Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PPS03-04 会場:424 時間:4 月 29 日 09:45-10:00

月面での回転観測：可能性と問題点
Observations of lunar rotation on the Moon: possibility and problems.

花田 英夫[1*] ; 鶴田 誠逸[1] ; 浅利 一善[1] ; 千葉 皓太[2] ; 稲葉 健太[2] ; 船崎 健一[2] ; 佐藤 淳[2] ; 谷口 英夫[2] ; 加藤 大雅[2] ; 菊池 護[2] ; 荒木 博志[1] ; 野田 寛大[1] ; 鹿島 伸悟[1]
HANADA, Hideo[1*] ; TSURUTA, Seiitsu[1] ; ASARI, Kazuyoshi[1] ; CHIBA, Kouta[2] ; INABA, Kenta[2] ; FUNAZAKI, Ken-ichi[2] ; SATOH, Atsushi[2] ; TANIGUCHI, Hideo[2] ; KATO, Hiromasa[2] ; KIKUCHI, Mamoru[2] ; ARAKI, Hiroshi[1] ; NODA, Hirotomo[1] ; KASHIMA, Shingo[1]

[1] 国立天文台 RISE 月惑星探査検討室, [2] 岩手大学工学部
[1]RISE Project, National Astronomical Observatory, [2]Faculty of Engineering, Iwate University

The lunar rotation is one of the essential and basic target of selenodetic observations for investigation of the interior of the Moon as well as those of gravity fields, and high accuracy of the observations have a potential to detect signals related to the structure of lunar deep interior including the core. We have developed a small telescope like a PZT (Photographic Zenith Tube) for observations of Lunar rotation with the target accuracy of 1 milli-seconds of arc (1 mas)[1]. Theoretical investigation shows that observations by the telescope in the polar area of the Moon will open great possibilities for determining the libration in inclination ρ and node Iσ with the accuracy much better than before, although the determination of the libration in longitude will not be very well. It also showed that the determination error in the libration angles will not exceed $\sqrt{2}\varepsilon$, where ε is the positioning error of stars and is regarded as 1 milli-seconds of arc [2].

There are several technical problems to be solved in the development of the telescope. Effect of large temperature change is one of the most serious problem for such a precise observation, and we can loosen thermal condition by about ten times by introducing a diffraction lens compared with the case not introducing it. It is possible, on the other hand, that the vibrations of the mercury surface caused by the ground vibrations lead to fluctuations of star positions on CCD as large as 1 second of arc judging from laboratory experiments. The amplitude of the fluctuations depend on the amplitude of the ground vibrations and the depth of mercury pool. We can reduce the effect of the vibrations by making the mercury pool shallow down to the minimum depth. In the case of the mercury pool of 64mm diameter, the depth of 0.5mm is the best according to our experience [3]. It is important to keep the proper period of the mercury pool away from the period of ground vibrations in order to avoid the resonance. It is also effective to lengthen the integration time, and it can improve the reliability of the mean value of the center of a star image by statistical procedure.

We have already made a bread board model (BBM) and we will observe the deflection of the vertical on the ground by using the BBM for the time being in order to evaluate the characteristics of the total system of the telescope.

References
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キーワード: 回転, 月, 望遠鏡, PZT, 物理ひょう動
Keywords: rotation, moon, telescope, PZT, librations