



# Enabling power and methodologies of international cooperation

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FROM THE ITALIAN SPACE AGENCY

# International cooperation

- ▶ ***International cooperation is a foundation for space exploration***
- ▶ Despite the political implications of the Space Race, already at that time there was room for scientific international cooperation (e.g. Swiss solar wind experiment onboard Apollo 11)
- ▶ Today, the international cooperation is crucial:
  - ▶ It lowers the cost load and failure risk of a space mission for a single country
  - ▶ Offers the possibility to promote the technological and scientific capabilities of a single country at international level
  - ▶ Space activity is a field for soft diplomacy

# Complexity

There are numerous high level international organizations and working groups engaged in a variety of activities related to space.

For instance:

- ▶ UN-COPUOS (United Nations Committee on the Peaceful Uses of Outer Space);
- ▶ IAF (International Astronautical Federation);
- ▶ IAU (International Astronomical Union);
- ▶ COSPAR (Committee on Space Research);
- ▶ ISECG (International Space Exploration Coordination Group);
- ▶ IADC (Inter-Agency Space Debris Coordination Committee).

# Challenges

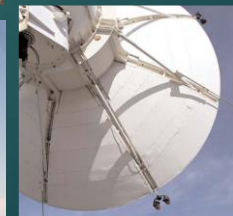
- ▶ Complexity
  - ▶ Overlapping operating fields of different international organizations
  - ▶ Necessity for a single country to act within multiple panels in a coordinated way
- ▶ Interaction between National and International interests and planning
- ▶ Sociological aspects in the dynamics within wide international working groups (e.g. people strive for consensus within a group).

# Topics

- ▶ **Italian Space Agency (ASI)**
- ▶ International Space Station (**ISS**)
- ▶ International Mars Exploration Working Group (**IMEWG**)

# The Italian Space Agency (ASI)

- ▶ Established 1988 with the scope of coordinate the Italian space activities
- ▶ Currently almost 300 employees:
  - ▶ Administrative
  - ▶ Technical/technological
  - ▶ Scientific
- ▶ Several centers:
  - ▶ Headquarters in Rome
  - ▶ Space Science Data Center in Rome
  - ▶ Space Geodesy Center in Matera
  - ▶ Sardinia Deep Space Antenna in Cagliari
  - ▶ Space Center Luigi Broglio in Malindi (Kenya)
  - ▶ Partecipation in 5 Companies



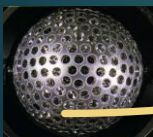
# The mission of ASI

- ▶ Within the Italian community
  - ▶ Promotion, development, coordination and funding of scientific and technological space research
  - ▶ Promotion and support of national aerospace industry
  - ▶ Support of space education and training of students and young professionals
- ▶ Internationally:
  - ▶ Coordinates the Italian participation in ESA programs and activities;
  - ▶ Supports the Italian participation in European Union programs for the promotion of space research and technology;
  - ▶ Negotiates and defines bilateral and multilateral space agreements with other agencies and countries;
  - ▶ Maintains international relations with other countries for space related topics

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# ASI main programs for Solar System exploration

1992  
Lageos2



1997  
Cassini/Huygens



2003  
Mars Express



2004  
Rosetta/Philae



2005  
Venus Express



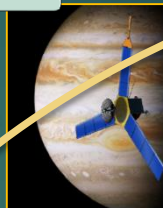
2005  
MRO



2007  
Dawn



2011  
JUNO



2016  
ExoMars 2016



2018  
Bepi Colombo  
Solar Orbiter



In preparation:  
2020 – ExoMars  
2022 – JUICE

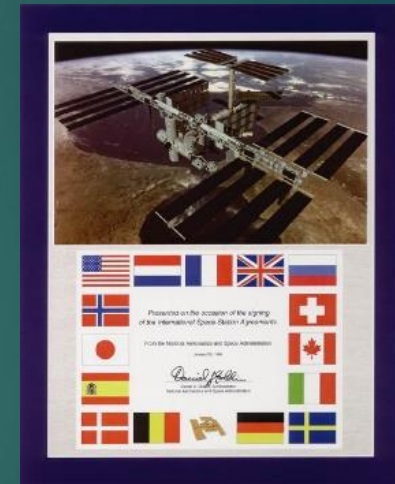


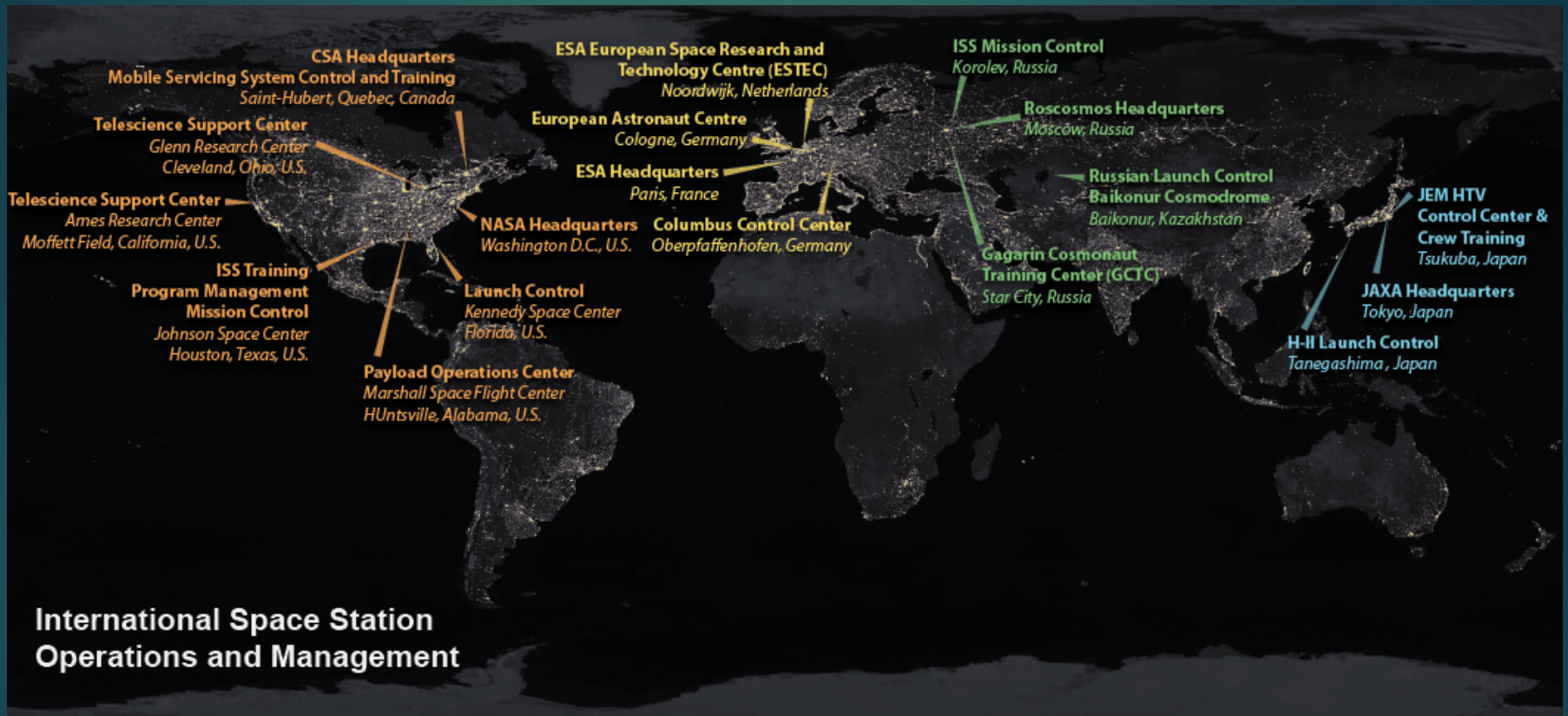
# Topics

- ▶ Italian Space Agency (**ASI**)
- ▶ **International Space Station (ISS)**
- ▶ International Mars Exploration Working Group (**IMEWG**)

# International Space Station (ISS)

- ▶ The International Space Station (ISS) is the most politically complex space program ever undertaken.
- ▶ The ISS brings together:
  - ▶ international flight crews;
  - ▶ globally distributed facilities (launch, operations, training, engineering, and development);
  - ▶ communications networks;
  - ▶ scientific research community.
- ▶ The ISS is a unique case and should be used as reference for any future international exploration mission.





# Topics

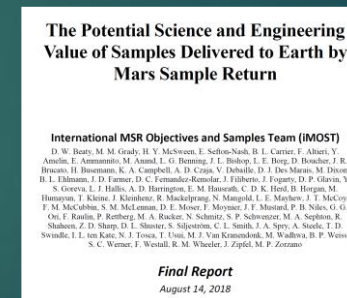
- ▶ Italian Space Agency (**ASI**)
- ▶ International Space Station (**ISS**)
- ▶ **International Mars Exploration Working Group (IMEWG)**

# International Mars Exploration Working Group (**IMEWG**)

- ▶ IMEWG is a non-binding group and does not create any legal obligations.
- ▶ The objective is to facilitate the development of a comprehensive, co-ordinated, and sustainable international Mars Exploration Programme.
  - ▶ 1. Share information and future plans on the development of national and international Mars Exploration Programmes,
  - ▶ 2. Encourage international co-operation and co-ordination in the development of Mars Exploration Programmes,
  - ▶ 3. Facilitate the interoperability of Mars exploration systems and minimize duplication,
  - ▶ 4. Explore opportunities for collaboration and/or coordinated missions.

# IMEWVG and the Mars community

- ▶ Two teams have been chartered by IMEWVG to support the Mars Sample Return (MSR) mission:
  - ▶ **i**nternational **M**ars **A**rchitecture for the **R**eturn of **S**amples (**iMARS**)
    - ▶ chartered in 2006;
    - ▶ a scientific and Technical team to develop a plan for Mars Sample Return Mission Architecture
    - ▶ iMARS-1 (2008) and iMARS-2 (2016)
  - ▶ **i**nternational **MSR** **O**bjectives and **S**amples **T**eam (**iMOST**)
    - ▶ chartered in 2017;
    - ▶ a scientific team to assess the expected value of the samples to be collected by the Mars2020 rover.

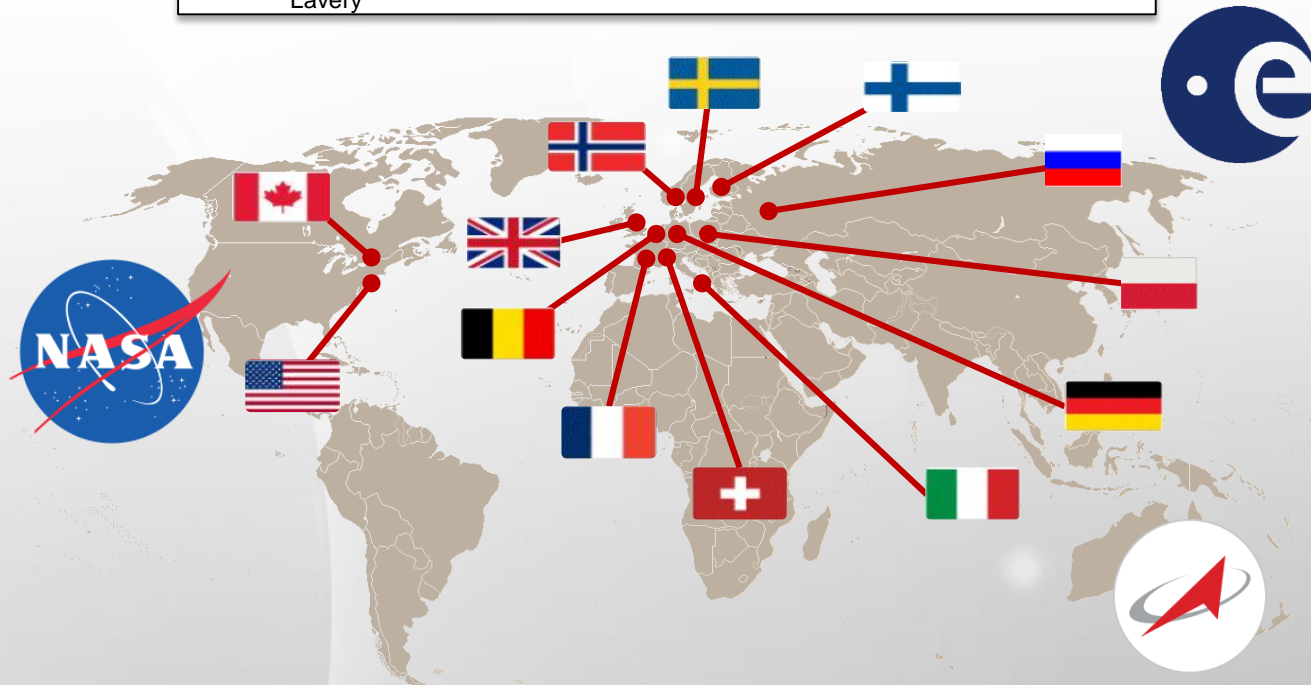


*Steering Committee*Lisa May → Dave  
Lavery

Rolf de Groot



Lev Zelenyi

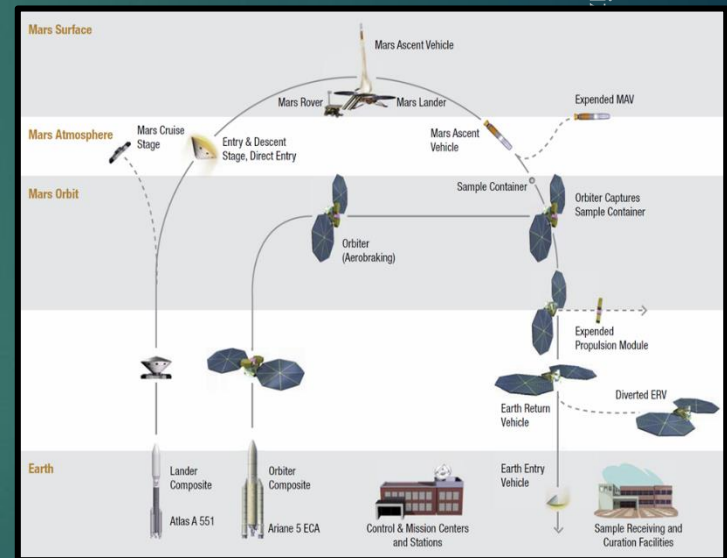


# iMARS Phase 1:

## Preliminary Planning for an International Mars Sample Return Mission

Full report published in 2008  
([https://mepag.jpl.nasa.gov/reports/iMARS\\_FinalReport.pdf](https://mepag.jpl.nasa.gov/reports/iMARS_FinalReport.pdf))

- ▶ scientific return of MSR depends on the character, diversity, and quality of the samples returned.
- ▶ substantial effort in the short/medium terms to reach a correct maturity level of technologies.
- ▶ Planetary protection challenges in the post-return segment.
- ▶ Complex architecture.
- ▶ ~20 separate elements for funding by different international entities.
  - ▶ Interfaces between these different elements is a challenge.
  - ▶ Determining “who does what” would be partly a technical and partly a political question.



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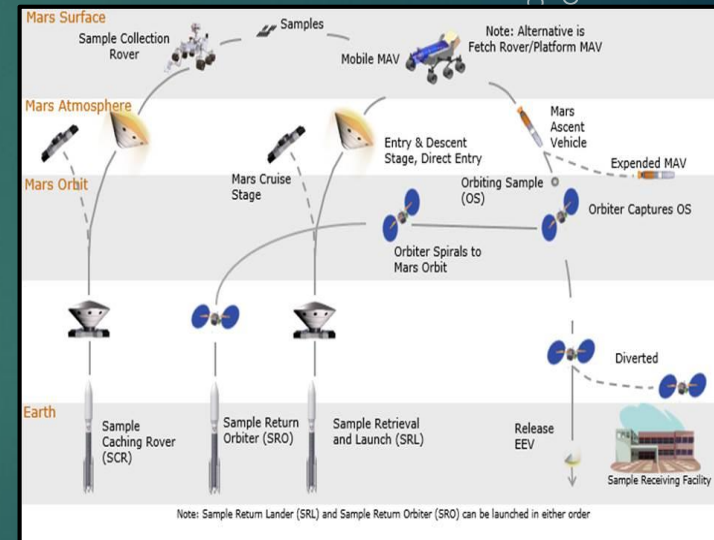


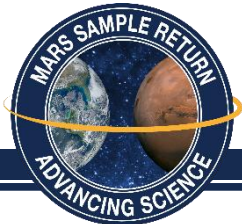
# iMARS Phase2:

## A Draft Mission Architecture and Science Management Plan for the Return of Samples from Mars

The WG's key recommendations (Halting et al. 2018, <https://www.liebertpub.com/doi/10.1089/ast.2018.29027.mars>):

- ▶ interested international partners must declare their interests, define a cooperation framework, and determine their contributions.
- ▶ An internationally-tasked and -accepted planetary protection protocol for MSR should be produced as soon as possible.
- ▶ Establish an international MSR Science Institute upon approval to return samples from Mars.
- ▶ Two key MSR enabling technologies (MAV and sample containment) require further investments to proceed with development.





# Report of the iMOST Study

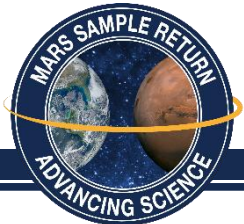
June 26, 2018

## International MSR Objectives and Samples Team (iMOST)

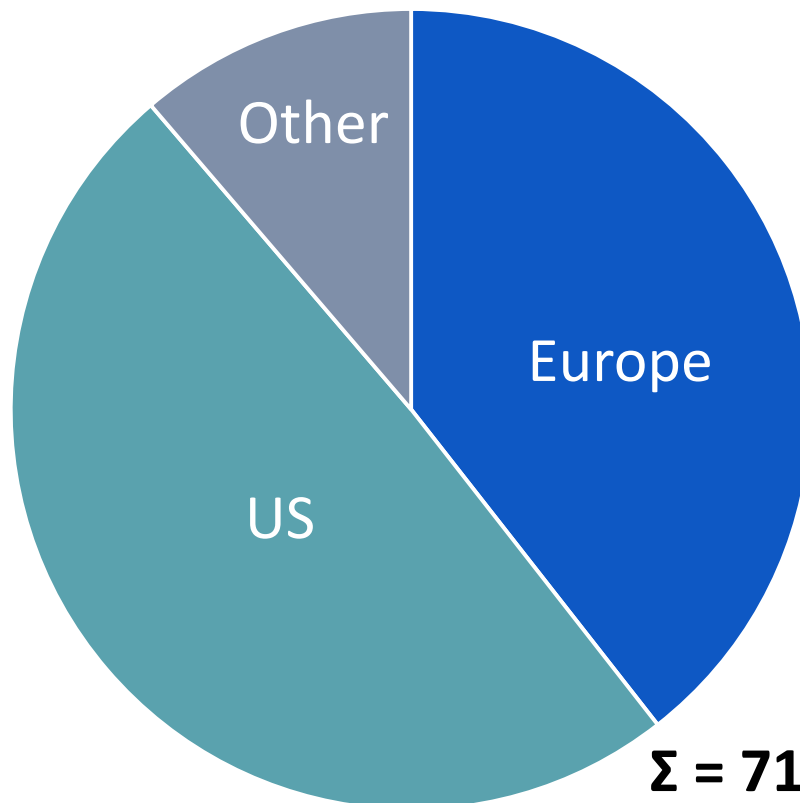
D. W. Beaty, M. M. Grady, H. Y. McSween, E. Sefton-Nash (co-chairs), B. L. Carrier (documentarian), F. Altieri, Y. Amelin, E. Ammannito, M. Anand, L. G. Benning, J. L. Bishop, L. E. Borg, D. Boucher, J. R. Brucato, H. Busemann, K. A. Campbell, B. L. Carrier, A. D. Czaja, V. Debaille, D. J. Des Marais, M. Dixon, B. L. Ehlmann, J. D. Farmer, D. C. Fernandez-Remolar, J. Filiberto, J. Fogarty, D. P. Glavin, Y. S. Goreva, L. J. Hallis, A. D. Harrington, E. M. Hausrath, C. D. K. Herd, B. Horgan, M. Humayun, T. Kleine, J. Kleinhenz, R. Mackelprang, N. Mangold, L. E. Mayhew, J. T. McCoy, F. M. McCubbin, S. M. McLennan, D. E. Moser, F. Moynier, J. F. Mustard, P. B. Niles, G. G. Ori, F. Raulin, P. Rettberg, M. A. Rucker, N. Schmitz, S. P. Schwenzer, M. A. Sephton, R. Shaheen, Z. D. Sharp, D. L. Shuster, S. Siljeström, C. L. Smith, J. A. Spry, A. Steele, T. D. Swindle, I. L. ten Kate, N. J. Tosca, T. Usui, M. J. Van Kranendonk, M. Wadhwa, B. P. Weiss, S. C. Werner, F. Westall, R. M. Wheeler, J. Zipfel, M. P. Zorzano

### Notes

- *An earlier version of this PPT file was presented and discussed at the 2<sup>nd</sup> International Mars Sample Return Conference, in Berlin, Germany, April 25-27, 2018. This version incorporates feedback received.*
- *This document is the PPT representation of a large text-formatted report (working title: “The Potential Science and Engineering Value of Samples Delivered to Earth by Mars Sample Return”). In case of discrepancies, the text report should be interpreted as superior.*
- *This study was sponsored by the International Mars Exploration Working Group (IMEWG).*



## International Participation, iMOST Study



Countries Represented	
Australia	Netherlands
Belgium	Norway
Canada	Spain
France	Sweden
Germany	Switzerland
Italy	UK
Japan	US
New Zealand	

# Final thoughts

- ▶ ***International cooperation expands the horizon of space exploration***
- ▶ The ISS is an example of a functional complex international cooperation
- ▶ There is the need for a common platform where science objectives and methodologies are continuously discussed and agreed
- ▶ Every effort towards international cooperation will work better in the presence of an effective national coordination system (also at scientific level)