Relationship between solar energetic particles and spectral fine structures of metric type II radio bursts

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It is well known that a type II burst is one of sporadic and intense solar non-thermal radio phenomena, which shows gradual negative frequency drift in the metric to kilometric wavelength ranges and is generated with a coronal mass ejection (CME) event. As a plausible generation process of type II bursts, it is proposed that electro-static plasma waves originated from energetic electrons are effectively converted to electro-magnetic waves (type II bursts) at the region where the local plasma frequency is equal to wave frequency. A type II burst often occurs with energetic protons and ions with the energy of more than the MeV grade, and such an energetic phenomena is called a solar energetic particle (SEP) event. The coincident occurrence of type II bursts and SEPs strongly suggests that both energetic electrons and protons/ions would be the same origin initiated by a CME event. The occurrence characteristics of type II radio bursts and also SEPs have important information on the origins and generation processes of energetic particles and have been of course investigated well individually, however their relationships have been not well known except a recent research for the kilometric to hectometric type II bursts (Iwai et al., 2020).

We have investigated the relationship between SPEs and metric type II bursts from a view point of the clarification of characteristics of SEPs from the occurrence characteristics of type II bursts. We have especially paid attention to spectral fine structures of type II bursts identified in the metric wavelength by our group (Kashiwagi et al., 2016). At the first stage of this study, we have reanalyzed drift rates of fundamental elements of type II bursts using the radio data observed with the AMATERAS system, Tohoku University for three type II burst events observed in 2011 –2013 with weak to extinct SEP natures. In our presentation, we will introduce purpose of this study including a viewpoint of space-weather and preliminary results of the relationship between SEPs and spectral fine structures of type II bursts.

Keywords: sun, energetic particle event, type II radio bursts, fine spectral structure

