Statistical characteristics of spectral fine structures in solar radio type II bursts

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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 in and/or around a shock wave. A type II burst appeared as a group of spectral fine structures with the typical duration of a few hundreds msec is reported recently [e.g. Sato et al. in the JpGU2014 meeting]. Such spectral fine structures can be interpreted as the motion of non-thermal electron beams accelerated in the shock region.
In this study, we performed a statistical analysis to investigate generality of spectral fine structures of type II bursts 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. We identified occurrence of totally 13 type II bursts for the period of Oct. 2010 to Sep. 2014, which were all associated with solar flare events. As the result, we revealed that all of them were accompanied by spectral fine structures. This fact strongly suggests a possibility that the spectral fine structures are general characteristic of type II bursts. The drift rates of the spectral fine structures were analyzed for all type II events. It is found that they showed both positive and negative senses and were in the time scale of tens to hundreds MHz/s. By assuming a general coronal plasma density model, for example the Newkirk model [Newkirk, 1961], particle speeds for some fine structures are estimated to be unrealistically high; i.e., faster than the light speed. The drift rates are faster than those of the well known spectral fine structure in type II burst 'herringbone structure', therefore, it is notable that the spectral fine structure identified in this study is a 'newly identified type' in type II bursts. And the unrealistically high drift rate implies the existence of denser plasma structure than general coronal plasma possibly near the shock regions. In the presentation, we will show the general characteristics of the fine structures of type II bursts and also discuss possible source regions.

Keywords: Solar type II burst, spectral fine structure

