

# 3D CZT spectro-imagers for hard X- and Soft $\gamma$ -ray astronomy: development status and preliminary results from a stratospheric balloon flight

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New instruments require detectors exploiting high dynamics to cover a large energy band and very high performance in terms of efficiency, spectroscopy, imaging, and, in particular after the launch of IXPE, high polarimetric capabilities. Recently, ASI funded a project (“3D-CZT Module for spectroscopic imaging, timing and polarimetry in hard X-/soft  $\gamma$ -rays satellite mission - 3DCaTM”) dedicated to develop a prototype demonstrator based on an innovative CZT drift strip sensor unit (3DCZT) and implementing a digital readout of signals to obtain unprecedented

performance with three-dimensional spatial resolution ( $<0.5$  mm), fine spectroscopy (1% FWHM at 511 keV), and high response uniformity (few %'s) with a limited number of electronics channels.

Furthermore, in the framework of the European HEMERA program for stratospheric balloon flights we launched in September 2022 the BADGER (BALloon Detector for Gamma ray with three-dimensional Resolution) payload consisting of a detection system based on one of the 3DCZT developed sensor. Herein, we present the principles on which the 3DCZT sensors are based, the state of their development and the prospects for use in future satellite missions for high energy astrophysics. We conclude by describing the stratospheric balloon payload BADG3R developed from this type of detector and the preliminary results obtained from a performed flight.

## Summary

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