New solar radio telescope of NICT and its space weather forecasting

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The solar corona contains many eruptive phenomena such as flares. Non-thermal electrons accelerated in the coronal eruptive phenomena emit radio waves. As a result, many types of solar radio bursts are observed. The radio emission propagates faster than the particles. Hence, the monitoring observation of the solar radio bursts is one of the efficient tools to forecast the arrival of the space weather phenomena such as coronal mass ejections (CMEs) and solar energetic particles (SEPs). National Institute of Information and Communications Technology (NICT) have been observed the solar radio burst since 1980's at Hiraiso. The current solar radio observation instruments named HiRAS have been used to monitor the solar radio burst for more than 20 years. Recently, we developed a new solar radio telescope to improve the observation quality and achieve the better space weather forecasting. The new telescope was constructed in the Yamagawa radio observation facility of NICT at Kagoshima prefecture. This telescope has an 8m parabola dish. The feed system of this telescope consists of two wideband log-periodic antennas. These two antennas are tuned for different frequency bands and the entire observation frequency band of this telescope is between 0.07 GHz and 9.0 GHz. The apparent diameter of the Sun is about 0.5 degree. The higher band of the feed system is de-focused to cover the entire solar disc on the field of view. The received signal is divided in the receiver system and fed to the digital fast Fourier transform (FFT) spectrometers made of the field-programmable gate array (FPGA). We developed two types of digital spectrometers. The one has 2 GHz bandwidth and 4096 FFT points. The other one has 1 GHz bandwidth and 32768 FFT points. These spectrometers have no dead time and spectra are accumulated inside the FPGA processors. The accumulated spectra are recorded every 8ms. The observation system has a total of 10 digital spectrometers. The entire system can simultaneously observe the right and left handed circular polarizations of the solar radio emission between 0.07 and 9.0 GHz with 8ms time resolution. This wide observation frequency band is very efficient to capture the various types of solar radio bursts. Therefore, the new observation system will improve the detection accuracy of the space weather phenomena. In addition, the high time resolution of this instrument has a significant benefit to detect the various fine spectral structures of the radio bursts that are thought to be generated by the micro plasma processes in the corona. Hence, the new system will also be sued to understand the coronal plasma physics such as the particle acceleration processes of the solar flares.

Keywords: Sun, solar rasio burst, space weather forecasting, solar energetic particle, radio observation

