The role of COSPAR in space exploration and in preserving and promoting science

Pascale Ehrenfreund,
Chair, Panel on Exploration, COSPAR,
Space Policy Institute, USA

COSPAR Committee on Space Research-1958

- COSPAR represents national science institutions from 44 member countries, 13 international scientific unions and 5 associated companies

- Strives to promote the use of space science for the benefit of mankind and for its adoption by developing countries and new space-faring nations

- Panel on Exploration (PEX) – 2008

  "Toward a Global Space Exploration Program: A Stepping Stone approach", June 2010

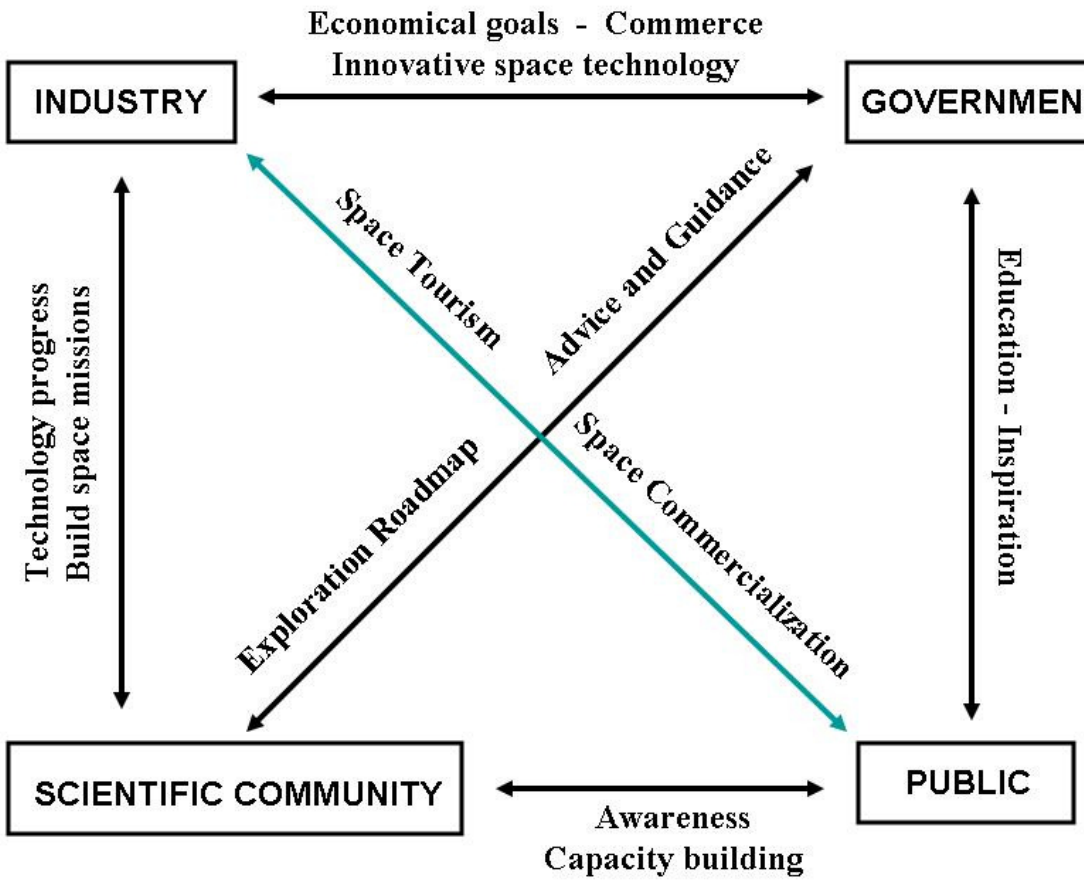
http://cosparhq.cnes.fr/

Space Exploration

IAA, ILEWG, LEAG, MEPAG, CAPTEM…..
Global Exploration Strategy GES

Emerging new space exploration context will be international, human centric, trans-disciplinary and participatory…..

Stakeholders in global space exploration

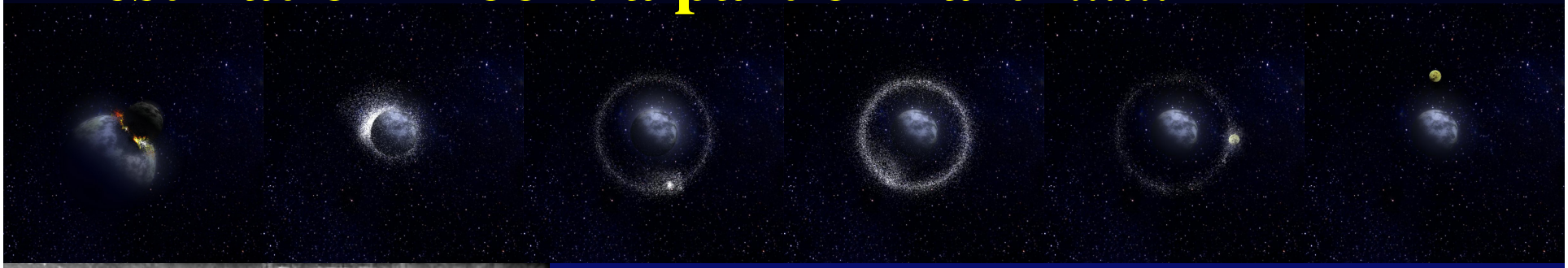


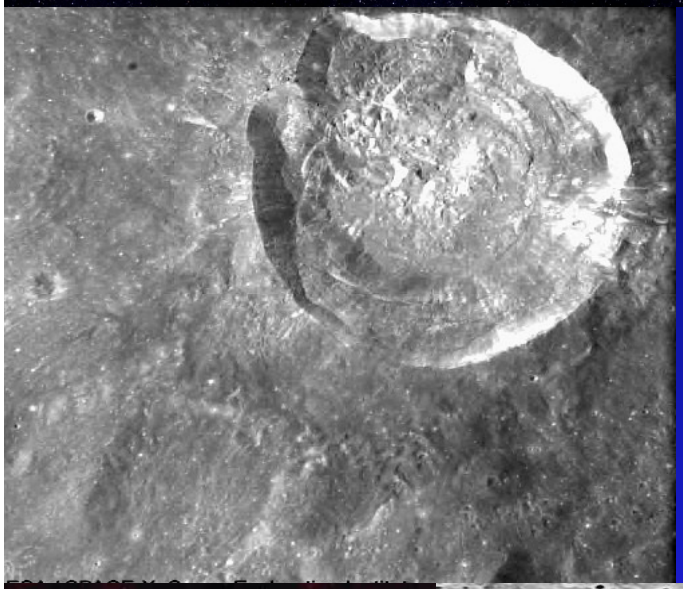
Ehrenfreund & Peter, Space Policy 25, 2009

→ New avenues of space commercialization may strengthen the link between industry and society

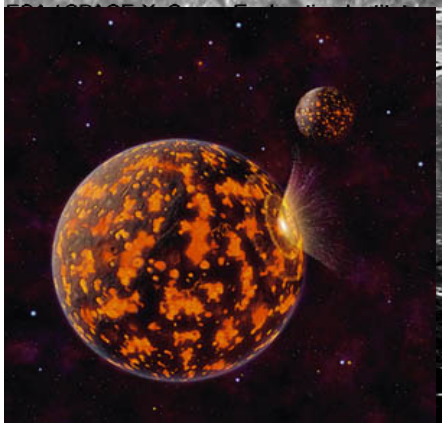
Exploring the Earth-Moon-Mars space

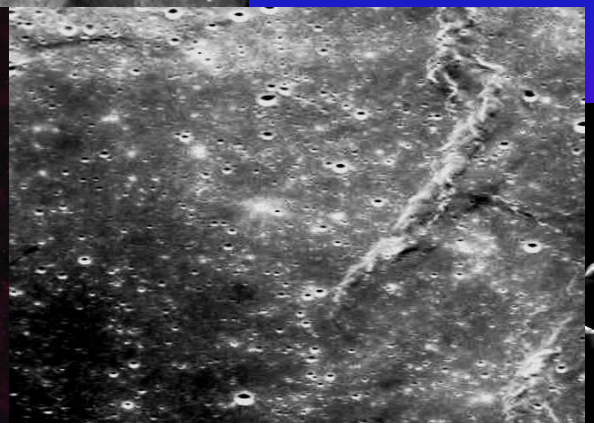
Destination Moon: a part of Earth.....

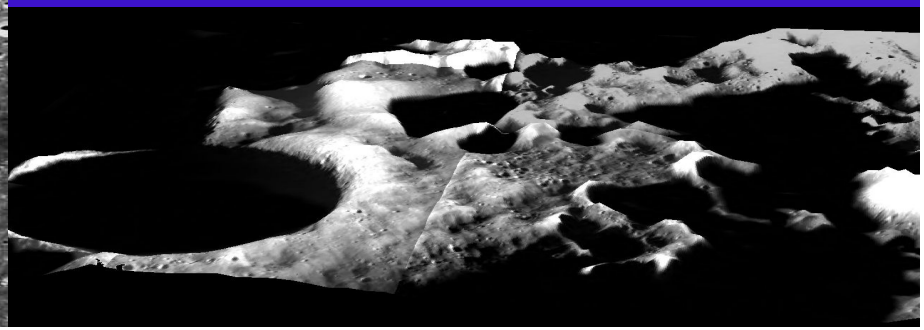




- Early Earth-Moon System
- Terrestrial Planet Differentiation and Evolution
- Solar System Impact Record
- Lunar Environment

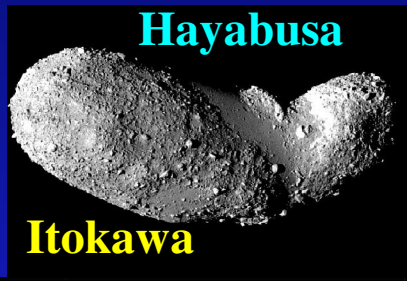


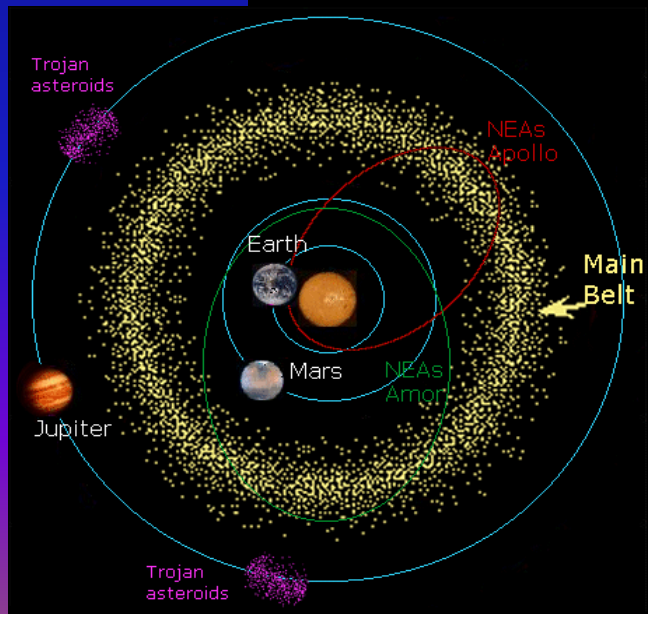




Destination Near-Earth Asteroids: tracing origins...

- Knowledge of formation, properties, distribution and evolution of NEOs
- Record: solar system and planet formation

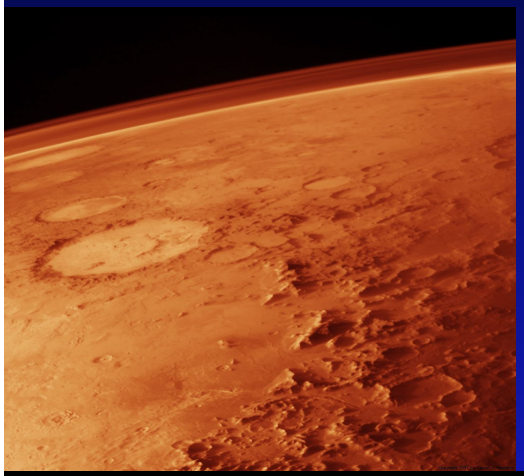


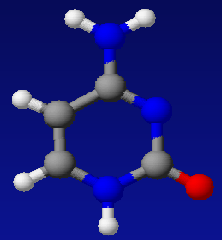


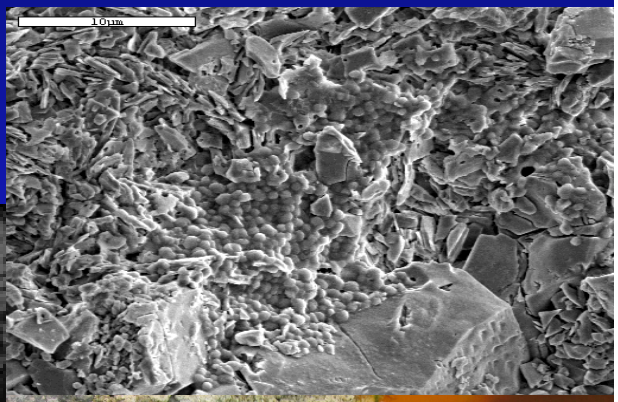
- Human NEO mission expands our spaceflight experience base beyond LEO
- Provides a milestone for exploration and for hazard mitigation

Destination Mars: searching for life……

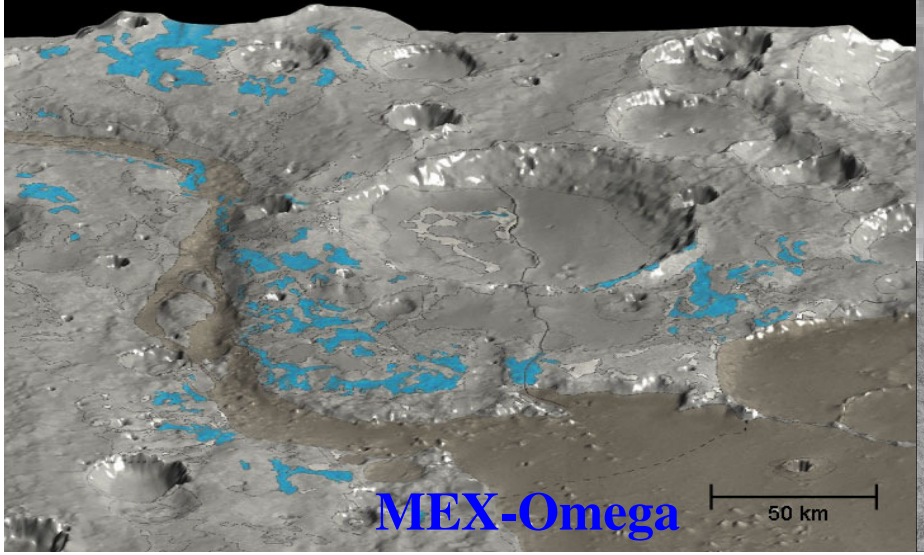
- Determine if life ever arose on Mars
- Understand climate
- Evolution of surface & interior
- Prepare for human exploration

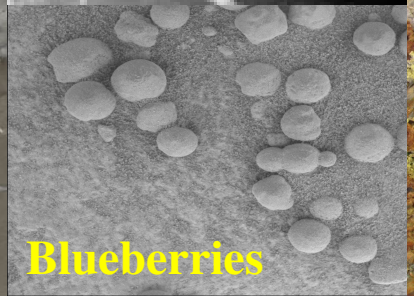






Phyllosilicates → aqueous origin





How to go from here?

COSPAR actions

Support transition period toward global space exploration:

Stepping stones conducted in synergy with several stakeholders

- International Earth based field research program
- Joint program for international research activities (e.g. ISS)
- World-wide Small-Sat program
- Global Robotic Village
- Joint Sample Return Mission
- International Human Bases

International planetary exploration analog field program

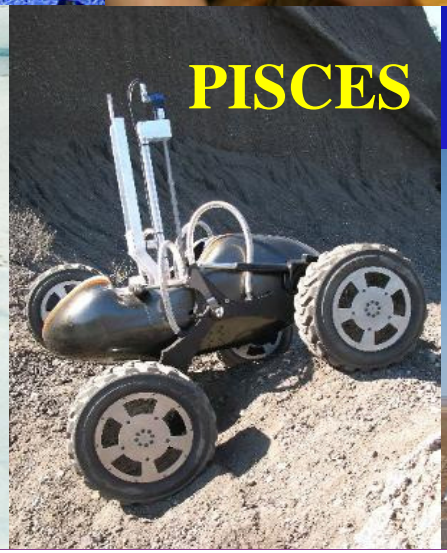
Concordia, Antarctic

Mars 500

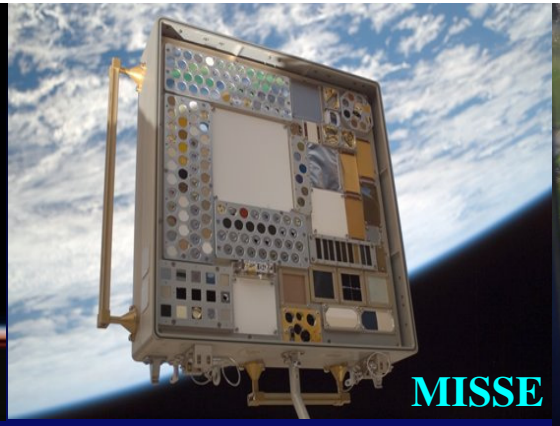
MDRS Devon Island

AMASE

PISCES



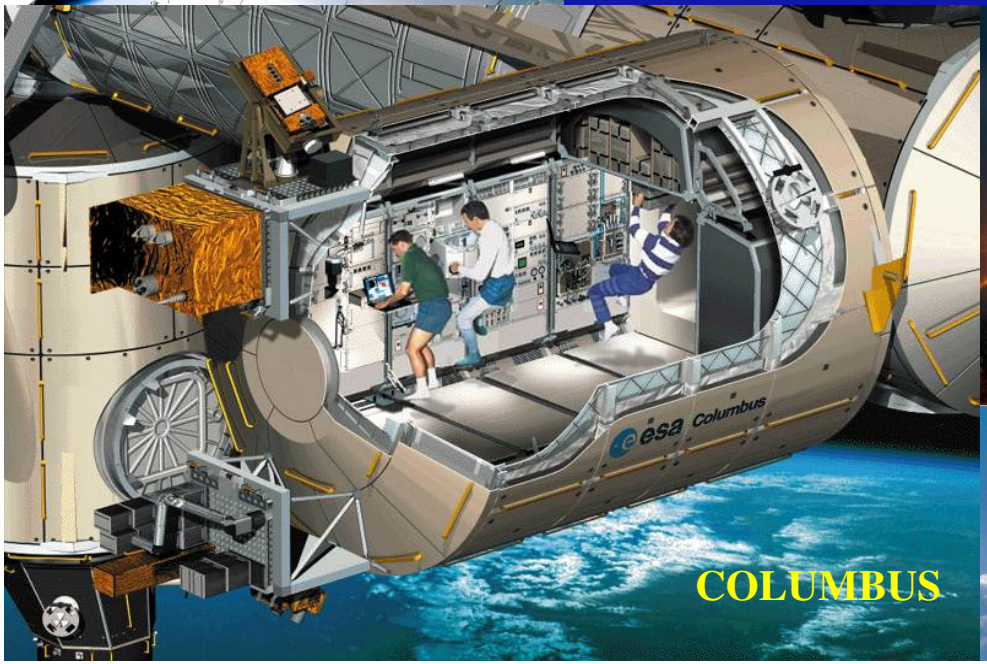
RATS Desert



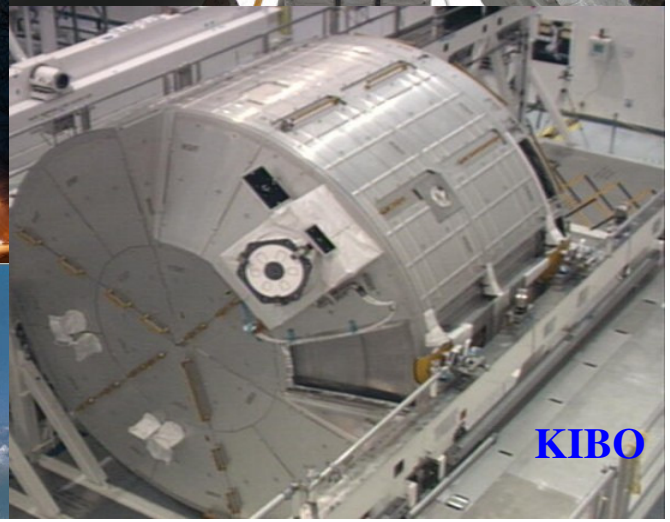
MISSE

LADA

International exploitation of the ISS in preparation for exploration

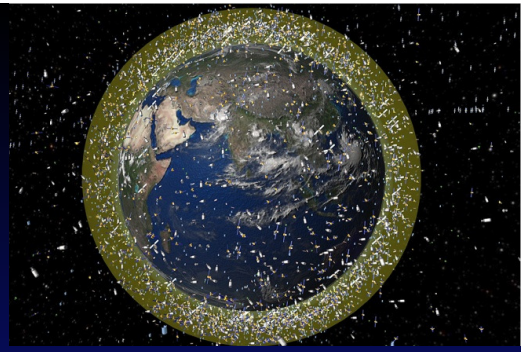


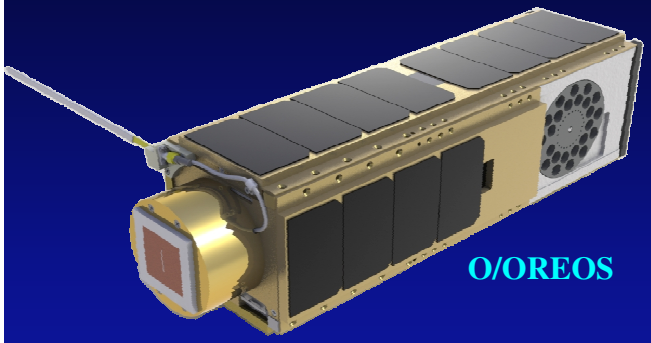
COLUMBUS



KIBO

Worldwide Small-Sat program in support of exploration





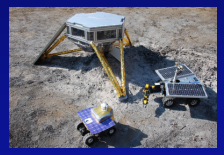
O/OREOS

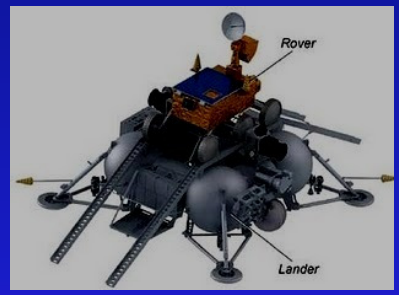
- Research in biology, atmospheric science space weather, materials..
- Hitch-hikers on missions to Moon and Mars

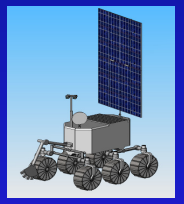
- Academia
- Governments
- Private sector
- Developing countries

Global Robotic Village

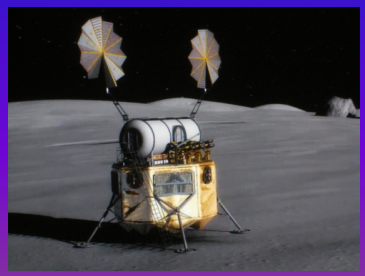
Coordination of international surface and orbital elements for research, technology development and future human exploration



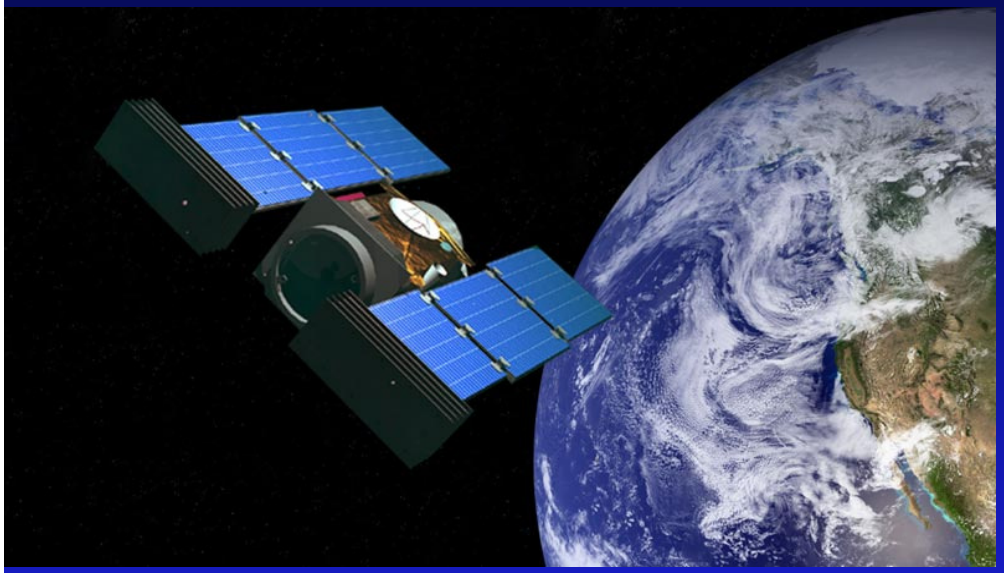




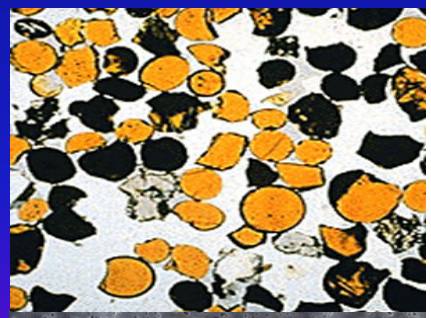
- Solar power
- Telecommunication
- Navigation beacons
- Long-range research rovers
- In-situ resource utilisation
- Robotic assistants to humans
- Landing and launch area

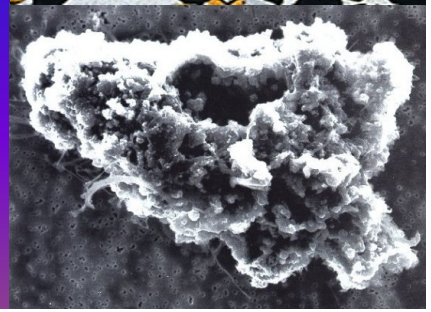


International Sample Return Mission



- Touch and go
- Surface collection (CAPTEM)
- SR from carbonaceous NEA
- Multi-Element MSR
- International Curation facility

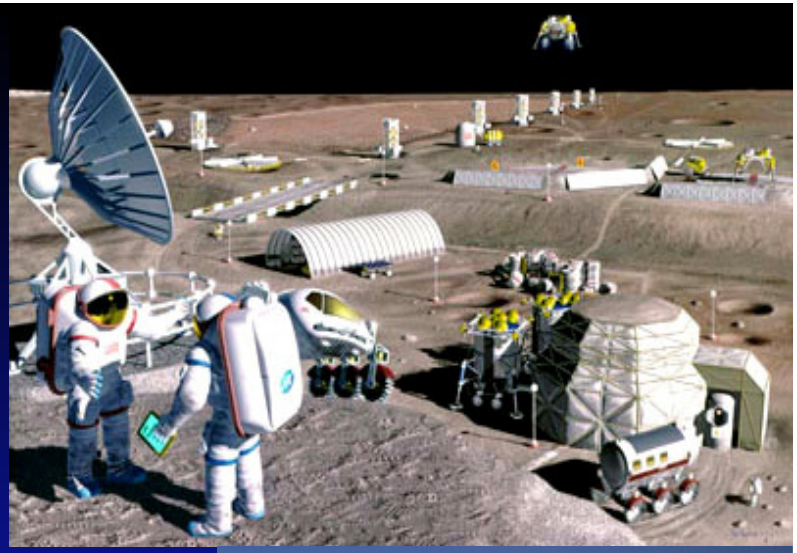




High priority in the science community
Closest simulation for human exploration

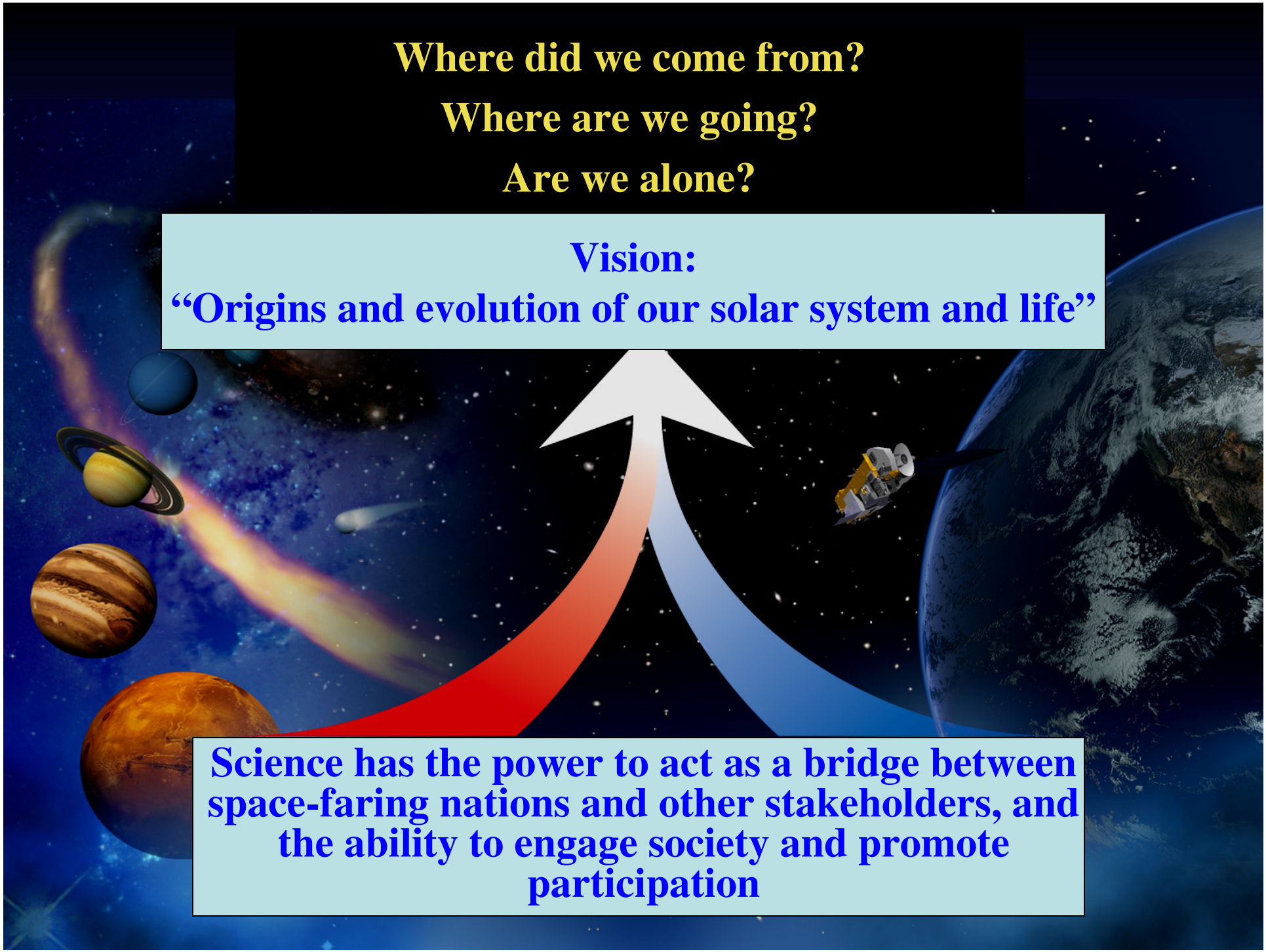
Human bases – using Antarctica as a model

- ILEWG/LEAG roadmaps
- IAF/IAA Forum
- Beijing Declaration 2008
- Multidisciplinary endeavor



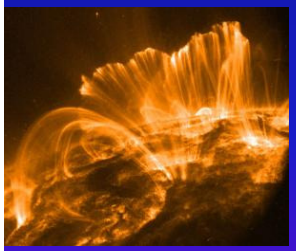
Antarctica: International Arena

- Nations compete and cooperate
- Bases, no settlement
- Long-term science platform
- Antarctic treaty

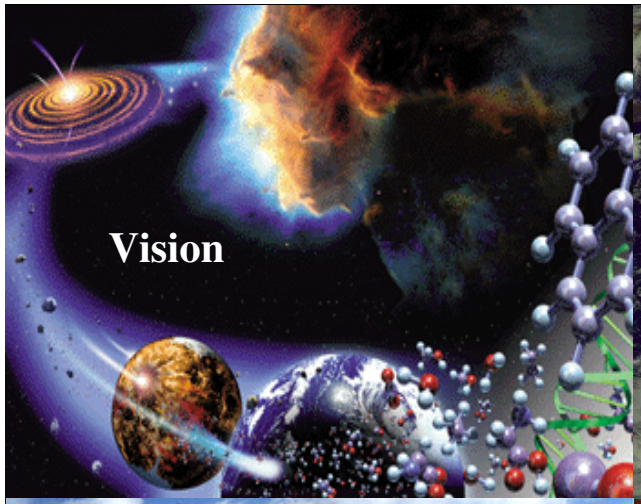

Where did we come from?
Where are we going?
Are we alone?
Vision:
"Origins and evolution of our solar system and life"
Science has the power to act as a bridge between space-faring nations and other stakeholders, and the ability to engage society and promote participation

Bridging the Earth and space communities

- Protecting life on Earth requires similar concepts and information as investigations of life beyond Earth
- Instrumentation, technology to probe surface/subsurface require similar methods
- Network to enable interchange of scientific insights leading to the development of new common policies



Martian climate history
Extreme life
Earth observations from ISS and Moon….

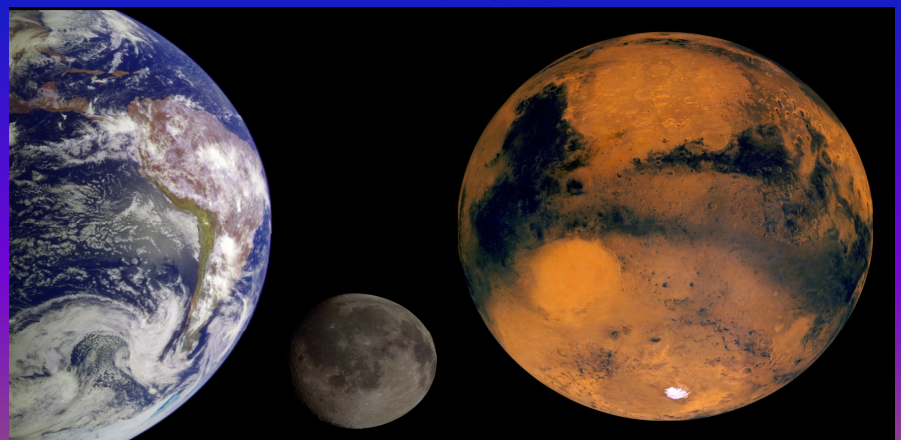


Exploring the Earth Moon Mars Space

Searching for our origins …..

Protecting solar system environments

- We risk losing the ability to measure and understand the subtle pristine conditions of these bodies before they are irrevocably altered by human-induced activity
- Factors: dust raising, seismic disturbance, biological contamination, site destruction, electromagnetic interference, radioactive contamination…
- Greater need for environmental protection as commercial pressures relegate



PPP
IAA studies

Treaties to protect the Earth-Moon-Mars space

1967 Outer Space Treaty OST
1979 Moon Agreement MA
Antarctic Treaty regime:

….. natural reserve – devoted to peace and science

- **Necessary to clarify and complement the legal regime currently regulating the exploration of the Moon and other celestial bodies**

- **Additional regulations need to be elaborated to ensure valuable, safe, economic, and broadly-based exploration that encompass and balance a diverse set of stakeholder interests and will benefit both current and future generations**

PEX: Future Perspectives

- **PEX, working with COSPAR Scientific Commissions and Panels, and with the international science foundations, the IAA, IAF, UN bodies, and the IISL, will support science-driven national and international space exploration working groups in the new era of planetary exploration**

- **Regular workshops to promote Stepping Stones**

  March 2011, Space Policy Institute:

  "International Earth-based research program as stepping stone for global space exploration"

- **Support activities in capacity building for space exploration**

Back-up

PEX: Synergies and Recommendations

PEX will take specific actions to:

- support a worldwide Earth based field research program
- support the international exploitation of the ISS in preparation for exploration
- support a worldwide CubeSat program for developed and developing countries in preparation for exploration
- support the ILEWG lunar Global Robotic Village
- support studies and precursor activities toward International Human Bases (Moon, Mars) using research activities in Antarctica as a model
- support synergies between Space Exploration and Earth science
- support the Panel on Planetary Exploration in protecting the lunar and martian environments for scientific research
- support updated regulations to protect the Earth-Moon Mars space
- support activities in capacity building for space exploration
- involve and engage the public stakeholder and youth in participatory ways

Engage with COSPAR commissions, ESF, NSF, IAA/IAF, UN bodies, IISL to support planetary exploration and national/international working groups

Science and Human Space Flight Today

International Space Station Science Research: Accomplishments during the assembly years: An Analysis of Results from 2000-2008 (Evans et al.)

2010: NASA Decadal survey: Life and Physical Sciences Space Research:
Among the research objectives:*"Define and align life and physical sciences research to meet the needs of exploration missions"*

ELIPS 3 European Programme for Life and Physical Science in Space: ESA ISS Utilization period 2008-2012
Among the research objectives:
"Preparation of Human Exploration of Space"

Scientific Rationale for Human Exploration of the Moon (Crawford et al. 2009, White paper)

- Planetary science stands to be a major beneficiary of human space exploration
- Facilitation of landing, operating and maintaining massive and complex scientific equipment
- Facilitation of large-scale exploratory activities (e.g. drilling)
- Intelligent and efficient collection of samples – large quantities, different location, wider geographical areas
- Increased opportunities for serendipitous discoveries
- Trouble shooting problems

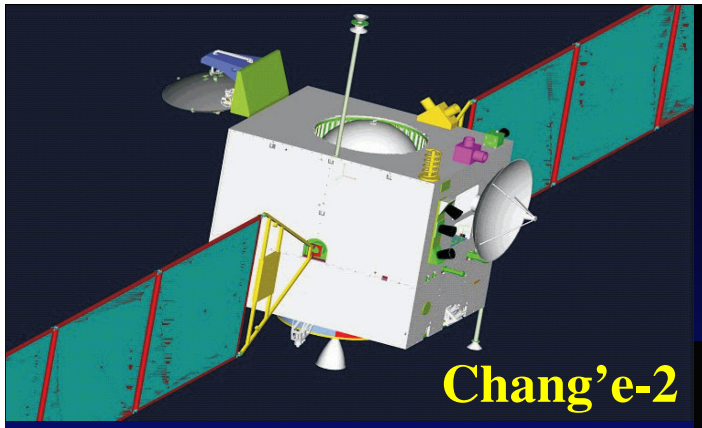
Scientific Vision for planetary exploration

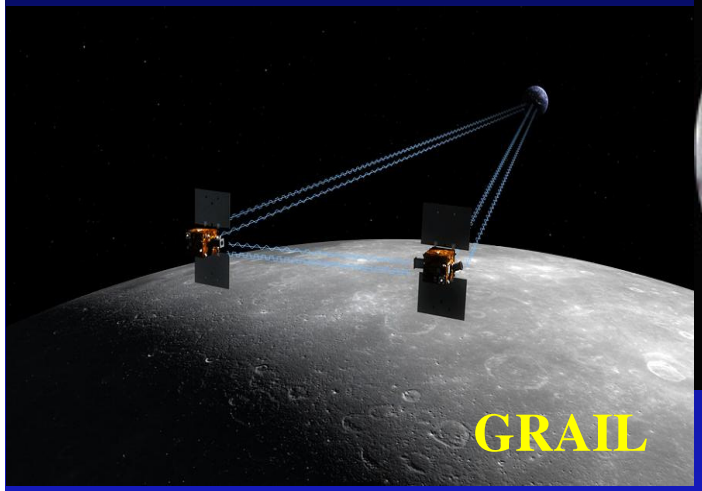
There has been ample activity concerning space exploration in recent years, e.g.:

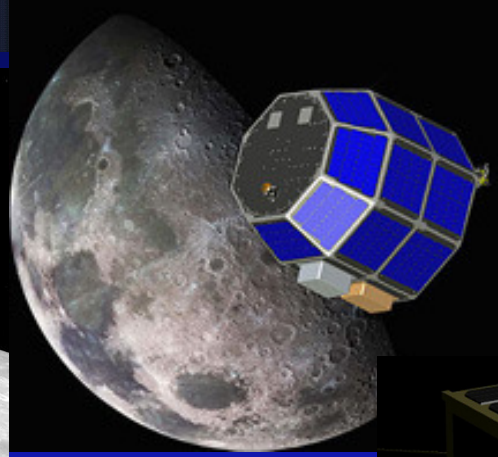
- **IAA Cosmic study "Next steps in exploring deep space" 2004**
- **International Lunar Exploration Working Group ILEWG**
- **Lunar Exploration Analysis Group LEAG**
- **National Research Council (NRC) reports**
- **NASA Lunar Science Institute nodes LSI**
- **Mars Exploration Planning and Analysis Group MEPAG**
- **Curation and Analysis Planning Team for Extraterrestrial Material CAPTEM**
- **International Mars Exploration Working Group IMEWG**
- **International Space Exploration Coordination group ISECG**

PEX provides a summary of science roadmaps and exploits synergies to support the development of worldwide space exploration programs and to safeguard the scientific assets of solar system objects

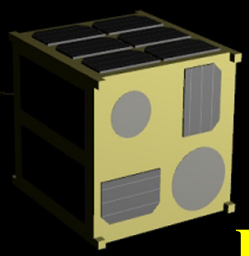
Moon Decade



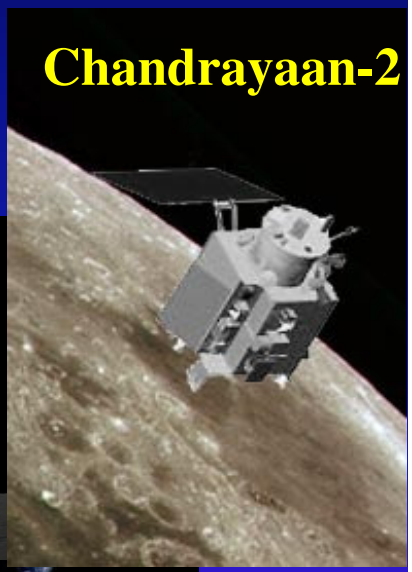


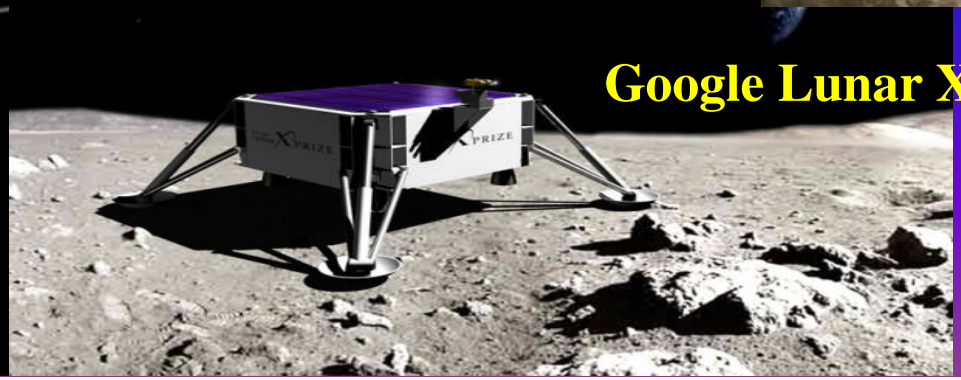


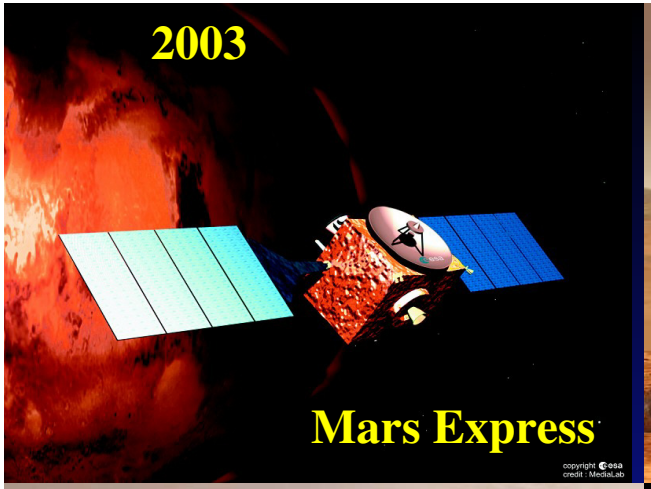
LADEE



ESMO



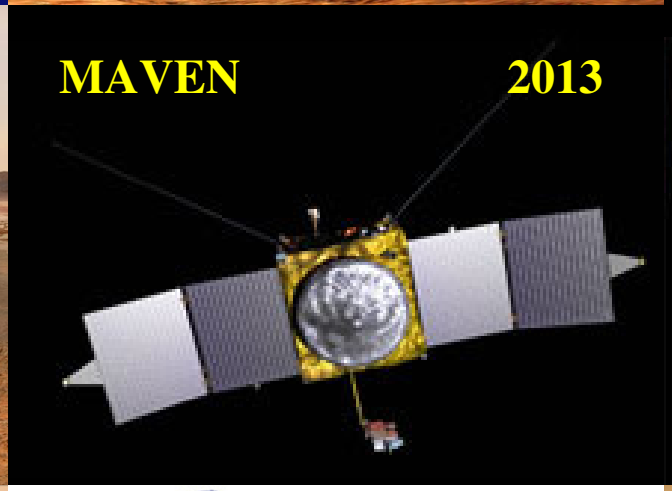



2003
Mars Express
copyright esa
credit : MediaLab

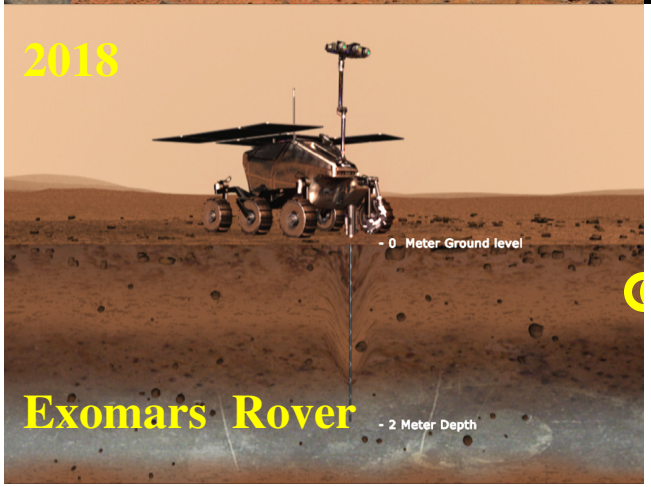

2003
Mars Exploration Rovers

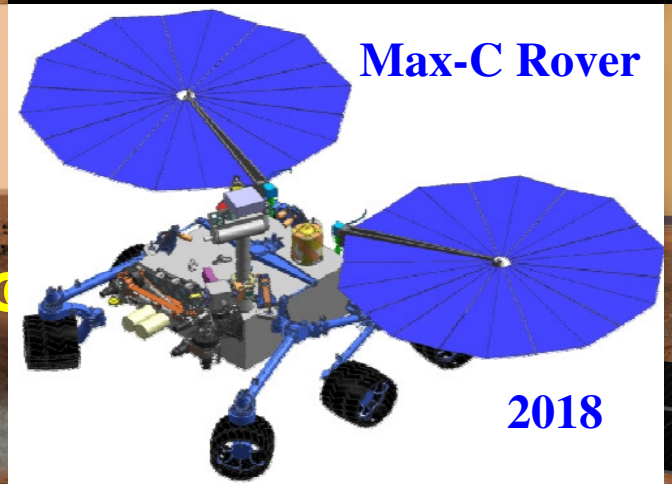

2006
Mars Reconnaissance Orbiter


2011
Mars Science Laboratory


MAVEN
2013


Trace Gas Orbiter
2016
2016


2018
- 0 Meter Ground level
Exomars Rover
- 2 Meter Depth


Max-C Rover
2018


> 2020
Mars Sample Return

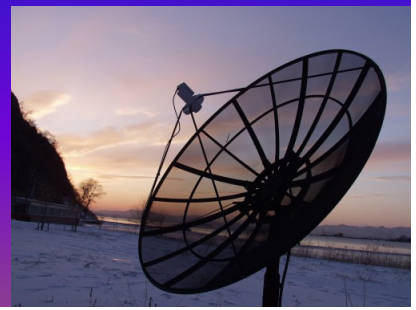
Capacity Building

- **Both, CubeSats and CubeBots can address preparatory research supporting exploration missions**

- **These new payloads can provide ample opportunities for developing countries to participate to a global space exploration program while enabling mature space actors to tap into a global robotics talent pool**

Areas of potential cooperation: UNBSTI, COSPAR etc.

- ***Exploration science roadmap for Cube-Sats***
- ***Worldwide ground station network for CubeSats***
- ***Piggyback rides in exchange for data sharing***



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