

A Hard X-Ray Test of HCN Enhancements As a Tracer of Embedded Black Hole Growth

Privon, G. C., Ricci, C., Aalto, S., Viti, S., Armus, L., Diaz-Santos, T., ...Pérez-Torres, M. A. (2020). A Hard X-Ray Test of HCN Enhancements As a Tracer of Embedded Black Hole Growth. *The Astrophysical Journal*, 893, (2), 1- 10. <https://doi.org/10.3847/1538-4357/ab8015>

Abstract

Enhanced emission from the dense gas tracer HCN (relative to HCO⁺) has been proposed as a signature of active galactic nuclei (AGN). In a previous single-dish millimeter line survey we identified galaxies with HCN/HCO⁺ (1–0) intensity ratios consistent with those of many AGN but whose mid-infrared spectral diagnostics are consistent with little to no ($\leq 15\%$) contribution of an AGN to the bolometric luminosity. To search for putative heavily obscured AGN, we present and analyze NuSTAR hard X-ray (3–79 keV) observations of four such galaxies from the Great Observatories All-sky LIRG Survey. We find no X-ray evidence for AGN in three of the systems and place strong upper limits on the energetic contribution of any heavily obscured ($N_H > 10^{24} \text{ cm}^{-2}$) AGN to their bolometric luminosity. The upper limits on the X-ray flux are presently an order of magnitude below what XDR-driven chemistry models predict are necessary to drive HCN enhancements. In a fourth system we find a hard X-ray excess consistent with the presence of an AGN, but contributing only $\sim 3\%$ of the bolometric luminosity. It is also unclear if the AGN is spatially associated with the HCN enhancement. We further explore the relationship between HCN/HCO⁺ (for several Jupper levels) and LAGN/LIR for a larger sample of systems in the literature. We find no evidence for correlations between the line ratios and the AGN fraction derived from X-rays, indicating that HCN/HCO⁺ intensity ratios are not driven by the energetic dominance of AGN, nor are they reliable indicators of ongoing supermassive black hole accretion.