



Ultra Low Frequency Waves Observed in the Inner Magnetosphere by Magnetospheric Multiscale

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Magnetospheric Multiscale (MMS) was launched on March 13, 2015 into a low inclination orbit with apogee around 12 Earth radii in the pre-dawn local time sector. The spacecraft were initially in a string-of-pearls configuration as the orbit precessed through the nightside inner magnetosphere. This spacecraft configuration allowed for unambiguous determination of the azimuthal wave number of the waves, and we typically find them to be westward propagating in the nightside. This is consistent with drift resonance with ions. The MMS spacecraft observed both toroidal and poloidal waves. This initial case study indicates that the poloidal waves were observed near the magnetic equator, with the spacecraft around 8-10 Earth radii. This might be expected for drift resonance with ions in the ~ 10 keV range, corresponding to the plasma sheet rather than the ring current. The toroidal waves, on the other hand, were observed much closer in, and quite far from the equator. They also had a significant component of their phase velocity outward, to higher latitudes. Their azimuthal phase velocity was much larger than the poloidal waves. It is possible that these waves are shear-mode waves that have been mode converted from fast-mode waves, which in turn have been generated by an external source.