemical tools for obtaining and recycling sparsely available phosphorus. It has been shown that plants with cluster roots have a significantly lower total phosphorus requirement than other species.

Work conducted on cluster roots of several South African species, namely the King Protea and Rooibos, has shown that cluster roots additionally provide a plant with nitrogen conversion processes. This further enhances the role of cluster roots as an adaptation to extreme environments where phosphorus and nitrogen is lacking. Utilising cluster rooted species as a study system, the identification of different adaptations for circumventing excessive phosphorus use and increasing phosphorus acquisition can be utilised in important agricultural species. This could extend our phosphorus supply further and promote food security for future generations. – Dr Stian Griebenow



Nodules and cluster roots of Rooibos plants.



Cluster roots of the King Protea taken before removal and close-up.



Sceletium growing in the wild in its typical growth form, hidden beneath another larger shrub for protection.

Wide variations in chemical composition of *Sceletium*

The search for interesting chemistry and pharmacological actions from medicinal plants that can help with mental health is ongoing. Peering into our rich traditional medicine system in South Africa may hold the answer to the chemical diversity we are in search of. One such plant with fascinating chemistry that could help with anxiety and depression is *Sceletium*.

Sceletium is an ancient medicinal succulent plant that was used by the Khoi and San people on long hunting trips as a hunger and thirst suppressant. Occasionally, however, *Sceletium* was used recreationally as a mood elevator. It is this mood elevation activity that sparked research to understand its mood elevation activity.

PhD student Kaylan Reddy, supervised by Prof Nox Makunga, investigates how the chemistry and genetics of this group of medicinal plants varies across South Africa. From the research thus far, it was observed that the chemical composition of *Sceletium* differed across populations collected. Furthermore, by simulating the parts of the brain and spine that control anxiety and depression computationally (*in silico*), it was suggested for the first time, that minor chemicals in the plant could be responsible for helping with anxiety and depression. Within *Sceletium* there are two chemical classes that it produces, the major alkaloids (mesembrine) and minor alkaloids (Joubertiamine, *Sceletium* A4 and Tortuosamine). With the chemical mesembrine being in the highest proportion and being most investigated, it is important to industry and is preferred over plants with chemical Profiles that are low in mesembrine.

Across populations and species these chemical Profiles differ in terms of the type of alkaloids as well as their concentrations. These differences in chemistry are suspected to be influenced by physiological stresses such as UV intensity and nutrient stress in the environment. Some populations of *Sceletium* contained a diversity of minor alkaloids. The findings of the PhD study and *in silico* results suggest that minor alkaloids will preferentially bind to the receptors (GABA-A, SERT, AChE) that control anxiety and depression over major alkaloids. This new perspective shifts the narrative to the compounds in *Sceletium* that may hold medicinal potential to help with mental health.



Photo: Hamish Robertson

Ocymyrmex flaviventris from Dregghorn, Northern Cape.

Unravelling the biogeographical history of the southern African ant genus *Ocymyrmex*

Africa has undergone major environmental changes associated with fluctuating historical climatic conditions, which influenced ecosystems and the distribution of many species within them. These paleoclimatic changes are considered to be some of the major drivers of species diversification and regional diversity patterns.

Nokuthula Mbanyana-Nhleko, a student in Prof Theresa Wossler's lab, focused on an endemic ant fauna that includes species in the genus *Ocymyrmex*. Currently, there are 34 described species of *Ocymyrmex* that are considered valid. The taxonomic status and phylogenetic relationships among *Ocymyrmex* species were reviewed. A highly resolved and supported phylogeny for the genus was recovered. Four of the currently described species were shown to be conspecific, requiring synonymisation. This study also provides an updated species-level identification key, including the description of six new species. Further, the genus has higher species diversity in the western arid regions of southern Africa compared to tropical and subtropical parts of the continent.

The processes that produced these patterns of diversity and distribution of arid adapted ants in southern Africa have never been assessed or analysed. The results suggest that *Ocymyrmex* species likely originated in the arid regions of south-western Africa during the Oligocene (around 32 Ma). Subsequent paleoclimatic changes and topographic heterogeneity during the Miocene, which led to habitat changes, likely drove diversification in the genus. Key life-history traits are therefore expected to mimic this diversity. The physiological traits measured in this study were similar across the *Ocymyrmex* species. High thermal tolerance,



Photo: Simon van Noort

Dr Nokuthula Mbanyana-Nhleko digging up *Ocymyrmex* nests in the Leon Taljaard Nature Reserve near Vryburg in the North-West Province of South Africa.

long chain hydrocarbons and high abundance of alkanes are physiological adaptations for all *Ocymyrmex* species irrespective of where they occur and hence there was no phylogenetic signal for these traits. The results from this study suggest that *Ocymyrmex* ants may have experienced strong selection for arid-adapted traits. Dr Nokuthula Mbanyana-Nhleko is currently the Curator of Entomology at Iziko Museums of South Africa. – Prof Theresa Wossler

Research Activities

Prof Allan Ellis gave his inaugural lecture titled "Dazzling daisies and forlorn flies: Namaqualand tales of unrequited love". He also gave talks at the Mediterranean ecosystems (MEDECOS) conference, and at the Royal Museum of Central Africa in Belgium and the University of Hamburg in Germany.

Prof Susana Clusella-Trullas is on the editorial advisory board of the *Journal of Experimental Biology*. She presented a plenary at the Research School of Biology at the Australian National University titled "Thermal vulnerability indices and the elephant in the room" as part of an international working group on thermal tolerance. She was invited to write a News and Views article for *Nature*, titled "The point of no return for species facing heatwaves".

Prof Leanne Dreyer was interviewed on RSG radio with PhD student Brian du Preez during Woordfees. The title of

the interview was "Fire in Fynbos". Prof Dreyer serves on the editorial board of *Botany Letters* and frequently gives media interviews. She manages the Stellenbosch University Herbarium and is on the advisory board of the Stellenbosch University Botanical Garden.

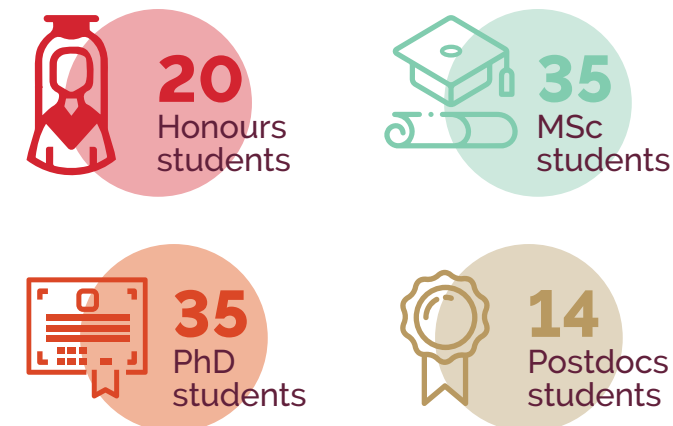
Prof Carol Simon is the chair of the local organising committee of the 14th Polychaete Conference to be held in Stellenbosch in 2023. She presented two papers at the 17th South African Marine Science Symposium in Durban

Miss Zaynab Shaik presented her midway PhD lecture at the Gothenburg University titled "Extensions of the multispecies coalescent for species delimitation and inferring trees under the isolation with migration model". She received a research grant from the Southern African-Nordic Centre.

Prof Tammy Robinson-Smythe was appointed as Research Chair: Managing Invasions in Protected Areas.

Academic Affairs

Student Information 2022



The Department of Botany and Zoology continues to support the School for Climate Studies, which aims to create a transdisciplinary capacity that will combine the climate-related knowledge systems of SU faculties, public sector climate policies and initiatives, private sector climate redress and innovation capacities, and SU's social impact mission, in both academic and applied ways – all in support of the transition to a climate-resilient society and a low-carbon economy. This inter-Faculty entity is hosted in the Department under the directorship of Prof Guy Midgley, who likewise holds a 1/8th position within the Department. The School for Climate Studies was involved with the Conference of the Parties (COP27) in Egypt in November 2022 in various activities, in collaboration with the Global Alliance of Universities on Climate (GAUC).

Awards to Staff and Students

Prof Brian van Wilgen was awarded the National Research Foundation Lifetime Achievement Award for his outstanding contribution to the development of science in and for South Africa with respect to his research contributions in the fields of ecology and biological invasions.



Prof Brian van Wilgen (middle), recipient of the NRF Lifetime Achievement Award 2022. On the left is Mr Buti Manamela, Deputy Minister of Science and Innovation, and on the right is Dr Fulufhelo Nelwamondo, Chief Executive Officer of the National Research Foundation.

Caitlin Ching-Sent received the Zoological Society of South Africa (ZSSA) award for the best Honours student at SU, while **Isabella de Beer** received the ZSSA award for the best third year student at SU. **Arjan Engelen** received the Department's best MSc talk award at the Annual Research Meeting. **Jamila Janna** won the Best Student Poster award at the South African Marine Science Symposium and the Best Student Presentation Award at the Western Indian Ocean Marine Science Symposium. **Amoré Malan** received the Junior Captain Scott Memorial medal for the best MSc dissertation at a South African university.

Prof Guy Midgley received the Green Economy Award at the National Science and Technology Forum (NSTF)-South32 Awards ceremony. The Green Economy Award is given in recognition of outstanding work in trans-disciplinary research or human capital development that promotes

environmental sustainability within an academic or non-academic context. He also received an Eco-Logic award at the same function. He was elected as president of the JRS Biodiversity Foundation, an independent grantmaking foundation based in the United States that awards grants to increase the access to and use of biodiversity information in sub-Saharan Africa. He was also introduced as editor-in-chief of the *African Journal of Climate Studies*.

Dr Nasreen Peer won the South African Network for Coastal and Oceanic Research (SANCOR) Young Researcher's Award. **Kaylan Reddy** won the first runner-up award in the FameLab South Africa National Finals. **Catherine Wilkinson** was awarded the Department's best PhD talk at the Annual Research Meeting. **Prof John Wilson** was nominated a Fellow of the Royal Society of South Africa.

Staff Matters

Saudah Jacobs, departmental secretary, resigned to take up a position at Facility Management. **Chandré Engelbrecht** was appointed senior secretary in the Department of Botany and Zoology in 2022.

Social Impact

The Global Alliance of Universities on Climate (GAUC)

Students of climate change impacts will soon need to step into roles in which they can advise our country's negotiators and ensure that the African perspective and needs are accounted for in global policy. To this end, they need to be trained to understand how global policy discussions work, and how their research can best be used to inform policy.

In 2022, Nosipho Gqaleni, Olivia Jones, Yenziwe Mbuyisa, and Kayleigh Murray took part in a pilot training programme hosted by the Global Alliance of Universities on Climate (GAUC). The alliance is made up of 15 leading universities from around the world that have a dedicated focus to transdisciplinary climate change studies. Member universities include Columbia University (USA), Cambridge (UK), and Tshingua University, (CH).

The Climate X Leadership pilot training program was established to give students practical training in disciplines related to climate change from the research frontiers of these fields. The aim of this training is to give students the knowledge and skills necessary to enter climate change negotiation spaces and develop themselves as leaders and advocates for policy that will affect change from respective fields of expertise. The course brought students from different disciplines and countries together to investigate solutions to the issues posed by climate change, and to better understand how to pursue the research and policy landscapes.

The students also attended the United Nations Framework Convention on Climate Change (UNFCCC) 27th conference

of the Parties (COP27) as GAUC ambassadors with Prof Guy Midgley and Ms Kerry-Anne Grey (SU's GAUC organiser). Both took part in panel discussions held by GAUC during COP27, which was attended by various delegates and dignitaries from across the world. Overall, the GAUC program was a valuable introduction to policy and negotiation discourse. – *Kayleigh Murray and Yenziwe Mbuyisa*

LiTHOPS – Learning, Teaching and Opening Science

There is often a big gap between what happens in the academic sphere in science and what people tend to be informed about; and such gaps are often the result of disinterest, miscommunication, and ignorance. Access to excellent Science, Technology and Mathematics (STEM) education at school level is often delineated on socioeconomic lines. Huge disparities may exist when comparing how natural sciences are taught in different schools and this can lead to a disregard for the natural world. We believe one of the ways in which this problem can be resolved, at least in part, is through active sharing of knowledge to a wide audience in an accessible environment, by passionate people who are active in researching a wide variety of topics associated with plant and animal biodiversity.

LiTHOPS as a social impact initiative was launched in 2021 and piloted at several schools in a series of short, informative, engaging, and inclusive talks during 2022. Through research talks, teaching and assistance classes and informative tours, LiTHOPS as a social impact initiative strives to bring learners from local schools on an equal footing concerning subjects associated with life sciences. – *Prof Nox Makunga*



Photo: Stefan Els

Four postgraduate students were selected for the GAUC programme: Olivia Jones, Nosipho Gqaleni, Yenziwe Mbuyisa and Kayleigh Murray.

limbovane Outreach Project

limbovane is an education programme that provides curricular support to educators and helps learners develop practical science skills in the field of biodiversity and invasion science. limbovane had several highlights in 2022 and remains a valuable science education initiative of the Department of Botany and Zoology.

In 2022, limbovane trained 921 Grade 10 learners through classroom lessons and field studies in their respective schoolgrounds. Besides increasing the learners' content knowledge during the classroom lessons, limbovane also helped them develop important practical science skills such as measuring, collecting biological samples, following a scientific protocol, analysing data, and using microscopes and using scientific keys to identify species.

limbovane's educational impact was enhanced through four multiday workshops during the school holidays. These workshops, held at Grootvadersbosch Nature Reserve, Bainskloof and Kylemore, were attended by 61 learners. During these workshops learners conducted mini-research projects in different ecosystems and collected biodiversity and environmental data using various methods. The learners also got to identify plant and invertebrate species, giving them hands-on experience with the use of field guidebooks and microscopes. The practical part of looking at the species and then identifying them complemented their theoretical understanding of how living organisms are classified, which forms a large part of their school Grade 10 Life Science curriculum. The interactive nature of the research projects allows the learners to learn hands-on skills while collaborating and solving problems as a group. Learners also received valuable training in the use of computer programmes such as Excel and PowerPoint. Many of these learners have never worked on computers before but will now be able to prepare class assignments and presentations using the computer skills they gained during their participation in limbovane.

Feedback from learners attending these holiday workshops emphasise the value of such holiday programmes in helping them to develop skills which they otherwise would not have been able to do.

"Today I improved my microscope skills. I learned how to make a Powerpoint, learning about insects isn't as easy as you think it is. There's way more to an ant than just a small insect. I never knew it would be that hard just to identify a specific ant - well, I guess these small things are the ones with the most difficulty."

"I learned today that there are five different ways of capturing different types of insects, most commonly insects captured are the 'ants'. The five different ways are baiting, vacuum, sweep nets, beating and pitfalls. I also learned a plant's name called 'noem-noem' and I saw for the first time a forest tree fern. I learned how to identify plant and invertebrate species."

In 2022, limbovane continued to work closely with its education partners which led to the co-hosting of several workshops with CapeNature, Nature Connect and Cape Leopard Trust. In addition, the project team were also approached by private schools and home-schooler groups for day programmes on local biodiversity and invasive alien species. Through these collaborative workshops and day programmes, limbovane trained a further 142 learners.

Educator training also formed an important aspect of 2022's activities. In April, limbovane provided two days of training to the SU's Post Graduate Certificate in Education (PGCE) students. This training equipped the students (and future educators) with the necessary skills to present a practical field investigation for learners and was attended by 44 students. limbovane also allowed six students to assist with its holiday workshops, thereby giving them practice and mentorship in planning and implementing a practical investigation on biodiversity. A further 121 educators were trained through educator training workshops presented by the limbovane. – *Dorette du Plessis*



Photo: Dorette du Plessis

Mogau Motlatla, a student enrolled for a Postgraduate Certificate in Education, learning to differentiate between different fynbos species in preparation for an limbovane workshop.

PhD student **Kaylan Reddy** was interviewed on Cape Talk in a segment called 25@25, where they interviewed 25-year-olds about their career paths and aspirations. Kaylan also presented his research at the FynbosLIFE Fair for Garden Day and spoke about his journey as a student and researcher at the TEDxYouth Summerveld, in partnership with the University of KwaZulu-Natal, in a presentation titled "The Art of blooming where you're planted".

Collaboration

Angola/Botswana/South Africa

Wild Bird Trust Okavango Research Project

Australia

Macquarie University
RMIT University
University of the Sunshine Coast

Belgium

Royal Museum Central Africa

Brazil

Federal University of Rio de Janeiro

Canada

University of Toronto

China

The University of Hong Kong



Photo: Dorette du Plessis

Learners attending limbovane workshops learn how to use a "pooter/vacuum" and a sheet to collect invertebrates.



The **Global Alliance of Universities on Climate (GAUC)** is made up of **15 leading universities from around the world** that have a dedicated focus to transdisciplinary climate change studies

Czechia

The Czech Academy of Sciences

France

Sorbonne University
Université de Rennes 1
Université Toulouse, France

Germany

Friedrich-Alexander University Erlangen-Nurnberg, Germany

Hungary

MTA-MTM-ELTE Research Group for Paleontology

India

Wildlife Institute of India

Italy

Institute for Sustainable Plant Protection

Japan

University of the Ryukyus
Natural History Museum

Kenya

Kenya Marine and Fisheries Research Institute

Mozambique

Eduardo Mondlane University

Nieu Zealand

University of Auckland

Norway

Nord University

Norwegian University of Science & Technology

Portugal

Universidade do Porto (CIBIO)

Republic of Palau

Palau International Coral Reef Centre

Scandinavia

University of Gothenburg

Senegal

Cheikh Diop Anta University

South Africa

Agricultural Research Council
Kwazulu-Natal Museum
Nelson Mandela University
South African National Biodiversity Institute (SANBI)
University of Cape Town
University of the Free State
University of KwaZulu-Natal

University of Pretoria
Wild Bird Trust

Spain

University of the Balearic Islands

Sweden

Gothenburg Global Biodiversity Center

Switzerland

University of Fribourg

The Netherlands

KNMI, Netherlands (Royal Netherlands Meteorological Institute)
Wageningen University

Trinidad and Tobago

Caribbean Environment Science and Renewable Energy Journal

United States of America

University of Buffalo
University of Florida
University of Rhode Island
University of Vermont
US Forest Service
Washington University
Yale University

United Kingdom/Ireland

Cambridge University
Global Species Programme, Cambridge
Oxford University
University of East Anglia
University of Edinburg
University of Chester
University of Liverpool

Funding

Australian Research Council
Belgium Directorate-general Development Cooperation
Botswana Wild Bird Trust
Centre for Energy Technology (CEBRA), Germany
Department of Science and Innovation
Escom Annual Koeberg Monitoring
Human Frontier Science Programme
Marine and Coastal Research
National Research Foundation

Royal Museum of Central Africa
South African Institute for Aquatic Biodiversity (SAIB)
South African National Biodiversity Institute
Syngenta SA
Thünen Institute of Climate-Smart Agriculture
University of Pretoria
University of the Western Cape
University of Toronto
World Bank

NRF-rated Researchers

Leading international research	
Prof GF Midgley	Ecology and ecophysiology
Prof DM Richardson	Biological invasions and conservation biogeography
Internationally acclaimed researchers	
Prof BA Anderson	Plant-animal interactions
Prof S Daniels	Molecular systematics, phylogeography and conservation of invertebrates
Prof AG Ellis	Evolutionary ecology of plants and insects
Prof CA Matthee	Molecular systematics and phylogeography
Prof CA Pauw	Evolutionary ecology of plants and their pollinators
Emeritus Prof D Baird	Marine ecology
Emeritus Prof B van Wilgen	Biological invasions and conservation
Extraordinary Prof J Wilson	Biological invasions and conservation
Extraordinary Prof WJ Przybylowicz	Applications of nuclear microprobes in biology
Established researchers	
Prof S Clusella-Trullas	Thermal adaptation of ectotherms and implications for climate change
Prof LL Dreyer	Evolution of Cape Flora
Prof NP Makunga	Medicinal plant biotechnology
Prof TB Robinson	Drivers, patterns and impacts of marine invasions
Prof CA Simon	Marine invertebrate; reproduction and worm taxonomy
Prof S von der Heyden	Marine molecular ecology and conservation
Dr S Kumschick (CIB)	Invasion biology
Prof J Measey (CIB)	Conservation and ecology of invasive species
Extraordinary Prof L Foxcroft	Invasion ecology
Extraordinary Prof JM Mesjasz-Przybylowicz	Plant ecophysiology

Staff List

Academic

Prof BA Anderson
Prof MI Cherry
Prof S Clusella-Trullas
Prof SR Daniels
Prof LL Dreyer
Prof AG Ellis
Dr AF Flemming
Prof NP Makunga
Prof CA Matthee
Prof GF Midgley
Dr M Mouton
Prof CA Pauw
Dr N Peer
Dr VR Rambau
Prof DM Richardson
Prof TB Robinson-Smythe
Ms Z Shaik
Prof CA Simon
Prof S Von der Heyden
Prof TC Wossler (Head of Department)

Academic Staff: Centre of Excellence for Invasion Biology

Dr S Kumchick
Prof J Measey
Prof J Wilson (Extraordinary Professor)
Prof B van Wilgen (Emeritus Professor)

Extraordinary Appointments

Dr S Andreotti
Dr S Elwen
Prof W Foden
Prof L Foxcroft
Dr T Gridley
Prof J Le Roux
Prof W Przybylowicz
Prof J Przybylowicz
Prof JR Wilson

Emeritus Professors

Prof D Baird
Prof J Gilomee
Prof JAJ Nel
Prof AJ Reinecke
Prof SA Reinecke
Prof TJ Robinson
Prof VR Smith
Prof DE van Dijk
Prof B van Wilgen
Prof H Van Wyk

Support staff

Ms J Basson
Ms C Engelbrecht
Ms F Gordon
Ms S Johnson
Ms DJD Willemse
Ms J Hutton
Ms MJ Mathese
Ms AC Nel

Mr R Robertson
Ms MP Sauerman
Mr N Solomons
Mr JP Williams
Mr H Witbooi

Support staff: Centre of Excellence for Invasion Biology

Ms D du Plessis
Ms S Kritzinger-Klopper
Ms C Momberg
Ms L Msomi
Ms E Nortjé

Postdoctoral fellows

Dr A Alvarez Aguilar
Dr J Baxter-Gilbert
Dr H Beckett
Dr C Botella
Dr A Da camara dandas Ferreira
Dr H Hirsch
Dr JH Keet
Dr B Loedolff
Dr NA Masondo
Dr A Melotto
Dr M Moir
Dr A Ndhlovu
DR MM Nsikani
Dr N Stevens
Dr JL Van Velden



Photo: Chokniti Khongchum

Contact Details

Tel: 021 808 3236 | E-mail: botzoo@sun.ac.za
Fax: 021 808 2405 | Web: www.sun.ac.za/botzoo

Photo: Stefan Els

Department of Chemistry and Polymer Science

Research Interests

Organic and medicinal chemistry; Inorganic and organometallic chemistry; Analytical chemistry; Polymer science; Materials technology (Performance properties of functional textiles); Physical and computational chemistry; Supramolecular and materials chemistry; Chemistry education; Nanotechnology

Research Highlights

Developing new hit compounds against malaria and TB

The PhD work of Dr Tania Olivier, a 2022 graduate from the bioinorganic "Haem Team SU" research group led by Dr Katherine de Villiers, was published as a Very Important Paper in *ChemMedChem*. In this publication, which was co-authored by Tania's co-supervisor in Organic Chemistry, Prof Gareth Arnott, they show for the first time that there is a statistically significant correlation between *in silico* adsorption energy for a ligand to the fastest growing face of a malaria pigment (hemozoin crystal), and experimental inhibition activity against the formation of synthetic hemozoin. Following graduation, Dr Olivier completed a short post-doctoral fellowship in the bioinorganic research group before taking up a second post-doctoral fellowship at UCT in the Holistic Drug Discovery and Development (H3D) Centre. Dr Olivier continues to use her synthetic and computational skills to develop new hit compounds against malaria and tuberculosis. – Dr Katherine de Villiers

Click-fragment approach used in PhD dissertation

The cover art for this manuscript in the journal *ChemMedChem* (Wiley), published on behalf of Chemistry Europe (a consortium of European chemical societies), describes a collaboration between the groups of Prof Daniel Rauh of Technical University Dortmund and Prof Willem van Otterlo at SU. The work focuses on the design, synthesis and testing of a set of molecules aimed at inhibiting the Akt family of kinases, enzymes that have been implicated in the progression of cancerous tumors. In this research three novel allosteric imidazopyridine-based compounds were synthesized which exhibited (through biochemical and cellular evaluations) irreversible inhibition of Akt and displayed submicromolar antiproliferative activity against several cancer cell lines, potentially paving the way for new covalent allosteric inhibitors with improved properties. These results were from research performed at SU by PhD candidate Leandi van der Westhuizen (PhD 2019), who used a "click fragment approach" as part of the South African-Germany collaboration. The manuscript was published on invitation in a special issue on "Biological and Medicinal Chemistry in Africa".



Polymer separation group: Expanding the boundaries of polymer analysis

Researchers at the Leibniz-Institute for Polymer Research (IPF) in Dresden and Stellenbosch University have been cooperating actively over the past few years on the specific adaptation of field flow fractionation (FFF) to effectively and reliably analyze biomimetic, responsive and highly complex macromolecular systems. Understanding the interplay of multiple structural parameters and their simultaneous determination in minute sample quantities allows for the rapid development and screening of polymer drug carriers or polymer hybrid structures.

In 2020, the collaboration was formalized with the establishment of a joint IPF-SU research group in polymer separation, led by Prof Albena Lederer from IPF Dresden. Prof Lederer is head of the Centre for Macromolecular Structure Analysis in the Institute for Macromolecular Chemistry at IPF Dresden. She is now also holder of the Sasol Research Chair in Analytical Polymer Science at SU.

This group has since been instrumental in advancing the development of innovative FFF methods and expanding the frontiers for the analysis of supramolecular and complex polymers. Especially by coupling different methods, Lederer's group has enriched the deep understanding of structural changes within complex macromolecular samples as a function of various parameters (such as molar mass, crosslinking, pH, concentration, etc.). Multiple

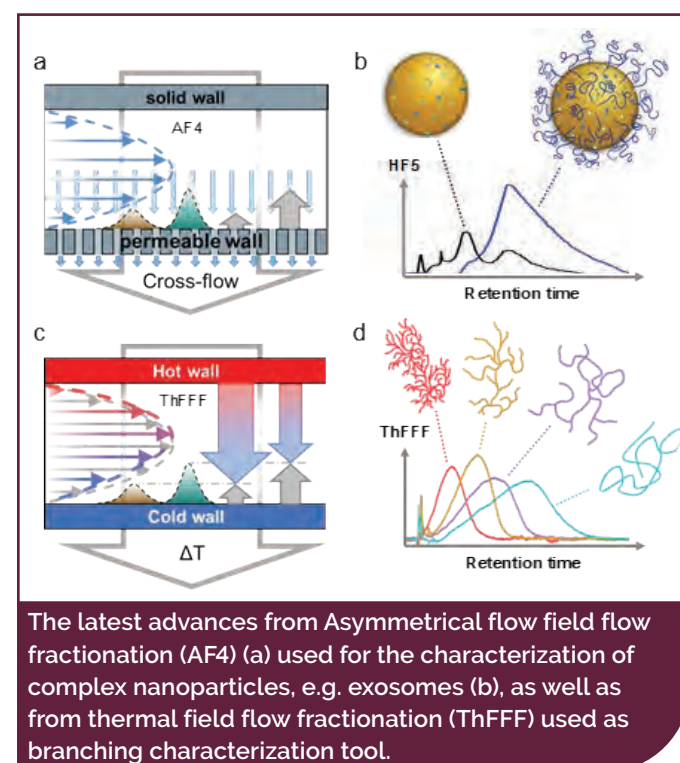
detections provide a large quantity of information from a single measurement. Numerous parameters describing the molecular shape in dilute solutions are considered, such as scaling, molar mass, size, shape, apparent density and intrinsic viscosity. The separation and quantification of encapsulated or released drugs realized in this manner are of great importance for the development of new therapeutic methods.

In the future, a single measurement will provide even more information when quintuple detection is coupled with thermal FFF (ThFFF). Due to the thermophoretic properties of the analytes, it will then also be possible to separate and analyze polymers according to microstructure, topology and chemical composition. In recent years, they have made great progress in moving from a trial-and-error approach to a targeted theory-based method, including analytical predictions. ThFFF is, therefore, to be developed over the next few years into a powerful tool that can be used, for example, to study ultrahigh-molecular-weight polyolefins or the distribution of plasmonic properties in metal-polymer hybrid systems.

Together with the junior scientists Dr Susanne Boye, Dr Upenyu Muza, Dr Zanelle Viktor, Dr Helen Pfukwa and Dr Martin Geisler, the research focuses on three fields: theoretical and applied FFF for complex nanostructures; new characterization methods and high-temperature separation of polyolefins; and innovative methods for analytics of natural and complex synthetic polymers and for the development of materials from renewable resources.



Prof Albena Lederer from the Institute for Polymer Research (IPF) Dresden in Germany was jointly appointed at SU in 2020. She has now expanded her polymer separation research group at IPF, founded in 2007, to include the Sasol Research Chair at SU, formerly held by Prof Harald Pasch. Her work is supported by junior scientists such as Dr Susanne Boye, Dr Martin Geisler, Dr Zanelle Viktor, Dr Helen Pfukwa and Dr Upenyu Muza.



SU hosts National Convention of the SA Chemical Institute

The 44th National Convention of the South African Chemical Institute was hosted in Stellenbosch in early January 2023. Prof Catharine Esterhuysen and Prof Delia Haynes acted as the Chair and Vice of the organising committee, respectively. Profs Willem van Otterlo, Peter Mallon, André de Villiers and Gareth Arnott as well as Dr Rehana Malgas-Enus served on the organising committee.



The local organising committee and the postgraduate students who assisted with the hosting of the 44th SACI National Convention.

Research Activities

Prof Gareth Arnott served as convenor of the chemistry panel for NRF ratings. He gave an invited talk at the Academic Consortium for the twenty-first century (AC21) event held at the University of Cape Town.

Prof Len Barbour is associate editor of *Crystal Growth and Design*, which is published by the American Chemical Society (ACS). He serves on the editorial advisory boards of *CrystEngComm* (an RSC journal) and *ACS Sustainable Chemistry and Engineering*, as well as *Chemistry of Materials* (an ACS journal).

Dr Margaret Blackie continues to serve as treasurer for the Western Cape division of the South African Chemical Institute (SACI). She serves on the committee for the International Conference for Chemical Education and on the committee for the Suellen Shay Memorial Symposium. She resigned in May 2022.

Dr Ebrahiem Botha is a member of the South African Chemical Institute (SACI) and lectures chemistry in the Extended Degree Programmes (EDP). The EDP offers alternative access to the broad STEM (Science, Technology, Engineering and Mathematics) fields and enable students to acquire academic skills and knowledge needed to complete a degree programme successfully at SU. He presented his research on Capacitive Deionisation (a water purification method) at the 44th SACI National Convention.

Dr Prinessa Chellan was elected as an African Academy of Sciences Affiliate Fellow and appointed to the Early

Career Editorial Board for the *ChemBioChem* journal. She was an invited speaker at the 2021 International Symposium on Bioorganometallic Chemistry (being held virtually due to COVID-19) where she presented the latest research from her group on organometallic platinum group metal (PGM) complexes as antiplasmodial agents. She presented her research at the SACI Western Cape 'New Chemists on the Block' event held at Stellenbosch University on 29 June 2022.

Prof André de Villiers serves as chair of the Western Cape division of the Chromatographic Society of South Africa (ChromSA). He is also a member of the editorial advisory boards of the *Journal of Chromatography*, *Analytical Chemistry*, *Chromatographia* and *LCGC*.

Dr Katherine de Villiers is a member of the Organisation for Women in Science for the Developing World as well as the Women in Malaria network. She gave an invited webinar on the heme detoxification pathway in the malaria parasite as part of the Holistic Drug Discovery and Development (H3D) centre series.

Prof Catharine Esterhuysen is the chair of the Special Interest Group on Molecular Interaction and Recognition of the European Crystallographic Association and a member of the Commission on Crystallographic Teaching of the International Union of Crystallography. She is a member of the International Advisory Boards of the *Canadian Journal of Chemistry* and the International Symposium on Halogen Bonding and an associate editor of *New Journal of Chemistry* and a Fellow of the Royal Society of Chemistry and the Royal Society of South Africa. She presented invited talks at the 12th Triennial Congress of the World Association

of Theoretical and Computational Chemists, Vancouver, Canada, in July 2022; at the FreeStatePhyChem-2022 Symposium in Bloemfontein, November 2022; and a keynote lecture at the 33rd European Crystallographic Meeting (ECM33), in Versailles, France in August 2022.

Prof Delia Haynes serves as the first president of the African Crystallographic Association and is an elected member of the Executive Committee of the European Crystallographic Association (2018 – present). She is also the regional editor for Africa for the International Union of Crystallography Newsletter (2018 – present), a member of the SACI Western Cape Committee (2014-present), and a member of the Advisory Board of the RSC journal *CrystEngComm*. She was on the advisory board and scientific committee of the third Pan-African Conference on Crystallography, held in Kenya in January 2023, and is a member of the International Programme Committee for the International Union of Crystallography Convention to be held in 2023. She gave an online plenary lecture at the National Crystallographic Meeting in Portugal in July 2022, and an invited lecture at the 25th International Conference on the Chemistry of the Organic Solid State in Macedonia in July 2022.

Prof Bert Klumperman is an associate editor of *Macromolecules* (ACS) and editor-in-chief of the *Transactions of the Royal Society of South Africa*. He has been elected vice-president of the Royal Society of South Africa. In November 2021 he gave an invited lecture at the American Chemical Society (ACS) Symposium on Living Radical Polymerization in Charleston, USA.

Prof Alben Lederer is a guest editor of a special issue for *Macromolecular Chemistry and Physics* (2022) and member of the editorial board of the *International Journal of Polymer Analysis and Characterization* (Taylor and Francis) and of *Materials* (MDPI). In 2022 she became the chair of the scientific committee for the International Symposia on Field and Flow Fractionation and is a member of the scientific committees of the International Symposium on Separation and Characterization of Natural and Synthetic Macromolecules (SCM-10, 2022, Amsterdam).

Dr Rehana Malgas-Enus served as an editor for *Springer Nature Applied Sciences*. She also served on the NRF Thuthuka review panel, as well as the SU Social Impact committee and the SU Transformation committee. Dr Malgas-Enus was also awarded the prestigious Eleonore Trefftz Professorship at the Chair of Inorganic Molecular Chemistry (Faculty of Chemistry and Food Chemistry) at the Technische Universität Dresden from 5 September to 16 December 2022.

Prof Peter Mallon serves as a Titular member of the International Union of Pure and Applied Chemistry (IUPAC) Division IV: Polymer and is a permanent member of the Subcommittee on Polymer Terminology and the Subcommittee on Polymer Education. Prof Mallon also serves as a founding executive board member

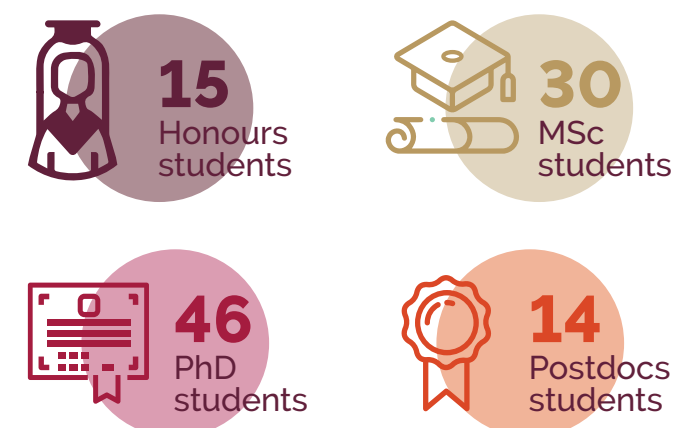
of the Commonwealth Chemical (the Federation of Commonwealth Chemistry Societies) and is the immediate past president of the South African Chemical Institute. Prof Mallon has also been elected as a Fellow of the South African Chemical Institute.

Prof Selwyn Mapolie continues to serve as committee member of the Catalysis Society of South Africa (CATSA).

Prof Willem van Otterlo currently serves as President of the South African Chemical Institute and as one of two Alexander von Humboldt (AvH) Ambassador Scientists for South Africa, appointed from 2019 to 2022. He is on the editorial control board of the Platinum open-access journal, Archives of Organic Chemistry – Arkivoc. He assisted the NRF ratings system by being a panel accessor. In the first week of December 2022, he organised an Academic Consortium (AC21) event at Stellenbosch involving researchers from the Universities of Strasbourg and Freiburg which attracted over 150 delegates over the three-day event held at SU, UWC and UCT.

Academic Affairs

Student Information 2022



In Memoriam



It was with shock and great sadness that we lost Dr Rehana Malgas-Enus who tragically passed away while on sabbatical as an Eleonore Trefftz fellow at the Technische Universität Dresden in late September. This is a great loss for the department and chemistry in South Africa in general. Dr Malgas-Enus had made a large impact in the department and her contributions will be greatly missed.

NRF-rated Researchers

Leading international research	
Prof Len Barbour	Nanostructured functional materials
Prof Bert Klumperman	Living radical polymerization and advanced macromolecular architectures
Internationally acclaimed researchers	
Prof Ben Burger	Chemical communication in living organisms
Prof Helgard Raubenheimer	Ligand design aimed at applications in homogeneous catalysis, gold chemistry
Prof Willem van Otterlo	Organic synthesis and medicinal chemistry
Prof André de Villiers	Separation science fundamentals and applications
Prof Delia Haynes	Crystal engineering of non-metal containing materials
Established researchers	
Prof Gareth Arnott	Inherently chiral calixarenes; asymmetric methodology
Dr Margaret Blackie	Organic chemistry
Dr Katherine de Villiers	Antimalarial agents
Prof Catharine Esterhuysen	Intermolecular interactions
Prof Ivan Green	Small molecule syntheses for medicinal application
Dr Robbie Luckay	Ligand design for metal ion coordination in industrial and medical applications
Prof Peter Mallon	Complex polymer materials and polymer nano-composites
Prof Selwyn Mapolie	Catalytic transformations using late transition metal complexes
Prof Albert van Reenen	Polyolefins
Promising young researchers	
Dr Helen Pfukwa	Biomass valorisation and polymer characterisation
Dr Rueben Pfukwa	Living radical polymerisation

Collaboration

South Africa

Cape Peninsula University of Technology
Drug Discovery and Development Centre (H3D), University of Cape Town
Nelson Mandela University
North-West University
Rhodes University
University of Cape Town
University of Johannesburg
University of KwaZulu-Natal
University of Pretoria
University of Venda
University of the Witwatersrand

Australia

Griffith University
Queensland University of Technology

Austria

Medical University of Vienna
University of Natural Resources and Life Sciences

Belgium

Free University Brussels
Ghent University

Canada

McGill University
University of Alberta
University of Waterloo

Czech Republic

Technical University of Liberec
University of Chemical Technology Prague

France

Université de Lorraine
University of Strasbourg

Germany

Albert Ludwig University of Freiburg
Dortmund Technical University
Leibniz-Institut für Polymerforschung Dresden

India

Jawaharlal Nehru University

Ireland

University of Limerick

Italy

Turin University
University of Naples Federico II

Japan

Nagoya University

Netherlands

University of Amsterdam
Vrije University Amsterdam

Poland

Adam Mickiewicz University
University of Warsaw

Portugal

NOVA University Lisbon

United Arab Emirates

New York University Abu Dhabi

United Kingdom

Lancaster University
National History Museum
University of Birmingham
University of Glasgow
University of Nottingham
University of Warwick

United States of America

Carnegie Mellon

Emory University
Georgetown University
Georgia Institute of Technology
Gustavus Adolphus College
Texas State University (TSU)
University of Texas Southwestern Medical Centre
Virginia Polytechnic Institute



Funding

Academic Consortium 21 (AC21, Universities of Strasbourg, Freiburg and Nagoya)

African Academy of Sciences

DFG German Research Foundation

DST/NRF SARCHI Programme

European Union (M-ERA-NET Initiative)

Medical Research Council (MRC)

National Institutes of Health (NIH)

NRF Competitive Programme for Rated Researchers

NRF National Equipment Programme

NRF Thuthuka Programme

Royal Society

Sasol

Stellenbosch University

Technology Innovation Agency (TIA)

Wellcome Trust

Staff List

Academic staff Research Chairs

Prof LJ Barbour

Prof L Klumperman

Prof A Lederer

Professors / Associate Professors

Prof GE Arnott

Prof AJ de Villiers

Prof C Esterhuysen

Prof DA Haynes

Prof PE Mallon (*Departmental Head*)

Prof SF Mapolie

Prof WAL van Otterlo

Prof AJ van Reenen

Senior Lecturers / Lecturers

Dr MAL Blackie

Dr E Botha

Dr P Chellan

Dr KA de Villiers

Dr WJ Gerber

Mrs A Gericke

Dr CH Kaschula

Dr RC Luckay

Dr M Lutz

Dr R Malgas-Enus

Dr R Pfukwa

Senior Researchers / Research associates / Fellows

Dr AGJ Tredoux

Extraordinary Professors

Prof W Mackenroth

Prof J Wiegand

Emeritus Professors

Prof BV Burger

Prof HG Raubenheimer

Support staff

Administrative staff

Mrs MMG Cooper

Mrs PH Davidse

Mr MK Dlodlu

Dr M du Plessis

Mr JG Goldie

Technical staff

Mr TA Hunt

Mr EJ Lukhele

Mr MG Marupula

Mr MA Mclean

Mr S Mohamed

Mr JS Motshweni

Mr A Nxopo

Dr H Pfukwa

Mr GR Willemse

Assistants

Mr H Gordon

Ms D Isaacs

Ms M Jones

Mr CW Maart

Ms Y Mgqala

Ms NS Ntwana

Ms CJ van Reenen

Ms DC Wenn

Post-doctoral fellows

Dr A de Cuyper

Dr L Kellerman

Dr TA Leigh

Dr K Masike

Dr ME Matthews

Dr NJ Nnaji

Dr T Olivier

Dr S Ndumiso

Dr CM Smit

Dr HK Tanui

Dr DP van Heerden

Dr A van Niekerk

Dr LM van Wyk

Dr AI Vicatos



Contact Details

Tel: 021 808 3172

E-mail: ec@sun.ac.za

Web: <http://www.sun.ac.za/chemistry>

Photo: Stefan Els

Department of Earth Sciences

Research Interests

Geology

Tectonics and orogenic processes; Archean geology; Sedimentology and palaeontology; Igneous petrogenesis; Metamorphic petrology; Experimental petrology; Gold- and base-metal mineralisation; Heavy mineral deposits; Geometallurgy

Environmental geochemistry

Trace-element and isotope geochemistry; Marine geochemistry; Hydro-geochemistry; Hydrogeology; Environmental geochemistry; Isotope hydrology



Photo: Kurtin Martin @kurt_artin

South Africa's polar research vessel the SA Agulhas II sailing in the sea ice zone as the SCALE 2022 expedition focussed on understanding processes close in the area influenced by sea ice



Group photo of all SCALE 2022 expedition participants on board the SA Agulhas II.

Research Highlights

Environmental geochemistry research

Dr Susanne Fietz and Dr Lynwill Martin from the South African Weather Service (SAWS) received funding for a new NRF PROTEA (SA-FRANCE) project (2022-2023) titled "Knowledge and technology transfer to investigate marine mercury contamination in SA". The project includes collaboration with Dr Lars-Eric Heimbuerger-Boavida's Mercury Laboratory at the University of Marseille, France. Susanne and Lynwill also visited the Mercury Laboratory in Marseille in October 2022 to discuss future mercury sampling in the waters around southern Africa and Antarctica.

Within this NRF PROTEA project, a group of postgraduate students from SU Earth Sciences and the French partner led by Dr Fietz and Casper Labuschagne (SAWS), joined the South African Winter expedition #SCALE22 into the Southern Ocean in July-August 2022. The team studied bioactive trace metals and mercury in the Antarctic seawater and in the sea ice. Trace metals can act as fertilisers (such as iron, for example), but some can be toxic in the environment (such as mercury). The team's work helps in understanding where the trace metals and mercury come from, how they are distributed and what their impact on the sensitive Antarctic ecosystem may be.

Sedimentology research

Sedimentologist **Dr Ryan Tucker** was out of office for much of September, taking part in a multidisciplinary international expedition to remote portions of the Eastern Gobi Desert in south-eastern Mongolia. Dr Tucker has teamed up with collaborators from the United States and Japan to critically assess climate change during one of Earth's warmest periods, the transition from lower to upper Cretaceous. In the past, Dr Tucker has taken an active role within this collaboration to focus on contextualising climate change and landscape modification due to tectonics during the middle Cretaceous, along with assessing the effects of those changes to fossil assemblages preserved therein. These efforts are ongoing in Utah, New Mexico (USA), Thailand and Laos, all documented in numerous papers and conference proceedings. The team recognised a missing piece to the puzzle and Dr Tucker's work in the Gobi thus far has identified multiple sedimentary successions including fluvial (rivers), lacustrine (lakes), and aeolian (deserts), all exhibiting multiple phases of tectonic

alterations. Furthermore, for the first time, Dr Tucker reports ash-fall and bentonites from key stratigraphic sections that will greatly help elucidate both local and regional stratigraphic relationships, which up to now have been tenuous at best.

The present work forms the foundation for ongoing work in the area and Dr Tucker aims to continue to play a key role within this international team to address this knowledge gap by exploring remote areas of the eastern Gobi. In addition to this, he involves numerous Stellenbosch postgraduate students in the field work and the broader research team.



Ash bed-bentonite in the east-central Gobi Desert, ice axe for scale is 70cm.

Hydrogeology research

2022 was the inaugural year of the Hydrogeological Field School, brainchild of **Dr Reynold Chow** and **Prof Alekandra Roychoudhury**. Over two weeks in July, the first group of Honours students received some hands-on training on hydrogeological techniques related to groundwater exploration, including borehole siting, core logging, well installation, water level monitoring and hydraulic well tests. The course was supported by industry geologists from local hydrogeological consultancies and made use of the existing infrastructure and boreholes at the Marydahl experimental farm, part of SU's Welgevallen farm. Reynold and MSc student Ritshidze Nenweli highlighted critical knowledge gaps in the management of our ground water resources in an article in the *Cape Times* and contributed to a documentary on water sustainability on the China Global Television Network (CGTN).

Pesticides in surface waters and groundwater

Dr Reynold Chow continues to focus on the study of pesticides in surface waters and groundwater in the Western Cape. The work takes place against the background that South Africa is the leading pesticide user in Sub-Saharan Africa. Some of these pesticides can enter non-target environments, such as surface water or groundwater, where they can potentially harm aquatic biota or even human health. Reynold and his team sampled rivers (Berg, Krom, and Hex Rivers) from three agricultural catchments in the Western Cape and found that all samples contained at least three pesticides and that a majority of samples contained five or more. They further investigated drivers of aquatic pesticide pollution with the hopes of identifying effective mitigation measures.

Metamorphic petrology research

A recent collaboration between the Czech Geological Survey, Université Jean Monnet in France and **Dr Matthew Mayne** has resulted in a cross-software platform that allows the thermodynamic modelling program Rcrust (www.tinyurl.com/rcrust) to output data into the plotting and analysis program GeoChemical Data toolkit (<http://www.gcdkit.org/>). This new pipeline allows users to automate the data analysis and interrogation of phase equilibrium results with custom-built geochemical functions and plotting algorithms. The research exchange was generously supported by the Czech Geological Survey and was accompanied by a public presentation of the work in Prague in May 2022.

Economic geology research

Dr Bjorn von der Heyden has recently been awarded a research chair position in the emerging field of Geometallurgy. The research chair is sponsored by African Rainbow Minerals (ARM) and is being shared with a colleague from the Department of Process Engineering, **Dr Margreth Tadie**. The research will involve postdoctoral fellows, PhD and MSc students in both environments. The research chair will kick off formally from 2023 and hopes to make a meaningful contribution to this field of science within the local minerals sector.



Photo: Wiida Fourie-Basson
Dr Margreth Tadie (left) and Dr Bjorn von der Heyden (right) will lead up the new African Rainbow Minerals GeoMetallurgy Research Chair from 2023.

Geocongress 2023 hosted in Stellenbosch

The preparations for Geocongress 2023 in Stellenbosch intensified in the second half of 2022. This meeting was initially planned for June 2020 – coinciding with the 125th anniversary of the Department of Earth Sciences. It had to be cancelled due to the Covid-19 pandemic, rescheduled to 2021, cancelled again and, third time lucky, scheduled for January 2023. Over 400 registrations were received with four parallel sessions planned, including hybrid presentations, field trips and workshops. The meeting will be held in the new Jan Mouton Learning Centre making use of state-of-the-art presentation facilities.

Research Activities

Dr Reynold Chow continues on the study of pesticides in surface waters and groundwater in the Western Cape and he presented results of his research at a pesticide pollution conference at the University of York (UK) and as a peer-reviewed article on aquatic pesticide pollution. Reynold continues to foster international ties and participated in two Tunisia-South Africa bilateral meetings, one held in Tunisia, one in Stellenbosch. He also hosted Ms Ipshita Tomar from Waterloo University (Canada) as an intern for three months as part of the exchange programme between SU and Waterloo as well as four students from Erasmus Brussels University for their internships.

Dr Susanne Fietz participated in a successful collaborative effort by several South African and European groups to reconstruct air temperatures for south-east Africa based on lipid biomarkers in peat from the Mfabeni peatland in KwaZulu-Natal. The last 43 000 years do not indicate a clear control of local temperatures by greenhouse gas concentrations and insolation. Instead, Mfabeni air temperatures are affected, next to global changes, by Indian Ocean sea surface temperatures (SSTs) and position of the westerlies. The record thus underlines the sensitivity and vulnerability of south-east Africa to global and regional climate forcings. Susanne continues to serve as associate editor for the journal *Global Biogeochemical Cycles*, is member of the steering committee and national representative of the international initiative GEOTRACES and SU's BIOGRIP programme, was part of the local organising committee for the SOLAS Open Science Conference, Cape Town, in September 2022 and Geocongress 2023 in Stellenbosch. Since 2022 she is external moderator for CPUT for the Postgraduate Diploma in Marine Sciences.

Dr Matthew Mayne presented a virtual poster at the European Geosciences Union (EGU) General Assembly in April 2022, taking place in Vienna, Austria. The poster, titled "Adapting phase equilibria modelling to crustal and planetary scale problems", details the latest advances to the Stellenbosch University Rcrust software and its application to planetary sciences. One of his MSc students, Sean Hoffman, presented a virtual poster titled "A new methodology for considering minor elements of geologic importance in phase equilibria modelling" detailing his contribution to Rcrust, which consists of a new methodology for considering minor elements.

Prof Alex Kisters concluded a first cycle of research on the controls of hydrothermal fluid flow and gold mineralisation in the Archaean Barberton greenstone belt. The industry-funded research generated five full research papers, numerous abstracts presented at international conferences and involved 11 students at MSc and Honours level, many of whom completed their degrees *cum laude* and with national awards. Some of the results were presented as a lecture series on hydrothermal gold mineralisation, coordinated by Prof Neil Phillips, research associate in the department, and can be viewed on Youtube, where the talks have received several thousand hits. Prof Kisters also presented and served on an expert panel for Eskom on the potential of seismic events at the Koeberg nuclear site. Current research continues to revolve around gold mineralisation, in Namibia and the Murchison and Barberton region of SA, respectively (involving PhD student Josia Shilunga and MSc students Luke Carlton and Simon Riekert); the 3D modelling of Koperberg basic bodies in the Okiep Copper District and implications for the emplacement mechanics of the mafic magmas (MSc student Andeon Bester), and the regional-scale compilation of strains in basement rocks of the Western Cape, a first of its type in the Western Cape (MSc student Chris Rheeder).

Dr Ryan Tucker has been busy in 2022 with ongoing internationally collaborative projects in North America, Thailand-Laos, and Mongolia, along with the successful graduation of PhD student Charl Cilliers. Ryan was lead author of two publications in 2022: the first presented novel age dating results for Early Cretaceous sedimentary succession in the Khorat Basin of Thailand, published in the *Journal of Palaeogeography, Palaeoclimatology, Palaeoecology* along with a revision of the sedimentological history for the Mussentuchit Member of the Cedar Mountain Formation of Central Utah in the USA, published in the *Journal of Sedimentary Research*.



Dr Tucker also embarked on a high-risk, high-reward expedition to the famed Gobi Desert of Mongolia and will report in future publications on the discovery of five new dinosaurs and three first ash beds, a first in the Eastern Gobi. Radiometric age dating of these ash falls will be vital to unravelling the complexity of rift basin tectonics in the Mesozoic Gobi Basin. Dr Tucker continues to serve on the auction committee of the Society of Vertebrate Paleontology. He serves on the editorial boards of the journals *Frontiers in Ecology and Evolution* and *Earth Science*, and as review editor for *Paleontology and Earth Sciences*.

Dr Bjorn von der Heyden continues as the principal organiser of the Geological Society of South Africa's Geocongress planned for 2023. He is a committee member of the Mineralogical Society of South Africa (MINSAs), external moderator for the undergraduate programme at Rhodes University, a member of the organising committee for the African Light Sources international conference; a member of the International Science Council's Special Committee on Oceanographic Research (SCOR), and representative for the Earth Sciences in the African Strategy for Fundamental and Applied Physics (ASFAP). He continues to collaborate with researchers from the University of Johannesburg, the University of the Witwatersrand and the University of Cape Town, as well as the Namdeb Diamond Corporation in Namibia. From Canada he collaborates with researchers from the University of Alberta and the *Institute national de la recherche scientifique* (INRS), and from France, the Université Jean-Monnet and the Université de Montpellier.

Social Impact

SU Earth Sciences now has a greater social media presence

To keep abreast of modern trends and to better interact with past, current and prospective students who are all becoming more familiar with and reliant on social media interactions, the Department of Earth Sciences is pleased to announce the release of its own Facebook, Twitter, Instagram and Tiktok accounts. These accounts are being kept current and interesting by MSc student Emma Davies, who aims to encourage interest in both the department and in the broader field of Earth Sciences. We hope that by connecting with prospective students through these platforms, we will continue to attract a throughput of interested and high-caliber earth science graduates. For more information, follow the QR codes below, and see additional links at our existing departmental webpage <http://www.sun.ac.za/english/faculty/science/earthsciences>.

In August 2022, SU alumnus Andile Mkandla invited **Dr Susanne Fietz** and **Dr Ryan Cloete** to join a Career Day and High School debate that Andile and CLS South Africa held at CPUT. The Career Day focussed on opportunities in the maritime sector. The debate topic was "The exploration and production of oil and gas must not be allowed on any of the South African coasts". Two high schools, LEAP2 and Soneike High, participated in the event.

Dr Bjorn von der Heyden encouraged students to think about a career in the Earth Sciences. He was an invited lecturer at the seventh African School of Physics (ASP2022) (28 November–9 December 2022) at Nelson Mandela University in Gqeberha, where he engaged with over 500 learners from all over Africa.



Academic Affairs

Postgraduate students 2022



20
BScHons
students



25
MSc
students



10
PhD
students



The final get-together of the 2022 BSc Honours class in Earth Sciences, before they disperse to all corners of the country and world.

Awards to Staff and Students

The Economic Geology study group at SU has experienced some notable successes during the latter part of 2022. These have mostly taken the form of student awards.

Yann Waku and **Steve Chingwaru** won respectively first and third best MSc poster awards at the Prospectors and Developers Association of Canada's (PDAC) conference in Canada. Yann's work looks at gold mineralisation in the Moto greenstone belt in the DRC, and Steve has conducted a detailed investigation of the mineralogical deportment of gold in the Witwatersrand tailings materials.



Yann Waku (left) and Steve Chingwaru (right) were recent winners of student science at the PDAC conference in Canada.



Ryan Rosenfels (left) and Rutger la Cock (far right, next to Bjorn von der Heyden) were recent award recipients from the Geological Society of South Africa's annual awards.

Ryan Rosenfels and **Rutger la Cock** respectively received the Geological Society of South Africa's John Handley Medal (for the best MSc thesis in South Africa) and the Haughton Award (for the best Honours thesis in South Africa). Ryan's work characterised the cobalt and copper mineralisation at the Fungurume 88 deposit in the DRC, whereas Rutger's Honours thesis focussed on manganese mineralisation in the Western Cape.

Daniel Ferreira claimed third place for the best scientific poster during the Faculty of Science Postgraduate Student Research conference. Daniel's work looks at the occurrence of sulphide minerals and platinum group elements in the Tantalite Valley Complex in Namibia.

Yamkela Mapetshana scooped first place in the Honour's level presentations given at the South African Geophysical Association's (SAGA) 17th Biennial Conference held in Sun City between 28 November and 1 December. Her BSc Hons thesis focussed on the Raman vibrational characteristics on Mn-bearing sphalerite.

Staff Matters

We welcome **Ms Melita Dlelana** into the department. She joined us in May 2022 as postgraduate coordinator, amongst many other duties. Postgraduate students are at the centre of any academic department and we have, on average, between 60 to 70 Honours, MSc and PhD students in any given year. Melita looks after our postgraduate students, from the early stages of student admissions to the administrative sides of research projects to the eventual graduations. Apart from this, she also keeps a close tab on our website, student records and collates and enters our research outputs. We sincerely hope she enjoys her time in the department.

In recognition of her wide range of research activities, but also outreach activities and her many administrative roles at faculty level and in the department, first and foremost as Honours coordinator for many years, **Dr Susanne Fietz** was promoted to Associate Professor as of 1 January 2023. Congratulations, Susanne!

Funding

South Africa

Anglo American
Barrick Gold Corporation
CNRS/NRF funding to BUCOMO France/RSA
DSI-NRF Centre of Excellence (CoE) for Integrated Mineral and Energy Resource Analysis (CIMERA)
National Research Foundation (NRF): African Origins Platform (AOP)
National Science Foundation (NSF): Frontier Research in Earth Sciences (FRES)
NRF SARCHI funding
Orange River Pegmatite Company
Osino Resources
Pan-African Resources
Stellenbosch University: Early Career Advancement Grant 2020
Stellenbosch University: Sub Committee B

NRF-rated Researchers

Internationally acclaimed researchers

Prof JD Clemens (retired)	Granite petrogenesis
Prof A Kisters	Structural geology
Prof G Stevens	Experimental petrology
Prof A Roychoudhury	Environmental geochemistry, biogeochemistry and hydrogeology

Established researchers

Dr S Fietz	Environmental geochemistry, biogeochemistry
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Promising young researchers

Dr B von der Heyden	Economic geology
Dr R Tucker	Sedimentology and palaeontology

Staff List

Academic

Dr R Chow
Dr S Fietz
Dr R Heyn
Prof A Kisters
Dr M Klausen
Dr M Mayne
Prof A Roychoudhury
Prof G Stevens
Dr R Tucker
Dr B von der Heyden

Extraordinary researchers

Dr I Basson, Tect Consultancy
Dr G Brown, Boswell Capital, Toronto Canada
Dr D Cornell, formerly Gothenburg University, Sweden
Dr M De Wit, consultant
Dr C Koegelenberg, Tect Consultancy
Dr N Phillips, Phillipsgold, Australia
Support Staff
Ms M Dlelana
Mr G Olivier

Ms G Strydom
Mr F Timney

Emeritus Professors

Prof JD Clemens
Prof A Rozendaal

Postdoctoral Fellows

Dr S Saumik
Dr R Cloete
Dr A Ferreira

Contact Details

Tel: 021 808 3219

E-mail: earthsciences@sun.ac.za

Web: www.sun.ac.za/english/faculty/science/earthsciences

Department of Microbiology

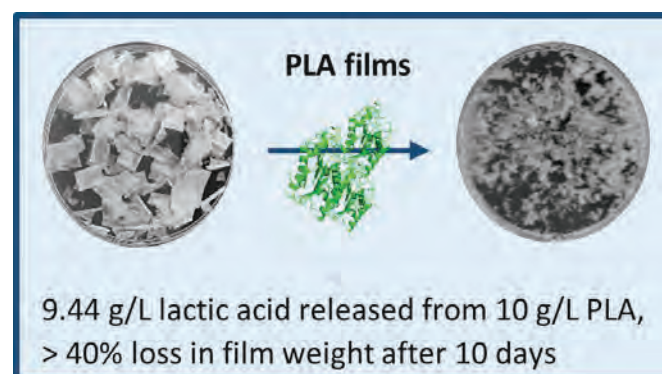
Research Interests

Bioprocessing; Synthetic and systems biology; Lactic acid bacteria; Antimicrobial peptides, probiotics, nano-biosensors; Microbial ecology and mycology; Water treatment; Secondary metabolite production and antifouling potential; Fungal biotechnology for bioenergy and the bioeconomy; Functional microbial bioinformatics; Biotechnologies for water treatment; Interactions of opportunistic pathogens; Biofilm ecology; Wastewater-based epidemiology; Environmental analytical chemistry; Environmental microbiology; Eco-toxicology; Real-time microbial activity and water quality monitoring.

Research Highlights

Developing improved expression systems for yeast

Prof Miranda ViljoenBloom's research programme focuses on the value-addition to agricultural products through microbial processing. Supported by Dr Rose Cripwell, the Bloom Lab investigates the hydrolysis of starch using genetically modified yeast strains expressing amylolytic enzymes to hydrolyse raw starch to produce bioethanol. Different alpha and glucoamylases have been cloned and evaluated to find the best combination for raw starch hydrolysis. To ensure efficient starch hydrolysis and high bioethanol production levels, different strategies have also been investigated to increase the expression of amylase genes through the development of improved expression systems for yeast.



In 2020, PhD student Wessel Myburgh initiated a new project on the recombinant expression of a polyester hydrolase in yeast for the microbial hydrolysis of commercial polylactic acid-based (PLA) bioplastics. These microbial hydrolases can be applied in PLA pre-treatment for

anaerobic digestion and composting facilities, removal of PLA contaminants in recycling streams and/or cradle-to-cradle recycling processes. A PCT patent application on the yeast expression system was submitted in October 2022.

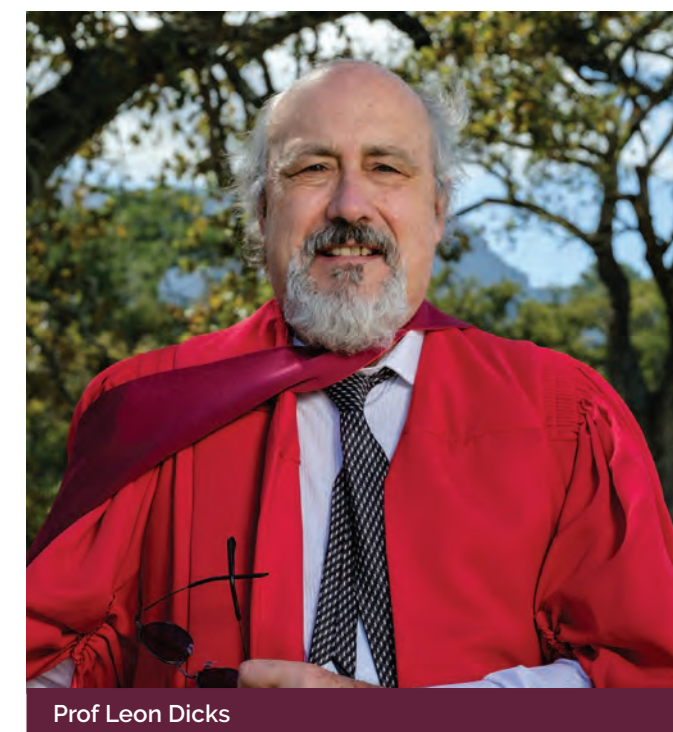
Another exciting new initiative is developing an antimicrobial expression system for *S. cerevisiae* as the host organism. Spearheaded by PhD student Michelle Rossouw, different antimicrobial peptides have been cloned and expressed in *S. cerevisiae*, resulting in yeast strains with antimicrobial activity. Michelle presented her results at the 2022 Federation of European Microbiological Societies' (FEMS) Conference on Microbiology in Belgrade, Serbia, and was awarded an ABSTC-ISBR student scholarship to attend the 16th International Society for Biosafety Research Symposium in St Louis, Missouri, USA.

Three spin-out companies in three years

Postgraduate students from Prof Leon Dicks' laboratory registered three spin-out companies over the last three years, involved in peptide expression and purification, peptide (enzyme) testing, and the production of probiotics for the poultry industry. The group works in close collaboration with electronic and electrical engineers to develop point-of-care (POC) devices for the medical field and the measuring of water quality combined with drone technology. In 2022 the probiotic Entiro™ developed by the group and marketed by CiplaMedpro was the most prescribed probiotic in SA.

Second doctorate awarded to Prof Leon Dicks

Prof Dicks received his second doctorate, with the title: "Interactions Between Gut Microbiota and the Central Nervous System, with Emphasis on Quorum Sensing Between Commensal Lactic Acid Bacteria and Human Cells in Microbiology" at the March 2023 graduation. His supervisor was Prof A. Botha.



Prof Leon Dicks

Focus on the ecophysiology of fungi in river systems

Prof Alf Botha's research group focuses on the interactions of clinically relevant fungi with their natural environment. An MSc student in the Botha Laboratory, Heidi Steffen, demonstrated that thermotolerant, opportunistic clinically relevant yeast species frequently occur in the Plankenbrug / Eersterivier river system of Stellenbosch. Strikingly, she showed that while some culturable yeast species are associated with more polluted waters, blooms of the opportunistic yeast *Meyerozyma guilliermondi* occurred in the more oxygenated waters — irrespective of pollution levels. She therefore argued that in addition to pollution levels, natural factors may affect culturable yeast numbers in these waters.

Kat Smith from Prof Gideon Wolfaardt's laboratory then studied the results of metagenomic analyses that they conducted on the mycobiome of the river system, however, they point out that the mycobiome was significantly affected by pollution. Heidi also obtained evidence for the presence of pollution-associated culturable opportunistic yeast species, i.e., *Candida glabrata* and *Clavispora lusitanae*, in the river system. Heidi contended that these results suggest that the river system poses a risk of fungal infection — exacerbated by the presence of antifungal-resistant strains, which she had identified with antifungal susceptibility testing according to the appropriate guidelines.

To obtain a clearer picture of the risk of yeast infections after exposure to the above-mentioned river water, Heidi conducted the first quantitative microbial risk assessment (QMRA) for yeast infections, which shows the risk of infection via river water ingestion. The results of this assessment indicated that the calculated risk of infection is strongly reliant on species-specific pathogenic potential. She demonstrated that species such as *Candida albicans* and *Candida tropicalis* pose a greater threat due to their associated higher pathogenic potential. Overall, Heidi's study highlighted mycoses-related health risks associated with exposure to polluted river water and emphasised the need for future research, such as exploring pre-clinical studies to validate the pathogenic potential of fungi and studying the ecophysiology of fungi in rivers. The results of were published in the journal *Water Research*.

Bio Automation Challenge award

Dr Heinrich Volschenk's research group received the 2022 Bio Automation Challenge award. The award offers life science researchers access to the Emerald Cloud Lab to improve the reproducibility of life science research and gather large datasets, especially for groups focused on protein engineering. Dr Volschenk's group was one of nine groups that were selected, including groups spanning seven universities and three continents. The award includes receiving training, cloud lab development time, a reagent budget, and transition funding.



Soil microbiology in agriculture

Prof Karin Jacobs' research group continued with their work in soil microbiology in agricultural systems. Prof Jacobs was involved in arranging two conferences on regenerative agriculture to the sector in June and September, where she also delivered a talk on the importance of microbiology in agriculture. She was also invited to share her experiences with the National Conservation Agriculture Task Force (NCATF) in November 2022. Prof Jacobs and Casper Brink successfully filed a patent for the encapsulation of bio-products for agricultural use.

Dr Tersia Conradie-Ter Haar, Janine Schuin and Prof Jacobs attended the congress of the International Society of Microbial Ecology (ISME) in Lausanne, Switzerland. Both Tersia and Janine presented their research as posters. They also secured funding from BerrieZA for the next four years to investigate fungal interactions with blueberries. Dr Tersia Conradie-Ter Haar took over the day-to-day management of Sporotec from Casper Brink, who resigned in March 2022. Under her leadership the number of samples analysed by this diagnostic company, specialising in soil biology, increased from 1500 to 2500.

Investigating the biotechnological potential of enzymes

Dr Heinrich Volschenk's research focuses on the biotechnological potential of *Coniochaeta pulveracea*, a fungus with wood-degrading capabilities that may be a rich source of novel industrially relevant lignocellulolytic enzymes. By assembling the genome of *C. pulveracea* CAB 683 and analysing its carbohydrate-active enzyme (CAZyme) Profile, the study confirmed the fungus's potential in depolymerising lignocellulose. Additionally, gene expression analysis revealed that certain cellulolytic, hemicellulolytic, and ligninolytic CAZymes are significantly upregulated when the fungus is cultured on complex lignocellulosic substrates. These findings may have commercial applications for producing individual enzymes or enzyme cocktails to break down plant biomass.

His group also explores alternative sugar sources to combat the rising prevalence of diabetes and other health problems associated with high sugar consumption. One such sugar is D-allulose, a rare sugar with similar sweetness to natural sugars but metabolised differently by the body. Dr Volschenk's project is the first to evaluate the production of the D-allulose 3-epimerase enzyme in the methylotrophic yeast *Komagataella pastoris*. By expressing this enzyme in a yeast system, researchers aim to develop sugar alternatives that may mitigate the adverse health effects associated with dietary sugar.

Microbial technologies for discovering novel antimicrobial peptides

Dr Heinrich Volschenk's research group is developing microbial technologies for novel antimicrobial peptides (AMPs), which may find applications in health and biomanufacturing. Combining automation, cell-free expression, peptide engineering, and machine learning, the research aims to advance the discovery of novel AMPs and develop microbial technologies for large-scale production. This project specifically focuses on the *Komagataella pastoris* cell-free gene expression system, which provides numerous advantages as an expression host and potentially benefits the scientific community.

Developing local technologies to produce enzymes used in mRNA synthesis

Dr Heinrich Volschenk research group is a member of the South African mRNA vaccine consortium (SAMVAC) which was established to address the challenges associated with creating a self-sufficient, sustainable, and pandemic-responsive African mRNA vaccine manufacturing hub. African-based production of mRNA vaccines currently relies heavily on international supplies of essential reagents which inflate manufacturing costs.

The global response to the SARS-CoV-2 Omicron variant and associated travel bans and supply chain disruptions highlight the urgent need for African vaccine manufacturing to become self-reliant to support resilient local health systems. By developing local technologies to produce enzymes used in mRNA synthesis, Dr Volschenk's research aims to provide competitive and cost-effective alternatives for local biomanufacturing to simultaneously secure supply chains and reduce vaccine manufacturing costs.

Spearheaded by Dr Kim Trollope, the project aims to establish partially automated workflows using a high throughput biofoundry system. The team will leverage expertise in microbial expression systems, enzyme engineering, and bioprocess development to rapidly develop production strains for several vital enzymes. This biofoundry infrastructure will bring together innovative technologies, equipment, and skilled researchers to accelerate the engineering and prototyping of biological and microbial production systems.

This research will significantly benefit the South African COVID mRNA vaccine technology transfer hub and lay the groundwork for the first African biofoundry dedicated to recombinant strain engineering. The facility can be further applied to other research fields, such as mRNA vaccines

for future pandemics, protein vaccines, protein/enzyme engineering, alternative proteins for future foods, and green chemicals. By attracting investment in this critical infrastructure and researcher training, Dr Volschenk's team aims to bolster African vaccine manufacturing capabilities, supporting public health across the continent.

Research Activities

Prof Alf Botha is a member of the editorial board of *FEMS Yeast Research* (2008 – present); editor of the *Canadian Journal of Microbiology* (associate editor since 2011).

Prof Leon Dicks serves on the editorial boards of the journals *Probiotics and Antimicrobial Proteins* (associate editor from 2008 to the present), *Beneficial Microbes* (associate editor, from 2008 to the present), *Annals of Microbiology* (2013 to the present) as well as *Bioscience of Microbiota, Food and Health* (2011 to the present). The latter is the joint scientific journal of the Japan Bifidus Foundation, the Japanese Association for Food Immunology, and the Japan Society for Lactic Acid Bacteria. Prof Dicks serves as chief editor of the *South African Journal of Enology and Viticulture* (editor since 2005).

Prof Karin Jacobs is a member of the editorial boards of *Mycology: An International Journal of Fungal Biology* (Taylor and Francis), *African Biodiversity and Conservation Journal (Bothalia)* (AOSIS) and *ISME Communications* (Nature journal).

Prof Wesaal Khan forms part of the South African Higher Education Community Engagement Forum and formed part of the organising committee of a virtual symposium for the third annual South African World Health Organisation (WHO) World Antimicrobial Awareness Week, titled, "Antimicrobials: Handle with care – Spread awareness, Stop resistance". The virtual symposium was jointly hosted by the Faculty of Health Sciences at the University of Johannesburg, the Water Research Commission (WRC) of South Africa, North-West University, and SU's Department of Microbiology from 22 to 23 November 2022. During the symposium Dr Brandon Reyneke presented a keynote talk titled "ESCAPE'ing antibiotic resistance: surveillance, risk assessment and biocontrol".

Prof Marinda Viljoen-Bloom renewed a 15-year collaboration with Prof Lorenzo Favaro at the University of Padova, Italy, on the expression of antimicrobial peptides and bioplastic hydrolases in *Saccharomyces cerevisiae*. Two students from her group, Kirstie Schwerdtfeger and Michelle Rossouw, presented posters at the 2022 FEMS Conference on Microbiology in Belgrade, Serbia.

Dr Heinrich Volschenk research group is a member of the South African mRNA vaccine consortium (SAMVAC) which was established to address the challenges associated with creating a self-sufficient, sustainable, and pandemic-responsive African mRNA vaccine manufacturing hub. African-based production of mRNA vaccines currently relies heavily on international supplies of essential reagents

which inflate manufacturing costs. Dr Volschenk serves as president of the South African Society for Microbiology (SASM) 2021-2022.

Prof Gideon Wolfaardt secured two new European Union Horizon projects involving SU colleagues as well as several international partners and continued his collaboration with the Fraunhofer Alliance through the Fraunhofer Innovation Platform for the Water-Energy-Food Nexus at SU. Working with Innovus, he and PhD student Kyle Kloppe filed two patent applications and received additional funding for further development towards commercialisation from the Technology Innovation Agency (TIA).

Academic Affairs

Postgraduate students who graduated in 2022 (March 2023 included)

The Department is host to nine postdoctoral fellows.



Awards to Staff and Students

BSc Honours student Darya Babenko in Prof Alf Botha's laboratory won an international essay competition during which the participants needed to explain how they would make a meaningful contribution to the world through their studies. Being a microbiologist, Darya stated in her essay that "Microbiology is a field of revolving wonder and unprecedented opportunities. The microscopic world is omnipresent, its inhabitants follow us whether we are cooking a meal in our homes, feeling a bit queasy at the doctors, or studying the deepest parts of our ocean. Despite their minute size, the impact these microbes have on our lives should not be underestimated". Her research during her Honours focussed on improving the nutritional quality of bread via fermentation, using safe microorganisms that naturally occur in healthy foods.

Social Impact

Prof Karin Jacobs participated in Woordfees from 10-15 October 2022. She formed part of a panel to discuss the future of agriculture in South Africa and participated in the Science Café Stellenbosch series with the title “Fantastic microbes and where to find them”.

Prof Gideon Wolfaardt and Mr Manuel Jackson, project manager at the SU Water Institute (SUWI), received funding from Tshikululu Social Investments and the Hotazel Manganese Mining Trust to perform a study to determine the feasibility for the establishment of a greenhouse at Kamden Village in the Northern Cape province. They also received funding from the Dutch Ministry for Foreign

Affairs aimed at strengthening education for Climate Smart Agriculture in the Cape region, with the informal settlement of Masipumelele as a primary beneficiary.

In celebration of National Science Week, postgraduate students in Microbiology, Biochemistry and Genetics presented a series of talks on how their research achieves a better and more sustainable future for the world population. Profs Wesaal Khan (Microbiology), Donita Africander (Biochemistry) and Aletta van der Merwe (Genetics, Faculty of Agrisciences) co-ordinated and hosted the series of presentations.

Funding

South Africa

Central Analytical Facilities (CAF), Stellenbosch University
Cipla MedPro
Claude Leon Foundation
Department of Science and Innovation, South Africa
Energy and Water Sector Education and Training Authority (EWSETA)
First Rand
FirstRand Foundation
National Research Foundation
NRF SARCHI research chair for Biofuels
Rand Water
South African Biosystematics Initiative
South African National Energy Research Institute
Stellenbosch University
Water Research Commission
Western Cape Government, Environmental Affairs and Development Planning
South African Medical Research Council

International

Bill & Melinda Gates Foundation
Grand Challenges Africa
EPSRC/GCRF Global Challenges Research Fund
European Commission Horizon 2020
BMBF (German Federal Ministry of Education and Research; water security in Africa Programme)
Global Challenges Research Fund
UKRI GCRF/Newton Fund Agile Response call to address COVID-19

NRF-rated Researchers

Internationally acclaimed researchers	
Prof LMT Dicks	Probiotics and antimicrobial peptides of lactic acid bacteria; nano-biosensor point-of-care devices
Prof WH van Zyl	Yeast biotechnology with a focus on cellulosic ethanol and biorefineries (SARCHI Chair)
Prof GM Wolfaardt	Applied and environmental microbiology
Prof A Botha	Yeast ecology
Established researchers	
Prof H Volschenk	Discovery, engineering, and recombinant production of novel enzymes/proteins of industrial relevance using synthetic biology and functional bioinformatics approaches in yeast
Prof K Jacobs	Microbial ecology and taxonomy
Prof W Khan	Innovation in rainwater treatment and monitoring; biosurfactants as alternative antimicrobials and antifouling agents
Prof M Viljoen-Bloom	Expression of recombinant proteins in yeasts

Staff List

Academic staff

Prof A Botha (Departmental chair)
Prof LMT Dicks (Distinguished Professor)
Prof K Jacobs
Prof W Khan
Prof WH van Zyl (Distinguished Professor; Biofuels Research Chair)
Prof M Viljoen-Bloom
Dr H Volschenk
Dr T Jansen
Prof GM Wolfaardt (Director: Stellenbosch University Water Institute and Rand Water Chair in Public Health)

Extraordinary Professors

Prof S Liss
Prof LM Joubert

Affiliated

Prof TE Cloete (vice-rector: research and innovation)
J Daniels
LJ Daniels
J de Kock
M Gey van Pittius
M Stuurman
T van der Merwe
W Wentzel

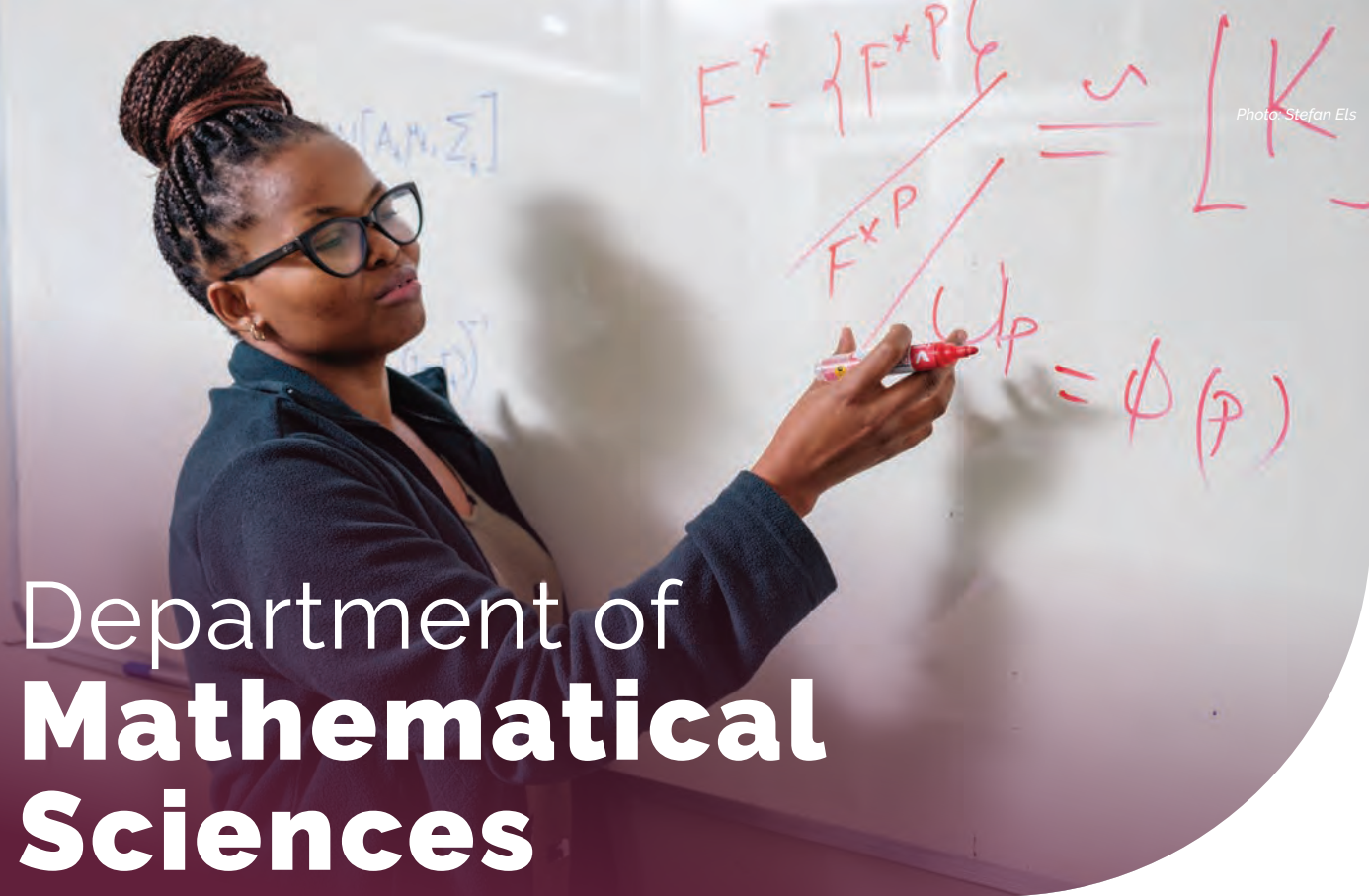
Support staff

Postdoctoral fellows and researchers

Dr Elanna Bester
Dr Kim Bester
Dr Marelize Botes
Mr Casper Brink
Dr Tanya Clements
Dr Rose Cripwell
Dr Tersia Conradie
Dr Shelley Deane
Dr Brandon Reyneke
Dr Shaunita Rose
Dr Wendy Stone
Dr Du Preez van Staden
Dr Christoff Truter
Dr Winschau van Zyl
Dr Monique Waso
Dr Taskeen Ebrahim

Contact Details

Tel: +27 (0) 218085847 E-mail: wendyw@sun.ac.za
Tel: +27 (0) 218085846 Web: <http://www.sun.ac.za/english/faculty/science/microbiology>



Department of Mathematical Sciences

Research Interests

Applied Mathematics Division

Fluid dynamics and modelling; Numerical analysis and scientific computing; Computational fluid dynamics; Flow through porous media; Mathematical applications in industry; Computer vision, pattern recognition, machine learning; Applied discrete mathematics; Probability theory and simulation methods applied to physics and machine learning; Stochastic processes; Dynamical systems; Remote sensing and interferometry.

Computer Science Division

Automata and grammars: theory and applications; Computing and society; Computer networks; Assistive technology and human computer interactions; Software engineering: program testing and verification; Machine learning, computational intelligence, and artificial intelligence; Data Science.

Mathematics Division

Algebra; Algebraic geometry; Algebraic number theory; Analytic number theory; Biomathematics; Category theory; Discrete mathematics and algorithms; Functional analysis; Model theory.

Research Highlights

How many tree species are there on Earth?

The paper "The number of tree species on Earth", published in Proceedings of the National Academy of Sciences USA, was featured in a BBC news item under the heading "Earth has more tree species than we thought". The finding, that there are 14% more tree species than previously thought, is the first "scientifically credible" estimate. Of the 73,300 estimated species, the researchers predicted that there are 9,200 that are yet to be discovered. But most rare species are in tropical forests, fast disappearing because of climate change and deforestation.

The study is based on a database of tens of millions of trees in more than 100,000 forest plots around the world. The researchers used statistical techniques to predict the likely number of tree species, correcting for gaps in existing data. The findings suggest more must be done to protect the incredible life forms needed for food, timber and medicine and to fight climate change by sucking carbon dioxide from the air.

More than 140 international researchers, including Prof Cang Hui, worked on the study. According to one of the co-authors, Dr Yadvinder Malhi from the University of Oxford, tropical forests are the "global treasure chests of biodiversity" and significant absorbers of carbon dioxide emissions, slowing global warming. This study showed that tropical forests are even more diverse in their trees than we had previously imagined. – Prof Cang Hui

Bioinformatics key to conservation

The paper "Co-limitation towards lower latitudes shapes global forest diversity gradients" published in *Nature Ecology & Evolution* was featured as a Stellenbosch University news item. In this study, co-authored by Prof Cang Hui, researchers developed a range of high-resolution maps depicting the local diversity of tree species across the globe, as well as the environmental drivers of this diversity. As such, the maps will serve as a benchmark for the future management of forest ecosystems under a changing climate. The maps are based on 1.3 million sample plots and 55 million trees archived in the Global Forest Biodiversity Initiative database. It took 249 researchers from 50 countries two years to compile and standardise the database, with one-third of them based in traditionally underrepresented regions such as Africa and South America. – Prof Cang Hui

Special session in honour of Richard Brualdi

Prof Karin-Therese Howell attended the 24th Conference of the International Linear Algebra Society (ILAS) in Galway, Ireland, and presented a joint talk on the Matroids of Near-vector Spaces with Prof Nancy Neudauer from Pacific State University. It was part of a special session in honour of Richard Brualdi, emeritus Professor of combinatorial mathematics at the University of Wisconsin-Madison.

SA biodiversity agencies need a culture of data sharing

Dr Pietro Landi and co-authors advocated for a culture of data sharing in the context of South African biodiversity agencies in the paper "Drowning in data, thirsty for information and starved for understanding: A biodiversity information hub for cooperative environmental monitoring in South Africa" published in *Biological Conservation*. In another paper "Predicting invasive consumer impact via the comparative functional response approach: linking application to ecological theory" published in *Biological Invasions*, Dr Landi and co-authors MW McCoy and JR Vonesh have grounded the empirically used Comparative Functional Response Approach into ecological theory, and highlighted the strengths and weaknesses of the approach.

Research Activities

Dr Liam Baker published a co-authored paper with colleagues from the University of the Witwatersrand, AIMS Rwanda, and Nairobi University in *ZDM – Mathematics Education* titled "Mathematical competitions in Africa: their prevalence and relevance to students and teachers" in their special issue on Mathematics competitions. He also had a research visit with Dr Cecile Armana at the University of Besancon and with Vincent Bosser at the University of Caen, both in France, during June 2022.

Dr Bruce Bartlett was invited by Prof Catherine Meusberger at the University of Erlangen-Nuremberg to write the chapter on "Extended TQFTs" in the upcoming second edition of the *Encyclopedia of Mathematical Physics* to be published by Elsevier. Dr Bartlett became a co-supervisor for Filippos Sytilidis, a PhD student at the University of Oxford. His supervisor at Oxford is Prof Chirs Douglas, who is a collaborator. Filippos is working on results in parameterized Morse theory, which will assist to finish up work that his study leaders worked on. During 2022 Dr Bartlett gave five research talks: "Modular forms, geometric quantization and coherent loop states" at the GANDA (Geometry and Arithmetic) workshop in March; "Dirac's belt trick and the Wonderful World of Spinors" at a SU Mathematics Society talk in March; "The geometry of the classical and quantum 6j symbols" at a colloquium of the National Institute for Theoretical and Computational Sciences (NITheCS) in May; "The work of Hugo Duminil-Copin" at a Fields medal seminar in October; "Coherent states in complex geometry with application to representation theory" at the 65th Annual Congress of the South African Mathematical Society in December. He hosted two speakers for the online African Mathematics Seminar – Dr Naina Ralaivaosaona from SU and Dr Simon Willerton from the University of Sheffield. The weekly African Mathematics seminars are building networks across Africa and showcasing the continent's mathematical talent.

Dr Dirk Basson hosted, in September-October 2022, two research visitors, Dr Magdaleen Böhm-Marais, extraordinary lecturer in mathematics at SU; and Dr Janko Böhm from RPTU Kaiserslautern-Landau. They are collaborating on a project to develop an improved algorithm to normalise singular plane curves.

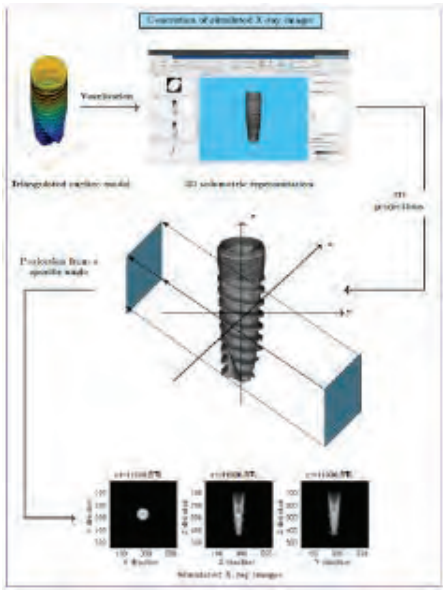
Dr RONALDA BENJAMIN presented a talk at the 2022 Banach Algebras and Applications conference held at the University of Granada, Spain, titled "r-Fredholm theory in general ordered Banach algebras". She was a member of the local organising committee of the Functional Analysis and Operator Theory South Africa 2022 (FAOTSA22) workshop held at the Kruger National Park from 30 September to 3 October 2022 and one of the co-organisers of the SAMS Special Session on Functional Analysis and Operator Theory hosted by SU from 6 to 8 December 2022. From 28 to 30 March 2022 Dr Benjamin visited Dr Christopher Schwanke at the University of Pretoria to initiate discussions on a proposed joint project. Dr Francois Schulz (funded by NITheCS) visited Dr Benjamin at SU from 4 to 8 July 2022. A co-authored paper titled "Spectrally additive maps on Banach algebras" stemmed from his visit. In addition to the above-mentioned paper, Dr Benjamin's collaboration with Dr Christiaan Budde from the University of the Free State has resulted in a paper titled "A note on the order Lozanovsky spectrum for positive operators".

Prof Gareth Boxall published a joint paper, titled "Rational values of transcendental functions and arithmetic dynamics", with Gareth Jones and Harry Schmidt in the *Journal of the European Mathematical Society*, one of the leading journals in Mathematics. He also received a special invitation to Neostability Workshop to be hosted in February 2023 by the prestigious Banff International Research Station for mathematical innovation and discovery. He has continued collaborating with his former PhD student Dr Taboka Chalebgwa who is currently a postdoctoral fellow in the Mathematical Logics research group at McMaster University in Canada.

Prof Willie Brink published a co-authored paper titled "Improving the performance of image captioning models trained on small datasets" in *Artificial Intelligence Research* and co-authored two papers in the peer-reviewed conference proceedings of the Southern African Conference for Artificial Intelligence Research (SACAIR). He continues to have a strong cohort of postgraduate students: he co-supervised to completion one PhD student and three MSc students. In addition, he is currently supervising four doctoral students and one masters student. He was a participant and volunteer at the Deep Learning Indaba in Tunis, Tunisia in August. He continued as the organiser of Maties Machine Learning, a seminar series which brings together people working on machine learning at SU.

Dr Maret Cloete was exposed via Dr Hardus Diedericks to a new research field called Coastal Dynamics which she plans to pursue.

Dr Hanno Coetzer has published two co-authored papers titled "Hand VeinBased Biometric Authentication with Convolutional Neural Networks and Support Vector Machines" in the *International Journal of Recent Research in Electrical and Electronics Engineering* and "Deep Learning Based Dental Implant Recognition using Synthetic Xray Images". He has been very active in postgraduate student supervision and is currently supervising three doctoral students and three MSc students.



Dr Hardus Diedericks published a paper describing electrical conduction through isotropic porous media in *Chemical Engineering Science*. This was the result of his collaborative work with Prof Sonia Fidler-Woudberg, Prof Francois Smit, and his PhD student Yannick Nkocko Awountsa. His collaboration with Prof Neill Goosen at the Department of Process Engineering at SU continued. His research report, "Modelling the hydrodynamics in Sörvágsfjördur to support simulation of related fish farming process" for the fish farming company Hiddenfjord has given rise to plans to send an MSc student to the Faroe Islands in 2023 to conduct measurements. He was the main supervisor for the project of BScHons student Francois Naudé. His project used data from the Norwegian fish farm accrediting company, Åkerblå, and there are plans for collaboration on one of their research projects.

Dr Andie de Villiers participated in a workshop on Configurational Peridynamics in Cape Town in November 2022. She gave three conference presentations: "Visco-elastic continuum-kinematics inspired peridynamics" at Africomp, Cape Town; "Configurational peridynamics" at the seventh International Conference on Material Modelling and at the 65th Annual Congress of the South African Mathematical Society. As part of her new collaborative research on configurational peridynamics, she hosted three international research visitors: Dr Ali Javili from Bilkent University, Turkey; Dr Andrew McBride from the University of Glasgow, UK, and Prof Paul Steinmann from the University of Erlangen.

Dr Marcel Dunaiski was invited as a panellist for "Data Management, Centralisation, System Architecture" for the Symposium on Biodiversity Informatics in South Africa held in Stellenbosch in November. He hosted two researchers, Dr Anıl Baş and Dr Imke van Heerden from the Faculty of Technology at Marmara University in Turkey, for one month. He also hosted Joana Linhares a postgraduate student in Computer Engineering from the Universidade Federal de Itajubá, Minas Gerais, Brazil. He co-supervised one masters and one PhD student and recruited a PhD student together with Prof Goosen from the Department of Process Engineering, who will start in 2023 under their supervision together with Prof Franco Ruzzenenti from the University of Groningen. Marcel was jointly appointed with the School for Data Science and Computational Thinking which enabled him to collaborate on projects and co-supervise students from other affiliated research groups such as the Centre for Epidemic Response and Innovation (Ceri) and Industrial Engineering.

Prof Andries Engelbrecht was appointed in 2022 as Deputy-Editor-In-Chief of the *Engineering Applications of Artificial Intelligence Journal*. He serves as an associate-editor for five journals: *IEEE Transactions on Evolutionary Computing*; *IEEE Transactions on Neural Networks and Learning Systems*; *Swarm Intelligence*; *Evolutionary Computation*; *Complex and Intelligent Systems*; *International Journal of Cognitive Computing in Engineering*. He is also the Artificial Intelligence Series Editor for IntechOpen Series. He presented a keynote, "Training Neural Networks using Particle Swarm Optimisation", at the 11th International Conference on Soft Computing for Problem Solving. In addition, he was involved in the organisation of three international conferences: Technical chair of the 13th International Conference on Swarm Intelligence, Malaga, Spain; General co-chair and proceedings editor of the International Conference on Intelligent Systems Design and Applications, Web conference; and general co-chair and proceedings editor of the International Conference on Computer Vision and Robotics, India.

Prof Sonia Fidler-Woudberg published a paper with her PhD student, Yannick Harrison Nkocko Awountsa, in the journal *Chemical Engineering Science*. Dr Hardus Diedericks is the co-supervisor and also co-author of the paper. Yannick is a recipient of the DAAD In-Region PhD Scholarship through AIMS-SA. The paper is on the analytical prediction of the formation factor for isotropic mono-sized unconsolidated porous media. Prof Francois Smit contributed to the numerical modelling part of the study and is also a co-author on the paper.

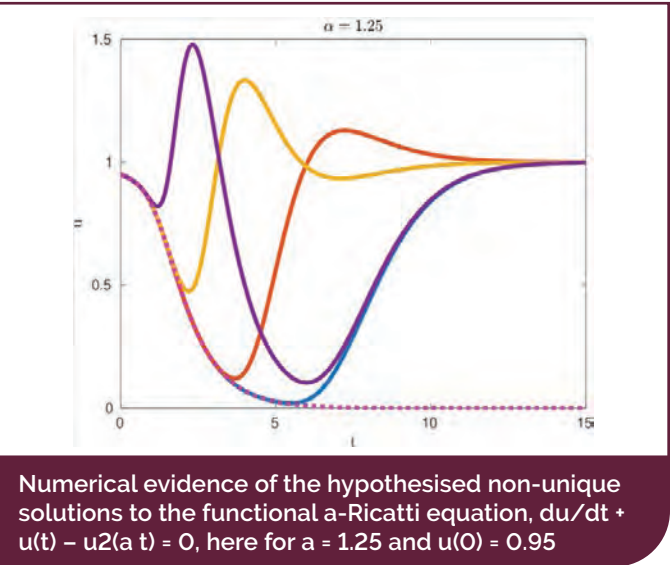
Prof Bernd Fischer published a comprehensive paper describing the lazy sequentialisation approach to the bounded verification of multi-threaded programs in *ACM Transactions on Programming Languages and Systems*, summarising a ten-year collaborative research project. Prof Fischer served as chair of the steering committee of the Automated Software Engineering conference series and as a member of the ASE/ESECFSE/ICSE conference

coordination group; as chair of the International Federation for Information Processing member of the Technical Committee-2 (IFIP TC-2) Working Group 2.11; and as the General Chair of the International Conference on Software Language Engineering (SLE). He was a member of the programme committee of the International Conference on Software Engineering (ICSE), the International Conference on Automated Software Engineering (ASE), and the International Symposium on Formal Methods (FM). As a visiting Professor at the University of Molise in Isernia, Italy, he collaborated with Prof G Parlato during a four-week research visit.

Dr James Gray published two papers "Complete objects in categories" in the *Journal of Pure and Applied Algebra* and "A note on images of cover relations" in *Theory and Applications of Categories* and completed another two papers for submission. He presented three talks: an online talk titled "On categorical conditions in the semi-abelian context" for the Algebra, Logic and Topology Seminar of the Centre for Mathematics at the University of Coimbra; an online talk "On the relationship between action accessible and weakly action representable categories" for the Conference on Topology, Algebra and Category Theory at UNISA; and "Split extension cores for internal semi-abelian algebras in a cartesian closed category" at the 65th annual congress of the South African Mathematical Society.

Dr Trienko Grobler presented together with Willem de la Bat and Danie Ludick their research titled "The application of machine learning for computational electromagnetic solver selection" at the 16th European Conference on Antennas and Propagation (EuCAP) in Madrid Spain in March/April 2022. He continued his collaboration with Dr W Kleynhans at the University of Pretoria and Dr G Azzopardi at the University of Groningen.

Prof Nick Hale submitted a journal article on a new technique for using spectral collocation methods to obtain numerical solutions of functional and delay differential equations, titled "A spectral collocation method for functional and delay differential equations".



Numerical evidence of the hypothesised non-unique solutions to the functional a-Ricatti equation, $du/dt + u(t) - u^2(a\ t) = 0$, here for $a = 1.25$ and $u(0) = 0.95$

Prof Hale began a research project in collaboration with Prof André Weideman and Prof Enrique Thomann from Oregon State University on investigating solutions of the a-Ricatti equation, a functional differential equation related to the study of global existence and uniqueness for the 3D Navier-Stokes and related equations. He presented a research talk titled "A spectral collocation method for functional and delay differential equations" at the 65th annual congress of the South African Mathematical Society (SAMS) in December 2022. He successfully served as the chair of the local organising committee for the 65th annual congress of SAMS.

Dr Retha Heymann published a paper co-authored with Dr Christian Budde from the University of the Free State titled "Extrapolation of operator-valued multiplication operators" in *Quaestione Mathematicae*. She hosted Dr Budde for a short research visit in December and arranged a research visit to the University of Tübingen in Germany, for January 2023. She continued work on her research projects on multiplication operators and decompositions of spaces and supervised her master's student project on "Positive Weighted Koopman Semigroups on Banach lattice modules".

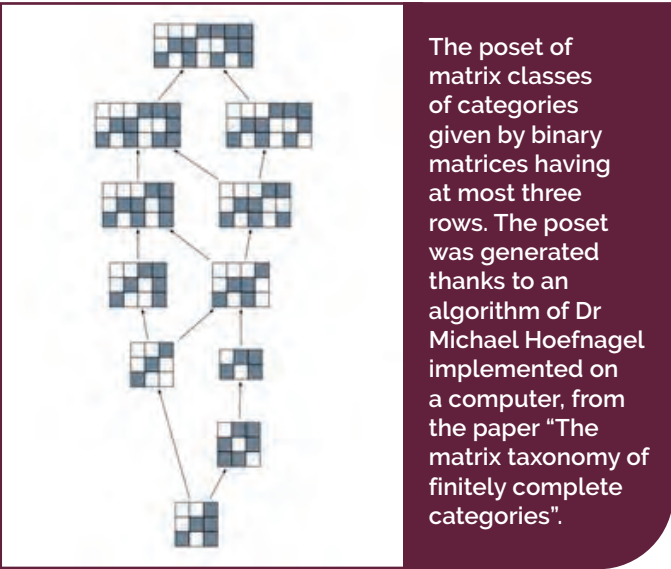
Dr Michael Hoefnagel visited Dr P-A Jacqmin at the Université catholique de Louvain (UCL) in Belgium and Prof D Rodelo at the University of the Algarve in Portugal. Together with P.-A. Jacqmin, they have initiated several research projects, one of which is named "Partial algebras and matrix taxonomy". In December he presented some of his research findings in this direction at the 65th Annual Congress of the South African Mathematical Society.

Prof Karin-Therese Howell and Prof Nancy Neudauer contributed a book chapter titled "On Building a Research Community of Women Mathematicians in Africa" to the book *Count Me In: Community and Belonging in Mathematics*, published by the American Mathematical Society. They also wrote an article titled "Grace Alele-Williams – Mother of Nigerian Academia" which appeared in the *Notices of the American Mathematical Society*. She presented joint talks with Prof Neudauer at the International Linear Algebra Society (ILAS) conference in 2022 and another with Dr Jacques Rabie on hyper near-vector spaces at the 65th annual congress of the South African Mathematical Society in December 2022. Two papers related to hyperstructures, one with Dr Amartya Goswami from the University of Johannesburg and Prof Bijan Divvaz from Yazd University in Iran on the hyperideals and hyperstructure spaces of hyperrings. Another paper, studying hyper near-vector spaces with Dr Rabie and Prof Divvaz, was completed.

Prof Cang Hui published 14 co-authored articles in flagship SCI journals, including in the *Proceedings of the National Academy of Sciences USA* (IF=12.779), *PLoS Biology* (IF=9.593), and *Nature Ecology & Evolution* (IF=15.46). An authored book, *Invading Ecological Networks*, was published by Cambridge University Press. Two of the multi-author papers about tree species on earth were highlighted in

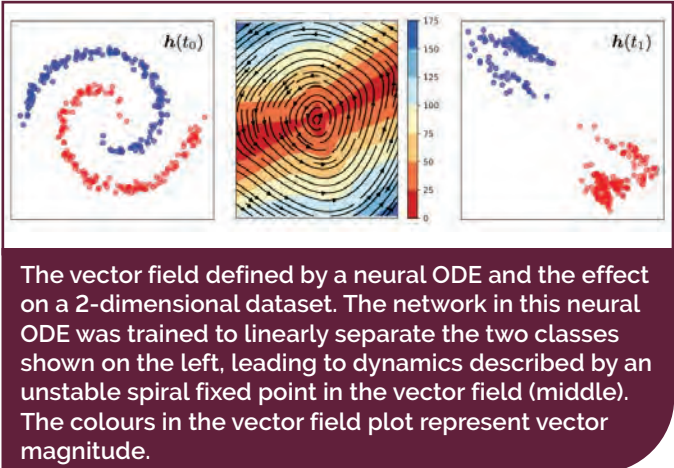
the media. Prof Hui is leading three research projects: the SARChI Research programme for Mathematical and Theoretical Physics Biosciences (2019-2023); the GLoBal Insect Threat-Response Synthesis (GLITRS, UK NERC grant); and the Ecological Community in Transitions from Biological Invasions (Australian Research Council). He gave several presentations including: "Multisite dissimilarity modelling of compositional turnover" at the Savannah Science Networking Meeting (SSNM 2022), Skukuza, March-10, 2022; "Drivers of compositional turnover of invasive alien plants in Kruger National Park" at the International Statistical Ecology Conference (ISEC 2022), Cape Town, June-29, 2022; "From data to data products: Co-limitation towards lower latitudes shapes global forest diversity gradients" at the Stellenbosch Symposium on Biodiversity Informatics (SSBI), Stellenbosch, Nov-30, 2022. He hosted four international visitors: Prof M Favretti from the University of Padova, Italy; Prof A Amir from Harvard University, USA; Dr TK GrandPre from Princeton University, USA; and Prof RA Watson from the University of Southampton, UK. He was the meeting host and organiser for the Stellenbosch Workshop on Entropy and Ecological Network Transitions (5 to 9 September, Spier) and the Stellenbosch Symposium on Biodiversity Informatics (28 to 30 November, STIAS). He is involved with editorial work for eight accredited journals: Associate Editor for *Bulletin of Mathematical Biology*, for *Global Ecology and Biogeography*, for *Biological Invasions and for Ecological Complexity*; editorial board member for *BMC Ecology and Evolution* and for *Frontiers in Ecology and Evolution*, and for *Journal of Dynamics and Games*; and reviewer editor for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

Prof Zurab Janelidze published two papers in 2022: "A Dedekind-style axiomatization and the corresponding universal property of an ordinal number system", co-authored with PhD student Ineke van der Berg, was published in the *Journal of Symbolic Logic*; "The matrix taxonomy of finitely complete categories", co-authored with Michael Hoefnagel and Pierre-Alain Jacqmin, was published in *Theory and Applications of Categories*.



Prof Janelidze is an editorial board member of the journals *Cahiers de Topologie et Géométrie Différentielle Catégoriques* and *Applied Categorical Structures*. He served on the programme committee of the international conference Topology, Algebra and Categories in Logic that was held from 20 to 24 June 2022 in Coimbra, Portugal. He gave a talk at the 65th SAMS Congress on "Noetherian form of sets", based on his on-going joint work with Dr Francois van Niekerk. He also gave an online talk at the Topology, Algebra, and Category Theory international conference (19 to 22 September) dedicated to the 65th birthday of Themba Dube. In 2022, as part of the Mathematical Structures research programme under the National Institute for Theoretical and Computational Sciences (NITheCS) Prof Janelidze co-hosted research visits of Dr Charles Msipha from the Tshwane University of Technology (TUT); Dr Amartya Goswami, Micheala Hoenselaar, Dr Francois Schulz, Dr Cerene Rathilal and Kishan Dayaram from the University of Johannesburg; Prof Dharmanand Baboolal from the University of KwaZulu-Natal (UKZN); Prof Paran Pillay from the University of the Western Cape (UWC); Dr Partha Pratim Ghosh from the University of South Africa (UNISA); Noluntu Baart from SU; and Dr Christian Budde from the University of the Free State (UFS). Through mini-workshops with these visitors a number of collaborative research projects were started between them and other SU colleagues and postgraduate students on various topics within and across the fields of category theory, topology, functional analysis, frame theory, homological algebra and mathematics education. During 2022, Prof Janelidze supervised two masters and five PhD students, including two original honours research projects. Both honours students, Gideo Joubert and Gregor Feierabend, gave talks on their projects at the 65th SAMS Congress and will continue with MSc studies in mathematics in 2023.

Mr Shane Josias was invited to attend the Nobel Symposium on Predictability in Science in the Age of AI on 23 October. He presented his research on Jacobian norm regularisation and conditioning in neural ODEs at the Southern African Conference for Artificial Intelligence Research (SACAIR 2022) and at the 65th Congress of the South African Mathematical Society in Stellenbosch in December 2022. This work has also been published in the journal *Communications in Computer and Information Science*.



Prof Steve Kroon undertook research visits to Dr Michael Burke at Monash University and Prof Stephan Chalup at the University of Newcastle in Australia and presented research seminars on recent work at both universities. He has been pursuing joint research work with Dr Burke, investigating the NewtonianVAE model in collaboration with SU postgraduate student Thomas Marshall and with Prof Franca Hoffmann (Caltech/AIMS Rwanda/Friedrich-Wilhelms-Universität Bonn) and Dr Nikolas Nüsken from King's College, London, on the correspondence between neural networks and kernel methods for solving PDEs. This work is done in collaboration with postgraduate student Bernardin Amougou from the Université Paris Cité.

Dr Pietro Landi is currently working on several research projects in collaboration with Prof Cang Hui and Dr Sandra MacFayden in the Mathematics Division at SU and international collaborator Prof Ulf Dieckmann at the Okinawa Institute of Science and Technology. Dr Landi co-organised and presented at the Entropy Workshop held at Spier in September with international guests from the universities of Padua, Princeton, Harvard and Southampton.

Dr Sophie Marques published two papers: "The Geometry of the moduli space of non-cyclic biquadratic field extensions", joint work with Mr Mpendulo Cele who completed his MSc in 2020, and "Toward an intuitive understanding of the structure of near-vector spaces", joint work with Prof Karin Howell. She also completed another four papers: "Near-field structures induced by multiplicative automorphisms, their limits, and generalized means for complex numbers" and "Near-field structures on a given scalar group", both with Dr Leandro Boonzaaier; "Near-linear algebra" with MSc student Daniella Moore; and "Quadratic cyclotomic moduli spaces" with PhD student Elizabeth Mrema. Dr Marquez presented with Dr Leandro Boonzaaier a talk titled "Near field structures on a multiplicative group" at the SAMS Conference in December 2022 and gave a presentation on the human side of supervision at the CREST Alumni Networking event in Stellenbosch. She is a regular reviewer for *ZbMath* and for *Quaestiones Mathematicae*. Her collaborator Dr Luigi Pagano from the University of Copenhagen visited twice to continue their collaboration using Jet Schemes to extend the ramification group to an algebraic geometry setting. In doing so, they needed to start with recovering the classical ramification theory through the notion of Jet Algebra. Together with her collaborator, Dr Ben Blum-Smith from John Hopkins University, she showed that, over a field of characteristic two, there does not exist an $Sd+1$ -equivariant isomorphism between the Stanley-Reisner ring of a d -simplex and that of its barycentric subdivision, as modules over the common subring of $Sd+1$ -invariants. This answers an open question of Prof Satoshi Murai from Waseda University in Japan. She is co-author on two papers with PhD students: with Damas Mgani on the categorical definition of Gluing; and with Elizabeth Mrema they are describing all 2-cyclotomic extensions. Dr Marques, Prof Zurab Janelidze and MSc student Daniella Moore have proved that near-vector spaces in the sense of J. André, when considered over a fixed scalar group, form an abelian category.

Prof Sonja Mouton presented a plenary lecture with title “The restricted topology in Banach algebras” at the Functional Analysis and Operator Theory South Africa 2022 Workshop (FAOTSA), which was held in the Kruger National Park. As the expert in ordered Banach algebras, she was invited to contribute a paper to a special issue of *Quaestiones Mathematicae*, which will commemorate the famous Dutch American mathematician Wim Luxemburg. She has been supervising her PhD student, Dimby Rabearivony, who presented a successful talk titled “Generalized Ergodic Domination in Ordered Banach Algebras” at the SAMS conference held in Stellenbosch.

Dr Mkhusele Ngxande is pursuing research in the fields of neuro-symbolic AI, computer vision, and machine learning for road safety. He presented two papers at the South African Institute of Computer Scientists and Information Technologists (SAICSIT) conference in Cape Town in July: “Robust Anomaly Detection in CCTV Surveillance” together with Thomas Scholtz, a software and systems engineer at EPI-USE Labs; and “Robust Facial Recognition for Occlusions using Facial Landmarks” with Kyle Johnston, software engineer at Entelect. He also served as a reviewer for the *Journal of Supercomputing* and *IET Intelligent Transport Systems*.

Dr Naina Ralaivaosaona completed his project on the phase transition in random digraphs and submitted for publication a 75-page manuscript titled “The birth of the strong components”. His extended abstract titled “The Number of Sources and Isolated Vertices in Random Directed Acyclic Graphs” was accepted and presented at the 33rd International Conference on Probabilistic, Combinatorial and Asymptotic Methods for the Analysis of Algorithms (AofA 2022). He also presented a paper titled “The domination number in Galton-Watson trees” at SAMS 2022. Dr Ralaivaosaona undertook research visits to Labo IRIF University of Paris Diderot, the number theory research group at the University of Copenhagen, and the combinatorics research group at the University of the Witwatersrand. He served as the Junior Focus Area coordinator for Number Theory for the Centre of Excellence in Mathematical and Statistical Sciences (CoE MaSS) at the University of the Witwatersrand; and as a reviewer for *Quaestiones Mathematicae*, *Monatshefte für Mathematik*, and *Research in Number Theory*.

Dr Riana Roux was invited to present a talk at a special session in graph reconfiguration at the 53rd Southeastern International Conference on Combinatorics, Graph Theory, and Computing (SEICCGTC) at Florida Atlanta University in March. The networking at the conference led to a visit from Dr Joe Fehribach from Worcester Polytechnic Institute in August and a visit to Prof Leslie Hogben and Dr Bryan Curtis at Iowa State University in November. She is a researcher in the Graph Theory node of the Centre of Excellence for Mathematical and Statistical Sciences and participated in several graph theory workshops. This led to a visit from

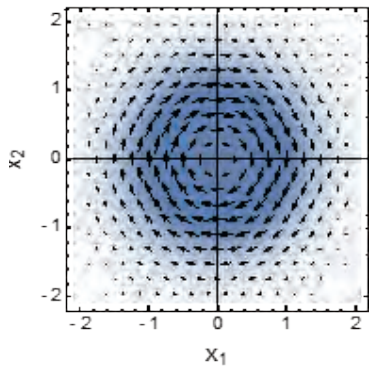
Drs Eric Andriantiana from Rhodes University and Simon Mafunda from the University of Johannesburg. Dr Zekhaya Bernard Shoji from Sol Plaatje University joined the team of the Graph Theory node at the subsequent workshop. As a team they are working on extremal trees with fixed segment diameter. Together with student research assistants she is continuing on a project regarding the localisation game on unicyclic graphs. A project with Prof Michael Henning from UJ, Dr Anna Maria Lemanska from the Wroclaw Medical University in Poland and Dr Katarzyna Dettlaff from the Poznan University of Medical Sciences, also in Poland, on subdivision criticality continued online. In December Prof Henning visited and Drs Dettlaff and Dr Hanna Furmanczyk from the University of Gdansk visited for joint work on b-colourings of regular graphs.

Prof Ingrid Rewitzky was invited to present her research on using complexity theory to guide programme evaluation at the SU Learning and Teaching Enhancement Seminar on 12 May 2022 and at the fifth Annual Diagnostic Mathematics Information for Student Retention and Success Symposium hosted jointly with the Universities of South Africa (USAf) Mathematics Community of Practice in September 2022. She is an associate editor for *Quaestiones Mathematicae* and served on the local organising committee for the 65th Annual Congress of the South African Mathematical Society hosted in Stellenbosch in December.

Prof Francois Smit and MSc student Jose Sequeira presented a co-authored paper, with Stefan van der Walt and Johan Maré, titled “Determining the lethality of a hand grenade against personnel target using AVAL” at the 32nd International Symposium on Ballistics in the USA in May 2022.

Prof Hugo Touchette

finished a long article with Johan du Buisson, a PhD student from the Department of Physics, on the large deviations of linear diffusions. The article was submitted in December 2022 to *Physical Review E*.



Prof Touchette was an invited speaker at three conferences in 2022. In particular, he presented his work on machine learning of large deviations at the 2022 CECAM Workshop on Numerical Techniques for Nonequilibrium Steady States on 19 April 2022; and at the Workshop from Information to Control and Nonequilibrium held at the Université Nice-Cote d’Azur in France on 6 June 2022. He presented a short survey on numerical methods for large deviations at the Workshop on Bridges between Quantum and Classical Non-Equilibrium Systems at STIAS, Stellenbosch, 7 November 2022

Prof Bill Tucker attended the International Conference on Information and Communication Technology and Development (ICTD) that took place from 27 to 29 June in Seattle at the University of Washington. For this conference he facilitated an Open Session on “n-way Teaching and Learning of ICTD”, sat on a panel for another session titled “Using familiar tools in an unfamiliar context”, and on the Programme Committee to review submissions.

Prof Brink van der Merwe’s paper on Ordered Context-Free Grammars, co-authored with Dr Martin Berglund from Umeå University in Sweden, was presented at the 26th Implementation and Application of Automata Conference in Rouen, France. He hosted Dr Berglund as a research visitor in September for their collaborative project on explaining the limitations of the transformer architecture (as used for example in OpenAI’s ChatGPT) and using algebraic automata theory, more specifically Krohn-Rhodes theory. He is associate editor for the *Journal of Universal Computer Science*.

Prof Francois van Niekerk together with Prof Karin Wolff from SU’s Faculty of Engineering presented a talk titled “A cumulative learning approach to integrating mathematics in the engineering sciences” at the SU Scholarship of Teaching and Learning Conference in October 2022.

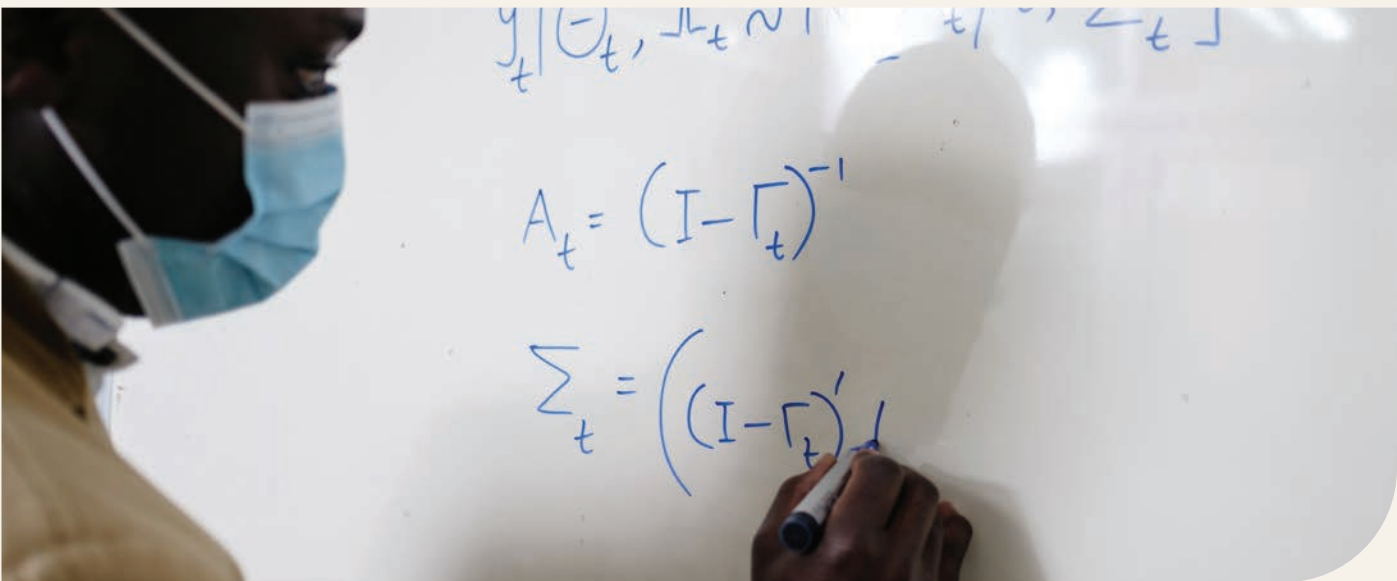
Prof Leon van Wyk co-authored a 28-page paper titled “Maximal commutative subalgebras of Leavitt path algebras” which was accepted for publication in the high-impact general mathematics journal *Communications in Contemporary Mathematics*. This is the result of continuing successful cooperation with his Polish collaborator Michal Ziemkowski and two of Ziemkowski’s PhD students, Grzegorz Bajor and Anna Cichocka. Prof Van Wyk is associate editor of *Afrika Matematika* and *Quaestiones Mathematicae*, and editor of *Miskolc Mathematical Notes*.

Prof Lynette van Zijl is associate editor of the *Journal of Universal Computer Science*. She presented a paper on cellular automata with clustering at the Asian Conference on Cellular Automata Technology. The paper was co-authored with BScHons student Caleb Zeeman and based on results from his Honours project in Computer Science. She also co-authored a paper on the descriptonal complexity of non-unary self-verifying symmetric difference automata in the *International Journal on Foundations of Computer Science*, together with Dr Laurette Marais, senior researcher at the Council for Scientific and Industrial Research (CSIR).

Prof Willem Visser is associate editor of *IEEE Transactions on Software Engineering* (TSE).

Prof JAC Weideman gave a plenary talk titled “Blow-up in nonlinear heat equations: before, at, and after” at the 65th Annual Congress of the South African Mathematical Society in December. The talk was based on a paper co-authored by John King (University of Nottingham) and Marco Fasondini (University of Leicester), which has since been accepted to appear in *Physica D*. His main contribution was the introduction of numerical techniques that allow one to integrate through the blow-up singularity. The post-blow-up dynamics shown in this paper have not been observed before.

Prof Weideman served as associate editor for *Numerical Algorithms* and *Electronic Transactions of Numerical Analysis* and organised the special SANUM session at the 65th Annual Congress of the South African Mathematical Society in December. During a research visit in April to the United Kingdom he collaborated with Prof John King from the University of Nottingham and Dr Marco Fasondini from the University of Leicester and participated in a research-in-groups meeting at the International Centre for Mathematical Sciences (ICMS) in Edinburgh, led by Dr Michael Grinfeld from the University of Strathclyde. Prof Enrique Thomann from Oregon State University visited from mid-November to the end of the year, for research collaboration with Prof Weideman and Dr Nick Hale.



Academic Affairs

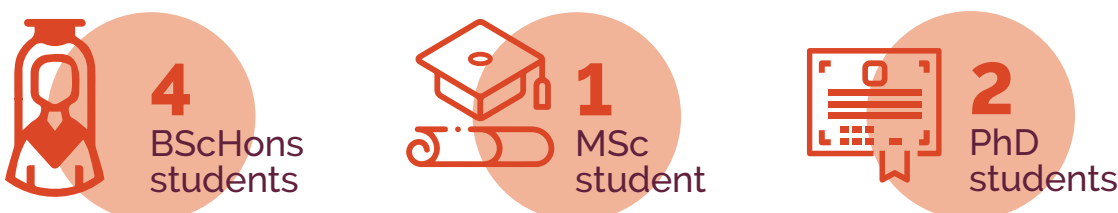
Graduates: Applied Mathematics



Graduates: Computer Science



Graduates: Mathematics



Prof Sibusiso Moyo, DVC Research, Innovation and Postgraduate Studies at SU, together with the MSc and PhD graduates in mathematics and their supervisors on their graduation day in December 2022.

In 2022, the one-year structured MSc degree in Machine Learning and Artificial Intelligence was launched with **Prof Willie Brink** as the programme coordinator. A total of 12 students enrolled, selected from more than a hundred applications. Guest lecturers included industry experts from DeepMind, Criteo AI, InstaDeep, and IBM. Graduates have moved on to local and international PhD programmes, and startup companies. During 2022 a number of DeepMind scholarships have also been secured, specifically to support students from Africa.

Dr Bruce Bartlett successfully rebooted the postgraduate seminar after the pandemic. The seminar is held biweekly on Friday afternoons, and food and drinks are served in the tearoom afterwards, to give an opportunity for the postgraduate students to interact with each other and to use the tearoom.

Prof Zurab Janelidze was invited to present online postgraduate-level courses under various national initiatives: "Python-Based Introduction to Mathematical Proofs" (NITheCS & CHPC Summer School 2022), "Introductory Set Theory" (NITheCS Mini-School in August 2022), "Category Theory" (NGA coursework). He also presented, jointly with Dr Partha Pratim Ghosh from UNISA and Dr Cerene Rathilal from UJ, an online course on "Mathematical Structures" (SATACS at NITheCS).

The second-semester honours module in Logic has been, for the last few years, one of the popular module choices. **Prof Zurab Janelidze** has been teaching "abstract logic" in this module, based on a categorical approach to logic, due to FW Lawvere.



Class photo of students in the BSc Honors in Logic module with Prof Zurab Janelidze, September 2022.

Dr Jacques Rabie graduated in December 2022 with his PhD in Mathematics under the supervision of Prof Howell. His thesis was titled "Geometry of Near-Vector Spaces". His research paper titled "Geometries with non-commutative joins and their application to near-vector spaces" was published in *Quaestiones Mathematicae*. He is now pursuing his postdoctoral research at the University of Cape Town under the supervision of Dr Juana Sanchez-Ortega.

Dr Hosana Ranaivomanana successfully graduated in April 2022 with a PhD. Her thesis was titled "Investigations on the Wigner derivative and on an integral formula for the quantum 6j symbols". After completion of her PhD, she became a Lead Tutor at AIMS. In January 2023 she returned to Madagascar. She is now teaching a course at the University of Antananarivo.

Tarryn Surajpal graduated with her MSc in Applied Mathematics (*cum laude*). Her thesis is titled "Near-filed dispersion modelling of discharged effluents under various hydrodynamic conditions" supervised by Prof Francois Smit and Dr Hardus Diedericks. During her masters studies Ms Surajpal won the SU heat of the 2022 cycle of the national FameLab science communication and public speaking competition.

Awards to Staff and Students

New NRF ratings were awarded to six colleagues: **Prof André Weideman** (A1), **Prof Bernd Fischer** (B1), **Prof Nick Hale** (B3), **Dr James Gray** (C1), **Dr Pietro Landi** (C2), and **Dr RONALDA Benjamin** (Y2).

At the First-year Achievement Awards evening five colleagues were recognised by top-performing first-year students in 2021 as their most inspiring lecturers: **Mrs Elizabeth Burger** (one student from the Faculty of Science), **Prof Karin-Therese Howell** (four students from the Faculty of Economic and Management Sciences), **Dr Pietro Landi** (one student from the Faculty of Engineering), **Dr Francois van Niekerk** (one student from the Faculty of Engineering), and **Prof Hugo Touchette** (three students from the Faculty of Science).

The National Graduate Academy for Mathematical and Statistical Sciences awarded Mathematical Sciences Early Career Fellowships to **Dr Liam Baker** (Mathematics), **Dr Andie de Villiers** (Applied Mathematics), **Dr Marcel Dunaiki** (Computer Science) and **Dr Michael Hoefnagel** (Mathematics).

The Centre of Excellence for Mathematical and Statistical Sciences (CoEMASS) sponsored several events in the department – including the 65th Annual Congress of the South African Mathematical Society.

The following eight postgraduate students from African countries were awarded full-cost DAAD In-Region scholarships to study Mathematics at Stellenbosch starting in 2023. These scholarships were secured by **Dr Bruce Bartlett** in 2020. For masters studies: Aaron Mubatapasango (Zimbabwe) with supervisors Prof Karin Howell and Dr Riana Roux; Briā Razanaparany (Madagascar), with supervisor Dr Naina Ralaivaosaona; Jamiu Aliyu (Nigeria) with supervisor Dr RONALDA Benjamin; and Kevine Toukam (Cameroon), with supervisor Dr Retha Heymann. For doctoral studies: Tobi Olabiyi (Nigeria), with supervisor Dr Retha Heymann; Sonick Mumba (Zambia), with supervisor Dr RONALDA Benjamin; Nelson Kyakutwika (Uganda) with supervisor Dr Bruce Bartlett and co-supervisor Dr Mesias Alfeus; and Dennis Gikunda (Kenya) with supervisor Dr Naina Ralaivaosaona.

Prof Willie Brink was instrumental in extending the DeepMind Scholarship Programme with another R2 million for a 2023 intake. The project now totals close to R8 million.

Gregor Feierabend was awarded a prize for his talk at the 65th Annual Congress of the South African Mathematical Society, which was based on his honours project.

Nzaganya Edson, a PhD student of Dr Bruce Bartlett, visited the Mathematical Physics group at the University of Hamburg under Prof Christoph Schweigert for three months. This strengthened Dr Bartlett's collaboration with the Hamburg group.

Francois Naudé, an Applied Mathematics Honours student, received the prestigious Harry Crossley bursary to pursue his MSc.

Dr Jacques Rabie was one of 200 young researchers from more than 50 countries worldwide selected for the honour of participating in the Heidelberg Laureate Forum (HLF) in Germany in September 2022.

Three students in the Mathematical Sciences programme, **Mr Karlo Grobbelaar** (first year), **Ms Danielle Kleyn** (second year), and **Mr Nicholas Sander** (third year) were included in the Hall of Fame of the ASSA South African Tertiary Mathematics Olympiad (SATMO).

Top achievers in Applied Mathematics for the 2021 academic year were: **Danielle Kleyn** and **Abel Kotze** (best first year students), **Alexandra van der Spuy** and **Emil van der Walt** (best second year students), **Stefan Conradie** (best third year student) and **Emma Nel** (best Honours student). They were rewarded for their hard work with certificates and book prizes sponsored by Cambridge University Press.

The following students received book prizes as part of the Rubbi Awards for Mathematics for the 2021 academic year: **Danielle Kleyn** and **Abel Kotze** (best first year students); **Gerben Visser** and **Danika Altenroxel** (best first year engineering mathematics students); **Alexandra van der Spuy** and **Emil van der Walt** (best second year students); **Gregor Feierabend** and **Kyla Raoult** (best third year students); **David Smith** and **Samantha Parle** (best Honours students).

Industry-sponsored prizes were awarded to the top-achieving Computer Sciences students for the 2021 academic year: **Ian le Roux** and **Jean Weight** (best first year students); **Danielle Kleyn** and **Liam Foxcroft** (best second year students) with **Emil van der Walt** as runner up. Their prize money was sponsored by EPI-USE. **Brendan Watling** received the Van der Walt Medal in recognition of being the best third year student. **Dylan Callaghan** and **Caleb Zeeman** made history in terms of the Computer Science Division being unable to separate their achievement, when they both received the prize for the best honours student and for the best honours project. Their prize money was sponsored by [AlphaWave/EMSS](#) and [Vastech](#). Kevin Brand was the best honours student in machine learning.



Prize winners and their sponsors at the annual prize-giving ceremony of the Computer Science Division.

Several postgraduate students and researchers from the department were recognised for their excellent presentations at the 65th Annual Congress of the South African Mathematical Society (SAMS): **Gregor Feierabend**, **Emma Nel**, and **Brice Razakarinoro** were awarded prizes for their research presentations in the Student Sessions. **Cornel Stander** and **Shane Josias** were awarded the first and second prize respectively in the Student Poster Session for posters based on their doctoral research. **Amogelang Motloutsi** was awarded the third prize for a poster based on his Honours project. **Dr Michael Hoefnagel** was awarded the UCDP prize in the young academic poster session.

Staff Matters

Prof Sonja Mouton was promoted to Professor in Mathematics, **Dr James Gray** was promoted to Associate Professor in Mathematics and **Dr Trienko Grobler** was promoted to Senior Lecturer in Computer Science, all with effect from 1 January 2032.

Prof Willie Brink completed his second two-year term as Division Head of Applied Mathematics. **Prof Hardus Diedericks** was appointed Division Head of Applied Mathematics from 1 January 2023 to 31 December 2024. **Dr Wasiela Fish** was appointed as Senior Lecturer from 1 January 2023 with the primary responsibility to offer the Mathematics modules as part of the Extended Degree Programme and to pursue research in Mathematics Education in Higher Education.

Dr Jacques Masuret resigned with effect from 30 June 2022. Jacques joined the department in 2015 as a Junior Lecturer (on a fixed-term contract), having already been involved in offering various mathematics modules since 2012. After graduating in 2017 with his PhD in Mathematics from SU and the Vrije Universiteit Brussels, he was promoted to Lecturer (part-time, permanent). Over the past seven years Jacques has primarily been involved in offering Mathematics 186 as part of the EDP programme. He has a

special rapport with his students, inspiring and challenging them as they prepare for Mathematics 114 or Engineering Mathematics 115. Jacques has been nominated most years as the most inspiring lecturer by the top performing EDP student. In addition, Jacques has been the inspiration and energy behind the hybrid learning Mathematics ULUs which he has been developing together with Mrs Elizabeth Burger and Mr Rodney Randall (EMS).

Prof Ingrid Rewitzky was re-appointed Head of the Department of Mathematical Sciences from 1 January 2023 to 31 December 2025. **Prof Bill Tucker** presented his inaugural lecture titled 'Forward together' on 5 May 2022. **Prof Brink van der Merwe** served his first year as Division Head of Computer Science. **Prof Leon van Wyk** was re-appointed Division Head of Mathematics from 1 June 2022 to 31 May 2024. **Prof André Weideman** was granted the opportunity to continue as Distinguished Professor in Applied Mathematics until the age of 70.

Prof Nick Hale successfully chaired the local organising committee for the 65th Annual Congress of the South African Mathematical Society held in December 2022. The plenary speakers were Prof Zingiswa Jojo from the University of South Africa; Prof Betsie Jonck from the University of the Witwatersrand; Prof Jeff Murugan from the University of Cape Town; Prof Stefan Veldsman from Nelson Mandela University and La Trobe University; and Prof André Weideman from Stellenbosch University.



There was a record number of 221 registered participants and 148 oral presentations at the 65th annual congress of the South African Mathematical Society.

Prof Karin Howell serves on the executive committee of the African Institute for Mathematical Sciences South Africa (AIMS-SA), the AIMS-SA Associate Faculty, the Advisory Council for Mathematics of the South African Mathematics Foundation, the Mathematics Committee of the National Graduate Academy and the South African Mathematical Society's council as secretary.

Prof Zurab Janelidze is the President of the South African Mathematical Society (2022-2023) and in this capacity was invited by the NRF to represent South Africa at the General Assembly of the International Mathematical Union

held from 3 to 4 July 2022. He was one of the four Principal Investigators in the Mathematical Structures Research Programme at NITheCS (National Institute for Theoretical and Computational Sciences) in 2022 and was invited to serve on the Management Committee of NITheCS as an Associate Representative.

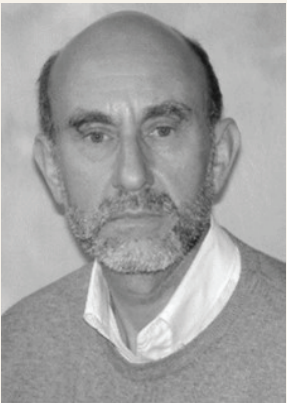
Mr Shane Josias was jointly appointed with the School for Data Science and Computational Thinking and assumed the role of the Junior Data Science co-chair in the Standard Bank-Lab. In this capacity he met with Standard Bank to brainstorm solutions to problems, completed a Standard Bank sustainability blitz/workshop, and planned and executed the Data School Hackathon in which undergraduate and postgraduate students participated.

Dr Sophie Marques is coordinating mobility and exchange opportunities through the ALGANT programme, Ganda programmes, and the cross-mobility programme initiated by the French Ministry of Europe and Foreign Affairs.

Prof Sonja Mouton serves on the South African National Committee for the International Mathematics Union (SANCIMU).

Prof Ingrid Rewitzky is a member of the International Mathematical Union Committee on Electronic Information and Communication (CEIC), is a member of the SU-UIC Standardisation Sub-committee for the International Senior Certificate introduced in 2022 and is serving on the Council for Higher Education External Audit Panel member for North-West University, July 2022-March 2024.

In Memoriam



Prof Anthony E. Krzesinski, Emeritus Professor in Computer Science, passed away in April 2022. He obtained the MSc in Theoretical Physics from the University of Cape Town in 1968 and the PhD in high energy physics from the University of Cambridge in 1971. Thereafter he joined the Shell Research Laboratory in Amsterdam where he worked on the development of mathematical models to

predict the performance of computer systems. In 1975 he joined Computer Science at Stellenbosch University and in 1985 was promoted to Professor of Computer Science. His research interests were in the areas of computer performance evaluation and modelling and computer communication networks. In 1980 he co-founded, with Prof Pieter Kritzing, the Institute for Applied Computer Science. The goal was to contribute towards the South African software industry by attracting computer scientists who conduct research in software engineering and who are interested in providing a consultation service to industry.

Social Impact

Dr Liam Baker, as an award-winning International Mathematics Olympiad (IMO) alumnus, was significantly involved with mathematics competitions: Problem Committee at the PAMO in Morocco in June, Team Leader for the IMO in Norway in July, SA Mathematics Olympiad Senior Round three paper-setting committee in February and October, Problem Committee and marking for the 2022 Simon Marais Mathematics Competition, coach at the training and selection camps for the IMO and PAMO in April, June and December.



In January a team of undergraduates with experience in competition mathCo-ematics from the Massachusetts Institute of Technology (MIT), travelled to Stellenbosch to run a training camp for South Africa's top 15 high school mathletes.

Dr Liam Baker and **Dr Dirk Basson** were co-organisers of the SU undergraduate student participation in the SA Tertiary Mathematics Olympiad and of the Boland section of the SA Mathematics Team Competition.

Dr Bruce Bartlett presented a talk "The Math of Maryam – A Lightning Tour" at the Faculty of Science Movie Night during National Science Week in August 2022.

Dr Ronalda Benjamin was one of the guest speakers at the UWC's Women in Mathematics Mini-Convention held at Capetonian Hotel on 25 August 2022. She was also the guest speaker at the sixth Annual Life Orientation Teacher Awards held at PnP Head Quarters, Kenilworth, on 5 October 2022.

Mr Willem Bester served as mentor for the UmojaHack data science competition.

Prof Willie Brink participated in the Deep Learning Indaba mentorship programme and co-organised Maties Machine Learning (with Dr Herman Kamper from the Faculty of Engineering).

Dr Hardus Diedericks provided service to industry including calculating wave heights at Ibo Island (Mozambique) for WML Coast and simulating the 3D hydrodynamics in Lough Foyle (Ireland) for Longline Environment (Pty) Ltd.

Prof Karin-Therese Howell, together with the African Women in Mathematics (AWiM), offered an online seminar consisting of four talks from 12 April to 12 May 2022. The speakers were Dr Angela Tabiri, an AIMS-Google AI postdoctoral fellow at AIMS-Ghana; Dr Cerene Rathilal from the University of Johannesburg; Prof Maria Vlasou from the University of Twente; and Prof Oghenetega Ighedo from the University of South Africa. Ms Sarah Selkirk, who is pursuing her PhD studies at Klagenfurt University, Austria, assisted with the coordination. Prof Howell participated in the HERS-SA Academy, 4-8 September 2022 and the Science Alumni event focussed on "Why it is important to talk about women in the mathematical sciences?" hosted by Prof Louise Warnich, Dean of the Faculty of Science.



From the left, Prof Ingrid Rewitzky (SU), Mariëtta van den Worm (SU); Zinhle Mthombothi (South African Centre for Epidemiological Modelling and Analysis); Prof Karin-Theresa Howell (SU); Prof Louise Warnich (SU); Lezanne Human (co-founder of Bank Zero); Nerina Visser (director and co-owner at etfSA Portfolio Management Company). In front, Jacobie Mouton (MSc student in machine learning); Tarryn Surajpal (MSc student in applied mathematics); Prof Marelise Davel (Faculty of Engineering, North-West University); Helena Conradie (CFA and non-executive director of the Satrix Investments) and Dr Ronalda Benjamin (SU).

Prof Zurab Janelidze was interviewed for the Weekend Breakfast with Refiloe Mpakanyane on the topic of whether maths trauma is real. He also gave a YouTube interview to Dr Cerene Rathilal for the Meet a Mathematician series, as part of a celebration programme for the International Day of Mathematics on 14 March.

Prof Zurab Janelidze and **Dr Sophie Marques** led a team of SU undergraduate and postgraduate students in mathematics and the arts to present a theatrical production, "Fundamano", on 4 November 2022 at the Drostdy Theatre. The aim of the production was to convey the explorative nature of mathematics and the importance of conceptual thinking in a light-hearted artistic setup. The production featured a discussion around exploration-based learning in mathematics and in music, between Prof Zurab Janelidze, Dr Sophie Marques, and a South African composer, Emeritus Professor in the Department of Music at SU, Hans Roosenschoon. The production, which was well received, with a nearly full house attendance, was an official event under the banner of the International Year of Basic Sciences

for Sustainable Development. It was initiated within SAMS and was supported by NITheCS, ASSAf, and DSI. The production videos can be viewed at: <https://www.youtube.com/@fundamano>



Scenes from the Fundamano production.

Dr Sophie Marques is a member of the founding team of the Ubuntu Mathematics Institute (UMI), is the founder and managing director of *Wisaarkhu*, and assists with the African Women in Mathematics (AWiM) events. It took *Wisaarkhu* a few years and a search around the world to find creative and special people, who are concerned about the overall well-being of the people around them and what they have to say, but also refuse to compromise on the excellence, validity and quality of their research. *Wisaarkhu* wants to show that there is way to reach our best self in a manner that is compatible with compassion and understanding. At *Wisaarkhu*, we give people a voice when they do not usually have a voice on a platform that aims to reach an academic community as well as a broader audience. The articles are put together in a creative way, mixing art and poetry.

Prof Francois Smit held an advanced workshop on V/L modelling from 3-7 May at Rheinmetall Denel Munition (RDM) in Potchefstroom.



Prof Bill Tucker serves on the Board of Zenzeleni, a company that currently serves broadband internet to thousands of local community members at R25/month uncapped in the rural Eastern Cape. This low rate is subsidised by anchor clients such as Zithulele Hospital, Mdumbi Backpackers, local schools, and businesses.

Prof Lynette van Zijl continues her collaboration with the Pioneer School for the Blind in Worcester. Her group develops dedicated software to support teaching for the blind.

Collaboration

Australia

Griffith University
International Institute for Applied Systems Analysis
Monash University
University of Newcastle
University of New South Wales

Belgium

KU-Leuven
Ghent University
Vrije University
Université Catholique de Louvain

Brazil

Universidade Federal de Itajuba

Canada

Brock University
University of Quebec

Cyprus

Research Centre on Interactive Media, Smart Systems and Emerging Technologies
University of Cyprus

France

IMT Atlantique in Nantes
University of Cote d'Azur

Germany

Braunschweig University of Technology
Friedrich-Willhelms University, Bonn
Max-Planck Institute for Mathematics, Bonn
Technical University of Kaiserslautern
University of Erlangen

Hungary

Renyi Institute of Mathematics
University of Miskolc

India

Indian Institute of Technology Roorkee

Ireland

Trinity College, Dublin

Japan

Okinawa Institute of Science and Technology

Poland

Gdańsk University of Technology
Warsaw University of Technology

Portugal

University of the Algarve

South Africa

Council for Scientific and Industrial Research (CSIR)
University of Cape Town
University of Johannesburg
University of Pretoria
University of South Africa
University of the Western Cape
University of the Witwatersrand

Spain

Institute of Agriculture and Food Research and Technology, Barcelona
University Fuenlabrada
Universidade de Vigo

Sweden

Nordita, Stockholm
Umeå University

The Netherlands

University of Groningen
Vrije Universiteit Amsterdam

Turkey

Bilkent University
Mammara University

United Kingdom

Aberystwyth University
Imperial College London
InstaDeep (South African Office) DeepMind
King's College London
Lancaster University
University of Glasgow
University of Leicester
University of Manchester
University of Oxford
University of Strathclyde

United States of America

John Hopkins University
Machine Intelligence Research Labs, Auburn, Washington
Oregon State University
Pacific State University
Stanford University
University of Louisiana at Lafayette

Zambia

University of Zambia

Funding

South Africa

Centre of Excellence for Mathematical and Statistical Sciences (CoE MASS)	Sciences (NITheCS)
DST/NRF SARCHI Programme	NRF Thuthuka Programme and Rated Researchers Programme
National Graduate Academy for Mathematical and Statistical Sciences (NGA-MASS)	International SA / France (NRF-PROTEA)
National Institute for Theoretical and Computational	Stellenbosch University – Subcommittee B

NRF-rated Researchers

Leading international researchers	
Prof A Engelbrecht	Artificial Intelligence
Prof JAC Weideman	Numerical analysis and scientific computing
Prof W Visser	Software failure, software engineering and software development
Internationally acclaimed researchers	
Prof B Fischer	Software engineering
Prof N Hale	Numerical analysis and scientific computing
Prof C Hui	Biomathematics and ecological modelling
Prof Z Janelidze	Category theory
Prof H Touchette	Theory of large deviations
Prof L van Wyk	Matrix algebras, Lie properties in associative algebras, Leavitt path algebras
Established researchers	
Prof G Boxall	Model theory and some aspects of number theory
Prof S Fidler-Woudberg	Fluid modelling
Dr J Gray	Category theory
Prof K-T Howell	Near-vector spaces
Prof RS Kroon	Machine learning
Dr P Landi	Mathematical Ecology
Prof S Mouton	Banach algebras and spectral theory
Prof WD Tucker	Computing and society
Prof AB van der Merwe	Automata theory
Prof L van Zijl	Automata theory
Promising young researchers	
Dr R Benjamin	Spectral theory in (ordered) Banach algebras
Dr T Grobler	Remote sensing data
Dr N Ralaivaosaona	Analytic number theory, Probabilistic combinatorics
Dr R Roux	Graph theory

Staff List

Academic

Dr B Bah (jointly with AIMS-SA)

Dr L Baker

Dr B Bartlett

Dr DJ Basson

Dr R Benjamin

Mr W Bester

Prof G Boxall

Prof W Brink (Division Head: Applied Mathematics)

Mrs EJ Burger

Dr M Cloete

Dr H Coetzer

Dr A de Villiers

Dr H Diedericks

Dr M Dunaiski (joint appointment with the School for Data Science and Computational Thinking)

Prof A Engelbrecht (joint appointment with the Department of Process Engineering)

Prof S Fidder-Woudberg

Prof B Fischer

Dr JRA Gray

Prof N Hale

Dr R Heymann

Dr M Hoefnagel

Prof K-T Howell

Prof C Hui (SARCHI)

Dr CP Inngs

Prof Z Janelidze

Mr S Josias (joint appointment with the School for Data Science and Computational Thinking)

Prof RS Kroon

Dr P Landi

Dr MF Maritz

Dr S Marques

Dr J Masuret

Prof S Mouton

Mr S Mungwe

Dr M Ngxande

Dr D Ralaivaosaona

Prof IM Rewitzky (Executive Head)

Dr R Roux

Prof F Smit

Prof H Touchette

Prof WD Tucker

Prof AB van der Merwe (Division Head: Computer Science)

Prof L van Wyk (Division Head: Mathematics)

Prof L van Zijl

Prof WC Visser

Prof JAC Weideman

Dr L Wessels

Prof M Wild

Extraordinary appointments

Prof J Bishop (Extraordinary Professor, Computer Science)

Prof B Herbst (Extraordinary Professor, Applied Mathematics)

Dr M Hoffmann (Extraordinary Senior Lecturer, Computer Science)

Dr U Paquet (Extraordinary Professor, Applied Mathematics)

Prof H-E Porst (Extraordinary Professor, Mathematics)

Prof F Yamaguchi (Extraordinary Professor, Computer Science)

Emeritus Professor

Prof AE Krzesinski

Prof H Proding

Support staff

Mrs L Adams

Mrs G Fortuin

Mrs S Fortuin

Mrs W Isaacs

Mrs H Lamb

Mrs L Muller

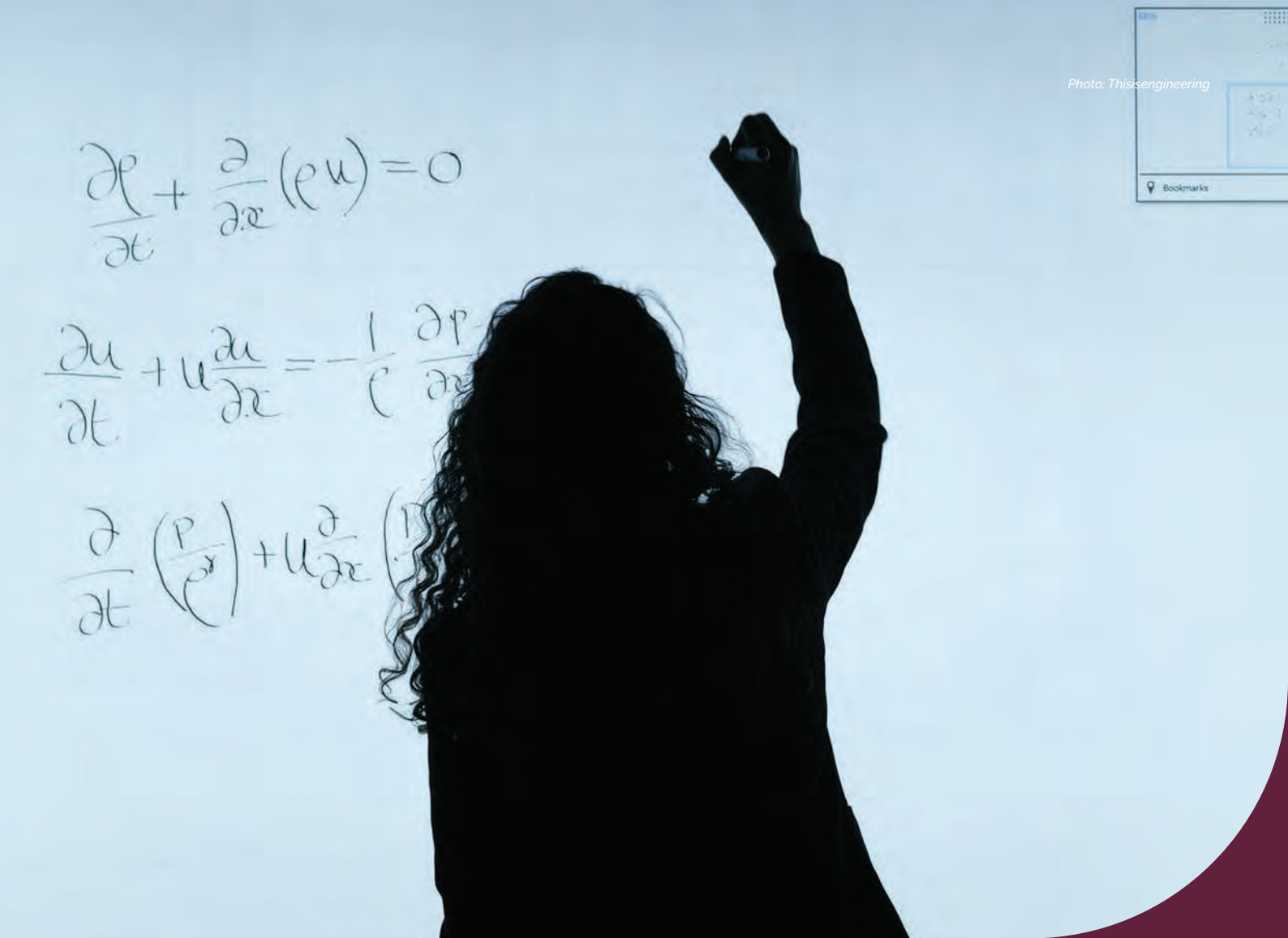
Ms M Sebastians

Postdoctoral Fellows

Dr D Nickelsen, joint with AIMS and NITheP

Dr J Rodger

Dr S MacFadyen



A person with long dark hair is seen from behind, writing mathematical equations on a whiteboard. The equations are written in black marker. The first equation is $\frac{\partial p}{\partial t} + \frac{\partial}{\partial x}(p u) = 0$. The second equation is $\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} = -\frac{1}{\rho} \frac{\partial p}{\partial x}$. The third equation is $\frac{\partial}{\partial t} \left(\frac{p}{\rho} \right) + u \frac{\partial}{\partial x} \left(\frac{p}{\rho} \right) = 0$. The person is holding a white marker in their right hand.

$$\frac{\partial p}{\partial t} + \frac{\partial}{\partial x}(p u) = 0$$

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} = -\frac{1}{\rho} \frac{\partial p}{\partial x}$$

$$\frac{\partial}{\partial t} \left(\frac{p}{\rho} \right) + u \frac{\partial}{\partial x} \left(\frac{p}{\rho} \right) = 0$$

Contact Details

Applied Mathematics Division

Tel: 021 808 4215

E-mail: appliedmaths@sun.ac.za

Web: <http://appliedmaths.sun.ac.za/>

Computer Science Division

Tel: 021 808 4232

E-mail: head@cs.sun.ac.za / secretary@cs.sun.ac.za

Web: <http://www.cs.sun.ac.za>

Facebook: <https://www.facebook.com/groups/csmaties/>

Mathematics Division

Tel: 021 808 3282

E-mail: maths@sun.ac.za

Web: <http://www.sun.ac.za/english/faculty/science/Mathematics>

Department of Physics

Photo: Stefan Els

Research Interests

Theoretical Physics

Condensed matter; Soft condensed matter and biophysics; Solitons in field theory and particle physics; General relativity, cosmology, and the physics of black holes; Quantum phase transitions and exceptional points; Non-commutative quantum mechanics and field theory.

Nuclear Physics | Health and Radiation Physics

Nuclear structure and interactions; Structural properties on the atomic nuclear and fundamental interactions within the nucleus; Nuclear techniques and technologies to study nuclear radiation in the environment; Nuclear radiation in the medical and health sector; Nuclear clustering phenomenon in light and heavy nuclei; Pygmy resonance within nuclei; Fundamentals of single particle properties on nucleons inside a nucleus; Co-linear cluster tripartition mode in ternary fission; New radiation detector technologies.

Laser Physics

Quantum light-matter interactions; Quantum information processing with light; Quantum sensing; Closed loop quantum control and quantum simulation using trapped ions; Transient absorption spectroscopy; Super resolution microscopy; Terahertz sources and spectroscopy; Laser pulse shaping for microscopy; Nonlinear spectroscopic and imaging techniques; Resonant ionisation spectroscopy and ion beam production; Laser-based additive manufacturing and X-ray tomography.

Research Highlights

Laser Research Institute (LRI)

The Laser Research Institute had a very productive year. There were 31 journal publications, eight conference proceedings and one book chapter published this year from researchers associated with the LRI. The research was published in leading journals, including *Physical Review A* and two in *Scientific Reports*. The Stellenbosch Laser Student Chapter again took it upon themselves to organise a variety of outreach activities to various schools and took the lead in organising the annual road trip, this year to the Eastern Cape, visiting five schools along the way and performing various physics demonstration at the schools.

Nobel in Africa guest lecture by Sir Michael Victor Berry

Sir Michael Victor Berry, a mathematical physicist at the University of Bristol, England, delivered a guest lecture at Stellenbosch University on Monday 24 October 2022. The lecture, titled "How quantum physics democratized music: a meditation on physics and technology", formed part of the outreach activities of the Nobel in Africa Symposium on the Predictability of Science in the Age of Artificial Intelligence. Nobel in Africa is a STIAS Initiative in partnership with Stellenbosch University, under the auspices of the Nobel Foundation and the Royal Swedish Academy of Sciences with funding from the Knut and Alice Wallenberg Foundation.



Sir Michael Victor Berry, a mathematical physicist from the University of Bristol.

Research Activities

Mr Gary Andrews made progress in writing a Physics textbook aimed at students in the Extended Degree Programme (EDP), adding three more chapters. These will also be translated into isiXhosa.

Dr Gurthwin Bosman produced an output on the application of chemometrics and fluorescence spectroscopy for direct quantification of phenolics in red wines. This work is done in collaboration with colleagues from the Department of Viticulture and Oenology at SU. Dr Bosman was also co-author of two conference proceedings: one at the local South African Institute of Physics (SAIP) conference titled "Investigating the morphology of an optically trapped particle using Mie scattering" and a contribution titled "On-Chip Mid-Infrared Supercontinuum Generation in Silicon Germanium waveguide" at an international conference, the Frontiers in Optics 2022 in New York. He was also invited to present at the BioPhotonics workshop of the SAIP 2022 event. His talk was titled "Breaking the diffraction limit: Brief take on super resolution imaging techniques". The talk served as an introduction for the delegates into the field of super resolution microscopy.

Prof Kristian Müller-Nedebock presented a keynote lecture at the meeting EUTOPIA IV in Trento, Italy, during September 2022.

Dr Hannes Kriel is part of the AIMS (African Institute for Mathematical Science) executive team.

Dr Pieter Neethling is the chairman of the Photonics Division of the South African Institute of Physics and director of the Laser Research Institute (LRI). During 2022 he re-applied for an NRF rating and was awarded a C2 rating by the National Research Foundation. He published one paper in *Scientific Reports* in 2022 and presented at the International Commission on Optics/Optics Within Life Sciences (ICO/OWLS) conference in Dresden, Germany, in September 2022. He also published one conference proceedings from the South African Institute of Physics annual conference.

Prof Frederik Scholtz refereed papers for the journals *Physical Review Letters*, *Physical Review C&D*, *Physics Letters A*, *European Journal of Physics* and *European Physics Letters*.

Dr Christine Steenkamp continued with negotiations for an industry-funded research project. As part of her teaching, she developed 17 hybrid learning units with support and input of colleagues. The learning units, developed to improve the mathematics and problem-solving skills of first-year physics students, have been rolled out in 2023 and was used by more than 2300 students. As community interaction she did two large projects translating physics material for use in schools into Afrikaans.

Prof Mark Tame's group published papers in the international journals *Nature Scientific Reports*, *Applied Physics Letters* and *Physical Review A*, in addition to conference proceedings (three from SAIP 2021 and four from SAIP 2022). Of the seven postgraduate students in the group, two graduated with their MSc (Unathi Skosana and Hjalmar Rall). Unathi is continuing as a PhD student in the group, while Hjalmar left to pursue his PhD studies at Munich Technical University in Germany. Prof Tame helped at one of the departmental open days in 2022, during which he took six groups of students and members of the public around the group's lab, describing the science behind each of the experiments being carried out. He also travelled to Johannesburg to give a talk at an industry expo event, highlighting the research Stellenbosch University is doing in quantum technologies. Prof Tame was a judge at the university's first postgraduate conference and gave a public outreach talk on the science behind the 2022 Nobel prize in physics for quantum entanglement. Prof Tame has continued with his regular service of giving invited talks and seminars, as well as acting on various committees, a government initiative on quantum technology and carrying out reviews. Of special note was a visit to Pennsylvania State University, where Prof Tame gave a seminar and helped develop a new course on quantum technology. A highlight of the year was the securing of roughly R7.5M from the Department of Science and Innovation for quantum technology research over the next three years.

Prof Herbert Weigel presented at the virtual SIAM Conference on Applications of Dynamical Systems (DS21) with a paper titled "Fluctuations about Solitons in One Space Dimension". He gave a plenary talk titled "Quantum Corrections to the ANO Vortex" at the SIG IX Workshop: Solitons at Work (virtual). He was invited to contribute an article on "Quantum Effects for Solitons" to the review volume *The State of the Quantum Vacuum: Casimir Physics in the 2020s* edited by Prof K.A. Milton, a world leading researcher in the field.

Academic Affairs

Student Information 2022



16
BScHons
students



12
MSc
students



22
PhD
students



1
Postdoctoral
fellows

In Memoriam



The Department of Physics was saddened by the passing of **Prof Anthony Cowley** in October 2022. To his colleagues and students in the Department, Anthony will be remembered for his kindness, leadership and expertise. As a B1 rated researcher, Anthony is recognised for his extraordinary contribution to the field of Nuclear Physics. Having joined Stellenbosch University in 1992, Anthony served as Chair of the

Department between 1996 and 1998, and he supervised more than a dozen PhD students during his three decades at the university.

Social Impact

The department again hosted the annual "Public lectures about the science behind the Nobel Prizes" awarded in the year, in collaboration with the Departments of Chemistry and Polymer Science and Physiological Sciences on 27 October 2022.

The Optica Stellenbosch Students Chapter continued to host and organise a range of public and outreach activities in 2022 (mentioned in the LRI part above), including hosting visiting lecturer Dr Jan Rothardt (Jena).



During the Physics Open Day, members of the public were taken on tours to several of the laboratories in the Department of Physics.

Collaboration

South Africa

Cape Peninsula University of Technology
Council for Scientific and Industrial Research (CSIR)
Executive Engineering
iThemba LABS
Klydon
LRS implants
Nanodyn
Nelson Mandela University (NMU)
Rapid3D
University of Cape Town
University of KwaZulu-Natal (UKZN)
University of Pretoria
University of South Africa (UNISA)

Belgium

Katholieke Universiteit Leuven
University of Antwerp
Université Catholique de Louvain

Ethiopia

Addis Adaba University

Germany

Fraunhofer
Johannes Gutenberg University
Karlsruhe Institute of Technology
Leibniz Institute of Photonic Technology (IPHT)
Max Planck School of Photonics, Jena

India

SN Bose Center for Basic Science, Kolkata
Indian Institute of Science (IIS) in Bangalore

Italy

University Trento

Netherlands

University of Groningen

Korea

Quantum Universe Center, Korea Institute for Advanced Study
Hanyang University

Lesotho

National University of Lesotho

Norway

Norsk Medisinsk Syklotronsenter AS
Norwegian University of Science and Technology (NTNU)

Switzerland

University of Bern

United Kingdom

Rutherford Appleton Laboratories, Oxford

Sheffield University
University of York

United States of America

ASP Isotopes
Oak Ridge National Laboratory
Pennsylvania State University
University Texas El Paso

Funding

South Africa

African Laser Centre
ARMSCOR – Virtual Defense Engagement Programme and Laser Defense Research Project (DESUP)
Centre for Nuclear Safety and Security
Council for Scientific and Industrial Research (CSIR)
CSIR National Laser Centre's Rental Pool programme
CSIR Rental Pool Program
CSIR/SU Research Chair in Quantum, Optical and Atomic Physics
CSIR-DST Inter-Programme Postgraduate Bursary Support
Institute for Maritime Technology (IMT)
National Research Foundation (NRF)
Nkosi Innovations
NRF SA-China bilateral collaboration funding
NRF unrated researchers funding
NRF/DST SARCHi Chair in Quantum Information Processing
SA-CERN Consortium
SA-JINR grant for development of a virtual laboratory for Nuclear Physics
SA-JINR travel grant
SAQuTI
South African Institute for Physics (SAIP), Women in Physics in SA (WiPISA)

Africa

African Laser Centre
DSI Collaborative Program in Additive Manufacturing (CPAM)
DSI M-era.net project on NiWRe alloys for new X-ray gratings for NDT applications

Europe

DAAD scholarships in Germany
European Physical Society
Federal Ministry of Education and Research (BMBF), Germany
Newton Fund, Rutherford Appleton Laboratory
NT-MDT Spectrum Instruments
PicoQuant
Wirsam Scientific International Centre for Theoretical Physics

United States of America

Optical Society of America (OSA)
International Society of Optics and Photonics (SPIE) for the Laser Student Chapter

NRF-rated **Researchers**

Leading international researcher	
Prof Dieter Heiss	Physical effects and significance of spectral singularities
Internationally acclaimed researchers	
Prof Anthony Cowley	Mechanism of proton-induced pre-equilibrium nuclear reactions, alpha-particle clusters in atomic nuclei and light-ion transfer reactions
Prof Herbert Weigel	Quantum field theories emphasising on many different scenarios in which standard perturbative treatments cannot be applied. This comprises field configurations with localized energy densities, known as solitons or solitary waves. They have innumerable applications in physics, ranging from properties of subatomic particles via condensed matter phenomena to cosmological defects.
Prof Mark Tame	Quantum nanophotonics which involves the study of light-matter interactions at the quantum level with applications in quantum computing, quantum communication and quantum sensing
Prof Fredrick Scholtz	Non-commutative quantum mechanics and quantum field theory
Established researchers	
Prof Erich Rohwer	Laser development, laser techniques and applications, laser spectroscopy and microscopy
Prof Anton du Plessis	Additive Manufacturing, X-ray tomography, Biomimicry
Prof Richard Newman	Radionuclide metrology, environmental radioactivity, dosimetry, radiation transport modelling, radiation safety, elemental analysis, physics education
Promising young researchers	
Dr Hannes Kriel	Condensed matter physics with a focus on interacting quantum systems and closed quantum systems out of equilibrium, with applications of methods such as continuous unitary transformations (CUTS) and algebraic techniques within this setting

Staff List

Academic

Mr Gary Andrews
Dr Gurthwin Bosman
Prof Anton du Plessis
Dr Anslyn John
Dr Hannes Kriel
Prof Kristian Müller-Nedebock (Departmental Head)
Dr Pieter Neethling
Prof Richard Newman
Prof Erich Rohwer
Prof Frikkie Scholtz
Dr Philip Southey
Dr Christine Steenkamp
Prof Mark Tame

Prof Brandon van der Ventel
Dr JJ van Zyl
Prof Herbert Weigel
Prof Shaun Wyngaardt

Extraordinary Professors

Dr Faiçal Azaïez
Prof Andrew Forbes
Prof Dieter Heiss
Dr Pieter Kotze
Dr Noel Mkhaza
Prof Jie Meng
Prof Tony Parker
Prof F Petruccione
Dr Einar Ronander
Prof Herbert Stafast

Professors Emeritus

Prof Piet Walters
Prof Anthony Cowley
Prof Hubertus von Bergmann

Support staff

Mr Stanley February
Ms Ursula Isaacs
Ms Sandra Josias
Mr Cashwall Pool

Technical staff

Mr Tinus Botha
Mr Patrick Benting
Mr Phlip Cornelissen
Mr Johan Germishuizen
Mr Joshwine Gertze
Mr Eben Shields



Contact Details

Tel: 021 808 3391
Fax: 021 808 3385
E-mail: physqueries@sun.ac.za
Web: www.sun.ac.za/physics

Department of Physiological Sciences

Research Interests

Cancer research; Cardio-metabolic research; Cardio-oncology research; Chemotherapeutic resistance in breast cancer; Clinical haemorheology and coagulation research; Metabolic physiology and health; Bio-inspired drug delivery research; Muscle physiology and cell biology research; Neuro research

Research Highlights

From the cancer research group

One of the main research focuses of our group is currently to develop testing protocols for cancer patients utilising a personalised medicine approach. Cancer does not distinguish between race, gender, age or socioeconomic position; it is merciful to no-one and despite the political will driving a concerted global effort, only marginal progress has been made in the war against cancer.

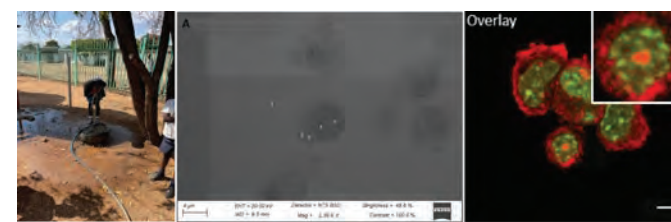
One aspect which contributes to the poor progress in the management of cancer relates to the severe collateral damage associated with the current treatment strategies. Although anthracyclines such as doxorubicin has proven to be one of the most successful approaches to cancer treatment, it induces various side effects such as nausea, vomiting, hematopoietic suppression and cumulative, dose-dependent cardiac toxicity. However, this is not the only challenge that researchers and clinicians are faced with: cancer cells are becoming increasingly resistant to chemotherapy-induced cell death. The timely

identification of drug resistance is critical for optimal therapy management, however there are presently no technologies for real time surveillance or prospectively determining drug resistance in South Africa. Upfront knowledge of innate drug resistance and early detection of emerging acquired resistance thus have major clinical and financial implications, especially if such knowledge can be obtained non-invasively and in real-time. – *Prof AM Engelbrecht*

Neuro research

The neuro research group, led by Prof Ben Loos, seeks to better understand the relationship between autophagy dysfunction and cell death onset in neurodegeneration, neuronal injury and gliomas. Several aspects were highlights for the group in 2022. For example, the group focussed on metal neurotoxicity, based on mining activities in the Limpopo and Northern Cape regions, where copper, manganese, iron and cadmium pose a risk for the onset of neurotoxicity. Water samples from community taps, boreholes, surface water and rivers were analysed and the metal-micro environment re-created *in vitro*. Metal uptake was quantified using EDX-analysis.

Photo: Stefan Els



Images: Sinnéad Cogill and Asandile Mangali

Water collection in Limpopo and Northern Cape and analysis for metal-induced neurotoxicity (left), EDX-spot analysis (middle) and acidic compartment assessment (right).

Prof Loos' lab also collaborated with Dr Gurthwin Bosman from the Department of Physics to develop an operational light sheet instrument, primarily designed for spheroid-acquisitions. In addition, the first correlative light and electron microscopy work was performed on human glioma spheres.

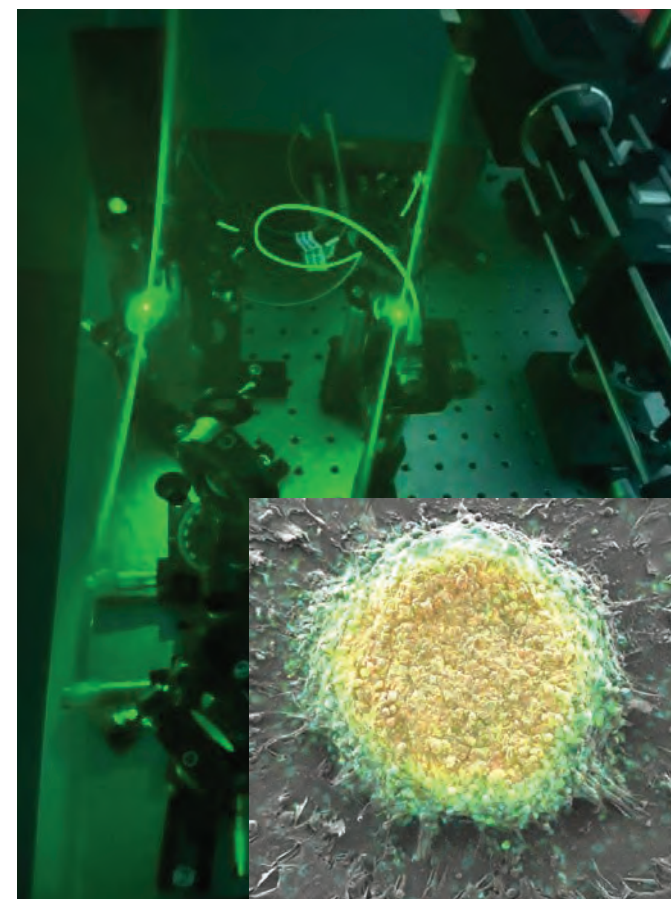
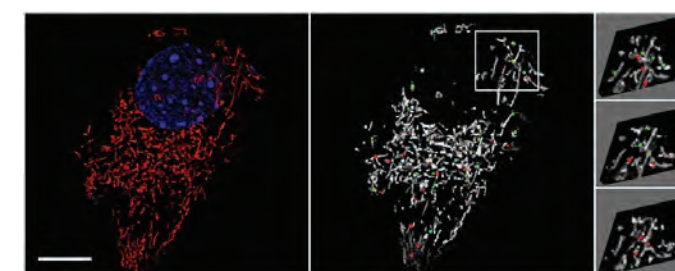


Image: Meenal Bhaga and Imraan Badroodin

Light sheet system with a 488 laser, and a spheroid in CLEM mode.

The in-house developed software MEL (mitochondrial event localiser) has been extensively implemented to assess mitochondrial dynamics, including fission and fusion events, quantitatively. – *Prof Ben Loos*

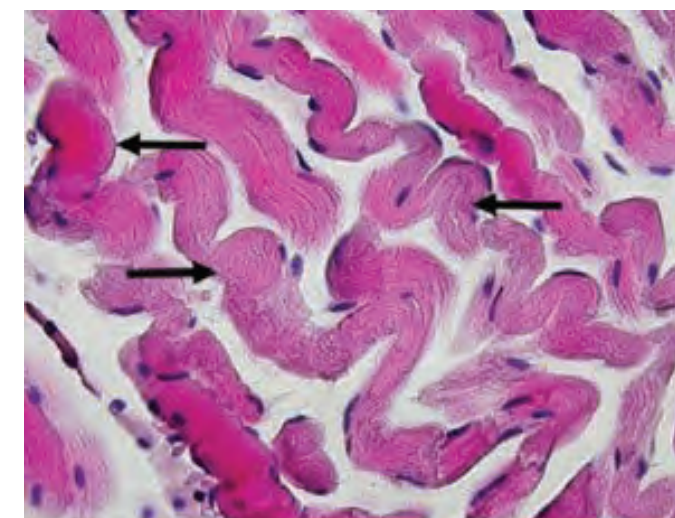


Images: Sholto de Wet and Dr Rensu Theart

Mitochondrial fission and fusion assessment.

Muscle physiology and cell biology

Prof Kathy Myburgh's NRF B2 rating attests to the well-established international acclaim her research receives. Her published articles were cited 2400 times in total in 2022, in part due to the explosion of research in nano-sized extracellular vesicles. A multi-authored guidelines article gained 1567 new citations, while original research from her laboratory gained seven new citations in the one-year time frame. Her long-standing international collaboration with researchers from the University of Palermo, Italy, resulted in two publications in 2022 – these covered muscle performance in healthy, young individuals, as well as muscle pathology due to a rare inherited disorder of a chaperone protein that results in wavy muscle fibres. – *Prof Kathy Myburgh*



Micrograph from Scalia et al 2022

Longitudinal section of skeletal muscle from a patient with a rare inherited disorder.

Clinical haemorheology and coagulation research

The aim of **Prof Resia Pretorius's** research is the reduction of the global disease burden by identifying and targeting novel disease markers to mitigate and arrest their effects on inflammation in humans. Our research has spanned the areas of haematology and systemic inflammation. We have shown how circulating inflammatory molecules in systemic inflammatory diseases lead to pathological blood clotting, hyperactivated platelets and erythrocytes that undergo eryptosis (cell death).

While also covering scanning electron microscopy, fluorescence microscopy, flow cytometry and viscoelastic techniques, our focus has evolved from studying clotting pathology to discovering that direct protein-protein interactions between circulating inflammatory molecules and soluble clotting protein, fibrinogen, are main drivers of clotting pathologies. We discovered that this structural and biochemical change in fibrinogen structure results in clotting protein taking on an amyloid nature. This conformational change leads to both hypercoagulation and hypofibrinolysis. This brought our focus to the biochemical and structural nature of fibrinogen, as well as platelets and their role as potent signalling entities during systemic inflammation.

Those initial novel discoveries presented evidence on how circulating inflammatory molecules, also from bacteria, may directly impact on pathological clotting, erythrocyte and platelet pathology. We showed that such protein may be measured, and its formation tracked, using our state-of-the-art microscopy techniques and that bacterial inflammagens drive this misfolding. What started with novel data concerning the impact of clotting during inflammatory conditions, has led to the identification of trapped inflammatory molecules within plasma protein aggregates that we have termed fibrin amyloid 'microclots'. This resulted in scientists recognising that the extent of the presence of microclots, and their trapped inflammatory molecules, is a key influencer in Long COVID pathology. SU has patented and licensed the method for diagnosing Long COVID; the start-up company Biocode has exclusive rights to the sub-license. The methods have been replicated in other labs. A lab in Germany has been given rights of use and we're in discussion with a lab in the USA. Two clinical trials in the UK and two in the USA, for treatment of vascular pathology and microclots, will be initiated and will include the research methods for detecting microclots.

This work received extensive media coverage in the South African and international media, including the *Wall Street Journal*, *UK Times* and *The Guardian*. Their findings have also been discussed in the US Government Accountability Office document and publications such as *Science*, *Nature* and *New Scientist*.

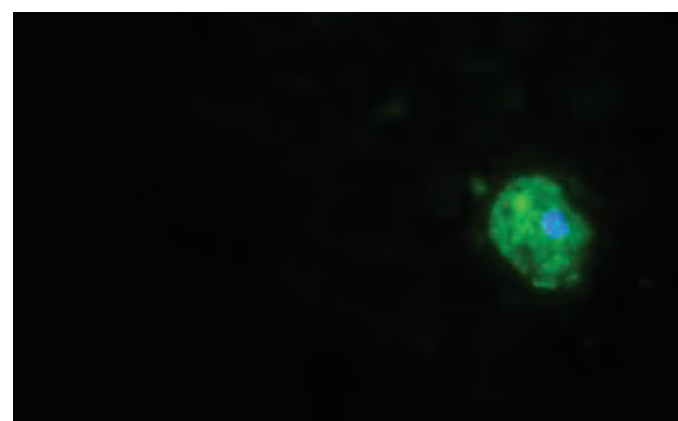
Research Activities

Two postdoctoral fellows in **Prof Anna-Mart Engelbrecht's** group, Dr Manisha du Plessis and Dr Carla Fourie, were invited to Charles University in Prague, Czech Republic, to receive training to isolate circulating tumour cells (CTCs) from the blood of cancer patients. This enabled them to carry out their post-doctoral research project for which they have received ethical approval to isolate CTCs from gynaecological cancer patients, to evaluate the efficacy of chemotherapy regimes in primary biopsy cultures of patients and genetic testing on circulating tumour cells to develop a testing protocol that can inform clinicians of the optimal treatment for individual patients.

Prof Engelbrecht and three postdoctoral fellows Drs Niel Olivier, Carla Fourie and Manisha du Plessis) also presented their research at the European Association for Cancer Research (EACR 2022) Conference with the theme "Translating Biology to Medicine" in Spain from 20-23 June 2022. Dr Olivier received a MITACS grant to work for three months at the University of Manitoba in Canada to receive bioinformatics training. His hosts were Prof Britt Drögemöller, Department of Biochemistry and Medical Genetics, and Prof Galen Wright, Department of Pharmacology and Therapeutics.



Dr Carla Fourie at Charles University in Prague, Czech Republic, where she received training to isolate circulating tumour cells (CTCs) from the blood of cancer patients.



Cancer cells were isolated from liquid biopsies by means of size-based separation. Cell fluorescence (CellTracker) represents cytoplasm and blue (NucBlue) represents the nucleus. Cancer cells are distinguished by size and nucleus-cytoplasm ratio.

Dr Danzil Joseph's cardiometabolic research group started a new research project exploring the interplay between hyperglycaemia (in the diabetes setting) and exposure to variants of SARS-CoV-2 spike proteins. The project investigates the resultant metabolic and molecular changes to understand the underlying mechanisms that link diabetes, specifically hyperglycaemia, as important contributory factor to severe outcomes associated with COVID-19. The project is funded by the South African Medical Research Council (SAMRC). BScHons student Andrea Laubscher and MSc student Tara Michaels worked on the project. Dr Joseph established collaborations with Prof Faadiel Essop in the Division of Medical Physiology at the Faculty of Medicine and Health Sciences, and from within the department with Drs Balindiwe Sishi, Theo Nell and Sanjeev Rambharose.

Prof Kathryn Myburgh's research continues to focus on adult skeletal muscle stem cells, called satellite cells. A scarce technique and research tool in the group is to isolated satellite cells from muscle biopsy samples and to grow them in culture *in vitro*. These are termed primary human myoblasts (PHMs). Based on his expertise in genetically altering PHMs, PhD-student Rhys McColl was invited to speak at the Society for Advanced Cell Culture Models' conference that took place in Potchefstroom. Through his research he was able to prove that the Kirrel protein is required for myoblast fusion, but that overexpression actually reduces fusion. This may be ascribed to a phenomenon called molecular crowding, which inhibits the protein's interactions with binding partners at the molecular level.

The new focus area is nano-sized extracellular vesicles released by skeletal muscle and the cargo that they carry. Prof Myburgh's MSc students presented at the Physiology Society of Southern Africa (PSSA) conference held in Stellenbosch in September 2022. Kyle Hagemann presented findings on the effect of C2C12 myoblast cell confluence on exosome production *in vitro* which has implications for biotechnology and upscaling of exosome production *in vitro*. Both students also presented this work at the first SU Faculty of Science Postgraduate Conference held in November 2022. MSc students Maia Rawlins and Kyle Hagemann also presented at the conference. Maia's presentation covered the pre-mobilisation of neutrophils from acute exercise-induced muscle damage and the potential implications for short-term vaccination responses, satellite cell dynamics and skeletal muscle recovery. This work was particularly relevant to the Covid-19 vaccination rollout, exploring the effects of exercise and vaccination on neutrophil responses and skeletal muscle recovery.

Prof Myburgh serves on the editorial board of the *Journal of Muscle Research and Cell Motility*. She served as reviewer for the National Research Foundation Standing Panel for Natural and Life Sciences and refereed two NRF re-rating applications in the biomedical sciences field. She maintains active collaboration with several researchers: Prof Carola U Niesler at the University of KwaZulu-Natal; Prof Dirk Lund Christensen at the University of Copenhagen, Denmark; Ass Prof Filippo Macaluso and colleagues at the University of Palermo in Italy; Prof Ivan Vechetti at the University of Nebraska in the USA; Dr Naomi Brooks at Stirling University, Scotland. In 2022, virtual meetings of the Fellows of the newly established Academy of the International Union of Physiological Societies took place. Prof Myburgh put forward an agenda suitable for Africa, recommending the establishment of a task team to create digital physiology apps specifically for cell phones.

Prof E Pretorius presented at a range of conferences during 2022. In September she was an invited speaker at RECOVER R3: Clinical Spectrum of PASC – Focus on Coagulopathies with a presentation titled "Clotting and platelet pathology in Long COVID". In July she was an invited speaker at the Global Virus Network: Science of Long

COVID meeting, with a presentation titled "Microclots in Long COVID". During July she was invited to present on the same topic at the Long COVID collaborator meeting Oxford 2022/Oxford ME/CFS; at the Dysautonomia International tenth annual conference; and ISTH in London. In May she was an invited speaker at the PainSA Congress in Cape Town with presentation title "The role of microclots in Long COVID"; and in March at the second Lorenz Workshop at the University of Leiden with a presentation on iron biology and its role in neuroinflammation and the role of iron/ inflammation in a clinical context. In May, she delivered a keynote presentation at the University of North Carolina's (UNC) Long COVID Symposium: Recovery and Rehabilitation using a Multidisciplinary Approach with the title "Clotting and platelet pathophysiology in Long COVID/PASC". In February she was an invited speaker at the Physiological Society of the United Kingdom's conference on Long COVID: Mechanisms, Risk Factors and Recovery with a presentation titled "Insights into clotting and platelet pathophysiology in Long COVID/PASC".

Dr Sanjeev Rambharose was a member of the local organising committee for the congress of the Physiological Society of Southern Africa (PSSA), hosted by Stellenbosch University from 4 to 7 September 2022 where he also presented a poster, titled "Antidiabetic effects of Psidium x durbanensis Baijnath & Ramcharun ined. (*Myrtaceae*) leaf extract on streptozotocin-induced diabetes in rats". He also reviewed grants for the National Research Foundation (NRF) and serves as a reviewer on several pharmaceuticals and drug delivery journals. Dr Rambharose maintains active collaboration with several researchers at the University of Cape Town, University of KwaZulu Natal, the University of Texas at El Paso, United States Naval Medical Research Unit San Antonio, United States Department of Defence and the United States International University-Africa, Nairobi, Kenya.



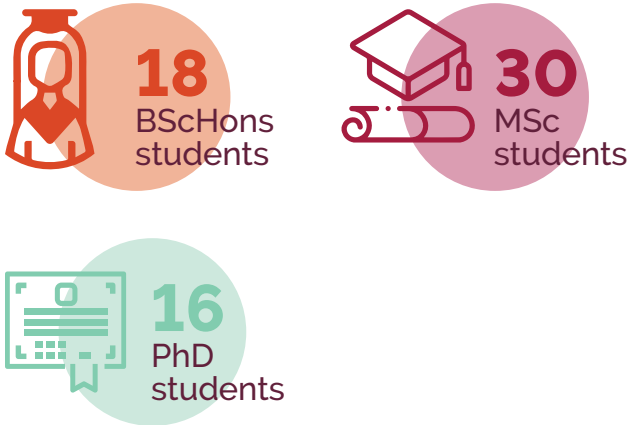
The main research focus of our group is currently to develop **testing protocols for cancer patients** utilising a personalised medicine approach.

Academic Affairs

Prof Anna-Mart Engelbrecht was asked to do an opinion piece for News24 on World Cancer Day with the title "Do the 'powerhouses' of cancer cells hold some keys to personalised cancer treatment?" All members of her research group attended the Carnegie African Diaspora Fellowship Program workshop on Precision Medicine as well as the Beckman Coulter Life Sciences Oncology Flow cytometry workshop.

Dr Danzil Joseph presented a poster at the annual congress of the Physiological Society of Southern Africa (PSSA) in collaboration with Dr Sanjeev Rambharose titled "Teaching physiology during the COVID-19 pandemic: reflections of newly appointed lecturers". The work was also presented at the Stellenbosch University Scholarship of Teaching and Learning (SoTL) conference. Dr Joseph was the module coordinator for Physiology 114 and 144. He was the study leader of one BSc Hons graduate (*cum laude*) and co-supervisor to one MSc graduate (*cum laude*). **Prof KH Myburgh** was the study leader of seven PhD, MSc and Hons graduates, one of whom graduated *cum laude*.

Postgraduate student cohort



Staff Matters

Prof Ben Loos held his inaugural lecture, titled "On the role of autophagy and cell death control in neurodegeneration and glioma".



Awards to Staff and Students

Our postgraduate students walked away with several awards during the Physiology Society of Southern Africa (PSSA) conference: **Tara Michaels**, MSc student in the cardiometabolic research group, won the second prize in the Johnny van der Walt poster competition; **Logan Smith**, MSc student with the Centre for Cardiometabolic Research in Africa (CARMA), won a prize for Most Innovative Method and first prize in the Wyndham Oral competition; **Sinnead Cogill**, MSc student in the neuro research group, was awarded third place in the prestigious Wyndham competition, as well as the Best Method award. She has been implementing quantitative EDX analysis, which she developed to full implementation, as well as associated molecular techniques in her studies.

Nicola Heathcote received the Zeiss prize for the best micrograph as well as the Scientific Group award for best confocal microscopy presentation during the Microscopy Society of Southern Africa (MSSA) conference. **Sholto de Wet** received the MITACS exchange opportunity and spent three months in the Angus McQuibban lab at Toronto University, learning to dissect brains of *Drosophila*.

Dr Manisha du Plessis from the cancer research group was awarded a travel grant by the European Association for Cancer Research (EACR) to attend the 28th annual EACR congress: Translating biology to medicine (Sevilla, Spain, 20 – 23 June 2022) as well as a DRD travel grant from the Division for Research Development at SUto travel to Charles University, Prague, Czech Republic, to receive training on the isolation of circulating tumour cells from the whole blood of cancer patients from 19 – 21 September 2022.

Tracey Ollewagen, who graduated with her PhD in 2022 under co-supervision of Prof Myburgh, won first prize for a Young Scientist in Basic Pharmacology in 2022 at the South African Society for Basic and Clinical Pharmacology 2022 Conference.

Department of Physiological Sciences celebrates centenary

The Department of Physiological Sciences celebrated their centenary in 2022, ending the celebrations with a formal prize giving function.



Social Impact

Drs Danzil Joseph, Balindiwe Sishi, Theo Nell, Sanjeev Rambharose, Miss Veronique Human and postgraduate students from the department were involved in the fourth annual SU Life Science Outreach Initiative. The initiative is managed in partnership with Life Science teachers from local schools. Practical sessions involved experiments where learners make use of household items to explore various concepts in their Life Science curriculum. COVID-19 and resultant restrictions limited in-person facilitation of the practical sessions in 2021 and the first half of 2022. The programme continued successfully through provision of practical material and resources in the form of individually packaged kits to the school (prepared by the staff members and students involved). The teacher facilitated the sessions and assessments. This approach enabled the successful completion of the required practical programme and provided valuable lessons for the long-term sustainability and growth of the initiative. The initiative featured in the 2021/2022 *Social Impact at Stellenbosch University* report.

Collaboration

Africa

United States International University-Africa, Kenya

Austria

Vienna University

Denmark

University of Copenhagen

Germany

Max-Planck-Zentrum für Physik und Medizin

Israel

EDS/Chiari Center at Mount Sinai South Nassau Hospital

Icahn School of Medicine at Mt Sinai

Mt Sinai Health System

New Zealand

University of Auckland

Scotland

Stirling University

South Africa

Stellenbosch University, Faculty of Medicine and Health Sciences

University of Cape Town

University of KwaZulu-Natal

Thailand

Chulalongkorn University

Faculty of Medicine, King Chulalongkorn Memorial Hospital

United Kingdom

Francis Crick Institute

University College London (UCL)

University College London Hospitals (UCLH)

University of Manchester

United States of America

NYU Grossman School of Medicine

PolyBio Research Foundation

The University of Texas at El Paso

United States Department of Defence

United States Naval Medical Research Unit San Antonio

University of Kansas Medical Center

University of Nebraska

Funding

Cancer Association of South Africa
Carnegie Fellowship, USA
Department of Science and Innovation
Medical Research Council
National Research Foundation
Royal Society, United Kingdom
SA Rooibos Council

Stellenbosch University Faculty of Science
Stellenbosch University Subcommittee B
Steno Institute, Denmark
Technology Innovation Agency (TIA)
University Technology Fund (UTF) grant
Water Research Commission

NRF-rated Researchers

Internationally acclaimed researchers	
Prof ME Essop	Cardiometabolic research
Prof K Myburgh	Biomedical sciences
Prof E Pretorius	Inflammatory blood biomarkers and blood coagulation
Established researchers	
Prof Ben Loos (C-1)	Autophagy and cell death
Promising Young Researchers	
Dr Sanjeev Rambharose	Health Sciences; Biological sciences; Bio-nanotechnology

Staff List

Academic

Dr C de Villiers
Prof A-M Engelbrecht
Dr D Joseph
Prof B Loos
Prof KH Myburgh
Dr T Nell
Prof E Pretorius (Departmental Head)
Dr S Rambharose
Dr B Sishi

Extraordinary Professors

Prof Angus Dalgleish (St George University, London)
Prof DB Kell
Prof I Laher (University of British Columbia)
Prof Zara Zakeri (Queens College, New York)

Research Fellows

Dr Graham Ellis
Dr Johann Riedemann
Dr Paula Ansley

Support Staff

Ms J Farao
Ms V Human
Mr J Isaacs
Dr A Krygsman
Mrs G Simon
Dr C Venter

Postdoctoral Fellows

Dr Manisha du Plessis
Dr Carla Fourie
Dr Niel Olivier
Dr E Teer



Photo: Stefan Els

Contact Details

Tel: 021 808 3391
Fax: 021 808 3385

E-mail: physqueries@sun.ac.za
Web: www.sun.ac.za/physics

Centre for Bioinformatics and Computational Biology

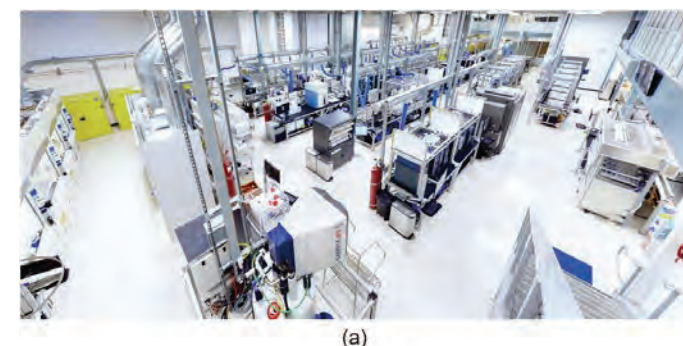
Research Interests

Epigenomics, synthetic biology and bioinformatics; Infectious diseases, biostatistics and bioinformatics; Viral genetics and bioinformatics; Pathogen genomics and bioinformatics; Systems biology and bioinformatics; Wine biotechnology and bioinformatics; Microbial biotechnology and bioinformatics; Population genetics and bioinformatics; Infectious diseases, biotechnology and bioinformatics; Human genomics and bioinformatics.

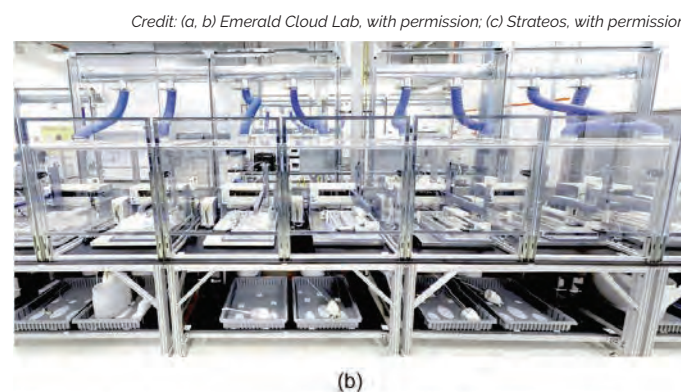
Research Highlights

Bioautomation challenge award

Dr H Volschenk received the 2022 Bioautomation Challenge award. The award offers life science researchers access to the in order to improve the reproducibility of life science research and gather large datasets, especially for groups focused on protein engineering. Dr Volschenk was one of nine groups that were selected, including groups spanning seven universities and three continents. The award includes receiving training, cloud lab development time, a reagent budget, and transition funding.



(a)



(b)

(a) Some of the more than 200 kinds of instruments in Emerald Cloud Lab's facility in South San Francisco, CA, USA.

(b) A row of automated devices in the Emerald Cloud Lab.

Credit: (a, b) Emerald Cloud Lab, with permission; (c) Strateos, with permission



(c)

(c) A view of the San Diego, CA, USA, cloud lab facility operated by Strateos. Human workers still perform some essential jobs, such as delivering samples to the instruments, but they are spared from tedious repetitive tasks like pipetting.

Wastewater surveillance programme to track spread of SARS-CoV-2 variants

In collaboration with the South African Medical Research Council (SMRC), **Dr C Viljoen**, **Prof C Kinnear** and **Prof M Möller** were part of the wastewater surveillance programme. This programme was critical in tracking the spread of SARS-CoV-2 variants of concern in various communities around South Africa. This programme tracks the levels of SARS-CoV-2 RNA in 80 wastewater treatment plants around South Africa and sequences samples from each of these sites on a monthly basis to track the spread of known variants of concern and to identify possible new variants of concern. Their whole genome sequencing confirmed presence of Omicron lineage defining mutations in wastewater with the first occurrence reported 23 November 2021 (BA.1 predominant). The variant spread rapidly, with prevalence of Omicron-positive wastewater samples rising to >80% by 10 January 2022 with BA.2 as the predominant sublineage by 10 March 2022, whilst on 18 April 2022 BA.4 and BA.5 were detected in selected wastewater sites. These findings demonstrate the value of wastewater-based epidemiology to monitor the spatiotemporal spread and potential origin of new Omicron sublineages.

Research Activities

Prof HG Patterson continued with work on bioinformatics of epigenomics as well as the development of neural network approaches to the "inverse protein folding" problem, where the sequence of a protein is predicted from the 3-dimensional structure of the protein. This has important applications in synthetic biology and biotechnology. Three papers were published during 2022 in *PlosOne*, *Nucleic Acids Research*, and *Frontiers in Microbiology*.

Prof GC Tromp continued to support several research scientists in their projects. He contributed to some ten publications. He is involved with several large international consortia doing tuberculosis research and for one of these is processing RNAseq data from approximately 2,700 whole-blood specimens for subsequent modelling to predict relapse in tuberculosis. Data processing is expected to be complete at the end of the year. Prof Tromp also continued bioinformatic education and training activities with students in CBCB as well as in other academic divisions. He was integral to the CBCB's teaching activities.

Prof JT Burger continued with the Chenin Blanc 'clone' project. Over the last 370 years, the white wine varietal, Chenin Blanc, have been propagated independently in France and in South Africa, giving rise to many French and South African Chenin clones, some of which are believed to be well adapted for certain terroirs and even linked to particular flavour Profiles in the wines produced from them. Ironically, the term clone is a contradiction since strictly it implies genetic identity. This project aims to investigate the intra-varietal genetic variation among and between French and South African Chenin Blanc clones. This is a collaboration between the AGAP Institute (Genetic Improvement and Adaptation of Mediterranean and Tropical Plants), the Joint Technological Unit UMT Geno-Vigne in France and Stellenbosch University. Results from the initial phase of the project were presented at the second Chenin Blanc International Congress, held in Stellenbosch in November 2022. Research was also published in inter alia the journals *Viruses* and *Virus Genes*.

Prof T. de Oliveira and his research group at the Centre for Epidemic Response and Innovation (CERI) have a track record in being able to deliver on the use of genomics surveillance for the fight against epidemics and pandemics. For example, during 2022, Prof De Oliveira's team published a *Nature* manuscript that detected, validated and informed the world of the Omicron variant. The quick identification became a global example of trust and transparency with large societal and political impact. His team published a number of other high impact manuscripts in *Nature*, *Science*, *Nature Medicine* and *the Lancet*.



Example of some of the high-impact publications of Prof T de Oliveira's research program in 2022.

Prof JM Rohwer is a member of the international STRENDa (Standards for Reporting Enzymology Data) Commission. He currently serves as associate editor for *BMC Bioinformatics* and *Biochemical Society Transactions*. He serves on the editorial advisory board of *In silico Plants*, a new online journal specialising in plant systems biology, and is statistics editor of the *Journal of Experimental Botany*. Prof Rohwer delivered an oral presentation at the online conference of the SA Society of Biochemistry and Molecular Biology (SASBMB2022) on tools for making enzymology data FAIR (Findable, Accessible, Interoperable and Reusable). He also delivered an oral presentation at the Third EnzymeML Workshop, held in October 2022 in Rüdeshheim, Germany, where he presented his work on EnzymeML, a standardised markup language for enzymology data.

Prof JL Snoep and **Dr Dawie van Niekerk**'s core research efforts are in Computational Systems Biology, a combined experimental, modelling and theoretical approach to quantitatively understand the functional behavior of Biological Systems resulting from the characteristics of their components. Their main focus is on metabolism of human pathogens, such as *Plasmodium falciparum*, *Mycobacterium tuberculosis*, and on modelling disease states such as glucose metabolism in cancer cells, type 2 diabetes and HIV pathogenesis at a whole-body level. They are active in software development for model simulations and integration of data and models in the JWS Online initiative, a model and simulation database for running simulations in your web browser that has been up and running since 2003. In 2022 they published two papers with a focus on Bioinformatics and Computational analyses, in high impact journals *Nucleic acids research* and *Current Opinion in Biotechnology*. Six honours students, four MSc and two PhD students graduated in the group during 2022.

Prof FF Bauer collaborated with the CBCB on several projects. This includes the analysis of metagenomic, genomic and transcriptomic data sets. One paper which required input from CBCB in terms of data management and analysis was published in 2022 in the journal *mSphere*, and another bioinformatic-relevant paper in the *Journal of Fungi*. Currently, one PhD student (Mr Justin Asmus) and one MSc student (Ms Jneya Reddy) are co-supervised by Profs Patterton and Bauer. Mr Asmus focuses on transcriptome analysis of interacting yeast species, and Ms Reddy on yeast genome annotations.

Dr H Volschenk published a paper in *Microbiology Resource Announcements*.

The objective of **Prof S Sampson**'s Host-Pathogen Mycobactomics (HPM) research group is to advance understanding of how the pathogen *Mycobacterium tuberculosis* interacts with its host to cause disease. To achieve this, they use molecular mycobacteriology and infection models together with data-rich methodologies such as whole genome sequencing, transcriptomics, and proteomics. These methods are underpinned by

computational approaches. Through a recent NIH D71 award, they are contributing to capacity development in TB bioinformatics. In 2022, the group published six peer-reviewed articles, including one titled "Dynamic mathematical model development and validation of in vitro *Mycobacterium smegmatis* growth under nutrient- and pH-stress", by Apiyo *et al* in the *Journal of Theoretical Biology*. In this, in collaboration with members of Process Engineering at SU, they exploited an *in vitro* stress model to develop a dynamic mathematical model to predict the response of *M. smegmatis* grown in batch culture and subjected to *in vitro* environmental stresses, including acid stress, as experienced inside host macrophages. Two MSc and one PhD student graduated.

Prof G van der Spuy and Dr E Maasdorp undertook the successful implementation of a completely revised biostatistics module in the MBHG honours course. He also expanded his collaborations to include colleagues in the Mycobacterial genetics research group. He was involved in seven papers, three of which were published in *Frontiers in Immunology*, *Genome Biology* and *PLoS One*.

Dr C Viljoen, Prof C Kinnear and **Prof M Möller** investigate the impact of host genetics on susceptibility and resistance to the development of both TB infection and disease. The group expanded its niche to include host genetic susceptibility to Coronavirus disease 2019 (COVID-19), human population genetics, some animal genetics work and rare diseases (including Primary Immunodeficiency Disorders) as well as functional studies with a special focus on autophagy. The five key research themes are: Genetic susceptibility to TB, Population Genetics, Primary Immunodeficiency Disorders (PIDD), Autophagy and Genetic susceptibility to COVID-19. In total, the team contributed to 12 manuscripts during 2022, published in *Pathogens*, *Frontiers in Neurology*, *PLoS One* and *Scientific Reports*. Three BSc Hons students (Natalie Alexander, Chené Kitchin and Shannon Arendse), three MSc (Nicole Brown, Carene Ndong Sima and Brandon Paarwater) and five PhD students (Naomi Okugbeni, Elouise Kroon, Yolandi Swart, Anél Sparks and Gerald van Eeden) graduated. Dr Haiko Schurz won the Top 20 Postdoctoral Research Fellow Award for Exceptional Achievement from Stellenbosch University.



Dr H Volschenk received the **2022 Bioautomation Challenge award** that offers life science researchers access to **improve the reproducibility of life science research and gather large datasets, especially for groups focused on protein engineering.**

Dr E Maasdorp is a clinician and member of the South African Tuberculosis Bioinformatics Initiative which aims to both investigate immune mechanisms involved in progression to tuberculosis and response to treatment, as well as discover biomarkers for diagnosis or treatment response, from omics datasets. She is part of the bioinformatics teams of two international consortia, Immune Mechanisms of Protection against *Mycobacterium tuberculosis* (IMPac-TB) and Predict-TB (A biomarker-driven treatment shortening clinical trial), which investigate the whole spectrum of tuberculosis, from early disease to treatment failure. IMPac-TB aims to unravel immune processes in mice, non-human primates and humans, early after *Mycobacterium tuberculosis* infection, leading to either pathogen control by the host, or progression to disease. These processes can ultimately inform vaccine development and host-directed therapies. Dr Maasdorp contributed to the publication of the protocol for the early disease human study which is ongoing and will recruit more than 200 participants to undergo broncho-alveolar lavage and PET-CT scans to classify them into distinct risk and disease groups, and to generate several sequencing and high-throughput flow cytometry datasets. The Predict-TB trial will generate RNA-sequencing data which the bioinformatics teams will analyse for biomarker discovery as well as to understand the mechanisms of treatment failure.

Academic Affairs

Number of graduates 2022



20
BScHons
students
(7 with distinctions)



3
MSc
students
(2 with distinctions)

Staff Matters

Prof GD van der Spuy was promoted to the academic rank of full Professor. **Dr Caitlin Uren** was appointed as a lecturer in the Faculty of Medicine and Health Sciences. **Dr Elizna Maasdorp** was jointly appointed as senior lecturer in the Faculty of Medicine and Health Sciences and the School for Data Science and Computational Thinking.



Photo: Stefan Els

Funding

Global

Beilstein Institut (Germany)
Bill and Melinda Gates Foundation
Distributed Platform in OMICS (DIPLOMICS)
European Union (EU) Commission / EDCTP (Horizon 2020)
H3ABioNet
National Institutes of Health (NIH)
South African Medical Research Council (SAMRC/GSK-Novartis)

South Africa

NRF Competitive Programme for Rated Researchers (CPRR)
NRF/DSI funding for SARCHI project "Mechanistic modelling of health and epidemiology"
Stellenbosch University Faculty of Science
Stellenbosch University Subcommittee B
Winetech

NRF-rated Researchers

Internationally acclaimed researchers	
Prof Jacky Snoep	Computational Systems Biology
Prof Johann Rohwer	Computational Systems Biology
Prof FF Bauer	Integrated Wine Sciences
Prof S Sampson	Biomedical Sciences
C-rating	
Prof Craig Kinnear	C1 rating
Prof Marlo Möller	C3 rating
Y rating	
Dr Caitlin Uren	Y rating

Staff List

Academic

Prof H-G Patterson

Support staff

Ms O van Wyk

Members & Associate Members

Prof GC Tromp
Prof JT Burger
Prof JM Rohwer
Prof T de Oliveira

Prof JL Snoep
Prof FF Bauer
Dr H Volschenk
Dr C Viljoen
Prof MA Vivier
Prof S Sampson
Prof C Kinnear
Prof G van der Spuy
Prof M Möller
Dr E Maasdorp



Photo: Kenneth Mulindwa

Contact Details

Tel: 021 808 9514

E-mail: oliviavw@sun.ac.za (Admin Officer)

Web: www.sun.ac.za/sci-bioinformatics

CONTACT US

Physical address:

Al Perold Building
Second Floor
Campus, Stellenbosch University
Between Langenhoven Student Centre and JS Gericke Library

Postal address:

Science Faculty
Private Bag X1
Matieland
7602, South Africa

Faculty related enquiries:

General Enquiries

Ms Suzette Els

Dean's Secretary

Tel +27 21 808 3072

Academic Enquiries

Ms Aatika Valentyn

+27 21 808 3931

Registration Enquiries

Ms Shivvon Ruiters

+27 21 808 9111

Media Enquiries

Ms Wiida Basson

+27 21 808 2684

Website:

<http://www.sun.ac.za/english/faculty/science/>

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