

# Quantum transfer between arbitrary pairs of protected states in a topological ladder

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In recent years, the number of proposed quantum protocols which use the protected end states of topological insulators has increased steadily [1-4]. Most of them, however, are constrained by two limitations: the transfer can only happen between the ends of the system, and the time it takes to be completed scales exponentially with distance.

We explore solutions to these issues by proposing a family of quantum transfer protocols between any two topological states in a quasi-1D topological insulator: the multi-domain Creutz ladder.

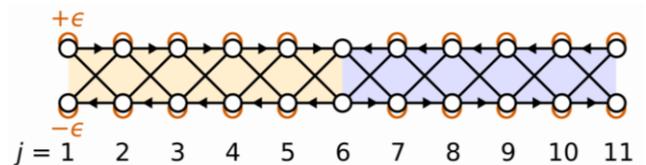
This model can have an arbitrary number of topological modes. Each of its domain walls holds two such states, which can be tuned with a control parameter [5]. This is possible due to the interference created by the magnetic field, which is also responsible for the flat bands of the model. In our work [6], we describe its topological subspace in detail, propose the transfer protocols mentioned above, and discuss some applications in the field of quantum information.

## References

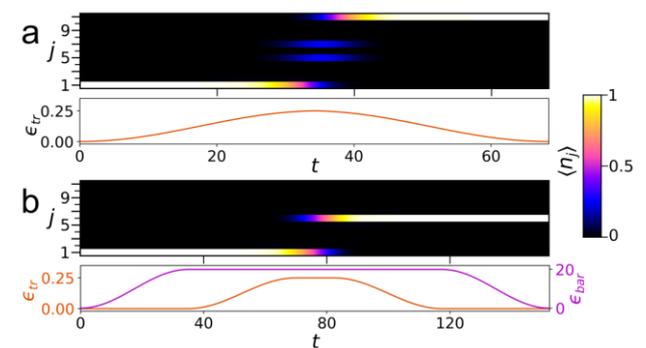
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## Figures



**Figure 1:** Two-domain Creutz ladder with an energy imbalance of  $2\epsilon$ . The two non-equivalent topological domains are defined by the magnetic field values of  $\phi = \pi$  (yellow) and  $\phi = -\pi$  (blue).



**Figure 2:** Topological transfer protocols in a two-domain Creutz ladder. The occupation number per rung is represented as a function of rung number  $j$  and time  $t$ . The energy imbalances of the model, which act like control parameters, are represented below the transfer picture. (a) Left-to-right transfer. (b) Left-to-center transfer.