N^{th}-Order Superintegrable Systems Separating in Polar Coordinates

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ABSTRACT

Classical and quantum Hamiltonian systems in two- dimensional Euclidean plane and allowing separation of variables in polar coordinates are investigated. The additional integral of motion is assumed to be a polynomial of degree $N > 2$ in momenta. After analyzing the particular cases of $N = 3, 4$ and 5, a general description will be given. This leads to a classification of superintegrable potentials into two major categories. For the exotic potentials, the existence of an in finite family of superintegrable potentials in terms of the sixth Painleve transcendent P6 is conjectured and will be demonstrated for the first few cases.