

Finnish Meteorological Institute's ongoing planetary instrumentation missions

Maria Hieta (1), Maria Genzer (1), Walter Schmidt (1), Esa Kallio (2), Juhani Huovelin (3), Timo Nikkanen (1), Matias Meskanen (1), Harri Haukka (1), Jouni Polkko (1) and Ari-Matti Harri (1)

(1) Finnish Meteorological Institute, Helsinki, Finland, (2) Aalto University, Espoo, Finland, (3) University of Helsinki, Finland

Abstract

Finnish Meteorological Institute (FMI) has strong heritage in building instrumentation for planetary missions and small solar system bodies including landers and orbiters. FMI is currently participating in many ongoing planetary missions of different types and target bodies. This presentation will give an overview of all the ongoing activities.

1. Atmospheric instruments for Mars landers

FMI has a long history of building meteorological miniature low-power instrumentation for Mars missions in co-operation with Vaisala Inc. Currently two instruments are already on Mars onboard Curiosity rover and two missions are to be launched in 2020.

These past and ongoing missions will also serve as payload precursors for FMI-lead new kind of planetary exploration mission MetNet. The Mars MetNet mission is based on a new semi-hard landing vehicle which is developed in collaboration between FMI, Lavochkin Association, Space Research Institute (IKI) and Instituto Nacional de Tecnica Aeroespacial.

1.1. MSL Curiosity

NASA's Curiosity rover launched on 2011 and has been operating on Martian surface since 2012. FMI delivered pressure measurement device REMS-P and relative humidity measurement device REMS-H for the Rover Environmental Monitoring Station (REMS) supplied by INTA-CAB of Spain. The biggest advantage of the REMS-P and REMS-H devices is their good accuracy, small size and low power consumption. The devices have delivered successfully time series on pressure and relative humidity on Martian surface for almost 7 years and they still continue to operate without problems.



Figure 1: Curiosity rover with REMS-H device visible on the mast below wind sensor. Credit: NASA

1.2. Mars 2020 rover

Mars 2020 is a Mars rover mission by NASA with a planned launch on July 2020. One of the scientific payloads onboard the rover mission is Mars Environmental Dynamic Analyzer (MEDA): a set of environmental sensors for Mars surface weather measurements. FMI provides a pressure measurement device (MEDA PS) and a relative humidity measurement device (MEDA HS) for MEDA. MEDA PS is based on REMS-P but with next generation pressure sensor heads. MEDA HS has new relative humidity sensor heads and new mechanical design compared to previous missions.

1.3. ExoMars 2020 surface platform

ExoMars 2020 is a joint mission between ESA and Roscosmos comprising a surface science platform and a rover. First part of ExoMars mission was launched 2016 and that included Trace Gas Orbiter and Schiaparelli Entry, Descent and Landing Demonstrator Module (EDM). FMI delivered pressure and relative

humidity sensors for DREAMS (Dust Characterization, Risk Assessment, and Environment Analyser on the Martian Surface) package. Schiaparelli's landing failed, but the mission provided important experience about new pressure sensor heads and a space qualification of an automotive microcontroller that were then used in the following missions.

For the 2020 launch FMI provides METEO-P pressure and METEO-H humidity measurement devices for METEO meteorological instrument package on board the Russian led Surface Platform element of the mission. The device pair operations are managed by the instrument controller, heritage of DREAMS-P/H, integrated on the METEO-P board.

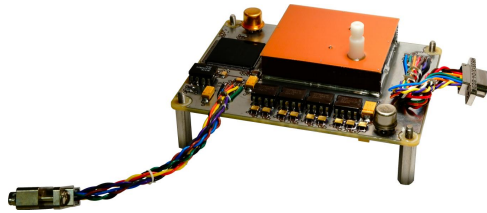


Figure 2: METEO-P device for ExoMars 2020.

2. BepiColombo SIXS

BepiColombo is a joint mission of ESA and JAXA to Mercury launched in 2018. FMI is participating in Solar Intensity X-ray and Particle Spectrometer (SIXS) instrument located in Mercury Planetary Orbiter (MPO). MPO carries also another X-ray spectrometer: MIXS (Mercury Imaging X-Ray Spectrometer) which is closely linked to SIXS. MIXS will analyse the surface of Mercury by collecting fluorescent X-rays, emitted by the surface rocks after stimulation by high energy solar X-rays. SIXS will measure those solar X-rays to provide the base level data for the MIXS results. FMI is responsible of project management and quality management of SIXS instrument and common MIXS/SIXS data processing unit (DPU).

3. JUICE PEP-Lo DPU

The JUpiter ICy moons Explorer (JUICE) is an interplanetary spacecraft in development by ESA. FMI is participating in Particle Environment Package (PEP) which includes sensors for the measurements of electrons, ions, energetic neutrals, and neutral gas. Aalto University is providing the data processing unit (DPU) for PEP-Lo and has subcontracted the flight hardware

and software development to FMI. PEP has heritage from ASPERA (Phobos 1 and 2), ASPERA-3 (Mars Express, still active) and ASPERA-4 (Venus Express, still active) instruments for which FMI has also provided DPUs. JUICE is set for launch in June 2022 and will reach Jupiter in 2029.

References

- [1] MetNet Missions website, <http://metnet.fmi.fi>
- [2] Gómez-Elvira, J., et al. (2014), Curiosity's rover environmental monitoring station: Overview of the first 100 sols, *J. Geophys. Res. Planets*, 119, 1680–1688, doi:10.1002/2013JE004576.
- [3] NASA website, "Mars 2020 Rover", <https://mars.nasa.gov/mars2020>
- [4] ESA website, "Robotic exploration of Mars", <http://exploration.esa.int/mars/>
- [5] ESA website, "JUICE", <http://sci.esa.int/juice/>
- [6] University of Leicester website, "BepiColombo - the mission to Mercury", <https://le.ac.uk/bepicolombo/mixs>