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Dynamical Unification of Tidal Disruption Events

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Tidal Disruption Events (TDEs) were first investigated as theoretical possibilities in the 1970s-1980s, exploring what would happen if a black hole devours an unlucky star. The first detection in 1996 was consistent with the formation of an accretion disk emitting primarily in the X-rays as predicted by theory. However, in recent decades, the situation has become much more complicated. There are now two main classes of TDEs: X-ray and optical-dominated TDEs, and a newly discovered subclass that starts optical bright but steadily increases X-ray luminosity to peak at 10s-100s of days after the optical peak, called X-ray rebrightening.

In this talk, I discuss how we can link these three classes of TDEs to a dependence on the viewing angle and accretion rate of a super-Eddington disk geometry. Specifically, I employ Monte Carlo radiative transfer calculations on 3D general relativistic radiation magnetohydrodynamics simulations of super-Eddington accretion disks. Our results confirm the unified model proposed by Dai et al. (2018), suggesting that the observed emission properties depend largely on the observer's viewing angle. We show as the accretion level declines with the fallback rate, we expect more X-rays to leak out along intermediate viewing angles, providing a natural explanation for the diversity of emission properties observed in TDEs through geometrical considerations

Primary author: Mr THOMSEN, Lars (The University of Hong Kong)

Co-authors: Prof. RAMIREZ-RUIZ, Enrico; DAI, Jane (The University of Hong Kong); Prof. ROTH, Nathaniel; Ms WU, Samantha; KWAN, Tom (The University of Hong Kong)

Presenter: Mr THOMSEN, Lars (The University of Hong Kong)

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