The impact of Roman on accurate X-ray source classification

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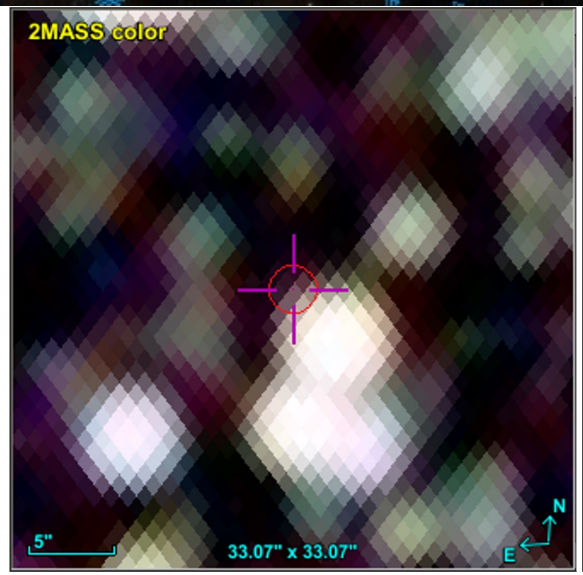
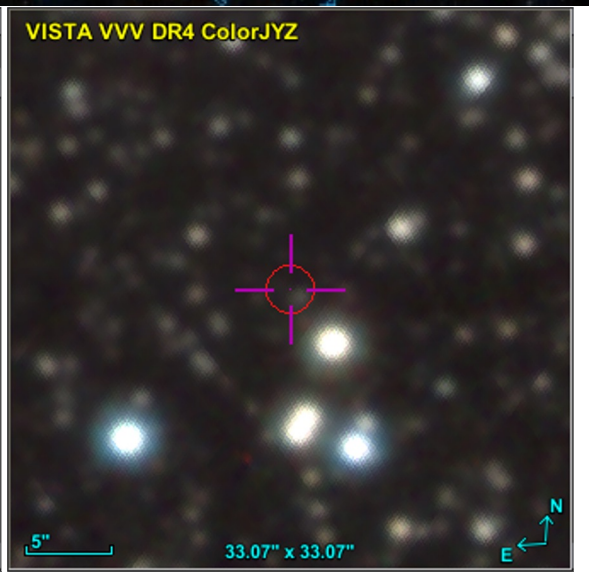
Background

X-ray catalog	Sources within Galactic Plane (|b|<2)
Chandra Source Catalog v2.1 (Evans et al. 2024)	86957
5XMM-DR15 (Webb et al. 2020)	100001
Living Swift-XRT Point Source (Evans et al. 2023)	56753
eRASS1 (Merloni et al. 2024)	21600

- Among them are quiescent black hole low mass X-ray binaries (microquasars) which are associated with PeV LHAASO sources, high-mass gamma-ray binaries, millisecond pulsars which may be responsible for e+/e- annihilation line emission near the galactic center, and ultra-compact X-ray binaries which are expected to be the dominant galactic source of Gravitational Waves for LISA.
- Many of these are faint in X-rays, hence establishing optical/IR counterparts (or the lack of thereof) is crucial for their accurate classification.
- Roman Galactice Plane Survey (GPS) enables <0.1” positional accuracy and depth down to ~23 mag.





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The MUWCLASS Pipeline and Performance

- The MUlti-Wavelength CLASSification (MUWCLASS, Yang et al. 2022) pipeline utilizes X-ray and multi-wavelength data to classify X-ray sources.
- The pipeline uses the random forest algorithm (Breiman 2001), a supervised machine-learning approach that requires a training dataset.
- The X-ray sources are matched to their multi-wavelength counterparts using the NWAY probabilistic crossmatching algorithm (Salvato et al. 2018).
- The MUWCLASS pipeline accounts for measurement uncertainty by sampling from the uncertainties in a source's features and performing multiple classifications.
- The MUWCLASS pipeline has been applied to ~66,000 Chandra sources across the whole sky (Yang et al. 2022), 1,206 Chandra sources within the extent of 73 4FGL gamma-ray sources (Yang et al. 2024), and source in stellar clusters (Chen et al. 2023, 2025).
- NIR magnitudes are critical for classification in the Galactic Plane as they are less impacted by absorption. The deep Roman GPS will help find faint counterparts not detected in more shallow surveys (e.g., 2MASS, VISTA VVV).