Uncovering Accretion Disks with the VLTI

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Abstract

Accretion onto supermassive black holes at the centre of galaxies is an important component in galaxy evolution. This process is at the heart of the multi-phase structures known as active galactic nuclei (AGNs). However, we do not know specifically how accretion and accretion disks work. The two main competing models are a geometrically thin, optically thick disk and a geometrically slim, optically thin disk. The main challenge we face in observing these structures we cannot spatially resolve these regions, not even with current VLTI capabilities. Using continuum reverberation mapping we can temporally resolve the disk. Countless reverberation mapping studies over the past decade, however, have uncovered a fundamental problem: significant levels of continuum emission do not only arise from the disk but also the larger broad line region (BLR), and it is nigh-impossible to disentangle these signals. This is where the VLTI can step in: km-baselines will provide sub-uas resolutions in differential phase, comfortably resolving the BLR. As such, we can separate out the BLR emission line and the co-located continuum emission from the smaller scale emission from the disk. For the first time, we will be able to accurately isolate the disk flux, and together with its directly measured size, determine the opacity. This is a strong constraint on disk models, differentiating between optically thick and thin configurations. Further expansion towards shorter wavelengths (YHJ) can probe even smaller regions. Moving to 800 nm can even get us to the Paschen jump, which is a predicted distinct feature in the BLR continuum. The VLTI has the potential to play a central role in the study of accretion.

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