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Phonon-induced topological insulation

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Recent years have witnessed the unexpected discovery of novel topological phases in certain electrically insulating and semimetallic solids whose low-energy bulk excitations are Dirac fermions.
Topological phases in these "Dirac materials"are characterized by nonzero integers (topological invariants), which manifest themselves through peculiar and robustly gapless states localized at the boundaries of the material.
Partly enticed by a vision of transistors that would operate by switching topological invariants on and off, there is keen interest in finding ways to induce topological phases in intrinsically nontopological materials.

In this talk, I will show that electron-phonon interactions can alter the band topology of narrow-gap Dirac insulators and semimetals, at both zero and nonzero temperature.
The underlying mechanism for this effect can be explained in terms of the electron-phonon scattering matrix elements, which show a peculiar dependence on the sign of the mass of the Dirac fermions.
Contrary to the common belief that increasing temperature always destabilizes topological phases, our results highlight instances in which phonons might lead to the appearance of topological surface states above a crossover temperature in a material that has a topologically trivial ground state.
I will discuss possible experimental implications of this effect in HgTe/CdTe quantum wells and in Bi Tl(S_x Se_{1-x})_2.

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