Computation of topological invariants in disordered systems using algebraic projectors

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We present a method to efficiently identify the topological phases of strongly disordered systems, such as alloys, disordered crystals, or amorphous systems. Our method extends the idea of real space markers of topological invariants[1]. A localized approximation of the band projector based on the kernel polynomial method[2], combined with the stochastic trace approximation and an appropriate choice of boundary conditions, builds up an efficient computation of topological invariants. We apply this systematic approach to the case of $Pb_{1-x}Sn_xTe$ alloy, a three dimensional mirror Chern insulator [3, 4]. The efficiency of our computation allows us to obtain the mirror Chern number for systems with more than 10^7 degrees of freedom, and makes it possible to study large samples and compounds, where disorder plays a central role.

References

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Figures

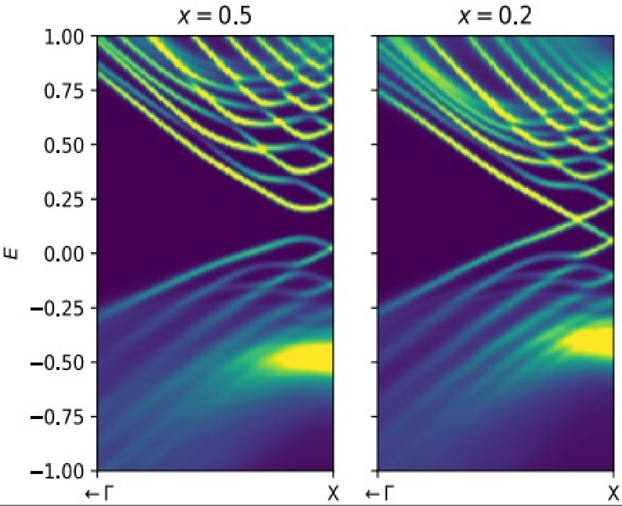

Figure 1: Surface spectra of a 20×80×80 sample of $Pb_{1-x}Sn_xTe$ in the trivial and topological phase. The presence of a gapless surface Dirac cone indicates the mirror Chern insulator phase.

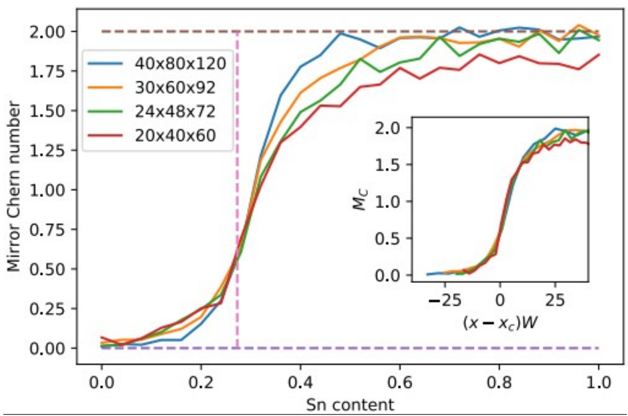

Figure 2: Transition between trivial and mirror Chern phase when varying x for $Pb_{1-x}Sn_xTe$. Inset: Finite size collapse of the curves.