Old novae in the eROSITA All Sky Survey

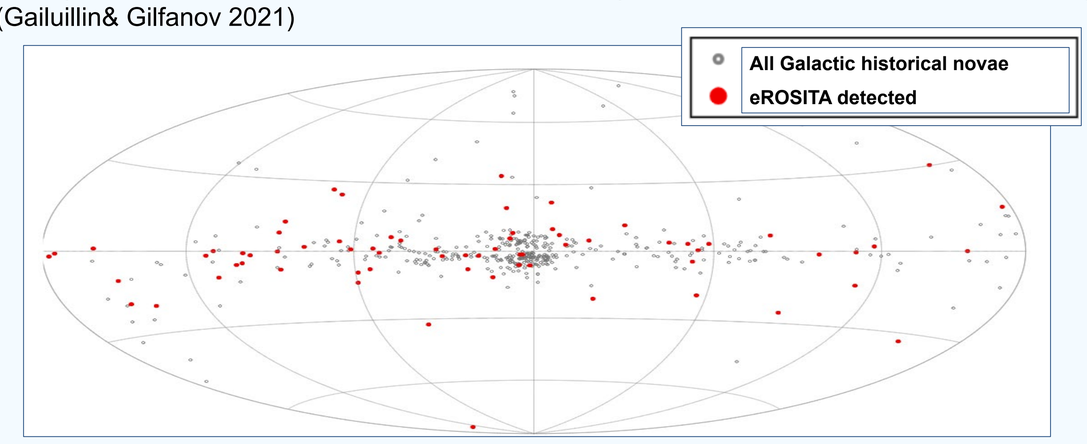
Glòria Sala (UPC-IEEC), Frank Haberl (MPE), Axel Schwope (AIP),
Elif Safak (UPC), Chandreyee Maitra (MPE), Jochen Greiner (MPE)

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

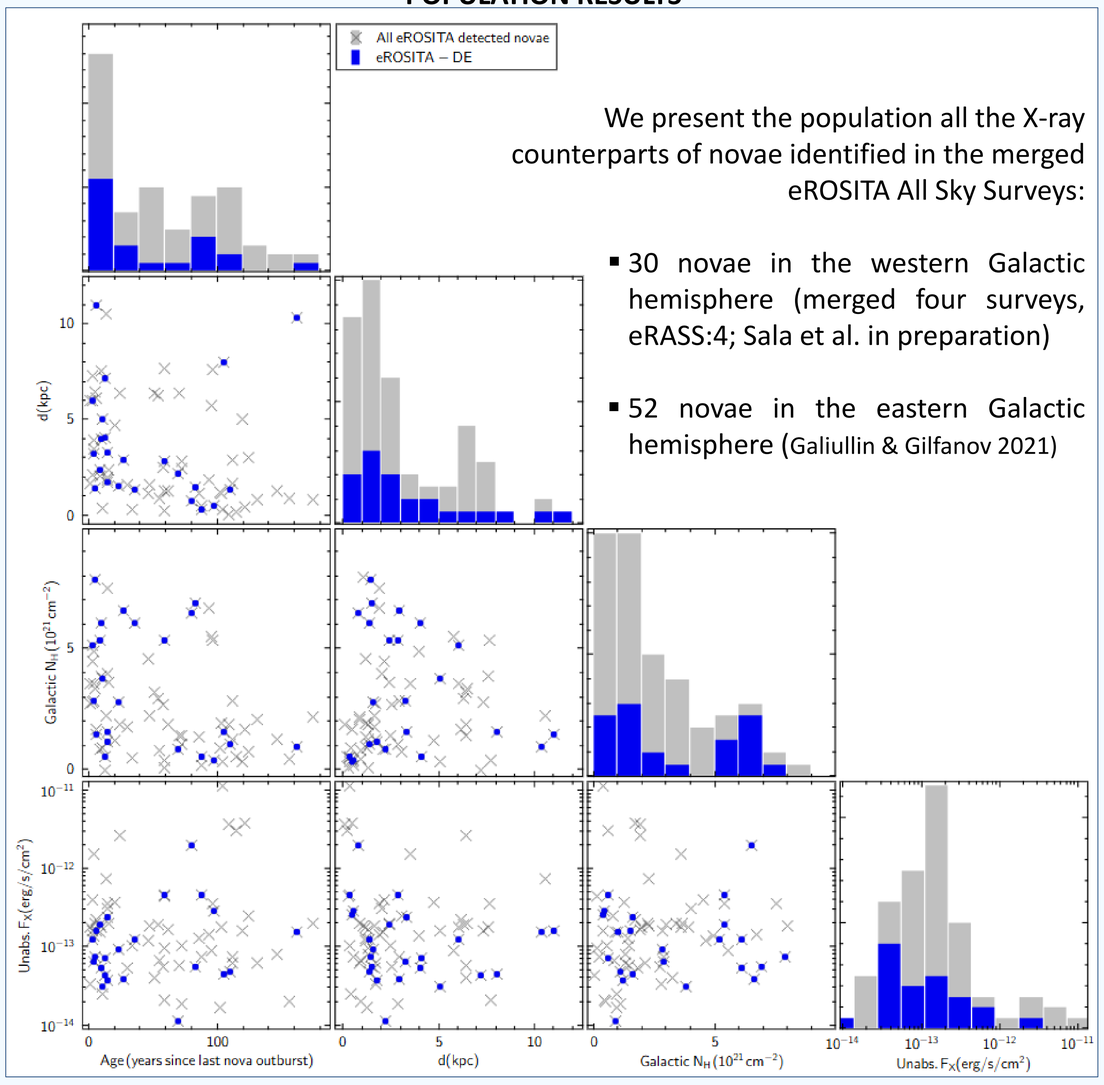
IEEC Institut d'Estudis Espacials de Catalunya

Nova explosions are thermonuclear events on top of an accreting white dwarf in a binary system. The nova event results in the increase of the optical luminosity by 7-8 orders of magnitude. That makes the nova outburst detectable at any distance in the Galaxy. However, due to the resulting distance distribution of novae, the host system remains unknown for most cases. Accretion powers X-rays in the host system once the mass transfer is resumed and the white dwarf starts to accrete again. We search for X-ray counterparts to old novae in the eROSITA All Sky Survey. A total of 30 old novae are identified in the western Galactic hemisphere, with 17 new detections in the X-rays of the historical novae. We analyze the properties of the historical novae population. We find that the fraction of X-ray detected hosts is 18%, with a deficit of detections towards the Galactic center due to absorption. Our sample shows that the accretion rate is enhanced after the nova outburst and decreases during the first decades. We identify AT Cnc as a new magnetic cataclysmic variable.

eROSITA scanned the whole sky four times between December 2019 to February 2022 (Predehl et al. 2021, Merloni et al. 2024). We search for X-ray counterparts of **all historical Galactic Novae** in the merged eROSITA All Sky Surveys (eRASS:4) of the western Galactic hemisphere. We combine our data with results reported for the eastern Galactic hemisphere (Gailuillin& Gilfanov 2021)

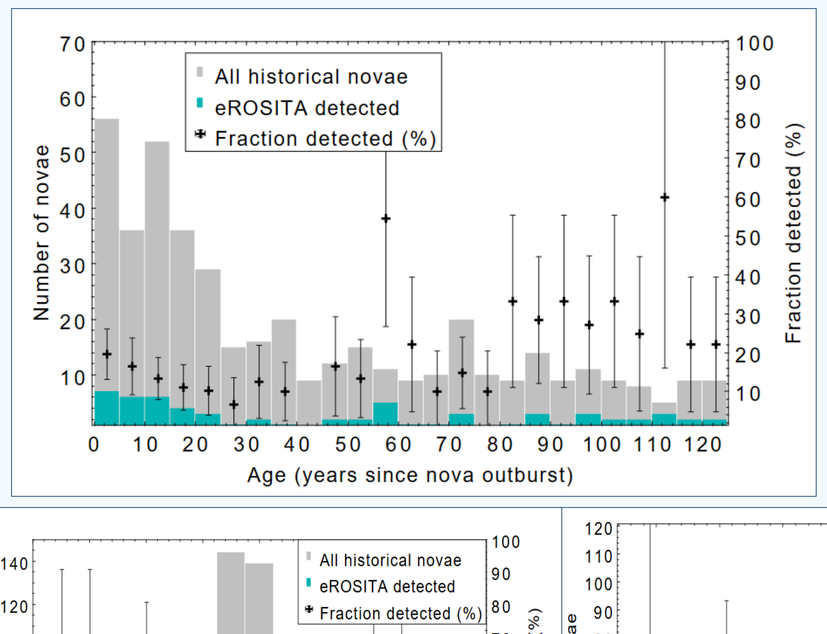


POPULATION RESULTS



We present the population all the X-ray counterparts of novae identified in the merged eROSITA All Sky Surveys:

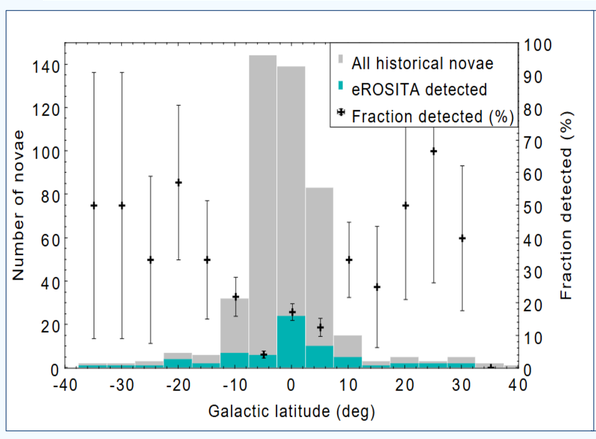
- 30 novae in the western Galactic hemisphere (merged four surveys, eRASS:4; Sala et al. in preparation)
- 52 novae in the eastern Galactic hemisphere (Galiullin & Gilfanov 2021)

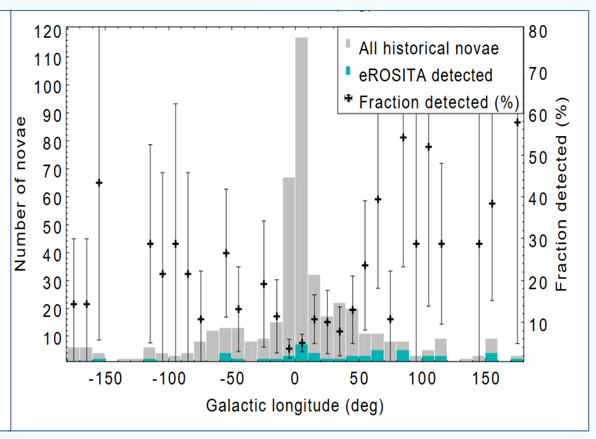


The total number of detected novae is about 18% of the total Galactic nova population.

The number and fraction of novae detected in X-rays decreases with time after outburst during the first decades.

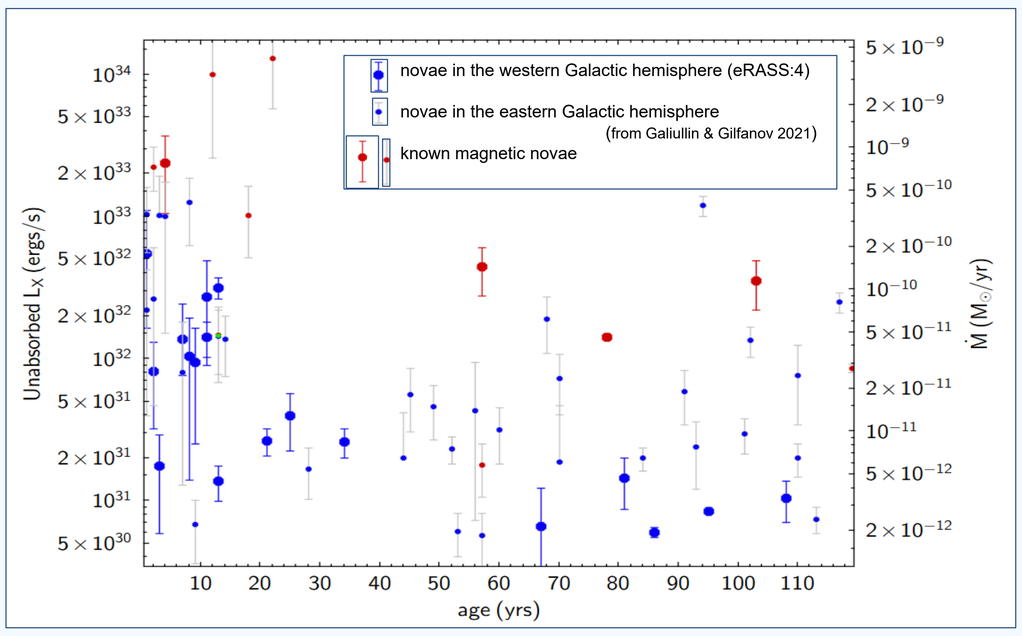
The fraction of X-ray detected novae is smaller towards the Galactic center and in the Galactic plane.



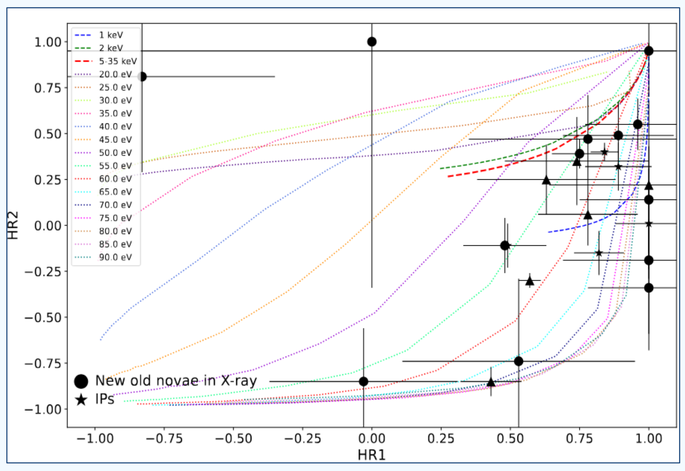


Evolution of the accretion rate after the nova outburst

With the distance and absorption known for all sources, we obtain the unabsorbed X-ray luminosity, a direct indicator of the accretion rate of each nova. We provide the first observational study of the evolution of the accretion rate as a function of time after the nova outburst. The accretion rate is higher in the first years after the nova outburst, due to an increased transfer rate from the expanded donor, irradiated by the nova outburst (as predicted numerically by Hillman et al. 2020). Magnetic systems are systematically brighter.



Hardness ratio

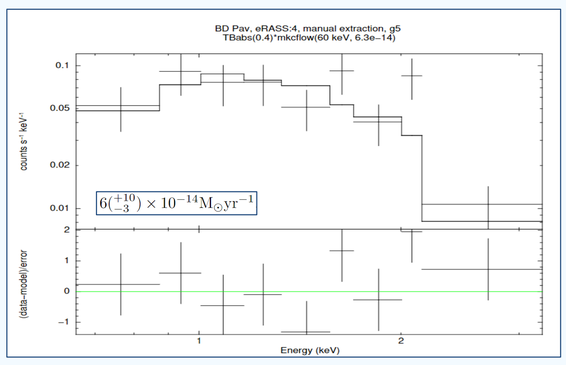


We plot our detections in the hardness ratio plot and compare with simulated paths for only thermal plasma emission (dashed lines) or plasma plus soft excess (dotted lines) with increasing absorption column from left to right (from 10^{20} to $2\text{x}10^{22}$ cm^{-2}). The absorption column can hide the soft excess in the hardness ratio plot, so magnetic systems (labeled as IPs in the plot) do not occupy a specific region in the hardness ratio plane.

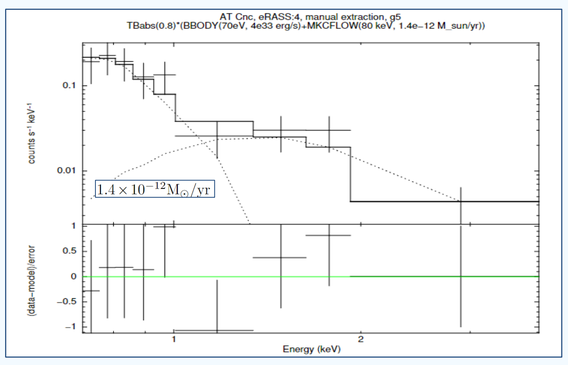
HR1=(P2-P1)/(P2+P1); HR2=(P3-P2)/(P3+P2); P1: 0.2-0.5 keV, P2= 0.5-1.0 keV, P3=1.0-2.0 keV

Spectral results of selected sources: BD Pav and AT Cnc: two new X-ray old novae

Several sources have enough statistics for spectral analysis. We fit their spectra with an absorbed cooling flow model (mkcflow) plus a blabkbody when soft excess is present, suggesting the magnetic nature of the white dwarf. Most known sources show spectra and fluxes compatible with previous detections. Here we present two new X-ray detected old novae:



BD Pav (Nova Pav 1934)
First reported X-ray detection of the host CV, no soft excess, i.e., no indication of magnetic system.



AT Cnc (Nova Cnc 1700)
First X-ray detection of the host CV, soft excess suggesting a magnetic system.

REFERENCES
Hillman et al. 2021, Nature Astronomy, 4, 886
Galiullin & Gilfanov, 2021, Astronpomy Letters 47, 587
Merloni et al. 2024, Astronomy & Astrophysics, 682, A34
Predehl et al. 2021, Astronomy & Astrophysics, 647, A1

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