Title: Nonlinear electrostatic excitations of charged dust in degenerate ultra-dense quantum dusty plasmas
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**Abstract.** The linear and nonlinear properties of low-frequency electrostatic excitations of charged dust particles (or defects) in a dense collisionless, unmagnetized Thomas-Fermi plasma are investigated.
A fully ionized three-component model plasma consisting of electrons, ions, and negatively charged massive dust grains is considered. Electrons and ions are assumed to be in a degenerate quantum state, obeying the Thomas-Fermi density distribution, whereas the inertial dust component is described by a set of classical fluid equations. Considering large-amplitude stationary profile travelling-waves in a moving reference frame, the fluid evolution equations are reduced to a pseudoenergy-
balance equation, involving a Sagdeev-type potential function. The analysis describes the dynamics of supersonic dust-acoustic solitary waves in Thomas-Fermi plasmas, and provides exact predictions for their dynamical characteristics, whose dependence on relevant parameters (namely, the ion-to-electron Fermi temperature ratio, and the dust concentration) is investigated. An alternative route is also adopted, by assuming weakly varying small-amplitude disturbances off equilibrium, and then adopting a multiscale perturbation technique to derive a Korteweg–de Vries equation for the electrostatic potential, and finally solving in terms for electric potential pulses (electrostatic solitons). A critical comparison between the two methods reveals that they agree
exactly in the small-amplitude, weakly superacoustic limit. The dust concentration (Havnes) parameter h=¼Zd0.nd0/ne0 affects the propagation characteristics by modifying the phase speed, as well as the electron/ion Fermi temperatures. Our results aim at elucidating the characteristics of electrostatic excitations in dust-contaminated dense plasmas, e.g., in metallic electronic devices, and also arguably in supernova environments, where charged dust defects may occur in the quantum plasma regime.