Hamiltonian Topological Optics

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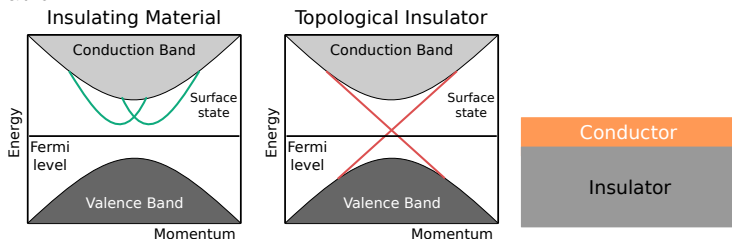
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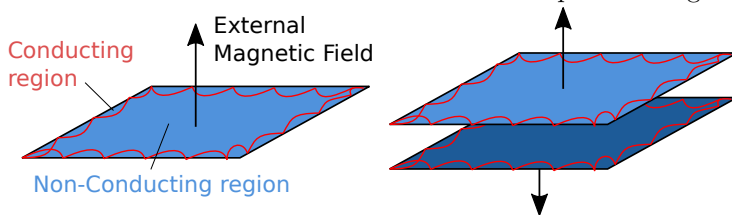

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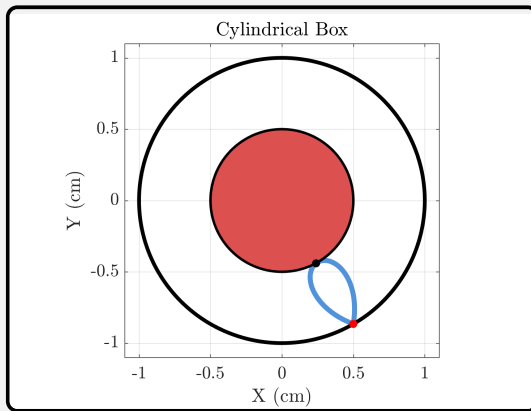
Topological Physics

Q: What does topology mean for an optical system?

- Topology is the study of materials and what happens to their physical properties under deformations.
- A topological insulator (TI) exploits the electrical properties in atom configuration.
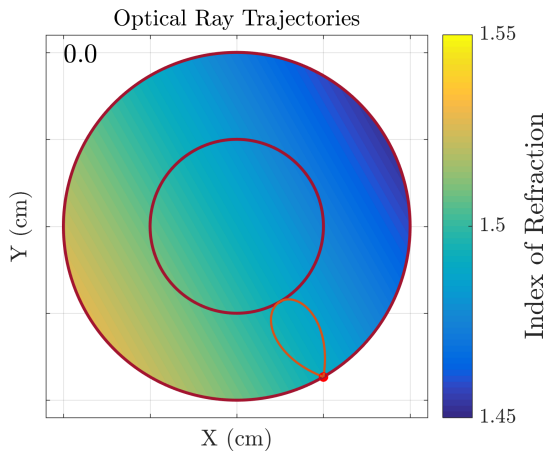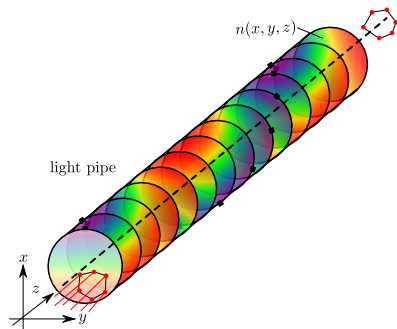

- Simple model of a TI: two sheets of electrons with anti-parallel magnetic fields.

Topological Optics

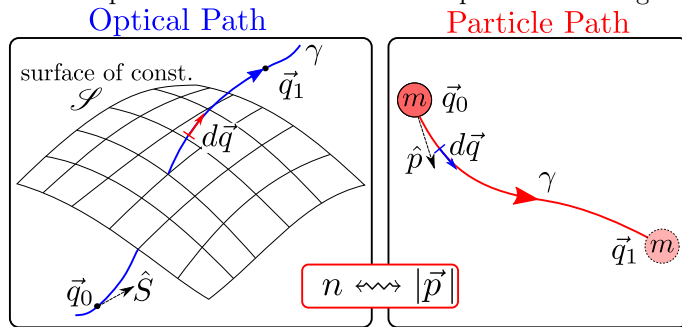Design new techniques to control the phase or *trajectories* of rays.

- **If you can numerically integrate $\dot{x} = F(t, x)$ you can start right now!**
- **Hamiltonian Mechanics**

$$H(q, p) = \frac{p^2}{2m} + V(q) \quad \Rightarrow \quad \dot{q} = \frac{\partial H}{\partial p}, \quad \dot{p} = -\frac{\partial H}{\partial q}$$

- **Hamilton's Optomechanical Analogy**
  Fermat's Principle of Least Time: Light path minimizing time
  Maupertuis' Principle of Least Action: Classical path minimizing action

Simulate optical paths using classical trajectories.