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The XGIS instrument for THESEUS Mission: Onboard Detector Principle and Readout Electronics

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Transient High-Energy Sky and Early Universe Surveyor (THESEUS) is a multi-instrument space mission concept candidate under European Space Agency (ESA) M7 Phase-Assessment study for medium size missions with an intended launch in 2037. The main goals of this mission include exploring the early universe by identifying and localising Gamma Ray Bursts (GRBs) at high redshifts (potentially up to z = 10 and beyond) and contributing to multimessenger time-domain astrophysics through extensive X/gamma-ray transient universe monitoring. Crucial to THESEUS success is its comprehensive transient detection and characterization capabilities, provided by wide and deep sky monitoring across a broad energy band (0.3 keV –10 MeV) in which the X and Gamma-ray Imaging Spectrometer instrument (XGIS, 2 keV - 10 MeV) plays an essential role. Additionally, high positional accuracy (≤ 2 arcmin) and immediate transient identification with highly accurate redshift determination is achieved through the onboard Soft X-ray Imager (SXI, 0.3 - 5 keV) and the InfraRed Telescope (IRT), respectively. The XGIS is a set of two coded-mask monitor cameras capable of covering an unprecedented wide energy band (2 keV –10 MeV), with imaging capabilities and location accuracy <15 arcmin up to 150 keV over a Field of View of 2 sr, a few hundreds eV energy resolution in the X-ray band (<30 keV) and timing resolution of around few μs based on a sandwich of monolithic SDDs (Silicon Drift Detectors) and scintillator crystals based X-ray and gamma-ray detectors.
This presentation mainly focuses on the instrument design, detector working principle, and expected detector performances of the XGIS instrument, illustrating its evolution from the beginning of M5 Phase A to the current M7 Phase A with its unprecedented capabilities. Additionally, performance characterization of ORION, a very low noise multichip read out and processor electronics designed specifically for the XGIS instrument will be briefly presented.

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