

Initial Report on Plasma Wave Observation using Waveform Capture (WFC) onboard KAGUYA(SELENE)

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The waveform capture (WFC) [1] is one of the subsystems of the Lunar Radar Sounder (LRS)[2] on board the KAGUYA spacecraft. The WFC measures two components of electric wave signals detected by the two orthogonal 30 m tip-to-tip antennas from 100Hz to 1MHz. The scientific objectives of the WFC are 1) lunar science and 2) extra-lunar science. The former is the science of the plasma physics re-lated to the moon itself. One of the most specific phenomena of interest to be obtained from the WFC data is the dynamics of lunar wake. Another scientific topic at the moon is the plasma physics related to a mini-magnetosphere caused by the magnetic anomaly of the moon. As for the extra-lunar science, various kinds of plasma waves and radio waves originating from the sun and the earth and other planets are ex-pected to be observed by taking advantage of a moon orbiter. By taking advantage of a moon orbiter, the WFC measures plasma waves and radio emissions around the moon at about 60 of earth's radii in the so-lar wind, in the magnetosphere, and in the lunar wake.

The main electrics of the WFC consist of two kinds of passive receivers named WFC-H and WFC-L. The WFC-H is a fast sweep frequency analyzer covering the frequency range from 1 kHz to 1MHz. The WFC-L measures waveforms in the frequency range from 10 Hz to 100 kHz. The detected signals are processed by a high-performance and multi-functional software receiver in which most of the functions are realized by a DSP (digital signal processor) and PDCs (programmable down converters) implemented on the WFC board. As the telemetry budget is restricted compared to the amount of the raw data, we need to process the raw data and reduce the amount of mission data to be sent to the ground by the DSP.

The data rate assigned for the WFC is 4/80/160 kbps. Due to the restriction of the power consumption and telemetry budget, available telemetry rate for the WFC depends on the observation modes of the other subsystems of the LRS. Under the restriction of the telemetry rate, both the WFC-H and WFC-L are operated with various kinds of observation modes controlled by the DSP software.

The extension of the two orthogonal antennas and the initial check out of LRS/WFC was successfully performed in the end of October, 2007. The background noise level of the receiver was firstly examined and we found that the data quality is satisfactory based on the EMC (electro-magnetic compatibility) cri-teria, which was enacted to meet our scientific requirements. Several natural plasma waves such as AKR (auroral kilometric radiation) and UHR (upper hybrid resonance) emissions were observed. In addition, distinct transition of wave activities from dayside to night side of the moon was identified. In the present paper, we briefly introduce some initial results obtained by the WFC observation during the initial verifi-cation phase of the KAGUYA spacecraft.

KAGUYA was shifted to the nominal operation phase in the middle of December, 2007 and we expect the WFC receiver to produce many interesting scientific data.

[1] Y. Kasahara, Y. Goto, K. Hashimoto, T. Imachi, A. Kumamoto, T. Ono, and H. Matsumoto, Plasma Wave Observation Using Waveform Capture in the Lunar Radar Sounder on board the SELENE Space-craft, Earth, Planets and Space, 2008, (in press).

[2] T. Ono, A. Kumamoto, Y. Yamaguchi, A. Yamaji, T. Kobayashi, Y. Kasahara, and H. Oya, Instrumentation and Observation Target of the Lunar Radar Sounder (LRS) Experiment on-board the SELENE Spacecraft, Earth, Planets and Space, 2008, (in press).