HI absorption in high-z radio galaxies

Research Field
Radio Astronomy

Project Suitability
Summer / Winter
3rd Year
Honours

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Before the very first galaxies formed, the Universe was a sea of hydrogen and helium, gently cooling and collapsing. When the first galaxies formed, they ionised the surrounding gas, turning it from an opaque absorbing cloud into the transparent, ionised plasma we see today: this time is called the Epoch of Reionisation.

This change will have occurred at different rates in different locations in the Universe (Figure 1). When we look at high-redshift galaxies which emit in the radio spectrum, any neutral hydrogen along the line-of-sight will absorb the characteristic HI line at that redshift. For the highest-redshift galaxies, this HI line is shifted from 1.4GHz down to ~200MHz. This is within the frequency range of the Murchison Widefield Array, a radio telescope operated by Curtin University and based in the Murchison Radio Observatory.

This project aims to detect HI absorption in high-redshift radio galaxies using the MWA. We have developed a pipeline to efficiently process data and search for lines. An example spectrum produced after running the pipeline is shown in Figure 2. There are hundreds of hours of data already taken on several targets and fields which would be suitable for this search. A detection would be a world-first and have huge scientific impact. Applying the pipeline to wide survey fields would pathfind toward similar studies with SKA_LOW.

Aims of the project:

i. Process existing data through the spectral line pipeline and search the resulting data cubes for HI absorption;
ii. Use detections or limits to understand the environment of the target radio galaxies;
iii. (Honours-only) Search fields for lines in survey fields to blindly detect high-*z* galaxies.

This project is well suited to a student with an interest in astrophysics and astronomy, and excellent computing and organisational skills.

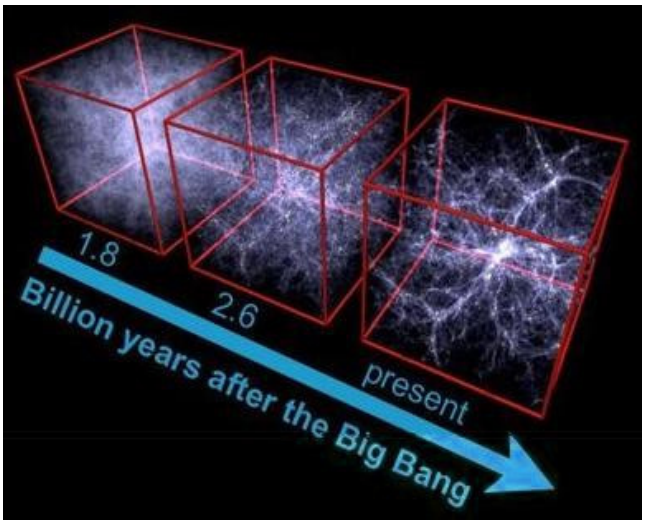

Figure 1 The Universe ionises, transforming from a sea of opaque hydrogen into the complex structures we see today.

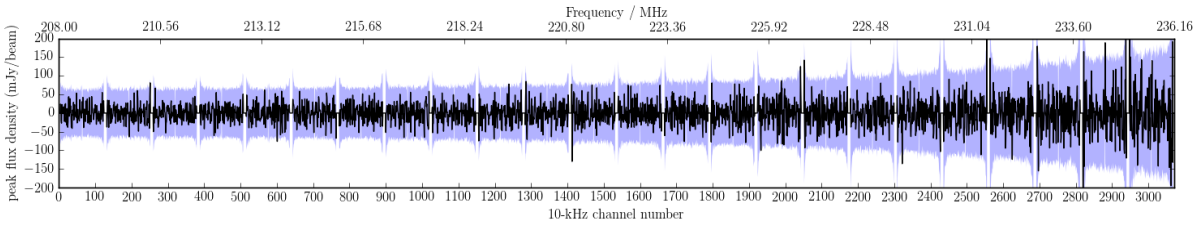

Figure 2 Spectrum produced for a high-redshift radio galaxy from several hours of data processed through the existing pipeline. The black lines indicate the value at the target, and the blue shading indicates 3x the noise level in each channel.