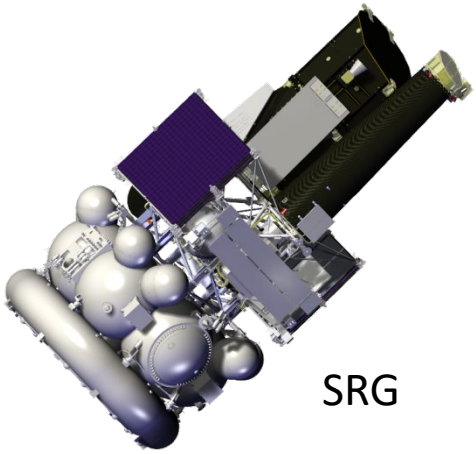
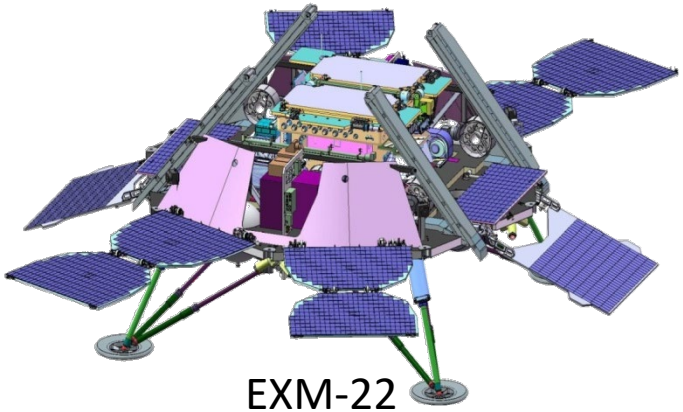
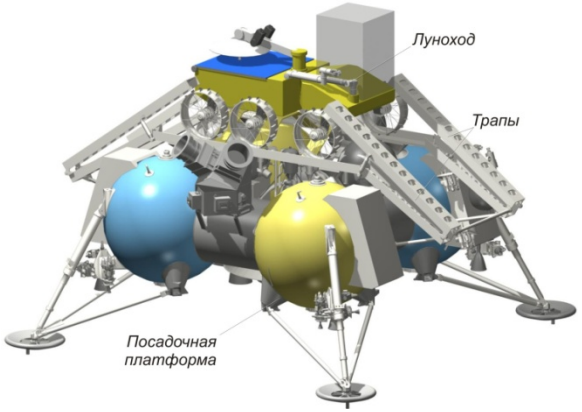
Russian Space Science Perspective



SRG



EXM-22



Luna-25

LEV ZELENYI

SPACE COUNCIL

RUSSIAN ACADEMY OF SCIENCES

DEPUTY CHAIR

SPACE SCIENCE WEEK

SSB 23-03-2021

MIKHAIL PANASUIK.

(SCOBELTSYN INSTITUTE)

- **ERIC GALIMOV**

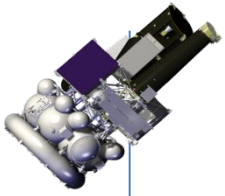
(VERNADSKY GEOCHEMISTRY INSTITUTE)

- **VLADIMIR FORTOV**
- (Former RAS PRESIDENT, NAS MEMBER)

FSP-2025

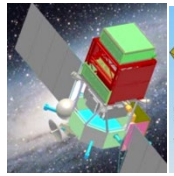
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 later

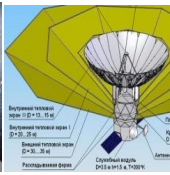
Astrophysics



Spectrum-RG

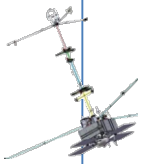
Spectrum-UV



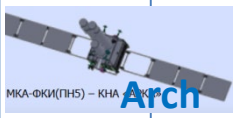


Spectrum-M

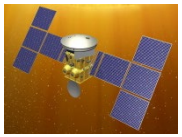
Space weather



STRANNIK



Arch

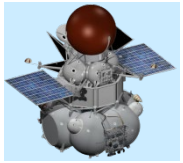


Interhelioprobe

Planetary research

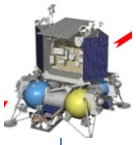
ExoMars-1

ExoMars-2

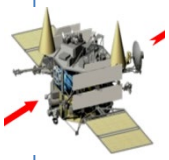


Venus-D

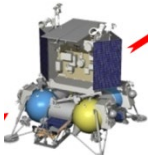
Lunar research



Luna-25



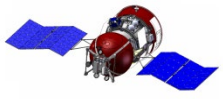
Luna-26,



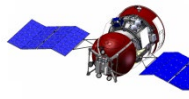
-27

Luna-28

Space biology and biotechnology

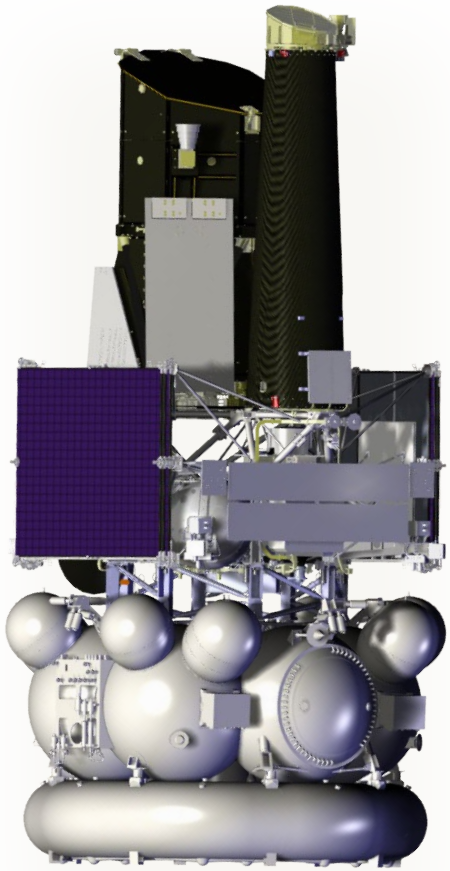


Bion-M2



Bion-M3

SPECTRUM-ROENTGEN-GAMMA



- HALO-ORBIT AROUND L2

PLATFORM NAVIGATOR

- S/C MASS – 2647 KG
- PAYLOAD – 1228 KG, 680 W,

TWO X-RAY MIRROR TELESCOPES:

- EROSITA (MPE, DLR, GERMANY), 0.5–10 KEV
- ART-XC (IKI @ VNIIEF, ROSCOSMOS, MSFC/NASA, USA), 6–30 KEV
- LIFE TIME – 7.5 YEARS:
- THREE MONTHS – FLIGHT TO L2, VERIFICATION AND CALIBRATION OF PAYLOAD

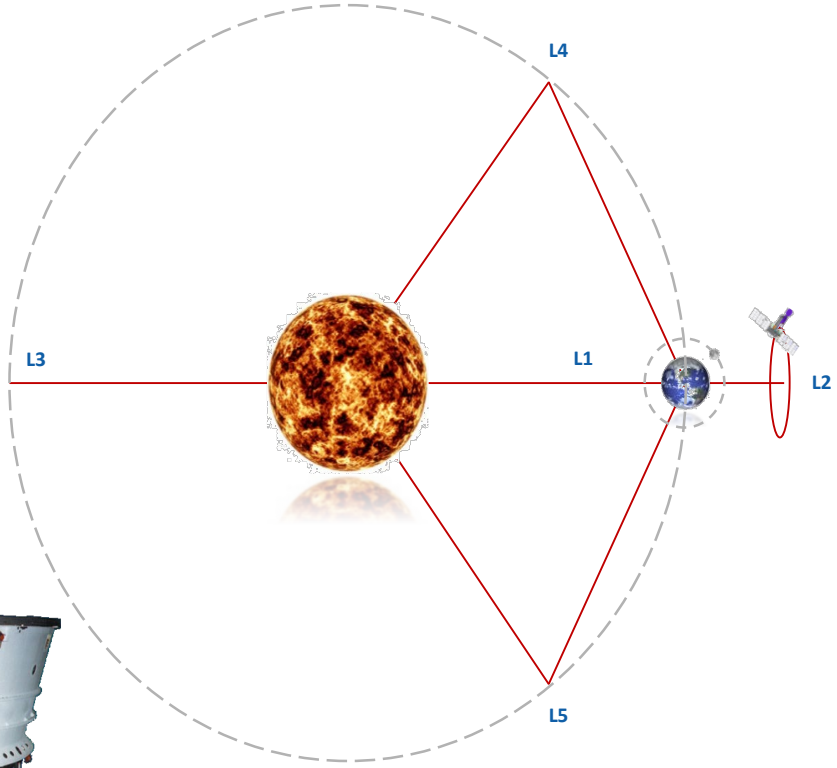
- 4 YEARS – ALL SKY SURVEY
- 3 YEARS – ON FOLLOW-UP POINTED OBSERVATIONS OF A SELECTION OF THE MOST INTERESTING GALAXY CLUSTERS AND AGNS.

SRG

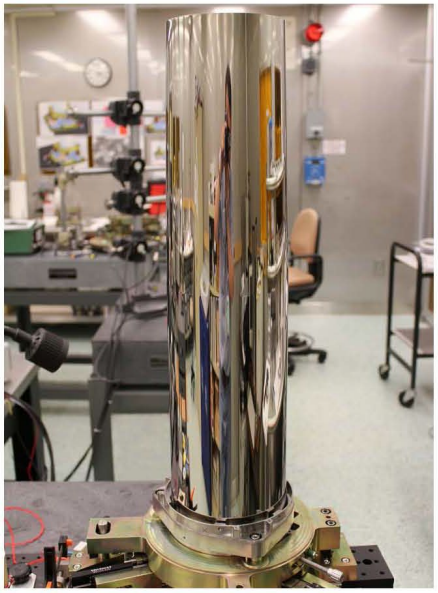
LAUNCH -June 21, 2019

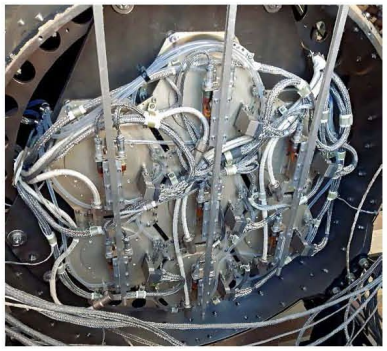
Proton-M

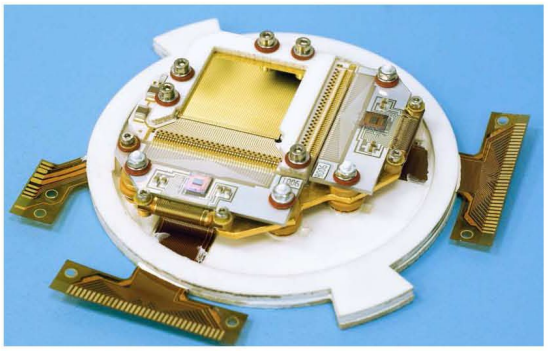
DM-3 buster

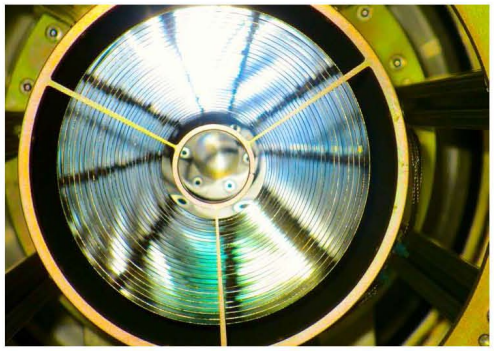


Mikhail Pavlinsky ART-XC telescope

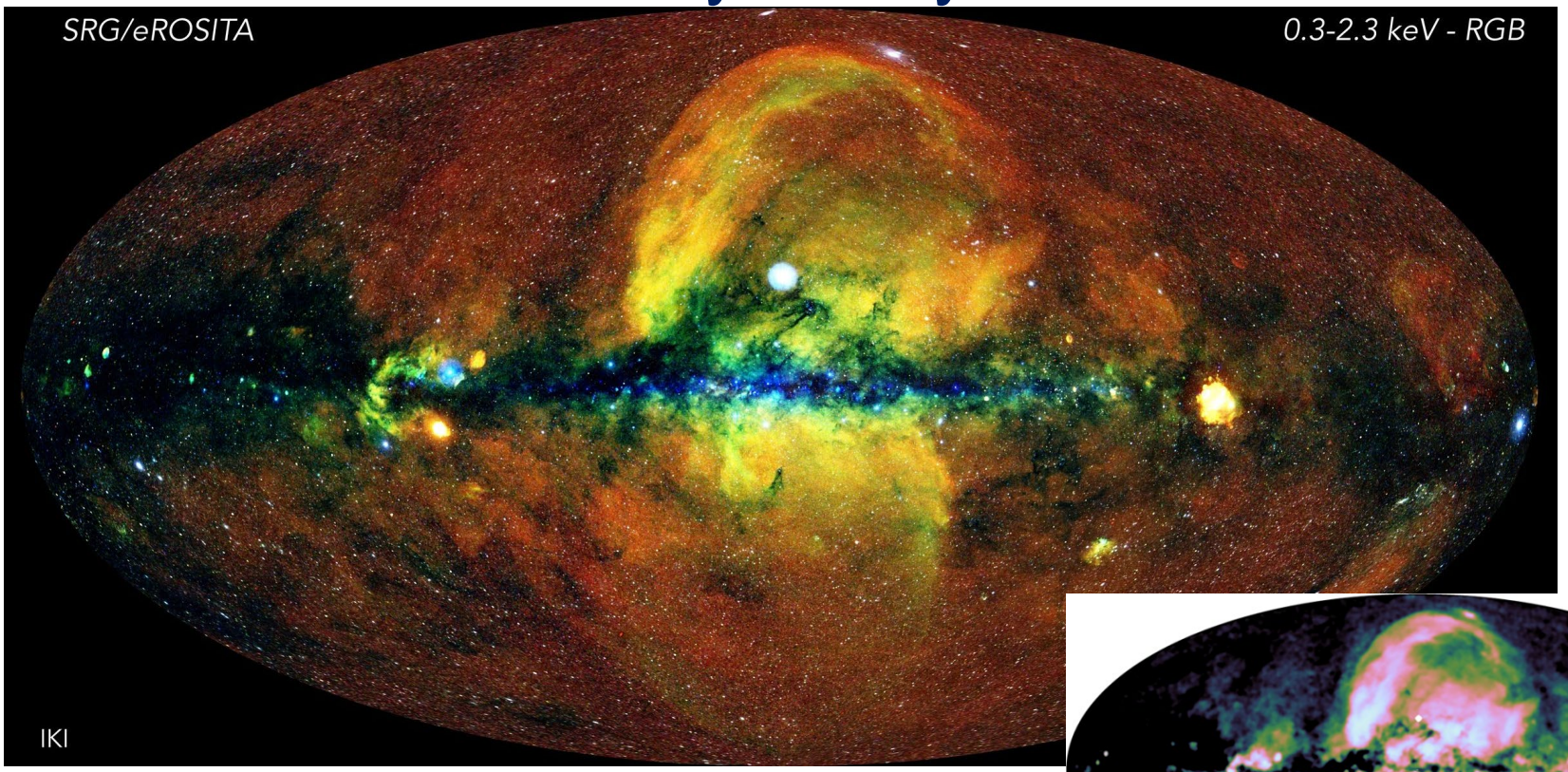


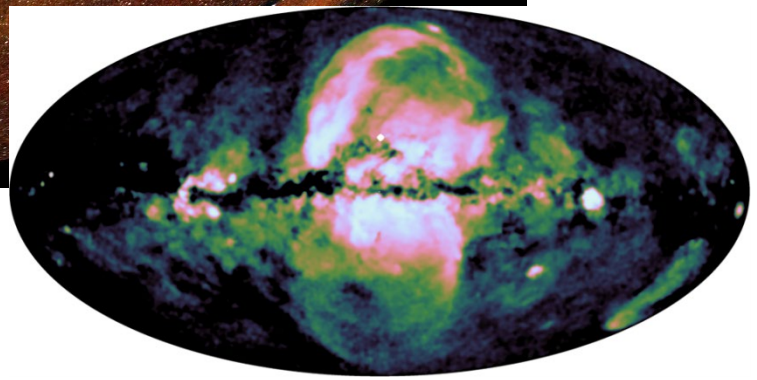






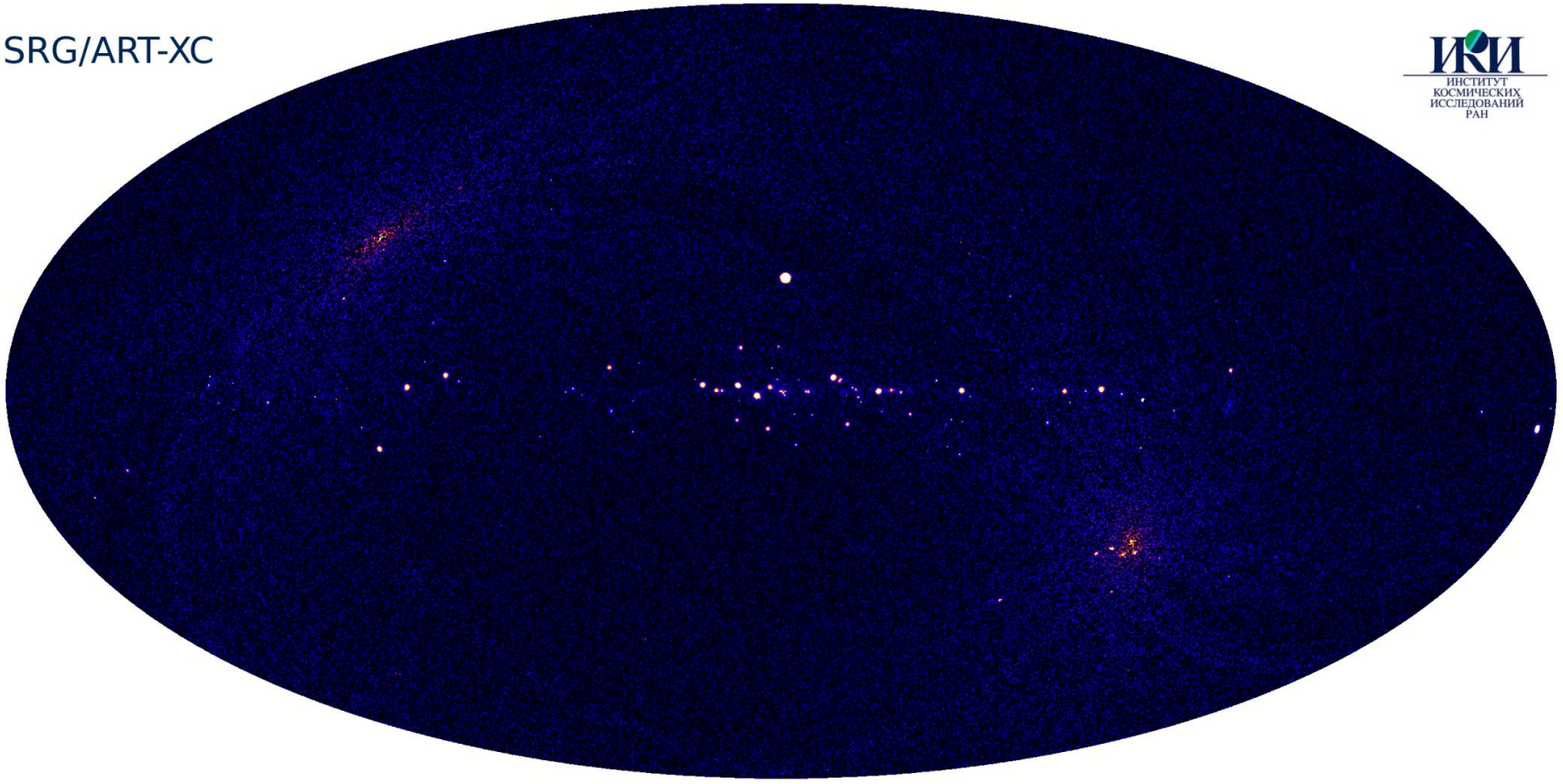
First all-sky survey with eRosita



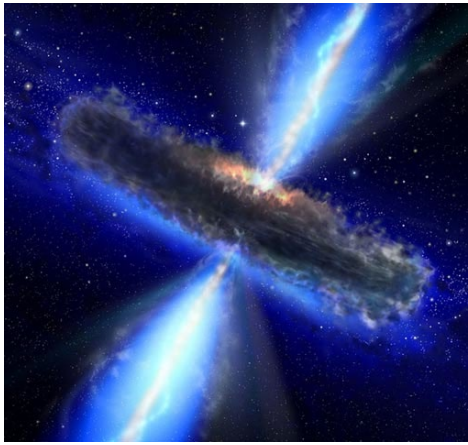


eROSITA has revealed a large hourglass-shaped structure in the Milky Way. These “eROSITA bubbles” show a striking similarity to the Fermi bubbles, detected a decade ago at even higher energies. The most likely explanation – a massive energy injection from the Galactic centre in the past, leading to shocks in the hot gas envelope of our galaxy.

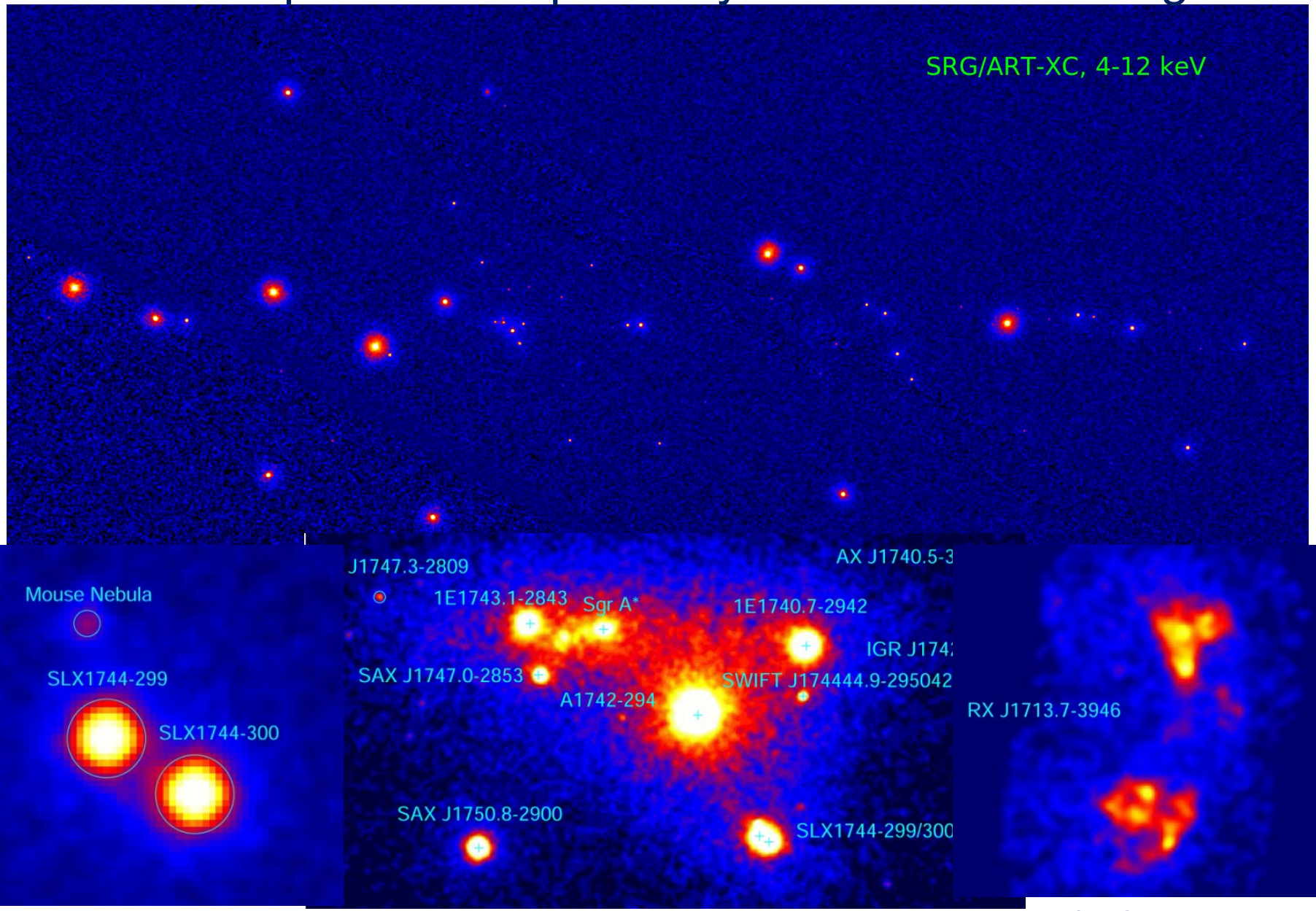
First all-sky survey with ART-XC in 4-12 keV



~800 sources, threshold (0.5-1)x10^{-11} erg s^{-1} cm^{-2},
~40% extragalactic sources (active galactic nuclei, cluster of galaxies), other galactic ones
ART-XC found several dozen new sources, some of are not detected by eRosita
Analysis and optical observations are in progress



Galactic plane + deep survey of the Galactic bulge



~150 sources

WSO - UV

Geosynchronous orbit, i=40°
Launcher “PROTON”

WORLD SPACE OBSERVATORY – ULTRAVIOLET

launch 2025

РОСКОСМОС

ИНАСАН
Институт астрономии РАН

UNIVERSIDAD COMPLUTENSE MADRID

RUSSIA + SPAIN

EXOMARS
2016
2022

NOMAD

High resolution occultation and nadir spectrometers

Atmospheric composition (CH_4,O_3, trace species, isotop) dust, clouds, P&T profiles

UVIS (0.20 – 0.65 μm) λ/Δλ ~ 250	SO	Limb	Nadir
IR (2.3 – 3.8 μm) λ/Δλ ~ 10,000	SO	Limb	Nadir
IR (2.3 – 4.3 μm) λ/Δλ ~ 20,000	SO		

CaSSIS

High-resolution camera

Mapping of sources; landing site selection

ACS

Suite of 3 high-resolution spectrometers

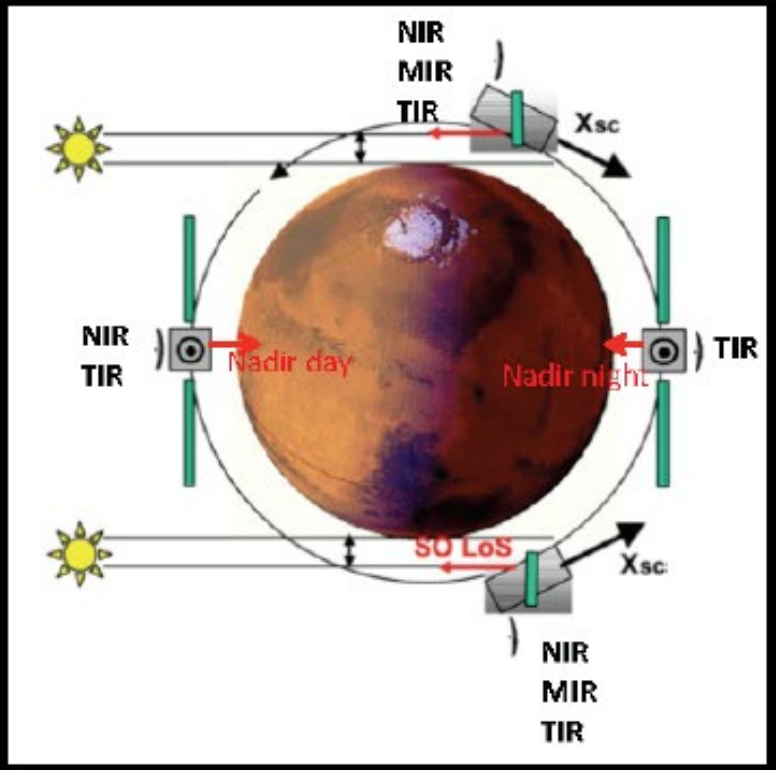
Atmospheric chemistry, aerosols, surface T, structure

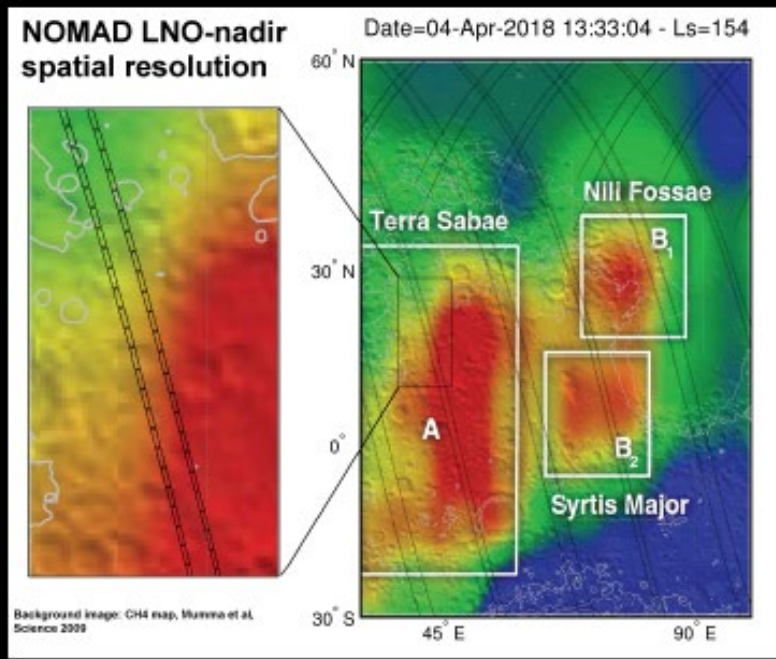
Near IR (0.7 – 1.7 μm) λ/Δλ ~ 20,000	SO	Limb	Nadir
IR (Fourier, 2 – 25 μm) λ/Δλ ~ 4000 (SO)/500 (N)	SO		Nadir
Mid IR (2.2 – 4.5 μm) λ/Δλ ~ 50,000	SO		

FREND

Collimated neutron detector

Mapping of subsurface water



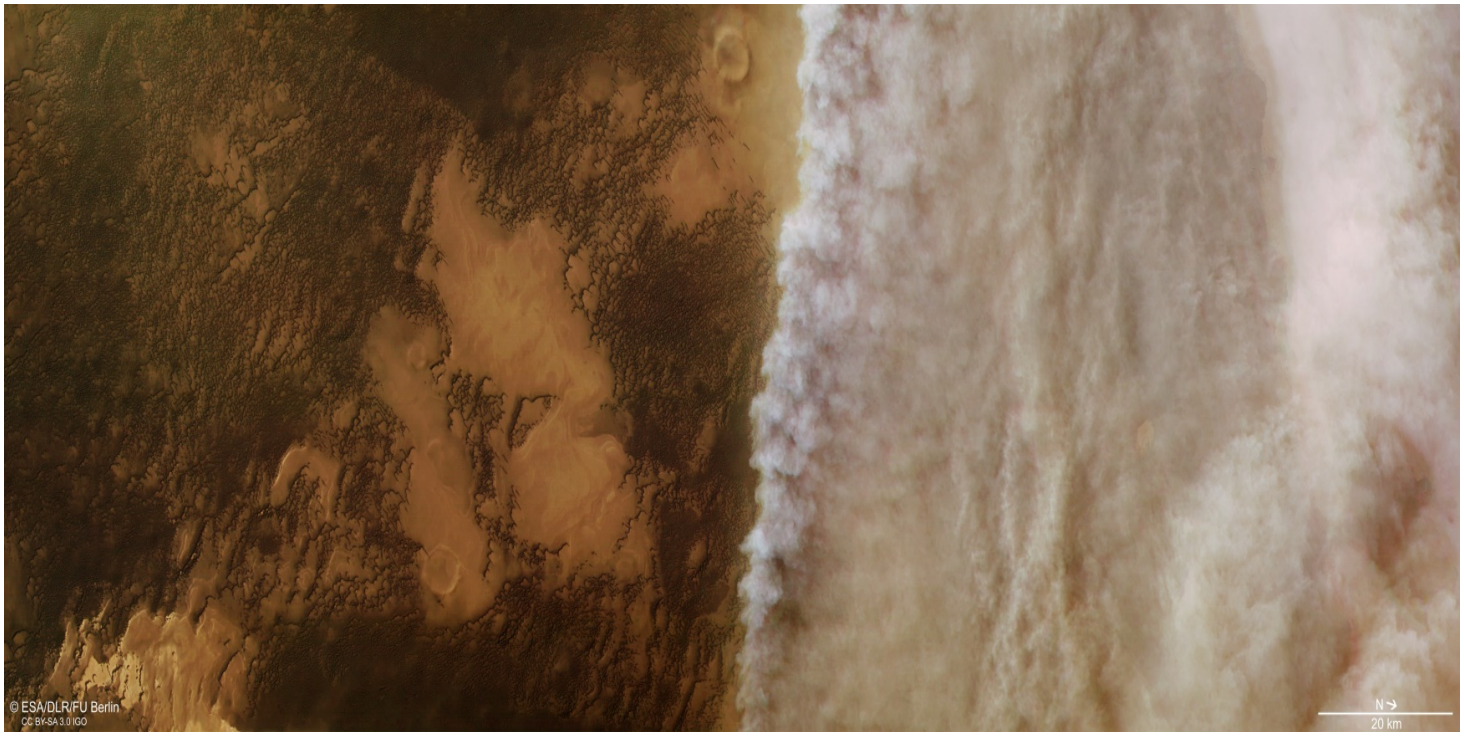


No detection of methane

O. Korablev & A.C. Vandaele

and ACS & NOMAD Science Team

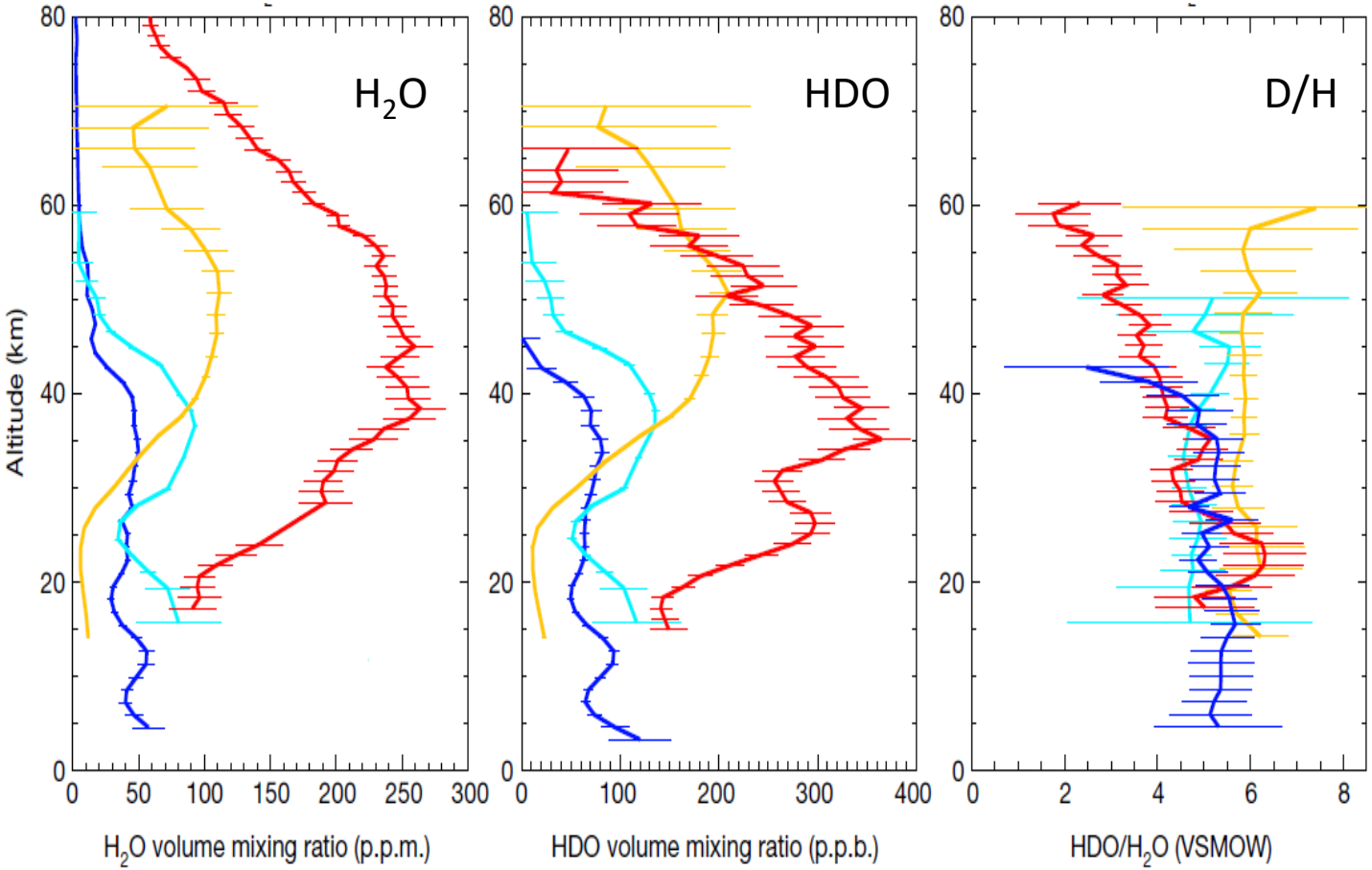
Global Dust Storm



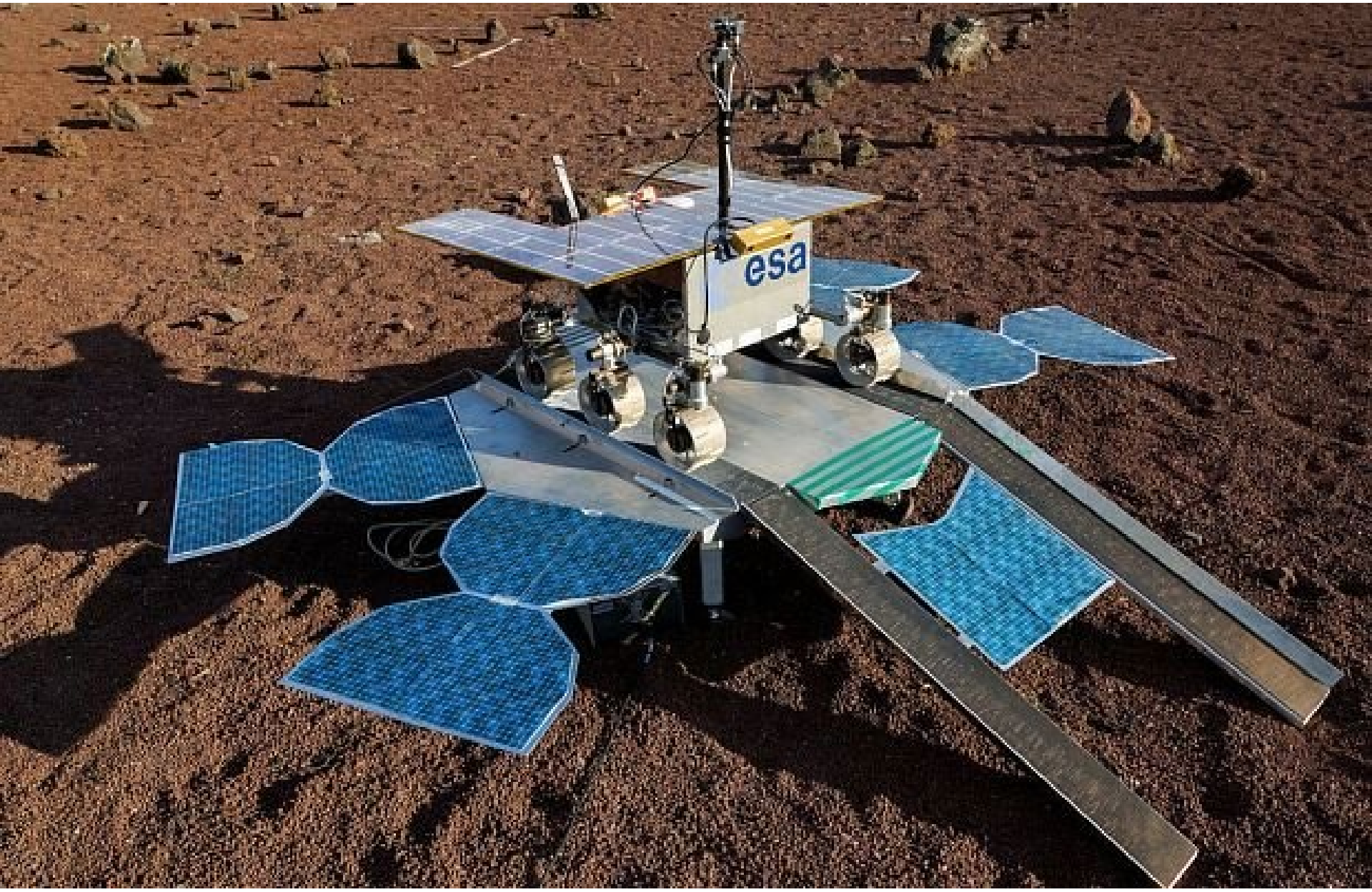
High resolution stereo camera on Mars Express image taken in April 2018, ESA/DLR/FU Berlin

- Northern latitudes: layers at 25-40 km altitude appear
- Mid latitudes: always many layers and lot of dust; at higher altitude during GDS
- Southern latitudes: dust layers move to higher altitudes

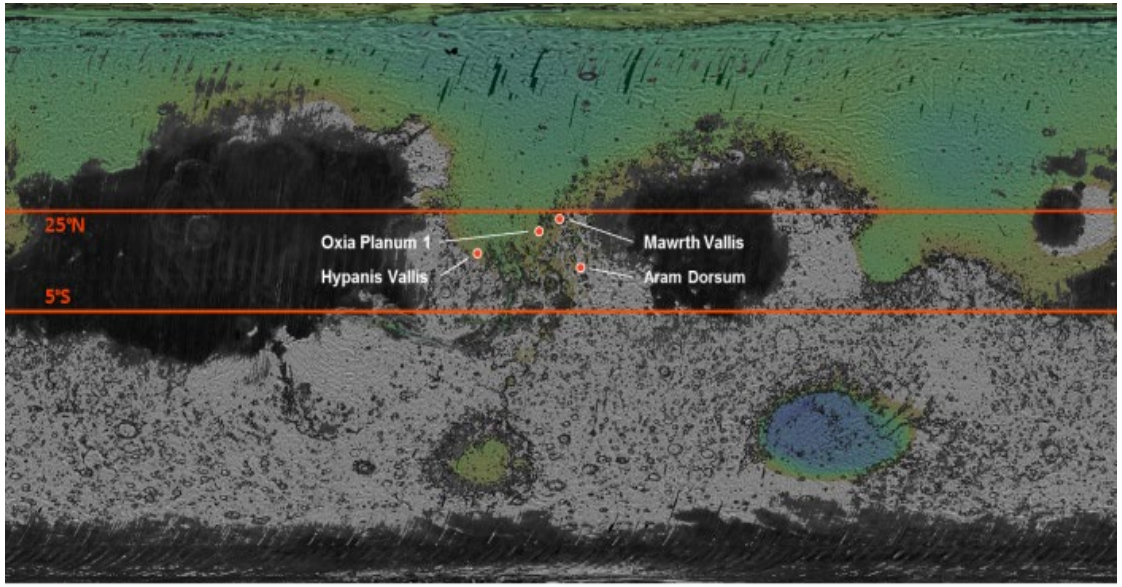
H_2O, HDO and D/H observations

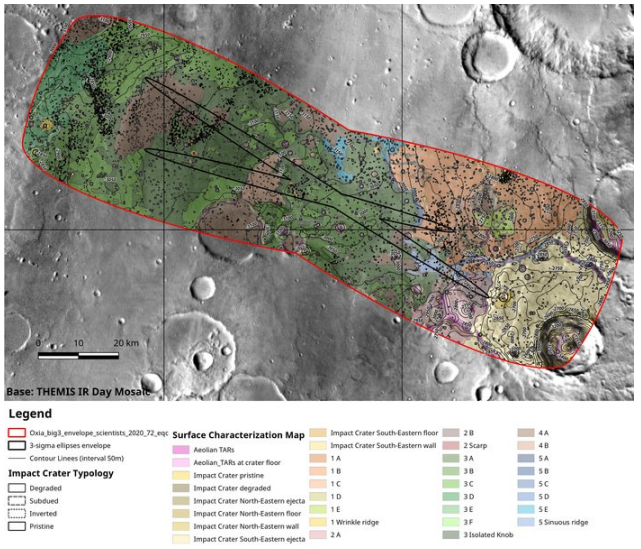


- Increase of densities
- Uplifting to higher altitudes
- Fast phenomenon


esa

SELECTION OF THE LANDING SITE FOR EXM-2022





4 Candidates sites were recommended:

- **Oxia Planum**
- **Mawrth Vallis**
- **Aram Dorsum**
- **Hypanis Vallis**

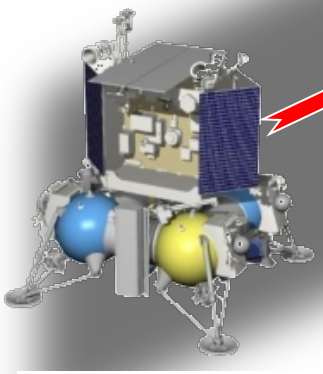
REGOLITH - DUST- PERMAFROST-- VOLATILES

LUNAR PROGRAM

1976

LUNA-24

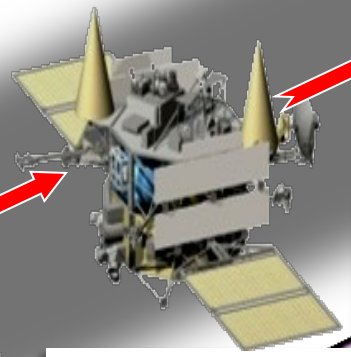
2021



LUNA-25

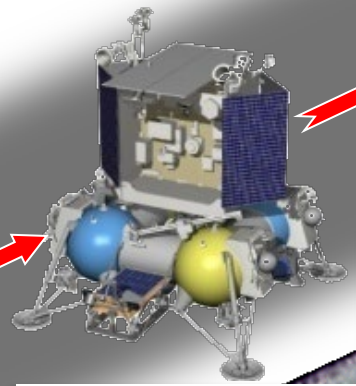
TECHNOLOGY OF POLAR SOFT LANDING, STUDY OF LUNAR SOUTH POLE (1450/530 KG)

2023-24

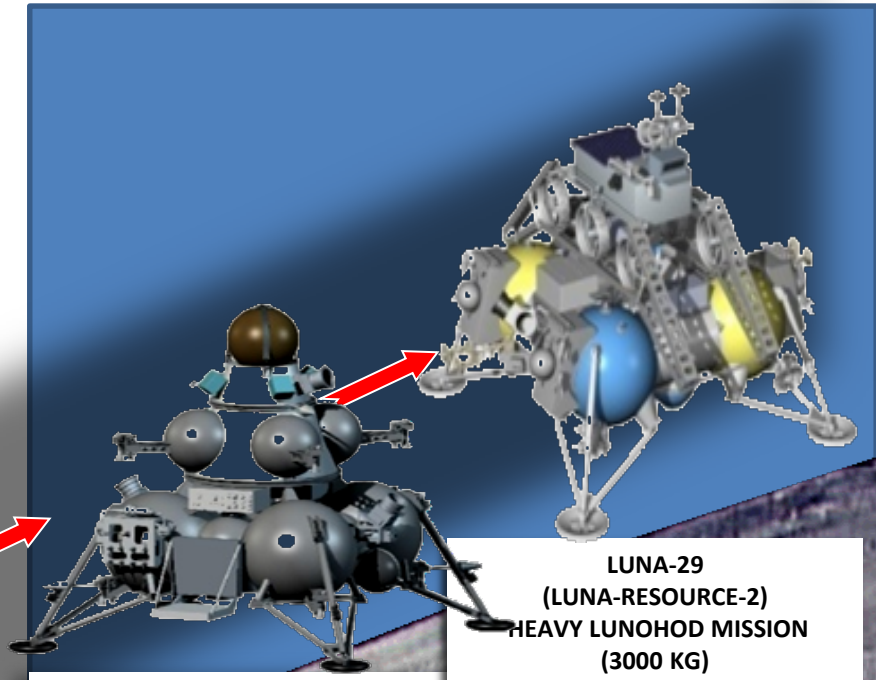


LUNA-26
GLOBAL ORBITAL STUDIES OF THE MOON

2025



LUNA-27
STUDIES OF SOUTH POLE REGOLITH AND EXOSPHERE (2200/810 KG)

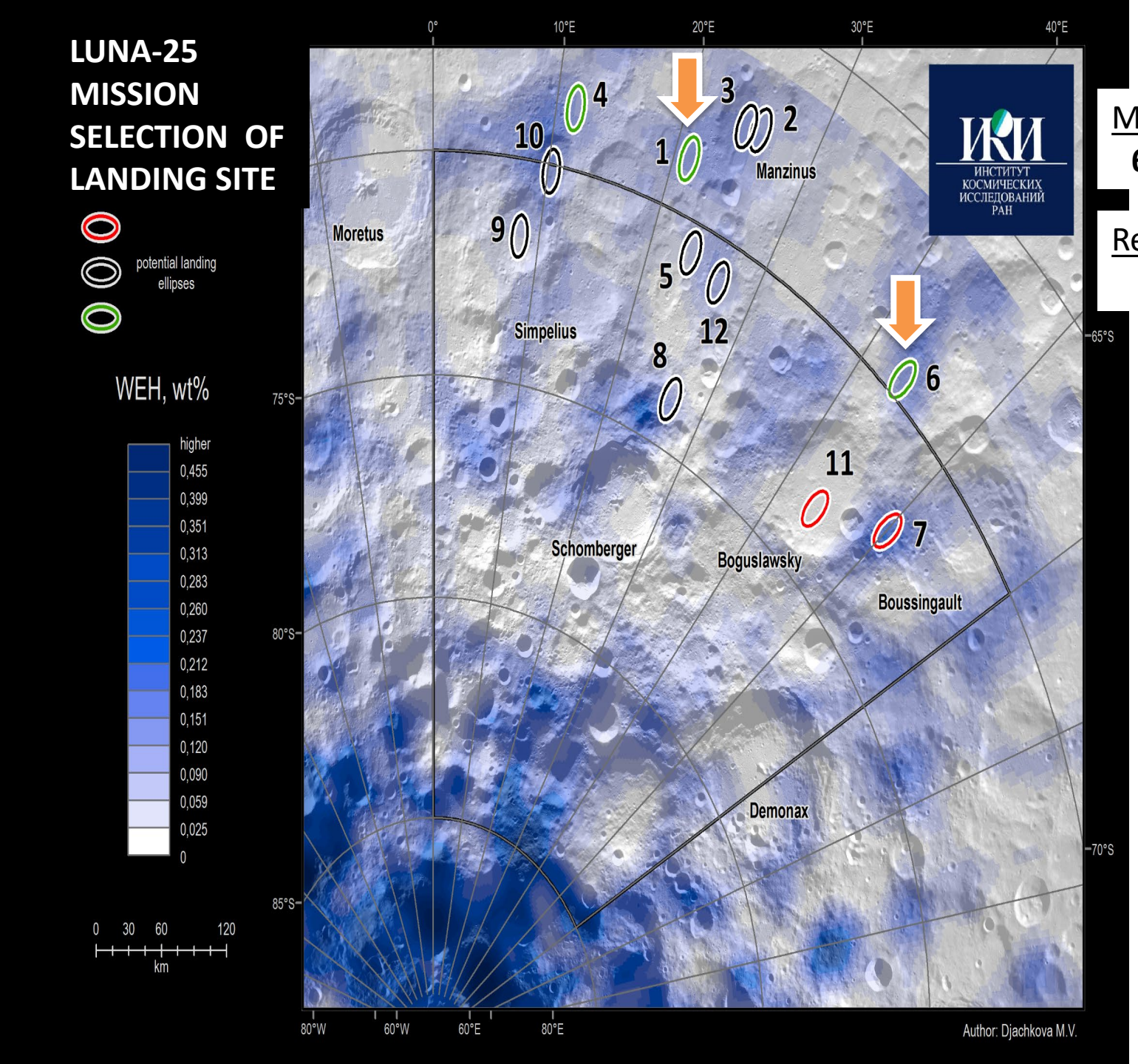


LUNA-28
(LUNA-GRUNT)
CRYOGENIC SAMPLES RETURN FROM SOUTH POLE
(3000 KG)

LUNA-29
(LUNA-RESOURCE-2)
HEAVY LUNOHOD MISSION
(3000 KG)

ESA CONTRIBUTIONS

LUNA-25 MISSION SELECTION OF LANDING SITE



Main landing site

69.55°S 43.54°E

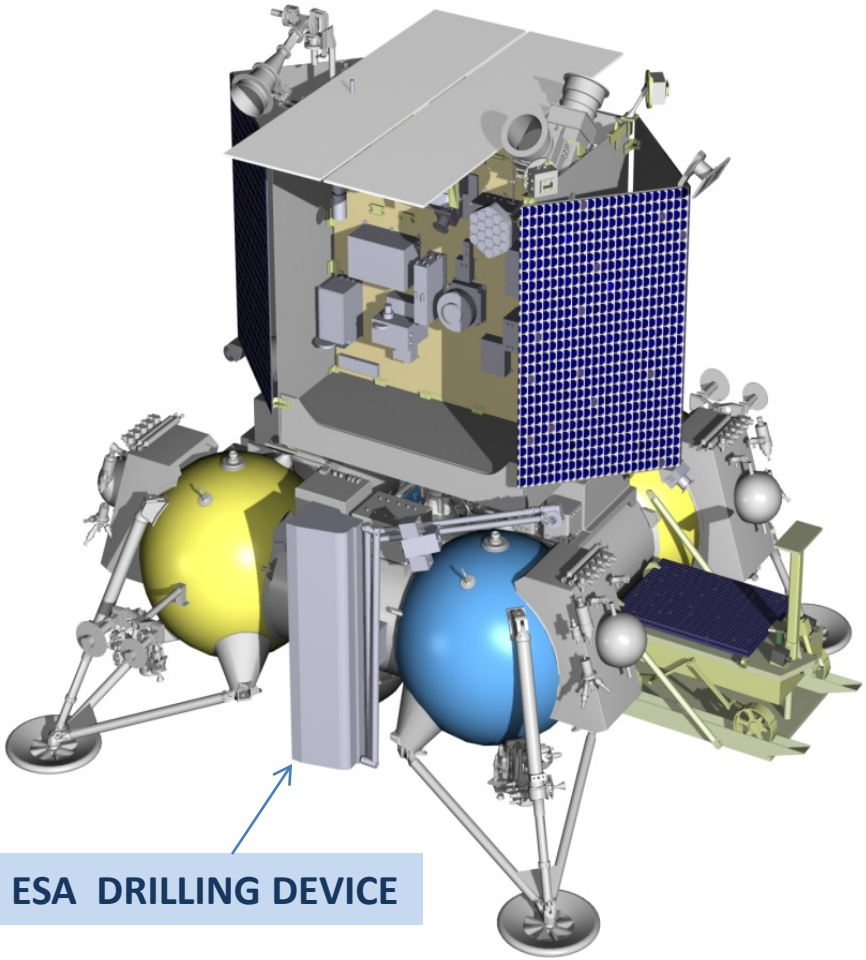
Reserved landing site

68.77°S 21.21°E

Djachkova, M.V., Litvak, M.L., Mitrofanov, I.G. et al. Sol Syst Res (2017) 51: 185. https://doi.org/10.1134/S0038094617030029

EGU 2018

Luna-27 LANDER



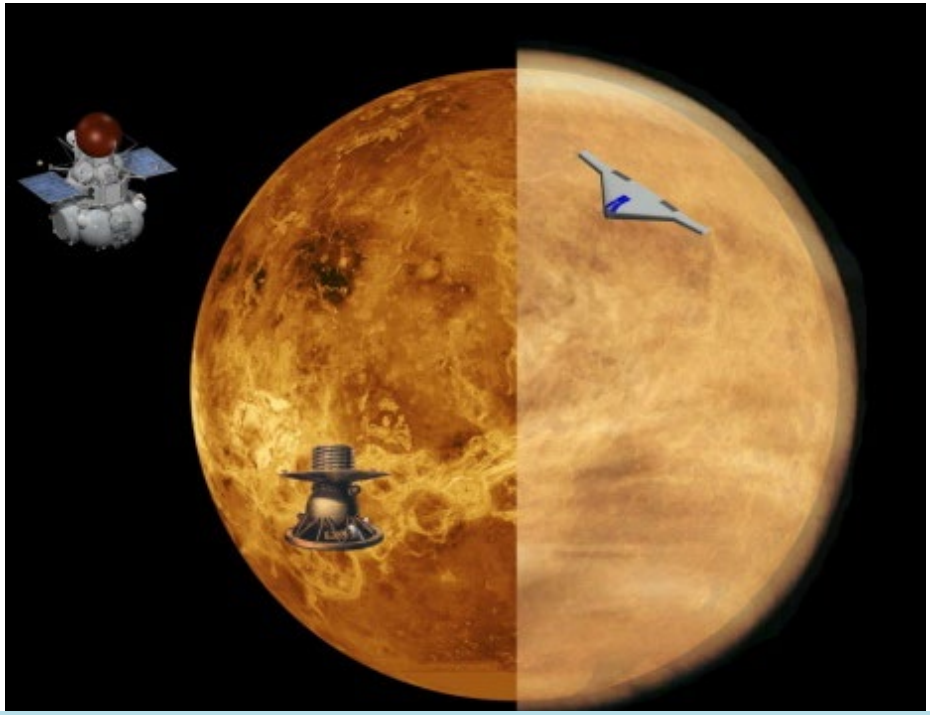
Technology:

- *High precision landing and hazard avoidance*
- *Pole-orbiter UHF radio link tests and experience*
- *Cryogenic drill testing and validation*

Science:

- *Mechanical/thermal/compositional properties of polar regolith within 2 meters*
- *Water content and elements abundance in the shallow subsurface of the polar regolith*
- *Plasma, neutral and dust exosphere at the pole*
- *Seismometry and high accuracy ranging*

VENUS PLANS (>2029)



Venera-D

Joint Science Definition Team

Artist concept of the joint mission to Venus with Venera-D orbiter and Lander and Venus Atmospheric Maneuverable Platform (VAMP)

Orbiter:

- Study of the dynamics and nature of super-rotation, radiative balance and nature of the greenhouse effect;
- Characterize the thermal structure of the atmosphere, winds, thermal tides
- Measure composition of the atmosphere; study the chemistry of clouds

Lander:

- Perform chemical analysis of the surface material
- Study of interaction between the surface and atmosphere;
- Perform direct chemical analysis of the cloud aerosols;
- Search for volcanic and seismic activity; search for lightning

THANKS FOR YOUR ATTENTION