STFC funded PhD Project

Reference: STFC-Goad

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Project Title: Mapping accretion flows near supermassive black holes.

Project Description

Correlated continuum and broad emission line variability studies (reverberation mapping, RM) have proven a powerful probe of the central regions of Active Galactic Nuclei (AGN). Traditionally RM has focused on probing the spatial distribution and kinematics of gas in close proximity to the black hole (the broad emission line region, BLR), necessary for determining its mass.

More recently, correlated continuum variations have been used to : (i) measure the distance to the hot dust (dust RM), and (ii) map the disc radial temperature profile, T(R). Dust delays provide an upper limit to the BLR outer boundary necessary for constraining photoionization models, while the disc inter-band continuum delays can be used to determine the mass accretion rate through the disc for AGN with known black hole mass.

This program will focus on constructing photoionization models of the BLR in low and high accretion rate sources in the context of self-consistent energy conserving models of the ionizing spectral energy distribution (SED), necessary for quantifying the BLR diffuse continuum (DC) contribution to the inter-band continuum delays (e.g., Fig 1), (the major contaminant to the disc delay signature). By quantifying and then removing the DC contribution to the delay signature we can use the residual delays to directly test the standard model for accretion.

Recent international RM campaigns (AGN STORM 1 & 2) have revealed the presence of outflowing material (winds) located interior to the BLR, and likely responsible for the unusual broad emission-line behaviour impacting the data analysis and interpretation. We will investigate the behaviour of the broad emission lines in the presence of winds, exploring the balance of emission, wind versus BLR, as the source luminosity varies.

This project will include photoionization modelling with publicly available software (CLOUDY), as well as data reduction and analysis. We have extensive ground-based optical—near ir data with Liverpool Telescope in support of HST/UV spectroscopy (200 orbits) and Swift/XRT/UVOT photometric monitoring programs, providing ground-based spectrophotometry, for disc, dust and broad emission-line variability studies, as well as related Intensive Broadband Reverberation Mapping (IBRM) programs aimed at measuring the disc sizes in a dozen nearby AGN.

Competency in programming would be an advantage.

References

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