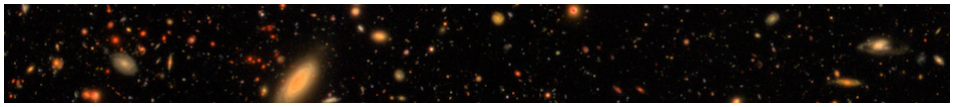

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Searching for ultralight bosons with supermassive black hole ringdown

Tuesday, September 28, 2021 2:45 PM (15 minutes)

One class of competitive candidates for dark matter are ultralight bosons.

If they exist, these bosons may form long-lived bosonic clouds surrounding rotating black holes via superradiant instabilities, acting as sources of gravity and affecting the propagation of gravitational waves around the host black hole.

During extreme-mass-ratio inspirals, the bosonic clouds will survive the inspiral phase and can affect the quasinormal-mode frequencies of the perturbed black-hole-bosonic-cloud system.

In this work, we compute the shifts of gravitational quasinormal-mode frequencies of a rotating black hole due to the presence of a surrounding bosonic cloud.

We then perform a mock analysis on simulated LISA observational data containing injected ringdown signals from supermassive black holes with and without a bosonic cloud.

We find that with less than an hour of observational data of the ringdown phase of nearby supermassive black holes such as Sagittarius A* and M32, we can rule out or confirm the existence of cloud-forming ultralight bosons of mass $\sim 10^{-17}\mathrm{eV}$.

(The talk is based on arXiv:2107.05492, which has just been accepted by Physical Review D)

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