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Preparations for measurements of electromagnetic signals on the surface of Mars

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Abstract

Dust grains in the Martial dust storms or dust devils may be electrically charged by triboelectric effects [1] and laboratory experiments show that under specific conditions electric discharges might occur in the dusty Martian atmosphere [2]. Broadband emissions of radio waves from theses discharges [3] have been found in the laboratory experiments [4]. Remote measurements from the Earth using a 34-m Deep Space Network antenna have shown a non-thermal component of electromagnetic radiation from Mars which has been attributed to the effects of discharges in the dust storms [5] but observations of the radar receiver onboard the Mars Express spacecraft [6] showed no credible radio signals from Martian lightning between 4 and 5.5 MHz. Additionally, no optical counterparts of the discharges have been identified in the images of Martian dust devils and dust storms up to now.

However, direct measurements of radio waves are not yet available from the surface of the planet. We plan to experimentally investigate possible radio emissions of atmospheric origin generated by electrical discharges, as well as electromagnetic waves linked to the interactions of interplanetary plasma medium with the Martian ionosphere and magnetic anomalies. The questions to be addressed are: i) Can we observe electromagnetic radiation propagating from the interplanetary space down to the surface of the planet? ii) Can we observe electromagnetic radiation from electric discharges in the Martian dusty atmosphere? These questions have never been answered by direct observations on the surface of Mars.

The ExoMars 2020 Surface Platform instrumentation will include the Wave analyzer module, consisting of an assembly of magnetic and electric antennae and dedicated electronics, as a part of the Martian ground electromagnetic tool instrument. The module will be dedicated to the measurement of electromagnetic field fluctuations in the frequency band from 100 Hz to 8 MHz.

References

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