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Impact of Central Massive Black Hole Accretion on the Event Horizon, Host Galaxy, and Beyond

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Astrophysical black holes are surprisingly simple physical objects. Their gravitational field can be fully described by two parameters: mass and spin. We cannot directly observe black holes as no light escapes from the event horizon. However, we can detect the light from accreting gas, which forms a dense disk around the black hole, known as an accretion disk. The accretion of material by a massive black hole at the center of its host galaxy forms an active galactic nucleus (AGN), the innermost region of which emits X-ray radiation. An AGN is energetically efficient for regulating the growth of galaxies and is crucial for the development of the Universe we see today. One of the most important tools to probe the innermost accretion flow is the detection of X-ray reverberation echoes, where the X-ray photons reflected from the accretion disk are delayed relative to the primary X-ray source. In this talk, I will first discuss how detailed measurements of the reflected X-rays from the accretion disk can be used to probe the innermost regions of accretion flow just outside the event horizon and determine the fundamental properties of the black hole, such as its spin, across the complete mass scales from $\sim 10^5 - 10^{10}$ solar masses. Peering into the growth channels of black holes, I will discuss how we can distinguish accretion vs. merger-dominated black hole growth and probe the cosmological evolution of black hole spins in the last 10 billion years of cosmic history. Finally, I will show how enigmatic relativistic winds or Ultra-Fast Outflows (UFOs) launched from the AGN accretion disk can be used to probe the feedback mechanism connecting the central black holes with their host galaxies.

Keyword-1

Black Hole Accretion/Growth

Keyword-2

AGN Feedback

Keyword-3

Black Hole-Galaxy Co-evolution

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