

Mathematical Physics

Infinitely many shape invariant potentials and cubic identities of the Laguerre and Jacobi polynomials

Satoru Odake, Ryu Sasaki

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We provide analytic proofs for the shape invariance of the recently discovered (Odake and Sasaki, Phys. Lett. B679 (2009) 414-417) two families of infinitely many exactly solvable one-dimensional quantum mechanical potentials. These potentials are obtained by deforming the well-known radial oscillator potential or the Darboux-P\"{o}schl-Teller potential by a degree ℓ ($\ell=1,2,\dots$) eigenpolynomial. The shape invariance conditions are attributed to new polynomial identities of degree 3ℓ involving cubic products of the Laguerre or Jacobi polynomials. These identities are proved elementarily by combining simple identities.

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