Hamiltonian Moments: The Geometry and the Symmetry

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Abstract

The nth moment of the Hamiltonian operator H for a given vector ψ is defined as $< \psi|H^n|\psi >$. It is well known that the 'n' eigenvalues of a given system can be calculated from the $(2n-1)$ moments of the operator, using an appropriate starting vector. This formation is equivalent to that of calculating the eigenvalues of the Hamiltonian operator, using an n dimensional orthogonal eigenbasis.

In this paper, the moments are calculated for the oscillator Hamiltonian through the route of Lanczos algorithm. The distribution of $(2n-1)$ moments and the distribution of 'n' eigenvalues are compared. Further, changes brought in the geometrical distributions of moments and the eigenvalues by the addition of new terms in the oscillator potential are systematically studied. Symmetries associated with moments are investigated and analysed.