Topological Quantum Phases and Light Spheres

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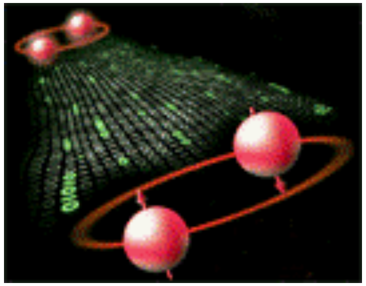


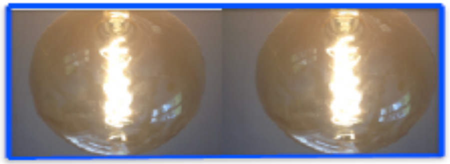
https://www.cpht.polytechnique.fr/cpht/lehur/Karyn.LeHur.html

Periodic Table of Topological Invariants: Application of Topology to Physics
Topological Insulators and Superconductors

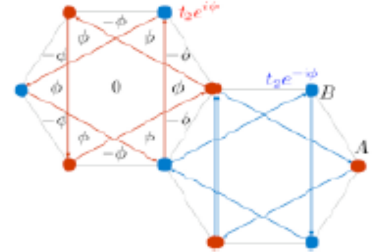
Symmetry Class	Time reversal symmetry	Particle hole symmetry	Chiral symmetry
A	No	No	No
AIII	No	No	Yes
AI	Yes, $T^2 = 1$	No	No
BDI	Yes, $T^2 = 1$	Yes, $C^2 = 1$	Yes
D	No	Yes, $C^2 = 1$	No
DIII	Yes, $T^2 = -1$	Yes, $C^2 = 1$	Yes
AII	Yes, $T^2 = -1$	No	No
CII	Yes, $T^2 = -1$	Yes, $C^2 = -1$	Yes
C	No	Yes, $C^2 = -1$	No
CI	Yes, $T^2 = 1$	Yes, $C^2 = -1$	Yes

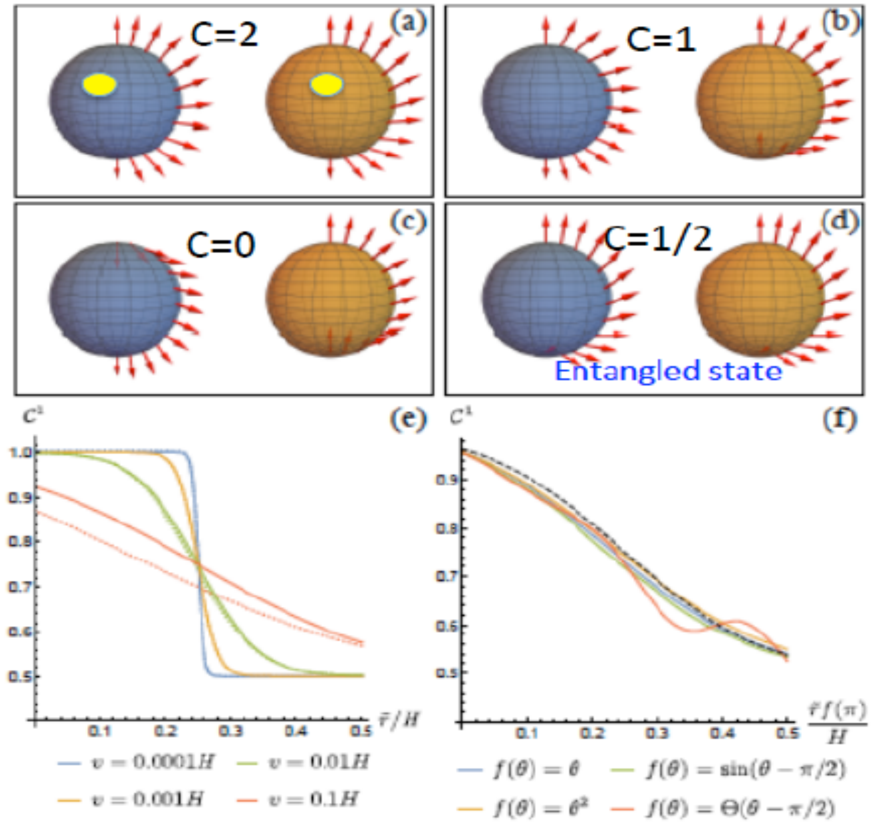
Topological states are characterized by a topological invariant linked to transport
Topology can also be achieved by applying a radial magnetic field on a (Bloch) sphere

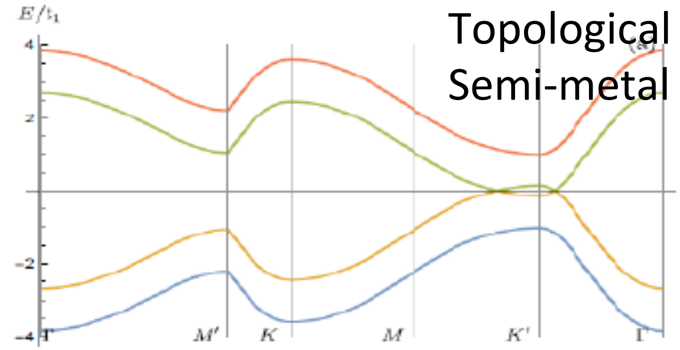
Analogy to Gauss' law for electromagnetism
Realized with current technology, spin-1/2 in curved space



Spheres realizable
in cQED mesoscopic
and atomic systems







Topological
Semi-metal

spheres	lattices
Spin 1/2	- 2 sublattices - Nambu basis
Radial Field on S^2	- Haldane model - P-wave SC - Resonating Bonds

Joel Hutchinson and Karyn Le Hur arXiv:2002.11823 and Communications Physics 1, **11** (2021)
https://www.nature.com/articles/s42005-021-00641-0

Peng Cheng, Philipp W. Klein, Kirill Plekhanov, Klaus Sengstock, Monika Aidelsburger, Christoph Weitenberg, Karyn Le Hur, Phys. Rev. B (2019) , application in bilayer systems

New Objectives

https://www.nature.com/articles/s42005-021-00641-0
Circuit with more spheres: wire model in curved space
Analogy with coupled planes models and coupled wires, 3D

Quantum Hall Effect, Topological insulators and superconductors
https://arxiv.org/abs/1910.04816
https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.2.022043

- Interaction Effects, stochastic approach and Coulomb Forces

https://arxiv.org/abs/2002.01742

- New Geometry, Transport and Light-Matter Systems

https://arxiv.org/abs/2106.15665

- Time Protocols, Measures and Entanglement, codes

https://arxiv.org/abs/1901.06489
https://arxiv.org/abs/1702.05135

- Applications for Energy as Emitter of Light, quantum dynamo effect

https://arxiv.org/abs/1611.05085