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Gravitational Lensing in Simulated and Observed Images of Black Holes

Thursday, 8 July 2021 18:30 (20 minutes)

In 2019, the Event Horizon Telescope published the first image of a black hole, paving the way for future efforts to improve our understanding of emission around compact objects. However, many of the most prominent and unexpected effects of black holes on their images are only visible at extremely fine resolutions. To analyze these features, I will describe an approach to adaptive ray-tracing that allows us to efficiently generate high-resolution images of black holes by concentrating rays near sharp features of the image. I will present examples that provide key insights into the turbulent accretion flow and photon ring, particularly showcasing the role of subring decompositions in probing strong lensing effects. Using these high-resolution simulations, I will then discuss applications to space interferometry. While a ground-based array is unlikely to resolve higher order photon subrings, a geosynchronous orbit could could extract the interferometric signature of the n=1 subring, particularly with an extension to 345 GHz observing frequency. I will discuss the role of baseline length, observing frequency, and mission duration in optimizing our chances to see the photon ring, and I will illuminate ways in which we can use simulations to make these efforts more robust.

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