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A GENERAL POTENTIAL AND REDUNDANT POLES FOR THE S-MATRIX

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ABSTRACT

The purpose of this short communication is to show that at "redundant poles" the linear independence of two basic solutions used for evaluating usual S-matrix for a general potential

$$V(r) = -\frac{n(n+1)\alpha^2}{\cosh^2 \alpha r}$$

breaks down.

1. Introduction

Several authors [1-6], applying suitable functional transformations to a second order differential equation, have constructed solvable potentials for the non-relativistic Schrödinger equation, the relativistic Klein-Gordon and Dirac equations. The potentials were obtained from hypergeometric, confluent hypergeometric and Bessel differential equations. A potential of the type

$$V(r) = -\frac{n(n+1)\alpha^2}{\cosh^2 \alpha r}$$

was constructed by one of the authors of the present communication [7] by transforming the associated Legendre differential equation following the method used in our previous papers. This potential derives its importance from the fact that for particular values on $n = 1$ it gets reduced to the potential already derived [8]. Similarly for $n = 1$ and replacing $\alpha by - \alpha/2$, it takes the form of an Eckart [9] type of potential (with special value $\beta = 1$).

It is well-known that the poles of the s-matrix in the upper half plane of the complex momentum variable correspond to genuine bound states of the system; and a set of states must include these bound states before they constitute a complete set. It was shown [10] that in the case of an exponential potential for the s-wave, S–matrix, there exist poles that do not contribute the completeness even though they appear in the same part of k- plane as the bound state poles. These

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