Observations of the lunar subsurface structures and natural radio waves by the Lunar Radar Sounder (LRS) onboard the Kaguya

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The Lunar Radar Sounder (LRS) onboard the Kaguya (SELENE) spacecraft [Ono et al., 2000; 2008; Kumamoto et al., 2008; Kasahara et al. 2008; Ono et al., 2010] successfully obtained 2363-hours worth of radar sounder data and 6570-hours worth of natural plasma wave data in the nominal operation period from October 29, 2007 to September 10, 2008 and 2390-hours worth of natural plasma wave data in the extended operation period until June 10, 2009.

It was found by the LRS observation that there are distinct subsurface reflectors with a depth of several hundred meters below the surface of the nearside maria. The reflectors are inferred to be old regolith layers covered by basalt layers [Ono et al., 2009]. Based on further analyses, Oshigami et al [2009] reported that the subsurface echoes are found only in 10% of the western nearside maria such as Mare Humorum, Mare Imbrium, and Oceanus Procellarum. Pommerol et al. [2010] also suggested that detectability of the subsurface echoes depend on abundance of TiO_2 and FeO in the surface material. Kobayashi et al. [2010] proposed the estimation method of the thickness of the surface regolith by the apparent difference of altitudes measured by laser altimeter (LALT) and LRS. It enables us to obtain regolith thickness with several m, which is much less than the range resolution of LRS, or 75m. In order to take advantage of lunar global subsurface radar soundings performed by the Kaguya spacecraft, we have to establish the analysis methods of radar sounder data obtained not only in nearside maria but also in farside highland regions and polar regions. We have two strategies: (a) Echo simulation based on subsurface models and surface topographic data obtained by LALT [Araki et al., 2008; 2009] and Terrain Camera (TC) [Haruyama et al., 2008], and (b) synthetic aperture radar (SAR) analyses [Kobayashi et al., 2002a; 2002b; 2006; 2007].

LRS was operated not only for the radar sounder observation but also for the passive radio wave observation. Through the operation period from October 2007 to September 2008, we could detect numerous events of auroral kilometric radiation (AKR), 39 events of type III solar radio bursts, and 7 events of Jovian hectometric (HOM) radiation. Unfortunately, we could not detect so many Jovian HOM events during the operation period. However we could obtain several Jovian HOM spectrograms with high time resolutions of 2 sec and 0.1 sec.