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MYTHEN III, a high performance, single photon counting strip detector

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MYTHEN III is the latest generation of single photon-counting strip detectors developed by the PSD detector group at the Paul Scherrer Institut. It presents the same geometry as its predecessor MYTHEN II (50 μm pitch, 8 mm long strips, 6.4 cm wide modules), but its performance has been greatly improved, in terms of noise, threshold dispersion, count rate capability and frame rate.

The new readout chip, developed in 110nm UMC technology, contains 128 readout channels. Every channel features a double polarity preamplifier and shaper with variable gain and shaping time. Three discriminators, each one having a dedicated threshold, trim bit set and gate signal, process independently the shaped signal. The outputs of the three discriminators feed a counting logic that, according to the selected mode of operation, generates the increment signals for the three following 24-bit counters.

The various chip modes of operation allow use in new applications: the three fully independent counters per strip enable energy binning, time resolved pump-probe applications, but can also push the count rate capability to above 20 MHz per strip with 90% efficiency, thanks to the possibility of counting piled-up photons. Additionally, we implemented an innovative digital communication logic between channels, allowing charge sharing suppression and improving the spatial resolution beyond the strip pitch, as a first demonstration of on-chip interpolation in a single photon-counting detector.

A full MYTHEN III detector has been commissioned, consisting of 48 modules with 10 chip each, covering 120°, which recently started user operation at the powder diffraction end station of the Swiss Light Source.

We will present the architecture of the new detector, starting from the readout chip, and its latest characterization results, showing its superior performance with respect to MYTHEN II. Particular emphasis will be given to the many unpublished results of the novel modes of operation.

Collaboration

Primary author: DINAPOLI, Roberto (Paul Scherrer Institut)

Co-authors: MOZZANICA, Aldo (Paul Scherrer Institut); BERGAMASCHI, Anna (Paul Scherrer Institut); SCHMITT, Bernd (Paul Scherrer Institut); LOPEZ-CUENCA, Carlos (Paul Scherrer Institut); MEZZA, Davide (Paul Scherrer Institute); GREIFFENBERG, Dominic (Paul Scherrer Institut); FRÖJDH, Erik (Paul Scherrer Institut); ZHANG, Jiaguo (Paul Scherrer Institut); HEYMES, Julien (Paul Scherrer Institut); ANDRÄ, Marie (Paul-Scherrer-Institut); BRÜCKNER, Martin (Paul Scherrer Institut); HINGER, Viktoria (Paul Scherrer Institute)

Presenter: DINAPOLI, Roberto (Paul Scherrer Institut)

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