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Excitation of stationary structures in a flowing dusty plasma

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We report experimental observations on the excitation of stationary solitary structures in a flowing complex plasma. The experiments are performed in a π- shaped Dusty Plasma Experimental (DPEx) [1] device where a DC glow discharge Ar plasma is created in between a disc shaped anode and a long tray shaped cathode. A dusty plasma is then formed using poly-dispersive kaoline particles. A floating copper wire mounted radially on the cathode creates a sheath around it in the plasma environment and acts as a charged object for the flowing dusty plasma fluid. The flow of dust cloud is initiated by lowering the potential of the charged object from ground potential and the flow speed is controlled precisely by connecting the wire from grounded potential to various intermediate potentials including floating potential. It is found that for particular discharge conditions and critical velocities of the fluid flow, high amplitude non-linear standing structures get excited. The amplitude, width and number of the excited structures are studied for different flow velocities of the dust cloud. It is noticed that with the increase in the flow velocity, the amplitude of the stationary structures increases whereas the number increases from one, two to many. These solutions are distinct from previously observed non-stationary precursor solitons [2] and constitute a new class of driven nonlinear structures. The experimental observations are compared with special solutions of a model forced-Korteweg de Vries (f-KdV) equation and found to be in good qualitative agreement. The potential applications of such excitations in the context of solar wind interaction with planets and satellite interaction with ionospheric plasmas are discussed.

[1] S. Jaiswal, P. Bandyopadhyay, and A. Sen, Rev. Sci. Instrum. **86** (2015) 113503.

[2] S. Jaiswal, P. Bandyopadhyay, and A. Sen, Phys. Rev. E **93** (2016) 041201(R).