Forming a bound state in the continuum by interference of Floquet-Feshbach resonances

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ABSTRACT

Open quantum systems are exposed to their environment, leading to dissipation and loss that limit control and coherence. This impacts specifically impurities coupled to many-body systems in quantum information processing, sensing or simulation.

In my talk, I show how we use tight control of scattering resonances to suppress this coupling to the environment via destructive interference, realizing a long-sought quantum mechanical bound state in the continuum. Using Floquet engineering in an ultracold atomic gas, we coherently couple two tunable Feshbach resonances and induce an avoided crossing. At a critical parameter point, all coupling to the continuum vanishes, yielding a molecular state above the dissociation threshold. Loss spectroscopy, quench dynamics, and rf-photoassociation directly reveal suppressed decay and vanishing overlap with scattering states. Full coupled-channel calculations and a minimal non-Hermitian model quantitatively capture the observations, identifying a Friedrich–Wintgen bound state in the continuum. Our results establish quantum interference as a tool for controlling openness and engineering non-Hermitian Hamiltonians.