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Field Ionization of Cold Atoms near the Wall of a Single Carbon Nanotube

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We observe the capture and field-ionization of individual atoms near the side wall of a single charged suspended nanotube. Our studies are carried out with a pulsed source of laser-cooled rubidium atoms. The interactions of cold atoms with nanostructures reveal extraordinary behaviors. Extremely large cross sections for ionization from the atomic beam are observed due to the nanotube's small radius, extended length, and the peculiar dynamics of a polarizable neutral atom near an extended, almost infinitely thin, charged wire. We observe the dynamics of both the capture and ionization process for individual atoms interacting with a single charged nanotube. The effects of the field strength on both processes are clearly distinguished in the data, as are prompt and delayed ionizations related to the locations at which they occur. The system can be used directly as a chip-integrated neutral atom detector with single atom sensitivity, high temporal and spatial resolution, and species selectivity.

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