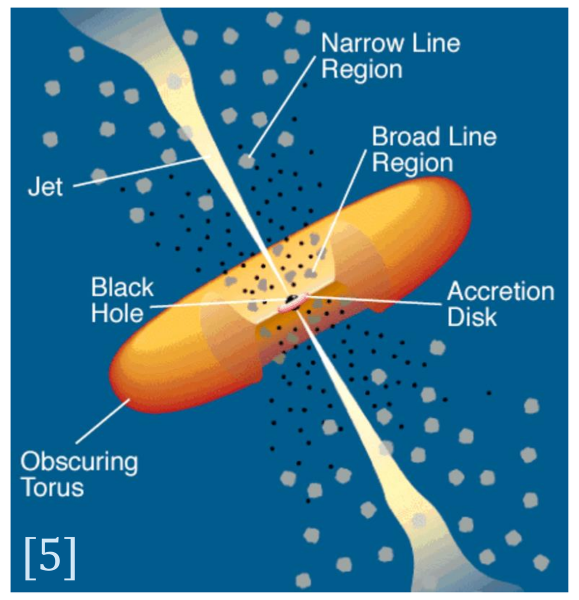
Multiwavelength Comparison of X-ray and Infrared Selected Active Galactic Nuclei

Thresa Kelly [a,b], Connor Auge [a], David Sanders [a]
[a] Institute for Astronomy, University of Hawai`i, 2680 Woodlawn Drive, Honolulu, HI 96822, USA
[b] Department of Physics & Astronomy, University of Kansas, Lawrence, KS 66045, USA

Introduction



- **Active galactic nuclei** (AGN): [1] luminous sources in the centers of galaxies that are powered by matter accretion onto a black hole.
- The **corona** emits energy in the **X-ray**, the **accretion disk** emits in the **ultraviolet** (UV), and the **dusty torus** emits in the **infrared** (IR) [1].

- **Motivation**: to understand black hole growth and the affects of AGN on their host galaxy, it is vital to study a complete sample of obscured and unobscured AGN.
- **Goals**: compare the emission properties of AGN identified by two techniques to explore their completeness and limitations.

Data

Catalog: **COSMOS** (2 deg^2 on sky)
- X-ray luminosity and redshifts from Chandra-COSMOS Legacy Survey [2].
- Photometry and redshifts from COSMOS 2020 catalog [3].

We require that each source has redshift measurements and MIR detections (*Spitzer*/IRAC channels and at 24).

AGN identification:
- Intrinsic 0.5-10keV X-ray luminosity ($L_x > 10^{43}$ erg/s):
  1517 X-ray selected AGN.
- Mid-infrared (MIR) colors (Donley et al., (2012) wedge [4]):
  1009 MIR selected AGN.

Results

AGN samples:
- **Exclusive X-ray** (blue): $L_x > 10^{43}$ erg/s but fall outside the MIR selection wedge.
- **Exclusive MIR** (red): AGN inside the wedge but are not identified by the X-ray selection criteria.
- **Inclusive X-ray & MIR** (yellow): AGN that meet both X-ray and MIR criteria.

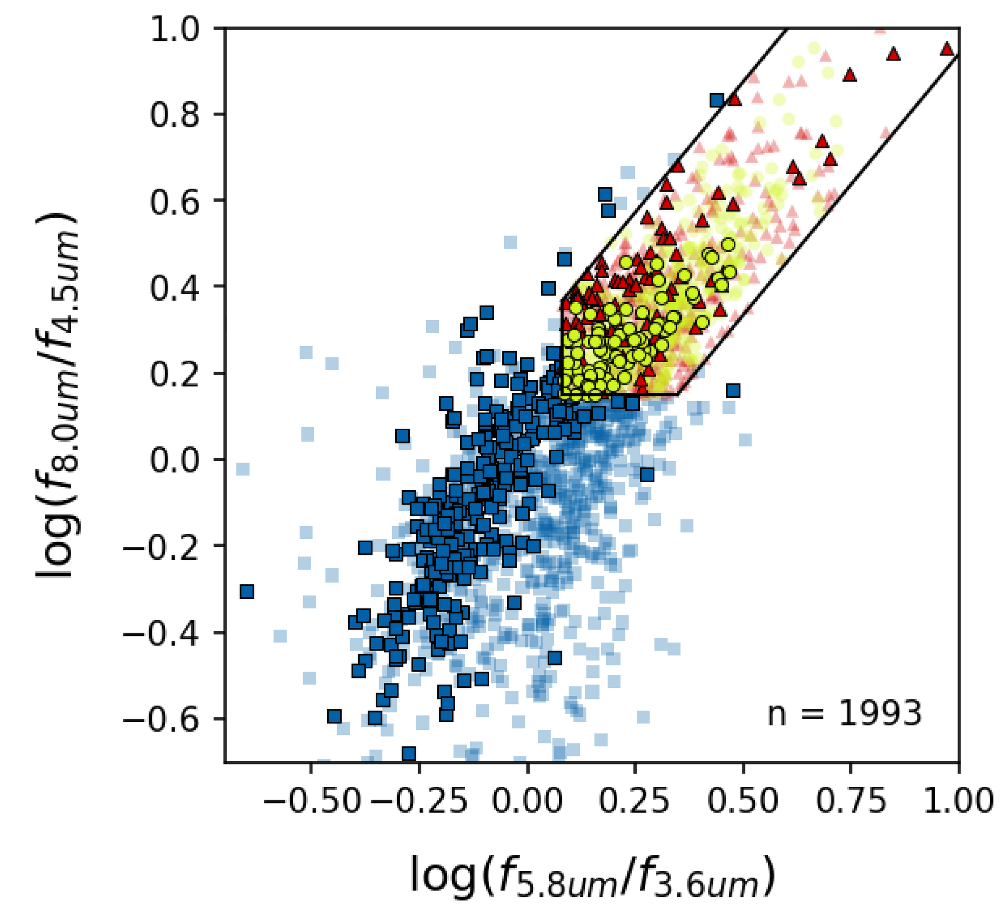
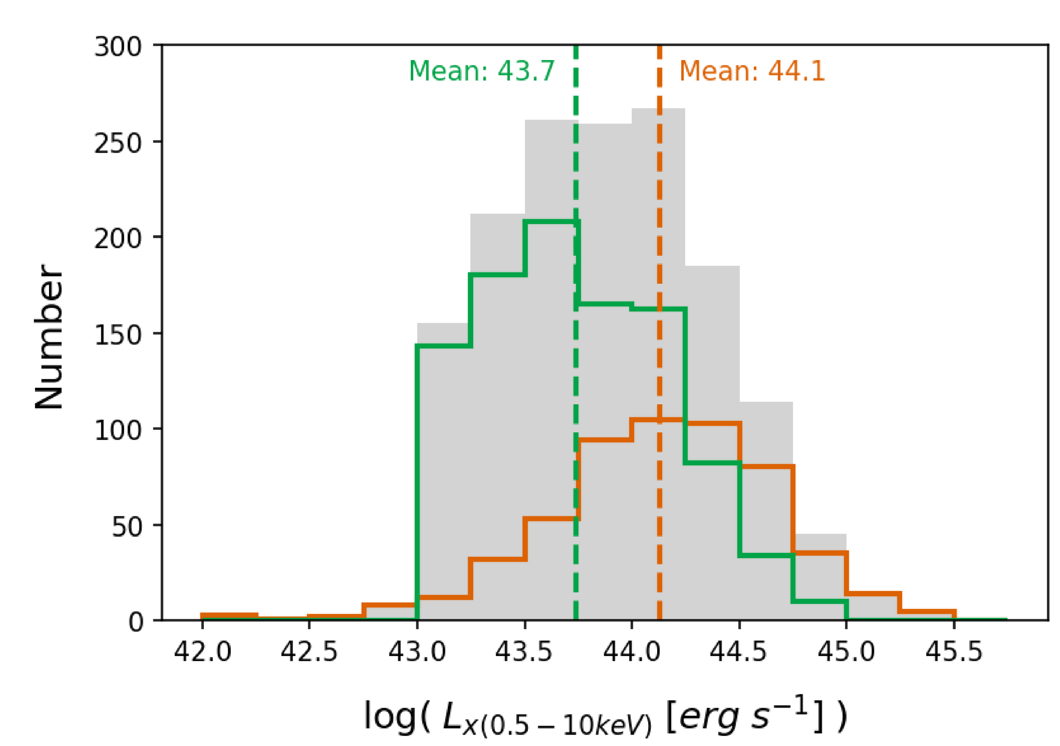


Fig.↑: MIR color-color diagram. Sources inside the black wedge are MIR identified AGN. Many X-ray selected AGN fall outside the wedge. Outlined points have z ≤ 1, otherwise sources have 1 < z < 6.

Fig.↓: Histogram of X-ray detected sources inside (orange) and outside (green) the MIR selection wedge [4]. Gray is all sources.



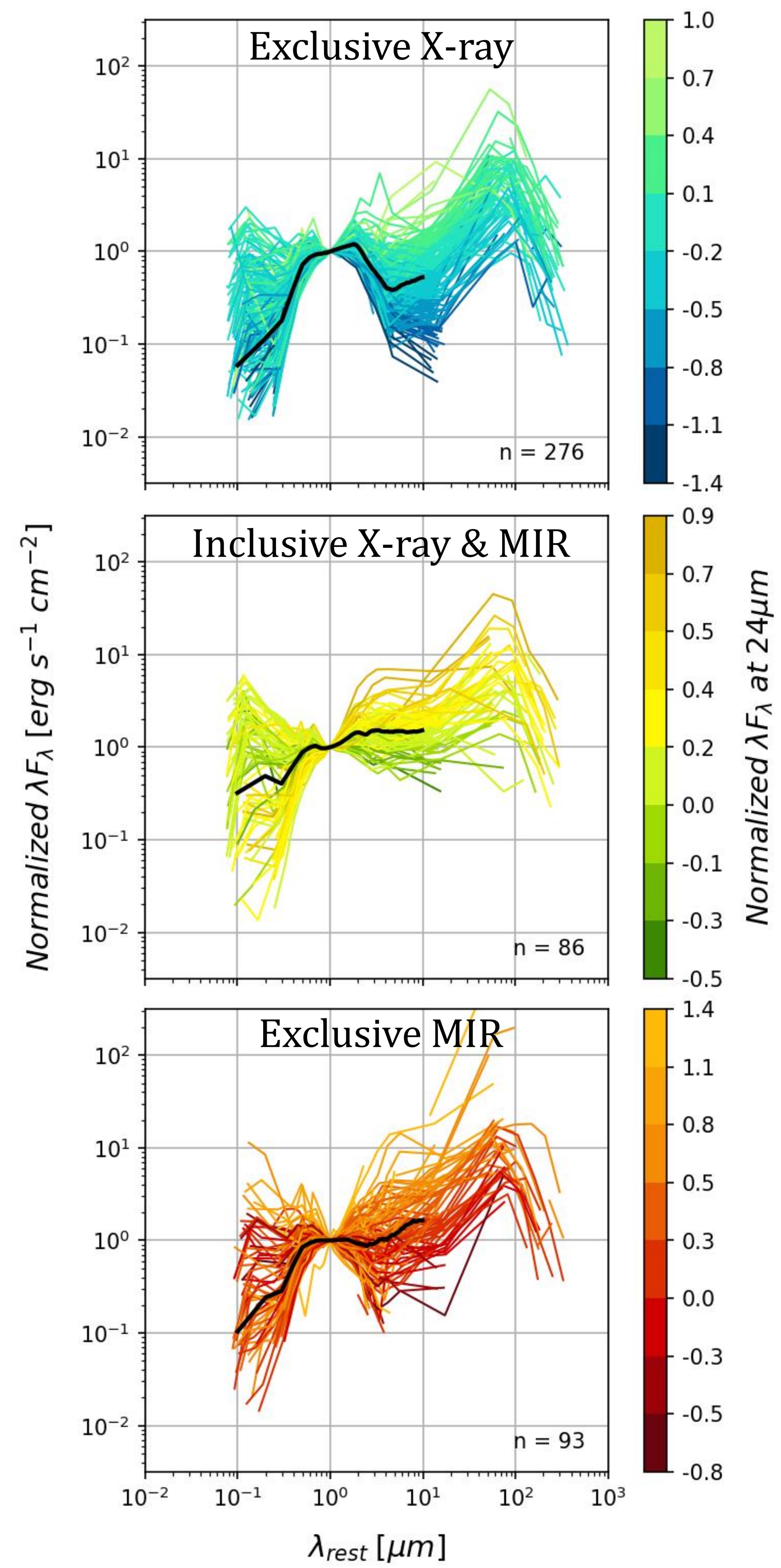


Fig.↑: Spectral energy distributions (SEDs) for AGN by selection method for sources with z ≤ 1 normalized at 1 μm. The black line is the median SED curve from UV to MIR.

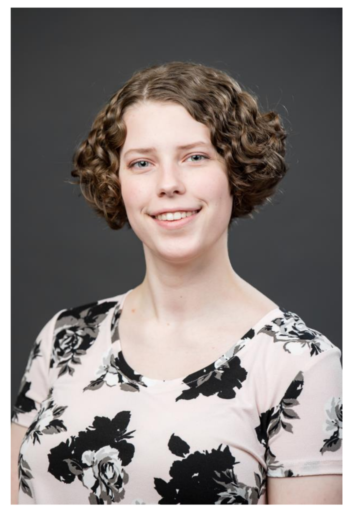
Conclusions

For the full AGN sample (z < 6):
- **Neither X-ray nor MIR selection method captures all types of AGN**: 65% of X-ray selected AGN are not identified by the MIR selection wedge and 47% of MIR identified AGN are not X-ray luminous.
- The **MIR selected AGN are more powerful as the intrinsic L_x is 2.5x greater** than the AGN not identified by their MIR colors.

For the low redshift AGN sample (z ≤ 1):
- **X-ray selection method is more effective at capturing all types of AGN**: 76% of X-ray selected AGN are not identified by the MIR method and 52% of MIR identified AGN are not X-ray luminous.
- **MIR selected AGN have the brightest MIR emission** out of all sources. Exclusive X-ray selected AGN have the weakest MIR emission.
- **The X-ray selection capture the full range of emission properties** but miss many Compton thick AGN that are identified by MIR colors.

References

[1] **Padovani**, P., Alexander, D. M., Assef, R. J., et al. 2017, Astronomy and Astrophysics Review, 25, 2
[2] **Marchesi**, S., Civano, F., Elvis, M., et al. 2016, The Astrophysical Journal, 817, 34
[3] **Weaver**, J. R., Kauffmann, O. B., Ilbert, O., et al. 2022, The Astrophysical Journal Supplement Series, 258, 11
[4] **Donley**, J. L., Koekemoer, A. M., Brusa, M., et al. 2012, The Astrophysical Journal, 748, 142
[5] **Urry**, C. M., & Padovani, P. 1995, PASP, 107, 803



ThresaKelly133 @gmail.com