Present Status of the 7/10 m Telescope of CANGAROO II

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Abstract

A 7/10 m diameter Čerenkov telescope of the CANGAROO II project will start operation in 1999 in Woomera, South Australia, with a 7 m aperture using 60 plastic mirrors. The telescope aims to observe 100 GeV gamma-ray sources in the southern sky.

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Table 1
Characteristics of the CANGAROO 7/10 m telescope.

Mirror	
Type	Composite
Shape of the frame	Parabolic
Focal length	8 m
Segment	80 cm diameter spherical mirror
Number of segments	60 (114) at a 7 (10) m aperture
Camera	
Pixel size	1/2 inches ($0^\circ.091$)
Number of pixels	512
Field of view	$\sim 3^\circ$ in diameter

1 Introduction

The CANGAROO group has observed southern gamma-ray sources with the threshold energy of about 2 TeV using the 3.8 m Čerenkov telescope [1] and attempts to extend the observable energy region down to 100 GeV with a new Čerenkov telescope of a 7 or 10 m aperture. The new telescope will be located in Woomera ($136^\circ 47'$ E, $31^\circ 06'$ S) near the 3.8 m telescope. Characteristics of the 7/10 m telescope are summarized in Table 1. The design concept of the telescope has already been presented elsewhere [2,3] and we note here that our challenge is in the plastic mirrors and the mirror tuning system.

2 Status of the construction work

Mirror: We start observations of the new telescope with a 7 m aperture using 60 spherical mirrors of 80 cm in diameter. The Carbon Fiber Reinforced Plastic (CFRP) is used for the main material of the spherical mirrors. The weight of one mirror is only about 6 kg, which is about 4 times lighter than the glass mirror of the same volume. The blur spot of each CFRP spherical mirror was measured by a CCD camera using a point-like light source at the curvature center of the mirror. The FWHM of a typical spot taken at the same distance as the curvature radius from the mirror is about 15 mm, which corresponds to about 8 mm ($\sim$ a half of the spacing size between PMTs) for the spot of parallel light.

Mirror tuning system: To tune and remote-control each mirror segment

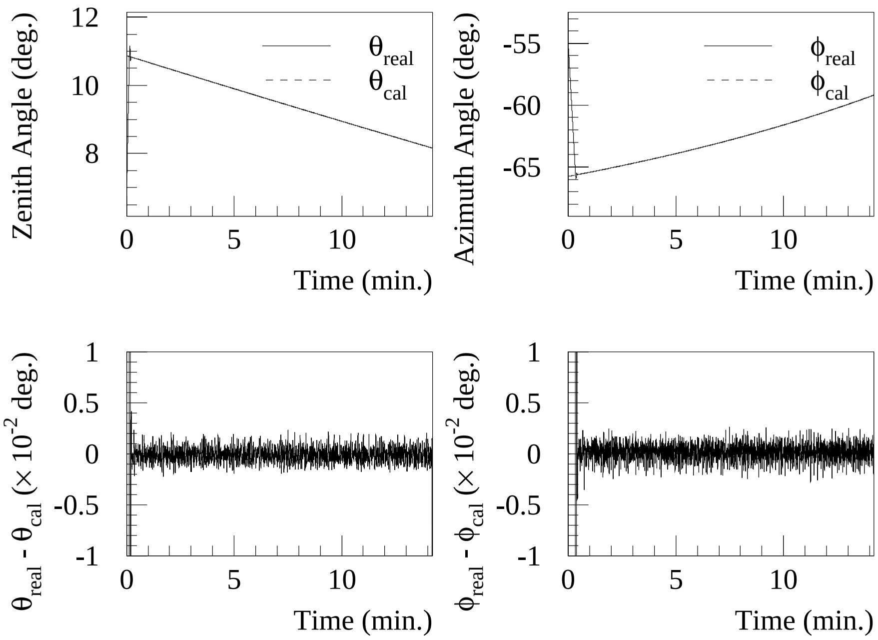

Fig. 1. Results of a tracking test of the telescope drive. Real (encoder) and calculated values of zenith (θ, left) and azimuth (ϕ, right) angles are plotted at the top figures as a function of time. The bottom figures show their differences.

we developed a tuning system using stepping motors. The attitude of each spherical mirror is adjusted by two stepping motors in the accuracy of 0.8 μm, which corresponds to 6×10^{-4} degrees of the mirror direction.

Telescope drive: The alt-azimuth mount of the 7/10 m telescope made by the Mitsubishi Electric Corporation was already assembled in Japan to test the performance of the telescope drive. Figure 1 shows results of a tracking test of the telescope drive. The drive was forced to track a dummy celestial object and real coordinates of the telescope direction (encoder values) were compared with calculated coordinates. Differences between real and calculated values are about $0^\circ.001$ for both of zenith and azimuth angles. This accuracy is better by one order than that of the 3.8 m telescope.

3 Schedule and prospects

The 7/10 m telescope will be transported to Woomera at the end of 1998 and the construction at the site will start in January 1999. We will be ready to observe with a 7 m aperture in March 1999. The aperture of the mirror will be extended to about 10 m when the other 54 mirror segments are funded. We have a hope to add three more 10 m telescopes as soon as possible to have stereoscopic observations and to lead the new era with VERITAS and HESS projects.

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References

[1] T. Hara et al., *Nuc. Inst. Meth. Phys. Res. A*, 332 (1993), 300.

[2] T. Tanimori et al., Proc. *Towards a Major Atmospheric Čerenkov Detector IV* (Padova, 1995), ed. M. Cresti, p. 316

[3] Y. Matsubara, Proc. *Towards a Major Atmospheric Čerenkov Detector V* (Kruger, 1997), ed. O.C. de Jager, p. 447