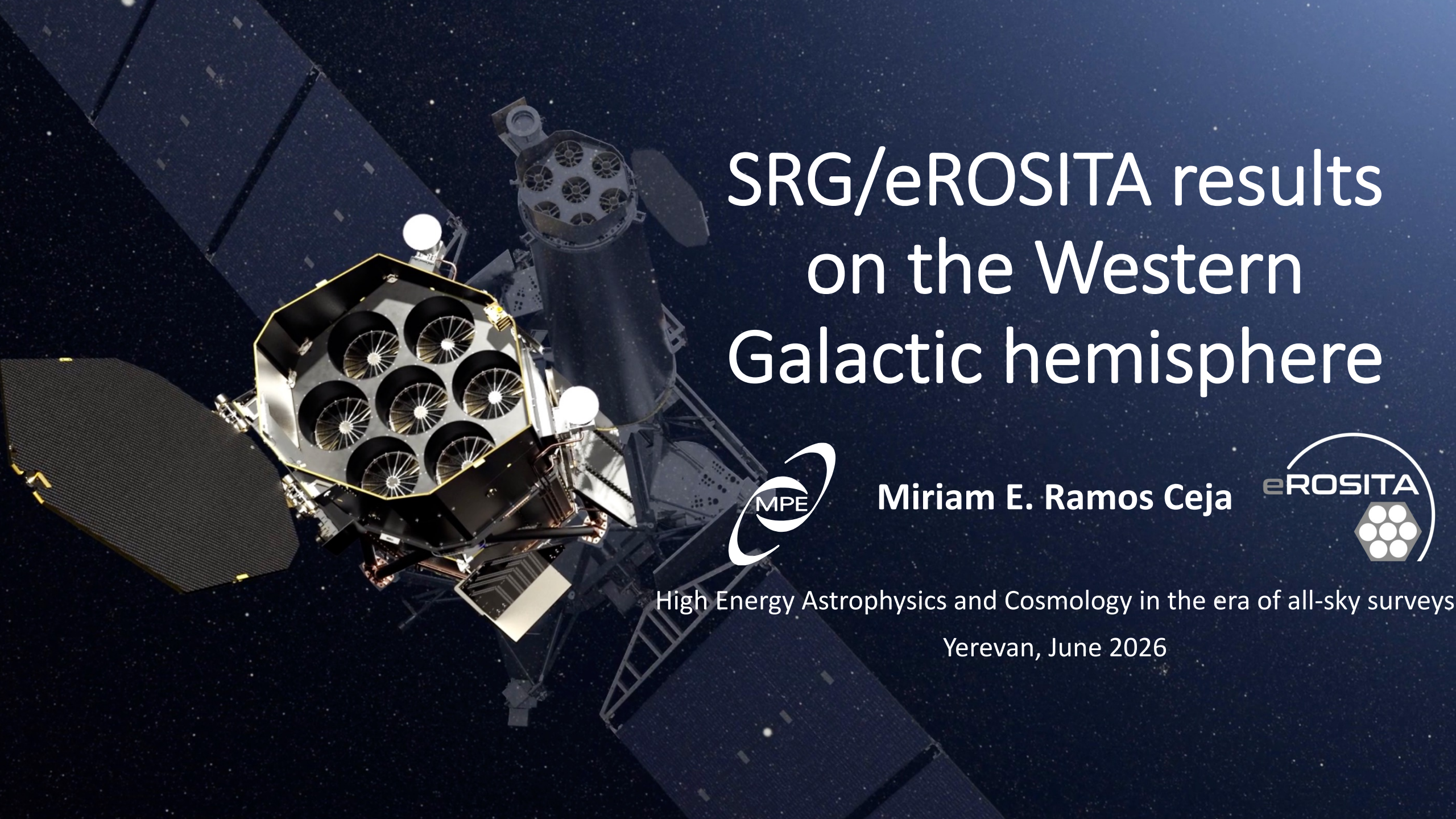


SRG/eROSITA results on the Western Galactic hemisphere

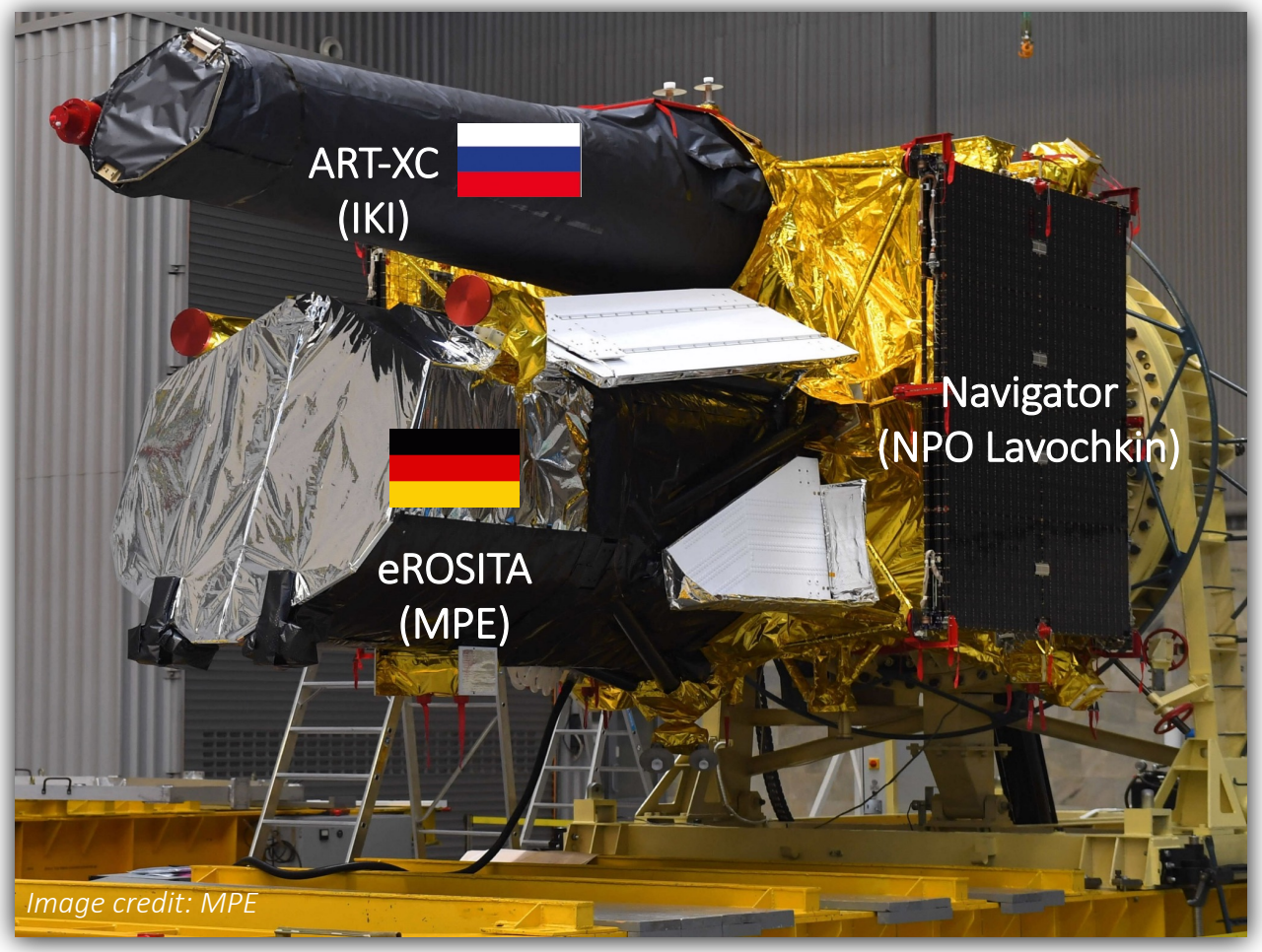
Miriam E. Ramos Ceja

High Energy Astrophysics and Cosmology in the era of all-sky surveys

Yerevan, June 2026

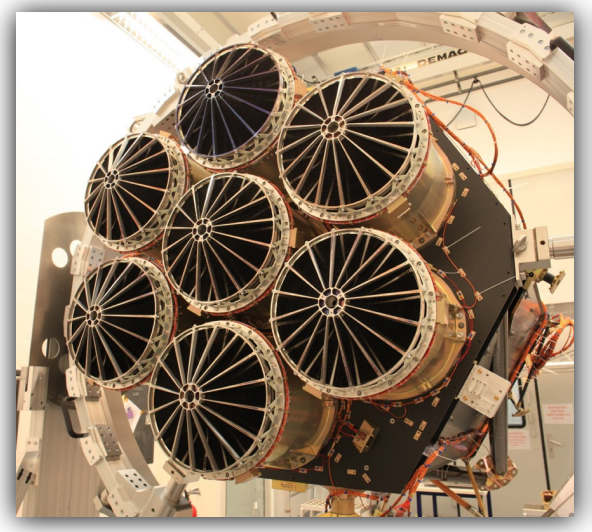
eROSITA X-ray telescope on SRG (Спектр-РГ)

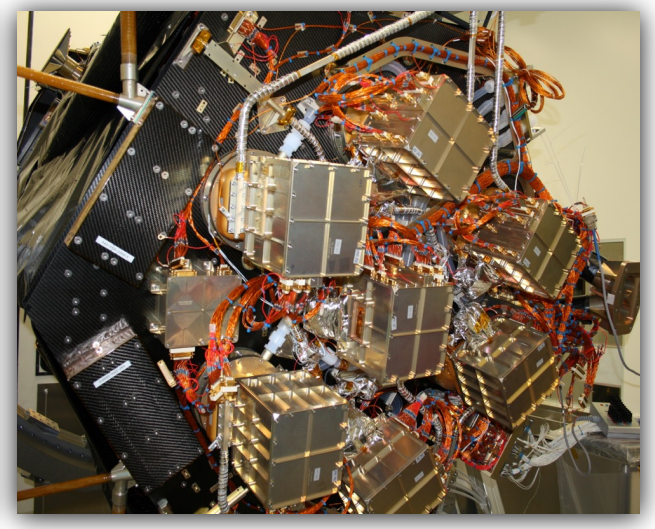
- extended ROentgen Survey with an Imaging Telescope Array
- Spectrum-Roentgen-Gamma (SRG) observatory
- Launch: July 13 2019, from Baikonur cosmodrome
- Orbit: Lagrange 2 (L2) point



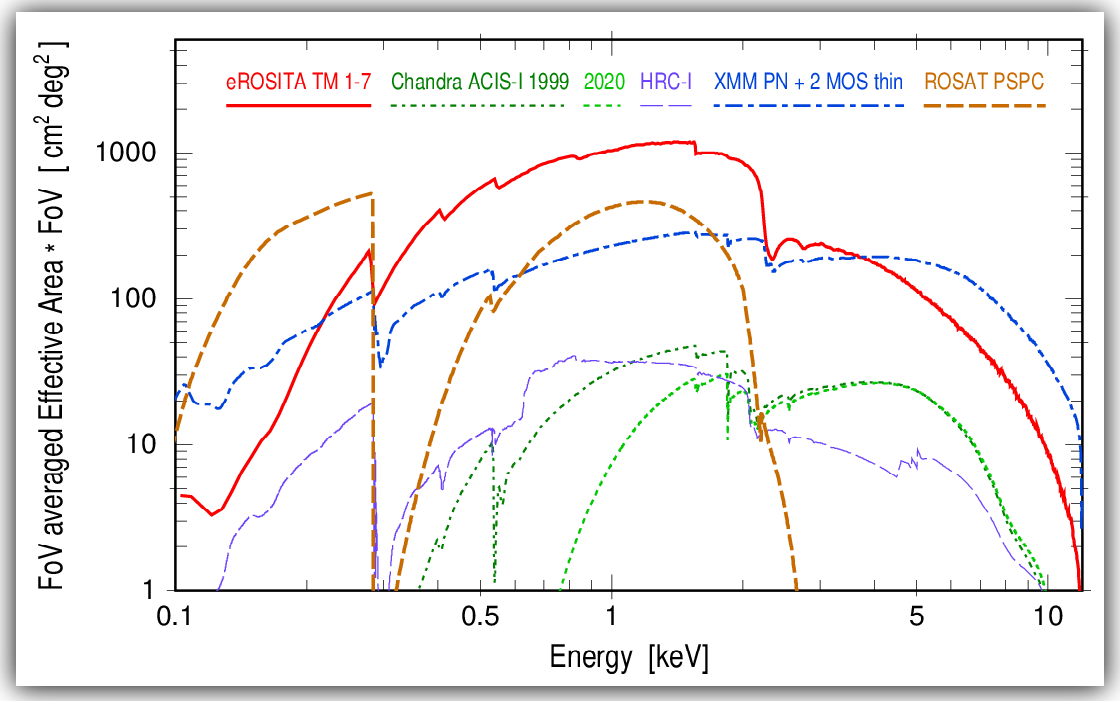
eROSITA in numbers

- 7 Wolter-I telescopes
- Each with 54 nested mirror shells
- Energy range: 0.1 – 10 keV
- Field of view: ~ 1 degree
- Effective area: 1237 cm^2 @ 1keV, 139 cm^2 @ 5 keV
- Half-Energy width (HEW): ~ 18” (on-axis, pointed), ~ 30” (FoV averaged, survey)
- Positional accuracy: ~4.5” (1σ)
- Completed 4.4 all-sky surveys in ~2.5 yr

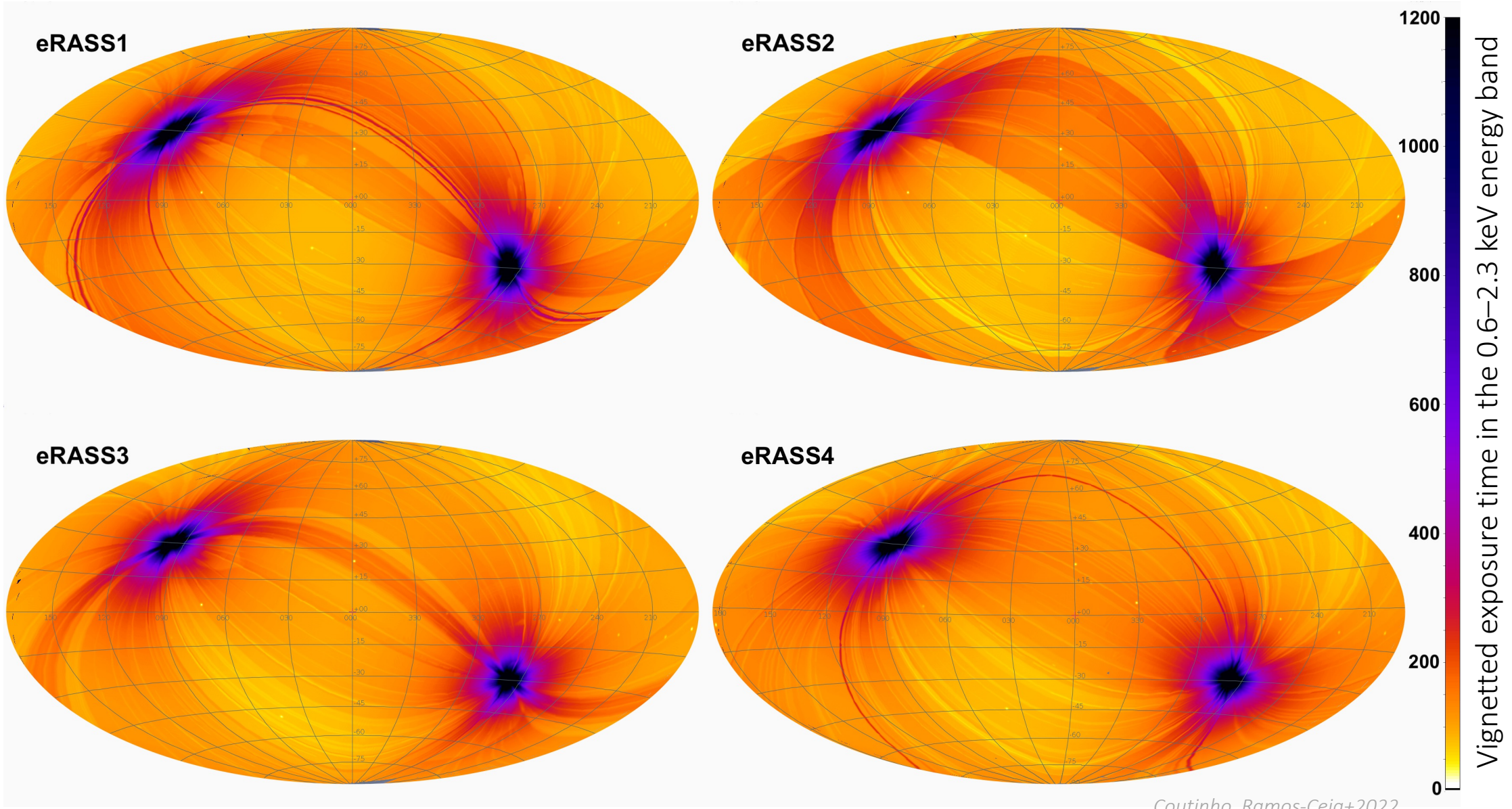




Predehl+2021

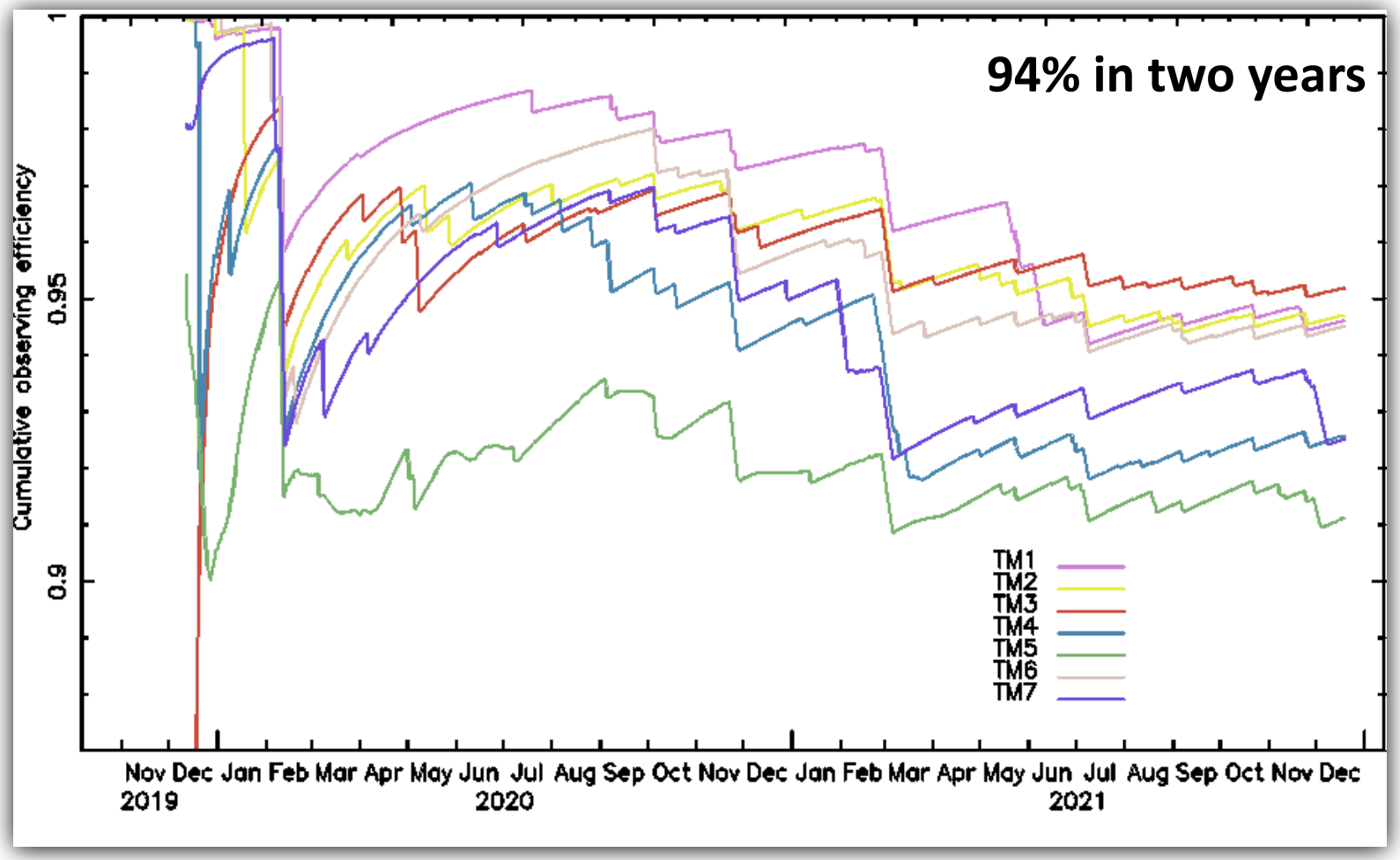


eROSITA observation efficiency



Coutinho, Ramos-Ceja+2022

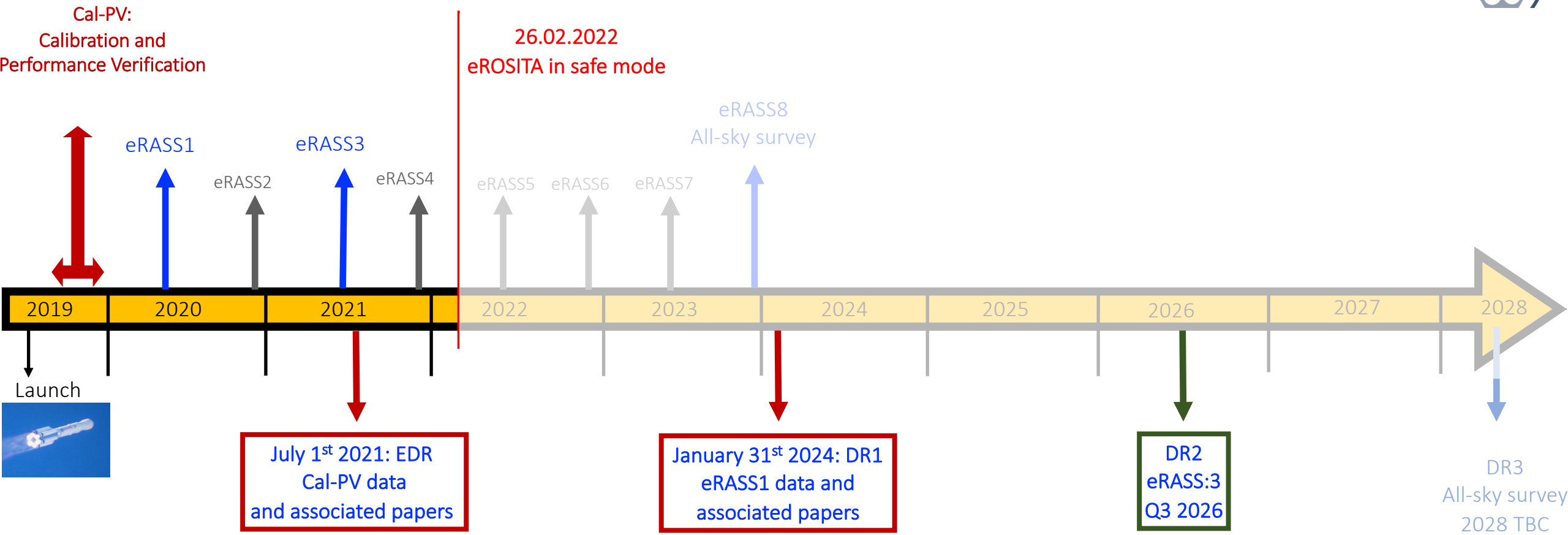
eROSITA observation efficiency



- Camera electronics and Interface and Thermal Controller anomalies
- Orbit corrections
- Light leak in telescope modules 5 and 7

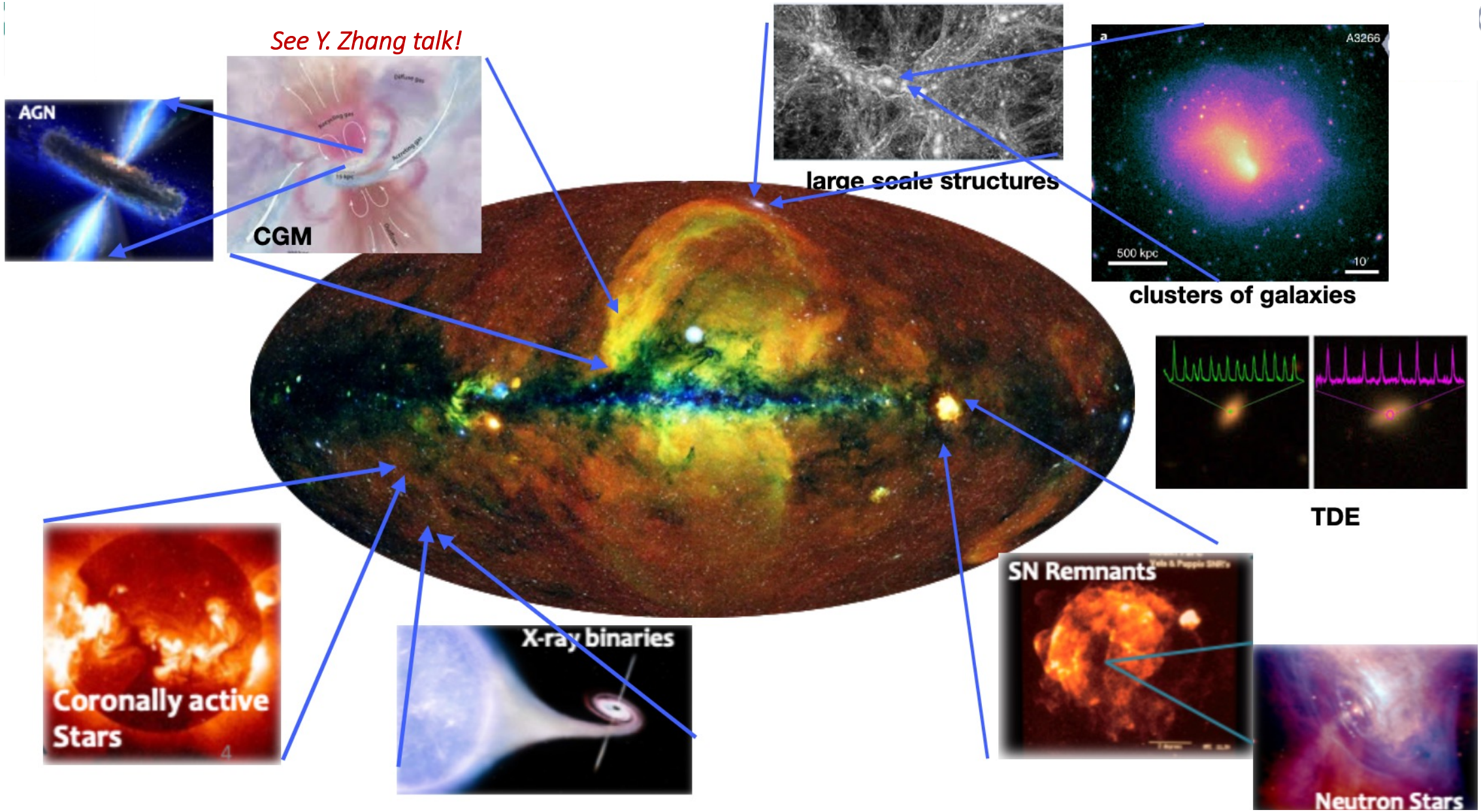
Coutinho, Ramos-Ceja+2022

eROSITA programmatics

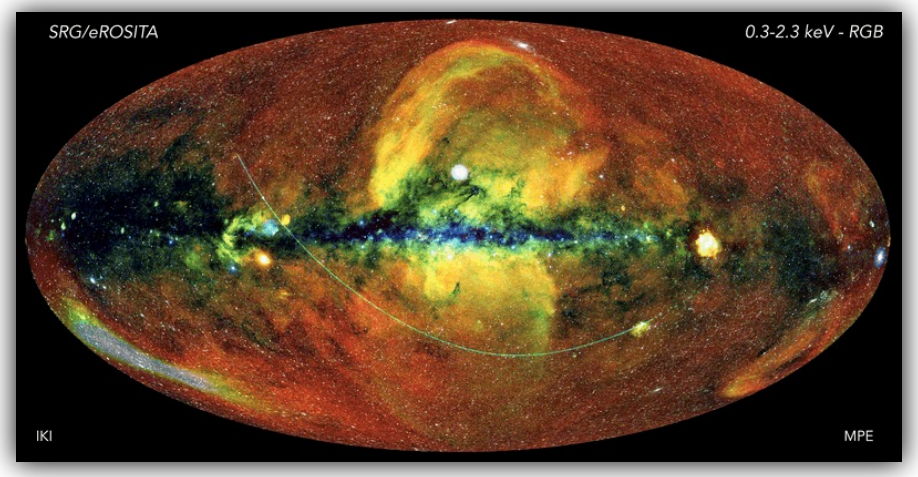


- Early Data Release (EDR) in 2021: several fields, including eFEDS mini-survey *https://erosita.mpe.mpg.de/edr*
- Data Release 1 (DR1) in 2024: eRASS1 data, including source catalogues *https://erosita.mpe.mpg.de/dr1*

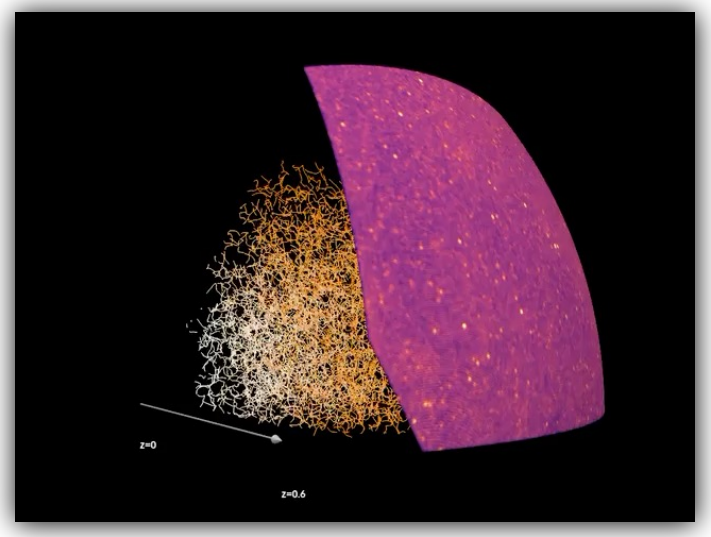
eROSITA: Illuminating the Hot, Energetic Universe



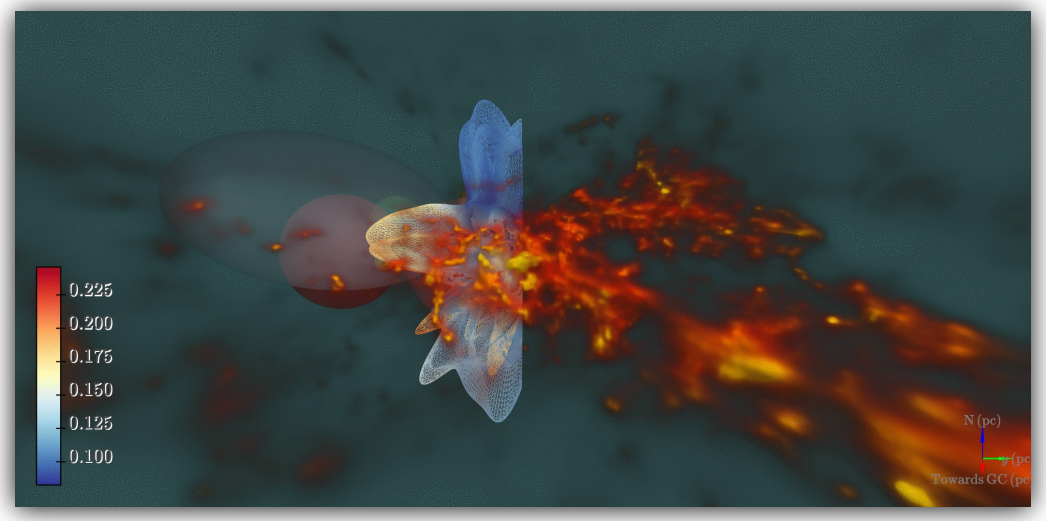
Selected science highlights since DR1



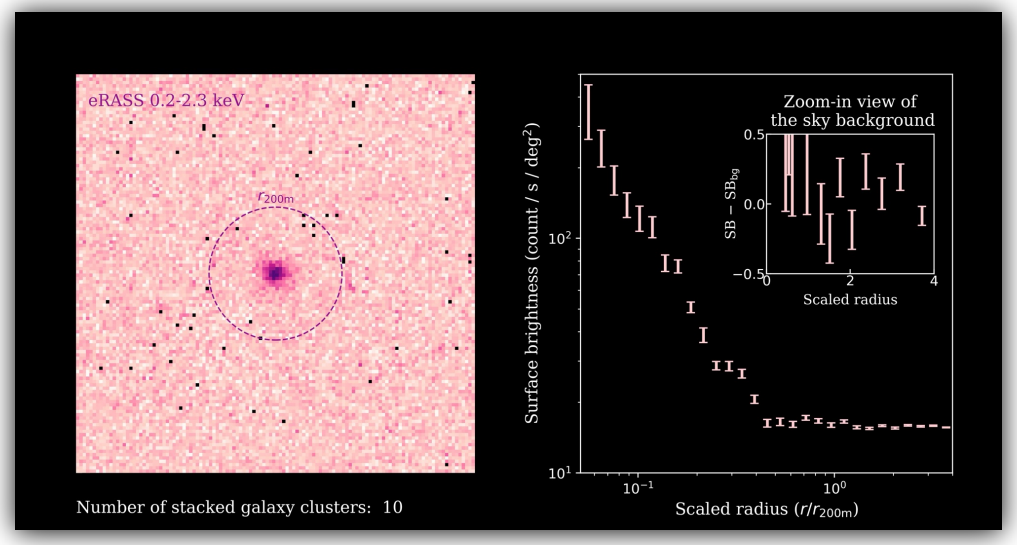
Dennerl+2026



Zhang+2024



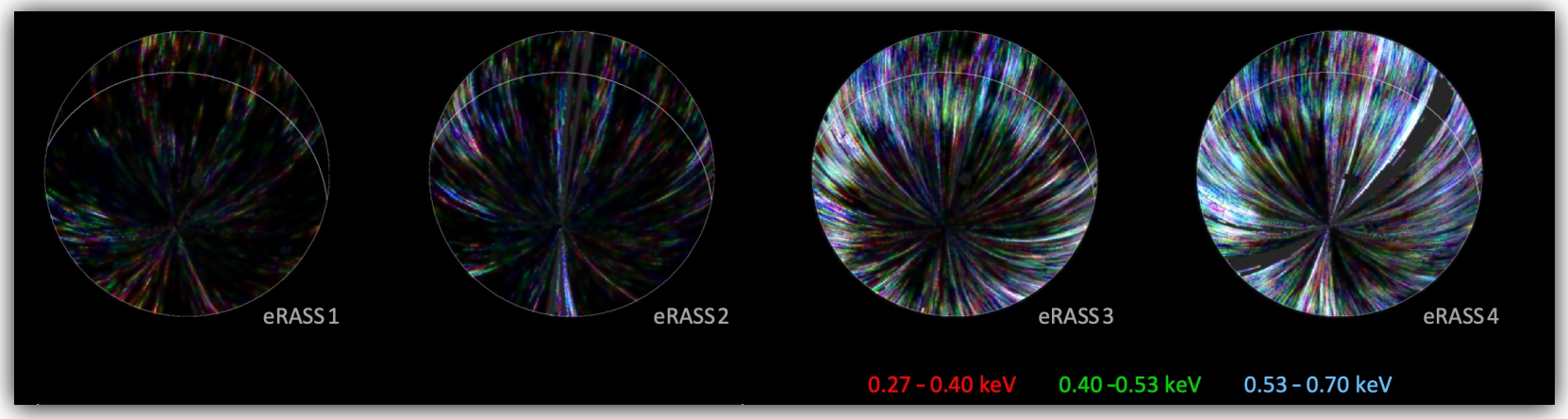
Yeung+2024

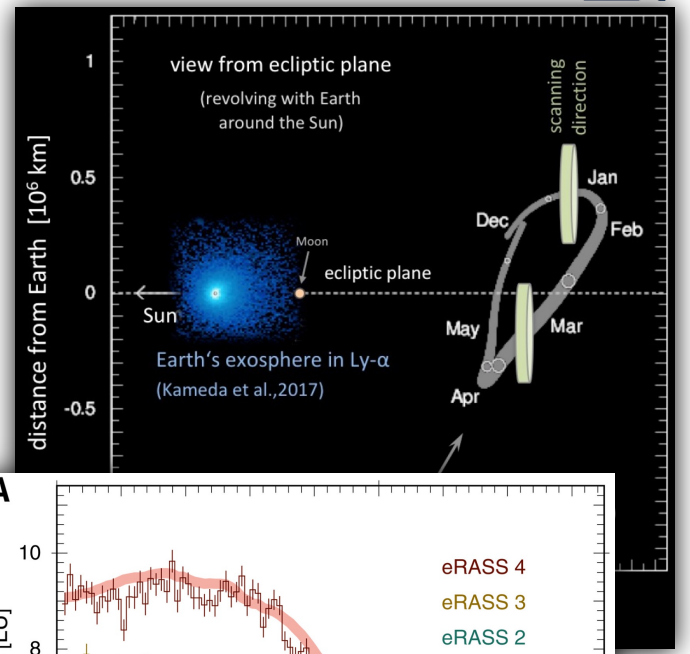


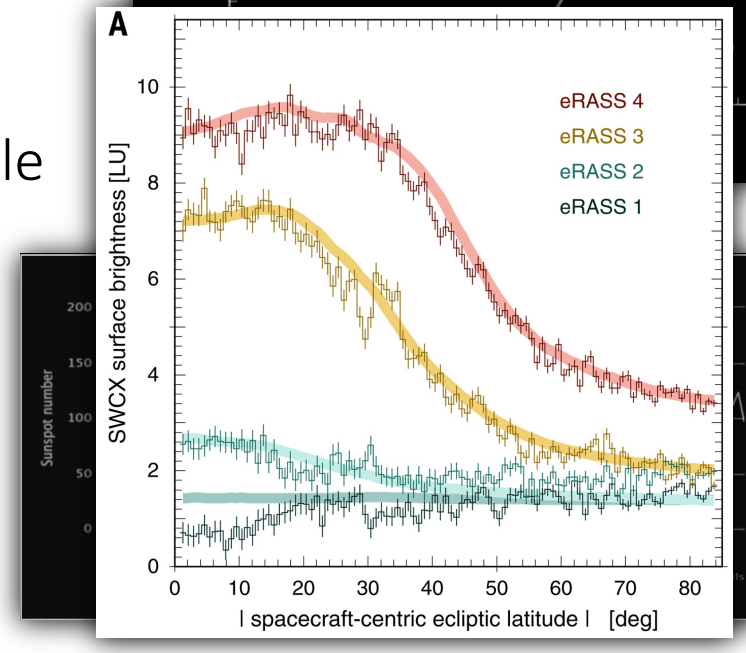
Zhang+2026

Solar System contribution to the soft X-ray sky

- X-rays are produced by ions picking up electrons from neutral gases, e.g., geocorona and heliosphere: solar-wind charge exchange (SWCX) emission
- SRG/eROSITA: first X-ray satellite which avoids geocoronal emission
- Isolated the heliospheric component and reconstructed the soft X-ray sky as it would appear when observed from outside the Solar System
- Clear evolution of heliospheric X-ray emission across the solar cycle



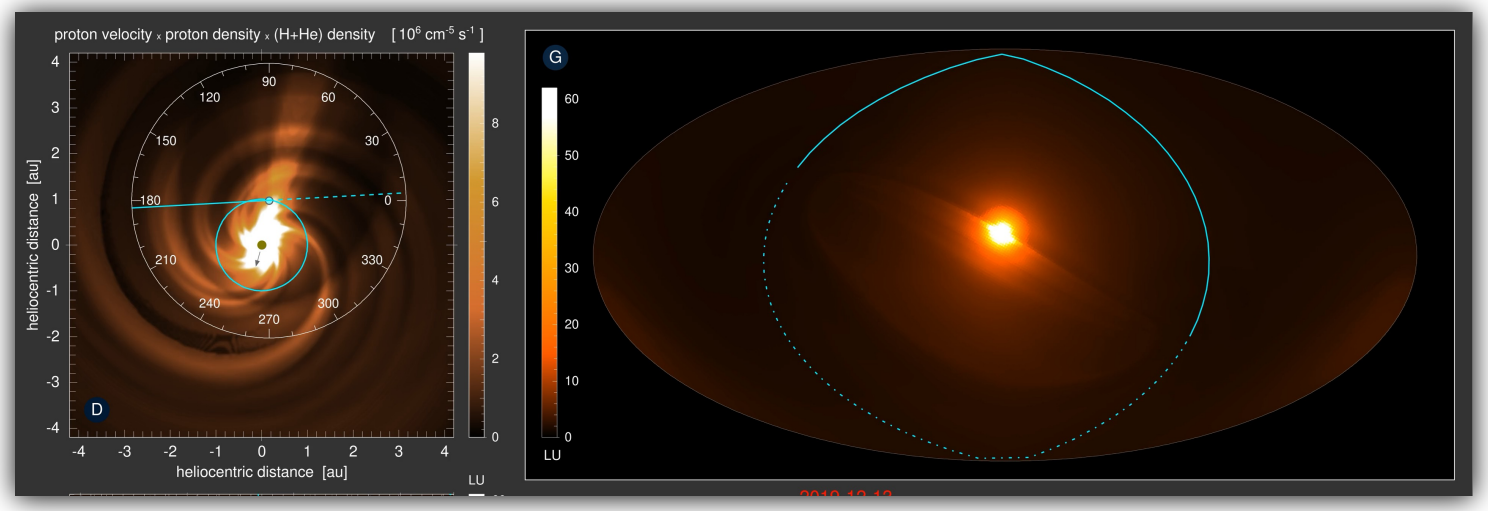


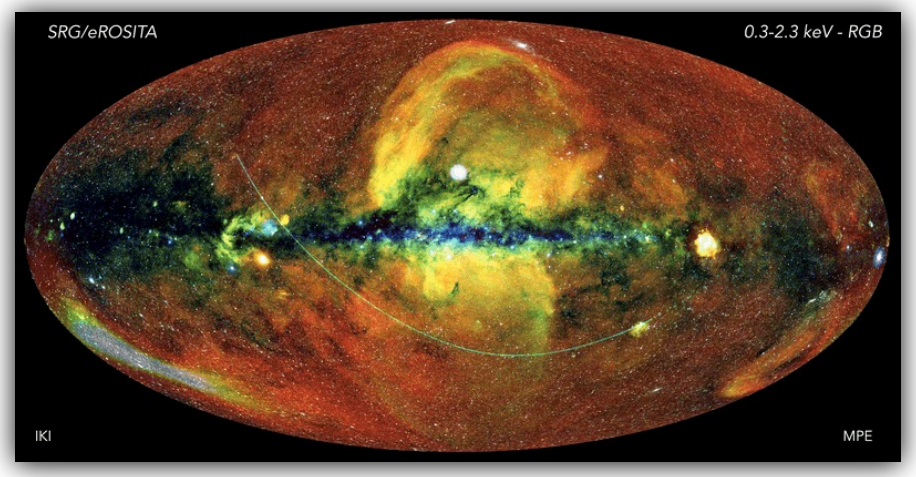


K. Dennerl+2026

Solar System contribution to the soft x-ray sky

- Localized region of enhanced X-ray emission that does not revolve around the Sun
- Solar System moves through the Galaxy, gas containing helium atoms flows through it
  - Sun's gravity bends their trajectories, creating the helium focusing cone (predicted in the 70's)
- 3D model using solar wind measurements and interstellar matter data
- Emission predominantly originates from spiral structures produced by varying solar wind speeds

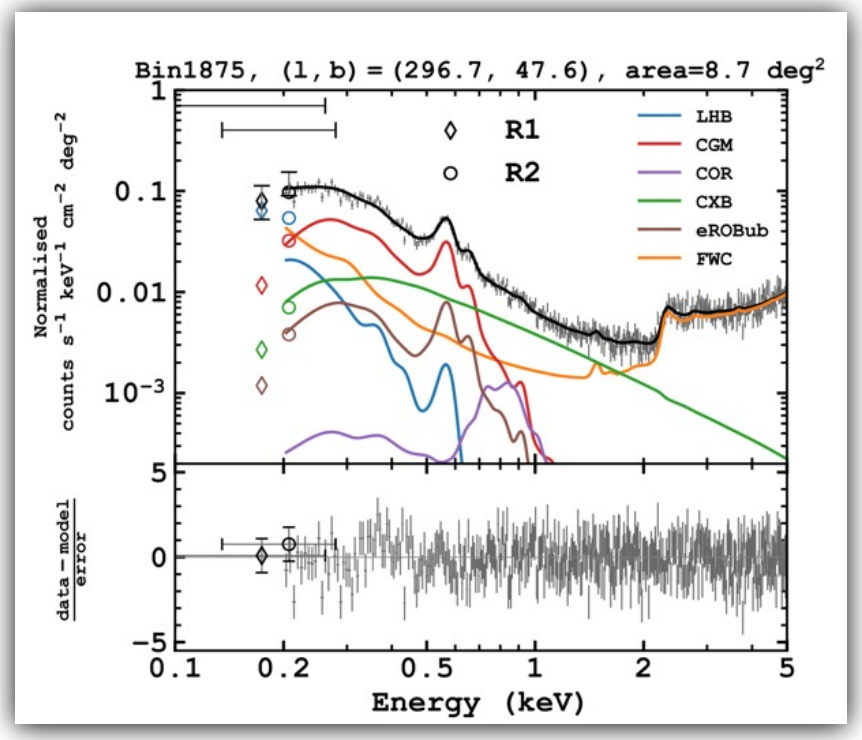


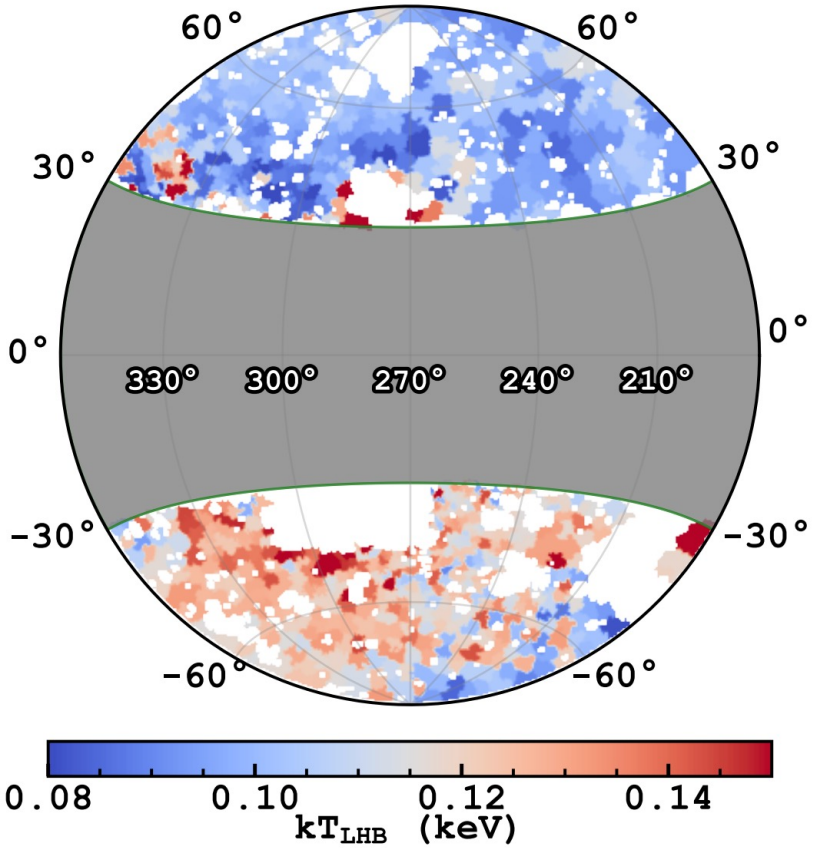


K. Dennerl+2026

The Local Hot Bubble

- eRASS1 (less SWXC contaminated) study of the diffuse soft X-ray background (SXRB): Local Hot Bubble
- North-South temperature difference and gradient towards low latitudes





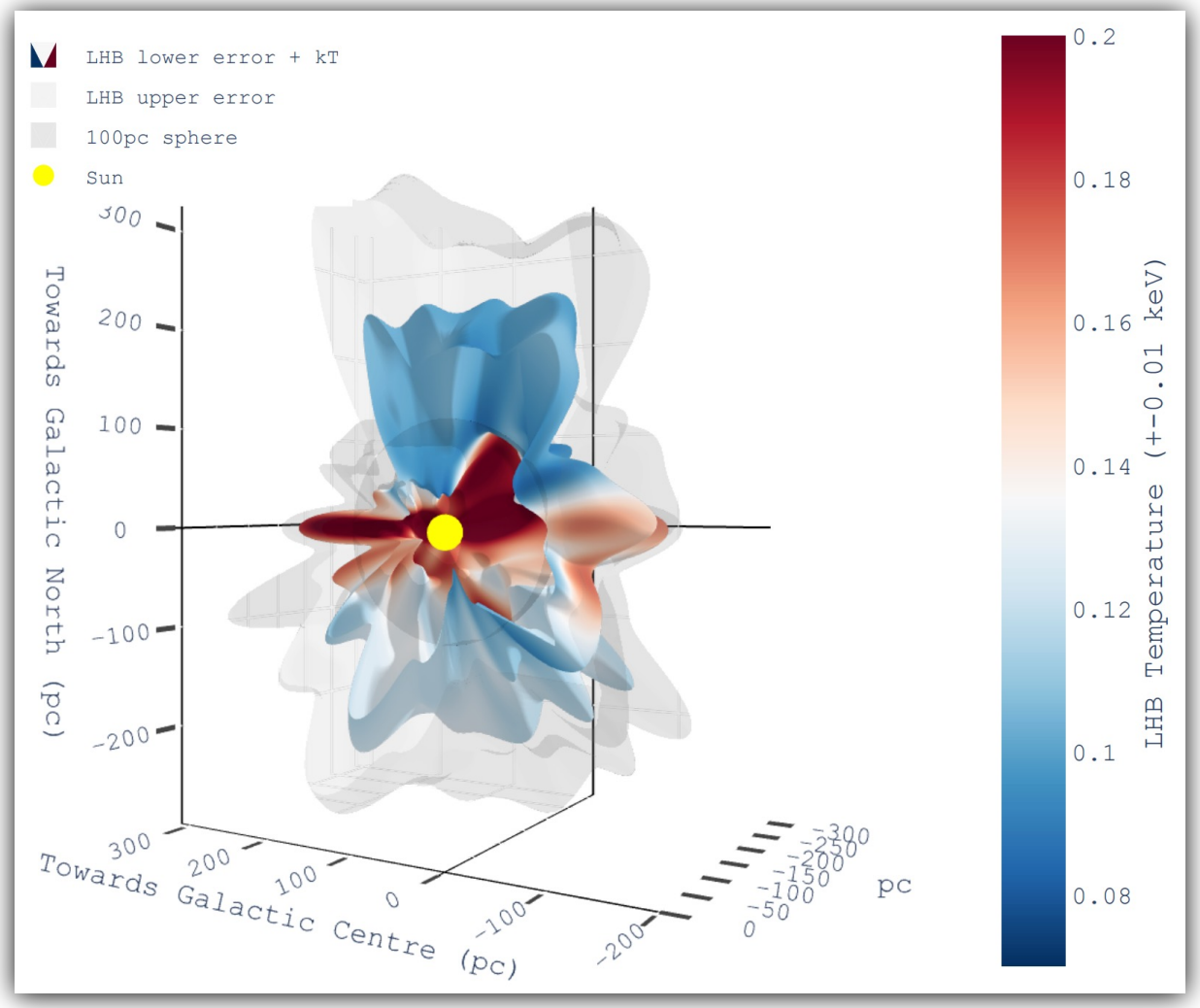
$kT_N = 100.8 \pm 0.5$ eV

$kT_S = 121.8 \pm 0.6$ eV

M. C. H. Yeung+2024

The Local Hot Bubble

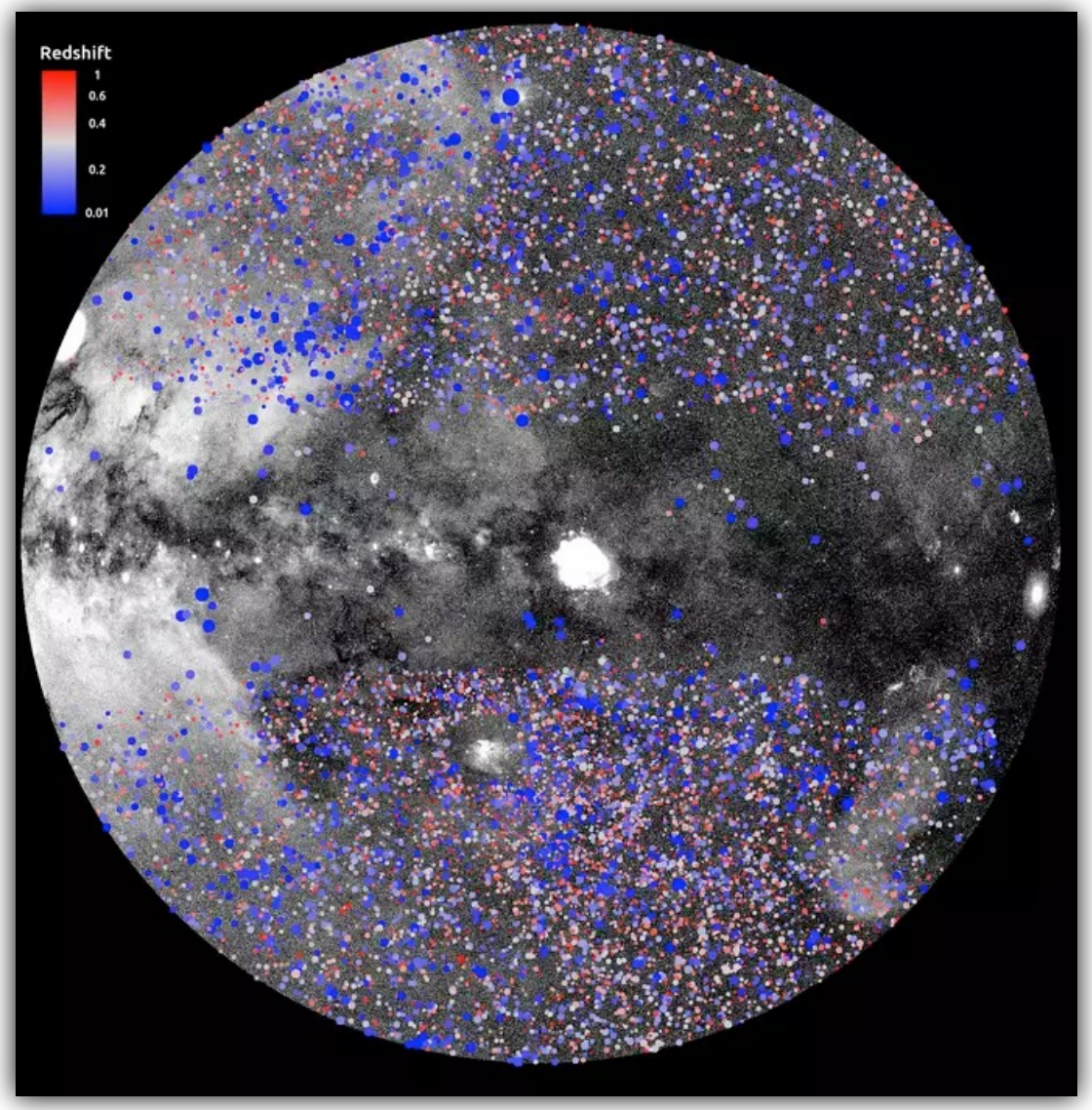
- eRASS1 (less SWXC contaminated) study of the diffuse soft X-ray background (SXRB): Local Hot Bubble
- North-South temperature difference and gradient towards low latitudes
- 3D map of the local hot bubble, constructed from emission measure assuming constant density



M. C. H. Yeung+2024

Galaxy clusters and groups in eRASS1

- Primary sample (L_{ext}>3):
  - Total effective area: 13.1k deg^2
  - 12,247 clusters with redshift measurements
  - 86% purity
- Weak lensing survey coverage
  - DES, HSC, and KiDS surveys
  - Coverage: 4968 deg^2



E. Bulbul+2024, A. Liu+2024, M. Kluge+2024

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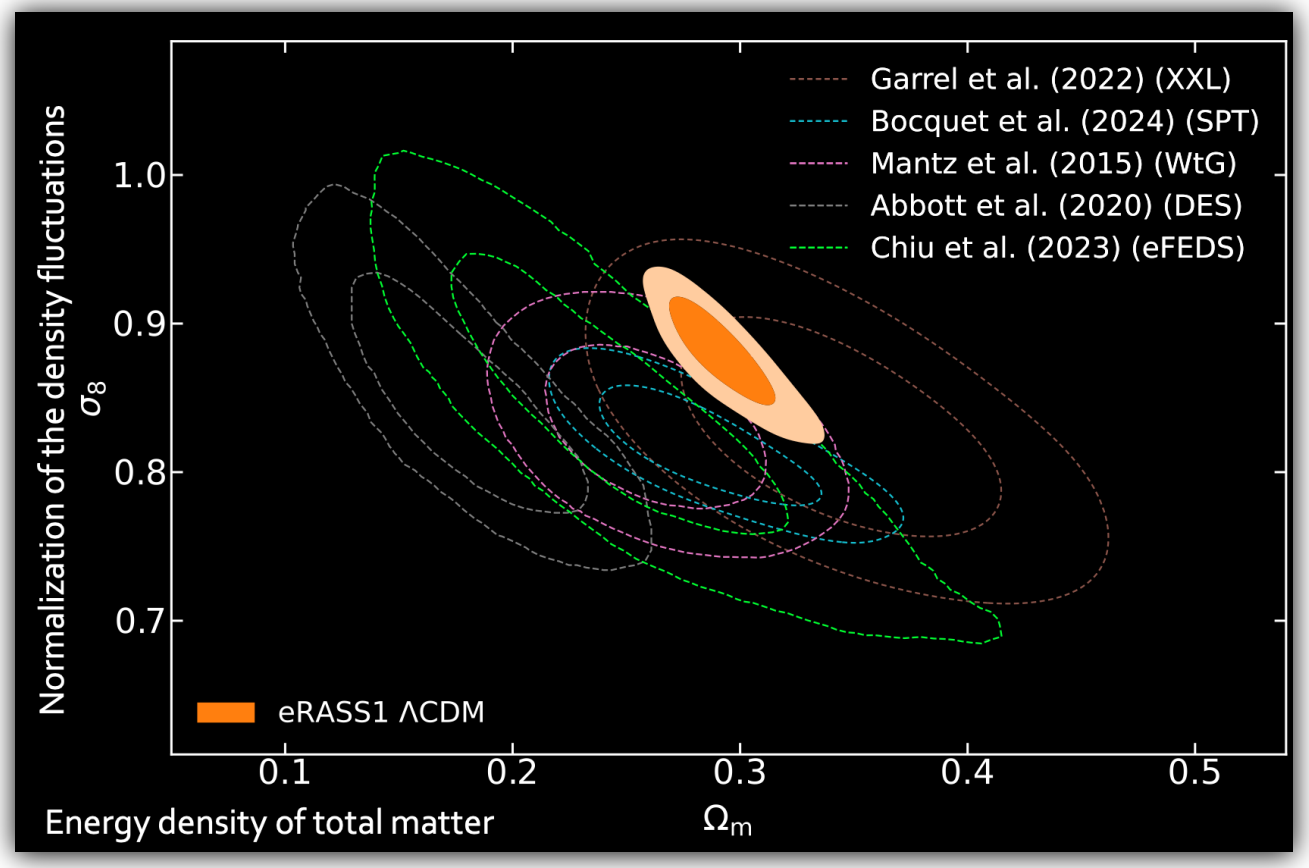
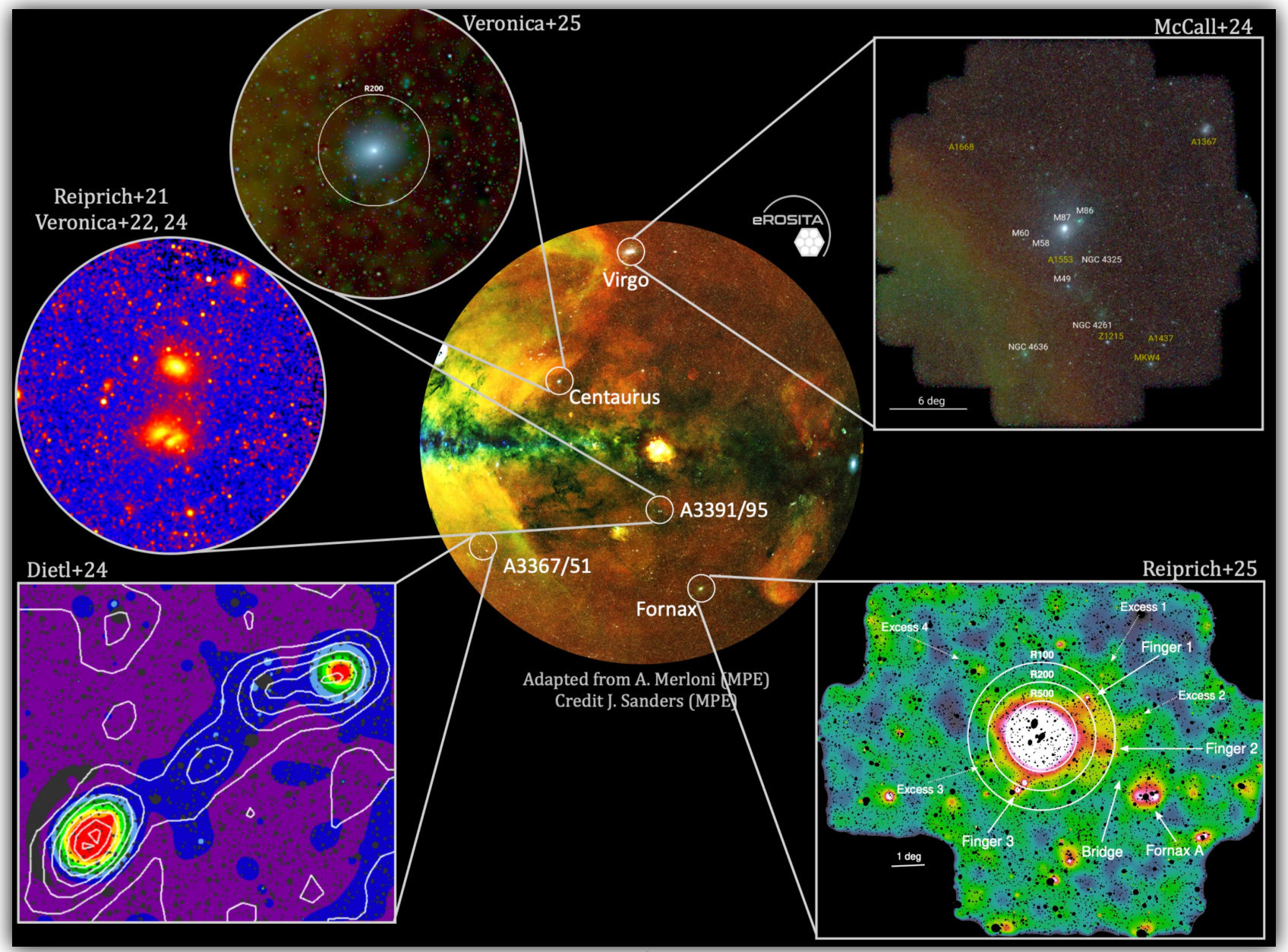


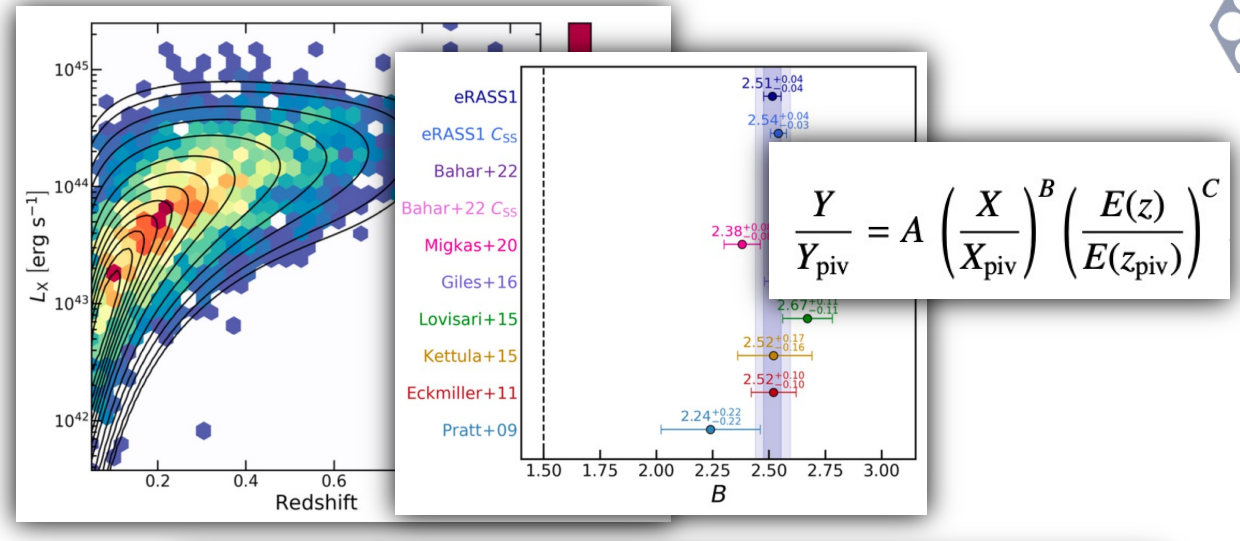
E. Bulbul+2024, A. Liu+2024, M. Kluge+2024

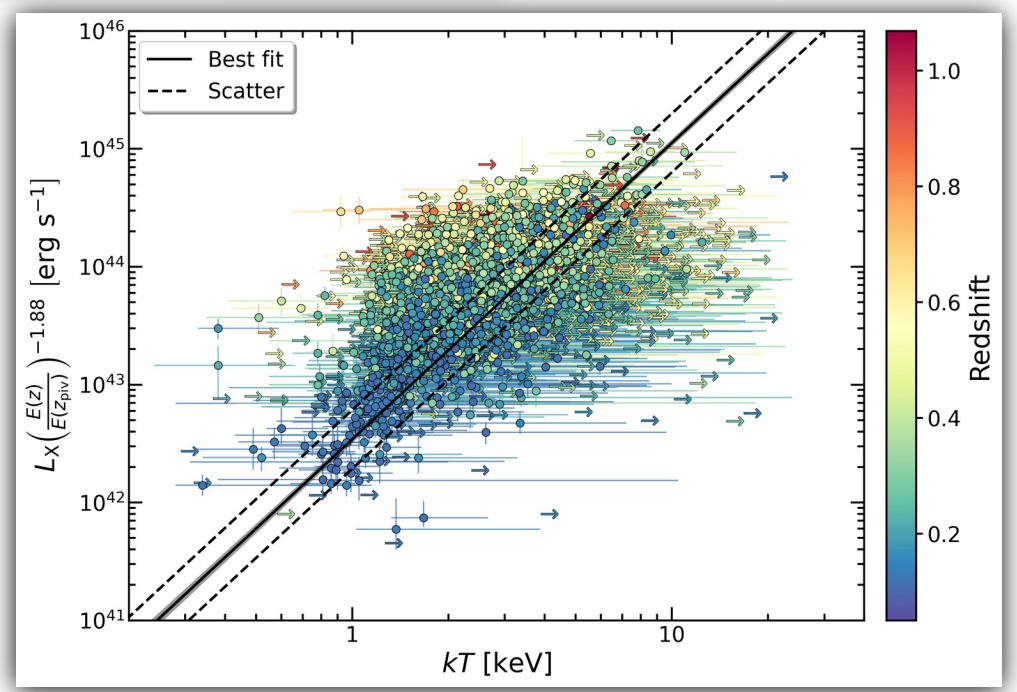
eROSITA results on individual galaxy clusters



X-ray scaling relations of galaxy groups and clusters

- 3061 galaxy groups and clusters from eRASS1
- Redshift range: 0.05 – 1.07
- Mass range: 1.1×10^{13} – 1.6×10^{15} $M_\odot$
- Selection effects fully modeled using simulations
- L_X–T, L_X–M_{gas}, L_X–Y_X, and M_{gas}–T
- Scaling relation slopes deviate from self-similar predictions
- Redshift evolution matches self-similar expectations



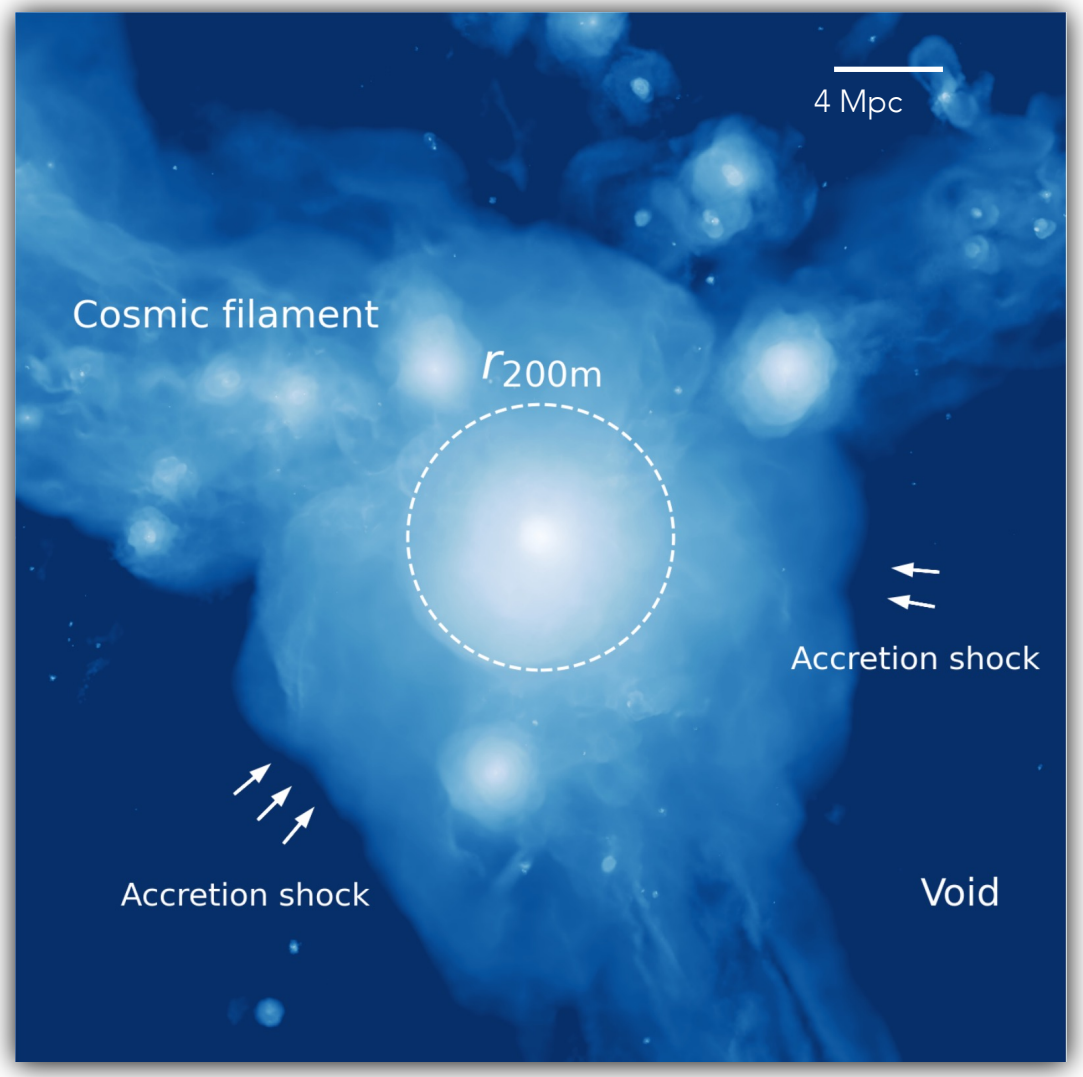


M. E. Ramos-Ceja, L. Fiorino+2025 (A&A submitted)

Detection of baryons beyond the virial radius

- Distribution of shock-heated gas from the outskirts of galaxy clusters into the large-scale accretion regions

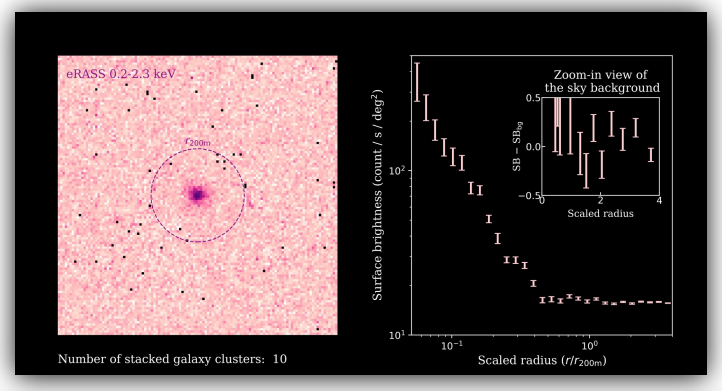
- eRASS:4 data, high-fidelity imaging of nearby structures
- Stacking of 680 massive clusters ($M_{500} > 10^{14}$ M) at $0.03 < z < 0.2$
- ~3M total photon counts

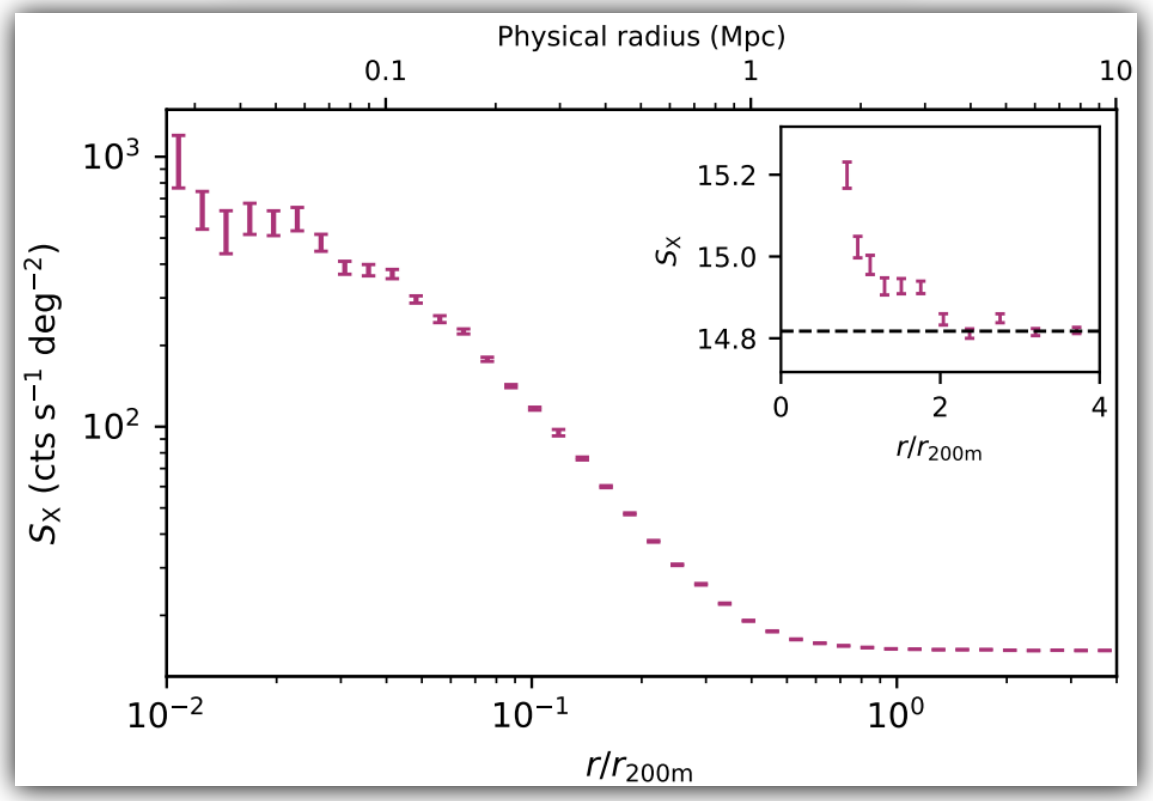


X. Zhang+2026

Detection of baryons beyond the virial radius

- Cluster outskirts & emission:
  - Extended to ~4.5 Mpc ($2R_{200m}$): 12σ
  - Baryon overdensity: Δ = 30
  - Transition Radius (R_{200m}): 40% of emission originates from filaments or unresolved haloes
  - Help to disentangle feedback models
  - Gas mass fraction is reduced if residual clumping is added

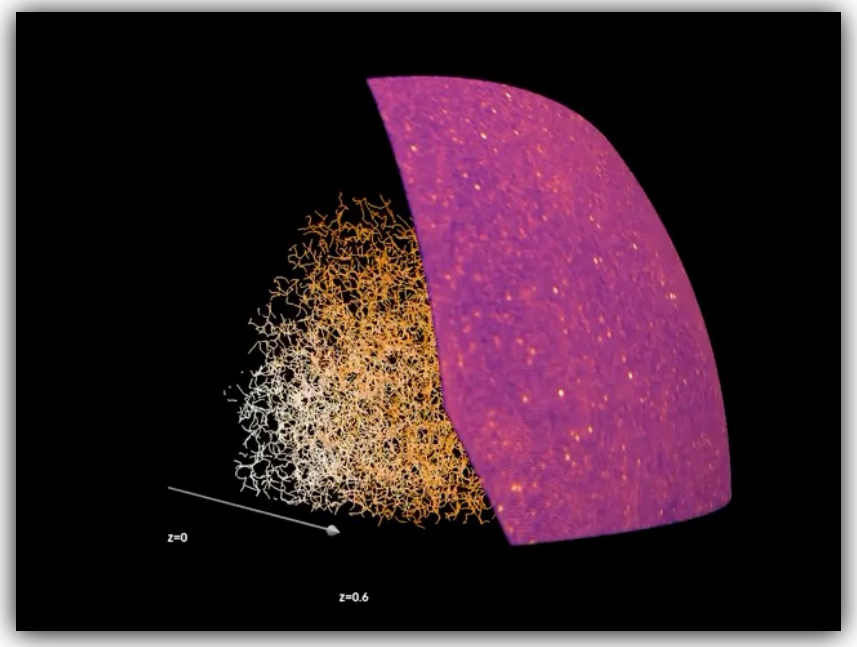


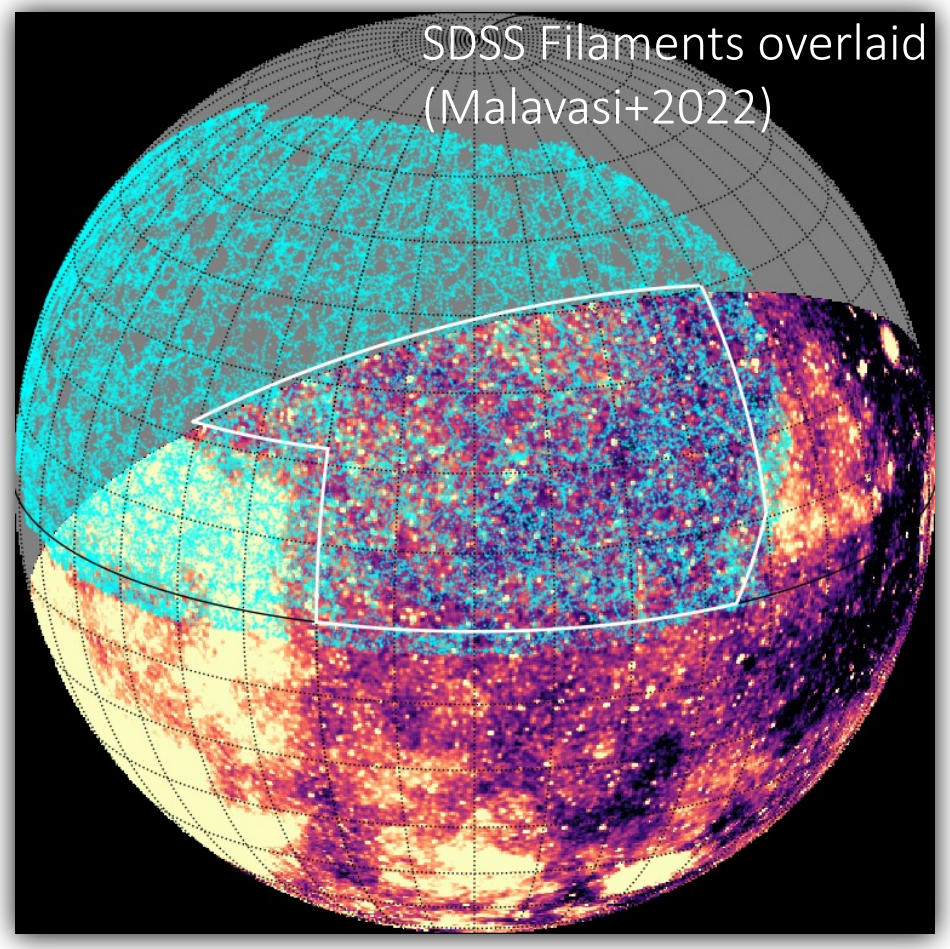


X. Zhang+2026

X-ray emission from the warm-hot phase gas in long cosmic filaments

- The elusive warm-hot intergalactic medium
- eRASS:4 data
- 7817 filaments stacked in $0.2 < z < 0.6$ (from SDSS)
- Physical length $20\ \mathrm{Mpc} < l < 100\ \mathrm{Mpc}$

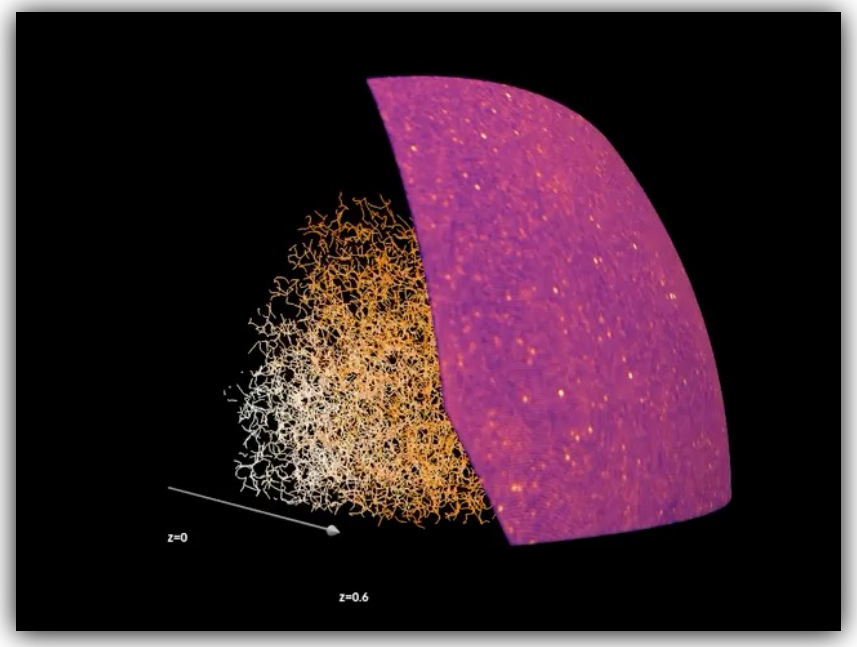


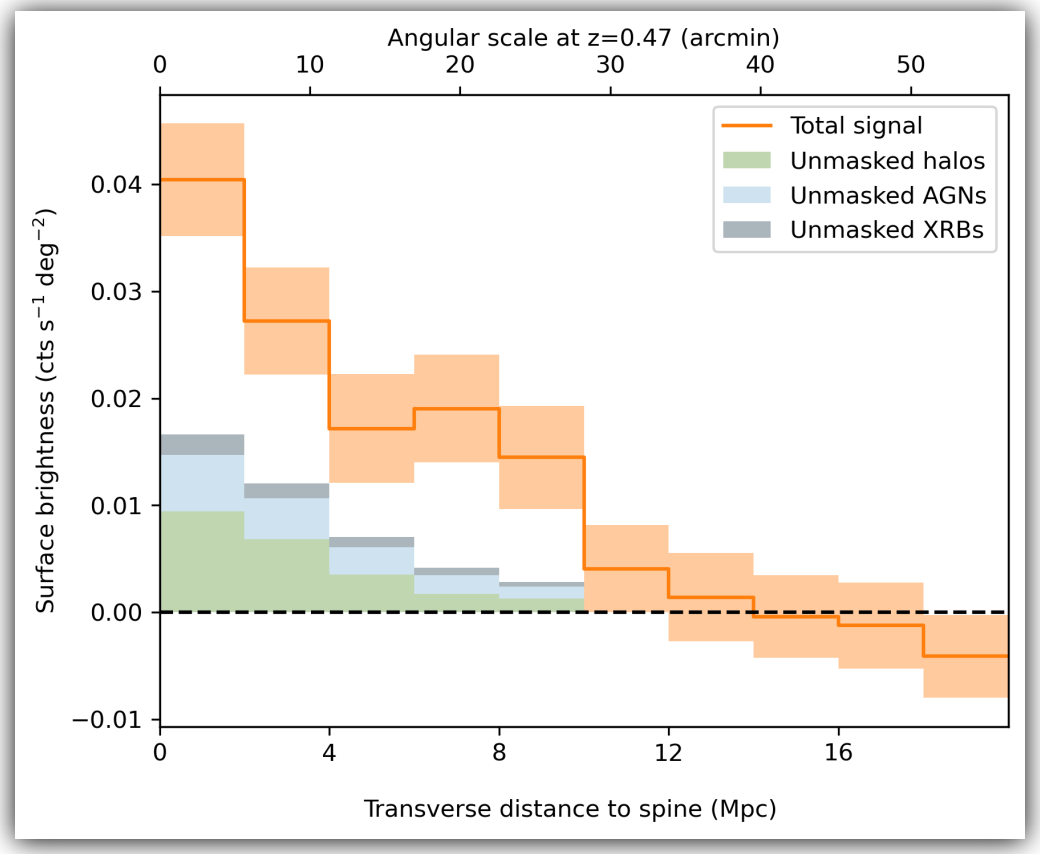


X. Zhang+2024

X-ray emission from the warm-hot phase gas in long cosmic filaments

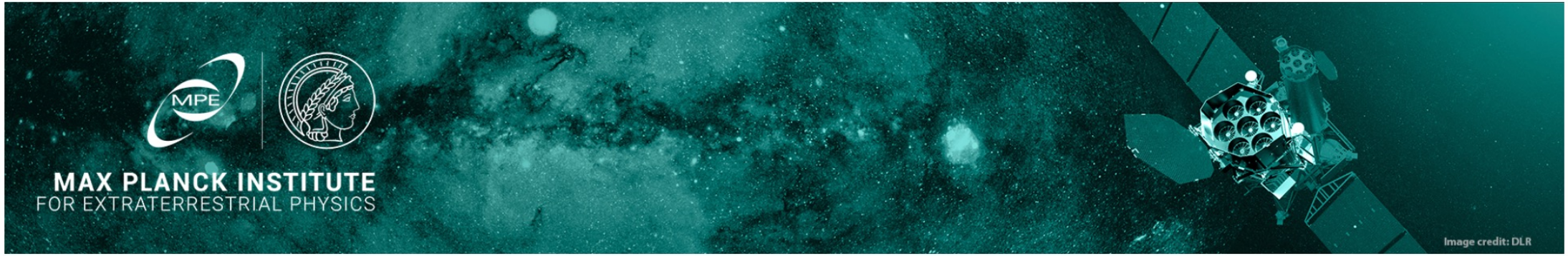
- Stacked 9σ detection of WHIM (0.3–1.2 keV)
- ~40% could be contamination from unmasked sources
- ~60% from the hottest and densest part of the WHIM
- 5.4σ detection of WHIM





X. Zhang+2024

eROSITA-DE publication list



eROSITA-DE Science Portal

Home | Public eROSITA site | Data Releases | Future releases | All-sky HiPS exposure maps | Publications | Team | Visibility tool | Clock | Internal pages

https://erosita.mpe.mpg.de/

2026

Yeung, M. C. H., et al., The SRG/eROSITA diffuse soft X-ray background II. spectra and morphology of the eROSITA bubbles in the western Galactic hemisphere, A&A, submitted (2026).

Sbarrato, T., et al., BLAZ4R and the eROSITA view of z>4 blazars, A&A, submitted (2026).

Buchner, J., et al., A large population of over-massive black hole quasars at z=0.3-0.8 revealed by eROSITA, A&A, submitted (2026).

Ota, N., et al., Bulk and turbulent gas motions in the interacting galaxy cluster Abell 3395 South observed with XRISM, PASJ, submitted (2026).

Gatuzz, E., et al., Probing habitable regions with SRG/eROSITA, A&A, submitted (2026).

Qi, N., et al., Investigating central star formation in local AGN host galaxies: is there tension between coeval growth and AGN feedback?, A&A, accepted (2026).

Markowitz, A., et al., A Changing-Look Seyfert Discovered by eROSITA Reveals a Two-Component Broad-Line Region, A&A, accepted (2026).

Zheng, X., et al., The average X-ray spectrum of the volume-complete M-, F-, G-, and K-type star sample within 10 pc of the Sun, A&A, 709, 275A (2026).

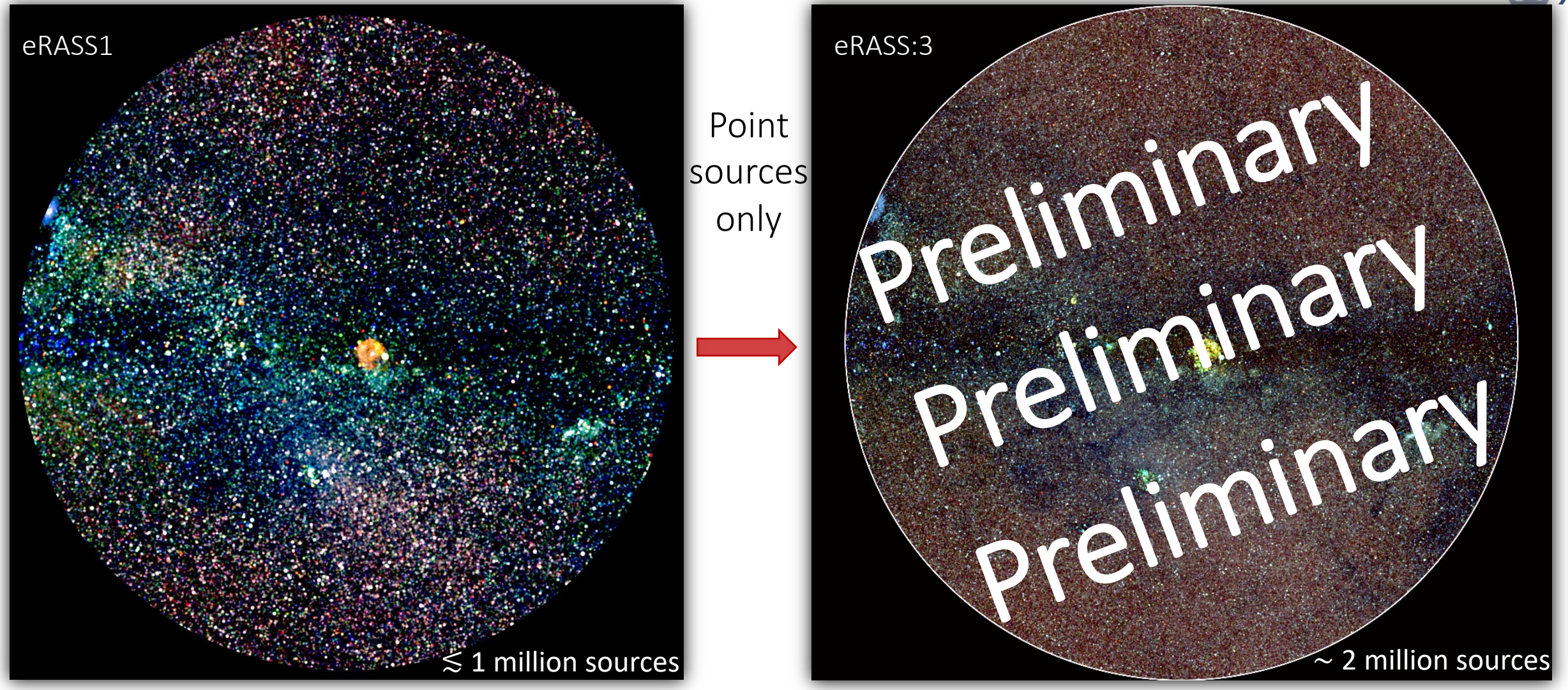
Zheng, Y.-L., et al., Unveiling the Sources of X-Ray Luminosity in DESI Galaxy Groups: Insights from the SRG/eROSITA All-sky Survey, ApJ, 997, 111 (2026).

Zhang, X., et al., The SRG/eROSITA All-Sky Survey. Detection of shock-heated gas beyond the halo boundary into the accretion region, A&A, 709, 72A (2026).

Haemmerich, S., et al., BlazEr1: The eROSITA Blazar Catalog. Blazars and Blazar Candidates in the First eROSITA Survey, A&A, 709, 37A (2026).

Dennerl, K., et al., Determination of the Solar System contribution to the soft x-ray sky, Science, 392, 285 (2026).

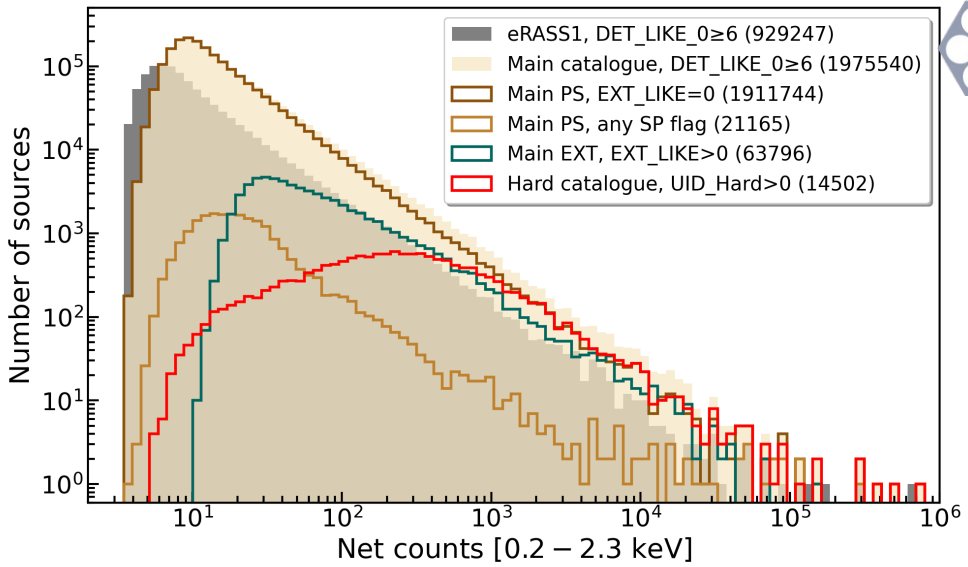
eROSITA-DE Data Release 2 (DR2)

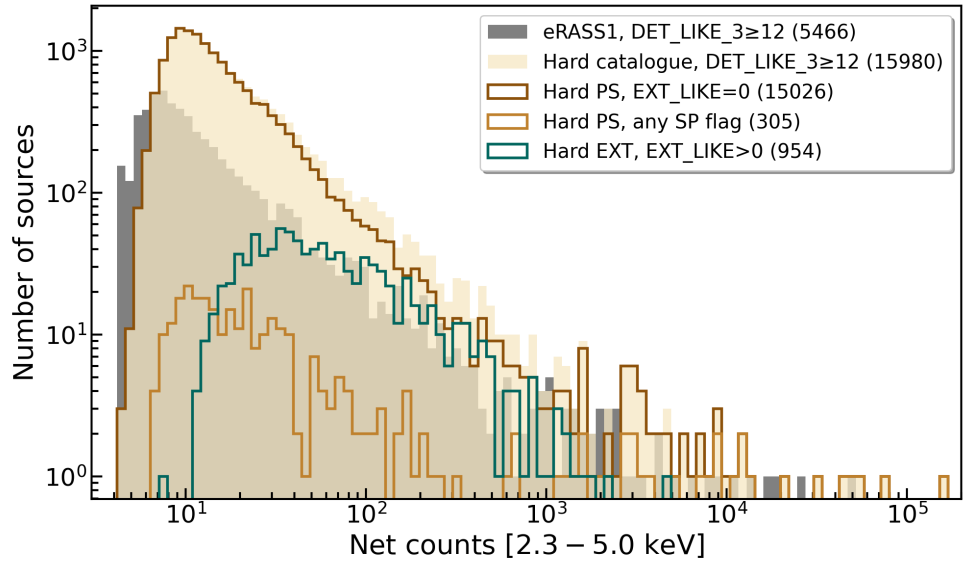


M. E. Ramos-Ceja+2026 (A&A submitted)

Data Release 2 (DR2)

- Based on eRASS:3 data (1.5 years of observations).
- **Only** X-ray catalogues are released:
  - Main catalogue (0.2–2.3 keV): ~2 million sources (~1.9M point-like, ~64k extended).
  - Hard catalogue (2.3–5.0 keV): ~15,000 sources.
- Extensive comparisons with eRASS1, 2RXS, 5XMM and CSC 2.1.
- Additionally:
  - Six catalogues that identify and classify the optical and infrared counterparts of the point-sources (LS10, CW20, GDR3).
  - Majority of identified sources are extragalactic.





M. E. Ramos-Ceja+2026 (A&A submitted)

Summary

- X-ray astronomy plays a fundamental role in exploring the Universe by revealing both common and extreme astrophysical phenomena.
- eROSITA aboard SRG is the most powerful wide-field X-ray telescope developed to date. Since beginning operations in 2019, it has completed 4.4 all-sky surveys over more than two years of observations.
- Its large grasp, stable instrumental background, and regular observing cadence enable eROSITA to probe previously unexplored regions of X-ray parameter space.

Thank you for your attention!

(Credit: DLR)