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Investigating Low Frequency Foregrounds with PSP/FIELDS

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Characterizing foregrounds at low radio frequencies is of interest for a number of astronomical fields. In particular, precise knowledge of astrophysical foregrounds is relevant for cosmological experiments attempting to measure radiation produced by the 21-cm transition of neutral hydrogen that has been redshifted to frequencies of ~1-200 MHz. Complicating a complete study of foreground emission over this frequency band is the difficulty of performing observation below ~30 MHz from the ground due to ionospheric contamination. However, space-based instruments residing above Earth's ionosphere are free of this complication.

Several studies of the foreground below 30 MHz have been conducted using data from space-based instruments including Manning & Dulk [1], which used data from the WIND spacecraft to show that the location of maximum sky brightness shifts from the plane of the galaxy at 10 MHz and above to the galactic poles at 1 MHz due to free-free absorption.

In this presentation we describe how we have utilized spectral data from the FIELDS instrument [2] on board the Parker Solar Probe to investigate the foregrounds at frequencies from 1-19 MHz. The FIELDS instrument consists of four nearly orthogonal monopole antenna which protrude from behind the PSP heat shield perpendicular to the body of the spacecraft. While generally pointed at the Sun, the spacecraft occasionally performs "coning roll" maneuvers, in which the spacecraft is pointed off the Sun and the antennas sweep across the sky. The FIELDS data taken during these coning rolls exhibits are periodic modulation corresponding to the period of the roll due to the pointing of the antenna relative to the galactic emission. Binning the data according to the phase of the roll reveals the periodic shape more clearly.

Ultimately, we can infer information about physical parameters of the galactic emission such as the spatial distributions of the spectral index and the free-free absorption component by performing model fits to the phase binned FIELDS data. Using a Markov chain Monte Carlo analysis, we explore the full distributions of these parameters and their covariances. The information gleaned from this study will be extremely useful for characterizing foreground systematics for future space-based low frequency experiments.

1. R. Manning and G. Dulk, "The Galactic Background Radiation from 0.2 to 13.8 MHz," *Astronomy & Astrophysics*, **372**, June 2001, pp. 663-666, doi: 10.1051/0004-6361:20010516

2. S. Bale et al. "The FIELDS Instrument Suite for Solar Probe Plus," *Space Science Reviews*, **204**, December 2016, pp. 49-82, doi: 10.1007/s11214-016-0244-5