Solving the Hubble tension with the VLTI

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Abstract

Optical interferometry can provide a decisive contribution to the Hubble tension problem from spectro astrometric angular measures of Active Galactic Nuclei Broad Line Regions (AGN BLR) combined with linear measures on the same targets provided by Reverberation Mapping (RM). To achieve such a major breakthrough in cosmology three conditions must be met. First, we need enough targets allowing to combine these two methods. Second, we need the SM measurements to be accurate enough. Third we need improved BLR models with additional geometrical constraints allowing to remove the model fitting biases that appear when we combine only SA and RM measures. We analyze these three conditions, and we show that they can be met on the VLTI with its current baselines and with the GRAVITY+ upgrade if we can extend the VLTI toward shorter wavelength. The J and H band give access to a higher angular resolution and to strong emission lines at low or moderate redshifts compatible with RM campaigns in less than 2-3 years. The gain in resolution is sufficient on the VLTI as it is to complement the SA measures with Differential Visibility (DV) measures on a large sample of targets. We show that DV yields a decisive complement of geometric constraints that, unlike SA measures, are not degenerate with the BLR kinematics. They can validate AGN model constraints derived from mid IR observations in the L, M and N bands. Accessing multiple lines at once with different ionization potentials also provides constraints on the radial structure of the BLR. To access enough targets in the J and H bands to meet the first condition we need to be able to fringe track at least up to magnitude K_˜15. We also mention strong evidence that such a fringe tracking magnitude is well within reach at the VLTI under GRAVITY+ with a new generation fringe tracker.

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