Envelope localized electrostatic wavepackets in space and laboratory plasmas [1]

Ioannis Kourakis [*,†,2], Padma Kant Shukla[*,3]

[*] *Institut für Theoretische Physik IV, Fakultät für Physik und Astronomie*
Ruhr–Universität Bochum, D–44780 Bochum, Germany
[†] *On leave from: U.L.B. - Université Libre de Bruxelles*
Association Euratom - Etat Belge, C.P. 231 Physique Statistique et Plasmas
Boulevard du Triomphe, B-1050 Brussels, Belgium

The nonlinear amplitude modulation of electrostatic plasma modes is examined by applying a generic collisionless fluid model. Both cold– (zero-temperature) and warm–fluid descriptions are discussed and compared. The weakly nonlinear oscillation regime is investigated by applying a multiple scale technique and a Nonlinear Schrödinger Equation(NLSE) is obtained, describing the evolution of the slowly varying wave amplitude in time and space. This NLSE admits localized envelope (solitary wave) solutions of bright (pulses) or dark (holes, voids) type, whose characteristics (maximum amplitude, width) depend on intrinsic parameters. Effects like amplitude perturbation obliqueness, finite temperature and defect (dust) concetration are explicitly considered. The relevance with similar highly localized modulated wave structures observed during recent satellite missions is discussed. This description, regarding a general class of known plasma modes, has been applied to specific cases of relevance to astrophysical and laboratory (complex) plasmas, including ion– [1] and electron– [2] acoustic waves in the presence of two distinct temperature populations as well as dust–ion [3, 4] and dust– [5] acoustic waves.

References

[1] I. Kourakis and P. K. Shukla, *J. Phys. A: Math. Gen.*, **36**, 11901 (2003).

[2] *Idem*, *Phys. Rev. E*, **69**, in press (2004).

[3] *Idem*, *Phys. Plasmas*, **10**, 3459 (2003).

[4] *Idem*, *Eur. Phys. J. D*, **28**, 109 (2004).

[5] *Idem*, *Phys. Scripta*, **69**, 316 (2004).

[1] Workshop on Theoretical Physics, ICTP Trieste, 5 - 16 july 2004.

[2] Email: ioannis@tp4.rub.de

[3] Email: ps@tp4.rub.de