Russian perspectives on space science priorities 2030-2050

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mission selection

Council on Space
Russian Academy of Sciences

- determines science priorities
- approves specific missions, including science goals, experiments and timing
- reviews progress and results

50+ members

18 sections and commissions

~500 members, including industry

Roscosmos
(Russian Space Agency)

- funds missions
- controls industry and launches
- manages missions

bottom – up: missions are proposed starting from “Phase 0” feasibility studies

fast track: mostly internationally driven “missions of opportunity”
ExoMars 2016 & 2020 (approved in 2013!)

perspectives 2030-2050

- Russian federal space program is for 2016-2025
- 2030-2050 is beyond formal planning

discussion items – completely unofficial

- multispacecraft mutiscale in-situ plasma
- polar lunar base
- return to Venus
- large astroparticle detector
- next generation VLBI and telescopes

international cooperation will increase

russian instruments on ESA, NASA, JAXA missions

2001 MARS ODYSSEY / HEND

2003 MARS-EXPRESS / OMEGA, SPICAM, PFS

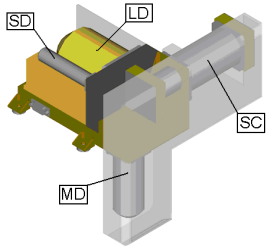
2003 SPIRIT, OPPORTUNITY / Mossbauer spectrometer

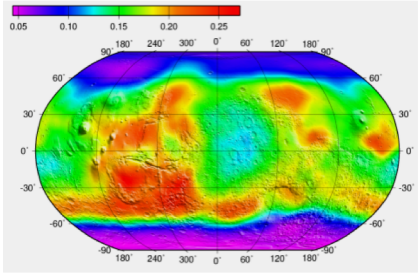
2006 VENUS-EXPRESS / SPICAV, SOIR, PFS

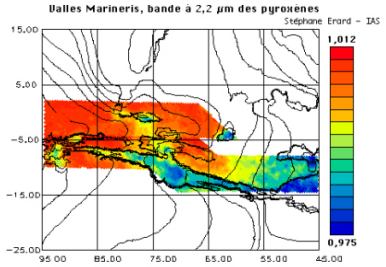
2009 LRO / LEND

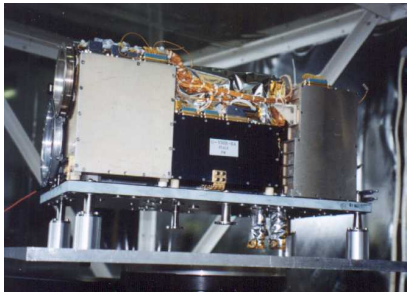
2011 MSL / DAN

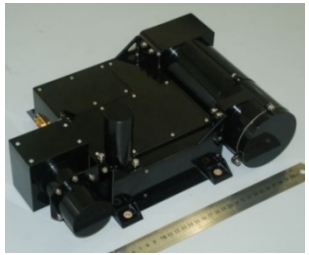
2018 BEPI-COLOMBO / PHEBUS, MGNS

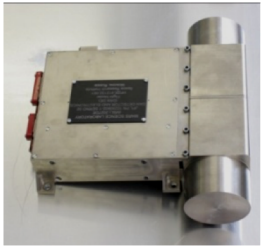


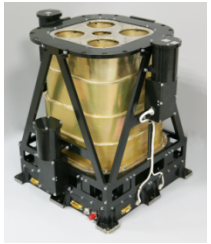


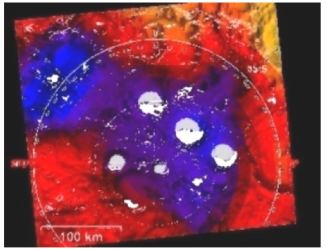






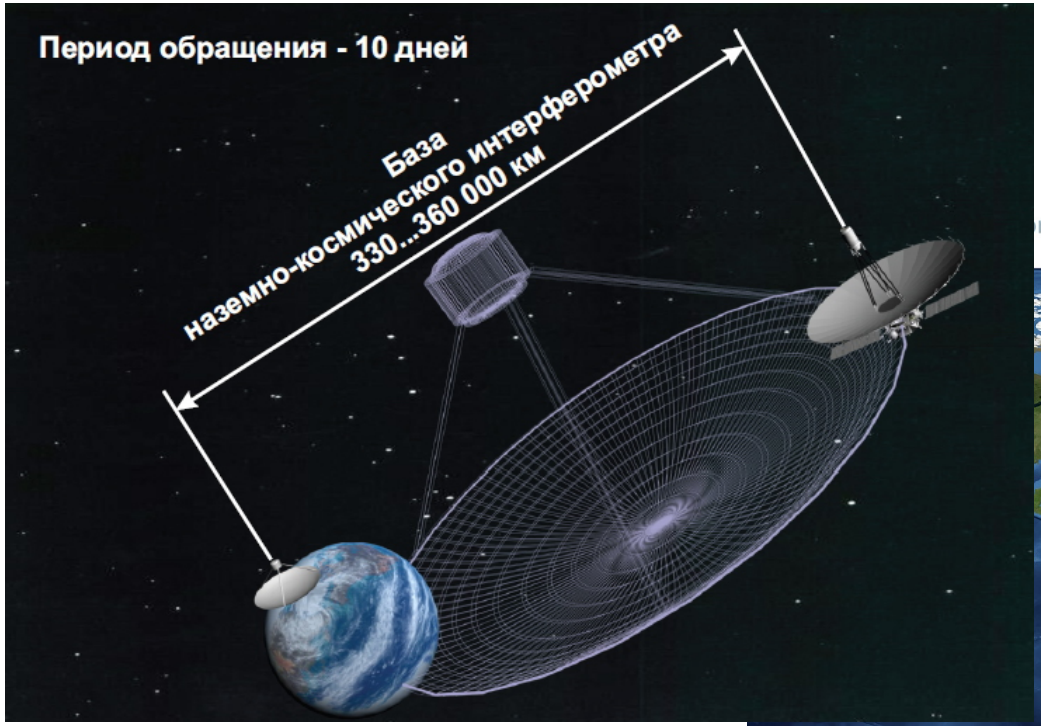






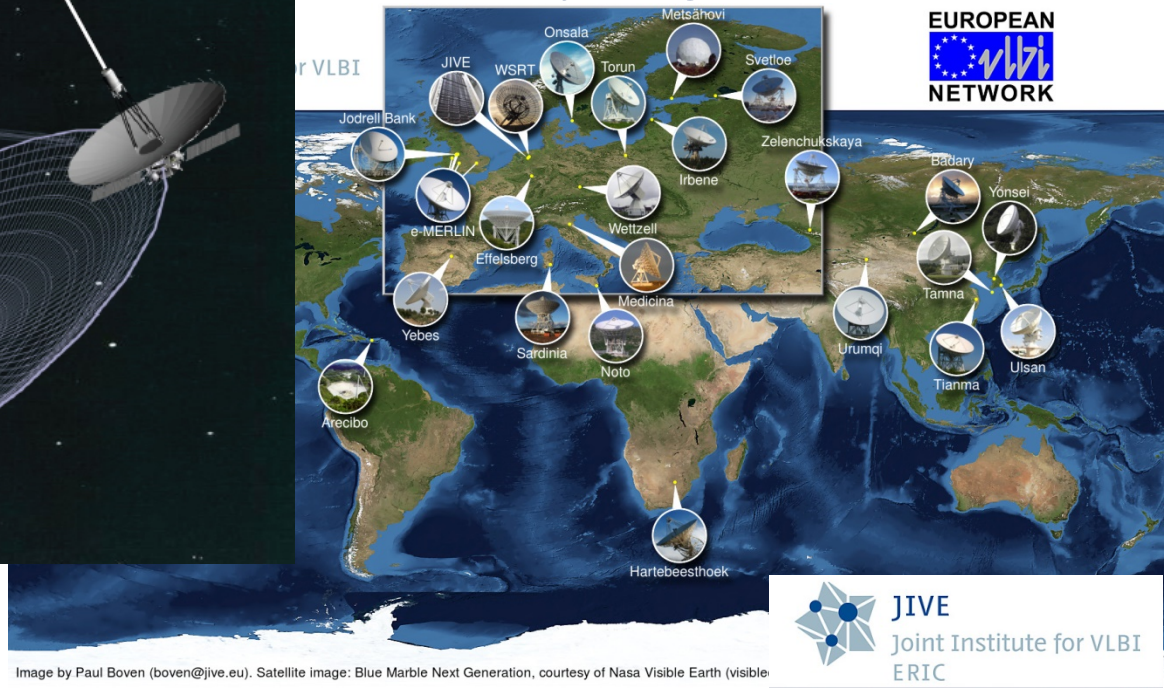
Spectr-R

space VLBI mission



2011-2019

all radio telescopes with VLBI at
92, 18, 6 and 1.35 cm bands
all four major regional VLBI

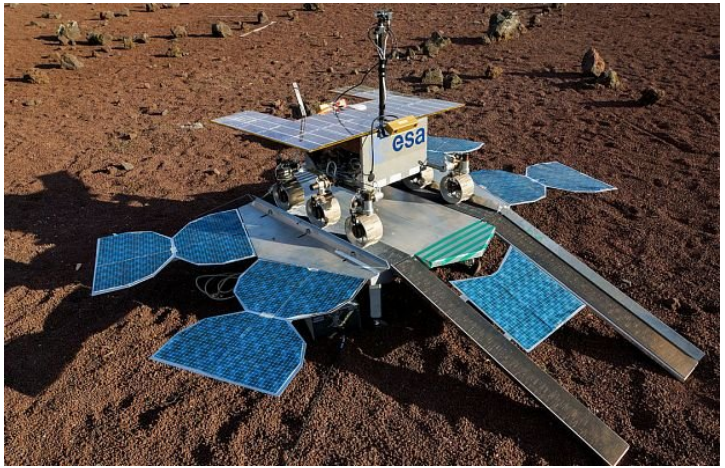


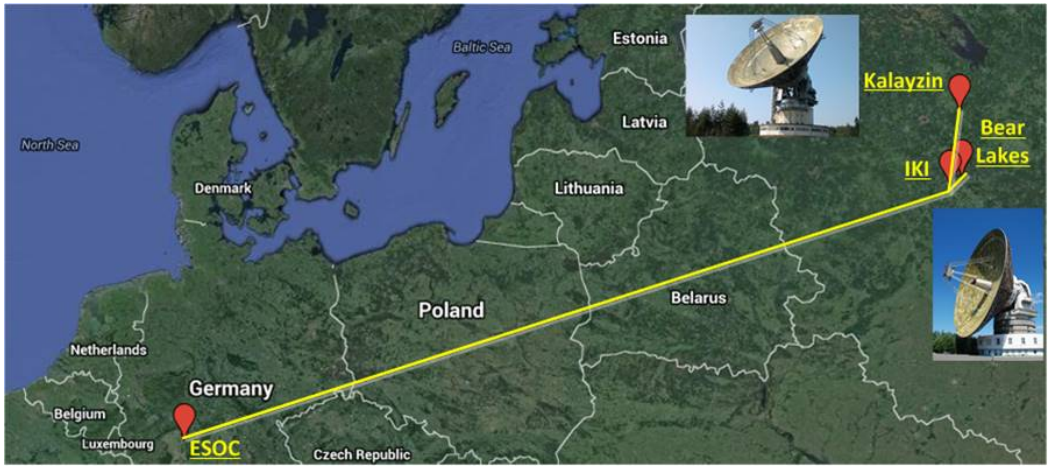
ExoMars

- **2016 launch** + ACS & FREND
- **2020 launch +** ADRON & ISEM on **rover + lander**

  13 instruments on **landing platform**
- ESA-compatible **ground segment**

  50% of Exomars data





Spectr-RG

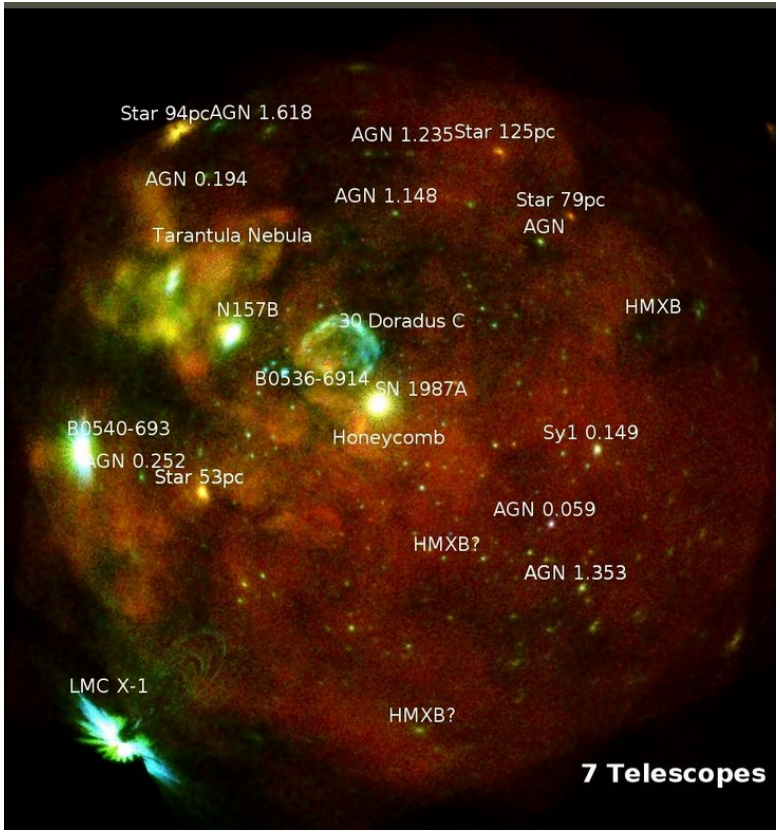
13 July, 2019 launch
22 October, 2019 at L2

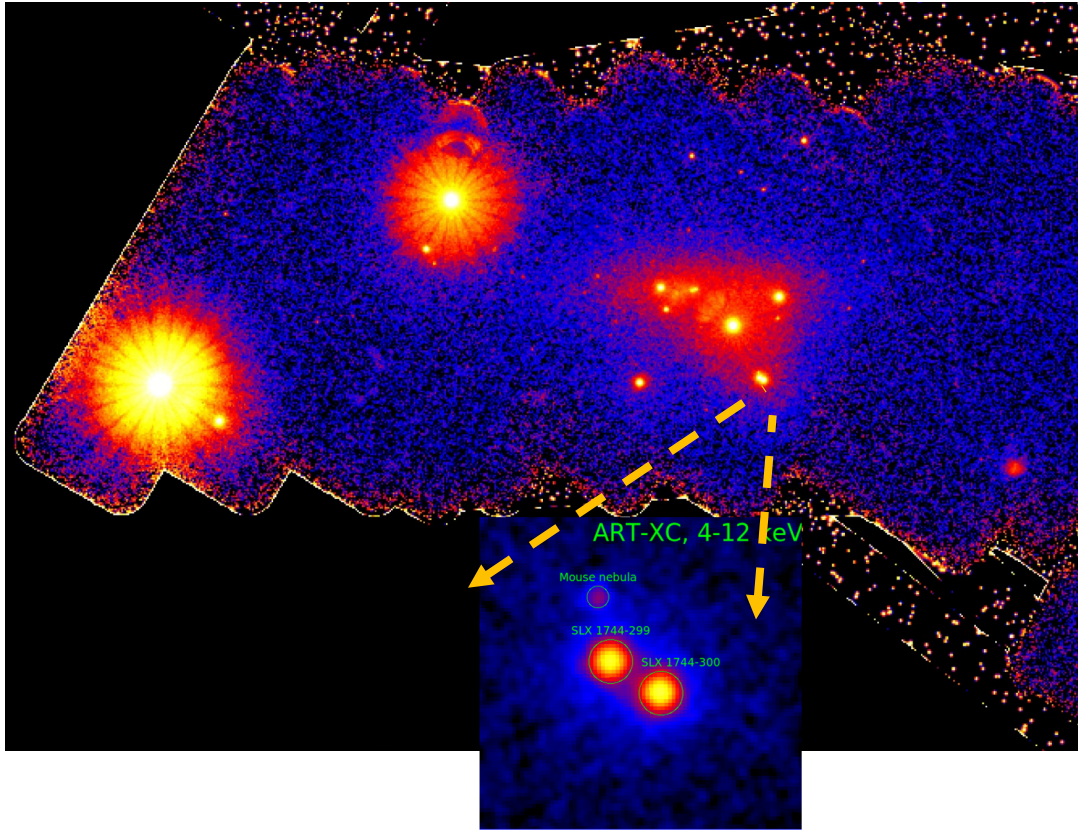
ART-XC Russia
- energy 5-30 keV
- mass 350 kg

eROSITA Germany
- energy 0.3 -11 keV
- mass 815 kg

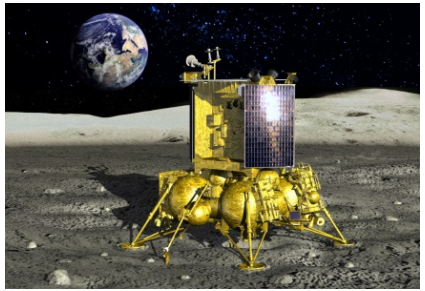
Spectr-RG

first light



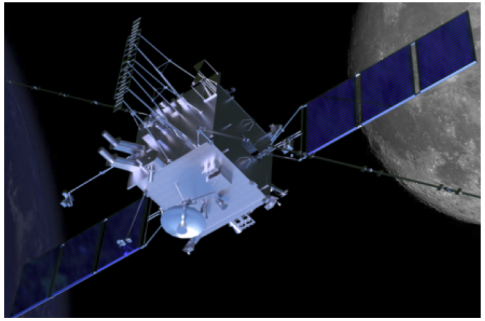


instruments on russian missions 2021-2025

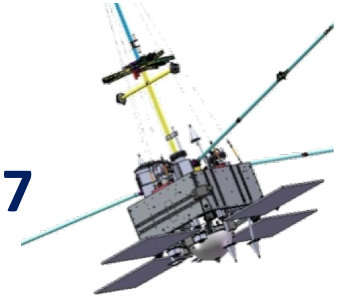


Luna-25

15+ instruments
funded by ESA or national agencies

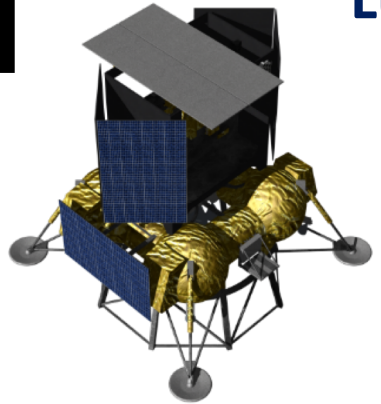


Luna-26



Resonance

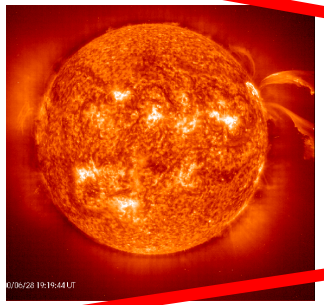
Luna-27

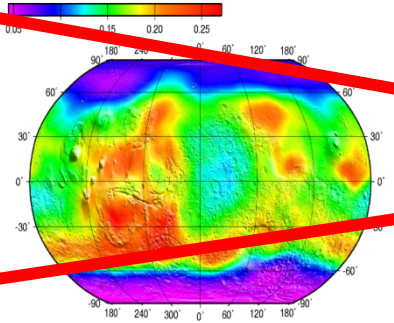


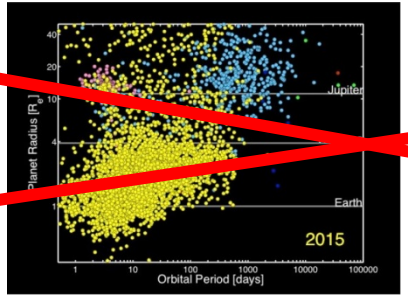
Spectr-UF

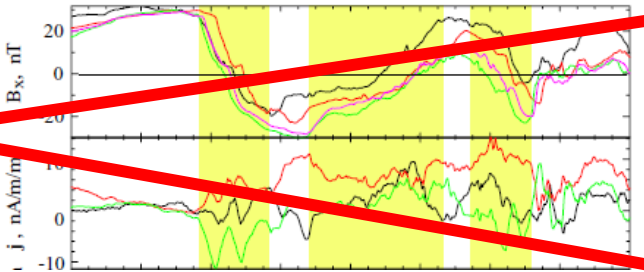
perspectives 2030-2050

- **science priorities are difficult to foresee (compare 25 years before, in 1994)**





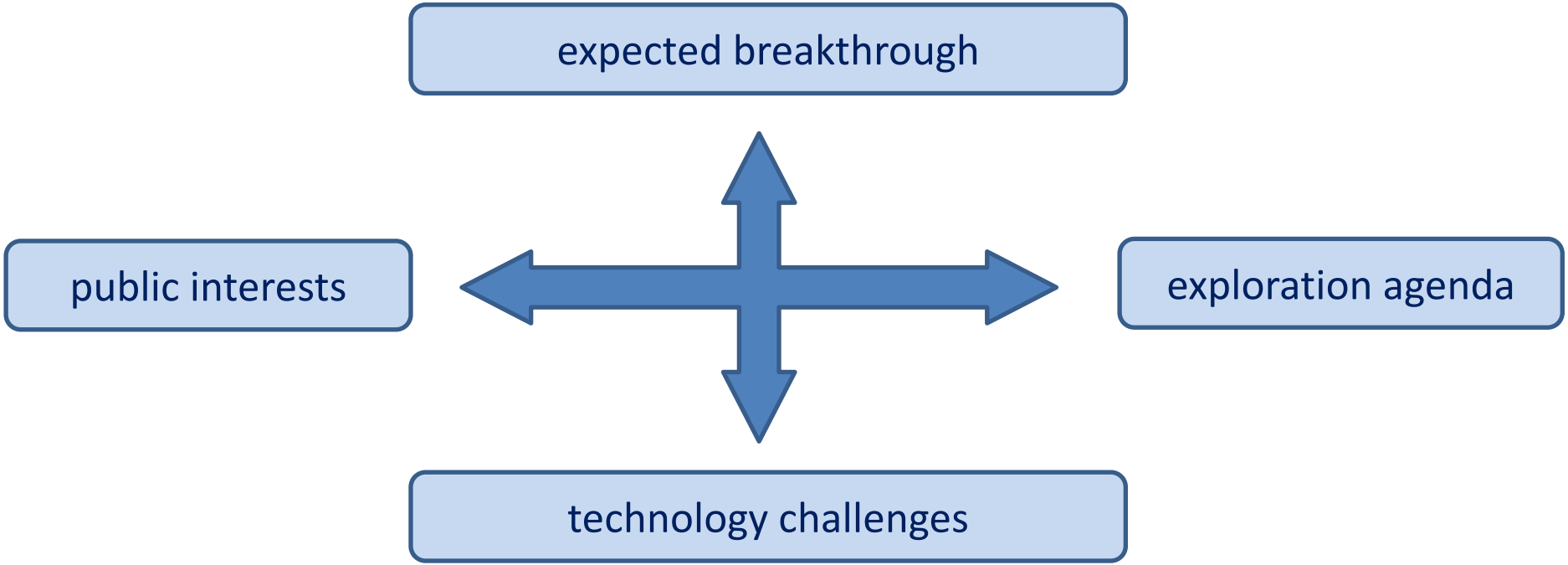




- long-term planning is important
  to shape space industry & technology development,
  to convince taxpayers

perspectives 2030-2050

game-changers in the next space age?



in-situ plasma and geoscience

breakthroughs

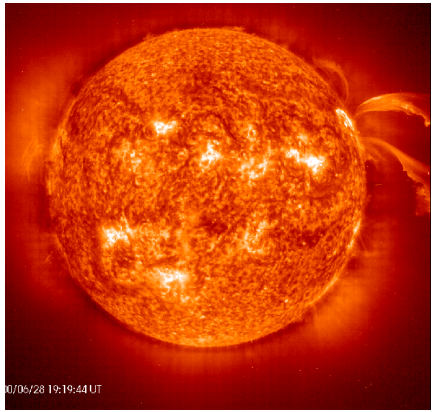
- quantitative global models
- ground truth for astro objects

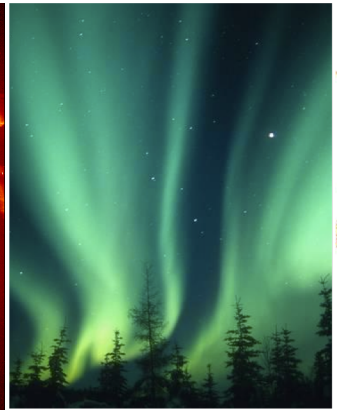
public interest

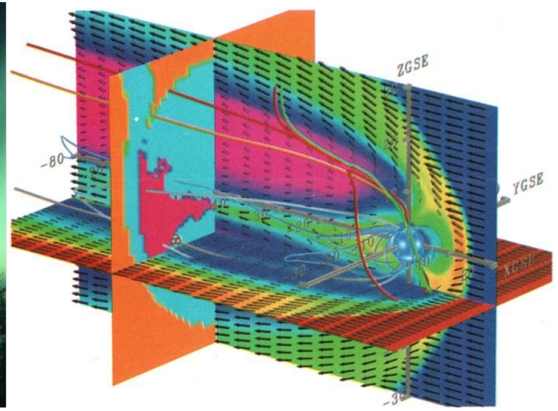
safe Earth

technical challenges

dozens of smaller satellites
with diverse payloads







astro and fundamental physics

breakthroughs

- origins of dark matter and dark energy
- extension of standard particle and universe theories

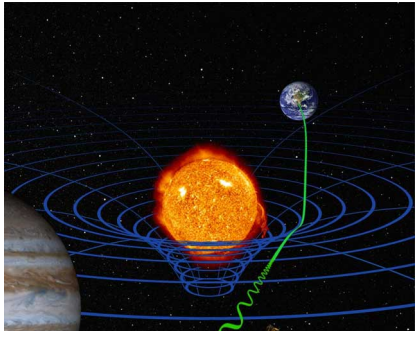
new physics in space

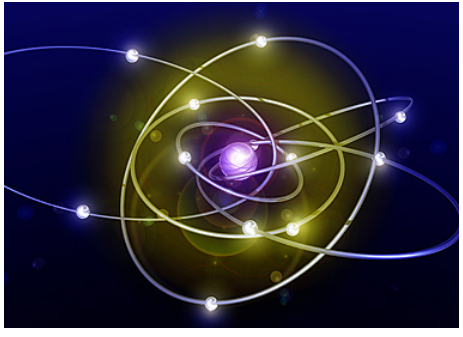
public interest

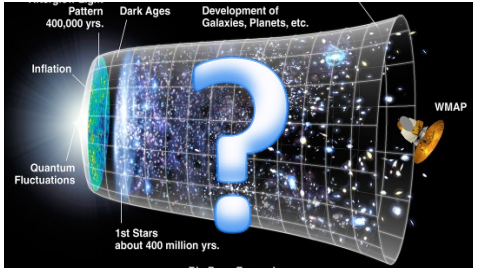
new energy sources

technical challenges

- large telescopes & astroparticle detectors
- high mass & power







planetary science

breakthroughs

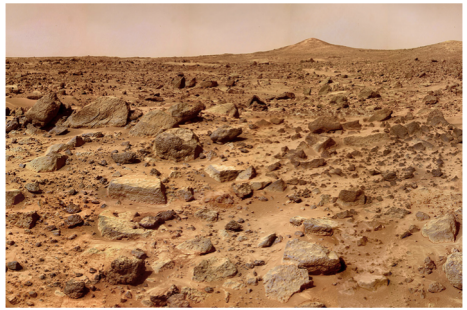
- life (traces) on Mars or icy satellites
- exact Earth twin
- interstellar space

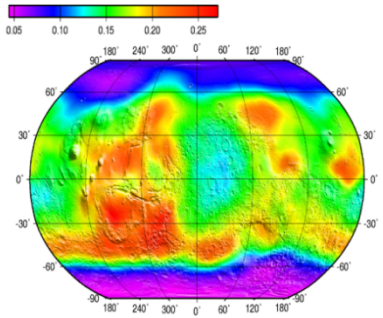
public interest

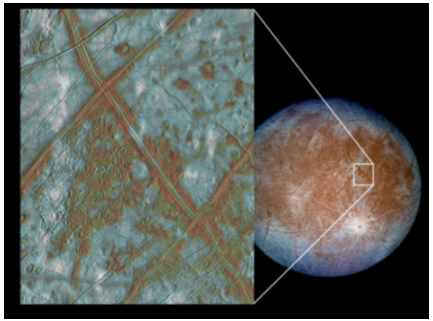
contact exolife

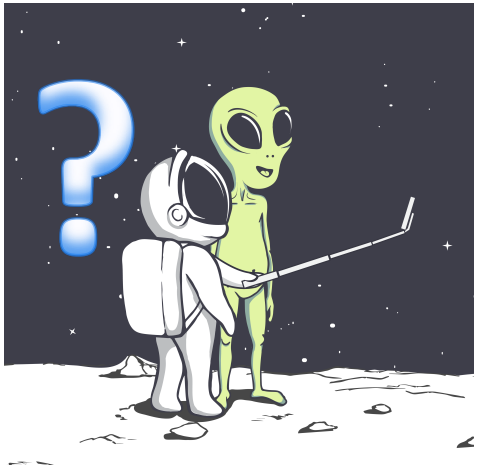
technical challenges

- large telescopes
- signaling
- high ΔV for sample return







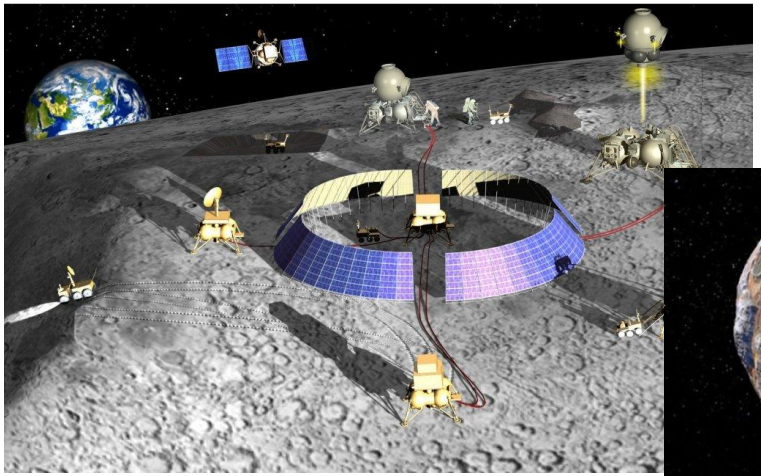


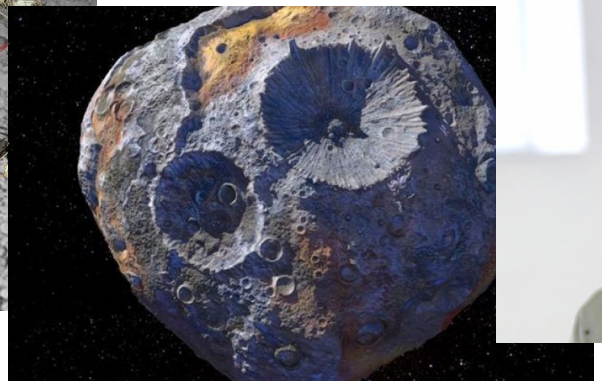
exploration agenda

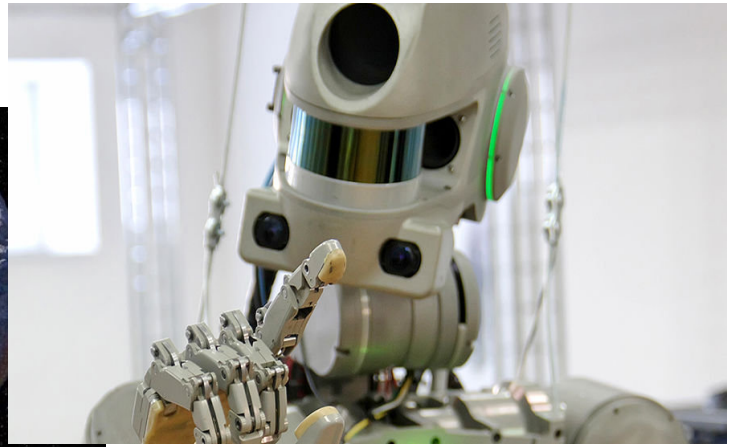
- Moon base
- asteroids
- start of Mars base

- power supply
- transportation
- robotics

- delivery of small payload
- large area scouting & samples
- large observatories



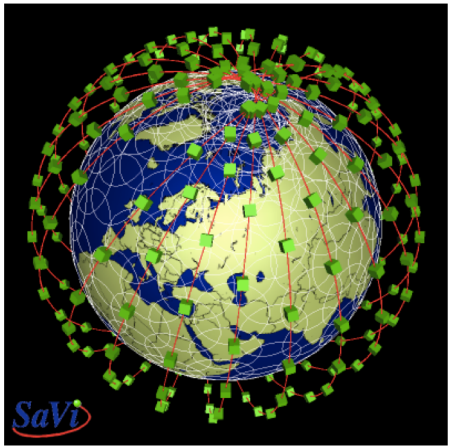




technical challenges

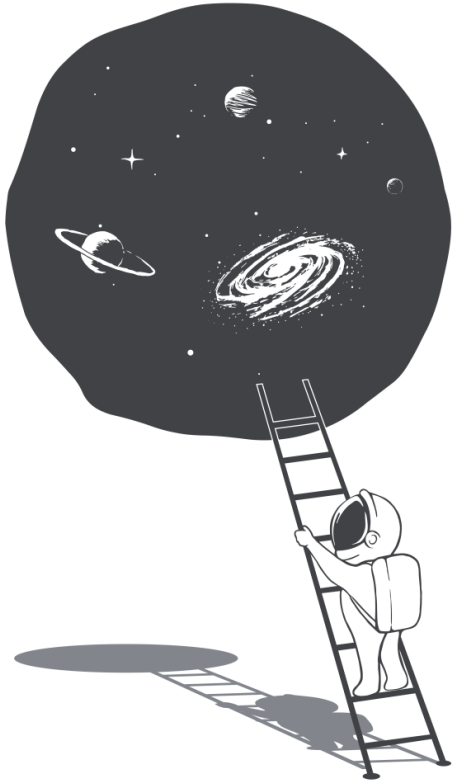
- 10-s tons in L2, Moon
- 100-s tons on EO
- ΔV up to 100 km/s
- 100 kW power
- optical data links
- mega-constellations

- super heavy launch
- nuclear power
- cheaper access to space

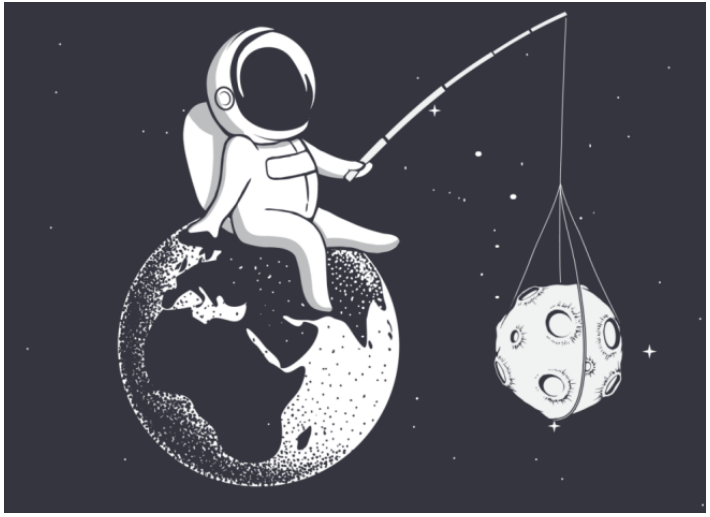


conclusions

science planning 2050



- identify goals
- request technical advances
- coordinate with exploration agenda



space is unpredictable