X-ray Spectroscopy of the Candidate AGN in Dwarf Galaxy Henize 2-10: A Likely Supernova Remnant

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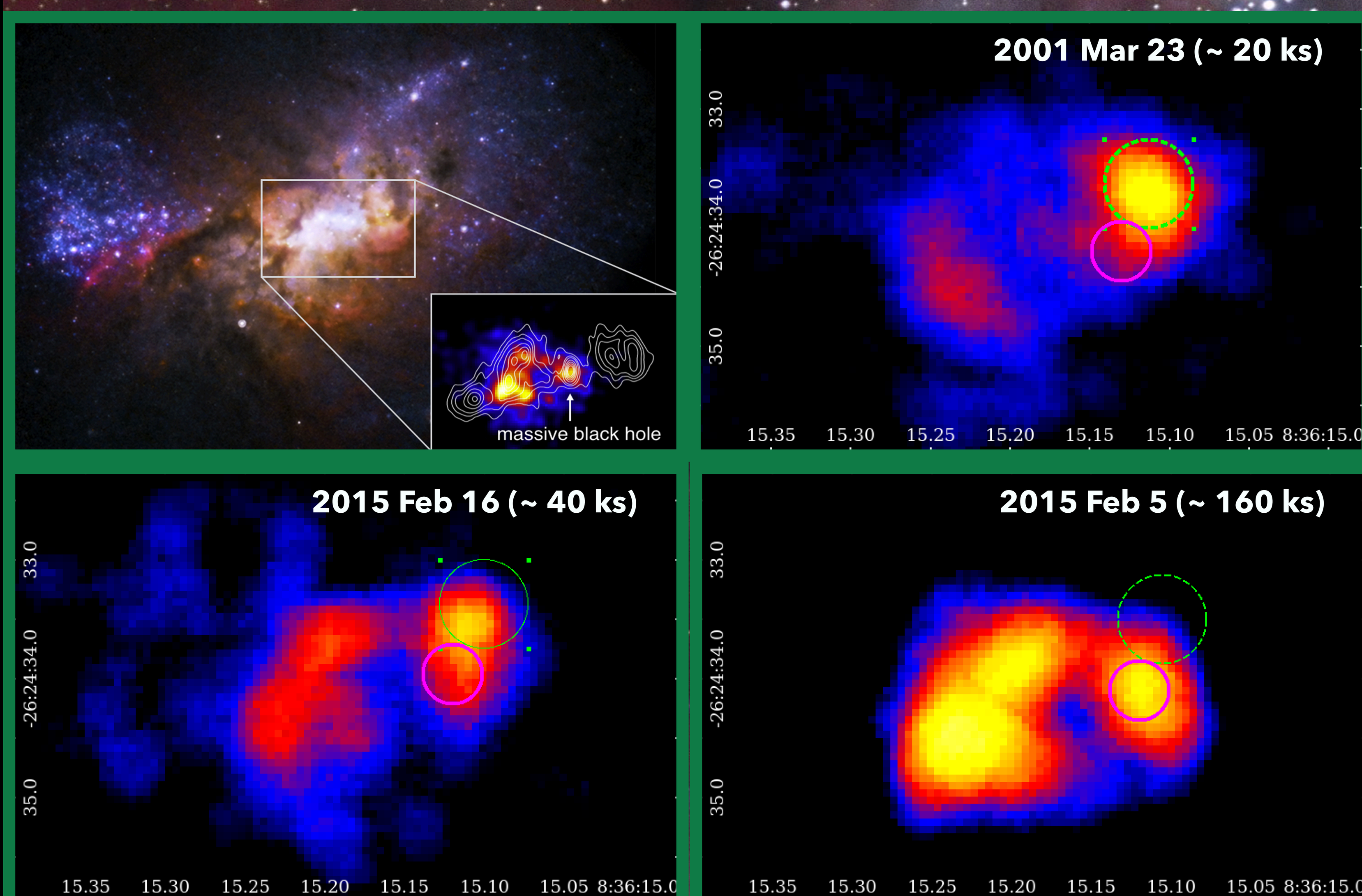


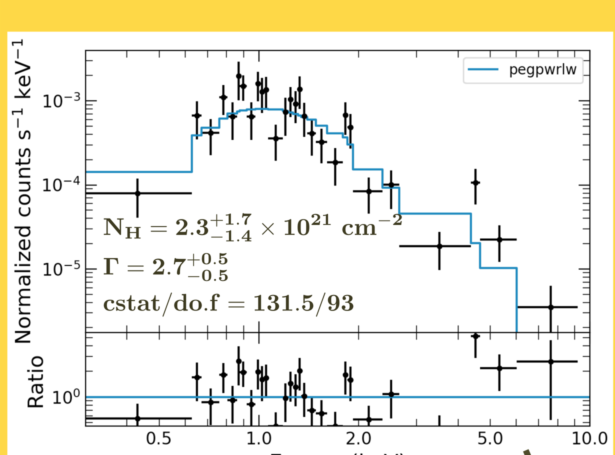
(Top-left) HST image of Henize 2–10. The inset shows the radio contours from overlaid on the *Chandra* X-ray image. *(Others) Chandra* images of Henize 2–10 by Reines et al. (2016) at different epochs. Magenta circle shows the radio position. X-ray images show a variable off-nuclear source (dashed green circle), in addition to the radio-counterpart.

AGN in dwarf galaxies

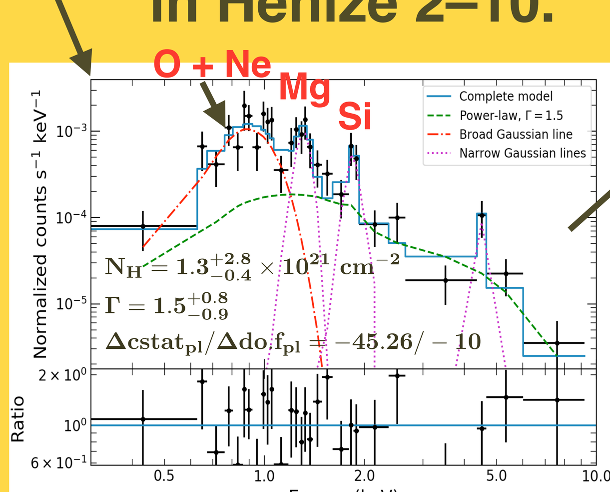
Supermassive black-holes (SMBHs) can regulate the properties of their host galaxy through active galactic nuclei (AGN) feedback. Investigating AGN in dwarf galaxies is crucial to understand the evolution of galaxies and the origin of SMBH seeds. However, studying AGN activity is harder in low-mass galaxies whose radiation can be contaminated with star-formation regions.

Henize 2–10 is a dwarf starburst galaxy. Reines et al. (2011, 2016) argued for a massive AGN at Henize 2–10 based on the X-ray and radio luminosities. However, X-ray spectral analysis by Reines et al. (2016) couldn't differentiate between power-law and thermal plasma models. Cresci et al. (2017) showed that MUSE optical observations of Henize 2–10 do not indicate AGN ionization. Here, we present a minimally binned spectral analysis of the candiate AGN in Henize 2–10.

Line emission in spectrum!

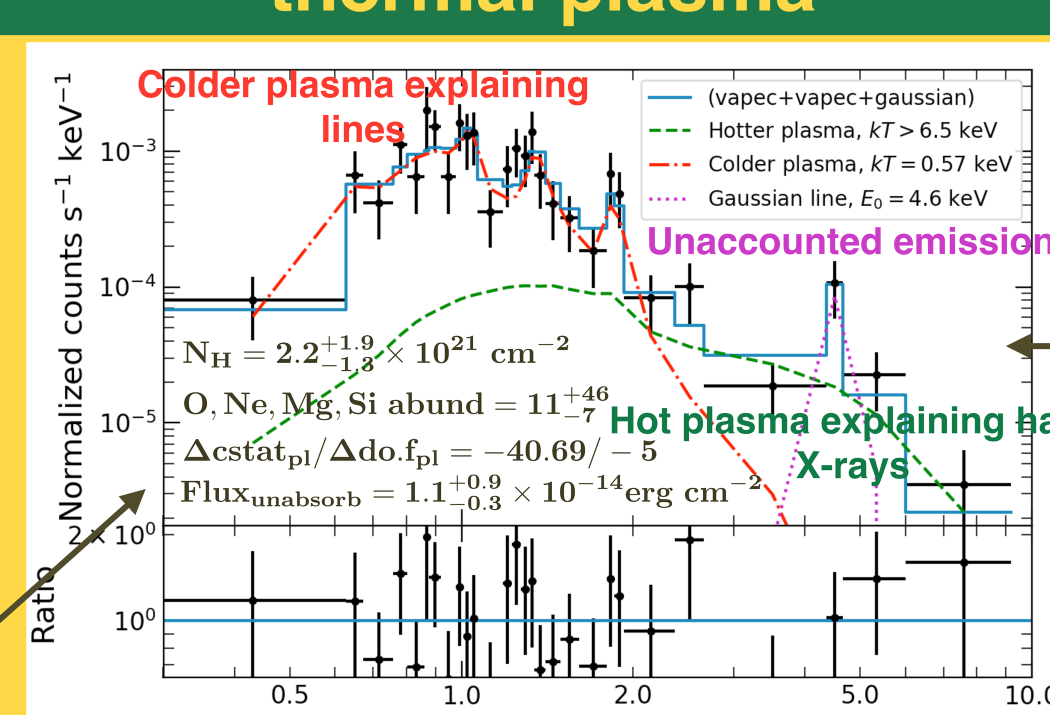


Simple power-law model is a poor fit to the minimally-binned X-ray spectrum of candidate AGN in Henize 2–10.



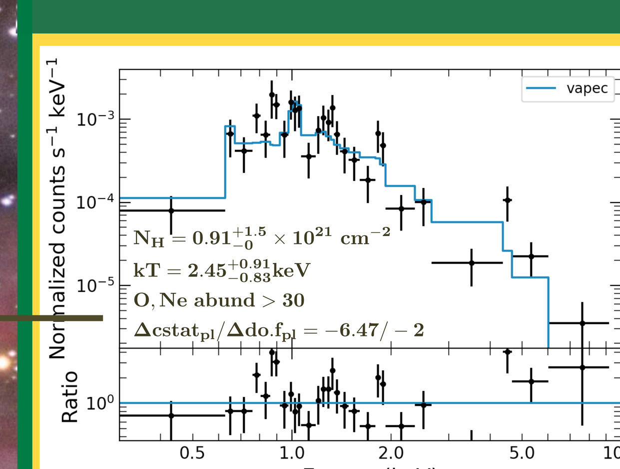
Adding Gaussian lines improves the fit by ~37000. Strong emission lines suggest a high-metallicity thermal plasma.

Final model - Two temp. thermal plasma



Akaike Information Criteria with correction for small samples reveals that this model is ~2 x 10^5 times better than a power-law model.

Single temperature plasma does not fit!



Single temperature plasma model has Mg and Si at a higher ionization, and cannot reproduce the obseved lines.

This suggests a two-temperature thermal plasma model, which could be the case for young SNRs where the reverse shock has not reached the core.

Discussion and Conclusions

- ✳ Two temperature plasma model with high abundance of O, Ne, Mg and Si fits the X-ray spectra much better than a simple power-law, suggesting that the X-ray source is more likely to be a young SNR.
- ✳ We do not understand the emission line at 4.6 keV. It could be Ka line of Ti (but would require extremely high abundance) or a blue shifted Ca line (by ~ 0.1c!).
- ✳ We plan to devise generalized hardness ratios to use this capability of CCD spectra to resolve clear X-ray lines, to distinguish line-dominated spectra from continuum ones.

References

1. Reines et al., 2011, *Nature,* 470, 66
2. Reines et al., 2016, *ApJ*, 830, L35
3. Cresci et al. 2017, *A&A*, 604, A101
4. Kormendi & Ho, 2013, *ARA&A, 51, 511*

Acknowledgements

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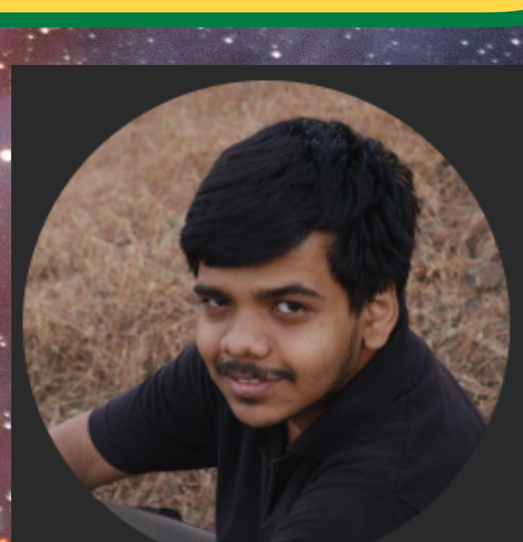

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