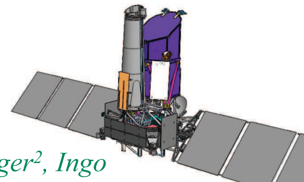
Max-Planck-Institut für extraterrestrische Physik

Simulating the eROSITA sky: exposure, sensitivity, and data reduction



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eROSITA on SRG

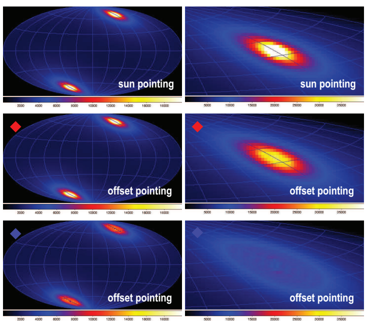
eROSITA (*extended Roentgen Survey with an Imaging Telescope Array*) is the primary instrument on the Russian Spektrum-Roentgen-Gamma (*SRG*) mission, scheduled for launch in 2013. eROSITA consists of seven Wolter-I telescope modules, each of which is equipped with 54 mirror shells with an outer diameter of 36 cm and a fast frame-store pn-CCD, resulting in a field-of-view (1° diameter) averaged PSF of 25´´-30´´ HEW (on-axis: 15´´ HEW) and an effective area of 1500 cm² at 1.5 keV. eROSITA/SRG will perform a four year long all-sky survey, to be followed be several years of pointed observations (Predehl et al. 2010).

More info on eROSITA: http://www.mpe.mpg.de/erosita/

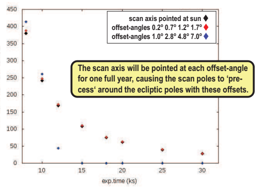
eROSITA orbit and scanning strategy

Orbit: eROSITA/SRG will be placed in an L2 orbit with a semi-major axis of about 1 million km and an orbital period of about 6 months.

Survey scanning law: during the four year all-sky survey, the eROSITA telescopes will scan the sky in great circles with one full circle being completed every four hours. The scan axis is either pointed directly towards the sun or alternatively up to several degrees away from it. As the satellite moves around the Sun, the plane of the scan is advanced by about 1° per day, resulting in a full coverage of the sky every half year.

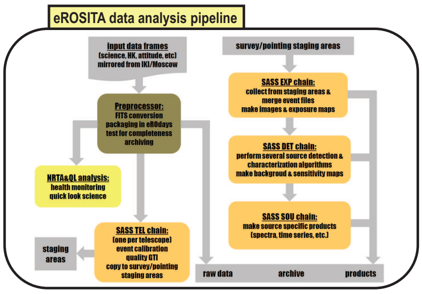


All-sky survey exposure: After four years (eight full scans of the sky), a minimum exposure of 1.3 ks (at the ecliptic equator) and a mean exposure of 2.0 ks is achieved (assuming 80% observing efficiency) . The exposure close to the ecliptic poles can be optimized by appropriately choosing the offset-angles of the scan axis from the sun direction (details tbd). Examples: 100 deg² around each pole, covered with an exposure of at least 15 ks (red symbols on the right), or alternatively 250 deg² with an exposure above 10 ks (blue symbols).



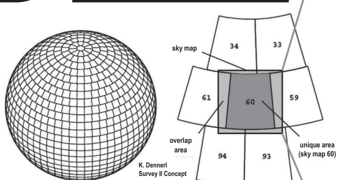
Data reduction and catalogue creation

eROSITA data analysis pipeline



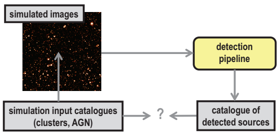
- ✓ Software derived from ROSAT, Abrixas, XMM-Newton + newly developed code
- ✓ Compiler: F90/GFortran (for compatibility with exiting code)
- ✓ CFITSIO for file i/o
- ✓ CALDB calibration interface
- ✓ PIL (FTOOLS) command line interface
- ✓ Same programs for pipeline processing and interactive analysis
- ✓ 15 FTE forseen for software development - 50% done

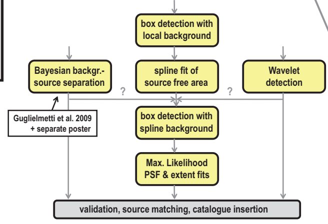
- ✓ Sky is devided into 5839 equal area fields of ~3°x3°
- ✓ After event-calibration, incoming data stream is split and accumulated in same number of overlapping 3.6°x3.6° all-sky survey maps, centred on these fields.
- ✓ Source detection and further souce-level analysis is performed on these maps.



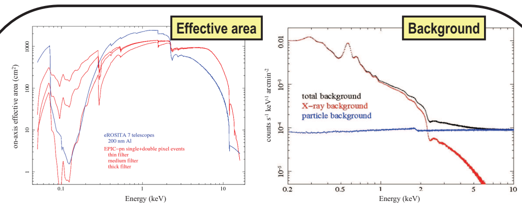
Source detection and characterization

- ✓ Performed simultaneously in five energy bands (baseline: E_{min}-0.5, 0.5-1, 1-2, 2-4, 4-8 keV - details tbd)
- ✓ Several different detection algorithms – ongoing simulations to determine specific setup of detection pipeline (see example on the right)

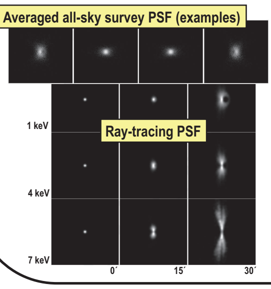


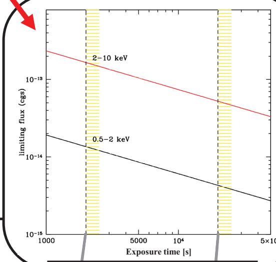


All-sky survey sensitivity



Averaged all-sky survey PSF (examples)





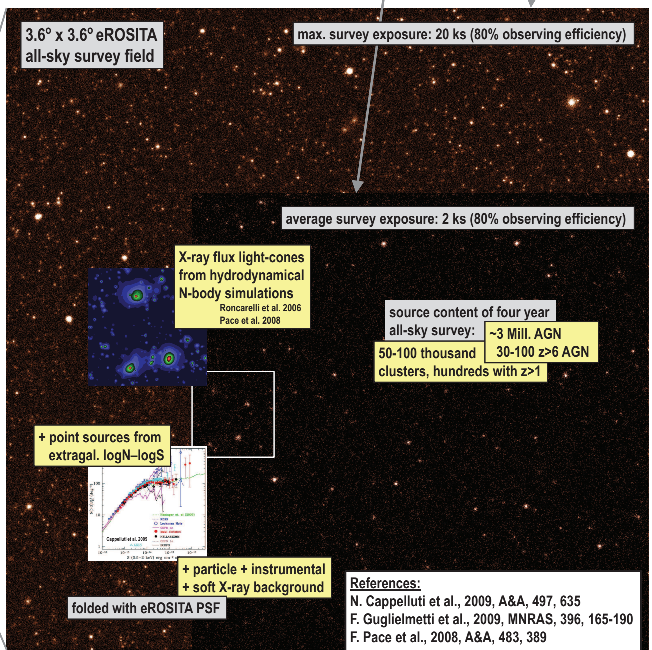
Point source detection sensitivity

Comparison XMM-*Newton* - eROSITA

Field-of-view averaged effective area at 1.5 keV is ~1500 cm² for XMM-*Newton* and eROSITA. ☺
Field-of-view of eROSITA is four times XMM-*Newton*. ⇨ Grasp is four times XMM-*Newton*. ☺ ☺
On-axis PSF has 15´´ HEW for XMM-*Newton* and eROSITA. ☺ But field-averaged eROSITA PSF (25´´-30´´ HEW) is twice XMM-*Newton*. ☹

To achieve same soft band sensitivity, 10 ks of XMM-*Newton* exposure time corresponds to about 15 ks of eROSITA time.

Simulating the eROSITA sky



References:
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P. Predehl et al., 2010, SPIE, 7732, 77320U
M. Roncarelli et al., 2006, MNRAS, 348. 1078

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