The observation of lunar brightness temperature and the subsurface dielectric constant using UHF-band radio telescope

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In Apollo program, many workers investigated about properties of lunar soil and rock samples. From these works, electrical and chemical properties of lunar surface samples are well known. Since the end of the Apollo mission, a lot of investigation about moon surface physics, chemistry and geology were terminated. However in recent years, Clementine mission (NASA), Lunar Prospector mission (NASA) and Smart1 mission (ESA) have been launched, and also number of lunar exploration missions are planned in many nations. Especially SELENE mission is planed to launch in 2008 by JAXA. On the other hand, ground-based moon observation which contains radio wave observation has carried out by many workers [Mayer, 1964; Evans, 1969; Hagfors et al., 1969]. In these observations, they use short wave length radio waves (for example infrared or GHz band). Wave length of the radio waves determines the skin depth of lunar surface region, then longer the wave length become, the deeper its skin depth become. When we use long wave length, we are able to know deeper subsurface region.

So in this study, the moon thermal radiation has been observed in UHF band using Iitate Planetary Radio Telescope (IPRT). The observation frequency of IPRT is 325MHz and the antenna beam width is 1.6 degree. IPRT are usually used for observation of Jovian Synchrotron Radiation (JSR). In the present study we applied IPRT to realize the observation of moon thermal emission. In this case, it is very important to consider that moon size which affect as a shield for the back ground galactic noise. When analyzing moon radio observation data, we have to consider about the correction of shielding effect. From numerical analysis, the shielding effect is 8.42 % of the power of back ground galactic noise level.

The observation of the thermal emission has been carried out successfully since December 2004. From the observational data, 16 thermal emission data have been successfully obtained and analyzed using y-factor method. Then we derived the brightness temperature of the moon at 325MHz from observational data. In past studies which used infrared and GHz radio band, the lunar surface temperature change with lunar cycle, and the peak of temperature has time lag from the full moon. However, in the present data, there is no signature of the temperature variation depending on the lunar age. The temperature is constant over lunar cycle, and the average temperature is derived as 289K, within the error bar of 17%. From this result, the observed lunar temperature is expected to be coincide with the temperature of subsurface region with the depth of 80m.

In future, the detail temperature profile of the lunar surface over the depth from 0 m to ˜100 m will become clear, when we cover the all frequencies range of lunar thermal emissions in UHF and VHF bands.