



The Manatee Nebula W50-SS433: a Galactic PeVatron?

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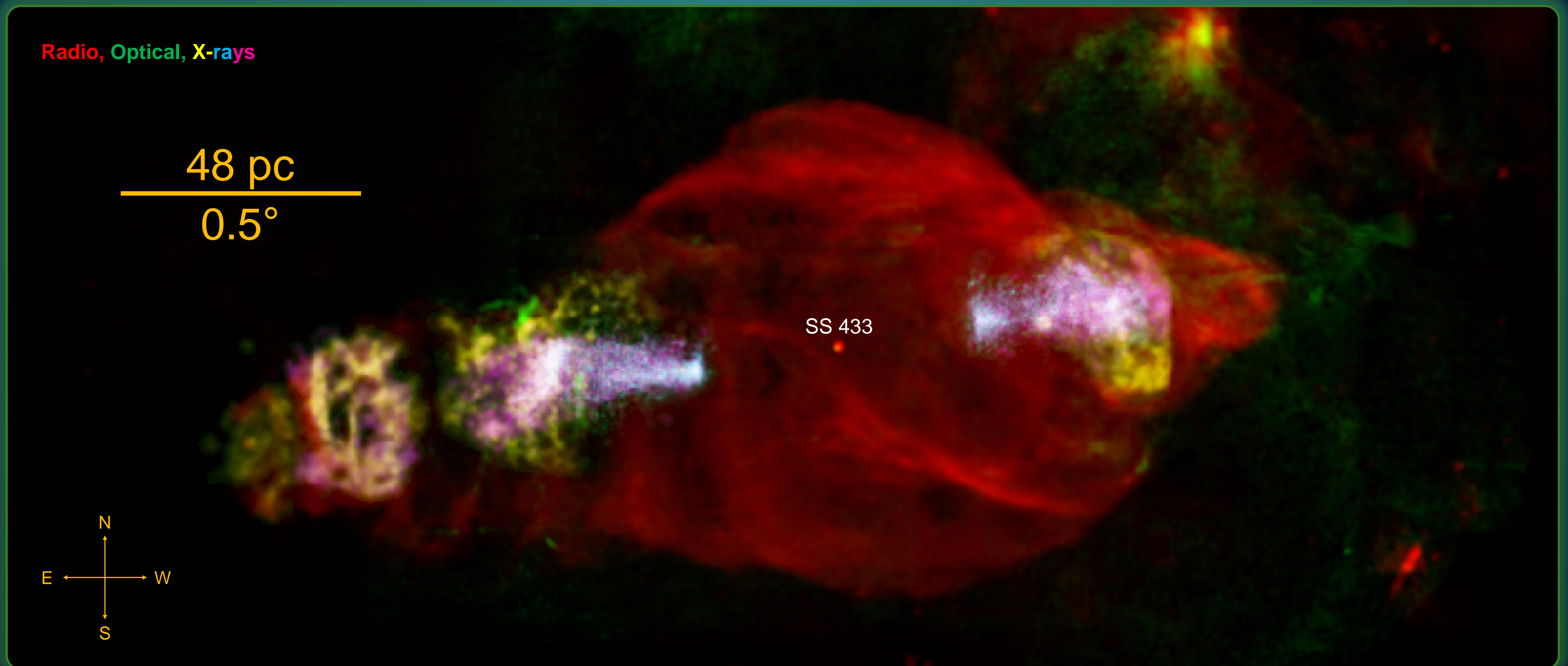
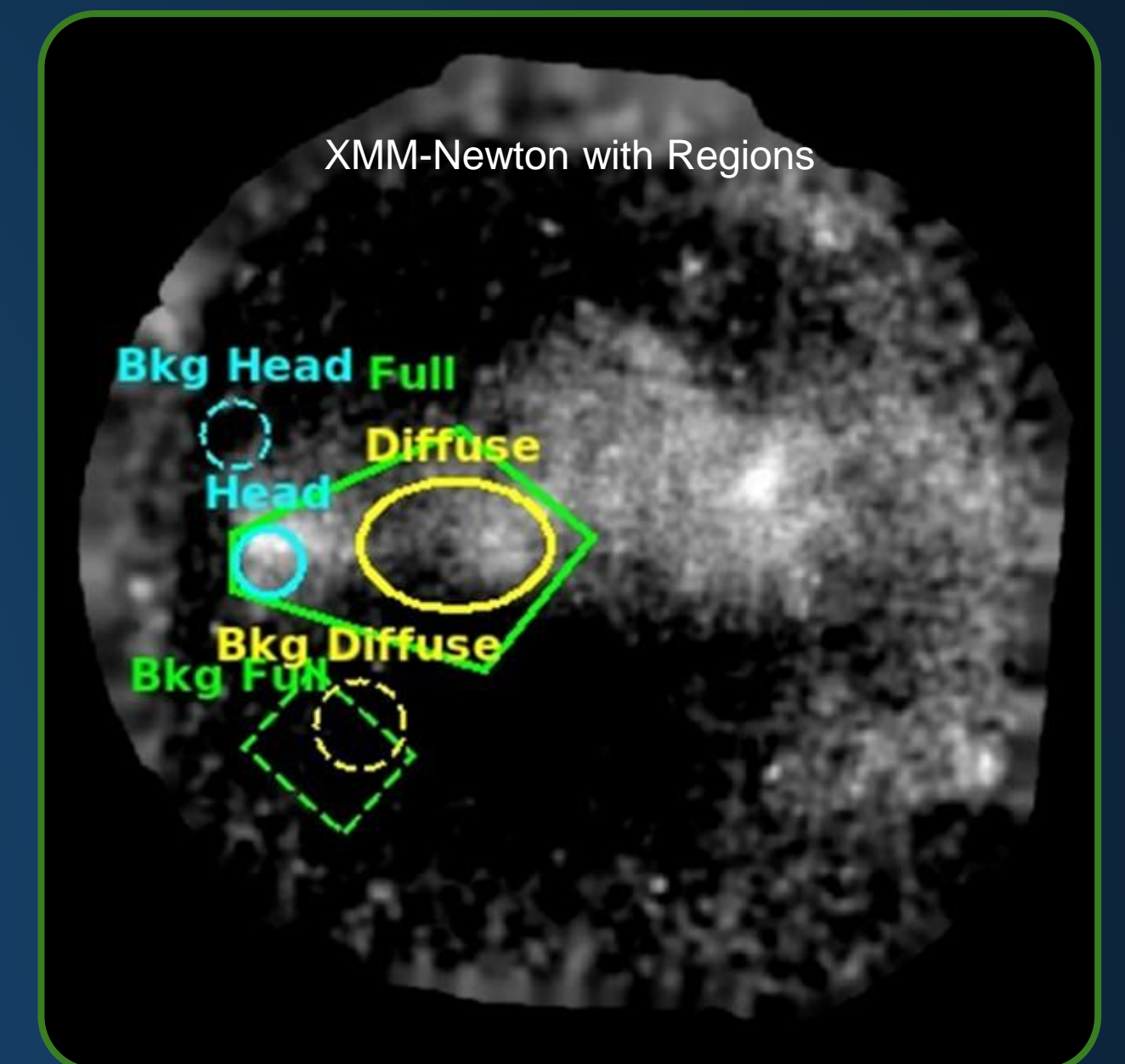
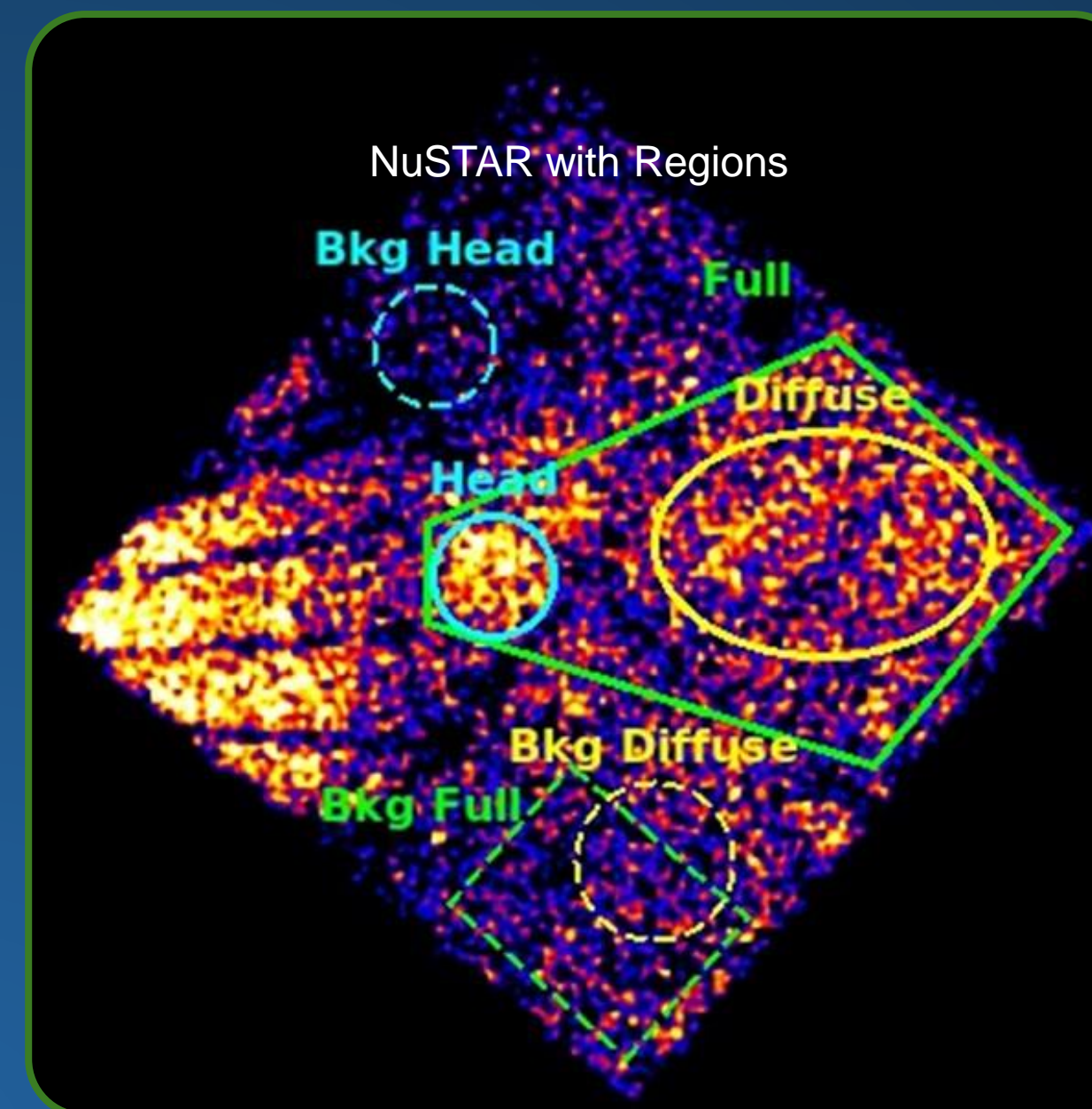
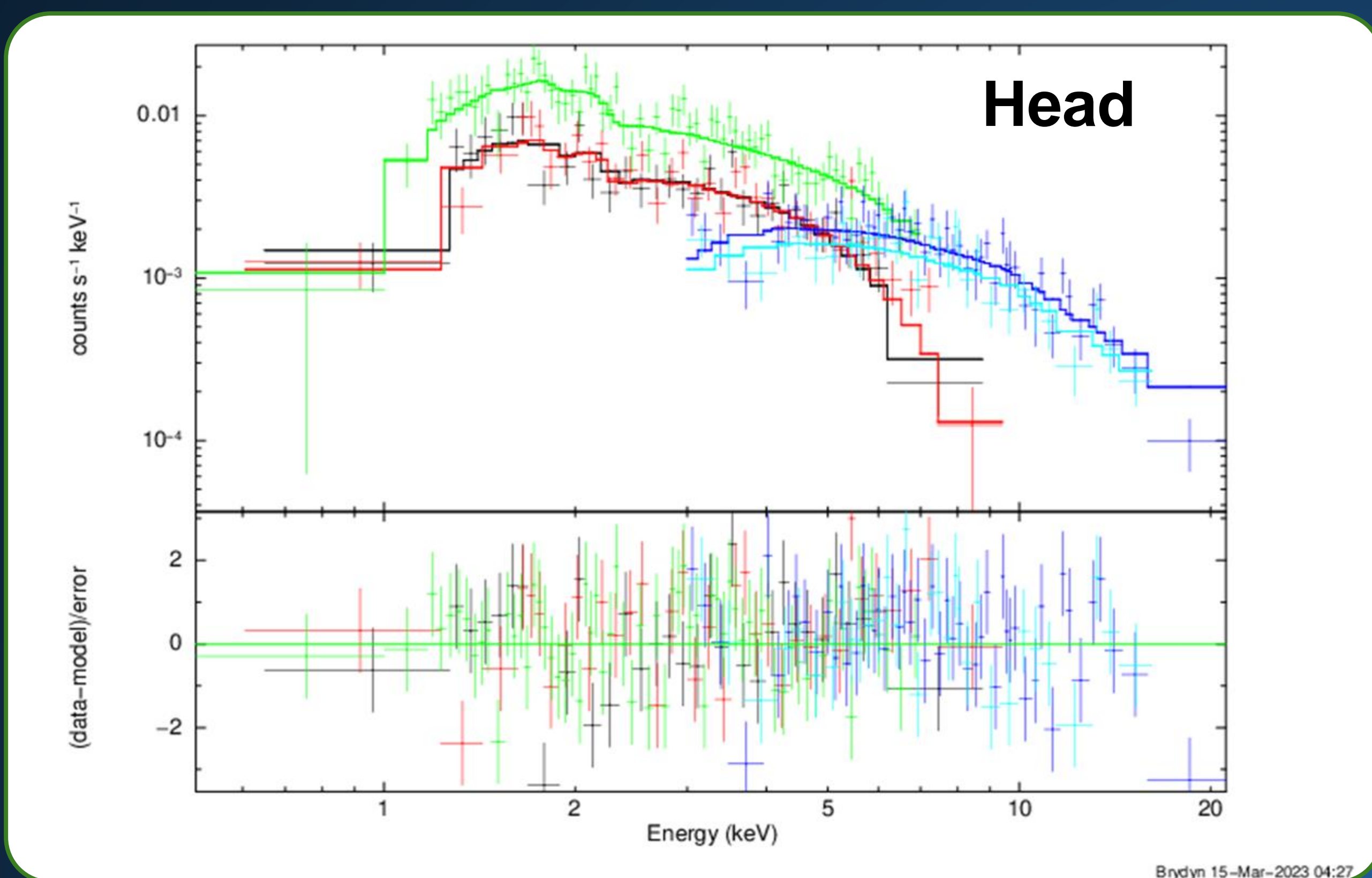


Introduction

- Safi-Harb and Petre (1999), predict W50 is accelerating particles up to 100's of TeV energies.
- HAWC Collaboration (2018) recently detect very high-energy gamma-rays from W50, reviving interest. (And HESS as of Gamma2022, Spain)
- We now present the first NuSTAR (3-79 keV) and XMM-Newton (0.1-10 keV) observations of the inner western lobe of W50.
- This data, when analysed, can be used with archival observations to constrain the spectral energy distribution (SED) of the W50 nebula; supporting the Galactic PeVatron interpretation.

Data Analysis

- Three viable regions of interest (see image below) were selected from the NuSTAR observation for analysis.
- NuSTAR (3-30 keV) and XMM-Newton (0.5-10 keV) joint broadband spectral analysis was performed on all three regions.
- These regions have been labeled as the "Head" at the beginning of the jet, "Diffuse" as the jet expands outwards, and "Full" which contains the jet as seen by NuSTAR. These follow conventions from the eastern lobe study.
- Hydrogen Column Density was fit (see Table) with the more sensitive XMM-Newton observations, and frozen for broadband fitting (including NuSTAR data).
- The best-fit parameters for all regions was found by an absorbed Power-law model in XSPEC to 95% confidence.



| Region | Photon Index | Flux [unabsorbed] (ergs/cm ² /s) | Column Density (cm ⁻²) | χ^2_{ν} (D.o.F.) |
|---------|--------------|---|------------------------------------|-------------------------|
| Head | 1.54 ± 0.07 | 1.82 × 10 ⁻¹² | 1.9 × 10 ²² | 1.23 (242) |
| Diffuse | 1.67 ± 0.04 | 3.97 × 10 ⁻¹² | 1.46 × 10 ²² | 1.27 (665) |
| Full | 1.72 ± 0.03 | 1.07 × 10 ⁻¹¹ | 1.61 × 10 ²² | 1.19 (1579) |

Conclusion

This work supports a Galactic PeVatron interpretation. Substantiating published results on the jet structure found in the inner eastern lobe of W50; it is dominated by non-thermal emission with a relatively hard power-law index with an inferred magnetic field of 15 μG. Our western lobe analysis clarifies symmetries and locations of particle acceleration in the system. Upcoming modelling will constrain the SED with these new results.



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