

High Performance System of Plasma Wave Receiver for Satellite/Rocket Observations

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Wave particle interaction in collisionless space plasma is much important. We observe electric/magnetic waves by the instrument such as PWI(Plasma Wave Instrument) onboard Geotail spacecraft. Observed waves inform us about space plasma phenomena in detail. Plasma wave instruments were developed and loaded into many science satellite/rocket in Japan and other countries. In our study, we will introduce about several instruments for plasma wave onboard satellites and rockets.

Our study explores the development of a plasma wave observation system in order to put digital computer technology to practical and highly efficient use and to expand the related applications such as a wave particle correlator for a future space science mission. We have developed a high performance plasma wave observation system for the SS-520-2 rocket experiment, programmed the high efficiency data transfer system, and studied the observation results. We have also designed a digital wave particle correlator for use in plasma wave observations. For a practical application of a plasma wave instrument, a direct measurement system of wave-particle interactions is one of the important systems to the space science mission. Electron bunching generates wave interactions and in the previous spacecrafts and rockets, an observation target for conventional wave particle correlator is a packet-like Langmuir wave generated in the polar aurora or in the solar wind. This instrument can observe wave-particle interactions by calculation of the cross correlation functions between obtained waveforms and detected particles onboard.

In Japan, we have never developed or flown a direct measuring system for wave particle interaction before. We firstly designed and developed a Digital Wave Particle Correlator (DWPC) system. Our designed system is assembled in one FPGA (Field Programmable Gate Array) IC. For a new electron instrument in the development stage, FPGA is installed in many latest rocket and spacecraft to combine multi-channel, multi-frequency range array of correlators with technical improvements. We realized 3-channel of variable waveform filter and data synchronization with waveform and particle in the DWPC system. In FPGA, our algorithm controls waveform data, particle data, and magnetic field data.