



ГОСУДАРСТВЕННАЯ КОРПОРАЦИЯ ПО КОСМИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ  
РОСКОСМОС

# **RUSSIAN SPACE SCIENCE PROGRAMME**

**update for ESSF 55th ESSC meeting  
Geneva 23 May**

**Presented by Oleg Korablev, Space Research  
Institute, IKI  
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# Academy update

- Fall 2017: the election of the new President of the Academy, Acad Alexander Sergeev
  - 1st Vice-president Acad Yuri Balega
- Space Science is coordinated by the Space Council of the Academy
- Alexander Sergeev chairing the Space Council
  - Deputy chair Acad Lev Zelenyi
- FASO
  - Federal Agency of Science Organizations was in charge of Academy institutes since 2015
  - With the new Government in 2018 FASO is replaced by Ministry of Science and Education (high education)
  - The Minister is Mikhail Kotyukov (head of FASO)

# Roscosmos update

- In 2015 Roscosmos has become “State Corporation” (Federal Space Agency before)
- The head is Igor Komarov
  - The deputy responsible for space science is Mikhail Khailov
  - New Government in place in May 2018
- Federal Space Programme in its “Fundamental” (i.e. science part)
  - Multiple budget cuts since 2015 (2017 and 2018 affected in particular)
  - Many missions delayed (appr. two years)
  - Candidate prospective missions (introduced by the Space Council in 2014-2015) disappeared from the programme
  - FSP 2016-2025 still being revised (now submitted to the Government)

# CURRENT RESEARCH

## In course

Mars Odyssey (HEND)	2001
<b>INTEGRAL</b> (launch, 25% time)	<b>2002</b>
Mars Express (3 instruments)	2003
LRO (LEND)	2009
Curiosity (DAN)	2011
<b>RADIOASTRON</b>	<b>2011</b>



## The most recent

Lomonosov (Moscow University)	2016
ExoMars TGO comm. started	Mar 2016



## Upcoming

Bepi Colombo (3 instruments)	Oct 2018
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MANY IN COOPERATION WITH ESA, NASA

# Federal Space Programme, Fundamental Space Research 2016-2025

2018

2019

2020

2021

2022

2023

2024

2025

beyond

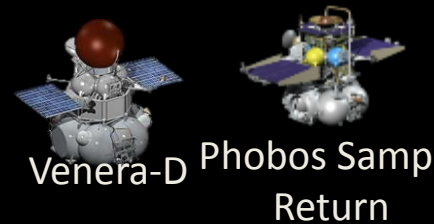
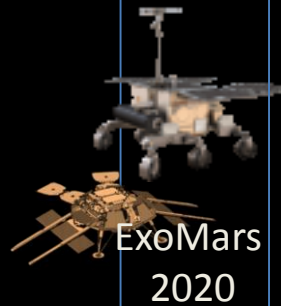
## Astronomy



## Solar-Tereestrial



## Planets



## Moon



## Biology and microgravity

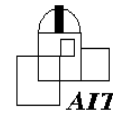


## Mission of Opportunity



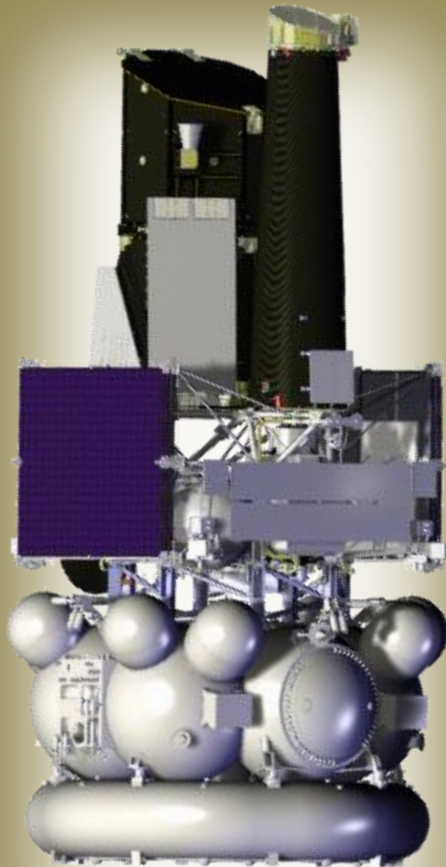


**SRG**



# SPECTRUM-ROENTGEN-GAMMA

2017 → 2019



- HALO-ORBIT AROUND L2
- PLATFORM NAVIGATOR
- S/C MASS – 2647 KG
- PAYLOAD – 1228 KG, 680 W, TWO X-RAY TELESCOPES:
  - EROSITA (MPE, DLR) 0.5–10 KEV
  - ART-XC (IKI, VNIIEF, ROSCOSMOS, MSFC/NASA) 6–30 KEV
- LIFETIME – 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.



# WSO-UV or Spectrum-UV

## WORLD SPACE OBSERVATORY - ULTRAVIOLET

2021 → 2023-24

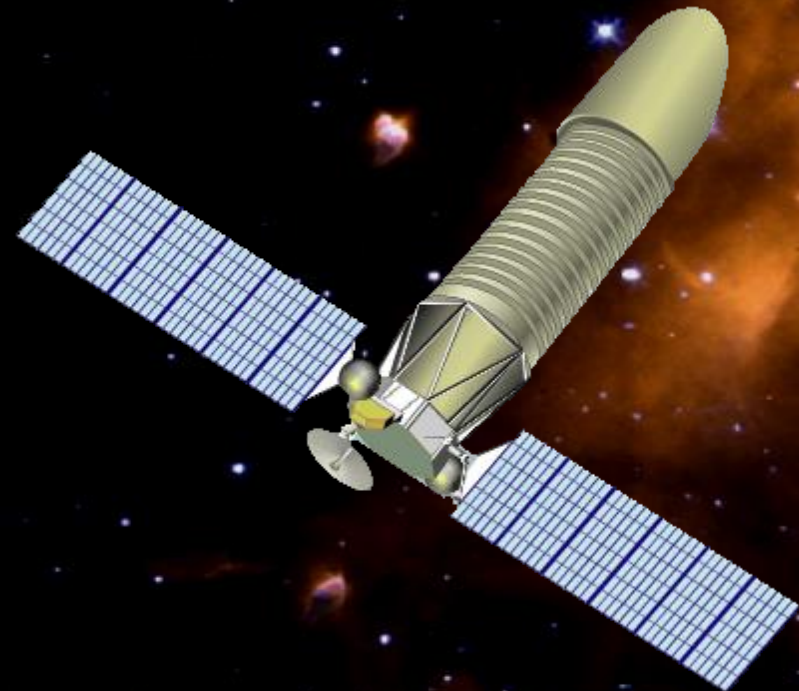
THE WORLD SPACE OBSERVATORY ULTRAVIOLET (WSO-UV) PROJECT IS AN INTERNATIONAL SPACE OBSERVATORY DESIGNED FOR OBSERVATIONS IN THE ULTRAVIOLET DOMAIN WHERE SOME OF THE MOST IMPORTANT ASTROPHYSICAL PROCESSES CAN BE EFFICIENTLY STUDIED WITH UNPRECEDENTED CAPABILITY. THE OBSERVATORY INCLUDES A SINGLE 170 CM APERTURE TELESCOPE AND FOCAL PLANE INSTRUMENTS: UV IMAGERS AND THREE SPECTROMETERS (RESOLVING POWER 1000 – 55000).

UV RANGE OF A SPECTRUM (110-340 NM), INACCESSIBLE TO GROUND TELESCOPES BECAUSE OF ABSORPTION OF RADIATION BY A TERRESTRIAL ATMOSPHERE, ARE KEY IN THE DECISION OF FUNDAMENTAL PROBLEMS OF ASTROPHYSICS:

- COSMOLOGY AND EVOLUTION OF GALAXIES;
- PHYSICS ACCRETING DOUBLE SYSTEMS;
- HOT STARS AND THE INTERSTELLAR ENVIRONMENT;
- ATMOSPHERES OF (EXO)PLANETS.

WSO-UV WILL ALLOW US TO OBSERVE OBJECTS 4-5 MAGNITUDES FAINTER THAN POSSIBLE WITH HST, PROVIDING COMPLETELY NEW OPPORTUNITIES IN PLANETARY SCIENCE, STELLAR ASTROPHYSICS, EXTRAGALACTIC ASTRONOMY AND COSMOLOGY

**INTERNATIONAL PARTICIPATION: SPAIN, JAPAN (UNDER DISCUSSION).**

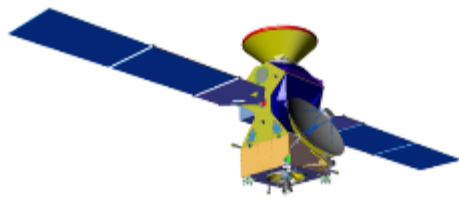


# EXOMARS: Programme Overview

- The 2016 mission consists of a Trace Gas Orbiter (TGO) with four science instruments. It also included an EDL Demonstrator Module (EDM=SCIAPARELLI). Launched 14.03.2016, in orbit since 19.10.2016, aerobraking completed ~10.03.2018
- The 2020 mission consists of a Carrier Module (CM) and a Descent Module (DM) with a Rover and a stationary Landing Platform

## 2016 Mission

Trace Gas Orbiter (TGO)



Two ESA+ two ROS science instruments



Schiaparelli EDL Demonstrator Module (EDM)

Proton M



ESA ESTRACK



NASA DSN



ROS Antennas



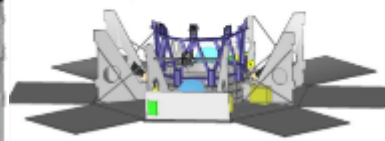
MOCC @ ESOC Spacecraft Operations

Science Operations Centre ESAC

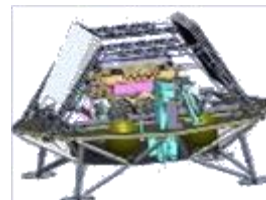
Science Archive Back-up Centre IKI

## 2020 Mission

Carrier Module (CM)



Descent Module (DM)



Surface Platform + multiple ESA systems + two instruments



Rover + two science instruments

Proton M



LPOCC

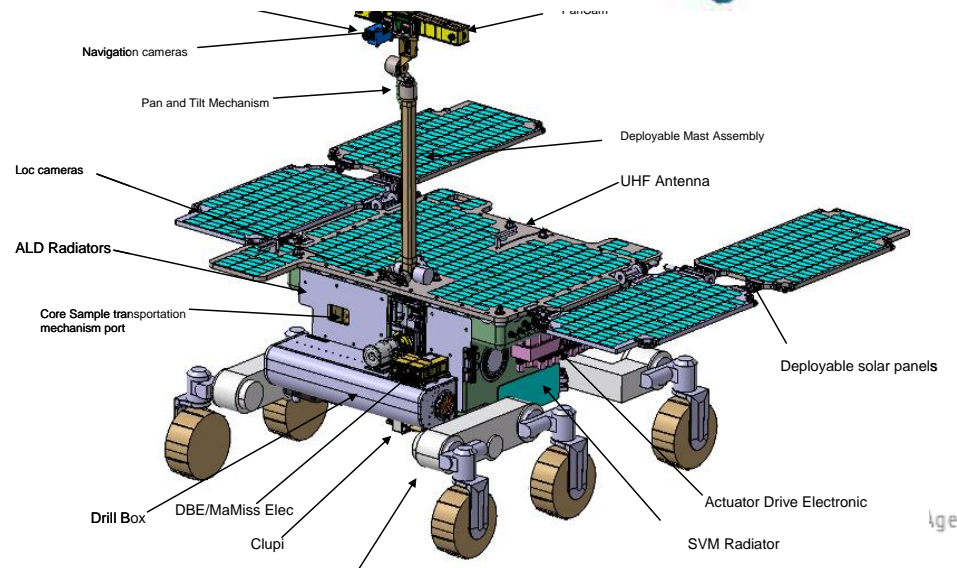
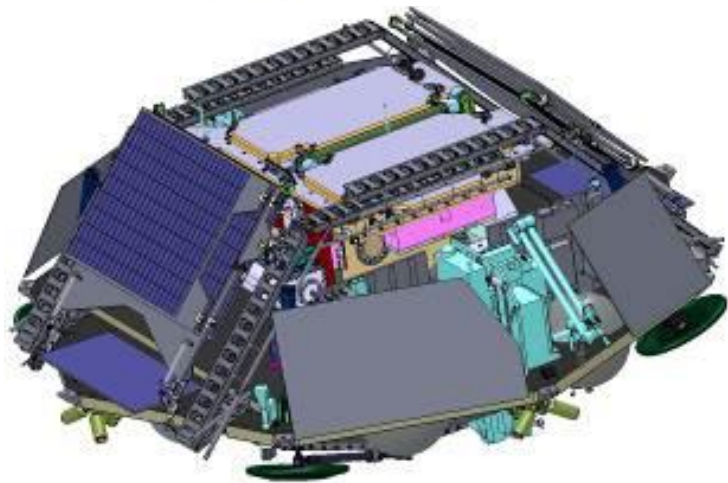
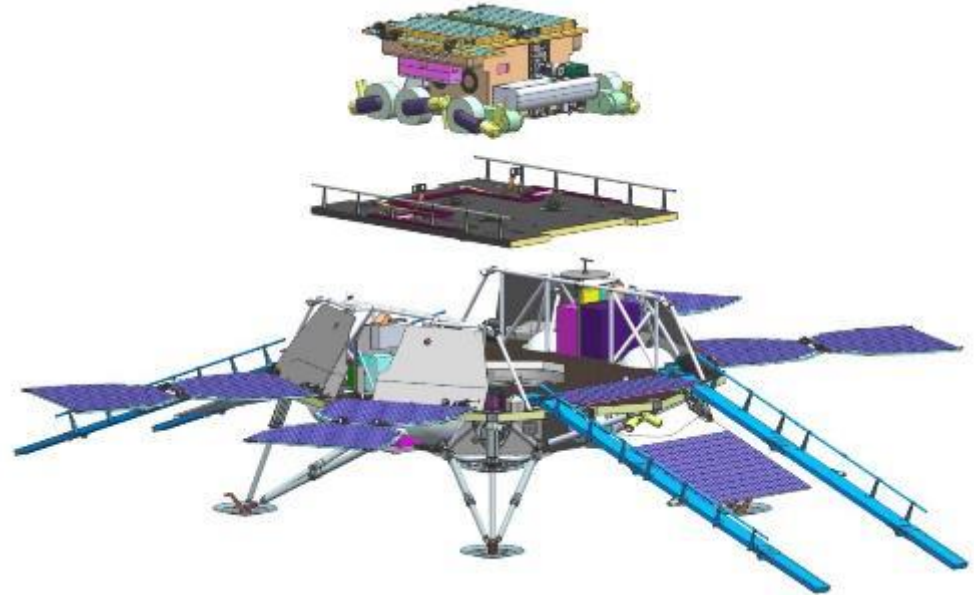
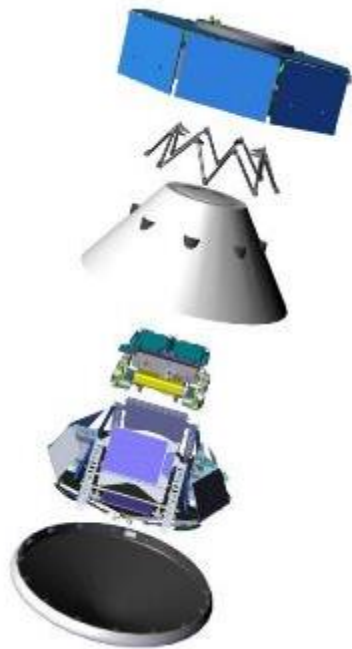


ROCC





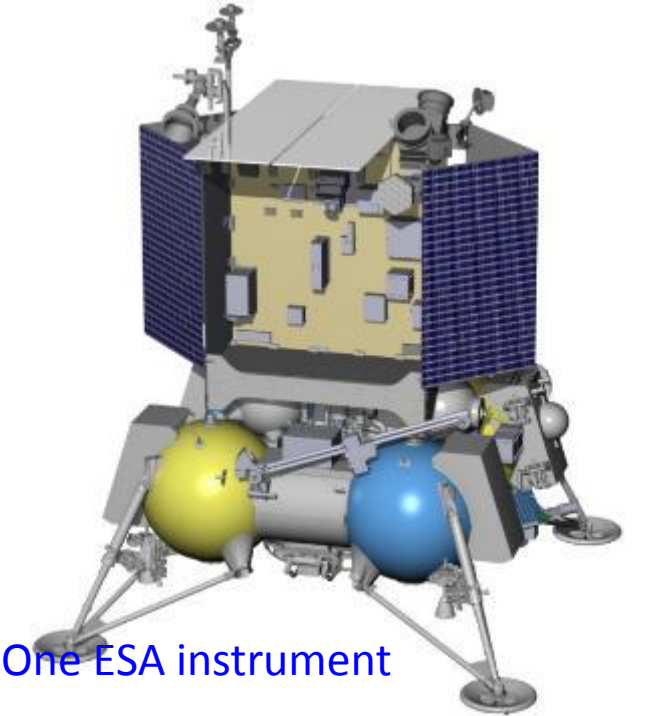
# ExoMars 2020 CDR completed



# Luna-25 LANDER

2019→2021

## Luna-25 (Luna-Glob) polar landing demonstrator



One ESA instrument

**REGOLITH =  
LUNAR SOIL  
TILLAGED BY  
MICROMETEORITES  
AND SOLAR WIND**

### Technology:

- *Re-design of soft landing technology*
- *Pole-Earth radio link tests and experience*
- *Thermal design validation*
- *Robotic arm testing and validation*

### Science:

- 1. Mechanical/thermal properties of polar regolith***
- 2. IR composition measurements of polar regolith***
- 3. Water content and elements abundance in the shallow subsurface of the polar regolith***
- 4. Plasma and neutral exosphere at the pole***
- 5. Dust exosphere at the pole***
- 6. Thermal variations of the polar regolith***

# Luna-26 ORBITER

2021-2022



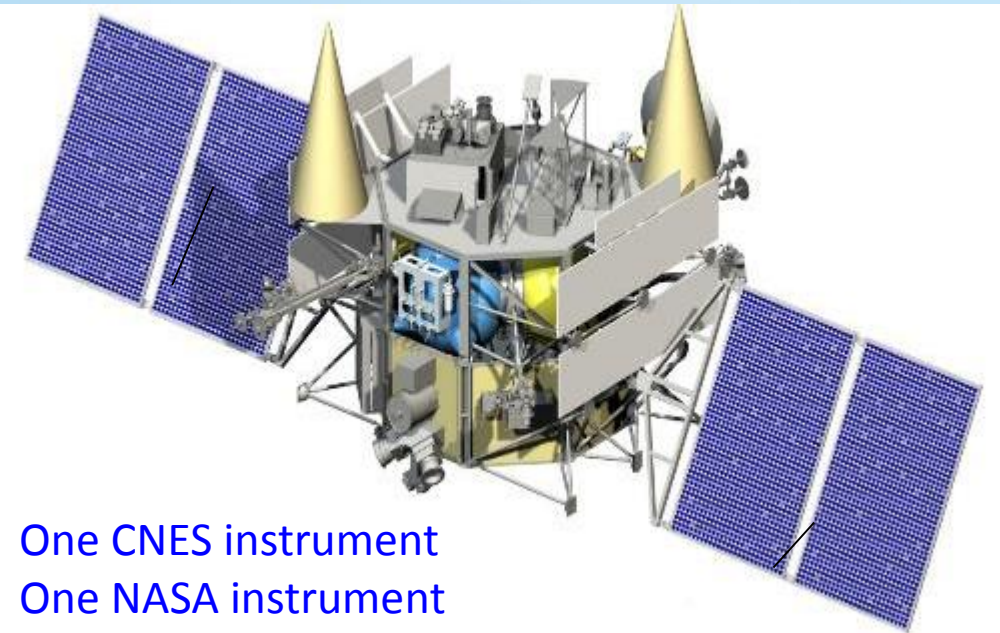
## Polar Orbiter Luna-26 (Luna-Resurs)

### Technology:

- *Polar-orbit UHF radio link tests and experience*
- *Orbital operations*

### Science:

- *Space plasma in the lunar vicinity*
- *Lunar monitoring*
- *Luna-27 landing sites candidates*

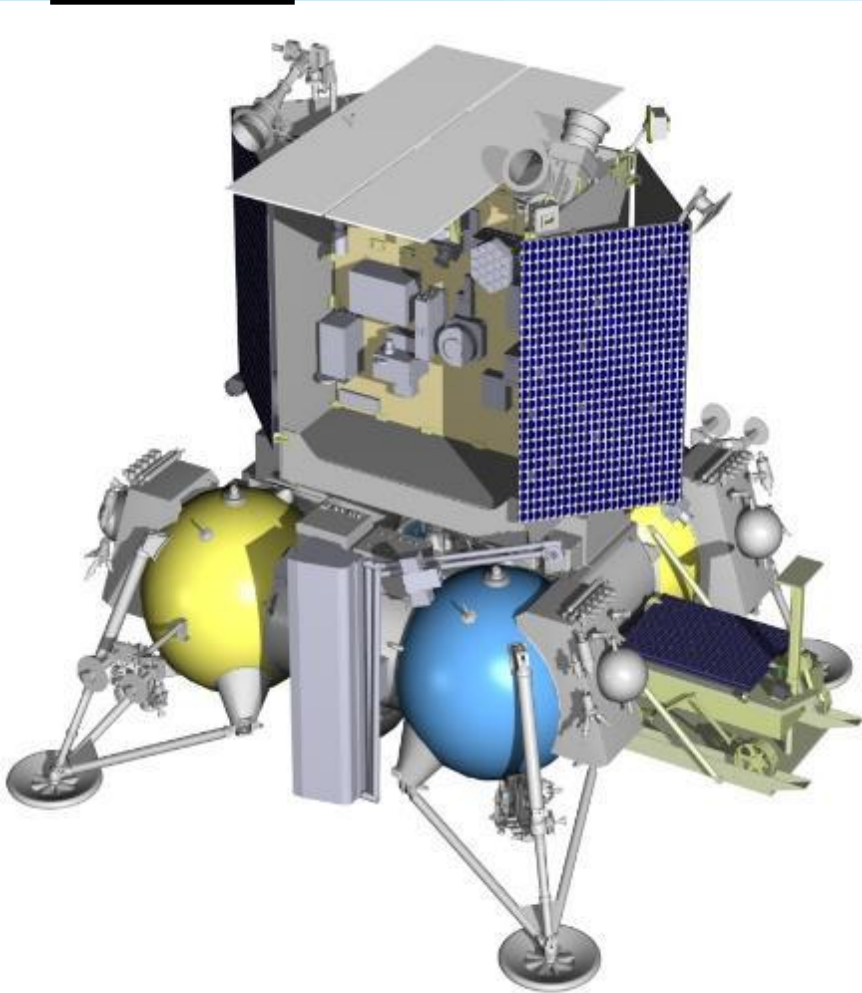


One CNES instrument  
One NASA instrument

# Luna-27 LANDER

2019→2021

## Polar Landing+ Drilling+ analysis



### Technology:

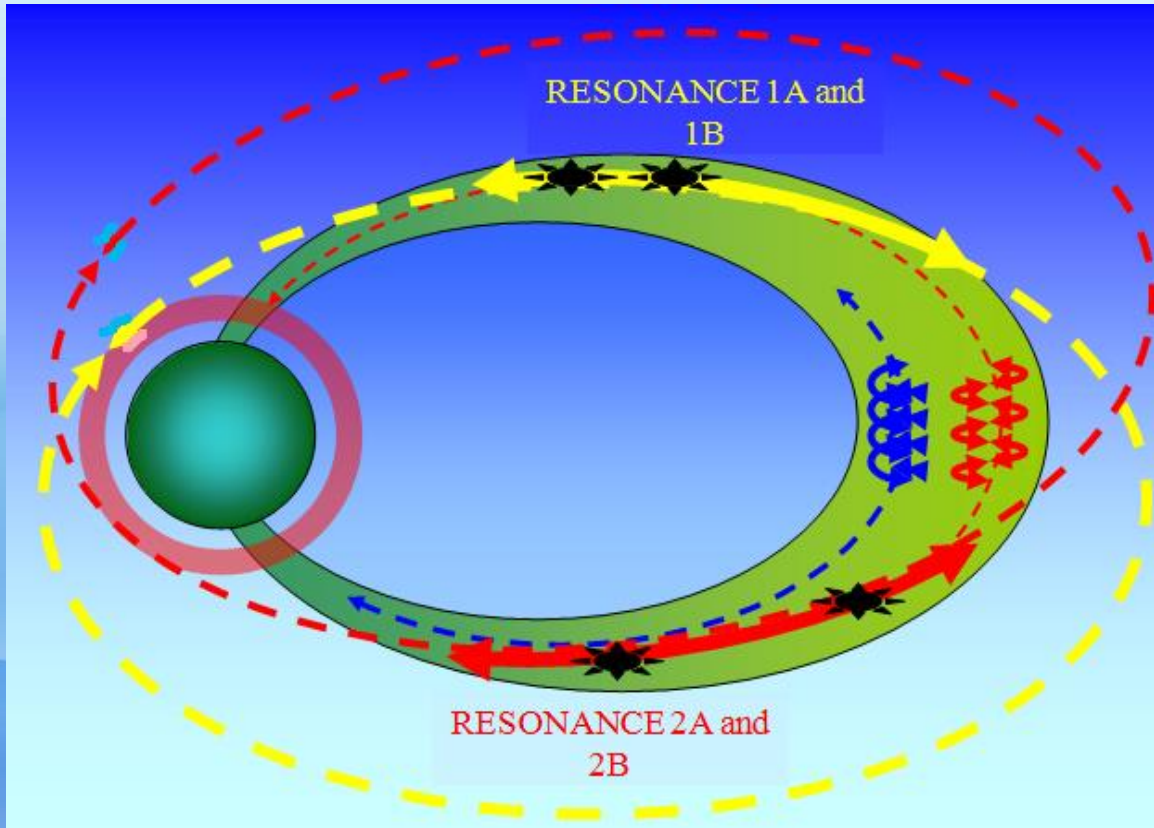
- *High precision landing and hazard avoidance (ESA)*
- *Cryogenic drilling (ESA)*
- *Pole-orbiter UHF radio link*

### Science:

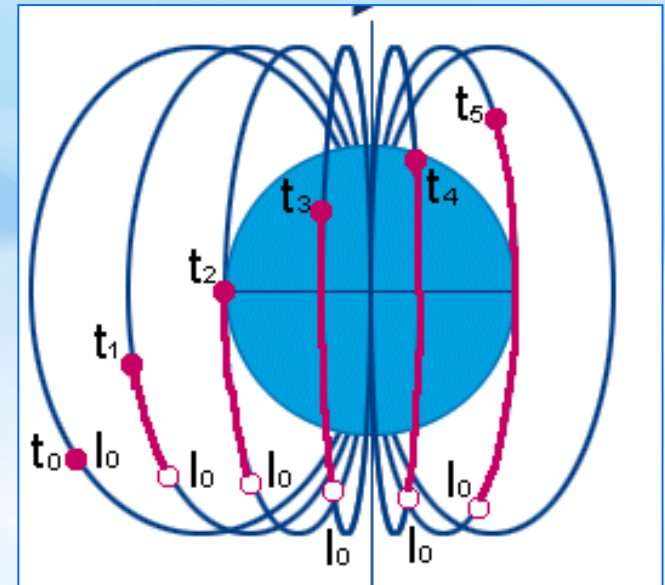
- *Mechanical/thermal/compositional properties of regolith within 2 meters*
- *Water content and elements abundance in the shallow subsurface*
- *Ionized, neutral and dust exosphere at the pole*
- *Seismometry and high accuracy ranging*

## TWO PAIRS OF SPACECRAFT

DISTANCE IN PAIRS: VARIES FROM 1-10 KM TO 100-1000 KM



- PERIOD: 8 h
- APOGEE: ~27000 KM
- INCLINATION: 63.5°
- CO-ROTATION WITH MAGNETIC LINE AT  $L \sim 4-5$

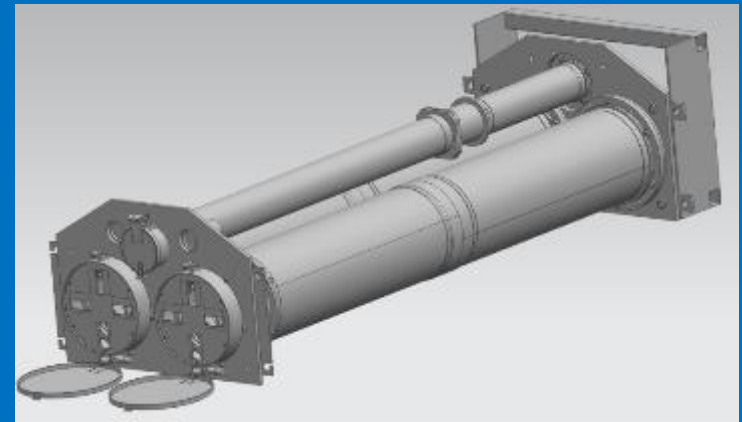
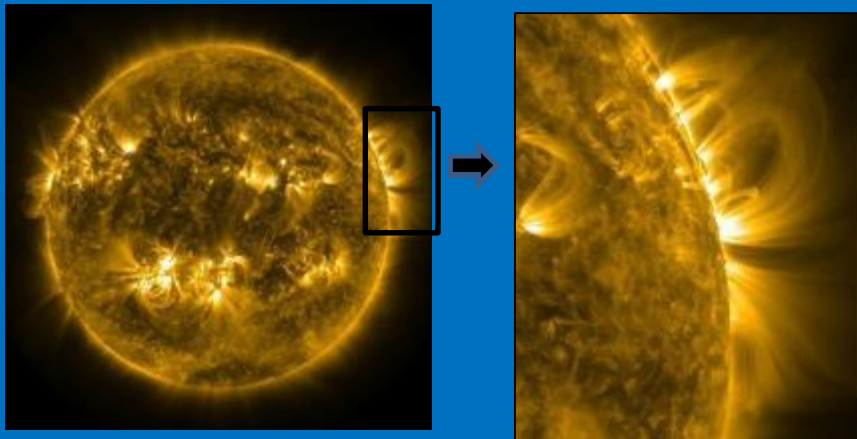


RESONANCE-MK DEMONSTRATOR (ONE SPACECRAFT) NOW PLANNED FOR 2023 LAUNCH

# ARKA

2023 ← 2024

ARKA is a small explorer mission intended to get images of solar corona and transition layer of the Sun with the highest spatial resolution ever :  $\sim 5$  km per pixel. The Sun will be observed in narrow angle.



- Detectors are are 6kx6k CCDs by e2v
- Launch of Arka together with Resonance-MK demonstrator would allow to advance the project by one year.



# Federal Space Programme, Fundamental Space Research 2016-2025

2018

2019

2020

2021

2022

2023

2024

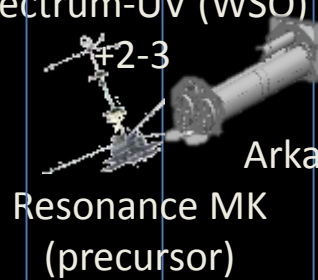
2025

beyond

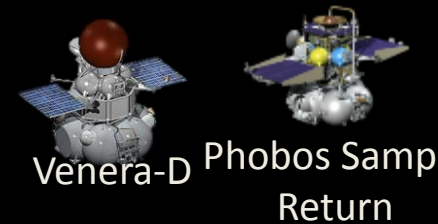
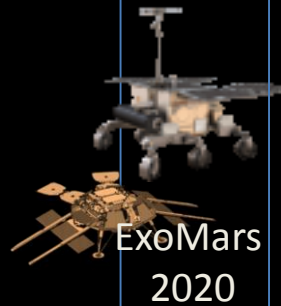
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## Solar-Tereestrial



## Planets



## Moon



## Biology and microgravity

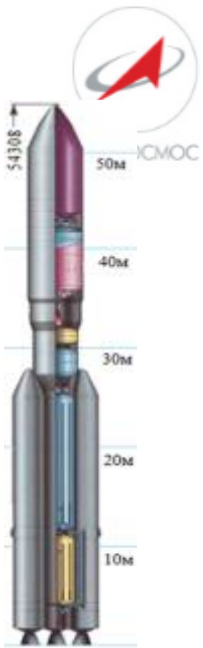


## Mission of Opportunity



**THANK YOU**

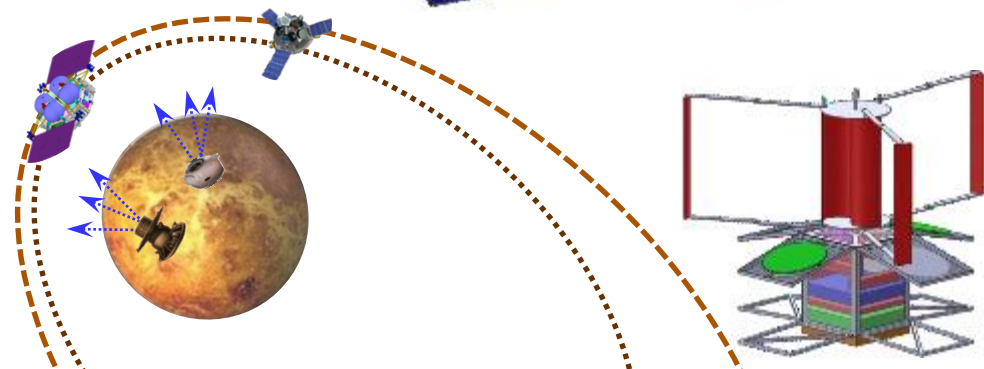
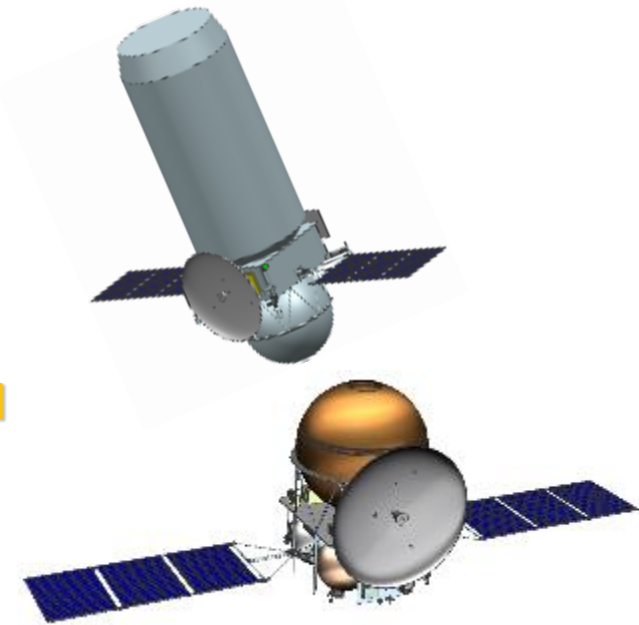




# VENERA-D: JSWG with NASA

Launch after 2026.

NB: Venera-D is not (yet) included in the Federal Space Programme



- Venera-D main elements:
  - 2-3h lifetime lander
  - Science orbiter
- Optional dischargeable elements:
  - Long living hot station (s)
  - Sub-satellite
- Launch options: **2026, 2028, 2029, 2031**

# STRATEGY FOR THE FUTURE PROGRAMME: MOON AND MARS ARE THE FIRST PRIORITIES

## MAIN FEATURES:

- TWO MAIN DESTINATIONS MOON AND MARS
- NEW MISSION TO PHOBOS
- SAMPLE RETURN FROM THE MOON , PHOBOS AND MARS
- GRADUAL DEVELOPMENT – EACH MISSION IS A BASIS FOR THE NEXT ONE

## MOON :

- ORIGIN
- POLAR REGIONS
- SEARCH FOR WATER
- **SAMPLE RETURN**

## PHOBOS:

- ORIGIN
- GEOCHEMISTRY
- **SAMPLE RETURN**

## MARS:

- HABITABILITY
- PAST CLIMATE
- PRESENT CLIMATE, CONDITIONS
- **SAMPLE RETURN**

# Mars Programme


The first stage

**2016**



**ExoMars TGO**  
Proton, Orbiter,  
Two Russian instruments  
ASC и FRENД

**2020**

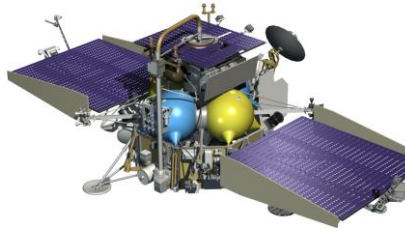


**ExoMars Lander**  
Proton,  
Rover, Mars  
Lander

**ExoMars Rover**  
Soil study along  
the Rover way

Joint mission

**202??**



**Boomerang**  
(Phobos-Soil-2)

Proton,,  
Phobos SR, Phobos  
inverstigation

Under  
discussion

Cooperation with ESA?

Contribution to MMX

**202??**



**Mars-SR**

2 Proton,  
Mars SR,  
Mars inverstigation

Under  
discussion



### ТСПП

**ИКИ**

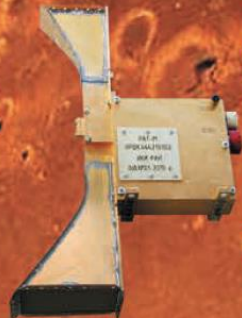
телевизионная система для видеосъёмки, панорамы места посадки, динамики атмосферных процессов, стереосъёмки марсианского ландшафта, контроля за работой манипулятора



### СЭМ

**ИКИ**

сейсмометр для изучения микроколебаний поверхности Марса



### РАТ-М

**ИКИ**

радио-термометрические бесконтактные микроволновые измерения. Оценка температуры поверхности на 3-х уровнях глубины, оптической толщины атмосферы во время пылевой бури



### МГАК

**ИКИ**

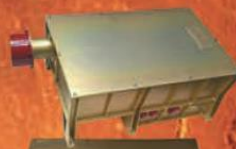
марсианский газо-аналитический комплекс для исследования динамики микро-компонентов атмосферы у поверхности



### ФАСТ

**ИКИ**

Фурье-спектрометр для исследования атмосферы и мониторинга климата Марса



### М-ДЛС

**ИКИ**

лазерный спектрометр для исследования химического и изотопного состава атмосферы вблизи поверхности Марса и летучих компонент марсианского грунта



### ПК

**ИКИ**

пылевой комплекс для контактного изучения свойств пылевых частиц, переносимых ветром у поверхности Марса



### АДРОН-ЭМ

**ИКИ**

детекторы нейтронов и гамма-лучей с возможностью активного зондирования для определения содержания воды и элементного состава подповерхностного грунта, мониторинг радиационной обстановки



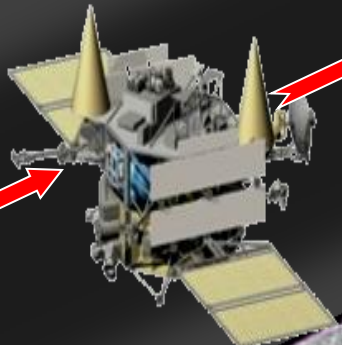
# LUNAR PROGRAMME

1976



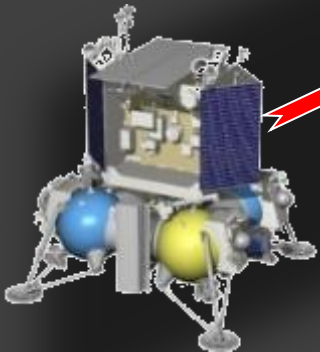
LUNA-24

2022



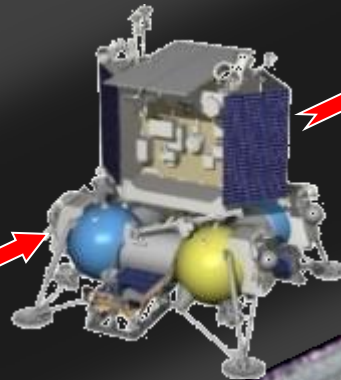
LUNA-26  
(LUNA-RESOURS-ORBITER)  
GLOBAL ORBITAL STUDIES  
OF THE MOON

2021



LUNA-25  
(LUNA-GLOB)  
TECHNOLOGY OF POLAR  
SOFT LANDING, STUDY OF  
LUNAR SOUTH POLE  
(1450/530 KG)

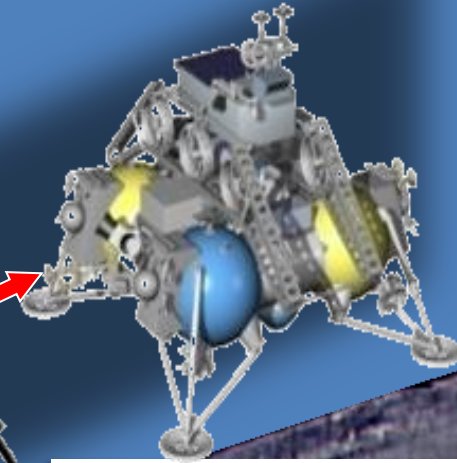
2020-2023



LUNA-27  
(LUNA-RESOURS\_LANDER)  
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)  
LUNOHOD MISSION  
(3000 KG)

JOINT MISSION

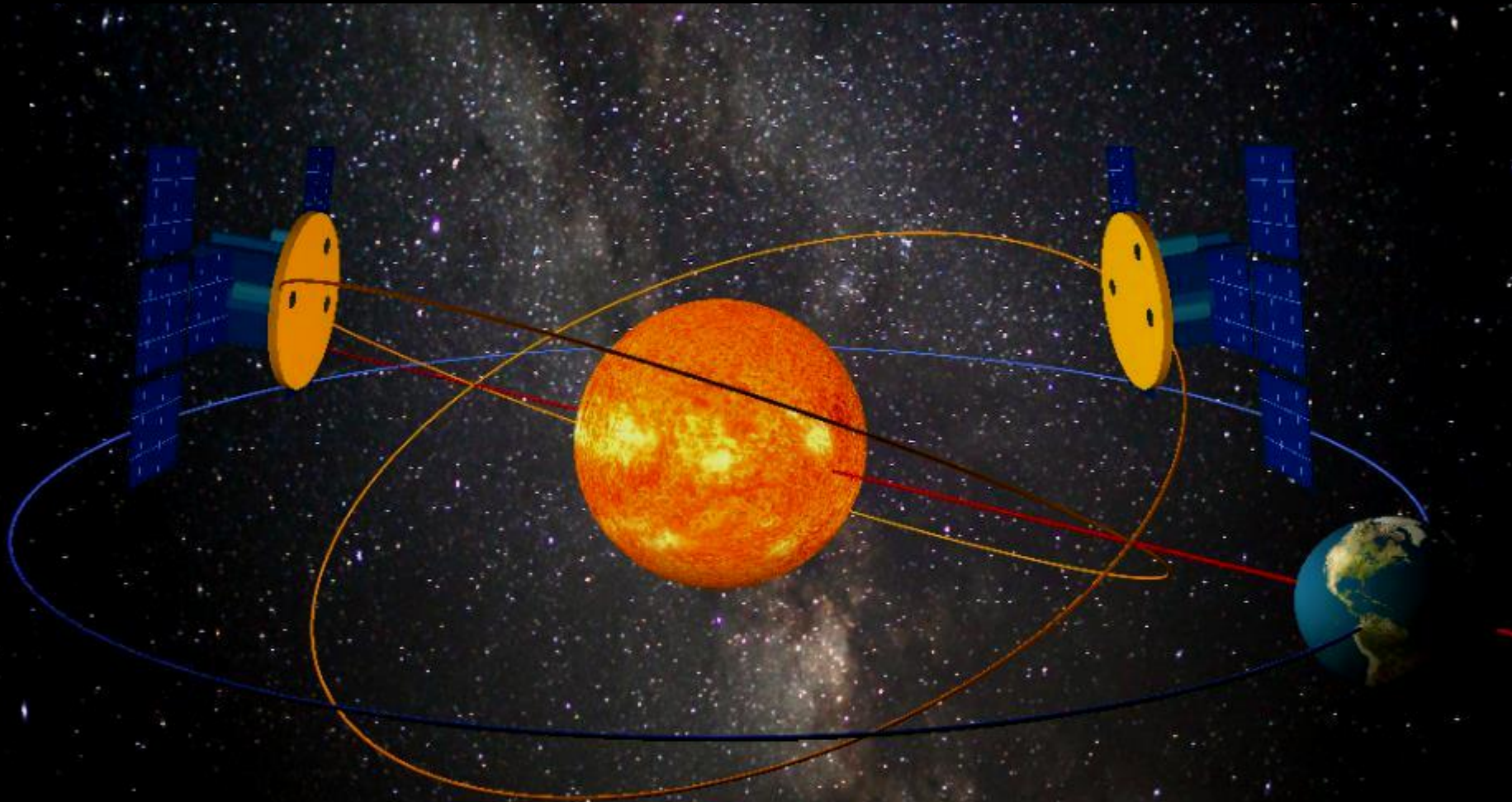
HIGH ACCURACY LANDING  
RADIO LINK MOON-ORBIT  
CRYOGENIC DRILLING  
SCIENTIFIC INSTRUMENTS

ESA INSTRUMENT

PLANNED ESA INVOLVEMENT

# INTERHELIOPROBE

>2025

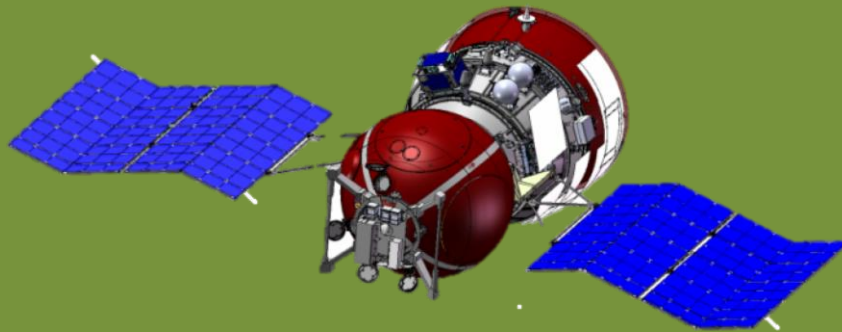


**SYNCHRONOUS OBSERVATIONS OF THE SUN AND IN-SITU  
MEASUREMENTS IN THE INNER HELIOSPHERE WITH TWO SPACECRAFTS**



2020, 2025

# BION-M



- Studies of radiation effect on biological materials and living species
- Flight duration 30 days
- Orbit 1000 km



# Earth Observations

- Led by Roscosmos (RKS, Planeta) and Rosgidromet
- Present orbital group: 8 S/C, observing in visible and IR spectral ranges
  - Resource-P #1, 2, 3 (visible)
  - Canopus-V (vis, NIR)
  - Electro-L #1, 2 (vis, IR, geostationary)
  - Meteor-M #1, 2 (vis, IR, radio, radar)
- Group on Earth Observations, GEO-XIII held in St Petersburg 9 Nov 2016