On the algebraic structure of rotationally invariant two-dimensional Hamiltonians on the noncommutative phase space

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Abstract

We study two-dimensional Hamiltonians in phase space with noncommutativity both in coordinates and momenta. We consider the generator of rotations on the noncommutative plane and the Lie algebra generated by Hermitian rotationally invariant quadratic forms of noncommutative dynamical variables. We show that two quantum phases are possible, characterized by the Lie algebras or su(2) according to the relation between the noncommutativity parameters, with the rotation generator related with the Casimir operator. From this algebraic perspective, we analyze the spectrum of some simple models with nonrelativistic rotationally invariant Hamiltonians in this noncommutative phase space, such as the isotropic harmonic oscillator, the Landau problem and the cylindrical well potential..