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SYMPOSIUM ON TECHNOLOGICAL REQUIREMENTS FOR FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS (A7)
Technology Needs (Part 1) (1)

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VERY LARGE CERAMIC TELESCOPES IN ASTRIUM FOR SPACE ASTROPHYSICS

Abstract

The development of Silicon Carbide (SiC) ceramic technology for space telescope was started by Astrium and Boostec about 20 years ago. The first flying application was for the OSIRIS camera on board the Rosetta comet chaser. To date, seven Astrium SiC-made optical payloads are satisfactorily operating in space, and more than eight payloads are currently under development. This results in the manufacturing and testing of more than 150 SiC mirrors and structural parts for space applications, designed to work under environmental conditions varying from ambient to deep cryogenics. For astronomy, the largest worldwide space telescope launched so far was developed by Astrium for the ESA Herschel mission, in orbit since 2009. The Herschel telescope is all SiC-made, with a primary mirror of 3.5m diameter; it operates at about 70K. SiC was the sole technology enabling to fulfil the optical quality requirements within a stringent mass constraint of 350 kg. A study was recently conducted for ESA and JAXA related to a cryogenic infrared space observatory, SPICA, featuring as well a SiC telescope of 3.5m diameter. For the ESA astrometry mission Gaia, to be launched at the end of this year, two SiC telescopes are co-aligned on a toroïdal SiC optical bench of 3m diameter. The telescopes aperture is of 1.4m x 0.5m. In December 2012, ESA has awarded to Astrium the development of the EUCLID Payload Module. The EUCLID mission aims at exploring the Dark Universe with two cosmological probes: weak gravitational lensing and baryonic acoustic oscillations. The payload module features a SiC telescope of 1.2m diameter, operating in very cold condition in visible and NIR domains. Since several years, Astrium has undertaken Research Development on the largest monolithic space telescope that can be accommodated within an Ariane 5 fairing. The project foresees currently a 4.1m diameter main mirror, and implements active WFE control with a small deformable mirror located in an intermediate pupil. Ceramic mirrors and structures have become extremely attractive for high precision light weight opto-mechanical applications. The paper will briefly present the SiC technology and highlight its interest for space astrophysics missions as demonstrated on past and current ESA missions (Herschel, SPICA, Gaia, EUCLID). More information will be then given about the ultimate monolithic telescope of 4.1 m with its active WFE control that optimally exploits fits the Ariane fairing.