25th International Workshop on Radiation Imaging Detectors.

Contribution ID: **124** Type: **Poster**

Functional Tests of the Detector Assembly Demonstration Model of the eXTP Wide Field Monitor: System Description and Results

Wednesday 3 July 2024 14:18 (1 minute)

The enhanced X-ray Timing and Polarimetry mission (eXTP) is a scientific space mission aimed at studying the state of matter under extreme conditions of density, gravity and magnetism. This objective will be achieved through searching for and observing some primary targets such as neutron stars, magnetars and black holes [1, 2, 3]. The eXTP satellite will be equipped with an unprecedented suite of state-of-the-art instruments enabling the simultaneous spectral-timing-polarimetry studies of cosmic sources in the energy range from 0.5 to 30 keV and beyond.
The payload includes four instruments (Fig. 1): the Spectroscopic Focusing Array (SFA), i.e. a set of 9 X-ray telescopes based on Silicon Drift Detectors (SDDs); the Large Area Detector (LAD), i.e. a set of 640 SDDs [4]; the Polarimetry Focusing Array (PFA), consisting of 4 X-ray telescopes; a set of 3 coded-mask, wide-field-of-view camera pairs based on position-sensitive SDDs called Wide Field Monitor (WFM) [5].

[see attachment Fig_1.png]
Figure 1. Depiction of the eXTP satellite, with a magnified view of a camera pair of the WFM (right inset).

The main purpose of the WFM is to detect new X-ray transients and known X-ray sources undergoing spectral state changes, allowing for follow-up observations with the other pointing instruments of eXTP. Therefore, the WFM is designed to cover, in a single observation, a portion of the sky of about 3.7 sr with a 1-day sensitivity of 4 mCrab in the 2-50 keV range.
The WFM consists of 3 pairs of coded-mask cameras, each made up of 4 Detector Assemblies (DAs), with the SDDs in each pair oriented orthogonally to one another, achieving a FWHM angular resolution better than 4.3 arcmin and an energy resolution better than 300 eV at 6 keV. Each DA mounts a detector on its Front-End Electronics (FEE), forming the so-called sandwich, and a mechanical/thermal interface attached to the sandwich, allowing the cooling and the fine positioning of the whole DA [6]. The detector is a large-area SDD featuring 384 anodes with a pitch of 169 μm, for a total effective area of 6.50×7.00 cm². The readout is performed by 24 32-channel Application-Specific Integrated Circuits (ASICs) mounted on the FEE. The DAs are then controlled by the so-called Back-End Electronics (BEE).

Before proceeding with the mass production of these cameras, a number of DA Demonstration Models (DMs) must pass a series of reduced and full functional tests aimed at qualifying the design and the assembly procedures by operating the DA through a test electronics. Therefore, a dedicated, yet versatile, test system has been developed, which can be connected to the DA DM and operated from a PC (Fig. 2).

[see attachment Fig_2.png]
Figure 2. Block diagram of the test system connected to the DA DM (and to the auxiliary setup).

The Electrical Ground Support Equipment (EGSE) that acts as a test BEE consists of a mixed-signal interface board, an FPGA board for control and communication, and a PC software with a Graphical User Interface (GUI). To fully operate and characterise the DA, the interface board is equipped with signal-conditioning stages, ADCs, a DAC-based pulser, temperature and power-consumption monitors, voltage regulators and ancillary electronics. It can be connected to both the FEE and an auxiliary setup, which is extremely convenient for preliminary testing and debugging while the DAs are under production.
The FPGA board is connected to the interface board through an HSMC cable and to a PC via USB. This arrangement allows for testing the mixed-signal interface of the EGSE and the DA enclosed together in a climatic chamber while the FPGA is at some distance. The FPGA is responsible for the low-level control of the interface board and the FEE, as well as acquiring and transmitting the data to the PC.
The PC software comes with a fully featured GUI which allows the user to program the entire set of 24 ASICs of the DA and to carry out tests on them, while constantly checking the status of the system. The measurements can be performed either as single tasks (e.g. pulser-amplitude sweeping) or specific automated test sequences, which make it possible to collect several types of data with a single user action.

This contribution will provide a detailed description of the EGSE developed for the functional tests of the DA DMs, as well as reporting the successful results of such tests together with some preliminary performance characterisation.

[1] S. N. Zhang et al., Proc. SPIE, Volume 9905, 99051Q (2016).

[2] S. N. Zhang et al., Sci. China Phys. Mech. Astron., Volume 62, Issue 2, 029502 (2019).
[3] eXTP website, https://www.isdc.unige.ch/extp/
[4] M. Feroci et al., Proc. SPIE, Volume 12181, 121811X (2022).
[5] M. Hernanz et al., Proc. SPIE, Volume 12181, 121811Y (2022).
[6] F. Zwart et al., Proc. SPIE, Volume 12181, 1218167 (2022).

Authors: ANTONELLI, Matias (INFN Trieste (IT)); ZAMPA, Gianluigi; BONVICINI, Valter (INFN); BOSISIO, Luciano (Universita e INFN, Trieste (IT)); CIRRINCIONE, Daniela; Mr ORZAN, Giulio (INFN Trieste (IT)); RACHEVSKI, Alexandre (INFN, Section of Trieste); RASHEVSKAYA, Irina (TIFPA INFN); ZAMPA, Nicola (Universita e INFN Trieste (IT)); AITINK-KROES, Gabby (SRON (NL)); DE LA RIE, Rob (SRON (NL)); IN 'T ZAND, Jean (SRON (NL)); LAUBERT, Phillip (SRON (NL)); ZWART, Frans (SRON (NL)); TACKEN, Roland (Neways Electronics International N.V. (NL)); CERAUDO, Francesco (INAF/IAPS (IT)); DELLA CASA, Giovanni (INAF/IAPS (IT)); EVANGELISTA, Yuri (INAF/IAPS (IT)); FEROCI, Marco (INAF/IAPS (IT)); GÁLVEZ, José-Luis (IEEC/ICE-CSIC (ES)); HERNANZ, Margarita (Institut d'Estudis Espacials de Catalunya (IEEC/ICE-CSIC)); BAUDIN, David (IRFU, CEA (FR)); MEURIS, Aline (IRFU, CEA (FR)); BELLUTTI, Pierluigi (FBK); BORGHI, Giacomo (Fondazione Bruno Kessler); CENTIS VIGNALI, Matteo (FBK); FICORELLA, Francesco (FBK (IT)); Dr PEPPONI, Giancarlo; PICCIOTTO, Antonino (Fondazione Bruno Kessler-Micron Nano Facility); SAMUSENKO, Alina (FBK (IT)); ZORZI, Nicola (FBK - Fondazione Bruno Kessler (IT))

Presenter: ANTONELLI, Matias (INFN Trieste (IT))

Session Classification: Poster Session