Gauge field theory approach to spin transport in semi-conductors

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We discuss the Pauli Hamiltonian within a $SU(2)$ gauge theory interpretation, where the gauge symmetry is broken. This interpretation carries directly over to the structural inversion asymmetric spin-orbit interactions in semiconductors and offers new insight into the problem of spin currents in the condensed matter environment. The central results is that symmetry breaking leads to zero spin conductivity in contrast to predictions of Gauge symmetric treatments. Computing the translation operator commutation relations comprising the simplest possible structural inversion asymmetry due to an external electric field, we derive a new condition for orbit quantization. The relation between the topological nature of this effect is consistent with our non-Abelian gauge symmetry breaking scenario.