Using SunRISE as a Pathfinder for Detecting Low Frequency Radio Emission from Extrasolar Planets with Space Based Radio Arrays

Alexander M. Hegedus[(1)], Justin C. Kasper[(1)], Joseph Lazio[(2)], Andrew Romero-Wolf[(2)], and Timothy S. Bastian[(3)]

(1) Climate and Space Sciences and Engineering, University of Michigan, Ann Arbor, MI

(2) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

(3) National Radio Astronomy Observatory, Charlottesville, VA

Synthetic aperture interferometers in space operating above the Earth's ionosphere could open a new window to study the physical processes previously blocked for ground-based radio arrays. One possible target for such an array is low frequency (0.1 – 25 MHz) radio emission of extrasolar planets, generated by electron cyclotron masers in their magnetic polar regions. Current estimates of the signal strength for such emission predict flux densities several orders of magnitude below the Galactic noise floor. Detecting these emissions would necessitate an array with a large collecting area. Such a large array would be the first of its kind due to the technological and data processing challenges posed in recording and analyzing the data. A smaller, cheaper array with a stronger signal target would lay the groundwork for such an array. The Sun Radio Interferometer Space Experiment (SunRISE) is a NASA Heliophysics Mission of Opportunity mission in Phase A that intends to do just this.

SunRISE would be made up of 6 CubeSats in GEO graveyard orbit for which the primary target is Solar Radio Type II and III bursts. These are the brightest radio sources in the sky when they occur, with a signal above the Galactic noise floor, making them a good first target for a space-based array. The antenna aboard the spacecraft will be electrically short for its observing range of 0.1 – 25 MHz and thus have a nearly isotropic response pattern, allowing the array to see nearly the entire sky at all times. Jupiter is planned to be a calibration target for SunRISE because of its periodic, high intensity radio emission. We know where Jupiter is ahead of time, so observing radio emission from its true position can verify that the data processing pipeline of SunRISE is correct. In addition to Jupiter, SunRISE has plans for a student collaboration in which University of Michigan undergraduates will undertake a project to rephase the array toward Saturn, Uranus, and Neptune as a demonstration of the concept of remote sensing of planetary magnetic fields. The data processing and science analysis required for SunRISE will be comparable to that of a larger array searching for similar emission from extrasolar planets. In this paper we describe these data processing and science analysis pipelines for SunRISE and discuss the scaling up that would have to be done in order to see low frequency radio emission from extrasolar planets.

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