P.N. Lebedev Physical Institute of the Russian Academy of Sciences

4. Information about Scientific Projects of the Federal Space Program of the Russian Federation with are at the Development (Working out) Stage

In 2014-2015, the Laboratory of X-ray astronomy of the Sun participated in the following projects (being at the development stage) in the framework of the Federal Space Program of Russia.

1) Project «Design of the SORENTO instrument for the Interhelioprobe space mission»

- study of thermal and non-thermal components of solar x-ray flares; testing of thick and thin target models for energy release during the impulsive phase of solar flares; testing of the collapsing trap model for particle acceleration in solar flares;
- search for regions of primary energy release during solar flares; search for evidence of magnetic reconnection in the solar corona;
- study of electron acceleration mechanisms in solar flares;
- spectral diagnostics for plasma state in the solar corona; measurements of the plasma characteristics in the coronal emission sources: temperature, emission measure and the electron density;
- measurements of the principal characteristics of the accelerated electrons in solar flares: the total amount of particles, their total energy and distribution;

- study of hot (T ~ 10 MK) and superhot (T ~ 100 MK) plasma in solar corona;
- measurements of non-thermal component of solar micro- and nanoflares;
- stereoscopic observation of the Sun in hard x-rays.

Energy range	5-100 keV
Field of view	1.52
Angular resolution	7"
Temporal resolution	0.1 sec
Dimensions	236 (diameter) × 1000 mm
Mass	8 kg
191035	(without cables)
Modes	Quiet and Flare modes
Energy	6 W
Telemetry	50 Mbyte/day

Expected results of the experiments with using this equipment:

Expected results are consistent with the list of the scientific tasks.

2) Project «Design of the TREK instrument for the Interhelioprobe space mission»

- study of the structure and dynamics of the solar corona in the temperature range of about 1 million K;
- study of the structure and dynamics of the solar corona in the temperature range of about 100 thousand K.;
- study of the structure and dynamics of the solar corona in the temperature range of about 10 million K;
- observation of eruptive solar phenomena in the altitude range from the Sun's surface to the distance of 1 solar radius;
- observation of solar flares in the vacuum ultraviolet spectral range (including micro- and nano-flares).

Number of telescopes	4
Number of spectral	5
channels	
Wavelengths	8.42, 131, 171 and 304 Å
Temporal resolution	5 – 20 sec
Angular resolution	1.2" – 3.5"
Dimensions	120 × 65 × 20 sm
Mass	15 kg
	(without cables)
Energy	20 W
Telemetry	100 – 1000 Mbyte/day

Expected results of the experiments with using this equipment:

Expected results are consistent with the list of the scientific tasks.

3) Project «Design of the OKA instrument for the Interhelioprobe space mission»

- study of the structure and dynamics of coronal mass ejections, including the observations from outside the plane of the ecliptic;
- study of the mechanisms of solar wind acceleration and coronal mass ejections;
- a comprehensive study of non-stationary processes in the solar atmosphere in a wide temperature range;
- observations of structure and dynamics of different x-ray objects in the solar corona (coronal loops, x-ray bright points, transient events);
- spectral diagnostics of plasma in the solar atmosphere: determination of the plasma electron density, temperature, differential emission measure and the chemical composition;
- out-of-ecliptic observations of polar coronal holes;
- study of the global activity of the Sun, including observations of the back solar hemisphere (invisible from the Earth).

Dimensions	722 × 184 × 124 mm
Mass	5 kg
Number of spectral	Δ
channels	
Spectral range	Visible region (400-650 nm)
Field of view	8°
	7 W
Energy	(maximal – 12 W,
	minimal – 3 W)
Telemetry	100 Mbyte/day

Expected results of the experiments with using this equipment:

Expected results are consistent with the list of the scientific tasks.

4) Project «Design of the HELIOSPHERA instrument for the Interhelioprobe space mission»

- study of the structure and dynamics of coronal mass ejections, including the observations from outside the plane of the ecliptic;
- study of the mechanisms of solar wind acceleration and coronal mass ejections;
- a comprehensive study of non-stationary processes in the solar atmosphere in a wide temperature range;

- observations of structure and dynamics of different x-ray objects in the solar corona (coronal loops, x-ray bright points, transient events);
- spectral diagnostics of plasma in the solar atmosphere: determination of the plasma electron density, temperature, differential emission measure and the chemical composition;
- out-of-ecliptic observations of polar coronal holes;
- study of the global activity of the Sun, including observations of the back solar hemisphere (invisible from the Earth).

Dimensions	515 × 188 × 168 mm
Mass	5 kg
Number of spectral	1
channels	
Spectral range	Visible region (400-650 nm)
Field of view	20 °
Energy	16 W
	(minimal – 3 W)
Telemetry	100 Mbyte/day

Expected results of the experiments with using this equipment:

Expected results are consistent with the list of the scientific tasks.

5) Project «Scientific equipment for the ARKA space mission»

- study of the coronal heating mechanism;
- study of the mechanisms for energy accumulation and release in solar flares;
- search for experimental evidences of magnetic field reconnection in the solar micro-structures ("magnetic carpet");
- study of the mechanism for energy and plasma transfer from solar chromosphere to corona;
- study of the micro- and macro- manifestations of solar activity, including micro- and nano-flares.

Number of telescopes	3
Number of spectral	3
channels	
Wavelengths	131, 171 and 304 Å
Temporal resolution	1 – 30 sec
Angular resolution	0.1"
Dimensions	2300 × 300 (diameter) – telescopes # 1 and 2
	950 × 120 (diameter) – telescope # 3
Mass	109 kg
Energy	100 W
Telemetry	10 000 Mbyte/day

Expected results of the experiments with using this equipment:

Expected results are consistent with the list of the scientific tasks.