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Hard X-ray and Microwave Emissions from Solar Flares with Hard Spectral Indices

KAWATE, Tomoko[1*], NISHIZUKA, Naoto[2], OI Akihito[3], OHYAMA Masamitsu[4], NAKAJIMA Hiroshi[5]

[1]Kwasan & Hida Observatory, Kyoto university, [2]Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, [3]Ibaraki University, [4]Shiga University, [5]Nobeyama Solar Radio Observatory, NAOJ,

We analyze ten flare events that radiate intense hard X-ray emission with significant photons over 300 keV to verify that the electrons that have a common origin of acceleration mechanism and energy power-law distribution from solar flares emit hard X-rays and microwaves. Most of these events have the following characteristics. Hard X-rays emanates from footpoints of flare loops, while microwaves from tops of flare loops.

The time profiles of the microwave emission show delays of peak with respect to that of the corresponding hard X-ray emission. The spectral indices of microwave emissions show gradual hardening in all events, while the spectral indices of the corresponding hard X-ray emissions are roughly constant in most of the events, though rather rapid hardening is simultaneously observed in both indices during the onset time and the peak time in some of them. These characteristics suggest that the microwave emission emanates from the trapped electrons. Then, taking account of a role of the trapping of electrons for the microwave emission, we compare the observed microwave spectra with the model spectra calculated by a gyrosynchrotron code. As a result, we successfully reproduce the eight microwave spectra. From this result, we conclude that the electrons that have a common acceleration and a common energy distribution from solar flares emit the both hard X-ray and microwave emissions in the eight events, though microwave emission is contributed by electrons with much higher energy than hard X-ray emission.

Keywords: the Sun, microwave, hard X-ray, particle acceleration