APPROCHER LES DEUX INFINIS PAR LES ONDES ELECTROMAGNETIQUES

Preparations for measurements of impulsive electromagnetic signals on Mars, on the low Earth orbit, and at Jupiter in a broad (but still finite) interval of frequencies

Préparations pour les mesures des signaux électromagnétiques impulsifs sur Mars, sur l'orbite orbite terrestre basse et près de Jupiter dans un large (mais toujours fini) intervalle de fréquences

Ondrej Santolik [1,2] ***and Ivana Kolmasova***[1,2]

[1] *Department of Space Physics, Institute of Atmospheric Physics, The Czech Academy od Sciences, Prague, Czechia*
[2]*Faculty of Mathematics and Physics, Charles University, Prague, Czechia*

Keywords : Spacecraft measurements, lightning, sprites, Mars
Mesures d'instruments spatiaux, éclairs, sprites, Mars

Résumé/Abstract

Dans un proche avenir, de nouvelles mesures de signaux électromagnétiques impulsifs seront effectuées par le satellite français TARANIS, par la mission JUICE (Jupiter icy moons explorer) de l'Agence spatiale européenne et par la plate-forme de surface ExoMars 2020.

In the near future, new measurements of impulsive electromagnetic signals will be done by the French satellite TARANIS, by the JUICE (Jupiter icy moons explorer) mission of the European Space Agency, and by the ExoMars 2020 Surface Platform.

1 Low Earth orbit

The French satellite TARANIS (Tool for the analysis of radiation from lightning and sprites) will be launched in 2020 on a polar low Earth orbit with an altitude of 700 km. Department of Space Physics of the Institute of Atmospheric Physics in Prague in cooperation with French colleagues developed a receiver for the IME-HF instrument (Instrument de Mesure du champ Electrique Haute Fréquence), designed to study electromagnetic radiation from lightning discharges and associated transient luminous events occurring above thunderstorms. The analyzed frequency band is from 5 kHz to 35 MHz and interesting parts of the electric field waveform sampled at 80 MHz will be selected by a flexible detection algorithm.

Observations of electromagnetic radiation from space will provide us with important information about lightning properties, mainly in the case of intra-cloud discharges which are difficult to detect optically. We prepare a ground-based observational campaign with an identical high frequency analyzer. After the launch of the TARANIS satellite this campaign will complement the observations from space.

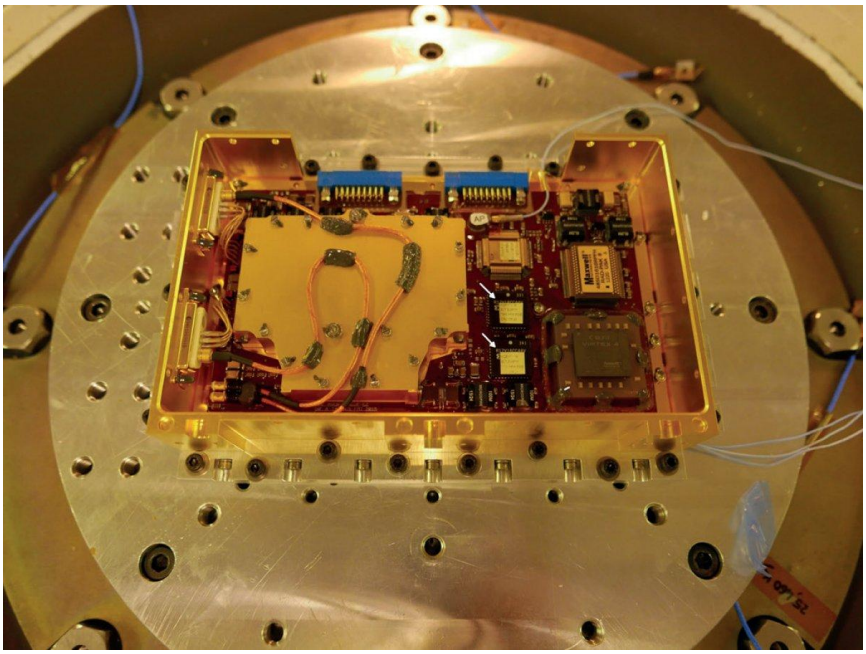

Figure 1: The IME-HF analyzer during the vibration tests

2 Jovian icy moons

The JUICE (Jupiter icy moons explorer) mission of the European Space Agency is scheduled for launch in 2022 and in 2030 it will arrive to Jupiter and its icy moons. The Radio and Plasma Waves Investigation instrument is being developed in a broad international cooperation of 25 institutions from 9 countries. Our receiver within this instrument will provide multi-component measurements of electromagnetic fields at frequencies up to 20 kHz.

These measurements will concentrate on research of electromagnetic waves in the Jovian magnetosphere and in the vicinity of Jovian moons, especially Ganymede where the Galileo probe discovered impulsive electromagnetic signals similar to those which accelerate electrons in the Earth's radiation belts.

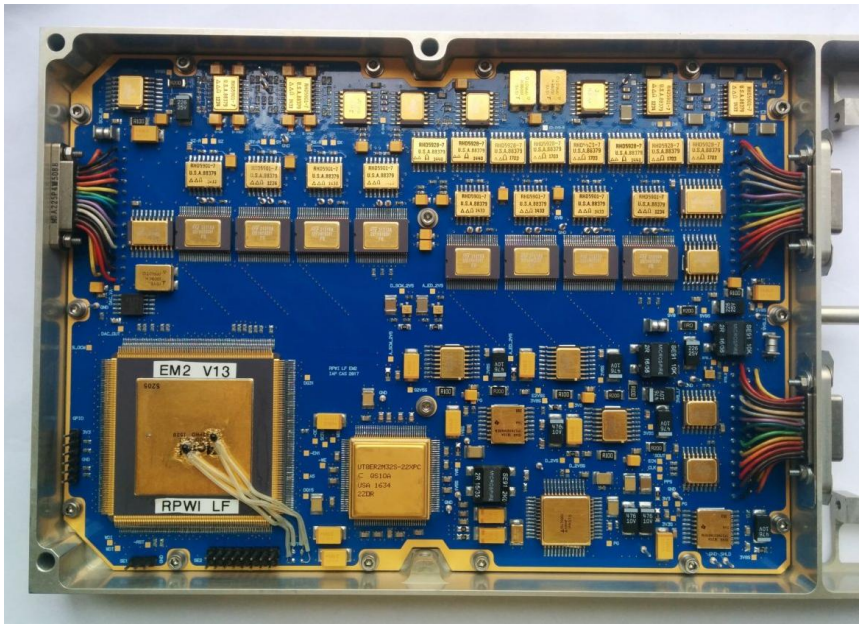

Figure2: The second engineering model of the LF analyzer for the JUICE/RPWI instrument

3 Surface of Mars

The ExoMars 2020 Surface Platform (to be launched in 2020, and landed on Mars in 2021) will conduct environmental and geophysical measurements with the aim to study the Martian surface and subsurface environment at the landing site. As a part of the scientific goals of the project, we will investigate electromagnetic waves in a broad range of frequencies up to 8 MHz by a wave analyzer module, consisting of an assembly of magnetic and electric antennae and dedicated analyzer electronics. The scientific questions which we plan to address have never been answered by direct measurements on the surface of the planet.

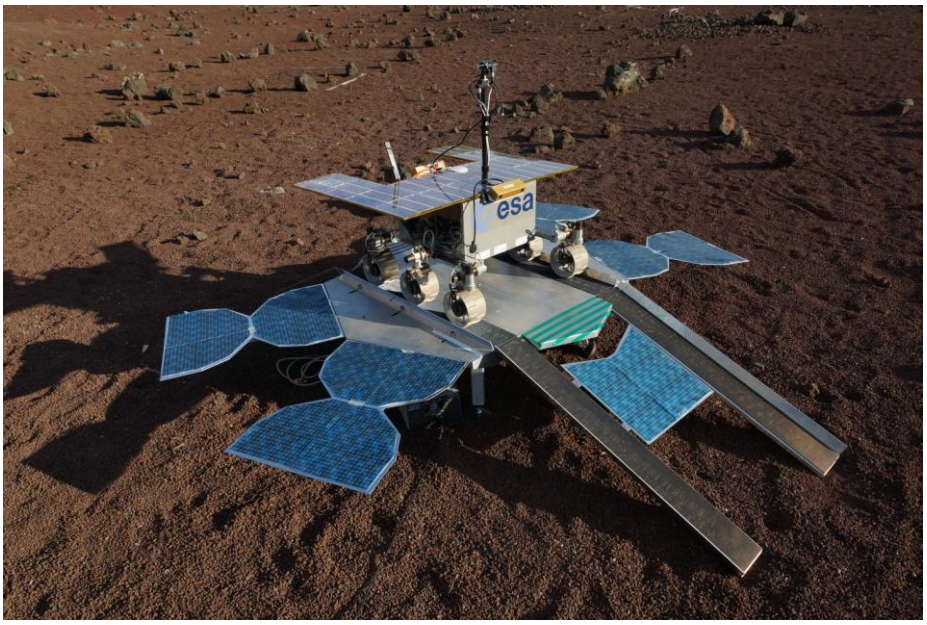

Figure 3: Model of the ExoMars 2020 surface platform and rover during tests in Toulouse

(Credits: ESA)

We plan to analyze emissions of atmospheric origin and possible wave activity originated in electrical discharges in dust storms. The wave activity linked to the interactions of interplanetary plasma medium with Martian ionosphere and Martian magnetic anomalies and interactions related to space weather effects will be also investigated.

The immediate questions to be answered 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 hypothetical electric discharges in the Martian dust storms or dust devils?