Abstract

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The Tunneling Effect for Schrödinger operators on a vector bundle

In the semiclassical limit $\hbar \to 0$, we analyze a class of self-adjoint Schrödinger operators $H_\hbar = \hbar^2 L + \hbar W + V \cdot \mathrm{id}_{\mathscr{E}}$ acting on sections of a vector bundle $\mathscr{E}$ over an oriented Riemannian manifold M where L is a Laplace type operator, W is an endomorphism field and the potential energy V has non-degenerate minima at a finite number of points $m^1, \dots m^r \in M$, called potential wells. Using quasi-modes of WKB-type near m^j for eigenfunctions associated with the low lying eigenvalues of $H_\hbar$, we analyze the tunneling effect, i.e. the splitting between low lying eigenvalues, which e.g. arises in certain symmetric configurations. Technically, we treat the coupling between different potential wells by an interaction matrix and we consider the case of a single minimal geodesic (with respect to the associated Agmon metric) connecting two potential wells and the case of a submanifold of minimal geodesics of dimension $\ell + 1$. This dimension ℓ determines the polynomial prefactor for exponentially small eigenvalue splitting.