UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

69th Annual Conference of the South African Institute of Physics

SOUTH AFRICAN INSTITUTE OF PHYSICS

7-11 July 2025

EXHIBITORS AND SPONSORS

The organising committee of SAIP2025 expresses their sincere thanks to the Exhibitors and Sponsors. Please visit the exhibition booths that will be located in Solomon Mahlangu House Basement Level, West Wing Drawing Hall (SHWWDH).

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LOCAL ORGANISING COMMITTEE

Name	Role(s)
Professor Deena Naidoo	Co-Chair: Local Organising Committee (LOC)
Dr Robert Warmbier	Co-Chair: Local Organising Committee (LOC)
Associate Professor Philippe Ferrer	Chair: Scientific Programme (LOC)
Associate Professor Rudolph Erasmus	Ex-Officio
Dr Angela Dudley	LOC Member
Professor Andrew Forbes	LOC Member
Professor Matt Hilton	LOC Member
Dr Isobel Kolbe	LOC Member
Dr Mukesh Kumar	LOC Member
Associate Professor Mervin Naidoo	LOC Member
Ms Farah-Naaz Samuels	LOC Member
Dr Brian Masara	SAIP Office
Mr Tebogo Mokhine	SAIP Office
Ms Michelle Gallant	Wits Functions and Events/Advancement

General Information

MAP OF EAST CAMPUS: UNIVERSITY OF THE WITWATERSRAND

Map Legend:

A: Solomon Mahlangu House
B: Robert Sobukwe Building
C: Gate House
D: Physics Building
E: Main Dining Hall - Matrix
F: Jubilee Hall (Men's Residence)
G: Sunnyside (Women's Residence)
H: Pedestrian Entrance (Sutton Close)
J: Yale Road North car entrance
K: Wits Anglo American Digital Dome

WEATHER IN JOHANNESBURG, GAUTENG PROVINCE

The weather in Johannesburg in July is cold with temperatures between 8°C and 18°C, warm clothes are strongly recommended. No rain is expected in Johannesburg during July.

TRANSPORT FROM AIRPORTS (OR TAMBO AND LANSERIA) TO THE UNIVERSITY

- Gautrain only from OR Tambo to Rosebank: https://www.gautrain.co.za/ then road transport is required as below.
- EZ Shuttle: https://www.ezshuttle.co.za/
- E-hailing services e.g. Uber, Bolt.

ACCESS TO THE UNIVERSITY

VISITOR'S VEHICLES AND PEDESTRIANS

- All delegates who enter campus must have a valid ID or Passport or Driver's License.
- Delegates who arrive via *cars* should use any of the entrances on Yale Road.
- Sutton Place is a *pedestrian* entrance and thoroughfare on the Wits University campus, specifically at 24 Jorissen Street, between the Richard Ward Building and Solomon Mahlangu House.

DROP-OFF/PICK-UP

- Drop-off/ pick up will be allowed at designated areas outside campus: Designated area: 24 Jorissen Street (Braamfontein) as above.
- Security personnel will be deployed in this designated area.
- After 18:00 Weekends/Public Holidays, Ubers/Metered Taxis will be allowed to drop off and pick up passengers on campus as follows:
    - Monday to Friday: 18:00 - 05:00, Weekends: 24 hours.
    - Public Holidays: 24 hours.

SAFETY

Please take care of your personal belongings on campus and don't leave bags, computers etc. unattended. When off-campus, ensure that your car doors are locked and windows are closed.

REGISTRATION

Registration will be open daily from Monday, 07 July 2025 to Friday, 11 July 2025 from 07h30 to 17h00 in Solomon Mahlangu House Basement Level, West Wing Drawing Hall (SHWWDH), University of the Witwatersrand, Braamfontein, East Campus.

CONTACT DETAILS DURING CONFERENCE

General enquiries: (011) 717 6838
Emergency contact: 24-hour Security at the Great Hall Foyer, (011) 717 4444 or (011) 717 6666.

INTERNET FACILITIES

You can connect to Guest-Wi-Fi by selecting: ***Wits-Guest***
Username: 726g8
Password: 3dc4Ef5G

Alternately, *eduroam* access is available.

MESSAGES
A message poster board will be placed in Solomon Mahlangu House Basement Level, West Wing Drawing Hall (SHWWDH) near the registration area.

LOCAL ORGANISING COMMITTEEE AND ASSISTANTS
Delegates: Blue Lanyards
Local Organising Committee and Student Assistants: Red Lanyards

NAME TAGS
Please wear your name tags at all times to gain access to the university, registration area, tea/coffee breaks, lunches, poster sessions, lecture halls, and social functions. Vouchers are included with your name tags as per your registration.

STUDENT RESIDENCE ACCOMMODATION
All rooms are single occupancy with central heating and shared bathroom facilities, and are provided with bedding; however, delegates need to bring their own towels, soap and cosmetics.

For delegates who booked student residence accommodation via your registration form please take note of the following details:

- Male: *Jubilee Hall* and Female: *Sunnyside Residence*.
- Check-in from 14h00 on Sunday, 06 July 2025 at the respective residences.
- Check-in from 14h00 on all other days; delegates must come to the registration desk at Solomon Mahlangu House Basement Level West Wing Drawing Hall (SHWWDH) thereafter you will be escorted to the respective residences.
- Check-out times at 10h00 on the date of departure.

    - **BREAKFAST**
      For delegates who have booked residence accommodation, breakfast is included and will be served in the Main Dining Hall above the Matrix Student Centre from 07h00 to 09h00.
    - **EVENING MEALS**
      For delegates who have booked evening meals, these will be served in the Main Dining Hall above the Matrix Student Centre from 19h00 to 21h00.

LUNCHES
Lunch will be served in the Main Dining Hall above the Matrix Student Centre from 12h35 until 13h45 during the week of the conference. Follow signage from Solomon Mahlangu House Basement Level, West Wing Drawing Hall (SHWWDH).

REFRESHMENTS
Tea, coffee, biscuits and savouries will be served daily in the mornings (10h20) and afternoons (15h40) during the week of the conference in Solomon Mahlangu House Basement Level, West Wing Drawing Hall (SHWWDH) with the exception of Friday afternoon. Limited bottled water will be available daily.

SHOPS AND BANKING FACILITIES

The Matrix Student Centre is a vibrant student hub that includes food stores, books, computer shops, printing and stationery outlets, banks and ATMs located on the Braamfontein East Campus. Other food outlets include:

Braamfontein Campus East:

- **VidaE Café:** Find us on the Amic Deck and SMH ground floor.
- **FoodArt@Origins centre:** conveniently situated at the entrance of the Origins Centre.

Braamfontein Campus West:

- **Wits Club:** Surrounded by old oak trees, the Wits Club has an old-world charm suitable for any event. Run by Olives and Plates.
- **Zesti Lemonz:** Find out more about them on their facebook page.
- **Maphelo @ Tower of Light.**

Halaal/Vegetarian Options:

- Delhi Delicious - Halaal (Matrix Student Centre)
- Sausage Saloon - Halaal (Matrix Student Centre)
- Jimmy's - Halaal (Matrix Student Centre)
- Planet Savvy - Halaal (Solomon Mahlangu House)
- Kara Nichhas – Vegetarian (Matrix Student Centre)

EXHIBITION AREA

Please support our eight exhibitors, who will be located in Solomon Mahlangu House Basement Level, West Wing Drawing Hall (SHWWDH) for the duration of the conference.

CONFERENCE PHOTOGRAPH

The Conference group photograph will be taken in front of the Great Hall on Thursday, 10 July 2025 at 12h30 (before lunch).

FREE SHOWS AT THE WITS ANGLO AMERICAN DIGITAL DOME

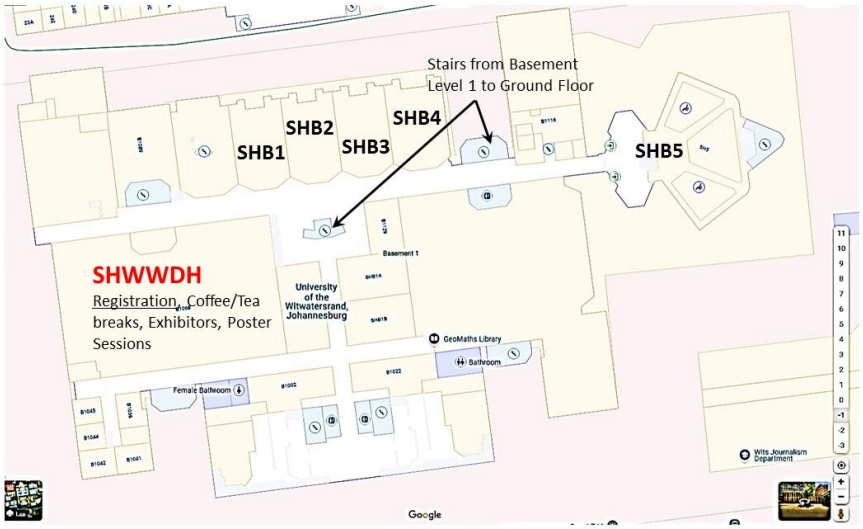
There will be free shows (repeated) on Tuesday, Wednesday and Thursday evenings at 18h00 at the Wits Anglo American Digital Dome with a maximum seating capacity of 200 at any time. The same shows will be repeated on the above days so please visit according to your choice of day selected as per your registration. More information can be accessed here: https://digitaldome.wits.ac.za/.

VISIT THE ORIGINS CENTRE MUSEUM

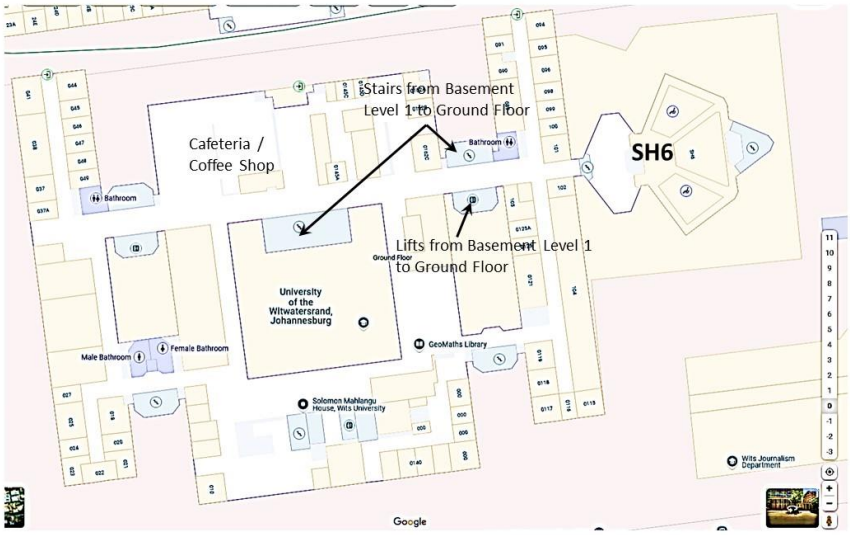
The Origins Centre Museum provides visitors with a unique experience of Africa's rich, complex heritage. The interactive exhibits take visitors on an extraordinary journey of discovery, which begins with the origins of humankind in Africa and then moves through the development of technology, art, culture and symbolism. The journey continues with an exploration of the diverse southern African rock art traditions, highlighting San and Khoe art and culture. These ancient masterpieces, and the artists, are illustrated through contemporary art installations by well-known South African artists. More information can be accessed here: https://www.wits.ac.za/origins/.

MAPS OF CONFERENCE REGISTRATION AND AREA AND VENUES

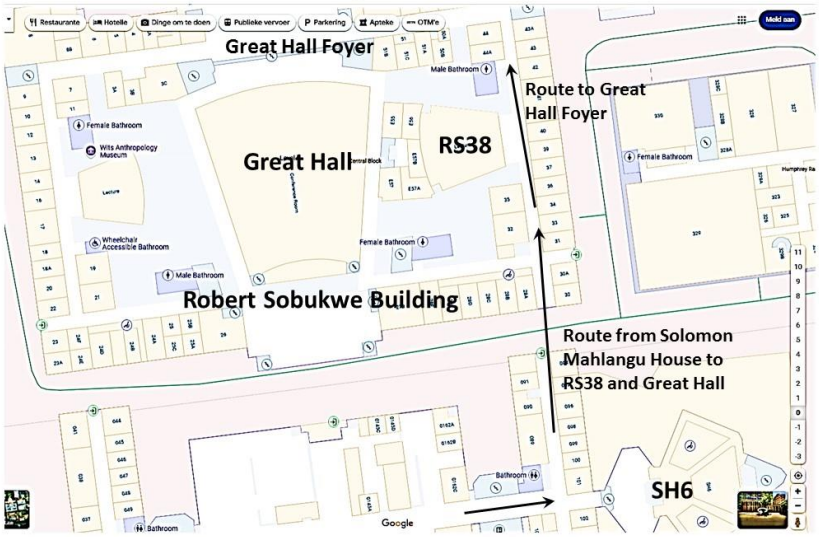
SAIP2025: Solomon Mahlangu House Basement 1 Level – Lecture Venues



SAIP2025: Solomon Mahlangu House Ground Floor – Lecture Venues



SAIP2025: Robert Sobukwe Building Ground Floor – Great Hall and Lecture Venue 38



GUIDELINES FOR PRESENTATIONS

ORAL PRESENTATIONS

- Oral presentations will need to be presented from the provided Windows Laptop using PowerPoint (*.pptx) or pdf files. Mac-users will have to provide their own HDMI adapters.
- Presentations should be started strictly on-time according to the scientific programme. Please ensure you know well ahead of time when your oral presentation is scheduled.
- Please arrive on time and report to the chair of the session. Inform the session chair if you are competing for a student prize.
- Speakers have a 15-minute timeslot for their presentation plus 5 minutes for questions or discussions. Please adhere to the schedule and keep within the allocated time.
- Plenary speakers: 40-minute presentation time and plus 5 minutes for questions or discussions.
- Non-specialist lectures: Timeslots as per the programme.
- Please respect the timekeeping of the chair of the session.
- Slide changer and laser pointer will be available in each venue.

PRESENTATION UPLOAD INSTRUCTIONS FOR ORAL PRESENTATIONS

- Log onto the SAIP2025 Indico page.
- On the menu on the left, click on “My Conference”, then “My Contributions”.
- A list of scheduled contributions will list on the right.
- Click on the title of the presentation that you wish to upload.
- Scroll to the bottom of the page where it says “Presentation Materials”.
- Click on the pencil icon on the right.
- A pop-up box appears. Click on “Upload Files”.
- Navigate to the file on your device and upload it.
- NB MAKE SURE YOU ACTIVATE THE “PROTECTED” ICON BY CLICK ON IT. It should turn blue when you click on it.
- Then click on “Upload” at the bottom of the page.
- The presentation will automatically upload to the directory corresponding to the presentation slot as scheduled in the oral programme.

POSTER SESSIONS

Posters are to be exhibited in Solomon Mahlangu House Basement Level, West Wing Drawing Hall (SHWWDH).

- Posters should be displayed on the allocated board. Poster boards will be numbered according to abstract numbers.
- Poster boards can accommodate **A0 Portrait** (841 mm wide by 1189 mm high) or A1 Landscape (841 mm wide by 594 mm high).
- Posters must be in English, and have a title, authors' names and affiliations at the top.
- The text should be at least 20 point (5 mm high).
- Posters must summarise the main points of the research, stimulate discussion, and should not just be a copy of the abstract or the written paper.
- Drawings, graphs, figures, charts and pictures must be labelled and large enough to be readable from a distance of 1.5 m.
- Poster adhesive tape will be supplied for each poster board.
- Posters should not be advertisements or commercial publicity and have no reference to trade, company or product names (posters breaching this rule will be removed by the organisers).

- There are two poster sessions scheduled for Wednesday, 09 July 2025 and Thursday, 10 July 2025 at 16h10.
- Posters for **Poster Session 1** on Wednesday, 09 July 2025 should be mounted by 14h00 on Tuesday, 08 July 2025 and removed following the session.
- Posters for **Poster Session 2** on Thursday, 10 July 2025 should be mounted by 10h30 on Thursday, 10 July 2025 and removed following the session.
- Please check poster allocations on the Conference Website or Conference Information Booklet or Notice Board.
- Presenters are requested to be present at their poster during the allocated session for discussion. Adjudication of posters entered for a student prize will be done during the assigned poster session only.

GUIDELINES FOR SESSION CHAIRS

- Check and verify the date, time, and venue of your session well ahead of time.
- Please be punctual and arrive at least 5 minutes before the scheduled start of your session.
- Ensure that all presentations for the session in question have been downloaded by the technical assistant on the venue laptop. The technical assistant in the venue can assist with this, as well as with information about the AV system if used.
- Identify the speakers before your session commences to ensure they are all present.
- Please honour the scheduled times and *do not move speakers* to an earlier presentation slot if there is a no-show presenter.
- Welcome delegates and speakers at the beginning of your session.
- Please make the following announcements:
    - Request that all mobile phones be switched off or set to silent mode.
    - Give the title of the presentation and the name of the speaker at the start of each presentation.
    - State whether the speaker is competing for an MSc or PhD prize.
- Thank all the speakers at the end of the session.
- Allow questions according to time available.
- Report any problems to the session technical assistant.
- Keep a record of absentee speakers and report them to the SAIP registration desk.

MESSAGE FROM THE VICE-CHANCELLOR AND PRINCIPAL,

UNIVERSITY OF THE WITWATERSRAND

PROFESSOR ZEBLON VILAKAZI (FRS, MASSAf, FAAS)

It is a great pleasure to welcome you to the 69th Annual Conference of the South African Institute of Physics (SAIP), hosted by the School of Physics at the University of the Witwatersrand. This year's convening takes place at a moment of global scientific significance, as we mark the United Nations' declaration of 2025 as the International Year of Quantum Science and Technology and situate ourselves within the broader International Decade of Sciences for Sustainable Development (2024–2033).

As the coordinating institution of South Africa's national Quantum Initiative, Wits University is proud to play a pivotal role in advancing the country's Quantum agenda. Our researchers are deeply engaged in pushing the frontiers of Quantum Science — from theory and simulation to next-generation technologies — and in building the human capital and research infrastructure necessary for Africa to contribute meaningfully to the global quantum future.

This leadership reflects our broader reputation for excellence in scientific research. Wits is home to internationally recognised research entities across a wide range of fields, from theoretical physics to particle cosmology, palaeosciences, artificial intelligence, and sustainable energy. We continue to invest in research that is not only globally competitive, but socially responsive — committed to tackling the grand challenges of our time.

The UN's focus on the Sciences calls for inclusive global collaboration, with special emphasis on bridging the Quantum divide and promoting gender equity in STEM. These principles are central to our mission at Wits, and we are proud to host this conference as a platform for scientific exchange, capacity-building, and partnership.

I wish you a stimulating and impactful conference. May your time with us spark new ideas, collaborations, and purpose.

Welcome to the University of the Witwatersrand. Welcome to Johannesburg.

MESSAGE FROM THE DEAN OF SCIENCE,

UNIVERSITY OF THE WITWATERSRAND

PROFESSOR NITHAYA CHETTY

It is my pleasure to welcome you to the 69th annual conference of the South African Institute of Physics, hosted this year at the University of the Witwatersrand. Wits has a proud and longstanding association with the SAIP, with several of its past presidents being Wits alumni or staff—among them the current SAIP President, Professor Rudolph Erasmus, and the current Head of the Wits School of Physics, Professor Deena Naidoo. I assumed the presidency when Wits last hosted SAIP in 2007 and have fond memories of that meeting. It is incredible to see how SAIP has grown since then, and I wish to especially acknowledge the Executive Officer, Dr Brian Masara, for the leading role that he has played. Brian was interviewed for his SAIP job right here at Wits in 2007!

Our School of Physics, one of the largest and most established in the country, was founded alongside the University itself, over a century ago. We have active research areas in theoretical physics, high energy physics, nuclear physics, condensed matter physics, photonics, astronomy, physics education, amongst other areas.

This year's conference takes place during the UN-declared International Decade of Science for Sustainable Development, an initiative championed by the International Union for Pure and Applied Physics. Physics, perhaps more than any other discipline, provides the methods and the ideas to confront the critical sustainability challenges of our time founded on quantitative, evidence-based insights amidst competing political and economic interests. As scientists, we understand the value of grounding action in understanding, and physics continues to play a central role in shaping informed responses to the global crises we face. 2025 is also the International Year for Quantum Science and Technology. Wits is proud to host the South African Quantum Technologies Initiative (SA QuTI), contributing to national and international efforts in this important field. Quantum mechanics—once regarded as an abstract and bewildering subject—is increasingly entering the public imagination and everyday discourse. This progress is due not only to sustained education and outreach, but to necessity: the future of technology, security, and communication depends on quantum science. It's a reminder that today's fundamental research seeds tomorrow's revolutions.

I wish you all an engaging, stimulating, and fruitful conference here at Wits.

MESSAGE FROM THE HEAD OF SCHOOL OF PHYSICS,

UNIVERSITY OF THE WITWATERSRAND

PROFESSOR DEENA NAIDOO

It is with great delight as the Head of School of Physics and Co-Chair to welcome all participants to the 69th Annual Conference of the South African Institute of Physics hosted by the School of Physics, Faculty of Science, University of the Witwatersrand.

The School of Physics, the largest in the country, engages in internationally competitive research within very diverse fields, some emerging and some established, including experimental and theoretical high energy physics, namely string theory, phenomenology, gravitation and cosmology, materials physics, experimental and theoretical condensed matter physics, nuclear physics, astronomy, astrophysics and astro-particle physics, photonics, space propulsion and physics education. The School hosts two DSI-NRF Chairs and is home to the Materials Physics Research Institute with significant experimental infrastructure, the Mandelstam Institute for Theoretical Physics, the Institute of Collider Particle Physics, the Wits Centre for Astrophysics, the Nuclear Structure Research Group, and the WitsQ Research Group focused on quantum technologies. Currently, the Gauteng Node of the National Institute of Theoretical and Computational Sciences (NITheCS) operates from the School.

This conference is recognizing the "*International Year of Quantum Science and Technology, 2025 and the International Decade of Sciences for Sustainable Development, 2024–2033"*. The conference scientific programme which comprises of 300 and 204 oral and poster presentations, respectively, 7 invited plenary speakers and an Industry Day which will provide an enriching experience to local and international experts across all branches of physics including academics, researchers, postdoctoral fellows and postgraduate students. The support of industry, business and government partners are acknowledged. I am very grateful to the invited plenary speakers for their participation and contributions to the scientific programme. My sincere appreciation to all the conference exhibitors and sponsors for their involvement in enhancing the success of the conference.

I wish all participants an enriching conference with excellent discussions, exchange of ideas, fostering of collaborations and as a platform to inspire of students and young researchers to continue with a career in Physics.

Finally, I would like to express my sincere appreciation to all members of the local organising committee, in particular to Dr Robert Warmbier (Co-Chair), Professor Phil Ferrer (Chair: Scientific Programme), Ms Michelle Gallant (Wits Functions & Events / Advancement Division), Professor Rudolph Erasmus (ex-officio), Dr Angela Dudley, Dr Brian Masara and Mr Tebogo Mokhine (SAIP Office) for their tremendous efforts and time devoted in organising the conference.

MESSAGE FROM THE PRESIDENT OF SOUTH AFRICAN INSTITUTE OF PHYSICS (SAIP)

PROFESSOR RUDOLPH ERASMUS

It is my sincere pleasure to welcome all delegates to the 69th annual conference of the South African Institute of Physics, hosted by the University of the Witwatersrand, Johannesburg! Wits hosted the conference in 2007. The year 2025 is the 70th birthday of the SAIP, and the conference numbering reflects the indelible fingerprint of the Covid-19 pandemic in the counting of future conferences due to the cancellation of the 2020 conference.

This year's conference is large with about 550 registered delegates. All Divisions have full and diverse oral and poster presentation programmes and a Physics for Development & Industry Day takes place on Thursday morning. The schedule features 7 plenary lectures by national and international experts and 5 Winter Schools taking place in parallel on Monday 7 July. There is thus a veritable cornucopia of choice, and I wish all delegates a hugely successful and enjoyable conference, with active engagement in presenting, listening and networking. This opportunity only occurs once a year!

In addition to the support of research and study of physics and its applications that the conference promotes, it is also a vehicle for development and outreach activities. I would like to specifically highlight the already mentioned Physics for Development & Industry Day and encourage delegates to attend the presentations. South Africa urgently needs more innovators and partnering with industry is essential here. I also highlight the Southern Africa Physics Network (SAPhysNet) meeting taking place on Friday morning. This project was formally launched at SAIP2024 and is gathering momentum very well under the enthusiastic leadership of Prof Azwinndini Muronga. During the conference, a Teacher's Development Workshop for 110 physical sciences teachers takes place in a parallel workshop. This forms part of the expanding series of such training workshops organised by the SAIP with the assistance of various national, regional and district government departments. The SAIP specifically thanks the sponsors that make these workshops possible

Diversity, gender equality and inclusivity are key elements of our institutional culture and need special attention with current zeitgeist in certain corners of the globe. The Women in Physics in South Africa (WiPiSA) project celebrates its 20th anniversary this year and have invited Dr Yaseera Ismail from Stellenbosch University to present the WiPiSA Plenary Lecture on Friday 11 July. Please attend this important event.

The core of SAIP's new 5-year strategic plan will be presented at this year's AGM on Friday 11 July 2025. It is my sincere hope that every physicist will live "We shape the future" and Ignite, Inspire and Empower in their research, teaching and outreach activities so that all South Africans understand what role physics can play in improving our lives.

I express my sincere gratitude and appreciation to the Local Organising Committee of SAIP2025, co-chaired by Prof Deena Naidoo and Dr Robert Warmbier. I appreciate your hard work in compiling a very exciting programme. I would also like to thank the SAIP Office, the Division and Forum Chairs, the SAIP Council, and everyone else who has worked behind the scenes to help make this conference a reality.

I look forward to a memorable conference!

Invited Plenary Speakers

PROFESSOR VAL ZWILLER (KTH Royal Institute of Technology, Stockholm, Sweden)

Title: Generation and detection of light at the single photon level.

Abstract

We develop quantum devices to enable the implementation of quantum technologies based on controlling light at the single photon level with the aim of on-chip integration and novel instrumentation. Future quantum communication and sensing will require high-performance quantum devices able to generate and detect light one photon at a time. Schemes to manipulate light on-chip, based on integrated photonics, are carried out in our group. Single photon sources based on semiconductor quantum dots can generate single as well as entangled photon pairs at telecom wavelengths to enable implementation of long-distance quantum communication. We operate a quantum network made of deployed optical fibers in the Stockholm area and demonstrate single photon transmission and quantum key generation over 34 km.

The ability to detect single photons is crucial for quantum optics as well as for a wide number of applications. Several technologies have been developed for efficient single photon detection in the visible and near infrared. The invention of the superconducting nanowire single photon detector in 2001 enabled the development of a new class of detectors that can operate close to physical limits. Different aspects will be discussed including wavelength detection range, time resolution, dark counts, saturation rates and photon number resolution along with various applications such as Lidar, quantum communication, deep space communication, microscopy and bio-medical measurements. Multipixel single photon detectors based on superconducting nanowires will also be discussed, including a quantum spectrometer that is based on an array of high-performance single photon By time stamping single photon detection events at the output of a spectrometer we generate data that can yield spectra as well as photon correlations such as g(2), g(3) to g (n) as well as cross correlations among different spectral lines, under pulsed excitation, transition lifetimes can also be extracted. This instrument therefore replaces a spectrometer, a streak camera, a Hanbury-Brown Twiss interferometer and operates with far higher signal to noise ratio than is possible with existing detectors that are commonly used in the infrared.

Biography

Val Zwiller is a professor of physics at the Royal Institute of Technology (KTH) inStockholm, Sweden, where he heads the Quantum Nano Photonics group in the Department of Applied Physics. He is also Chief Science Officer at Single Quantum, a company which he co-founded in Delft, Netherlands, which develops single photon detector technology. He studied at Strasbourg and UC Berkeley and

obtained his PhD from Lund University in 2001. He was an assistant professor at EPFL Lausanne and ETH Zurich before appointment as an associate professor at TU Delft and later as a full professor at KTH with a joint appointment at the Karolinska Institute to develop quantum science for life sciences. He is Chief Editor for Quantum Optics at Frontiers in Photonics, founder of Quantum Scopes AB, and a referee for Nature, Science, Nature Physics, Nature Photonics, Nature Materials, Nanoletters, Physical Review Letters, Physical Review B, and Applied Physics Letters. He is also deputy representative for Sweden to the European Quantum Flagship. Val Zwiller's research lies at the intersection of quantum optics and nanoscience where fundamental questions meet technology. His team develops new systems to generate, manipulate and detect quantum states of light and proceeds to demonstrations. They use advanced nanofabrication techniques to develop their quantum devices and perform most of their measurements at cryogenic temperatures with custom-made equipment allowing for optical and electrical measurements at the single photon level.

PROFESSOR SVEN HEINEMEYER (Universidad Autonoma de Madrid, Spain)

Title: Indications for new physics at the LHC.

Abstract

The Standard Model (SM) of particle physics provides a very good description of nearly all available experimental data. Notable exceptions are Dark Matter (DM) and the Baryon asymmetry of the universe (BAU, the question why we only see matter, but not antimatter). These questions point towards physics beyond the SM (BSM). While DM points towards some new so far undiscovered symmetry, the BAU leads to models with extended Higgs sectors.

The Large Hadron Collider (LHC) at CERN is searching for BSM physics. However, no clear signal of BSM physics was discovered so far. While the need for BSM is firmly established, the LHC data nevertheless exhibits some interesting anomalies that could point towards BSM theories with new symmetries and/or extended Higgs sectors. I will review the status of the BSM searches at the LHC and discuss some promising excesses in the data. I will demonstrate how this kind of excesses can be analysed with future (High Luminosity-) LHC data, or at a future e+e- collider. The confirmation of any of the many excesses and anomalies in the LHC data would pave the way for future experimental and theoretical explorations.

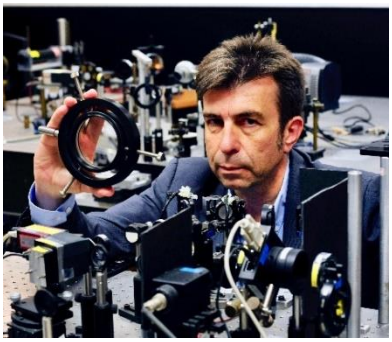
Biography

Professor Sven Heinemeyer graduated in 1998 at the University of Karlsruhe, Germany, in the field of precision predictions in supersymmetric theories. Postdoctoral Fellows at DESY (Hamburg, Germany), Brookhaven National Laboratory (USA), LMU Munich (Germany) and CERN, then moved

to Spain. Since 2017, currently a Research Professor (highest level) of the Spanish Research Council (CSIC), at the Institute for Theoretical Physics (IFT) in Madrid (Spain).

The Higgs boson at 125 GeV as a probe of SM and BSM physics; phenomenological predictions and analyses for the LHC and future e+e- colliders in the SM and BSM models; indications for BSM physics in current experimental data and their implications for the (HL-)LHC and future e+e- colliders; implications for BSM models from cosmology and gravitational waves; low-energy and electroweak precision observables as a test of the SM and BSM. Professor Heinemeyer has published more than 200 journal articles with an average citation of 250+ and an h-index of 89. He is a member of the LEP Higgs working group (until 2000); leader of the LHC Higgs working group 2012-2014 (at the Higgs discovery); member of the Particle Data Group; convenor for various working groups for FCCee and ILC physics; editor for European Physics Journal C; main organizer of the annual workshop “Higgs Days at Santander”. Author of the codes HiggsTools (HiggsBounds, HiggsSignals), FeynHiggs, MasterCode and 2hdmtools

PROFESSOR PABLO ARTAL (University of Murcia, Murcia, Spain)



Title: Wearable adaptive optics for the eye.

Abstract

The optics of the human eye is at once simple, robust, and remarkably well adapted to the needs of the visual system. However, how different optical aberrations, whether naturally occurring or artificially induced, affect vision remains a central question in ophthalmology and visual optics. One of the most powerful approaches to investigate this involves the use of adaptive optics (AO) visual simulators. Traditionally, AO visual simulators have been developed as laboratory or clinical desktop systems. These instruments combine wavefront sensing to measure the eye’s optical aberrations with phase modulation devices, such as deformable mirrors or spatial light modulators, that allow the controlled induction of specific optical profiles. This enables direct testing of visual performance under well-defined optical conditions, providing insights into the visual impact of aberrations and the design of new advanced optical corrections. In recent years, we have extended this concept into wearable devices. These emerging systems aim to bring high-resolution visual simulation and testing into real-world settings, enabling assessment under natural viewing conditions and over extended periods of time. In this presentation, I revise the evolution of adaptive optics in vision science, from retinal imaging to visual simulation. Special emphasis will be placed on the technological challenges and opportunities of miniaturizing and adapting these systems for use in dynamic, real-life environments. Wearable adaptive optics has the potential to transform both vision research and clinical care, opening new possibilities for personalized correction or myopia control strategies.

Biography

Professor Pablo Artal is a world-renowned optical scientist specializing in vision, ophthalmology, and biomedical imaging. He earned his Ph.D. in Physics from the University of Zaragoza, Spain and he pursued postdoctoral research at Cambridge University (UK) and the Institut d'Optique in Orsay, France, before securing a permanent research position at the Instituto de Óptica in Madrid. In 1994, he became the first Full Professor of Optics at the University of Murcia, where he founded the Laboratorio de Óptica. He has held sabbatical positions in Rochester (USA) and Sydney (Australia) and is currently a Distinguished Visiting Professor at the Aier School of Ophthalmology, Central South University, in Changsha, China.

Professor Artal has made pioneering contributions to understanding the optical limitations of human vision and developing novel ophthalmic instruments. Many of his innovations have been integrated into clinical ophthalmology. He has published over 400 peer-reviewed papers, accumulating more than 26500 citations (h-index: 87), and has delivered over 300 invited talks at international conferences. His work has been recognized with prestigious awards, including the Edwin H. Land Medal (2013), the King Jaime I Award in New Technologies (2015), the Spanish National Research Award "Juan de la Cierva" (2018), the OSA Edgar D. Tillyer Award (2019) and in 2021, he was awarded the medal of the Spanish Royal Physics Society. He is a Fellow of OSA, ARVO (Gold Class), EOS, and SPIE and holds 30 international patents. Additionally, he co-founded four spin-off companies, translating his research into real-world applications and has been the mentor of many students and post-docs.

PROFESSOR CHRISTO VENTER (North-West University, South Africa)

Title: Gamma-ray Pulsars: Puzzles and Progress.

Abstract

Pulsars are spectacular, enigmatic, astrophysical objects that emit regular pulsations across the electromagnetic spectrum. Moreover, they are thought to be factories of cosmic rays as well as gravitational waves upon merging events, making them true multi-messenger objects. They are Nature's exquisitely accurate timepieces, being the super-dense remnants of supernova explosions. They are extremely stable rotators with magnetic fields that are a trillion times stronger than that of Earth. These fascinating attributes make them valuable laboratories to test theories of gravity, nuclear physics, plasma physics, beaming effects, quantum mechanical effects, and radiation physics in relativistic, strong-field regimes that cannot be replicated on Earth. In the gamma-ray energy band, there has been a number of revolutionary discoveries, including the milestone detection of 300 high-energy pulsars; the detection of pulsations from the famous Vela pulsar up to 20 TeV and the Crab pulsar up to 1 TeV; mode-changing phenomena observed in the Gamma Cygni pulsar; and the existence of a pulsar fundamental plane that relates gamma-ray luminosity, spectral cut-off

energy, surface magnetic field, and spin-down luminosity, to name a few. There has also been evidence for multipolar field structures and highly efficient acceleration processes in these systems. Pulsars reveal themselves in interesting settings such as binaries, globular clusters, pulsar wind nebulae, and supernovae. Several models that attempt to capture the essence of pulsar radiation have been developed and refined over the years, involving several techniques ranging from geometrical to electrodynamical to particle-in-cell to magneto-hydrodynamics. Even 50 years after their discovery, many open questions remain. In this talk, I will review the status of the field, highlighting the major breakthroughs that we can expect with the substantial increase in the pulsar population and quality of temporal, spectral, spatial, and polarisation data with the advent of several new experiments.

Biography

Professor Christo Venter joined the Centre for Space Research, North-West University (NWU) in 2002 as a graduate student. Upon completion of his PhD in 2008, he successfully applied for a NASA Postdoctoral Program (NPP) Fellowship and spent 2009 at the Goddard Space Flight Center in Maryland, USA. He held the following NWU positions: Lecturer (2005 – 2008), Senior Lecturer (2009 – 2014), Associate Professor (2015 – 2017), Full Professor (2018 – present), Subject Chair (2015 – 2017) and Research Director (2020 – 2022). Christo has been involved in modelling of pulsars and pulsar-like systems, being part of the High Energy Stereoscopic System (H.E.S.S.) Collaboration, a world-class very-high-energy Gamma-ray telescope situated in Namibia, the Fermi Large Area Telescope (LAT) gamma-ray satellite, as well as the next-generation ground-based gamma-ray experiment called the Cherenkov Telescope Array (CTA). Of late, he has moved closer to radio astronomy and has been the principal investigator of four Open Time Proposals on the MeerKAT radio telescope.

The National Research Foundation (NRF) awarded him a B1 rating (2024 – 2030). Professor Venter is co-author of 33 peer-reviewed papers, 37 peer-reviewed proceedings, 29 conference proceedings articles, 214 H.E.S.S., 25 Fermi LAT, and 4 MeerKAT papers. He has attended 61 international and 29 local conferences and has given 13 plenary talks, supervising 11 Honours projects, 9 M.Sc. students (2 ongoing), 5 Ph.D. students (3 ongoing), and 3 postdocs (2 ongoing). He plans to continue research in the lively field of multi-messenger astronomy, including the use of data from facilities such as H.E.S.S., Fermi, CTA, Chandra, NICER, MeerKAT and SKA.

PROFESSOR DIPANKAR DAS SARMA (Indian Institute of Science, Bengaluru, India)

Title: Halide perovskites and related materials: A new playground of material discovery.

Abstract

The last fifteen years have seen the most spectacular rise of a class of materials initially known as the hybrid halide perovskites, with the field quickly evolving to encompass all-inorganic halide perovskites and double perovskites, low-dimensional hybrid halide materials, and quantum dots. With intense worldwide research activities over the last decade, photovoltaic, light-emissive, and detection properties of this class of materials have reached superlative performance levels within this exceptionally short period and have taken the world by surprise. I shall discuss some historical aspects of this field of study, followed by some of our recent results to exemplify the excitement in this field in terms of discovering new materials and material properties. If time permits, I shall touch upon another exciting field comprising chiral systems where some of the systems can even be made ferroelectric.

Biography

Professor Dipankar Das Sarma earned a 5-year Integrated MSc in Physics from the Indian Institute of Technology, Kanpur, in 1977 and a Ph.D. from the Indian Institute of Science (IISc) in 1982. During 1984-1986, he was a Visiting Scientist at Kernforschungsanlage Jülich, Germany.

Professor Sarma served as a faculty member at IISc during the period 1986-2021 and was the first J. N. Tata Chair there in 2017-2020. He concurrently served as a Distinguished Scientist (2011-2016) at the Council of Scientific and Industrial Research and as the MLS Chair Professor of Physics (2006-2008) at the Indian Association for the Cultivation of Science. He is now an Honorary Professor (2021-2026) and CSIR Bhatnagar Fellow (2021-2026) at IISc.

His research interests include strongly correlated electron systems, semiconductor nanocrystals, and energy materials, utilizing various experimental and theoretical techniques. He was instrumental in establishing two Indo-Italian synchrotron beamlines dedicated to diffraction experiments at Elettra in Trieste. Professor Sarma has published about 500 scientific papers and holds several patents. He is an elected Fellow of the Indian National Academy of Engineering, The World Academy of Sciences (TWAS), the American Physical Society, and all three science academies of India. He has received numerous national and international awards, including multiple honorary doctorates. He has also held many prestigious visiting and honorary academic positions globally and within India, including roles at institutions like the University of Tokyo, Uppsala University, University of Vienna, Ecole Polytechnique, TIFR, JNCASR, and SNBNCBS. Further details are available via his group webpage and Google Scholar profile (https://scholar.google.co.in/citations?hl=en&pli=1&user=2yLbffsAAAAJ).

DR YASEERA ISMAIL (Stellenbosch University, South Africa)

Title: Shaping the Future: A Physics Journey to Groundbreaking Research in Quantum Technologies.

Abstract

Quantum communication holds the promise of ultra-secure information transfer and lays the foundation for the future quantum internet. At the heart of this vision is the ability to distribute entanglement and quantum keys over long distances, including via satellite. My research focuses on free-space quantum communication, and most recently, on implementing satellite-based quantum links. In a ground-breaking achievement, we implemented South Africa's first quantum satellite link, and the longest intercontinental quantum satellite secure link of 12900 km between China and South Africa, which was published in a recent Nature (2025) publication. This achievement establishes a critical foundation for Africa's sustained participation in and contribution to the global quantum research and innovation landscape.

As a female physicist navigating the scientific landscape in Africa, I have also been fortunate to benefit from strong mentorship, collaborative networks, and an unwavering belief in the potential of homegrown excellence. These experiences have taught me that developing scientific capacity is dependent on building collaborations.

In this lecture, I will share my journey, from the early days of navigating local constraints in quantum optics to conducting cutting-edge research. Along the way, I hope to offer a message of encouragement to young women in physics and a vision of what is possible when dedication meets opportunity.

Biography

Dr Yaseera Ismail is a Senior Lecturer in the Department of Physics at Stellenbosch University, South Africa, and heads the QuPhotonics Lab. She is an experimentalist who specializes in developing quantum optical tools to advance free-space, long-range secure quantum communication. In 2016, she received the TechWomen Emerging Leader Award, in 2018, she was recognized as an Optica Ambassador, and is an Optica-appointed Vice President on the International Commission for Optics. Dr Ismail is the Chair of Optica's Theodor W. Hänsch Prize in Quantum Optics and the Chair of the ICO IUPAP Young Scientists Prize in Optics. She is a fellow of the DHET Future Professor Program, and in 2024, she was inaugurated into the South African Young Academy of Sciences.

PROFESSOR SHONISANI MULOVHEDZI (University of Venda, South Africa)

Title: Practitioners' understanding of integrating basic science into lessons in the early childhood development playroom.

Abstract

Early Childhood Development serves as a crucial foundation for lifelong learning, with basic science education playing a key role in fostering curiosity, critical thinking, and problem-solving skills of young children. However, many practitioners look like face challenges in integrating science concepts into playroom activities. Understanding how practitioners apply basic science in these settings is essential for improving early science education. This study aims to explores practitioners' understanding of integrating basic science into lessons in the early childhood development playroom. A qualitative research approach will be adopted, using an exploratory case study design to gain in-depth insights into practitioners' understanding and pedagogical approaches. Data will be gathered through semi-structured interviews, classroom observations, and document analysis. Interviews will provide insights into practitioners' perspectives, while observations captured real-time teaching practices. Lesson plans and activity guides will be analysed to assess curriculum alignment with science learning objectives. The study will be conducted in eight selected Early Childhood Development centres. Four from urban and four from rural settings to capture diverse teaching contexts. The population included qualified Early Childhood Development practitioners. This study grounded in Vygotsky's sociocultural theory were also used to examine how children acquire scientific knowledge through play and social interaction. The expected finding assumes that while practitioners recognise the importance of science education, many lack formal training in early science instruction. Play-based strategies such as storytelling, sensory exploration, and nature-based activities will be used. Despite a willingness to integrate science into playroom lessons, gaps in training and resources hinder effective implementation. The study will conclude that addressing these gaps can improve science learning outcomes in Early Childhood Development settings. The study will recommend that encouraging knowledge-sharing among practitioners to exchange best practices in early science education is crucial to improve basic science literacy and inquiry-based learning from an early age.

Biography

Professor Shonisani Agnes Mulovhedzi is a Full Professor and Head of the Department of Early Childhood Education at University of Venda. She holds a PhD degree in Early Childhood Education from the University of Pretoria. She is an executive committee member of the South African Research Association for Early Childhood Education, a Provincial Early Childhood Development Inter-Sectoral committee member, serve as a Reviewer for the National Research Foundations and for Thuthuka grants. Professor Mulovhedzi is a mentor of the Nurturing Emerging Scholarship Programme funded by the Department of High Education and Training. Professor Mulovhedzi is

coordinating the Univen-Model Preschool. She worked as a preschool teacher for more ten years at Mbilwi Childcare Centre. She also worked as a Foundation Phase teacher in various primary school around Vhembe District. She joined the University of Venda since 2014 as a lecturer. In 2018, she got senior lecturer position, and in 2022, she appointed as Head of the Department of Early Childhood Education.

In 2023, Professor Mulovhedzi was promoted to an Associate Professor and in 2024 to a Full Professor. Her research and teaching focus on special issues specialised on leadership, Life Skills, inclusive education and Science Education in Early Childhood Education. She won several Vice-Chancellors excellence awards in Research and in teaching & learning. She has written and published book chapters and articles in accredited journals. She has authored and co-authored numerous articles and book chapters and reviewed articles, books and book chapters. Furthermore, Professor Mulovhedzi is a C3 rated researcher for Early Childhood Education.

Plenary Lectures

Date & Time	Title of Lecture	Presenter
Tuesday 08 July 2025 08h30 – 09h15 Venue: SHB5	Halide perovskites and related materials: A new playground of material discovery	Professor D D SARMA
Tuesday 08 July 2025 13h50 – 14h35 Venue: SHB5	Generation and detection of light at the single photon level	Professor Val ZWILLER
Wednesday 9 July 2025 08h30 – 09h15 Venue: SHB5	Indications for new physics at the LHC	Professor Sven HEINEMEYER
Wednesday 09 July 2025 13h50 – 14h35 Venue: SHB5	Practitioners' understanding of integrating basic science into lessons in the early childhood development playroom	Professor Shonisani MULOVHEDZI
Thursday 10 July 2025 08h30 – 09h15 Venue: SHB5	Wearable adaptive optics for the eye	Professor Pablo ARTAL
Friday 11 July 2025 08h30 – 09h15 Venue: SHB5	Gamma-ray Pulsars: Puzzles and Progress	Professor Christo VENTER
Friday 11 July 2025 13h50 – 14h35 Venue: SHB5	Shaping the Future: A Physics Journey to Groundbreaking Research in Quantum Technologies	Dr Yaseera ISMAIL

Non-Specialist Lectures

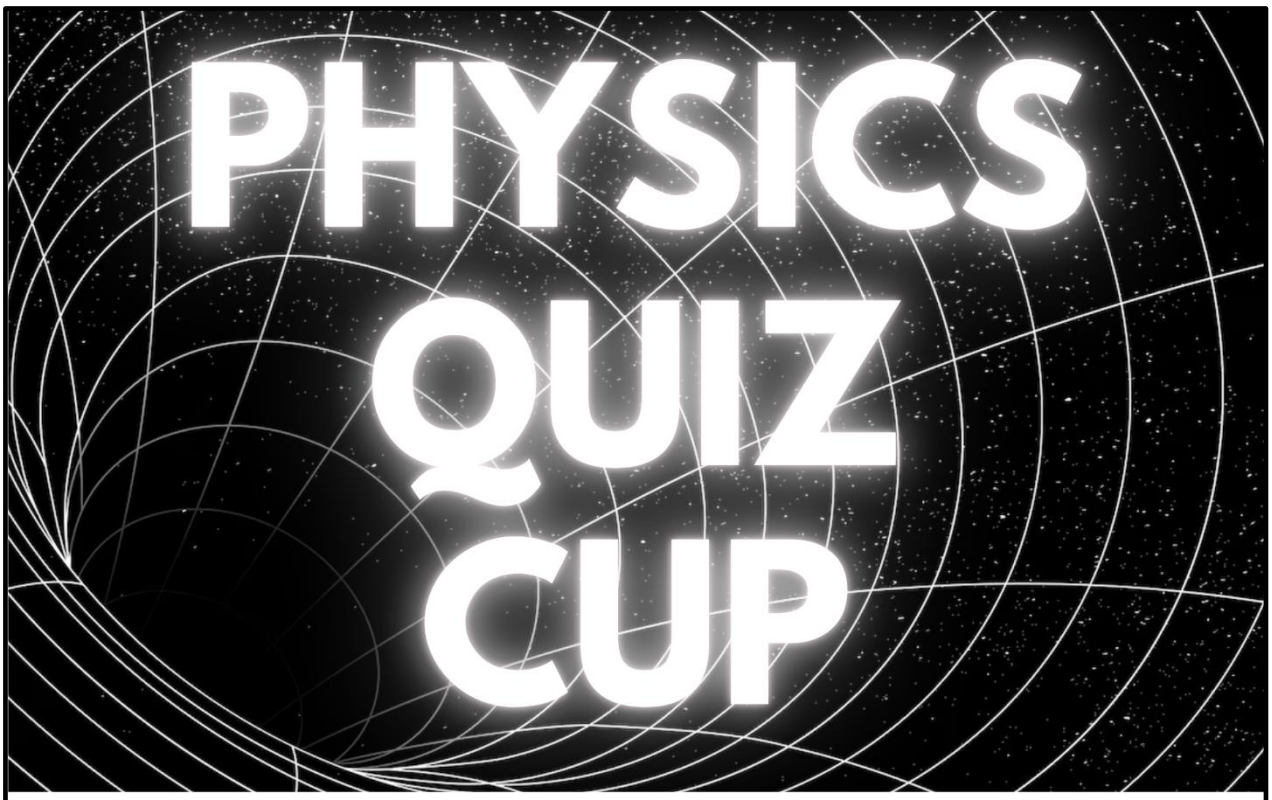
Date & Time	Title of Lecture	Presenter
Wednesday 9 July 2025 10h50 – 11h30 Venue: SHB5	Quantum materials in 2D flatland	Professor Biplab SANYAL
Thursday 10 July 2025 13h50 – 14h30 Venue: SHB2	Characterising Photovoltaic Modules for Performance, Reliability, and Sustainability	Professor Ernest VAN DYK
Friday 11 July 2025 10h50 – 11h30 Venue: SHB3	Two-photon Infrared Vision	Professor Pablo ARTAL

Conference Meetings

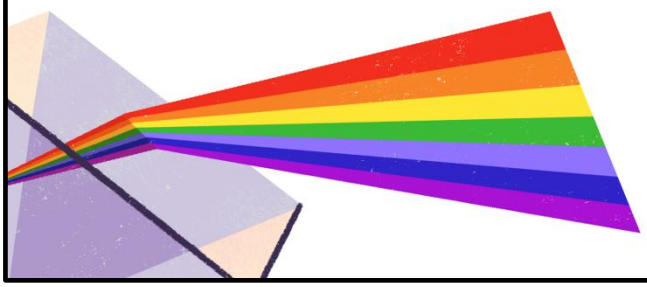
Date & Time	Activity	Venue
Monday 7 July 2025 09h00 – 16h00	SAIP Council Meeting	Gate House, First Floor Boardroom GH102A
Wednesday 9 July 2025 15h00 – 15h40	ECD Science Skills Accelerator Programme & Collaboration Meeting	Solomon Mahlangu House Ground Floor Venue: SH6
Wednesday 9 July 2025 18h00 – 19h00	Council Meeting with Heads of Schools and Departments of Physics	Gate House, First Floor Boardroom GH102A
Thursday 10 July 2025 09h20 – 12h30	Physics in Industry Day	Solomon Mahlangu House Ground Floor Venue: SH6
Thursday 10 July 2025 13h50 – 14h50	Division Meeting: Physics of Condensed Matter and Materials	Solomon Mahlangu House Basement Lecture Venue: SHB5
Thursday 10 July 2025 13h50 – 15h30	Division Meeting: Nuclear, Particle and Radiation Physics	Solomon Mahlangu House Basement Lecture Venue: SHB1
Thursday 10 July 2025 13h50 – 15h30	Division Meeting: Theoretical and Computational Physics	Robert Sobukwe Building Ground Floor Venue: RS38
Thursday 10 July 2025 14h30 – 15h30	Division Meeting: Applied Physics	Solomon Mahlangu House Basement Lecture Venue: SHB2
Thursday 10 July 2025 14h50 – 15h30	Division Meeting: Astrophysics and Space Science	Solomon Mahlangu House Basement Lecture Venue: SHB4
Thursday 10 July 2025 14h50 – 15h30	Division Meeting: Physics for Development, Education and Outreach	Solomon Mahlangu House Ground Floor Venue: SH6
Thursday 10 July 2025 18h00 – 19h00	Council Meeting with Division Chairs	Gate House, First Floor Boardroom GH102A
Friday 11 July 2025 09h20 – 12h30	SAPhysNet Forum Meeting	Solomon Mahlangu House Ground Floor Venue: SH6
Friday 11 July 2025 11h30 – 12h30	Division Meeting: Photonics	Solomon Mahlangu House Basement Lecture Venue: SHB3
Friday 11 July 2025 14h40 – 16h40	Annual General Meeting of the SAIP	Solomon Mahlangu House Basement Lecture Venue: SHB5

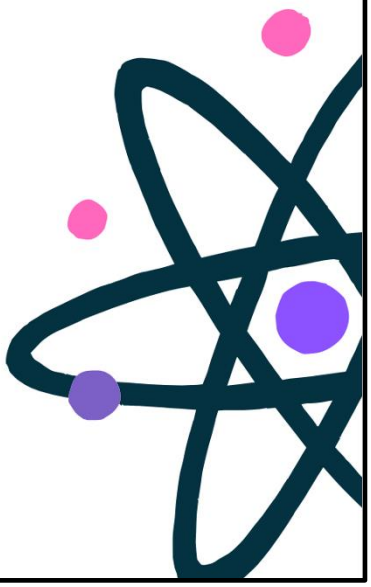
Social Functions

Function/Event	Date/Time/Venue	Information
Welcome Reception	Date: Monday, 07 July 2025 Time: 18h00 Venue: Great Hall	Formal Events will take place in the Great Hall with a reception with finger supper and refreshments hosted in the Robert Sobukwe Exam Hall Exams Hall (above the Great Hall).
Free Show	Tuesday, 08 July 2025 Time: 18h00 Venue: Wits Anglo American Digital Dome	Attend as indicated on your registration form. Maximum seating capacity 200.
Free Show	Wednesday, 09 July 2025 Time: 18h00 Venue: Wits Anglo American Digital Dome	Attend as indicated on your registration form. Maximum seating capacity 200.
Free Show	Thursday, 10 July 2025 Time: 18h00 Venue: Wits Anglo American Digital Dome	Attend as indicated on your registration form. Maximum seating capacity 200.
Physics Quiz Cup	Thursday, 10 July 2025 Time: 18h00 Venue: SHB5	Team competition
Conference Banquet	Friday, 11 July 2025 Time: 18h00 Venue: The Empire Conference & Events Venue, 16 Empire Road, Parktown, Johannesburg	Buses Depart: @ 17h30 from the parking area at the Wits Anglo American Digital Dome. Buses Depart: @ 22h00 and 23h00 from Empire Events and Functions Venue. <u>Directions for delegates arriving by car:</u> The premises where the venue is located is on the corner of Empire Road and Hillside Road. The car entrance is NOT in Empire Road, but in Hillside Road. Driving east from Wits along Empire Road, delegates should turn right into Hillside Road from Empire (there is a BP Garage with a KFC and MacDonald's diagonally opposite the intersection). Once in Hillside Road, the entrance is the first entrance to the right. Security guards will direct delegates to park in Basement parking 3, and there will be signs and staff to guide delegates to Building B, where the venue is on level 4 via the lifts.



Test Your Knowledge in the Ultimate Quiz Night and Win!





WELCOME RECEPTION PROGRAMME

Date: Monday 07 July 2025

Venue: Great Hall, University of the Witwatersrand, Johannesburg

Time	Programme
17h30 – 18h00	Arrival (Music in foyer)
18h00 – 18h10	Master of Ceremonies and SAIP2025 LOC Co-Chair: Professor Deena Naidoo
18h10 – 18h15	Wits Choir
18h15 – 18h25	Welcoming remarks: Vice-Chancellor and Principal, Professor Zeblon Vilakazi
18h25 – 18h35	Welcoming remarks: Dean of Faculty of Science, Professor Nithaya Chetty
18h35 – 18h40	Wits Choir
18h40 – 18h50	Welcoming remarks: President of SAIP, Professor Rudolph Erasmus
18h50 – 18h55	Introduction of Guest of Honour
18h55 – 19h15	Official Opening & Keynote Address: Minister of DSTI, Professor Blade Nzimande
19h15 – 19h20	Wits Choir
19h20 – 19h30	Vote of Thanks; Announcements to Delegates
19h30 – 21h00	Reception with finger supper and refreshments: Robert Sobukwe Exam Hall

SAIP2025 Conference Banquet Programme

Date: Friday 11 July 2025

Venue: The Empire Conference & Events Venue

16 Empire Road, Parktown, Johannesburg

Time	Programme
17h30 – 18h00	Arrival and seating of guests
18h00 – 18h15	**Welcome Remarks** SAIP LOC Co-Chair, Professor Deena Naidoo
18h00 – 18h30	*Starter is served*
18h15 – 18h30	**Remarks by outgoing SAIP President** Professor Rudolph Erasmus
18h30 – 19h30	**Awarding of Student Prizes** Professor Rudolph Erasmus and Division Chairs
19h30 – 20h30	*Dinner is served*
20h30 – 20h45	**Handover of gifts to Plenary Speakers** SAIP2025 LOC
20h45 – 21h00	**Award and Acceptance: 2025 SAIP Fellow** Professor Rudolph Erasmus
21h00 – 21h15	**Remarks by Incoming SAIP President** Professor Eric Maluta - Mace handover
21h15 – 21h30	**Vote of Thanks by SAIP2025 LOC Chairs** Professor Deena Naidoo and Dr Robert Warmbier - Conference Mace handover to the hosts of SAIP2026
21h30 – 21h45	**Group photograph of all SAIP Presidents (Past & Present) in attendance**
21h30 – 23h00	*Dessert & Music / Dancing*

WINTER SCHOOL PROGRAMME 1

Title: Advances in Condensed Matter and Materials Physics
Venue: Lecture Venue SHB5, Solomon Mahlangu House Basement Level
Monday, 07 July 2025

09h00-10h20: Session 1

- 09h00 to 09h15: Opening of the Winter School
- 09h15 to 09h35: Vibrant field of Condensed Matter and Materials Physics (Dr. A Pandey, University of the Witwatersrand-South Africa)
- 09h35 to 10h20: Fascinations of semiconductor nanomaterials: Their extraordinary luminescence properties (Professor D D Sarma, Indian Institute of Science-India)

10h20-10h50: Morning Tea

10h50-12h20: Session 2

- 10h50 to 11h35: Brighter side of semiconductor nanocrystals: How to make defects useful (Professor D D Sarma, Indian Institute of Science-India)
- 11h35 to 12h20: Phosphor-converted white light-emitting diodes (Professor T Kroon, University of the Free State-South Africa)

12h35-13h45: Lunch (Main Dining Hall: Above Matrix)

14h00-15h30: Session 3

- 14h00 to 14h45: Energy materials: Landscape and devices (Professor D Wamwangi, University of the Witwatersrand-South Africa)
- 14h45 to 15h30: Neutron scattering investigations of exotic magnetic and topological materials (Professor J Lynn, National Institute of Standards and Technology-USA)

15h30-16h10: Group Photo & Afternoon Tea

16h10-17h00: Session 4:

- 16h10 to 16h50: Magnetism understood from ab initio theory (Professor B Sanyal, Uppsala University-Sweden)
- 16h50 to 17h00: Closing of the Winter School

WINTER SCHOOL PROGRAMME 2

Title: Introduction to Lattice Field Theory
Venue: Lecture Venue SHB1, Solomon Mahlangu House Basement Level
Monday, 07 July 2025

09h00-10h20: Session 1

- Introduction to Lattice Field Theory - Lecture 1; Speaker: Dr. Anosh Joseph

10h20-10h50: Morning Tea

10h50-12h30: Session 2

- Introduction to Lattice Field Theory - Lecture 2; Speaker: Dr. Anosh Joseph

12h35-13h45: Lunch (Main Dining Hall: Above Matrix)

13h50-15h40: Session 3

- Introduction to Lattice Field Theory - Tutorial 1; Tutorial Coordinator: Dr. Anosh Joseph

15h40-16h10: Afternoon Tea

16h10-17h00: Session 4

- Introduction to Lattice Field Theory - Lecture 3; Speaker: Dr. Anosh Joseph

WINTER SCHOOL PROGRAMME 3

Title: Celebrating our quantum past, and embracing its future
Venue: Lecture Venue SHB2, Solomon Mahlangu House Basement Level
Monday, 07 July 2025

Scientific Programme

09:00 Optical computing *Dr Isaac Nape (Wits)*

09:30 Quantum computing and quantum machine learning *Prof. Francesco Petruccione (SU)*

10:00 Quantum teleportation *Professor Thomas Konrad (UKZN)*

10:30-11:00 Morning Tea

11:00 Quantum device development at CPUT *Rory Pentz (CPUT)*
11:30 Quantum imaging *Professor Andrew Forbes (Wits)*
12:00 Quantum dots for spectroscopy *Dr Malik Khan (UniZulu)*

12:30-13:30 Lunch (Main Dining Hall: Above Matrix)

13:30 Quantum biology *Professor Tjaart Kruger (UP)*
14:00 Quantum research at the CSIR *Dr Kelvin Mpofu (CSIR)*
14:30 Quantum metrology with electrons *Professor Mark Blumenthal (UCT)*
15:00 South Africa's Quantum Technology Initiative (SA QuTI) *Jodie Watson (Wits)*
15:30 Closing remarks *Professor Andrew Forbes (Wits)*

15:40 Afternoon Tea

WINTER SCHOOL PROGRAMME 4

Title: Hands-on heavy-ion physics with the ALICE detector
Venue: Computer Aided Laboratory – CAL, School of Physics, 2nd Floor Physics Building
Facilitators: Zinhle Buthelezi, Isobel Kolbe
Monday, 07 July 2025

Scientific Programme

09h00-10h20: Session 1

- Fundamentals of particle physics, accelerators, the LHC, and the ALICE detector, Q&A

10h20-10h50: Morning Tea

10h50-11h40: Session 2

- Theoretical modelling of the QGP

12h35-13h45: Lunch (Main Dining Hall: Above Matrix)

13h50-15h40: Session 4

- Hands-on experimental measurement

15h40-16h10: Afternoon Tea

16h10-17h00: Session 5

- Plotting, results, discussion

WINTER SCHOOL PROGRAMME 5

Title: Applications of Machine Learning in Particle Physics
Venue: Lecture Venue SHB3, Solomon Mahlangu House Basement Level
Monday, 07 July 2025

Scientific Programme

09h00-10h20: Session 1 - Introduction to Particle Physics

This session will provide an accessible overview of the fundamental concepts and motivations of particle physics. It will cover the structure of the Standard Model, the role of high-energy colliders, and the main experimental and theoretical challenges currently driving the field. The session is designed to equip participants with the necessary background to appreciate how data-driven methods, including machine learning, can contribute to modern particle physics research.

10h20-10h50: Morning Tea

10h50-12h30: Session 2 - Introduction of Machine Learning

Participants will be introduced to the foundational principles of machine learning, including supervised and unsupervised learning, neural networks, and model evaluation. Emphasis will be placed on practical understanding, using examples that demonstrate how these tools can extract insights from large and complex datasets. This session aims to bridge the gap between traditional physics approaches and modern data science techniques.

12h35-13h45: Lunch (Main Dining Hall: Above Matrix)

13h50-15h40: Session 3 - Selected applications of Machine Learning in Particle Physics

This session will showcase specific use cases where machine learning has been successfully integrated into particle physics workflows. Topics may include particle identification, anomaly detection, fast simulation, and event classification. Real-world examples from current experiments will highlight the impact and potential of AI in advancing scientific discovery in high-energy physics.

15h40-16h10: Afternoon Tea

16h10-17h00: Session 4: Q&A session

An open-floor discussion where participants can ask questions related to the day's topics. This interactive session will allow for deeper exploration of specific concepts, clarification of technical content, and discussion of future directions for machine learning in particle physics. It also serves as a networking opportunity between students and domain experts.

PHYSICS FOR DEVELOPMENT AND INDUSTRY DAY 2025

Time	Item	Presenter
09:20- 09:25	Welcome	Professor Rudolph Erasmus
Session 1: Physics for Industry, Development & Improving Quality of Life		
09:25 – 09:40	Physics for Development and SAIP Activities Overview	Professor Rudolph Erasmus
09:40 – 10:00	Physics over the Bridge from Academia to Industry	Professor Alan Matthews
10:00 – 10:20	Physics-based technologies to optimise farming efficiency, sustainability, and resource management.	Dr Livhuwani Masevhe
10:20 – 10:50	**Morning Tea Break**	
10:50 – 11:10	Technology Transfer activities from the SA-CERN program	Professor Bruce Mellado
11:10 – 11:30	Ways of working with the industry in an engineering school	Professor Estelle Trengrove
Session 2: Shaping the Future:		
11:30 – 12:45	"Open discussion session featuring inputs from government departments and private sector representatives, exploring the role physics can play in enhancing service delivery—particularly through DDM Pillar 1: People Development—as well as innovations for industry and business."	All
12:45 – 13:00	Way Forward and Closing Remarks	
13:00 – 13:45	**Lunch** (Main Dining Hall: Above Matrix) **and Departure**	