Nonlinear dust ion acoustic solitary waves in a relativistic dusty plasma

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Nonlinear dust ion acoustic solitary wave(DIASW) in a fully relativistic dusty plasma is investigated based on the Sagdeev potential. The solutions of the localized waves are found by a numerical method. Both cases of negative and positive dust grains are examined. When the dust is negatively charged, there exist the compressive DIASW alone, and the combinations of the solitary wave solutions, i.e., compressive, rarefactive, and double layers(DLs), but a rarefactive DIASW and DLs do not exist independently. Most importantly, new solutions are found which consist of two or three types of the well-known solitary waves in succession, i.e., compressive wave, rarefactive wave and DL. For example, a chain of solution is found where the compressive DIASW, the DLs, and the rarefactive DIASWs are connected side by side. When the dust is positively charged, the rarefactive DIASW is found to exist alone. Also, the compressive wave becomes the DL when the dust charge approaches to the specific positive value. It is concluded that the solitary solutions in a relativistic plasma are different from those in a non-relativistic plasma and that the dust charge plays an impotent role in determining the type of the solution.