

Project Title: Studying the Evolution of HI from $z=0-0.5$ with CHILES

Level: PhD project

Supervisor: SRAO SARChI chair, Renée Kraan-Korteweg (kraan@ast.uct.ac.za), D.J. Pisano (djpisano@mail.wvu.edu), Sarah Blyth (blyth@ast.uct.ac.za)

Requirement: MSc in astronomy or closely-related field

Description:

The COSMOS HI Large Extragalactic Survey (CHILES) is a 1000-hour survey with the Very Large Array (VLA) capable of detecting neutral atomic hydrogen (HI) from galaxies similar to the Milky Way from $z=0-0.5$. The observed field spans a wide range of environments from voids to filaments and isolated galaxies to dense galaxy groups. CHILES provides the first look at how time and environment affect the properties and evolution of galaxies over the past 5 billion years. It further serves as a pathfinder survey and independent confirmation on the results from the LADUMA (Looking At the Distant Universe with the MeerKAT Array) survey.

The first data cubes from the 1000-hour dataset are due to be available later in 2021 and be released in 2022. However, the initial data reduction of CHILES reveals that the effects of residual radio frequency interference (RFI) remain problematic for the survey. To maximize the scientific return of CHILES and to enable detections of the faintest sources at the highest redshifts, we will need to re-reduce the CHILES data and re-image it using what we have learned from the initial reduction. This is particularly important as the RFI environment around the world continues to degrade with more sources of RFI being present on the ground, in the air, and from satellites in space such that CHILES may provide the only view of HI at some redshifts.

This project will see the student reprocess the 1000-hour CHILES data using the lessons learned from the initial reduction and including some of the techniques being used by other surveys, as necessary. The student will help to produce a final CHILES cube that will be used for studies of HI evolution over cosmic time and across various environments.

Detailed Requirements: Students should have familiarity with programming in Python (or similar languages) and some familiarity with processing radio astronomy data in CASA.

Further Reading: Fernandez et al. 2013, ApJ, 770, L29; Fernandez et al. 2016, ApJ, 824, L1; Hess et al. 2019, MNRAS, 484, 2234; Blue Bird et al. 2020, 492, 153