

Direct In Situ Observations of Whistler-Mode Chorus Modulation of 500eV EDI Electrons by MMS

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We present here direct observations of chorus-wave modulated quasi field-aligned electrons using the Electron Drift Instrument (EDI) on board the Magnetospheric Multiscale mission. These events found fluctuations in the count rates of 500 eV electrons exhibiting the same spectral characteristics as simultaneously observed whistler-mode chorus waves using the on-board search coil magnetometer. These periods of wave activity were additionally observed to be modulated by Pc5-frequency magnetic perturbations, some of which have been identified as mirror-mode structures. The spacecraft encountered these mirror-mode structures just inside of the duskside magnetopause.

Using the high sampling rate provided by EDI in ambient burst sampling mode (1024 samples per second), we are able to observe the individual count fluctuations of field-aligned electrons in this region up to 512 Hz. Additionally, we use the multiple look directions of EDI close to the alignment direction in combination with the sweep of the instrument as the spacecraft spins to generate both pitch angle and gyrophase plots of the fluctuating counts. With chorus wave frequencies of 100Hz, we are able to orient this gyrophase information relative to the wave electric field perturbation directions. Our observations often show unidirectional flow of these modulated electrons along the background field, and in some cases demonstrate gyrophase bunching in phase with the rotating wave electric field. While the relationship between electrons and right-hand circularly polarized waves such as whistler-mode waves is well-documented in theory and on statistical scales, this is the first mission to offer sufficient detail in instrument data to observe in situ wave-particle interactions over individual wave cycles.