Tunable-Coupling Quantum Antidot Molecule

WEI ZHOU, F.E. CAMINO, V.J. GOLDMAN, Stony Brook University — We report experiments on two double-antidot devices. The molecule is formed by two equal-size lithographic antidots fabricated from a very low-disorder GaAs/AlGaAs heterostructure. The two antidots are close enough so that the states bound on each antidot become hybridized and form bonding and antibonding states, like in a diatomic molecule or a qubit [1]. We observe resonant tunneling peaks on the $f=1$ and $1/3$ quantum Hall plateaus. The quantum-coherent coupling between the antidots can be tuned by a gate bias and by magnetic field $B$. The $f=1$ conductance peaks display three regimes as a function of $B$: (i) one peak per period $\Delta = h/2eS$, like in single antidot, but the total area $2S$ contributing. (ii) At higher $B$, the peak splits into two overlapping peaks; (iii) at yet higher $B$, nearly sinusoidal double-frequency (one oscillation per $\Delta/2$) conductance oscillations are observed. The fractional regime shows bonding-antibonding split peaks that display a charge $e/3$ back-gate coupling.