Contribution ID: **474** Type: **Poster**

Prototype Schwarzschild-Couder Telescope for the Cherenkov Telescope Array: Commissioning the Optical System

Friday 16 July 2021 19:18 (12 minutes)

The Schwarzschild-Couder Telescope (SCT) is a candidate for medium-sized telescopes of the Cherenkov Telescope Array (CTA). CTA will enable improvements in multi-wavelength and multi-messenger observations due to higher angular resolution and increased sensitivity, capable of detecting Crab-like gamma-ray point sources nearly 100 times faster than current arrays. A prototype SCT (pSCT) has been constructed at the Fred Lawrence Whipple Observatory. The pSCT uses a dual-mirror design with a 9.7 m primary mirror and 5.4 m segmented secondary mirror. It has a wide field of view (8 degrees), and allows a compact, high-resolution SiPM camera (0.067 deg per imaging pixel), and substantially improves the off-axis performance giving better angular resolution across all of the field of view with respect to single-mirror telescopes. The novel optical system requires a submillimeter-precision custom alignment system, which was successfully achieved with an on-axis PSF of 2.8 arcmin prior to first-light detection of the Crab Nebula in 2020. Future commissioning work aims to meet the on-axis PSF design goal of 2.6 arcmin, measurement and improvement of the off-axis PSF and development of techniques to maintain alignment stability over telescope structural deformations from pointing and temperature variations. In this contribution, we report on the commissioning status, the alignment procedures, and alignment results during the ongoing commissioning phase of the optical system of the prototype SCT to meet remaining design specifications.

Keywords

Atmospheric Cherenkov telescopes; Telescopes; Optical alignment; Optical instrument design; Alignment procedures; Mirrors; Point spread functions; Silicon photomultipliers

Collaboration

CTA

other Collaboration

Subcategory

Experimental Methods & Instrumentation

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Session Classification: Discussion

Track Classification: Scientific Field: GAI | Gamma Ray Indirect