NITheCS Colloquium

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National Institute for Theoretical and Computational Sciences

On the quest for reliable measurements of Cosmic Dawn

Dr Steven Murray (Stellenbosch University)

DATE: Monday, 20 April 2026 | 16h00–17h00 SAST

VENUES:

- **Stellenbosch University:** Neelsie Cinema
- **University of the Witwatersrand**: Room P215, 2nd Floor, Physics Building
- **North-West University:** Seminar Room K310, Physics Building G5
- **Online**

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

ABSTRACT

For decades radio astronomers have exploited a curious property of neutral hydrogen (HI) atoms – that they on very very rare occasion spontaneously emit radiation at a wavelength of 21cm – to make discoveries about both our own Galaxy and other galaxies. The grandest goal of 21cm observations however concerns not our local universe but the very early universe – the first billion years, in which the very first stars were born and died, defining "Cosmic Dawn". At these times, HI gas dominated the Universe – not only within galaxies but throughout the entire cosmic web – providing an opportunity for 21cm observations to fully map the growth of cosmic structure over this vast epoch, and what's more, an opportunity *unique* to 21cm observations. This grand goal lies at the heart of the inception and development of the SKA, and has generated many "precursor" experiments, including HERA in South Africa, in order to understand the challenges of such a measurement so that we are prepared when the SKA obtains first light. The challenges unveiled by the precursors are not for the faint of heart, and only seem to grow as we dig deeper. Most pernicious is that the signal we seek can be mimicked by the way the instrument interacts with and distorts signals from our own Galaxy. If this is so, how will we ever trust a future measurement of Cosmic Dawn?

In this talk, I will chart a course through these issues, illuminating how the HERA experiment has strategised towards reliability through massive simulations, and touch on some of the technical advancements that have been required to make this possible.

BIOGRAPHY

Steven Murray is a Senior Lecturer in the Physics Department at Stellenbosch University. After obtaining his PhD at the University of Western Australia on cosmological structure formation, he joined the MWA EoR research team at Curtin University (Perth) as a postdoc in 2015. He moved to Arizona State University in 2018, and joined both the HERA and EDGES 21cm experiments, focusing on developing software pipelines and analysis validation techniques, as well as improving the physical inference infrastructure. In 2023 he took up a Marie Curie fellowship at the Scuola Normale Superiore in Pisa, Italy, where he worked on forward models of 21cm observations, before joining Stellenbosch in 2025.

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