is based on a drill to take rock samples underneath the oxidised soil layer, on a sample preparation and distribution system devoted to condition and bring the sample to a set of analytical instruments to carry out in-situ chemical and mineralogical investigations. The facility benefits of the presence of optical microscope, gas chromatograph, several spectrometers (Raman, Mass, Mossauer, APX-Ray), and further instruments.

In the frame of planetology, Officine Galileo is collaborating with several Principal Investigators to the definition of a set of instruments to be integrated on the Mars 2003 Lander (a NASA-ASI cooperation). A drill (by Tecnospazio), with the main task to collect Mars soil samples for the subsequent storage and return to Earth, will have the capability to perform several soil analyses, e.g. temperature and near infrared reflectivity spectra down to 50 cm depth, surface thermal and electrical conductivity, sounding of electromagnetic properties down to a few hundreds meter, radioactivity. Moreover a kit of instruments for in-situ soil samples analyses if foreseen; it is based on a dust analyser, an IR spectrometer, a thermoluminescence sensor, and a radioactivity analyser.

The attention to the Red Planet is growing, in parallel with the findings of present and planned missions. In the following years the technology of Officine Galileo will carry a strong contribution to the science of Mars.

8.02

VIRTIS Optics Module Thermal Mechanical Qualification Testing
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In the frame of the Rosetta mission the VIRTIS instrument (Visible and Infrared Thermal Imaging Spectrometer), built by Officine Galileo as Prime Contractor for the Italian Space Agency (ASI) and with contributions from the French Observatoire de Paris-Meudon and the German DLR (Deutsches Zentrum für Luft und Raumfahrt), is an imaging spectrometer that combines three unique data channels in one compact instrument committed to the multispectral mapping and high resolution spectral analysis of the comet 46P/Wirtanen. This is accomplished by means of two separate optical heads, ViritS-M (VM) and ViritS-H (VH) integrated in the Optics Module (OM). The ViritS OM is composed of an optical bench which provides mechanical support and thermal insulation to the VM and VH optical heads, the passive radiators system for cooling the optical heads at an operating temperature of about 130K and an active cooling to maintain the infrared detectors at 70K, based on Stirling cycle cryocoolers. The OM includes also a pair of very compact cover mechanisms. Two optical heads with three focal planes in a very compact design, high thermal gradients, multi-stage passive cooling and a mass limited to about 20 Kg result in a thermo-mechanical sophisticated design. This paper presents an overview of the OM configuration and the results of the environmental qualification testing performed on a representative model.

Keywords: Optics Module, passive cooling, active cooling, environmental testing.

8.03

A new Infrared Heterodyne Instrument for measurements of Planetary Wind and Composition
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A new Heterodyne Instrument for Planetary Wind And Composition (HIPWAC) will be presented. HIPWAC has advanced capabilities to investigate winds and molecular composition in low-pressure high-altitude regions of planetary atmospheres, and for studies of other extraterrestrial molecular emissions, for example cometary comae or circumstellar gases. A frequency stabilized CO₂-laser local oscillator (LO) allows observations at wavelengths between 9 and 12 μm. The stability of the LO and the IF spectrum analyzer provide a frequency resolution of better than λ/Δλ > 10⁷. The band-width of the instrument is about 2 GHz per sideband. The use of carbon composite materials for CO₂-laser and the optical bench guarantees low thermal expansion and high optical stability of the instrument. Its compact low mass design will permit its use at various observatories, especially the new 8–10 meter class telescopes. The achievable diffraction limited FOV on appropriately large telescopes will permit the study of small scale phenomena and small bodies: e.g., the direction and magnitude of Titan’s atmospheric circulation (in support of the Cassini Huygens Probe), the study of Mars global dynamics, investigation of seasonal variations on Venus, a study of global and local (polar hot spot) stratospheric dynamics, storms, auroral phenomena on Jupiter, and observation of comets and planets during orbital periods distant from the Earth (e.g., Mars during conjunction).

The instrument design and expected improvements in the measurement of planetary atmospheric parameters will be discussed.

8.04

Electric Propulsion System for Constellation Deployment and Orbit Control of Minisats
P. Bianco, L. De Rocco, M. Lovera (Carlo Gavazzi Space SpA)

The late technology developments and the demand for low-cost space missions have raised the interest in small satellites and in their potential use as parts of satellite formations as well as building units of satellite constellations. Formation flying of small satellites can be used to bring in-orbit spares for failed payloads on larger satellites as well as to replace large satellites at all by flying the mission on more small satellites, each carrying a single payload. Small satellites can be used in constellations for scientific missions (e.g. remote sensing) as well as for commercial purposes (e.g. data relay). Yet, “small satellite” doesn’t necessarily mean “cheap satellite”: cost reduction must be enforced into the space mission design since the very beginning of it, at system level. This usually implies seeking for trade-offs on most expensive system items for a small sat. Among these, we surely have in launch and the onboard propulsion system for orbital manoeuvres and station keeping: the stricter the requirements, the higher the costs. And, when dealing with satellite constellations or formations, orbital requirements can be quite challenging. The system designer is faced with the dilemma on whether to buy a relatively expensive dedicated launch or to have a highly cost-impactive autonomous onboard propulsion system that should perform orbit transfers as well. The present paper, which is an up-to-date version of the one presented at IAF-99, introduces a system based on FEEP (Field Emission Electric Propulsion) technology, featuring low thrust plug-on propulsion units. Thanks to the self-contained concept of FEEP thrusters and to the plug-on feature of the whole system, a very low cost-impactive onboard propulsion system can be implemented in order to serve for both orbital manoeuvres (constellation / formation deployment, orbit rising) and orbit maintenance (drag compensation, station keeping relative to other satellites). Most convenient strategies to operate such propulsion systems with respect to orbital requirements, principal design drivers and sizing methods are presented and discussed as well as practical up-to-date case study results performed at Carlo Gavazzi Space.

8.05

UV imaging results of comet C/1995 O1 (Hale-Bopp) and other planetary targets using the Southwest UV Imaging System (SWUIS) aboard the Space Shuttle

The Southwest UV Imaging System (SWUIS) is a compact, low-cost ultraviolet/visible/infrared imaging system designed for remote sensing observations from a manned platform in space. SWUIS has made two flights aboard the Space Shuttle on flights STS-85 in August 1997 and STS-93 scheduled for launch in late July 1999. During its maiden flight aboard STS-85, SWUIS collected > 4.1 x 10⁷ images of comet Hale-Bopp (C/1995 O1) in key emission bands spanning the mid-UV/VIS wavelengths at a time when the solar elongation of Hale-Bopp was too small to permit HST and other UV observations. From this data set, H₂O and dust production rates were calculated for Hale-Bopp at a heliocentric distance of 2.33 AU. The H₂O production rate, Q_H₂O, based on the observed brightness of the OH emission at 308.5 nm, was 2.6 x 10⁷ g⁻¹. Hale-Bopp’s dust produc-