UCT MSc Project

Deep HI Mapping of the Halo of Andromeda

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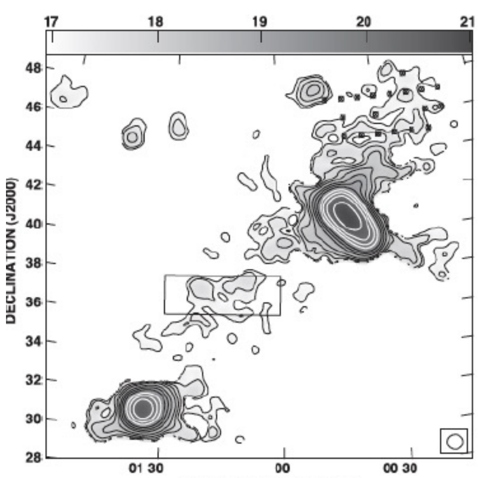
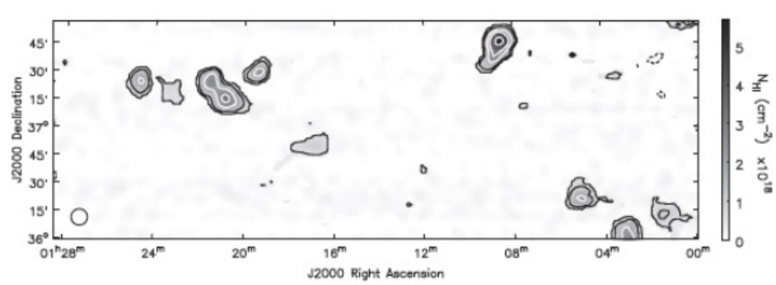
Background:

The Andromeda Galaxy (M31) is the closest, large spiral galaxy to the Milky Way, and so we can study it and its surroundings with unprecedented sensitivity and resolution. As such, it is the ideal target for a detailed study of the circumgalactic medium (CGM) of an analog to the Milky Way. An understanding of the CGM is essential as it is the region where gas flows onto and out of the galaxy. If we are to understand how galaxies, like the Milky Way, obtain their gas, we must understand their CGM. Theory suggests that galaxies accrete their gas through two types of accretion: hot and cold. Hot accretion involves gas falling into the dark matter halo, being shock-heated to the virial temperature of the halo, and then slowly cooling onto the disk of the galaxy in a quasi-spherical manner. This mode of accretion is predicted to be dominant for higher mass galaxies in the present day. On the other hand, cold mode accretion involves gas remaining at relatively cooler temperatures as it enters the dark matter halo and falling directly onto the disk of a galaxy along filamentary structures. This process should be the dominant accretion process in the early universe and for low mass galaxies in lower density environments. In 2004, Braun & Thilker (BT04) discovered a faint bridge of neutral atomic hydrogen (Hi) that appears to connect M 31 and M 33 (see figure left below). This filamentary structure appears to be evidence of putative cold mode accretion. Wolfe et al. (2013, 2016) used the Green Bank Telescope (GBT) to make higher resolution observations of a 12 square degree section of this filament to reveal that it is not a simple, smooth structure, but is comprised of clumps of HI (see figure right showing the boxed region from the left panel).





Unfortunately, the Wolfe et al. maps only cover a small region of the BT04 filament. While we have observed an additional 50 square degrees along this filament both south and north of M31.

Aims:

For this project, the student will process these existing GBT data to make the most complete map of the CGM of M31 to date. Additional, if time is granted, the student will have the opportunity to reduce and analyse high resolution MeerKAT observations of one of the clouds in the CGM of M31. The resulting data will allow for a complete catalog of HI clouds along the filamentary structure and a more detailed understanding of how the HI is interacting with the surrounding hot CGM. At the end of this project, we should have a better idea of the origin and fate of the HI surrounding M31.