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Intensities and periodic structures of magnetospheric line radiation and quasiperiodic emissions: Dependence on solar wind parameters

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Magnetospheric Line Radiation and Quasiperiodic Emissions

We present an analysis of the dependence on solar wind parameters (i.e., interplanetary magnetic field, proton density, flow speed, flow pressure) of characteristic properties of the two wave phenomena observed in the inner magnetosphere called magnetospheric line radiation (MLR) and quasiperiodic emissions (QP). The events were measured by the French low-altitude spacecraft DEMETER, which operated between 2004 and 2010. Altogether, 653 MLR events and 2264 QP emissions observed by this satellite were used in this analysis.

MLR events are usually observed at frequencies from 1 to 8 kHz and they are characterized by the their frequency modulation of wave intensity. The typical properties of these events are hence frequency drift and frequency spacing. The origin of this type of events remains unclear.

QP emissions, in contrast to MLR events, are typical by the time modulation of wave intensity. These events usually occur in the frequency range 0.5 – 4 kHz. Our study suggests that there might be two types of QP events distinguished by their modulation period (time separation between two consecutive wave elements). We thus investigated the events with modulation periods lower/larger than 20 s separately. The properties investigated for their possible relation to solar wind parameters are modulation period and maximal event intensity.

Possible Time Delays Between SW Parameters & Event Properties

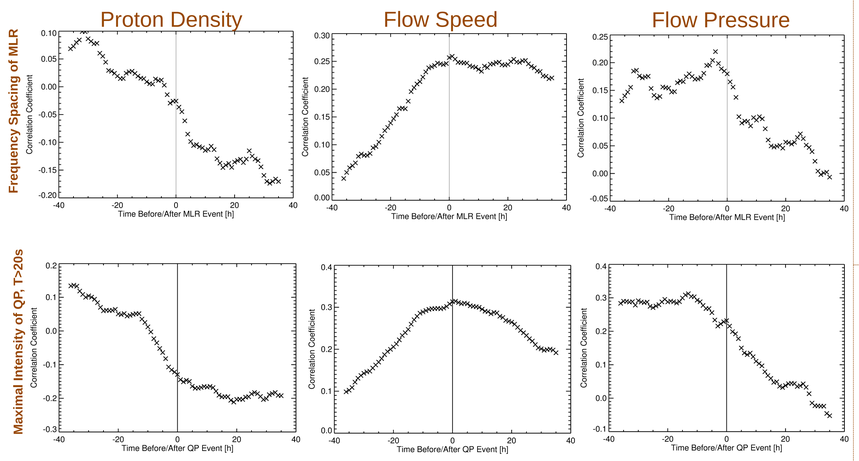

Figure 7: Correlation coefficients between solar wind parameters and event properties as a function of time relative to the event occurrence.

MLR Events

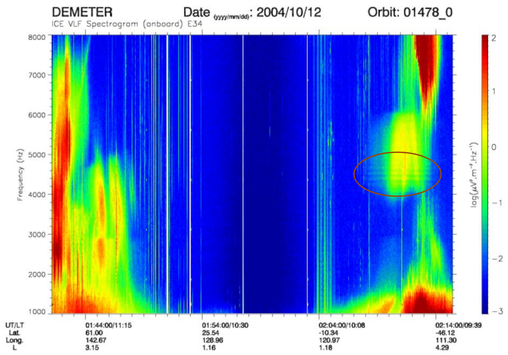

Figure 1: Example of an MLR event observed by the DEMETER spacecraft on 12 October 2004 between 02:08 and 02:14 UT at frequencies of about 4500 Hz.

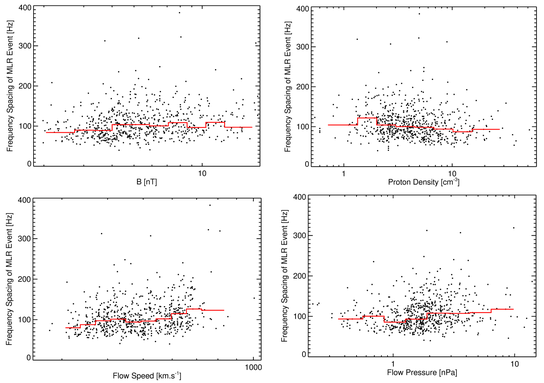

Figure 2: Dependence of the frequency spacing of MLR events on solar wind parameters (i.e. interplanetary magnetic field, proton density, flow speed, flow pressure). Median values in the selected intervals are shown by the red lines.

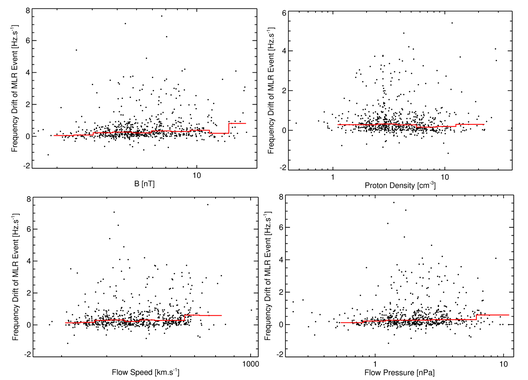

Figure 3: Dependence of the frequency drift of MLR events on solar wind parameters. The red lines show the median values of the frequency spacing in selected intervals.

QP Emissions

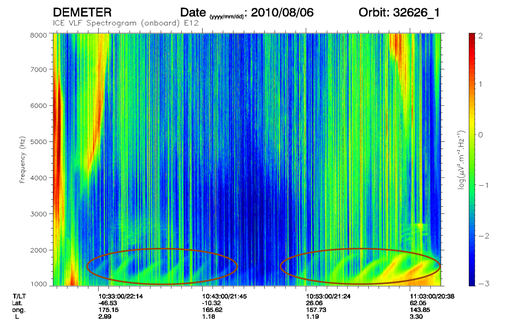

Figure 4: Frequency-time spectrogram showing two identified QP emissions. The events occurred on 6 August 2010 between 10:33 and 10:48 UT and 10:52 and 11:06 UT at frequencies of about 1200 Hz.

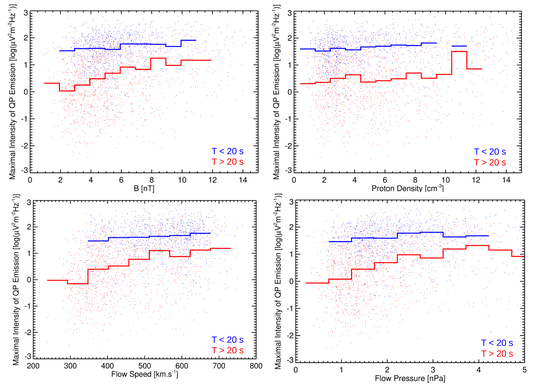

Figure 5: Influence of solar wind parameters on the maximal intensity of QP events. The emissions are divided according to their modulation period into events with period lower than 20 s (blue) and higher than 20 s. Median intensity values in selected intervals are shown by the horizontal lines.

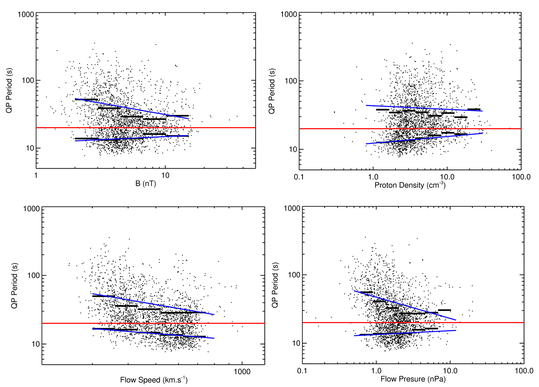

Figure 6: Dependence of the QP modulation period on solar wind parameters. The periods lower/larger than 20 s are separated by the red line. The median values of the periods in selected intervals are shown by the black horizontal lines. The blue lines show linear interpolations of the data points in respective modulation period intervals.

MLR vs QP

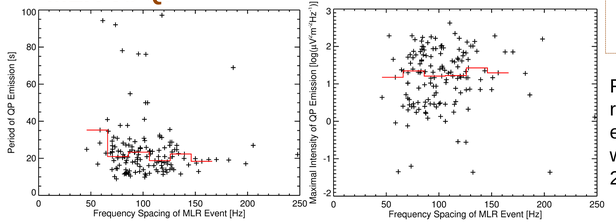

Figure 8: Analysis of a possible relation between MLR and QP event properties. The events which were observed less than 2 hours apart were analysed.

Conclusions

The frequency spacing of MLR events increases with the flow speed. No clear dependence of the MLR frequency drift on solar wind parameters was identified.

The dependence of maximal intensity and modulation period of QP emissions differs according to their modulation periods. This indicates that there might be two types of QP events (with low vs large modulation periods).