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Peak Flux Distributions of Solar Radio Type-I Bursts from Highly Resolved Spectral Observations by AMATERAS

Kazumasa Iwai[1*], Satoshi Masuda[2], Yoshizumi Miyoshi[2], Fuminori Tsuchiya[3], Akira Morioka[3], Hiroaki Misawa[3]

[1]Nobeyama Solar Radio Observatory, National Astronomical Observatory of Japan, [2]STEL, Nagoya University, [3]PPARC, Tohoku University

Type-I noise storms are one of the most frequently observed solar radio phenomena in the metric frequency range. They are thought to be plasma emission at the local plasma frequency. Type-I noise storms contain many complex fine structures in their spectra called type-I bursts. They are thought to be caused by some inhomogeneities of particle acceleration, wave generation, radio emission, and/or radio propagation processes. However, the detailed spectral characteristics of them have not been understood well because of the complex spectral structures, limited spectral resolutions of the previous observations, and numerous instances of radio frequency interference (RFI) in the observed radio spectra.

We developed a two-dimensional auto burst detection algorithm that can remove RFI and distinguish an individual type-I burst element from complex type-I noise storm spectra. This algorithm removes RFI from the observed radio spectra by applying a moving median filter along the frequency axis. Burst and continuum components are distinguished by a two-dimensional maximum and minimum search of the radio dynamic spectra. Then we derived the peak flux distributions of type-I bursts using AMATERAS (the Assembly of Metric-band Aperture TElescope and Real-time Analysis System; Iwai et al. 2012), a solar radio telescope that can distinguish the fine spectral structures of metric radio bursts with high time and frequency resolution. The analysis result shows that each type-I burst element has one peak flux without double counts or missed counts. The peak flux distribution of type-I bursts derived using this algorithm follows a power law with a spectral index between 4 and 5. This extremely soft spectrum is observed for the first time in solar phenomena.

Keywords: Sun: radio radiation, Sun: corona, ground-based observation, particle acceleration, AMATERAS