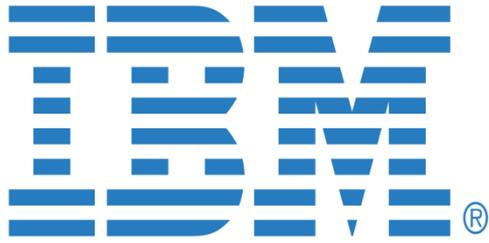


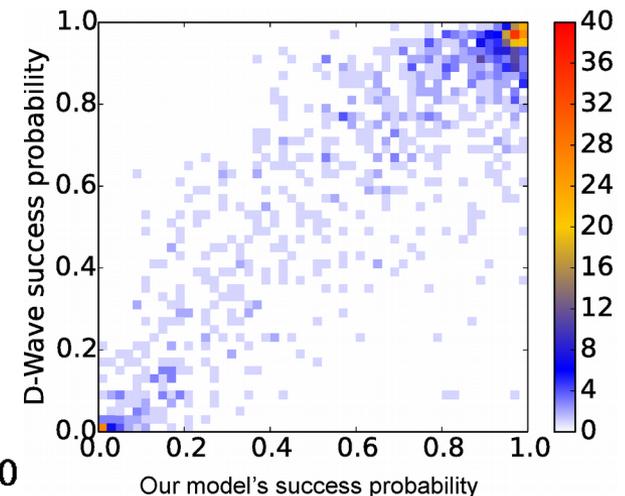
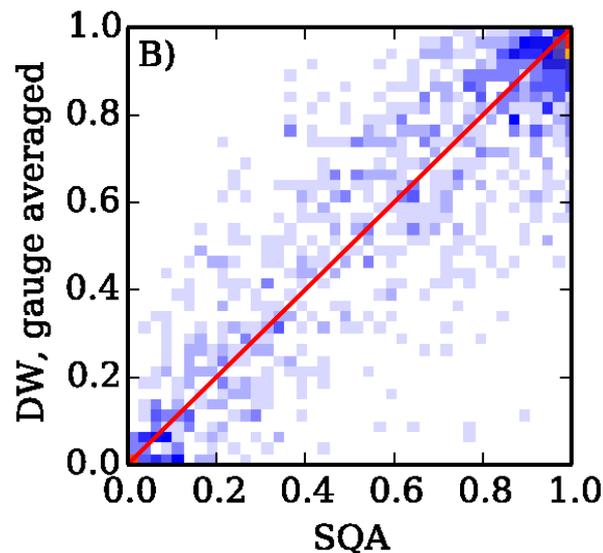
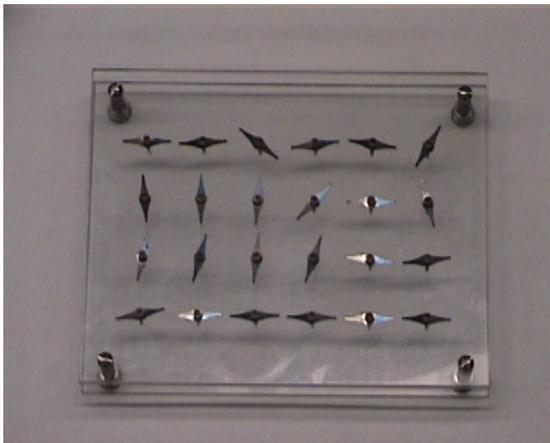


- IBM Research
- John A. Smolin
- Theory Team: C.H. Bennett, K. Temme, S. Bravyi, G. Smith, A. Cross, L.S. Bishop, E. Magesan, A. Mezzacapo and F. Solgun



# How to convince someone you have a quantum computer

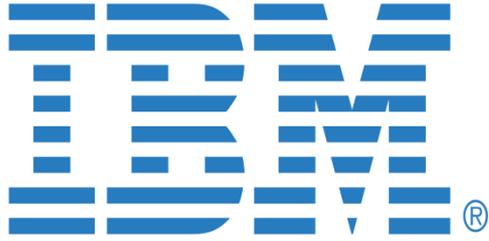
- Solve some problem faster than any classical algorithm
  - Should include scaling with problem size
  - Ronnow et al. shows neither—Why not?
  - If there is a classical model of the system, it's not going to have a quantum enhancement
- 





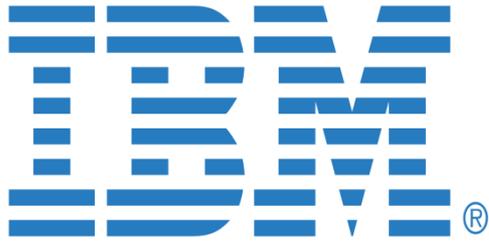
# Value of Skepticism

- *Classical signature of quantum annealing* cited 41 times
- *How “Quantum” is the D-Wave Machine* cited 35 times
- Many responses to our work sharpen the evidence for QEO in D-Wave
- New evidence points to regions of the problem space for which the classical model is not predictive—for example, large connected islands of spins
- These are regions where quantum enhancement must be!



# Research Directions

- Refinement of classical models to further narrow search for quantum enhancements
- Quantum “inspired” classical optimization
- Alternatives to quantum annealing
- Analogue quantum computation and simulation
  
- Available time on Blue Gene supercomputer
- Broad base of theoretical know-how at IBM
- Extensive classical optimization expertise



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