Can JWST tell us whether AGN tori evolve with cosmic time?

Devang Haresh Liya, David Rosario, Adam Ingram

Evidence for evolution?

The evolution of AGN is closely linked with that of their hosts. While there is evidence for significant evolution in the galaxy properties between the time of cosmic noon (z~2) and present, there are no such studies for evolution in the nuclear environments. With **high resolution JWST imaging**, it has become possible to separate nuclear emission from galaxy emission at high redshifts and study the cosmic evolution of the surroundings of SMBH.

AGN sample

We have identified **75 X-ray AGN** (Buchner+,15) in the **100 sq. arcmin** region of EGS that has multi-band infra-red JWST imaging from the CEERS program. These sources also have UV-FIR multi-wavelength coverage.

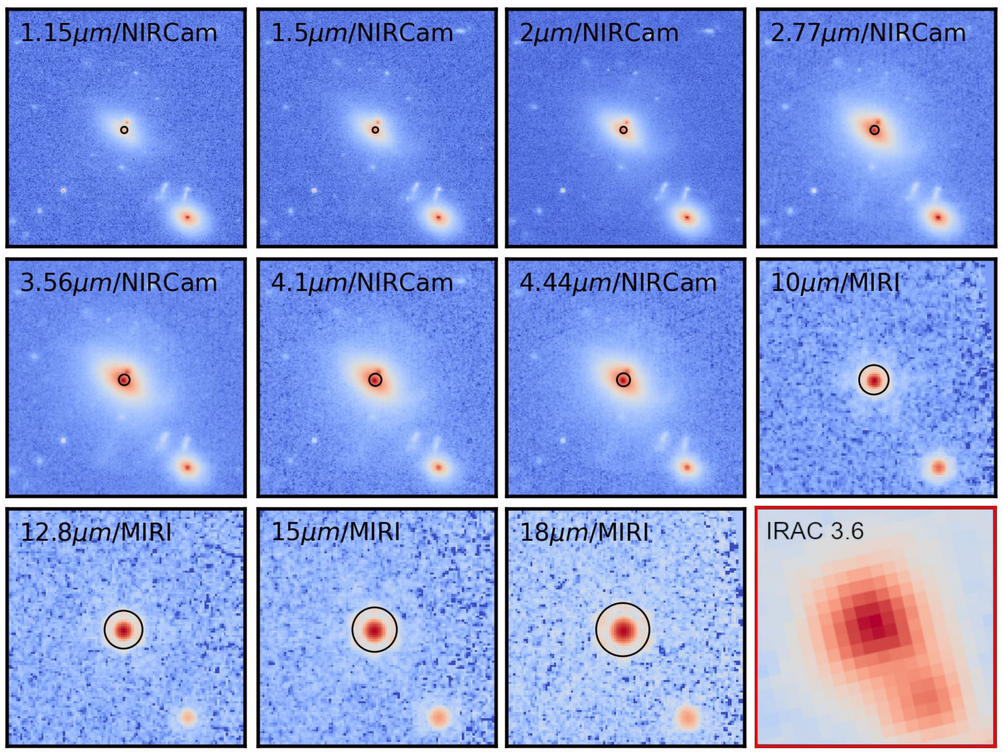

Fig. 1: 10x10 arcsec images of one of our AGN taken using JWST. The circles show the apertures that enclose 80% of the energy from a point source. The last panel shows this same source observed at 3.6 μm using IRAC.

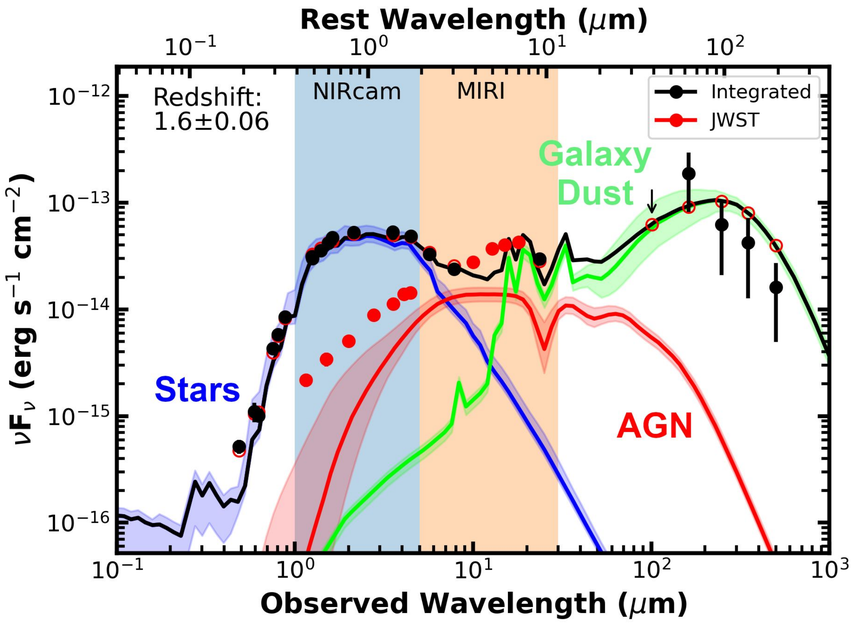

Fig. 2: An example 3-component fit to the existing UV-FIR data for the AGN shown in Fig 1. The filled red points show the JWST photometry of the central region aligning with the fitted AGN component.

Bayesian SED fitting

We are using FortesFit (Rosario, 19) along with Nested Sampling to fit a multi-component model to the existing integrated UV-FIR photometry. We will incorporate SKIRTOR (Stalevski+, 12a, 16), a physical radiative transfer-based dusty torus model, with a range of parameters capturing the geometry of the torus. This, along with the JWST photometry from the central region of the AGN, can **constrain the properties such as the covering fraction, and the ratio between inner and outer radius of the obscuring torus**. The Bayesian framework will then allow us to probabilistically study these properties at population level to look for signs of evolution.

Key takeaways

- We are able to separate the nuclear-scale AGN emission from the host galaxy using multi-band JWST imaging.
- We are incorporating these measurements to constrain torus parameters and look for their evolution across redshifts.
- We are devising machine learning techniques to speed up and improve the fitting framework.
- We will explore different AGN selection criteria such as IR selection and expand our sample to include AGN from the COSMOS and GOODS fields.

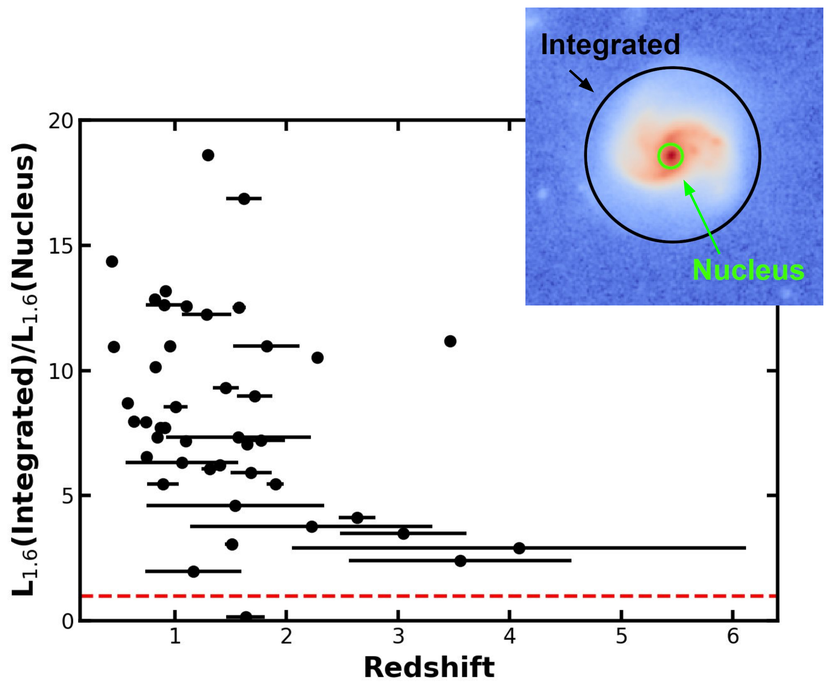

Fig. 3: The ratio of integrated to nuclear 1.6 micron luminosity for all our AGN. The inset shows the physical scales across which these luminosities are measured. Higher numbers indicate better nuclear characterisation.

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