



How eROSITA came to be!

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eROSITA is an X-ray telescope on the Russian space mission SRG

SRG was launched in 2019 from Baikonur

We made 4.4 all-sky surveys

eROSITA was put into safemode in February 2022

Historical Development



Spectrum-XG
Jet, AR, etc.

SRG was a planned X-ray mission of USSR
The project died 1999

Negotiations between Roskosmos and ESA
on a "new" Spectrum-XG mission (2005)

MoU between Roskosmos and DLR (2007)
„Detailed Agreement“ (2009)



ROSAT
1990-1998

First X-ray all-sky survey
with an imaging telescope



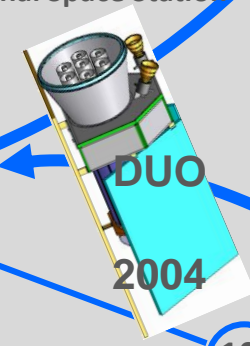
ABRIXAS

Bundle of 7 small telescopes
To extend the all-sky survey
towards higher energies



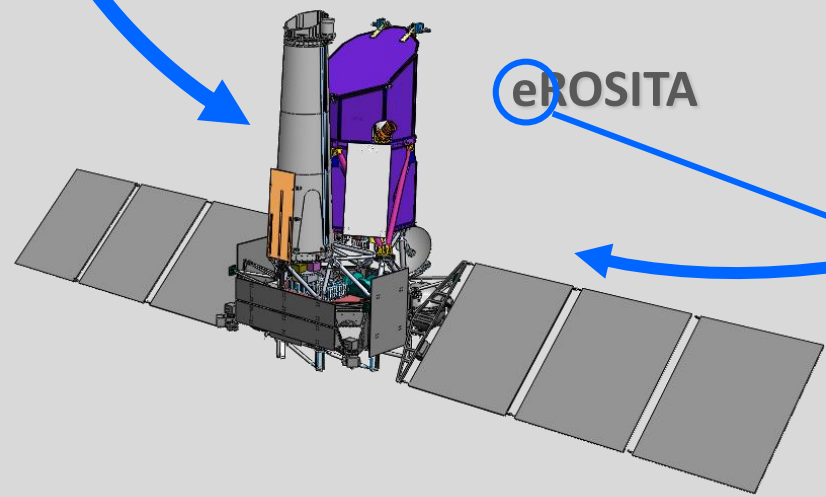
ROSITA
2002

ABRIXAS science on the
International Space Station

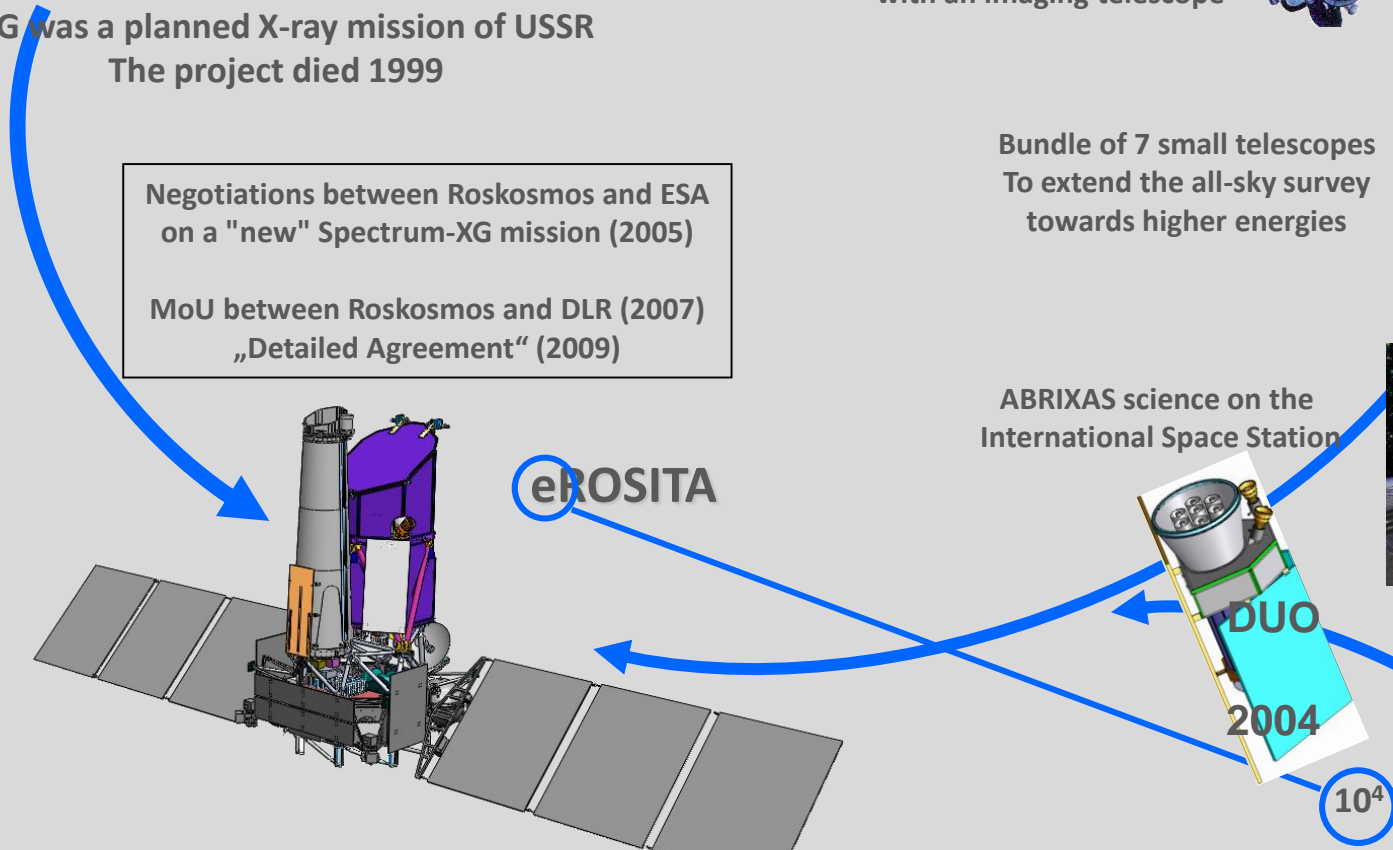


DUO
2004

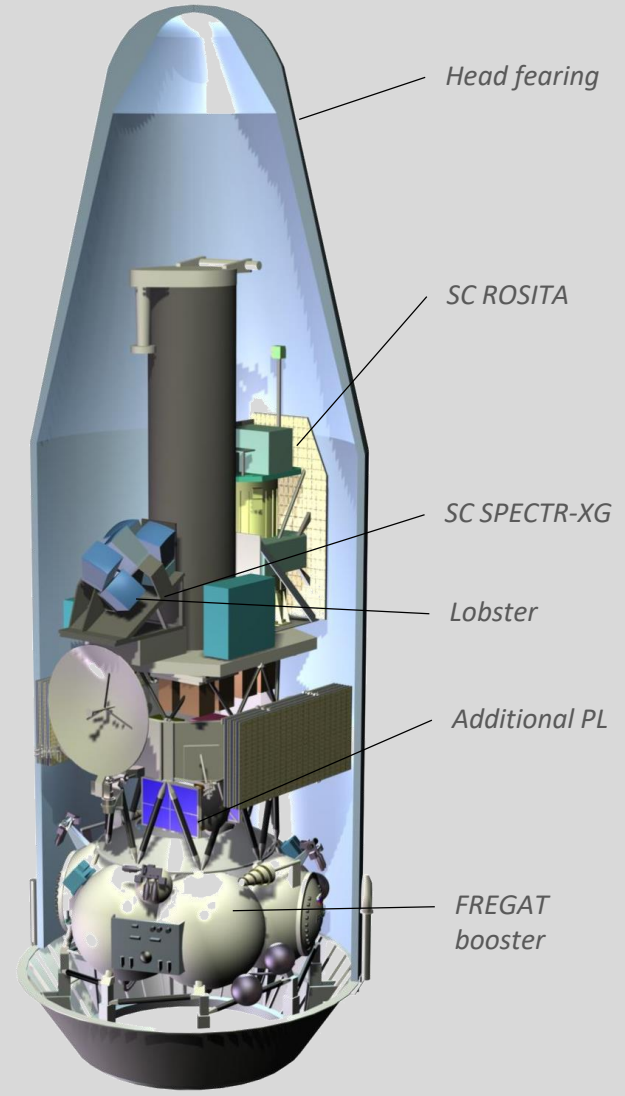
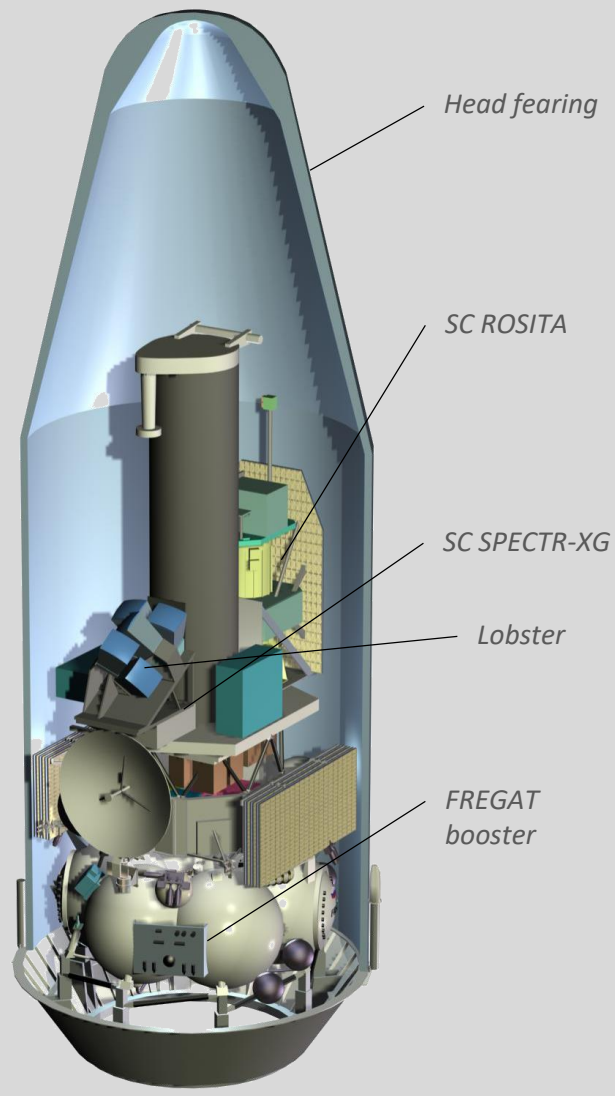
Dark Energy
10⁴ Clusters of Galaxies



eROSITA



May 2005



eROSITA

2005: On a flight from Munich to Moscow:

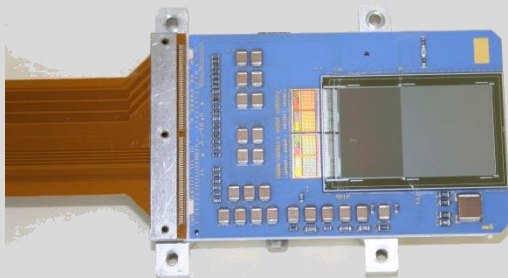


ABRIXAS 7×27 mirror shells

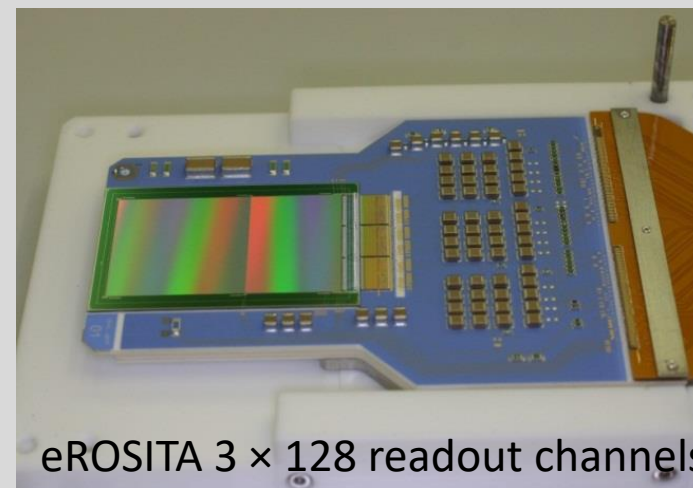


eROSITA 7×54 mirror shells

2006: During a breakfast in Orlando:

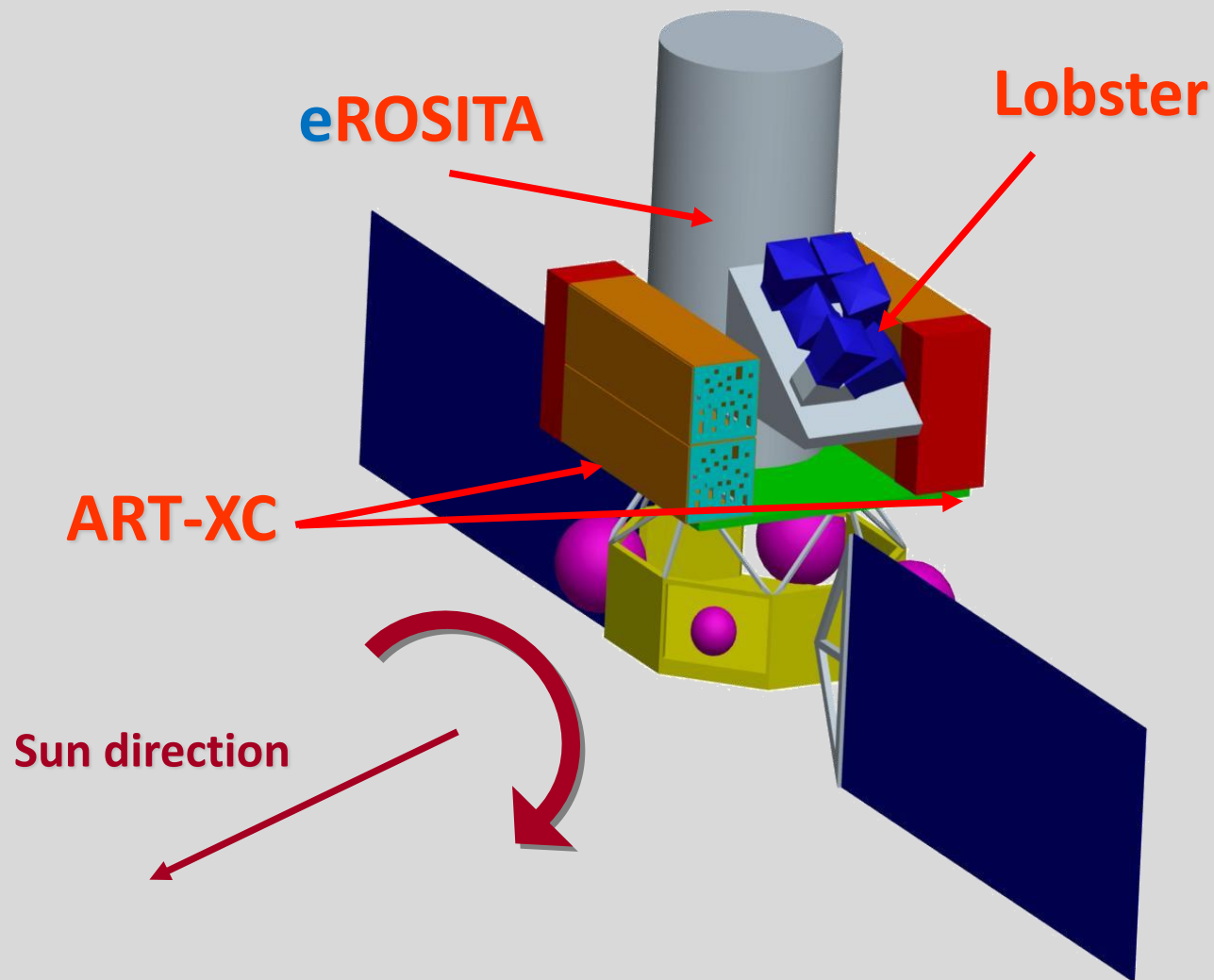


DUO 2×128 readout channels



eROSITA 3×128 readout channels

September 2005



Launch with Soyuz-Fregat from Kourou in 2010

LEO, equatorial

eROSITA Collaboration



Core Institutes (DLR funding):

MPE, Garching
Universität Erlangen-Nürnberg
IAAT (Universität Tübingen)
SB (Universität Hamburg)
Leibniz-Institut für Astrophysik Potsdam

Associated Institutes:

USM (LMU München)
AIFA (Universität Bonn)

Russian Partner Institute:

IKI, Moscow

Industry:

Media Lario/I Mirrors, Mandrels
Tecnotron/D PCBs
Kayser-Threde/D Mirror Structures
Carl Zeiss/D ABRIXAS-Mandrels
Invent/D Telescope Structure
pnSensor/D CCDs
IberEspacio/E Heatpipes
RUAG/A Mechanism
HPS/D,P MLI
+ many small companies

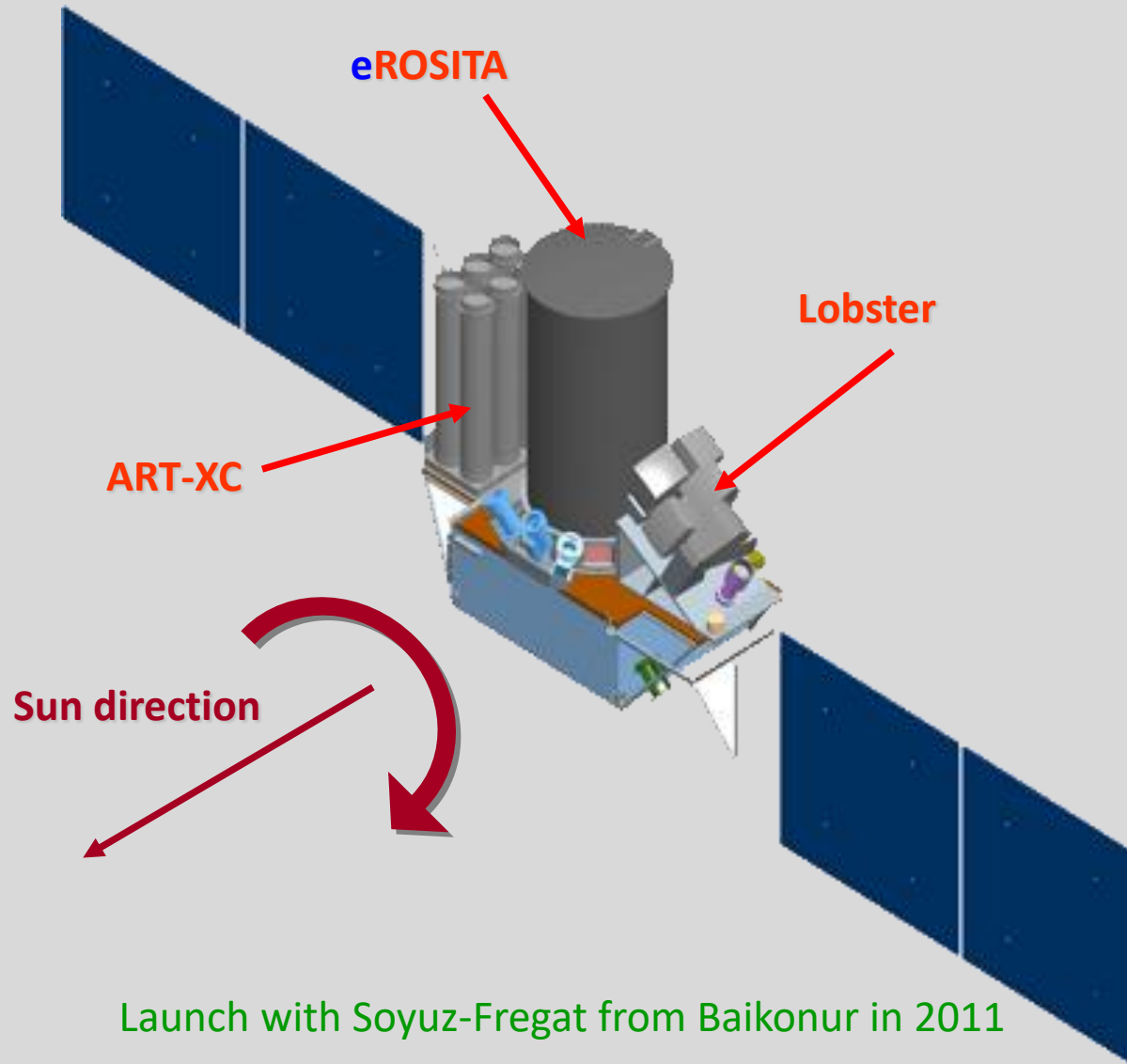
NPOL – Lavochkin Association

MPE: Scientific Lead, Project Management

Instrument Design, Manufacturing, Integration & Test
Operation, Data Analysis, Archive



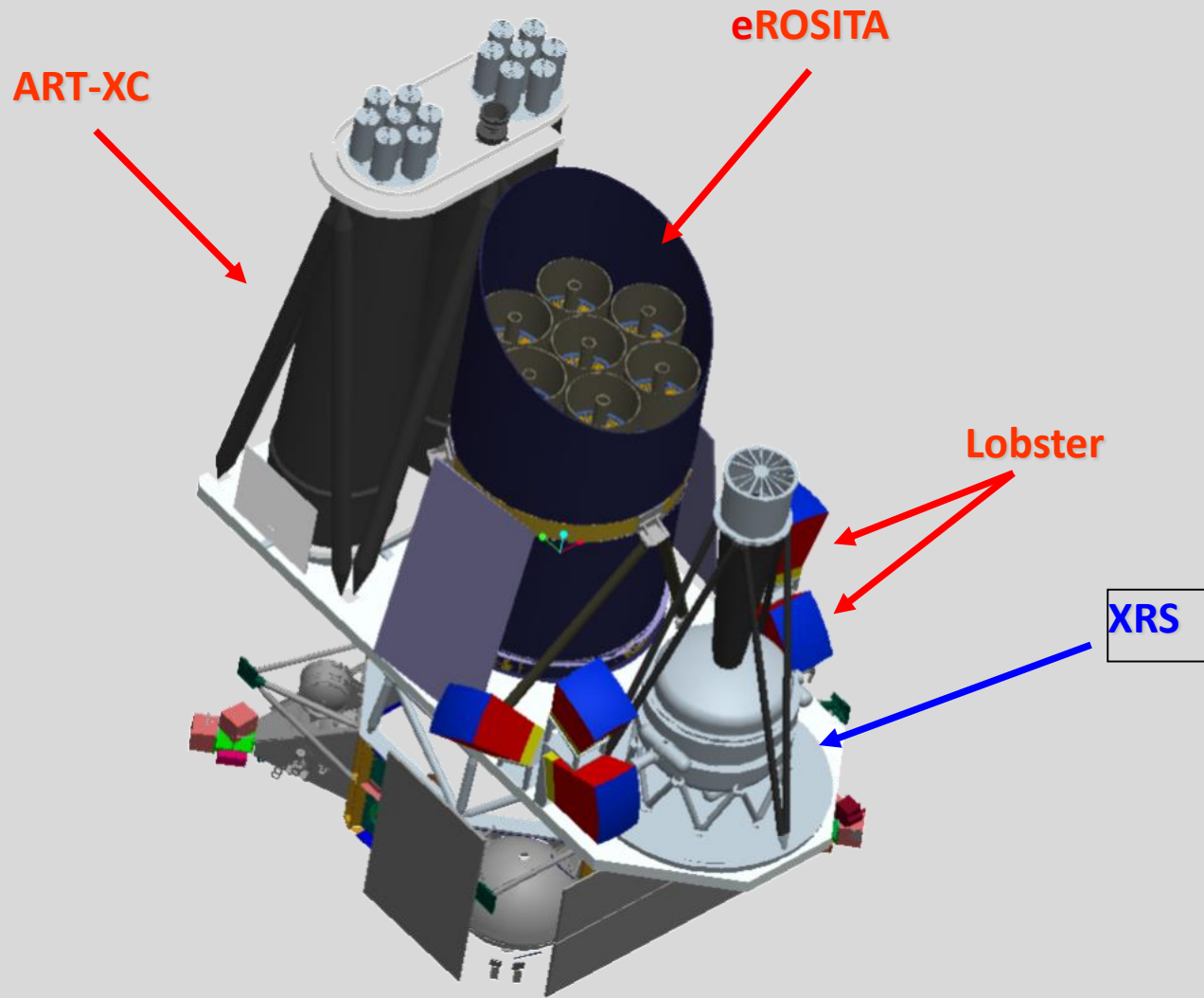
September 2006



Launch with Soyuz-Fregat from Baikonur in 2011

30° LEO, (mobile) groundstation in Namibia

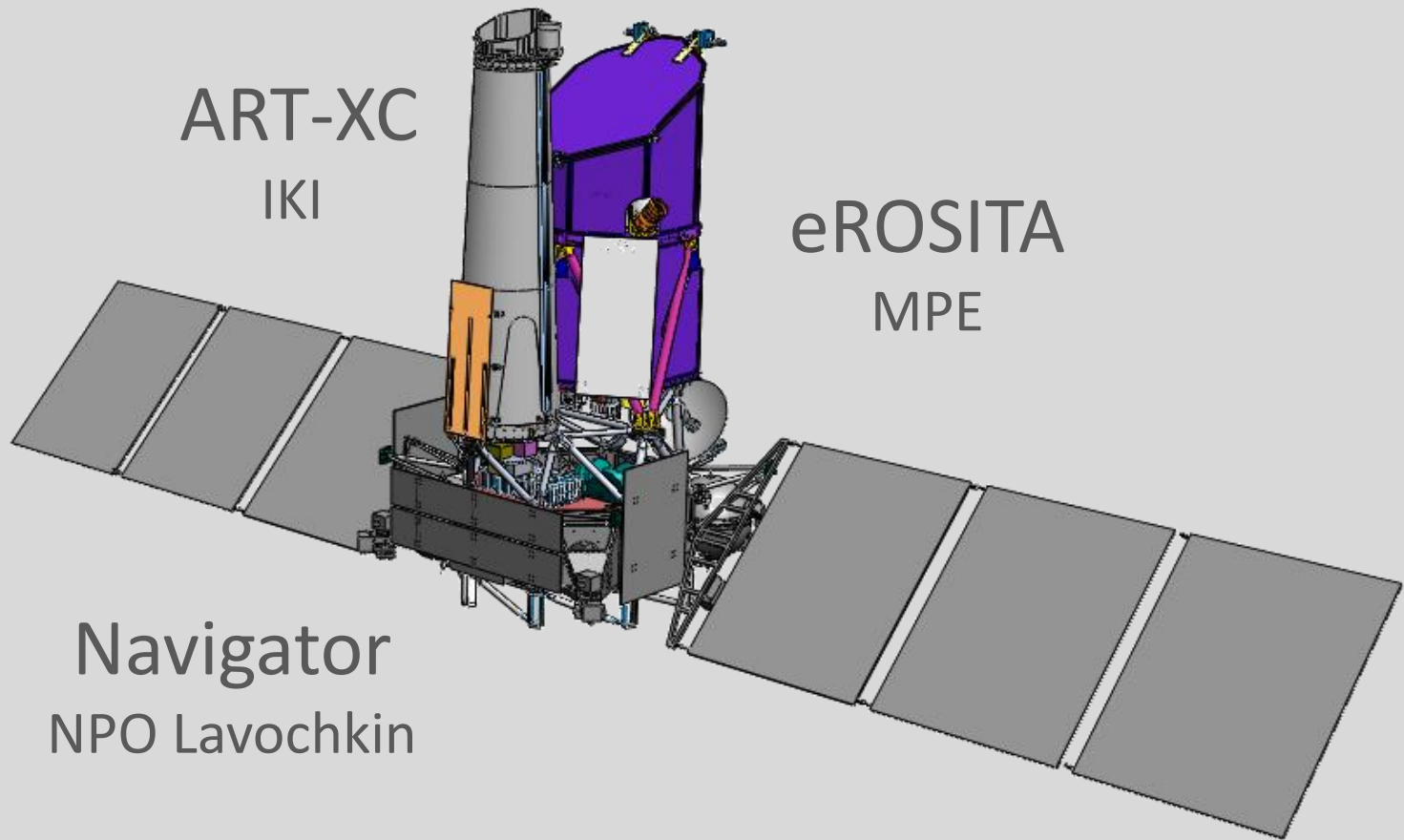
March 2007



August 2009: Detailed Agreement between DLR and Roskosmos



August 2009



ART-XC
IKI

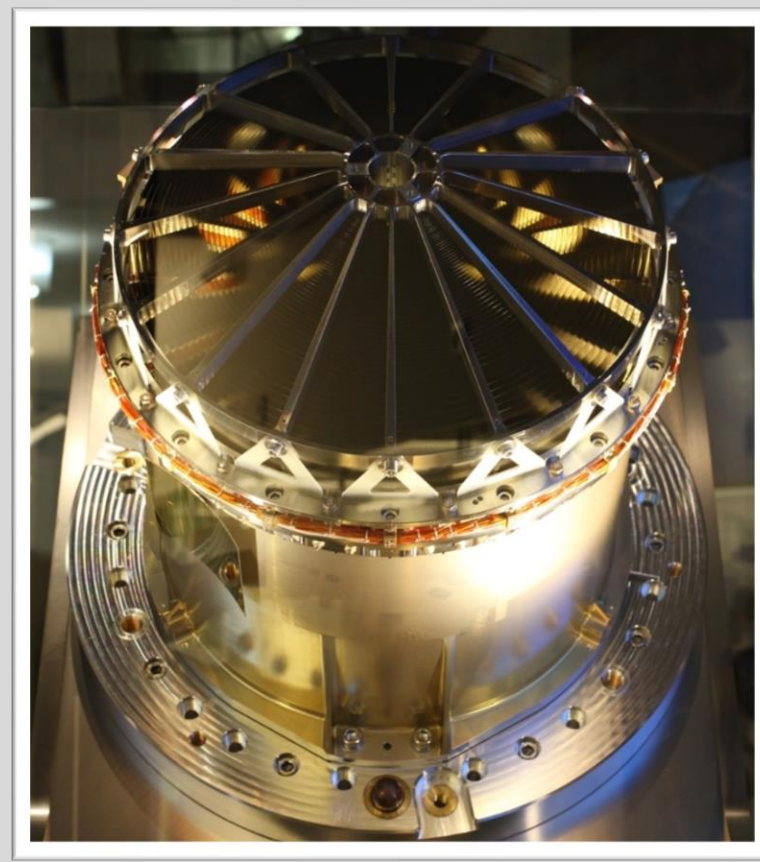
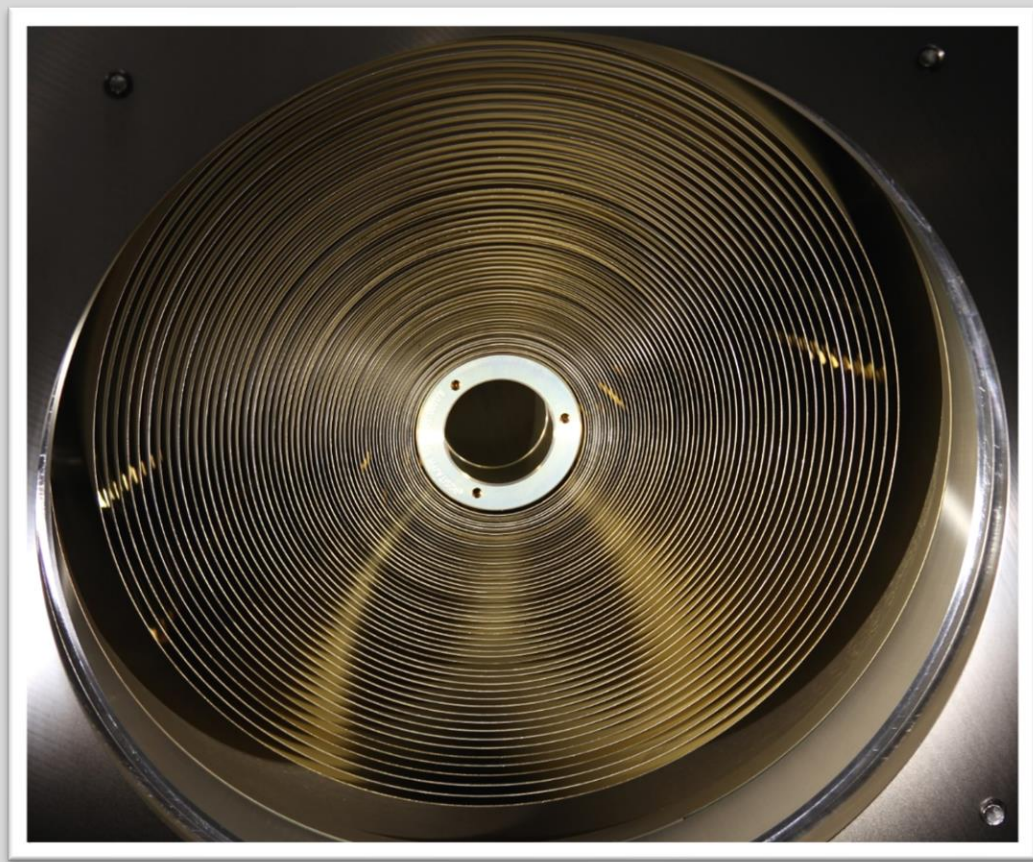
eROSITA
MPE

Navigator
NPO Lavochkin

Launch to L2 from Baikonur with *Zenit-Fregat*, >2014
ground stations in Russia

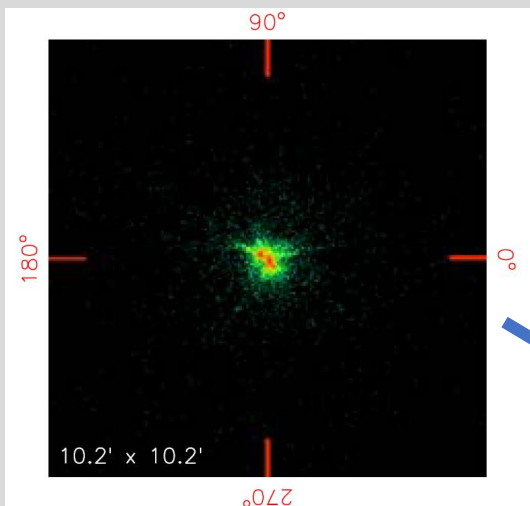
7+1 Mirror Modules

Mirror + Baffle

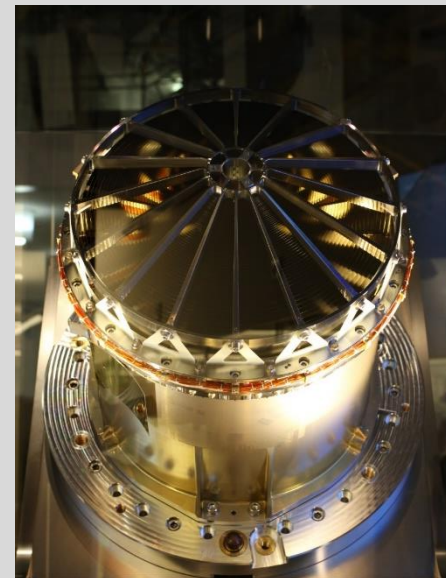


more by Peter Friedrich later

Mirror Modules

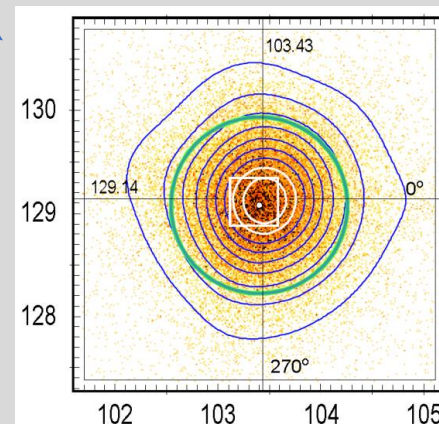


engineering model, 2009
42 arcsec



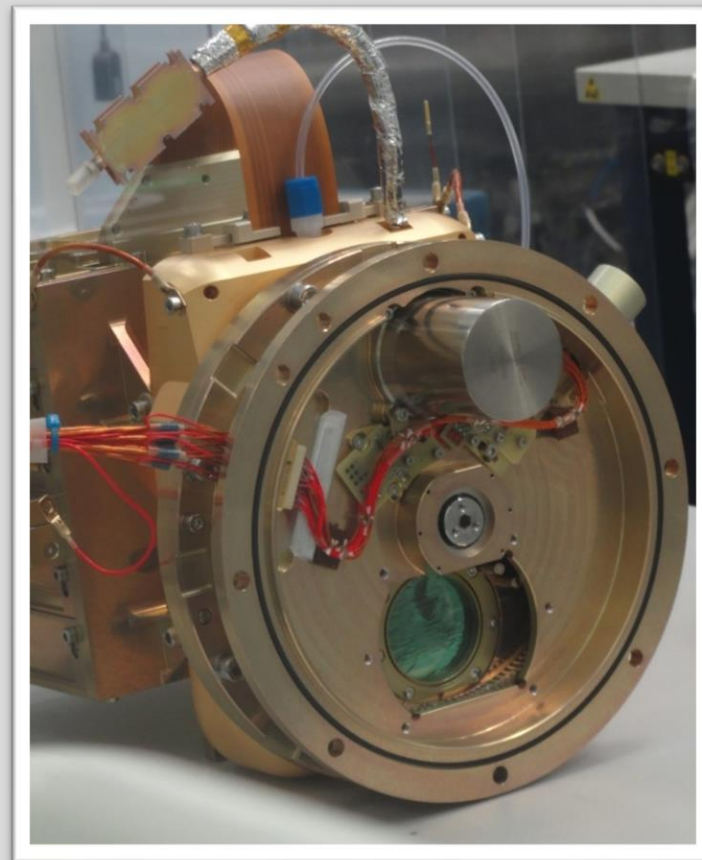
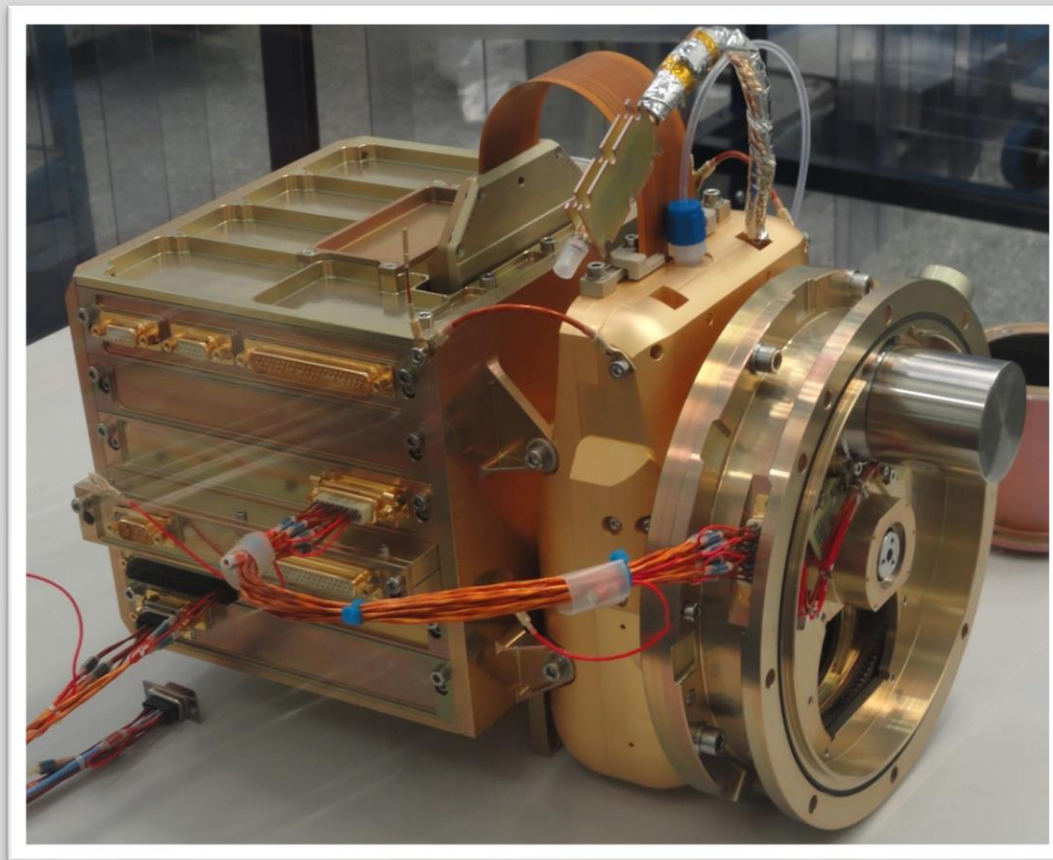
flightmodel, 2013
16 arcsec

Via Mala



7+1 Camera Units

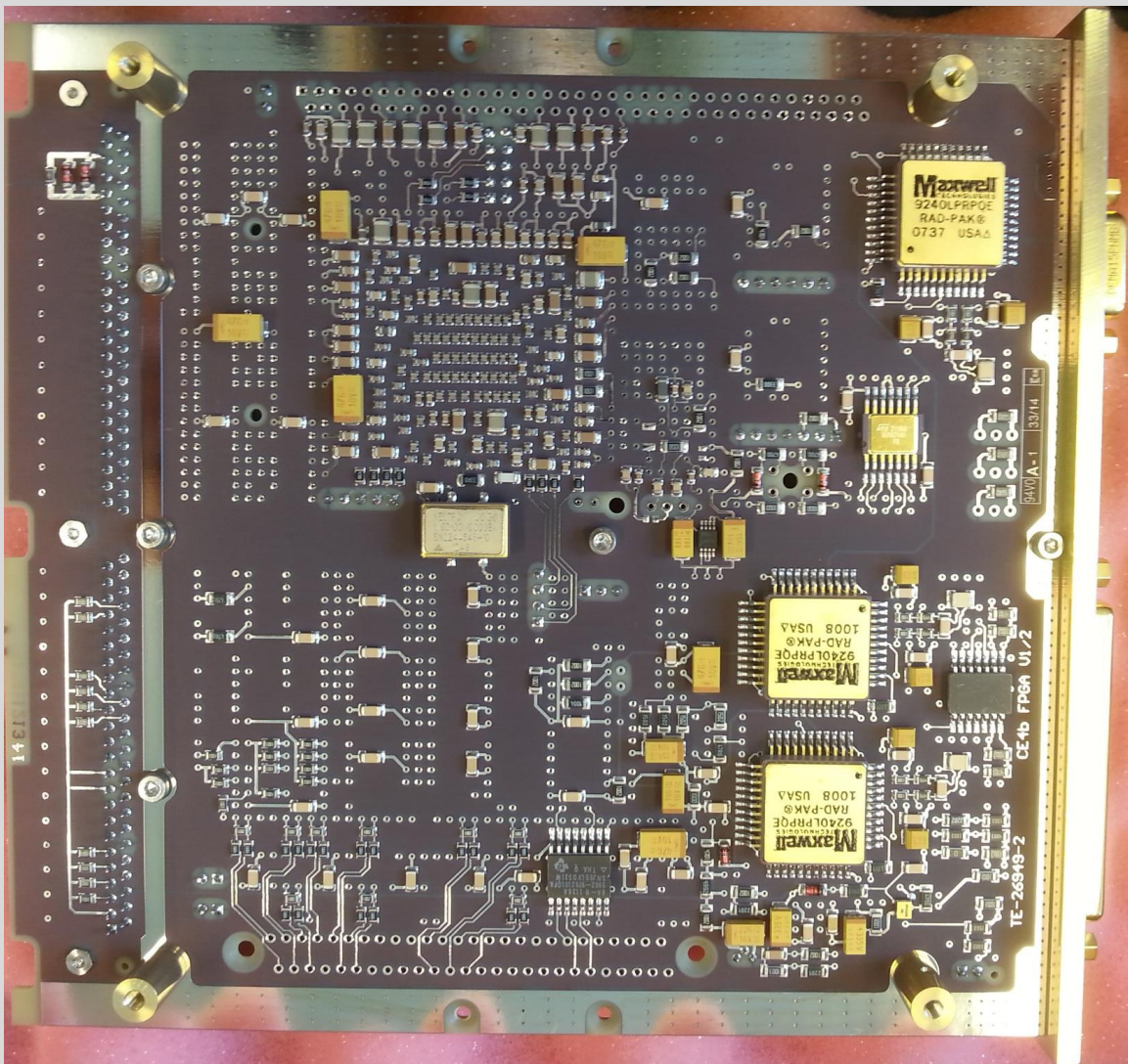
electronics, camera, filter wheel

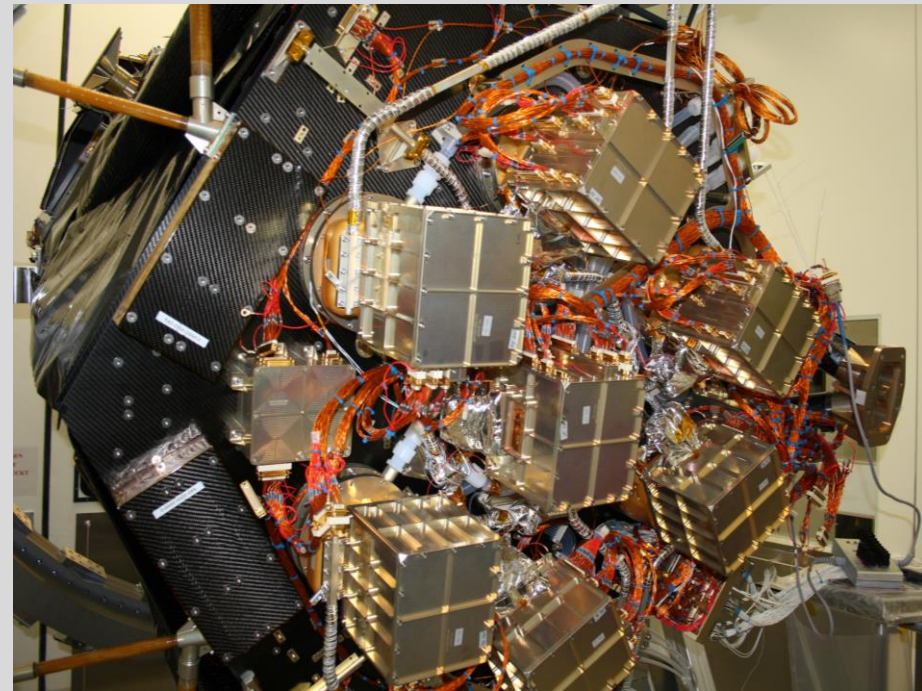
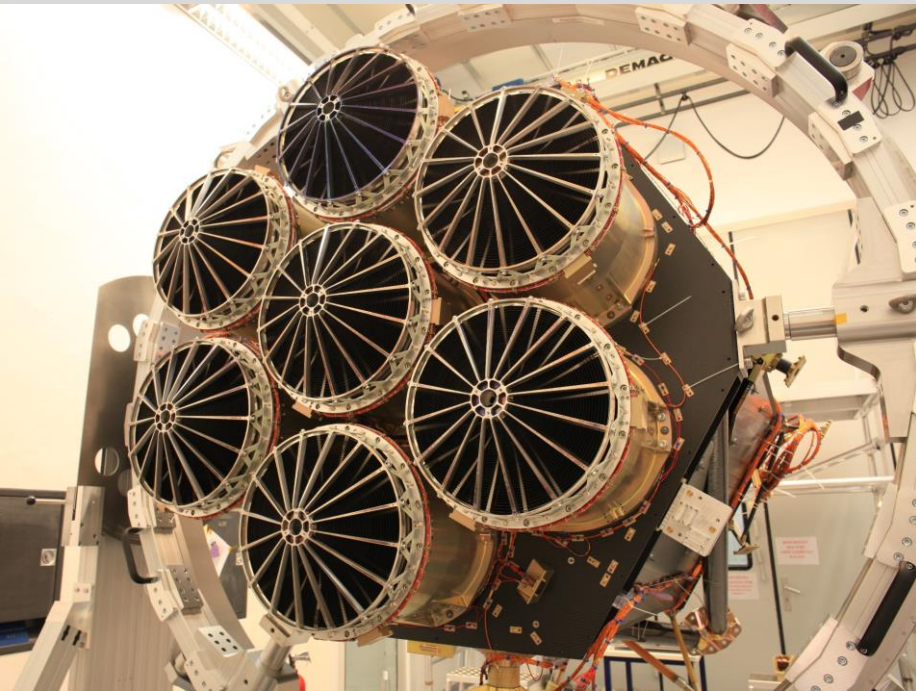


more by Norbert Meidinger later



~35.000 electronics components
radiation hard, space qualified





- Large Effective area ($\sim 1300 \text{ cm}^2$ @1keV, \sim XMM-Newton)
- Large Field of view: 1 degree (diameter)
- Grasp (effArea x FoV) $\sim 2 \times$ XMM-Newton
- Half-Energy width (HEW) $\sim 18''$ (on-axis, point.); $\sim 30''$ (FoV avg., survey)
- Positional accuracy: $\sim 4.5''$ (1σ)
- X-ray baffle: 92% stray light reduction
- pnCCD with framestore: $384 \times 384 \times 7$ pixels ($9.4''$), no chip gaps, no 'out of time' events
- Spectral resolution at all measured energies within specs ($\sim 80 \text{ eV}$ @1.5keV)

Predehl et al. (2021)



Vibration Test

8.12.2016

S

iABG



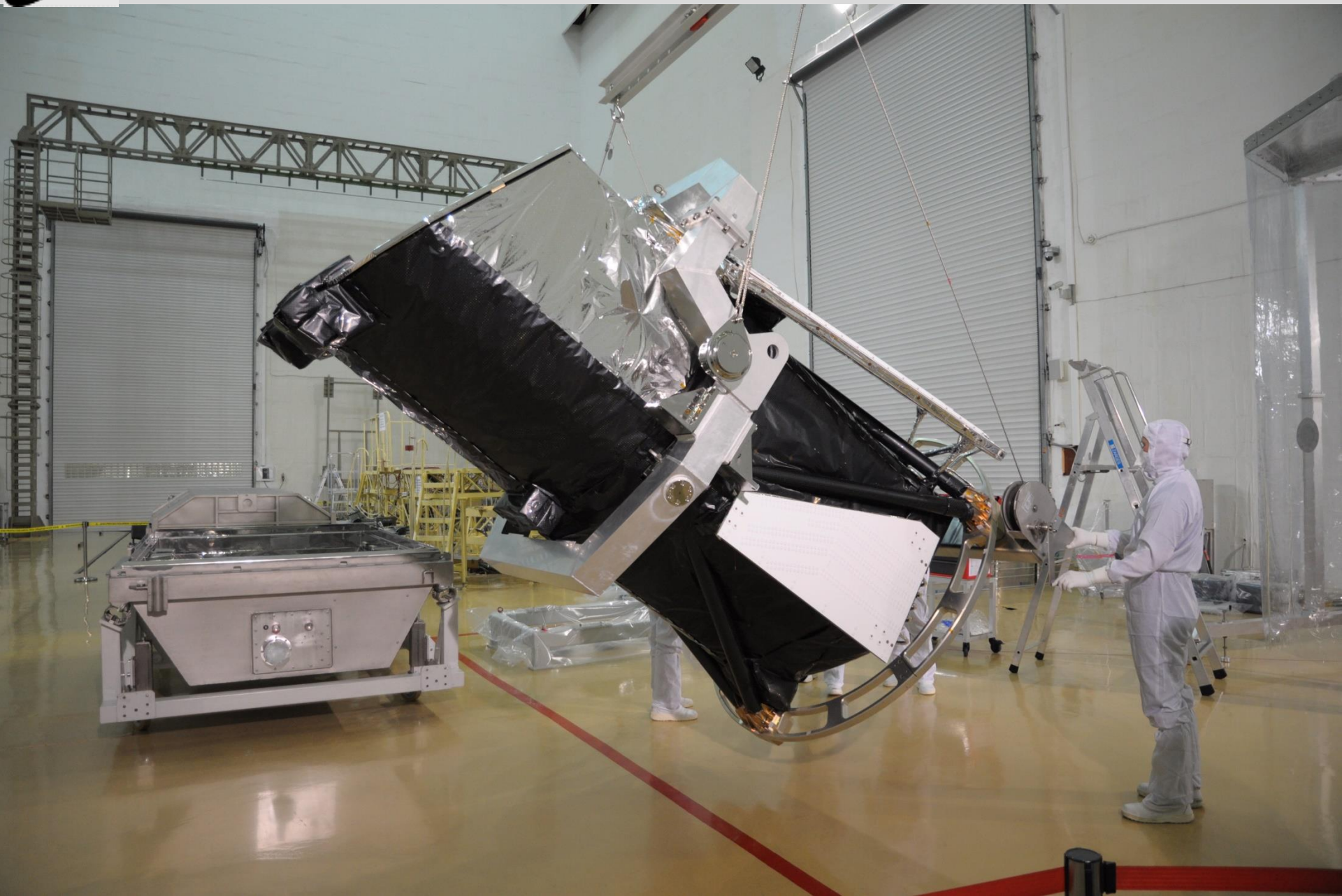


Airport Munich, 20.01.2017



Transport von SVO zu NPOL





ART-XC (IKI)



eROSITA (MPE)

Navigator
(NPO Lavochkin)

Спектр-РГ







23. Juni 2019 in Baikonur Ready to launch?



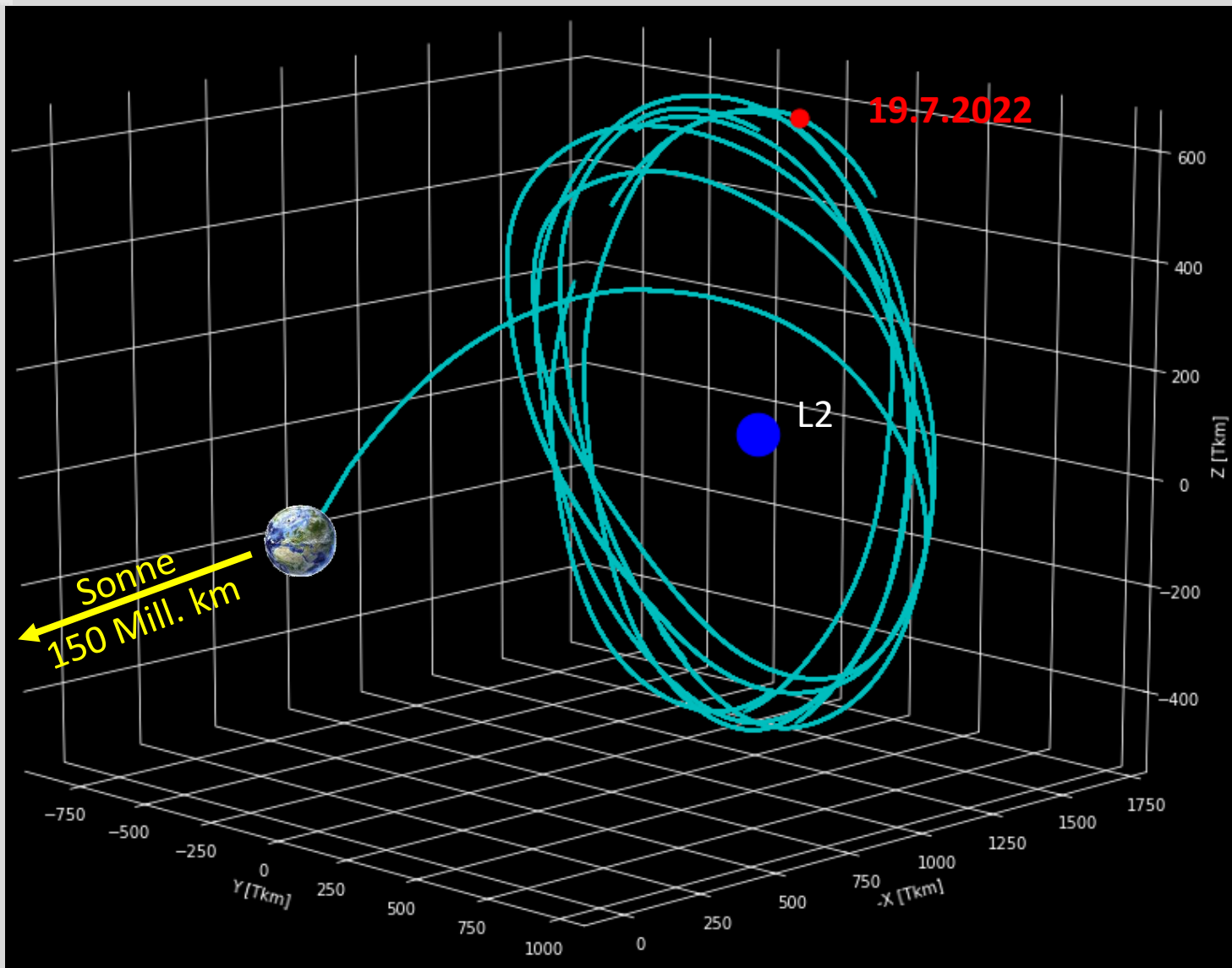


13.07.2019, 17:31



credit: Roscosmos

SRG Orbit



- 4 years

8 all sky surveys (6 rotations/day)

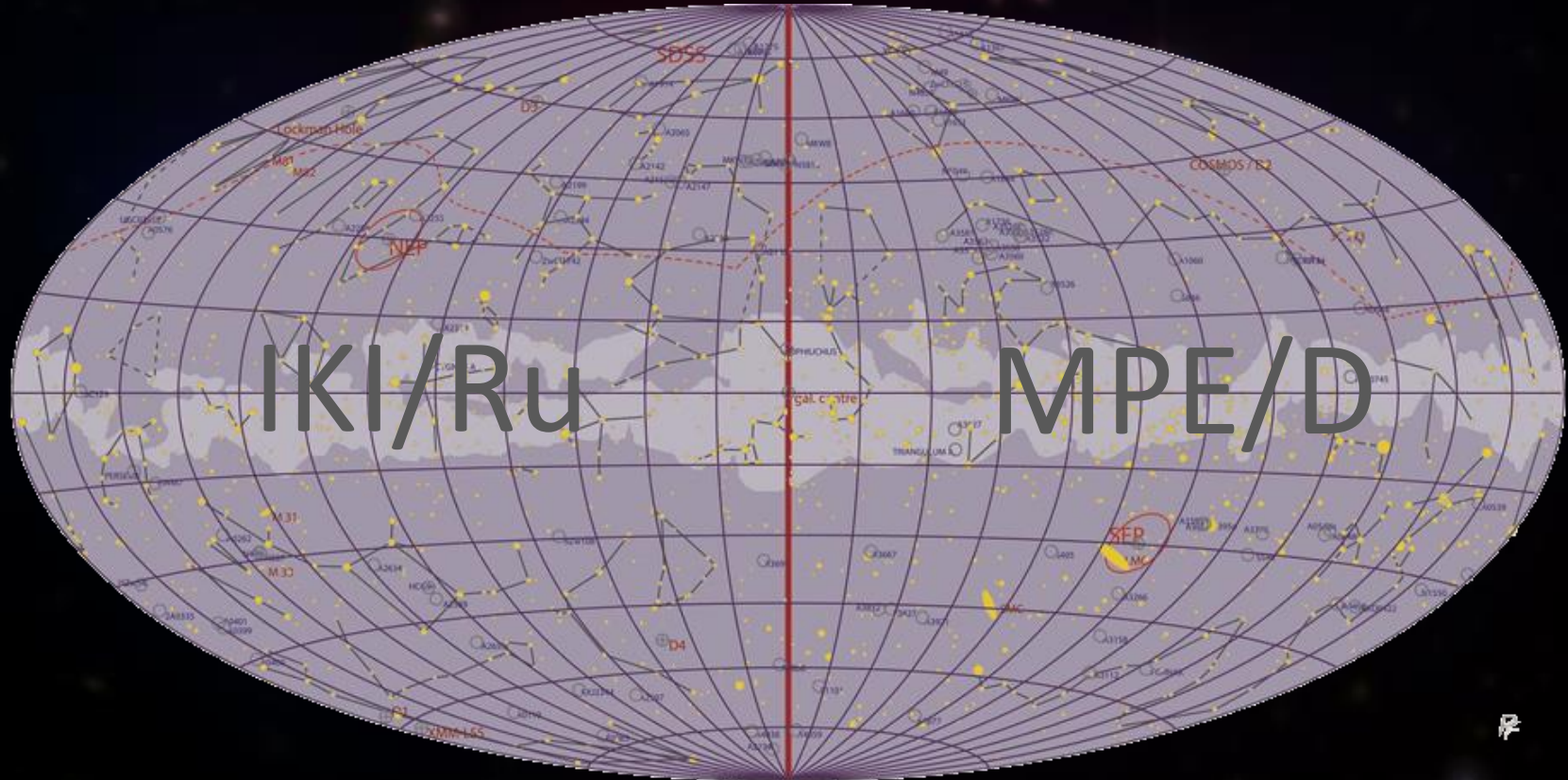
Russian-German "Spectrum-Roentgen-Gamma" SRG mission

Mission: All sky-survey in the X-ray band

Location: L2 orbit, 1.5 million kilometres from Earth

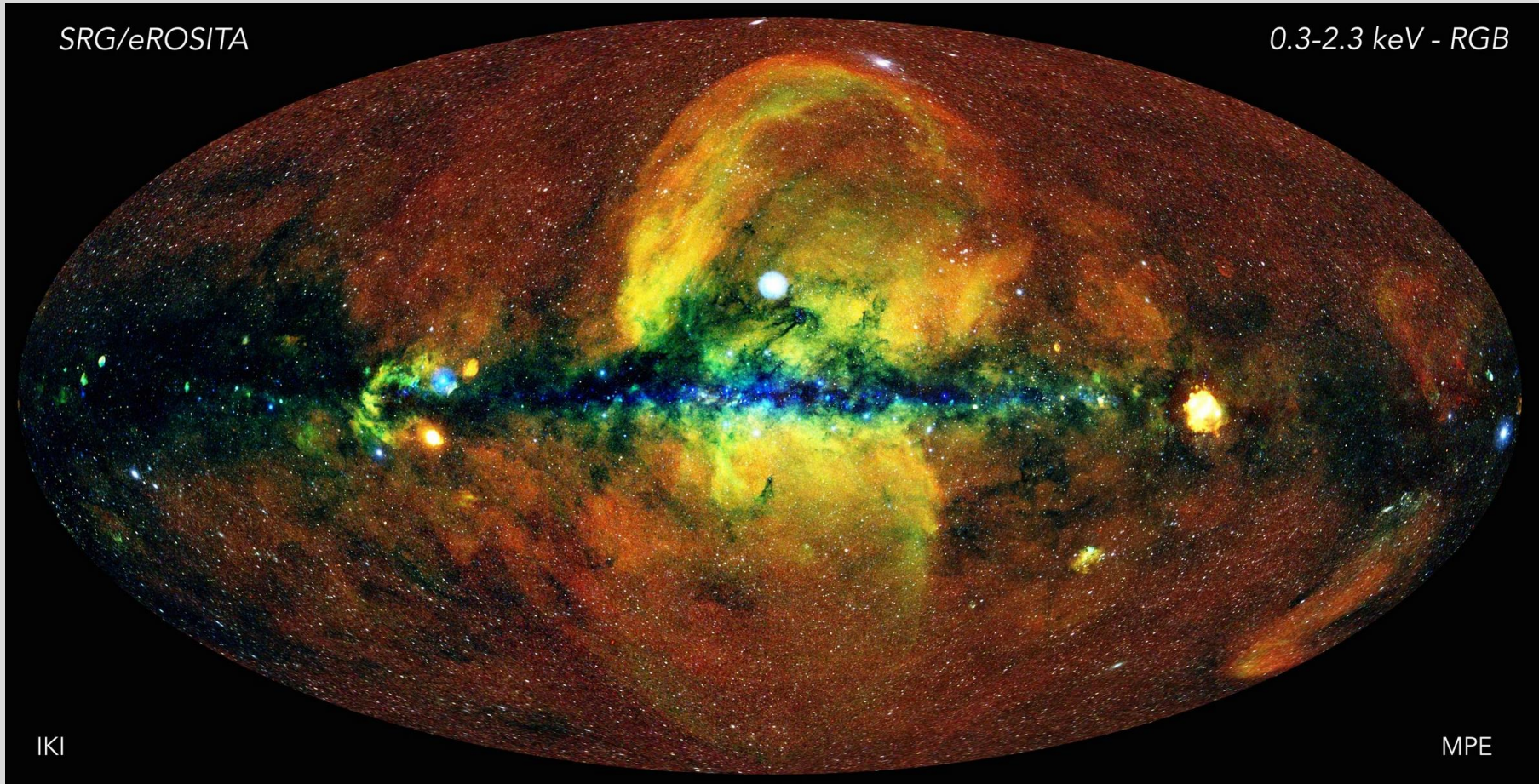
Mission lifetime: 7.5 years

Data Share



Data releases after 2 years.
Open to world wide community

eRASS1 (1/8)



> 1.000.000 X-ray sources detected

More than all X-ray observatories of the last 50 years combined!

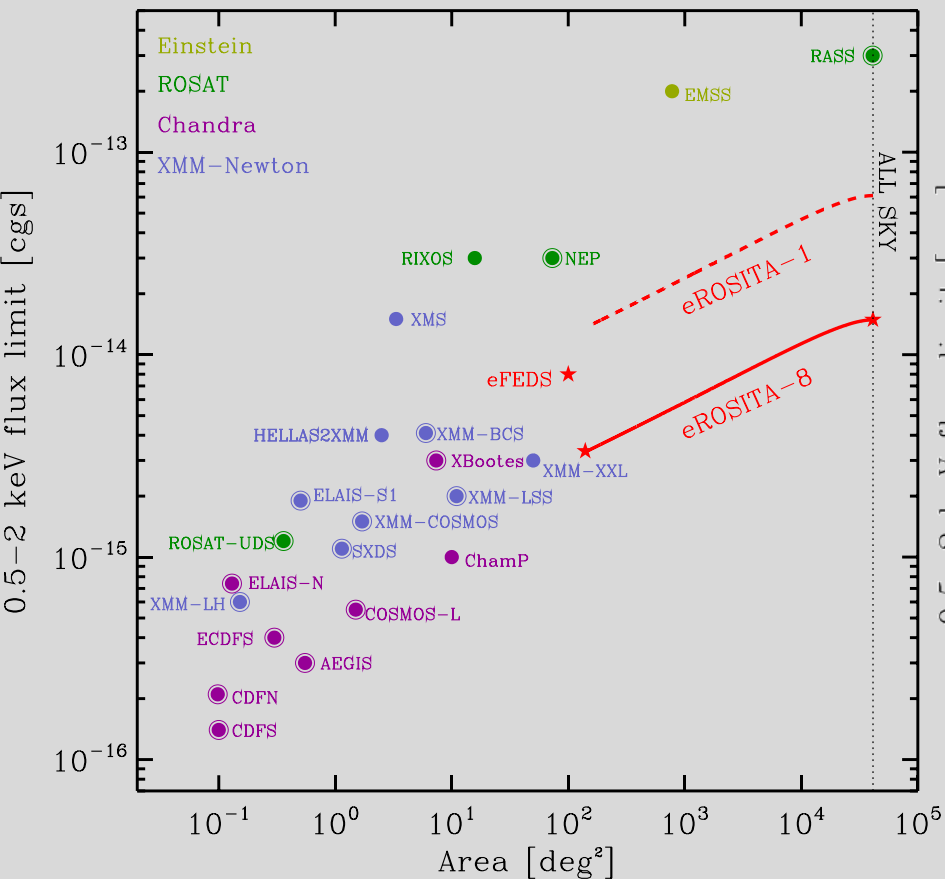
J. Sanders, H. Brunner, E. Churazov, M. Gilfanov, and the eSASS team



eROSITA surveys in context

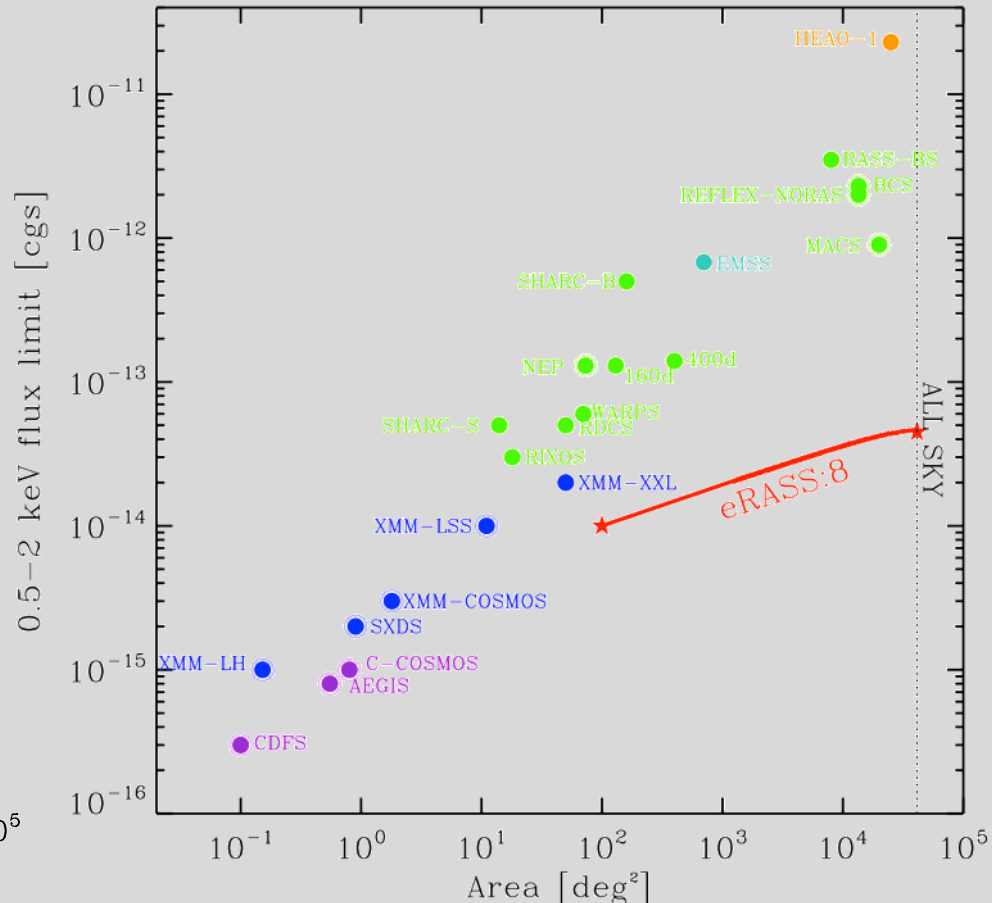


Point sources sensitivity



All sky: 10^{-14} (0.5-2 keV)
 2×10^{-13} (2-7 keV) [erg/cm²/s]

Extended sources sensitivity



All sky: 3.4×10^{-14} (0.5-2 keV)



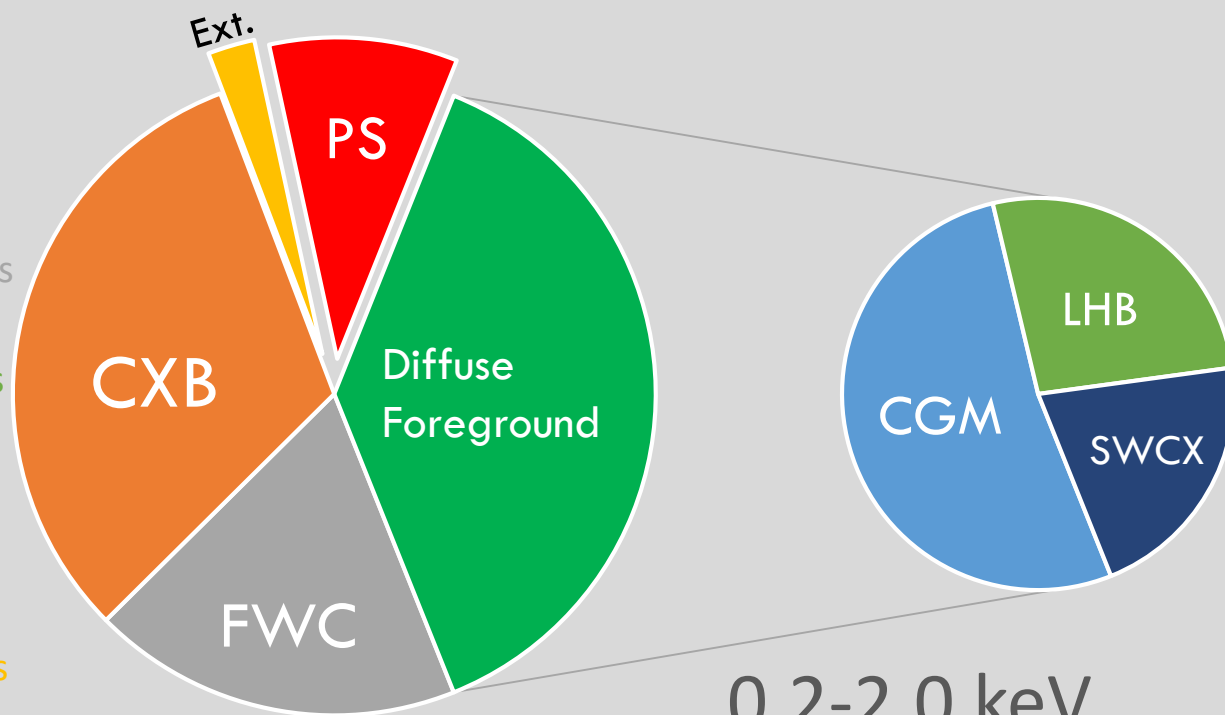
The All-Sky Surveys by Numbers

- Completed ~ 4.4 all-sky survey (12/2019 – 2/2022)
- Uniform exposure, avg. ~ 800 s; up to 120ks at the Ecliptic Poles (confusion limited)
- Very few background flares, flexible mission planning: no gaps in exposure
- ~ 1.7 Billion 0.2-5keV calibrated photons (~ 380 Gb telemetry)
- Typical (point-source) sensitivity:
 - Single pass (eRASS1,2,3,4)
 - $\sim 5 \times 10^{-14}$ erg/s/cm² [0.2-2.3 keV]; 4-5x deeper than RASS
 - $\sim 7 \times 10^{-13}$ erg/s/cm² [2.3-5 keV]
 - Cumulative (eRASS:4)
 - $\sim 2 \times 10^{-14}$ erg/s/cm² [0.2-2.3 keV]
 - $\sim 2 \times 10^{-13}$ erg/s/cm² [2.3-5 keV]
- eRASS1 (half-sky): 0.9M point sources \sim doubles the number of known X-ray sources!
- eRASS:4 (half-sky): 2.8M point sources; 87k extended; ~ 45 k confirmed clusters

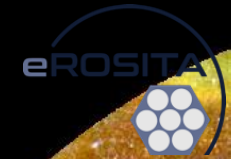
The eRASS1 (soft) photon Pie

~340 Million calibrated events

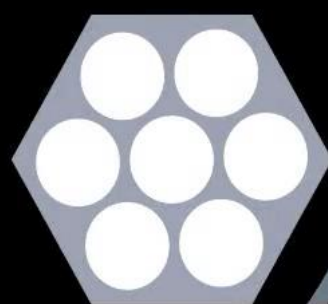
- 107M CXB photons
- 67M MW CGM photons
- 63M Instrumental BKG photons (FWC)
- 34M Local Hot Bubble photons
- 27M Solar Wind Charge Exchange photons
- 32M Point Sources' photons
 - 24M AGN; 8M Stars
- 8M Extended Sources' photons



0.2-2.0 keV

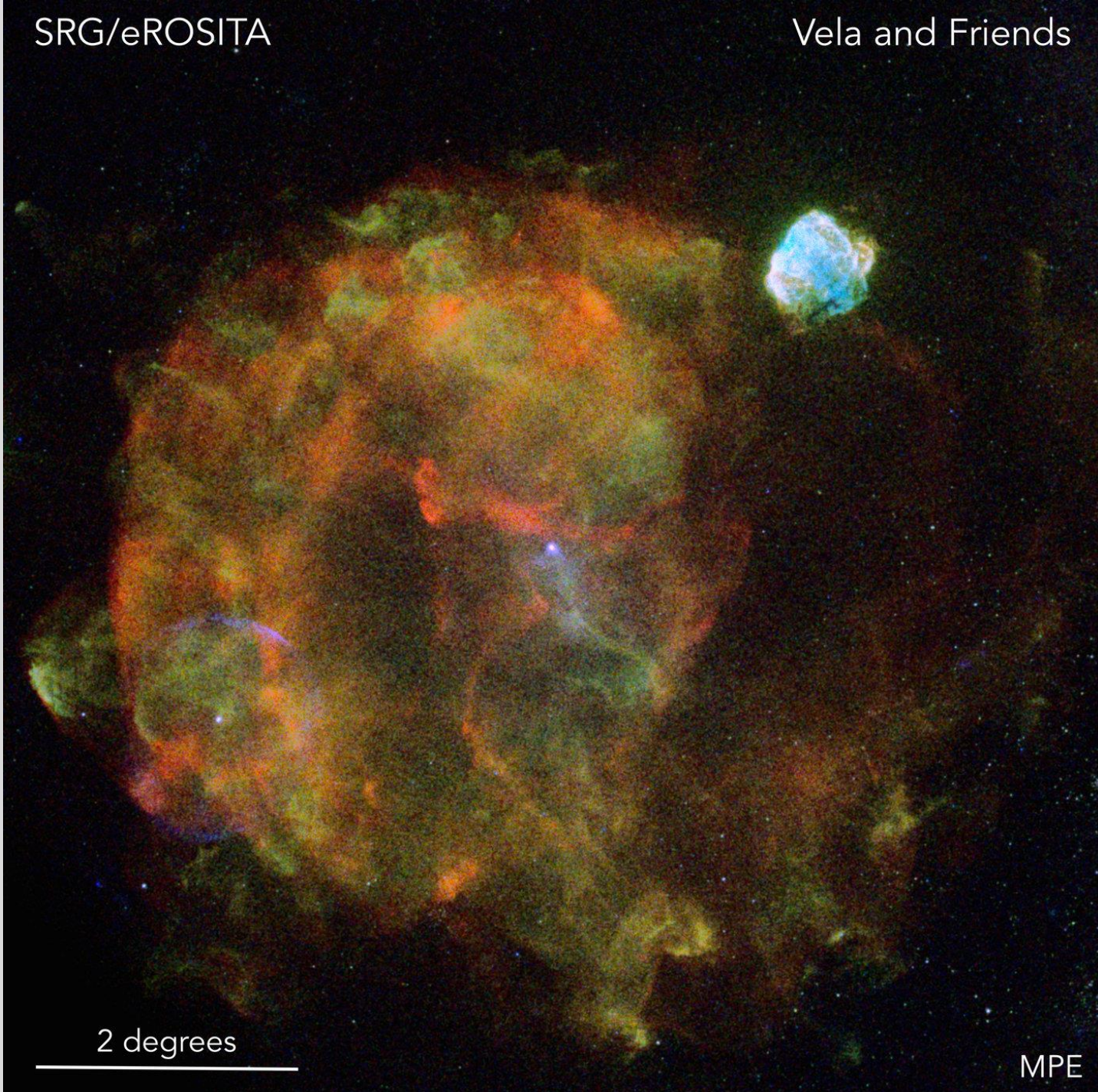


eROSITA



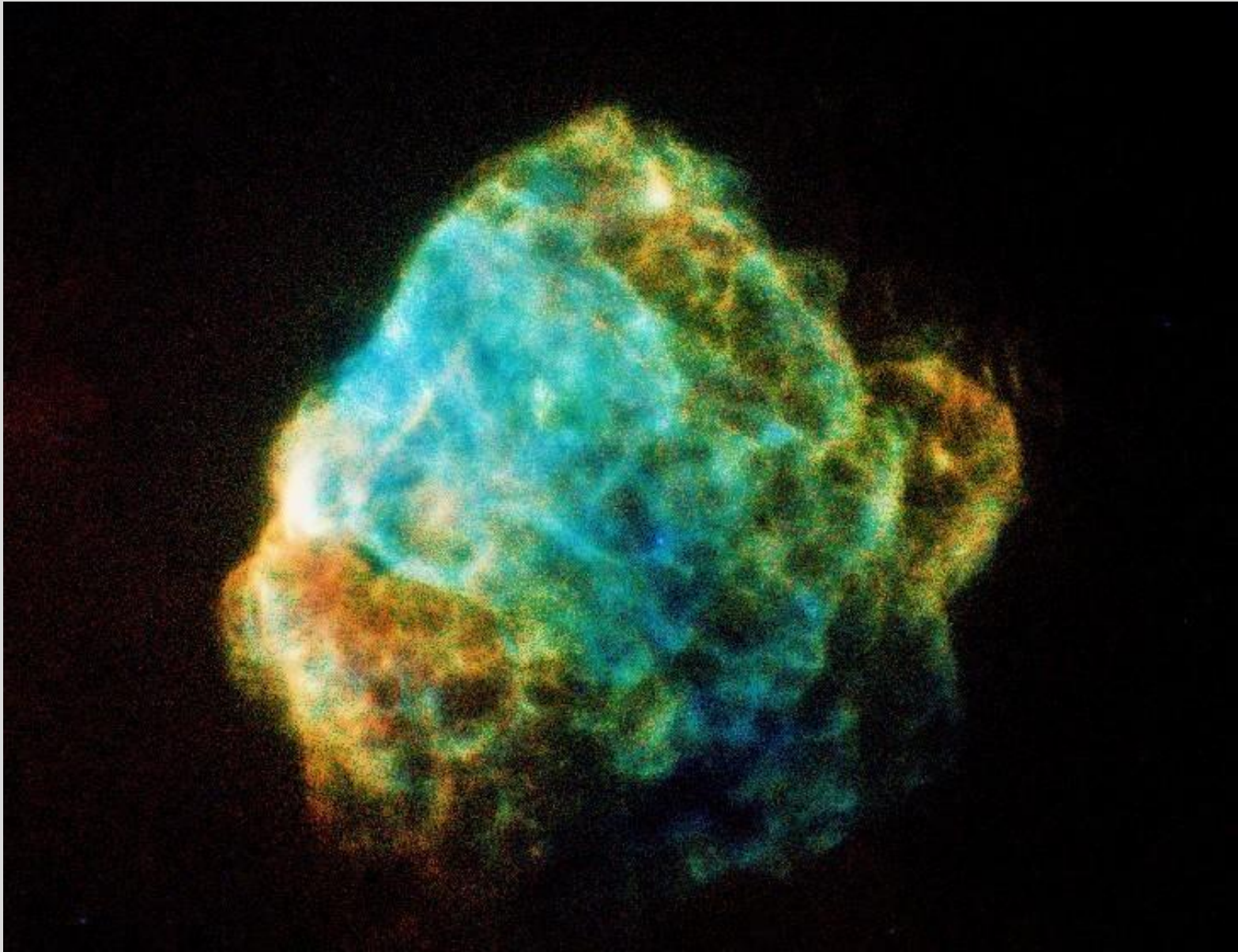
**A tour of the western
galactic hemisphere
in eRASS1**

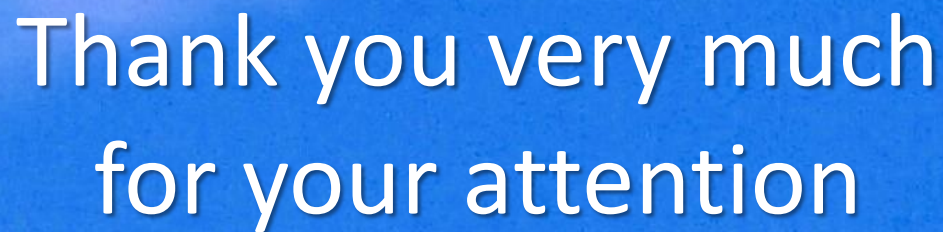
**Orthographic projection
Animation: J. Sanders for the MPE/eROSITA-DE collaboration
Music: Tonic by Torus**



2 degrees

Puppis A



A photograph of the eROSITA satellite in space, showing its cylindrical body and a bright, multi-pointed starburst pattern of light trails from its X-ray detectors, set against a dark blue background.

Thank you very much
for your attention

