21st IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

Author: Prof.Dr. Alim Rustem Aslan
Istanbul Technical University, Turkey, aslanr@itu.edu.tr

Mr. Ertan Umit
Gumush Aerospace & Defense, Turkey, umite@gumush.com.tr
Mr. Mustafa Erdem Bas
Istanbul Technical University, Turkey, erdem.bas@itu.edu.tr
Mr. Mehmet Şevket Uludağ
Istanbul Technical University, Turkey, uludagm@itu.edu.tr
Mr. Isa Eray Akyol
Istanbul Technical University, Turkey, akyoli@itu.edu.tr
Mr. Mehmet Deniz Aksulu
Istanbul Technical University, Turkey, aksulu@itu.edu.tr
Prof.Dr. Emrah Kalemci
Turkey, ekalemci@sabanciuniv.edu

DEVELOPMENT AND IN ORBIT TESTING OF AN X RAY DETECTOR WITHIN A 2U CUBESAT

Abstract

A CdZnTe based semiconductor X-ray detector (XRD) and its associated readout electronics is developed by the space systems design lab of Istanbul Technical University and High energy physics lab of Sabanci University along with an SME partner. Such orthogonal CdTe/CdZnTe strip detectors have been proposed as detector material for X-ray observatories before, but they have never been realized in space (a Japanese Mission ASTRO-H plans to use CdTe strip detectors in the Hard X-ray Imager). For small satellite systems, having low number of readout channels have advantages in terms of power and space outweighing the problems with the minimum energy and energy resolution. The detector will utilize 32 orthogonal cross strip electrodes (and 3 steering electrodes in between anodes) whose geometry is optimized by an extensive set of simulations and energy resolution measurements. The signals will be read by RENA 3b ASIC controlled by MSP 430 microcontroller. The system will have its own battery and will be turned on intermittently due to power constraints. CdZnTe based X-ray detectors have been utilized in space, but they are either pixellated (NuStar), or consist of many individual crystal pieces (BAT in Swift satellite). The aim of the XRD is to show that large volume crystals with orthogonal strips are viable alternatives, especially for small satellite systems with medium energy resolution requirement. XRD will also characterize the hard X-ray background in 20-150 keV at low Earth orbit conditions as a function of altitude. While in principle the XRD has imaging capability, due to power and telemetry constraints, the individual events will be corrected for hole trapping on-board, histogrammed, and only the X-ray spectra will be transmitted to the ground station.

The XRD is planned to travel into space, as a secondary science mission, on board Beeaglesat which is a 2U CubeSat developed as one of the possible 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. QB50 has the main scientific objective to study in situ the temporal and spatial variations of a number of key constituents and parameters in the lower thermosphere with a network of about 50 double and triple CubeSats, separated by few hundred kilometers and carrying a determined set of sensors (www.qb50.eu).

The full paper the details of XRD development within the context BeEagleSAT.