

STRONG FIELD BEHAVIOUR OF ZERO MODES OF PAULI AND WEYL-DIRAC OPERATORS

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ABSTRACT. We consider zero-energy eigenfunctions, or *zero modes*, of the Pauli operator $\mathcal{P}_A = [\sigma \cdot (-i\nabla - A)]^2$ in \mathbb{R}^d when $d = 2$ or 3 . The strong field (or, equivalently, semi-classical) regime can be studied by considering the asymptotic occurrence of zero modes for scaled potentials tA (A fixed, $t \rightarrow \infty$). When $d = 2$ zero modes can be explicitly characterised using a result of Aharonov and Casher; by working on a bounded region (with Dirichlet boundary conditions) we give a sense in which this result can be localised, leading to “approximate zero modes”. The situation when $d = 3$ is more subtle. Progress towards a general asymptotic result includes rough but widely applicable bounds, and asymptotics for special classes of “symmetric” potentials (when the problem can be reduced to a two dimensional one).