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Nonlinear dynamics of ion sound instability in a finite length plasma[1] LIANG XU, Institute for Theoretical Electrical Engineering, Ruhr University Bochum, D-44780 Bochum, Germany, ANDREI SMOLYAKOV, SALOMON JANHUNEN, Department of Physics and Engineering Physics, University of Saskatchewan, Saskatoon, Saskatchewan S7N 5E2, Canada, IGOR KAGANOVICH, Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543, USA — The ion sound waves can be driven unstable by the subsonic ion flow in a finite length plasma as a result of the coupling (mediated by plasma boundaries) of the ion sound waves propagating in opposite directions. In this work, the nonlinear regime of this instability is studied by particle simulations with kinetic ions and Boltzmann electrons. There are two types of the ion sound instability that are well identified in the linear theory and simulations: aperiodic zone [$Re(\omega) = 0$] and oscillatory zone [$Re(\omega) \neq 0$]. We study here the nonlinear regime and show that the mode saturation results in coherent nonlinear structures. For oscillatory instability, the instability saturates with the oscillating virtual anode structure resulting in the ion beam acceleration and formation of system-long ion hole (vortex in phase space). For aperiodic instability, the mode saturates with either the virtual anode scenario or a global oscillation, depending on the initial condition.

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