

Probing Ultralight Bosons with Compact Eccentric Binaries

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Ultralight bosons can be abundantly produced through superradiance process by a spinning black hole and form a bound state with hydrogen-like spectrum. We show that such a “gravitational atom” typically possesses anomalously large mass quadrupole and leads to significant orbital precession when it forms an eccentric binary with a second compact object. Dynamically formed black hole binaries or pulsar-black hole binaries are typically eccentric during their early inspirals. We show that the large orbital precession can generate distinct and observable signature in their gravitational wave or pulsar timing signals.

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