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Orbits around Spinning Black Holes

A Mathematica demonstration was published on the Mathematica website showing the orbit of a compact test particle around a spinning black hole. It allows users to select the spin direction, spin value, particle angular momentum, particle energy and time of orbit. The Hamiltonian equations of motion were used to define the movement of the particle and the chosen spin value restricted the available angular momentum and energy values of the particle, preventing the orbit from being plunging or unbound. Closed expressions for the three characteristic radii of a black hole were derived in terms of the spin, angular momentum and energy. Using these equations, a closed expression for $\Delta\Phi$, the equatorial angle accumulated in one radial cycle from apastron to periastron. The energy, angular momentum and $\Delta\Phi$ were calculated for various closed black hole orbits. Using Levin's notation for classifying closed orbits as mixed numbers, all three quantities were found to scale to fixed values.