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Symmetries of non-relativistic quantum-mechanical Hamiltonian
BOJAN TUNGUZ, Wabash College — In non-relativistic quantum mechanics the most fundamental invariance group of the Hamiltonian is the Galilean group of transformations: the group spatial and temporal translations and rotations. The quantum-mechanical wave functions in that view belong to an infinite-dimensional representation of the Galilean group, and the generators are represented with first-order differential operators. In this work we look at all the higher order differential operators that commute with the Hamiltonian and construct the most general group that leaves the Hamiltonian invariant. We show how the Galilean group fits within this group, and we show how the interaction terms break the symmetry of the free-particle Hamiltonian. We argue that the interpretation of the Hamiltonian in terms of individual interacting particles is the consequence of this broken symmetry.

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