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A Self-Shadowing Black Hole Accretion Disc during a Soft State Decay

The geometry and physical conditions of black hole accretion discs are expected to change dramatically as a function of mass accretion rate and the resulting X-ray luminosity. Theoretical models predict that these changes become particularly relevant as the luminosity approaches the Eddington limit (L_{Edd}), a regime where the standard thin-disc solution is thought to break down in favour of alternative configurations, many of which predict vertically extended, radiation-pressure-supported structures in the inner regions. However, the threshold for this transition, and its observational signatures, remain poorly constrained.

I will present simultaneous X-ray, optical, and near-infrared spectroscopic observations during the decay of a black hole outburst, focusing on the soft accretion state. Below ~0.1L_{Edd}, the optical and infrared spectra are consistent with a highly irradiated outer disc, characterised by weak high-excitation emission. In contrast, a substantially cooler spectrum is observed at the outburst peak (~0.2L_{Edd}), dominated by strong double-peaked recombination lines of hydrogen and helium. This behaviour can be explained by self-shadowing effects, which shield the outer disc (where these low-ionisation lines form) from the high-energy emission produced near the black hole. In this context, the inner accretion flow would deviate from the standard thin-disc structure already at moderate luminosities, providing an observational link between inner flow geometry and outer disc spectral behaviour in stellar-mass black holes. I will discuss how these structural changes can leave a measurable imprint far beyond their immediate surroundings, with important implications for our understanding of spectral variability, disc winds, and state transitions in accreting black holes.

Contribution

Oral talk

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