Fine spectral structures of a solar radio type-II burst observed with AMATERAS

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Solar radio type-II burst is a metric to hectometric solar radio burst associated with coronal shocks. Non-thermal electrons accelerated by coronal shocks excite Langmuir waves. They are converted into radio waves and finally observed as a type-II burst at the frequency around the local electron plasma frequency and/or its harmonics. Type-II bursts have a drift structure in their spectra due to the motion of a coronal shock along the coronal density gradient. In addition to this main drift structure, type-II bursts have a fine spectrum structure in their spectra called a ”herringbone”(Roberts, 1959). They also have a drift structure but the drift rate is much larger than that of the main component of type-II bursts. They are interpreted as the motion of energetic electrons accelerated by the shock. Particle acceleration mechanisms of them, however, have not been fully understood. One of the reasons is a lack of high-resolution radio spectra that can reflect processes of electron accelerations around the shock. The purpose of this study is to extract characteristics of fine spectrum structures of type-II from high-resolution observations and investigate the acceleration processes.

AMATERAS (the Assembly of Metric-band Aperture Telescope and Real-time Analysis System; Iwai et al., 2012) is a ground-based solar radio telescope developed by Tohoku University. This system enables us to observe solar radio bursts in the frequency range between 150 and 500 MHz with the 10 ms accumulation time and 61 kHz bandwidth, which is suitable for observing characteristics of fine spectrum structures of solar radio bursts. We observed a type-II burst on November 12, 2010 associated with the C4.6 class flare. The type-II burst appeared from 01:37 UT to 01:43 UT in the frequency range between 210 MHz and 125 MHz. The drift rate was 0.24 MHz/s. We found herringbone structures embedded in the spectrum of the observed type-II burst. The typical duration of them was about 0.2 s to 0.3 s. They showed drift structures with drift rate from 37 to 58 MHz/s. The drift rates corresponded to the velocity of non-thermal electrons from 0.16 c (speed of light) to 0.25 c. In this presentation, we will also show time and frequency dependence on the observed herringbone structures.