Broad line regions, accretion disks, and binary super massive black holes

James Leftley*[1]

[1]University of Southampton – United Kingdom

Abstract

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 model of the BLR geometry. The BLR can only be directly probed by the long baseline interferometry and a full investigation will likely require longer baselines or shorter wavelengths at the VLTI.

An ordered BLR can provide distances and black hole masses through PDI; conversely, PDI also makes it clear when the BLR is no longer ordered. Binary SMBHs from merger events are expected to be both a key perturbation of BLRs and a topic of high interest by themselves as well as for the preparation of LISA's gravitational waves programs. A binary SMBH, 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 as possibly between bluer IR/optical continuum dominated by the accretion disk and redder IR continuum dominated by the dust sublimation region in type I AGN. We will present the accessible discovery space of the VLTI given current and future capabilities for such binary SMBH systems from a combination of signal amplitudes from our BLR models and noise analysis derived from the VLTI instrumental experience.

*Speaker