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Termination of Superradiance from a Binary Companion

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We study the impact of a binary companion on black hole superradiance at orbital frequencies away from the gravitational-collider-physics (GCP) resonance bands. A superradiant state can couple to a strongly absorptive state via the tidal perturbation of the companion, thereby acquiring a suppressed superradiance rate. Below a critical binary separation, this superradiance rate becomes negative, and the boson cloud gets absorbed by the black hole. This critical binary separation leads to tight constraints on GCP. Especially, a companion with mass ratio q > 10^{−3} invalidates all GCP fine structure transitions, as well as almost all Bohr transitions except those from the |ψ211> state. Meanwhile, the backreaction on the companion manifests itself as a torque acting on the binary, producing floating/sinking orbits that can be verified via pulsar timing. In addition, the possible termination of cloud growth may help to alleviate the current bounds on the ultralight boson mass from various null detections.

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