

EQUIPPING THE VLA FOR VHF OPERATION TO MAP HI
STRUCTURES PRESENT DURING THE EPOCH OF REION-
IZATION

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We report on a program proposed by the SAO to equip the NRAO Very Large Array with VHF receivers (170-200 MHz) to enable detection of neutral Hydrogen at the end of the cosmological epoch of reionization (EOR).

The structure and evolution of the universe during the EOR are essentially unknown. Analyses of Cosmic Microwave Background (CMB) temperature and polarization fluctuations detected with WMAP have been used to infer reionization began between redshifts 11 and 30 (Kogut et al., *ApJS*, **148**, 161, 2003), while Ly α absorption in the optical spectra of quasars have been used to argue reionization was largely complete at redshift $z \sim 6.2$. What occurred in between is uncertain, and the history of reionization may have been complex, with multiple peaks (e.g., Wyithe Loeb *Nature*, **427**, 815, 2004).

With VLA VHF receivers, it may be possible to detect and image HI emission from shells of warm material surrounding the many-Mpc-scale HII bubbles ionized by quasars. There are three quasars known from the Sloan sky survey that are believed to lie “within” the EOR ($z \sim 6.2 - 6.4$). Detection would enable estimation of fundamental quantities, e.g., the neutral fraction of the universe, state of the IGM – warm or cold, anisotropy of emission, and quasar ages or formation time after cosmological recombination. Overall, hard estimates would provide much needed constraint for cosmological theory. In addition to direct imaging of structure, the deep integrations used to detect cosmological HII bubbles may also be used to describe the statistics of weak HI brightness fluctuations, much as has done in experiments to measure CMB fluctuations once foreground sources have been subtracted, and to further constrain theory.

The planned SAO VHF system leverages past investments in VLA hardware and software to achieve “first science” in short order (2005) and at lower cost than the other, larger facilities that are in the works (e.g., MWA, PAST). Little is known about the EOR from observations. First detection of an EOR signal with the VLA will have a high (scientific) impact, and it will be helpful in guiding development and operation of the later facilities.

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