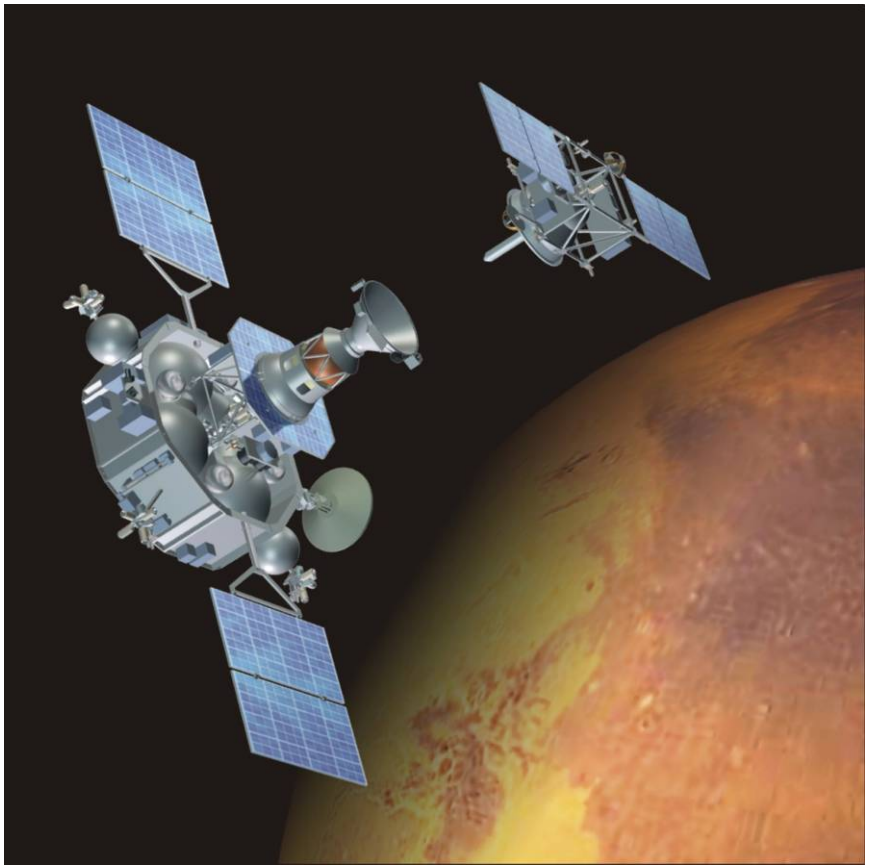
SPACE MISSIONS



2010

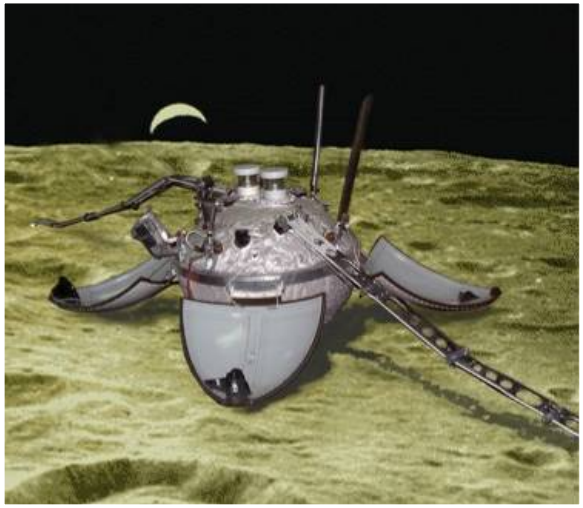
LAVOCHKIN ASSOCIATION HERITAGE

MOON EXPLORATION

27 launches were performed.

For the first time in the world:

- **The soft moonfall was performed (“Luna-9”),**
- **The Moon satellite was developed (“Luna-10”)**
- **Lunar soil samples were delivered to Earth (“Luna-16”)**
- **The moon rover “Lunokhod-1” was designed and developed**



Landers
(“Luna-9,-13,-15,-16,-17,
-18,-20,-21,-23,-24”)

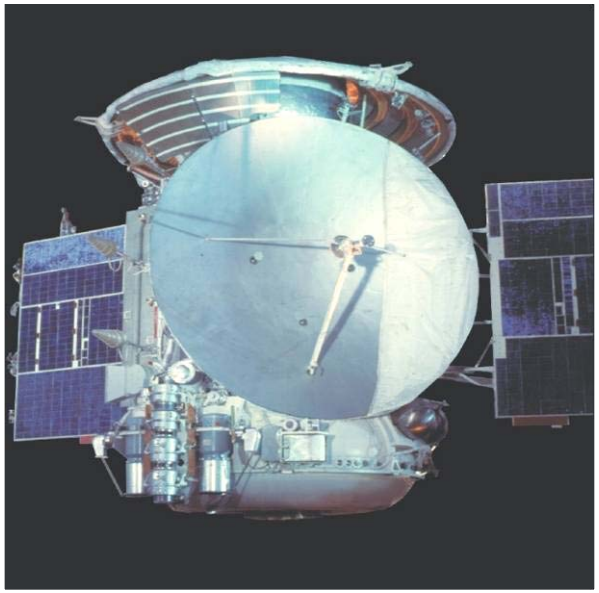
Moon rovers:
“Lunokhod-1,-2”
(“Luna-17,-21”)

MARS EXPLORATION

11 launches were performed

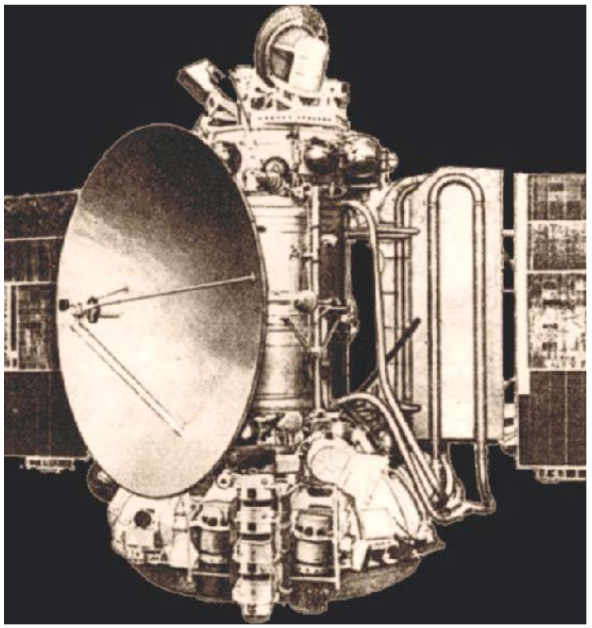
For the first time in the world

- Mars landing was performed (“Mars – 3”)



Fly-by spacecraft
(“Mars-2,-3,-6,-7”)

Landers (“Mars-2,-3,-6,-7”)



Orbiters (“Mars-4,-5”)

LAVOCHKIN ASSOCIATION HERITAGE

VENUS EXPLORATION

18 launches were performed

For the first time in the world:

-Venus soft landing was performed (“Venera-7”),

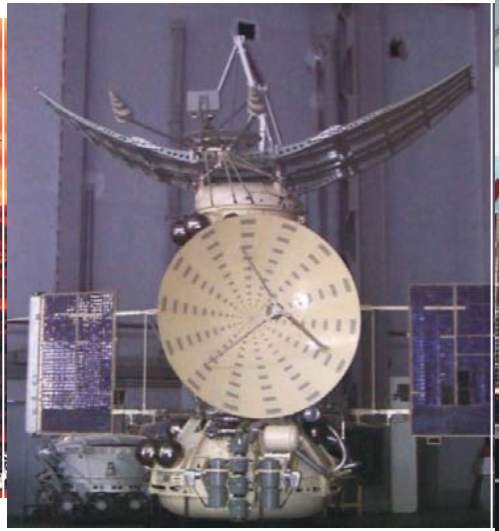
- First image of Venus surface was received (“Venera-9”)

- Venus colored panoramic sight was received and Venus soil samples were studied (“Venera-13”)

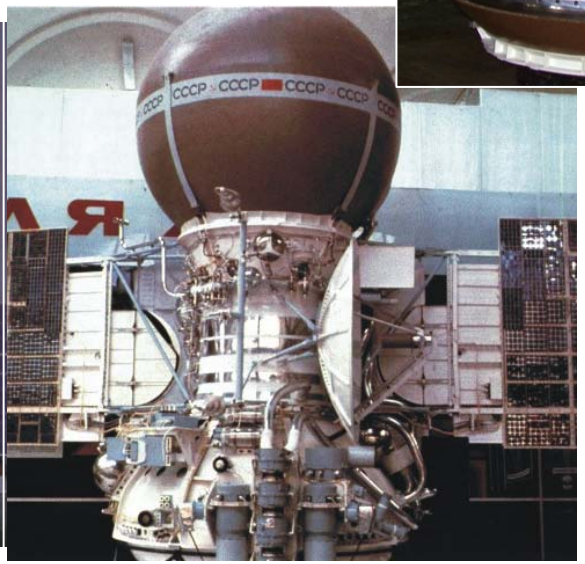
- Balloon-borne probe was launched in Venus atmosphere (Vega-1”)

“Vega-1”
and “Vega-2”

Landers
(“Venera-4,5,6,7,8,
9,10,11,12,13,14”)



Orbiters
(“Venera-15,16”)



Fly-by spacecraft
(“Venera-11,12,13,14”)

LAVOCHKIN ASSOCIATION ACTIVITIES

MAIN AREAS OF ACTIVITIES

Lines of activities

Information systems

Astrophysical research

Planetary explorations

Small spacecraft

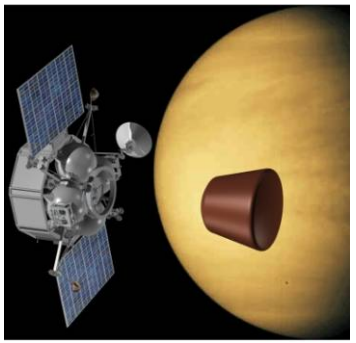
Launch vehicles

Unmanned aerial vehicles

PLANETARY MISSIONS

Mars exploration

Moon exploration

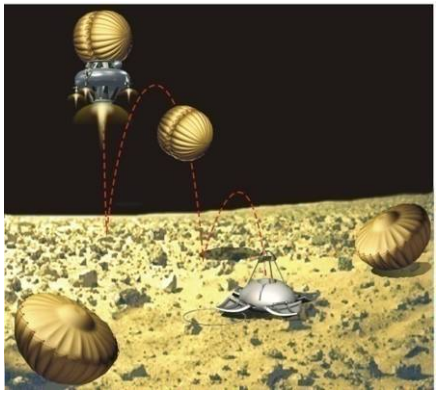


Venus exploration

Russian planetary program

Jupiter system exploration

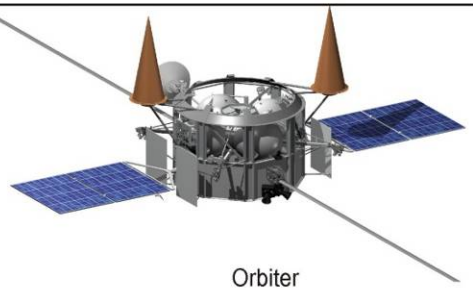
Sun exploration



Mercury exploration

ROBOTIC MOON EXPLORATION PROGRAM

Luna-Glob:
Remote sensing from lunar orbit;
In-situ studies in the near-polar area of the Moon;
Natural resources survey;
Study of influence of incoming corpuscular fluxes and e-field radiation on the Moon
(one-launch mission)



Orbiter

Lander

Luna-Resource/1:
In-situ studies in the near-polar area using stationary surface station in the framework of russian-indian joint project
(one launch mission)

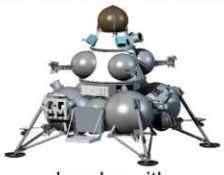
Orbiter (India)

Lander (Russia)
with minirover (India)

Luna-Resource/2: (Moon Sample Return):
Studies in the near-polar area by multi-functional lunar rover, soil samples collection and delivery to the Earth
(two-launches mission)

Lander with Moon rover

Landing mission

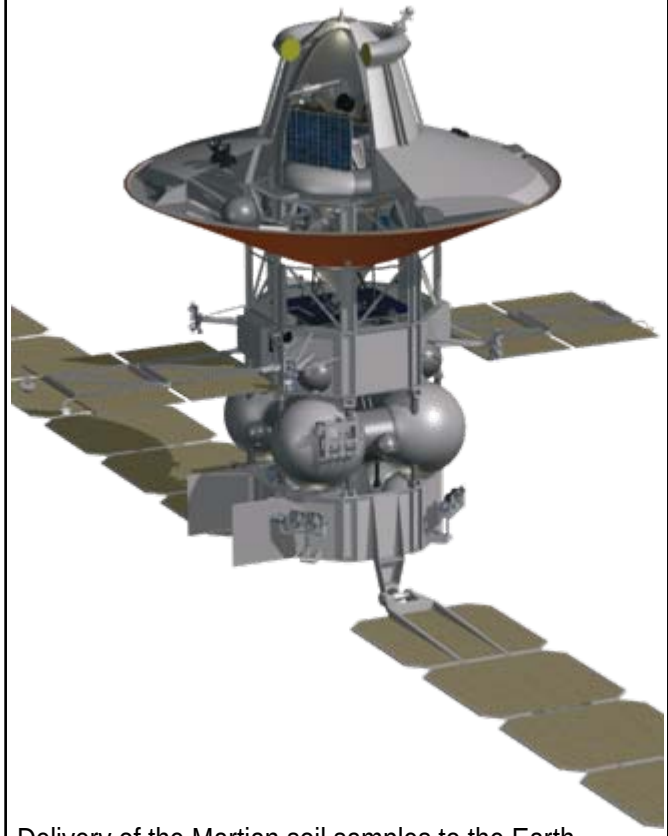


Lander with
Lunar ascent vehicle

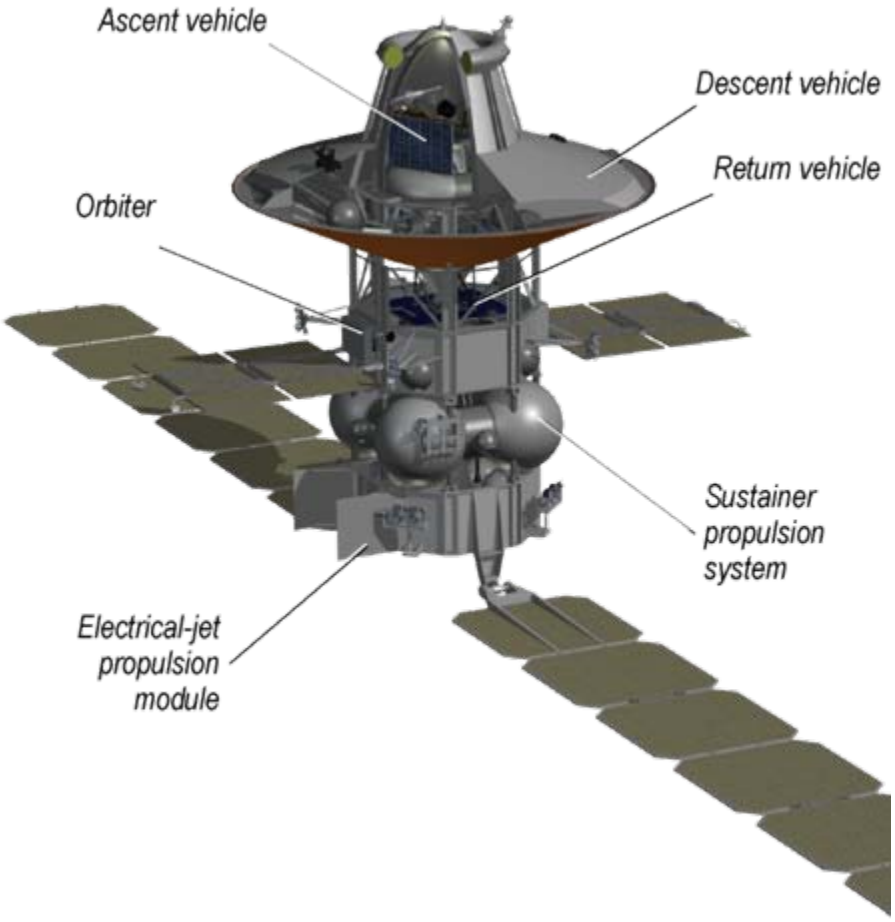
Landing-return mission

Lunar polygon:
Creation on the lunar surface of the scientific-research base

ROBOTIC MARS EXPLORATION PROGRAM

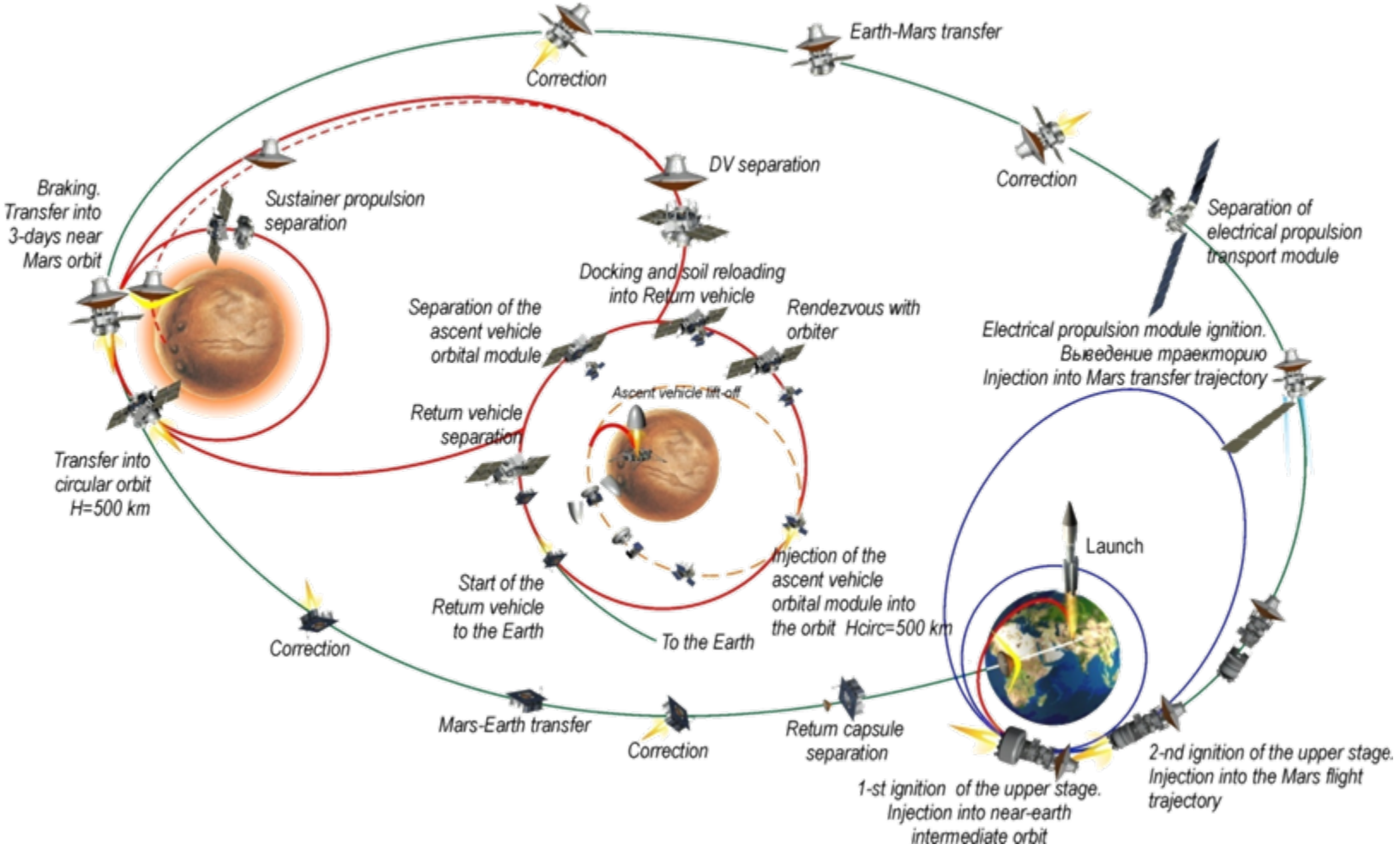
PHOBOS-GRUNT	MARS-NET	MARS-GRUNT
		
Phobos samples return; Investigation of Phobos and Mars monitoring from the lander; Investigation of Phobos and ambient space from the orbiter.	Long-term investigations of Mars by contact and remote methods	Delivery of the Martian soil samples to the Earth

"MARS-GRUNT" MISSION (MARS SAMPLE (RETURN)

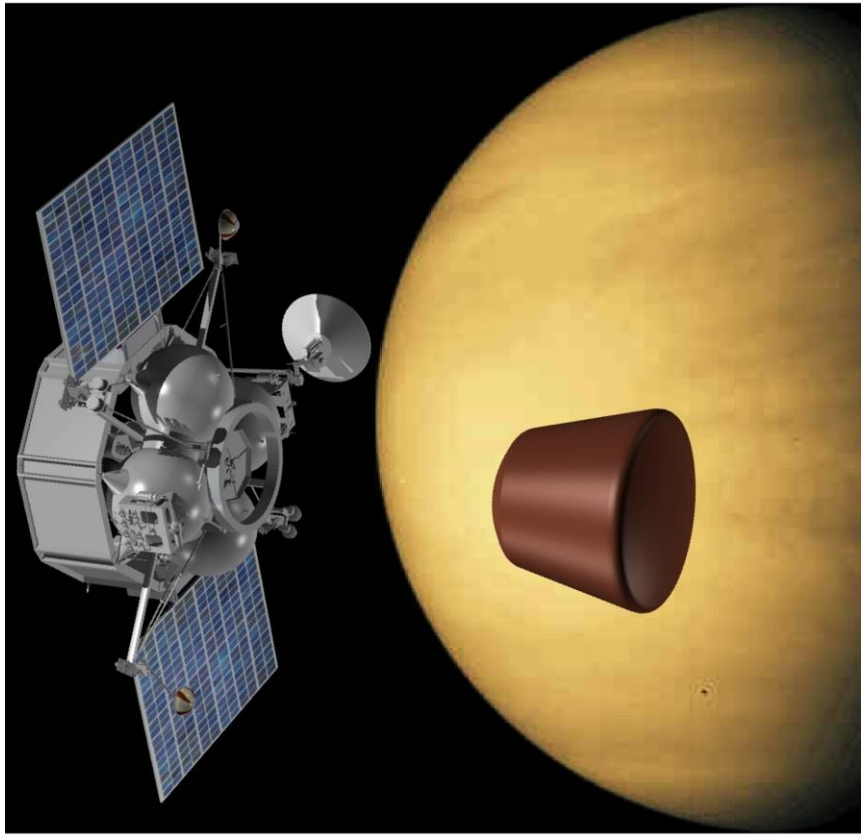


Purpose	Mars sample return
Launch vehicle	“Angara-5"/"Breeze-M"
Mission concept	Single –launch scheme with docking on the Mars orbit
SC mass	6 040 kg
PL mass on the Orbiter	50 kg
PL mass on the Lander	20 kg
Mass of delivered samples	0.2 kg

"MARS-GRUNT" MISSION PROFILE

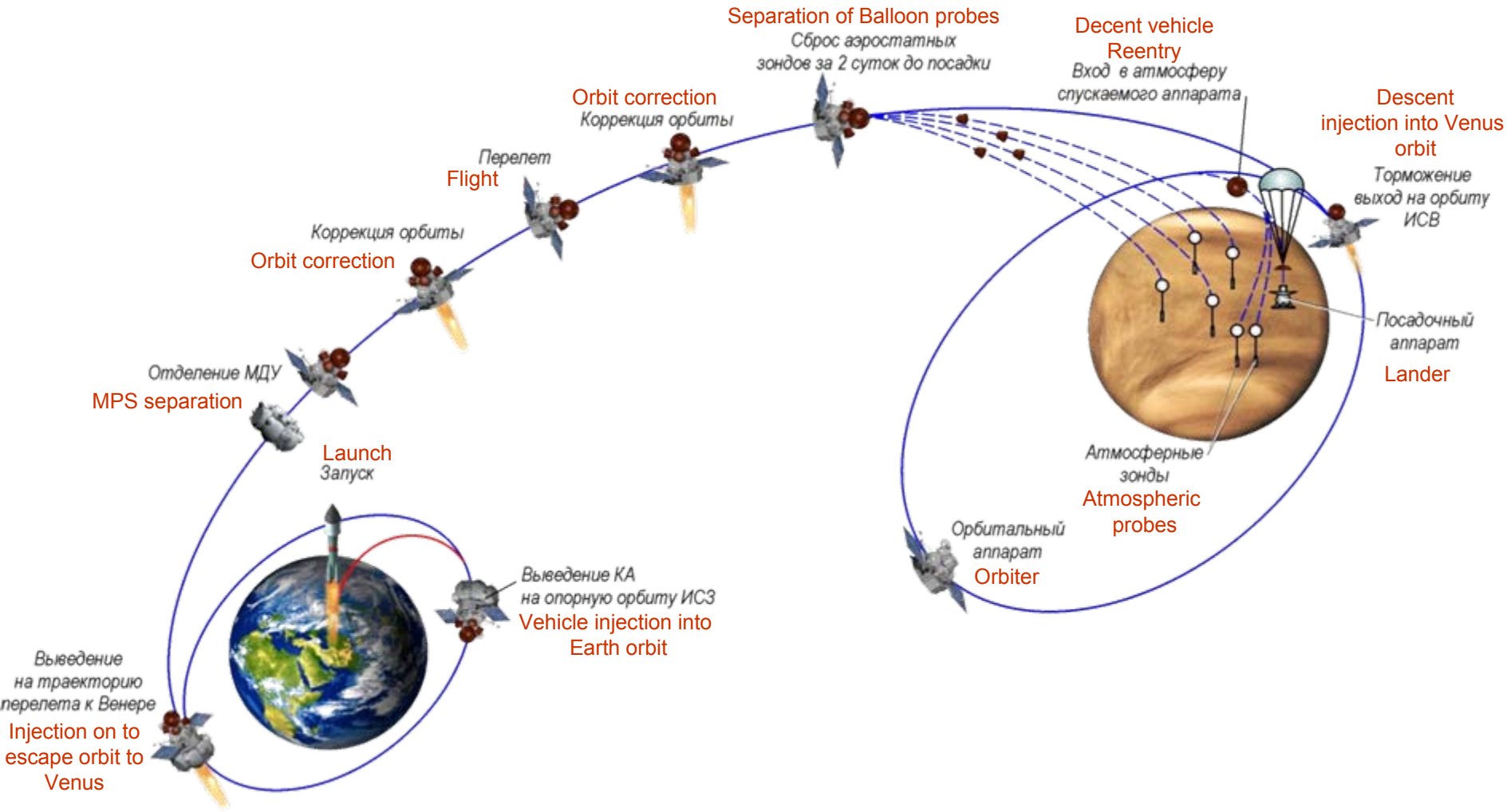


"VENERA-D" MISSION

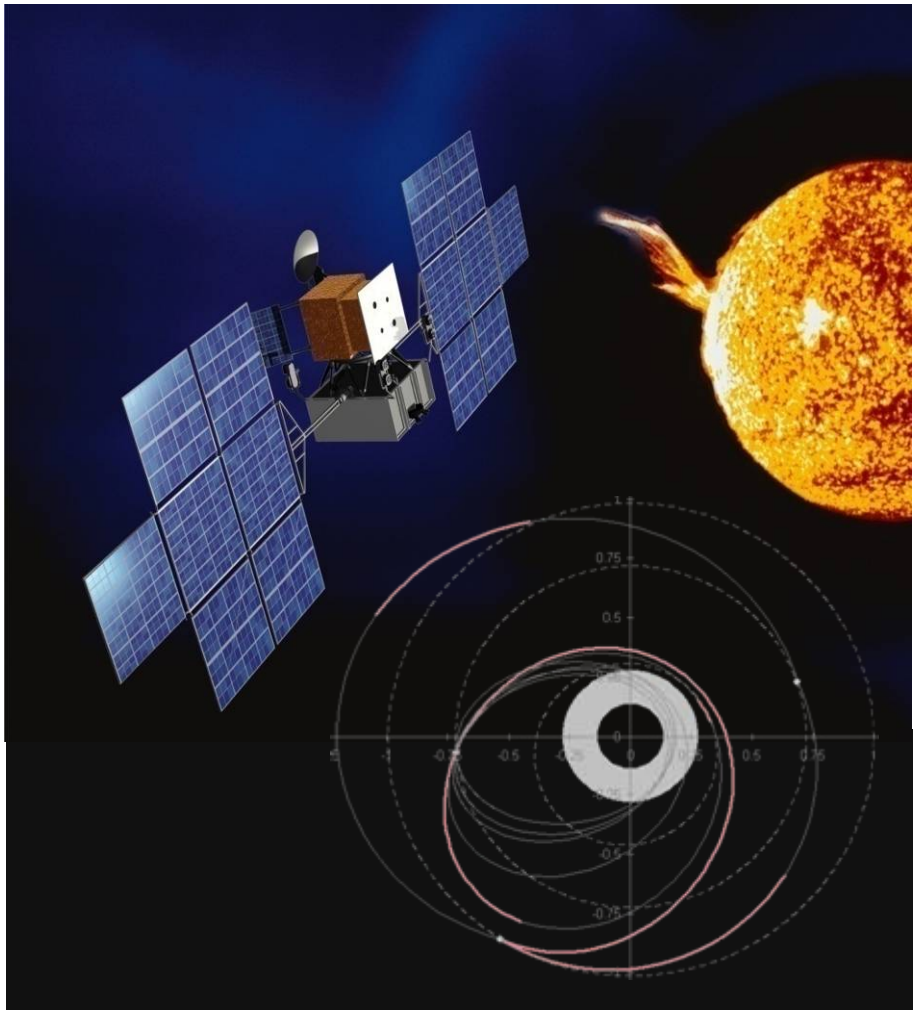


Purpose	Exploration of the Venus by contact and remote methods
Launch year	2016 (TBC)
Launch vehicle	“Soyuz-2"
SC composition	– Injection Propulsion Module – Orbiter – Lander
SC mass	8 120 kg
Lander mass	170 kg

"VENERA-D" MISSION
MISSION PROFILE

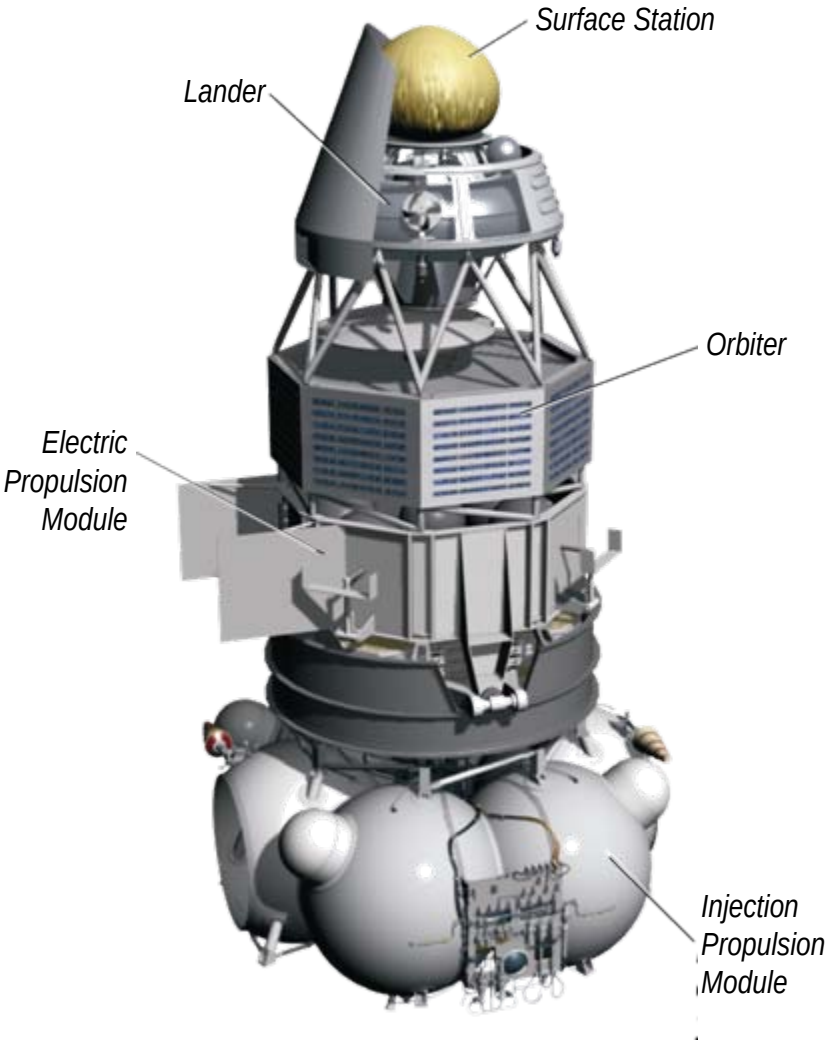


"INTERHELIO-ZOND" MISSION



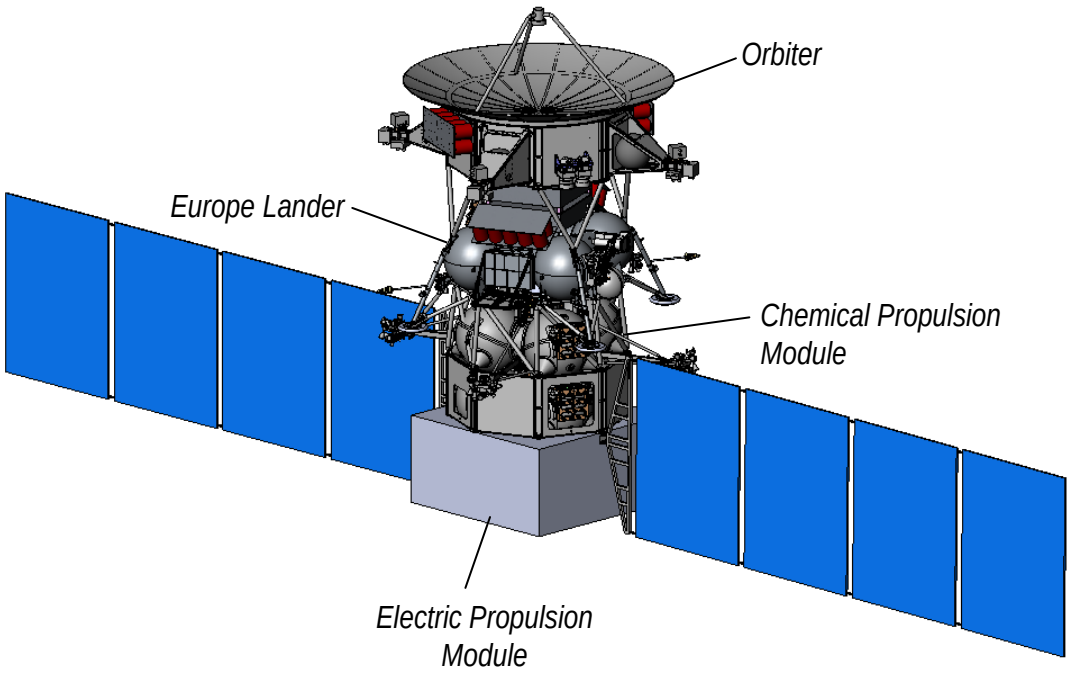
Purpose	Sun exploration from 30-40 its radius
Launch year	2014
Launch vehicle	“Soyuz-2"
SC mass	8 120 kg
Payload module mass	> 300 kg
Flight to - 47 RS - 34 RS - inclination 30 deg	 1.9 years 3.7 years 4.9 years

"MERCURY-P" MISSION



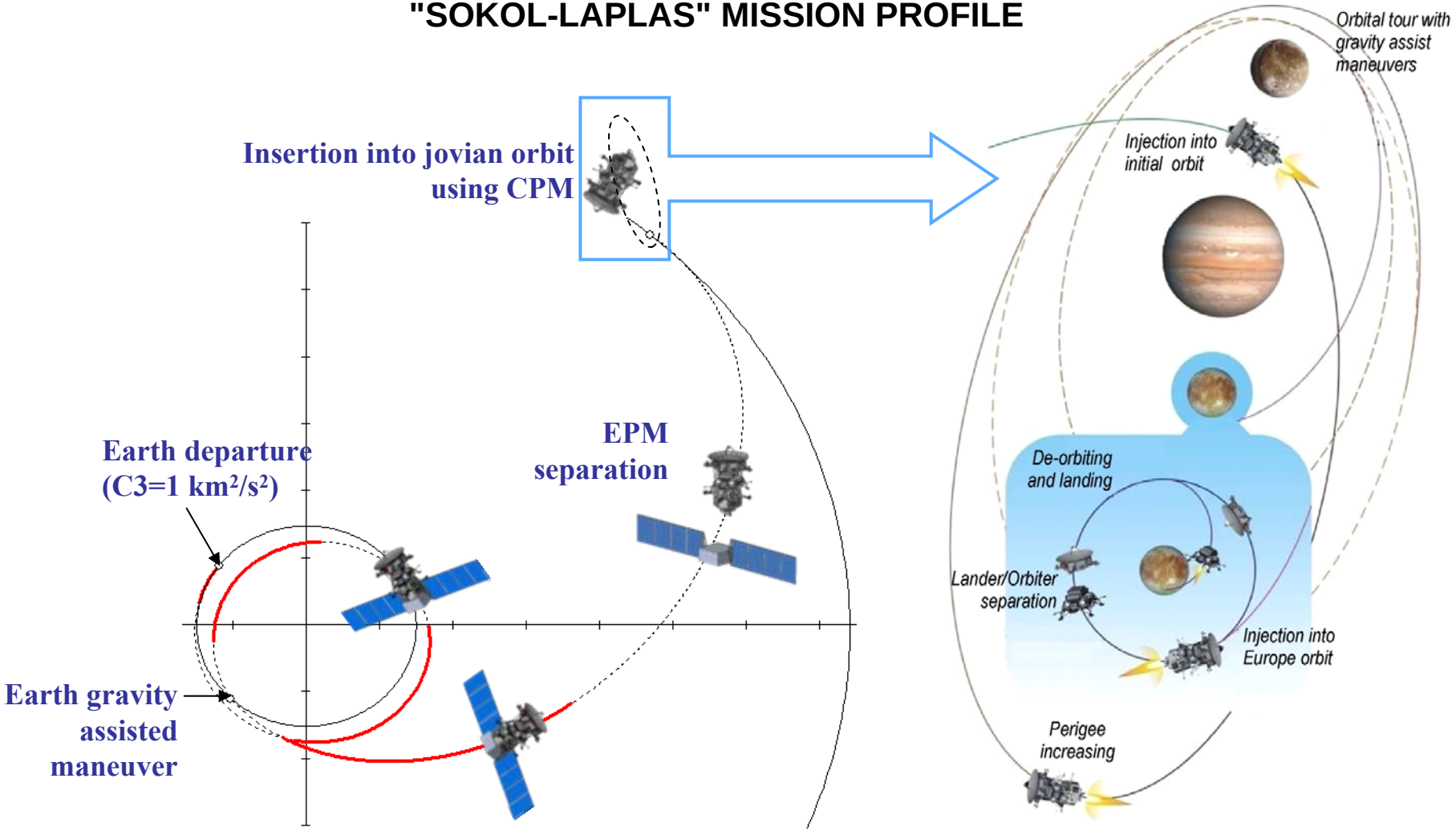
Purpose	Exploration of Mercury by contact and remote methods
Launch vehicle	“Soyuz-2"
SC mass	8 120 kg
Lander mass	710 kg
Surface Station mass	40 kg
PL mass on Orbiter	50 kg

"SOKOL-LAPLAS" MISSION

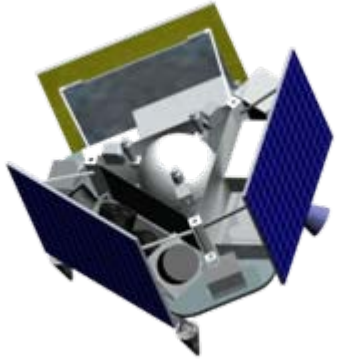


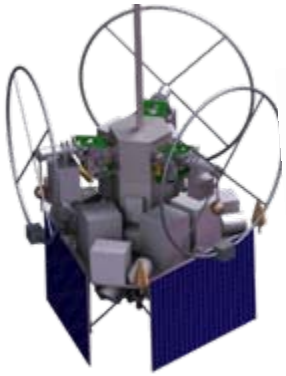
Purpose	Exploration of Jupiter system by contact and remote methods
SC mass	6 360 kg
Europe Lander mass	1 210 kg
Orbiter mass	395 kg

"SOKOL-LAPLAS" MISSION PROFILE

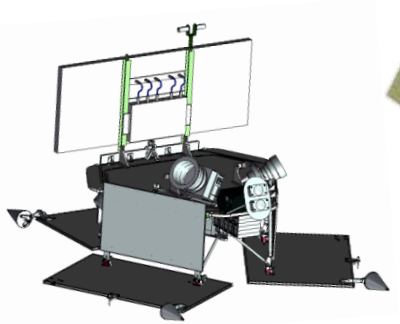


SPACECRAFT BASED ON “KARAT” UNIFIED PLATFORM

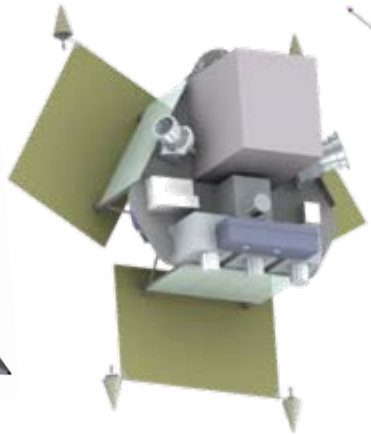




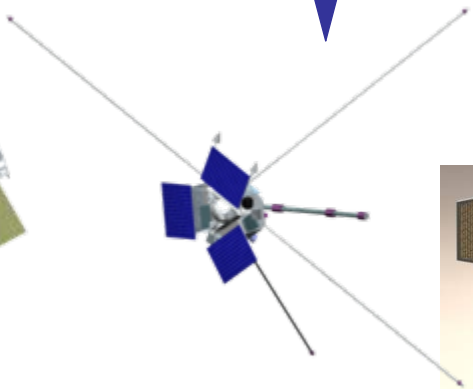
RESONANCE



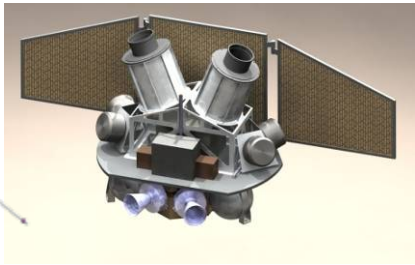
ZOND-PP



MONIKA-RELEK



STRANNIK



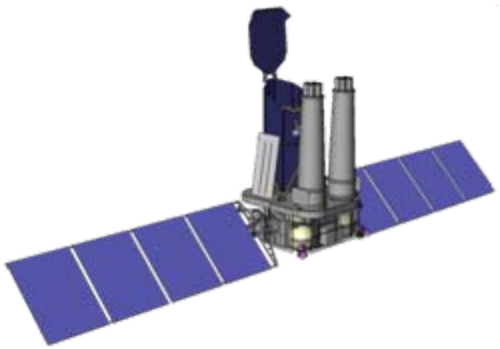
KONUS

ASTROPHYSICAL PROGRAM CONCEPT

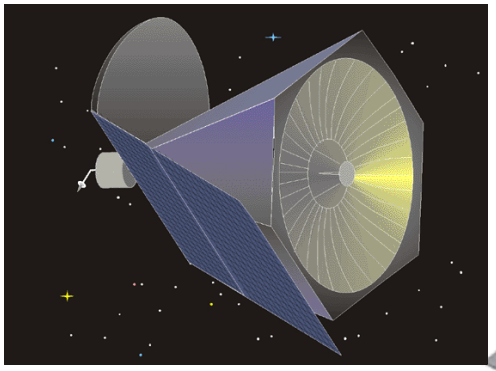
SPEKTR-R

SPEKTR-UF

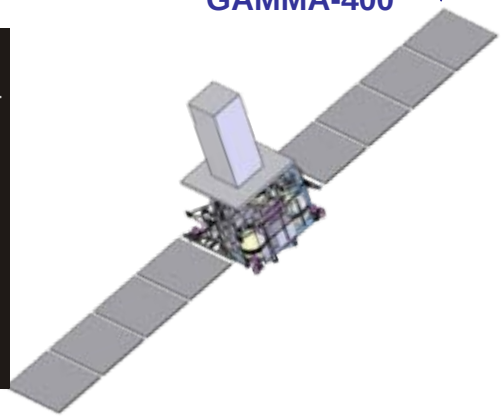
SPEKTR-RG



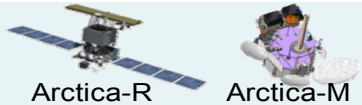
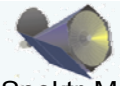
SPEKTR-M



GAMMA-400



ADVANCED SPACE COMPLEXES

	Karat	Navigator	Flagman	Dvina-TM
2010	 Zond-PP	 Spektr-R  Electro-L		
2011	 Monika-Relek	 Spektr-UF	 Phobos-Grunt	
2012	 Resonance	 Spektr-RG  Electro-L	 Luna-Resource	
2013	 Konus	 Gamma-400 Arkon-2M	 Luna-Glob	
2014	 Strannik	 Arctica-R Arctica-M	 Luna-Grunt	 Interheliozond
2015	 MKA-FKI #5	 Spektr-M  Electro-M	 Venera-D	
2016		 Arctica-R  Arctica-M	 Mars-NET	 Mercury-P
2017	 ROY	 Arkon-2		
2018			 Mars-Grunt	 Sokol-Laplace
2019	 ROY			
2020		Astrometria	 Mars-NET	

FREQUENCY RANGES

The following frequency ranges are used in the advanced and present missions:

S – range – for A-category spacecraft (small spacecraft in the near-Earth orbits);

C – range – for A-category spacecraft (Electro, Spektr-R);

X – range – for both A and B category spacecraft (Phobos-Grunt, Spektr-RG, Spektr-RG, Moon missions, Interheliozond).

GROUND CONTROL SEGMENT

Objectives of ground control segment are as follows:

Issue of command-program data to the SC board :
bit rate – 2 kilobit/sec;
Telemetry downloading from SC :
Bit rate – up to 4 Mb/sec;
Navigation measurements, including:
one way Doppler;
two way Doppler:
VLBI (is not implemented in ground segment).

Automated data exchange via telecommunications in the ground segment structure and with external objects.

GROUND STATIONS

Currently in the Russian Federation for the abovementioned missions the following ground stations are involved:

- Ussuriysk (Ø – 70m) (X and C ranges);
- Medvezhi Ozera (Ø – 64m) (X and C ranges);
- Medvezhi Ozera (Ø – 12m) (X range);
- Medvezhi Ozera (Ø – 9m) (S and C ranges);
- Kaliningrad(Ø – 12m) (X range);
- Baikonur (Ø – 12m) (X range);
- Khabarovsk (Ø – 12m) (X range);
- Krasnoyarsk (Ø – 6m) (C range).

In addition the following ESA ground stations are involved:

- Cebreros (Ø – 35m) (X range);
- New Norcia (Ø – 35m) (X range);
- Maspalomas, Perth, Kuru (Ø – 15m) (X range).

Involvement of NASA ground stations

There are sufficient reasons for NASA ground stations involvement in order to provide the following activities in frame of “Venera-D”, “Laplace”, “Interheliozond”, “Mercury”, and Lunar missions:

Navigation measurements, including:
one way Doppler;
two way Doppler:
VLBI.

Measurements accuracy with the following errors:

- ranging error – no more than 10 m;
- range rate error – no more than 0.5 mm/sec.

Telemetry data reception (data receive rate – up to 4 Mb/sec).