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Coupled CJJ

\[ I_{g}(t) \rightarrow \Phi_{x}^{I_{p,i}} \]

\[ |I_{q}^{P}| \text{ Comp. } i \]

\[ \Phi_{x}^{I_{p,j}} \]

\[ M_{i} \propto h_{i} \]

\[ |I_{q}^{P}| \text{ Comp. } j \]

\[ M_{j} \propto h_{j} \]

\[ \Phi_{x}^{\Phi_{co,ij}} \]

\[ M_{ij} \propto K_{ij} \]

\[ I_{ccjj}(t) \rightarrow \Phi_{ccjj}^{x} \]

R. Harris et. al.
Adiabatic Interpolation

\[ H(t) = A(t) \sum_j \sigma_x + B(t) H_{\text{Ising}} \]
Scalable design...

<table>
<thead>
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<th>Unit cells</th>
<th>Qubits</th>
<th>Couplers</th>
<th>DACS</th>
<th>JJs</th>
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</tbody>
</table>

but no microwave control!!!

$T_2$ and $T_1$ times worse than other superconducting qubits.

Johnson et. al.
Ising Spin Glasses

- Ground state is an NP-Complete problem (Barahona 1982)
- Complex graphs can be embedded into simpler graphs using strong ferromagnetic couplings (Kaminsky and Lloyd, 2002)
  
  ![Diagram of a complex graph and a simpler graph embedded into it.](image)

- The strength of the ferromagnetic couplings grows with the degree of the embedded graph (Choi 2008)
- In principle, an N-complete graph can be embedded in the geometry implemented by Dwave using $N^2$ vertices (Choi 2010)
Exact “chimera” solver (Belief propagation)

M. Drew-Brook
Gaps of spin glasses

Karimi et al. 2010
Spin Glasses (108 spins)  
Prob. vs. time

N. of instances (over 1000)
Spin Glasses
90th percentile

Estimated time (99%) in us (90 percentile)

Number of spins

Estimated time (99%) in us (90 percentile)
Questions?