

Electron acceleration region in a small solar flare observed with Nobeyama Radioheliograph and MUSER

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Nobeyama Solar Radio Observatory, NAOJ, was closed at the end of March 2015. After that, Nobeyama Radioheliograph has been operated by the International Consortium for the Continued Operation of Nobeyama Radioheliograph (ICON). After the five-year extension of the operation by ICON, finally, it was shut down at the end of March 2020. On the other hand, a new Chinese solar radio telescope, 'Mingantu Spectral Radioheliograph (MUSER)' was developed and started observations during this extension period. While NoRH observes the sun at two frequencies (17 and 34 GHz), MUSER observes at relatively lower, but much wider frequency range (0.4 – 15 GHz). The observation using these two instruments provides us the information of the accelerated electrons with different energies and at different altitudes in the solar atmosphere. This is a great advantage to reveal the electron acceleration process in a solar flare.

At first, we made a list of the events which was simultaneously observed with NoRH and MUSER. The total number of the events was twenty-five. Among them, we analyzed a small solar flare with a duration of about 15 seconds on 22 November 2015. In this event, a group of weak type-III bursts appeared in the 1-2 GHz range. Its appearance frequency changed from low/high to high/low frequency before/after the peaktime of the 17 GHz flux. In addition, there was a blank (= no emission) frequency range between the type-III bursts with a negative and positive frequency drift, emitted by high-energy electrons moving upward and downward, respectively. In the frequency range higher/lower than the blank, the most of bursts show negative/positive frequency drift. This blank might correspond to the acceleration region and accelerated electrons move both upward and downward from that altitude. In addition, the frequency of the blank continuously moved to the higher frequency range at least until the peaktime. This indicates that the electron acceleration region gradually moved to the higher altitude during the flare. Here, there are two candidates as the acceleration region. One is the magnetic reconnection site, and the other is the fast shock region above the flare loop in the standard CSHKP-type flare scenario. Integrating the EUV imaging observations by SDO/AIA, we discuss which is more consistent with the observational results.

Keywords: solar flare, radio emission, particle acceleration