On Rotationally Invariant (Super)Integrability with Magnetic Fields in 3D

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ABSTRACT

Superintegrable Hamiltonian systems possess remarkable properties from a physical and mathematical point of view. To obtain these systems, one can start from integrable systems and look for additional integrals of motion. We will consider 3D Hamiltonian systems admitting a nonzero magnetic field, and more precisely, we will focus on such systems that possess two quadratic integrals of motion of nonsubgroup type, where one of them has its leading order term in angular momentum. If the magnetic field is set to zero, it leads to the three cases that allow separation of the Hamilton-Jacobi or Schrödinger equations in the circular parabolic, prolate and oblate spheroidal coordinates. In addition, we will provide some superintegrable systems, mainly for the circular parabolic case.