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COLLOQUIUM

Multi-messenger Pulsar Astronomy

Prof Christo Venter (North-West University)

DATE: Monday, 26 May 2025 | 16h00–17h00 SAST

VENUES:
- Neelsie Cinema, Stellenbosch University
- Online

--- A recording of the talk will be published on the NITheCS YouTube channel afterwards ---

ABSTRACT

Pulsars are extremely dense, highly magnetic, rapidly spinning remnants of massive stars. They emit radiation across the electromagnetic spectrum and blow winds of relativistic particles. Recent advances in multi-messenger astronomy combine photons, gravitational waves, neutrinos, and cosmic rays and open new windows on these enigmatic systems. Very-high energy pulsations, broadband spectra, and polarimetric signals of pulsars are revealing new aspects of their emission. Many young pulsars are surrounded by pulsar wind nebulae (PWNe) – bubbles of energetic particles and magnetic fields – which reveal complex morphologies, polarised light, and extreme particle acceleration. Some pulsars are embedded in large TeV halos that may help explain the puzzling cosmic-ray positron excess detected near Earth. Pulsars, particularly in dense star clusters called globular clusters, may also account for part of the excess in GeV photons seen toward the centre of the Milky Way. Spider binaries contain neutron stars that gradually evaporate their companions and form intrabinary shocks, offering unique insights into pulsar evolution. When PWNe interact with nearby molecular clouds, they may produce neutrinos - ghost-like particles that pass through matter almost undisturbed. The future is bright as we enter a new era of pulsar research, with observatories like the Square Kilometre Array (SKA), Cherenkov Telescope Array (CTA), IceCube-Gen2, and upcoming X-ray polarimeters set to making key contributions to the field.

BIOGRAPHY

Christo joined the Centre for Space Research at the North-West University (NWU) in 2002 as a graduate student. After completing his PhD in 2008, he received a NASA Postdoctoral Program Fellowship and spent 2009 at the Goddard Space Flight Center in Maryland, USA. His academic roles at NWU include 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's research focuses on modelling pulsars and pulsar-like systems. He has contributed to the High Energy Stereoscopic System (H.E.S.S.) in Namibia, the *Fermi* Large Area Telescope (LAT), and the next-generation Cherenkov Telescope Array (CTA). Recently, he has added radio astronomy to his portfolio and has been the principal investigator for four Open Time Proposals on the MeerKAT radio telescope. The NRF awarded him a B1 rating (2024–2030).

He has co-authored 33 peer-reviewed papers, 37 peer-reviewed proceedings, 29 conference articles, 214 H.E.S.S., 25 *Fermi* LAT, and 4 MeerKAT papers. Christo has presented at numerous conferences, including 13 plenary talks. He has supervised 11 Honours projects, 9 MSc students (2 ongoing), 5 PhD students (3 ongoing), and 3 postdocs (2 ongoing). He aims to continue research in the lively field of multi-messenger astronomy, including the use of data from H.E.S.S., *Fermi*, CTA, *Chandra*, *NICER*, MeerKAT, and SKA.

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