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Plasmaron structure in the single-particle spectrum of the 2D electron system RAYMOND ASHOORI, OLIVER DIAL, Massachusetts Institute of Technology, LOREN PFEIFFER, KEN WEST, Alcatel-Lucent Bell Labs — Despite the central role that the tunneling (or single-particle) particle density of states (TDOS) plays in our theories of many-body systems, it has proven a difficult quantity to access experimentally in two dimensional electron systems (2DES). We have developed a technique, time domain capacitance spectroscopy, which allows measurement of the TDOS over a range of 30 meV centered about the Fermi surface, revealing the detailed structure present in these systems far from the Fermi energy. Remarkably, we observe a long-lived excitation in the 2DES whose creation requires more energy than is needed to eject an electron from the most tightly bound state in the 2DES. At zero field, this feature appears as a low spectral-weight band below the band edge of the 2DES, while upon raising the magnetic field it smoothly evolves into a series of "negative energy" Landau levels. Based on its energy as a function of the 2D electron density and behavior when a magnetic field is applied, we identify this excitation as a hole in the 2DES coupled to a plasmon. Such a "plasmaron" has been predicted in calculations of the density of states for 3D [1] and 2D [2] electron gases, but direct observation has proven elusive. [1] L. Hedin, B.I. Lundqvist, and S. Lunqvist. Solid State Comm. 5, 237-239 (1967). [2] P. von Allmen. Phys. Rev. B 46, 13345 (1992).

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