Poster Session #C
Gravity theories

C15

Impact of multiple modes on the black-hole superradiant instability

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Ultralight bosonic fields in the mass range $\sim (10^{-20} - 10^{-11})$ eV can trigger a superradiant instability that extracts energy and angular momentum from an astrophysical black hole with mass $M \sim (5, 10^{10}))M_{odot}$, forming a nonspherical, rotating condensate around it. So far, most studies of the evolution and end-state of the instability have been limited to initial data containing only the fastest growing superradiant mode. By studying the evolution of multimode data in a quasiadiabatic approximation, we show that the dynamics is much richer and depend strongly on the energy of the seed, on the relative amplitude between modes, and on the gravitational coupling. If the seed energy is a few percent of the black-hole mass, a black hole surrounded by a mixture of superradiant and nonsuperradiant modes with comparable amplitudes might not undergo a superradiant unstable phase, depending on the value of the boson mass. If the seed energy is smaller, as in the case of an instability triggered by quantum fluctuations, the effect of nonsuperradiant modes is negligible. I will discuss the implications of these findings for current constraints on ultralight fields with electromagnetic and gravitational-wave observations. I will also present results of my ongoing work on the evolution of a scalar field in a binary black-hole environment.