Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM25-P02 Room:Convention Hall Time:May 25 18:15-19:30

Statistical analysis of spectral fine structures in solar radio type II bursts observed with AMATERAS

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Type II bursts are one of the solar radio bursts associated with flare and coronal mass ejections(CMEs). They are thought to be a plasma emission from non-thermal electrons accelerated by a shock wave. A type II burst appeared as a group of spectral fine structures whose typical duration is within one second is reported recently [e.g. Sato et al., the 26th JpGU meeting]. Such spectral fine structures can be interpreted as the motion of non-thermal electron beams accelerated in the shock region. The spectral fine structures are, therefore, thought to reflect electron acceleration processes by the shock.

In this study, we performed a statistical analysis to investigate generality of spectral fine structures of type II bursts to reveal their generation processes by using the meter wave band solar radio telescope AMATERAS developed by Tohoku University [Iwai et al., 2012]. AMATERAS enables us to observe solar radio bursts in the frequency range between 150 and 500 MHz with the 10 msec accumulation time and 61 kHz bandwidth. Many solar radio bursts have been observed by this system since its construction in 2010.

We identified occurrence of nine type II bursts from the AMATERAS database. Some of them showed fundamental-harmonic band structures and some of them showed band-splitting structures. In addition, it is notable that all of them were accompanied by spectral fine structures. This result implies a possibility that the spectral fine structures are general characteristic of type II bursts. We analyzed drift rates for the spectral fine structures of three events from them. As the result, some of the drift rates indicated more than 100MHz/s. By assuming a general coronal plasma density model, for example the Newkirk model [Newkirk, 1961], the particle speed for the drift rate is estimated to be unrealistic value. The result is similar to the past study [Sato et al., the 26th JpGU meeting] and implies the existence of peculiar plasma structure in the source region of the burst, while the wave generation and particle acceleration processes for the fine structures have not been understood. In this presentation, we will show precise characteristics of drift rates for the spectral fine structures in several type II bursts and also discuss inferred generation processes.

Keywords: corona, particle acceleration, radio burst, spectral fine structures, AMATERAS