

量子物理学・ナノサイエンス第 453 回セミナー

Analytic structure of quantum resonances via exact WKB, scattering theory, and complex scaling

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概 要

Quantum resonances appear in a wide range of physical systems as metastable states embedded in, or coupled to, a continuum. While they are commonly characterized as poles of the scattering matrix at complex energies, their relation to wave functions, boundary conditions, and the continuum spectrum is more subtle than in ordinary bound-state problems.

In this seminar, I will discuss quantum resonances from the viewpoint of analytic continuation and complex spectral theory. After reviewing the basic connection between resonant states, outgoing boundary conditions, and poles of the scattering amplitude, I will introduce the exact WKB method as a useful framework for analyzing resonances nonperturbatively through the analytic structure of wave functions in the complex plane. I will then explain how complex scaling provides a complementary description in which resonant states can be treated as discrete eigenstates separated from the rotated continuum.

Using simple one-dimensional examples, I will illustrate how exact WKB, scattering theory, and complex scaling provide mutually consistent descriptions of resonance energies, decay widths, and continuum states. I will also comment on possible connections to non-Hermitian physics and resonance phenomena in many-body and condensed-matter systems.

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