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Lovelock Black Holes in the Five-Dimensional Spacetime

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The black holes solution of the Lovelock theory in five-dimensional spacetime plays an important role in higher dimensional theories of gravity. In five dimensions there are two orders of Lovelock Gravity, where the first order of Lovelock gravity is equivalent to Einstein's theory of gravity. The second order of Lovelock gravity is equivalent to the Einstein-Gauss-Bonnet (EGB) theory, including the quadratic curvature correction of Einstein's theory with a non-vanishing coupling constant α_2 known as the Gauss-Bonnet term. The corresponding Lovelock black holes are formulated in asymptotically flat spacetime in this work. The Lovelock black hole is formulated by finding metric solutions of the first and second-order field equation of the Lovelock theory with a static spherically symmetric ansatz. We also study the charged black holes in a spherically symmetric electric field. The first-order Lovelock black hole is equivalent to the five-dimensional Schwarzschild-Tangherlini solution.
In contrast, the first order charged Lovelock black hole is equivalent to the five-dimensional Reissner-Nordström solution. The second-order Lovelock black hole is equivalent to the neutral Einstein-Gauss-Bonnet solution, and the second-order charged lovelock black hole is equivalent to the charged Einstein-Gauss-Bonnet solution. Lastly, the property of the solution is studied by variating its parameters (in terms of mass, charge, and coupling constant).

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