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Measuring and Modeling Dopant Charging in Semiconductors using a Scanning Probe Method STUART TESSMER, IRMA KULJANISHVILI, CEMIL KAYIS, JAMES HARRISON, CARLO PIERMAROCCHI, THOMAS KAPLAN, Michigan State University, LOREN PFEIFFER, KEN WEST, Bell Laboratories, Lucent Technologies — The ability to manipulate and probe small numbers of dopant atoms in semiconductors represents an emerging line of research, motivated by the continued miniaturization of semiconductor devices and potential applications where the dopants themselves form the functional part of a device. For example, the low-lying electronic states of donor atoms have been proposed as candidate systems for quantum computation. We have performed a localized measurement of the electron addition spectrum of silicon donors in a gallium-arsenide heterostructure using a scanning probe technique. The data are compared to a theoretical model based on the idea that nearest-neighbor pairs effectively form two-donor-molecules. To the best of our knowledge, this is the first low-temperature scanning probe measurement to resolve individual electrons entering a semiconductor system.

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