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SYMPOSIUM ON NEW TECHNOLOGIES FOR FUTURE SPACE ASTRONOMY MISSIONS (A7)
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THE CANADIAN CONTRIBUTION TO THE JAMES WEBB SPACE TELESCOPE: THE FINE GUIDANCE SENSOR (FGS) AND THE TUNABLE FILTER IMAGER (TFI).

Abstract

The James Webb Space Telescope, also called JWST or Webb, will be the premier observatory of the next decade, enabling us to probe the origins of galaxies, stars, and planetary systems, with unprecedented angular resolution and sensitivity in the infrared spectrum. To achieve this, the observatory will orbit the Lagrange L2 earth-sun point and be passively cooled to cryogenic temperature. As part of an international collaboration with NASA and the European Space Agency (ESA), the Canadian Space Agency (CSA), with its prime Contractor COM DEV, is contributing two astronomical instruments for the telescope: the Fine Guidance Sensor (FGS) and the Tunable Filter Imager (TFI), which are scheduled for delivery to NASA at the end of 2011.

As an essential element of the telescope's attitude control system, the FGS will perform star identification and provide continuous pointing information, more specifically, guide star centroids, with a precision better than 4.0 milliarcseconds. The other instrument, the TFI, will perform narrowband imaging for the survey of deep fields and star formation regions, as well as extra-solar planets characterization. It will operate at wavelengths in the range of 1.6 to 4.9 microns via a tunable Fabry-Perot etalon, with a spectral resolution between 70 and 150.

The ambitious objectives of the Webb program imposed challenging instrument system requirements, high technical risk, the necessity to resort to innovative technologies, and the inherent complexity of testing highly sophisticated optical space systems at cryogenic temperature. This paper will summarize the scientific objectives, present the key technical specifications for the FGS and the TFI, and describe the key engineering technologies and steps that have successfully contributed to the production of the Canadian flight instruments. Major data and test results will be presented to explain how engineering analyses, optical measurements, hardware and software integration, and environmental testing were conducted to meet the required system performance.

Finally, the paper will briefly report on a study conducted by the Canadian Space Agency, in collaboration with COM DEV, which demonstrates how technologies and capabilities developed for the FGS could be used for future space astronomy missions.