Initial Results of the Lunar Radar Sounder (LRS) Experiment on-board the KAGUYA (Selene) Spacecraft

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The Lunar Radar Sounder (LRS) on-board the KAGUYA (Selene) lunar orbiter is currently being equipped to provide the data of subsurface stratification and tectonic features in the shallow part (several km deep) of the lunar crust, by using an FM/CW radar technique in HF (~5MHz) frequency range (Ono and Oya, 2000; Ono et al. 2007). Knowledge of the subsurface structure is crucial to better understanding, not only of the geologic history of the moon, but also of the moon's regional and global thermal history of the moon and of the origin of the Earth-Moon system (Yamaji et al., 1998). In addition to the subsurface radar experiment, LRS will provide the spectrum of plasma waves and solar and planetary radio waves in a wide frequency range from 10 Hz to 30 MHz (Kumamoto et al., 2007; Kasahara et al., 2007). After completing all the pre-flight model integration tests, the KAGUYA (Selene) spacecraft has been launched on September 14, 2007.

The technique of the instrumentation of LRS is based on the plasma waves and sounder experiments which have been established through the observations of the earth's magnetosphere, plasmasphere and ionosphere on-board Jikiken, Ohzora and Akebono satellites, and extended to observations of the Martian ionosphere as well as surface land shape on-board the Nozomi spacecraft. To provide necessary efficiency for transmission of high-power (800Watts) pulses and detection of reflected echoes with 5MHz frequency, Bi-Stem antennas with length of 15m are equipped. By using digital signal processing techniques for the RF waveform generation and on-board data analyses, it becomes possible to improve the S/N ratio and resolution, as well as capability of data handling for the subsurface sounding of the Moon (Ono and Oya, 2000; Ono et al. 2007). The instrumental and theoretical studies showed that the observations on-board the SELENE spacecraft will provide detailed information about the subsurface structures within a depth of 5 km from the lunar surface, with a range resolution of less than 75 m for a region with a horizontal scale of several tens of km (Kobayashi et al., 2002, 2006).

The present state of the LRS passed the initial test. The LRS experiment is now continuing the standard observation phase of the KAGUYA (Selene) spacecraft. This paper provides initial results from the LRS function test and observation on-board the Kaguya (Selene).

Bibliography

1. Ono, T., 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 Space, 59 (in press), 2007
2. Kumamoto, A., T. Ono, Y. Kasahara, Y. Goto, Y. Iijima, and S. Nakazawa, Electromagnetic compatibility (EMC) evaluation of the SELENE spacecraft for the lunar radar sounder (LRS) observations, Earth Planets Space, 59 (in press), 2007.
3. Kasahara, Y., Y. Goto, K. Hashimoto, T. Imachi, A. Kumamoto, T. Ono and H. Matsumoto, Plasma Wave Observation using Waveform Capture (WFC) on LRS/SELENE, Earth Planets Space, 59 (in press), 2007.
4. Kobayashi, T., and T. Ono, SAR/InSAR observation by an HF sounder, 112, E03S90, doi:10.1029/2005JE002576, 2007.
5. Kobayashi T., T. Ono, Estimation of planetary surface roughness using radio sounder A-scope data, J.

Geophys. Res., 111, E06S10, doi:10.1029/2005JE002575, 2006.
6. Kobayashi, T.,H. Oya, and T. Ono, A-scope analysis of subsurface radar sounding of lunar mare region, Earth Planets Space, 54, 973-982, 2002.
7. Kobayashi, T., H. Oya, and T. Ono, B-scan analysis of subsurface radar sounding of lunar highland region, Earth Planets Space, 54, 983-991, 2002.
8. Ono, T., and H. Oya, Lunar Radar Sounder (LRS) experiment on-board the SELENE spacecraft, Earth Planets Space, 52, 629-637, 2000.
9. Yamaji, A., S. Sasaki, Y. Yamaguchi, T. Ono, J. Haruyama, and T. Ogada, Lunar tectonics and its implications for the origin and evolution of the moon, Mem. Geolo. Soc. Japan, No. 50, 213-226, July, 1998.