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Extremely microwave-rich solar flare

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High-energy particle from the sun is one of the important issues of space weather research. Usually the amount of accelerated particles depends on the size of a solar flare like GOES X-ray class. However, this is not always true. In this presentation, we report an extremely microwave-rich flare which particle acceleration effectively work rather than plasma heating.

A compact flare was observed with Nobeyama Radio Heliograph (NoRH) near the west limb around 2:56 UT on 10 March 2011. Its duration was only one minute. The peak values of microwave flux at 17GHz and 34GHz were 210 and 133 SFU, respectively. This level corresponds to the 11th intense flare observed with NoRH in this solar cycle as of the end of January, 2012. All of the ten flares which are more intense than this event are M- or X-class flares. In this event, however, any significant enhance was not found in the GOES X-ray light curve during the flare period. Since the GOES background level was around C1 at that time, so at least we can say the upper limit of this flare was C1. From microwave images, this flare might occur slightly behind the west limb. We check STEREO-A SECCHI EUV images during the flare period. There was almost no signature of a flare. Only in SDO/AIA 131A images, a small loop-brightening was observed. Summarizing these observations, although thermal emissions were very small in this flare, intense microwave emissions were detected. In terms of hard X-ray observations, unfortunately RHESSI was in the shadow of the earth during this flare.

What causes the relatively intense microwave emissions? Considering that the brightness temperature was about 19 MK, the microwave emissions should be gyro-synchrotron emissions by high-energy electrons. Fleishman et al. (2011) reported a cold tenuous flare with acceleration, but without heating. This flare seems to be similar. However, footpoint regions, i.e., strong magnetic field regions, were occulted in the case of this flare. Additionally, in a higher-frequency range like 34GHz, intense microwave emissions were detected in this case. These features are different from the event reported by Fleishman et al. and make more difficult to understand these observational results. We summarize the characteristics of this unique flare and discuss what kind of process/situation produced it.

Keywords: solar flare, particle acceleration, microwave