UN Committee
Vienna

April 27th, 2021

SRG Orbital Observatory
with Russian ART-XC and
German eRosita X-Ray Telescopes
aboard

A million of accreting supermassive
Black Holes
on the X-Ray Map of the whole Sky

Rashid Sunyaev
Space Research Institute (IKI),
Russian Academy of Sciences
Moscow
Lavochkin industry
mass 2700 kg

eRosita (808 kg)
3.5m * 1.9m
Germany

ART-XC (350 kg)
Russia

Navigator Platform
During 100 day long flight to the Lagrange point L2 there were adjustments, calibrations and long observation of interesting areas and sources in the framework of "Performance Verification"
Every day the plane of the scan shifts slowly to one degree, following the Sun and leaving one degree wide strip on the sky map.

One revolution around direction toward Sun every 4 hours.

Every source on the sky is observed 6 times per day once in a half year (This permits to look for the short time variability)
ART-XC named after Mikhail Pavlinsky

- Energy range: 5-30 keV
- FOV: 34’
- On-axis resolution 1’
- Energy resol. 12% at 14keV
- Time res. 27 microsec

IKI, Russian Federal Nuclear Center VNIIEF

X-Ray grazing incidence mirrors: Marshall Space Flight Center, NASA

- 7 mirror modules on an optical bench plate
- Carbon-fiber tube
- Radiator
- Star tracker with its own radiator
- Detectors system: 7 detector modules with collimators and cooling pipes
Pulsar *PSR B1509-58* in X-rays

ART-XC has excellent time resolution of 23 μs.  

ART-XC team

The integration time of the eROSITA CCDs is 50 ms.
The first SRG all-sky survey allowed to construct a map containing almost 8 times more X-Ray sources than the former world-best map of the ROSAT satellite, obtained in 1990.

Three quarters of a Million objects on this map are distant quasars and active galactic nuclei powered by accretion of matter onto supermassive black holes residing in their centers. They are far beyond the Milky Way at distances of hundreds of millions and billions of light years from us. We see also 20 000 extended objects (mainly clusters of galaxies) and more than 200 000 galactic stars with active coronae.
Optical spectrum of quasar SRGEJ170245.2+130107 (discovered by SRG/eROSITA) obtained with the BTA 6m telescope. The vertical dashed lines show the expected positions of the peaks of the emission lines of the quasar at $z = 5.466$. Adopted from (Khorunzhev et al. 2021)

All lines are redshifted 6.466 times!
SRG/eRosita during first sky survey detected X-Rays from 90 stars with known exoplanets. This is close to 10% of all nearby stars with known exoplanets on the RU side of sky (except Kepler spacecraft field).

We do not yet see in X-rays a single star with exoplanets in habitable zone.
Extragalactic transients

Typically we detect ~3-5 objects per day changing their flux by >10 times (stars, AGN, X-ray binaries in the Milky Way). On average, we detect one good TDE candidate per ~10 days. They are being followed up by telescopes in Russia, Hawaii, Turkey.

Tidal star disruption by a supermassive black hole (TDE)

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Coma cluster, flattened image and suggested trajectory of the group NGC 4839 around most massive cluster of galaxies Coma in our vicinity.
Spectroscopy capabilities of SRG/eRosita

200 seconds per pixel

SN 1987A in the LMC

Cyg Loop

SS 433 jets

IKI
Future plans – additional 2.5 years of scans. Then – 2 years in pointing mode and scans of selected deep fields.

We are grateful to many people in the Lavochkin industry, two giant antennae in Bear Lakes (64 m) and Ussiriysk (70 m), MPE and IKI, who are every day sending commands to the spacecraft and telescopes, receiving scientific data and sending them to scientists.

And many thanks to scientists and engineers who created excellent grazing incidence telescopes and Navigator platform, Proton launcher and its DM-03 upper stage, to people in Baikonur launch site for a beautiful and successful launch