

Symplectic mechanics of a spinning particle around a Schwarzschild black hole

Friday 7 July 2023 09:00 (20 minutes)

I will present a new Hamiltonian analysis of the motion of a spinning particle orbiting a Schwarzschild black hole. First I will reduce the Mathisson-Papapetrou equations at linear order in spin to a Poisson system. Second, I will present a reduction of this system to a 6 degrees-of-freedom (dof), constrained Hamiltonian system. Third, specialising to the Schwarzschild spacetime, a reduction by invariants and by SSC constraints will be performed, using a new set of symplectic variables adapted to the underlying $SO(3)$ and $SO(1,3)$ symmetries in the problem. The whole dynamics are then showed to be governed by a very simple, integrable and decoupled 2 dofs system: the radial dynamics are solvable in terms of elliptic functions (as for the non-spinning case), while the rotational dynamics (orbital+spin) combine nicely into a single Hill's equation. All these results do not rely on any assumptions of circularity, spin-alignment and/or planarity, the latter cases being fixed points of the general dynamical system.

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