URSI AP-RASC 2019, New Delhi, India, 09 - 15 March 2019

Implications of the Presence of Positrons in Earth's Magnetosphere --- Solitary Waves and Double Layers

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Recently, there has been a lot of interest in studying the linear and nonlinear waves in electron-positron (e-p) [1] and electron-positron-ion (e-p-i) plasmas [2]. Most of these works are focused on low frequency (ion mode) solutions while the present investigations have revealed the existence of high frequency (electron mode) solitary waves in an unmagnetized electron-positron-ion (e-p-i) plasma. Electron-positron plasmas have been thought to exist primarily in the astrophysical plasma system viz., pulsar magnetospheres, active galactic nuclei etc. However recent satellite observation have confirmed the existence of a positron radiation belt in the Earth's inner magnetosphere [3,4]. There are observations of low energy positron spectra in the Earth's orbit [5]. Investigations of e-i and e-p-i plasmas in the context of Earth's magnetosphere thus remain a open and challenging task for the space plasma physicists. Some key questions involved the understanding of the generation and transport processes of positrons in the earth's magnetosphere. Another key issue is the effect of the presence positron on the bipolar and monopolar electrostaic soltary waves (ESWs) which are known to be ubiquitous across the Earth's magnetosphere. In the present work, using Sagdeev pseudopotential technique, we have derived high frequency electron mode solitary pulses in the presence. The analytically estimated shapes and sizes of the wave is then compared with the satellite observations of the auroral region and the inner magnetosphere. Especially in the auroral region, it shows a good agreement with the observed positive amplitude bipolar pulses. It encourages us to believe that the presence of the positron may affect the microphysics of the Earth's magnetosphere significantly.

1. A. E. Dubinov,, I. D. Dubinova, and V. A. Gordienko, "Solitary electrostatic waves are possible in unmagnetized symmetric pair lasmas", *Phys.~Plasmas* **13**, 2006, 082111,

2. S. I. Popel, S. V. Vladimirov, and P. K. Shukla, "Ion-acoustic solitons in electron-positron-ion plasmas", *Phys. Plasmas*, **2**, 1995, pp. 716-719,

3. A. A. Gusev, U. B.Jayanthi ,I. M. Martin, G. I. Pugacheva, and W. N. Spjeidvik, "Nuclear reactions in the uppermost Earth atmosphere as a source of the magnetospheric positron radiation belt", *J. Geophys. Res.*, **106**, A11, 2001, pp. 26,111-26,115,

4. G. I. Pugacheva, A. A.Gusev, U. B. Jayanthi, I. M. Martin, and W. N. Spjeldvik, "Antiparticles and light element isotope ions in the Earth's magnetosphere", *J. Atmos. Solar-Terres. Phys.*, **64**, 2002, pp. 625-631,

5. V. V. Mikhailov, "Low energy electron and positron spectra in the Earth orbit measured by MARIA-2 instrument", *Int.J. Mod. Phys.A*, **17**, 12/13, 2002, pp. 1695-1704,

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