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ORIGINAL ARTICLE

Rogue wave in Titan's atmosphere

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Abstract Rogue wave in a collisionless, unmagnetized electronegative plasma is investigated. For this purpose, the basic set of fluid equations is reduced to the Korteweg-de Vries (KdV) equation. However, when the frequency of the carrier wave is much smaller than the ion plasma frequency then the KdV equation is also used to study the nonlinear evolution of modulationally unstable modified ion-acoustic wavepackets through the derivation of the nonlinear Schrödinger (NLS) equation. In order to show that the characteristics of the rogue wave is influenced by the plasma parameters, the relevant numerical analysis of the NLS equation is presented. The relevance of our investigation to the Titan's atmosphere is discussed.

Keywords Plasma · Rogue wave · Titan atmosphere · Envelope solitons

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1 Introduction

The nonlinear Schrödinger (NLS) equation is considering one of the most important equations which governs the movement of the nonlinear structures in many branches of physics ranging from condensed matter, nonlinear optics, plasma, and even biophysics (see e.g., Davydov 1985; Hasegawa 1989; Infeld and Rowlands 1990; Remoissenet 1994; Sulem and Sulem 1999). One of the solutions of the NLS equation is the rational solution that could describe the rogue wave propagation. The latter is been a part of the marine folklore for centuries, while oceanographers did not believe in their existence (Ma 2010). Actually, the first measurement of the rogue wave is taken on the oil platform in Norway in 1995 (Müller et al. 2005). The importance of the rogue wave in the study of the ocean waves are due to the fact that the amplitude of the rogue wave can reach more than twice the value of the surrounding chaotic waves (Bludov et al. 2010). Actually, its appearance can not be predicted, so this wave represents a real danger on the ships and boats and thus many studies dealt with the ocean rogue