MODELLING THE GALACTIC FOREGROUND AND BEAM CHROMATICITIES FOR LUNAR-BASED GLOBAL 21-CM EXPERIMENTS. Joshua J. Hibbard¹, Jack O. Burns¹, David Rapetti^{1,2,3}, Keith Tauscher¹, and Neil Bassett¹. ¹University of Colorado Boulder, Boulder, CO; ²NASA Ames Research Center, Moffett Field, CA; ³Universities Space Research Association, Mountain View, CA.

Introduction: The lunar farside offers the unique advantage of a radio-quiet environment to make exquisitely sensitive measurements of the early Universe, including measuring the cosmological Dark Ages global 21-cm signal at unprecedented redshifts of z ~ 50-100. In particular, the latter will allow for precision testing of the standard cosmological model predictions for the early Universe, a parameter space that has yet to be explored, and indeed, which remains inaccessible to current ground-based observational approaches due to the abundance of radio frequency interference, plasma noise, and limitations imposed by the ionosphere [1]. The Dark Ages Polarimeter PathfindER (DAPPER) is a NASA-funded concept designed specifically to take advantage of this lunar environment to measure the global 21-cm signal and investigate these currently unexplored epochs of the Universe.

The Galactic Foreground: Of all challenges arrayed against global 21-cm experiments, the problem of modelling the diffuse galactic foreground at lowfrequencies remains one of the most singular. It is bright, dynamic, and ubiquitous (Figure 1), being 4-6 orders of magnitude larger than the predicted cosmological signal. Furthermore, the chromatic distortions of the antennas employed for these measurements must also be accurately modelled to reduce systematic uncertainties and produce accurate milli-Kelvin constraints.

To characterize and model this low-frequency, diffuse radio emission of the galactic beam-weighted foreground, we present an analysis combining analytical and observational models of both the spectral index and sky brightness temperature with simulations of beams having various angular and spectral dependencies (anisotropy and chromaticity). Each combination (spectral index model, sky temperature map, and beam) creates a unique beam-weighted foreground. Using Singular Value Decomposition, we form optimal basis vectors to fit every unique realization of each beam-weighted foreground model. This allows us to examine the effect on these eigenmodes as we vary the beam-weighted foreground and to then directly compare these optimal bases.

In conclusion, by leveraging the unique environment of the lunar farside with the measurement capabilities of DAPPER, it will be possible to extract the global 21-cm signal using a robust model of the fore-



log(Temperature) map [2].

ground that combines analytical and observational models with beam simulations.

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