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# Quantifying Australian atmospheric properties for a Gamma-ray Observatory to operate at energies greater than 10 TeV

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For the degree of Masters of Science (Astrophysics)

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# Abstract

Newly proposed $\geqslant$ 10 TeV (1 TeV = $10^{12}$ eV) imaging atmospheric Cherenkov technique (IACT) $\gamma$-ray experiments will need optimal sites for their construction and operation at energies above 10 TeV. Quantifying the optical properties of Australian atmospheres will be part of a site survey to determine the viability of possible IACT Australian sites. Atmospheric optical properties need to be quantified as a TeV IACT $\gamma$-ray array detects Cherenkov radiation that has propagated through the atmosphere within the visible spectrum. For the optimum collection of Cherenkov radiation, sites with the highest optical atmospheric transmission are ideal. Another optical property of concern is the night sky background (NSB) level. NSB photons are a form of background noise that can cause accidental triggering, therefore sites with the lowest levels of NSB are desired. Further information on IACT and the NSB is presented in Chapter 2.

The optical properties of the Australian atmosphere which I quantified for the site surveys were the optical transmission and the NSB. The optical transmission was measured through the star extinction coefficient. The star extinction coefficient and the NSB were found through the method of photometry using a Pentax K10D digital single lens reflex (DSLR) camera. Because a Pentax K10D DSLR camera has not previously been used for this purpose, I initially conducted viability tests on its ability to measure the NSB and star extinction coefficients. I will present these results in Chapter 5. Data collected from multiple trips to Fowlers Gap in New South Wales, Australia, were used for this purpose. I will present the results of star extinction coefficient and NSB level measurements in Chapter 6.

To further help understand the effects of atmospheric conditions, I have investigated the effects of differing levels of aerosols and the effects of cirrus clouds on the performance of a simulated $\geqslant$ 10 TeV IACT $\gamma$-ray array. I give more information about simulated IACT $\gamma$-ray array's in Chapter 3 and present the results in Chapter 4. The effects of cirrus clouds were investigated as these clouds occur at a similar height to the maximum emission of Cherenkov photons for $\gamma$-ray shower energies around 10 TeV.

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