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Study of Solar Flare Energetic Electrons by Using Synthesized Microwave Emission Based on Fokker-Planck Simulation Resul

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Temporal, spatial and spectral variation of microwave emissions from solar flares are studied by solving the electrons transport in a flare loop and their production of gyro-synchrotron photons. The issue of generation mechanisms of high-energy electrons in flares have been known but have not yet understood for more than decades. In observations, for example, the Nobeyama Radio-heliograph has made clear descriptions on the gyro-synchrotron emissions from them, such as, relative brighter loop-tops than footpoints, and steeper (softer) spectra toward footpoints. These observational results should include information on the phase-space-density of injected electrons and could be used as keys to the acceleration mechanisms. It is, however, not straightforward and is a difficult task since such injection information is strongly modulated through the transport and the emission processes. We study this problem by a ”forward” approach: First, we solve the electron transport Fokker-Planck equation along a flare loop. The dependence of phase-space density on time, space, electrons pitch-angle, and their energy is derived. The pitch-angle scattering by the Coulomb collisions throughout the loop and the electrons loss at both footpoints are included. Second, the gyro-synchrotron emission (assumed optically-thin) is derived from non-isotropic distribution of emitting electrons. We found that: (1) The loop top is relatively brighter than the footpoints. (2) Both footpoints have steeper (softer) spectrum than the loop top. (3) The emission is harder than what is expected from the isotropic electrons.

Keywords: solar flare, acceleration, microwave observations