SEARCHING FOR ELECTRIC CHARGING OF DUST PARTICLES DURING THE 2018 MARS DUST STORM WITH THE VERY LARGE ARRAY. M. C. Parks[1], N. Heavens[2], and M. Busch[3], [1]University of California Los Angeles, Los Angeles CA, 90095, (maxparks@g.ucla.edu), [2]Space Science Institute, Boulder CO, 80301, [3]SETI, Mountain View CA, 94043.

Summary: Utilizing the Karl G. Jansky Very Large Array to observe the L-band emission of Mars during the 2018 global dust storm could allow for novel detection methods of electric discharge in the dusty Martian atmosphere.

Introduction: The dust on Mars is known to create weather phenomena ranging from dust devils to planet-encircling events known as global dust storms. Near the surface, larger dust particles can become electrically charged when excited by these weather events, and the particle-particle collisions that follow are hypothesized[1] to create small electrostatic discharges. The radiant energy from these arcs would not be detectable compared to the total overall energy flux coming from Mars. However, in longer wavelengths, the flux would create a detectable increase, as described below in the Model section.

Using the Very Large Array to observe these electrostatic discharges would answer an outstanding question regarding the nature of Mars' atmosphere and would demonstrate a new way for ground-based remote sensing to provide insight on Martian atmospheric models. Additionally, confirmation of electrostatic discharges would inform Martian soil science investigations, some of which have called upon such mechanisms to explain elements of Mars' soil chemistry.[2]

There have been previous approaches to detect Martian electric discharge,[3] but subsequent follow-up observations were unable to repeat these findings[4]. This investigation follows the approach of Renno et al. (2003)[1] by examining the brightness temperature of Mars in radio wavelengths. Renno et al. identify radio observations of Mars that had anomalously high brightness temperatures from 1975.[5] However, these observations lacked spatial resolution, and so were only able to attain disk-averaged images of Mars by central meridian longitude, limiting the ability to constrain the enhanced flux in radio to the regions with the most dust uplifting (and thus hypothesized electrostatic discharge).

Model: Following preliminary calculations based on the Renno et al. approach, the expectation is that there may exist an enhanced brightness temperature on the order of tens-to-hundreds degrees Kelvin higher within the wavelengths that our VLA observations targeted. The L band was chosen due to the proportionally enhanced signal in microwave wavelengths; this peak is driven by the Martian dust particle size and collision rate, as described in Renno et al. 2003.

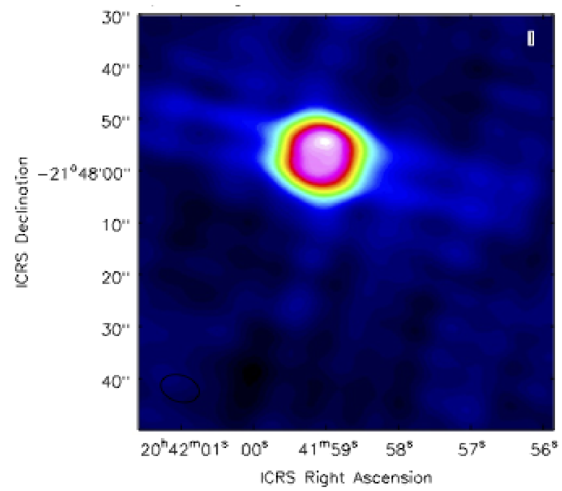

Figure 1. VLA observation of Mars during the global dust storm of 2018. The enhanced flux in the brightest region of the disk may be an indicator of electrostatic discharges near the surface, which could result in nonthermal emission from Mars detectable at λ = 20cm.

Observation: In 2018, a global dust storm encircled Mars and provided an opportunity to look again for electrostatic discharge, utilizing advances in Earth-based radio observatories to improve spatial resolution and thus signal within a resolving beam. Observations were taken using the Karl G. Jansky Very Large Array on the 9th of June, 2018. The L band was used due to its ability to probe the Martian atmosphere all the way down to the surface, and more specifically the 2-meter high saltation layer where the electric field is generated.

The data are currently undergoing analysis. Preliminary analysis in Figure 1 shows one of the observations of Mars, with the bright patch in the northeastern corner possibly representing an area of enhanced flux coming from electrostatic discharge.

Conclusion and Future Work: Further data processing will improve spatial resolution and reduce background noise. Should there be a detection of electrostatic discharge in the Martian atmosphere, it would inform future work on soil composition, rover electronics, and weather phenomena. On the other hand, if the analyzed data show no nonthermal flux in the L-band, it will be the most effective test to date of Renno et al.'s theory regarding arcing between colliding dust particles on Mars, and serve to inform future investigations into electric fields within Martian dust events.

References: [1] Renno et al. (2003) *Geophys. Res. Lett*., 30, 2140, [2] Wang et al. (2020) *Journal of Geophysical Research: Planets,* 125, [3] Ruf et al. (2009) *Geophys. Res. Lett.,* 36, L13202, [4] Anderson et al. (2011) *ApJ* **744** 15, [5] Doherty et al. 1979, *ApJ* **233** L166