

Measuring Geometric Distances Using Interferometry and Reverberation Mapping of Broad-line Regions

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The geometric distances of active galactic nuclei (AGNs) are challenging to measure because of their exceptionally compact structure, yet vast cosmic distances. A combination of spectroastrometry and reverberation mapping (SARM) of broad-line regions (BLRs) constitutes a novel means to probe the geometric distance of AGNs, which has recently become practically feasible owing to successful interferometric observations with the Very Large Telescope Interferometer/GRAVITY. Here, we perform SARM analysis of four nearby quasars: Mrk 509, PDS 456, 3C 273, and NGC 3783. Results for the former two are reported for the first time, and the latter two are revisited using our improved BLR dynamical modeling that includes the radial-dependent responsivity of BLRs. This allows us to self-consistently account for the emissivity weighting of the BLR in spectroastrometry and responsivity weighting in reverberation mapping. We obtain angular-diameter distances of the four quasars, from which we derive a Hubble constant of $H_0=69(-10 +12)\text{km/s/Mpc}$. Although this constitutes a large uncertainty for a measurement of H_0 , it is anticipated that the precision will improve to a competitive level once a greater number of AGNs are accessible following the upgrade of GRAVITY in the near future.

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