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Orbital-plane precessional resonances for binary black-hole systems MICHAEL KESDEN, XINYU ZHAO, University of Texas at Dallas, DAVIDE GEROSA, University of Cambridge — We derive a new class of post-Newtonian precessional resonances for binary black holes (BBHs) with misaligned spins. According to the orbit-averaged spin-precession equations, the angle between the orbital angular momentum $\mathbf{L}$ and the total angular momentum $\mathbf{J}$ oscillates with a period τ during which time $\mathbf{L}$ precesses about $\mathbf{J}$ by an angle α. If α is a rational multiple of 2π, the precession of $\mathbf{L}$ will be closed indicating a resonance between the polar and azimuthal evolution of $\mathbf{L}$. If α is an integer multiple of 2π, the misalignment between the angular momentum $\Delta\mathbf{L}$ radiated over the period τ and $\mathbf{J}$ will be minimized, as will the opening angle of the cone about which $\mathbf{J}$ precesses in an inertial frame. However, the direction of $\Delta\mathbf{L}$ will remain nearly fixed in an inertial frame over many precessional periods, causing the direction of $\mathbf{J}$ to tilt as inspiraling BBHs pass through such a resonance. Generic BBHs encounter many such resonances during an inspiral from large separations. We derive the evolution of $\mathbf{J}$ near a resonance and assess their detectability by gravitational-wave detectors and astrophysical implications.

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