Astrophys Space Sci (2014) 349:5–10
DOI 10.1007/s10509-013-1602-3

LETTER

Magnetosonic rogons in electron-ion plasma

E.I. El-Awady · H. Rizvi · W.M. Moslem · S.K. El-Labany · A. Raouf · M. Djebli

Received: 3 July 2013 / Accepted: 10 August 2013 / Published online: 26 September 2013

Abstract Magnetosonic rogue waves (rogons) are investigated in an electron-ion plasma by deriving the nonlinear Schrödinger (NLS) equation for low frequency limit. The first- and second-order rogue wave solutions of the NLS equation are obtained analytically and examined numerically. It is found that for dense plasma and stronger magnetic field the nonlinearity decreases, which causes the rogon amplitude becomes shorter. However, the electron temperature pumping more energy to the background waves which are sucked to create rogue waves with taller amplitudes.

Keywords Rogue waves · Magnetosonic waves

E.I. El-Awady (✉) · W.M. Moslem · A. Raouf
Department of Physics, Faculty of Science, Port Said University, Port Said 42521, Egypt
e-mail: eielawady@hotmail.com

E.I. El-Awady
e-mail: eielawady@yahoo.com

W.M. Moslem
e-mail: wmmoslem@hotmail.com

W.M. Moslem
e-mail: wmm@tp4.rub.de

H. Rizvi
Department of Physics, POSTECH, Hyoja-Dong San 31, KyungBuk, Pohang, 790-784, South Korea

H. Rizvi
Theoretical Plasma Physics Division, PINSTECH, P.O. Nilore, Islamabad, Pakistan

S.K. El-Labany
Department of Physics, Faculty of Science, Damietta University, New Damietta 34517, Egypt
e-mail: skellabany@hotmail.com

M. Djebli
Theoretical Physics Laboratory, Faculty of Physics USTHB, B.P. 32 Bab Ezzour, 16079 Algiers, Algeria
e-mail: mdjebli@usthb.dz

The magnetosonic wave is one of the basic low-frequency modes in electron-ion (*e-i*) magnetized plasma (Adlam and Allen 1958; Berezin and Karpman 1964; Kakutani and Ono 1969; Mushtaq and Shah 2005). The magnetosonic waves play an important role in accelerating the particles, heating the plasma (Hazeltine and Mahajan 2004; Ohsawa 1985, 1986a, 1986b; Stasiewicz 2007; Matthaeus et al. 2005), and transport of energy in laboratory, space, as well as astrophysical plasmas (Bittencourt 1986). The magnetosonic wave is somewhat similar to electromagnetic wave, because the time varying magnetic field is perpendicular to the direction of wave propagation but parallel to the magnetostatic field, whereas the time varying electric field is perpendicular to both directions of propagation and the magnetostatic field. The resorting forces in the magnetosonic wave are the fluid pressure gradient and the gradient of the compressional stresses between the magnetic filed lines. If the fluid pressure is greater than magnetic pressure then magnetosonic wave becomes essentially an acoustic wave. On the other hand, if the magnetic field is strong and magnetic pressure is much larger than the fluid pressure, then phase velocity of the magnetosonic wave becomes equal to Alfvén wave velocity propagating in the perpendicular direction. During this decade, there has been much interest in investigating the nonlinear magnetosonic waves in plasma. Boldyrev (1998) has investigated the magnetosonic waves propagating in a multi-ion species plasma perpendicular to an external magnetic field. It is found that due to the presence of several ion species, magnetosonic mode splits into