SYMMETRY PROPERTIES OF THE COULOMB POTENTIAL WITH A LINEAR DEPENDENCE ON ENERGY[*]

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Abstract

The D-dimensional Schrödinger equation for a Coulomb potential with a coupling constant depending linearly on energy is analytically solved. The energy spectrum in the asymptotic regime of the slope parameter is found to be fully determined up to a scale only by its quantum numbers. The raising and lowering operators for this limiting model are determined from the recurrence properties of the associated solutions. It is shown that they satisfy the commutation relations of an $SU(1,1)$ algebra and act on wave-functions which are normalized differently from the case of the usual bound state problem for an energy independent Coulomb potential.

MSC: 81Rxx, 33Cxx, 34Axx

keywords: Energy dependent potentials, Coulomb potential, $SU(1,1)$ symmetry, Asymptotic expansion

1 Introduction

Exactly solvable problems associated to quantum systems have always attracted much attention due to their simple but elegant algebraic structure.