Chapter 1 Design Principles

1. The Power and Limitations of Quantum Computing
2. Formalism
3. Fault Tolerant Quantum Computing
4. Silicon Phosphorus
5. Optimal Control

Chapter 2 Surface codes

Chapter 2: Architecture design

1. The heavy hexagon surface code
2. The dipole surface code
3. The exchange surface code
4. **Heavy hexagon in silicon**
   * Design specifications
   * Why it’s a bad idea
     + Reduced frequency collisions not applicable to global control SiP
     + Criss cross wire maps poorly onto hexagonal lattice
     + Hexagon maps poorly onto silicon lattice.
       - Reduced symmetry results in greater number of variations due to placement imprecision
5. Heavy square?
6. Light hexagon (unlikely)?

Chapter 3: Quantum control

1. Overview of Quantum control
2. A useful example: Nuclear electron spin swap
3. 2 qubit CNOT
4. 3 qubit CNOT

Chapter 4: Parallel CNOT Optimisation

1. Multi-System control with GRAPE
2. Two qubit CNOTs in parallel
3. Three qubit CNOTs in parallel
4. Problems
   1. Swapping with exchange active
   2. Couplers as a means of avoiding control over exchange

Chapter 5: Tying together into a feasible architecture?

1. No placement imprecision
   1. Couplers become much more feasible
   2. Nuclear spin – nuclear spin 3 qubit CNOT with GRAPE ?
2. Placement imprecision incompatible with coupler architecture
   1. Assume control over exchange
   2. All 2 qubit CNOTs can be done in parallel
3. Coupler architecture with full control over individual loading and unloading
   1. Can do groups of 3 qubit CNOTs (if NE swap works)

Chapter 6 (if time): Noise

1. Minimize noise for single 2 qubit CNOT
2. Minimize noise for multiple 2 qubit CNOTs
3. Minimize noise for single 3 qubit CNOT.