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NOMAD, a spectrometer suite for Nadir and Solar Occultation observations on the ExoMars Trace Gas Orbiter

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Abstract

NOMAD, the "Nadir and Occultation for MArs Discovery" spectrometer suite was selected as part of the payload of the ExoMars Trace Gas Orbiter mission 2016. This instrument suite will conduct a spectroscopic survey of Mars' atmosphere in the UV, visible and IR regions covering the 0.2-0.65 and 2.2-4.3 µm spectral ranges. NOMAD's observation modes include solar occultation, nadir and limb observations.

1. Introduction

The NOMAD instrument is composed of 3 channels: a solar occultation only channel (SO) operating in the infrared wavelength domain, a second infrared channel capable of doing nadir, but also solar occultation and limb observations (LNO), and an ultraviolet/visible channel (UVIS) that can work in all observation modes. The spectral resolution of SO and LNO surpasses previous surveys in the infrared by more than one order of magnitude. NOMAD offers an integrated instrument combination of a flight-proven concept (SO is a copy of SOIR on Venus Express), and innovations based on existing and proven instrumentation (LNO is based on SOIR/VEX and UVIS has heritage from the ExoMars lander), that will provide mapping and vertical profile information at high spatio-temporal resolution. The three channels have each their own ILS and optical bench, but share the same single interface to the S/C. We will present the instrument and its capabilities in term of detection of a broad suite of species, its possibilities to improve our knowledge on vertical structure of the atmosphere as well as its mapping possibilities.

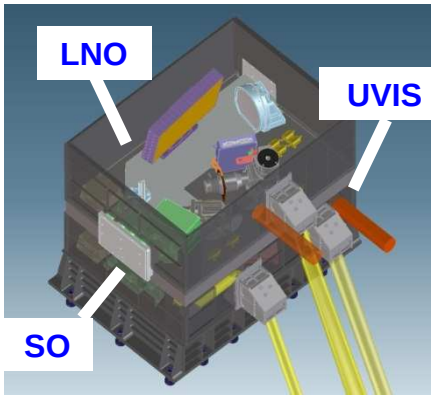

Figure 1: NOMAD 3 channels.

2. Current developments

There have been lots of technical advances in the NOMAD design since last year. The cryoradiator has become a 4 layer V-groove radiator, with a planet shield. This radiator is connected to an insulated cryo-baseplate in the LNO channel, where the majority of the spectrometer optics are located. The baseplate surrounded in MLI can expand and contract and slide over the baseplate with the rest of the components.

The detector in use here is a spare from SOIR/Venus Express but NOMAD will use a newer version of this Sofradir IDDCA and a longer lifetime cooler from Ricor. We took delivery of these this year.

In the cooled section, the echelle grating that splits the light into a spectrum will be machined out of one piece of aluminium with its holder. This reduces thermal gradients between holder and grating and thus minimises optical aberrations. The same principle is applied to the parabolic mirror and its holder. The AOTF, that selects a small wavelength domain, has been specially developed for the LNO

channel and cut out of a very large, uniform crystal of TeO_2. The driver electronics for this AOTF – that supply the radio frequency to tune the wavelengths allowed through the crystal - are also a new development.

NOMAD doesn't bolt onto the deck of TGO with normal bolts – our interface attachments are flexures that ensure no deformation of the instrument is transmitted to the deck, and vice versa.

NOMAD's periscope mirrors – for solar occultation viewing - can move significantly to align to another instrument (ACS), but with fine precision for internal co-alignment of the 3 channels.

Sophisticated straylight subtraction routines will be used to increase the performance of the UVIS channel, where the Mars signal is weak but very interesting scientifically.

3. The NOMAD Team

The NOMAD team: PI - Dr. A.C. Vandaele (IASB-BIRA, Belgium), Co-PI - Dr. J.J. López-Moreno (IAA, Spain)

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