Mars MetNet Mission Payload Overview

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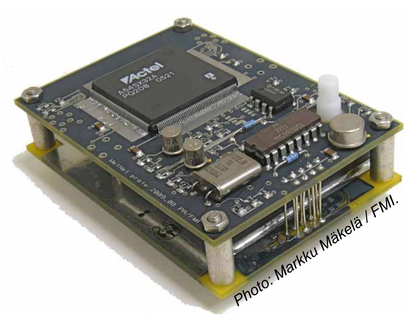
Mission Scientific Objectives

- Atmospheric dynamics and circulation
- Surface to Atmosphere interactions and Planetary Boundary Layer
- Dust raising mechnanisms
- Cycles of CO_2, H_2O and dust
- Evolution of the Martian climate

A new kind of planetary exploration mission for Mars is being developed in collaboration between the Finnish Meteorological Institute (FMI), Lavochkin Association (LA), Space Research Institute (IKI) and Institutio Nacional de Tecnica Aerospacial (INTA). The Mars MetNet mission is based on a new semi-hard landing vehicle called MetNet Lander (MNL).

The main idea behind the MetNet landing vehicles is to use a state-of-the-art inflatable entry and descent system instead of rigid heat shields and parachutes as earlier semi-hard landing devices have used. This way the ratio of the payload mass to the overall mass is optimized and more mass and volume resources are spared for the science payload. MetNet Mission payload instruments are specially designed to operate in very low power conditions. MNL flexible solar panels provide a total of approximately 0.7-0.8 W of electric power during the daylight time. As the provided power output is insufficient to operate all instruments simultaneously they are activated sequentially according to a specially designed cyclogram table which adapts itself to the different environmental constraints.

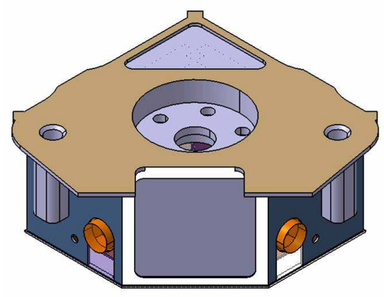


MetBaro Pressure Device: The MetBaro pressure device instrument is based on Vaisala Inc. Barocap® micromachined capacitic silicon sensor and Vaisala transducer technology.

- Weight about 100g with the FPGA card (FPGA is shared with the MetHumi humidity device)
- Resolution: 0.5 Pa; Range: 0 – 1015 hPa
- Accuracy: ~5 Pa BOL, <10 Pa EOL

MetHumi Humidity Device: Miniature MetNet Humidity Instrument is based on MSL/REMS design and Vaisala Inc. Humicap® sensor and transducer electronics that have been used in Vaisala radiosondes.

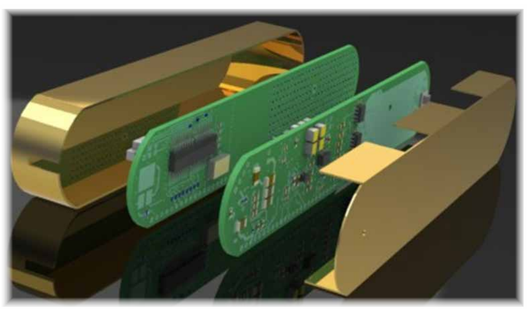
- Weight about 20g without the wires
- Resolution: 0.5 %RH; Range: 0 – 100 %RH
- Accuracy: ±2 %RH at -20 °C, ±4 %RH at -40 °C, ±8 %RH at -70 °C



Panoramic Camera: CCD technology based camera (3D scheme on the left) takes panoramic photos of the surrounding environment of the MetNet Lander. PanCam consist of four lenses with 90 degree of FOV. Weight about 100g.

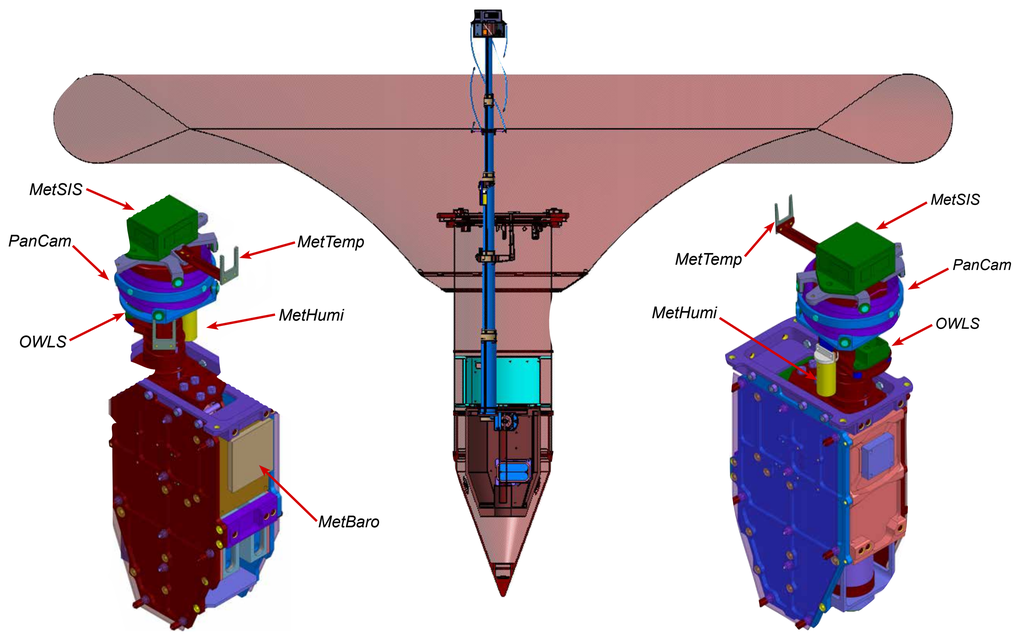
MOURA Magnetometer / Gradiometer: MOURA is an intelligent, compact and low power instrument for the measurement of the magnetic field vector, based on two sets of triaxial magnetometers (permalloy stripe detectors). MOURA is a complex system composed by the following sensors:

- Two triaxial magnetometers shifted in the Z direction with the double objective of redundantce and the capability of performing gradiometry.
- One triaxial inertial sensor for referente in a gravitacional field.
- One temperature sensor for thermal compensation of the magnetic and inertial sensors.

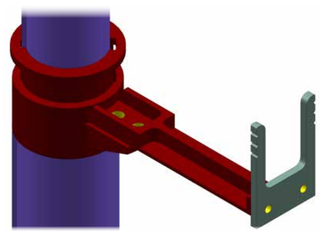


MOURA Main Goals in Mars MetNet Mission:

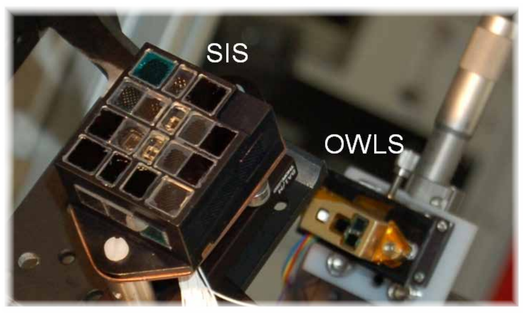
1. Measurement of termomagnetic curves of minerals of the martian soil.
2. Investigation of Martian Ionosphere and solar events on the Red Planet.



Temperature Sensors: Temperature observations, performed at two positions along the mast, are used to investigate the heat gradients and fluxes and other surface-to-atmosphere interactions. Together with the pressure and humidity observations they provide data to study large scale atmospheric dynamics. The sensors are lightweight, 2g each, redundant thermocouples.



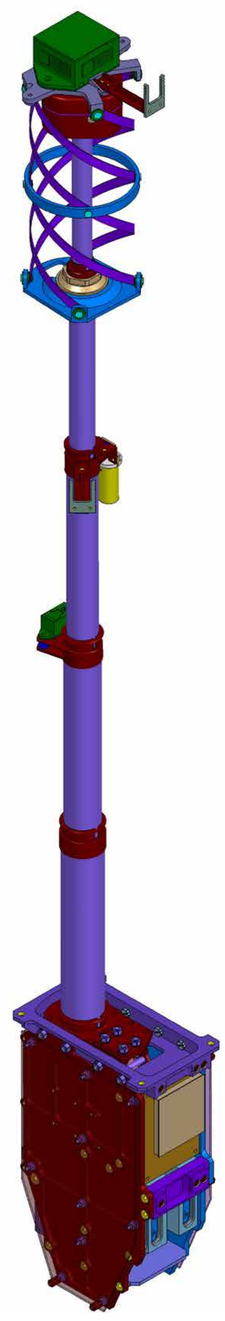
MetSIS Solar Irradiance Sensor: SIS is a smart, compact and low-power instrument, provided with optical wireless communication for command and data transmission. It is capable of measuring both direct and diffusse solar irradiance in up to 11 bands, ranging from UV to near IR. SIS is a complex system that integrates 27 spectral detectors: Si and CSi PIN photodiodes with optical filters, dedicated detectors for H2O, O3 bands, UV bands and dust optical depth measurements, reference sensor to evaluate the degradation in the photodiodes due to radiation effects, 2 temperature sensors and one angle sensor to determine the relative position of the Sun.



SIS Main goals in Mars MetNet Mission:

1. Measurement of the solar spectrum in the Martian surface and its daily and seasonal variations.
2. Estimation of the atmospheric optical depth (comparison with previous missions).
3. Characterization of the Martian atmosphere.
4. Observation of Phobos transits: calculation of the exact landing site.
5. Characterization of the moment of inertia of the nucleus by means of a rotation model

Dust Sensor (DS): Measures the particle size distribution of the airborne dust on the Martian surface. The DS is composed by a multispectral detector, a pulsed emitter, both in MWIR and a SMA actuator for automatic calibration. In contrast to other Martian dust instruments measuring the opacity produced by particles, the DS measurement principle is IR Mie scattering. The purpose of this selection is twofold, to accomplish with the severe restrictions in weight and power consumption and to take advantage of the fact that the IR wavelengths are quite similar to the particulate size expected, improving the detection effect based on Mie scattering. During the mission, the DS will take multispectral measurements in MWIR. Thanks to the strong dependence between the particle size and the scattered wavelength, the DS is able to quantify the particle size distribution inside the optical interaction volume which is open to the Martian atmosphere.



Telescopic mast with SIS, antenna, panoramic camera, MetHumi and 2 of the 3 temperature sensors.

Payload Instruments

Atmospheric Instruments

- Pressure Device MetBaro (FMI)
- Temperature Sensors (IKI)
- Humidity Device MetHumi (FMI)

Optical Devices

- Panoramic Camera (LA)
- Solar Irradiance Sensor MetSIS (INTA) with Optical Wireless Link System OWLS
- Dust Sensor, DS (INTA)

Composition and Structure Devices

- Tri-axial magnetometer MOURA (INTA)
- Triaxis System Accelerometer and Gyroscope (FMI)

More information from the Mars MetNet Mission website http://metnet.fmi.fi

Poster design: Harri Haukka, FMI
Background image: NASA