AIMS | African Institute for Mathematical Sciences SOUTH AFRICA

Annual Report 2023-2024

About Us

The African Institute for Mathematical Sciences (AIMS) is a pan-African network of centres of excellence for postgraduate education, research and public engagement in mathematical sciences. Its mission is to enable Africa's brightest students to flourish as independent thinkers, problem solvers and innovators capable of driving Africa's future scientific, educational and economic self-sufficiency.

AIMS was founded in Cape Town, South Africa, in 2003. Since then AIMS centres have opened in Senegal (2011), Ghana (2012), Cameroon (2013) and Rwanda (2016).

This is the annual report of AIMS South Africa for the period 1 August 2023 to 31 July 2024. It includes an overview of all activities of AIMS South Africa and its associated projects, as well as the financial statements for the 2023 calendar year.

Since AIMS South Africa opened in 2003, 1059 students, of which 35% are women, from 42 different African countries have graduated from its core academic programme. This total includes the first 16 students who graduated from the new AI for Science Master's Stream, introduced in 2023.

AIMS South Africa has local association with the Universities of Cape Town (UCT), Stellenbosch (SU) and the Western Cape (UWC) and international association with the Universities of Cambridge, Oxford and Paris-Saclay.

AIMS South Africa offers:

- An intensive one-year structured Master's in Mathematical Sciences with intakes in August and January which includes an AI for Science Stream.
- Specialised courses as part of regular postgraduate programmes at South African universities.
- A well-established research centre which hosts regular workshops and conferences.
- Professional development programmes for teachers.
- Public engagement activities.

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Foreword by Director

When the June 2023 graduation ceremony drew to a close, our parting message to our guests was that AIMS will look very different when they return. As our cohort of students departed, renovation teams moved in, thus starting an exhilarating 2023-2024 year.

The year had three flagship deliverables. These were mission-critical projects whose success (or failure) would chart the course of AIMS for many years, and they where:

1. A full-scale renovation of AIMS's main building;
2. The launch of the new AI for Science stream in our Master's programme, fully supported by Google DeepMind;
3. Organising AIMS's 20th birthday festival conference, Siyakhula, in grand style.

Each of these drew on different strengths of AIMS, and in each we had to overcome unique challenges. In my mind as director, I knew that if our team could score these "three big wins", the institute would be on a good growth trajectory.

Firstly, our physical infrastructure was in dire need of repair and renovation, and we only had two months before the new intake of students moved in and lectures would resume! Everything from rebuilding all bathrooms in the building, to rebuilding lecture rooms, to the thoughtful decentralization of hot water systems to save electricity – everything had to be completed in two months. The builders and contractors were coordinated very capably by Igsaan Kamalie, who in the last stretch ran a "countdown timer" to ensure that the last paint dried before students moved back in. Today we look back to these times with fondness, and are still somewhat in awe that all the deadlines were met in a complex construction project.

The outside of our main building was renovated over the summer (when it's not raining) and returns the old "Rio Grande Hotel" to the age of Art Deco elegance. It looks fresh, young, and fitting to the period in which it was built.

Main building renovations

Secondly, we launched a new AI for Science Master's stream! It is a personal dream that was born in the Google DeepMind offices in London one year before I relocated from the United Kingdom to Cape Town. One can't launch something impactful without a team of champions, and the programme would not exist without the unwavering support of Demis Hassabis, Obum Ekeke and other colleagues in Google DeepMind. There are always risks. Will

students apply? Will more lecturers be generous with their time and expertise? The answer was "yes" to all of these, and the first intake was a tremendous academic success.

Jakob Macke & Cornelius Schroeder, Tübingen & Pedro Goncalves, VIB-Neuroelectronics Research, lecturers on the the Simulation-based Inference AI for Science Course

Thirdly, AIMS crossed the two decade mark, and to celebrate the occasion our team of staff spent more than a year organizing the Siyakhula Festival. Siyakhula means "we are growing" in Zulu, and brought together friends and partners from across the world, including all other centres from the AIMS network. Siyakhula grew into a week of non-stop parallel mathematics workshops and events, which also celebrated the first decade of the German Research Chairs programme in Africa and the first decade of the DSTI-NRF Centre of Excellence in Mathematical and Statistical Sciences (CoE-MaSS). It was a party for many birthdays! This cross-cutting project could only succeed through intricate coordination between everyone in AIMS. Our new glass boardroom wall served as a physical planning space, where hundreds of Post-it notes with tasks moved from "to do" to "in progress" to "done".

A year is more than just three milestones. A year tells the story of the dynamic threads between people in a community. Like the tides washing over our beach (and surfers!), a year contains the ebb and flow of students and the ebb and flow of lecturers. They, together with our staff, are the pulse of AIMS. They are our community.

In this annual report you'll meet them again. They'll share data and accounts with you to tell you our story:

Siyakhula!
(we are growing)

Prof. Ulrich Paquet
Director

Siyakhula Opening Ceremony

Siyakhula Closing Ceremony

Siyakhula Festival

Siyakhula Festival Participants

From 17 to 22 March 2024, AIMS South Africa hosted the Siyakhula Festival, a dynamic week-long celebration in Muizenberg, Cape Town. Coinciding with AIMS's 20th anniversary, the event also marked the 12th anniversary of the German Research Chairs Programme and the 10th anniversary of the Centre of Excellence in Mathematical and Statistical Sciences (CoE-MaSS). "Siyakhula," meaning "we are growing" in Zulu, reflected the expanding influence of AIMS and its partners in mathematical sciences across Africa and beyond.

This festival highlighted AIMS's role in advancing mathematics throughout Africa and fostering international collaboration. The agenda featured diverse workshops on mathematical optimisation, artificial intelligence for climate action, and the role of women in mathematics. The opening ceremony brought together AIMS students, alumni, partner universities, institutions, and policymakers to celebrate two decades of scientific progress.

Dr Rejoyce Gavhi-Molefe, AIMS House of Science Manager and Siyakhula Chair, emphasised the festival's significance in sharing the stories of pioneers who have shaped Africa's mathematical landscape. She noted that these visionaries, activists, and scientists have worked tirelessly to transform the future of mathematics and inspire young minds across the continent.

A key highlight was the keynote address by AIMS founder Prof. Neil Turok, who shared the institute's journey and its transformative impact on Africa. The Pan-African AIMS Stories sessions showcased the evolution of each AIMS centre, illustrating their contributions to research, education, and social change. The event also celebrated milestones in international collaboration, particularly through the German Research Chairs Programme and CoE-MaSS.

Prof. Neil Turok, AIMS Founder

The German Research Chairs Programme has played a vital role in strengthening AIMS's academic and research capabilities by attracting leading scholars and driving innovative projects. The programme's impact was showcased in a special session featuring distinguished speakers who underscored the value of international cooperation. Prof. Neil Turok highlighted how scientific progress is enriched by diverse cultural perspectives, while Prof. Dr Sabine Döring, Germany's State Secretary of Education and Research, expressed pride in Germany's partnership with AIMS. Minister Dr B.E. Nzimande, South Africa's Minister of Science and Innovation, reaffirmed the government's commitment to supporting AIMS and recognized the programme's contribution to national development.

German Research Chairs at AIMS with Prof. Dr. Sabine Döring, State Secretary of the Federal Ministry of Education and Research in Germany

CoE-MaSS was another focal point, with a dedicated day celebrating its efforts in advancing mathematical and statistical sciences in South Africa. Keynote talks and interactive discussions explored contemporary challenges and breakthroughs, underscoring CoE-MaSS's role in fostering interdisciplinary research and innovation.

Throughout the festival, the themes of empowerment, innovation, and collaboration were prominent. Workshops and discussions addressed critical issues such as artificial intelligence for climate action, gender equity in mathematics, and advances in topology and functional analysis. These sessions reinforced the festival's commitment to using mathematical sciences to solve global challenges.

AIMS alumni were also celebrated, with inspiring talks showcasing their contributions to academia, industry, and policymaking. Their experiences illustrated how AIMS has empowered them to apply mathematical sciences in solving real-world problems, driving innovation, and shaping policy. These success stories demonstrated the institute's impact beyond education, emphasizing its role in developing Africa's next generation of scientific leaders.

More than just a gathering, the Siyakhula Festival embodied progress, demonstrating the power of mathematics in addressing complex global challenges and advancing societal well-being. As AIMS looks ahead, the festival's legacy of excellence, collaboration, and innovation will continue to shape future initiatives, ensuring the institute remains a leader in scientific and educational transformation across Africa and beyond.

Poster Sessions

Renovations Report

A journey through time: The original signage of the African Institute for Mathematical Sciences (AIMS) being painted in 2003 (top right), and the new signage being installed in 2024 after renovations (main image). A testament to two decades of academic excellence and growth!"

During the reporting period, our facilities team completed transformative renovations, enhancing both functionality and aesthetics across our properties. The Watson Street upgrades set a high standard, while the main building underwent extensive interior improvements. Spaces were repurposed into modern lecture facilities, including a 60-seat room, a 40-seat former biomaths lab, and redesigned seminar and library areas. Additional upgrades included an expanded laundry room, a new cloakroom for kitchen staff, a dedicated drystore, and a flexible boardroom. Glass partitions replaced much of the ground-floor dividers, creating a more open and contemporary feel.

Operational efficiency also improved with a decentralized hot water system, modernized electrical systems, and lighter, more functional furniture. The exterior received a careful refurbishment, addressing window deterioration, water ingress, and new signage installation — all scheduled to minimize disruption.

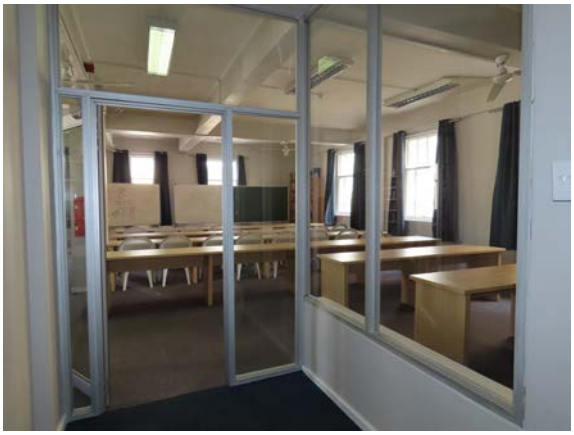
Looking ahead, planned improvements include kitchen renovations, a relocated generator for better power reliability, and long-overdue repainting of the Villa and Hall. Further updates to workspaces and lecturer accommodations are being coordinated with academic schedules and funding. These efforts reinforce our commitment to maintaining a safe, modern, and dynamic learning environment.

The new Fritz Hahne Lecture Hall that replaces the old Biomaths Lab.

Renovated common area

Revamped main building entrance displaying African Art

The new Boardroom



Renovated libary

The revamped Main Lecture Hall

ACADEMIC
Programmes

AIMS South Africa offers a single degree, the Master's in Mathematical Sciences, with two distinct streams: Mathematical Sciences and AI for Science. While both streams lead to the same qualification, they follow different academic flows, particularly in the review course phase. The introduction of the AI for Science stream in August 2023 marked a major milestone, expanding the programme's scope to meet the growing demand for AI-driven scientific applications. This year also saw significant growth in our student body, with enrollment increasing by approximately 60% compared to previous cohorts, reflecting both the rising demand for advanced mathematical and computational sciences and AIMS's success in attracting top talent across the continent.

In response to these exciting developments, 2024 marks the first time AIMS South Africa's academic structure is led by two academic directors — one overseeing AI for Science and the other Mathematical Sciences. This leadership structure allows for a focused approach to curriculum development, research integration, and student support across both streams. Stepping into these roles together has given us the opportunity to immerse ourselves in AIMS's processes, understand the foundations of what has been built, and explore ways to enhance and strengthen our academic offerings.

One key development has been the extension of the project phase, allowing students more time to engage deeply with their research. Even with just a few extra weeks added to the timeline, we have already seen the positive impact, and this will remain a priority moving forward. Another exciting addition has been the introduction of Design Thinking, in collaboration with the Hasso Plattner School of Design Thinking at UCT. This workshop gave students the chance to explore creative problem-solving and innovation in a structured way, opening up new ways of thinking.

A strong academic programme is built on robust support structures, and we have focused on assembling an exceptional tutoring team, with two head tutors — one for Mathematical Sciences and one for AI for Science — ensuring high-quality support for both students and lecturers. Student well-being is another key focus for us, and we have made strides in mental health support, with on-site counselling services available as needed.

What makes AIMS special is the close-knit nature of its community. With a residential programme and carefully curated cohort sizes, we have the privilege of accompanying each student on their unique journey, sharing in their challenges and successes. Each graduation is bittersweet — saying goodbye to students we've seen grow, while feeling immense pride and excitement for what they will accomplish next. The term AIMS family is not just a phrase; it is something deeply real and meaningful to every student, tutor, and lecturer who has been part of this institution.

We are honoured to be leading the academic programme at AIMS and look forward to continuing to shape an environment where students flourish, push boundaries, and realize their ambitions.

Prof. Karin-Therese Howell
Academic Director

Prof. Claire David
Academic Director

Programme Structure

AIMS South Africa has a dual-intake system, with students starting in January or September. Regardless of their intake, all students follow the same rigorous academic programme, progressing through coursework, research, and professional development activities.

Students also receive scientific communication training, led by Ms Lynne Teixeira, equipping them with essential skills in scientific writing, public speaking, and professional communication. Additionally, they participate in leadership and mentoring initiatives through the AIMS House of Science, engaging in community outreach, interdisciplinary collaboration, and professional development activities.

Admissions

The admissions process has transitioned, with a more structured and rigorous process to ensure that the selection process removes admissions bias due to the variability in transcripts across different regions. Students complete some mathematical questions, and programming (for the AI stream) as part of their application process. Each placement is matched by seventy students who start the application process. A first round review results in a shortlist of applicants who are invited for an interview with a panel of AIMS representatives, including at least one French speaker. During the interview candidates are asked about the solutions to the submitted questions , their background and future goals and how joining our programme aligns with these. Final offers are made based on the score for the transcript, questions answered, as well as the interview.

Mathematical Sciences Stream

The January 2024 intake consisted of Mathematical Sciences students, with 20 students (12 South Africans). The August 2023 intake consisted of 18 Mathematical Sciences students from seven African countries.

Students on this stream begin their academic journey with a rigorous set of foundational skills courses: Mathematical Problem Solving; Python Programming; Experimental Programming with Sage; Statistical Skills; and Problem Solving in Physics.

Following the foundational phase, students select from 11 elective courses spanning pure and applied mathematics, statistics, computing, and physics.

The programme culminates in an independent research project, where students apply their skills to solve real-world mathematical problems under faculty guidance.

In June 2024, Mathematical Sciences students attended a one-day workshop on Design Thinking at the Hasso Plattner School of Design, where they explored creative approaches to problem-solving.

The January 2023 intake saw one student earning a distinction, with 78% achieving strong passes. Among the 2023-24 cohort, 25% secured distinctions, and 45% earned good passes. At least three research projects were developed into articles submitted for publication.

AI for Science Master's Stream

The AI for Science Master's Stream, launched in September 2023 with funding from Google DeepMind, had a split intake due to visa delays. 16 students arrived in September, followed by 14 more between January and March 2024. The curriculum was adapted to accommodate this change while maintaining its high standards.

Students began with five foundational courses in: Mathematical Problem Solving; Introduction to Machine Learning and Experimental Mathematics; Functional Programming and Cloud Computing; Physics for Machine Learning; and Statistical Inference and Causality.

Following this, students selected 11 electives, covering topics such as Bayesian Modelling, Probabilistic Programming, Generative Models, Neural Networks, and AI applications in astronomy, ecology, epidemiology, and neuroscience.

A unique feature of this programme was the Google Cloud Compute Platform (GCP) budget, where students received US$2,000 to deploy AI models on GCP, with expert training provided by a Google DeepMind scholar. Additionally, each student was paired with a Google DeepMind mentor, providing one-on-one academic and career guidance.

The AI cohort performed exceptionally well, with four students (25%) earning distinctions and half of the projects forming the basis for research publications. Four students have already secured PhD offers, and final results for the January intake students are currently being finalised.

Tutors

AIMS's strong tutoring team is a crucial pillar of student success. The 2023 tutors were: Musa Alnour Musa Hussien (Head Tutor); Faratiana Brice Razakarinoro; Riham Kamal Ibrahim Ahmed; Timothy Oreta; Khisa Gillian Kisembe; Maryse Manuella Moutamal Epse Rockefeller; Emmanuel Owusu Ahenkan; Bria Aimé Razanaparany; Mmatlou Kubyane; Milanto Ferdinand Rasolofohery; Hortence Phalonne Yiepnou Nana. With the introduction of the AI for Science Master's Stream, two dedicated head tutors were appointed: Brice Razakarinoro (Mathematical Sciences) and Emmanuel Ahekan (AI for Science)

Student Outings

Beyond academics, students engaged in excursions and conferences that broadened their exposure to cutting-edge research and industry applications:

- 22 September – Visit to the Centre for Epidemic Response and Innovation (CERI) at SU.
- 2–6 October – Participation in the Leeds-Africa Conference on Data Science and Artificial Intelligence, organised by the University of Leeds and the University of Pretoria. AIMS students contributed actively, particularly in research discussions relevant to their projects.
- 26 October, 3 November, 24 October – Visits to UWC, SU, and UCT, the partner universities where AIMS students are registered.
- 7 June 2024 – Design Thinking workshop at the Hasso Plattner School of Design at UCT, where students explored how creative problem-solving techniques can be applied to mathematical and scientific challenges.

Participants at the Leeds-Africa Conference on Data Science and Artificial Intelligence

Students participating in the Design Thinking Workshop

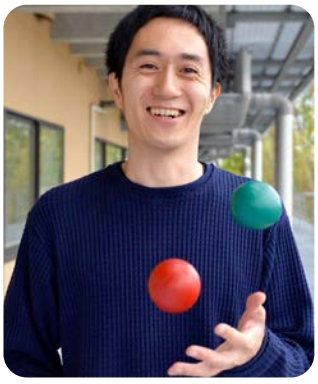
Looking Ahead

The 2023-2024 academic year has been a year of growth, adaptation, and refinement. With the extension of research timelines, deeper integration of AI and mathematical sciences, enhanced student support, and opportunities for real-world applications, AIMS continues to be a leader in mathematical and scientific training in Africa.

As we move forward, our commitment remains the same: to empower the brightest minds, foster collaboration, and equip students with the knowledge and skills to shape the future of science and technology across the continent.

Combined Courses Table

Period	Lecturer	Course
		2023
7-9 Sept	AIMS Staff	IT introductions and Beginner English classes
11-29 Sept	Jan Groenewald, AIMS South Africa	**Introduction to Computing and Latex** Introduces students to AIMS computing facilities and packages, encompassing LaTeX learning via texmaker and engagement with LaTeX Wikibook content and related resources like the American Mathematical Society materials. (MS)
	Lynne Teixeira, AIMS South Africa	**English language and communication skills** This course enhances communication skills crucial for scientific careers, focusing on academic writing and spoken English within a supportive environment, enabling ongoing skill development throughout the programme. (AI/MS)
	Dimbinaina Ralaivaosaon, Stellenbosch	**Mathematical Problem Solving** The course considers challenging problems across pure mathematics branches, promoting discussions, varied problem-solving approaches, and research methods to equip students with problem-solving skills. (AI/MS)
	Claire David, AIMS South Africa	**Introduction to Machine Learning** This course covers fundamental machine learning concepts such as linear regression, gradient descent, and logistic regression, along with common supervised algorithms like decision trees and neural networks. Students will code these algorithms and learn performance evaluation techniques. The course also introduces unsupervised learning methods like dimensionality reduction and clustering, and covers hyperparameter optimisation and advanced techniques. (AI)
18 Sept - 6 Oct	Jeff Sanders & Martha Kamkuemah, AIMS South Africa	**Programming with Python** This course teaches Python programming from scratch, emphasising structured methods over traditional "hack and try" approaches. Students learn Python syntax in a Jupyter environment, integrating theory with practice. The outcome is a stepwise proficiency in Python programming. (MS)
2 - 20 Oct	Siaka Longue, Institut de Recherche en Science de la Santé	**Statistics** Focuses on applying statistics in public health, covering experimental designs, data analysis, and impact evaluation using R software. (MS)
	Gina Rakotonirainy, Cape Town	**Experimental Mathematics with Sage** This course teaches how to use the Sage computer algebra system to conduct mathematical experiments in fields like algebra and calculus. Students will learn Sage's features and by the end, will be able to create their own sage notebooks for various mathematical applications. (MS)
	Ulrich Paquet, AIMS South Africa	**Applied Machine Learning at Scale** This practical course explores how machine learning (ML) is applied in large-scale online systems, particularly within the "internet of things." Students will build recommender systems from scratch, covering topics such as A/B testing, ranking, and user and entity modelling, including how users interact with online content like news stories. (AI)
	William Dekou, Google & Jeff Sanders, AIMS South Africa	**Cloud and Functional Programming** This course teaches students to run Python and C++ machine learning code on Google Compute Engine's Virtual Machines with GPUs. It covers cloud computing fundamentals, including service and deployment models, virtualisation levels (virtual machines and containers), and core Google Cloud components like VPC, Compute Engine, and Cloud Storage. Practical sessions involve setting up Virtual Machines with GPUs, using SSH and GCloud tools to connect, building container images, and running code on these Virtual Machines. (AI)
30 Oct - 17 Nov	Karin Therese-Howell & Jacques Rabie, Stellenbosch	**Algebraic Methods** The course will have an Algebra and a Linear Algebra component. Under Algebra we will discuss functions, relations, partitions, groups, morphisms, quotients, the Isomorphism Theorems for groups and direct products. As part of the Linear Algebra component we will discuss linear spaces, linear functionals and operators, matrices, change of basis, eigenvalues and eigenvectors and the normal form. (MS)



"At AIMS, all essential facilities — including lecture rooms, offices, the computer room, the library, the cafeteria, and bedrooms — are housed within the same building. Thanks to this close-knit environment, we have continuous interaction among students and lecturers, creating a unique experience of learning mathematics together while immersing ourselves in the rich and diverse cultures of Africa."

- Hidetoshi Masai, Musashino Art University (formerly with Tokyo Institute of Technology)

I enjoy the bright variety at AIMS Muizenberg. Bright primary colours of the sky, sea and beach huts, a contrast to cold gray UK. Lively students from all over Africa, with different questions and enthusiasms. I like the development from a class of unfamiliar faces to a collection of colleagues with particular interests and challenges. I aim to use a variety of data sets in my teaching, which leads to varied conversations about health, law, philosophy. Thank you for the opportunity to contribute to education and to be inspired by the variety.
- Jane Hutton (University of Warwick)

	Jorge Jimenez Urroz, Universitat Politècnica de Catalunya	**Cryptography** This is an introductory course on Cryptography. We will focus on public key Cryptography and Elliptic curve Cryptography. The objective of the course is to provide the students with the necessary tools to understand and analyse the mathematical problems behind the security of the transmission of cipher messages. (MS)
	Hugo Touchette, Stellenbosch	**Physics for Machine Learning** This course covers techniques from physics that are useful in Machine Learning. Monte Carlo methods form a family of stochastic approximation techniques, and are widely used in fields spanning Physics, Statistics and Finance. It is also a principal tool for statistical inference in ML. The module will cover Markov chains and Monte Carlo methods, including Metropolis-Hastings algorithms. (AI)
	Willie Brink, Stellenbosch	**Computer Vision** This Computer Vision course explores its role in advancing machine learning and deep learning. It starts with convolutional neural networks (CNNs) for image classification and covers enhancements such as dropout, batch normalisation, data augmentation, transfer learning, and visual attention. The course also provides an overview of other typical Computer Vision tasks like object segmentation, colourisation, style transfer, and automated image captioning. (AI)
6 - 21 Nov	David Aschman, Cape Town	**Concepts and Problem Solving in Physics** Emphasises physics as mathematically describing reality, utilising problem-solving techniques like perspective shifts, estimation, and numerical approaches, with examples from various physics fields, and involving active student engagement in reading, discussions, presentations, computation, and tutorials. (MS)
27 Nov - 15 Dec	Hidetoshi Masai, Tokyo Institute of Technology	**Verified computation** Despite advances in computer memory and speed, their finite capacity limits calculations, making it challenging to handle infinite real numbers and achieve mathematically rigorous proofs. This course addresses these limitations through approaches like floating point arithmetic and verified computation methods in linear algebra and equation solving. (MS)
	David Holgate Western Cape, Cerene Rathila & Simo Mthethwa, KwaZulu-Natal	**Computational Topology** Covers topology's continuous deformation concepts, from foundational sets and metric spaces to advanced topological spaces, including digital and lattice-based aspects. The course was followed by a "Topology for Tomorrow" workshop at AIMS, at which students could participate in sessions including attending a panel discussion on topological data analysis. (MS)
	Rafael Nepomechie, Miami	**Introduction to Quantum Computing** This course introduces quantum computing fundamentals, including key quantum algorithms and practical exercises on IBM Q simulators and devices. It begins with linear algebra and quantum mechanics basics, then explores quantum gates, circuit diagrams, and protocols like quantum key distribution and teleportation. (MS)
	Ulrich Paquet, AIMS South Africa & St John Grimbly, Cape Town	**Statistical Inference and Causality** This course is divided into two parts: The first delves into Bayesian inference for machine learning, covering topics from Chris Bishop's "Pattern Recognition and Machine Learning," including Bayesian linear models, graphical models, and information theory. The second part challenges the notion that "correlation does not imply causation" by introducing graphical causal modelling, demonstrating how data combined with assumptions can yield valid causal conclusions, particularly relevant in the machine learning context. (AI)
	Mike Giles, Oxford	**CUDA Programming for GPUs** This course teaches NVIDIA's CUDA programming, an extension of C/C++, focusing on GPU applications beyond graphics, notably in machine learning. Students will learn to write GPU code, assess performance, and optimised data movement. Applications include Monte Carlo simulations and solving finite difference PDE approximations through lectures and practical exercises. (AI)

2024		
8 - 26 Jan	Gerhard Pfister & Wolfram Decker, Kaiserslautern	**Computer Algebra** Groebner bases and Buchberger's algorithm for ideals and modules will be studied. Applications to commutative algebra, selected problems in singularity theory and algebraic geometry will be given as well as applications to electronics and engineering. The course includes an introduction to the computer algebra system SINGULAR and its programming language. (MS)
	Graduate Modelling Camp and Study Group	**Mathematics in Industry Study Group** This is a five-day workshop at which academic researchers and graduate students work collaboratively with representatives from industry on research problems submitted by local industry. (MS)
	Steven Bradlow, Illinois at Urbana-Champaign	**Mathematics and Art in Africa** Mathematics describes distinctive order in African decorative arts, while these arts also employ a range of mathematical principles; this course examines this synergy using examples like Islamic tiling, Ndebele decorations, Mozambican basketry, and Chokwe drawings, covering symmetry, graph theory, Euler cycles, and number theory. (MS)
	Richard Katz, Oxford	**Fluid Dynamics** Explores fluid dynamics in contexts like air, oceans, and industrial fluids, translating physical problems mathematically. Beginning with viscous fluid understanding, it advances to multidimensional flows, pressure gradients, and momentum-mass conservation coupling. Simple experiments boost mathematical understanding. Prerequisites are fluency in differential equations and vector calculus, and no prior fluid dynamics knowledge is needed. (AI/MS)
	Ryan Sweke, IBM Research, Almaden	**AI for Quantum and Quantum for AI** This course explores the intersection of quantum computing and AI, focusing on using ML algorithms on quantum computers for complex quantum many-body physics problems and applying advanced ML tools to enhance quantum computing development. It begins with fundamental quantum computing concepts, progressing to the development and implementation of relevant ML algorithms for both theoretical and practical applications in the field. (AI)
	Jakob Macke, Tübingen, Cornelius Schroeder, Tübingen & Pedro Goncalves, VIB-Neuroelectronics Research Flanders	**Simulation-based Inference** This course introduces simulation-based inference, focusing on statistical inference using simulator-based models. It starts with key concepts in probability and statistics, then explores how advances in probabilistic deep learning address complex inference problems. Examples from various scientific disciplines, particularly neuroscience, illustrate the method's versatility and effectiveness. By course end, participants will understand the basics and applications of simulation-based inference, equipping them to apply it in their scientific research. (AI)
	Martin Butz, Tübingen	**AI, Mind and Brain** This course explores how the brain develops into a cognitive architecture capable of solving fundamental cognitive science problems and controlling the body. Key topics include reinforcement learning, reasoning, planning, the free energy principle, generative models, scene segmentation, causality, and compositionality. The course concludes with a discussion on a comprehensive, self-organising model of the human mind, considering its potential and implications. (AI)
29 Jan - 16 Feb	Mohau Mateyisi, CSIR & Makhamisa Senekane, Johannesburg	**Python** This course guides students through Python programming, covering basics to advanced concepts. (MS)
	Jeff Sanders, AIMS South Africa	**Applying logic** Mathematics aids numerical reasoning via calculus, equations, and statistics. This course readies students for related careers, introducing Mathematical Logic's role in discrete systems. Covering propositions, predicate, and modal logic, it emphasises implication and offers case studies for each technique. Concluding with machine learning and security examples, it imparts discrete system skills. (MS)
	Tevian Dray & Corinne Manogue, Oregon State	**Lie groups and Lie Algebra** Lie groups extend continuous symmetries like rotation groups, while Lie algebras represent their infinitesimal counterparts. This course introduces this theory through matrix groups, blending algebra and geometry, emphasising properties of orthogonal and unitary groups to illustrate concepts from differential geometry and abstract algebra. (MS)
	Claudiu Remsing. Rhodes	**Transformation Groups** This course provides an introduction to transformation groups, focusing on symmetries in various mathematical structures like sets and manifolds. It begins with a foundational survey of group theory and introduces elements of Lie theory. The core of the course examines how groups act on sets and delves into the intricate relationship between transformation groups and geometry, featuring numerous examples and exercises. (MS)
	Ulrich Paquet, AIMS South Africa	**Machine Learning** This practical course explores how machine learning (ML) is applied in large-scale online systems, particularly within the "internet of things." Students will build recommender systems from scratch, covering topics such as A/B testing, ranking, and user and entity modeling, including how users interact with online content like news stories. (MS)

The environment offered by AIMS provides a more personal and human touch to the learning experience. Having the possibility to meet students during breakfasts, lunches and dinners gives a chance to know both their cultural origin and background, together with their academic and life objectives. This helps in setting the course goals and organising its activities to achieve them. This learning adventure is a double sided road during which the lecturer can share its life experiences helping students to shape their future.
- Joan Simon Soler (University of Edinburgh)

	Neil Hart, Oxford	**AI in Climate Science** This module examines how machine learning and AI enhance climate science and weather prediction. It covers unsupervised learning, computer vision, and causal inference applications in weather-climate problems, with examples of Explainable AI (XAI) techniques. The module also reviews recent weather prediction advances like GraphCast and AIFS, aiming to equip students with AI skills applicable to climate science. (AI)
	Marta Spinelli, ETH Zurich & Landman Bester,SARAO/Rhodes	**Principles of Imaging for Radio Astronomy** This course explores Radio Cosmology, focusing on neutral hydrogen's role in mapping the Universe's large-scale structure and using AI for data analysis and simulation. It covers key concepts of Modern Cosmology, the Bayesian approach, and Universe simulation techniques. The course highlights the SKA Observatory project in South Africa, its significance in understanding dark matter and dark energy, and the use of 21cm Intensity Mapping and machine learning to analyse radio astronomy data. (AI)
	Emmanuel Dufourq,, Lorène Jeantet, AIMS South Africa & Matthew Van den Berg, Stellenbosch	**Deep Learning for Ecology** This course examines how deep neural networks can aid wildlife conservation by applying machine learning to tasks like detecting animal vocalisations, images, and behaviours. Students will use acoustic, image, and accelerometry data, design a Raspberry Pi acoustic recording unit, record natural sounds, and build a machine learning classifier. Coding will be done in Python and Jax. (AI)
26 Feb - 15 Mar	Nancy Neudauer, Pacific	**Mathematical Problem Solving** Explores challenging elementary problems across various branches of pure mathematics, fostering discussions on investigations, solution methods, and generalisations. It aims to teach students diverse problem-solving approaches and research techniques through practical examples. (MS)
	Phil Knight, Strathclyde	**Networks** This course introduces network theory, providing a mathematical framework to analyse vast networks that influence the global economy. Students will learn key tools for understanding complex behaviours and structures in real-world networks. The course emphasises the relationship between matrix algebra and graph theory, enabling practical network analysis. Using Python, students will simulate and analyse networks, identify key members, and reveal both local and global structures obscured by large datasets. (MS)
	Lyndsay Kerr, Edinburgh	**Analytical Techniques in Mathematical Biology** Applies mathematics to real biological issues, focusing on mathematical models for biological systems. It addresses long-term outcomes, parameter impacts, species coexistence, tumour cell growth, disease spread, immunisation effects, and animal coat patterns. Infection models estimate factors like infection rates using real data. The course aims to connect mathematics and biology for practical insights. (MS)
	Stéphane Ouvry, Paris Saclay	**Information Theory** Introduces random systems, probability theory, and Shannon information theory with a mathematical emphasis. Topics include probability calculus, central limit theorem, random walks, Brownian curves, random numbers, Monte Carlo sampling, Shannon entropy, LZW compression, Diaconis riffle shuffle, and random permutations applied to sailing boat regattas. (MS)

Teaching at AIMS is a brilliant experience. By largely disconnecting from the rest of the world and focusing on teaching, I was able to make more progress on my book in three weeks than in the six months before that! The stay was very well accommodated and teaching AIMS students is incredibly rewarding. And last but not least: I have only found cappuccinos similar in quality to the ones I drank in Muizenberg in Italy!
- Max Welling (University of Amsterdam)

	Roland Herzog, Ekaterina Kostina, & Evelyn Herberg, Heidelberg	**Mathematical Optimisation** The first part of the course, Fundamentals of Optimisation, reviews fundamental concepts of linear algebra and calculus indispensable for optimisation, including multivariate calculus, Newton's method, linear systems of equations, and cones. The second part, Linear, Integer and Nonlinear Optimisation, provides an introduction to linear optimisation, integer optimisation, and nonlinear constrained optimisation. For each topic, the course covers the theoretical background as well as numerical algorithms. Lectures were accompanied by practical exercises. (MS)
	Luigi del Debbio, Edinburgh	**Theoretical Foundations of Machine Learning and AI** This course explores the statistical properties of trained Neural Networks using an effective field theory approach. It begins with foundational concepts in statistics and Machine Learning before delving into field-theoretical methods. Numerical examples help visualise theoretical results. The course covers stochastic variables, neural network architecture, parameters, initialisation, datasets, and training. It examines the statistical description of preactivation functions at initialisation and their connection to field theory. Finally, it explores training as a flow in the configuration space of a field theory, presenting analytical results. (AI)
	Arnu Pretorius, InstaDeep	**Reinforcement Learning** This course introduces Reinforcement Learning (RL), covering Markov decision processes, dynamic programming, Monte Carlo methods, value-based methods like temporal difference learning, function approximation, and policy gradient methods. The course balances theory and practical coding using notebooks. It concludes with an overview of advanced RL topics and applications. (AI)
25 Mar -12 April	Eric Andriatiana, Rhodes	**Experimental Mathematics with Sage** This course introduces an approach to doing mathematics that is founded on experiment and inquiry. It does so in the medium of Sage, a Python-based tool for computation and experiment. Some of the problems studied come from (but not limited to) Geometry, Probability Theory, Number Theory and Graph Theory. Skill with Sage will be important for many subsequent courses. (MS)
	Dugald MacPherson, Leeds	**Model Theory and Homogeneous Structures** Mathematical Logic spans maths, philosophy, and computer science, tackling rigorous foundations, infinity, computability, and reasoning. Model Theory studies structures in logical languages, with broad applications. This course introduces model theory, covering sets, functions, sizes, equivalence, orders, and graphs. It discusses definable sets, compactness, and applications, along with homogeneous structures and the "random graph." (MS)
	Grae Worster & Jerome Neufeld, Cambridge	**Geophysical Fluid Dynamics** This course introduces mathematical fluid dynamics for predicting geophysical flows. Topics include the impact of Earth's rotation on weather, flows through porous media affecting groundwater and CO2 storage, and phase changes in geological processes like ocean freezing and rock formation. (AI/MS)
	Patrick Dorey, Durham	**Solitons** This course explores solitons, long-lasting solutions to certain nonlinear partial differential equations, highlighting their intriguing properties and applications in mathematics and physics since their discovery in 1834. (MS)
	Max Welling, Amsterdam	**Framing Research Problems** This course delves into three intersections of machine learning and science: generative models from nonequilibrium statistical mechanics, training DFT functionals and force fields, and machine learning in neuroscience. Each week includes lectures and discussions on research papers. The goals are to learn about these topics and develop research projects suitable for top-tier publications. (AI)
	Elizaveta Semenova, Oxford	**Bayesian Modelling and Probabilistic Programming with Examples from Epidemiology** This course covers Bayesian inference, hierarchical modelling, Gaussian processes for spatial statistics, and ordinary differential equations for disease transmission modelling. Using Numpyro, students will build probabilistic models and perform Bayesian inference to characterise uncertainty. While computationally focused, the course draws inspiration from epidemiological modelling practices. (AI)
	Jan Buys & Francois Meyer, Cape Town	**Natural Language Processing** This course aims to introduce you to the most important applications and models in Natural Language Processing. You will learn how to design and build data-driven systems for classifying, labelling, and generating text. You will be exposed to basic terminology, evaluation techniques, fundamental mathematical/statistical models and algorithms, optimisations and trade-offs, application areas and contemporary topics. You will learn how to formalise natural language processing problems, process datasets, and choose appropriate machine learning models and algorithms to use in your own applications. (AI)

22 Apr - 10 May	Matt Macauley, Clemson	**Algebraic Biology** Mathematical biology has changed using discrete maths and computational algebra, shifting from traditional differential equations to finite dynamical systems like Boolean networks. This course introduces "algebraic mathematical biology," exploring how multivariable polynomials and computational algebra address systems biology problems. (MS)
	Jane Hutton, Warwick	**Statistics Skills** This course teaches statistical problem solving using real-world data from healthcare, agriculture, and legal systems. It covers data analysis, visualisation, descriptive statistics, and the design of data collection. Students learn fundamental statistical concepts including probability, parameter estimation, and modeling, applying these through R software to various distributions and regression analyses. (MS)
13 - 31 May - 31	Joan Simon Soler, Edinburgh	**Quantum Information** This course introduces information and quantum theory, starting with classical information theory and Shannon entropy. It then covers the foundational axioms of quantum mechanics, including density matrices and entanglement, concluding with von Neumann entropy and its applications. (MS)
	Aniekan Ukpong, KwaZula-Natal	**Problem-solving in Physics** This course covers fundamental physics concepts and key problem-solving principles. It combines in-class discussions with laboratory-based computational investigations to demonstrate hands-on problem-solving in both classical and quantum physics. The goal is for students to learn various problem-solving approaches through concrete examples. (MS)
29 May -	Julia Mortera, Universita Roma Tre, Italy	**Statistical Inference** This course covers classical and Bayesian statistical inference, emphasising exploratory data analysis, linear and generalised linear models. It includes applications like Bayesian networks for forensic evidence and GLMs in legal cases. Students will use real data from health and law sectors with RStudio and Hugin software, learning to distinguish between parameter estimation, hypothesis testing, and prediction, and to select and interpret statistical methods for decision-making. (MS)
1 - 19 July	Nezhla Aghaei, Southern Denmark	**Introduction to the Representation of Finite Groups** This course covers group theory, including types like abelian and cyclic groups, and introduces representation theory with applications to these groups. It also explores basic topology, focusing on knot theory and the classification of knots. The course concludes by linking representation theory to knot theory through matrix representations. (MS)
	Mehrdad Ghaziasgar, Western Cape	**Reinforcement Learning Fundamentals** This course introduces reinforcement learning, starting with Markov Decision Processes (MDPs) and their key solving algorithms, including value and policy iterations. It progresses to model-based reinforcement learning methods, exploring how environmental models are built and used. The course concludes with model-free approaches, focusing on practical applications and epsilon-greedy Q-learning. (MS)
22 July - 9 August	Fernando de Pestana, Aberta	**Ordinary Differential Equations** This course offers an introduction to Ordinary Differential Equations (ODEs), focusing on qualitative theory methods. It starts with basic ODE solving techniques like separable equations and integrating factors, then moves to the Picard-Lindelof theorem for solution existence and uniqueness.(MS)
	Dimbinaina Ralaivaosaon, Stellenbosch	**Mathematical Problem Solving** The course considers challenging problems across pure mathematics branches, promoting discussions, varied problem-solving approaches, and research methods to equip students with problem-solving skills. (MS)

"It was again my pleasure and privilege to be able to teach Mathematical Problem Solving at AIMS in 2024. I remember how much Prof. Alan Beardon of Cambridge University, who designed this course, inspired me when I sat in his class in 2006, and it has been my motivation to inspire the new generation of young mathematicians from the continent by preserving the unique way of teaching this course.

AIMS has evolved in remarkable ways over the years, and I am proud and grateful to still be part of it. But one thing remains the same—you will never find students as positive and enthusiastic as the students at AIMS. I am proud to be contributing to the academic journey of these special students."
- Dimbinaina Ralaivaosaona (Stellenbosch University)

Research Projects for the 2023 and 2023-24 Intakes

Full name	Gender	Origin	Research Project Title	Supervisor
January 2023 Intake				
Clinton Garayi	M	Zimbabwe	Multiscale Modelling of Tick-borne Diseases with Application to Theileriosis	W Garira, Venda
Emmanuel Kwarirandunda	M	Zimbabwe	Confronting contamination using Gaussian mixture modelling	J Ferreira, Pretoria
Lusanda Makrwanana	M	South Africa	Forecasting the Price of Ethereum with Fractional Ornstein-Uhlenbeck-Lévy process: A Machine Learning Approach	J Mba, Johannesburg
Edmond Malepane	M	South Africa	Limitations of conversational agents for statistical analysis	T Gebert, Carnegie Mellon
Pretty Josias Maphalle	M	South Africa	Topological Data Analysis and Applications	C Rathilal, KwaZulu-Natal
Ntladi Derick Maserumule	M	South Africa	A study of the fourth-order nonlinear Benjamin-Ono equation of plasma physics	C M Khalique, North-West
Faith Buhlebenkosi Matema	F	Zimbabwe	Network models for Malaria transmission	P Knight, Strathclyde
Promise Mathebula	F	South Africa	Variable Annuities with GMDB and GMIB	J Nzeutchap, Moody's Analytics AXIS, Canada & I Mbonda, AIMS South Africa
Siyabonga Phiofillas Mthimkulu	M	South Africa	Topogenous orders on faithful functors	David Holgate, Western Cape
Rofhiwa Adolph Muthikitha	M	South Africa	Estimation of Barrier Option Prices Using the Least Squares Method	P Mashele, South Africa
Thifundedzwi Nemukula	M	South Africa	Bond Immunisation	G van Vuuren, Witwatersrand
Jérémie Mabiala Nlandu	M	DRC	Gaussian Process Regression for Multivariate Functional Data	S Dabo, Université de Lille
Ontlotlile Frans Nthite	M	South Africa	A Methodology to Create a Valid (Consistent) Correlation Matrix for Risk Management (Stress Testing) and Option Pricing Purposes.	G van Vuuren, Witwatersrand
Oprah Natasha Phiri	F	Zimbabwe	High-Fidelity Synthetic Distributions of Interaction Sequences in Two-Sided Marketplaces	T Gebert, Carnegie Mellon
Maria Mankone Ramaoka	F	South Africa	Application of Deep Reinforcement Learning in Financial Portfolio Management	F Mhlanga, Limpopo
Liteboho Samuel Sekholomi	M	Lesotho	Number of subtrees of caterpillars with given degree sequence	E Andriantiana, Rhodes
Pheeha Audrey Selabe	F	South Africa	Development of a Fair Machine Learning Model for Credit Risk Scoring	M Senekane, Johannesburg
Neo Kevin Sibuyi	M	South Africa	Value at Risk and Expected Shortfall	G van Vuuren,
Marry Thekhwe	F	South Africa	Evaluation of computational fluid-structure interaction approaches based on OpenFOAM	R Suliman, CSIR
Oprah Natasha Phiri	F	Zimbabwe	High-Fidelity Synthetic Distributions of Interaction Sequences in Two-Sided Marketplaces	T Gebert, Carnegie Mellon
Maria Mankone Ramaoka	F	South Africa	Application of Deep Reinforcement Learning in Financial Portfolio Management	F Mhlanga, Limpopo
Liteboho Samuel Sekholomi	M	Lesotho	Number of subtrees of caterpillars with given degree sequence	E Andriantiana, Rhodes
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Neo Kevin Sibuyi	M	South Africa	Value at Risk and Expected Shortfall	G van Vuuren,
Marry Thekhwe	F	South Africa	Evaluation of computational fluid-structure interaction approaches based on OpenFOAM	R Suliman, CSIR
Kukhanya Zondo	M	Zimbabwe	Transfer Learning on Accelerometry Data for Endangered Sea Turtle Conservation	L Jeantet & E Dufourq, AIMS South Africa

2023-2024 Intake				
Mahmoud Khaled Ahmed Amin Abdelkader*	M	Egypt	Mathematical Modelling and Implementation of Game Strategy for the Board Game Quoridor.	M J Winckler, Heidelberg
Olivier Mahumawon Adjagba**	M	Benin	Exploring the geographical links between environmental factors and population density on dengue incidence prediction	H Tegali, Stellenbosch & J Lourenço, Universidade Católica Portuguesa
Aurel Jundolf Selidji Agbodoyetin**	M	Benin	AI-enhanced classification and early detection of SARS-CoV-2 variants for timely public health response	J Xavier, Vales do Jequitinhonha e Mucuri, Brazil & H Tegally, Stellenbosch
Herimampionona Andriniaina **	M	Madagascar	An Investigation into achieving Batch Size-Invariance for Proximal Policy Optimization in Reinforcement Learning	R de Kock, InstaDeep & C Formanek, Cape Town & InstaDeep
Ny Haingo Miantsatiana Andry**	M	Madagascar	Digital Surveillance of Infectious Diseases through Language Models	J Xavier, Vales do Jequitinhonha e Mucuri, Brazil & H Tegally, Stellenbosch
Voalaza Mahavily Romuald Aubert*	M	Madagascar	Free Objects in Categories	D Holgate, Western Cape
Anas Ahmed Abdou Awadalla**	M	Egypt	Increasing Sampling Efficiency for Robotic Control using Behavior Cloning	G Berseth, MILA, Canada
Aness Chelfat**	M	Algeria	Quantify large population following climate disasters using satellite remote sensing imagery	H Tegally, Stellenbosch & M Kraeme, Oxford
Linda Wiseman Dlamini*	M	Eswatini	The surface code - A study in quantum error correction	R Sweke. IBM
Carlin Foka Takamgno**	M	Cameroon	Uncovering the climatic and environmental correlates of Arbovirus transmission in Africa using a Phylodynamic framework	H Tegally & G Mwanyika, Stellenbosch
Volana Onisoa Herimanana*	F	Madagascar	Various Notions of Connectedness	P Pillay, Western Cape
Knight Nasirumbi Juma*	F	Kenya	Fitting Step Selection Function with Environmental Covariates for the Movement of Elephants in Kruger National Park	C Hui & S MacFadyen, Stellenbosch
Béria Chingnabé Kalpelbe**	M	Chad	Anomaly Detection In High Energy Physics Data	D Murnane, Copenhagen & Lawrence Berkeley National Laboratory
Moses Kargbo*	M	Sierra Leone	A New Modified Modi Distribution and its Application to Real Data	S Ouvry, Paris-Saclay
Ester Kanyaa Kitengu*	F	Kenya	Investigating El Niño 2023 Impacts on Public Health in Kenya and Future Projections	N A Arreyndip, Ca' Foscari University of Venice
Vincent Ondima Kongo*	M	Kenya	Investigating the Changes in Precipitation Patterns and Extremes during El Niño 2023 Event and its Impacts on Planting Season over the West Africa Agricultural Zone	N A Arreyndip, Ca' Foscari University of Venice
Hassan Mahamat Nil**	M	Chad	Active Learning in Simulation-Based Inference for 2-Parameter Confidence Sets in SIR Epidemiological Modeling	H Prosper, Florida State
Motlatso Masego Malatji	F	South Africa	Generalized additive and dissimilarity modelling of butterfly community richness and turnover	C Hui & G Kietzka, Stellenbosch
Zeinab Abdelnaeem Ibraheem Mohamed*	F	Egypt	Exploring Quantum Error Correction: A Guide to Stabilizer Codes	R Sweke, IBM
Refilwe Molefe	M	South Africa	Evaluate the impact of COVID-19 on Malaria and Family Planning using an Interrupted time Series Method with an AutoRegressive Integrated Moving Average - SARIMA	S Lougue, Institut de Recherche en Sciences de la Santé

Agbokpé Gaglozoun Melchior N'Bouke*	M	Benin	The Combinatorial Nullstellensatz	T P Chalebgwa, Pretoria
Ntokozo Ntshona	F	South Africa	Missing Values Imputation in Time Series Data: Comparison of Several Imputation Methods	S Lougue, Institut de Recherche en Sciences de la Santé
Tlotlo Montshwari Oepeng**	M	Botswana	Particle Track fitting with Transformer	D Murnane, Lawrence Berkeley National Laboratory
Reagan Otieno Okumu*	M	Kenya	On The Malleability of RSA Moduli and Pseudoprimes	J Urroz, Politècnica de Catalunya & D Ralaivaosaona, Stellenbosch
Noelson Sophonie Daniel jaonarivonivelomanantsoa**	M	Madagascar	Discovering Cooperative Skills with Diversity in Multi-Agent Reinforcement Learning	F Chalumeau, InstaDeep & C Formanek, Cape Town & InstaDeep
Tsiry Meva Sisih Rakotondratoetra*	F	Madagascar	On the Duality of Sober Spaces and Spatial Frames	C Rathilal, KwaZulu-Natal
Maminiaina Rakotovao**	M	Madagascar	Component separation algorithms to unveil the large-scale structure of the Universe	M Spinelli, Observatoire de la Côte d'Azure, France
Miandrisoa Voara Rakotovaomino**	M	Madagascar	Exploring deep learning model architectures for automatic identification of green turtle behavior from accelerometers	L Jeantet & E Dufourq, AIMS South Africa/ Stellenbosch
Tiana Fandresena Gérald Ramonjison**	M	Madagascar	Conceptual design of Therapeutic Isotope Imager with Gamma Ray (TIIGR)	F Retière TRIUMF, Canada
Antonio Yves Razafindriamiadanarivo	M	Madagascar	What is Chern-Simons theory?	N Aghaei, Geneva
Mickaya Aimé Razanaparany*	M	Madagascar	Denominator Regularization in Quantum Field Theory	W A Horowitz, Cape Town
Abel Legese Shibiru**	M	Ethiopia	Enhancing Peptide Mass Spectra Encoder through Pretraining using Contrastive Predictive Coding	K Eloff, Amandla Mabona & J Van Goey, InstaDeep
Desta Legesse Wubishet**	M	Ethiopia	Machine Learning Methods in Predicting Consumer Price Index (CPI) - The South African Case	F K Mutombo, Lubumbashi & M R Gavhi-Molefe, AIMS South Africa

The January 2024 Intake with Prof. Jane Hutton

Students on the January 2024 Intake

Name	Gender	Origin
Clément Adandé **	M	Benin
Pelumi Victor Aderinto **	M	Nigeria
Wisdom Aduah **	M	Ghana
Dumisane Baloyi	M	South Africa
Yvan Marcel Carré Vilmorin **	M	Cameroon
Natasha Chola	F	Zambia
Annette Dariose Diffo Mboudjiho **	F	Cameroon
Catherine Nana Nyaah Essuman **	F	Ghana
Helen Tizazu Fekede	F	Ethiopia
Comfort Sunday Jones	F	Nigeria
Ingrid Thandeka Kabinde	F	South Africa
Fermat Leukam **	M	Cameroon
Benvollens Maluleke	M	South Africa
Lindokuhle Nhlakanipho Manana	M	South Africa
Siyanda Kabelo Maswanganye	M	South Africa
Siphosethu Lucas Mathonsi	M	South Africa
Rivaldo Messia Moleya	M	South Africa

Tshepo Nakedi Moropane	M	South Africa
Oumarou Moussa Bola	M	Niger
Esau Moyoweshumba	M	Zimbabwe
Williams Naab	M	Ghana
Emmanuel Nyandu Kagarabi Ndatoro **	M	DRC
Gaylord Ndembo Ndatoro Ndatoro **	M	DRC
Blessing Adetayo Ogunlaran	M	Nigeria
Isaac Temiloluwa Omolayo **	M	Nigeria
Lerato Ramoyadi	F	South Africa
Tatenda Shoko	M	Zimbabwe
Herman Franclin Tesso Tassang **	M	Cameroon
Hermann Michaël Titcho Titcho **	M	Cameroon
Khangweleni Jameson Tshirundu	M	South Africa
German Shâma Wache **	M	Cameroon

** AI for Science Stream Students

BSc Honours with a Focus in Biomathematics Students

Since 2008, AIMS South Africa, in partnership with Stellenbosch University, has offered the Honours in Mathematics with a focus in Biomathematics. It is a unique offering in that students spend the first half of the year at AIMS and the second half of the year at SU. During the first half the students complete a varied programme of courses, including computing, statistics, modelling in biosciences, and algebraic biology. One student was registered for 2023, and one student is enrolled for 2024.

Graduations

January 2023 Intake

On 13 December 2023, AIMS South Africa celebrated the success of 20 students, including 14 South Africans, from the January 2023 intake at a Recognition of Achievement Ceremony held at the Centre.

In his welcome address, Prof. Ulrich Paquet, acknowledged the students' dedication and personal growth, "Today we celebrate your hard work, the friendships you have formed, and the intellectual growth you have experienced. It is said that minds once stretched can never return to their original dimensions. My hope is that your time at AIMS has expanded your thinking in ways that will enrich your future."

Speaking on behalf of the students, Marry Thekhwe and Neo Kevin Sibuyi, both from South Africa, expressed their gratitude to AIMS and its supporters. Ms Thekhwe remarked, "We came here determined to acquire knowledge, and today we celebrate our success — not just as individuals, but as a collective." Mr Sibuyi added, "Wherever we go — academia or industry — we will make AIMS proud. As the youth of Africa, we must take an active role in driving the economy and creating something special."

The guest speaker, Prof. Mike Giles (University of Oxford, AIMS Council member), commended the students' achievements and shared valuable advice, "Seize opportunities, step out of your comfort zone, and develop resilience. Enjoy your work and do what inspires you. Most importantly, be an active part of the AIMS community."

Kukhanya Zondo, from South Africa, received the award for Academic Excellence.

2023-2024 Intake

On 11 July 2024, AIMS South Africa hosted its Recognition of Achievement Ceremony, celebrating the 2023-2024 intake in partnership with UCT, UWC, and SU. These institutions have been integral to AIMS's success, shaping the future of mathematical sciences in Africa.

Prof. Ulrich Paquet, warmly welcomed attendees, setting a celebratory tone for the event. "On behalf of all AIMS staff and lecturers, we are immensely proud of you for the dedication you have shown. I often see you working late at night, showing honesty and integrity," he remarked, highlighting the students' relentless effort and commitment.

Recognition of Achievement Ceremony December 2023

Recognition of Achievement Ceremony July 2024

This year, 33 graduates, including 7 women from 12 African countries, received their Recognition of Achievement Certificates, marking their academic excellence and perseverance. Agbokpé Gaglozoun Melchior N'Bouke was awarded the Stephen Hawking Award for Academic Excellence, while additional honours were presented to Volana Onisoa Herimanana, Voalaza Mahavily Romuald Aubert, Vincent Ondima Kongo, Tiana Fandresena Gérald Ramonjison, Abel Legese Shibiru, Anas Ahmed Abdou Awadalla, Ny Haingo Miantsatiana Andry, and Tsiry Meva Sisih Rakotondratoetra for their outstanding achievements.

A significant milestone was the introduction of the AI for Science Stream, funded by Google DeepMind, with 16 students completing the programme - the first cohort in this pioneering initiative. Prof. Claire David remarked, "Your expertise in AI and algorithms is rare and valuable; you are now considered experts in the field."

The keynote speaker, Dr Elizabeth Rasekoala, commended AIMS: "I applaud AIMS South Africa for sustaining this unique academic programme for 20 years and wish you continued success for decades to come."

Student representatives shared heartfelt reflections. Vincent Ondima Kongo noted, "Our time at AIMS has not only expanded our knowledge but deepened our passion for mathematics and intelligence." Anas Ahmed Abdou Awadalla added, "We are part of Africa's story — one of growth, perseverance, and endless possibilities. With the skills gained here, we will shape the future of our continent."

The ceremony celebrated not just a year of rigorous study, but the promise of AIMS graduates as future leaders in science and technology, ready to drive innovation and change across Africa and beyond.

Dr Elizabeth Rasekoala

Mr Vincent Ondima Kongo

Mr Anas Ahmed Abdou Awadalla

Graduate Profiles

Maria Mankone Ramaoka
AIMS South Africa 2023

Maria obtained a Bachelor's degree in Mathematics & Applied Mathematics (2021) and a BSc Honours in Applied Mathematics (2022) both from the University of Venda. She graduated from AIMS in December 2023.

During her time at AIMS, she actively participated in the Africa Scientifique programme and attended the Leeds-Africa conference which only enhanced her curiosity and interest in Data Science.

"My experience at AIMS has significantly refined my programming, analytical, and presentation skills, as well as my ability to communicate scientific concepts effectively. I am immensely appreciative of the invaluable lessons learned there, particularly the institution's commitment to fostering a culture of diversity and inclusivity."

Her research project at AIMS was on the Application of Deep Reinforcement Learning in Portfolio Management. She is currently a Graduate Trainee in Business and Commercial Banking, Credit Risk, at Standard Bank Group.

She aspires to pursue a PhD in Data Science in the near future while developing her expertise in the field of Banking.

Kukhanya Zondo
AIMS South Africa 2023

Kukhanya obtained a BSc in Applied Mathematics (First Class) from the National University of Science and Technology (NUST), Zimbabwe, in 2021. Before joining AIMS South Africa in January 2023, he briefly worked as an Employee Benefits and Policy Services Administrator at First Mutual Life in Zimbabwe.

At AIMS, his goal was to explore areas of mathematics he hadn't formally studied, such as Machine Learning, Network Theory, and Optimisation. His Master's project, titled "Transfer Learning on Accelerometry Data for Endangered Sea Turtle Conservation," was supervised by Dr Lorène Jeantet and co-supervised by Dr Emmanuel Dufourq from the Machine Learning for Ecology Research group.

Reflecting on his time at AIMS, Kukhanya shares, "The AIMS experience was invaluable, offering exposure to a broad range of mathematical fields. I'm deeply grateful to the guest lecturers from around the world, as well as the AIMS Institute's directors, staff, and colleagues who enriched the entire experience."

Kukhanya earned his Master's in Mathematical Sciences (with Distinction) in December 2023. Afterward, he worked as a temporary full-time lecturer at NUST for two months before joining First Mutual Microfinance as a Quantitative Specialist and Back Office Supervisor.

Looking ahead, he plans to pursue a Financial Risk Management qualification, where he aims to further apply the skills gained throughout his academic journey.

Graduate Profiles

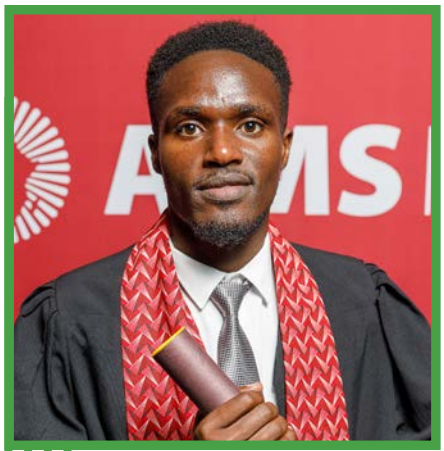
Meva earned her Bachelor's degree in Teaching and Didactics of Experimental Sciences and Mathematics from the Ecole Normale Supérieure Antananarivo, Madagascar, in 2021. In 2022, she completed one year focused on developing in-depth scientific competence in mathematics at the same institution. She completed her Master's degree at AIMS South Africa in 2024.

During her time at AIMS, she actively participated in community engagement initiatives, including serving as one of the Mastercard Foundation Scholars Representatives. Meva developed a strong passion for pure mathematics, with a particular focus on topology. Her research project at AIMS was supervised by Dr Cerene Rathilal from the University of KwaZulu-Natal, and explored pointfree topology.

Meva is currently involved in the AIMS Network as the Mastercard Foundation Scholars Representative. She has been awarded a National Research Foundation bursary for her Research Master's in Graph Topology in the AIMS Research Centre under the supervision of Prof. Karin-Therese Howell. She aims to further her studies in pure mathematics and contribute to the development of mathematical education. Meva is dedicated to inspiring the next generation of mathematicians in her home country.

"AIMS has been a pivotal support in my academic journey. It has provided me with an environment to grow not only as a mathematician but also as a leader."

Tsiry Meva Sisih Rakotondratoetra
AIMS South Africa 2023-2024



Vincent Ondima Kongo
AIMS South Africa 2023-2024

Vincent earned his undergraduate degree in Applied Statistics with IT from Maseno University, Kenya, graduating with First Class Honours in 2022. In 2023, he joined AIMS South Africa to pursue a Master's degree in Mathematical Sciences, graduating with distinction.

While at AIMS, Vincent took part in various leadership and volunteer activities. He served as the student representative, volunteered at the House of Science and for the Siyakhula event, and actively participated in the Africa Scientifique workshops. His time at AIMS allowed him to explore a wide range of mathematical fields, deepening his understanding of how mathematical concepts can be applied to solve real-world problems.

"My time at AIMS was life-changing. I had the privilege of learning from world-class lecturers and collaborating with brilliant peers from across Africa. It was a transformative period where my mind was stretched into high and new dimensions."

Following his studies at AIMS, Vincent joined Industry Immersion Africa (iiAfrica), where he underwent intensive training designed to facilitate a smooth transition from academia to industry. He now works on various personal and client projects, showcasing his expertise in mathematics, particularly in data science.

Vincent is currently exploring opportunities to pursue a PhD to further enhance his knowledge and skills. He is particularly interested in data science and machine learning, with a focus on their applications in the health and climate sectors.

Ny Haingo Miantsatiana Andry

AIMS South Africa 2023-2024

Haingo completed his undergraduate and Master's degrees in Physics at the University of Antananarivo. In July 2024, he graduated from AIMS South Africa as part of the first cohort of the new AI for Science Stream in partnership with Google DeepMind.

Haingo chose AIMS because it is one of the best institutions for learning mathematics in the world, providing him with opportunities to learn from distinguished lecturers. "My experience at AIMS improved not only my skills in mathematics and computer science but also expanded my capacity for problem-solving and innovative thinking in interdisciplinary science." The unique environment of discussions and collaboration at AIMS sparked his interest in applying mathematics and artificial intelligence to the most challenging problems, particularly in scientific areas that truly impact and improve people's lives.

Currently, Haingo is pursuing a PhD in Applied Mathematics at Stellenbosch University, affiliated with AIMS, and working closely with the team at the Centre for Epidemic Response and Innovation (CERI) to explore how artificial intelligence can assist in addressing key epidemiological questions. He is excited about the potential of artificial intelligence in scientific discovery and is determined to be at the forefront of this interdisciplinary field.

Béria, originally from Chad, holds an engineering degree in Applied Statistics with a specialisation in Information Systems and Decision-Making Statistics from the Sub-regional Institute of Statistics and Applied Economics in Cameroon. He is also part of the inaugural cohort of the AI for Science Stream, funded by Google DeepMind.

Béria has diverse professional experience, having worked as a Data Analyst for public institutions in Chad in 2022 and volunteering as a Statistician for the World Food Programme (WFP) in 2023. Currently, he works remotely as a Data Visualisation Specialist for a company in England, while also collaborating with world-class researchers at Stanford University as part of the predoctoral Fatima Fellowship. He leads a team dedicated to advancing AI technologies in his local language, Mundang, focusing on collecting language data, training models, and making them freely available online.

His research interests lie in Perception, Vision, and Language Intelligence for Robotics. "I am passionate about harnessing these tools to drive the development of Intelligent Agriculture, a technology I believe is crucial for Africa to emerge as a global economic leader."

Béria Chingnabé Kalpelbe

AIMS South Africa 2023-2024

Post AIMS

Progress of Recent Students

Full name	Gender	Origin	Institution	Programme/ Position
Graduate from January 2023 Intake				
Clinton Garayi	M	Zimbabwe	TBC	PhD
Emmanuel Kwarirandunda	M	Zimbabwe	Murimi247	Operations Manager
Lusanda Makrwanana	M	South Africa	South African Tourism	Analytics & Insights Intern
Edmond Malepane	M	South Africa	Mercedes-Benz South Africa	Intern Business Analyst
Pretty Josias Maphalle	M	South Africa	ABSA Group	CIB Intern
Ntladi Derick Maserumule	M	South Africa	Planning to start own business	
Faith Buhlebenkosi Matema	F	Zimbabwe	Still exploring opportunities	
Promise Mathebula	F	South Africa	Standard Bank	Client Services Officer
Siyabonga Phiofillas Mthimkulu	M	South Africa	AIMS/ University of the Western Cape	PhD
Rofhiwa Adolph Muthikitha	M	South Africa	ABSA Group	Business Process Optimisation Intern
Thifundedzwi Nemukula	M	South Africa	Terra Firma Solutions	Portfolio Manager
Jérémie Mabiala Nlandu	M	DRC	AIMS AMMI	Research Master's
Ontlotlile Frans Nthite	M	South Africa	Still exploring opportunities	
Oprah Natasha Phiri	F	Zimbabwe	Ecumenical Church Leaders Forum	Monitoring and Evaluation Officer
Maria Mankone Ramaoka	F	South Africa	Standard Bank	Graduate Trainee in Credit Risk
Liteboho Samuel Sekholomi	M	Lesotho	Still exploring opportunities	
Pheeha Audrey Selabe	F	South Africa	Still exploring opportunities	
Neo Kevin Sibuyi	M	South Africa	WorldQuant University	Master's Degree, Financial Engineering
Marry Thekhwe	F	South Africa	University of Cape Town	Research Master's
Kukhanya Zondo	M	Zimbabwe	First Mutual Microfinance, Zimbabwe	Quantitative Specialist & Back Office Supervisor
Graduates from 2023-2024 Intake				
Mahmoud Khaled Ahmed Amin Abdelkader	M	Egypt	TBC	PhD
Olivier Mahumawon Adjagba	M	Benin	Still exploring opportunities	
Aurel Jundolf Selidji Agbodoyetin	M	Benin	Heidelberg University	Research Assistant Internship
Herimampionona Andriniaina	M	Madagascar	Stellenbosch University	PhD
Ny Haingo Miantsatiana Andry	M	Madagascar	Stellenbosch University	PhD
Voalaza Mahavily Romuald Aubert	M	Madagascar	ICTP, Italy	Pre-PhD

Anas Ahmed Abdou Awadalla	M	Egypt	Ministry of Communications & information Technology, Egypt	Research Engineer
Aness Chelfat	M	Algeria	CSID Lab, Heidelberg	Fellowship
Linda Wiseman Dlamini	M	Eswatini	Stellenbosch University	Research Master's
Carlin Foka Takamgno	M	Cameroon	Center for Epidemic Response and Innovation (CERI), Stellenbosch University	PhD
Volana Onisoa Herimanana	F	Madagascar	Stellenbosch University	Research Master's
Knight Nasirumbi Juma	F	Kenya	Still exploring opportunities	
Béria Chingnabé Kalpelbe	M	Chad	Deep Knowledge Group, London	Data Visualization Specialist
Moses Kargbo	M	Sierra Leone	Leeds University	PhD
Ester Kanyaa Kitengu	F	Kenya	University of Münster	YAM Fellowship
Vincent Ondima Kongo	M	Kenya	Industry Immersion Africa	Internship Programme
Hassan Mahamat Nil	M	Chad	Heidelberg University	Research Intern in CSAID Lab
Motlatso Masego Malatji	F	South Africa	Fairtree	Risk Intern
Zeinab Abdelnaeem Ibraheem Mohamed	F	Egypt		Teaching Assistant
Refilwe Molefe	M	South Africa	University of the Western Cape	Research Master's
Agbokpé Gaglozoun Melchior N'Bouke	M	Benin	AIMS Research & Innovation Centre, Rwanda	Visiting Research Assistant
Ntokozo Ntshona	F	South Africa	Still exploring opportunities	
Tlotlo Montshwari Oepeng	M	Botswana	AIMS South Africa	Tutor
Reagan Otieno Okumu	M	Kenya	University of L'Aquila	Erasmus Mundus Joint Master's Degree
Noelson Sophonie Daniel Rajaonarivonivelomanantsoa	M	Madagascar	Instadeep Cape Town	Research Intern Engineer/PhD
Tsiry Meva Sisih Rakotondratoetra	F	Madagascar	AIMS/Stellenbosch University	Research Master's
Maminiaina Rakotovao	M	Madagascar	Still exploring opportunities	
Miandrisoa Voara Rakotovaomino	M	Madagascar	Onja Madagascar	Analyst
Tiana Fandresena Gérald Ramonjison	M	Madagascar	Simon Frazer University, Canada	Reseach Master's
Antonio Yves Razafindriamiadanarivo	M	Madagascar	Still exploring opportunities	
Mickaya Aimé Razanaparany	M	Madagascar	Heidelberg University, Germany	Internship
Abel Legese Shibiru	M	Ethiopia	Barcelona, Spain	Research Engineer
Desta Legesse Wubishet	M	Ethiopia	Bahir Dar University, Ethiopia.	Mathematics Lecturer

RESEARCH

Centre

AIMS South Africa continues to be a hub for cutting-edge research, fostering collaborations across mathematics, artificial intelligence, machine learning, ecology, and environmental sciences. Through strategic partnerships, visiting scholars, and dedicated research groups, AIMS advances knowledge in key scientific domains while addressing some of the most pressing global challenges.

In 2023–2024, research activities at AIMS were strengthened by the appointment of a new AIMS-Carnegie Junior Research Chair, an increasing number of international research visits, additional research focus areas and AIMS's involvement in major global research initiatives, including Oxford University's Intelligent Earth Centre.

The Machine Learning for Ecology Research Group remains at the forefront of applying deep learning techniques to conservation, enhancing the ability to monitor and protect wildlife more efficiently. The launch of a new group focusing on Algebra and Topology in March 2024, known as AT AIMS, expands the fundamental mathematical areas covered in the Research Centre. The Centre also continues to host leading scientists and emerging researchers, fostering a vibrant environment of intellectual exchange and interdisciplinary innovation.

This section highlights key research milestones, collaborations, and academic contributions that have shaped the research landscape at AIMS South Africa over the reporting period.

Appointment of AIMS-Carnegie Junior Research Chair

AIMS South Africa announced the appointment of Dr Emmanuel Dufourq as the AIMS-Carnegie Junior Research Chair, a position he assumed for a three-year term. In this role, Dr Dufourq continues to advance machine learning for ecology, both in Africa and internationally, through the Machine Learning for Ecology Research Group at AIMS South Africa.

This initiative drives critical research projects focused on wildlife monitoring, addressing the urgent global challenge of biodiversity decline. Factors such as over-exploitation of resources, deforestation, and climate change have significantly impacted natural ecosystems, prompting widespread calls for immediate action to restore and protect biodiversity.

Deep learning techniques have proven to be a transformative tool in tackling these challenges, significantly reducing the time and effort required to analyse large and complex wildlife datasets. The Junior Research Chair focuses on further developing and enhancing these applications, enabling automated analysis that supports more efficient and effective conservation strategies.

AT AIMS

Launched at the Siyakhula Festival in March 2024, this research group introduces the fundamental mathematical fields of Algebra and Topology to the AIMS Research Centre. Led by Prof. Karin-Therese Howell and Prof. David Holgate, Dean of Natural Sciences at UWC, who holds a joint research position with AIMS and UWC, the group aims to advance these critical areas of mathematics.

AT AIMS will focus on high-quality research in algebra, algebraic biology, and topology, while also supervising students, hosting collaborators, and organising workshops. Ultimately, its goal is to inspire excitement and engagement in these mathematical fields, fostering a vibrant research community.

Journal of Artificial Intelligence for Sustainable Development

As part of AIMS South Africa's commitment to advancing AI-driven research for Sustainable Development, the Journal of Artificial Intelligence for Sustainable Development (JAISD) was launched on 22 March 2024 during the 20th anniversary celebrations. Established under the NAiXUS Network of Excellence, JAISD serves as a pioneering academic platform dedicated to fostering interdisciplinary research and promoting AI-driven solutions for Sustainable Development Goals (SDGs). The journal brings together researchers from diverse backgrounds, spanning multiple continents, to address critical global challenges — from climate action and economic development to social equity

and technological innovation. Through peer-reviewed publications, case studies, and insights, JAISD aims to advance knowledge, bridge research gaps, and drive impactful change in AI for sustainability. For more information and submission guidelines, visit www.jaisd.org.

Research Visits and Collaborations

In September 2023, Master's students from Heidelberg University, Ufuk Cakir (Physics) and Changjing Hu (Interdisciplinary Scientific Computing), conducted research with the Machine Learning for Ecology Group on AI-driven wildlife monitoring (11 September – 10 November 2023).

Machine Learning for Ecology Group September 2023

Several distinguished researchers had extended research stays, including:

- Dr Ian Durbach, AIMS Associate Research Fellow (5 September – 4 October 2023)
- Dr Marcel Atemkeng (4 October – 30 November 2023)
- Mr Gael-Pacome Nguimeya Tematio, visiting PhD student (4 December 2023 – 31 January 2024)

In February 2024, Dr Sarab Sethi (Imperial College London) collaborated with the Machine Learning for Ecology Group under the Imperial-AIMS Connect Partnership Fund, developing AI and sensing technologies for ecological monitoring.

Further visits included:

- Ella Orme (PhD, Imperial College London) – spent three months at AIMS (from 24 March 2024), participating in AI courses and conducting research with Prof. Paquet.
- Clint Wankouo Ngouleu (PhD, University of Dschang, Cameroon) – a two-month visit (from 2 April 2024) focused on AI-driven hybrid renewable energy systems for rural electrification in Cameroon, funded by the AGNES Intra-Africa Mobility Grant.
- Ms Munira Omar, visiting Master's student from Sudan (15 February – 15 March 2024)
- Prof. Wilfred Ndifon, AIMS Research and Innovation Centre (5 – 12 May 2024)

German Research Chairs Public Lectures

On 27 September 2023, AIMS South Africa hosted a series of public lectures, featuring candidates applying for a German Research Chair at the AIMS South Africa Research Centre. This programme, which supports research chairs at AIMS Centres, is managed by the Alexander von Humboldt Foundation and funded by the German Federal Ministry of Education and Research.

The lectures showcased cutting-edge research topics, presented by distinguished scholars:

- **Dr Ignace Aristide Minlend** *(University of Douala, Cameroon) – 'Overdetermined Boundary Value Problems'*

- **Prof. Dr Sergej Rjasanow** *(University of the Saarland, Germany) – 'The World of Particles'*

- **Dr Bruce Bartlett** *(Stellenbosch University, South Africa) – 'From Quantum Topology to Topological Quantum Computing'*

- **Dr Ryan Sweke** *(IBM Almaden Research Centre, USA) – 'Quantum Machine Learning: An Overview of Potential and Limitations'*

A representative from the Humboldt Foundation concluded the session with an overview of the foundation's research programmes and funding opportunities.

The lectures were live-streamed on YouTube and remain available for viewing:

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AIMS South Africa: A Partner in Oxford's New Centre for Doctoral Training

AIMS South Africa is proud to be a partner in the University of Oxford's newly established Centre for Doctoral Training (CDT). This CDT will integrate Oxford's expertise in artificial intelligence (AI), machine learning, Big Data, and environmental sciences, focusing on addressing global environmental challenges.

The Intelligent Earth Centre, led by Prof. Philip Stier, will serve as a hub for advancing AI-driven environmental research. As Prof. Stier explains: "AI is rapidly transforming environmental sciences, allowing us to scale existing research to unprecedented levels while opening entirely new areas of discovery. However, progress in this field will increasingly depend on access to highly skilled graduates. The Intelligent Earth Centre will play a crucial role in bridging this gap."

Building on our research in Machine Learning and Biodiversity, AIMS South Africa looks forward to collaborative research and teaching exchanges with Oxford University.

HeiAIMS Partnership Activities

In November 2023, Dr Michael Winckler and Ms Sarah Steinbach from Heidelberg University's Interdisciplinary Centre for Scientific Computing (IWR) visited AIMS South Africa as part of the HeiAIMS partnership programme.

Key activities during their visit included:

- 20–23 November 2023: Dr Winckler conducted an Optimisation Bootcamp for AIMS students.

- 21 November 2023: AIMS staff and visitors participated in a board games afternoon, fostering informal academic interactions.

- 23 November 2023: Dr Winckler delivered a public lecture titled 'One (Wo)man – One Vote: The Mathematics of Voting and Elections'. The talk provided insightful discussions on voting mechanisms and electoral processes, attracting both AIMS students and members of the public.

Looking Ahead

AIMS South Africa continues to foster a dynamic and collaborative research environment, strengthening partnerships with leading institutions and expanding its impact in mathematics, machine learning, ecology, and environmental sciences. With growing initiatives such as the Machine Learning for Ecology Research Group, participation in Oxford's Intelligent Earth Centre, and ongoing collaborations with Heidelberg University and Imperial College London, AIMS remains at the forefront of scientific innovation.

The institute remains committed to cutting-edge research, knowledge exchange, and mentorship, ensuring that Africa's brightest minds contribute meaningfully to global scientific progress.

Resident Researchers

Full name	Current Position	Gender	Area of Research
Prof. Bruce Bassett	Senior Resident Researcher (appointment ended October 2023)	M	Cosmology and astrophysics
Ashleigh Basel	Researcher, funded by CIAT	F	Modelling and understanding the complexity of biodiversity patterns and biotic interactions.
Prof. Claire David	Resident Researcher	F	Machine Learning
Dr Emmanuel Dufourq	Resident Researcher and AIMS Carnegie Junior Chair	M	Machine learning for ecology
Dr Rejoyce Gavhi-Molefe	Resident Researcher	F	Computational mathematics: subdivision
Prof. Karin-Therese Howell	Resident Researcher	F	Abstract Algebra
Prof. Cang Hui	South African Research Chair Mathematical and Theoretical Biosciences (SU-AIMS)	M	Mathematical and theoretical physical biosciences
Dr Sinobia Kenny	Resident Researcher	F	Schools Enrichment Division
Dr Tejumade Ogundipe	Resident Researcher	F	Schools Enrichment Division
Prof. Ulrich Paquet	Senior Resident Researcher	M	Artificial Intelligence and Machine Learning
Prof. Jeff Sanders	Senior Resident Researcher	M	Theoretical computer science
Dr Mario Santos	South African Research Chair in Cosmology with Multi-Wavelength Data (UWC-SAAO-AIMS)	M	Cosmology and astrophysics
Dr Simukai Utete	Senior Resident Researcher (appointment ended December 2023)	F	Robotics

Postdoctoral Fellows

There were 7 postdoctoral fellowships during the period under review.

Name	Origin	Gender	Start date to end date	Research Field	Supervisor/Host
Sabrine Chebbi	Tunisia	F	1 April 2022 – 31 March 2024	Multi-armed Bandit, Theory and Application in Communication Networks	Dr B Bah
Hamid El Bahja	Morocco	M	1 April 2022 – 31 March 2024	Physics Aware Learning	Dr B Bah
Lorène Jeantet	France	F	1 April 2022 – 31 March 2024	Machine learning for ecology	Dr E Dufourq
Martha Kamkuemah	Namibia	F	1 July 2022 – 30 June 2024	Specification and Validation of Artificial Intelligence-based Internet of Things Systems	Prof. J Sanders
Jan Keet	South Africa	M	1 August 2022 – 1 July 2024	Spatio temporal dynamics of rhinoceros in the Kruger	Prof. C Hui
Joel Lontsi Sob	Cameroon	M	1 April 2023 – 1 March 2024	Machine learning for ecology	Prof. U Paquet & Dr E Dufourq
Ines Takong	Cameroon	F	1 August 2022 – 31 July 2024	Classification of High Frequency Trade direction using Machine Learning: Application to the South Africa Financial Data	Prof. B Green

Postgraduate Students in the Research Centre

The number of students hosted by the AIMS Research Centre and supervised by AIMS resident researchers totalled 28 during the period under review. 9 of these are doctoral students. The students who have graduated are asterisked in the table below.

PhD Students

No	Name of student	Origin	Gender	Research Topic	Study duration	Supervisor/Host	Based at
1	Everlyn Asiko Chimoto	Kenya	F	Neural Machine Translation for low-resource languages	February 2023 (ongoing)	Prof. B Bassett	AIMS/ UCT
2	Richard Gibbs	South Africa	M	Modelling adaptive movement behaviours of large mammals subject to environmental changes in sub-Saharan Africa	1 January 2022 (ongoing)	Prof. C Hui	SU
3	Mmatlou Kubyana	South Africa	M	Structure and stability of multilayer networks	1 March 2020 – March 2024	Prof. C Hui	SU
4	Carolina Marques	Portugal	F	Developing machine learning tools for automatic detection and classification of wildlife sounds	8 November 2022 (ongoing)	Dr E Dufourq	University of Lisbon
5	Samuel Ofosu Mensah	Ghana	M	Detecting Diseases on the Retina using Deep Learning Techniques	1 February 2019 (ongoing)	Dr B Bah & Prof W. Brink	AIMS/SU
6	Siyabonga Phiofillas Mthimkulu	South Africa	M	Topogenous orders on faithful functors	1 March 2024 (ongoing)	Prof. D Holgate	UWC
7	Rockefeller	Cameroon	M	Deep Learning Approaches for Wind Power Forecasting	1 January 2020 (ongoing)	Dr B Bah & Prof V. Marivate	AIMS/SU
8	Lorenzo Ruaro	Italy	M	Spatial population modelling of southern white rhinoceros, Ceratotherium simum simum	1 January 2020 (ongoing)	Prof. C Hui	SU
9	Abdulrahaman Lawal Suleiman	Nigeria	M	Modelling thermal adaptation of physiological reaction norms with adaptive dynamics	1 January 2018 (ongoing)	Prof. C Hui	SU

Research Master's Students

No	Name of student	Origin	Gender	Research Topic	Study duration	Supervisor/Host	Based at
1	Dorcas Asare	Ghana	F	Data-driven approaches to identifying anomalies in African disease data	1 July 2022 (ongoing)	Dr B Bah & Dr. Gibril Jobe	AIMS
2	Dean Blackburn*	South Africa	M	Convolutional neural network filter selection for passive acoustic monitoring models	1 December 2021 - 28 February 2024	Dr E Dufourq & Dr L Jeantet	AIMS/SU
3	Donavan Broughton*	South Africa	M	Evolving encapsulated neural network blocks	1 December 2021 - 28 February 2024	Dr E Dufourq	AIMS/SU
4	Thembelihle Rose Dlamini	Eswatini	F	Mitigating errors in quantum annealing	29 April 2022 (ongoing)	Prof. H Touchette & Dr D Nickelsen	SU/AIMS
5	Wesley Douglas	South Africa	M	Predicting future spread of invasive species across the Kruger National Park	1 February 2022 (ongoing)	Prof. C Hui	SU
6	Tomas Gueifão	Portugal	M	Estimating cue rates for beaked whales via convolutional neural networks: a stepping stone into passive acoustic density estimation of beaked whales	27 December 2021 (ongoing)	Prof. T Marques, Dr E Dufourq & Dr K Gkikopoulou	University of Lisbon
7	Charles Herbst	South Africa	M	Machine learning for data-scarcity and bioacoustics	1 March 2022 (ongoing)	Dr E Dufourq, Dr. L Jeantet & Prof. A Engelbrecht	AIMS/SU
8	Nonhlanhla Luphade*	Zimbabwe	F	Automated classification of Hainan Gibbon call type using deep learning	1 January 2021 - December 2023	Dr I Durbach, Dr E Dufourq & Mr S Britz	UCT
9	Tendai Mashiri	Zimbabwe	F	Possibility to use robotics in renewable energy systems to reduce carbon emissions	1 August 2023 (ongoing)	Prof. I Durbach & Dr R Rakotonirainy	AIMS/ UCT
10	Tebogo Malatsi*	South Africa	M	On symmetries and conservation laws of some classes of partial differential equations	1 March 2022 – 31 March 2023	Prof. Abdul Kara	WITS
11	Tendai Mashiri	Zimbabwe	F	Possibility to use robotics in renewable energy systems to reduce carbon emissions	1 July 2023 (ongoing)	Prof. I Durbach & Dr R Rakotonirainy	AIMS/ UCT
12	Victoria Okeowo	Nigeria	F	Devising agent-based models for elephant movement and conservation corridors to reduce human-elephant conflict	1 July 2022 (ongoing)	Prof. C Hui	SU
13	Tosin Samuel Osikoyo	Nigeria	M	Modelling the emergence of voltinism in insects	1 July 2022 (ongoing)	Prof. C Hui	SU
14	Milanto Rasolofohery	Madagascar	M	Compressed sensing for machine learning and bio acoustic monitoring	1 October 2022 (ongoing)	Dr E Dufourq	AIMS/SU
15	Alvin Reabow	South Africa	M	Classification of Obsessive Compulsive Disorder using Convolutional Neural Networks	12 February 2022 (ongoing)	Dr S Heany, Dr S Er & Dr E Dufourq	UCT
16	Marry Thekwe	South Africa	F	Integrating Machine Learning Techniques into Proton Therapy Dosimetry	I July 2024 (ongoing)	Prof D Bucher, & Dr R Ghavi-Molefe	UCT
17	Matthew Van den Berg	South Africa	M	Posture estimation on the endangered African Penguin adding in depth estimation and creating a more optimised model	1 March 2023 (ongoing)	Dr. E Dufourq & Dr. L Jeantet	AIMS/SU
18	Joseph Wacira	Kenya	M	Intelligent control for processing solar photovoltaic energy	22 March 2022 (ongoing)	Dr B Bah & Prof. A Vargas	AIMS/SU
19	Mukhtar Yahaya	Nigeria	M	Structural emergence in plant-animal mutualistic network	1 April 2022 (ongoing)	Prof. C Hui	SU

Research Outputs

List of Publications

2023

Aval, J.C., **Karimatou, D.,** McNamara, P.R.W.,(2023) 'Quasisymmetric functions distinguishing trees' *Algebraic Combinatorics,* Volume 6, Issue 3, p. 595-614

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Falola, O., **Tchamga, M.S.S.,** *et al.* (2023) *'SysBioIPGWAS: simplifying post-GWAS analysis through the use of computational technologies and integration of diverse omics datasets' Bioinformatics,* 39(1) btac 791

Finlay, C., **Bassett, B.A.,** Kunz, M., **Oozeer, N.,** (2023) 'Trajectory-based RFI subtraction and calibration for radio interferometry' *Monthly Notices of the Royal Astronomical Society,* 524, p. 3231-3251

Guilherme, F., **Dufourq, E.,** *et al.* (2023) 'Automatic detection and taxonomic identification of dolphin vocalisations using convolutional neural networks for passive acoustic monitoring', *Ecological Informatics,* 78, p. 102291

Hamid, E, (2023) 'Regularity and existence of solutions to parabolic equations with nonstandard p(x,t) q(x,t)-growth conditions' *Opuscula Mathematica* Volume 43, Issue 6, p. 759-788

Hordijk, I., **Hui, C.** *et al.* (2023) 'Evenness mediates the global relationship between forest productivity and richness' *Journal of Ecology,* 111 p. 1308-1326

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Mo, L., **(Hui, C.)** *et al.* (2023) 'Integrated global assessment of the natural forest carbon potential' *Nature* Volume 624, p.92-101

Yifeng, C., **Sanders, J.W.,** (2023) 'A modal approach to conscious social agents', *International Journal on Software Tools for Technology Transfer,*25, p. 707-716

Jeantet L., Dufourq E. (2023) 'Improving deep learning acoustic classifiers with contextual information for wildlife monitoring.' *Ecological Informatics*. Doi: 10.1016/j.ecoinf.2023.102256

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Abbasi A.O., Woodall C.W., Gamarra J.G.P., **Hui C.,** (et.al.) (2024) 'Forest types outpaced tree species in centroid-based range shifts under global change' *Ecology and Evolution* 12:1366568

Batist C., **Dufourq E., Jeantet L.,** Razafindraibe M., Randriamanantena F., Baden A., (2024) 'An integrated passive acoustic monitoring and deep learning pipeline for black-and-white ruffed lemurs (Varecia variegata) in Ranomafana National Park, Madagascar', *American Journal of Primatology, Volume 4,* p.e23599.

Cara P., **Howell K.-T. (SU),** Wessels L.K., (2024) 'On direct sums and quotient spaces of near-vector spaces', Afrika Matematika 35:29, doi: 10.1007/s13370-024-01168-7

Chevallier D., Maucourt L., Charrier I., Lelong P., Le Gall Y., Menut E., Wallace B., Delvenne C., Vincze O., **Jeantet L.** et al. (2024). 'The response of sea turtles to vocalizations opens new perspectives to reduce their bycatch', *Scientific reports*. Vol 14, Article 16519

Cui H., Seiligo A., Tan X., **Hui C.,** Zhang Y., Li W., Zhou Z., Peng Z., Ma P., Xiao Z., Ouyang F., (2024) 'Dynamic trends in maize diseases and pests across six regions in China over two decades', *Crop Protection* 186:106930

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Herbst C., **Jeantet L, Dufourq E.** (2024) 'Empirical Evaluation of Variational Autoencoders and Denoising Diffusion Models for Data Augmentation in Bioacoustics Classification' *Annual Conference of South African Institute of Computer Scientists and Information Technologists* p. 45-61

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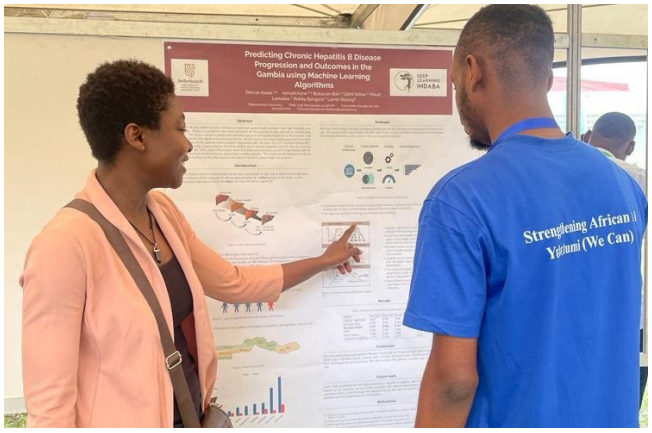
Presentations at Workshops and Conferences

- On 23 September, Prof. Bassett was a panellist at the Trieste Next Festival of Scientific Research. The panel discussed the topic "Chatgpt, do you love me?". This cross disciplinary panel looked at the question of relationships, identity and love in the age of AI.

Prof. Bassett Trieste

- Ms Dorcas Asare, a Research Master's student attended the Deep Learning Indaba conference in Accra, Ghana from 3 to 9 September. She presented a poster on her current research titled 'Predicting Chronic Hepatitis B Disease Progression and Outcomes in the Gambia using Machine Learning Algorithms' which won an award for one of the best scientific writings.



Ms Asare poster presentation

- Dr Jeantet participated in the EarthRanger User Conference 2023 held in Cape Town. On 2, 3 and 4 November, she presented 'Exploring the power of Deep Learning for Wildlife Monitoring' for the Machine Learning Research Group.

Dr Jeantet at EarthRanger

- From 30 October to 3 November, Rockefeller, a PhD student in the AIMS South Africa Research Centre had the opportunity to deliver a 30-hour training on Data Preprocessing and Feature Engineering Techniques at Ecole Superieure de la Finance, de l'Assurance et du Risque (ESSFAR) in Yaoundé, Cameroon.

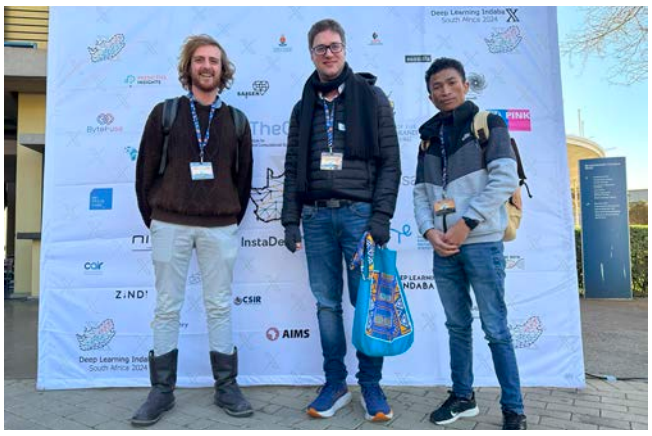
ESSFAR participants

- On 16 and 17 November 2023, Rockefeller gave a talk at the International Conference on Electrical, Computer, and Energy Technology in Cape Town. This came after the latest paper on 'Wind Power Prediction with HCNNs for Turbines', jointly written with Dr Bubacarr Bah, Dr Hans-Georg Zimmermann, and Prof. Vukosi Marivate had been accepted.

- From 20 to 24 November, Rockefeller participated in the Global Fellows Programme 2023 in Kigali, Rwanda. The programme brought together PhD students from AIMS and Imperial College London to work together in interdisciplinary and international groups, assisted by coaches, to develop professional, research, and collaborative skills as well as raise the intercultural awareness that is required to establish and continue successful collaborations. The participants applied their skills and competencies to address topics under the programme theme of 'African Data Science Solutions'.

Global Fellows Programme 2023

- In April 2024, Dr Jeantet participated in the launch of STEM MentHER as a 2024 mentor at Stellenbosch University. This programme is designed to support Grade 12 female students interested in pursuing careers in STEM.
- On 4 July 2024, Prof. Howell delivered a research talk, "The weird and wonderful world of near-vector spaces" at the 30th British Combinatorial Conference, held at Queen Mary University of London.
- Mr van den Berg, Dr Dufourq and Mr Rasolofohery attended the Deep Learning IndabaX in Johannesburg from 8 to 12 July. The aim of the conference was to provide a practical introduction to machine learning for beginners, to exchange scientific knowledge among researchers and to showcase cutting-edge applications from industry partners. Mr van den Berg presented a poster titled 'Posture Estimation for the Endangered African Penguin' and Mr Rasolofohery presented a poster titled 'Passive Acoustic Monitoring of Animal Populations with Compressed Sensing'. Dr Dufourq gave a keynote titled 'Deep Learning and Wildlife Monitoring.'



Mr van den Berg, Dr Dufourq & Mr Rasolofohery at the Deep Learning IndabaX

- Mr Herbst and Dr Dufourq attended SAICSIT 2024 which took place in Port Elizabeth from 15 to 17 July. Mr Herbst presented a talk titled 'Empirical Evaluation of Variational Autoencoders and Denoising Diffusion Models for Data Augmentation in Bioacoustics Classification' which was co-authored by Dr Jeantet and D Dufourq and was awarded the best computer science paper award.

Dr Dufourq & Mr Herbst

Seminars

Research Talks

On 28 February, Dr Sarab Sethi, who leads the Ecosystem Sensing Group at Imperial College London, presented a seminar titled: 'Fully autonomous eco-acoustic monitoring'.

Dr Sarab Sethi

On 2 April, Dr Sharon Neufeld, Senior Research Associate and Wellcome Trust Fellow, University of Cambridge, gave a talk titled: 'Statistical Models to Understand Changes in Depression over Development.'

On 10 April, Prof. Dr Max Welling, a fellow at the Canadian Institute for Advanced Research (CIFAR) and the European Lab for Learning and Intelligent Systems (ELLIS), gave a special seminar titled: 'Free Energy is All You Need.' The talk was presented by UCT-CERN and AIMS South Africa and hosted at UCT.

On 8 May, Prof. Wilfred Ndifon, Chief Scientific Officer AIMS Global Network and President of AIMS Research & Innovation Centre, Rwanda, gave a talk titled: 'Quantifying DNA, the building block of life.'

Journal Club

This is a seminar series of the AIMS Research Centre, where research students, AIMS researchers, visiting researchers and invited speakers present their research. The focus of the talks is to share the journey of obtaining research results including challenges faced and insights gained. The following talks were held in the period under review.

- On 3 October 2023, Prof. Ian Durbach an AIMS Associate Research Fellow from the University of St. Andrews gave a talk titled: 'How to know what isn't there: statistical methods for estimating animal abundance'

Prof. Ian Durbach

- Ufuk Çakır, Dr Jeantet, Joel Lontsi, Albert Agisha and Dr Dufourq presented their ongoing research at the Journal Club held on 7 November titled 'Evolutionary Spectrogram Optimisation'.

Journal Club held on 7 November

- On 14 November, Professors Corinne Manogue and Tevian Dray, from Oregon State University shared their expertise and insights on effective and innovative teaching methods through a presentation titled: 'Pedagogical Representation.'

Professors Corinne Manogue and Tevian Dray

- They gave a second talk on 20 November where they presented their studies in particle physics with a talk titled 'Using Octonions to Describe the Standard Model of Particle Physics.' The presentation was designed to be accessible for non-experts in particle physics, providing a valuable opportunity to explore the mathematics applied in this field.

- On 12 December, Mr Dean Blackburn a Master's student at SU, supervised by Dr Dufourq and Dr Jeantet and a member of the Machine Learning for Ecology Group in the AIMS Research Centre presented the results of his Master's thesis titled: 'Convolutional neural network filter selection using genetic algorithms.'

Workshops and Conferences

In the period under review AIMS South Africa hosted several significant workshops and conferences, making notable contributions to the advancement of mathematical sciences.

CIMPA School 2023

CIMPA School 2023

The Blockchain in Theory and Real Applications School was hosted at AIMS South Africa from 20 November to 1 December 2023. This event focused on two branches of blockchain technology: the development of algorithms to execute transactions consensually, and the mathematical tools and cryptographic protocols providing security. The opening ceremony, held on 24 November, welcomed notable guests including Prof. Barry Green, Mr Jesús Silva Fernández, the Spanish General Consul, and Prof. David Holgate, Chair of the AIMS Council. Attendees also enjoyed a performance by Dutch opera singer Amira Willlighagen.

The event was coordinated by Jorge Urroz from the Universidad Politécnica de Cataluña y Universidad Politécnica de Madrid, Spain, and Prof. Ulrich Paquet from AIMS South Africa. Speakers included Jordi Baylina (Hermez, Spain), Jose Muñoz (UPC, Spain), Marta Belles (UPF, Spain), Marc Guzman (UPC, Spain), Jules Mba (UJ, South Africa), Anthony Matlala (Polygon), and Mesias Alfeus (SU, South Africa), with 21 participants including current AIMS students. The workshop was sponsored by CIMPA, the International Mathematical Union, Polygon, and AIMS South Africa.

Workshop on Topology and Topological Groups

Held from 16 to 17 November 2023, this workshop was organised collaboratively by the research group in 'Topology, Algebra and Dynamical Systems' of UCT and the 'Topology for Tomorrow' Research Chair project of UWC. It focused on interactions between Topological Group Theory and Lie Theory and was by invitation only, attended by students, academics, and colleagues.

Workshop on Topology and Topological Groups participants

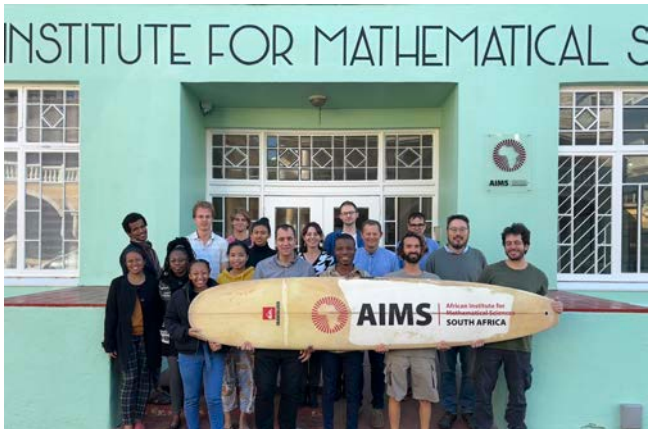
Topology for Tomorrow Workshop (T4T2023)

From 8 to 11 December 2023, this workshop aimed to build a cohort of future topology researchers in South Africa, intended to foster international partnerships. It featured three lecture series on advanced topics in topology, delivered by guest speakers including Prof. Maria-Manuel Clementino and Dr Graham Manuell from the University of Coimbra, Portugal, along with Prof. David Holgate. The workshop was attended by 40 participants, including postgraduate students and young academics.

Topology for Tomorrow Workshop participants

Algebraic Biology Workshop

On 25 April 2024, the Algebraic/Topology (AT) AIMS research focus hosted its first Algebraic Biology Workshop. This workshop covered topics in algebraic biology, topology, physics, and eco-evo-bio complexity and was co-organised with Prof. Cang Hui from SU. It provided a platform to connect, share innovative work, and explore new research frontiers.



Algebraic Biology Workshop

Clinic on Meaningful Modelling of Epidemiological Data

The MMED Modelling Clinic, focusing on the use of data to understand infectious disease dynamics, took place from 17 to 29 June 2024. It included 47 participants, 35 of whom were AIMS students, along with nine faculty members and seven mentors. Organised by SACEMA, AIMS South Africa, and the International Clinics on Infectious Disease Dynamics and Data (ICI3D), the clinic aimed to address practical questions through modelling projects based on epidemiological data.

Clinic on Meaningful Modelling of Epidemiological Data 2024

Imperial College-AIMS Connect Partnership Seed Workshop

From 10 to 14 June 2024, this workshop offered a platform to connect, learn, and share expertise, potentially marking the start of many new collaborative projects. It was organised by Prof. David Holgate and Prof. Karin-Therese Howell from AIMS, along with international partners, and was supported financially by the Imperial College London-AIMS Connect Partnership Seed Fund and Elsevier.

These workshops and conferences not only enhanced the academic and professional capabilities of the participants but also significantly contributed to the global mathematical sciences community, reinforcing AIMS South Africa's role as a centre of excellence.

Imperial College-AIMS Connect Partnership Seed Workshop

AIMSSEC

AIMS Schools Enrichment Centre

Since stepping into the role of Academic Manager on 1 September 2023, I have been excited and embraced the new opportunities it brings. My role enables me to work alongside a vibrant team, driving innovation in education and developing strategies that enrich both teaching and learning experiences. It has been a motivational journey characterised by growth and collaboration, paving the way for a promising future.

At the core of AIMSSEC is a compelling yet straightforward vision: Empowering Communities Through Mathematical Excellence and Equity. This vision represents more than a mere declaration; it embodies a collective resolve uniting stakeholders, staff, teachers, and learners as we forge a path forward through mathematics education.

Our dedication to excellence, innovative teaching pedagogies, and passion for learning create environments where teachers not only master mathematical thinking but also gain the confidence to pursue their dreams. By supporting continuous professional development, we address the needs and challenges faced by mathematics teachers in today's educational landscape. Together, we are cultivating classrooms that mirror the rich diversity of our communities and empowering learners from historically underrepresented backgrounds.

We are clear that mathematics and computer education go hand in hand. To our learners, whether they are exploring coding, seeing tangible results of algorithmic thinking, or interested in artificial intelligence, understanding mathematics and exercising mathematical thinking are keys to unlocking computers' potential. For a learner, this combination opens up endless possibilities. Our groundwork with them prepares learners to be at the forefront of innovation.

AIMSSEC is dedicated to fostering mentorship between secondary and primary school girls. Secondary schools from the Cape Flats pair with girls from feeder primary schools, creating a supportive environment where mutual learning and encouragement flourish. We provide a space for these girls to unite, with secondary school girls acting as scientific role models for the younger generation. Through empathy and connectedness, these young women thrive together. This is our story of hope — a story of tapping into potential, empowerment, and limitless possibilities in mathematics. Together, we are creating a world where mathematics education is a tool for transformation. Our mission is clear: To create a society where mathematical excellence is accessible, empowering individuals to thrive academically, professionally, and personally by cultivating a sustainable and innovative culture.

Dr Sinobia Kenny,
Academic Manager

At AIMSSEC, we understand that our vision requires careful planning. We see a need to:

- Forge strategic institutional partnerships by building collaborative initiatives that drive innovation and sustainable growth.
- To design flexible and cutting-edge mathematical science education programmes for teachers and learners.
- To contribute to research in mathematical sciences education that focuses on equity and inclusivity of girls and women across the educational landscape.
- Enrich schools with impactful, cutting-edge experiences in mathematical sciences to increase technological savvy in historically marginalised societies, thereby building a more skilled pipeline.

A new model of teacher training

The teacher training model has evolved from a top-down approach to one that emphasises peer-assisted learning. Alumni now train teachers who enrol in our courses, allowing current participants to witness the growth and success achievable within the AIMSSEC teacher training programme. Observing alumni return as teaching assistants, lecturer assistants, and lecturers gives teachers a concrete example of their potential for professional development. This model is effective because alumni contribute valuable firsthand experience from their time in the mathematics classroom, addressing its challenges directly in their mentorship roles. We have piloted four courses using this innovative model.

In 2023/2024, two online courses, Mathematical Thinking (MT5) and Mathematical Skills and Competencies for Employment (MSCE1), were delivered. These online courses presented several challenges, notably requiring a greater number of volunteers to serve as tutors to maintain teacher engagement throughout the courses.

The online courses were followed by two blended learning courses: Mathematical Thinking (MT33) and Differentiation and Inclusion in the Mathematics Classroom (DIMC2), which combined face-to-face and online elements. The initial blended learning course began with in-person sessions at Stellenbosch University, aiming to integrate teachers into a university setting to enhance their professional learning experience. However, while the intention was to offer a meaningful university experience, the dispersed nature of campus life meant that teachers were spread out, diluting the sense of unity within the professional learning community.

The subsequent blended learning course held its face-to-face sessions at Stellenbosch High School. This provided a more centralised location, fostering a cohesive environment where teachers could experience and discuss course content, lesson delivery, assignments, and modifications to their teaching practices together.

Summary of Teacher Training Courses 2023/2024

Period	July - Dec 2023	July - Dec 2023	Jan - April 2024	Jan - April 2024
Course	MT5	MSCE1	MT33	DIMC2
Mode of teaching	Online	Online	Blended Learning	Blended Learning
Enrolled (wk1)	78	46	77	71
Dropout rate	0%	0%	0%	0%
Distinction	17	21	18	13
Merit	25	13	20	19
Pass	31	8	31	33
Fail	5	4	8	6
Completion rate	93,6%	91,3%	89,6%	91,5%

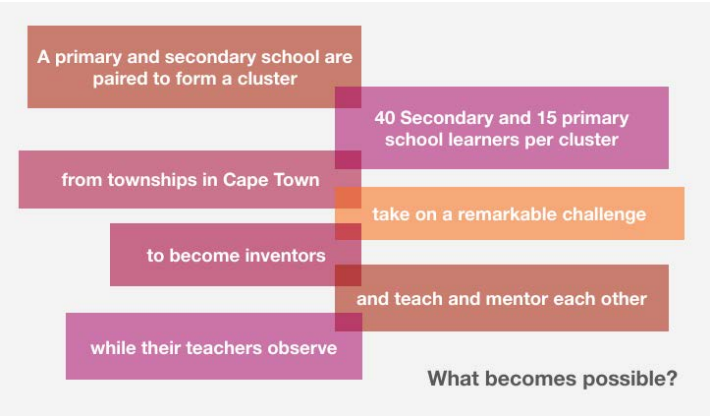
Course	Phase	Number completed both tests	Pre-Test Score Avg.	Post-Test Score Avg.	Score Improvement
MT5	SP	39	49,3%	63,1%	+13,74%
	FET	37	70,5%	76,0%	+5,54%
MSCE	SP	23	65,0%	80,0%	+15,0%
	FET	18	88,0%	88,5%	+0,5%
MT33	SP	38	66,7%	78,6%	+11,9%
	FET	37	70,3%	77,8%	+7,5%
DIMC2	SP	36	69,1%	69,6%	+0,5%
	FET	31	72,1%	76,0%	+3,9%

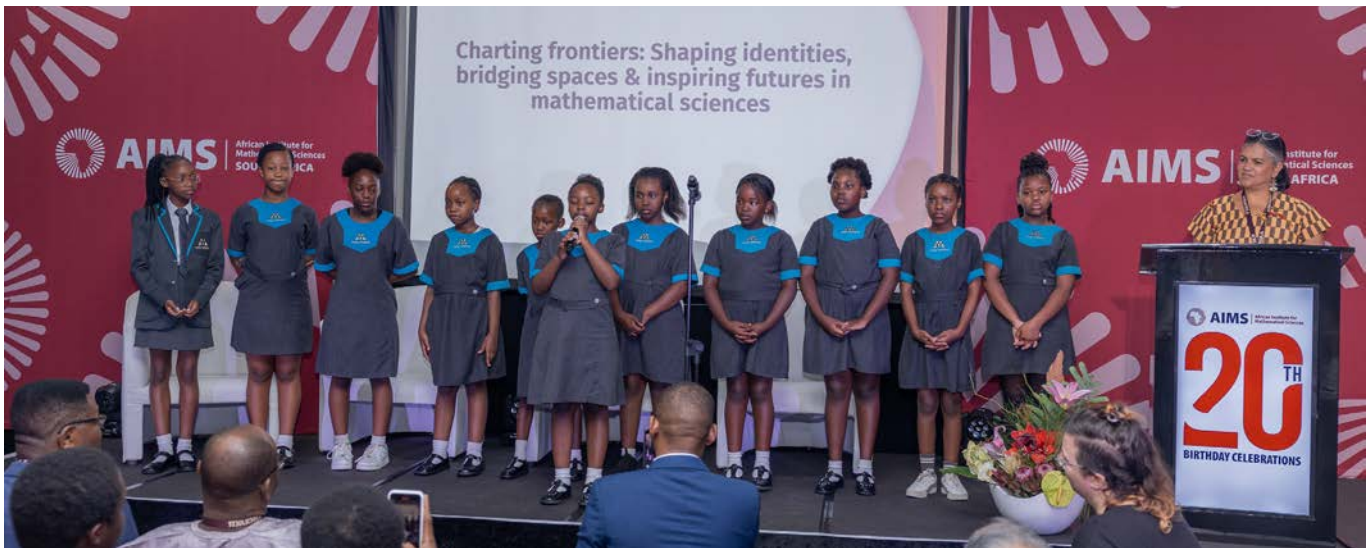
The courses we deliver target mathematics teachers in the Senior Phase (SP) and the Further Education and Training (FET). The SP encompasses Grades 7-9, while the FET covers Grades 10-12. Teachers in the SP within the MT5, MSCE1, and MT33 cohorts experienced the most notable improvements, indicating that the interventions were particularly effective at this level. In contrast, FET teachers generally began with higher pre-test scores, which resulted in smaller improvements, especially notable within the MSCE1 group, likely due to their already high performance. Minimal gains were observed among SP and FET teachers in the DIMC2 group, suggesting that this cohort may require further investigation to determine why the intervention had limited impact.

We extend our gratitude to the South Africa Mathematics Foundation (SAMF) and the National Skills Fund (NSF) for their support in making this teacher training possible. Additionally, we are thankful to the South African Council for Educators (SACE) for endorsing four AIMSSEC courses with professional development points, further enriching our teachers' educational pathways.

Introducing cutting-edge mathematical sciences for learner engagement

Our academic manager's vision was grounded in her roots on the Cape Flats, where she experienced a lack of accessibility to mathematical sciences institutions during her schooling and career. In her words, "The feminisation of mathematics during the apartheid regime ensured that women were kept out of mathematical sciences and redirected to become teachers", inspired her to create an inclusive and diversified environment within which mathematics was possible. Knowing that mathematical terminology was not always available in-home languages, her strategy was to teach mathematics (and its derivatives) without focusing on terminology but instead on understanding mathematics in contexts of creativity. In this regard, AIMSSEC embarked on an incredible journey of teaching young minds to become inventors to tap into learners' potential and see what happens. A project was born!





The Siyakhula event held at AIMS South Africa in March 2024 provided a platform to introduce computational thinking to learners from historically disadvantaged townships. The results were truly remarkable!

AIMSSEC TurtleStitch Workshops use a mentorship model where high school learners first acquire coding skills and then mentor primary school learners, promoting a knowledge transfer and empowerment cycle. Masibambane Secondary School played a key role, with its two learners acting as assistant teachers to help empower learners from other schools, and this is hoped to be replicated with other high school learners from the participating schools. This peer-to-peer learning approach, where "teachers teach learners, learners teach learners, and learners teach teachers," encourages collaborative learning, breaking down traditional educational hierarchies and fostering a sense of community involvement.

By introducing coding at both high school and primary school levels, the workshops equip learners with essential technical skills crucial in the digital age. Additionally, the mentoring experience reinforces understanding and builds leadership, communication, and teaching skills among the learners. This holistic development enhances their confidence and personal growth, opens opportunities in technology-driven fields, promotes gender diversity in STEM, and prepares a new generation of adaptable and skilled young leaders ready to contribute meaningfully to society.

TurtleStitch Workshop Participants

Name of Cape Flats School	Workshop Date	Number of Learners	Gender	Jan - April 2024
Masibambane Secondary School	16 March 2024	40	B&G	AIMS Computer lab
Molo Mhlaba School (Khayelitsha)	21 March 2024	15 +2 volunteers	G	AIMS Computer lab
Lavender Hill High School	20 July 2024	34 +2 volunteers	B&G	AIMS Computer lab
Masibambane Secondary School & Molo Mhlaba School	17 August 2024	20	B&G	Masibambane Secondary School
Lavender Hill High School & Lavana Primary School	31 August 2024	12 +2 volunteers 16	G G	AIMS Computer lab
Crestway High School	12 October 2024	30 +2 volunteers	B&G	AIMS Computer lab
Crestway High School & Lourier Primary School	26 October 2024	20 +2 volunteers 20	G G	Crestway High School
Inhlanganiso Secondary School	19 October 2024	40 +2 volunteers	B&G	AIMS Computer lab
Inhlanganiso Secondary School & Encotsheni Primary School	16 November 2024	20 +2 volunteers 20	G G	Depending on school facilities

Our computer education project would not be possible without the support of the Windfall Foundation.

Outreach Activities

Mathematics Olympiad Camp

From 7 to 12 April 2024, the AIMS South Africa was proud to host the annual International Maths Olympiad (IMO) Camp in South Africa. The camp, organised by the SAMF, was facilitated by Ms Najwa Chellan from AIMSSEC, who played a crucial role in its success. Fifteen talented students from Grades 8 to 12, representing the Western Cape, Eastern Cape, Free State, and Gauteng, gathered at AIMS for a week dedicated to mastering Algebra, Combinatorics, Geometry, and Number Theory.

Phil Labuschagne, the SAMF lead at the camp, challenged these young mathematicians to reach new heights of academic excellence. His guidance helped the participants refine their problem-solving skills and better tackle the complex questions typical of both African and international Maths Olympiads. By the end of the camp, the participants were selected into two teams: one set to represent South Africa at the forthcoming International Mathematics Olympiad in the UK from 11 to 22 July 2024, and another for the Pan-African Mathematics Olympiad (PAMO), to be hosted in South Africa from 10 to 20 August 2024.

Workshop to Support School Turnaround in Mathematics

On 10 May 2024, AIMS South Africa hosted a transformative workshop led by esteemed educator Prof. Jonathan Jansen aimed at improving mathematics performance at Crestway Secondary School.

Dr Corvell Cranfield captivated Grade 11 and 12 learners with an immersive session on Euclidean Geometry, igniting their curiosity and passion for mathematics.

Prof. Zurab Janelidze, President of the South African Mathematical Society, delivered a powerful message, highlighting that an incorrect answer in mathematics is not a flaw in one's approach but a unique pathway of mental processing — a valuable lesson for budding mathematicians. The workshop concluded on a high note with participants showing great excitement and engagement.

The learners returned on 17 May for a final mathematics revision session, solidifying their learning journey.

Case Study

"Who we are and who we become relies too heavily on an individual, making it almost impossible to become a scientist. This cannot be a learner's fight. It requires that institutions change their norms and cultures to be inclusive of young girls in the sciences. AIMSSEC is leading this change, as illustrated in the following story," notes Dr Kenny, drawing on the insights of Nancy Fraser.

Ivakele's New World of Coding

Imagine 9-year-old Ivakele Thongo from Khayelitsha, clutching a golden ticket to a future her mother and grandmother could only dream of. Ivakele is part of a new narrative in a township known for its struggles. At Molo Mhlaba School, thanks to a powerful partnership with AIMSSEC, she is learning to code through TurtleStitch workshops, turning algorithms into beautiful patterns rooted in African art.

This journey marks a stark contrast to the past where previous generations faced systemic barriers. Today, Ivakele thrives in an environment brimming with possibilities. Her experience is part of a broader transformation across Cape Flats schools such as Molo Mhlaba, Masibambane, and Lavender Hill. Supported by AIMSSEC, these schools are fostering a pipeline of STEM excellence, ensuring young girls can access quality education and meaningful opportunities.

At the heart of this initiative is a simple yet profound belief: every child deserves the chance to explore the boundless world of STEM. Through coding, mentorship, and cultural connections, Ivakele and her peers aren't just learning—they're creating. They are shaping a future where townships become vibrant communities of knowledge, innovation, and opportunity. This initiative isn't just teaching STEM—it's empowering girls like Ivakele to become leaders, creators, and change-makers, breaking the barriers that once held their communities back. Possibilities are as endless as the imagination of the children learning within them.

Sibulele Magini,
Head of School,
Molo Mhlaba NPC

Teacher training EDU Day Conference

On 22 June 2024, Jadga Huegle from SAP, alongside Dr Kenny and Dr Ogundipe, delivered a presentation titled 'An Initiative to Empower Township Learners with Algorithmic Thinking and Digital Art'. The presentation introduced teachers to TurtleStitch, a visual, block-based programming language derived from Snap! (https://snap.berkeley.edu). TurtleStitch features an intuitive drag-and-drop interface that is accessible to users at all skill levels, enabling the creation of a variety of engaging graphical outputs. It supports file exports for embroidery machines or plotters, making it suitable for numerous applications. TurtleStitch is highly adaptable for teaching, offering customization options for various languages and can incorporate advanced programming concepts and data manipulation, thereby serving as a versatile tool for both beginners and seasoned programmers.

Keynote Address at the 44th Uganda Mathematical Society Conference

On 26 July 2024, Dr Kenny delivered the keynote address at the 44th Teachers' Conference in Kampala, Uganda. This esteemed gathering convened educators, mathematicians, and thought leaders from across Africa, all dedicated to advancing mathematics on the continent.

The conference was distinguished by the noteworthy contributions of two AIMS alumni: Dr Joseph Ssebuliba, an alumnus of AIMS South Africa (2006-2007) and the current President of the Uganda Mathematical Society (UMS), and Ronaldo Arinaitwe Munyane, an AIMSSEC alumnus (2018) and the UMS Primary Schools' Representative. Their leadership and commitment to mathematics in Uganda have played a pivotal role in the success of this year's conference, exemplifying the profound influence of AIMS alumni in the field. The event provided a valuable forum for in-depth discussions on the future of mathematics in Africa, framed by the theme "Mathematics is the hinge for all careers." Dr Kenny's keynote speech not only accentuated the essential role of educators in fostering young mathematicians but also emphasised their significance in the wider mathematical community and the importance of initiatives like AIMSSEC that promote mathematical thinking and support both teachers and students.

Staff Updates

AIMSSEC bid farewell to two esteemed colleagues, Mr Kwethemba Moyo, Senior Programme Coordinator & Lecturer, and Mrs Elizabeth Turok, Lecturer, who both celebrated their final day with AIMSSEC on 30 August 2024. They have been instrumental members of the team, and their dedication and commitment have left an indelible mark on the department.

Mr Kwethemba Moyo,
Senior Programme Coordinator & Lecturer

Mrs Elizabeth Turok, Lecturer

PUBLIC ENGAGEMENT

House of Science

Advancing Public Science Communication & Gender Equity in STEM

I am deeply honoured to share the AIMS House of Science milestones during the 2023-2024 reporting period. Over the past six years, leading this transformative initiative has been both a privilege and a profound journey. This year, we celebrated two decades of AIMS's impactful work in mathematical sciences while navigating a world reshaped by the COVID-19 pandemic. The challenges we faced highlighted the urgent need for inclusive science communication and transformative action—an initiative that the House of Science is committed to championing and advancing.

The 2023-2024 reporting period was marked by challenges and invaluable opportunities. While navigating a leaner phase, we delivered impactful flagship programmes and enhanced the supervision and mentorship provided to AIMS students and interns. This focused guidance has shaped career trajectories and strengthened the role of African scientists as agents of change.

The House of Science's lead role in undertaking the conceptualisation, planning and delivery of the Siyakhula Festival created a challenging scenario that impacted the delivery of its full programmatic framework. Hence, the House of Science delivers fewer flagship programmes in this reporting period. The Siyakhula Festival, one of the AIMS most significant moments to which we contributed significantly, demonstrated our pivotal and dynamic role and capacity for innovation and collaboration, even in challenging times.

Our flagship programmes continue to serve as cornerstones for advancing public science communication and gender equity in STEM.

This includes:

- **Africa Scientifique**, delivered annually in partnership with African Gong since 2020, supports AIMS Master's students. In line with the South African government's strategic objectives for its transformation agenda, it has been expanded to include Honours Students and Lecturers from Historically Disadvantaged Institutions (HDIs) in South Africa. The first two beneficiaries of this expanded provision in 2024 are the University of Venda (UNIVEN) and Walter Sisulu University (WSU).

- Although deferred to 2025, **WAFIRA (Women's Advancement Forum: International Exchanges, Research & Academia)** and AIMS Gender Equity mentoring programme remains pivotal in empowering female researchers and postgraduate women in STEM academia and research across South Africa.

These programmes align with South Africa's transformation agenda, nurturing well-rounded scientists committed to societal impact.

Collaboration has been at the heart of our achievements. A renewed Memorandum of Understanding with African Gong strengthens our commitment to Pan-African science communication. Participation in Department of Science, Technology and Innovation (DSTI) initiatives, such as the 2024 National Science Week and 2024-25 DSI-HSRC Internship Programme, further exemplifies our role in shaping a vibrant national innovation ecosystem. Partnerships with the Interdisciplinary Center for

Scientific Computing (IWR) at Heidelberg University, the Muizenberg community, local libraries, and NGOs have enabled us to deliver the AIMS Public Lecture Series, community dialogues, and school tutorial sessions. These efforts ensure the House of Science bridges the gap between science and society, extending AIMS's impact beyond academia to address real-world challenges.

As AIMS embarks on its third decade, the House of Science is poised to amplify its contributions and impact. Our efforts will remain centred on advancing public engagement in mathematical sciences, fostering gender equity in STEM academia and research, and cultivating sustainable partnerships, all while fortifying our operational frameworks.
We embrace the opportunity to contribute meaningfully to AIMS' vision. Together, we will build a more inclusive, innovative, and transformative scientific community that drives progress and benefits African society.

With deep gratitude to the AIMS leadership, colleagues, and partners, I reflect on this year with a renewed sense of purpose. Our work is far from finished, but our progress confirms that we are on the right path.

Dr Rejoyce Gavhi-Molefe,
House of Science Manager

Siyakhula Festival

The festival took place from 17 to 22 March 2024, at AIMS in Muizenberg. The House of Science played a pivotal role in the successful and transformative delivery of this celebratory Mathematics festival in Africa, reflected in the strategic key outcomes of the event below:

- **Project Scope and Deliverables:** The festival delivered ten insightful keynote presentations, 65 interactive poster sessions, over ten thematic workshops and panel discussions, and networking and research information sessions. The House of Science provided leadership and strategic planning, assisting with the initiative's successful conceptualisation, delivery, and reporting.

- **Multi-Stakeholder Engagement & International Partnerships:** The House of Science worked closely with the AIMS Leadership and a diverse range of stakeholders both internally and externally to develop, align, and shape Siyakhula programme development and delivery, speakers' invitations, event management, providing strategic input and advocacy for gender equity, diversity and inclusivity in programme implementation. The festival expanded AIMS's in-Africa and global partnerships and collaborative networks, with many projects emerging and ongoing from Siyakhula.

- **Human Capital Development:** The festival empowered early-career researchers, particularly those from HDIs who are normally in silos, by connecting them with leading experts and exposing them to career and advanced research opportunities globally. House of Science played a role in recruiting and fundraising for their travel and accommodation scholarships.

- **South African National Systems of Innovation and its critical transformation agenda:** Through Siyakhula, AIMS aligned its contributions with South Africa's National System of Innovation agenda, reinforcing its unique role in advancing mathematical sciences and transformation in the country.

- **Slogan:** AIMS's new slogan, "In Africa's Youth, the Future of Science," was officially unveiled at the closing ceremony. House of Science contributed significantly by working closely with the AIMS Leadership to conceptualise and coordinate the competition.

- **Pan-African Influence:** Celebrating AIMS's 20-year legacy, the event showcased the Pan-African impact of AIMS Centres, uniting the AIMS Network community and underscoring its role in transforming mathematics education and research across the continent. House of Science played a role in recruiting and enrolling AIMS Alumni to contribute to the event.

Flagship Activities

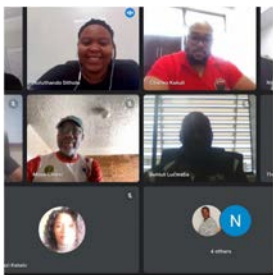
The **Africa Scientifique (AS) programme** is a unique capacity-building programme focused on Afrocentric science communication. It aims to support young and emerging African scientists, researchers, and academics to develop leadership, knowledge, and skills necessary for impactful science communication. The AS programme has been tailor-made to address students' critical needs to become well-rounded mathematical scientists and effective communicators across the African continent.

The programme is delivered in three phases: the AS Introductory Workshop (Phase 1), a three-day intensive AS Workshop (Phase 2), and a six-month Post-Workshop period that includes direct, peer-to-peer team mentoring, support, and project activities (Phase 3).

2024 Africa Scientifique Programme Highlights

The 2024 Africa Scientifique programme was delivered to the 5th cohort of AIMS South Africa Master's students and the Honours Students and Lecturers in Mathematical Sciences from UNIVEN and WSU. The programme was led by the House of Science Manager, the President of African Gong, and seasoned experts in science communication. Additional contributions came from AIMS leadership, mathematical scientists, and alumni of the AS programme, who are now making strides in academia and industry. AS programme alumni served as inspiring role models, sharing powerful testimonies about how the programme transformed their confidence, career trajectories, and perspectives as emerging African scientists.

Phase 1	• AIMS South Africa: Delivered in person on February 23, 2024, in Muizenberg, with 55 participants, including students, tutors, and researchers. • UNIVEN and WSU: Conducted online on 9 April 2024. o UNIVEN: 11 Honours students and 9 staff members. o WSU: 17 Honours students, 4 Master's students, and 4 staff members.
Phase 2	• A face-to-face workshop was held from April 17-19, 2024, at AIMS South Africa in Muizenberg. It brought together 29 AIMS students and 10 Honours students from UNIVEN and WSU for an engaging learning experience.
Phase 3	• From May to November 2024), the same group of participants in Phase 2 continued with Phase 3 activities, focusing on mentoring, support, and collaborative projects.



Participants of the AS Introductory Workshops (in-person and online).

Phase 1 — Introductory Workshops:

The phase was three-pronged. It introduced participants to the strategic background behind the AS programme development and its transformational pan-African contexts; the AS programme delivery at AIMS in terms of the organisation's vision, rationale, contexts, challenges and benefits for the students and AIMS; and global historical and contemporary contexts, practices and progressions to describe what science communication is about. The workshop also elaborated on empowering perspectives and the envisaged outcomes for participants.

> *Deep down in my heart, I know that I need it. I want to learn something I'm lacking, and that is voice projection and presenting my work in public. I feel like the workshop would be a life changer for me. I've seen the power of the workshop to people that I knew before they came to AIMS (Thembelihle). What the workshop did for her can never be undone. This does not only aid the individual at hand but also helps the whole community and individuals who look at us as role models. I would like to change the future of Africa, by shaping the present. I would like to be a good and exceptional example to the youth that's also interested in being a different version of scientists.*
>
> ***- 2024 AS Introductory workshop participant***

Phase 2 The 3-day Workshop:

Over the three intensive days, participants engaged in thought-provoking, hands-on, inclusive, transformative, and interactive sessions and networking opportunities. The workshop sessions framed globally inclusive yet Afrocentric discourses, narratives, and best practices to enhance participants' understanding and strengthen their commitment to equity, ethics, and hands-on public engagement actions going forward.

A key aspect of these practices is fostering solidarity with the African publics by foregrounding local and Indigenous languages for science communication delivery. This approach ensures public engagement is rooted in the continent's socio-cultural contexts, with a particular focus on gender inclusion.

Highlights of the 2024 3-day Workshop.

> *I have learned how to craft a social problem and use mathematical concepts to solve this problem. Knowing your community and the problems facing communities helps to provide critical solutions. It was an impactful session, and I have also learned to be a visionary scientist who is solution oriented. The overall delivery was very good, right from the start, working in groups to come up with ideas to making project proposals. I have learned a lot, and I would like to give back to the community through various projects.*
>
> ***- 2024 AS workshop participant***

> *Science communication plays a key role in gender inclusion and ensures that there's gender balance, especially in STEM. From now forward, I'll try to emulate this key message to ensure I use science communication to promote gender inclusion. Science communication also plays a key role in socio-cultural inclusion. In particular, we can use science communication to achieve Afrocentricity. From now forward, I will ensure we change from a Eurocentricity narrative to an Afrocentric.*
>
> ***- 2024 AS workshop participant***

Programme Awards:

- **Certificates of Achievement:** All 3-day Workshop participants were awarded certificates for completing the workshop.
- **AS Excellence Awards:** Ms Masego Ester Mothapo (UNIVEN) and Mr Esau Moyoweshumba (AIMS South Africa) were honoured with the AS Excellence Awards, including cash prizes conferred by African Gong. Both demonstrated significant growth in engagement and communication skills, such as presentation and proposal writing, inspiring their peers throughout the workshop.

Phase 3 — Six-month Post-Workshop Support and Delivery of Science Communication Projects

During this period, participants receive mentorship in planning, delivering, and evaluating public engagement activities. The projects demonstrate mathematics' power in solving everyday societal issues. Below are some of the innovative projects conceptualized and to be delivered by participants:

- 'Fairwater distribution in township & rural villages' by Ms Ingrid Thandeka Kabinde & Mr Siphosethu Lucas Manthosi (South Africa): Addressing unequal access to water by developing mathematical models for efficient and equitable water distribution.
- 'Sanitary pads and school dropouts' by Ms Helen Tizazu Fekede (Ethopia): Exploring the relationship between a lack of sanitary products and high dropout rates among schoolgirls, with solutions to bridge the gap.
- 'Predicting online scams' by Mr Blessing Adetayo Ogunlaran (Nigeria): Developing algorithms to identify patterns and predict potential online scams, enhancing cybersecurity awareness.
- 'Powering the community with electricity from waste' by Mr Vincent Ondima Kongo (Kenya): A project focused on using waste-to-energy technologies to provide sustainable electricity solutions for under-resourced communities in Nairobi.
- 'Safety science for skilled workers' by Mr Benvollens Maluleke (South Africa): Designing safety training and risk assessment models to protect skilled workers in hazardous professions.
- 'Modeling for health' by Ms Natasha Chola (Zambia): Creating mathematical models to predict and manage health risks in communities, enabling proactive healthcare solutions.
- 'Boosting Taxi Business' by Mr Esau Moyoweshumba (Zimbabwe): Using data analysis and optimisation techniques to improve the efficiency and profitability of local taxi businesses in Muizenberg.

Added Value Outcomes: Africa Scientifique Programme Spotlight

While visiting AIMS South Africa, students and lecturers from UNIVEN and WSU were exposed to AIMS's vision and programmes. They also had an opportunity to live, dine, and interact with AIMS students from various African countries, researchers, and staff. The highlight of their visit was the establishment of professional relationships and future academic collaborations.

> *Visiting AIMS was a nice experience for me as I met many amazing, smart and inspirational people. Getting to learn more about different people's research helped me understand science better, it motivated me also to pursue my studies and it taught me about a lot of projects related to science that I was not aware of.*
>
> ***- Ms Masego Mothapo, Student, UNIVEN***

UNIVEN and WSU Participants departing from their respective universities and introducing them to AIMS students.

Science Engagement Research Spotlight

Dr Gavhi-Molefe and Dr Rudzani Nemutudi (affiliated with NRF: iThemba LABS) co-authored a compelling book chapter titled "Building Capacity for Science Communication in South Africa: Afrocentric Perspectives from Mathematical Scientists." This chapter is featured in the groundbreaking book, "Race and Sociocultural Inclusion in Science Communication – Innovation, Decolonisation, and Transformation," edited by Elizabeth Rasekoala and published in July 2023.

- On 14 October 2023, Dr Gavhi-Molefe presented insights from the chapter at the 2023 Inclusive SciComm Symposium (ISCS), a hybrid conference organised by the University of Rhode Island's Metcalf Institute in Kingston, USA. ISCS is a growing global movement that aims to centre equity, inclusion, and marginalised perspectives in science communication.
- The book gained notable recognition and will be honoured with a Special Recognition Award from the ICOM CIMUSET Award Committee (International Council of Museums - International Committee for Museums and Collections of Science and Technology) on 2 September 2024. This accolade celebrates its innovative approach to addressing diversity, equity, and inclusion in science communication.
- As part of this honour, ICOM CIMUSET, in collaboration with Ingenium - Canada's Museums of Science and Innovation - will host a webinar on 13 December 2024. The event will feature an engaging discussion between the book's editor, Elizabeth Rasekoala, and two contributing authors, including Dr Gavhi-Molefe.
- Additionally, Dr Gavhi-Molefe will present insights from the chapter at the International Science Communication Symposium scheduled for 18 to 20 November 2024 at Stellenbosch University. The symposium aims to deepen understanding of effective public engagement around Discovery Science, also known as basic or foundational science, by exploring ways to improve the practice of communicating Discovery Science, share insights and create a supportive community for scientists and science communication practitioners focused on basic science.

Dr Gavhi-Molefe presenting at the 2023 Inclusive SciComm Symposium.

Africa Scientifique Workshop Alumni Spotlight

Community Outreach: Making Mathematics Accessible and Exciting in Honour of Mandela's Life and Legacy

Community engagement and enrichment through mathematics are integral to the AIMS mission. In addition to advancing research, AIMS students and researchers actively engage with the local communities to promote mathematics, empower the next generation of mathematicians, and drive positive change.

In celebration of Nelson Mandela International Day 2024, participants of the Africa Scientifique Programme (2023 and 2024 cohorts) partnered with Muizenberg Library to host Mathematics Expo-Tutorial Sessions for learners in Grades 8 -11 from Muizenberg and surrounding areas. Held on 18 and 20 July, the sessions showcased the excitement and relevance of mathematics in real-life applications, encouraging learners to view math as a tool for solving problems, not creating them.

Blessing Ogunlaran, Esau Moyoweshumba, Benvollens Maluleke, Ingrid Kabinde, Tshepo Moropane, Siphosethu Mathonsi, and Siyabonga Mthimkulu, from the 2023 and 2024 cohorts, facilitated the sessions. Serving as role models, they shared strategies for tackling Euclidean Geometry, which is a common challenge for many learners.

Twenty-four learners from various high schools and colleges attended the sessions, namely Muizenberg High, Ocean View High, Simon's Town High, Spine Road High, Zwaanswyk High, Steenberg High, Pelican Park High, the South African College of Applied Psychology, and False Bay College.

Nelson Mandela International Day, also known as Mandela Day, is an annual global celebration on 18 July, which marks Nelson Mandela's birthday. It honours his life and legacy by encouraging individuals to devote 67 minutes to helping others, representing the 67 years he dedicated to human rights.

With the mentorship and guidance of the House of Science, the unwavering support of Muizenberg Library, and the dedication of committed learners, Saturday tutoring sessions have been running successfully since July. These sessions are more than just academic support—they are a testament to the power of collaboration and community-driven education.

The ultimate goal is to ensure continuity and sustainability by transitioning leadership to the new intake of AIMS students, who will carry forward the programme's mission.

Through initiatives like the Mathematics Expo and these tutoring sessions, AIMS reaffirms its commitment to using mathematics as a tool for empowerment and growth. These efforts not only ignite a passion for mathematics in African youth but also equip emerging mathematicians with the skills to create lasting, positive change in their communities. The ripple effect of knowledge and inspiration continues to expand, fostering a brighter future for all.

Nelson Mandela Day Activities

> *I've been struggling a lot with maths lately, I feel like extra maths lessons would benefit me in terms of the teaching styles of the tutors being different from my maths teacher at school. Maybe I can also gain some knowledge on how to practice my maths at home. I learned that Maths is applied to almost everything around me. Maths is all about patience and reading carefully to the problems given to you.*
>
> ***Grade 11 participant***

> *Facilitating the Math Expo sessions has been a transformative experience for me as an emerging scientist. It has greatly enhanced my self-confidence, particularly in public speaking and communicating complex mathematical concepts to a diverse audience. Engaging with learners from different backgrounds has sharpened my ability to explain ideas clearly and accessibly, which is crucial for effective public engagement and science communication.*
>
> ***Tshepo Nakedi***

> *Always try to give back no matter how small, because it might be meaningful to someone. We hope that this initiative extends to other surrounding areas for those who could not make it, as I believe, everyone should have access to mathematics.*
>
> ***Siyabonga Mthimkulu***

Women in STEM Programme

Addressing the persistent gender imbalance in South Africa's scientific and innovation landscape is a cornerstone of AIMS's mission and the House of Science's initiatives. The **Women's Advancement Forum: International Exchanges, Research & Academia (WAFIRA)** is a transformative three-day intensive programme aimed at advancing African women's leadership, career growth, and professional development in STEM, particularly in academia and research.

Since its launch in 2014, WAFIRA has been successfully delivered across multiple African countries, impacting over 1,500 African female academics and researchers.

Due to the House of Science leading the Siyakhula Festival, the WAFIRA programme has been rescheduled for 2025 with two key sessions:

- **28 February – 1 March 2025:** Focused on AIMS female students, researchers, and participants from local universities and research institutions.
- **30 October – 1 November 2025:** Targeting newly enrolled AIMS female students and participants from two historically disadvantaged institutions (HDIs).

The long-term vision for WAFIRA is to secure funding and partnerships to scale the programme to a nationwide annual initiative. This expansion will target HDIs, aiming to significantly increase the representation of Black African women in leadership roles within academia and research in the mathematical sciences, where they remain significantly under-represented.

Through WAFIRA, AIMS is committed to fostering inclusivity, equity, and excellence in STEM, empowering the next generation of women leaders to shape the future of science and innovation in Africa.

Added Value Enrichment Activities

AIMS Gender Equity in STEM: Mentoring for Social Development & Transformation

The AIMS Gender in STEM (AIMSGIS): AIMS Women in STEM (AIMSWIS) and Mentoring for Transformative Masculinity (MTM) in-house mentoring programme for the students (both male and female) aims to:

- Create a safe space where students can obtain support from caring senior students who are willing to listen to them, serve as good role models, help them develop their life skills and build self-confidence.
- Provide a diverse environment for networking with successful professionals in STEM, including AIMS alumni.
- To improve the participation, progression and retention rates of women and girls in STEM-related fields.

Due to the House of Science leading the Siyakhula Festival, the mentoring events were deferred to the 2024/2025 academic year.

May 12, Celebrating Women in Mathematics

For the sixth edition of May 12: Celebrating Women in Mathematics, the SAMS Women in Mathematics (WiM) Division hosted Prof. Kerstin Jordaan (UNISA) for a talk on career advancement, research ratings, and networking opportunities.

The event was live-streamed from CoE-MaSS to multiple universities, including AIMS South Africa, SU, UKZN, and Rhodes University, with AIMS hosting students and staff from UWC, SU, and UCT.

Special thanks to CoE-MaSS for supporting this initiative.

Participants at AIMS South Africa

Public Lectures Series

The AIMS South Africa Public Lecture Series aims to provide an opportunity for scientists to share discoveries and engage with the broader community in Muizenberg and beyond on pressing scientific, technological, innovation and environmental issues –

and share practical, useful applications of mathematics in everyday life. During the period under review, we hosted two public lectures.

On 23 November 2023, we welcomed Prof. Michael Winckler, Administrator Director at the Interdisciplinary Center for Scientific Computing (IWR) from Heidelberg University, Germany. His lecture, titled 'One (wo) man - one vote: The mathematics of voting and elections,' began with a networking session that allowed AIMS students, researchers, and members of the public to interact.

Prof. Winckler discussed five different methods to determine a "winner" in elections, offering a deep dive into electoral systems. The event, part of the heiAIMS: Heidelberg – Cape Town Network for Applied Mathematics and Scientific Computing project, attracted 70 participants including schoolteachers, industry professionals, government officials, and students from various institutes.

Prof. Michael Winckler

The second lecture occurred on 13 February 2024, featuring Prof. Dr. Helga Nowotny, a founding member of the European Research Council and Professor Emerita at ETH Zurich. The topic, 'The illusion of control: Wisdom and regulation of AI, was explored through a lecture and subsequent panel discussion. The panel was facilitated by AIMS students Linda Wiseman Dlamini from Eswatini, Catherine Nana Nyaah from Ghana, and Anas Ahmed Abdou Awadalla from Egypt. The event started with welcome remarks by Mrs Romana Königsbrun, the Austrian Ambassador to South Africa, and saw a turnout of 115 attendees from local and international universities, the surrounding communities, and the Austrian Embassy. The Austrian Embassy contributed by donating 15 copies of Prof. Nowotny's book, "In AI We Trust," and the lecture was hosted in collaboration with the embassy.

Prof. Dr Helga Nowotny

These lectures not only provided platforms for scholarly discussion but also facilitated community engagement, underscoring our commitment to academic excellence and societal impact.

House of Science Intern

On the 1 August 2023, AIMS South Africa welcomed Noluthando Sithole. She joined the AIMS family as a new intern through the *DSI-HSRC Internship Programme* 2023/25. The programme offers practical work experience and mentorship to unemployed graduates and postgraduates to gain valuable skills in science, technology, engineering and mathematics, social sciences and humanities. Noluthando will work closely with Dr Gavhi-Molefe in the planning, implementing, delivering, monitoring, evaluating and promoting of the House of Science public engagement and women in mathematics projects, amongst other things.

Ms Sithole holds a BA in Media Communications and Culture from Nelson Mandela University. As an AIMS intern, she will gain from our Pan-Africanist environment and connect with leading academics, building potential collaborations. She succeeded Ms Karabo Makola, a former intern (2019-2020), who is now pursuing a PhD in the History of Science in Germany.

Noluthando Sithole

Governance and Administration

Trust

The AIMS Trust meeting was held on 26 March 2024. In attendance were Dr Rob Adam, Prof. Loyiso Nongxa, Prof. Neil Turok (Chair), Ms Nasima Badsha and Prof Daya Reddy, with Prof. Ulrich Paquet also joining the meeting.

Council

The AIMS South Africa Council meeting took place on 24 April 2024 via video conferencing. The meeting was attended by Prof. David Holgate from the University of the Western Cape, who served as Chair, along with Prof. Ulrich Paquet (Director, AIMS, ex officio member), Prof. Mike Giles (Oxford University), Prof. Neil Turok (Edinburgh University), Prof. Louise Warnich (Stellenbosch University),

Prof. Kerstin Jordaan (University of South Africa) and Prof. Grae Worster (Cambridge University).

Dr Thandi Mgwebi (National Research Foundation) and Prof. Daya Reddy (University of Cape Town) were unable to attend.

Staff

Prof. Ulrich Paquet, Director, is supported by the Management Team, which comprises the Academic Directors, Prof. Claire David (Artificial Intelligence) and Prof. Karin-Therese Howell (Mathematical Sciences), Dr Sinobia Kenny (AIMSSEC Academic Manager), Dr Rejoyce Gavhi-Molefe (House of Science Manager), Mr Igsaan Kamalie (Facilities and Logistics Manager), Mr Jan Groenewald (IT Manager) and Ms Linda Camara (Commmunications Manager)

During the period under review, AIMS South Africa bid farewell to Mrs Ashleigh Basel (Researcher), Dr Barrie Barnard (AIMSSEC Academic Manager), Mrs Elizabeth Turok (AIMSSEC Lecturer), Mr Kwethemba Moyo (AIMSSEC Lecturer and Senior Programme Coordinator), Ms Charmaine Stole (Catering), Mr Malcolm Clayton (Catering), Prof. Bruce Bassett (Senior Resident Researcher), Prof. Jeff Sanders (Senior Associate Researcher) and Dr Simukai Utete (Academic Director).

New appointments this year included Ms Kim Fry, Ms Mariam van Louw, Ms Ntombifikile Dathane and Ms Abegail Plaatjies, who joined the Catering Department. In addition, Mr Keenon Smith was appointed as Departmental Assistant in the Facilities and Logistics Department and Ms Gina Fourie as Senior Administrative Officer.

Further additions to the Management Team include the appointments of Dr Claire David as Academic Director, Artificial Intelligence, and Prof. Karin-Therese Howell as Academic Director, Mathematical Sciences.

At AIMSSEC, following the retirement of Academic Manager Dr Barrie Barnard, his position was filled by Dr Sinobia Kenny, and two new staff members joined the team: Ms Loveness Mahwire was appointed as Mathematics Education Lecturer and Ms Ntombekhaya Jacobs-Wana as Administrative Officer.

Information Technology

During the 2023–24 period, the AIMS South Africa IT department made significant progress in updating its technological infrastructure. A total of 130 outdated desktops—some as old as 16 years—were replaced by 90 modern units equipped with widescreen monitors, greatly enhancing student productivity. In addition, approximately 15 staff laptops were updated to newer models, each less than three years old, with over half now fitted with external monitors and docking stations. All nine data projectors were replaced and now feature integrated sound bars for improved audiovisual presentations. Substantial upgrades were also made to the network infrastructure, with 15 network switches replaced and 75 WiFi routers added.

Although there were initial teething problems in the second quarter of 2024, the WiFi network now successfully supports approximately 500 devices simultaneously and includes a QR code for easy access. Coverage has been extended to the upper floors of the main building, thereby enhancing connectivity in the residential areas. The tutor flats and the newly renovated AI accommodation — which have been connected via a wireless link for 20 years—were upgraded with new 60 GHz routers and are scheduled to transition to fibre optics in September 2024, driven by increased occupancy and new structural obstacles between Watson and Melrose Roads. Despite these advancements, further improvements are necessary. Expanding our computational facilities and maintaining our back-end infrastructure remain priorities. Currently, our IT staffing levels are lower than required—a situation reflecting pandemic-related reductions—which has limited our capacity to provide academic support and has hindered business operations. Addressing this shortfall will be crucial as we continue to enhance our IT capabilities.

Communications Report

During the review period, we enhanced our digital presence and supported various educational and promotional initiatives through tailored communication strategies. This year witnessed significant growth across our social media platforms. On Facebook, our follower count increased from 5,753 in March 2023 to 6,519 by April 2024, particularly through application-related posts that generated high engagement. Similarly, LinkedIn experienced a notable rise in engagement, boosting our visibility within the professional community. Our Twitter account reached 4,017 followers, with application-related tweets generating the most interactions. Although our YouTube channel's subscriber base grew by 22% to 17,000, there was a slight decline in overall views.

Our marketing efforts were robust, encompassing several initiatives including the creation of a special logo and designs for our 20th birthday celebrations, as well as comprehensive branding for the Siyakhula Festival, which featured a new logo, website and promotional materials. In addition, we designed and distributed materials such as invitations, programmes and certificates for graduation ceremonies.

The introduction of a new HTML email format for our newsletters last year has been very well received, improving both accessibility and engagement. These newsletters now reach 2,327 external subscribers and 1,829 internal recipients on a monthly basis.

We also bolstered recruitment efforts by producing various posters for dissemination via our website and social media platforms, and by crafting supportive materials — including posters and certificates — for the diverse activities of the House of Science. Furthermore, marketing materials were developed to promote our workshops, events and online activities, successfully supporting public lectures, seminars and research workshops that received a positive reception from the academic community. A unique logo was also created for the participant T-shirts for the MMED Modelling Clinic, further enhancing our brand's visibility and engagement during these events. Looking ahead, we will continue to provide robust communications support for all AIMS activities. These efforts are vital in promoting the institute's initiatives and in supporting our community through dynamic and engaging content, reflecting our commitment to advancing education and research in the mathematical sciences.

Financial Report 2023 – 2024

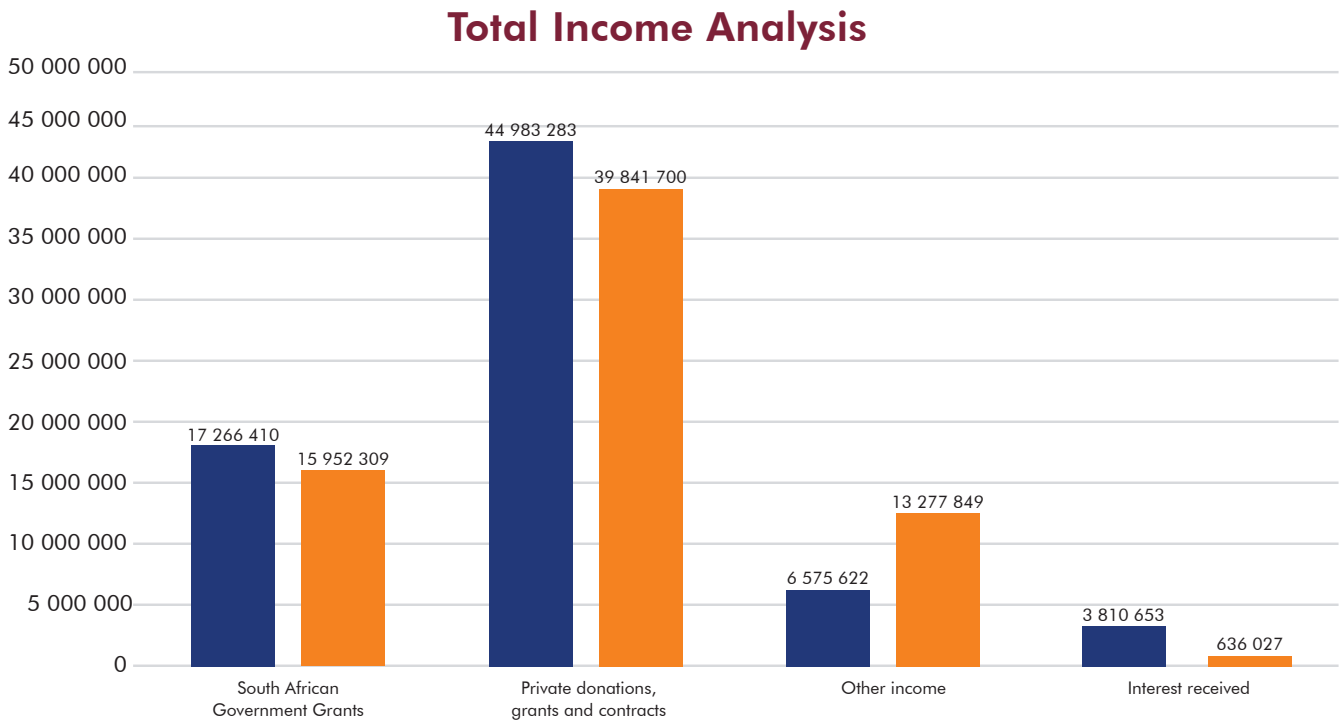


Figure 1. Total income per main component (Rand)

Overview

The African Institute for Mathematical Sciences (AIMS) reported a mixed financial performance for the year ended 30 June 2024. While income growth remained robust, the organization's overall surplus declined significantly, primarily due to increased operational and personnel costs, as well as a prior-year adjustment related to a receivable from Stellenbosch University. This adjustment resulted in a write-off of R6,957,848, reducing current assets. This report outlines the key movements in income, expenses, and reserves, and details the impact of the correction and receivable adjustment.

South African Government Grants

Government grant income increased by R1.8 million (8%), driven by the following:

i) An increase of R4.3 million in funding from the National Skills Fund.
ii) A R321,000 increase in the grant from the Department of Higher Education and Training.
iii) A R2.3 million decrease in the grant from the National Research Foundation.

Private Donations, Grants And Contracts

The rise in private donations, grants, and contracts was primarily due to:

i) Google DeepMind scholarship funding, awarded over a four-year funding cycle.
ii) Mastercard Foundation funding, awarded over a seven-year funding cycle.

Other Income

As of 30 June 2022, AIMS South Africa's cost centre at Stellenbosch University had been carrying a R5 million debt originally incurred by the AIMS Next Einstein Initiative (AIMS NEI) in Rwanda. This liability was correctly reassigned to AIMS NEI and is reflected as other income in AIMS South Africa's financial statements. In addition, Stellenbosch University assumed responsibility for a further R6 million in historical debt, which is also recognised as other income. The remaining balance of other income includes various bursary donations from multiple sources, most notably a R2.1 million research grant received from the Carnegie Foundation.

Interest Received

A dedicated bank account was established to ringfence the Google DeepMind scholarship funding. The interest earned on this account is the primary contributor to the increase in interest income.

Breakdown of South African Grants for the 2024 and 2023 financial years are as follows:

Department	Programme	2024	2023
Department of Higher Education and Training	Academic Programme	R 7 464 000	R 7 143 000
Department of Science and Innovation	Academic Programme, Research Programme and Post AIMS bursaries		R 1 035 000
National Skills Fund	AIMSSEC teacher training programme and MSc bursaries	R 6 973 880	R 2 628 718
National Research Foundation	Research Programme	R 2 828 530	R 5 145 591
Total South African Government Grants		**R 17 266 410**	**R 15 952 309**

Breakdown of private donations, grants and contracts for the 2024 and 2023 financial years are as follows:

Department	Programme	2024	2023
Mastercard Foundation	Taught Masters Programme, Siyakhula Festival, Renovations Project	R 19 126 826	R 13 653 430
The Alexander von Humboldt Foundation	German Research Chairs	R -	R 368 448
Carnegie	Research Chairs	R 2 191 637	R -
Google DeepMind	AI bursaries	R 20 129 715	R 22 986 273
Other Private Donations	Taught Masters Programme, ESMT, DSI and Teacher Training Programme	R 3 535 107	R 2 833 549
Total Private Donations, Grants And Contracts		**R 44 983 284**	**R 39 841 700**

Total Expenses Analysis

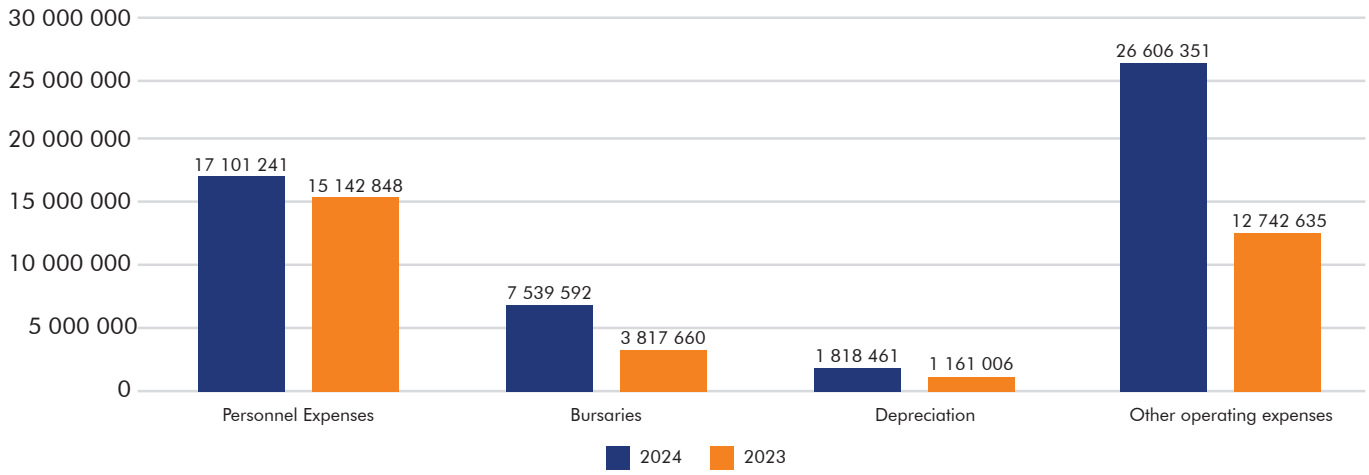


Figure 2. Total expenses per main component (Rand)

Expenditure: R 53,065,645 (↑ 61.5% from R 32,864,149 in 2023)
Reason for increase: The rise in expenditure was due to increased operational expenses (↑ 102%) and personnel expenses (↑ 13%). Significant increases included bursary costs (↑ 97%), transport and accommodation (↑ 35%), and consulting fees (↑ 150%).

Personnel Expenses: R 17,101,241 (↑ 13% from R 15,142,848)
Reason for increase: The rise in personnel expenses was driven by an increase in staffing levels and salary adjustments to support the growing programs and services of the Institute. This was necessary to meet the increased demands of its operations.

Breakdown of total expenses per main component

Expenses	2024	2023
Personnel Expenses	R 17 101 241	R 15 142 848
Bursaries	R 7 539 592	R 3 817 660
Depreciation	R 1 818 461	R 1 161 006
Other operating expenses	R 26 606 351	R 12 742 635
Total Expenses	**R 53 065 645**	**R 32 864 149**

African Institute For Mathematical Sciences - South Africa

Consolidated Statement Of Financial Position at 30 June 2024

	2024	2023
	R	R
Assets		
Non-Current Assets	**41 201 887**	**31 431 952**
Property, Plant And Equipment	35 921 520	26 724 082
Intangible Assets	1	1
Financial Assets	5 280 366	4 707 869
Current Assets	**80 326 444**	**48 849 723**
Cash And Cash Equivalents	76 461 320	39 625 815
Trade And Other Receivables	237 650	2 168 881
Inventory	73 004	97 179
Stellenbosch University Receivable	3 554 470	6 957 848
Total Assets	**121 528 331**	**80 281 675**
Funds And Liabilities		
Funds And Reserves	**77 893 435**	**57 817 596**
Accumulated Funds	72 227 429	52 889 541
Restricted Reserve: Endowment Fund	2 223 463	2 188 455
Restricted Reserve: Other	394 854	197 427
Fair Value Reserve	3 047 689	2 542 173
Current Liabilities	**43 634 896**	**22 464 079**
Stellenbosch University Payable	-	-
Trade And Other Payables	43 634 896	22 464 079
Total Funds And Liabilities	**121 528 331**	**80 281 675**

African Institute For Mathematical Sciences - South Africa

Statement Of Comprehensive Income For The Year Ended 30 June 2024

		2024	2023
		R	R
Government grants		17 266 410	15 952 309
Donations Income		44 983 283	39 841 700
Other income		6 575 622	13,277,259
Profit on sale of fixed assets		-	590
Gross Income		**68 825 315**	**69 071 858**
Operating expenses	**11**	(53 065 645)	(32 864 149)
Operating surplus		**15 759 670**	**36 207 709**
Finance income		3 810 653	636 027
Surplus for the year		**19 570 323**	**36 843 736**
Other comprehensive income:			
Item that may be subsequently reclassified to profit or loss			
Change in value of available-for-sale financial assets		505 516	391 372
Total comprehensive surplus for the year		**20 075 839**	**37 235 108**

Supporters for period under review

AIMS South Africa Donors and Supporters

Google DeepMind

The Mastercard Foundation

Government of South Africa:

- Department of Higher Education and Training (DHET)
- Department of Science and Innovation (DST)
- National Research Foundation (NRF)

German Federal Ministry of Education and Research (BMBF)

German Academic Exchange Service (DAAD)

Baden-Württemberg Stiftung

DST-NRF CoE in Mathematical and Statistical Sciences (CoE-MaSS)

Austrian Embassy Pretoria

Pan-African Network for the Popularization of Science & Technology and Science Communication (AFRICAN GONG)

Education, Training and Development Practices Sector Education and Training Authority (ETDP SETA)

NITheCS

Stellenbosch University

University of Cape Town

University of the Western Cape
University of Cambridge

University of Oxford

Université Paris-Saclay

University of Leeds

University of Strathclyde

University of Heidelberg

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- Peter Kellner

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Oppenheimer Memorial Trust

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