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Type : **Poster**

Dynamical Simulations of Self-Consistent Mass Accretion onto Black Holes in Ultralight Dark Matter

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Dark matter may be made of ultra-light bosonic particles, so light that it behaves like a large-scale quantum wave rather than a swarm of individual particles ("ultralight" or "fuzzy" dark matter). This wave nature changes how massive objects like black holes move through it: the drag that normally causes objects to sink toward a galaxy's center can behave very differently.

Prior work on a black hole moving through this kind of dark matter found strikingly different outcomes depending on the environment. Embedded in the dense, wave-supported core at a galaxy's center, the black hole doesn't simply sink; its orbit oscillates in a "stone-skipping" pattern as it repeatedly disturbs and rebounds off the vibrating core (Zhang, Wang, Zagorac & Easther 2026). In a smoother, more uniform environment, our own preliminary work instead finds enhanced dynamical friction due to the formation of a dense gravitational wake.

Such prior work was based on dynamical simulations where we held the black hole's mass fixed, which while arguably a small effect, still isn't complete given the vast timescales of a cosmological simulation. We add the missing piece: a black hole should also grow by swallowing the surrounding dark matter as it moves. We implement a physically calibrated accretion prescription, matched to the classical accretion rate used throughout astrophysics for objects moving through gas. The new tool also gives the black hole a physical momentum kick from the infalling matter, not just added mass. We present early results on how this self-consistent growth changes the dynamics in both environments considered before.

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Yes

What is your career level?

Postdoctoral

Which keyword describes the area of focus of this talk?

Black holes

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Session Classification : Black holes & Instrumentation