DACOTA: The Dense Array for Cosmological Transitions

David R DeBoer[1], Geoffrey C. Bower[1], Garrett Keating[1], Richard Plambeck[1], Tzu-Ching Chang[2], Paul T.P. Ho[2], Daniel Marrone[3], and Anthony Readhead[4]

[1] University of California, Berkeley, CA USA
[2] Academica Sinica Institute for Astronomy and Astrophysics, Taipei, Taiwan
[3] University of Arizona, Tucson, AZ USA
[4] California Institute of Technology, Pasadena, CA USA

The Epoch of Reionization (EoR) heralded the advent of the Universe we recognize today, containing stars, galaxies and super-massive black holes. A number of experiments to detect the red-shifted hydrogen signature of the atomic component of the intergalactic medium (IGM) are on-going (*e.g.* PAPER, MWA, LOFAR). Due to the faintness of the signal, the bright foregrounds, and the challenge of instrumental systematics, multiple techniques are essential to create a more robust detection and to provide the complete picture on the evolution of early galaxies.

We discuss here a proposed experiment to detect red-shifted molecular lines from the galaxies that drive the reionization. These low mass galaxies are too faint to be detected individually with telescopes such as ALMA and EVLA. Instead, we propose the use of "intensity mapping," the technique in which numerous galaxies are detected simultaneously through low resolution mapping. Theories predict a signature for carbon monoxide (CO) of approximately 1 microKelvin in a velocity bin of 300 km/s from redshift $z \sim 6$. Images of CO will form the negative of the HI signature at the EoR with bright regions of molecular emission where there are voids in the HI intensity. Initial experimental approaches to this problem will focus on power-spectrum detection before performing imaging observations. Currently we are analyzing data from the Sunyaev-Zeldovich Array (SZA) to develop the technique and derive upper bounds.

DACOTA, the Dense Array for Cosmological Transitions, is a small array designed to yield a detection or robust upper bound in a small range of spatial mode k-values of ensembles of galaxies by looking at the J=1-0 and J=2-1 transitions of CO. Cross-correlation between two spectral transitions is a powerful technique for rejecting systematic errors. The first phase of DACOTA will use the Academica-Sinica Institute for Astronomy and Astrophysics AMIBA telescope at 3 mm with a new digital correlator, then transition to 1 cm observations. AMIBA has $N = 13$ close-packed elements on a tiltable and rotatable mount, which allows coherent k-mode integration on the sky, reducing the needed integration time by a factor of $\sim N$. In 1000 hours we expect to achieve a power-spectrum sensitivity of $< 0.5\mu\text{K}^2$ at $k \approx 0.1$ Mpc^{-1}. A second platform with a full three-axis mount is being designed for the 2-cm band. The next phase of DACOTA would replicate the three-axis mount for both bands to achieve the sensitivity to detect and characterize the epoch of reionization.

978-1-4673-4778-5/13/$31.00