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A Glimpse into the Future: Gaia DR4 and Advancements in AGN Research

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In June 2022, the highly anticipated Gaia data release (DR3) was unveiled, marking a significant milestone with the introduction of the first-ever AGN catalog, specifically tailored to capture variability patterns. Leveraging insights from the established Gaia-CRF3 AGN catalog and employing key parameters indicative of object variability (such as Fractional Variability and Slope of the Structure Function), this new catalog, known as GLEAN, was meticulously curated through a series of rigorous selection criteria, resulting in an impressive compilation of approximately 872,000 sources.

Looking ahead to 2026, the forthcoming fourth data release of Gaia (DR4) promises an array of exciting advancements. With an extended data span of 66 months, researchers will gain access to photometric light curves, offering deeper insights into AGN variability. Furthermore, the updated AGN catalog accompanying DR4 will introduce additional parameters related to variability, enriching classification and characterization endeavors within the scientific community. Notably, DR4 opens avenues for more detailed investigations into temporal delays in lens quasars, potentially facilitating estimations of H0, albeit within the complexities of this endeavor.

Additionally, DR4 will facilitate access to low-resolution spectroscopic time series, presenting valuable opportunities for reverberation mapping studies. By observing the temporal delay between line and continuum measurements, researchers can glean insights into the structural dynamics of Broad Line Regions (BLR), particularly for the brightest objects.

Another notable enhancement in DR4 is the inclusion of astrometric time series, enabling investigations into both Radio-loud and Radio-quiet AGN. For instance, researchers may explore the detection of motion within extragalactic jets, as exemplified by studies such as Blinov et al. (2021) on Blazar 3C 279. Additionally, studies related to AGN suggest that large-scale modifications in the accretion disk and surrounding dusty torus can induce shifts in the photocentre, as evidenced by works such as Souchay et al. (2022), highlighting 41 sources with significant proper motion. While challenging, these endeavors underscore the transformative potential of Gaia data in advancing our understanding of AGN dynamics and morphology.

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