Reflectivity of the lunar surface measured by active and passive radio wave observations of the Kaguya spacecraft

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The reflectivity of the lunar surface has been investigated based on the radar sounder observations and passive radio wave observations performed by Lunar Radar Sounder (LRS) onboard the Kaguya spacecraft. LRS transmitted RF pulse in a frequency range from 4 to 6 MHz with a power of 753 W [Ono et al., 2008]. Considering free space propagation loss, antenna gain, pickup factor of the receiver, we can compare measured echo level with estimated echo revel without reflection loss, and obtain reflectivity of the lunar surface. It was found that (1) maximum of measured echo level is almost equal to estimated echo level, and (2) measured echo level varies in a range of 15 dB below the estimated echo level. Not only the radar sounder echo but also the natural and artificial echoes can be useful for investigation of reflectivity of the lunar surface. Natural Plasma Wave receiver (NPW), sub-receiver of the LRS, sometimes observed unique modulation pattern in spectrogram of auroral kilometric radiation (AKR). It suggests that interference between directly arrived AKR and AKR reflected at the lunar surface occurs. In High Frequency Active Aurora Research Program (HAARP) Moon Bounce Experiment on Jan. 19-20, 2008, LRS simultaneous observation was carried out. The measured HAARP signal level shows variations caused by the lunar surface reflection just as AKR. The range of HAARP signal level variation was 20 dB above the nearside maria region and 3 dB above the polar region, which suggests reflectivity is higher in maria region than in the polar region.

It is inferred that the lunar surface reflectivity depends on both roughness and dielectric properties of the lunar surface. In general the dependence on roughness seems to be dominant. However correlation between echo power and FeO abundance was also shown, which suggests dependence on dielectric properties [Nakagawa et al., 2009]. Synthetic aperture radar (SAR) analysis of LRS data and comparison with digital elevation model (DEM) based on LALT and terrain camera (TC) observations will be useful for distinction of the dependences on roughness and dielectric properties.

References

Nakagawa et al., submitted to GRL, 2009.
Ono et al., EPS, 60, 321-332, 2008.