Potential topics for student presentations or papers.

You can take the items in this list as inspiration for a topic; when multiple things are listed in a bulleted item you don't have to talk about all of them. You can also come up with your own topic. Feel free to reach out to me for suggestions or for more background information on any number of these topics. We will meet to discuss your chosen topic, or topics that you are debating between, starting at the end of the second week of class. At most one person per paper topic (though you can team up for a presentation) — you can start reserving topics now by emailing me (first come first serve). You are welcome to change topics later on, as long as no one has claimed your new topic.

Topics for weeks 4 or 5

- Continuous symmetries and Lie groups, Noether's theorem
- Lie algebras, Heisenberg and $\mathfrak{sl}_2$, uncertainty principle
- Multiple particle systems, hydrogen atom, spin
- Fermions and bosons, spin-statistics, Pauli exclusion, thermodynamics
- Quantum algorithms, quantum Fourier transform, Shor's algorithm
- Path integral formalism, Lagrangians, Wiener measure
- Quantum field theory, scattering, Feynman diagrams

Topics for week 6

- Poisson brackets and quantizing classical systems
- Wightman's axioms for quantum field theory and consequences
- Formalizing the spectral theorem for unbounded operators
- The WKB approximation
- Angular momentum and representations of the spin group
- Noether's current conservation theorem
- Phonons and quantum mechanics in solids
- Bose-Einstein condensation and the statistics of many-particle systems
- Gleason's theorem or Selon's theorem explaining quantum foundations
- C*-algebras and von Neumann algebras as an algebraic context for quantum mechanics
- Proving Pontryagin duality