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The Sun Radio Imaging Space Experiment (SunRISE) Mission

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Radio emission from coronal mass ejections (CMEs) is a direct tracer of particle acceleration in the inner heliosphere and potential magnetic connections from the lower solar corona to the larger heliosphere. Energized electrons excite Langmuir waves, which then convert into intense radio emission at the local plasma frequency, with the most intense acceleration thought to occur within 20 R_S. The radio emission from CMEs is quite strong such that only a relatively small number of antennas is required to detect and map it, but many aspects of this particle acceleration and transport remain poorly constrained. Ground-based arrays would be quite capable of tracking the radio emission associated with CMEs, but absorption by the Earth's ionosphere limits the frequency coverage of ground-based arrays ($\nu \gtrsim 15$ MHz), which in turn limits the range of solar distances over which they can track the radio emission ($\lesssim 3\,R_S$). The state-of-the-art for tracking such emission from space is defined by single antennas (Wind/WAVES, Stereo/SWAVES), in which the tracking is accomplished by assuming a frequency-to-density mapping; there has been some success in triangulating the emission between the spacecraft, but considerable uncertainties remain.

We describe the Sun Radio Imaging Space Experiment (SunRISE) mission concept: A constellation of small spacecraft in a geostationary graveyard orbit designed to localize and track radio emissions in the inner heliosphere. Each spacecraft would carry a receiving system for observations below 25 MHz, and SunRISE would produce the first images of CMEs more than a few solar radii from the Sun.

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