

Unveiling the Heart of the Milky Way:

New Chandra Survey of Central 4 x 6 degrees around Sgr A*

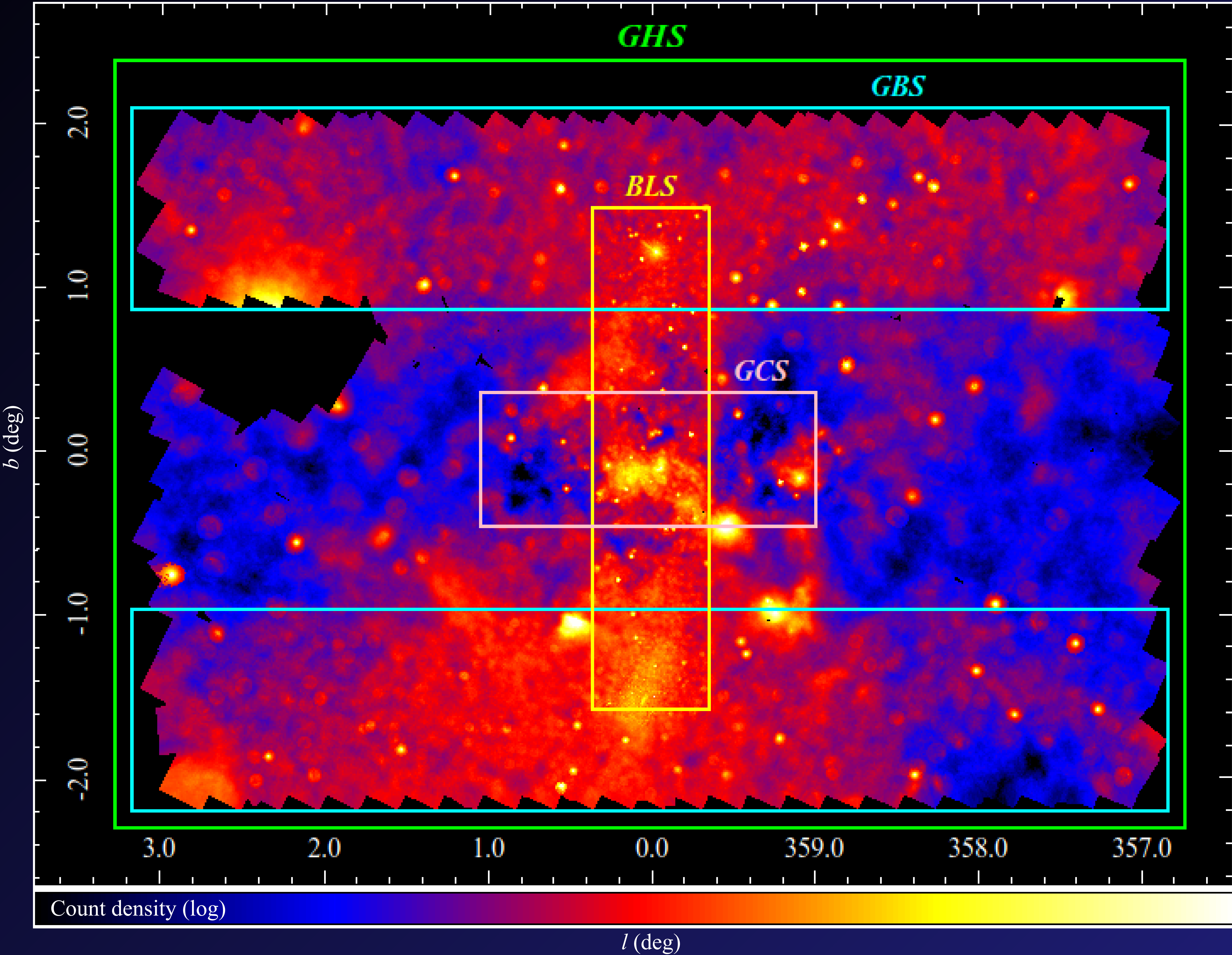
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Hi, I'm Harry, recent Columbia graduate and current Post-baccalaureate Researcher.

Come find me to chat!
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Figure 1: Chandra Observations Mosaic of Galactic Center



Galactic Heritage Survey (PI: Gabriele Ponti)

- 350 ~5 ks ACIS-I observations covering the central 4°x 6°
- 2.5× deeper coverage of previous Galactic Bulge Survey*¹
- Galactic Center diffuse X-ray background spurs “false” detections; likelihood estimates determines “real” sources

Scientific Implications

- Unprecedented coverage of region with highest X-ray source density in the sky
- Unexplored CV and LMXB populations beyond Sgr A*
- Multi-wavelength crossmatching, NIR color + X-ray hardness can differentiate source types
- Chandra's sub-arcsecond angular resolution necessary for cross-matching in the dense Galactic Center region

Figure 2: Classification of GHS Source Candidates

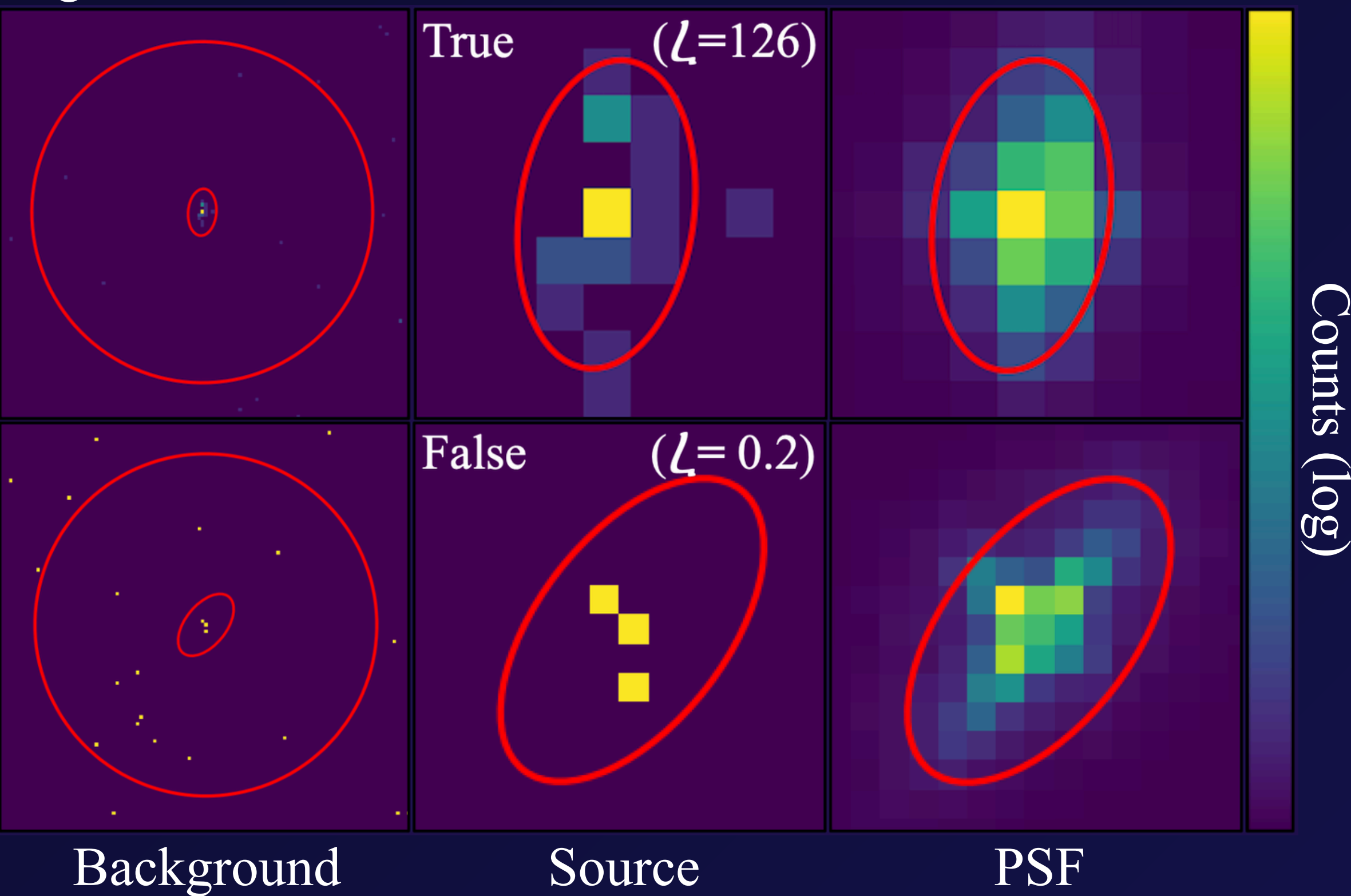


Figure 3: Source Detection and Classification Pipeline Flowchart

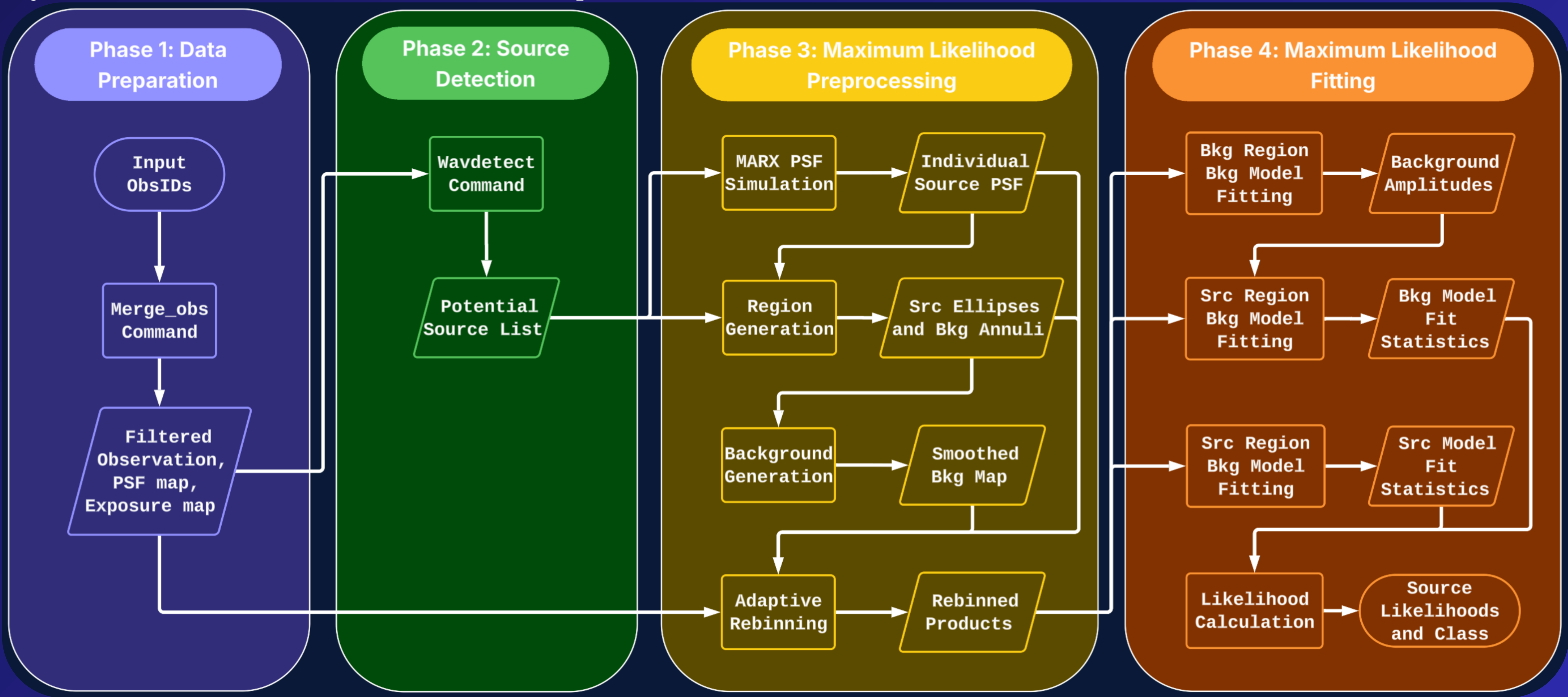
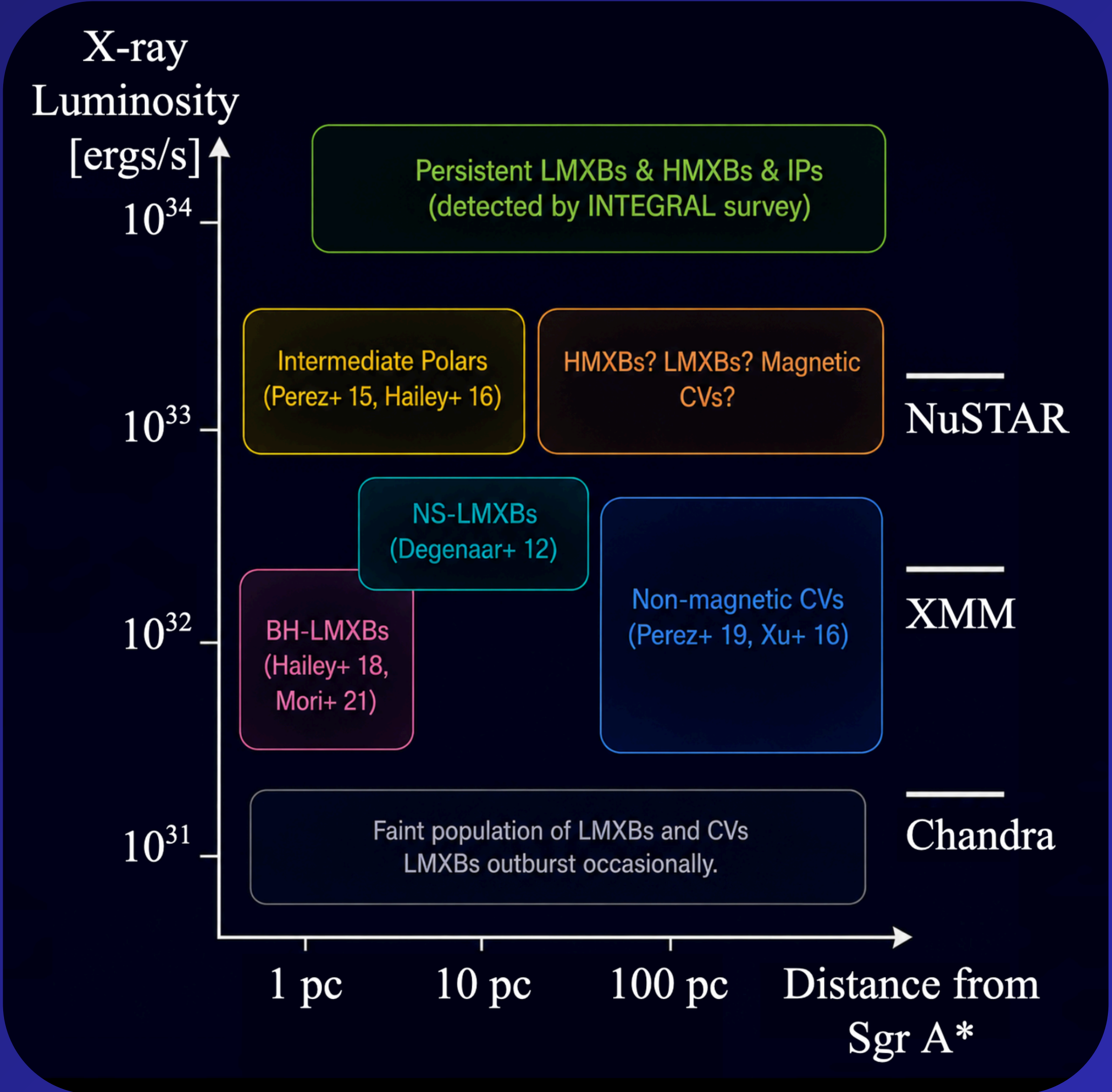


Figure 5: GC X-ray Source Populations



Preliminary Results

- 7151 source detections, 1578 high-likelihood sources with improved accuracy over CSC
- MARX simulation results:
 - Flux sensitivity 2×10^{-14} ergs/cm²/s (2-8 keV) for range of spectra
 - 95% detection rate for $FX > 4 \times 10^{-14}$ ergs/cm²/s (2-8 keV), < 7' off-axis

Future Work

- New pipeline to be released to the X-ray community as fully automated tool
- Full catalog publication expected end of 2026
- ML applications (training and validation) for next-generation X-ray data processing

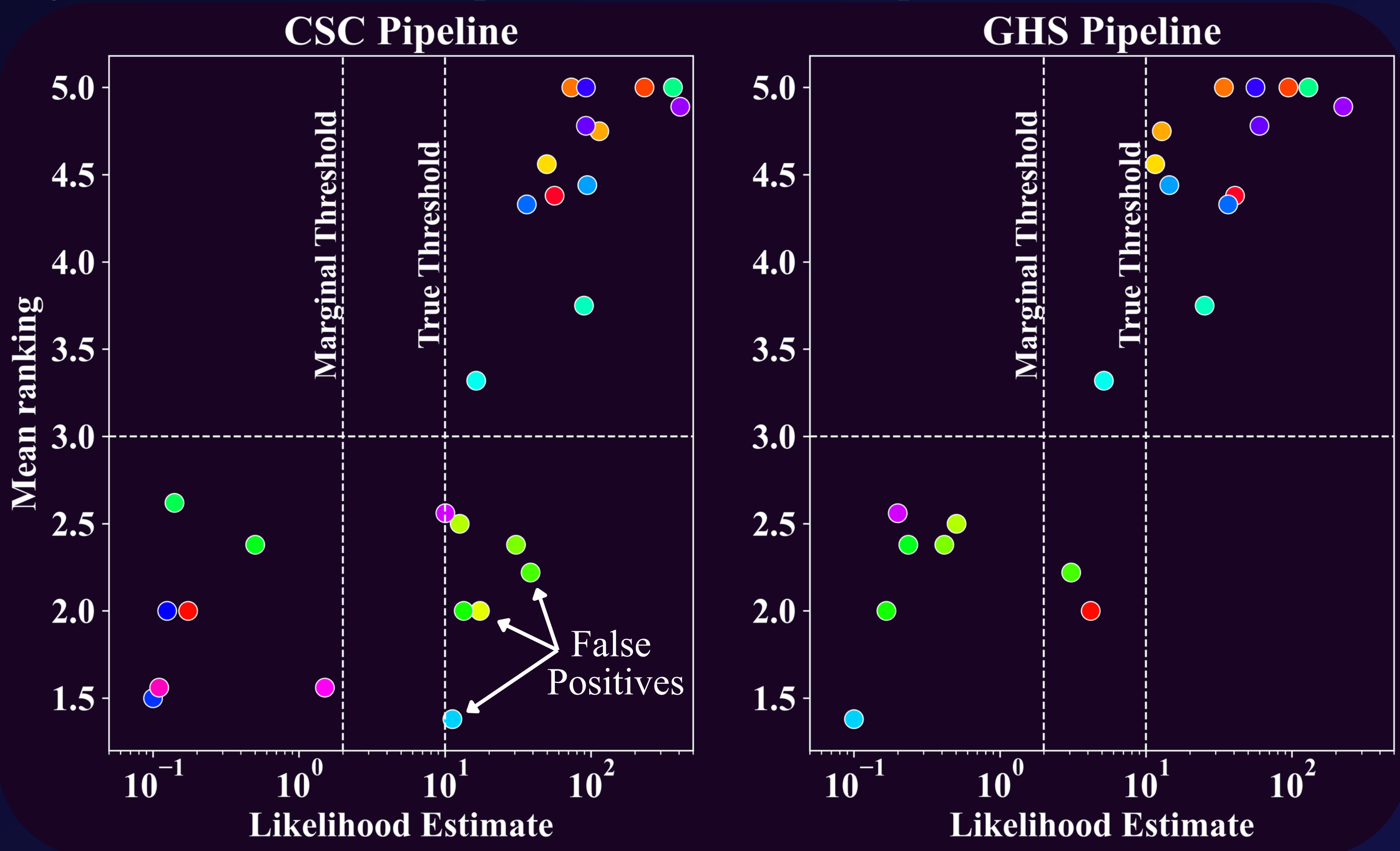
Novel Source Classification Pipeline

- Previous Galactic Center surveys: single-pass source identification with *wavdetect**²
- Chandra Source Catalog (CSC): preeminent source detection/classification pipeline
- Source class (true, false, marginal) based on likelihood L
 - Likelihood = $P(\text{true source})/P(\text{background fluctuation})$
- CSC pipeline is generalized for the entire sky
- Novel pipeline specialized for high-background, low-exposure ACIS-I observations where source identification is most difficult

Testing and Validation

- 10 astrophysicists visually ranked 60 GHS sources (1-5)
- 25 sources with high agreement compared against CSC and GHS pipelines (sources identified by color Fig 4.)
- GHS pipeline outperformed CSC in identifying “false positives”

Figure 4: CSC vs GHS Pipeline Likelihood Comparison



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References: *¹ Jonker, P. G., Bassa, C. G., Nelemans, G., et al. (2011). The Galactic Bulge Survey: Outline and X-ray Observations. The Astrophysical Journal Supplement Series, 194(2), 18. <https://doi.org/10.1088/0067-0049/194/2/18>;
*² Freeman, P. E., Kashyap, V., Rosner, R., & Lamb, D. Q. (2002). A Wavelet-Based Algorithm for the Spatial Analysis of Poisson Data. The Astrophysical Journal Supplement Series, 138(1), 185–218. <https://doi.org/10.1086/324017>