Wide band and high time resolution spectrometer for the solar radio observation

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Type I noise storm is an interesting solar radio emission on the points of their source regions and plasma acceleration mechanisms. The storm shows unique nature; narrow band emission, long time duration and strong circular polarization. During the noise storm emission, associated Type III storm bursts are sometimes observed. To explain these phenomena, it is generally considered that, non-thermal electrons made in some physical process become trapped in a closed magnetic field, and make Langmuir waves. Then the Langmuir waves are converted into o-mode waves and finally observed as Type I noise storms. If electrons are not trapped, Type III storm bursts may be generated in the same process. However generation processes of non-thermal electrons have not been understood. One of the reasons is lack of the wide band wave spectrum data for the bursts which have information of the source regions distributing from 0.1 to 0.5 solar radii.

To observe the solar radio bursts with sufficient frequency band and high time resolution, we are planning a solar radio observation using the Iitate Planetary Radio Telescope (IPRT) at Iitate, Fukushima, and we have newly developed a wide band and high time resolution observation system.

At the focal point of the IPRT, there is a plane reflector to stop down the directivity of the primary feed element. When we observe solar radio bursts, we need a feed with wide band sensitivity. A log periodic antenna is often used in the wide band radio wave observation. However, a log periodic antenna with a plane reflector has non uniform frequency dependence of the directivity. We designed a new feed system consisted of stack dipole antennas with different element lengths. It has wide band sensitivity with the plane reflector.

We also evaluated the performance of the AD+FFT board using FPGA (AC240) which is newly developed by Acqiris SA. We found that it took less than 10 ms to process one FFT signal and save the output data. The data is sampled with 8-bit, yielding a dynamic range of 48 dB. The dynamic range is further improved by statistical noise reduction.

In the presentation, we will introduce the new observation system with the purpose of this project.