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# Adiabatically compressed wave dark matter halo and intermediate-mass ratio inspirals

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The adiabatic growth of a central massive black hole could compress the surrounding dark matter halo, leading to a steeper profile of the dark matter halo. This phenomenon is called adiabatic compression. We investigate the adiabatic compression of wave dark matter - a light bosonic dark matter candidate with its mass smaller than a few eV. Using the adiabatic theorem, we show that the adiabatic compression leads to a much denser wave dark matter halo similar to the particle dark matter halo in the semiclassical limit. The compressed wave halo differs from that of the particle halo near the center where the semiclassical approximation breaks down, and the central profile depends on dark matter and the central black hole mass as they determine whether the soliton and low angular momentum modes can survive over the astrophysical time scale without being absorbed by the black hole. Such a compressed profile has several astrophysical implications. As one example, we study the gravitational waves from the inspiral between a central intermediate-mass black hole and a compact solar-mass object within the wave dark matter halo. Due to the enhanced mass density, the compressed wave dark matter halo exerts stronger dynamical friction on the orbiting object, leading to the dephasing of the gravitational waves. The pattern of dephasing is distinctive from that of inspirals in the particle dark matter halo because of the difference in density profile and because of the relatively suppressed dynamical friction force, originating from the wave nature of dark matter. We investigate the prospects of future gravitational wave detectors, such as Laser Interferometer Space Antenna, and identify physics scenarios where the wave dark matter halo can be reconstructed from gravitational wave observations.

**Presenter:** XUE, Xiao (UHH & DESY)

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