Localized Ionic-Scale Electrostatic Structures in a Relativistic Electron-Ion Fluid

M. McKerr[1], F. Haas[2] and I. Kourakis[1]

[1] Queen's University, Belfast, Northern Ireland
[2] Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

A new relativistic fluid model is presented for electrostatic excitations in one-dimensional two-species dense quantum plasmas [1]. Focusing on the ionic dynamical scale, we assume ions to be subject only to the effects of an electrostatic potential, whereas electrons are treated as inertia-free particles. The electron motion is governed by a new equation of state for relativistically-degenerate fermions in one dimension [1], similar (but not identical) in form to Chandrasekhar's equation of state [2], which is valid for a spherically-symmetric velocity distribution.

Exact solutions are sought in a traveling-wave form. The Sagdeev pseudopotential method is used to find supersonic bound solutions. Numerical analysis yields a domain of wave speeds which admit localized solutions. A parametric analysis in carried out in terms of the dependence of the dynamics on the electron density. The relation with the non-relativistic case is discussed.

[1] F. Haas & I. Kourakis, *Relativistic Hydrodynamic Equations for Fully Degenerate Plasma*, submitted to Int. Congress in Plasma Physics (ICPP 2014), Lisbon; see elsewhere in these Proceedings.
[2] S. Chandrasekhar, *Mon. Not. R. Astron. Soc.* **95**, 207 (1935).