SFB/TRR 21 - Colloquium

9. Mai 2014, Tübingen

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Experiments with superconducting metamaterials - from classical to quantum

Superconducting materials allow for utilizing ultra-compact electromagnetic meta-atoms down to the nanoscale while maintaining low-loss properties, very strong and well-controlled nonlinearity, and frequency tunability. This approach opens up an opportunity to develop novel superconducting devices and networks with non-trivially tailored electromagnetic properties. I will present our experiments with superconducting microwave-range metamaterials containing Josephson junctions. The advantage of superconducting thin-film metamaterials is that, due to the tunable intrinsic inductance of the Josephson junction, their resonance frequency can be changed by applying an external dc magnetic field. Using same approach, our work in progress involves tunable left-handed transmission lines as well as tunable split-ring resonators. Superconducting quantum metamaterials comprised of arrays of superconducting qubits are emerging new field for fundamental studies in quantum optics, opening a possibility to explore collective quantum dynamics under strong coupling between electromagnetic field and artificial atoms. A recent experiment with an array of 20 flux qubits will be discussed in the talk.

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