X-RAY ASTRONOMY 2019
Current Challenges and New Frontiers in the Next Decade
8-13 September 2019
CNR/INAF Research Area, Bologna, Italy

Contribution ID: **206** Type: **Poster**

Physical parameters of the torus from mid-IR and X-ray simultaneous spectral fitting

Friday 13 September 2019 17:24 (2 minutes)

To understand the diversity of classes observed in active galactic nuclei (AGN) it is required to obscure the inner parts of a geometrically and optically thick torus of gas and dust from some lines of sight. However, this torus is not spatially resolved even for the closest AGN. Spectroscopic studies have been broadly used to characterize the main properties of the torus. However, the torus has a large number of parameters that have not been constrained yet. X-rays shows signs of the torus emission throughout the reflection component peaking at ~20 keV. The X-ray spectral shape depends on the geometry of this emission. Mid-infrared emission is another powerful tool to study the properties of the torus, due to the fact that continuum emission in this range is dominated by the heating of dust by the AGN. We explore the combination of X-ray and mid-infrared spectra to constrain the physical parameters of the torus because both show important signatures of obscuration. To meet our goal we used the nearby type-2 IC 5063 as a test object. We included the high spectral resolution IRS/Spitzer spectra for mid-infrared observations and NuSTAR observations for X-rays. We used the radiative transfer code Borus (Baloković et al. 2018) for X-ray spectra and three models (Smooth from Fritz et al. (2006), Clumpy from Nenkova et al. (2008), and CAT3D-wind from Hoenig et al. (2017)) for mid-infrared spectra. The Borus model can be fitted with the X-ray spectral fitting software XSPEC. We develop a code able to convert mid-IR models and IRS/Spitzer spectra into XSPEC format to simultaneously fit mid-infrared and X-ray data. We found that the combination of the borus02 and Smooth models is the best choice to fit the mid-IR and Xspec spectra of IC 5063. Indeed both the inclination angle and the angular width of the torus can be linked indicating that the same structure that produces the reflection component is emitting through dust heating at mid-infrared. This is the first time such behavior is confirmed. Moreover, we found that all dusty torus parameters are found when the inclination and half-opening angles are linked between both baseline models. Therefore, we concluded that this technique can be used to infer the physical properties of the torus.

Topic

Active Galactic Nuclei: accretion physics and evolution across cosmic time

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Session Classification: POSTER SESSION