POS-10

A stacking search for gamma-ray emission from black hole X-ray binaries with LHAASO

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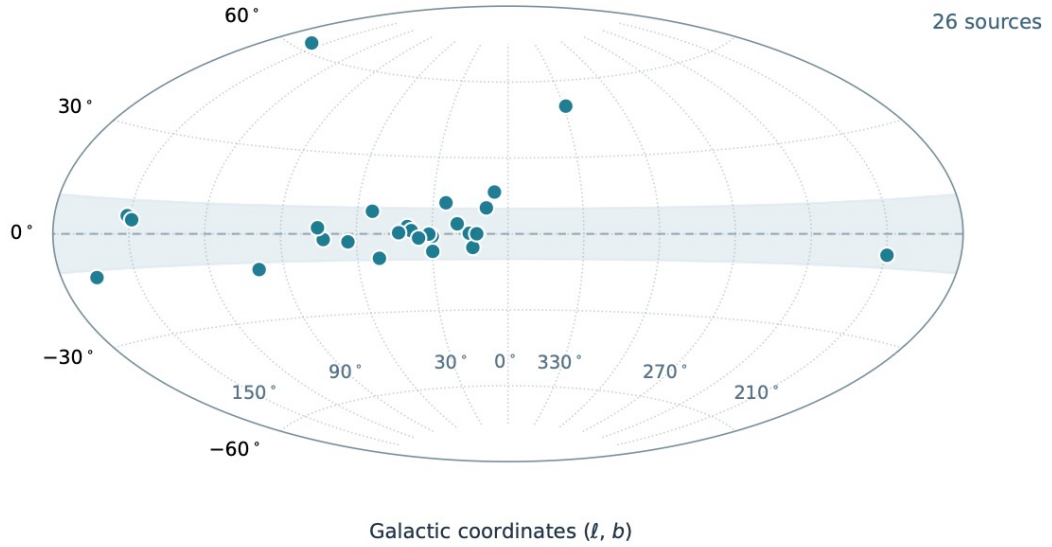
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Introduction

- Accreting stellar-mass black holes may contribute to the population of Galactic particle accelerators.
- Whether TeV–PeV gamma-ray emission is common in BHXRBs remains an open question.

Sample selection

- We select 26 BHXRBs and candidates from the catalogue compiled by Olivera-Nieto et al. (2026)
- The sample is restricted to the LHAASO observable sky region, with previously detected TeV gamma-ray systems excluded from our initial target list.



ANALYSIS METHODS

➢Individual-source Analysis

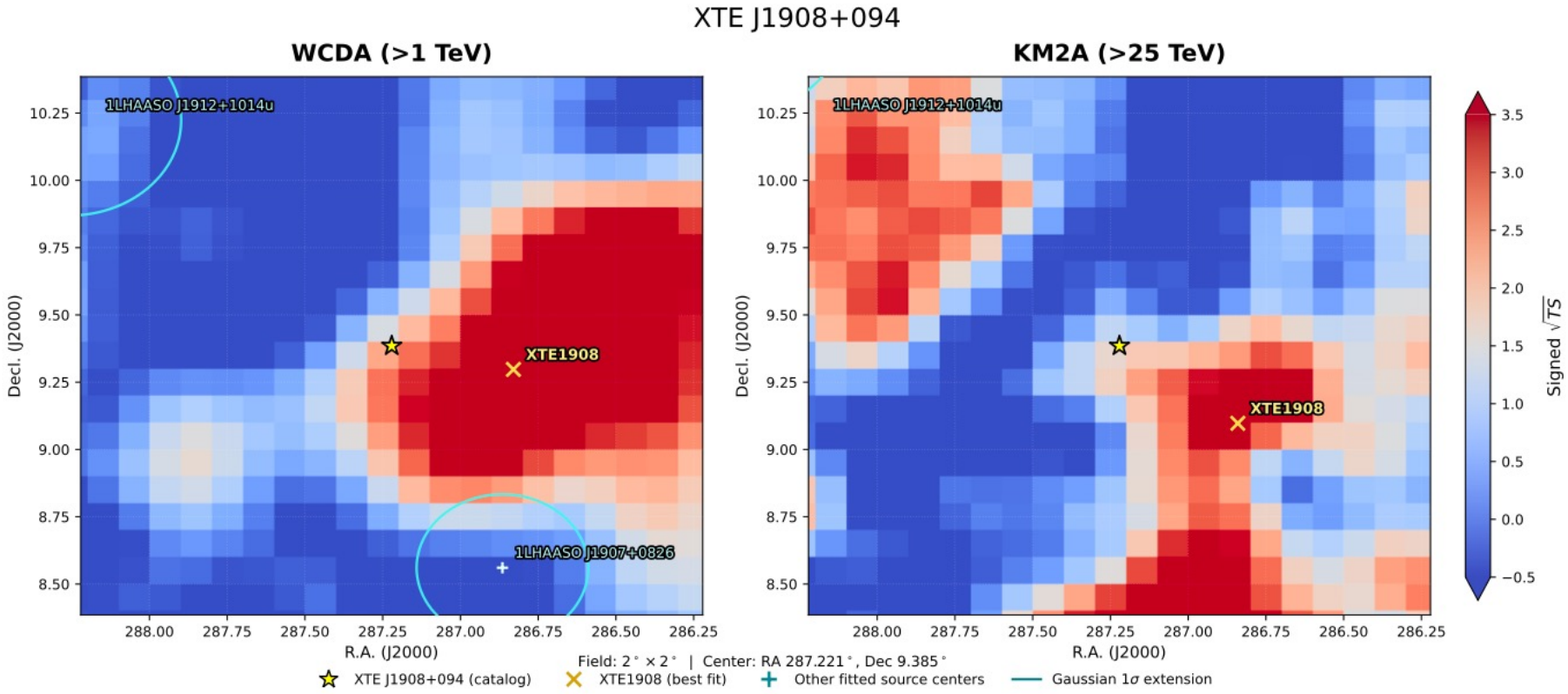
- All analyses are performed using Gammapy (v2.1), an open-source Python package for gamma-ray astronomy.
- We perform binned 3D maximum-likelihood analyses of LHAASO-WCDA (E > 1 TeV) and KM2A (E > 25 TeV) observations.
- The gamma-ray spectrum is modeled as a power law.

➢ Likelihood Stacking Analysis

- To search for collective gamma-ray emission from individually undetected sources, we combine their Likelihood functions.
- We adopt three weighting schemes: equal weights, X-ray-flux weights, and radio-flux weights, with GRS 1915+105 as the reference source.

Results

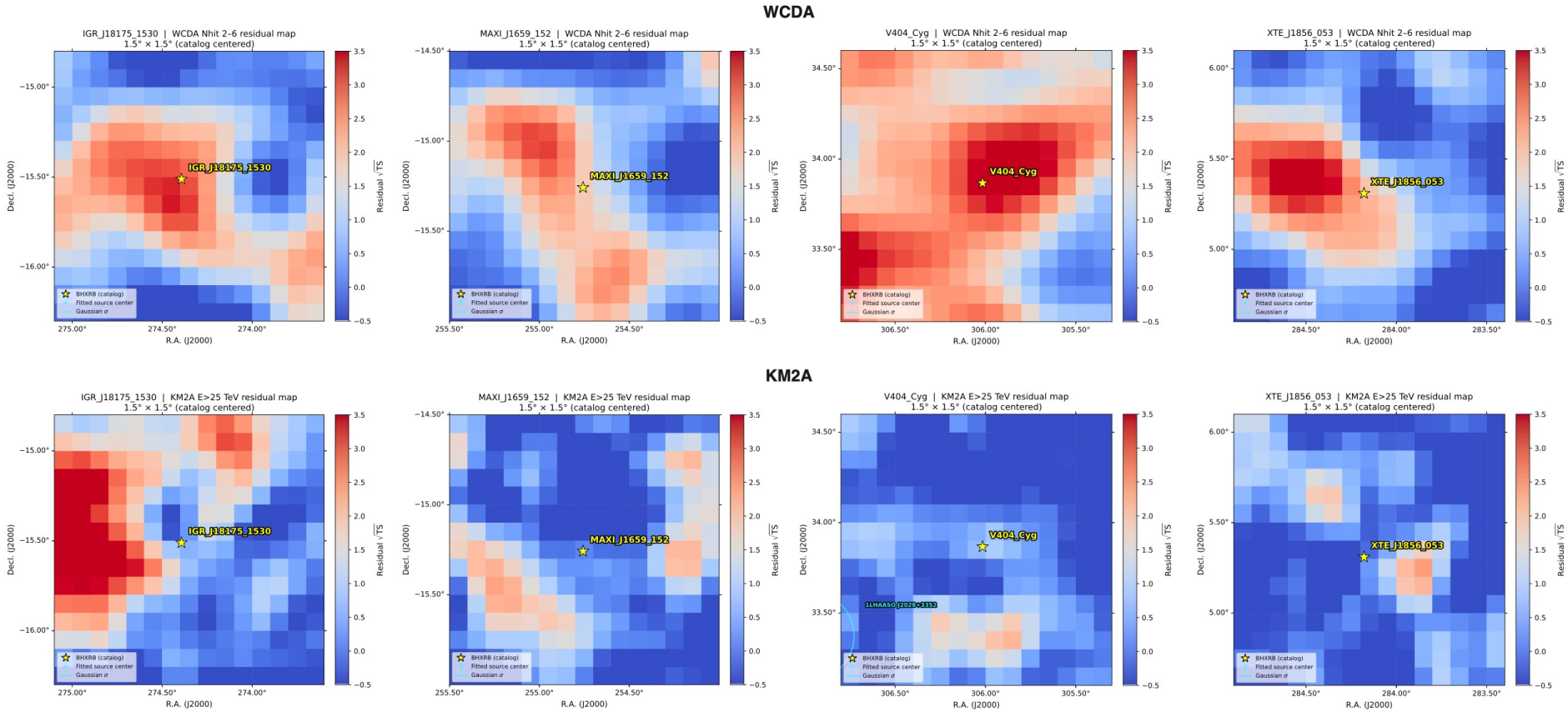
- Gamma-Ray Excess near XTE J1908+094



A gamma-ray excess with a local significance of approximately 5σ is found in the vicinity of XTE J1908+094.

Results

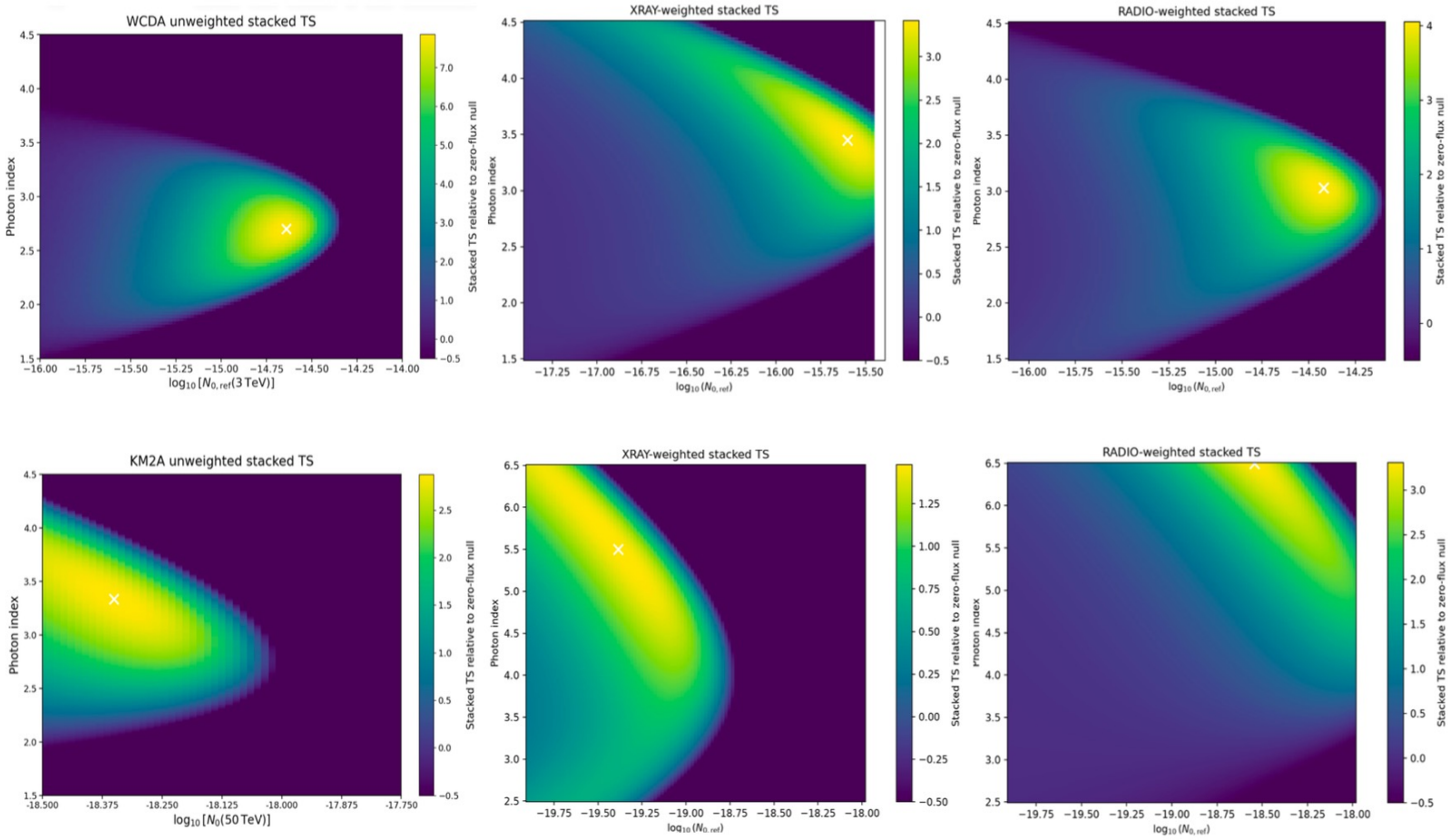
➢ Residual Maps of Selected Sources



We also present residual significance maps around four selected BHXRBs to illustrate their local gamma-ray environments in the WCDA and KM2A data.

Results

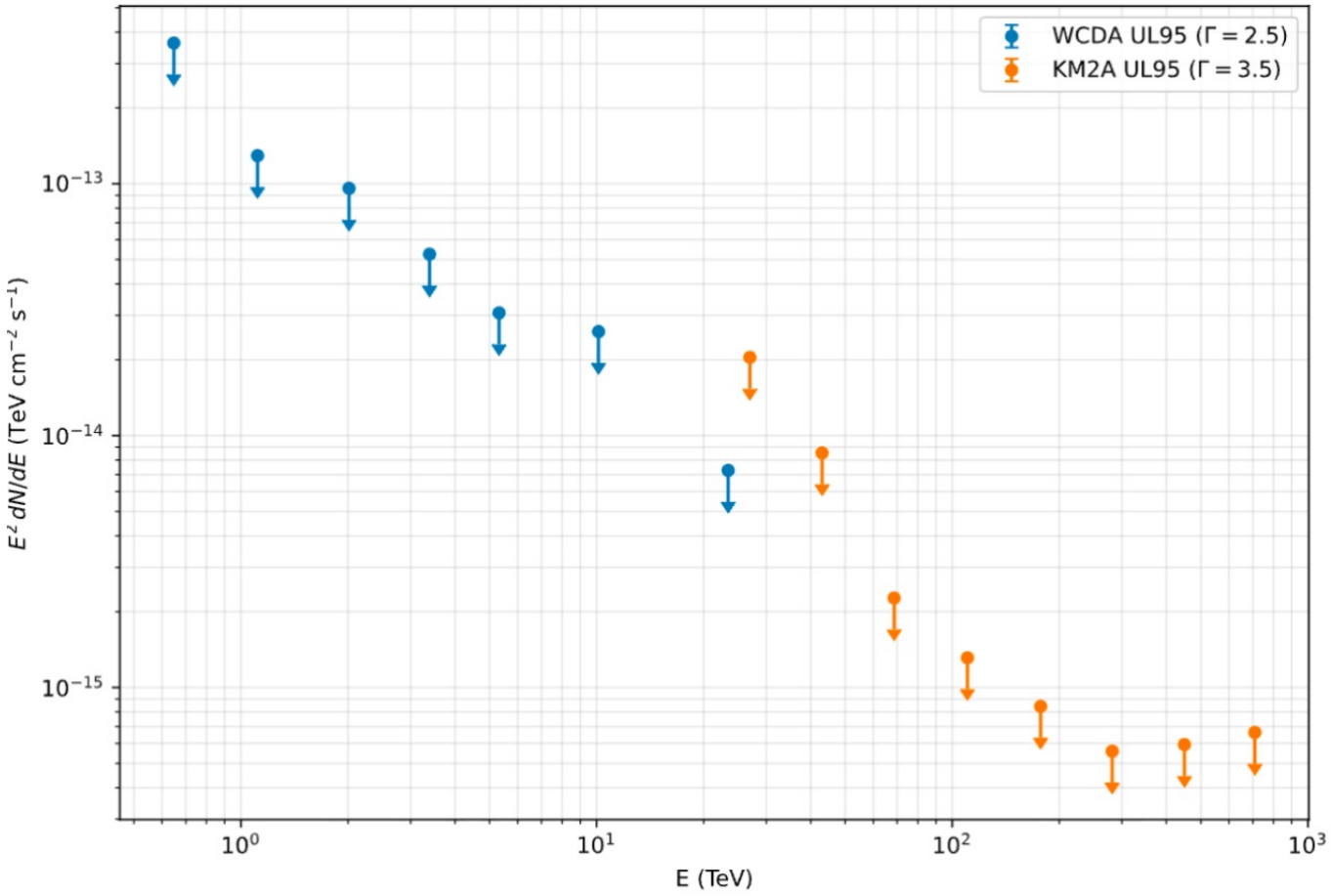
➢ Stacking Analysis Results



Two-dimensional stacked TS profiles as functions of the flux normalization and photon index. The results from three weighted schemes show that No statistically significant collective gamma-ray emission is detected in either the WCDA or KM2A data.

Results

- Gamma-ray Flux Upper Limits



95% CL differential gamma-ray flux upper limits obtained from the unweighted stacking analysis with LHAASO-WCDA (blue) and KM2A (orange)

Summary

- We searched for TeV–PeV gamma-ray emission from 26 BHXRBs and candidates using LHAASO-WCDA and KM2A observations, combining individual-source searches with likelihood-stacking analyses.

- A local excess of approximately 5σ is found near XTE J1908+094. Its positional offset and the complex surrounding gamma-ray environment leave its association with the binary uncertain.

- No statistically significant collective emission is detected with unweighted, X-ray-weighted, or radio-weighted stacking. We derive 95% CL flux upper limits from the unweighted analysis, constraining the common flux normalization of the analyzed sample.