UNC 2024 Celebration of Undergraduate Research

Lonely, Hungry Supermassive Black Holes: Quantifying the AGN Fraction in Cosmic Voids via Mid-Infrared Variability

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Observations and simulations suggest that the large scale environment plays a significant role in how galaxies evolve and, in particular, whether and when galaxies host an actively accreting supermassive black hole in their center (i.e., an Active Galactic Nucleus, or AGN). We use public data catalogs from the Sloan Digital Survey and ~12 years of data from the Wide-field Infrared Survey Explorer (ALLWISE/NEOWISE) to quantify the fraction of galaxies that host AGN in the most under-dense regions of the universe (cosmic voids) relative to the rest of the universe (cosmic walls) via measurements of mid-infrared variability. This diagnostic identifies elusive AGN activity where other, more traditional methods remain limited due to dust, star formation, or host galaxy light obscuring AGN light emissions. We find that the AGN fraction is largely consistent across both environments, although AGN activity in bright galaxies is slightly more common in voids. Our results constrain the role of galactic interactions in triggering AGN activity, supporting previous findings that the large scale environment has nuanced effects on galaxy evolution that vary based on galaxy size and luminosity.