Development of a multi-spectral auroral camera onboard the INDEX satellite

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In order to investigate the dynamics of fine-scale auroral arcs, a Multi-spectral Auroral Camera (MAC) is to be onboard the INDEX satellite which will be launched in 2005 into a polar orbit at an altitude of ~610 km. In addition, the characteristics of auroral particles will be simultaneously observed by Electron Spectral Analyzer (ESA) and Ion Spectral Analyzer (ISA) instruments onboard the INDEX satellite. In the nightside auroral region, MAC will observe monochromatic auroral images at three wavelengths of N2+1N band (427.8 nm), OI (557.7 nm), and N21P band (670 nm), with high time (max. 120msec) and spatial (max. ~2km@altitude of 100km) resolutions with the use of 3 CCDs (1024*1024 pixels, 6.5micron pixel-size, ~60%@557.7nm quantum efficiency), 3 interference filters and 3 lenses.

In order to realize above aurora observations, improvements, development on the thermal-structures for the cooling of CCDs and circuit board, the mechanical-structure for environment at the time of launch were made during the period from 1999 to present. Besides, it was confirmed that MAC has sufficient optical performance for aurora observations. The environmental tests, sensitivity calibration and estimation of noise in imaging data were carried out for MAC, then we confirmed that MAC has the mechanical structure sufficiently durable for launch and environmental on orbit, and performance for aurora observations. The results of sensitivity calibration and estimation of noise showed that the dynamic ranges of 428nm data in Mode-S are 0R-321kR, respectively with the typical noise of 3 counts r.m.s. which corresponds to ~500R. In the vibration test with approximately 16Grms O.A. random vibration was added to the MAC, and in the shock test, 1500G@2000Hz shock was performed for MAC. After these tests, the MAC was not damaged and the focus of MAC did not misaligned. In the radiation test, a single CCD was exposed to the 100MeV protons with a total doze of 9krad, and 3 interference filters with a total doze of 1, 3, and 10krad.The result was such that these components will have no damage due to the radiation in orbit because the total doze of 9krad is equivalent to the doze for approximately 3 years in orbit. These results provide us with an expectation of unprecedented aurora observation from the satellite.