32nd URSI GASS, Montreal, 19–26 August 2017

Full-Sky Maps of the VHF Radio Sky with the Owens Valley Long Wavelength Array

Michael W. Eastwood*(1), Gregg Hallinan(1)
(1) California Institute of Technology, 1200 E California Blvd, Pasadena, CA 91125

1 Extended Abstract

Low-frequency radio telescopes are opening up a window into the cosmic dawn of the universe, where the first stars and galaxies bathed the universe in light, and the epoch of reionization. During this time, the hyperfine transition of neutral hydrogen is measurable as a 10-100 mK perturbation in the spectrum of the cosmic background radiation [1]. Many low-frequency radio telescopes are attempting to detect this faint signature of highly redshifted neutral hydrogen (eg. HERA, MWA, LOFAR, SKA). However these measurements are primarily limited by the dynamic range they can achieve against low-redshift sources of low-frequency radio emission (ie. galactic synchrotron emission and AGN). Efforts to model the foreground contamination in these experiments are limited by the availability of suitable foreground maps at frequencies below 408 MHz [2].

The Owens Valley Long Wavelength Array (OVRO LWA) is a low-frequency (25 to 82 MHz) interferometer located at the Owens Valley Radio Observatory (OVRO). The OVRO LWA is composed of 288 antennas spanning 1.5 km, with 251 of those antennas located within a dense core that is 200 meters in diameter. This configuration ensures that the OVRO LWA is sensitive to diffuse galactic emission and point sources. I will present high-fidelity full-sky multi-frequency maps of the VHF radio sky captured from 100 hours of data from the OVRO LWA, and imaged using *m*-mode analysis [3]. *m*-mode analysis is a new technique for transit telescopes that greatly reduces the processing time to generate synthesis images of the entire sky with exact incorporation of widefield effects. Figure 1 is a preliminary example of these maps. This work will facilitate careful modeling of foreground contamination in current and future generations of 21 cm cosmology experiments.

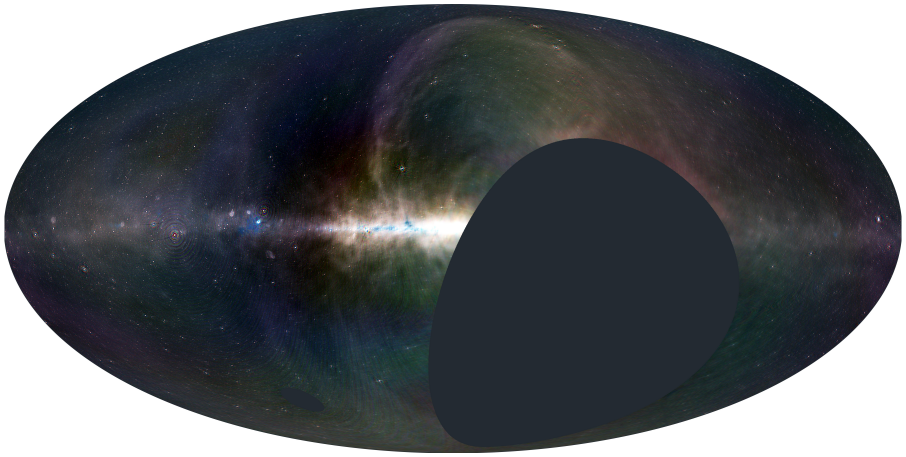

Figure 1. A Molleweide projected map of the VHF radio sky generated using *m*-mode analysis and 100 hours of data from the OVRO LWA. This image is generated by combining three monochromatic maps: 41.760 MHz (red), 57.456 MHz (green), and 73.152 MHz (blue). The dark hole in the lower right corresponds is the patch of the southern sky that is never visible from the Owens Valley, which is located at a latitude of 37° N.

References

[1] J. R. Pritchard and A. Loeb, "21 cm cosmology in the 21st century," *Reports on Progress in Physics*, vol. 75, no. 8, p. 086901, Aug. 2012.

[2] A. de Oliveira-Costa, M. Tegmark, B. M. Gaensler, J. Jonas, T. L. Landecker, and P. Reich, "A model of diffuse Galactic radio emission from 10 MHz to 100 GHz," *MNRAS*, vol. 388, pp. 247–260, Jul. 2008.

[3] J. R. Shaw, K. Sigurdson, U.-L. Pen, A. Stebbins, and M. Sitwell, "All-sky Interferometry with Spherical Harmonic Transit Telescopes," *ApJ*, vol. 781, p. 57, Feb. 2014.