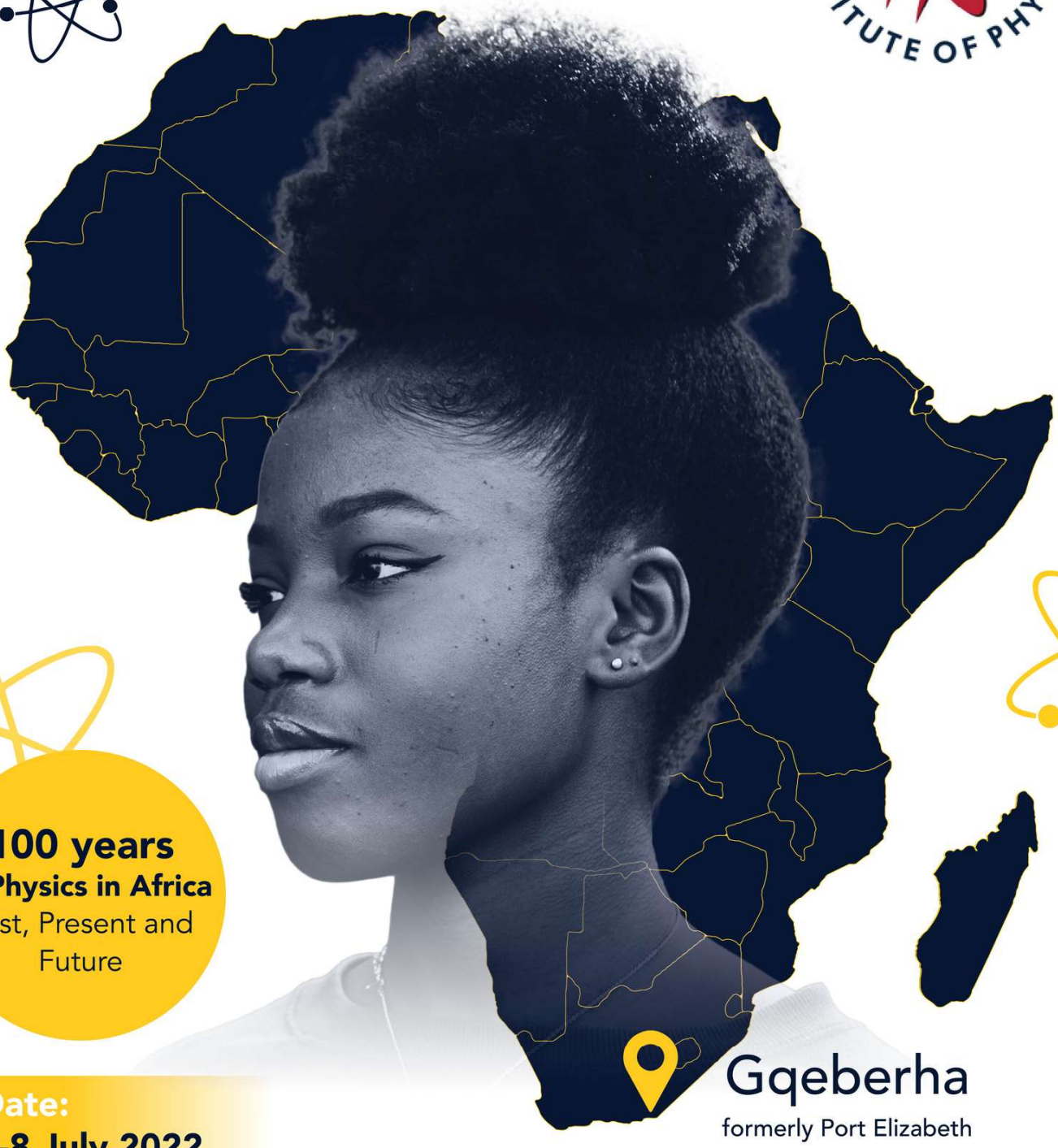
NELSON MANDELA UNIVERSITY

SOUTH AFRICAN INSTITUTE OF PHYSICS



100 years
of Physics in Africa
Past, Present and Future

Date:
4-8 July 2022

Gqeberha
formerly Port Elizabeth

Conference Proceedings

ANNUAL CONFERENCE OF THE SOUTH AFRICAN INSTITUTE OF PHYSICS (SAIP 2022)

Edited by Prof Aletta Prinsloo

PROCEEDINGS EDITOR-IN-CHIEF:
Prof Aletta Prinsloo, University of Johannesburg

PUBLISHER:
The South African Institute of Physics (SAIP)

The conference was hosted virtually by the Nelson Mandela University on 4–8 July 2022. The Proceedings of SAIP 2022, the 66th Annual Conference of the South African Institute of Physics, will be available electronically only on the SAIP website: `www.saip.org.za`.

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CONTENTS

EDITORIAL

Nelson Mandela University (NMU) hosted the annual South African Institute of Physics (SAIP) conference virtually during 2022. Despite the fact that many of the Covid-19 pandemic limitations were lifted, there were still many uncertainties and with interested parties hesitant to travel, NMU decided to rather run the 66th conference in the series of SAIP as a virtual event. This was done with great success and the delegates commented on the professional running of the online event. Some papers from this online meeting are collected in this peer-reviewed volume. Submissions for the proceedings of SAIP2022 were handled by an Editorial Board headed by an Editor-in-Chief and Associate Editors responsible for submissions in different subject tracks.

The Editorial Board of the SAIP2022 Proceedings received 120 manuscripts for consideration by the advertised deadline. A total of 106 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 in one step, together with the content reviews prepared by knowledgeable experts in each field. This year the Editorial Board 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 are 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 included a Technical Associate Editor, Dr Bruno Letarte from NWU. He took responsibility for finalising 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 Mr Jano Jonker from MNU for their support and help in preparing these proceedings.

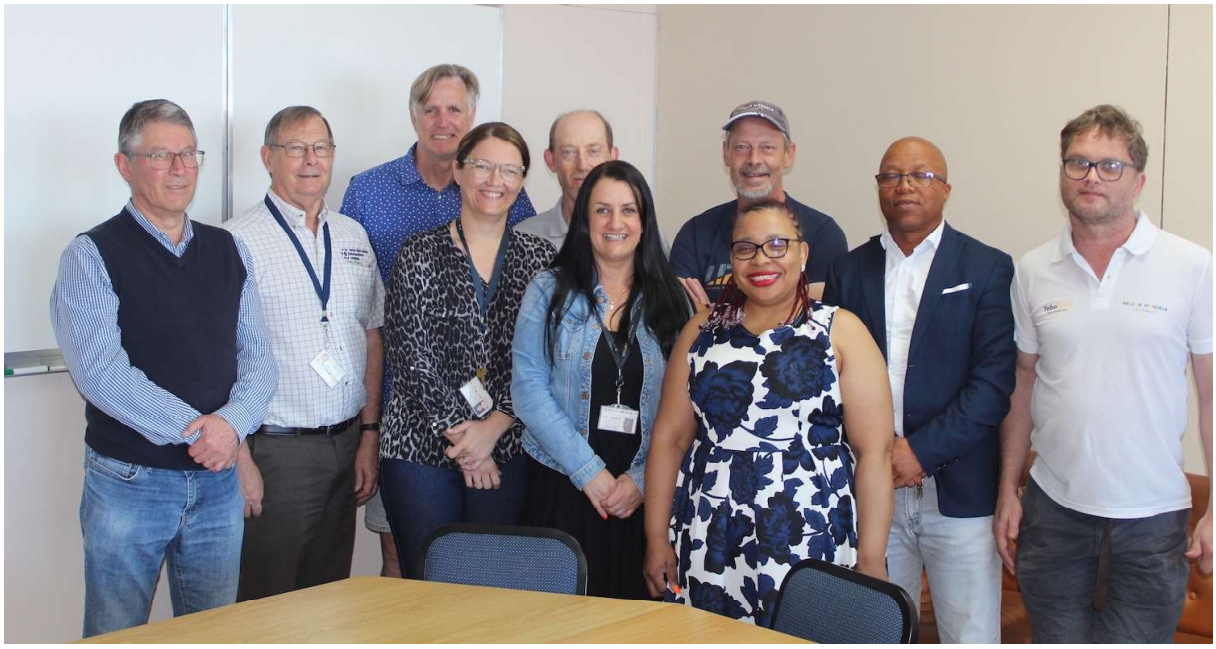
Finally, the Editorial Board wishes to thank all of the authors for submitting their research work to this proceedings to undergo the rigorous review process. It is our sincere hope that the final product offered here constitutes a due outcome of their hard work.

MESSAGE FROM THE ORGANISERS

The year 2022 is of great significance to the global physics community, being both the centenary of the International Union of Pure and Applied Physics (IUPAP 100) and also the International Year of Basic Sciences for Sustainable Development (IYBSSD 2022). As such, the 66th South African Institute of Physics Annual Conference aptly focused on "100 Years of Physics in Africa: Past, Present and Future". As the LOC (from Nelson Mandela University), we are privileged and proud to have been part of this historical event.

We would like to thank all participants, sponsors, editors and reviewers, without whom this conference would not have been possible. A special word of thanks to the plenary speakers for their willingness to give us their excellent lectures. Despite this conference being virtual (the last as such!), we as the LOC hope that it nevertheless contributed to the sense of community amongst physicists locally, and that it inspired the younger generation of physics students to persevere in their studies by showcasing the important role that physics plays in building a better and brighter future for all!

LOC 2022



From left to right at the back: Prof Ernest van Dyk, Prof Japie Engelbrecht, Prof André Venter, Mr Jano Jonker, Prof JR Botha, Mr Collin Bacela, Prof Tim Gibbon. Front row, from left to right: Dr Lindsay Westraadt, Ms Chanie Neveling, Dr Gretta Hashe.

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Editorial Team

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 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 Laser Research 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**
  – **Grace Phalwane** is a Dental Doctor and Health Professions Educationalist in the Department of Community Dentistry at the Sefako Makgatho Health Sciences University. Her research interest is focused on the Service Learning (SL), Problem-Based Learning (PBL) and Inter-Professional Education (IPE).

- **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.

– **Kittessa Roro** is the Principal Researcher & Research Group Leader for Energy Supply & Demand (ESD) Research Group (RG) within the Energy Centre at the Smart Places Cluster of the CSIR. He is C2 NRF rated researcher in the field of Energy, Renewable Energy, nanotechnology and solid-state Physics. The ESD RG underpins the Energy Centre work in solar, on- and off-shore wind, renewable energy production/supply forecasting, energy efficiency / demand response, and thermal energy optimisation inclusive of thermal energy efficiency, recovery, and storage. The group also research on techno-economic viability of emerging and existing approaches to energy supply and end-use efficiency to provide impartial advocacy to industry and consumers.

- **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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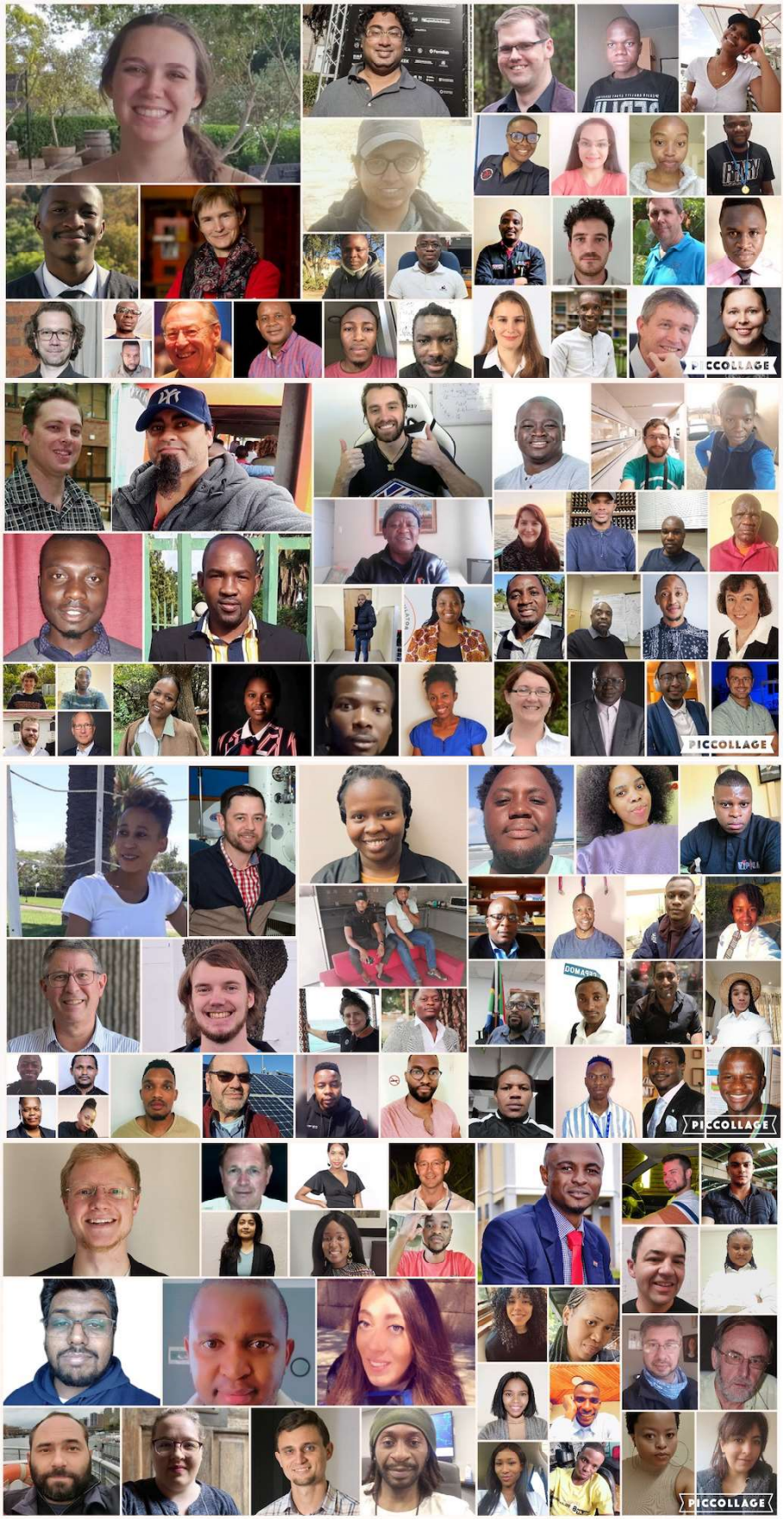
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