Exploring the early Universe with Radio Telescopes

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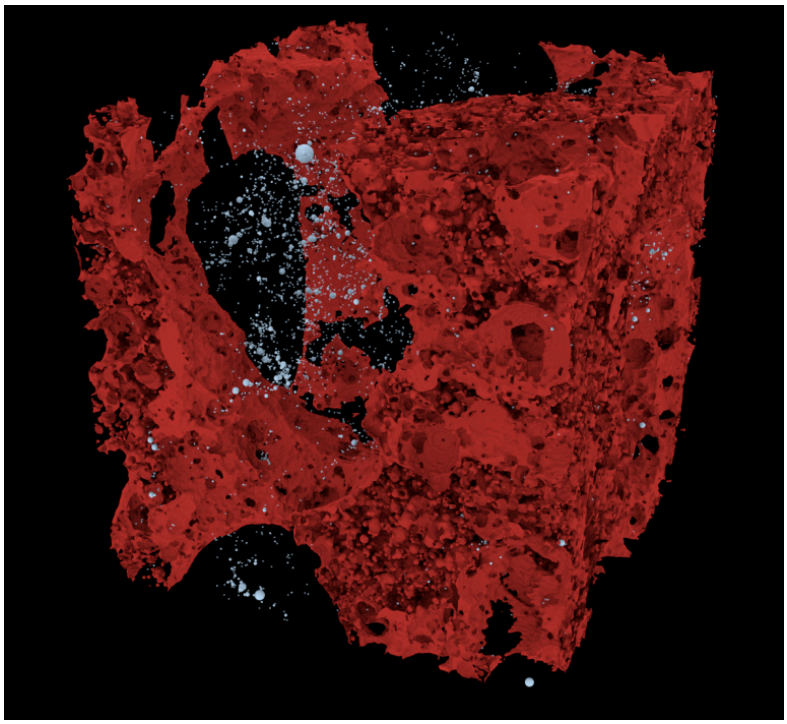
Overview: The Murchison Widefield Array telescope, and future SKA-Low telescope will explore primordial hydrogen from the early Universe to learn about the nature of the first generations of stars and galaxies. This precision experiment requires the connection of the key astrophysics to the expected radio signal and the telescope data. Low-frequency radio telescopes are complicated instruments, and the observational strategy and experimental details can have a large impact on the astrophysical interpretation. This project will span the Curtin and ANU research groups for the most sophisticated simulations and modelling tools.

Aims: This project will harness the latest set of high resolution and complete simulations of the early Universe, combined with an in-house telescope simulation tool, to understand how to interpret our data from the current MWA and upcoming SKA experiments. It will particularly focus on biases in the astrophysical interpretation introduced by choices in observational setup and methodology.

Key objectives are:
- Connect sophisticated DRAGONS simulations of the early Universe with the WODEN and OSKAR simulation tool to produce realistic MWA and SKA datasets
- Infer astrophysical parameters (e.g., properties of x-rays produced by the first stars; minimum galaxy mass that can produce stars) from simulated data and explore parameter biases from different observational choices
- Define a set of minimally-biased observations from which astrophysical parameters can be estimated.

Internship opportunities: This project has the potential for a research internship with SKAO.



Example volume of the Universe about 1 billion years after the Big Bang from the DRAGONS simulation showing ionisation fronts and neutral hydrogen gas. Credit: Paul Geil, Simon Mutch