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Measuring the Hubble constant from AGN continuum time delay in LSST data

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Determining the Hubble constant through active galactic nuclei continuum reverberation mapping requires high quality photometric light curves to disentangle physical components near supermassive black holes. Within the framework of the Rubin LSST In Kind Contribution POL NCB S6, we utilize our dedicated HORIZON AGN code software to model continuum light curves and spectral energy distributions. This physically motivated framework incorporates standard Shakura Sunyaev accretion disks, lamppost X ray irradiation, warm coronas, diffuse continuum and line emission from the radiation pressure regulated broad line region, and dusty torus reprocessing. By simultaneously fitting continuum lag spectra and broad spectral energy distributions, HORIZON AGN treats the accretion rate and luminosity distance as free parameters, yielding an independent measurement of the Hubble constant.

We have successfully applied this framework to two completed sources, archival data of NGC 5548 and our first target Fairall 9 from the Hubble Constant Constraint through AGN Light curve Observations program at Obserwatorium Cerro Murphy, while modeling for a third target is currently in progress. These targets illustrate the light curve quality needed for accurate time delay recovery.

Looking ahead, the Vera C Rubin Observatory will deliver transformative datasets. For Data Release 2, light curves spanning 6 filters (u, g, r, i, z, y) will benefit from up to a full year of continuous rolling history and forced photometry precision better than 20 milli magnitudes, where 1 mmag equals one thousandth of a magnitude or sub percent flux accuracy. In the LSST Deep Drilling Fields, this photometric precision combined with continuous baseline monitoring will dramatically improve continuum light curve resolution for vast AGN samples. However, applying HORIZON AGN to hundreds of sources requires reducing model free parameters. In this talk, I will present results from our completed and in progress targets, evaluate light curve standards for continuum mapping, and outline our strategy to optimize HORIZON AGN for upcoming Rubin LSST datasets.

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