Broken symmetry driven topological semi-metal to gapped phase transitions in SrAgAs

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Abstract
We show the occurrence of Dirac, Triple point, Weyl semimetal and topological insulating phase in a single ternary compound using symmetry preserving perturbations. Alloy engineering in SrAgAs (space group P63/mmc) leads to tune various excitonic phases from Dirac to topological insulating phase via intermediate triple point and Weyl semimetal phase. Time reversal symmetry (TRS) breaking perturbation leads to realize the Weyl state.

Objectives
- To understand the distinct topological phases from symmetry considerations
- To investigate the broken symmetry driven phase transition among different topological semimetallic states

Results & Discussions

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<tr>
<th>Symmetry elements</th>
<th>Material</th>
<th>SrAgAs</th>
<th>SrAg0.5Cu0.5As</th>
<th>SrAg0.25Cu0.75As</th>
<th>SrAgAs with broken TRS</th>
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<td>C6v (Γ - A)</td>
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<td>Phase</td>
<td>Dirac</td>
<td>Triple</td>
<td>TI</td>
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Summary
- Occurrence distinct topological phases in a single material via certain symmetry preserving perturbation
- Fermi arcs are band topology mediated phenomena which can not be avoided due non-trivial band topology

Hamiltonian under magnetic field:

$$H(k) = \epsilon_0 |k| + \begin{pmatrix} A(k) - M(k) & 0 & B(k) & M(k) \\ 0 & -M(k) & 0 & A(k) \\ B(k) & 0 & -M(k) & 0 \\ M(k) & A(k) & 0 & -M(k) \end{pmatrix}$$

$$E(k) = \epsilon_0 |k| \pm \sqrt{M(k)^2 + A^2 |k|^2 + B(k)^2}$$

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