

Development of spectral riometer for observation of energetic electron precipitation at Syowa Station, Antarctica

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Recently, from the viewpoint of the space weather research, much interest has been focused on the effect of energetic electron precipitation (EEP) from the magnetosphere on the atmosphere. The precipitation of the electrons with energies greater than several tens of keV can be detected by riometers from the ground. The riometer is an instrument that measures the ionospheric absorption of cosmic radio noise (CRN), which is caused by the electron density enhancement mainly in the ionospheric D region due to the auroral electron precipitation. However, the existing riometer which observes the CRN at a single frequency can detect the appearance of EEP only, but it cannot estimate the flux of the precipitating electrons quantitatively. In order to investigate the flux of precipitating electrons quantitatively, a wide-band riometer, so-called spectral riometer has recently been developed by the Sodankyla Geophysical Observatory (SGO) (Kero et al., 2014). We have developed the spectral riometer to conduct the wide-band-frequency riometer observation at Syowa Station, Antarctica, during the 63rd Japanese Antarctic Research Expedition (JARE-63, 2022-2023). The spectral riometer measures cosmic noise absorption (CNA) in the frequency range from 20 to 60 MHz and enables us to estimate the height profile of the electron density between about 50 and 120 km and the electron energy spectra in the energy range from several keV to about 1 MeV.

There is a problem to be solved in the spectral riometer observation at Syowa Station. At Syowa, a high-power atmosphere radar, PANSY, is being regularly operated at a frequency of 47 MHz, which is inside the frequency range of the spectral riometer. To solve this problem, we collect only the CRN signals when the PANSY radar is not transmitting pulses by using the software-defined radio (SDR) technique. The CRN signals and the transmission timing pulses from the radar are sampled by a sampler for SDR, and then the signals are transferred to the personal computer (PC). Using the transmission timing pulse, PC extracts CRN signals when the PANSY radar is not transmitting. The extracted CRN signals are then fast Fourier transformed and decimated in real-time, and the obtained power spectra are recorded every second. In the presentation, we will show the scientific goal of the spectral riometer observation, the observation system, and results of test observation.

References:

Kero, A., J. Vierinen, D. McKay-Bukowski, C.-F. Enell, M. Sinor, L. Roininen, and Y. Ogawa, Ionospheric electron density profiles inverted from a spectral riometer measurement, *Geophys. Res. Lett.*, doi:10.1002/2014GL060986, 2014.

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