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Electron hole tracking PIC simulation[1] CHUTENG ZHOU, IAN HUTCHINSON, Massachusetts Inst of Tech-MIT — An electron hole is a coherent BGK mode solitary wave. Electron holes are observed to travel at high velocities relative to bulk plasmas. The kinematics of a 1-D electron hole is studied using a novel Particle-In-Cell simulation code with fully kinetic ions. A hole tracking technique enables us to follow the trajectory of a fast-moving solitary hole and study quantitatively hole acceleration and coupling to ions. The electron hole signal is detected and the simulation domain moves by a carefully designed feedback control law to follow its propagation. This approach has the advantage that the length of the simulation domain can be significantly reduced to several times the hole width, which makes high resolution simulations tractable. We observe a transient at the initial stage of hole formation when the hole accelerates to several times the cold-ion sound speed. Artificially imposing slow ion speed changes on a fully formed hole causes its velocity to change even when the ion stream speed in the hole frame greatly exceeds the ion thermal speed, so there are no reflected ions. The behavior that we observe in numerical simulations agrees very well with our analytic theory of hole momentum conservation and energization effects we call "jetting".

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