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Quantum Mechanical Resonance and Limiting Absorption: The Many Body Problem

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Abstract. We introduce a notion of quantum mechanical resonance that does not rely on analytic continuation of resolvent or scattering matrix and relate it to slow temporal decay of certain distinguished resonant states. We proceed to prove existence of resonances for the generalized many body Schrödinger operator for a rather large class of potentials containing Coulomb and Yukawa, but also nonsymmetric and nonanalytic potentials with Coulomb-like singularities at the origin and certain differentiability and decay properties.

Introduction

There are several instances in classical quantum mechanics where a system possesses quasi-stable states, that are not eigenstates of the associated Schrödinger operator. For these states ordinary spectral and scattering theory fails to explain the longevity of these states

There have been several approaches proposed in the last fifteen years or so to account for these states and to give estimates of their half-lives. The most notable among these involve continuing the resolvent of the Schrödinger operator across the real axis onto the second sheet of the complex plane and identifying poles of this continued resolvent. We refer in particular to Simon [S1] and to some comments in Sect. 2 of this paper.

Such poles are called resonances and can be made responsible for
- longevity of associated quasi-eigenstates
- peaks in the spectral density of the operator
- peaks in the associated scattering amplitude.

In this paper we propose to study resonances based on limting absorption principles applied to the Schrödinger operator. This means we identify resonances directly as isolated peaks in the spectral density function and proceed to make the

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