

On-sky Performance of the CLASS Q-band Telescope

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The Cosmology Large Angular Scale Surveyor (CLASS) is mapping the polarization of the cosmic microwave background (CMB) at large angular scales ($2 < \ell < 200$) in search of a primordial gravitational wave B-mode signal down to a tensor-to-scalar ratio of $r < 0.01$. The same data set will provide a near sample-variance-limited measurement of the optical depth to reionization. Between 2016 June and 2018 March, CLASS completed the largest ground-based Q-band CMB survey to date, covering over 31,000 square-degrees (75% of the sky), with an instantaneous array noise-equivalent temperature sensitivity of . We demonstrate that the detector optical loading (1.6 pW) and noise-equivalent power (19) match the expected noise model dominated by photon bunching noise. We derive a 13.1 ± 0.3 K pW⁻¹ calibration to antenna temperature based on Moon

observations, which translates to an optical efficiency of 0.48 ± 0.02 and a 27 K system noise temperature. Finally, we report a Tau A flux density of 308 ± 11 Jy at 38.4 ± 0.2 GHz, consistent with the Wilkinson Microwave Anisotropy Probe Tau A time-dependent spectral flux density model.