

## Development of a Radio Technique using Multi-spacecraft for Plasma Imaging in the Magnetosphere

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Active experiments or measurements using multi-spacecraft will be forthcoming research subject on large scale dynamical plasma processes in the Earth's magnetosphere and around planets. For this purpose, we have been continuing to develop various methods of experiments making use of radio waves using multi-spacecraft.

As one of candidates of the experiments, we have been continuing to develop a feasible method of plasma imaging in the Earth's magnetosphere or around planets, using a propagation property of an FM-CW radio wave between spacecraft, which is different from the method proposed by Ergun et al.[1]. The principle of the determination of the plasma density in the magnetosphere is to detect the plasma cutoff frequency during the frequency sweep of radio wave propagating between spacecraft.

This technique is making use of FM-CW. An FM-CW wave is transmitted from a spacecraft, and other spacecraft receives its signal and compared its with other FM-CW signal which is prepared in the receiver system on the spacecraft, and whose waveform is quite the same as that of the transmitted signal. For this experiment, we have to keep two important points. One is the FM-CW signal waveform. All the waveforms on multi-spacecraft have to be quite the same. Another is the synchronization of starting times of FM-CW wave and of their sequential repetitions on all spacecraft. In order to meet these two points, one is prerequisite condition of the FM-CW wave formation from digital data, another is making use of an atomic oscillator in the wave formation system as a master clock.

At the first trial of FM-CW wave formation, we attempted to use ROMs in which all the digital values giving the waveform are stored into memories methodically. However, this method was unrealistic to accomplish the system because the system needed extremely enormous ROM capacity in storing the entire values of waveform for the actual experiment. Then we decided to use the Digital Signal Processor (DSP) for making the FM-CW waveform. And recently we have established a processing algorism and its source code for the FM-CW formation using the DSP. Although it generates not continuous frequency signal but discrete ones, it can make it possible to select specifications such as arbitrary minimum and maximum frequency and incremental frequency step and others.

Based on its accomplishment of the system, we are planning to make up the total circuit system toward an realistic experiment.

[1] R.E.Ergun, et al., Feasibility of a multisatellite investigation of the Earth's magnetosphere with radio tomography, J. Geophys. Res., 105, 361-373, 2000.