Stacking Neutral Hydrogen in the Cosmic Web with ALPACA

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We are requesting 30 hours of GBT time, using ALPACA, to map an 18 square degree region to stack the neutral hydrogen signal from the cosmic web. We have identified the large-scale structure in the region we propose to map using spectroscopic redshifts from the Sloan Digital Sky Survey as inputs, and the Discrete Persistent Source Extractor (DisPerSE) to define the filaments. GBT observations using ALPACA will allow us to map this a large area relatively quickly, while achieving a 1-sigma column density sensitivity of 3.5×10^{17} cm^{-2} over a 303 kHz channel. We can then use the identification of the large-scale structure by DisPerSE to stack spectra taken over filaments from the entire 18 square degree region. This procedure will produce a stacked 1-sigma column density sensitivity of 7×10^{15} cm^{-2} over a 303 kHz channel. A detection would be a direct measurement of the average neutral hydrogen mass within filaments, and a non-detection would be an upper limit on the column density sensitivity needed. The use of the 40 simultaneous beams of ALPACA allow this observation to be possible using only 30 hours of observing, rather than the approximately 1000 hours of observing it would take using the single pixel receiver.

Baryons in the Merian 800 square degree survey

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Dwarf galaxies make up a considerably unconstrained region in fundamental galaxy relations and properties. Galaxies with stellar masses of 1×10^8 – 1×10^9 M_{sun} exhibit diverse star formation rates and rotation curves, which have thus far been at odds with theoretical models. For this reason, is it important to characterize the baryonic processes in dwarf galaxies.

We propose to spend 800 hours on ALPACA to observe 800 square degrees of the sky overlapping the Merian project footprint, which aims to characterize the dark matter, feedback, and black holes in star forming dwarf galaxies. The ongoing Merian survey will sample 100,000 dwarf galaxies ($M^* \sim 1 \times 10^8$ – 1×10^9 M_{sun}) at $0.058 < z < 0.1$ with the Blanco telescope in Chile. Prior to ALPACA, the single pixel GBT L-band beam would have mapped this region to our mass limits in 12,000 hours. We will reach ~ 9 mK over the full 800 square degrees in 800 hours on ALPACA. This survey will complement and complete the characterization of the dark matter distribution and baryonic processes in these dwarf galaxies, and will be compared to hydrodynamical simulations to better understand the formation and evolution of dwarf galaxies.