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THE VOICE OF PHYSICS IN SOUTH AFRICA

UNIVERSITY OF ZULULAND
A NODE FOR AFRICAN THOUGHT

The 67th Annual Conference of the South African Institute of Physics (SAIP)

Transforming lives of our communities through Physics

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CONFERENCE PROCEEDINGS

Edited by Prof ARE Prinsloo

A NODE FOR AFRICAN THOUGHT

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EDITORIAL

The University of Zululand hosted the annual South African Institute of Physics (SAIP) conference during 2023. With the COVID-19 pandemic and the limitations associated with it something in the past, the University of Zululand decided to host an in person event. This was done with great success and the delegates commented on the professional running of the event, the wonderful food and the lovely surroundings near the coast. Some papers from this meeting are collected in this peer-reviewed volume. Submissions for the proceedings of SAIP2023 were handled by an Editorial Board headed by an Editor-in-Chief and Associate Editors responsible for submissions in different divisions.

The Editorial Board of the SAIP2023 Proceedings received 106 manuscripts for consideration by the advertised deadline. A total of 88 of these manuscripts met the relevant criteria and were submitted to a full peer-review process involving many individual reviewers. The list of the reviewer names are reflected elsewhere in the document and it is noted that certain reviewers took responsibility for more than one manuscript. The style of these proceedings is that of the (British) Institute of Physics Conference Series, similar to the styling used in previous SAIP Proceedings. Authors were requested to ensure that the defined layout were adhered to in their submitted pdf documents. In the past the review process was initiated with a layout review, followed by a content review. This year the Associate Editors conducted the layout review on each manuscript parallel with the content review. It was noted that there were small deviations between the layout templates available in MSWord and Latex - both of these formats were accepted by the Associate Editors. Manuscripts that deviated considerably from the specified layout specifications, while still broadly appropriate in their composition, were referred back to the authors for layout corrections. This was done together with the content reviews prepared by knowledgeable experts in each field, as well as considering Turnitin reports to ensure that the work is unique and not plagiarized. This year the Editorial Board again aimed to reduce the time between the submissions and publication, with the authors being informed of the outcome of their submissions before the closure for the December holiday and the publication of the document online shortly after that.

The publication of the SAIP Proceedings is highly dependent on the efficiency of the Associate Editors and the goodwill of reviewers from the scientific community in South Africa. The Editor-in-Chief wishes to acknowledge the hard work of the Associate Editors who spent much

time considering the papers and reviewer reports in order to ensure that acceptable academic standards were met during peer-review for the proceedings to be credible. The majority of the content reviews received were done with great care and diligence and to the highest standards. The Editorial Board wishes to voice their sincere thanks to the participating Reviewers for their pro bono work, specifically to those Reviewers that read more than one paper. The meticulous reviewing process described above has ensured that these proceedings contain thoroughly peer-reviewed manuscripts of a high professional standard, which report on novel work that has not been published elsewhere.

This year the Editorial Board again made use of the services of a Technical Associate Editor, Dr Bruno Letarte from NWU. He took responsibility for finalizing the complete document and ensured that it was of a high technical standard. The Editor-in-Chief wish to recognise Dr Letarte's enormous contribution in preparing the neat final document. The Editorial Board appreciate all the hours you dedicated into producing this exceptional document.

The Editor-in-Chief also wishes to recognise and thank Prof Strauss from NWU, Mr Mokhine from the SAIP office and Dr Ceboliyazakha Ndlangamandla from the University of Zululand for their support and help in preparing these proceedings.

Finally, the Editorial Board wishes to thank all of the authors for submitting their research work to this proceedings to undergo the rigorous review process. It is our sincere hope that the final product offered here constitutes a due outcome of their hard work.

MESSAGE FROM THE ORGANISERS

The Organizing Committee would like to take this opportunity to thank all the delegates and their valuable contributions towards the growth of Physics. We also like to convey our appreciation to the South African Institute of Physics (SAIP) for their crucial assistance in the preparation of the conference as well as the running of the conference. The University of Zululand Management under the leadership of Prof Xoliswa Mtose needs to be commended for its unwavering support to ensure that the 2023 SAIP conference is a success story. The reviewed conference proceedings are the consequences of a healthy organization as well as quality papers. The University of Zululand is inarguably and truly a 'Node of African Thought' as we move forward in transforming the lives of our communities through Physics.

LOC 2023

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Editor-in-chief:

– **Aletta Prinsloo** is a Professor of Physics in the Department of Physics at the University of Johannesburg. She is an NRF rated research physicist in the field of experimental solid state physics. Her research is focused on the magnetism of chromium-based bulk alloys, thin films and nanomaterials.

Associate Editors:

- **Physics of Condensed Matter and Materials**
  – **Charles Sheppard** is an Associate Professor and a member of the Cr Research Group in the Physics Department at the University of Johannesburg. His current research interest focuses on the various physical properties observed in bulk Cr alloys, Cr thin films, and chrome oxide magnetic nano-materials.

- **Nuclear, Particle, and Radiation Physics**
  – **Mukesh Kumar** is a Senior Lecturer of Physics in the School of Physics at the University of the Witwatersrand. He is an NRF Y-rated research physicist in the field of high energy particle physics. His research is focused on Higgs boson, top quark, and dark matter physics at the Large Hadron Collider (CERN) including the future $e^{-}p$ and $e^{+}e^{-}$ colliders. He is a member of TileCal Speaker committee for ATLAS detector at CERN.

- **Photonics**
  – **Pieter Neethling** is a Senior Lecturer in the Physics Department at Stellenbosch University. He is currently the Director of the Stellenbosch Photonics Institute at Stellenbosch University and the Chairman of the Photonics Division of the SAIP. His research focus is applied laser spectroscopy with applications in chemical and biological systems.

- **Astrophysics and Space Science**
  – **Eugene Engelbrecht** is a Professor of Physics at North-West University, whose research covers topics relevant to the transport of charged particles in turbulent astrophysical plasmas, including both theoretical and observational aspects pertaining to cosmic ray modulation, non-linear diffusion theories, and plasma turbulence.

- **Physics for Development, Education, and Outreach**
  – **Hartmut Winkler** is a Professor of Physics and former Head of the Department of Physics at the University of Johannesburg. He was a past recipient of the Vice-Chancellor Distinguished Teacher Award with an extensive teaching portfolio. His background is in astrophysics, where he has maintained an active interest in the study of the variability of Active Galactic Nuclei. More recently he has also diversified to solar energy research. He is a frequent media commentator on topics pertaining to energy and electricity.

- **Applied Physics**
  – **Thulani Hlatshwayo** is an associate Professor in the Department of Physics in the Faculty of Natural & Agricultural Sciences. His research is focussed on the understanding of the release of radioactive fission products from fuel in the modern nuclear reactors, where chemical vapour deposited (CVD)-SiC is the main barrier to fission products, and on finding alternative materials for nuclear waste storage. Professor Hlatshwayo recently received the Exceptional Young Researchers Award by the University of Pretoria. He is a PIs coordinator for SA-JINR projects in material research and nanoscience and is C2 NRF rated.

- **Theoretical and Computational Physics**
  – **W. A. Horowitz** is an Associate Professor of Physics at the University of Cape Town. Among other honours, Prof Horowitz has received the Claude Leon Merit Award for Early-Career Researchers and the Meiring Naudé Medal for Outstanding Early Career Contributions to Science from the Royal Society of South Africa. Prof Horowitz' research explores the non-trivial emergent many-body properties of the strong force using the methods of perturbative quantum field theory and the AdS/CFT correspondence.

- **Technical**
  – **Bruno Letarte** is a Senior Lecturer at the Centre for Space Research of the North-West University. He specialises in observational astronomy, photometry as well as spectroscopy, with his main interest in stellar astrophysics. He manages the optical telescope at the Nooitgedacht observatory, used to train undergraduate and postgraduate students. He is also the physics subject group leader, what other universities call head of department, on the Potchefstroom campus.

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