ExoMars 2016 Mission
ExoMars Programme

- Consists of two missions, in 2016 and 2018.
- A cooperation between ESA and Roscosmos (agreement signed in Mar 2013).
- The programme includes some important contributions from NASA.
- ExoMars constitutes ESA’s highest priority in robotic exploration.
2016 Mission Objectives

TECHNOLOGY OBJECTIVE

‣ Entry, Descent, and Landing (EDL) of a payload on the surface of Mars.

SCIENTIFIC OBJECTIVES

‣ To study Martian atmospheric trace gases and their sources;
‣ To conduct surface environment measurements.

- Data relay services for landed missions until 2022.
**Launch**

**Nominal**
- Launch date: Jan 2016
- Mars Arrival: Oct 2016
- EDM landing: Meridiani, −1 km MOLA
- Ellipse: 100 km x 15 km
- TGO Aerobraking: 12 months
- TGO Orbit: 74°, 400-km altitude
Modes of Observation

Orbit:
- Altitude: 400 km
- Inclination: 74°
- Period: 2 hours

Pointing possibilities:
- Solar occultation: Use the sun as bright IR source for high sensitivity observations.
- Nadir (±5° off-axis): To correlate atmospheric measurements and surface information.
- Limb scanning: For investigating atmospheric vertical structure.
**NOMAD**
High-resolution occultation and nadir spectrometers

*Atmospheric composition (CH₄, O₃, trace species, isotopes) dust, clouds, P&T profiles*

- UVIS (0.20 – 0.65 μm) \(\lambda/\Delta\lambda \sim 250\)
- IR (2.3 – 3.8 μm) \(\lambda/\Delta\lambda \sim 10,000\)
- IR (2.3 – 4.3 μm) \(\lambda/\Delta\lambda \sim 20,000\)

**CaSSIS**
High-resolution, stereo camera

*Mapping of sources Landing site selection*

**ACS**
Suite of 3 high-resolution spectrometers

*Atmospheric chemistry, aerosols, surface T, structure*

- Near IR (0.7 – 1.7 μm) \(\lambda/\Delta\lambda \sim 20,000\)
- IR (Fourier, 2.5 – 25 μm) \(\lambda/\Delta\lambda \sim 4,000\) (SO)/500 (N)
- Mid-IR (2.3 – 4.5 μm) \(\lambda/\Delta\lambda \sim 50,000\)

**FRENd**
Collimated neutron detector

*Mapping of subsurface water and hydrated minerals*

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**Background CH₄ map, Mumma et al. 2009**

**NOMAD nadir spatial resolution**

*Date 4 Apr 2008 13:33:04 Ls=154*

Credit: Kees Veenenbos

Vago, 8th Mars Conference
Posters

TGO Instruments:
- NOMAD: Vandaele et al., #62, Thu
- NOMAD: Thomas et al., #65, Thu
- CaSSIS: Thomas et al., #64, Thu

EDM-Schiaparelli Instruments:
- DREAMS: Esposito et al., #63, Thu
• Methane detection can be confirmed (if present) by many absorption bands.
• TGO sensitivity is 100 ppt (~1000 times better than Mars Express).
• The ability to also measure other hydrocarbons will help establish its origin.
Infrared:
CO$_2$ (and $^{13}$CO$_2$, $^{17}$OCO, $^{18}$OCO, C$^{18}$O$_2$), CO (and $^{13}$CO, C$^{18}$O), H$_2$O (and HDO), NO$_2$, N$_2$O, CH$_4$ (and $^{13}$CH$_4$, CH$_3$D), C$_2$H$_2$, C$_2$H$_4$, C$_2$H$_6$, H$_2$CO, HCN, OCS, HCl, HO$_2$, H$_2$S, aerosols/ice

Ultraviolet:
O$_3$ and SO$_2$
Innovative Stereo Camera

CaSSIS

- Stereo and colour (4 filters)
- Resolution ≤ 5 m/pixel
- Imaging swath is 9-km wide
Subsurface Water/Hydrogen

HEND/Odyssey data, 300-km resolution

Simulation of FREND/TGO data based on HEND/Odyssey, 40-km resolution

Credit: MEX/HRSC
EDM

- A demonstrator of technologies for landing payloads on Mars;
- A platform to conduct environmental measurements of interest during the dust storm season.

EDM PAYLOAD

- Integrated mass: 5 kg;
- Surface lifetime: 2–4 sols;
- Measurements:
  - Descent science;
  - P, T, wind speed and direction;
  - Optical depth;
  - Atmospheric charging;
  - Descent camera.
Conclusions

- **2016: ExoMars Trace Gas Orbiter**
  - Its science will improve our understanding of Mars and of key atmospheric processes of potential astrobiological relevance.
  - An excellent base for international collaboration.
  - Master landing technologies for future exploration missions.

- **2018: ExoMars Rover and SP**
  - A great exobiology mission.
  - The first ever to combine mobility with access to the subsurface.
  - The rover’s Pasteur payload contains next-generation instruments.
  - The rover will study for the first time:
    - Organics and biomarkers for past and present life at depth;
    - Vertical characterisation of geochemistry and water.
  - The SP will perform novel environmental measurements.
  - A step closer to Mars Sample Return.