PREDICTING TRIBOELECTRIC GLOW DISCHARGE AT GALE CRATER. H. Kalucha¹, M. Lemmon², T. H. McConnochie³, C. E. Newman⁴, M. Baker⁵, C. L. Smith⁶, and J. E. Moores⁷

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Introduction: Wind driven saltation has been observed on Mars at Gusev Crater, the landing site of the Spirit Rover [1]. Furthermore, the Mars Global Surveyor and the Mars Reconnaissance Orbiter observed erasure of the rover track from sediment transported by surface winds, which is further evidence of saltation [2]. More recently, HiRISE Images have enabled the calculation of the saltation flux at a number of sites. The Nili Patera dune field measured a flux of 5 m³/m²/year during northern hemisphere winter (Ls 268-360), which is very similar to an active aeolian environment on Earth such as Victoria Valley, Antarctica [3]. Saltation activity incurs strong seasonal variations (dominant in northern winter). Unfortunately, the frequency of saltation events and the threshold wind stress required to trigger an event remains unknown [4]. Since saltation has now been confirmed at the Bagnold Dunes in Gale Crater with data from the rover [5], we are presented with the first ever opportunity of capturing saltation induced triboelectric discharge, a phenomenon that has been hypothesized to occur on Mars. Laboratory simulations have suggested that saltation in a Martian atmosphere produces glow, due to the substantially smaller electric breakdown limit [6, 7]. The glow is a result of electrified dust particles ionizing gases in the atmosphere. Direct observation of this phenomenon would provide critical insight into the electrochemical processes taking place in the Martian atmosphere.

Glow Discharge Imaging: The most recent laboratory simulation of saltation under Martian conditions (8 mbar, Mars atmospheric composition, 10 g olivine basalt and plagioclase) has shown to produce glow discharge of magnitude 1 nW/cm² [8]. The experiment used a grain shaking speed of 1 m/s (which corresponds to a windspeed of 21.5 m/s) and the image was taken from an Olympus camera, 0.5 m away with 20 s of exposure. The saltation was able to ionize Argon (15.76 eV) and produced strong spectral emission of Ar and Ar⁺ in the wavelength range 700-870 nm.

Glow Discharge Conditions on Mars: The only necessary condition to observe glow discharge is a threshold wind stress that triggers saltation. Due to a lack of rover activity past sunset, the variation of wind stress at Gale Crater is poorly constrained, relying on late-night REMS activity and wind stresses predicted from atmospheric models. Figure 1 shows the wind stress variations in three hour groupings for an entire Mars Year. To capture glow discharge at night time, it follows that the best season would be after Ls 180, from 6-9 pm, when the highest night wind stresses are simulated. An observation campaign is being formulated to search for glow discharge at Gale with Curiosity. An in depth analysis of the ability of Curiosity’s cameras to capture such a glow proved that the signal would likely be under the detectable limits. However, even if nothing

Figure 1: MarsWRF predictions of wind stress as a function of Ls at MSL’s location in Gale Crater as of Dec 2019
is seen, the observational data will be useful in determining the upper limits on the magnitude of the glow.

**Implications:** The observation of glow discharge would confirm hypotheses of the electrostatic nature of the Martian atmosphere and near surface. Most significantly, it is theorized to be a reason for the lack of surface organics found on Mars [10]. This phenomenon must then also be accounted for in the safety planning of any manned missions to Mars [9].