The characteristics of type III solar radio bursts in ^{3}He-rich impulsive solar energetic particle phenomena

*Tatsuya Fujimoto[1], Hiroaki Misawa[1], Fuminori Tsuchiya[1], Takahiro Obara[1]

1. Tohoku University

Solar Energetic Particles (SEPs) are protons, electrons, and heavy ions of 10 keV to several tens GeV generated with flares and coronal mass emissions (CMEs), which are explosive phenomena near the solar surface. SEPs are classified into two types; i.e., impulsive and gradual types, based on the elemental abundances and the time profile of ion flux variations. Also, it has been reported that a phenomenon called type III radio bursts, which are suddenly appearing emissions caused by flares, are often observed in the tens to hundreds of MHz band when impulsive SEPs occur [Cane et al., 1986; McDowell, 2003]. Type III bursts are thought to be generated by energetic electrons accelerated by magnetic reconnections during flares, which propagate along the open magnetic field lines. That is, an injection of the energetic electrons into the solar corona leads to the generation of Langmuir plasma waves, and the waves are converted into radio waves as Type III bursts where the radio wave frequency is as same as the local plasma frequency. Type III bursts appear in the frequency range from GHz to kHz, and show rapid negative frequency drifts. The spectral structure is considered to reflect the motion of accelerated electron beams.
Impulsive SEPs, also known as electron-based events, show higher ratios of ^{3}He/^{4}He and Fe/O than general composition of the solar corona. Temerin and Roth [1992] proposed that the electromagnetic ion cyclotron (EMIC) waves would exist in the accelerating region of the electron beams that generate type III bursts in the solar corona by a similar physical process of the electron beam generation to that in the Earth’ s auroral region. In this idea, EMIC waves are thought to play a resonator which selectively increases flux of ions, such as ^{3}He and Fe. According to this idea, it is expected that both the flux of impulsive SEPs and the spectral structure of type III bursts include some features related to particle accelerations. However, there are few reports comparing characteristics of SEPs and spectrum structures of type III bursts from such a viewpoint, and the relationship between both of them has not been clarified. In this study, we have tried to make a detailed comparative analysis for impulsive SEP phenomena and type III bursts to elucidate relationship between both of them. We have analyzed energy and flux time profiles of SEPs using solar particle data observed with the ACE, WIND, and SOHO satellites staying around the L1 point. On the other hand, we have analyzed spectra of type III bursts such as frequency drift rates and micro structures using solar radio wave data observed with the WIND satellite, and ground-based solar radio telescopes AMATERAS of Tohoku University and the other domestic and overseas radio telescopes. In the presentation, we will report the results of the comparison studies for the characteristics of ion and electron fluxes of impulsive SEPs and those of the spectra of the type III bursts, and discuss the relationship both of them including generation processes of impulsive SEPs.

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