# Analytical study of nonlinear magnetosonic solitary waves in a magnetized dusty plasma

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Over the last many years, there has been a great deal of interest in studying the various kinds of nonlinear solitary structures in the framework of both perturbation and non-perturbation technique in laboratory experiments, space and astrophysical plasma environments. The ubiquitary existence of dust in space plasma has been an extensive area of research and has attracted numerous researchers for a comprehensive study of different kinds of nonlinear structures and is abundantly found in comet tails, asteroid zones, planetary rings, interplanetary space, the lower part of the Earth's magnetosphere, radio frequency plasma discharge[1] etc. The omnipresence of charged dust particulates possesses collective behaviour and introduces new types of low frequency modes like dust ion acoustic waves (DIAWs), dust acoustic waves (DAWs) and dust lattice (D-L) waves[2]. For dust particles in motion, there is the generation of new wave modes for shear Alfvén, magnetosonic (MS) and whistler waves, even for wave frequency smaller than the dust gyrofrequency. During the past few decades, magnetosonic (MS) waves have received quite attention due to their significant role in scattering energetic electrons in the magnetosphere through Landau resonance interaction. Magnetosonic waves are low frequency magnetohydrodynamic (MHD) waves and are ubiquitously observed in Earth's magnetosphere both inside and outside the plasma pause[3]. In the recent times, nonlinear coherent structures (solitons, shocks, cnoidal, and freak waves) have incited a great deal of interest in many researchers due to their significance in various kinds of plasmas[4]. The Korteweg–de Vries (KdV) equation is the best-known model to describe the characteristics of nonlinear structures. A solitary wave is a localized pulse that arises due to balance between nonlinearity and dispersion. The KdV equation describes how an unmodulated wave comprising of a pulse which does not have fast oscillations flourishes inside the wave packet, usually known as the KdV soliton. Solitary waves play a very important role for the comprehensive study of different nonlinear phenomena linked with the dynamics of charged particles in various space environments and laboratory experiments. A nonlinear Korteweg-de Vries (KdV) equation describing the evolution of nonlinear magnetosonic solitary waves is derived by using the standard reductive perturbation method and hence the first order Korteweg-de Vries (KdV) soliton is obtained. The KdV equation takes into account the nonlinear and dispersive effects of a medium. When these effects balance each other, a soliton solution to the KdV equation is obtained. Furthermore, the quasiperiodicity and chaos are also investigated numerically in the presence external periodic force[5]. The influence of different plasma parameters on the dynamical evolution of the nonlinear magnetosonic solitons is examined. It is observed that various plasma parameters namely, magnetic field, number density etc. play significant role on the characteristics of nonlinear solitary waves. The main goal of present investigation is to study the propagation characteristics of magnetosonic solitons as well as their chaotic behavior in a collisionless magnetized dusty plasma. The findings of present investigation may be helpful to provide a new insight to understand the evolution of nonlinear magnetosonic wave structures in different space plasma regions.

References

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