Session 27aD

Quantum dynamics of persistent-current quantum bits **27aD1**

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We are studying the response of single and dual persistent-current quantum bits to continuous and pulsed microwave radiation. The quantum bits consist of three small Josephson junctions in a closed ring with a phase bias of pi. The quantum states have persistent currents of opposite sign. To reduce the influence of external flux noise, qubits are pi-biased with metallic rings containing a trapped fluxoid. Spectroscopic transitions are seen in single and dual qubit samples. Fast pulse excitation and fast read-out are now attempted with different approaches.

Energy Level Spectroscopy with Inelastic Cooper Pair Tunneling **27aD2**

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We have investigated the energy levels of a SQUID with the method of inelastic Cooper-pair tunneling. One or more SQUID(s) are connected to a small Josephson junction, where according to the theory of phase fluctuations, non-coherent Cooper-pair tunneling in the subgap region is possible only if energy is exchanged with the surroundings. By measuring the IV-curve of the probe junction, one can perform spectroscopy of the junction environment. The structure of the IV-curve in the subgap region displays a number of resonances, which are due to energy levels in the SQUIDs. With an external magnetic field, the energy levels of the SQUIDs are modified, and this can be directly seen as a change in the position and weight of the resonance peaks. In our experiment, the measured energy levels can be explained with the band model for ultrasmall Josephson junctions.

27aD3 Tunnel spectroscopy of a double superconducting island qubit

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We have measured transport through a quantum system consisting of two superconducting islands strongly coupled by an ultrasmall Josephson junction. The double island can be seen as a charge qubit since the Josephson junction allows Cooper pair delocalization between the two islands and gate voltages control the state of the system. Tunnel spectroscopy is made possible by means of two other junctions weakly coupling the islands to measurement leads. The current through the device is a probe of the macroscopic energy levels of the double-island. We will show that three different transport regimes can be identified depending on the applied bias voltage. Current noise measurements will be also presented.

27aD4 Quantum Computing with Electrons on Helium

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A concept for a quantum computer based on electrons localized above a helium film as quantum logic elements (qubits) is described. Each qubit is made of combinations of the ground and first excited state of an electron trapped in the image potential well at the surface. A array of electrodes beneath the surface restrict the lateral motion of electrons. A superconducting transition-edge bolometer is used to detect electrons that tunnel from a given state of the surface potential. Proposed mechanisms for one and two qubit logic operations and a simultaneous readout of the final state of all qubits are discussed. Ripplon scattering limits the lifetime of the excited state and the dephasing time, but allows 10^5 operations to be made in a decoherence time.