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Unknown millisecond timescale phenomena in the Jovian Long-burst observed by wave-form receiver

Tomonori Koshida[1]; Takayuki Ono[2]; Masahide Iizima[3]; Atsushi Kumamoto[4]

[1] Geophys, Tohoku Univ; [2] Department of Astronomy and Geophysics, Tohoku Univ.; [3] Shukutoku; [4] Planet. Plasma Atmos. Res. Cent., Tohoku Univ.

S-burst has been observed by both sweep frequency spectrum receivers and WFRs that has high time and frequency resolutions [Litvinenko et al., 2004; Nigl et al., 2007; Ryabov et al., 2007]. However, L-burst has not been observed by high performance receivers such as WFR. One of the reason is that the amount of the data obtained by WFR, are too huge to deal with. The data rates becomes 160 Mbytes/s and difficult to store and analyze.

We developed the WFR that can operate for eight hours to observe Jovian DAM emission continuously. By selecting the output data can be reduced to 16 Mbytes/s. Therefore observation of Jovian DAM emission could be performed since March 26, 2008 to Sept. 16, 2008. During the period four Io-B events and two Io-A and Io-C events were detected.

We found unknown phenomena in the data obtained on June 4, 2008. The phenomena showed suppressed spectra. Riihimaa et al. (1981) named suppressed spectra in the Jovian DAM emission whose characteristics were similar to that of S-burst, as fast-drift shadow event (FDS-event). However, the drift rate of the suppressed spectra observed on June 4, 2008 by the WFR was different from S-burst and FDS-event. We named it slow-drift shadow event (SDS-event).

The SDS-event showed leading edge and trailing edge in the dynamic spectra. Both of the edges decreased and increased its drift rate at frequencies of 21.5 MHz and about 22 MHz. The parallel velocity of the radiation source of the edges of the SDS-event along magnetic field line were estimated based on the drift rate changes.

It is also found that the background radiation of L-burst showed wave-shape modulation in the frequency range of over one MHz in the dynamic spectra. The estimated modulation frequency was 15 Hz. It is similar to the typical resonance frequency of Alfven wave with Jovian ionosphere, 20 Hz, estimated by previous studies [Su et al., 2003; 2004; 2006; 2007; Ergun et al., 2006; Hess et al., 2007b; Arkhypov and Rucker, 2006; 2007; 2008].

Not only event study but also the statistical studies on drift rate of the SDS-event and the wave-shape modulation of L-burst were performed. The result suggests that the drift rate of both the SDS-event and the wave-shape modulation of L-burst were similar.

We also found some spectra with transient characteristics between SDS-event and the wave-shape modulation of L-burst. Both evidences suggest that the SDS-event and wave-shape modulation of L-burst were same phenomena and they can develop parallel electric field by inertial Alfvén wave theory.

In addition to that, wavelength of the SDS-event was estimated. It is defined that the SDS-event was caused by soliton. The estimated wavelength of the SDS-event is 1300 km, using modulation frequency of wave-shape modulation of L-burst, 15 Hz, and the drift rate of the SDS-event, 5 MHz/s. The length is equivalent to not only the spatial distance between leading edge and trailing edge of the SDS-event, but also similar to the spatial distance that the wave-shape modulation of L-burst appeared.

If the fluctuation of the background plasma densities were denser than more than 10 times of afore mentioned density, the drift rate and its change of the SDS-event can be explained by Alfven velocity that varied by fluctuations of background plasma density.