

The observation and coverage analysis of the moon-based ultraviolet telescope on CE-3 lander

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Abstract

The moon-based ultraviolet telescope (MUVT) is one of the payloads on CE-3 lunar lander. This article presents the statistics and analysis of observation coverage during the period of MUVT working from December 15, 2013 to December 2, 2015, a total of 25 months. The results show that MUVT implemented about 5.487% of a total survey area, to achieve the CE-3 survey mission. It has accumulated lots of observational data for research on stellar evolution, compact star and so on.

1. Introduction

In accordance with CE-3 mission, taking the Moon as a natural astronomical observation platform, MUVT works in the near ultraviolet spectrum, it will be the first long-term observatory to be deployed on the Moon, to study on the variation characteristics of celestial bodies and sky survey of low galactic latitude.

The MUVT consists of a Ritchey-Chretien telescope(RCT) that is a specialized Cassegrain Telescope. It uses a pointing mirror that features a two-dimensional gimbal to track objects.

The CE-3 MUVT observation mode has two types: one is the pointing observation of astronomical sources for a long time; another is survey of low galactic latitude area by the rotation of the moon. At the same time, in order to ensure the validity of the astronomical observation data, the CE-3 MUVT has been working, including attitude calibration, and photometric calibration, the instrument correction.

2. Data processing and coverage analysis

We make a systematic analysis and evaluation of the data acquisition, processing and survey of the MUVT from December 15, 2013 to December 2, 2015. For the MUVT, data processing includes: firstly, frame synchronization, decoding, sorting, and data decompression, secondly, physical transformation of data blocks, finally the data for instrument effect correction, background removal and positioning in celestial coordinate system.

The celestial coordinates in J2000 mean equatorial coordinate system are calculated for the center and the four corners for each of the images. The calculation is based on the pitch and azimuth angles of the gimbal and on the relationship between the attitude of the telescope and the lunar rotation pole.

In order to maintain the survey path of the MUVT and the shape of each image, and reduce the angular distortion of the image, when the data analysis and statistics, we use the azimuthal projection (the center of the projection is Latitude 65 degrees , Longitude - 90 degree).

Due to the limit of pitch angle between +11degreee ~+20 degree(zenith 0, north is positive), the north latitude 60 degree is within the observation range. According to the point observation, survey and attitude calibration three types, we perform our coverage analysis through the time stamp and coordinates of the MUVT images.

3. Figures

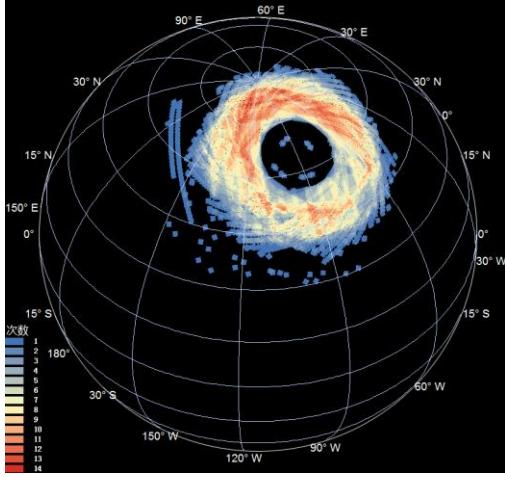


Figure 1: the coverage analysis results of MUVT during two years.

6. Summary and Conclusions

Through the analysis of all the observed images of MUVT, it is found that in the celestial coordinate system, all the images of the survey are concentrated at Latitude 65 degrees and Longitude -90 degrees as the center, a ring of 15 degrees width. The observation data analysis: the coverage of the northern area is up to 2263.8 square degrees, accounting for about 5.487% of the all area. The task is completed the observation target. For the first time, the MUVT in a long time has carried out the astronomical observations, and accumulated abundant observational data for basic research on the evolution of stars, compact star and high energy astrophysics and so on.

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References

- [1] Wen W. B., Wang F., et al. Data preprocessing and preliminary results of the moon-based ultraviolet telescope (MUVT) on CE-3 detector. *RAA*, 2014.
- [2] Tan X., Liu J. J., Li C. L., et al. 2014, *Research in Astron. Astron. Astrophys. (RAA)*, 2014.
- [3] Jia Yingzhuo. The report of the CE3' payload flight model, 2011.
- [4] Cao Li. The calibration summary report of the moon ultraviolet telescope, one of the CE-3' payloads. 2012.
- [5] J. Wang, J. S. Deng, J. Cui et: Lunar exosphere influence on lunar-based near-ultraviolet astronomical observations, 2011 (In *Adv. Space Res.*).
- [6] Ip, W.-H., Yan, J., Li, C.-L., & Ouyang, Z.-Y., 2014, *RAA (Research in Astronomy and Astrophysics)*, 14, 1511