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X-ray Reflection from Super-Eddington Accretion Flows

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X-ray reflection spectroscopy has proven a powerful technique for probing disk geometry and measuring black hole spin in the sub-Eddington accretion regime. Recent observations show that X-ray reflection can also happen in super-Eddington systems such as tidal disruption events. In this work, we conduct a series of general relativistic ray-tracing simulations to model the reflection signatures including the characteristic Fe K lines from super-Eddington accretion flows around black holes. We adopt a lamppost configuration for the corona and a cone geometry for the funnel which is surrounded by winds, with the wind profile inspired by state-of-the-art simulations of super-Eddington accretion. We also allow the photons to be reflected for multiple times in the narrow funnel. Our results show that the Fe K line profile is sensitive to the wind speed, the funnel open angle, and the height of the corona. Therefore, the Fe K lines can be used to effectively probe the funnel and winds produced in super-Eddington accretion. Also, very interestingly, we show that double-peak emission lines can be produced from super-Eddington accretion flow when viewed top-down, which has a physical origin completely different from that produced in thin-disk systems due to Doppler effects.

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