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2DEG depth-dependent leakage currents in GaAs/AlGaAs heterostructures BERNARD MATIS, DONG HO WU, Naval Research Laboratory — A quantum-dot device needs to be operated at low enough temperatures so that the charging energy of the device exceeds the thermal fluctuation energy. As the charging energy is known to be inversely proportional to the device size, one might be able to elevate the operating temperature of a quantum-dot device by reducing the device size. In an attempt to measure the operating temperature as a function of device size, we fabricated quantum-dot devices in different sizes ranging from 100 nm to 1 μm. These devices were fabricated on GaAs/AlGaAs heterostructure substrates with 2DEG depth of 40 nm to 160 nm. We used a shallower 2DEG for a quantum-dot device with a smaller lateral dimension. For the shallower 2DEG, we observed larger leakage currents between the top layer and the 2DEG layer. To prevent these leakage currents that disrupt the quantum device, we had to limit the miniaturization of our device to a certain size. In this talk we will discuss this limitation and the functional dependence between the 2DEG depth and the leakage-current strength.

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