On Realizations of Supersymmetric Dirac Operator with Aharonov - Bohm Magnetic Field

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We consider operator models for the supersymmetric Dirac Hamiltonian (supercharge) H describing electron moving in the singular Aharonov-Bohm magnetic field. In the standard model of H one takes a special self-adjoint extension H^s of the minimal operator which is uniquely determined as the self-adjoint extension of the minimal operator satisfying the conditions: 1) H^s is supersymmetric; 2) with $(H^s)^2 =$ diag (H^+, H^-) it holds $H^+ \geq H^-$ if $\nu > 0$ and $H^+ \leq H^-$ if $\nu < 0$. It occurs that the spectral shift functions $\xi(\lambda)$ for the pair $\{H^+, H^-\}$ associated with H^s is equal to $\xi(\lambda) = (\nu - [\nu])\theta(\lambda)$. However, this differs from the case of regular magnetic field with the same value of magnetic flux, where the corresponding spectral shift function $\xi(\lambda) = \nu\theta(\lambda)$. This difference comes from the presence of $[|\nu|]$ zero modes in the regular case.

We compare this with proposed nonstandard models of H based on the extension theory in Pontryagin spaces. Particularly, we discuss $[|\nu|]$-parametric family of realizations of the Dirac and Pauli Hamiltonians in Pontryagin spaces which have the same number of zero modes as in the case of regular magnetic field with the same value of magnetic flux.