

## Potential final projects:

- Quantum Entanglement: entanglement of mixed states, separability, bound and free entanglement, entanglement as a resource for teleportation
  - Preskill lecture notes, Chapter 4
  - R. Horodecki et al., Rev. Mod. Phys. 81, 865 (2009)  
<https://doi.org/10.1103/RevModPhys.81.865>
- Relation between tensor networks and quantum circuits
  - W. Huggins, Quantum Sci. Technol. 4 024001 (2019).  
[10.1088/2058-9565/aaea94](https://doi.org/10.1088/2058-9565/aaea94)
  - S.-J. Ran, Phys. Rev. A 101, 032310 (2020)  
<https://doi.org/10.1103/PhysRevA.101.032310>
- Quantum algorithms: VQE and subspace VQE for finding ground states of fermionic many-body models such as the Hubbard model; includes fermion to qubit mapping.
  - <https://arxiv.org/abs/2208.07192>
  - <https://arxiv.org/abs/1001.3855>
  - <https://journals.aps.org/prxquantum/abstract/10.1103/PRXQuantum.2.010333>
  - <https://arxiv.org/abs/2010.05638>
  - <https://arxiv.org/abs/2209.10571>
- Quantum algorithms: simulating nonequilibrium dynamics of quantum spin chains. Comparing Trotter evolution to variational approaches
  - <https://journals.aps.org/prxquantum/abstract/10.1103/PRXQuantum.2.030307>
  - <https://quantum-journal.org/papers/q-2019-10-07-191/>
- Noise tomography: gate set tomography (theory and application using pyGSTi)
  - <https://arxiv.org/abs/1509.02921>
  - <https://arxiv.org/abs/2009.07301>
  - <https://www.pygsti.info>
- Quantum error mitigation: application of probabilistic error correction (PEC) and probabilistic error reduction (PER) using the Python toolkit Mitiq
  - <https://arxiv.org/abs/1612.02058>
  - <https://journals.aps.org/prxquantum/abstract/10.1103/PhysRevA.104.052607>
  - <https://quantum-journal.org/papers/q-2022-08-11-774/>
- Quantum error mitigation (QEM): General resource theory of QEM
  - <https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.3.033178>
  - <https://arxiv.org/pdf/2210.00921.pdf>
  - <https://www.nature.com/articles/s41534-022-00618-z>

- Quantum error correction: Subsystem codes (Bacon-Shor codes)
  - [https://www.quantuminfo.physik.rwth-aachen.de/global/show\\_document.asp?id=aaaaaaaaaiidbg](https://www.quantuminfo.physik.rwth-aachen.de/global/show_document.asp?id=aaaaaaaaaiidbg)
  - <https://arxiv.org/abs/quant-ph/0506023>
  - <https://arxiv.org/abs/quant-ph/0508131>
- Quantum error correction: Floquet codes
  - <https://arxiv.org/abs/2107.02194>
  - <https://arxiv.org/abs/2107.02194>
- Quantum error correction: Surface/Toric code
  - <https://arxiv.org/abs/quant-ph/9707021>
  - <https://sites.google.com/site/danbrowneucl/teaching/lectures-on-topological-codes-and-quantum-computation>
- Quantum error correction: Bosonic codes such as the GKP code
  - <https://journals.aps.org/prapdf/10.1103/PhysRevA.64.012310>
  - <https://arxiv.org/abs/1908.00147>
- Merging QEM and QEC: IBM paper
  - <https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.127.200505>