

2. SCIENTIFIC SPACE PROJECTS OF THE FEDERAL SPACE PROGRAMME OF RUSSIA

2.1. CORONAS-F Project

The goal of the Project — to study atomic and collective (plasma and hydro-magnetic) processes occurred in the active Sun and in its neighborhood.



The orbital sun observatory “Coronas-F” with the Russian-Ukrainian Space apparatus AUOS-SM-CF was launched on July 31, 2001 (height of circle orbit 500 km, inclination 82.5°)

SCIENTIFIC PAYLOAD:

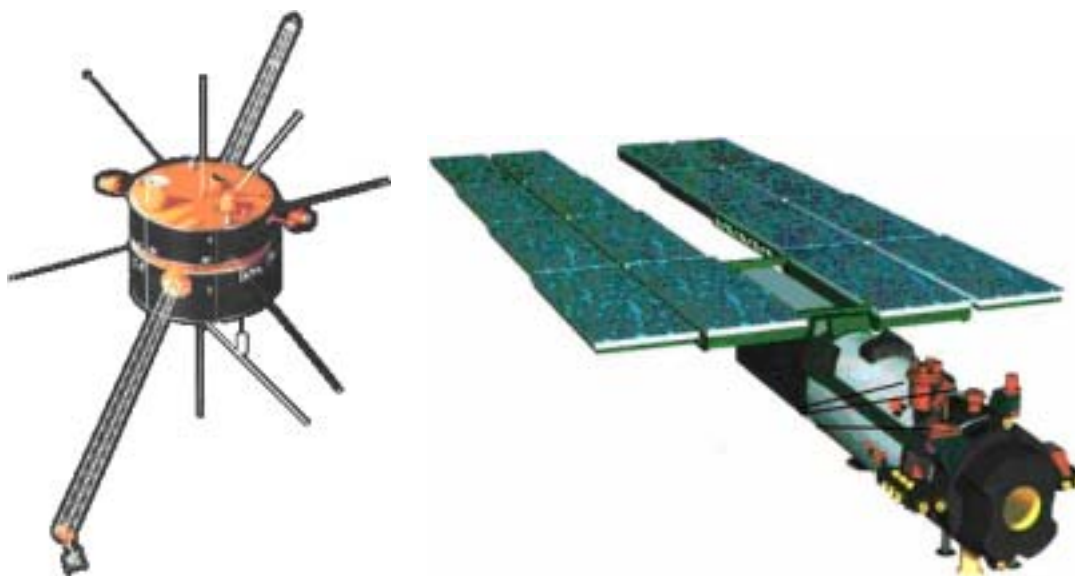
1. Multichannel Photometer (DIFOS)
2. Solar X-ray Telescope (SRT-K).
3. X-ray Spectroheliograph (RES-K)
4. Spectrometer («DIOGENESS»)
5. X-ray Spectrometer («RESIK»)
6. Solar spectropolarimeter (SPR-N)
7. Flare Spectrometer (IRIS)
8. Gamma Spectrometer (HELIKON)
9. X-ray Spectrometer (RPS)
10. Time-amplitude Spectrometer (AVS)
11. Solar UV Radiometer (SUFR-sp-k)
12. Solar UV Spectrophotometer (VUSS-L)
13. MCL - Cosmic Ray Monitor
14. SCI-3 - Spectrometer of the Energy and Ion Chemical Composition
15. SONG - Solar Neutrons and γ -rays Spectrometer
16. Data Build-up System (SSNI)

The flight program of complex observation of the Sun was completed on December 6, 2005.

2.2. THE BURST PROJECT (KONUS-WIND AND KONUS-A EXPERIMENTS)

Goals Of The Project:

- detailed study of the time histories of gamma-ray bursts;
- study of the gamma-ray burst energy spectra over a wide energy range from 10 keV up to 10 MeV;
- study of the fast spectral variability of burst radiation both in the continuum and in features;
- localization of gamma-ray burst sources by two independent methods: by the autonomously localization system and by the triangulation method in cooperation with the IPN;
- search and investigation of an optical activity of the burst sources beginning from initial phase of the event registered in gamma-rays, significant refinement of localization at possible detection of an optical transient.



The joint Russian-American KONUS-WIND experiment is successfully being carried out at the American spacecraft “Wind” since November 1994.

The minimum period of the active operation is 3 year.

The Planned date of the Russian apparatus launch is 2006

2.3. THE MSP-2001 PROJECT (HEND EXPERIMENT)

Project «MSP-2001» (High Energy Neutron Detector HEND) is Russian part of complex experiment Gamma Ray Spectrometer (GRS) on board of spacecraft of NASA (USA) «2001 Mars Odyssey» aimed on the measuring of gamma radiation and neutron albedo of Mars from near-planet orbit and on mapping of the surface element distribution.

Goals of the project:

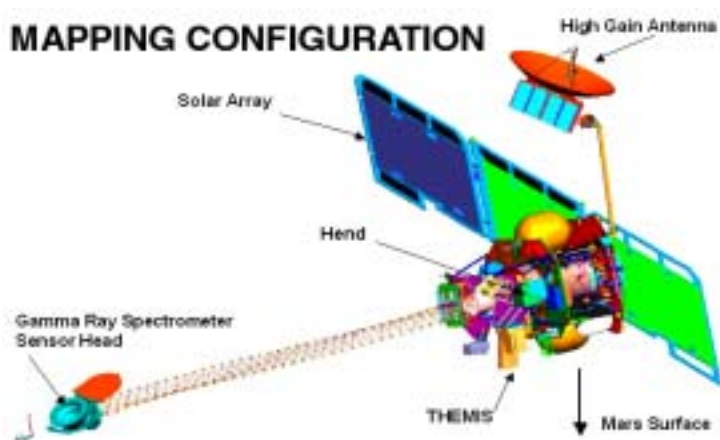
- The main goal of the GRS experiment with participation of the Russian-made instrument HEND is the scanning of the Mars' surface from a spacecraft and constructing the global map of the distribution of chemical elements on the Martian surface.

- The second important goal of instrument HEND is construction of a global map of fluxes of fast and epithermal neutrons for detecting the regions with high content of subsurface water or ice.

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Main parameters of hend

- Total mass (with cables) 3695 g
- Total power 5.7 Watts at 28 Volts
- Sensors with ^3He proportional counters
 - Small Detector (SD) with thin polyethylene moderator and cadmium shield;
 - Medium Detector (MD) with medium polyethylene moderator and cadmium shield;
 - Large Detector (LD) with thick polyethylene moderator and cadmium shield
- Scintillation block
 - Internal scintillation sensor (Stilben) for high energy neutrons (SC/IN);
 - External scintillation sensor (CsI) for anti-coincidence (SC/OUT)

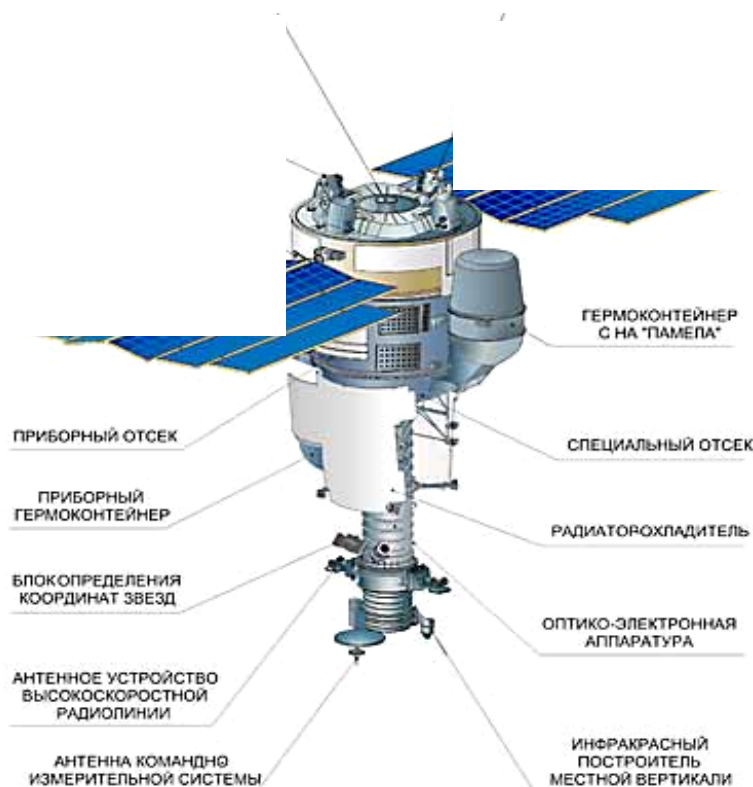


The Project started on the 7th of April, 2001 and is being conducted at present.

2.4. PROJECT “RIM-PAMELA” (RUSSIAN-ITALIAN MISSION)

Goal Of The Project — Study in the near-Earth space of fluxes of antiparticles (antiprotons, positrons, light nucleus), electrons and isotope abundance in the primary cosmic rays.

Experiment “Rim-Pamela” will be an additional scientific payload for the spacecraft “Resurs-01”. “Resurs-01” will be launched on a Sun-synchronized orbit with height 690 km and inclination 98.5°.

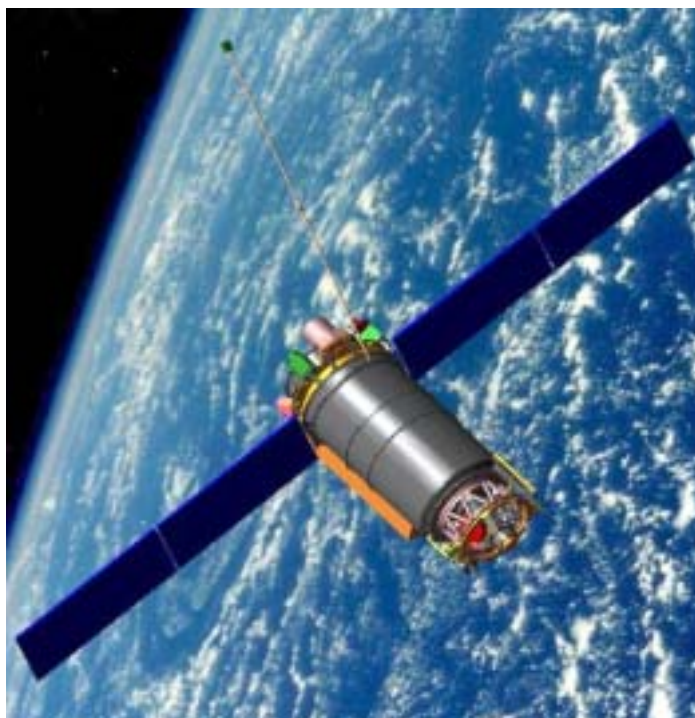


The Project started on the 15th june, 2006.

2.5. “CORONAS-PHOTON” PROJECT

Goal Of The Project — Investigation of the process of energy accumulation and its transformation to the energy of accelerated particles during solar flares, study of the acceleration mechanisms, propagation and interaction of the fast particles in the solar atmosphere. Study of the solar activity correlation with physics-chemical processes in Earth upper atmosphere.

The spacecraft launch of the “Meteor-3” type is planned for 2007.



Main characteristics of the spacecraft:

Height of circle orbit	500 km
Inclination -	82.5°
Pointing accuracy of the orientation to the Sun	<10'
Minimum duration of the active operation in orbit	5 years

2.6. “SPECTR-R” PROJECT (MISSION “RADIOASTRON”)

Main scientific tasks of the mission – syntheses of high-precision images of various Universe objects, its coordinates measurements and search their variability with the time. A beam width of the system is up to 35 microarcseconds.

Main characteristics of the space radiotelescope:

Spectral band:

- wavelength (cm) — 92; 18; 6.2; 1.35
- frequency (Ghz) — 0.327; 1.66; 4.83; 22.2



The orbit of the mission:

- apogee — 350 000 km
- perigee — 8 370 km
- declination — 51.5°
- period is equal to — 9,5 days
- guarantied time of activity — 5 years
- pointing accuracy of radiotelescope — 40"

Planned launch date **of the mission is 2007.**

2.7. “PHOBOS-SOIL” MISSION

Goal Of The Project - is delivery of Phobos soil samples to the Earth and for conducting scientific research for Phobos and Mars.

The basic scientific and technical tasks are:

- Determination of Phobos physical and chemical characteristics, distinctions of its internal structure, orbital and self-motion.
- Landing onto the heavenly body characterized by low gravitation.
- Launch from Phobos and delivery of the re-entry vehicle with the soil samples to the Earth.
- Determination of the soil sample chemical composition.
- Composition determination for the main rocks and their elements.
- Investigation of the solar wind interaction with Phobos.
- Study for the Phobos environment physical parameters (dust and gas components, space rays, magnetic field).
- Remote investigation of the Mars atmosphere and surface.



The mass of the Phobos soil pattern, delivered on the Earth — 0,1 kg.

Flight duration to the Mars activity sphere — 850 days.

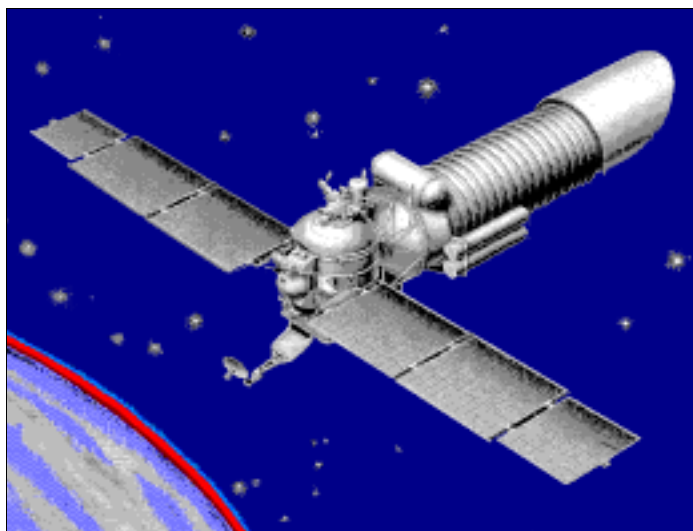
Flight duration to the Earth — 285 days.

Total mission duration — 1030 days.

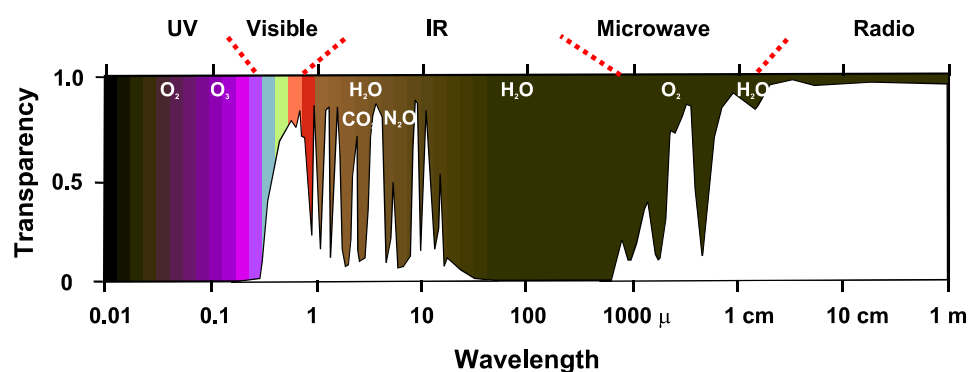
The spacecraft launch is planned for 2009.

2.8. THE SPECTRUM-UV PROJECT (THE WORLD SPACE OBSERVATORY)

The goal of the Project is the creation of an automatic space complex (observatory) aimed at the observation with high space and spectral resolution in ultraviolet region of the spectrum inaccessible for observation from the Earth.



Transparency of the Earth atmosphere



Orbit Parameters:

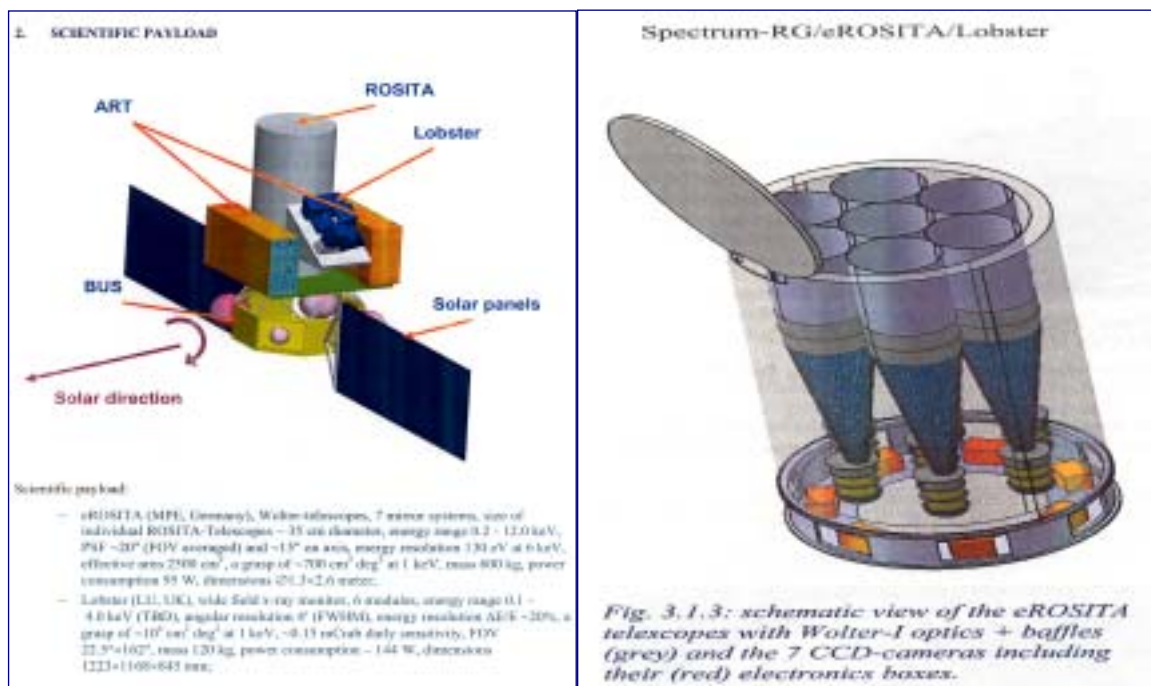
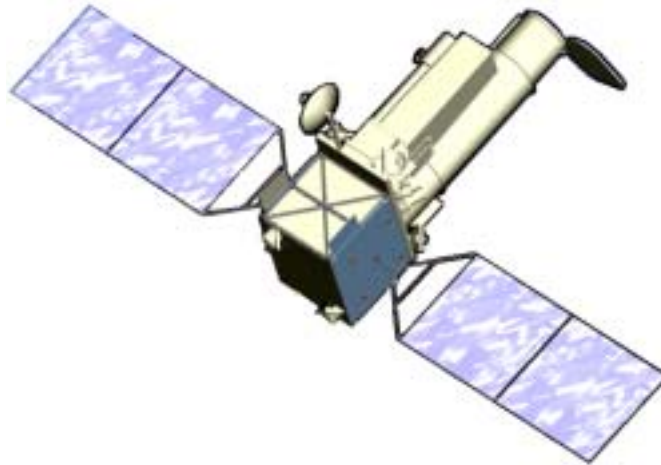
- apogee height — 300 000 km
- perigee height — 500 km
- inclination — 51°
- the operational lifetime — not less than 5–7 years

Planned launch date of the mission is 2010.

2.9. “SPECTRUM-X-GAMMA” PROJECT

Main scientific goals of the project:

- cosmological problems;
- extragalaxy astronomy;
- galaxy astronomy;
- relativistic astrophysics.



Planned launch date of the mission is 2011.

2.10. “RESONANCE” PROJECT

Goal Of The Project — study of resonance interactions of electromagnetic emissions with charged particles in the Earth’s magnetosphere.

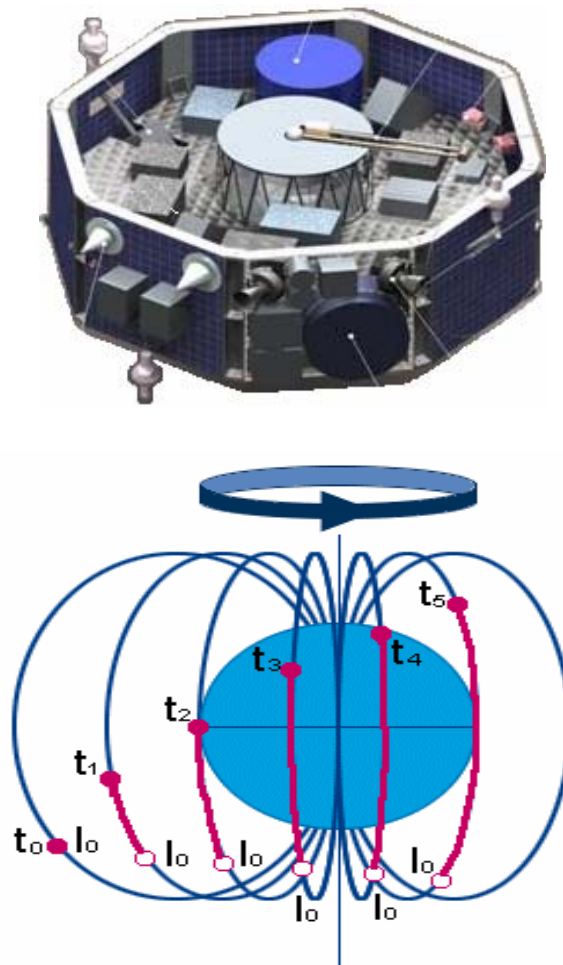


Illustration of the RESONANCE satellite motion along magnetic flux tube mapped of the heating station

Parameters of RESONANCE satellites orbit:

- perigee — 1 500 km;
- apogee — 26 000 km;
- inclination — 63°
- period — 8 hours

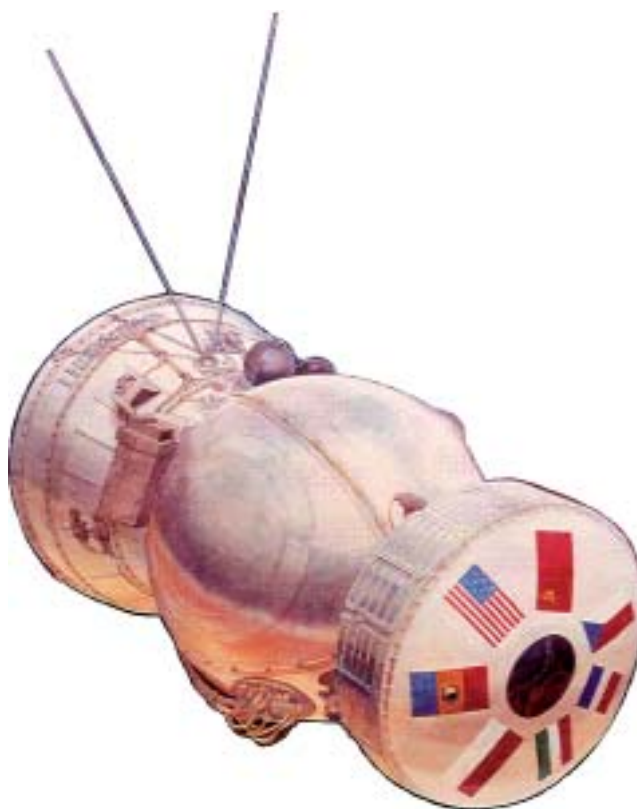
The spacecraft launch is planned for 2012.

2.11. “BIOCOSMOS-1” PROJECT

Goal Of The Project — is research of cellular and tissue cultures, unicellular organisms, insects, fish, amphibia, seeds and germs of higher plants, rats of Wistar Hannover strain.

The inflight experiments will be conducted aboard spacecraft “Bion-M”.

The preliminary date of launch of three “Bion-M” apparatus – from 2010 to 2015.



- mass of spacecraft — 6 300 kg;
- mass of payload — up to 900 kg.

Orbital parameters:

- apogee — 394 km;
- perigee — 226 km;
- inclination — 62,8°;
- total mission duration — 45 days.

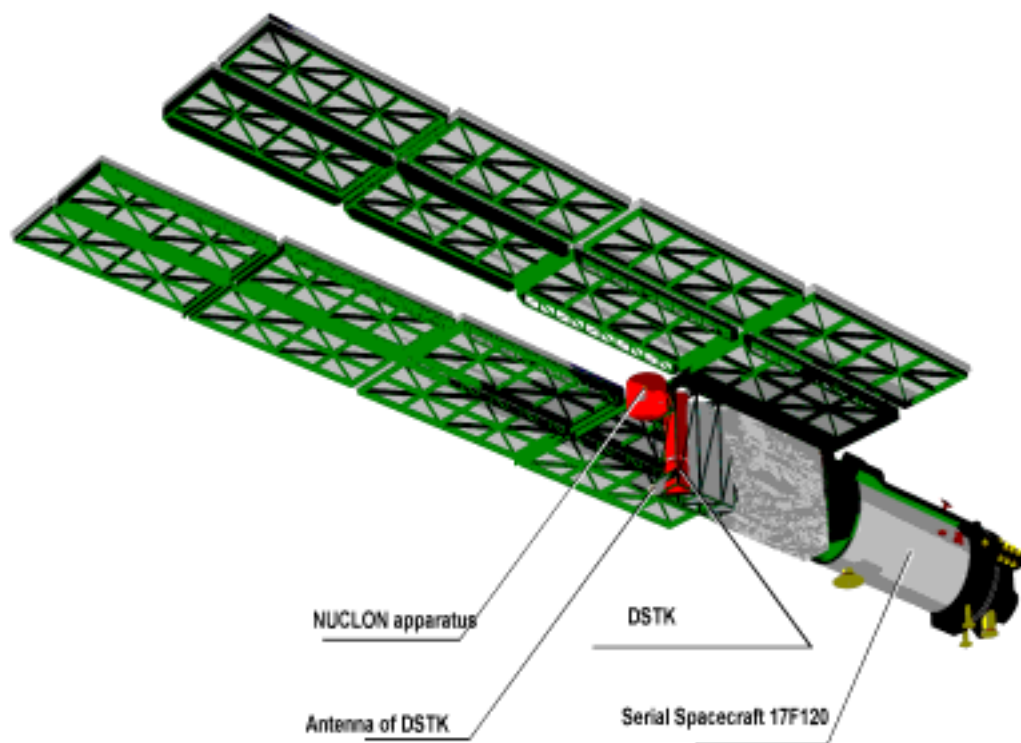
2.12. THE “NUCLON” PROJECT

Goal of the Project — astrophysical investigations of our Galaxy. Direct cosmic ray (CR) measurements in extremely wide energy and charge range in the near-Earth space will allow to solve the following fundamental problems in CR astrophysics:

- to verify astrophysical models of high-energy CR origin, acceleration and propagation in our Galaxy;
- to verify an astrophysical model of intrastellar nucleus synthesis with neutron capture, to investigate chemical evolution of matter in our Galaxy.

The basic technical parameters of the “Nuclon” apparatus are:

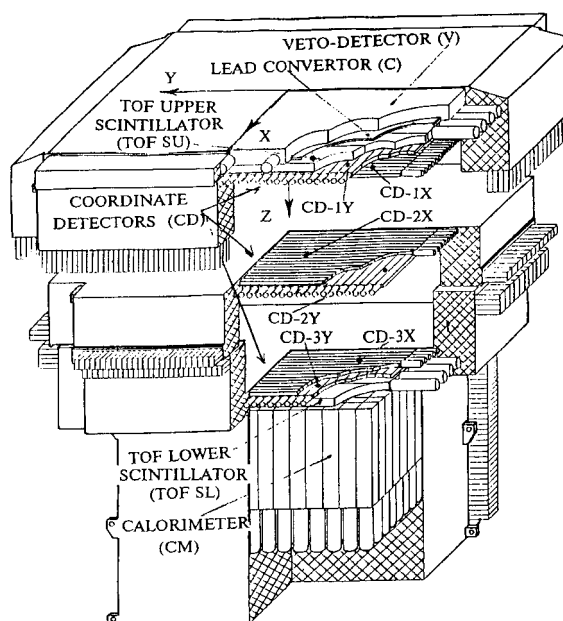
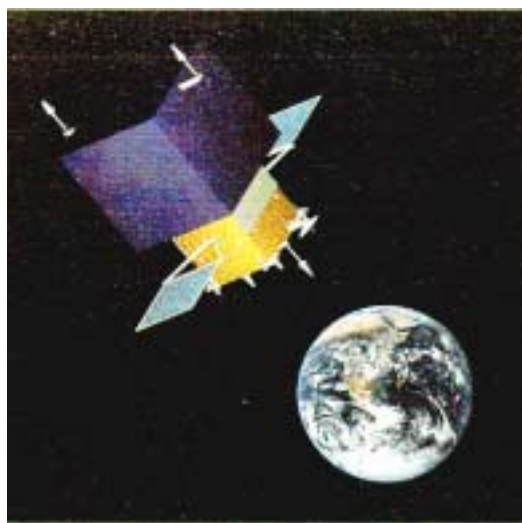
- geometrical factor: $>0.10 \text{ m}^2\text{sr}$ for the high-energy component of the NUCLON apparatus; $>0.25 \text{ m}^2\text{sr}$ for the low-energy component;
- flow of scientific and auxiliary information $<24 \text{ Mbyte}$ per day;
- exposure time in orbit $>1 \text{ year}$.



Planned launch date of the mission is 2006-2015.

2.13. THE “GAMMA-400” PROJECT

Goal of The Project — determine the nature of high-energy gamma-ray space emission in the energy range above 30 GeV.



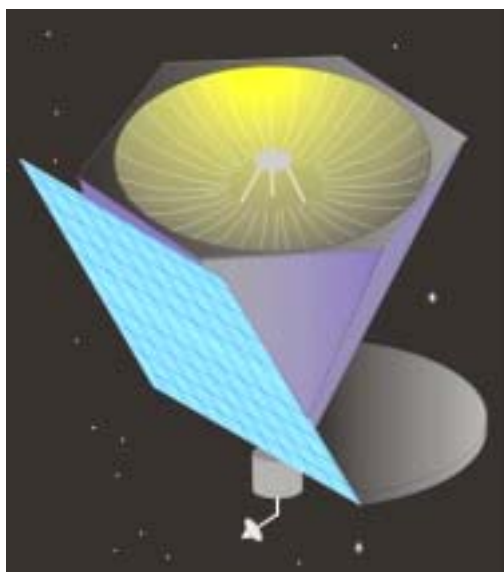
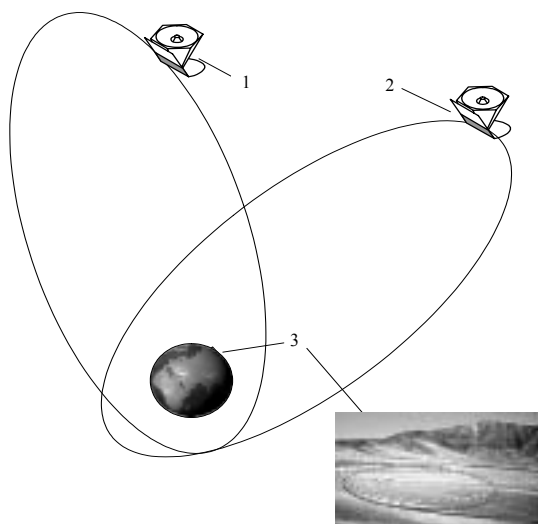
Basic physical performances of the telescope “GAMMA-400”:

- Energy range — 0.01-1 TeV
- Sensitive area — $80 \times 80 \text{ cm}^2$
- Geometrical factor — $3000 \text{ cm}^2 \text{sr}$
- Aperture — 90°
- Angular resolution — 3° at $E \sim 10 \text{ GeV}$
- Energy resolution — 2% at $E \sim 1 \text{ TeV}$
- Volume of telemetry data — up to 50 Mbytes/day

Planned launch date of the mission is 2013.

2.14. “MILLIMETRON” PROJECT

Goal Of The Project — creation of an international space observatory - the interferometer “Earth – Space – Space” in order to perform of astronomical investigations in millimeter, submillimeter and infrared regions with extremely high sensitivity (to a few nanoJanskies units of flux density in continuum spectrum) and extremely high angular resolution (to a parts of microsecond of arc).



Ballistic parameters and scheme of flight:

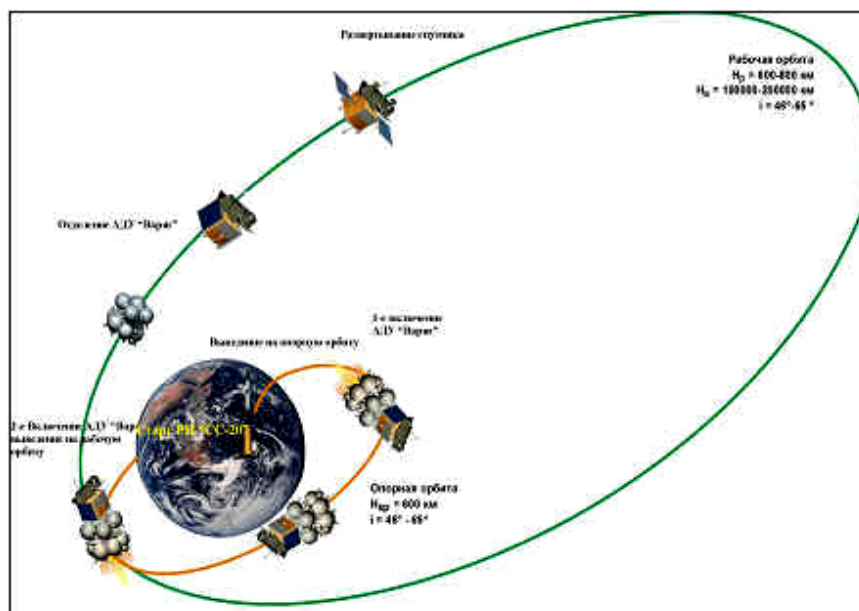
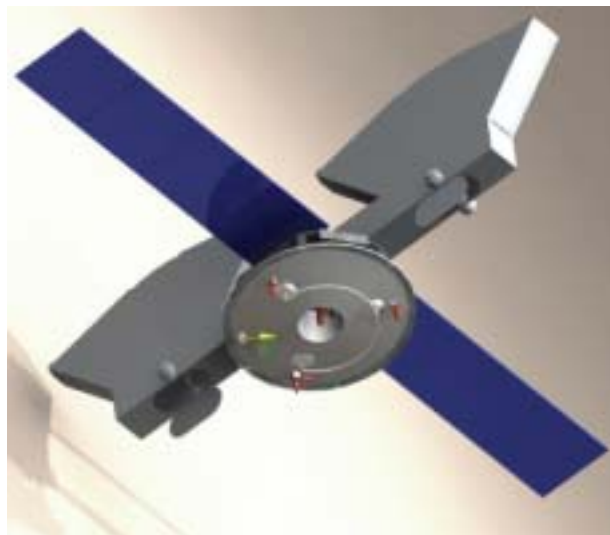
- Orbit of a space craft No. 1: period about 9 day, radius of an orbit in a perigee of 75 000 km, radius in apogee of 300 000 km. The orbit is subject to systematic perturbation of the Moon and consequently provides possibility of obtaining of the high-quality maps for any objects on a palate.
- The spacecraft No. 2 is started through 2–3 years after No. 1 on similar or higher orbit depending on outcomes of researches for this time.

The spacecraft launch is planned for 2015.

2.15. “ASTROMETER” PROJECT (SPACE ASTROMETRICAL ARC-MEASURING-INTERFEROMETER)

Goals of the Project:

- measurement of parallaxes to the selected objects in the Galaxy.
- realization of inertial system of celestial coordinates on bright navigation stars, based on the extra-Galaxy sources (Quasars) and at the microsecond precision level.
- high-precision measurements of the Solar system bodies position.



Guaranteed time of activity — 7–10 years.
The spacecraft launch is **planned for 2018**.