Exploring the Dusty Hearts of Active Galactic Nuclei: Constraints from Mid-Infrared and X-ray Simultaneous Torus Modeling

Donaji Esparza-Arredondo[1], Omaira Gonzaléz-Martín[1], Deborah Dultzin[1]

[1] *Instituto de Radioastronomía y Astrofísica (IRyA-UNAM), 3-72 (Xangari), 8701, Morelia, Mexico*

Dust in the nuclear regions of active galactic nuclei (AGNs) is key to understanding their observational properties and the interplay between radiation and the interstellar medium in extreme environments. This study presents a multi-wavelength analysis of 24 nearby AGNs classified as Seyfert galaxies using simultaneous spectral fitting of Spitzer mid-infrared and NuSTAR X-ray data. By combining physically motivated torus models across both regimes, we constrain the geometry, spatial distribution, and physical properties of the obscuring dust and gas.

Our results indicate that the dust and gas associated with AGN are co-located within 10 parsecs of the central engine. We observe a strong correlation between AGN classification and accretion properties with dust parameters, such as covering factor and half-opening angle. Additionally, more luminous AGNs appear to host more extended dusty structures.

Our findings reinforce the connection between circumnuclear dust and gas properties and AGN activity. Expanding this approach to larger samples and incorporating upcoming data from facilities such as JWST and XRISM will be key to unveiling the full complexity of dust in galactic nuclei. Moreover, studying AGN dust in conjunction with gas across multiple wavelengths not only refines our models of obscuration but also addresses broader questions in galaxy evolution, feedback processes, and the lifecycle of cosmic dust in extreme environments.