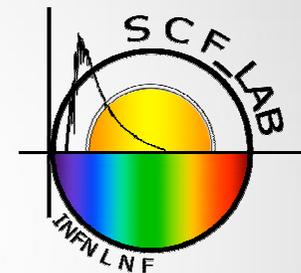


INRRI-EDM/2016:

THE FIRST LASER RETROREFLECTOR PAYLOAD ON MARS

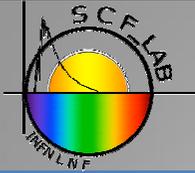


G. Delle Monache⁽¹⁾, S. Dell’Agnello⁽¹⁾, R. Vittori⁽²⁾, L. Porcelli⁽¹⁾, M. Tibuzzi⁽¹⁾, A. Boni⁽¹⁾,
N. Intaglietta⁽¹⁾, L. Salvatori⁽¹⁾, P. Tuscano⁽¹⁾, E. Ciocci⁽¹⁾, M. Martini⁽¹⁾, S. Contessa⁽¹⁾, G. Patrizi⁽¹⁾,
c. Mondaini⁽¹⁾, C. Lops⁽¹⁾, M. Maiello⁽¹⁾, G. Bianco⁽³⁾, C. Cantone⁽¹⁾.

1 INFN-LNF, Italy

2 INFN-LNF, ESA, Aeronautica Militare Italiana

3 ASI-CGS, Italy



Outline



1. INRRI overview
2. ExoMars EDM overview
3. INRRI qualification campaign for ExoMars EDM mission

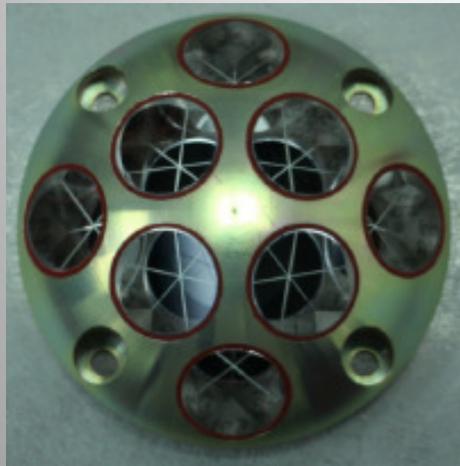
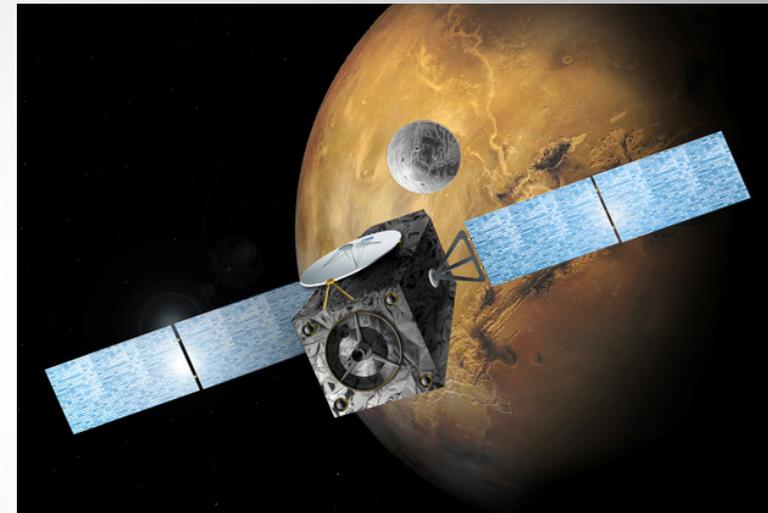
INRRI will enable the ExoMars 2016 EDM to be laser-located from Mars orbiters through one, or more, of the following means:

Laser Altimetry

Lidar atmospheric observation

Laser ranging

Laser flashes emitted by orbiters



Supported Science:

Mars Geodesy/Geophysics

Mars GR

Lidar atmosphere trace species

First-ever laser retroreflector on Mars and beyond the Moon



INRRI: INstrument for landing-Roving laser Retroreflector Investigations

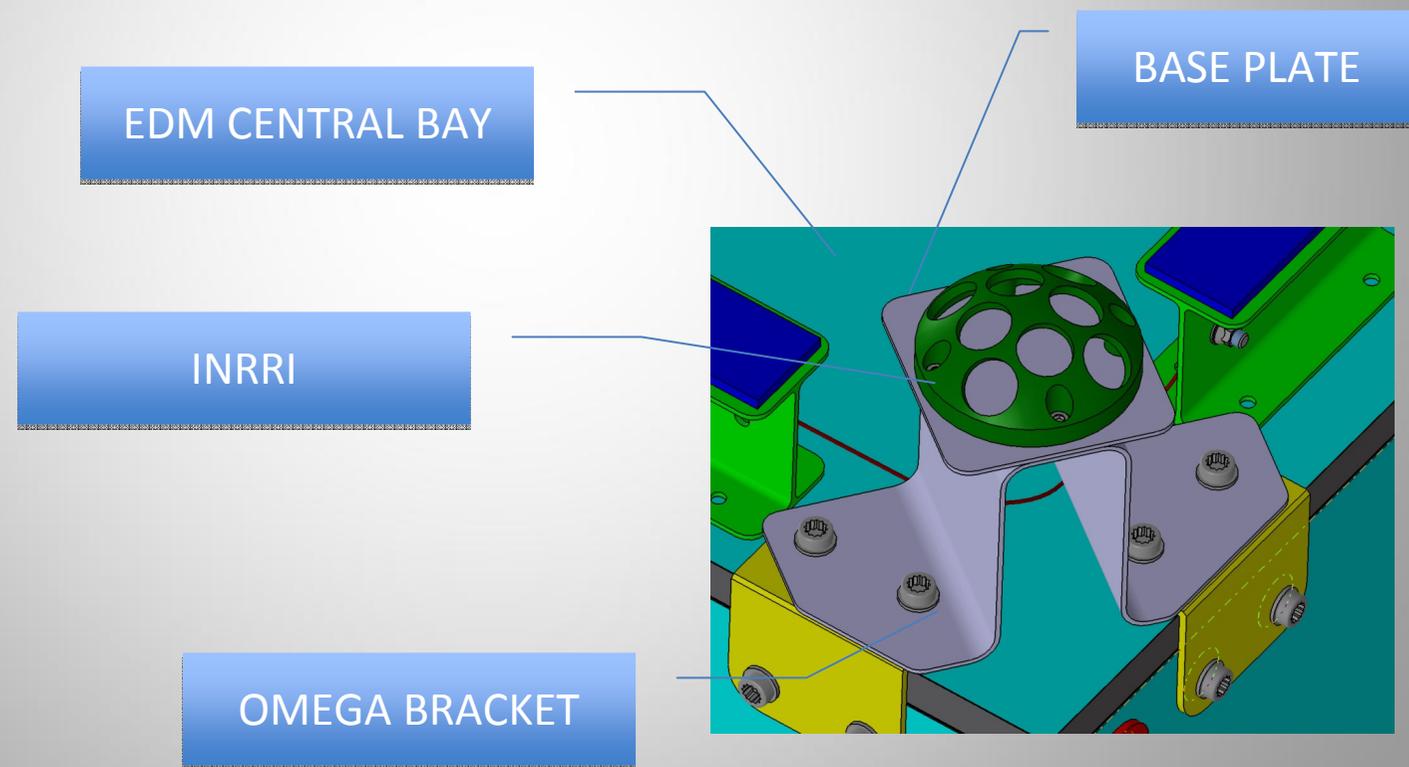
In the frame of the ExoMars Programme, the Entry Descent and Landing (EDL) Demonstrator Module (EDM) is the entry vehicle conceived to demonstrate the capability of the European industry to perform a controlled landing on the surface of Mars.

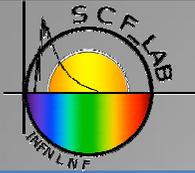
The EDM is composed by three main elements:

- the Back Shell;
- the EDM Surface Platform (Lander);
- the Front Shield.

 BACK SHELL FRONT SHIELD

The array is set on a bracket intended to increase the reflectors field of view for orbiting lasers





The INRRI article foresees a bonding process that has not been qualified for such mission profile, for this reason a full campaign has been required from ESA on a Proto Flight Model with the following tests sequence:

- Quasi-Static load
- “Peel” test on each CCR
- TVT
- Dynamic load: random, sine & shock
- “Peel” test repeated
- Mass loss check
- (FFDP)

ALL TESTS, EXCEPTED DYNAMIC, PERFORMED AT INFN SCF_LAB

A mass simulating 60 g has been set on each CCR face to check that ultimate performances are not reached. A standard peel test (determining the ultimate load) can not be performed on a PFM, so the test aims to determine differences in elastic properties before and after TVT and dynamic tests

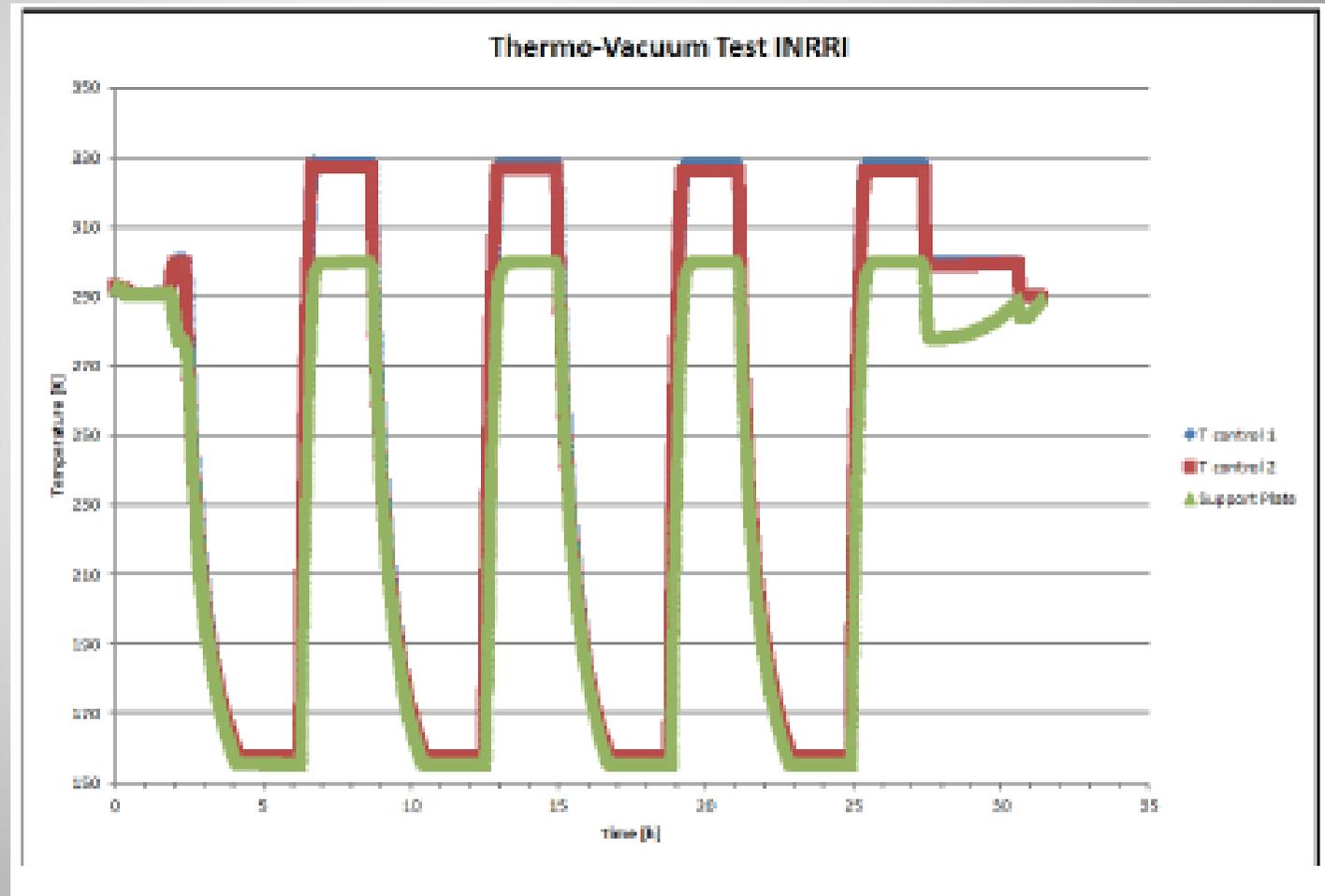


On a PFM only 4 cycles are requested/allowed.

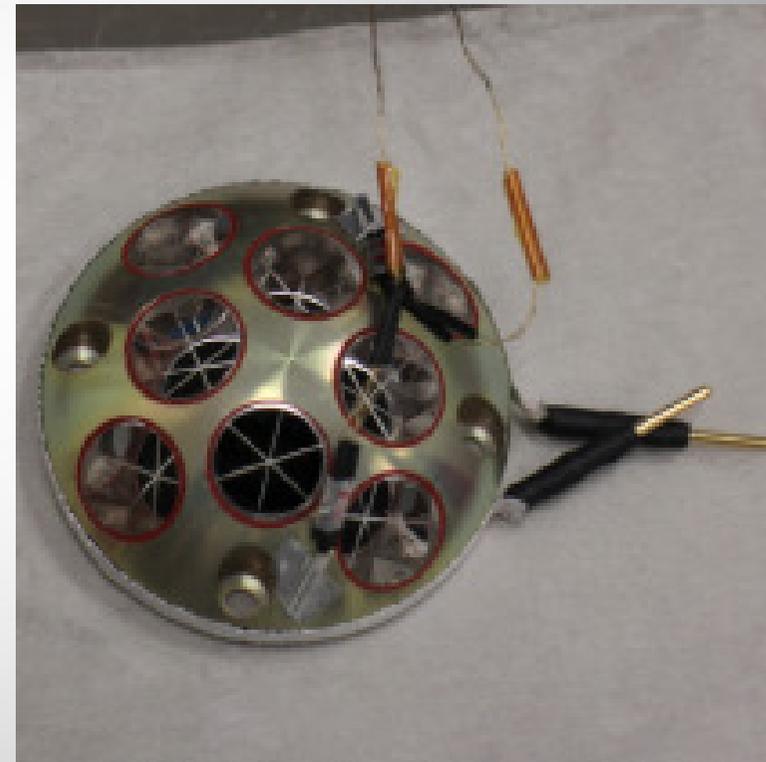
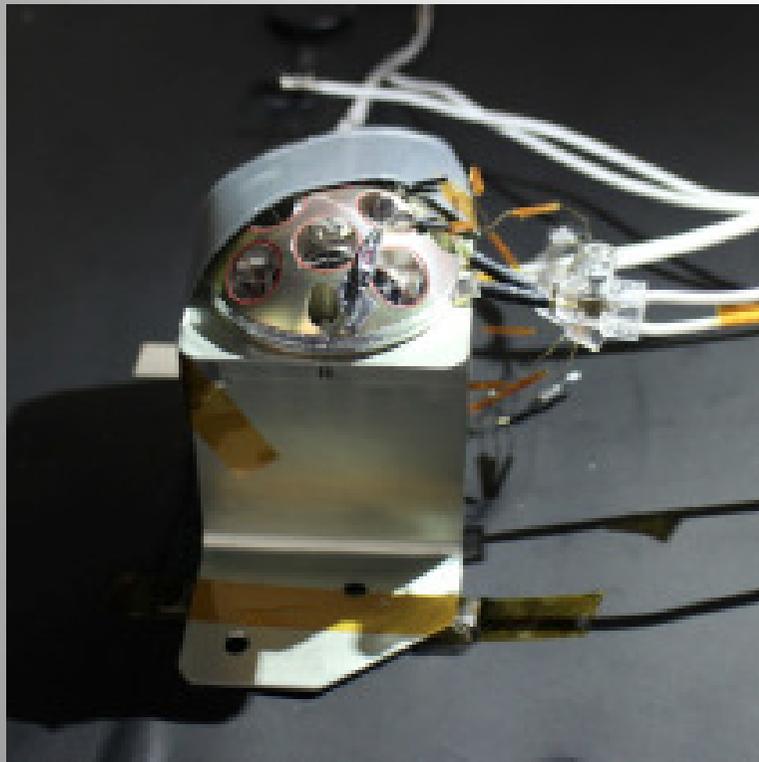
$T_{\min} = -115 \text{ }^{\circ}\text{C}$

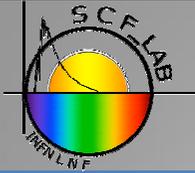
$T_{\max} = 50 \text{ }^{\circ}\text{C}$

$t_{\text{dwell}} = 2\text{h}$

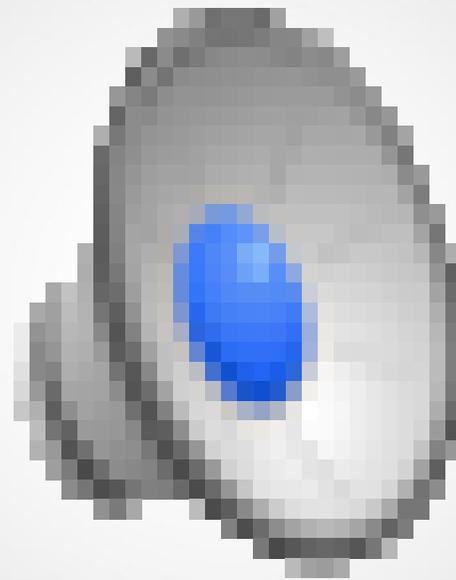


Tricky set up of the thermometers to check for radiation to LN2 shields biasing the measurement

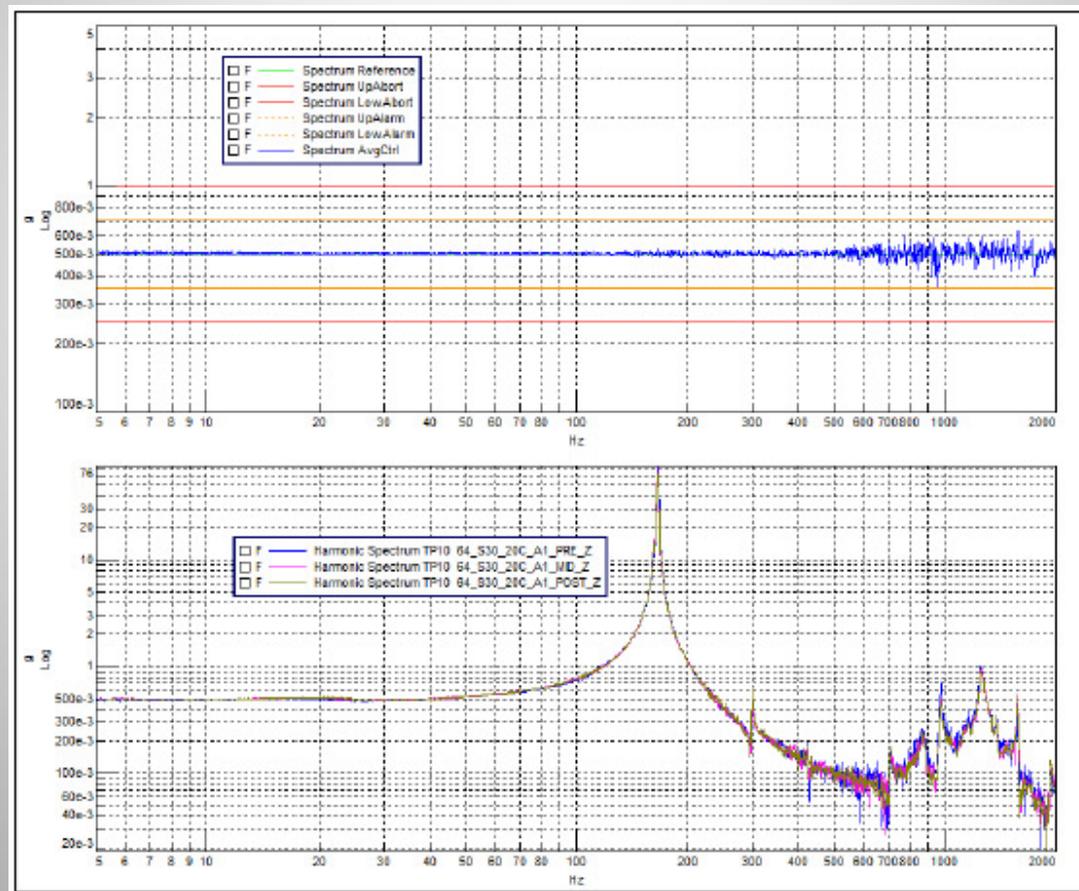


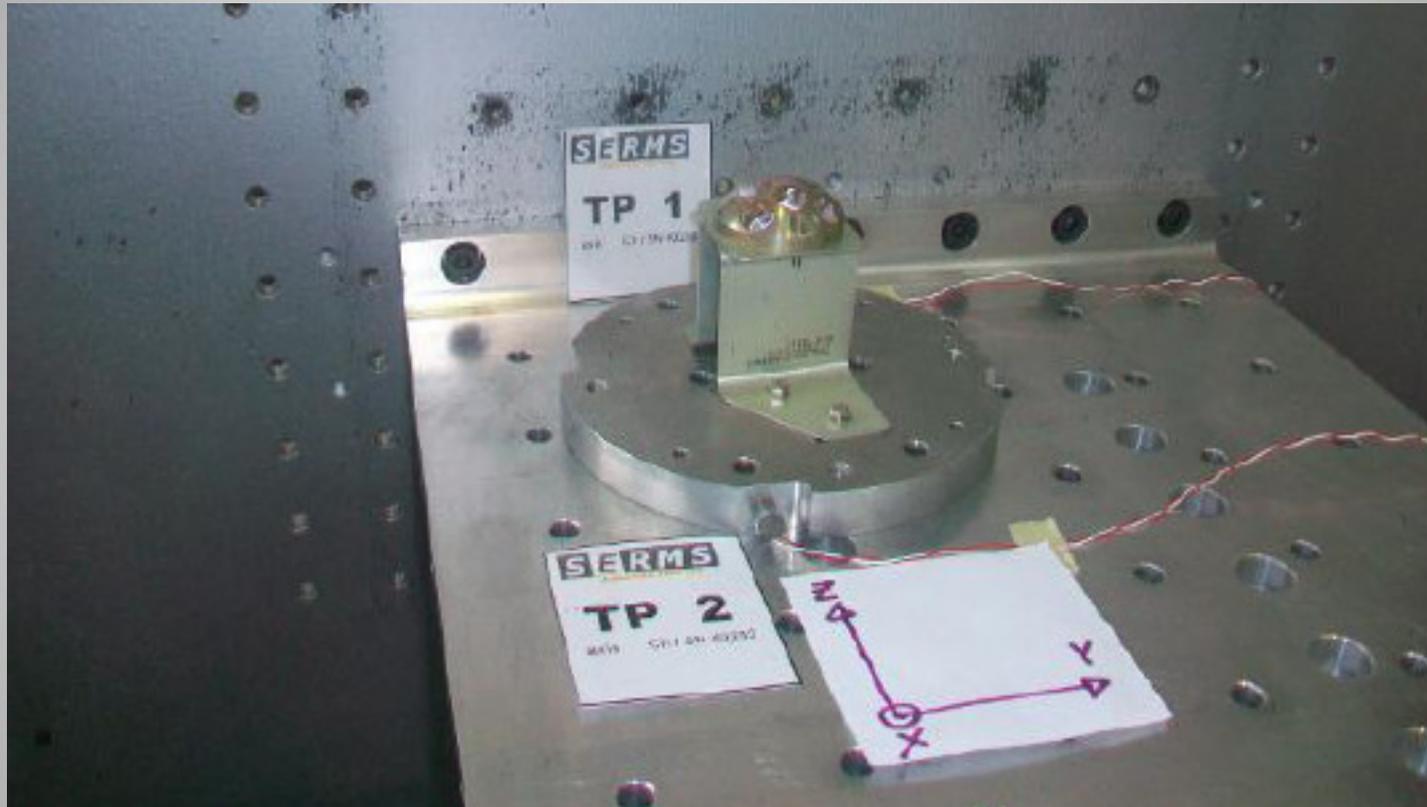


RANDOM TEST Y-AXIS



No resonance shift observed before and after the test





"Why don't you speak to me?!"





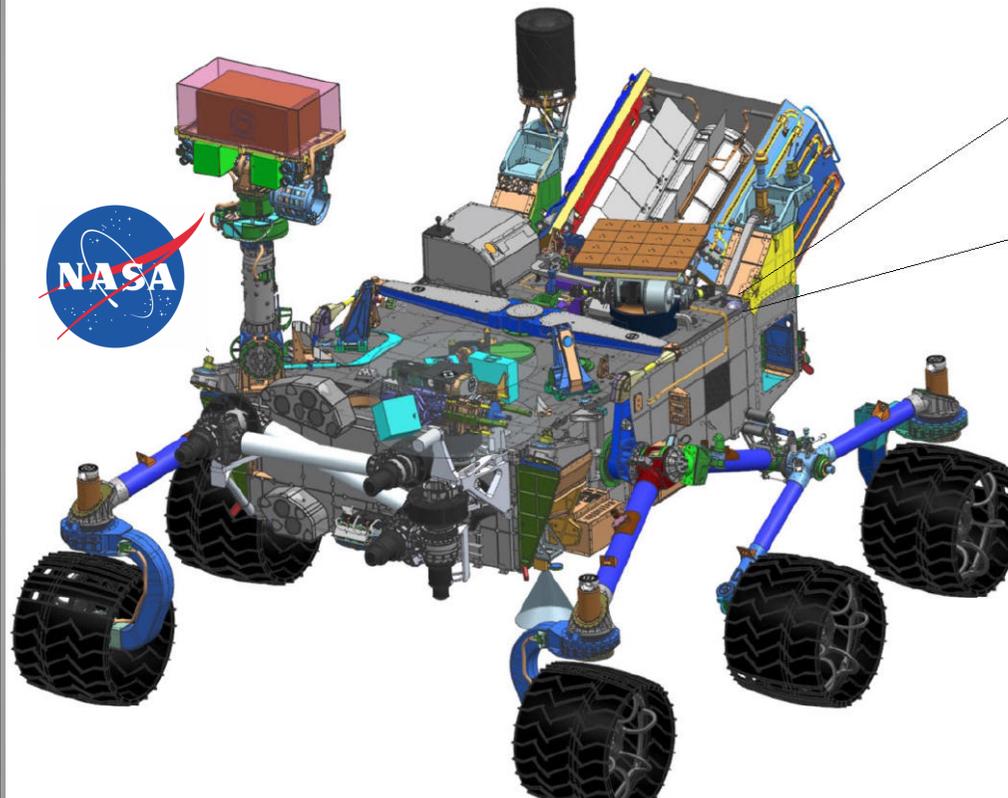
INRRI microreflector for Mars



INRRI\$2020:"

INstrument for landing Roving laser Retroreflector Invesga5ons"

for NASA **Mars 2020**



ESA
**ExoMars
2018**



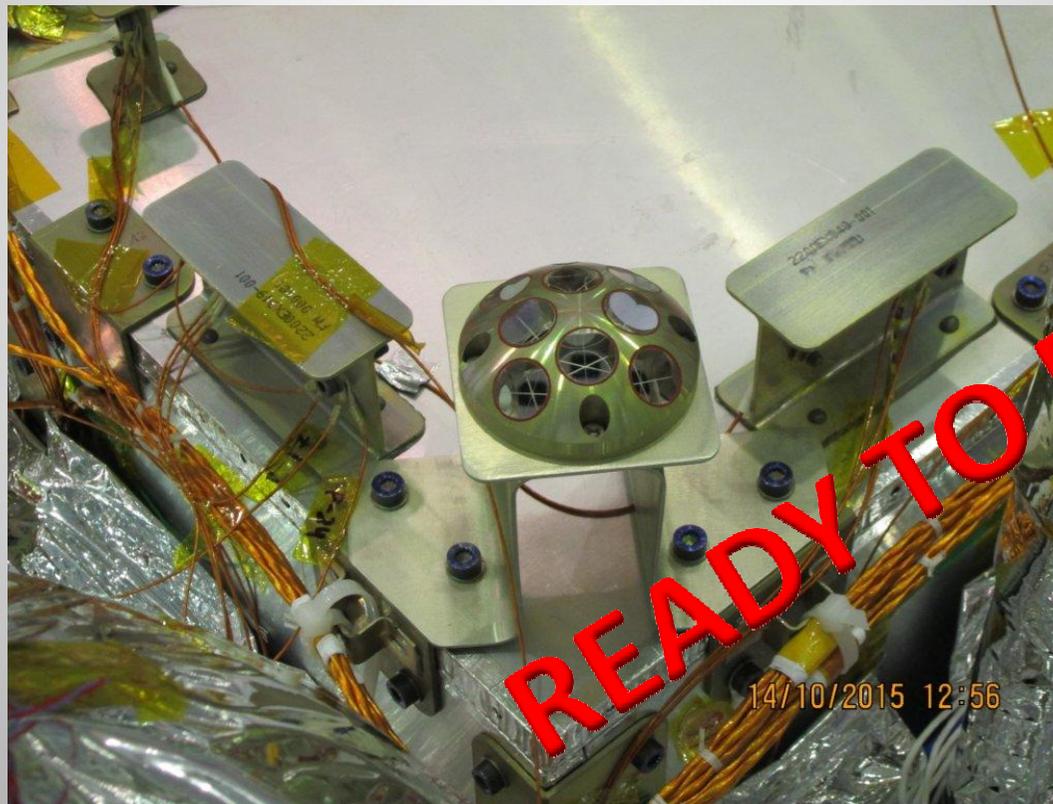
25 grams
Smaller than a computer mouse

13/11/2015

2015 ILRS Technical Workshop matera

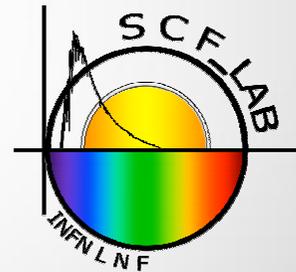
Giovanni O. Delle Monache et. al 15

INRRI got the “go-ahead” from ESA on October 13th and was integrated on EDM a day later, heading to the Red Planet in March 2016!



Thanks for your attention!

Questions?



dellemon@Inf.infn.it

INRRI-EDM/2016: the First Laser Retroreflector Payload on Mars