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Author: Dr. Anthony Horton
Australian Astronomical Observatory, Australia

Dr. Lee Spitler
Macquarie University, Australia
Dr. Naomi Mathers
Space Industry Association of Australia, Australia
Mr. Mike Petkovic
ANU Institute for Space (InSpace), Australia
Dr. Douglas Griffin
Australian Defence Force Academy (ADFA), Australia
Mr. Simon Barraclough
UNSW Australia, Australia
Dr. Craig Benson
Australian Defence Force Academy (ADFA), Australia
Mr. Igor Dmitrijevic
Australian Defence Force Academy (ADFA), Australia
Prof. Andrew Lambert
University of New South Wales, Australia
Mr. Anthony Previte
Tyvak International SRL, United States
Mr. John Bowen
Tyvak International SRL, United States
Mr. Solomon Westerman
Tyvak International SRL, United States
Dr. Jordi Puig-Suari
California Polytechnic State University, United States
Prof. Sam Reisenfeld
Macquarie University, Australia
Dr. Jon Lawrence
Australian Astronomical Observatory, Australia
Mr. Ross Zhelem
Australian Astronomical Observatory, Australia
Prof. Matthew Colless
Australian National University (ANU), Australia
Prof. Russell Boyce
Australian Defence Force Academy (ADFA), Australia

THE AUSTRALIAN SPACE EYE: STUDYING THE HISTORY OF GALAXY FORMATION WITH A CUBESAT

Abstract

The Australian Space Eye is a proposed astronomical telescope based on a 6U CubeSat platform. The Space Eye will exploit the low level of systematic errors achievable with a small space based telescope to enable high accuracy measurements of the optical extragalactic background light (EBL) and low surface brightness emission around nearby galaxies. To date absolute measurements of the EBL have proven elusive at these wavelengths; the variability of atmospheric emission and scattering make ground based measurements difficult while attempts to use sounding rockets have struggled to accumulate sufficient exposure time. An dedicated orbital telescope is required for a robust measurement, and Space Eye has been designed to fill this role. The scientific payload of Space Eye is a 90 mm diameter, clear aperture, all refractive telescope for wide field imaging using a set of 6 broadband filters in the i' (700–850 nm) and z' (850–1000nm) bands. The telescope design is optimised to minimise all sources of stray light which, when combined with the advantages of the space environment, will enable the most accurate measurements of the EBL so far. This project is also a demonstrator for several technologies with general applicability to astronomical observations from nanosatellites, in particular arcsecond level instrument pointing stability and efficient image sensor temperature control. These crucial capabilities are commonplace in larger scientific satellites but have yet to be flight proven in a CubeSat platform. For the former we have developed a two stage ADCS concept combining high precision star trackers, reaction wheels, and sensor-shift image stabilisation in the science instrument focal plane. Detailed system modelling, incorporating in flight performance data for many of the components, has verified that the design can achieve sub-arcsecond level pointing stability. We have also designed a thermal control system and concept of operations that enables passive cooling of the image sensor to below -40°C despite a thermally unfavourable low Earth orbit.