2/18 Kitaev Spin Liquids

- Context

Theory

∃ few examples where QSLs (quantum spin liquids) are rigorously known to be the ground-states

Lack of suitable theoretical methods

- Analytic large S / large N calculations "biased" (miss out on crucial aspect: entanglement)

- Computational methods ⇒ Need very high precision ⇒ ground-state nature

Kitaev Spin Liquid

Exactly Soluble (decomposition of Majorana fermions)

↑ we will discuss them shortly

Fractionalization of spin can be "tracked"

↙ static $\mathbb{Z}_2$ gauge field with a Δ

↙ KSL in ground-state flux sector

↘ (Majorana) fermion degree of freedom

Transitions out of QSL

⇓

"confinement" of Majorana fermions

- Experimental Realizations

  Crucial Aspects

  - Large Spin – Orbit Coupling
  - Bonding Geometry.

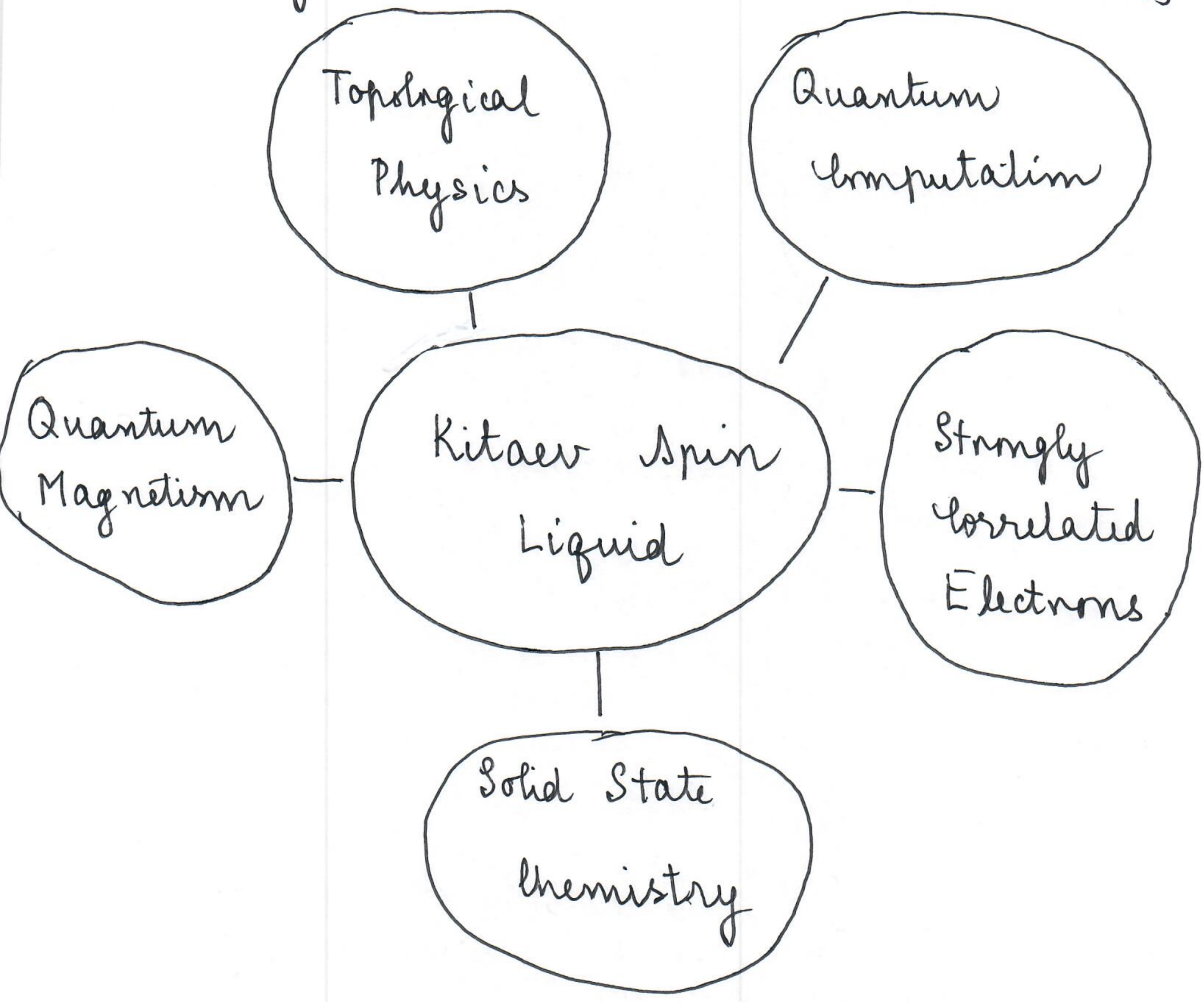
- Link to Toric Code (periodic boundary conditions)

  - Topological Order
  - Simple Topological Quantum Error Correcting Code

    - Local errors, thermal noise and decoherence are the main obstacles in the realization of a quantum computer

    - Topological properties (nonlocal) may be a way to address this in physical systems

- Qubits encoded in topological states may be robust to local perturbations



Quite impressive for a "toy model"!