Paper ID: 30428
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22nd IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

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LABORATORY PERFORMANCE OF X-RAY DETECTOR ON 2U CUBESAT BEEAGLESAT

Abstract

A CdZnTe based semiconductor X-ray detector (XRD) and its associated readout electronics has been developed by the Space Systems Design and Testing Laboratory of Istanbul Technical University and High Energy Astrophysics Detector Laboratory of Sabanci University along with an SME partner. The XRD will be the secondary science mission on board BeEagleSat, which is developed as one of the double (2U) CubeSats for the QB50 project. QB50 is a European Framework 7 (FP7) project carried out by a number of international organizations led by the von Karman Institute of Belgium (www.qb50.eu).

The heart of the XRD is a 2.5 mm thick, 15 mm x 15 mm CdZnTe crystal with orthogonal electrode strips on top and bottom for position resolution on the crystal. There are 3 sets of steering electrodes in between anodes. A commercial off the shelf (COTS) high voltage source provides necessary potential difference to transport electrons and holes towards electrodes. The signals from each strip are read by RENA 3b ASIC, controlled my MSP 430. The XRD board (single ∼10 cm x 10 cm board) also carries the necessary power regulators and 7 COTS batteries. In a previous paper presented at the IAC 2014, we discussed the main design of the XRD and provided results from some of the early vibration tests of the mechanical design. At the time, the CdZnTe crystal has not been attached, and the readout electronics and software were still in development phase. In this paper, we present the actual laboratory performance of the system, including calibration and energy resolution measurements. Thermal vacuum and vibration tests of all COTS components (HV source, ASIC) are to be shown.

The payload's power management, readout electronics and software can be turned into a standard platform, and different small satellite missions can be designed based on this platform using other photon and particle detectors (such as silicon drift detectors) thanks to the versatile ASIC. We will discuss design and development challenges for such a general, compact science payload on a CubeSat.