

Optical interferometry of AGN for direct distance measurements to quasars and detection of binary black holes

Differential Interferometry with the VLTI will soon allow hundreds of AGNs to be observed on parsec, and sub parsec, scale resolution. Phase Differential Interferometry (PDI) yields spectro-astrometric measurements of the positional differences between broad line region (BLR) clouds in the blue and red wings of the spectral emission lines giving the mass of the central super massive black hole (SMBH) and calibrate existing SMBH mass relations. Combined with Reverberation Mapping estimates of the linear size of BLR, spectro-astrometry gives a direct and independent distance measurements. However, to make these measurements precise and accurate enough to contribute decisively to the Hubble tension problem requires a good modeling of the BLR geometry to remove degeneracies of geometric and kinematic parameters that bias the analysis of the SARM combination of spectro-astrometry (SA) and reverberation mapping (RM). This can be obtained indirectly by dust torus observations in the L, M and N bands by MATISSE on the VLTI and more directly in the J band where the VLTI angular resolution is sufficient for a large number of Amplitude Differential Interferometry (ADI) measurements of geometrical parameters independently from the velocity distribution.

These methods depend on an accurate model of the ordered BLR; however, conversely disturbances and asymmetric structures to the BLR become clearly seen by PDI. Binary super massive black holes are expected to be both a key perturbation of this general picture and a topic of high interest by themselves as well as for the preparation of LISA's gravitational waves programs. A binary black hole, with a separation between the typical accretion disk and inner BLR sizes, produces a specific time variable shift of the differential phases between continuum and lines as well between near IR continuum dominated by the accretion disk and mid IR continuum dominated by the dust sublimation rim in type I AGN. We will present the accessible discovery space of the VLTI for such binary black hole systems from a combination of signal amplitudes from our BLR models and noise analysis derived from the VLTI instruments experience.