

Adiabatic annealing in arrays of superconducting qubits

Investigate scaling of 'quantumness' using highly-coherent qubits

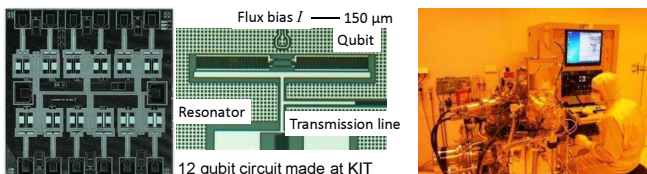
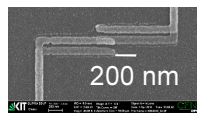
Research interests

Quantum Enhanced Optimization

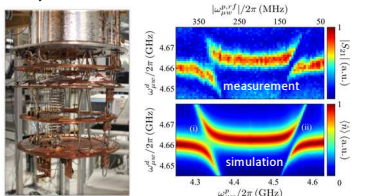
- Use highly-coherent qubits to investigate the behavior of (in general) classically unpredictable arrays of quantum bits
- Investigate and evaluate the foundations of superconducting qubit technology regarding scalability, including development of novel concepts for simulation, design and evaluation of quantum arrays
- Control, verify and simulate quantum array containing (at least) dozens of qubits

KIT quantum lab

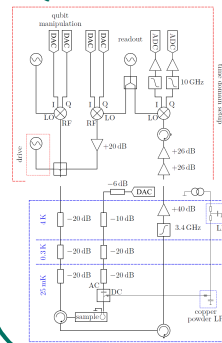
- Al-AlO_x-Al tunnel junction
- Al, Nb, TiN, NbN thin films
- Nanostructures down to ~5nm feature size
- Expertise in phase, flux and transmon qubits



- Several quantum measurement setups (e.g. two large volume dilution refrigerators)
 - RF (18) and DC (24) wires, filters, amplifiers
- Simulation software
 - QuTiP for quantum dynamics
 - Q-KIT for measurement
 - CST, Sonnet for EM fields



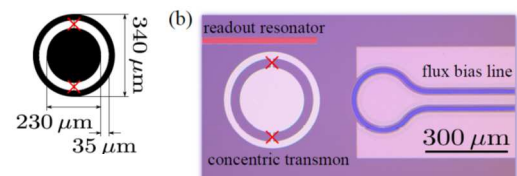
Quantum circuit control and readout



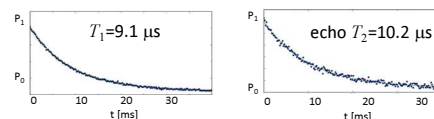
Time-resolved qubit manipulation

- Heterodyne single-sideband mixing, shaped pulses
- Quantum state tomography
- Clear path to scale and control larger numbers of qubits

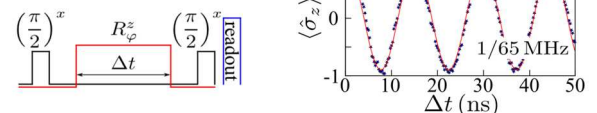
Concentric transmon qubit



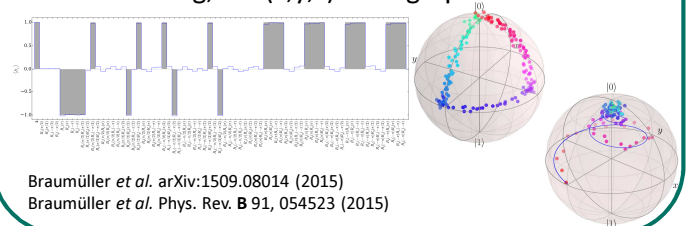
- Side-selective, inductive σ_z -coupling
- Minimized surface/ interface loss (TLS)
- Reduced radiative decay



- Fast (ns) tunability of splitting



- Benchmarking, full (x,y,z) tomographic control



Braumüller *et al.* arXiv:1509.08014 (2015)
Braumüller *et al.* Phys. Rev. B 91, 054523 (2015)

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