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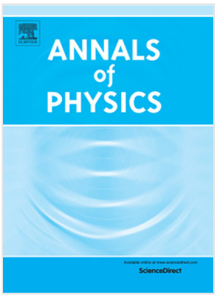

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Axel Schulze-Halberg, Pinaki Roy

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QUANTUM MODELS WITH ENERGY-DEPENDENT POTENTIALS SOLVABLE IN TERMS OF EXCEPTIONAL ORTHOGONAL POLYNOMIALS

Axel Schulze-Halberg† and Pinaki Roy‡

† Department of Mathematics and Actuarial Science and Department of Physics, Indiana University Northwest, 3400 Broadway, Gary IN 46408, USA, e-mail: axgeschu@iun.edu, xbataxel@gmail.com

‡ Physics and Applied Mathematics Unit, Indian Statistical Institute, Kolkata 700108, India, e-mail: pinaki@isical.ac.in

Abstract

We construct energy-dependent potentials for which the Schrödinger equations admit solutions in terms of exceptional orthogonal polynomials. Our method of construction is based on certain point transformations, applied to the equations of exceptional Hermite, Jacobi and Laguerre polynomials. We present several examples of boundary-value problems with energy-dependent potentials that admit a discrete spectrum and the corresponding normalizable solutions in closed form.

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Key words: exceptional orthogonal polynomials, energy-dependent potentials, point transformation

1 Introduction

Systems that feature energy-dependent potentials occur frequently in various areas of Quantum Mechanics and its applications. Recent examples for such systems can be found in magneto-hydrodynamic models of the dynamo effect [11], hydrodynamics [12], the Hamiltonian formulation of relativistic quantum mechanics [18], the area of quantum wells and semiconductors [2] [17], and models of heavy quark systems [4], just to name a few. Due to their practical applicability, mathematical properties of energy-dependent potentials have been studied thoroughly, especially in regards to the modified quantum theory that they obey. In particular, the construction of the completeness relation and the usual L^2-norm are affected [5]. Further theoretical work on energy-dependent potentials includes the application to confined models [14], their generation by means of the supersymmetry formalism [26] and through point transformations of hypergeometric equations [6]. Similar to the work done in the latter two references, the purpose of this research is to find quantum models featuring energy-dependent potentials. However, in difference to former work, here we are interested in models that admit solutions in terms of