NuSTAR and XMM Observations of Dual AGN Candidates

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Introduction

PLACE HOLDER VERSION OF THIS POSTER

Since the vast majority of galaxies contain supermassive black holes (SMBHs) and galaxy interactions trigger nuclear gas accretion, a direct consequence of the hierarchical model of galaxy formation would be the existence of dual active galactic nuclei (AGNs). Both theory and observations suggest that merger-triggered SMBH growth plays a vital role in driving the coordinated evolution of SMBHs and galaxies. *Dual* AGNs with separations < 10 kpc in particular provide unambiguous confirmation of an ongoing merger and are found in late stage mergers when the black holes experience their most rapid growth.

Despite decades of searching, and strong theoretical reasons that they should exist, dual AGNs are extremely rare. until recently only a handful of confirmed dual AGNs with separations < 10 kpc were currently known in the Universe (e.g Table 8 in Satyapal et al. 2017), all of which were discovered serendipitously. In the past few years, with the advent of large-scale optical spectroscopic surveys, more systematic surveys of dual AGNs have been possible. demonstrating that optical surveys are not effective at finding dual AGNs and uncovering a key stage in SMBH evolution.

Motivated by the possibility that AGNs are most likely to be obscured by the inflowing material during peak black hole growth, where dual AGNs are expected to be found, we used the *WISE* survey to identify a population of almost 200 strongly interacting galaxies that display extreme red mid-infrared colors ($W1 - W2 > 0.8$) highly suggestive of powerful AGNs. The vast majority of these galaxies are optically quiescent suggesting that they represent an obscured population of AGNs that cannot be found through optical studies. We were awarded short exposures by *Chandra* to observe the 15 brightest *WISE*-selected dual AGN candidates with separations of a few kiloparsecs.

Selection Methodology

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- **Mauris tempor** risus nulla, sed ornare
- **Libero tincidunt** a duis congue vitae
- **Dui ac pretium** morbi justo neque, ullamcorper

Eget augue porta, bibendum venenatis tortor.

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NuSTAR Imaging

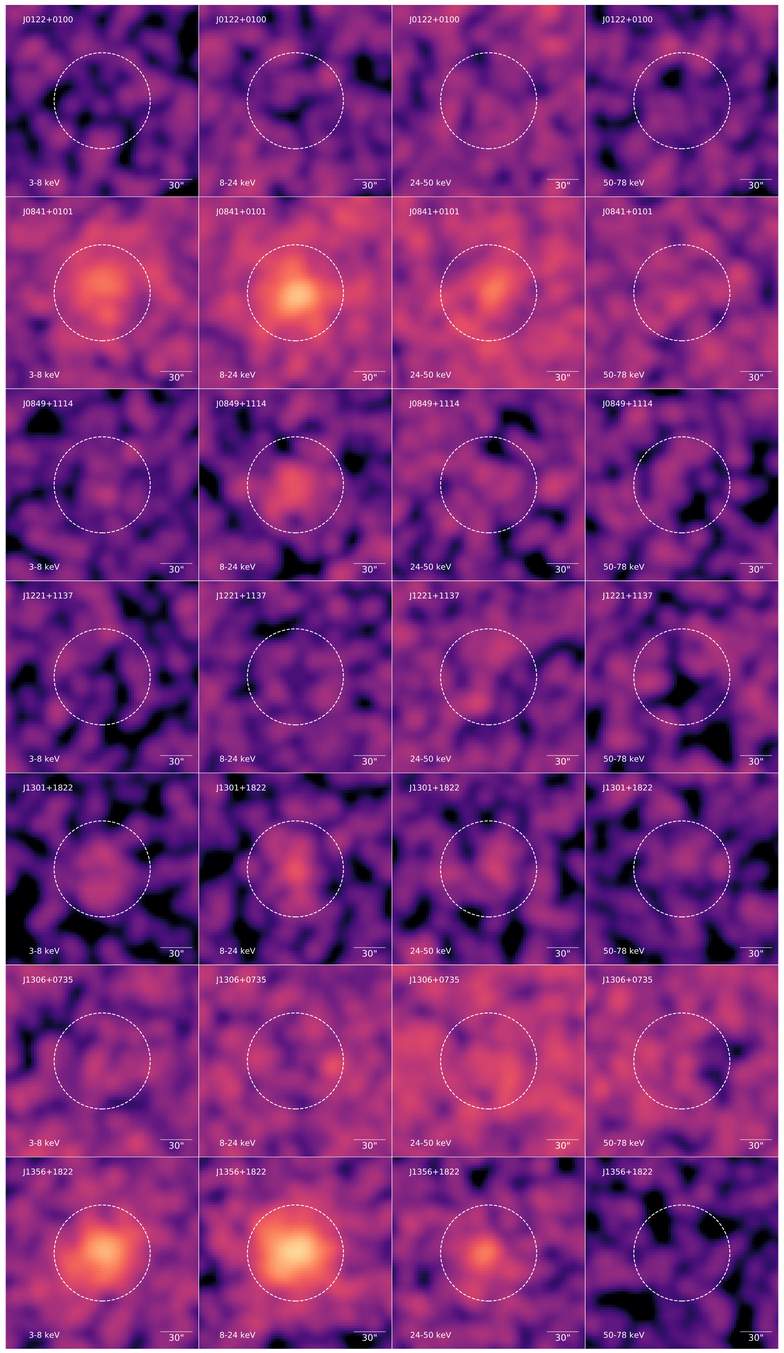

Figure 1. Another figure caption.

XMM-Newton Imaging

Results

Table 1. NuSTAR Upper Limit Fluxes for the AGNs

System	Observed Flux (10^{-13} erg cm^{-2} s^{-1})				$\log(N_{\rm H}/{\rm cm}^{-2})$
	3-24 keV	3-10 keV	10-24 keV	2-10 keV	
J0122+0100	< 0.895	< 0.434	< 1.19	< 0.558	24.9 (25.2)
J0841+0101	12.61 ± 0.68	4.67 ± 0.35	11.42 ± 0.95	5.99 ± 0.45	...
J1221+1137	< 1.81	< 1.07	< 2.36	< 1.37	24.8 (25.0)
J1306+0735	< 1.13	< 0.80	< 1.23	< 1.03	24.6 (24.8)

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Conclusions

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- Of the four newly observed mid-IR selected dual AGN candidates, three were not detected by : J0122+0100, J1221+1137, and J1306+0735. J0841+0101, however, is strongly detected by both and .
- The non-detections in J0122+0100, J1221+1137, and J1306+0735 imply there are no hard X-ray emitting AGNs in the 10-24 keV band in excess of 1.2×10^{-13}, 2.36×10^{-13}, and 1.23×10^{-13} erg s^{-1} cm^{-2}, respectively, in these systems.
- The upper limits on the fluxes for J0122+0100, J1221+1137, and J1306+0735 imply column densities in excess of log()=24.9, 24.8, and 24.6, if we attribute the non-detections to obscuration alone, but given that the 2-10 keV flux upper limits are higher than the more stringently determined fluxes derived from pfeifle219a, these column density limits are very likely to be overestimates.

References

[1] Claude E. Shannon. A mathematical theory of communication. *Bell System Technical Journal*, 27(3):379–423, 1948.