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Micro-ARES, an electric-field sensor for ExoMars 2016: Electric fields modelling, sensitivity evaluations and end-to-end tests.

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For the past few years, LATMOS has been involved in the development of micro-ARES, an electric field sensor part of the science payload (DREAMS) of the ExoMars 2016 Schiaparelli entry, descent and landing demonstrator. It is dedicated to the very first measurement and characterization of the Martian atmospheric electricity which is suspected to be at the very basis of various phenomenon such as dust lifting, formation of oxidizing agents or Schumann resonances. Although the data collection will be restricted to a few days of operations, these first results will be of importance to understand the Martian dust cycle, the electrical environment and possibly relevant to atmospheric chemistry. The instrument, a compact version of the ARES instrument for the ExoMars Humboldt payload, is composed of an electronic board, with an amplification line and a real-time data processing DSP, which handles the electric signal measured between the spherical electrode (located at the top of a 27-cm high antenna) that adjusts itself to the local atmospheric potential, and the lander chassis, connected to the mechanical ground.

Since the electric fields on Mars have never been measured before, we can rely on two sources in order to know their expected order of magnitude. The first one is the measurement of the atmospheric electric fields on Earth, at the surface (in dust storms or the so-called dust-devils) or in the high atmosphere (closer to the Martian temperature and pressure conditions). The second one is the computer simulation of the phenomenon, that we obtained by combining two models. On the one hand, the mesoscale PRAMS model, developed at SwRI, which has the ability to simulate the dust transportation, and on the other hand the implementation made at LATMOS of Farell's 2005 dust-triboelectricity equations. Those models allowed us to simulate electric fields up to tens or even hundreds of kilo-volts per meter inside dust devils, which corresponds to the observations made on Earth and transposed to the Martian atmospheric parameters.

Knowing the expected electric fields and simulating them, the next step in order to evaluate the performance of the instrument is to determine its sensitivity by modelling the response of the instrument. The last step is to confront the model of the instrument, and the expected results for a given signal with the effective outputs of the electric board with the same signal as an input. To achieve this end-to-end test, we use a signal generator followed by an electrical circuit reproducing the electrode behaviour in the Martian environment, in order to inject a realistic electric signal in the processing board and finally compare the produced formatted data with the expected ones.