Driven Topological Insulator Quantum Dot: A spin-particle source (SpPS)

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Abstract
We propose a device that allows for the emission of pairs of spin-polarized electrons into the edge states of a two-dimensional topological insulator [1]. Charge and spin emission is achieved using a periodically driven quantum dot weakly [2] coupled to the edge states of the host topological insulator. We present calculations of the emitted time-dependent charge and spin currents of such a dynamical scatterer using the Floquet scattering matrix approach. Experimental signatures of spin-polarized two-particle emission can be found in noise measurements [3,4]. Here we introduce a new form of noise suppression, named $Z_2$ anti-bunching. Additionally, we propose a setup in which entanglement of the emitted electrons is generated. This entanglement is based on a post-selection procedure and becomes manifest in a violation of a Clauser-Horne-Shimony-Holt inequality [3].

References

Figures
Zero-temperature emitted charge as a function of the height of the driving step $U_0$. The various lines correspond to different values of the reflection probability of the QPC $|\lambda_{pb}|^2$: $|\lambda_{pb}|^2=0.95$ (solid red line), $|\lambda_{pb}|^2=0.5$ (dashed blue line), and $|\lambda_{pb}|^2=0.1$ (dotted green line). Please note that the steps are given in units of twice the electron charge. Upper inset: The density of states of the QD for various values of $|\lambda_{pb}|$. Lower inset: Model of driving we consider: the driving of the gate is switched on at time $t_0$ and the potential is changed by a quantity $U_0$. 