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ELF and VLF emissions observed inside equatorial plasma bubbles during intense magnetic storms

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Very deep equatorial plasma bubbles are frequently observed in the post-sunset sector during the initial and main phases of geomagnetic storms. It is generally believed that low-latitude and equatorial electric field perturbations resulting from the prompt penetration of magnetospheric convection electric fields down to low latitudes in the first hour after storm onset are responsible for driving these structures. The orbit of the DEMETER satellite (polar and quasi-circular at 710 km altitude) is quasi-heliosynchronous with the orbital plane near the 10:00-22:00 LT meridian and therefore well suited to observe plasma bubbles in the late evening sector. During the intense (peak Dst $\sim$ -373 nT) magnetic storm of November 7-11, 2004, DEMETER encountered several deeply depleted bubbles with plasma density drop of two or three orders of magnitude. The wave instruments aboard the satellite detected ELF and lower hybrid turbulence throughout the bubbles together with much less intense HF broadband bursts just above the electron plasma frequency. Waveforms acquired when the wave instruments were operating in burst mode reveal the existence of coherent structures at the lower hybrid frequency with amplitudes up to 10 mV/m and typical duration of $\sim$ 20-30 ms similar to envelope solitons commonly observed on auroral field lines. In the ELF range, the waveforms show the existence of coherent electromagnetic waves of a few mV/m amplitude propagating nearly parallel to the ambient magnetic field ($\sim$10-20°) and characterized by an instantaneous well-defined frequency below the proton gyrofrequency (f$\sim$ 0.8 f_{cp}) and an oscillating nature of the amplitude modulation. These features are similar to those characterizing the so-called 'oscillitons' that may develop in multi-ion plasmas. Measurements by the plasma analyzer showed the existence of suprathermal O^+ and/or NO^+ ions with typical tem-

peratures of 5 to 20 eV, which indicates some heating. Similar events were observed on May 15, 2005 and on August 24, 2005 during two other magnetic storms of lower intensity (peak Dst$\sim$ -256 nT and -219 nT, respectively). We present some representative events and investigate the possible mechanisms that can lead to such soliton-like and oscilliton-like structures inside plasma bubbles.