



Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Science
EyeNzululwazi ngezeNdalo
Natuurwetenskappe

ANNUAL REPORT | 2023

VALUE STATEMENT

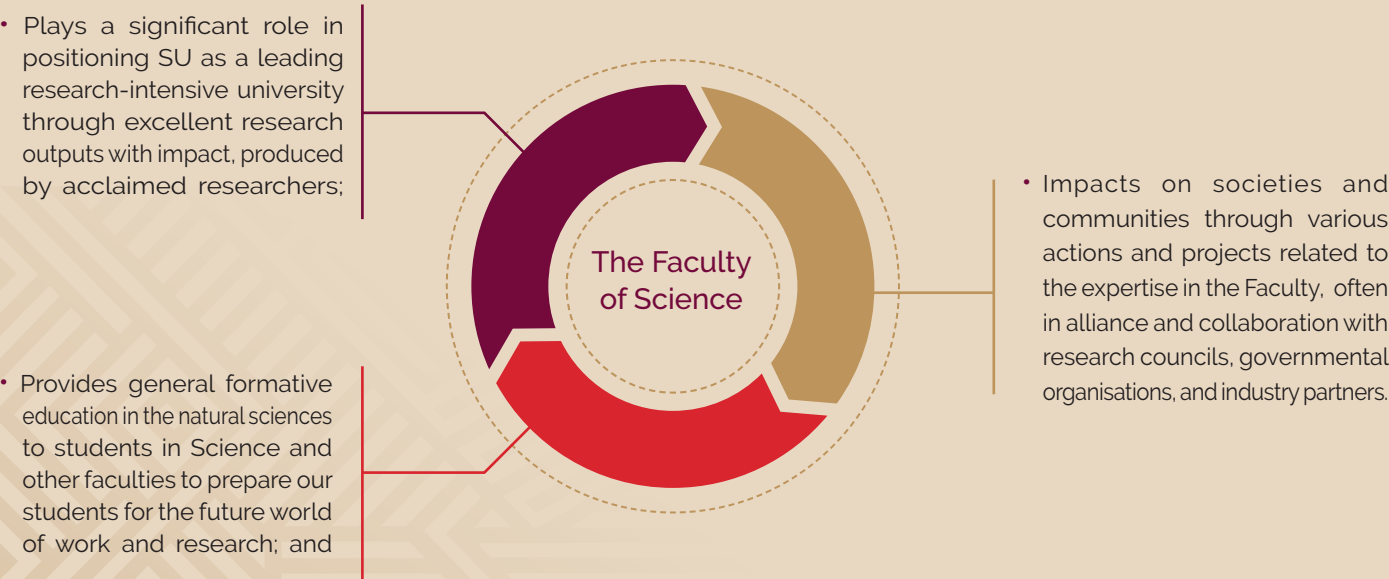


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FROM THE DEAN'S OFFICE



This past year has again been an eventful and fruitful period, thanks to the dedication and hard work of staff and students, and I am happy to report on some of the highlights.

It was a remarkable year in that all five promotions to full professors in 2023 were women scientists. Overall, the number of female academics has increased from 20% in 2015 to 41% in 2023, including the first Black and Coloured female professors. In the fields of microbiology, astronomy, and astrophysics we succeeded in making a number of strategic appointments. Prof. Thulani Makhalanyane joined the Department of Microbiology, and Prof. Yin-Zhe Ma joined the Department of Physics to establish a research group in astronomy and astrophysics.

At the same time, we continue to support and grow the next generation of senior academics. Three of our young and upcoming scientists were selected to participate in the Futures Professor Programme: Dr Sanjeev Rambharose, Dr Tawanda Zininga and Prof. Nox Makunga. We are also glad to announce that Prof. Guy Midgley maintained his A-rating from the National Research Foundation.

Prof. Eugene Cloete, a former dean of the Faculty of Science and later Vice-Rector: Research, Innovation and Postgraduate Studies, continued with a proud tradition in the Department of Microbiology when he was awarded a DSc in Microbiology at the December 2023 graduation ceremony.

Research and innovation

On the research and innovation front, dedicated and creative staff and students continued to produce excellent research results. In 2023, the African Rainbow Minerals (ARM) research chair in geomaterials was officially launched and is shared between Dr Bjorn von der Heyden from Earth Sciences and Dr Margret Thadie from Engineering.

Several of our researchers published in flagship SCI journals: Prof. Cang Hui co-authored two articles in *Nature* on assessing the global forest carbon potential and the impact of non-native trees in natural forests. Prof. Len Barbour, Prof. Catharine Esterhuysen, and PhD student Alan Eaby have been the first to show that water can be desorbed from

a porous material at temperatures as low as -70 degrees Celsius. This work was also published in *Nature*.

Prof. Heinrich Volschenk and Prof. Wesaal Kahn received funding from the National Research Foundation's National Equipment Programme to establish a biofoundry system in the Department of Microbiology. This will be a first for South Africa and Africa. Having access to such a high-throughput capacity will allow our researchers to rapidly pivot and respond to new challenges as they emerge.

There is a growing culture of innovation and entrepreneurship in the faculty. This year saw the establishment of another spinout company, Scientia Products, founded by an interdisciplinary group of scientists from chemistry, botany, and physiological sciences – they are Prof. Nokwanda Makunga, Prof. André de Villiers, Prof. Willem van Otterlo, Dr Catherine Kaschula and Prof. Anna-Mart Engelbrecht. Since 2018, the faculty has produced a total of eight spinout companies. At the annual Von Seidels Innovus Award ceremony, we received awards for the most Invention Disclosures, the most Granted Patents and the most Spinout Companies for 2023. At the same event, Prof. Anna-Mart Engelbrecht received the Researchpreneur award, while Prof. Leon Dicks was awarded the Research Innovator Award. Dr Sara Andreotti received a special award for her spinout company, SharkSafe Barrier (Pty) Ltd. Special mention must be made here of the first commercial installation of the eco-friendly shark barrier technology (SharkSafe Barrier™) at an island in the Bahamas. It was developed at SU and manufactured in the Western Cape.

Prof. Frikkie Scholtz, Vice-Dean of Research, organised the second SU Faculty of Science Postgraduate Research Conference, providing a platform for MSc and PhD students to present their research to a wider audience. This conference has now become a fixed event on the faculty's annual calendar. The year 2023 also delivered a record number of 190 BSc Honours graduates.

Awards

The pages of this annual report speak loudly of the achievements of our researchers and postgraduate students. Here I mention only a few: Dr Tawanda Zininga was awarded the Alexander von Humboldt Foundation's Georg Forster Research Fellowship for Experienced Researchers, while Dr Katherine de Villiers received the Simons Foundation Pivot Fellowship. Prof. Gideon Wolfaardt received the Havenga Prize in Life Sciences, awarded by the SA Akademie vir Wetenskap en Kuns, for original research in the natural sciences, while Prof. Dave Richardson is one of only 10 scientists from South African institutions on the Clarivate Global List of Highly Cited Researchers for 2023. Prof. Leon Dicks was awarded the Gold Medal of the South African Society for Microbiology, and Prof. Anton Pauw the South African Association of Botanists' Silver Medal. Prof. Kathy Myburgh became the second South African scientist to be recognised by the American College of Sport Medicine for her important contribution to exercise science. Please see our departmental reports for the many achievements of our postgraduate students on the national and international level.

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 (more than 50 talks since 2015), SU Open Day and a series of lectures on the science behind the Nobel Prizes in physics, chemistry, and the physiological sciences.

In April 2023, Dr Ronalda Benjamin successfully launched the Western Cape STEM MentHER program at SU with the goal of providing mentorship to top Grade 12 female learners from schools in the Western Cape.

Established in 2016, the faculty continues to build relationships with industry by means of the bi-annual meeting of our advisory board. Following the successful "Women in Mathematics" networking event in 2022, this year the Computer Science and Applied Mathematics Divisions

hosted a "Building AI and ML Expertise in Stellenbosch" networking lunch.

The Faculty of Science supported a second workshop focused on building science communication capacity in the Southern African Development Community (SADC) and Africa, in partnership with the Department of Science and Innovation, UNESCO and SADC.

Considering growing concern for student well-being and the NSFAS crisis, the faculty participated in SU's #MoveForFood and #BridgeTheGap initiatives. Thanks to generous donations from staff and students we handed over several supermarket trolleys packed with non-perishable food items and sanitary ware to the social workers. Earlier, Prof. Ben Loos participated in the Sanlam Cape Town Marathon and raised over R8,600 to support postgraduate students. Standing at R13 million, the Faculty's Catalyst Bursary Fund will soon be able to start paying out bursaries to deserving postgraduate students.

In conclusion

This report marks my final one as Dean of the Faculty of Science. Reflecting on the past decade, this period stands out as one of the highlights of my career, and I owe that to the wonderful people in this Faculty. I want to thank staff, students, and other stakeholders, for your commitment, support and hard work throughout this year and the past decade.

I will always be interested in the progress and success of this Faculty.

There are challenges in the Higher Education sector, but there are even more opportunities, and with the right mindset and approach this Faculty will continue to thrive and progress in the years to come.

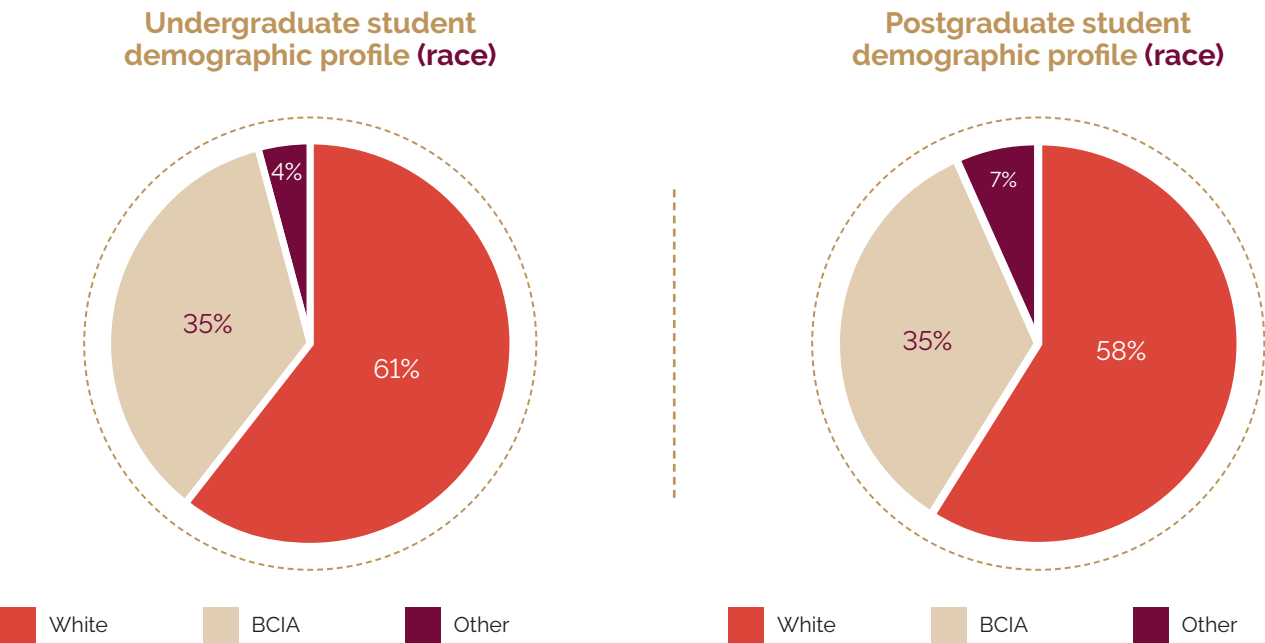
Prof. Louise Warnich
Dean: Faculty of Science

2023
AT A GLANCE

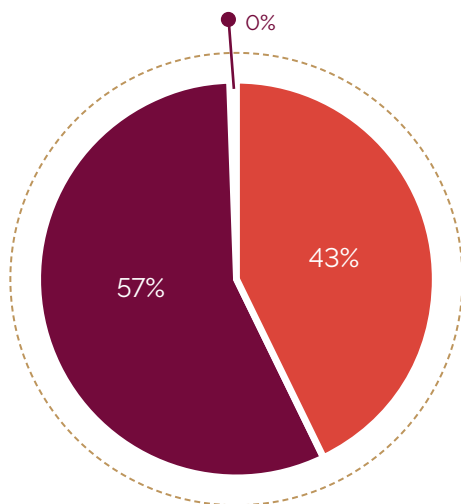
NRF-rated
scientists 2023



Student demographics

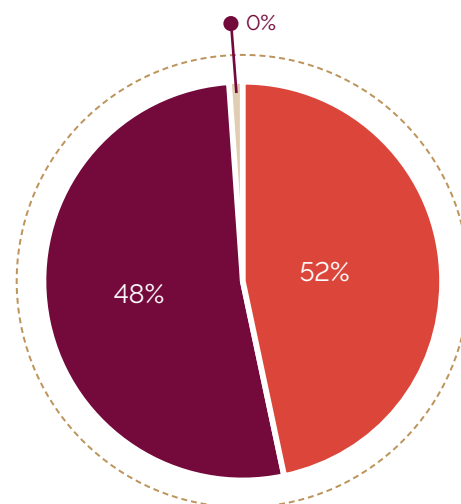


Undergraduate student demographic profile (gender)



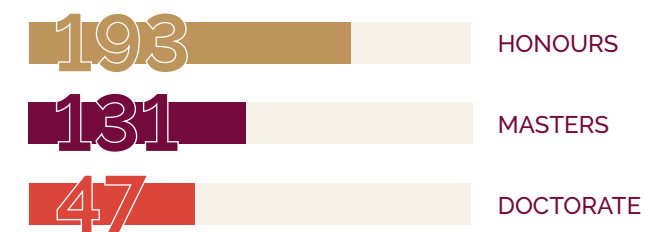
Male Female Nonbinary

Postgraduate student demographic profile (gender)

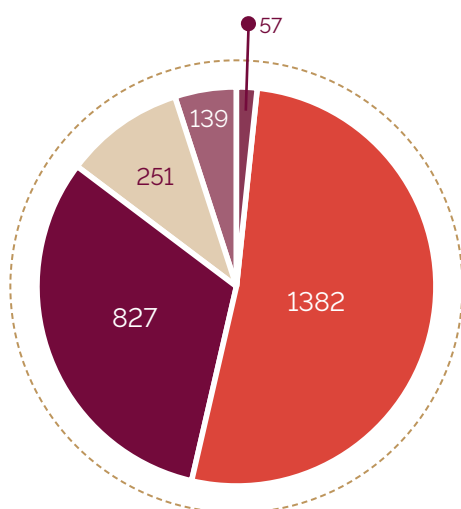


Male Female Nonbinary

Graduation of Honours, Masters' and Doctoral students 2023

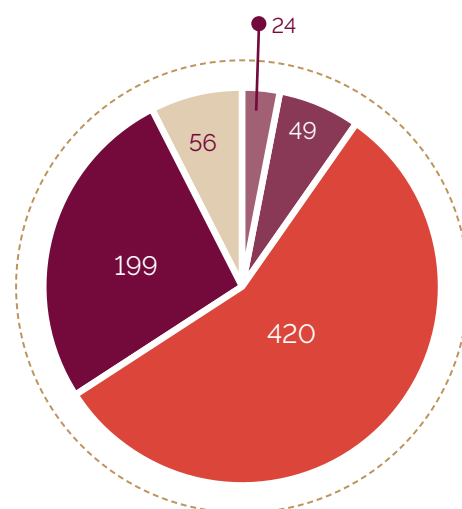


Undergraduate student demographic profile (home language)



English Afrikaans Other SA isiXhosa Other

Postgraduate student demographic profile (home language)



English Afrikaans Other SA isiXhosa Other

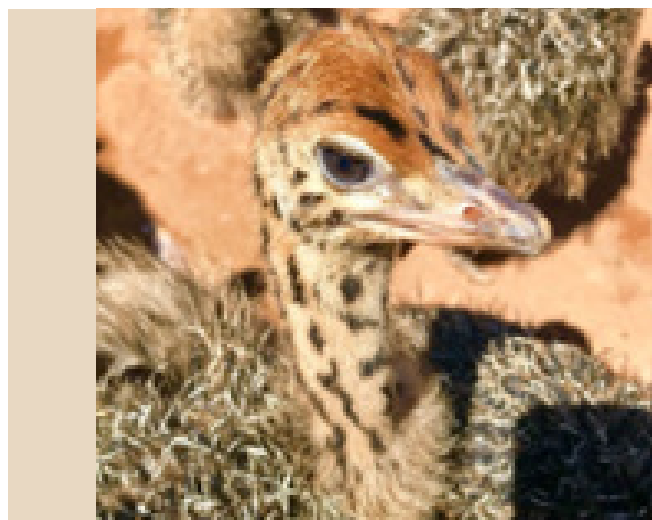


DEPARTMENTAL
REPORTS

DEPARTMENT OF BIOCHEMISTRY

RESEARCH INTERESTS

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



RESEARCH HIGHLIGHTS

Understanding the microbial gut communities of ostrich chicks

The first three months post hatch is a crucial time in the life of an ostrich chick. An increase in bacterial related gut infections, and subsequent mortalities, are experienced amongst this age group when raised within an intensive production system. The cause of these infections is not clear and could either

be related to the inadequate establishment of gut microbial communities, or diet formulations that do not sufficiently compensate for their hindgut fermentation capacity that is still in a developing phase. Dr Annelise Botes used metagenomic sequencing, a high throughput sequence technology, to provide a better understanding of the development of microbial communities in the gut of ostrich chicks, within the first three months post hatch. Results from this study allow for a better understanding of how microbial communities support structural gut development as well as hindgut fermentation capacity. In turn, these insights can be put to use to improve management and systems in ostrich chick production. Data generated in this study was submitted to the Sequence Read Archive (SRA), which is a publicly available repository of the National Center for Biotechnology Information (NCBI).

Nobel Symposium in Chemistry held at STIAS

Prof. Jacky Snoep was part of the local and scientific committees of the Nobel Symposium in Chemistry: Tuberculosis and Antibiotic Resistance – From Basic Drug Discovery to Clinic, and gave an oral presentation at the event held at STIAS, Stellenbosch, from 23 to 27 October 2023. This is the first time in 65 years that the Nobel Symposia series is organised outside Scandinavia.

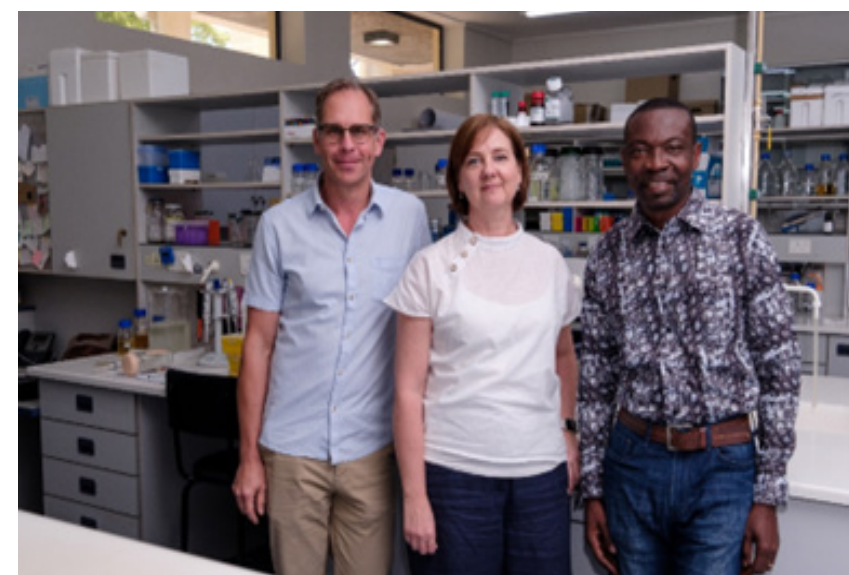
EnzymeML work published in Nature Methods

Prof. Johann Rohwer is part of an international consortium that was involved in the development of EnzymeML, a standardised markup language that contributes to seamless analysis and modelling of enzymatic data. A total of 23 authors across three continents contributed to this work, which was published in the prestigious journal *Nature Methods*.

Major boost in funding for drug development in fight against TB and malaria

The medical research charity LifeArc and the Bill & Melinda Gates Foundation made a US\$7.2 million joint investment in the Grand Challenges Africa Drug Discovery Accelerator (GC ADDA) programme to support a network of world-

class scientists across Africa to advance drug discovery against infectious diseases on the continent. GC ADDA will leverage US\$4.7 million (about R85 million) of the funding to develop new drugs in the fight against malaria and Tuberculosis (TB). Prof. Erick Strauss will be leading the GC ADDA-funded team focused on discovering new antituberculosis agents.



Erick Strauss (left) is one of the lead scientists, focusing on Tuberculosis, while Prof. Lyn-Marié Birkholtz from the University of Pretoria, and Dr Richard Amewu from the University of Ghana, lead the research focusing on malaria.

Photo: Stefan Els

RESEARCH ACTIVITIES

Prof. Donita Africander served on the editorial board of the *Journal for Ethnopharmacology*, as guest editor for *Frontiers in Immunology* and the *Journal of Steroid Biochemistry and Molecular Biology*, and is senior editor for the *Journal of Endocrinology and the Journal of Molecular Endocrinology*. 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 Pfeiffer from the Medical Research Council, Prof. Janet Hapgood from the University of Cape Town (UCT), Dr Michele Tomasicchio from UCT, Dr Pai Lin from Family Health International 360, Durham North Carolina, USA, and Dr Narender Kumar from the Population Council at Rockefeller University, New York City, USA.

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. 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 and 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 leads a research group focused on ostrich health issues that relate to production such as pathogen detection and epidemiology, immunity, microbiome analysis and antimicrobial resistance. She 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.

Prof. Marina Rautenbach leads the BIOPEP peptide group that turned 25 in 2022. They are currently focussing on creating peptide functionalised materials and nano-formulations with sterilising activity. Prof. Rautenbach delivered a plenary lecture on the BIOPEP group's research at the esteemed International Meeting on Antimicrobial Peptides (IMAP 2023) in Trieste, Italy, and a public lecture at the Swiss Federal Institute of Aquatic Science and Technology in Dübendorf, Switzerland. She serves on the editorial boards of *BBA Biomembranes* and the *Journal of Microbiological Methods* and is a review editor of *Frontiers in Chemistry* and *Frontiers in Microbiology*. She has active collaborations with colleagues in the Department of Microbiology, Prof. Leon Dicks, Prof. Wesaal Khan, and Prof. Alf Botha, in the search for new antibiotics from environmental samples. She also collaborates with Dr Tawanda Zininga from the Department of Biochemistry on antimalarial peptides interacting with heat-shock proteins. 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 various members of an European Union (EU) Horizon consortium on application of peptides in nanocellulose type materials, specifically to create broad spectrum sterilising cellulose-type materials. Further collaborations are on the biophysical aspects of peptide self-assembly with Prof. B. Bechinger at Strasbourg University in 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 Sanitouch SA for commercialisation of self-sterilising antimicrobial materials. She has also a partner in the Triple-A-Coat consortium project 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 relatively new online journal specialising in plant systems biology, and is statistics editor of the *Journal of Experimental Botany*. He also served as guest editor for a special issue of *Essays in Biochemistry*, focussing on computational biology.

Prof. Rohwer has active collaborations with a number of groups, both nationally and internationally: with Dr Che Pillay, University of KwaZulu-Natal, on the modelling of cellular redoxin networks; with Dr Egils Stalidzans, University of Latvia, Riga, on bioengineering of the MEP pathway in plants; with Prof. Jonathan Gershenzon, Max Planck Institute for Chemical Ecology, Jena, Germany, on flux and control analysis of isoprene synthesis in plants; with Dr Brett Olivier, Free University, Amsterdam, Netherlands, on the Python Simulator for Cellular Systems software; and with Profs Jürgen Pleiss and Nicole Radde, University of Stuttgart, Germany, on developing workflows and computational tools for reproducible enzyme kinetics. In the context of this collaboration, two doctoral students from the University of Stuttgart each spent three months in Prof. Rohwer's laboratory, and his doctoral student Kamogelo Matenchi paid a research visit and delivered a lecture on his work at the University of Stuttgart.

Prof. Rohwer delivered oral presentations at the Enzymology Symposium 2023 on future directions of the STRENDa initiative, and at the 4th EnzymeML Workshop on the kinetic analysis of enzymatic cascades with NMR spectroscopy. Both conferences were held in Germany.

Dr Naeem Sheik Abdul is a member of the Society of Toxicology. Dr Sheik Abdul actively collaborates with the group of Prof. J.L. 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. B. 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. B. Bakker from the University of Groningen (Netherlands); Prof. C. Goble from the University of Manchester (UK); Prof. H.V. Westerhoff and Dr Evelina Tutucci from the Vrije Universiteit Amsterdam (Netherlands); Prof. Mattias Goksör and Dr Caroline Adiels from the University of Gothenburg (Sweden); Prof. Dr. Bettina Siebers from the University of Duisburg-Essen (Germany); and Prof. Alben Lederer (Leibniz-Institut für Polymerforschung Dresden, 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").

Prof. Snoep gave oral presentations at the Nobel Symposium in Chemistry: Tuberculosis and Antibiotic Resistance – From Basic Drug Discovery to Clinic, STIAS, Stellenbosch; at the Institute for Community Medicine, University Medicine Greifswald, Germany; for the Pázmány Péter Catholic University, Budapest, Hungary; and at the Modelling the Context of African Health 2023 conference.

Prof. Marietjie Stander is a member of the Chromatography Society of South Africa and of the Food Safety Forum of the Seafood Industry. She is a member of the South African Food Juice Association and OliveSA and was elected on the board of the South African Botanical Products Association. Prof. Stander has active collaborations within the Department of Biochemistry and is involved in the following collaborations: From Stellenbosch University, Profs N.P. Makunga, A.J. de Villiers, and M. Rautenbach; from the ARC, Prof. D. de Beer, and L. Joubert; from the University of Johannesburg, Prof. B.E. van Wyk. A NEP grant was awarded to Profs Makunga and Stander for the first Cyclic Select IMS system in the Southern Hemisphere.

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*. Prof. Storbeck also serves 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 with Prof. Donita Africander and Prof. Jacky Snoep within the department of Biochemistry. Nationally Prof. Storbeck has collaborations with Prof. Julia Goedecke (South African Medical Research Council) on steroid hormones and diabetes risk in the South African population, and Prof. Janet Hapgood (University of Cape Town) on the role of progestins in women's health. His international collaborators include Prof. Wiebke Arlt from the UKRI MRC Laboratory of Medical Science (UK) and Prof. Michael O'Reilly (Royal College of Surgeons in Ireland) on 11-oxygenated androgen in health and disease, as well as 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. Storbeck delivered invited talks on the role of 11-oxygenated androgens in health and disease at ENDO2023 (the annual meeting of the Endocrine Society) in Chicago, and the international Steroid Congress, which was held online. He was also invited to present his work on 11-oxygenated androgens at a symposium celebrating the 50th anniversary of the Institute for Biochemistry and Molecular Genetics at the University of Ljubljana, Slovenia. Prof. Storbeck was hosted by Prof. Wiebke Arlt at the UKRI MRC Laboratory of Medical Science (UK) during his sabbatical. He also presented invited lectures at the Royal College of Surgeons in Ireland and the University of Edinburgh.

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 in the 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, UK. His interest in the use of structural biology for advancing drug discovery, and the establishment and expansion of the capacity to do such research in South Africa, has been supported through consortium grants from the UKRI; since 2022 a follow-up grant called START: Health & Biosciences, co-awarded with Prof. Trevor Sewell from the University of Cape Town, has provided further support of initiatives in this regard.

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. In 2023 the Bill & Melinda Gates Foundation and the UK medical charity LifeArc made a US\$7.2 million joint award to support the Grand

Challenges African Drug Discovery Accelerator (GC ADDA) network; of this funding, US\$2.2 million was earmarked to support a team that has as its specific focus the pursuit of new antituberculosis treatments. Over the next three years, Prof. Strauss will be leading this team of researchers from four institutions in South Africa and Kenya as they aim to apply a new methodology in antimicrobial drug development in the discovery of new tuberculosis treatments.

Dr Dawie van Niekerk is involved in the following collaborations on malaria research: Prof. L-M. Birkholtz from the University of Pretoria, Prof. Jacky Snoep (SU) and collaborators, and Prof. Albena Lederer (Leibniz-Institut für Polymerforschung Dresden, Germany, and SU) as part of the 3D4D2 M-ERA.NET project. In addition, he collaborates on tools for computational modelling and FAIR research with Prof. C. Goble from the University of Manchester (UK); Priv.-Doz. Dr. Wolfgang Muller from HITS in Heidelberg (Germany) and Prof. Jacky Snoep (SU); and on glycolytic oscillations with Prof. Mattias Goksör and Dr Caroline Adiels from the University of Gothenburg (Sweden), and Prof. Snoep (SU).

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, emeritus professor in

biochemistry, on the role of indigenous South African plants such as honeybush, rooibos and *Aloe ferox* 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. Alexandra Kiemer from Saarland University (Germany), 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; Prof. Marina Rautenbach and Prof. Erick Strauss at SU and Dr Ikechukwu Achilonu at the University of the Witwatersrand, with Prof. Karen Sliwa at the Cape Heart Institute and Hatter Institute for Cardiovascular Research in Africa, University of Cape Town; 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, Virginia, USA. He was invited to deliver a talk at the second international symposium on the chaperone code and the 12TH INTERNATIONAL SYMPOSIUM ON HEAT SHOCK PROTEINS IN BIOLOGY, MEDICINE AND THE ENVIRONMENT held in Old Town Alexandria, Virginia USA. He has served as an editorial member of *BMC Molecular and Cell Biology* since 2021.

ACADEMIC AFFAIRS

Postgraduate student cohort in the department:

21 Hons, 36 MSc, and 25 PhD students Number of graduates 2023



STAFF MATTERS

Mrs. Lynne du Toit retired after having served the department for more than 30 years in her capacity as senior technical officer responsible for the administration of the two second year Biochemistry modules, and preparation of their associated practicals. **Ms. Tarryn-Lee Kruger** and **Mr. Suleiman Sungay** joined the department as support staff during the course of 2023. Ms. Kruger filled the newly created post of postgraduate and research support officer, while Mr. Sungay took on the role of technical officer as successor to Mrs. Du Toit. **Dr. Dina Coertzen** joined the department for a brief period as lecturer.

SOCIAL IMPACT

Prof. Marina Rautenbach participated in a Science Café Discussion at the 2023 Woordfees in Stellenbosch to raise awareness of antibiotic resistance. Her talk title was "Antibiotic Armageddon – Can we win the war against resistant microbes?".

Dr Annelise Botes participated in an interview with Tinus de Jager from Moneyweb Radio (RSG Geldsake) with the title: "n Entstof teen voëlgriep is dalk nie die eenvoudige antwoord nie". South Africa currently has a stamping-out policy for avian influenza and because of this, suffered large-scale poultry losses in 2023. The discussion focussed on the feasibility of using a commercially available, inactivated vaccine, against avian influenza in South Africa. The interview is available online as a podcast.

FUNDING

Global

- Grand Challenges Africa (GC Africa)
- Bill & Melinda Gates Foundation
- LifeArc
- M-ERA.NET project: 3D4D2

South Africa

- BIOPEPTM 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 Institut
- Alexander von Humboldt Foundation

United Kingdom

- National Institutes of Health 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
- Dr D Coertzen
- Prof M Rautenbach
- Prof JM Rohwer
- Dr N Sheik Abdul
- Prof JL Snoep
- Prof K Storbeck
- Prof E Strauss (Head of Department)
- Dr DD van Niekerk
- Dr NJD Verhoog
- Dr T Zininga

Extraordinary professors

- Prof O Zierau
- Prof MA Stander

Extraordinary senior lecturers

- Dr M de Villiers

Emeritus professors

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

Support staff

- Ms W Maart (Secretary)
- Mr AP Arends
- Mr KD Botha
- Mr R Brandt
- Mrs L du Toit
- Dr Y Engelbrecht
- Mrs GD Gerstner
- Mr CR Jansen
- Ms T-L Kruger
- Dr R Louw-Du Toit

- Ms RP Louw
- Mrs L Prinsloo
- Mr S Sungay

Postdoctoral fellows

- Dr H Jackson
- Dr T Kouril
- Dr A Mafaune
- Dr L Mocke
- Dr K Mostert
- Dr D Neveling

NRF-RATED RESEARCHERS

Internationally acclaimed researchers

Prof Jacky Snoep Computational Systems Biology

Prof Johann Rohwer Computational Systems Biology

Established researchers

Dr Marietjie Stander Mass Spectrometry and Analytical Chemistry

Prof Karl Storbeck Steroid Biosynthesis and Metabolism

Dr Dawie van Niekerk Computational Systems Biology

Dr Tawanda Zininga Cell stress biology, antimalarial drug design and cardiovascular biomarker discovery

CONTACT DETAILS

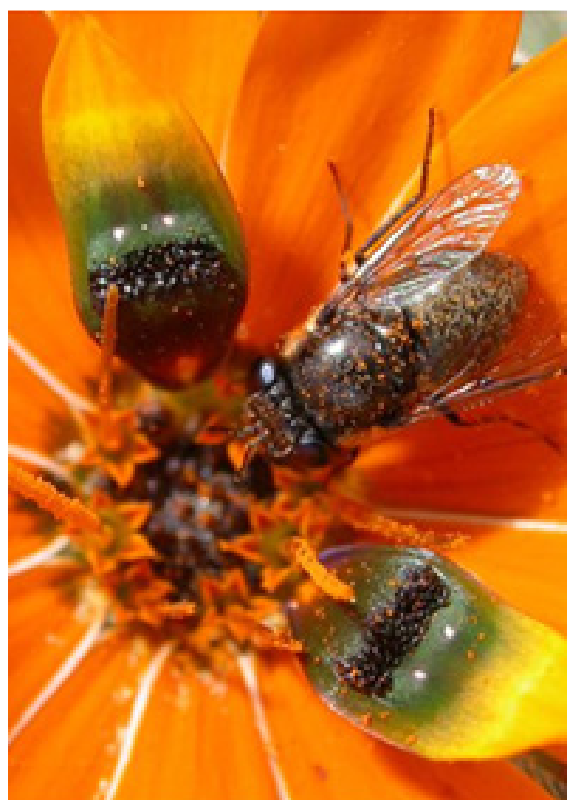
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DEPARTMENT OF BOTANY AND ZOOLOGY

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; Plant-microbe interactions.

RESEARCH HIGHLIGHTS



Female fly pollinator amongst fly-mimicking spots of *Gorteria diffusa*.

Photo: Allan Ellis

The genetic architecture of pollination by sexual deception in a South African daisy

Every year in Spring the western landscapes of South Africa are transformed into a tapestry of brightly coloured flowers which attract ecotourists from all over the world. The base-note of these spectacular displays is provided by showy annual daisy species, which are a core research focus of the lab group of Prof. Allan Ellis. Their research aims to catalogue the undescribed diversity and unusual floral features of these extremely common, but overlooked, species, and to understand how this diversity arose and is maintained. An unexpected finding of this work is that these daisies sometimes achieve pollination by tricking male flies into attempting to mate with complex petal ornaments that mimic female flies. This pollination strategy, known as sexual deception, was previously known only in orchids. In the latest contribution to this body of work, published in *Current Biology* in 2023, Prof. Ellis and his long-term collaborators at Cambridge University elucidate the genetic architecture underlying the production of female-fly mimicking structures on flowers of *Gorteria diffusa*. These complex sexually deceptive spots arose through three independent gene co-option events, where gene networks were deployed into the flower from totally different developmental contexts. Iron homeostasis genes produce petal spot colours similar to female pollinators, root hair genes make large papillate cells on the spots which elicit mating responses from male flies, and a transcription factor module controls the irregular arrangement of spots that optimises mimicry of female flies resting on the flower. These independent gene networks were co-opted sequentially, and then integrated, to produce the complex spot structures that allowed exploitation of mating flies for pollination in this daisy species. While gene co-option is a well-known mechanism creating morphological novelty, this is one of the first studies to show the role of modular integration of multiple independently co-opted genetic elements in the evolution of complex morphological features – Prof. Allan Ellis.

Documenting kelp biodiversity

Kelp forests occur along ~1000 km of the South African coastline. This biodiverse marine ecosystem is recognised for its economic and ecological value, however, significant knowledge gaps exist on the biodiversity of these kelp forests. As all marine ecosystems are under threat from climate change and anthropogenic pressures, it is crucial to understand not only which species live where, but also the ecological interactions that drive ecosystem function.



The Great African Seaforest.
Photo: Jannes Landschoff



Dr Nasreen Peer and students sorting invertebrates in the field.

Photo: Jannes Landschoff

Researchers from the Department of Botany and Zoology are collaborating with the Sea Change Project to fill these knowledge gaps on South African kelp forests. Dr Nasreen Peer, marine biologist, leads the Holdfast Project which studies the invertebrate life within the complex root-like structure of the kelp. Prof. Sophie von der Heyden, a marine molecular ecologist, is leading an eDNA metabarcoding project of the South African kelp forests. Dr Jannes Landschoff, marine biologist at Sea Change and research associate, is a collaborator and co-supervisor for students on both projects. Dr Landschoff also leads the 1001 Sea Forest Species project, funded by the Save Our Seas Foundation, in which he aims to document 1001 different species associated with the kelp forest.

Results so far have been promising with almost 200 invertebrate species identified from a total of 50 holdfasts. Many of these are endemic to South Africa, some present new distribution records, and a few are still unnamed to science. The first paper to be published in *Aquatic Biology* (Katharoyan et al. 2024) indicates that holdfast communities vary across different sites and that we need a lot more time and effort to properly sample these communities. Prof. Von der Heyden's group has seen similarly astonishing results with 880 operational taxonomic units of fish and invertebrates detected from a single site over 24 hours (Rossouw et al. 2024, "*npjBiodiversity*"). Both projects highlight that we have only scratched the surface in terms of our understanding of these valuable under sea habitats and that there is much work to be done – Dr Nasreen Peer

Marine conservation: the SharkSafe Barrier™

The SharkSafe Barrier™ technology manufactured in the Western Cape and developed by Dr Sara Andreotti and Prof. Conrad Matthee and their collaborators is now being used as a commercial installation at a private island in the Bahamas. The barrier combines biomimicry of thick kelp forests and the use of magnetic fields to keep humans and sharks apart without harming them or any other large marine species.



Sharksafe Barrier™ technology deployed at an island in the Bahamas.
Credit: www.sharksafesolution.com

After 15 years of development, the nature-inspired barrier technology is currently the only shark specific eco-friendly alternative to shark nets and has the potential to add significantly towards the conservation of marine top-predators. Shark nets have been in use since 1950 and kill thousands of harmless sharks, dolphins, whales, sea turtles and other large bony fish every year.

A second installation of the SharkSafe Barrier is planned also for the Bahamas in 2024 and the large scale roll-out of this technology will further strengthen marine conservation efforts in the Bahamas. In 2011 the Bahamas proclaimed the first shark sanctuary in the Atlantic Ocean, and, in 2018, a Marine Action Partnership (MAP) for Sustainable Fisheries. Shark tourism currently contributes approximately US\$100 million per year to the local economy.

The first commercial installation of the SharkSafe Barrier™ is the breakthrough that the team has been working towards for the past 15 years. This is a win-win situation, especially for areas that rely on ocean recreation as a main source of revenue, such as beach towns in South Africa, Brazil, New Caledonia, the Bahamas and Réunion. The SharkSafe Barrier was exposed to two large storms since installation. The barrier didn't need to be removed and didn't sustain any damages, and this confirms the robustness of the installation. This result further differentiates the SharkSafe Barrier technology from its competitors – Dr Sara Andreotti



SharkSafe Barrier™ technology packed and ready to be shipped for installation.
Photo: Wiida Fourie-Basson



The SharkSafe Barrier™ team at KND Fabrications in Maitland, Cape Town, shortly after the parts for the 30-metre-long installation were packed, ready to be shipped to the Bahamas. In the front, from the left, are Laurie Barwell, Errol Bourne, Dr Sara Andreotti, Ronnie Adams, Kezia Bowmaker, and Nina Sirba. At the back are Louie Miggel, Anthony Mederer, Matthew Mtshabe, Lincoln Calbert, Dirk Zimri, Nicolo Farmer, and Ricus du Toit. The factory owner, Rory Bruins, was travelling internationally when the photo was taken.

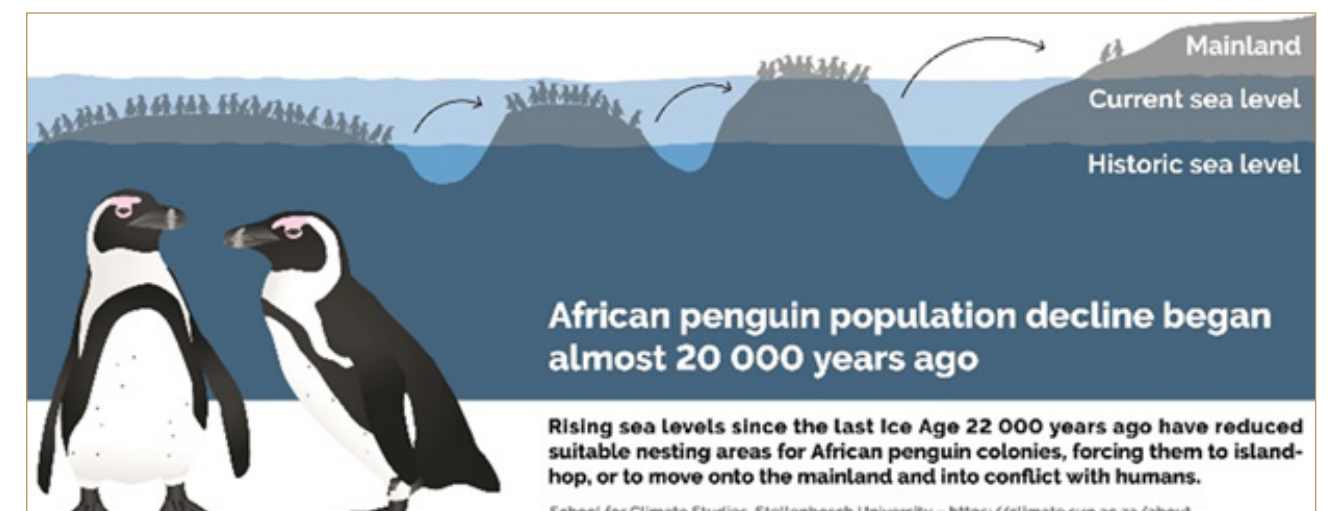
Photo: Wiida Fourie-Basson

The endangered African penguin in steep decline

The Global Change Biology Group, affiliated with the Department of Botany and Zoology and the School for Climate Studies, published a paper in the *African Journal of Marine Science*, titled "A natural terminal Pleistocene decline of African penguin populations enhances their anthropogenic extinction risk".

The study uncovers a new insight, during glacial times, some 18000 years ago, they estimate that between 6.4 million and 18.8 million individuals could have been found in the southern Cape coastal region. As sea levels rose with natural climate change, 15 000 to seven thousand years ago, this habitat for

the African penguins declined steeply, but African penguins managed to persist and thrive by "island hopping" as the sea levels rose, showing great inherent resilience before modern society developed in the Cape. By 2011 South Africa's African penguin population had collapsed to 21 000 breeding pairs and declined further to 13 600 by the end of that decade. While the International Union for the Conservation of Nature has classified the African penguin as endangered, this study shows even more starkly how this Pleistocene "refugee" species is much more threatened than previously believed, but also shows an inherent resilience that can be leveraged to aid its continued survival as a species – Prof. Guy Midgley



International Polychaete Conference hosted on home soil

The 14th International Polychaete Conference (IPC) took place from 3 to 7 July 2023 in Stellenbosch with Prof. Carol Simon as President and Chair of the conference. In hosting this conference in South Africa, the IPC achieved their goal in encouraging participation by African participants, which was facilitated by securing sponsorship from the Company of Biologists (CoB) especially for (South) African participants. To further encourage participation by (South) African participants, the IPC also co-hosted the Southern African Society for Systematic Biology, with a joint session for Polychaete Systematics, which introduced the topic to local researchers working in other fields.

There were 119 participants from 25 countries at the IPC, ~20% more than expected. This included 27 African participants from six countries (South Africa, Kenya, Ghana, Tunisia, Namibia and Ethiopia). Together, the African contingency presented eight (of 70) posters and 13 (of 70) oral presentations. Two PhD students from the Simon Polychaete lab, Stephanie Schoeman and Hendré van Rensburg, won first and third prize respectively for best oral presentation by students.

Using the money received from the CoB, IPC sponsored attendance by 5 participants: two international students (PhD student Mary Hannon, from Texas A&M University at Galveston, USA, and Post-doctoral fellow Dr Tejal Vijapure from the Centre for Ecological Sciences in India); and three African participants (2 MSc students, Mr Thaddeus Ombati from Egerton University and Mr Brendan Mutua from Pwani University, both in Kenya; and a post-doctoral fellow, Dr Marwa Chaibi from the University of Tunis, Tunisia). In addition, a local research grant, SeaMap, sponsored the attendance by five South African students at the conference and the pre-conference workshop.

The conference was preceded by an identification workshop which was facilitated by international experts from Spain, Russia, Brazil, France, Australia, Wales, Norway and South Africa. There were 25 participants, mainly from South Africa, but also from Namibia, Ghana, Japan, and Iceland. Most local participants were professionals; either environmental consultants or staff of the Department of Forestry, Fisheries and Environment. This workshop created an excellent opportunity for developing new collaborations and exchanging knowledge between the experts and participants. This continued throughout the conference, and from this perspective, the conference was a huge success. – Prof. Carol Simon.

RESEARCH ACTIVITIES

Prof. Michael Cherry is the Associate Editor for *EMU*.

Prof. Bruce Anderson is an associate editor for the *Journal of Pollination Ecology*.

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". She presented her inaugural lecture entitled, "Should I stay or should I go? Examining responses of cold-blooded animals to climate change".



With Prof. Susanne Clusella-Trullas is, from left to right, Prof. Frikkie Scholtz, Prof. Louise Warnich, Prof. Sibusiso Moyo, Prof. Theresa Wossler, and Prof. Ingrid Rewitzky.

Photo: Stefan Els

Prof. Savel Daniels is the Editor for the *Journal of Zoological Research and Systematics* and a guest speaker on Radio Sonder Grense.

Prof. Léanne Dreyer was actively involved in the 100th year anniversary of the Stellenbosch University Botanical Gardens during 2022. Following these events, she was one of three researchers interviewed and filmed for a video on the SU Botanical Gardens Centenary as part of the "Maties Legends and Pioneers" film series. She manages the Stellenbosch University Herbarium and is on the advisory board of the Stellenbosch University Botanical Garden.

Prof. Allan Ellis was invited to present a guest lecture on the VW sponsored field school "Mind the Darwinian Shortfalls – A graduate summer school on biodiversity and collection management in East Africa" in Rwanda. He presented a public lecture at the Center of Excellence in Biodiversity and Natural Resource Management, University of Rwanda, and a research talk at the Twelfth International Symposium on Pollination.

Prof. Nox Makunga was elected as Editor for the special issue of the *South African Journal of Botany*. She presented her inaugural lecture entitled, "Diving deep into a medicinal plant treasure trove: a focus on South African medicinal flora and beyond".



Prof. Nox Makunga during her inaugural lecture. With her is, from left to right, Prof. Theresa Wossler, Prof. Louise Warnich, Prof. Nico Koopman, Prof. Sibusiso Moyo, Prof. Ingrid Rewitzky, and Prof. Frikkie Scholtz.

Prof. Conrad Matthee is the associate editor for *Molecular Phylogenetics and Evolution* as well as the editor for the *African Journal of Marine Science*, and is on the editorial board of *Koedoe*. Prof. Matthee was also the African Representative for the Systematic Society (International).

Dr Victor Rambau is an Associate Editor for *African Zoology*.

Prof. Dave Richardson was one of only 10 scientists from South African institutions who made it onto the Clarivate Global List of Highly Cited Researchers for 2023. He is on the editorial boards of *Biological Invasions*, *Neobiota* and *AOB Plants*.

Prof. Carol Simon was the Chair of the International Polychaete Conference and is also President of the International Polychaete Association.

Dr Sabrina Kumschick was chair of the local organising committee of the National Symposium on Biological Invasions held in Grabouw. She also presented a talk at the Ecology and Management of Alien Plant Invasions conference in Chile. Furthermore, she serves on the Alien Species Risk Analysis Review Committee and is chair of the IUCN's Environmental Impact Classification for Alien Taxa (EICAT) Authority.

Prof. Sophie von der Heyden serves on the editorial boards of *Molecular Biology & Evolution*, *npjBiodiversity* and *Conservation Biology* and is a member of the UNESCO World Heritage Site eDNA monitoring steering committee and the Ocean Biomolecular Observation Network (OBON) eDNA steering advisory committee. She was also a plenary speaker at the Environmental DNA Society of Japan's International Conference. She presented her inaugural lecture entitled "A brief journey through the evolution of marine molecular ecology in Southern Africa: 15 years of perspectives".

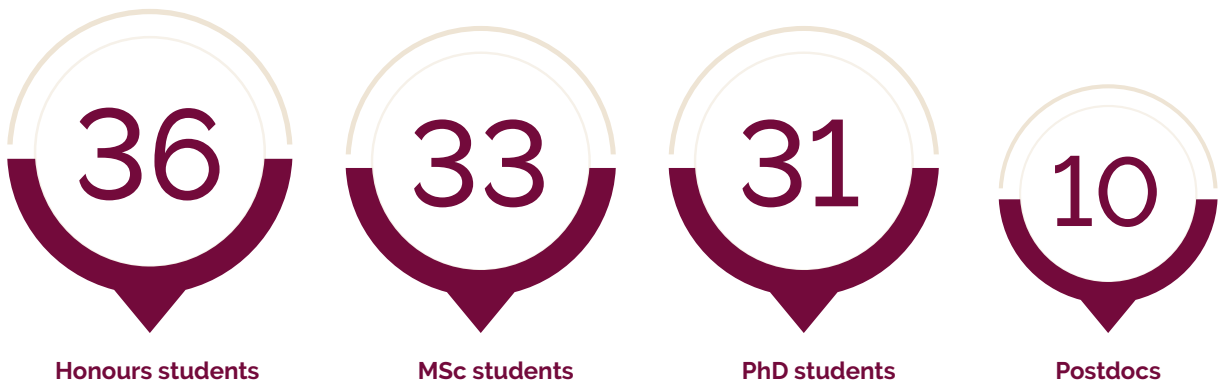


Prof. Sophie von der Heyden with Dr Ronelle Retief (left) and Prof. Sibusiso Moyo (right).

Prof. Theresa Wossler is the editor-in-chief of *African Zoology* and a council member of the Zoological Society of Southern Africa. She completed the Higher Education Leadership and Management (HELM) Foundations of Leadership (1 & 2) courses.

ACADEMIC AFFAIRS

Student Information 2023



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, while Profs Susana Clusella-Trullas and Sophie von der Heyden each hold a 1/8th position within the School for Climate Studies. These shared posts strengthen the partnership between the School and Department.

AWARDS TO STAFF AND STUDENTS

Bianca Boshoff received the best poster award at the Southern African Society of Aquatic Scientists (SASAqS) conference.

Aidan Bossert won best speed talk at the Oppenheimer Research Conference.

Marc Butler was awarded the Department's best Honours talk at the Annual Research Meeting.

Caitlin Ching-Sent was awarded the Department's best MSc talk at the Annual Research Meeting.

Courtney Gardner was awarded the Department's best PhD talk at the Annual Research Meeting.

Tallulah Glasby was awarded the best Honours student in the Department for 2023, and received the Zoological Society of South Africa (ZSSA) best third year student award at Stellenbosch University for 2022

Olivia Jones received the Zoological Society of South Africa (ZSSA) best Honours year student award at Stellenbosch University for 2022

Alex Nieto Lawrence received the Zoological Society of South Africa (ZSSA) Lawrence Memorial Grant and was awarded the best Hons/Masters presentation at the ZSSA conference.

Dr Refilwe Mofokeng was awarded best blitz presentation at the SU Postdoctoral Research Conference:

Khensani Nkuna received runner up for best poster presentation at the National Symposium on Biological Invasions.

Dr Andrew Ndhlovu was awarded best abstract at the SU Postdoctoral Research Conference.

Prof. Anton Pauw was awarded the SAAB (South African Association of Botanists) Silver Medal, which acknowledges significant contributions to the advancement of botany in South Africa.

Kaylan Reddy was awarded Best Young Botanist by SAAB for 2023. He proceeded to FameLab 2023 National finals and was first runner up at the SU Quick-fire Talks.

Stephanie Schoeman was awarded best oral presentation at the 14th International Polychaete Conference.

Zaynab Shaik was awarded best student presentation at the Southern African Society for Systematic Biology Conference.

Dewidine van der Colff received runner up for best oral presentation at the National Symposium on Biological Invasions.

Hendré van Rensburg received third prize for his oral presentation at the 14th International Polychaete Conference.

Katie Watson was awarded best oral presentation at the Southern African Society of Aquatic Scientists (SASAqS) conference.

Catherine Wilkinson won best poster award at the African Phytomedicine Scientific Society conference.

STAFF MATTERS

Dr Itumeleng Moroenyane was appointed senior lecturer in the Department of Botany and Zoology. **Dr Alex Flemming**, senior lecturer, took early retirement. **Dr Marnel Mouton** was appointed permanently within the Department of Botany and Zoology.



NRF-RATED RESEARCHERS

Leading international researchers	
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
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

SOCIAL IMPACT

LiTHOPS – Learning, Teaching and Opening Science

The dedicated team has successfully engaged with four local schools in the Stellenbosch area on a regular basis in 2023, namely Luckhoff, Kayamandi, Paul Roos and Rhenish High Schools. These engagements included academics and postgraduate students from the Department of Botany and Zoology presenting short interactive talks on their research at these schools. One of our major activities in 2023 was to pay closer attention to Kayamandi and Luckhoff High schools where interactions have seen senior learners from both schools attend informative guided tours at the Stellenbosch University Botanical Garden. This part of the social impact engagement was meant to provide a practical that fits in with their plant biodiversity module. At Kayamandi High School, we did a series of practical exercises as a demonstration that involved DNA isolations using a home-based tool kit and a thin layer chromatography analysis of extracts from chosen medicinal plants. The latter was also demonstrated to senior learners from Luckhoff. In both instances, volunteers from the groups were asked to participate in these hands-on activities. We have thus established relationships with the teaching community at the schools mentioned in this report and we plan to follow on with a science buddy mentorship programme and to interact with junior grades so as to inspire young learners so that they better understand why it is important to choose biology as a school subject, and gain a better understanding of why it is imperative to study South Africa's biodiversity. – Prof. Nox Makunga.



Grade 10 learners from Swellendam Secondary School sampling ants on their schoolground.
Photo: Dorette du Plessis

limbovane Outreach Project

limbovane, a science education initiative in the Department of Botany and Zoology, continued with its aim of offering curriculum support to educators and facilitating the development of practical science skills among learners, particularly in the fields of biodiversity and invasion science.



Learners from Kayamandi High School in the Stellenbosch University Botanical Garden.

limbovane continued to work closely with the Western Cape Education Department (WCED) and trained 460 learners through classroom lessons and practical field studies in their schoolgrounds. The field studies involved the collection of ant species in their schoolgrounds using scientific sampling methods, and the identification of the ants in a follow-up microscope lesson.



Learners receiving their certificates after completing an limbovane program on botanical studies and illustrations.
Photo: Dorette du Plessis

Besides giving classroom lessons, limbovane also hosted 12 day-programmes to schools and youth groups. These took place on and off campus and were tailored specific to the needs of the visiting group. Themes covered a range of topics from invasive alien species, fynbos plant and freshwater diversity, to something more creative such as botanical illustrations. A total of 222 learners were trained on these programmes.

A further 49 learners were trained during limbovane weekend camps. In May, a camp titled, "All about Aliens", took learners to Bainskloof where they learned to identify alien invasive plant species and how-to remove such species. All activities were practical, and learners were impressed with themselves after they successfully cleared an area covered in dense stands of Spanish broom (*Spartium junceum*). Another weekend camp took a group of learners from Augsburg Gymnasium to the Cederberg Wilderness Area, where they explored the biodiversity of the surrounding mountains. Learners performed plant and insect surveys while MSc student and Augsburg alumni, Handre Basson, helped them to identify the species they collected.

limbovane hosted two 5-day holiday programs in 2023, during which 47 learners received training. These programs immersed learners in hands-on fieldwork, allowing them to practice the methodologies employed by ecologists for

collecting biodiversity and environmental data. Following the fieldwork activities, the learners were engaged in identifying plant and invertebrate species, giving them valuable experience in utilizing field guidebooks and microscopes. By offering such immersive experiences, limbovane not only contributes to fostering a deeper appreciation for the environment but also equips learners with practical skills essential for ecological research and conservation.



Learners at the holiday programme doing plant surveys to determine the species richness of indigenous forests.
Photo: Dorette du Plessis

In 2023, limbovane prioritized educator training as a significant component of its activities. Collaborating with partners, limbovane conducted workshops that trained 124 educators. A notable workshop occurred in April, when limbovane facilitated training for 30 Post Graduate Certificate in Education (PGCE) students. The objective of this training was to provide these prospective educators with the essential competencies to deliver practical field lessons to learners.

limbovane presented posters at two conferences, the Western Cape Environmental Education Forum (WCEEF) Annual Conference and the 41st Annual Conference of the Environmental Education Association of Southern Africa (EEASA). The poster, titled "Tales from the timid and untamed", reflected on limbovane's long-term partnership with the education team of the conservation working group Cape Leopard Trust.

COLLABORATION

Angola/Botswana/South Africa

- Wild Bird Trust Okavango Research Project

Australia

- Macquarie University
- RMIT University

Belgium

- Meise Botanic Garden
- Research Institute for Nature and Forest (INBO)
- Royal Museum Central Africa

Brazil

- Federal University of Rio de Janeiro

Canada

- University of Toronto

China

- The University of Hong Kong

Czechia

- The Czech Academy of Sciences

France

- Agricultural Research Centre for International Development (CIRAD)
- National Institute for Research in Digital Science and Technology (INRIA)
- Sorbonne University
- Université de Rennes
- Université Toulouse

Germany

- Friedrich-Alexander University Erlangen-Nurnberg
- Justus-Liebig-Universität Gießen

India

- Wildlife Institute of India

Italy

- Institute for Sustainable Plant Protection

Japan

- University of the Ryukus
- Natural History Museum

Kenya

- Kenya Marine and Fisheries Research Institute

Mozambique

- Eduardo Mondlane University

New 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

Romania

- Universitatea Ovidius Constan a

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)
- South African National Parks (SANPARKS)
- University of Cape Town
- University of the Free State
- University of KwaZulu-Natal
- University of Pretoria
- University of Venda
- Wild Bird Trust

Spain

- University of the Balearic Islands

Sweden

- Gothenburg Global Biodiversity Center
- University of Gothenburg

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
- University of California, Santa Cruz
- US Forest Service
- Washington University
- Yale University

United Kingdom/Ireland

- Cambridge University
- Global Species Programme, Cambridge
- Oxford University
- University of East Anglia
- University of Edinburgh
- 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
Council for Scientific and Industrial Research (CSIR)
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 Environmental Observation Network (SAEON)
South African Institute for Aquatic Biodiversity (SAIB)
South African National Biodiversity Institute (SANBI)
Syngenta SA
Thünen Institute of Climate-Smart Agriculture
University of Pretoria

University of the Western Cape
University of Toronto
Weizman Institute of Science
World Bank

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 Itumelen Moroenyane
- Dr M Mouton
- Prof CA Pauw
- Dr N Peer
- Dr VR Rambau
- Prof DM Richardson
- 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 L Foxcroft
- Dr J Landschoff
- Dr T Gridley
- Prof J Le Roux
- Dr N Miranda
- Dr Samantha Mynhardt
- Dr C Tilbury
- 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 Sauerma
- Mr N Solomons
- Mr B van der Rheede

- Mr JP Williams
- Mr H Witbooi

Support staff: Centre of Excellence for Invasion Biology

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

Postdoctoral fellows

- Dr H Beckett
- Dr L Djeutchouang
- Dr L Fernandez
- Dr S McCallen
- Dr E McCullouch-Jones
- Dr R Mofokeng
- Dr J Muller
- Dr A Ndhlovu
- Dr L Potgieter
- Dr A Watson



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DEPARTMENT OF CHEMISTRY AND POLYMER SCIENCE

RESEARCH INTERESTS

Organic and medicinal chemistry; Inorganic and organometallic chemistry; Analytical chemistry; Polymer science; Materials technology; Physical and computational chemistry; Supramolecular and materials chemistry; Chemistry education; Nanotechnology.

RESEARCH HIGHLIGHTS



Prof. Alben Lederer and some of the members of the polymer separation research group at IPF and SU. They are, at the back, Dr Susanne Boye (IPF), Dr Martin Geisler (IPF), Dr Zanelle Viktor (SU/IPF), Dr Helen Pfuksa (SU) and Dr Upenyu Muza (IPF/SU).

Photo credit: Leibniz-IPF, Juliana Socher

International research group in polymer science

The Polymer Separation Group led by Prof. Alben Lederer was expanded at the end of 2020 to include a joint chair for Analytical Polymer Science at Stellenbosch University (SU)

and the Leibniz Institute for Polymer Research Dresden (IPF), Germany. This group is the first at SU to collaborate with an international research institution in this form. The group focuses on innovative analytical methods based on interaction and size exclusion chromatography, field flow fractionation and multiple detection techniques. The Polymer Separation Group develops innovative methods to effectively and reliably analyse biomimetic, reactive and highly complex macromolecular systems. Understanding the interplay of several structural parameters and their simultaneous determination in the smallest sample quantities enables, for example, the rapid development and screening of polymer drug carriers or polymer hybrid structures. The elucidation of structure-property relationships in complex macromolecular systems benefits greatly from international expertise and mobility, in which postgraduate students, scientists and technicians in Germany and South Africa are equally involved. – Prof. A. Lederer

34th International Symposium on Polymer Analysis and Characterization hosted by SU

ISPAC 2023 was jointly organised by the Department of Chemistry and Polymer Science at SU and the Leibniz Institute for Polymer Research Dresden in Germany. More than 120 scientists and engineers from 16 nations interested in advanced polymer characterization contributed to an exciting scientific program with a strong attendance from South African academia and Industry. Distinguished experts in the field of polymer science as well as talented young researchers presented their work. The conference featured short courses in state-of-the-art polymer analysis and characterization as well as a "Polymer Analysis meets Industry" event targeted at the future generation of polymer scientists. – Prof. A. Lederer, Dr H. Pfuksa

Nanosene launches first commercial products

Together with Gestél Kuyler, Prof. Bert Klumperman founded a spin-out company, Nanosene (Pty) Ltd, that focuses on the commercialization of amphiphilic copolymers for the isolation of membrane proteins. Terpolymers of styrene, maleic acid and N-benzylmaleimide were developed in Kuyler's PhD study, awarded as a dual PhD degree between

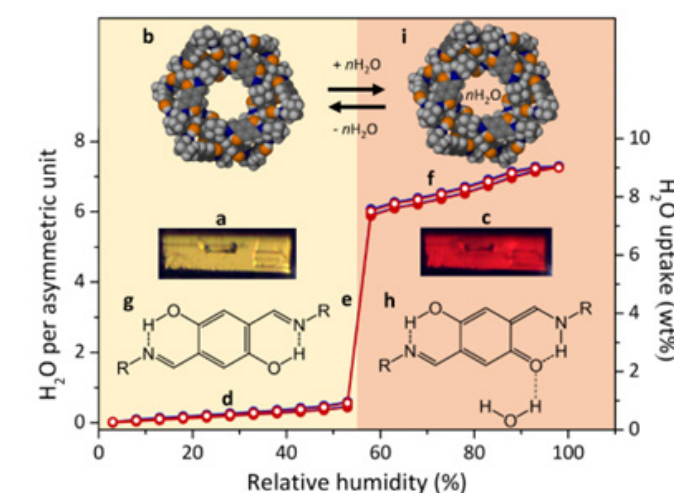
SU and Coventry University, UK. The polymers were used for the isolation of G-protein coupled receptors (GPCRs) in the lab of Prof. Mark Wheatley at Coventry University. In the meantime, Nanosene (Pty) Ltd has entered into a strategic partnership with Cube Biotech GmbH, Germany, who in October 2023 has launched the first series of commercial products based on the terpolymers mentioned above. – Prof. B. Klumperman



Nanosene and Cube Biotech GmbH exhibited their collaboration at SMALP-23, the inaugural International Conference on Native Membrane Nanoparticles in Knoxville, Tennessee, in October 2023. From left to right, Dr Jan Kubicek (Cube Biotech GmbH) and from SU, Prof. Bert Klumperman, Dr Gestél Kuyler, Dr Elaine Barnard and Dr Lauren Ball.

Nature paper

Profs Len Barbour and Catharine Esterhuysen, along with their students and colleagues from Adam Mickiewicz University in Poland, have been the first to show that water can be desorbed from a porous material at temperatures as low as -70 deg. C. Crystals of a triangular-shaped molecule that contain channels running along their length exhibit a rapid colour change from yellow to red along as water moves into the crystal at relative humidities over 55%. Similarly, as the humidity is lowered the water rapidly escapes from the channels with the colour returning to yellow. Remarkably this change was observed even down to temperatures well below the normal freezing point of water. Extensive experimental and computational studies were used to explain the origin of this phenomenon, which has potential applications in atmospheric water harvesting. – Prof. L.J. Barbour, Prof. C. Esterhuysen



New spinout company, Phynti Phytopharmaceuticals, started

Three SU Chemistry academics: Dr C.H. Kaschula, Prof. W.A.L. van Otterlo and Prof. A.J. de Villiers (together with Prof. Nox Makunga from the Department of Botany and Zoology, and Prof. A-M. Engelbrecht from the Department of Physiological Sciences), have started a SU spin out company called Phynti Phytopharmaceuticals. This company draws on South African indigenous knowledge of plant-based medicine to produce natural health solutions that promote wellbeing. The launching product for this company is due to go live at the end of April 2024 with a night-time product for sleep, and a day-time product for supporting calmness and focus. The company currently employs two full-time entrepreneurs, as well as interns and contract workers – all SU graduates.

Simons Foundation Pivot Fellowship awarded to Dr De Villiers

Dr Katherine de Villiers was one of only seven scientists worldwide to be awarded the Simons Foundation's Pivot Fellowship for 2024. She will join the research laboratory of Prof. Iqbal Hamza at the Center for Blood Oxygen Transport and Hemostasis at the University of Maryland School of Medicine for the period July 2024 to June 2025. During the sabbatical fellowship, Dr De Villiers will gain expertise in molecular genetics, cell biology and biochemistry to better understand heme transport and trafficking in eukaryotes, with implications for human health and disease.



Dr Katharine de Villiers.
Image: Stefan Els

Dr De Villiers hopes to advance the understanding of diseases of excess heme (and therefore iron), such as African iron overload.

RESEARCH ACTIVITIES

Prof. Gareth Arnott served on the 2023 South African Chemical Institute (SACI) National Convention committee. He gave invited talks at the Joint Conference on Calixarenes and Curcubiturils (Israel) and the 12th International Symposium on Nano & Supramolecular Chemistry (Thailand).

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). In collaboration with Prof. Catharine Esterhuysen and colleagues in Poland he published an article in the prestigious journal *Nature* in April 2023.

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 collaborates with the University of the Western Cape on water purification, specifically using capacitive deionization.

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.

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 A*, *Analytical Chemistry*, *Trends in 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 was one of seven recipients worldwide of a prestigious Simons Foundation Pivot Fellowship that will allow her to spend a yearlong sabbatical in 2024/25 at the University of Maryland School of Medicine, where she will investigate the molecular pathways involved in mammalian iron homeostasis.

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 an associate editor of *New Journal of Chemistry*, a member of the International Advisory Boards of the *Canadian Journal of Chemistry* and the International Symposium on Halogen Bonding. In addition to being a Fellow of the Royal Society of Chemistry and the Royal Society of South Africa, in 2023 she was made a Fellow of the South African Chemical Institute. She chaired the successful 44th Convention of the South African Chemical Institute held in Stellenbosch in January 2023. In collaboration with Prof. Len Barbour and colleagues in Poland she published an article in the prestigious journal *Nature* in April 2023. She gave an invited online webinar to the Spanish Crystallographic Association (GE3C) in April 2023.

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 journals *CrystEngComm* and *New Journal of Chemistry*. She was a member of the International Programme Committee for the International Union of Crystallography Convention held in Melbourne in 2023, and is a Fellow of the Royal Society of Chemistry and the Royal Society of South Africa. In 2023 she organised the first Stellenbosch Introductory Crystallography School, together with Profs Barbour and Esterhuysen.

Dr Catherine Kaschula

Dr Kaschula was invited to do a 15 min interview via Zoom on Channel 405 Newzroom Zoom on SABC3 television. The interview was part of a series of talks for World Cancer Day which focused on aspects of cancer awareness. Dr Kaschula gave some perspectives on medicines and supplements that can aid in cancer prevention.

Prof. Bert Klumperman is an associate editor of *Macromolecules* (ACS). He gave invited lectures in October 2023 at the SMALP meeting in Knoxville, TN, USA, and in November 2023 at the American Chemical Society (ACS) Symposium on Controlled Radical Polymerization in Charleston, SC, USA. He has been invited to organise the first ACS Symposium on Controlled Radical Polymerization outside the USA. This symposium will take place in Stellenbosch in November 2025.

Prof. Alben Lederer is a member of the editorial board of the *International Journal of Polymer Analysis and Characterization* (Taylor and Francis) and guest editor of a special issue *Macromolecular Chemistry and Physics* (Wiley). She is the chair of the scientific committee for the International Symposia

on Field and Flow Fractionation and was elected member of the SB of ISPAC. She was also the chair of the ISPAC meeting 2023 in Stellenbosch.

Prof. Peter Mallon has been elected as the Vice-President and President elect 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 Commonwealth Chemistry (the Federation of Commonwealth Chemistry Societies) and serves as the Chair of Finance. Prof. Mallon has also been elected as a Fellow of the South African Chemical Institute and serves on the Executive Committee and Council of SACI. He is also an Invited Fellow of the UK based Royal Society of Chemistry.

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

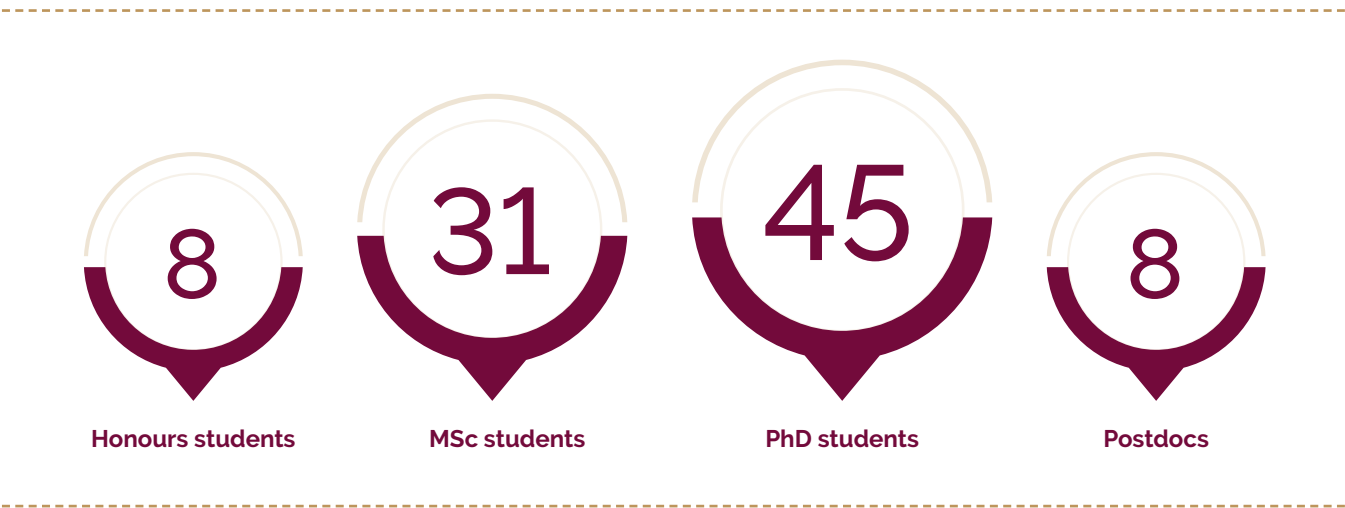
Dr Rueben Pfukwa was in the first cohort of US-Africa Frontiers Fellows of Science, Engineering and Medicine. He was a visiting professor at UVA Chemical Engineering in July 2023. He was in the organizing committee of the Polymer Institute of South Africa's conference held in October 2023 in Gordon's Bay. He is serving as Guest Editor of *Macromolecular Materials and Engineering's* special issue on Polymers in South Africa. He currently serves on the council of the Royal Society of South Africa.

Dr Helen Pfukwa was awarded an Alexander Von Humboldt fellowship for experienced researchers. She is a visiting researcher at the Institute for Polymer Research (IPF) in Dresden Germany. She was part of organising committee for the 34th International Symposium on Polymer Analysis and Characterization (ISPAC2023).

Prof. Willem van Otterlo completed his term as President of the South African Chemical Institute in August 2023. 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 September he gave the Victor Pretorius Memorial Lecture on invitation by the Department of Chemistry at the University of Pretoria, as well as giving a plenary lecture at the 16th Frank Warren Organic Chemistry Conference in Polokwane, Limpopo. In August 2023 he was accepted as South African National Representative for the International Union of Pure and Applied Chemistry (IUPAC) and joined its Division III which deals with Organic and Biomolecular Chemistry.

ACADEMIC AFFAIRS

Student Information 2023



NRF-RATED RESEARCHERS

Leading international researchers	
Prof L Barbour	Nanostructured functional materials
Prof B Klumperman	Living radical polymerization and advanced macromolecular architectures
Internationally acclaimed researchers	
Prof A de Villiers	Separation science fundamentals and applications
Prof D Haynes	Crystal engineering of non-metal containing materials
Prof A Lederer	Analytical Polymer Science
Prof W van Otterlo	Organic synthesis and medicinal chemistry
Established researchers	
Prof G Arnott	Inherently chiral calixarenes; asymmetric methodology
Dr K de Villiers	Antimalarial agents
Prof C Esterhuysen	Intermolecular interactions
Dr C Kaschula	Medicinal chemistry

Prof R Luckay	Ligand design for metal ion coordination in industrial and medical applications
Prof P Mallon	Complex polymer materials and polymer nano-composites
Prof S Mapolie	Catalytic transformations using late transition metal complexes
Dr R Pfukwa	Functional polymer materials
Prof A van Reenen	Polyolefins
Promising young researchers	
Dr H Pfukwa	Biomass valorisation and polymer characterisation

STAFF MATTERS

The Department underwent significant transformation in its research infrastructure in 2023, as all Inorganic research groups and laboratories were relocated to the Polymer Science Building. A substantial investment was allocated to refurbish the new laboratory within the Polymer Science Building, aligning with the department's strategic plan to consolidate research laboratories into two primary buildings or research hubs.

In 2023, the Department said farewell to **Dr Willem Gerber** who resigned to pursue another opportunity in the Eastern Cape. Towards the end of 2023, **Dr Megan Matthews** was appointed as a lecturer in Analytical Chemistry within the department, and **Mrs. Babalwa Ntandane** joined as an administrative officer. Additionally, the department saw the departure of two members of its technical support staff, **Mr. Hugh Gordon** and **Ms. Noluntu Ntwana**, who both transitioned to other roles within the University. To bolster the team, **Ms. Waajidah Arnold** and **Ms. Shannon Walbrugh** were welcomed as new Technical Assistants.

SOCIAL IMPACT

SUNCOI outreach continues

In 2023, SUNCOI helped nine schools (361 learners) with their grade 11 and 12 chemistry experiments. On this occasion, we also gave SUNCOI chemistry sets to the teachers so that they could demonstrate the same experiments at their schools. In this way, SUNCOI provide resources to ensure that the students were given the tools to help prepare them for tertiary scholarship at Stellenbosch University. – Dr E. Botha, E.J. Lukhele

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

Denmark

- University of Copenhagen

France

- Université de Lorraine
- University of Strasbourg

Germany

- Albert Ludwig University of Freiburg
- Dortmund Technical University
- Heinrich-Heine-Universität Düsseldorf
- Leibniz-Institut für Polymerforschung Dresden
- Johannes Gutenberg University of Mainz

India

- Jawaharlal Nehru University
- Tezpur 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
- Gulbenkian Institute of Science
- University of Porto

United Arab Emirates

- New York University Abu Dhabi

United Kingdom

- Coventry University

- 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
- Pennsylvannia State University
- Texas State University (TSU)
- University of Texas Southwestern Medical Centre
- University of Virginia
- Virginia Polytechnic Institute

FUNDING

- African Academy of Sciences
- DFG German Research Foundation
- DST/NRF SARCHI Programme
- Dutch Polymer Institute
- European Union (M-ERA-NET Initiative)
- Medical Research Council (MRC)
- National Institutes of Health (NIH)
- NRF Competitive Programme for Rated Researchers
- NRF Research Development Grants for Y-Rated Researchers
- NRF National Equipment Programme
- NRF Thuthuka Programme
- NRF International SA / France (Protea) programme
- Restek
- Royal Society
- SASOL
- Stellenbosch University
- Technology Innovation Agency (TIA)
- Wellcome Trust
- Wilhelm Frank Trust

STAFF LIST

Academic staff

- Research Chairs
- Prof LJ Barbour
- Prof L Klumperman
- Prof AS Lederer

Professors / Associate Professors

- Prof GE Arnott
- Prof AJ de Villiers
- Prof C Esterhuysen
- Prof DA Haynes
- Prof RC Luckay
- Prof PE Mallon
- Prof SF Mapolie
- Prof WAL van Otterlo (Departmental Head)

Senior Lecturers / Lecturers

- Dr E Botha
- Dr P Chellan
- Dr KA de Villiers
- Dr WJ Gerber
- Dr A Gericke
- Dr CH Kaschula
- Dr M Lutz
- Dr R Pfukwa

Senior Researchers / Research associates / Fellows

- Dr AGJ Tredoux

Extraordinary professors

- Prof J Wiegand

Emeritus professors

- Prof BV Burger
- Prof HG Raubenheimer
- Prof AJ van Reenen

Support staff Administrative staff

- Mrs MMG Cooper
- Mrs PH Davidse

- Mr MK Dlodlu
- Dr M du Plessis
- Mr JG Goldie
- Mrs BRR Ntandane

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

- Ms TL Abels
- Ms W Arnold
- Mr H Gordon
- Ms D Isaacs
- Ms M Jones
- Mr CW Maart
- Mr PT Page
- Ms NS Ntwana
- Ms CJ van Reenen
- Ms SC Walbrugh

Post-doctoral fellows

- Dr F Hasenmaile
- Dr MS Liprini
- Dr ME Matthews
- Dr SD Oladipo
- Dr HK Tanui
- Dr AI Vicatos
- Dr X Wei

CONTACT DETAILS

Tel: 021 808 3172
E-mail: ec@sun.ac.za
Web: http://www.sun.ac.za/chemistry

DEPARTMENT OF EARTH SCIENCES

RESEARCH INTERESTS

Geology

Tectonics and orogenic processes; Archean geology; Sedimentology and palaeontology; Igneous petrogenesis; Metamorphic petrology; Experimental petrology; Economic geology; Ore geology; Geometallurgy.

Environmental geochemistry

Air Quality, Trace-element and isotope geochemistry; Marine geochemistry; Hydro-geochemistry; Hydrogeology; Environmental geochemistry.

RESEARCH HIGHLIGHTS



Geocongress 2023 hosted in Stellenbosch

The 2023 Geocongress event was successfully hosted at SU between 11 to 13 January 2023 in the new Jan Mouton Learning Centre making use of state-of-the-art presentation facilities. The event was organised by a team from the Department of Earth Sciences along with the Geological Society of South Africa (GSSA). Initially planned for 2020 to

coincide with the 125th anniversary of both the Department and the GSSA, the event was ultimately postponed by three years on account of the local and international pandemic response. The conference was a great success as it brought together over 400 academics, industry professionals and students. It was marked by excellent presentations and a range of exciting field excursions and workshops. Given its very positive reception, the conference certainly served to raise the profile of the Department within the southern African earth sciences community.

Metamorphic petrology research

Two of the most notable advances in metamorphic petrology research at SU were the expansion of the phase equilibria modelling tool Rcrust to now consider trace element partitioning and accessory phase saturation as documented in the publication by Hoffman et al (2023) in *Lithos* and by the applications of this style of modelling to mafic igneous bodies where key findings by PhD student Tahnee Otto showed that peritectic mineral entrainment could produce a viable mechanism to explain chromium enrichment in the Bushveld igneous complex.

Official launch of ARM research chair in geometallurgy

Worldwide and in southern Africa the minerals sector is looking towards the emerging field of geometallurgy as a means towards unlocking value and enhancing sustainability practice during ore extraction. Geometallurgy is the integration of geological, mineralogical and metallurgical data in three-dimensional space to create a spatially aware processing model. Moreover, by incorporating economic, marketing, and ESG (Environmental, Societal and Governance) considerations, these models seek to predict and maximise value addition during the mine life cycle.

It is against this background that SU has recently partnered with African Rainbow Minerals (ARM) to establish the ARM Geometallurgy Research Chair. The objective of the chair is to advance knowledge and build capacity in this important field, thereby enhancing the resilience and environmental sensitivity of the local minerals industry. Due to the interdisciplinary nature of the research chair, it has been established as a shared position between Dr Bjorn von der Heyden from the Department of Earth Sciences and Dr Margreth Tadie from the Department of Chemical

Engineering. Dr Von der Heyden's field of specialisation is economic geology, geometallurgy and geochemistry, and that of Dr Tadie includes mineral processing, geometallurgy, and process optimisation and modelling.

Research capacity has been increased with the appointment of two post-doctoral research fellows, Dr Cedric Djeutchou and Evelyn Manjengwa. The current student cohort comprises seven master's students, who are all tackling various aspects of geometallurgy.



Staff and students from the Faculties of Science and Engineering attended the official launch of the African Rainbow Minerals research chair in geometallurgy at SU.

Image: Ignus Dreyer

RESEARCH ACTIVITIES

Dr Martin B. Klausen presented at three different international conferences, as well as at our local Geocongress. In addition, he continued his research on mostly mafic dykes and layered mafic-ultramafic intrusions from across southern Namibia, currently focusing on marginal Rehoboth Craton dyke swarms and the Tantalite Valley Complex, all of which are Mesoproterozoic in age. He contributed with petrological aspects on selected mafic dykes in both Namibia (Neoproterozoic) and Angola (Mesoproterozoic), in collaborations with paleomagnetists from the Universities of Yale, Texas and Helsinki. Since 2023, he is an external moderator of third-year exams of the Geology Department of Rhodes University.

Dr Bjorn von der Heyden was the principal organiser of the Geological Society of South Africa's Geocongress event in 2023. He co-holds the African Rainbow Minerals Chair in Geometallurgy, shared with colleague Dr Margreth Tadie from SU's Department of Chemical Engineering. He is a committee member of the Mineralogical Society of South Africa (MINSa), external moderator for the undergraduate programme at the University of Cape Town, a member of the International Science Council's Special Committee on Oceanographic Research (SCOR), a representative for the Earth Sciences in the African Strategy for Fundamental and Applied Physics (ASFAP), and a member of the national panel for the International Continental Scientific Drilling Program

(ICDP). He enjoys a wide network of international and national collaborators. During 2023 his group published eight original research articles, several of which relate to minerals needed for the green energy transition (Li, Co, Cu).

Dr Matthew Mayne conducted an extensive lecture tour as invited speaker and short course organiser from the University of Bern, Switzerland, to the doctoral training academy in Nainital, India, and at the Goldschmidt conference in Lyon, France. During these tours Matthew demonstrated the new advances to the phase equilibria modelling tool he developed (Rcrust) and collaborated on a number of papers which apply this tool to granite petrogenesis, lithium in pegmatite research and to trace element modelling. Dr Mayne received a Rehana Malgas-Enus Early Career Academic Development (ECAD) Award and secured a three-year NRF Thuthuka grant for 2024-2026 which will expand his research team to focus on pegmatite research and the potential extraction of lithium from granitic pegmatites, a critical commodity of interest for the renewable energy sector.

Dr Ryan Tucker took part in several multi-disciplinary and internationally collaborative projects in the Western Basin of North America and in the East Gobi Basin of Mongolia. Field-based efforts in the US are funded via a multi-year NSF grant, whereas, for Mongolia, Dr Tucker is currently an Explorer in Residence within the National Geographic Society, with funding for 2023 and 2024. Both projects have been very fruitful with the discovery of multiple new dinosaur taxa, which are actively being described and prepared for scientific description and museum display. In addition to this Dr Tucker was successful in publishing ten scientific peer-reviewed papers in the journals *Geology*, *Cretaceous Research*, *PLOS One* and *The Rocky Mountain Geologist*, which won best scientific paper award for 2023.

Prof. Gary Stevens currently serves as associate editor of *The Canadian Journal of Mineralogy and Petrology* and on the editorial review board of *The Journal of Metamorphic Geology*. He has built and runs the only experimental petrology laboratory in Africa, which is equipped with a range of autoclaves that allow direct investigation of metamorphic, magmatic, and ore-forming systems in Earth's crust and upper mantle. He has supervised or co-supervised 27 MSc students and 19 PhD students. He has authored or co-authored 115 journal articles and chapters in books and his most highly cited works have in excess of 500 citations and relate to the processes that produce granite magmas and the formation of Earth's continental crust. His principal collaborators are John Clemens, Alex Kisters and Matthew Mayne at SU; Jeff Moyon at the University of Clermont; Cristiano Lana at the University of Ouro Preto and Federico Farina at the University

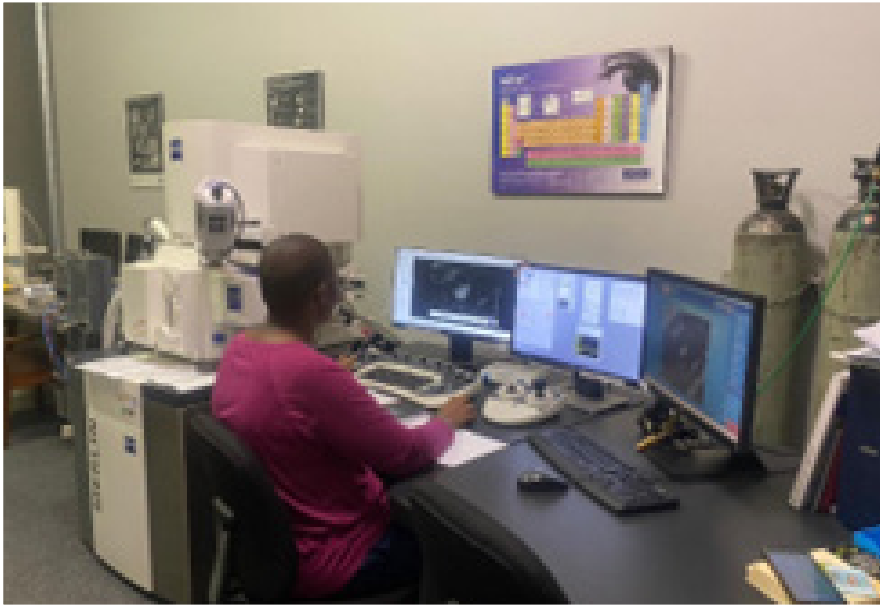
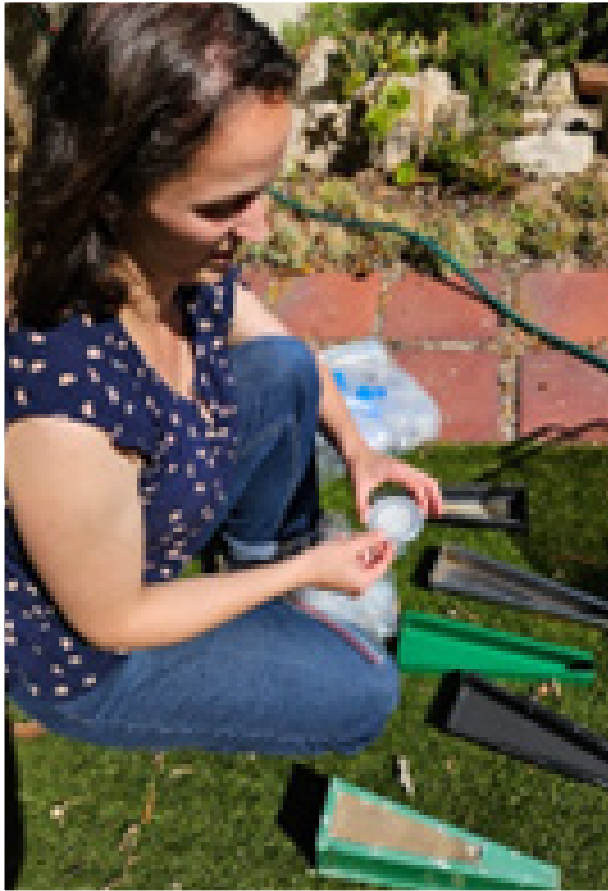
of Milan. His research is currently funded by joint CNRS-NRF IRP (International Research Project) funding to the BuCoMO Project (Building Continents from Mantle to Ore).

Prof. Alakendra Roychoudhury's TracEx research group had a busy 2023 with ongoing research on the Trace Metal Dynamics in the Southern Ocean and Whales in Changing Climate projects. It was also a transition year as a new crop of post-graduate students took over the research activities. The research included working with national and international multidisciplinary experts in physical oceanography and whale ecologists from the global south to understand the large ecosystem stability and whale migration in a fast-changing climate. The research group is constantly adding novel data on trace metal distribution and their speciation in sparsely studied marginal sea-ice and Southern Ocean. The research group published a myth-busting perspective article where they showed whales playing an insignificant role in carbon sequestration processes. Prof. Roychoudhury was invited to be a member of the editorial board of an Elsevier journal, and he continues to serve as member of the Board of Governors of a school in the Western Cape. During 2023 he published seven papers of which three in high impact journals such as *Scientific Reports*, *Nature Communication* and *Science Advances*.

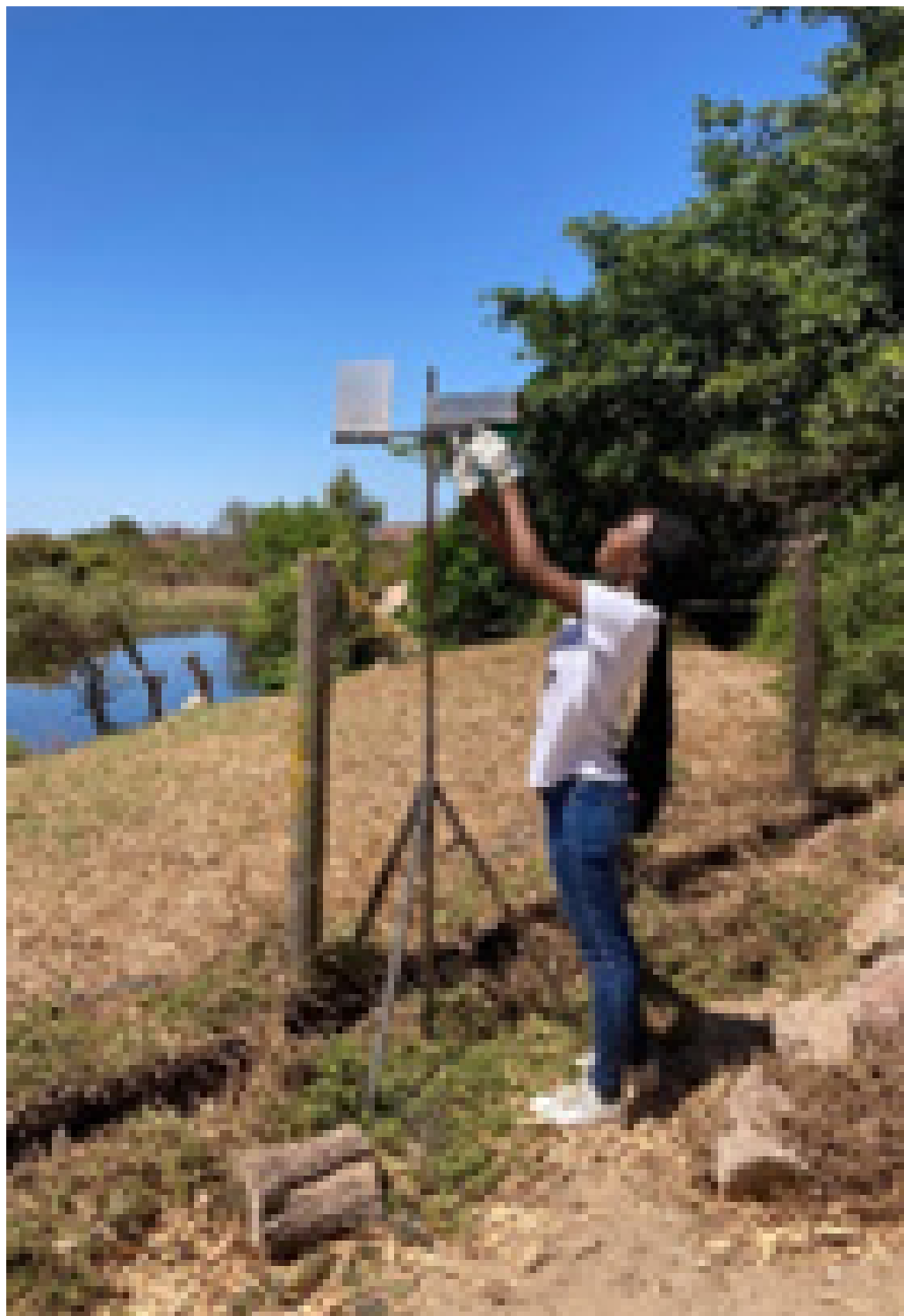


Members of the TracEx research group sampling seawater from the Benguela Upwelling system.
Image Skyla Thornton

Prof. Susanne Fietz' research in 2023 focussed on the air and surface ocean. The team studied various aspects, such as air quality in disadvantaged households as part of a project on "Building healthier communities" led by Prof. Ronelle Burger from SU's Department of Economics; as well as around Saldanha Bay in collaboration with support services manager René Toesie at the Saldanha Bay Municipality, assessing the potential health impact of fine particulates in the area. In addition, the team measured mercury in the atmosphere and surface ocean within a bilateral SA-France effort led together with South African Weather Service's Dr Lynwill Martin. The surface ocean also remained under investigation assessing the drivers of phytoplankton community distribution and impact of metals on algae. The community composition further served in a paleo-reconstruction study to decipher key past climate changes in the Benguela Upwelling system in a collaborative effort with Dr Eugene Bergh from Iziko Museums of South Africa and North-West University. As part of these efforts, Prof. Fietz gave invited talks and chaired sessions at an international conference (e.g., ASLO, Spain, June 2023) as well as at national events (e.g., SANAP Symposium, Western Cape, November 2023). She also published several international peer-reviewed publications and graduated two MSc students in 2023. She is furthermore Associate Editor for *Global Biogeochemical Cycles*, a Q1 international scientific journal, and served on international grant panels in 2023. This was also her last year (rotated off) as national representative of the GEOTRACES Steering Committee, an international initiative to measure trace elements and their isotopes in the ocean.



Dust sampling and analysis supporting assessment of potential health risks in the area. Dr Heleen Vos (left), postdoctoral researcher, and Honours student Anesu Karadzandima (centre) assembling and setting up a passive dust sampler in Saldanha Bay to collect bulk dust. On the right, MSc student Kereemang Gaoaaga analysing dust particles collected in RDP houses under the SEM at CAF-SU.

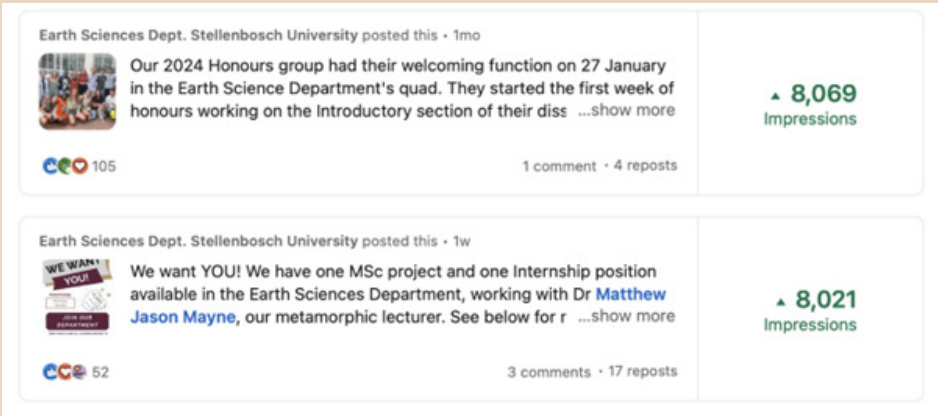


SOCIAL IMPACT

Social media presence

Dr Tahnee Otto, our social media representative, posts stories two to three times a week across social media platforms such as Facebook, Instagram, and LinkedIn. Video stories are posted on TikTok every few months. Some metrics: our department's Facebook posts reached 3,300 accounts and 335 engagements (reactions, comments, and shares) over the metric's standard 90 days. Our departmental Instagram

posts reached 1,900 accounts with 1,600 engagements (likes, comments, and shares) over the same standard 90 days period. Our departmental LinkedIn account reached 615 followers and had 80,700 impressions over the same past 90 days. Our followers are c. 30% geologists, and 40% related to the mining sector. Two examples of successful LinkedIn posts are:



School and traditional media interactions

Dr Bjorn von der Heyden presented a talk to over 200 grade 11 and grade 12 learners selected to attend the Department of Mineral Resources and Energy (DMRE) Learner Focus Week. The event took place at the University of Cape Town in July 2023. The title of the talk was "Critical raw materials required for renewable energy transitions".

Dr Von der Heyden, Melita Dlelana and two postgraduate students presented at an outreach event at Thembelihle Secondary School in Khayelitsha. The talk sought to attract students to the earth sciences and was conducted in partnership with a team from iThemba Labs.

Prof. Susanne Fietz gave newspaper and radio interviews in 2023 on aspects of climate change.

Translational deliverables

Dr Heleen Vos in collaboration with Dr Janine Colling (BIOGRIP) and Prof. Susanne Fietz produced a 19-page report for

Saldanha Bay/Langebaan Municipality to inform on potential sources and transport mechanisms of airborne nutrients and pollutants (bacteria, organics, metals, plastic), with recommendations for possible mitigation strategies.

AWARDS TO STAFF AND STUDENTS

PhD student **Steve Chingwaru** was invited as a panel expert in discussions with City of Johannesburg about the management of historical tailings, and opportunities for artisanal miners. MSc student **Rutger La Cock** received the Best Oral Presentation award at the DSI-NRF CIMERA Annual Research Colloquium. Postgraduate student **Yann Waku Mpaka** received the Best Student Presentation award at the Society for Geology Applied to Ore Deposits (SGA) 17th biennial conference in Zurich. A postgraduate student cohort comprising six students were selected as finalists for the Prospectors and Developers Association Conference (PDAC) Frank Arnott Next Generation Explorer Challenge in Canada. The Rehana Malgas-Enus Early Career Academic Development

(ECAD) Award was made to **Dr Matthew Mayne** for academic offering of short courses on phase equilibria modelling. He also received the NRF Thuthuka Post PhD track grant for 2024-2026 to investigate resources for clean energies in South Africa.

Llelani Coetzer won the Best BScHons Presentation award at the Igneous and Metamorphic Studies Group meeting. Postdoctoral fellow **Dr Heleen Vos** won the Best Early Career Oral Presentation at the 2023 International Conference on Aeolian Research in Las Cruces, New Mexico.

STAFF MATTERS

Dr Reynold Chow resigned on 1 January 2024 as lecturer in Hydrogeology and **Dr Amy Allwright** joined the department. **Mr George Olivier**, our senior technical officer, completed his PhD studies and will graduate in March 2024. **Dr Ryan Tucker** was promoted to Senior Lecturer. **Prof. Alex Kisters**' term as head of department ended. **Prof. Susanne Fietz** was elected as new head of department and will serve from October 2023 to September 2026.

FUNDING

- 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)
- NRF SARCHI funding
- National Research Foundation (NRF) Thuthuka program
- National Research Foundation (NRF) CPRR program
- National Science Foundation (NSF): Frontier Research in Earth Sciences (FRES)
- Orange River Pegmatite Company
- Osino Resources
- Pan-African Resources
- Stellenbosch University: Early Career Advancement Grant 2020
- Stellenbosch University: Sub Committee B
- Donor funding: Whales and Climate Change Program

STAFF LIST

Academic

- Dr R Chow
- Prof. 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 Saumik Samanta
- Dr Heleen Vos
- Dr Clement Demasy
- Dr O. Valk



CONTACT DETAILS

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NRF-RATED RESEARCHERS

Internationally acclaimed researchers	
Prof. JD Clemens (retired)	Granite petrogenesis
Prof. A Kisters	Structural geology
Prof. G Stevens	Experimental petrology
Established researchers	
Prof. S Fietz	Environmental geochemistry, biogeochemistry
Dr B von der Heyden	Economic geology
Dr R Tucker	Sedimentology and palaeontology

DEPARTMENT OF MATHEMATICAL SCIENCES

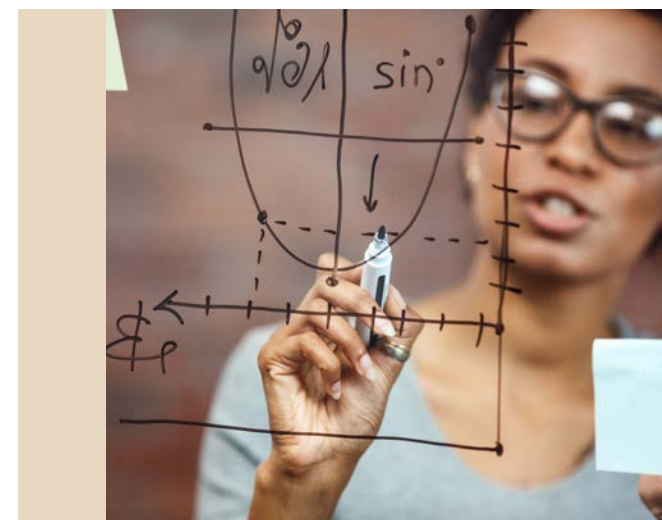
RESEARCH INTERESTS

Applied Mathematics Division

Fluid dynamics and modelling; Numerical analysis and scientific computing; Computational fluid dynamics; Flow through porous media; Solid Mechanics; 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.

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

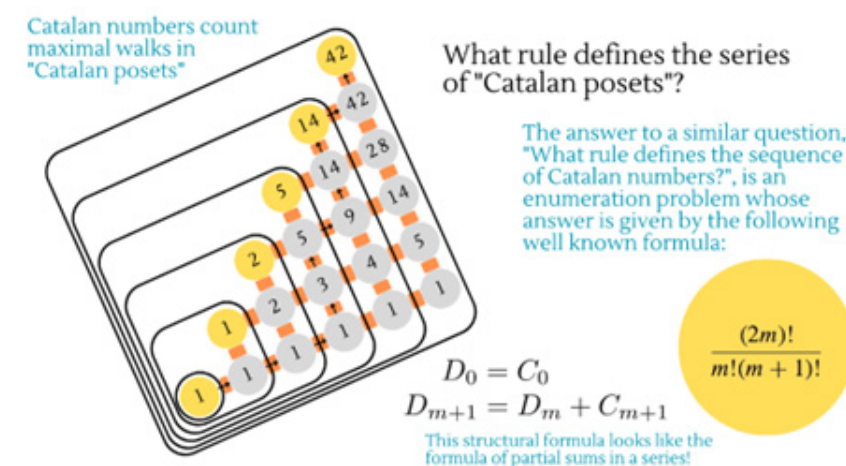
Prof. Cang Hui was one of over 100 co-authors of the paper 'Integrated global assessment of the natural forest carbon potential' published in the journal *Nature* in November. This study found that natural forests have the potential for carbon storage so reducing deforestation and revitalising ecosystems may contribute towards combating climate change. This forms part of a collective effort of the Global Forest Biodiversity Initiative in counting and mapping the world's forest ecosystem.

Prof. Hui was part of another global study to determine the relative importance of human activity, environmental conditions, and biological diversity as drivers of tree invasions worldwide. This resulted in the multi-author paper "Native diversity buffers against severity of non-native tree invasions" published by *Nature* in August. Two key findings were that the native biodiversity of natural forests largely buffers the severity of non-native tree invasions, but humans are most responsible for introducing non-native tree species to an area.

Wolfram Mathematica code developed by Prof. Hui for the paper "Disentangling the relationships among abundance, invasiveness and invasibility in trait space" published in *npj Biodiversity* was selected for editorial columns at Wolfram Community (<https://community.wolfram.com/groups/-/m/t/2936678>).

Prof. Zurab Janelidze published a paper in *Order* titled "Combinatorics arising from lax colimits of posets", co-authored with Profs H. Prodinger and F. van Niekerk, that introduced a methodology for uncovering a sequence of structures behind a sequence of integers, based on a

category-theoretic construction. He gave an invited talk on the topic of this paper at the Emerging Perspectives in Mathematics II conference in Zingwazi (near Durban) in April 2023.



A slide from an invited talk by Zurab Janelidze at the Emerging Perspectives in Mathematics II conference in Zingwazi (April 2023). The slide poses a question that leads to identifying a pattern of mathematical structures behind a sequence of integers.

RESEARCH ACTIVITIES

Dr Liam Baker had the opportunity to spend three-month research leave at the Institute for Advanced Studies on invitation from Prof. Peter Sarnak. During this time, he submitted a paper based on his PhD thesis (with some improvements) to the *Transactions of the American Mathematical Society*, worked on the Gardner Cubes Problem and strengthened his research collaboration with Dr Jonathan Kariv from the University of the Witwatersrand.

Dr Bruce Bartlett had two single author manuscripts accepted for publication: "The quintic, the icosahedron, and elliptic curves" to appear in the *Notices of the American Mathematical Society* – the most widely read journal in Mathematics as well as the invited book chapter "Extended topological quantum field theories" to appear in the second edition of the *Encyclopedia of Mathematical Physics*. In addition, he submitted two papers with his postgraduate students. In July, he was invited to

visit the Algebra and Mathematical Physics group at the University of Hamburg where he gave a research talk and had meetings to strengthen Stellenbosch-Hamburg partnership. In September and October, he delivered a six-week National Graduate Academy Masterclass on Complex Manifolds. He has established a vibrant research group in Topological Quantum Field Theory in the department with participation from his former and current postgraduate students.

Dr Dirk Basson's joint 85-page paper titled "Drinfeld modular forms of arbitrary rank" with Prof. Florian Breuer and Prof. Richard Pink was accepted for publication by the prestigious *Memoirs of the American Mathematical Society*. In addition, he has completed and submitted two single-author manuscripts "On a u-expansion principle for higher rank Drinfeld modular forms" to *Composito Mathematicae* and "Hecke operators on Drinfeld modular forms" to the *Journal of Number Theory*. His masters' student, co-supervised with Dr Magdaleen Marais and Janko Böhm, successfully completed a very good dissertation. Dr Basson organised the biennial Stellenbosch Number Theory Conference in January 2023 with participants from Australia, South Africa, Denmark, France, Germany, Taiwan, and the United Kingdom.

Dr RONALDA BENJAMIN had two joint papers accepted for publication: "Spectrally additive maps on Banach algebras" (with Dr Francois Schulz) in *Acta Mathematica Hungarica* and "A note on the order Lozanovsky spectrum for positive operators" (with Dr Christian Budde) in *Complex Analysis and Operator Theory*. She presented her research at the Functional Analysis and Operator Theory 2023 Workshop in Limpopo in July and visited her collaborators Dr Christian Budde (University of the Free State) and Dr Francois Schulz (University of Johannesburg) in August and December, respectively. In April, she successfully launched the Western Cape STEM MentHER program at Stellenbosch University with the goal of providing mentorship to top Grade 12 female learners from schools in the Western Cape.

Prof. Gareth Boxall was invited to attend and present his research at a model theory meeting at the Banff International Research Station in Canada in February. With the help of grant funding from CoE-MaSS, his postdoc, Tsinjo Rakotonarivo, visited their collaborator, Dr Charlotte Kestner from Imperial College in the UK and thereafter she visited Stellenbosch. He had two papers accepted for publication by prestigious journals one (with Dr Kestner) by *Journal of Symbolic Logic* and another as sole author in *Archive for Mathematical Logic*.

Prof. Willie Brink secured PhD fellowships from InstaDeep and extended the DeepMind-SU scholarship programme for 2024. With this support students can participate in the

Structured MSc in Machine Learning and Artificial Intelligence programme as well as pursue doctoral studies thereafter. He was an invited speaker at the Machine Learning Summer School in January and presented a three-week course for the AI for Science Masters' programme at AIMS-SA in November. Prof. Brink has a particularly good cohort of 10 postgraduate students, including five co-supervised PhD students (of which one graduated in 2023), and two MSc students, most of whom are aiming to complete their studies in 2024. Prof. Brink had two journal papers and two peer-reviewed workshop papers published in 2023 despite the limited number of manuscripts accepted by peer-reviewed journals and conferences in machine learning.

Dr Maret Cloete visited the University of Bergen (Norway) where she was part of the examination panel for a PhD and MSc student.

Dr Hanno Coetzer has a good cohort of six postgraduate students, including PhD students Aviwe Kohlakala who graduated in December 2023 and Emile Beukes who has submitted his thesis and will graduate in March 2024. Each of these students have accepted publications flowing from their thesis work. Dr Coetzer has sustained his collaboration with KU Leuven and Medical Care NV (Belgium).

Dr Hardus Diedericks published in the high impact journal *Aquaculture* a paper titled "From soil to sea: An ecological modelling framework for sustainable aquaculture" based on industry project work with Longline Environment. He has continued research collaboration with Dr Gunnvør á Nordi from the research institute Fiskaaling on the Faroe Islands. Through this collaboration his MSc student Francois Naudé had the opportunity to visit the Faroe Islands where he did some measurements for his research and visited four fish farms.

Dr Andie de Villiers was on research leave from April to December at the University of Southampton (UK) for collaboration with Prof. Georges Limbert on modelling fibre reinforced biological tissue. She also travelled to Erlangen (Germany) to participate in two research workshops and continue work on her ongoing project on configurational peridynamics with Paul Steinmann (University of Erlangen-Nuremberg, FAU), Ali Javili (Bilkent University) and Andrew McBride (Glasgow University). That collaboration has already led to a publication titled "Configurational peridynamics" in *Mechanics of Materials* as well as a conference presentation at Configurational Peridynamics (Conference on Fractional Mechanics) in Prague. One of her MSc students successfully completed her dissertation for graduation in March 2024.

Dr Marcel Dunaïski received a National Institute of Health (NIH) grant for the INFORM Africa Pilot Project with the Centre for Epidemic Response and Innovation (CERI) at Stellenbosch University. One of his MSc students completed his thesis within ten months and another successfully upgraded to PhD studies. He is a consultant at the Centre for Research on Evaluation, Science and Technology (CREST) working on various data mining problems.

Prof. Andries Engelbrecht served as Deputy-Editor-in-Chief of the *Engineering Applications of Artificial Intelligence* journal. In addition, he served as an associate-editor for *Swarm Intelligence; Evolutionary Computation; Complex and Intelligent Systems; International Transactions on Operational Research; MethodsX; and International Journal of Cognitive Computing in Engineering*. He served as the Artificial Intelligence Series Editor for *IntechOpen Series*. International roles include appointment as external research fellow at the Gulf University for Science and Technology in Kuwait, adjunct faculty member at South Asian University in India, and honorary chair professor at Bennet University in India. He served as advisory committee member of the Soft Computing Research Society of India, of the steering committee of the International Conference on Swarm Intelligence, and as member of the IEEE Computational Society Evolutionary Computation Technical Committee. He served as general co-chair and proceedings editor of the International Conference on Computer Vision and Robotics 2023, India. He presented two keynotes, i.e. "Set-based Particle Swarm Optimization and its Applications" at the International Conference on Intelligent Systems, Metaheuristics and Intelligence, and "A Belief Space Approach to Self-Adaptive Particle Swarm Optimization" at the Computer Applications and Technological Solutions Conference in Kuwait.

Prof. Sonia Fidler received an Erasmus+ scholarship to attend a one-week summer school at Radboud University, The Netherlands, in June. While abroad she visited her collaborator Prof. Jeff de Hosson at the University of Groningen, attended the 12th International Conference on Porous Metals and Metallic Foams (MetFoam 2023) in Dresden Radebeul, Germany, and visited two of the Fraunhofer Institutes. Her PhD student Esmari Maré successfully completed her doctoral dissertation within three years and graduated in December 2023. From her thesis research she has two publications, one international peer-reviewed conference paper and a third journal paper submitted.

Prof. Bernd Fischer was awarded the NRF B1 rating as well as the NRF Support for Rated Researchers grant titled "Grammar Inference through Repeated Localization and Repair". He received the Most Influential Paper award at the 38th IEEE/ACM International Conference on Automated

Software Engineering (ASE 2023) for his ASE '09 paper "SMT-Based Bounded Model Checking for Embedded ANSI-C Software". He was re-elected as the steering committee chair of ASE conference series. Prof. Fischer's PhD student Moeketsi Raselimo graduated and presented together with Prof. Fischer his research paper titled "Static Test Case Prioritization Strategies for Grammar-Based Testing" at the 14th International Workshop on Automating Test Case Design, Selection, and Evaluation held in Kirchberg (Luxembourg) in September. Dr Raselimo was awarded an SU Consolidoc grant to continue his research with Prof. Fischer. Another of his postgraduate students, Dylan Callaghan, successfully upgraded his MSc research to a PhD research proposal and presented together with Prof. Fischer their research paper "Improving Spectrum-Based Localization of Multiple Faults by Iterative Test Suite Reduction" at the International Symposium on Software Testing and Analysis held in Seattle (USA) in July.

Prof. James Gray had a productive year working on several projects from which he hopes several publications will arise in the coming year. In particular, he has been investigating a weakening of the notion of protonormal, with Dr Michael Hoefnagel, as well as a more conceptual proof of one of his previous results. In addition, he has been studying internal one cocycle objects and their link to cohomology.

Dr Trienko Grobler published five journal papers and one conference paper. Two of these are the result of collaboration on radio galaxy morphology classification with Prof. George Azzopardi at the University of Groningen and their co-supervised PhD student Steven Ndung'u. Dr Grobler's MSc students Jason Jackson and Christoff van Zyl graduated. Mr Jackson's MSc research on "Characterising the calibration systematics in radio interferometry due to partially modelled extended emissions" was published in the Monthly Notices of the Royal Astronomical Society.

Prof. Nick Hale was an invited speaker at the conference Numerical Analysis in the 21st Century held in honour of Prof. Nick Trefethen's retirement from the University of Oxford in August 2023. His MSc student Emma Nel graduated cum laude with an MSc in Applied Mathematics and will continue with her PhD studies under his supervision.

Dr Retha Heymann started working on the so-called Lyapunov Algebra following her research visit to Germany in January where she fostered her contact with Prof. Rainer Nagel at the University of Tübingen, Prof. Balint Farkas at the University of Wuppertal and Prof. Tanja Eisner at Leipzig University.

Dr Michael Hoefnagel attended the international conference Category Theory 2023 at the Université Catholique de Louvain in July. During his research visit in Europe, he established collaborations with various researchers, most notably with Prof. Dominique Bourn from Université du Littoral (France) as well as with Prof. Heinz-Peter Gumm from Universität Marburg (Germany). He also strengthened his collaboration with Prof. Diana Rodelo on Jónsson categories.

Prof. Karin-Therese Howell was an invited (online) speaker for the International Conference on Algebra, Analysis and Applications held in India in January. Together with Prof. Nancy Neudauer, from Pacific University (USA), they organised the "Women in Mathematics and its Applications Research Day" at AIMS-SA which was attended by students from higher education institutions in the Western Cape. In March, Prof. Neudauer and Prof. Carolyn Chun from the United States Naval Academy visited for collaboration on matroids of near-vector spaces.

Prof. Cang Hui published three lead-author articles and 12 co-authored articles in flagship SCI journals, including two articles in *Nature* (IF=64.8). These *Nature* papers on assessing the global forest carbon potential and the impact of non-native trees in natural forests, were highlighted in the media (*Time Magazine*, *The Guardian*, *Daily Maverick*, earth.com, SAFM, etc.).

Prof. Hui is leading four research projects: the SARChI Research Programme for Mathematical and Theoretical Physics Biosciences; the GLoBal Insect Threat-Response Synthesis (GLITRS, UK NERC grant); the Ecological Community in Transitions from Biological Invasions (Australian Research Council); and the B-cubed project (European Commission, Horizon Europe). He delivered the plenary "Formulating species turnover and accumulation with zeta diversity" at the British Ecological Society Macroecology meeting (BES Macro 2023), Birmingham, UK, July-13, 2023; and the plenary "Disentangling the relationships among abundance, invasiveness and invasibility in trait space" at the International Symposium on Modelling Adaptive Dynamics of Ecological Networks, Hefei, China, on 16 December 2023. He organised three topic-focused workshops at Stellenbosch, on "Identification of biotic interactions in microbiota", "Modelling community assembly with trait-mediated interactions", and "Modelling structural emergence in complex adaptive, open systems", and hosted four international visitors: Prof. S ElAidy from the University of Groningen, the Netherlands; Prof. J Molofsky from the University of Vermont, USA; Prof. F Dercole from Politecnico di Milano, Italy; and Prof. T Koffel from Université Lyon 1, France. He is involved with editorial work for eight accredited journals: Associate Editor for *Mathematics in*

Medical and Life Sciences (launched in 2023 at Taylors & Francis), *Bulletin of Mathematical Biology* (Springer), *Global Ecology and Biogeography* (Wiley), *Biological Invasions* (Springer), and for *Ecological Complexity* (Elsevier); editorial board member for *BMC Ecology and Evolution*, for *Frontiers in Ecology and Evolution*, and for *Journal of Dynamics and Games* (American Institute of Mathematical Sciences). He also served as the reviewer editor for the thematic assessment at the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

Dr Cornelia Inggs was involved with three ongoing research projects covering concurrency and code analysis. One of her MSc students successfully completed his dissertation on the problem of using transformer-based models to generate test cases.

Prof. Zurab Janelidze worked on several collaborative research projects, mostly with his postgraduate students (which includes seven PhD students). He gave invited talks at two international conferences: XIII Annual International Conference of the Georgian Mathematical Union in August/September as well as Logic and Algebra Satellite event to the 108th Peripatetic Seminar on Sheaves and Logic in Italy in September, where he gave an outline of the state of arts of the theory of exactness properties of categories – one of his main fields of specialization in categorical algebra. He presented a course on adjoint functions at the CIMPA school on "Logic at the Intersection of Algebra, Categories and Topology" held at the University of Johannesburg in January. He visited the Gravity Research Group at the University of Kwa-Zulu Natal in August as well as the Categorical Algebra Research Group at the University of Louvain-la-Neuve in September. During 2023, he hosted three research visitors: Prof. Peter Jipsen from Chapman University (USA) in January, Prof. Marino Gran from Université catholique de Louvain (Belgium), Dr Cerene Rathilal from the University of Kwa-Zulu Natal in May, and Prof. Mario Clementino from Coimbra University (Portugal) in November. He is a principal investigator in the Mathematical Structures and Modelling Research Programme at the National Institute for Theoretical and Computational Sciences and has worked on several research projects within this research programme, including a project that investigates mathematical structure of musical form, which led to several public engagement activities in Stellenbosch. In the context of Stellenbosch University, one of the notable activities within the research programme was the visit of Diana Rodelo (Portugal) to SU in August, who gave a lecture series in categorical algebra, attended by postgraduate and undergraduate students. During the visit of Prof. Hans Porst, a successful category theory seminar was organised by Prof. Janelidze and Prof. James Gray, which was attended by staff and students in



Category Theory Seminar organised for the visit of Prof. Hans Porst in March 2023.

Mr Shane Josias presented his PhD work at the peer-reviewed international conference workshop on the symbiosis of deep learning and differential equations in December. He was also the co-author, along with researchers from SACEMA and the Department, of a multi-author paper on "Deep learning approaches to landmark detection in tsetse wing images" published by *PLOS Computational Biology*.

Prof. Steve Kroon, together with his recently graduated MSc student Jacobie Mouton, published a paper titled "Integrating Bayesian network structure in residual flows and variational autoencoders" in *Transactions on Machine Learning Research*. In addition, he published two conference papers, including "Topological dynamics of functional neural network graphs during reinforcement learning" at the International Conference on Neural Information Processing, together with his collaborator Prof. Stephan Chalup from Newcastle University (Australia) and their joint PhD student, Matthew Muller. He was also invited to present on the topic of normalizing flows at the January 2023 edition of the Machine Learning Summer School organized by Praelaxis in collaboration with SU.

Dr Pietro Landi was the co-author, along with researchers from SACEMA and the department, of a multi-author paper on "Deep learning approaches to landmark detection in tsetse wing images" published in *PLOS Computational Biology*. He also presented an ongoing collaborative project titled "The effect of pollination on plant spread dynamics" at the annual British Ecological Society meeting in Belfast in December.

Dr Sophie Marques was on research leave from July to December. During this time, she spent three months on an extensive academic journey that spanned four different universities in Europe – University of Bordeaux (France) hosted by Prof. Qing Liu; Université de Pau et des Pays de l'Adour (UPPA) in France and hosted by Prof. Jean Valles; University

of Padova (Italy) hosted by Prof. Federic Bambozzi; and University of Coimbra (Portugal).

She delivered seven presentations in diverse academic settings, disseminating her research and facilitating academic networking: "Decolonial theory and humanizing pedagogy in postgraduate research" (respondent) at the Crest alumni network meeting; "La géométrie des espaces de modules: classification des extensions de corps à isomorphisme près" (joint work with Jacob Ward, Mpendulo Cele, Elizabeth Merma, Chad Brache) at the University of Bordeaux, France; "Exploration des équations polynomiales à travers la théorie des corps" at UPPA, France; "The Geometry of Moduli Spaces: Classification of Field Extensions up to Isomorphism" (with Jacob Ward, Mpendulo Cele, Elizabeth Merma, Chad Brache) at the University of Padova, Italy; "Exploring polynomial equations through Field Theory" at the University of Coimbra, Portugal, during the Algebra, Logic, and Topology seminar; "Early career mathematical scientists international research collaborations and networks" at the Early Career Mathematical Scientists conference; "Exploring the Intricacies of Polynomial Equations: A Journey into Mathematical Connections" at Coe-mass. In addition, Dr Marques achieved significant milestones as a postgraduate supervisor during her research leave: her two PhD students and one MSc student completed their theses for examination and her two PhD students each submitted two manuscripts for publication. In addition, she made significant progress towards completing research papers with her various collaborators for publication. Joint with Daniella Moore, the paper "Near-linear algebra" was accepted for publication in the *Journal for Algebra and Applications*.

Prof. Sonja Mouton had two research papers accepted for publication – one with her PhD student Dimby Rabearivony in *Quaestiones Mathematicae* and one with her collaborator Prof. Robin Harte in the *Bulletin of the Australian Mathematical*

Society. Her PhD student Dimby Rabearivony successfully completed his doctoral thesis within three years and had the opportunity to present his research at the Positivity XI Conference in Slovenia.

Dr Mkhusele Ngxande was a co-author on a 13-author paper titled "In-silico and in-vitro assessments of some fabaceae, rhamnaceae, apocynaceae, and anacardiaceae species against *Mycobacterium tuberculosis* H37Rv and triple-negative breast cancer cells" published in *BMC Complementary Medicine and Therapies*.

Dr Naina Ralaivaosaona was a co-author on a 97-page paper titled "The birth of the strong components" published in *Random Structures and Algorithms*. With his Italian collaborators Dr Alberto Cazzaniga from Area Science Park and Dr Andres Ricolfi from Scuola Internazionale Superiore di Studi Avanzati in Trieste, he published the article titled "Higher rank motivic Donaldson–Thomas invariants of A3 via wall-crossing, and asymptotics" in the *Mathematical Proceedings of the Cambridge Philosophical Society*. He secured a research grant from the Centre of Excellence in Mathematical and Statistical Sciences (CoE MaSS) at the University of the Witwatersrand for his project "Critical Random Digraphs". One MSc student completed his dissertation. He visited Prof. Hsien-Kuei Hwang at Academia Sinica in Taiwan in July 2023. As a part of an NRF-funded project, he visited Prof. Vlady Ravelomanana at the Institute de recherche en informatique fondamentale (IRIF) of Paris Cité University in October 2023.

Dr Gavin Rens co-authored paper titled "Safe reinforcement learning via probabilistic logic shields" was presented at the 32nd International Joint Conference on Artificial Intelligence in Macao (Portugal) in August, where it was acknowledged as one of three distinguished papers.

Dr Riana Roux has been actively working on her ongoing collaborative research projects including subdivision criticality with Prof. Michael Henning (University of Johannesburg), Dr Magdalena Lemanska and Dr Magda Dettlaff from Gdansk University (Poland), extremal trees with fixed segment diameter with Dr Erick Andriantiana from Rhodes University, Dr Sonwabile Mafunda from Soka University of America (USA) and Dr Zekhaya Shoji from Sol Plaatje University, as well as zero-forcing irredundance with Prof. Leslie Hogben and Dr Curtis from Iowa State University (USA). Dr Roux, together with Dr Simon Mukwembi from the University of the Witwatersrand and Dr Eric Adriantiana from Rhodes University, have organised as part of the CoE MaSS Graph Theory node several collaborative research activities, including the Graph Theory Research Retreat in Stellenbosch in

September. She had the rewarding yet challenging experience to present a course in graph theory at AIMS-SA in February.

Prof. Ingrid Rewitzky's SU Teaching Fellowship research on a complexity theory view of learning culminated in the paper "Re-envisioning our journey of learning in Mathematics" published in the *International Journal of Mathematical Education in Science and Technology* and presented at the 14th DELTA International Conference on the Teaching and Learning of Undergraduate Mathematics and Statistics in November. This was also the topic of her speech as invited guest speaker for the First-year Achievements Awards Evening in March 2023. Prof. Rewitzky is an associate editor for *Quaestiones Mathematicae*.

Prof. Francois Smit was co-supervisor and supervisor of three students, one PhD (as co-supervisor in collaboration with the Departments of Civil Engineering) and two Masters' students (one as supervisor and one as co-supervisor). All students successfully completed their dissertations for graduation in March 2024. One masters student, Mr Jose Sequeira, presented a paper titled "Shape from silhouette 3D reconstruction of natural fragmenting warhead fragments" at the 33rd International Symposium on Ballistics in October.

Prof. Hugo Touchette had three publications despite his extensive involvement in the offering of the Structured MSc in Machine Learning and Artificial Intelligence. His publication, with Prof. Francesco Coghi from the KTH Royal Institute of Technology and Stockholm University, titled "Adaptive power method for estimating large deviations in Markov chains" was published in *Physical Reviews E* and selected as the editor's suggestion. His PhD student Johan du Buisson graduated in March and started a postdoctoral position in Canada.

Prof. Bill Tucker submitted, together with current and former postgraduate students, several conference papers (one accepted by the 18th IFIP Working Group 9.4 Conference on the Implications of Information and Communication Technologies for Development) as well as a manuscript. Together with collaborator Mrs. Clarissa Robertson in SU's Ethics Office, he submitted a book proposal "Agile ethics review in a socio-technical world: A manifesto" for publication by EthicsPress.com.

Prof. Brink van der Merwe had six peer-reviewed research outputs. Two of these were with his longstanding collaborator Martin Berglund from Umeå University in Sweden. The paper "Re-examining regular expressions with back references" was published in the journal *Theoretical Computer Science* and "Formalizing BPE tokenisation" (i.e. on byte pair encoding as

used in the transformer architecture) was presented at the 13th International Workshop on Non-Classical Models of Automata and Applications. He co-authored with his MSc student, Andrei Dreyer, and Stefan Strydom, co-founder of Mast Analytics, a paper titled "Automatic assignment of diagnosis codes to free-form text medical notes". His work (with Daniel Barrish and Steve Kroon) on making superhuman AI more human in chess, can be viewed on YouTube. He served on the programme committee of the 27th International Conference on Implementation and Application of Automata.

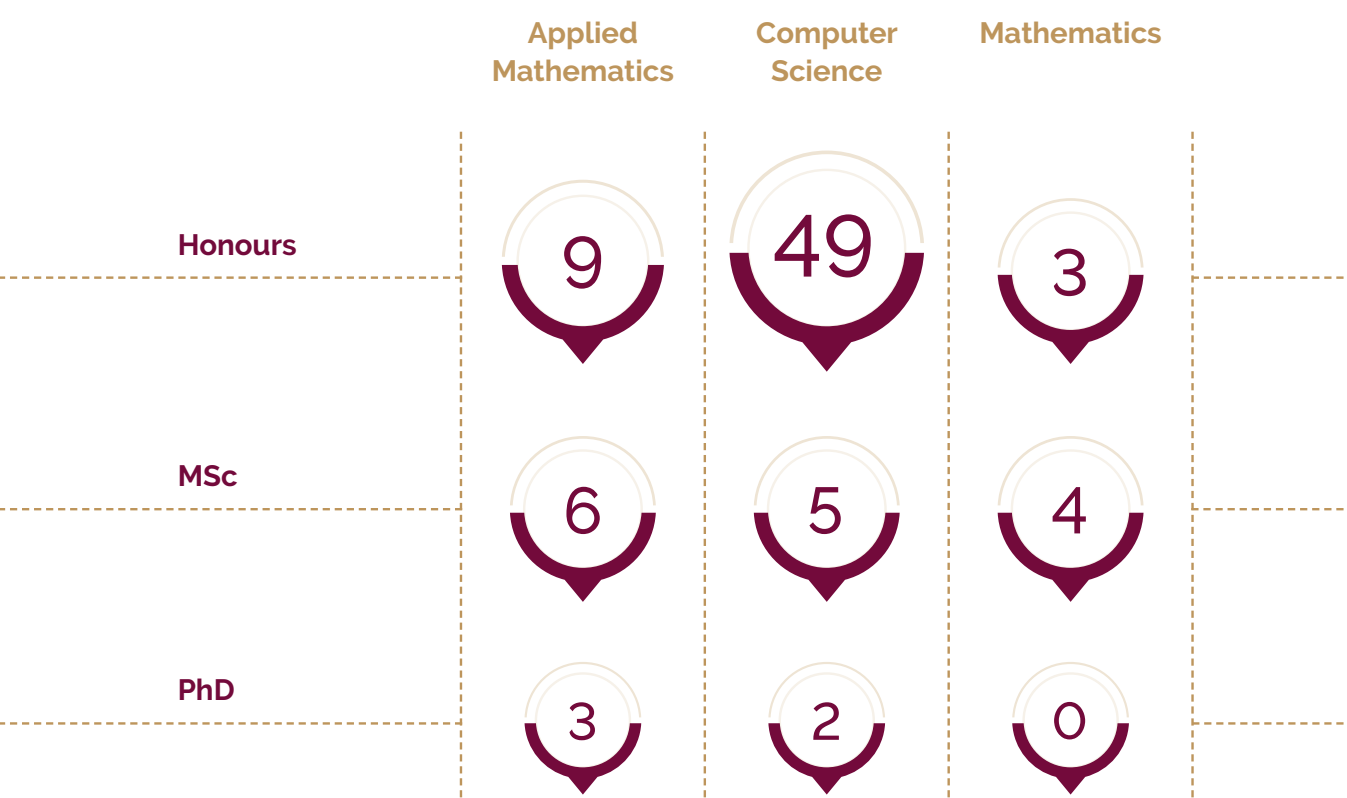
Prof. Francois van Niekerk's collaborative research with Prof. Zurab Janelidze and Prof. Helmut Prodinger culminated in the paper "Combinatorics arising from lax colimits of posets" which has been accepted by *Order*. Together with Prof. Janelidze, they submitted for publication a 68-page paper titled "Every topos has an optimal Noetherian form" which was based on his PhD dissertation.

Prof. Leon van Wyk achieved two significant research milestones resulting from longstanding successful collaborations: a paper titled "Cyclic algebras, symbol algebras and gradings on matrices" with his Romanian co-authors Sorin Dăscălescu and Crina Boboc, was submitted for publication in the best linear algebra journal *Linear Algebra and its Applications*, as well as a 39-page paper, with his Polish collaborator Michał Ziemkowski and Paweł Matras (PhD student of Ziemkowski), was submitted for publication in the prestigious algebra journal *Journal of Algebra*. Prof. Van Wyk also serves as associate editor of *Afrika Matematika* and *Quaestiones Mathematicae* as well as editor of *Miskolc Mathematical Notes*.

Prof. Lynette van Zijl, together with honours student Lisa van Staden, presented her honours project "Parsing Semi-Structured Languages: A Crochet Pattern to Diagram Translation" at the 44th Conference of the South African Institute of Computer Scientists and Information Technologists in July. Joint work with Dr Trienko Grobler on bordered box repetition-free words has resulted in two research outputs: a journal paper titled "Search Algorithms for the combinatorial generation of box repetition-free words" published in the *Journal of Universal Computer Science*, and a conference paper titled "A Tight Upper Bound on the Length of Maximal Bordered Box Repetition-Free Words" presented at the 25th International Conference on Descriptive Complexity of Formal Systems in July. She is an associate editor of the *Journal of Universal Computer Science*.

Prof. J.A.C. Weideman presented two invited talks, one at the AIMS-SA Workshop on Integrable Systems and Orthogonal Polynomials in April and a plenary talk at the conference Numerical Analysis in the 21st Century held in honour of Prof. Nick Trefethen's retirement from the University of Oxford in August 2023. He co-organised a follow-up workshop on the 2019 programme on Complex Analysis: Techniques, Applications and Computations at the Isaac Newton Institute on Mathematical Sciences, Cambridge University, in July. Prof. Weideman's research collaboration on blow-up solutions of nonlinear heat equations with Prof. John King and Dr Marco Fasoldini has resulted in one publication and another submitted. He served as associate editor for *Numerical Algorithms* and *Electronic Transactions of Numerical Analysis*.

ACADEMIC AFFAIRS



In addition, for the MSc in Machine Learning and Artificial Intelligence, there were 13 graduates in December 2023 and 1 graduate in March 2023.

Dr Marcel Dunaïski has developed a framework for autograding Python programmes which can be integrated with CodeRunner on Moodle. This was used for assessment in first-year Computer Science modules including the practicals. **Mr Indren Govender** planned and presented a workshop on Cybersecurity to third-year Computer Science students.

Dr Cornelia Inggs, together with her BSc Honours students, developed a scalable and robust online application for receiving program submissions and providing guided feedback on submissions. In addition, they developed techniques for automated testing, marking, and feedback generation for programming submissions.

AWARDS TO STAFF AND STUDENTS

Prof. Bernd Fischer received the Most Influential Paper award at the 38th IEEE/ACM International Conference on Automated Software Engineering (ASE 2023) for his ASE '09 paper "SMT-Based Bounded Model Checking for Embedded ANSI-C Software", for the "breakthrough contribution on the verification for embedded ANSI C-C software" presented in his ASE 2009 paper. This award is given retrospectively to selected papers that have had a proven impact on the field ten to fifteen years after their publication.

Gregor Feierabend, an honours student in mathematics and computer science, was awarded a Gates Cambridge scholarship to pursue his MPhil in Computer Science at the University of Cambridge from 2023.

Emma Nel, Masters' student in applied mathematics, **Elizabeth Mrema** and **Emma Theart**, PhD students in mathematics, received best talk awards at the annual congress of the South African Mathematical Society in the special sessions "Differential Equations", "Graph Theory and Number Theory", and "Category Theory, Algebra, Topology and Logic", respectively.

At the First-year Achievements Awards evening in March, four colleagues were nominated by top performing first year students: **Dr Dirk Basson**, **Ms Bessie Burger**, **Dr Francois van Niekerk**, **Dr Lesley Wessels**.

We had six students (**Kerry Porrill**, **Andrew Williams**, **Karlo Grobbelaar**, **Jean Weight**, **Danielle Kleyn**, and **Benjamin Kleyn**) in the top 12 of the Undergraduate section of the Wits Mathematics Competition, and Stellenbosch University was ranked first overall. Our participation in the competition was organised by **Dr Dirk Basson** and **Dr Liam Baker**.



The winning team in the annual Data School Hackathon was, from the left, Wicus van der Linden, Daniel van Zyl and Christiaan Hildebrand.

A team consisting of two fourth year Computer Science students and one third year BDat Science student won first place in the annual Data School Hackathon, which took place in collaboration with Standard Bank Lab and Mobylaz in August this year.

Top achievers in Applied Mathematics for the 2022 academic year were: **André Steyl** (best first year students), **Danielle Kleyn** and **Mia Stoffberg** (best second year students), **Alexandra van der Spuy** (best third year student) and **Francois Naudé** (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 2022 academic year: **Luka Joubert**, **Samuel Lloyd Johnson** (best first year students); **Christian Kotze**, **Kian Nicholas Claassen** (best first year engineering mathematics students); **Rachel Georgia Pereira**, **Kerry Jean Porrill** (best second year students); **Danielle Madeleine Kleyn**, **William Carlyle Stewart** (best third year students); **Bernardus Adriaan Wessels**, **Nicholas Jan Sander** (best Honours students).

Top performing students in the Computer Science Division was **Joseph Chemaly** (best first year) and **Darren Dube** (best first year: runner up); **Ryan Christie** (best second year) and **Joshua Bloom** (best second year: runner up); **Iain le Roux** (best third year and winner of the Van der Walt medal) and **Jean Weight** (best third year student: runner up); **Emile Ferreira** won the prize for both best honours student and best honours project. The student's prize monies were sponsored by FNB, Spatial Edge, Impact, Entelect and Praelexis.



The Van der Walt medal for the best third year student was handed to Iain le Roux by Mrs Mattie van der Walt, widow of the late Prof. Andries van der Walt. Photo: Wiida Fourie-Basson



Prize winners of the Rubbi Awards for Mathematics.

STAFF MATTERS

Dr Bruce Bartlett was promoted to Associate Professor in Mathematics, **Dr RONALDA BENJAMIN** and **Dr Michael Hoefnagel** were promoted to Senior Lecturer in Mathematics, all with effect from 1 January 2024.

Prof. Sonja Mouton presented her inaugural lecture titled "Spectral theory in ordered Banach algebras" on 3 October 2023.

Prof. Brink van der Merwe completed his first two-year term as Division Head of Computer Science and was re-appointed for a second term from 1 January 2024 to 31 December 2025.

There were three resignations in 2023. **Mr S'yande Mungwe** resigned from Applied Mathematics with effect from 1 April 2023 and **Dr Washiela Fish** resigned from Mathematics with effect from 1 September 2023. **Prof. Therese-Karin Howell** resigned with effect from 1 January 2024 to take up the position of Academic Director: Mathematical Sciences at AIMS-SA.

On 31 December 2023 four colleagues retired. **Prof. Marcel Wild** retired after 27 years of service in Mathematics. In 2010, Prof. Wild was awarded the South African Mathematical Society's Award for Research Distinction in recognition of, amongst others, his solution of a long-standing problem in coding theory. Most of his papers are single authored – in particular, 35 of his 45 papers, according to MathSciNet. Some of Prof. Wild's papers have close ties with computer science – for example, "Compression with Wildcards: From CNFs to Orthogonal DNFs by Imposing the Clauses One-by-One" was published in *The Computer Journal* in 2022.

Dr Milton Maritz retired after 22 years of service in Applied Mathematics. With his combined physics and applied mathematics background, Dr Maritz was the "go-to" person in Applied Mathematics for any research related problem. His students often expressed appreciation for his extensive course notes, commending him on their clarity, relevance, ease of reading, abundance of practical examples and usefulness. Dr Maritz's different way of looking at concepts led him to publish a few papers in educational journals such as the *College Mathematics Journal*, *CHAOS*, and the very prestigious *SIAM Review*. His knowledge of MATLAB was phenomenal and the MATLAB tools he developed will be used for many years to come. He served (2014-2019) as the director of the Bureau of Industrial Mathematics at SU which was a vehicle for researchers to engage with industry partners.

Mrs Bessie Burger joined the department in April 2011 as a junior lecturer offering mathematics as part of the Extended Curriculum Programme (ECP) for students from Science, AgriSciences, and Engineering. Her special rapport with her students and her reflective approach for motivating and supporting these students was acknowledged by the top performing ECP students (in 2013, 2021, 2022) who nominated her as their most inspiring lecturer. Mrs Burger was one of the three developers of the Mathematics Upskilling Learning Units (ULUs) for helping students bridge their mathematics proficiency gaps during their first year of study. This hybrid learning project evolved from the e-book developed with a view to providing an affordable and reliable mathematics resource for ECP students, encouraging self-directed learning, and using regular feedback as part of the learning process.

Mrs Lauretta Adams retired after 29 years of service as the Administrative Officer in Mathematics, responsible for supporting the academic staff in their offering of undergraduate and honours modules.

Dr Gavin Rens was appointed as Lecturer in Computer Science with effect from 1 April 2023. His appointment was against a new post in Computer Science created due to the increase in undergraduate and honours enrolments.

Dr Fabian Yamaguchi was appointed as a 4/8 adjunct professor for a five-year period until 2028. With both strong industry/entrepreneurial expertise and a strong academic profile, Dr Yamaguchi will strengthen the Computer Science Division's research capabilities, extend its teaching offering, play an instrumental role in setting up collaborative research projects with groups in Europe to secure EU funding as well as contribute to developing strong partnerships between industry and the Computer Science Division.

Dr Karin Bothma was appointed as Senior Lecturer from 1 January 2024 with the primary responsibility to offer the mathematics modules as part of the Extended Curriculum Programme and to pursue research in Mathematics Education in Higher Education.

Dr Graham Manuell was appointed as Lecturer in Mathematics from 1 February 2024. He completed his PhD in Mathematics at the University of Edinburgh in 2020 on the topic of quantal spectra of semirings. Thereafter, he worked as a junior researcher at the University of Coimbra in the Algebra, Logic, and Topology Group.

Mr Prince Nchupang joined Applied Mathematics as a Junior Lecturer on 1 October 2023. His doctoral thesis for his PhD

in Mechanical Engineering at the University of Cape Town was finalised in 2023 for submission in early 2024.

Mrs Desirè Louw was appointed as Administrative Officer in Mathematics from 1 January 2024.

Prof. Karin Howell served 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, re-elected for 2024-2025). He serves on the Management Committee of NITheCS as an Associate Representative.

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. She was re-appointed Vice-Dean (Learning and Teaching) in the Faculty of Science from 1 October 2024 to 31 September 2027.

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 Fidder-Woudberg	Fluid modelling
Prof 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

SOCIAL IMPACT

Dr Liam Baker's involvement with mathematics competitions continued to be significant in 2023 – he served on the Pan African Mathematics Olympiad (PAMO) Problem Committee, as Team Leader for the International Mathematical Olympiad (IMO) in Japan, on the South African Mathematical Olympiad Paper Setting Committee and on the Simon Marais Mathematics Competition Problem Committee. In addition, he was involved in coaching at the training and selection camps for the PAMO and IMO.

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) and presented a public talk on the science behind ChatGPT at a Stellenbosch Science Café in March.

Prof. Zurab Janelidze gave five public talks: at NITheCS titled "The mind, mathematics and sustainable development" in celebration of the International Day of Mathematics in March; a NITheCS Colloquium in July titled "A New Horizon for Teaching and Learning of Mathematics"; at the University of Kwa-Zulu Natal in August titled "What makes mathematics tick?"; two lunch-hour talks in the Department of Music at Stellenbosch University, where he and his research team, including Prof. Hans Roosenschoon, presented their work on the mathematical structure of musical form. He was also invited to give a similar talk at AIMS in November, where he performed (piano) an impromptu song with Dutch-South

African singer, Amira Willighagen. He was also invited at the annual research meeting of the CoE-MaSS to address postgraduate students on mathematical structures and modelling in the context of mathematical sciences landscape in South Africa. He co-organised several scientific/science engagement activities and events, including the launch of the mathematical exploration or research sessions for school learners and undergraduate students as part of the new Future Mathematics Programme. This programme hosted a session at the annual congress of the South African Mathematical Society where three undergraduate students at Stellenbosch University and an undergraduate student from the University of Cape Town gave original research talks. In his role as President of the South African Mathematical Society and in collaboration with the President of the Statistical Association of South Africa, he convened themed conversations: "Towards a national strategy for mathematical sciences" held in Stellenbosch in June, which led to the creation of Mathematical Sciences Strategic Alliance — a think tank consisting of leadership of various societies and national academic entities in mathematical sciences. Together with a team of academics and students mostly from SU, he presented the second instalment of the theatrical production "Fundamano" at the Drostyd Theatre in Stellenbosch in December, which was centred around the interplay of mathematical structure and musical improvisation.



Group photo from the Mathematical Exploration Olympiad at Stellenbosch University (27 August) organised by Zurab Janelidze within the framework of the Future Mathematician's Programme. Two teams from Stellenbosch University and two teams from the University of Cape Town competed in coming up with novel directions of research.

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.

Prof. Bill Tucker leads a research group entitled Computing and Societal Impact (CASI) and gives an Honours course entitled Computing & Society both of which engage directly with community stakeholders. He was on the board of Zenzeleni Networks which provides low-cost internet to remote rural areas in the Eastern Cape. He is the driver behind SignSupport, a joint project between Stellenbosch and the University of the Western Cape (UWC), which engages with Deaf communities across the Western Cape. CASI is also working with !Khwa Ttu San Cultural Heritage Centre looking at digital education and cultural preservation; community farmers in Khayalitsha together with Abalimi Harvest of Hope to manage their supply chain digitally; and to design a mobile data collection tool for the SADiLar group to collect data on childhood language resources with support for multiple South African languages.

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

Netherlands

- University of Groningen

France

- IMT Atlantique in Nantes
- University of Cote d'Azur

Germany

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

Hungary

- Alfréd Rényi Institute of Mathematics
- University of Miskolc

India

- Indian Institute of Technology Roorkee

Ireland

- Trinity College, Dublin

Italy

- University of Molise, Isernia

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

- Nordic Institute for Theoretical Physics (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

- Chapman University
- 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

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

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
- Mrs EJ Burger
- Dr M Cloete
- Dr H Coetzer
- Dr A de Villiers
- Dr H Diedericks (Division Head: Applied Mathematics)
- Dr M Dunaiski
- Prof. A Engelbrecht (joint appointment with the Department of Process Engineering)
- Prof. S Fidler-Woudberg
- Prof. B Fischer
- Dr W Fish (until 31 August 2023)
- Prof. JRA Gray
- Dr T Grobler
- Prof. N Hale
- Dr R Heymann
- Dr M Hoefnagel
- Prof. K-T Howell
- Prof. C Hui (SARCHi)
- Dr CP Inggis
- Prof. Z Janelidze
- Mr S Josias
- 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
- Dr G Rens
- Prof IM Rewitzky (Head of Department)
- 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 L Pretorius (Extraordinary Professor, Computer Science)
- Prof F Yamaguchi (Extraordinary Professor, Computer Science)

Emeritus professor

- Prof. H Prodingen

Support staff

- Mrs L Adams
- Mrs G Fortuin
- Mrs S Fortuin
- Mrs W Isaacs
- Mrs H Swart
- Mrs L Muller
- Ms M Sebastians
- Mr D Stephanus

Postdoctoral Fellows

- Dr D Nickelsen, joint with AIMS and NITheP
- Dr J Rodger
- Dr S MacFadyen
- Dr Tsinjo Rakotonarivo

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

Mathematics Division

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Web: <https://math.sun.ac.za/>

DEPARTMENT OF MICROBIOLOGY

RESEARCH INTERESTS

Bioprocessing; Synthetic and systems biology; Lactic acid bacteria: Antimicrobial peptides, Probiotics, Nano-biosensors; Microbial ecology and mycology; Environmental and host associated microbiomes; Water treatment; Secondary metabolite production and antifouling potential; Yeast and Fungal biotechnology for bioenergy and the bioeconomy; Bioplastic hydrolysis; 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



Urobo-Biotech was registered as a spin-out company, which makes it the fourth company that is being incubated in the department.

Prof Djamel Drider from Lille University Sciences and Technologies, France visited the department in February strengthening his research collaboration with the department.

The department hosted a successful SASM (South African Society of Microbiology) conference in September with invited speakers from across the globe which included prof. Joana Falcao Salles from Groningen Institute for Evolutionary Life Sciences, Prof. Nelesh Govender from University of Witwatersrand and Prof. Nicolas Guiliani from Universidad de Chile.

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. Botha's research focusses on the biology of clinically relevant fungi including yeasts. Using culture techniques, microscopy, enzyme assays, and ultra-high performance liquid chromatography tandem mass spectrometry analyses a PhD student, Lisa Koroleva, studied polyamine production by the clinically relevant fungus, *Emergomyces africanus*, in both its mycelial and yeast-like phases. Lisa managed to determine the activities of key polyamine synthesis enzymes, as well as the relative quantities of the different polyamines associated with the two phases. She subsequently found that polyamine biosynthesis inhibitors impact on the growth and dimorphic transition from the mycelial- to the pathogenic yeast-like phase of the fungus. Taken together, her findings provided evidence that polyamines play a significant role in the pathobiology and dimorphism of *E. africanus*. Her findings open a new field of research into the role of polyamines in the biology of *E. africanus* and she was subsequently selected to present her research on *E. africanus* at the FEMS Congress 2023, held on 9 - 13 July 2023, in Hamburg, Germany. Her presentation was well received by her audience, which included leaders in the field of medical mycology.

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 is a member of the editorial board of the *Journal of Environmental Chemical Engineering* (Elsevier)

Prof. Marinda Viljoen-Bloom, in collaboration with Prof. Lorenzo Favaro at the University of Padova, Italy, made significant strides in expressing antimicrobial peptides and bioplastic hydrolases in *Saccharomyces cerevisiae*. A new spin-out company, Urobo Biotech, was registered to commercialise the development of microbial enzymes for bioplastic hydrolysis. The company won first place in the research-based business category of the Entrepreneurship Development in Higher Education (EDHE) Intervarsity National Finals and participated in the Prototypes for Humanity exhibition at COP28 in Dubai.

Dr Heinrich Volschenk's 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.

Prof. Gideon Wolfaardt continued his collaboration with the Fraunhofer Alliance through the Fraunhofer Innovation Platform for the Water-Energy-Food Nexus at SU (Stellenbosch University).

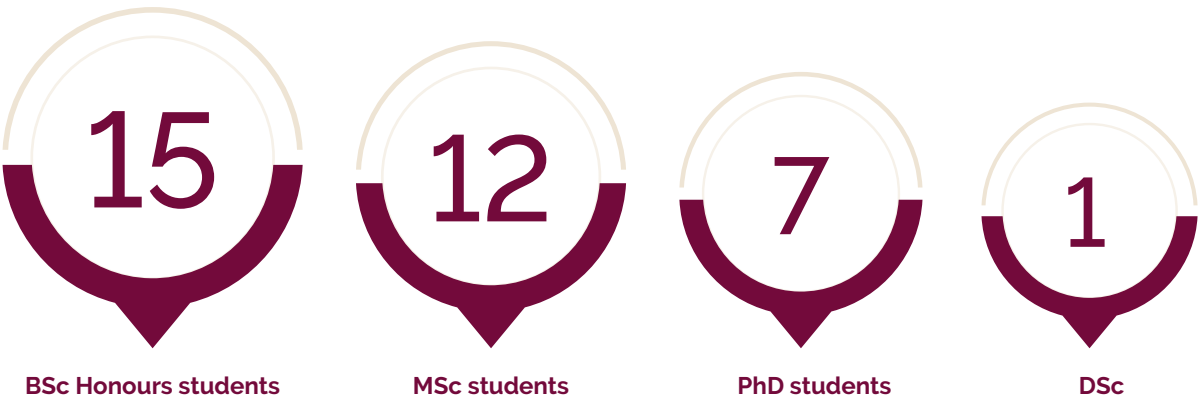
Prof. Thulani Makhalanyane serves as Editor in Chief of *The ISME Journal* and Senior Editor at *mSystems* and *The Journal of Sustainable Agriculture and Environment*. He is also Associate Editor for *Ecology Letters* and serves on the editorial boards of *FEMS in Microbial Ecology and Environmental Microbiology*. Thulani serves on the Executive Advisory Board for the International Society for Microbial Ecology. He is currently serves as convener of the Rating Specialist Committee for Basic and Applied Microbiology.

Dr Trudy Jansen serves as publications secretary of the South African Society of Microbiology (SASM) 2021 – 2023.

The local organising committee for SASM 2023 consisted of **Prof. Alf Botha, Prof. Leon Dicks, Prof. Marinda Viljoen-Bloom, Prof. Wesaal Khan, Dr Trudy Jansen, Tania van der Merwe, Dr Heinrich Volschenk.**

ACADEMIC AFFAIRS

Postgraduate students who graduated in 2023



The Department is host to 7 postdoctoral fellows.

NRF-RATED RESEARCHERS

Internationally acclaimed researchers

Prof LMT Dicks	Probiotics and antimicrobial peptides of lactic acid bacteria; nano-biosensor point-of-care devices
Prof GM Wolfaardt	Applied and environmental microbiology
Prof A Botha	Yeast ecology

Established researchers

Dr 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

Prestigious Awardee

Prof TP Makhalanyane	Microbial ecology
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AWARDS TO STAFF AND STUDENTS

Michelle Rossouw, one of three sponsored international students, presented a talk at the 16th International Society for Biosafety Research (ISBR) Symposium (St Louis, Missouri, USA).



Michelle Rossouw

Three students received awards at the meeting of the South African Society for Microbiology (SASM) Conference held in September 2023: **Wessel Myburgh** (best PhD student), **Sonica Betchu** (best undergraduate student), **Bianca Campbell** and **Johannes Malherbe** (runners-up: best poster presentation).

Elizaveta Koroleva received the Best MSc Student award at the Stellenbosch University Research and Innovation Excellence Awards held in October 2023.



Elizaveta Koroleva

Two students received awards at the Stellenbosch University Faculty of Science Postgraduate Research Conference held in November 2023 – they are **Aza Mqulwa** (Best Oral Presentation in the Biological Sciences), **Hannah Foster** (Best poster award in the Biological Sciences).



Aza Mqulwa
Photo: Ignus Dreyer

Wessel Myburg, founder of Urobo Biotech, took first place in the research-based category at the Entrepreneurship Intervarsity of the Entrepreneurship Development in Higher Education (EDHE) 2023 Regionals hosted by the University of Cape Town.

Prof. Gideon Wolfaardt received the Havenga prize for Life Sciences from the South African Academy of Science and Arts (September 2023).

Prof. Leon Dicks received the SASM Gold medal at the meeting of the South African Society for Microbiology (September 2023), as well as the Research Innovator award for 2023 at the annual Innovus and Von Seidels Inventors awards function.

Prof. Karin Jacobs received an award at the national EDHE Awards 2023, organised by the Entrepreneurship Development in Higher Education (EDHE) programme (November 2023).

Prof Thulani Makhalanyane was elected as a Member of the Academy of Sciences of South Africa.

SOCIAL IMPACT

Prof. Karin Jacob's spinout company Sporatec hosted two Soil Microbiology in Agriculture short courses aimed at the agricultural sector.

Postgraduate students and staff from the Microbiology Department were invited by the Pebbles Project to present a basic overview of biology to learners, aged 6 to 18. The Pebbles Project enables children from farming communities to access quality education programmes and health, nutrition, and social work services.

Engaging with learners through basic biology presentations fosters a sense of responsibility and contribution towards society. It allows postgraduate students and staff to share their knowledge and expertise, inspiring young minds and potentially sparking an interest in science among the youth. This interaction goes beyond traditional classroom settings, offering a hands-on and practical approach to learning that can be more impactful and memorable for the children involved.

FUNDING

South Africa

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

International

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

STAFF LIST

Academic staff

- Prof A Botha (Departmental chair)
- Prof LMT Dicks (Distinguished Professor)
- Prof K Jacobs
- Prof W Khan
- 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)
- Prof TP Makhalanyane
- Dr R Ngobeni-Nyambi

Emeritus professor

- Prof WH van Zyl
- Prof E Cloete

Extraordinary professors

- Prof S Liss, Queens University, Canada
- Prof LM Joubert, Stanford University, USA
- Prof L Lynd, Dartmouth College, USA
- Prof L Favaro, University of Padova, Italy
- Prof S Giannakis, Polytechnic University of Madrid, Spain

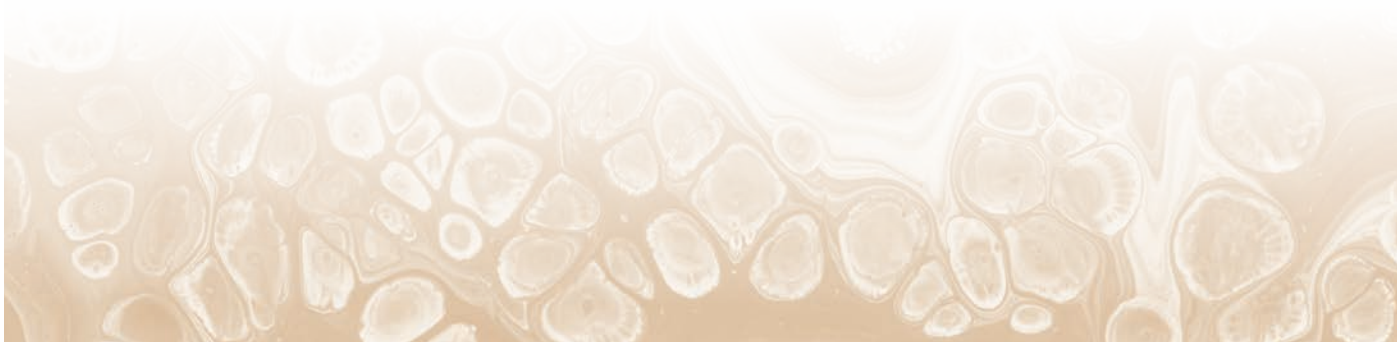
Support staff

- J Daniels
- LJ Daniels
- J de Kock
- M Gey van Pittius

- M Stuurman
- T van der Merwe
- W Wentzel

Postdoctoral fellows and researchers

- Dr Elanna Bester
- Dr Kim Bester
- Dr Marelize Botes
- Dr Rose Cripwell
- Dr Tersia Conradie
- Dr Shelley Deane
- Dr Taskeen Ebrahim
- Dr Benjamin Havenga
- Dr Samuel Leareng
- Dr. Peter Montso
- Dr Girish Nair
- Dr Nikita Nankoo
- Dr Shaunita Rose
- Dr Wendy Stone
- Dr Christoff Truter



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DEPARTMENT OF PHYSICS

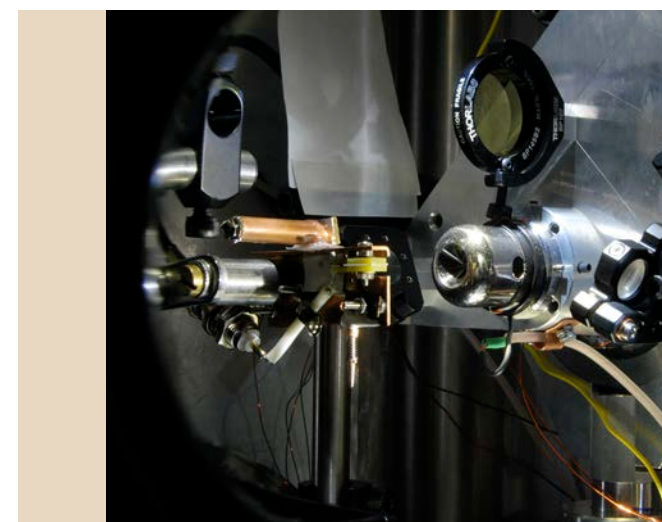
RESEARCH INTERESTS

Astrophysics | Cosmology

Theoretical cosmology, relativistic astrophysics, black hole accretion.

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; Computational nuclear physics and applications of artificial intelligence.

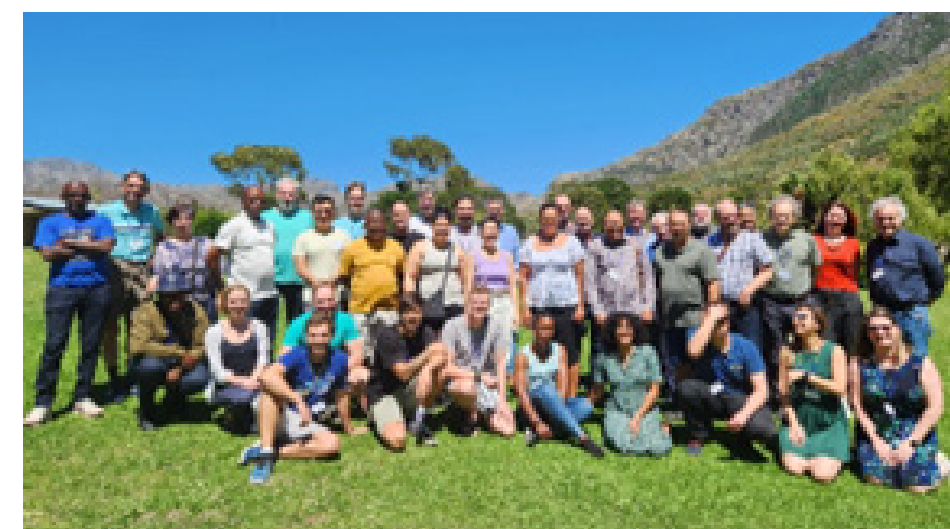
Laser Physics

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 ionization spectroscopy and ion beam production; Laser-based additive manufacturing and X-ray tomography.

RESEARCH HIGHLIGHTS

Collaboration with the ISOLDE facility at CERN

Dr Christine Steenkamp was invited to participate in an experiment at the ISOLDE facility, CERN, Switzerland. The principal investigators are Prof. Thomas Cocolios (Institute of Nuclear and Radiation Physics, KU Leuven, Belgium) and Prof. Xiaofei Yang (Peking University, China). The experiment focussed on extremely heavy Zn isotopes and was successful in measuring the hyperfine structure and isotope shifts of ^{81}Zn and isotope shifts of the even mass isotopes from ^{64}Zn up to ^{82}Zn thereby extending previous measurements. In addition, new equipment was commissioned.



The Paarl Africa Underground Laboratory (PAUL) project was launched during an International Symposium on Science at PAUL at the Du Kloof Lodge between Worcester and Paarl in January 2024.

Image: Wiida Fourie-Basson

Launch of the Paarl Africa Underground Laboratory project

The Paarl Africa Underground Laboratory (PAUL) project received seed funding of R5 million from the Department of Science and Innovation (DSI). The PAUL project has as its aim the establishment of a multi-disciplinary underground science laboratory in the Du Toitskloof Mountains, off the Huguenot Tunnel between Paarl and Worcester.

The science case for the PAUL was reviewed by two eminent international scientists and one local eminent scientist. There was unanimous support for the establishment of the PAUL. As part of the PAUL project, muon flux (associated with cosmic rays) measurements at the Physics Department were started in December 2023. The measurements were made with a detector on loan from Dr Jacques Marteau at the Centre National de la Recherche Scientifique (CNRS) in France.

RESEARCH ACTIVITIES

Dr Anslyn John delivered an oral presentation titled "Structure formation with shear viscosity" at the South African Gravity Society (SAGS) conference at Hluhluwe, 17 - 21 March 2023, and a poster presentation titled "Cerenkov radiation from a moving, charged black hole" at the Fourth European Physical Society Conference on Gravitation: Black Holes in Valencia, Spain, 13-15 November 2023.

Prof. Yin-Zhe Ma's appointment adds a new research direction in Astronomy and Astrophysics. His research interests include Theoretical Astrophysics, Cosmology, and Radioastronomy.

Prof. Richard Newman was appointed as project manager of the Paarl Africa Underground Laboratory (PAUL) by the PAUL Steering Committee.

Dr Christine Steenkamp's research focused on resonance ionisation spectroscopy of atoms with medical applications. During 2023 the project on zink isotopes was continued by doing novel measurements of the effect of magnetic field and laser polarizations on the selectivity of an odd-mass selective 3-step ionisation scheme for zink. She is also busy with research on quantum control of trapped ytterbium ions for the investigation of unsharp measurement. During 2023 simulation of the ytterbium-171 qubit led to publication of a tutorial paper. Experimental progress was made towards trapping ytterbium atoms in our setup. She delivered an invited presentation at the Education and Training in Optics and Photonics (ETOP 2023) conference from 15 to 18 May in the USA. The topic was in the field of Physics education research, titled "Laboratories-first optics and photonics education: analysing epistemic insights in an educational program".

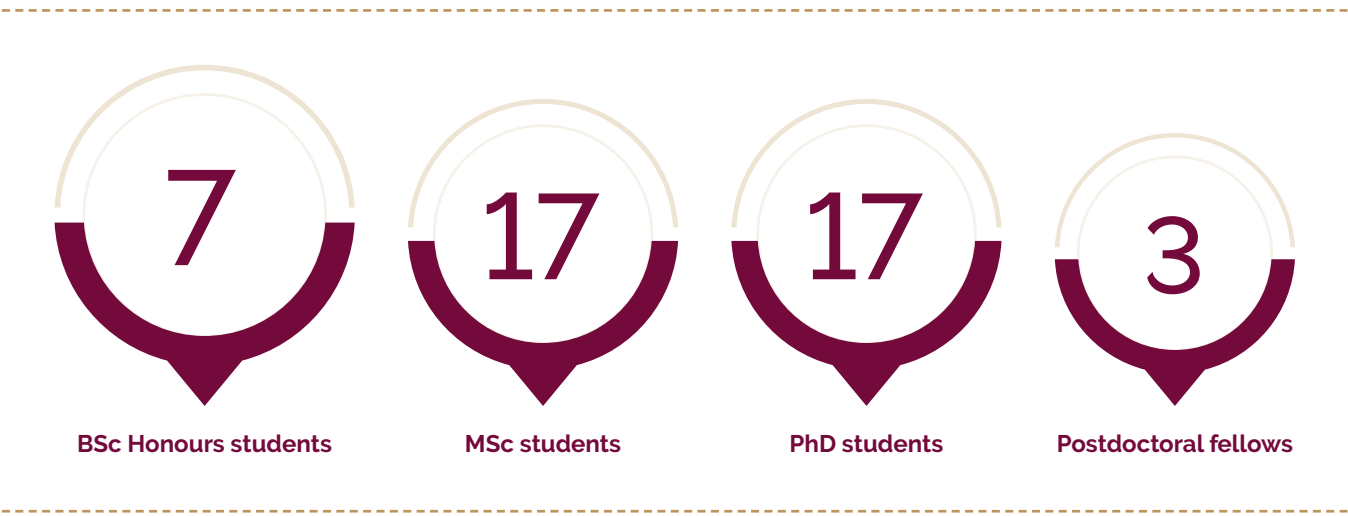
Prof. Mark Tame and his research group work in the field of quantum information science. The research is focused mainly on quantum nanophotonic systems, which involves the small-scale control of light and its interaction with matter at the quantum level. This has applications in quantum computing, quantum communication and quantum sensing. In 2023, they published several papers in international journals and conference proceedings. One PhD and one MSc student from the group graduated. They also secured a multimillion Rand grant from the DSI for their research activities.

Prof. Herbert Weigel continues research on vacuum polarization energies of solitons, in particular for models with impurities, applications to binding energies as well as for energy densities. Very recently he has started projects on discretized fields equations with applications to phonon scattering. He delivered invited presentations at Symmetry 2023 in Barcelona, Spain, and at the International Conference on New Frontiers in Physics in Kolymbari, Greece. He also lectured at the NITheCS (online) school on "Solitons and Solitary Waves in Physics and Mathematics".

Prof. Shaun Wyngaardt continues his research in nuclear clustering phenomenon and computational and theoretical nuclear physics. In 2023 his research expanded into the application of computational modelling and artificial intelligence in physics. He presented a talk at the Topics in Astro Particles and Underground Physics (TAUP) titled "Paving the way for the Paarl-Africa Underground Laboratory". This event was hosted by the University of Vienna and the Austria Academy of Science from 28 August to 1 September 2023. This was followed by a research visit to Prof. Fedor Simkovich at Comenius University in Bratislava, Slovakia. During this visit potential collaboration between the Slovak research community and the physics community in South Africa was discussed, including opportunities for student exchange and collaboration on projects such as the Paarl Africa Underground Laboratory.

ACADEMIC AFFAIRS

Student Information 2023



NRF-RATED RESEARCHERS

Leading international researcher	
Prof Dieter Heiss	Physical effects and significance of spectral singularities
Internationally acclaimed researchers	
Prof Anthony Cowley	Mechanism of proto-induced pre-equilibrium nuclear reactions, alpha-particle clusters in atomic nuclei and light-ion transfer reactions
Prof Herbert Weigel	Quantum field theories emphasizing 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 Frederick Scholtz	Non-commutative quantum mechanics and quantum field theory
Established researchers	
Prof Erich Rohwerw	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.

AWARDS TO STAFF AND STUDENTS

Dr Christine Steenkamp was awarded "Commendable" in the Scholarly Teacher category of the Stellenbosch University Individual Teaching-Learning-Assessment Awards 2023 for her teaching portfolio and involvement in education research.

SOCIAL IMPACT

Optica/SPIE student chapter outreach activities

In 2023 the Stellenbosch Laser Student Chapter (SLSC) worked with the physics postgraduate students to visit five local high schools, including Mfuleni High School, Kuils River Technical High School, Hoërskool Strand, and Paarl Girls' High School. At each school, we saw the physical science classes of a particular grade and did a fun and engaging physics experimental demonstration show which highlights some of the work they learn about in class. The aim of these outreach trips is to raise awareness of science and careers in STEM as well as recruitment for the Faculty of Science.

The physics postgraduates organised the annual outreach road trip in September to schools in the Western and Northern Cape. The group of eight postgraduate students visited eight schools and interacted with nearly 600 learners. At each school the group would perform the same demonstrations that we do on local outreach trips with the addition of several hands-on experiments that the learners can engage with in small groups. The aim of this road trip was to reach high schools in remote areas and groups of people with diverse backgrounds so we could tell them about the exciting opportunities offered by a career in physics and science. – Siann Bester

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)
- University of Western Cape (UWC)

Belgium

- Katholieke Universiteit Leuven
- University of Antwerp
- Université Catholique de Louvain

Ethiopia

- Addis Adaba University

France

- LPSC, Grenoble (CNRS)

- LP2I, Lyon (CNRS)

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
- Centre for Nuclear Safety and Security
- Council for Scientific and Industrial Research (CSIR)
- CSIR National Laser Centre's Rental Pool programme
- Department of Science and Innovation (PAUL project seed funding)
- South African Quantum Technology Initiative (SAQuTI)
- 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 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
- Ghana and USA (Middlebury College).

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

STAFF LIST

Academic

- Dr Gurthwin Bosman
- Prof Anton du Plessis
- Dr Anslyn John

- Dr Hannes Kriel
- Prof Kristian Müller-Nedebock
- 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 (Departmental Head)

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 Erich Rohwer
- 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

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Web: www.sun.ac.za/physics

DEPARTMENT OF PHYSIOLOGICAL SCIENCES

RESEARCH INTERESTS

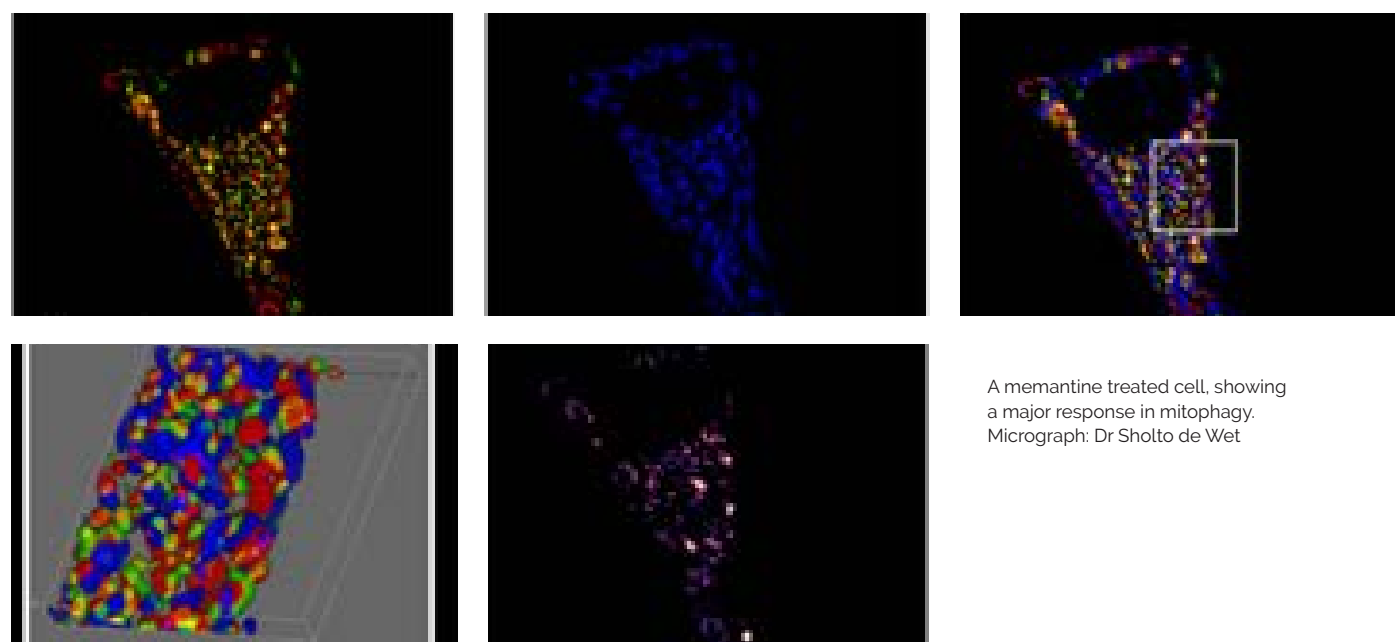
Cancer research; Cardio-metabolic research; Cardio-oncology research; Chemotherapeutic resistance in breast cancer; Clinical haemorheology and coagulation research; Metabolic physiology and health; Bio-inspired drug delivery research; Muscle physiology and cell biology research; Neuro research.

RESEARCH HIGHLIGHTS

Research on Alzheimer drug memantine sheds light on novel mechanism in maintaining cell health

In 2023, two particular research highlights stood out in the neuro research group. Firstly, Sholto de Wet, a final year PhD student, discovered that the Alzheimer's disease drug memantine, does not only alter the lysosome size, but also

induces a process termed mitophagy. This process is an integral part of the mitochondrial quality control system, whereby old and dysfunctional (depolarised) mitochondria are removed through the autophagy machinery in neurons. This keeps the mitochondrial population in check and enhances metabolic function. This action of the drug memantine had not been described previously and points to a very important mechanism, which, if exploited in a well targeted manner, may contribute to a new way of thinking and approaching the treatment of Alzheimer's disease. A second major finding was made by the MSc student Catherine Smit, who discovered that Rooibos tea extract increases mitochondrial dynamics, thereby improving neuronal health. Both above discoveries would not have been possible without a strong confocal, life-cell imaging based microscopy approach with a subsequent bioimage analysis pipeline, developed by Dr Rensu Theart from the Faculty of Engineering.



EV's carry valuable cargo for intercellular communication

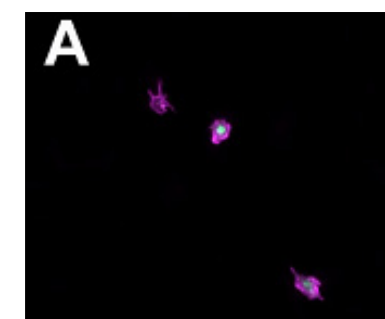
Nano-sized extracellular vesicles (EVs) are released by all cell types. Initially they were considered to be removing waste products from cells, but it was soon discovered that they carry valuable cargo important for intercellular communication with downstream functional effects. For the first time we were able to visualise EVs taken up by skeletal muscle myoblasts in culture. When the nano-vesicles were harvested from fibroblast-conditioned media, they interfered with the directionality of myoblast migration in vitro compared to when

vesicles derived from myoblasts were added. Therefore, there is an element of self-cell recognition when it comes to the origin of the vesicles.

Making strides in addressing Long COVID

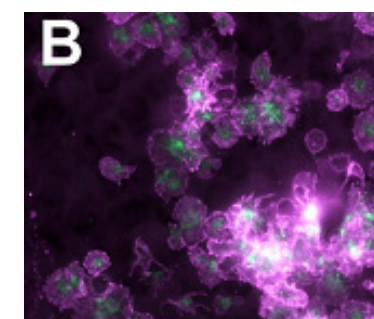
Throughout 2023, significant strides were made in addressing Long COVID, with research increasingly focusing on its underlying mechanisms such as persistent infection, immune dysregulation, and vascular anomalies, contributing to the prolonged symptoms experienced by patients.

Healthy Platelets

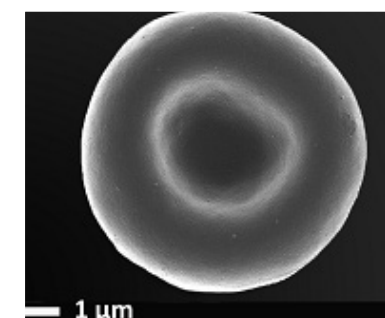


Platelet ultrastructure shows healthy versus Long Covid.

Platelets in Long COVID

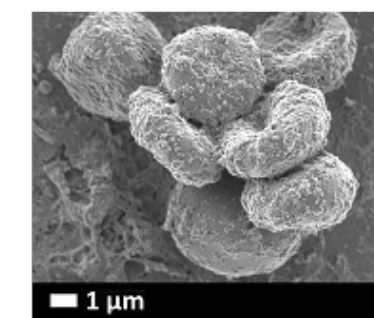


RBC from a healthy individual



RBCs showing health versus Long Covid.

RBC's from individual with Long COVID covered with microlots



Continued...

The year was rich with conferences that served as platforms for disseminating the latest findings and theories about Long COVID. Discussions often centered around the critical role of vascular dysfunction in Long COVID and the potential for innovative diagnostic techniques to improve patient outcomes. The symposium "Long COVID and Post-Acute Sequelae of SARS-CoV-2 (PASC): Pathogenesis and Treatment" was held at the Eldorado Spa and Resort in Santa Fe, New Mexico, from 27 to 30 August 2023. The conference was organized by Michael Holtzman, Steven Deeks, Resia Pretorius, and Catherine Blish. The overall objective was to bring together world experts in the pathogenesis of post-acute sequelae of COVID-19 to connect, collaborate, and advance the understanding of what drives this chronic illness, which is estimated to impact millions of people worldwide. The meeting brought together experts and stakeholders with diverse perspectives, including basic scientists, clinicians, patient advocates with lived experience, and funders including the National Institutes of Health, to collectively integrate their knowledge and tackle this debilitating disease.

During 2023 she contributed to many significant research papers:

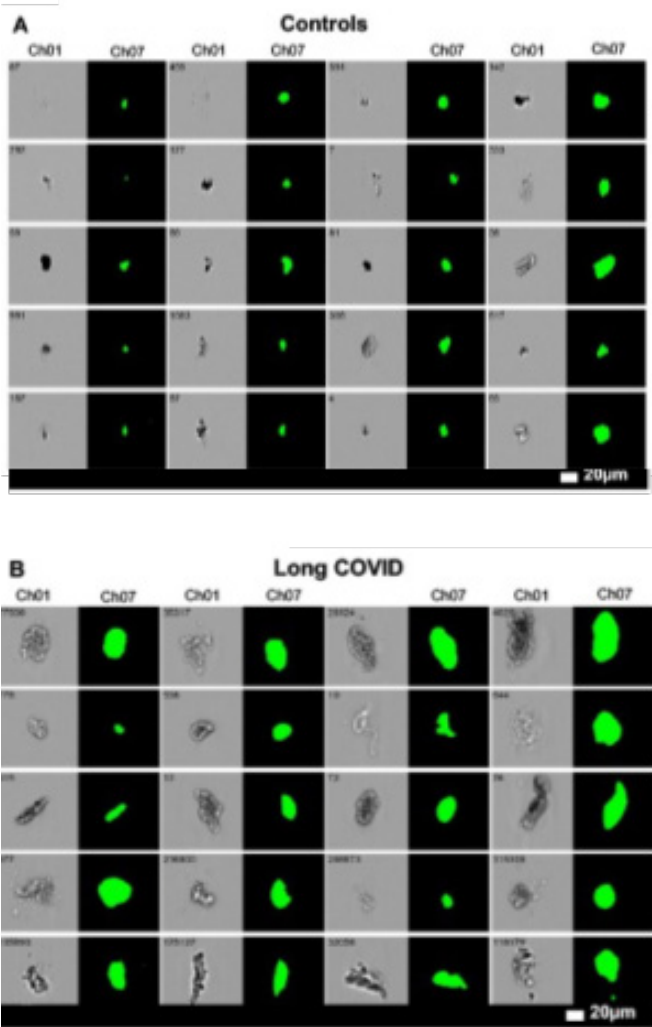
- Persistence of SARS-CoV-2 and Post-Acute Sequelae:** Published findings in *Nature Immunology* detailed the ongoing presence of SARS-CoV-2 in patients and its implications for post-acute sequelae, spotlighting the virus's role in chronic conditions post-recovery.
- Link Between Gut Health and Neuroinflammation:** Research paper in the *Journal of Neuroimmunology* connected gut dysbiosis to neuroinflammatory processes, exploring how altered microbial compositions can influence systemic inflammation and neurological symptoms.
- Advances in Microscopy for Clinical Investigations:** Technological advancements in microscopy, detailed in *Seminars in Thrombosis and Hemostasis*, have enhanced our ability to observe microclot formation in blood, offering insights into vascular complications in Long COVID.
- Microclots and Autoimmunity:** The *Biochemical Journal* featured studies on the potential role of microclots in triggering autoimmune responses in patients post-infection, suggesting a broader impact of clotting abnormalities.
- Cardiovascular and Hematological Insights in Chronic Conditions:** Emerging research in *Blood Reviews* linked

cardiovascular and hematological disruptions to chronic fatigue syndromes, highlighting overlapping pathologies with Long COVID and suggesting viral factors in their etiology.

- Future Directions and Challenges:** Discussions on data sharing, particularly in a South African scientific journal, emphasised the importance of collaborative research efforts and the challenges of managing large datasets, which are critical for driving forward our understanding of Long COVID.

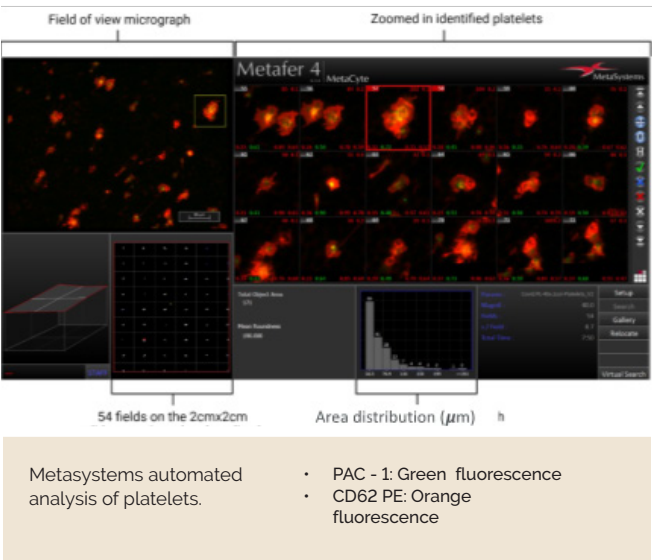
Innovative methodologies and discoveries include:

- Flow Cytometry in Long COVID Diagnosis:** An article in *Heliyon Cell* introduced a pioneering method using flow cytometry to detect specific types of microclots associated with Long COVID, proposing a potential breakthrough in how the condition is diagnosed. See images below:



A place for flow cytometry? Funded by the Balvi Foundation, KERNLS and Polybio Research Foundation. Results published in *Heliyon* with the title "Accelerating discovery: a novel flow cytometric method for detecting fibrin(ogen) amyloid microclots using Long COVID as a model".

We also developed an automated platelet detection method using software funded by the Balvi Research Foundation. See Figure below:



RESEARCH ACTIVITIES

Prof. Kathy Myburgh and her muscle research group hosted the second Extracellular Vesicles Workshop and Seminars. The workshop was attended by Prof. Carola Niesler and two postgraduate students from the University KwaZulu-Natal and Prof. Neil Davies and a postgraduate student from the University of Cape Town. Three representatives from Synexa Life Sciences and one scientist from Afrobodies attended. Twelve postgraduate students presented their ongoing research studies, one of whom was a visiting PhD student from McMaster University, Canada. Two academics and two industry representatives presented the key lectures for the different sessions of this two-day workshop. The following topics were covered: the roles of EVs in regeneration, therapeutic delivery, and cellular agriculture; the roles of exosomes in translational and clinical research; EV bioanalysis methods and potential of EVs as biomarkers of disease.

Prof. Ben Loos' neuro research group focussed on a range of projects associated with neurodegeneration, metal-induced neurotoxicity, rooibos tea, glioma spheroids

and method development using correlative microscopy techniques. At the core of the research remains the focus on controlling and measuring autophagy activity, for the benefit of governing cellular fate, be it in promoting cell survival or enhancing cell death onset. To this end, various microscopy approaches have been fostered and implemented, including correlative light and electron microscopy (CLEM), assessing autophagy probes, spearheaded by Nicola Heathcote (PhD student). Asandile Mangali assessed the role of mining associated metals, including manganese and copper, on neuronal health and mitochondrial function. In this way, the molecular defects are highlighted and assessed. Prof. Loos attended the International Microscopy Congress (IMC) conference in South Korea, the first international meeting since the COVID pandemic.

Dr Sanjeev Rambharose published several papers in high-impact international journals in 2023. He also reviewed grants for the National Research Foundation (NRF) and served as a reviewer in several pharmaceuticals and drug delivery journals. Dr Rambharose maintains active collaboration with several researchers at the University of Cape Town, the University of KwaZulu Natal, The University of Texas at El Paso, the United States Naval Medical Research Unit San Antonio, the United States Department of Defence, and the United States International University-Africa, Nairobi, Kenya.

Dr Danzil Joseph's cardiometabolic research group continued to focus on 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 an important contributory factor to severe outcomes associated with COVID-19. Tara Michaels (MSc student, graduated cum laude) uncovered novel data linking specific variants of the spike protein to metabolic alterations and changes in spike-interacting proteins in a pancreatic beta-cell line. Her abstract was accepted for presentation at the American Physiology Society Summit, Long Beach, CA, USA in April 2024. Mzolisi Dotwana (Hons student, graduated) focussed on oxidative stress in the beta-cell model. Fatimah Lakay (MSc student, continuing in 2024), Jana Strydom and Gabrielle Dunn (both Hons students, graduated) studied the effects of chemotherapeutic intervention on cardiac- and hepatic metabolic function. This project is in collaboration with Dr Bali Sishi's group.

Dr Bali Sishi presented a poster titled "Understanding the role of GP130 signalling during chemotherapy-induced cardiotoxicity" at the first Eastern African Association of Physiological Sciences (EASPS) Scientific Meeting from 29 November to 1 December 2023 at Dar Es Salaam, Tanzania.

Prof. Anna-Mart Engelbrecht's two MSc students, Cayleigh de Sousa and Madré Meyer, attended the Society for Advanced Cell Culture Modelling for Africa Conference in Potchefstroom from 9-11 October. Cayleigh's poster was titled "The effects of chemotherapy on metastasis in cervical cancer using a personalised medicine approach". Madré's poster, titled "The effects of senescence-induced treatment resistance in cervical cancer patients, was awarded the best poster, with Cayleigh as the runner-up. Dr Gina Leisching (former PhD student) and Claudia Christowitz (current PhD student), were selected to attend the Lindau Nobel Laureate meeting in Germany. Prof. Engelbrecht continues to serve on the Governing Boards of the African Cancer Institute (ACI) and the Institute of Biomedical Engineering (IBE). She is director and shareholder of two university spinout companies, Biocode and Phyenti (CEO). Dr Carla Eksteen (postdoctoral fellow) received the Innovus Research Fellow Award for intending to advance immunotherapy by developing a scoring system to predict whether a patient will respond to treatment based on whether the tumour is "hot" or "cold".

ACADEMIC AFFAIRS

Dr Sanjeev Rambharose was selected to participate in the Department of Higher Education and Training (DHET) National Future Professor Programme (FPP), as well as the Scholarship of Educational Leadership (SoEL) programme at SU.

Prof. Ben Loos has been serving as editor for the journal *Autophagy*. Moreover, an international Bioimaging conference, the 8th Exchange of Experience (EoE), was hosted by Ben Loos and Lize Engelbrecht (CAF-Microscopy), representing the South Africa Bioimaging community (SABI).

Dr Danzil Joseph was the module coordinator for Physiology 114 and 144. He was the study leader to three BSc Hons graduates and one MSc graduate (cum laude), and further co-supervisor to five MSc graduates (two of whom graduated cum laude).

Dr Bali Sishi was the study leader to one MPhil and two MSc students of whom one graduated cum laude.

AWARDS TO STAFF AND STUDENTS

Dr Sanjeev Rambharose was awarded the Early Career Researcher award at the Stellenbosch University Research and Innovation Excellence Awards 2023. **Prof. Resia Pretorius** received the Stellenbosch University Innovation Reward in November 2023.

Best poster awards during the Faculty of Science's Postgraduate Research Conference went to **Asandile Mangali** and **Daleen Conradie**.



Asandile Mangali (left) and fellow students.
Photo: Ignus Dreyer



Daleen Conradie with Prof. Sibusiso Moyo (left) and Prof. Louise Warnich.
Photo: Ignus Dreyer

STAFF MATTERS

NRF-RATED RESEARCHERS

Internationally acclaimed researchers

Prof ME Essop	Cardio-metabolic research
Prof K Myburgh	Biomedical sciences
Prof E Pretorius	Inflammatory blood biomarkers and blood coagulation

Established researchers

Prof Ben Loos	Autophagy and cell death
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Promising Young Researchers

Dr Sanjeev Rambharose	Health Sciences; Biological sciences; Bio-nanotechnology
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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 the school's Life Science teachers. Practical sessions involve 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. 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 publication.

COLLABORATION

Africa

- United States International University-Africa, Nairobi, Kenya

Austria

- Vienna University, Austria

Denmark

- University of Copenhagen

Germany

- Max-Planck-Zentrum für Physik und Medizin

Israel

- EDS/Chiari Center at Mount Sinai South Nassau Hospital
- Mt Sinai Health System
- Icahn School of Medicine at Mt Sinai

New Zealand

- University of Auckland

South Africa

- Stellenbosch University, Faculty of Medicine and Health Sciences
- University of Cape Town
- University of KwaZulu Natal

Thailand

- Faculty of Medicine, King Chulalongkorn Memorial Hospital, Chulalongkorn University, Bangkok

United Kingdom

- Francis Crick Institute, London, UK
- University College London (UCL)
- University College London Hospitals (UCLH)
- University of Manchester

United States of America

- NYU Grossman School of Medicine
- PolyBio Research Foundation
- University of Kansas Medical Center
- University of Nebraska
- The University of Texas at El Paso
- United States Naval Medical Research Unit San Antonio
- United States Department of Defence

FUNDING

Denmark

- Steno Institute, Denmark

South Africa

- Cancer Association of South Africa (CANSA)
- Department of Science and Innovation (DSI)
- Medical Research Council (SAMRC)
- National Research Foundation
- SA Rooibos Council
- Stellenbosch University Subcommittee B
- Stellenbosch University Faculty of Science
- Technology Innovation Agency (TIA)
- University Technology Fund (UTF) grant
- Water Research Commission

United Kingdom

- Royal Society
- Wellcome Leap

United States of America

- Carnegie Fellowship

Prof. Resia Pretorius maintains a large network of collaborators in blood laboratories all over the world since 2007. They are, in alphabetical order:

- Arizona University, USA
- Atherosclerosis/ Lipid Apheresis Center, Kansas, USA
- Emek Medical Center, Afula, Israel
- Ghent University, Belgium
- Indiana University School of Medicine, USA
- Institut régional du Cancer Montpellier, University of Montpellier, France
- King Chulalongkorn Memorial Hospital, Chulalongkorn University, Bangkok, Thailand
- Max Planck Institute for the Science of Light, Germany
- Max-Planck-Zentrum für Physik und Medizin, Germany
- Medical University of Vienna, Austria
- Mount Sinai South Nassau Hospital, New York, USA
- National Institute of Technology, Calicut, India
- New York University Grossman School of Medicine, USA
- PolyBio Research Foundation
- Shanghai Jiao Tong University, China
- Sheffield University, England
- University College London, England
- University of Auckland, New Zealand
- University of Birmingham, England
- University of California, San Francisco, USA
- University of Kansas Medical Center, USA
- University of Manchester, England
- University of Manchester/Liverpool, England
- University of Toledo, Ohio, USA
- University of Warwick, England
- University of Washington, USA
- Vanderbilt University, USA
- Vrije Universiteit Amsterdam, The Netherlands
- Yale University, USA

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

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 Carla Fourie
- Dr Jandr  Bezuidenhout
- Dr Rhys McColl



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CENTRE FOR BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

RESEARCH INTERESTS

Prof HG Patterson – Epigenomics, synthetic biology and bioinformatics

Prof GC Tromp – Infectious diseases, biostatistics and bioinformatics

Prof JT Burger – Viral genetics and bioinformatics

Prof T de Oliveira – Pathogen Genomics and bioinformatics

Prof JM Rohwer – Systems biology and bioinformatics

Prof JL Snoep – Systems biology and bioinformatics

Prof FF Bauer – Wine biotechnology and bioinformatics

Dr H Volschenk – Microbial biotechnology and bioinformatics

Dr C Viljoen – Population genetics and bioinformatics

Prof MA Vivier – Wine biotechnology and bioinformatics

Prof S Sampson – Infectious diseases, mycobacteriology and bioinformatics

Prof C Kinnear – Human genomics and bioinformatics

Prof G van der Spuy – Infectious diseases and bioinformatics

Prof M Moller – Infectious diseases and bioinformatics

Dr E Maasdorp – Infectious diseases and bioinformatics

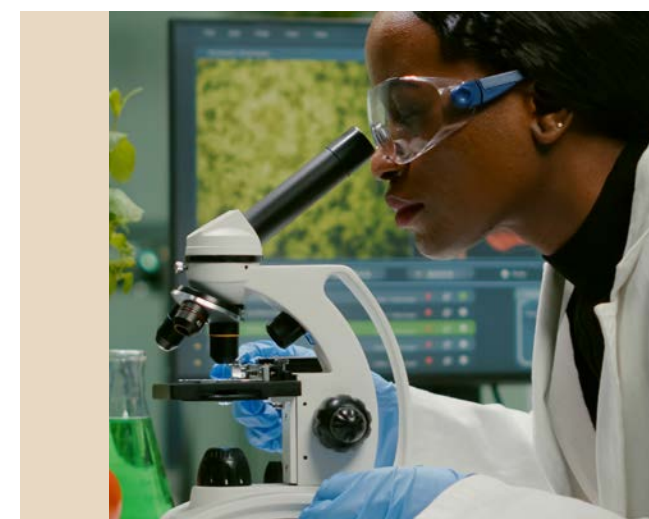
Dr E Wilkinson – Pathogen Genomics and bioinformatics

Dr J Greyling – Agriculture related data analysis

RESEARCH HIGHLIGHTS

Dr H Volschenk received the 2022 Bioautomation Challenge award. The award offers life science researchers access to the Emerald Cloud Lab 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.



Prof. G.C. Tromp

Prof. Tromp continued to support a large number of research scientists in their projects. He contributed to five publications. He is involved with several large international consortia doing tuberculosis research. For one of these, he is processing RNA-seq 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 teaching activities.

Relevant publications:

Kroon EE, Correa-Macedo W, Evans R, Seeger A, Engelbrecht L, Kriel JA, Loos B, Okugbeni N, Orlova M, Cassart P, Kinnear CJ, Tromp GC, Möller M, Wilkinson RJ, Coussens AK, Schurr E, Hoal EG. Neutrophil extracellular trap formation and gene programs distinguish TST/IGRA sensitization outcomes among Mycobacterium tuberculosis exposed persons living with HIV. *PLoS Genet* 2023;19:e1010888, PMID: 37616312, PMC10470897, doi: 10.1371/journal.pgen.1010888.

Musvosvi M, Huang H, Wang C, Xia Q, Rozot V, Krishnan A, Acs P, Cheruku A, Obermoser G, Leslie A, Behar SM, Hanekom WA, Bilek N, Fisher M, Kaufmann SHE, Walzl G, Hatherill M, Davis MM, Scriba TJ. T cell receptor repertoires associated with control and disease progression following Mycobacterium tuberculosis infection. *Nat Med* 2023, PMID: 36604540, doi: 10.1038/s41591-022-02110-9.

Richardson TR, Smith B, Malherbe ST, Shaw JA, Noor F, MacDonald C, van der Spuy GD, Stanley K, Carstens A, Fisher TL, van Rensburg I, Flinn M, Snyders C, Johnson I, Fransman B, Dockrell H, Thwaites G, Thuong NTT, Schacht C, Mayanja-Kizza H, Nsereko M, Tjon Kon Fat EM, Corstjens P, Geluk A, Ruhwald M, Penn-Nicholson A, Chegou NN, Sutherland J, Walzl G. Field evaluation of a point-of-care triage test for active tuberculosis (TriageTB). *BMC Infect Dis* 2023;23:447, PMID:

RESEARCH ACTIVITIES

Prof. H.G. Patterson

Prof. Patterson continued with work on a range of bioinformatics projects, including the simulation of the formation of metabolic networks due to random appearance of catalysts, a project aimed to shed light on the "chemistry first" or "information molecule first" hypotheses of the origin of life. In another project using a neural network previously developed, it was demonstrated that the codon to amino acid mapping in the codon table reflects pairings that causes minimal structural disruption to proteins following a mistranslation. Prof. Patterson also continued with overseeing the degree programmes in Bioinformatics and Computational Biology and managing the Centre for Bioinformatics and Computational Biology.

Relevant publications:

Lategan FA, Schreiber C, Patterson HG. 2023. SeqPredNN: a neural network that generates protein sequences that fold into specified tertiary structures. *BMC Bioinformatics*, 24(1):373. doi: 10.1186/s12859-023-05498-4.

37400753, PMC10318779, doi: 10.1186/s12879-023-08342-5. Shaw JA, Meiring M, Snyders C, Everson F, Sigwadhi LN, Ngah V, Tromp G, Allwood B, Koegelenberg CFN, Iruken EM, Lalla U, Baines N, Zemlin AE, Erasmus RT, Chapanduka ZC, Matsha TE, Walzl G, Strijdom H, du Plessis N, Zumla A, Chegou N, Malherbe ST, Nyasulu PS. Immunologic and vascular biomarkers of mortality in critical COVID-19 in a South African cohort. *Front Immunol* 2023;14:1219097, PMID: 37465683, PMC10351604, doi: 10.3389/fimmu.2023.1219097.

Simba H, Kuivaniemi H, Abnet CC, Tromp G, Sewram V. Environmental and life-style risk factors for esophageal squamous cell carcinoma in Africa: a systematic review and meta-analysis. *BMC Public Health* 2023;23:1782, PMID: 37710248, PMC10500769, doi: 10.1186/s12889-023-16629-0.

Prof. J.T. Burger

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 AGAP and UMT Genovigne in France, and Stellenbosch University, and the approach has been to establish a reference Chenin Blanc genome sequence (completed), which will be used to compare 12 South African and 14 French commercial Chenin clones, which have been re-sequenced and are currently being mapped to the Clone 220 reference. If significant and consistent differences are identified, these may be used to develop assays to distinguish between Chenin clones. Results of the initial phase of the project were presented at the second Chenin Blanc International Congress, held in Stellenbosch in November 2022.

Relevant publications:

Mostert, I.; Bester, R.; Burger, J.T.; Maree, H.J. 2023. Identification of interactions between proteins encoded by grapevine leafroll-associated virus 3. *Viruses* 15, 208.

Morgan, S.W., Read, D.A., Burger, J.T. et al. Diversity of viroids infecting grapevines in the South African Vitis germplasm collection. *Virus Genes*.

Prof. T. de Oliveira

The Centre for Epidemic Response and Innovation (CERI) is an

academic and research entity that is located within the School for Data Science and Computational Thinking at Stellenbosch University and the laboratories are situated at the state-of-the-art facilities at the Tygerberg Medical Campus. CERI's goal is to strengthen Africa's capacity to quickly identify and control its own epidemics and pandemics before they become a global problem. This goal is accomplished by a small but very capable multidisciplinary team of scientists with expertise in infectious diseases, public health, bioinformatics, computer science, genomics, bioinformatics, and epidemiology. The Centre is led by Prof. Tulio de Oliveira, who has worked for over 20 years with viral outbreaks, including HIV, Hepatitis B and C, Chikungunya, Dengue, SARS-CoV-2, Zika, and Yellow Fever Virus. The researchers at CERI have a track record in being able to deliver on the use of genomics surveillance in the fight against epidemics and pandemics. During 2023, CERI launched the CLIMADE Consortium that aims to generate knowledge, develop localized tools, and inform public health action for early warning and timely/targeted response to pathogens amplified by climate change.

Relevant publications:

Sisay A, Tshiabuila D, van Wyk S, Tesfaye A, Mboowa G, Oyola SO, Tesema SK, Baxter C, Martin D, Lessells R, Tegally H, Moir M, Giandhari J, Pillay S, Singh L, Ramphal Y, Maharaj A, Pillay Y, Maharaj A, Naidoo Y, Ramphal U, Chabuka L, Wilkinson E, de Oliveira T, Desta AF, San JE. Molecular Epidemiology and Diversity of SARS-CoV-2 in Ethiopia, 2020–2022. *Genes* 2023 Mar;14(3):705. doi: 10.3390/genes14030705. PMC10047986

Ismael N, van Wyk S, Tegally H, Giandhari J, San JE, Moir M, Pillay S, Utpatel C, Singh L, Naidoo Y, Ramphal U, Mabunda N, Abilio N, Arnaldo P, Xavier J, Amoako DG, Everatt J, Ramphal Y, Maharaj A, de Araujo L, Anyaneji UJ, Tshiabuila D, Viegas S, Lessells R, Engelbrecht S, Gudo E, Jani I, Niemann S, **Wilkinson E, de Oliveira T**. Genomic epidemiology of SARS-CoV-2 during the first four waves in Mozambique. *PLOS Global Public Health* 2023 Mar;3(3):e0001593. doi: 10.1371/journal.pgph.0001593.

Mvelase NR, Cele LP, Singh R, Naidoo Y, Giandhari J, Wilkinson E, de Oliveira T, Swe-Han KS, Mlisana KP. Consequences of rpoB mutations missed by the GenoType MTBDRplus assay in a programmatic setting in South Africa. *African Journal of Laboratory Medicine* 2023;12(1):1975. doi: 10.4102/ajlm.v12i1.1975.

Subramoney K, Mtileni N, Giandhari J, Naidoo Y, Ramphal Y, Pillay S, Ramphal U, Maharaj A, Tshiabuila D, Tegally H, Wilkinson E, de Oliveira T, Fielding BC, Treurnicht FK. Molecular

Epidemiology of SARS-CoV-2 during Five COVID-19 Waves and the Significance of Low-Frequency Lineages. *Viruses*. 2023 May; 15(5):1194. doi: 10.3390/v15051194.

Subramoney K, Mtileni N, Davis A, Giandhari J, Tegally H, Wilkinson E, Naidoo Y, Ramphal Y, Pillay S, Ramphal U, Simane A, Reddy B, Mashishi B, Mbenenge N, de Oliveira T, Fielding BC, Treurnicht FK. SARS-CoV-2 spike protein diversity at an intra-host level, among SARS-CoV-2 infected individuals in South Africa, 2020 to 2022. *PLoS One*. 2023;18(5):e0286373. doi: 10.1371/journal.pone.0286373.

Giovanetti M, Vazquez C, Lima M, Castro E, Rojas A, Gomez de la Fuente A, Aquino C, Cantero C, Fleitas F, Torales J, Barrios J, Ortega MJ, Gamarra ML, Villalba S, Alfonso T, Xavier J, Adelino T, Fritsch H, Iani FCM, Pereira GC, de Oliveira C, Schuab G, Rodrigues ES, Kashima S, Leite J, Gresh L, Franco L, Tegally H, Van Voorhis WC, Lessells R, de Filippis AMB, Ojeda A, Sequera G, Montoya R, Holmes EC, de Oliveira T, Rico JM, Lourenço J, Fonseca V, Alcantara LCJ. Rapid Epidemic Expansion of Chikungunya Virus East/Central/South African Lineage, Paraguay. *Emerging Infectious Diseases*. 2023;29(9):1859-1863.

Tegally H, Wilkinson E, Tsui JL, Moir M, Martin D, Brito AF, Giovanetti M, Khan K, Huber C, Bogoch II, San JE, Poongavanan J, Xavier JS, Candido DDS, Romero F, Baxter C, Pybus OG, Lessells RJ, Faria NR, Kraemer MUG, de Oliveira T. Dispersal patterns and influence of air travel during the global expansion of SARS-CoV-2 variants of concern. *Cell*. 2023 Jul 20;186(15):3277-3290.e16. doi: 10.1016/j.cell.2023.06.001.

Tsui JL, McCrone JT, Lambert B, Bajaj S, Inward RPD, Bosetti P, Pena RE, Tegally H, Hill V, Zarebski AE, Peacock TP, Liu L, Wu N, Davis M, Bogoch II, Khan K, Kall M, Abdul Aziz NIB, Colquhoun R, O'Toole Á, Jackson B, Dasgupta A, Wilkinson E, de Oliveira T; COVID-19 Genomics UK (COG-UK) consortium¶; Connor TR, Loman NJ, Colizza V, Fraser C, Volz E, Ji X, Gutierrez B, Chand M, Dellicour S, Cauchemez S, Raghwanji J, Suchard MA, Lemey P, Rambaut A, Pybus OG, Kraemer MUG. Genomic assessment of invasion dynamics of SARS-CoV-2 Omicron BA.1. *Science*. 2023;381(6655):336-343.

Giovanetti M, Pinotti F, Zanoluca C, Fonseca V, Nakase T, Koishi AC, Tscha M, Soares G, Dorl GG, Marques AEML, Sousa R, Adelino TER, Xavier J, de Oliveira C, Patroca S, Guimaraes NR, Fritsch H, Mares-Guia MA, Levy F, Passos PH, da Silva VL, Pereira LA, Mendonça AF, de Macêdo IL, Ribeiro de Sousa DE, Rodrigues de Toledo Costa G, Botelho de Castro M, de Souza Andrade M, de Abreu FVS, Campos FS, Iani FCM, Pereira MA, Cavalcante KRLJ, de Freitas ARR, Campelo de Albuquerque CF, Macário EM, Dos Anjos MPD, Ramos RC, Campos AAS, Pinter A, Chame M, Abdalla

L, Riediger IN, Ribeiro SP, Bento AI, de Oliveira T, Freitas C, Oliveira de Moura NF, et al. Genomic epidemiology unveils the dynamics and spatial corridor behind the Yellow Fever virus outbreak in Southern Brazil. *Science Advances* 2023;9(35):eadg9204. doi: 10.1126/sciadv.adg9204.

Francisco NM, van Wyk S, Moir M, San JE, Sebastião CS, Tegally H, Xavier J, Maharaj A, Neto Z, Afonso P, Jandondo D, Paixão J, Miranda J, David K, Inglês L, Pereira A, Paulo A, Carralero RR, Freitas HR, Mufinda F, Lutucuta S, Ghafari M, Giovanetti M, Giandhari J, Pillay S, Naidoo Y, Singh L, Tshiabuila D, Martin DP, Chabuka L, Choga W, Wanjohi D, Mwangi S, Pillay Y, Kebede Y, Shumba E, Ondoa P, Baxter C, Wilkinson E, Tessema SK, Katzourakis A, Lessells R, de Oliveira T, Morais J. Insights into SARS-CoV-2 in Angola during the COVID-19 peak: Molecular epidemiology and genome surveillance. *Influenza Other Respir Viruses*. 2023;17(9):e13198. doi: 10.1111/irv.13198.

Mavian CN, Tagliamonte MS, Alam MT, Sakib SN, Cash MN, Moir M, Jimenez JP, Riva A, Nelson EJ, Cato ET, Ajayakumar J, Louis R, Curtis A, De Rochars VMB, Rouzier V, Pape JW, de Oliveira T, Morris JG Jr, Salemi M, Ali A. Ancestral Origin and Dissemination Dynamics of Reemerging Toxigenic *Vibrio cholerae*, Haiti. *Emerging Infectious Diseases*. 2023;29(10):2072-2082.

Choga WT, Kurusa Gasenna GK, San JE, Ookame T, Gobe I, Chand M, Phafane B, Seru K, Matshosi P, Zuze B, Ndlovu N, Matsuru T, Maruapula D, Bareng OT, Macheke K, Kuate-Lere L, Tlale L, Lesetedi O, Tau M, Mbulawa MB, Smith-Lawrence P, Matshaba M, Shapiro R, Makhema J, Martin DP, de Oliveira T, Lessells RJ, Lockman S, Gaseitsiwe S, Moyo S. Rapid dynamic changes of FL.2 variant: a case report of COVID-19 breakthrough infection. *International Journal of Infectious Diseases* 2023; 10:S1201-9712(23)00772-5. doi: 10.1016/j.ijid.2023.11.011.

Prof. J.M. Rohwer

Prof. 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 relatively new online journal specialising in plant systems biology, and is statistics editor of the *Journal of Experimental Botany*. He also served as guest editor for a special issue of *Essays in Biochemistry*, focussing on computational biology. Prof. Rohwer has active collaborations with a number of groups, both nationally and internationally: with Dr Che Pillay, University of KwaZulu-Natal, on the modelling of cellular redoxin networks; with Dr Egils Stalidzans, University of Latvia, Riga, on bioengineering of

the MEP pathway in plants; with Prof Jonathan Gershenzon, Max Planck Institute for Chemical Ecology, Jena, Germany, on flux and control analysis of isoprene synthesis in plants; with Dr Brett Olivier, Free University, Amsterdam, Netherlands, on the Python Simulator for Cellular Systems software; and with Profs Jürgen Pleiss and Nicole Radde, University of Stuttgart, Germany, on developing workflows and computational tools for reproducible enzyme kinetics. In the context of this collaboration, two doctoral students from the University of Stuttgart each spent three months in Prof. Rohwer's laboratory, and his doctoral student Kamogelo Matenchi paid a research visit and delivered a lecture on his work at the University of Stuttgart.

Prof. Rohwer delivered oral presentations at the Enzymology Symposium 2023 on future directions of the STRENDa initiative, and at the fourth EnzymeML Workshop on the kinetic analysis of enzymatic cascades with NMR spectroscopy. Both conferences were held in Germany. He co-authored a paper in a high-impact journal on a new markup language facilitating modelling of enzymatic data.

Relevant publications:

Lauterbach, S., Dienhart, H., Range, J., Malzacher, S., Spöring, J.-D., Rother, D., Pinto, M. F., Martins, P., Lagerman, C. E., Bommarius, A. S., Høst, A. V., Woodley, J. M., Ngubane, S., Kudanga, T., Bergmann, F. T., Rohwer, J. M., Iglezakis, D., Weidemann, A., Wittig, U., Kettner, C., Swainston, N., Schnell, S. and Pleiss, J. (2023), EnzymeML: seamless data flow and modeling of enzymatic data, *Nat. Methods* 20(3), 400-402.

Prof. J.L. Snoep

Prof. 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. Our 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, steroid metabolism, and HIV pathogenesis at a whole-body level. In addition, we 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 2023 we published three papers with a focus on Bioinformatics and Computational analyses.

Relevant publications:

Niekerk, D.D. van, Toit, F. du, Green, K., Palm, D. & Snoep, J.L.

(2023) A detailed kinetic model of glycolysis in *Plasmodium falciparum*-infected red blood cells for antimalarial drug target identification. *Journal of Biological Chemistry*, 299, 105111.

Kouril, T., October, C., Hollocks, S., Odendaal, C., Niekerk, D.D. van & Snoep, J.L. (2023) Inhibitor titrations reveal low control of glyceraldehyde 3-phosphate dehydrogenase and high control of hexokinase on glycolytic flux in an aggressive triple-negative breast cancer cell line. *Biosystems*, 231, 104969.

Niekerk, D.D. van, Rust, E., Bruggeman, F., Westerhoff, H.V. & Snoep, J.L. (2023) Is distance from equilibrium a good indicator for a reaction's flux control? *Biosystems*, 232, 104988.

Student cohort

Six honours students, three MSc and four PhD students graduated in the group in 2023.

Prof. F.F. Bauer

The CBCB has provided support for several projects in our environment. This includes the analysis of metagenomic, genomic and transcriptomic data sets. A manuscript with CBCB co-authorship has been submitted and is currently under revision:

NA. Luyt, RN. deWitt, B Divol, HG. Patterton, ME. Setati, P Taillandier, FF. Bauer. 2023. Physical cell-cell contact elicits specific transcriptomic responses in wine yeast species. Submitted to *Microbiology Spectrum*.

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

Relevant publications:

Mqulwa AZ, Chan WY, Du Toit LA, Trollope KM, Volschenk H. Draft Genome Sequence of *Bacillus*. strain YC2, an Isolate from the South African Medicinal Plant *Pelargonium sidoides*. *Microbiology Resource Announcements* 2022; 11(4):e00879-21, 2.

Prof. S. Sampson

The Host-Pathogen Mycobactomics (HPM) Research Group continues to investigate how the pathogen *Mycobacterium tuberculosis* interacts with its host to cause disease. To achieve this, we 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 an NIH D71 award, we are contributing to capacity development in TB bioinformatics; this has been leveraged to successfully apply for an NIH D43 award to commence in 2024 (on which Moller, Sampson are co-PIs, Tromp, Maasdorp, Patterton are Key Personnel). A recent manuscript exploited genomic and in silico modelling approaches to identify the target of a new compound with anti-mycobacterial activity. Two MSc and one PhD student graduated in 2023.

Relevant publications:

Kapp E, Calitz H, Streicher EM, Dippenaar A, Egieyeh S, Jordaan A, Warner DF, Joubert J, Malan SF, Sampson SL. Discovery and biological evaluation of an adamantyl-amide derivative with likely MmpL3 inhibitory activity. *Tuberculosis (Edinb)*. 2023 141:102350.

Prof. G. van der Spuy

My work currently has two foci. The first is the analysis and predictive modelling of -omics data related mostly to tuberculosis. The second is the development of software solutions for managing clinical studies and the data and meta-data derived from them.

Dr C. Viljoen, Prof. C. Kinnear and Prof. M. Möller

The Tuberculosis Host Genetics group aims to understand the impact of host genetics on susceptibility and resistance to the development of both TB infection and disease. The group expanded to 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 - PIDD) as well as functional studies with a special focus on autophagy. There are five key research themes: (1) Genetic susceptibility to TB, (2) Population Genetics, (3) PIDD, (4) Autophagy and (5) Genetic susceptibility to COVID-19. In total, the team contributed to 10 manuscripts during 2023. Finally, two CBCB BSc Hons students (Sara Stapar, Alistar West) and one CBCB MSc student (Odile Ortell) graduated from our group. Overall, we had one PhD student, three MSc students and five BSc Hons students that graduated.

Relevant publications:

Molecular epidemiology of SARS-CoV-2 in Northern South Africa: wastewater surveillance from January 2021 to May 2022. Tambe LAM, Mathobo P, Matume ND, Munzhedzi M, Edokpayi JN, Viraragavan A, Glanzmann B, Tebit DM, Mavhandu-Ramarumo LG, Street R, Johnson R, Kinnear C, Bessong PO. *Front Public Health*. 2023 Dec 19; 11:1309869.

doi: 10.3389/fpubh.2023.1309869. eCollection 2023. PMID: 38174083 Free PMC article.

Identification and control for the effects of bioinformatic globin depletion on human RNA-seq differential expression analysis. Sheerin D, Lakay F, Esmail H, Kinnear C, Sansom B, Glanzmann B, Wilkinson RJ, Ritchie ME, Coussens AK. *Sci Rep*. 2023 Feb 1;13(1):1859. doi: 10.1038/s41598-023-28218-7.

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Dr E. Maasdorp

Dr 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. Current work includes biomarker projects in children and teenagers, in collaboration with the Desmond Tutu TB Center, analysis of single cell RNA-sequencing, which is investigated by an MSc student, as well as post-tuberculosis lung disease, in collaboration with colleagues from Pulmonology at Tygerberg Hospital. Dr Maasdorp is also part of the D43 NIH grant awarded to Prof. Sampson and contributes to the development of bioinformatics educational resources.

Dr E. Wilkinson

Dr Wilkinson serves as the head of Bioinformatics at the Centre for Epidemic Response and Innovation (CERI) at SU. His interest lies in the use of genomic data to track the spread of common pathogens, such as HIV, TB, SARS-CoV-2 and more recently *Vibrio cholerae*. Since the COVID-19 pandemic, CERI and Dr Wilkinson's research interest has shifted toward addressing questions relating to climate change and how it will affect the spread of pathogens. This research interest has culminated in the creation of the Climate Amplified Diseases and Epidemics consortium or (CLIMADE). CLIMADE focuses mostly on improving genomic surveillance of vector borne or water-borne infectious diseases such as Dengue, Zika, Chikungunya and Cholera, in low- and middle-income countries, by providing access to equipment, reagents and skills training. Over the past year Dr. Wilkinson's research resulted in 14 publications in some of the leading journals internationally, including *Cell & Science*.

Relevant publications:

Tegally, H.*, Wilkinson, E.*, Tsui, J.L-H., Moir, M., Martin, D., Brito, A.F., Giovanetti, M., Khan, K., Huber, C., Bogoch, I.I., James, E.S., Poongavan, J., Xavier, J.S., Candido, D.S., Romero, F., Baxter, C., Pybus, O.G., Lessells, R.J., Faria, N.R., Kraemer, M.U.G., and de Oliveira, T. Dispersal patterns and influence of air travel during the global expansion of SARS-CoV-2 variants

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Subramoney, K., Mtileni, N., Giandhari, J., Naidoo, Y., Ramphal, Y., Pillay, S., Ramphal, U., Maharaj, A., Tshiabuila, D., Tegally, H., Wilkinson, E., de Oliveira, T., Fielding, B.C., and Treurnicht, T.K. Molecular Epidemiology of SARS-CoV-2 during Five COVID-19 Waves and the Significance of Low-Frequency Lineages. *Viruses*. 2023. 15:(7), pp 1194.

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Pillay, S., James, E.S., Tshiabuila, D., Naidoo, Y., Pillay, Y., Maharaj, A., Anyaneji, U.J., Wilkinson, E., Tegally, H., Lessells, R.J., Baxter, C., de Oliveira, T., and Giandhari, J. Evaluation of miniaturized Illumina DNA preparation protocols for SARS-CoV-2 whole genome sequencing. *PLOS ONE*. 2023. 4:(18), e0283219.

Sisay, A., Tshiabuila, D., van Wyk, S., Tesfaye, A., Mboowa, G., Oyola, S.O., Tesema, S.K., Baxter, C., Martin, D., Lessells, R., Tegally, H., Moir, M., Giandhari, J., Pillay, S., Singh, L., Ramphal, Y., Maharaj, A., Pillay, Y., Maharaj, A., Naidoo, Y., Ramphal, U., Chabuka, L., Wilkinson, E., de Oliveira, T., Desta, A.F., and James, E.S. *Genes*. 2023. 14:(3), pp 705.

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James, E.S., van Wyk, S., Tegally, H., Eche, S., Wilkinson, E., Kanzi, A.M., de Oliveira, T., and Kiran, A.M. SeqPanther: sequence manipulation and mutation statistics toolset. *Journal of Open Source Software*. 2023. <https://doi.org/10.21105/joss.05305>

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STAFF MATTERS

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. Dr Caitlin Uren was on maternity leave in 2023.



ACADEMIC AFFAIRS

Number of graduates 2023
(including March 2024 graduation)



FUNDING

Global

- Abbott Pandemic Defense Coalition
- Beilstein Institut (Germany)
- Bill and Melinda Gates Foundation
- DAAD
- DIPLOMICS
- European Union (EU) Commission / EDCTP (Horizon 2020)
- GlZ commissioned by the Government of the Federal Republic of Germany
- H3ABioNet
- Health Emergency Preparedness and Response Umbrella Program (HEPR Program), managed by the World Bank Group
- National Institutes of Health (NIH)
- Rockefeller Foundation
- South African Medical Research Council (SAMRC) South African mRNA Vaccine Consortium (SAMVAC) SAMRC/GSK-Novartis

South Africa

- DSI/NRF SARCHI in Mycobactomics
- 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

STAFF LIST

Academic

- Prof H-G Patterton
- Support staff
- Ms Janice Williams
- 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

NRF-RATED RESEARCHERS

Internationally acclaimed researchers

Prof Jacky Snoep	Computational Systems Biology
Prof Johann Rohwer	Computational Systems Biology B2 rating
Prof FF Bauer	Integrated Wine Sciences

Established researchers

Prof. Samantha Sampson	Dept. Biomedical Sciences, FMHS; CBCB Associate; C2 rating (new application submitted February 2023, awaiting outcome)
Prof Craig Kinnear	Human genomics and bioinformatics
Prof Marlo Möller	C3 rating (awaiting new rating in May 2024)

Y-rating

Dr Caitlin Uren

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