Optical readout of a triple-GEM detector with a CMOS sensor

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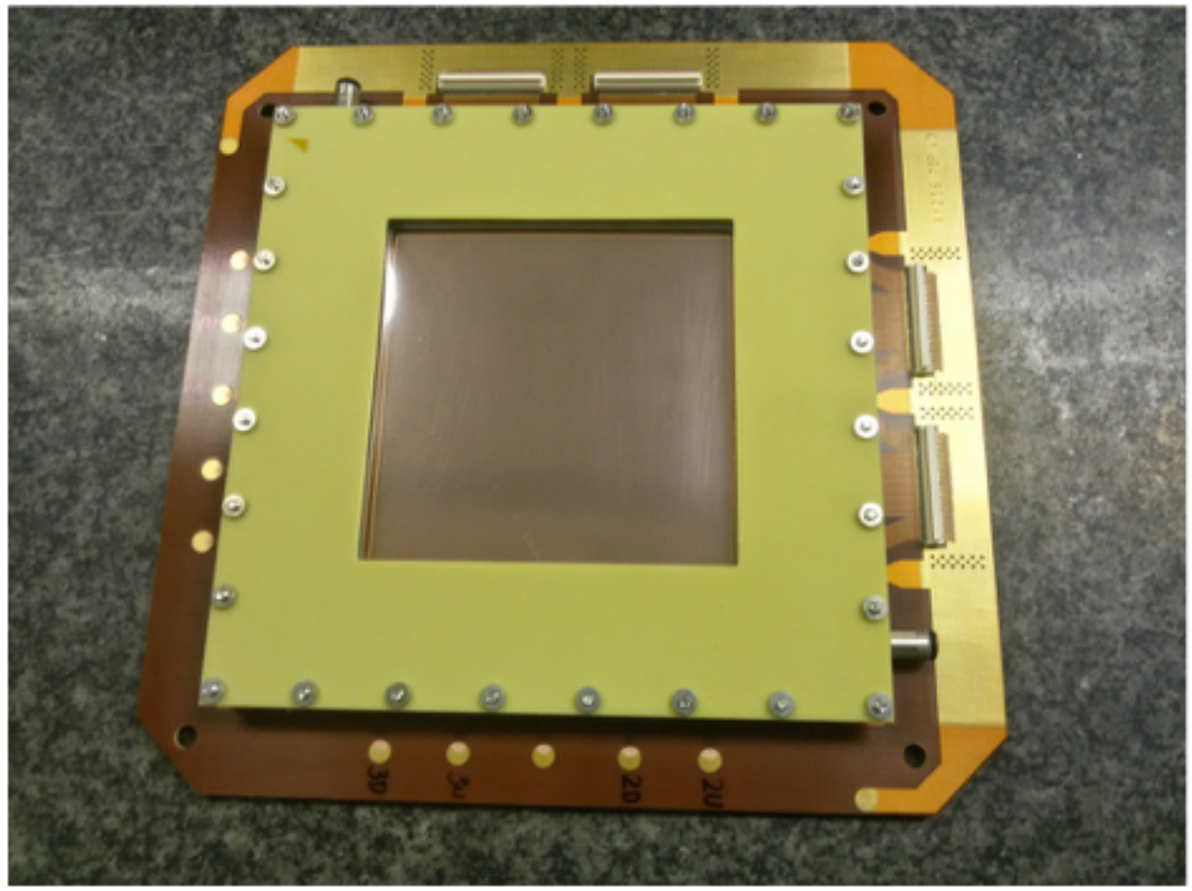
The aim of this study is to optimise the light yield of a triple-GEM based detector in order to make it possible to read it out by means of a commercial CMOS based camera.

Standard 140/70 GEM;

3 mm wide drift gap and two 2 mm wide transfer gaps;

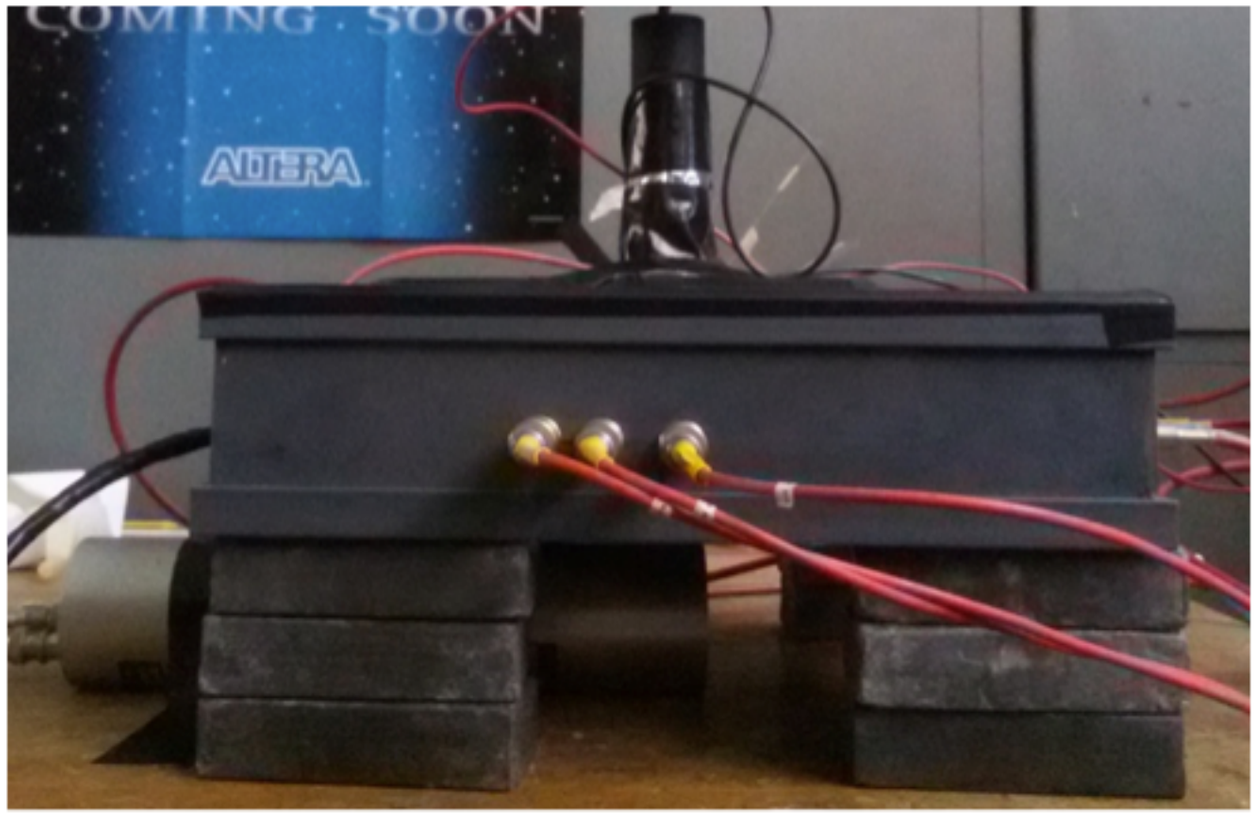
Electrons are collected on the bottom of the third GEM and only photons are read out;

The readout plane was removed and replaced by a transparent plastic foil window.



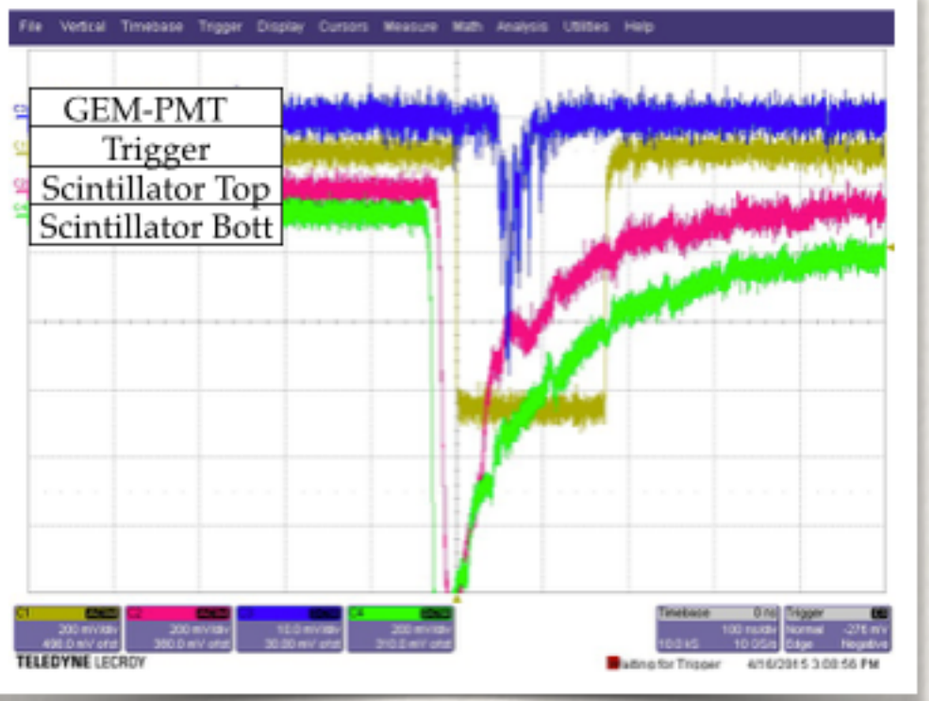
Test with cosmic rays

The detector light yield, read-out by a PMT, was optimised by cosmic rays



Detector tested with cosmic rays;

Two NaI scintillators used to trigger the muons.



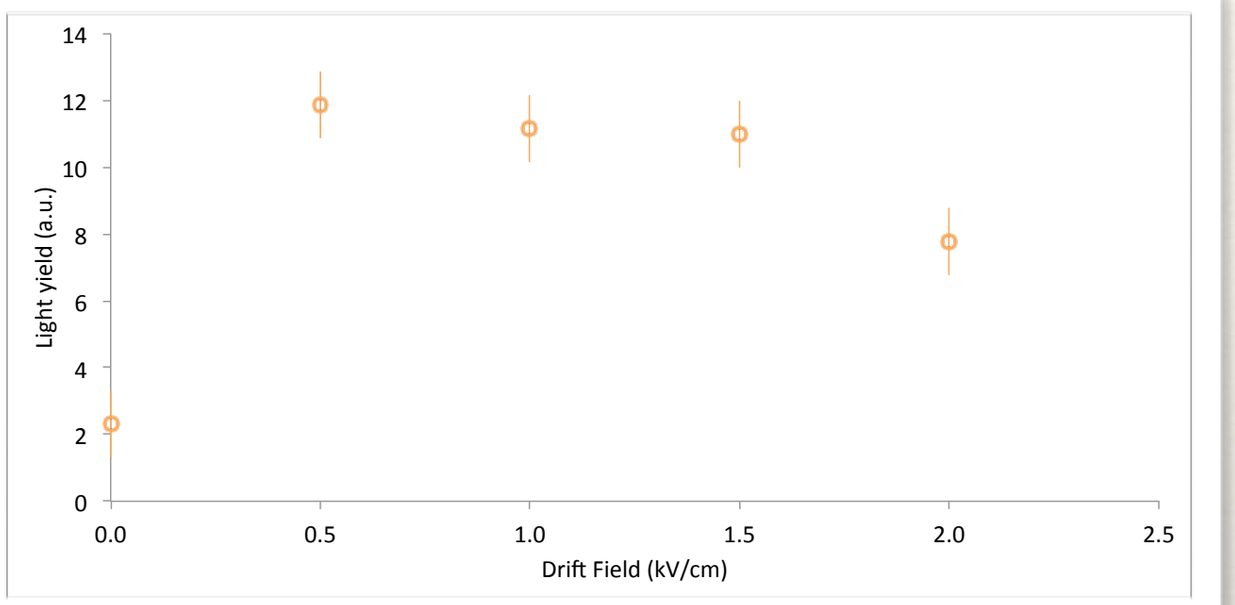
Light collected by a R9800 PMT;

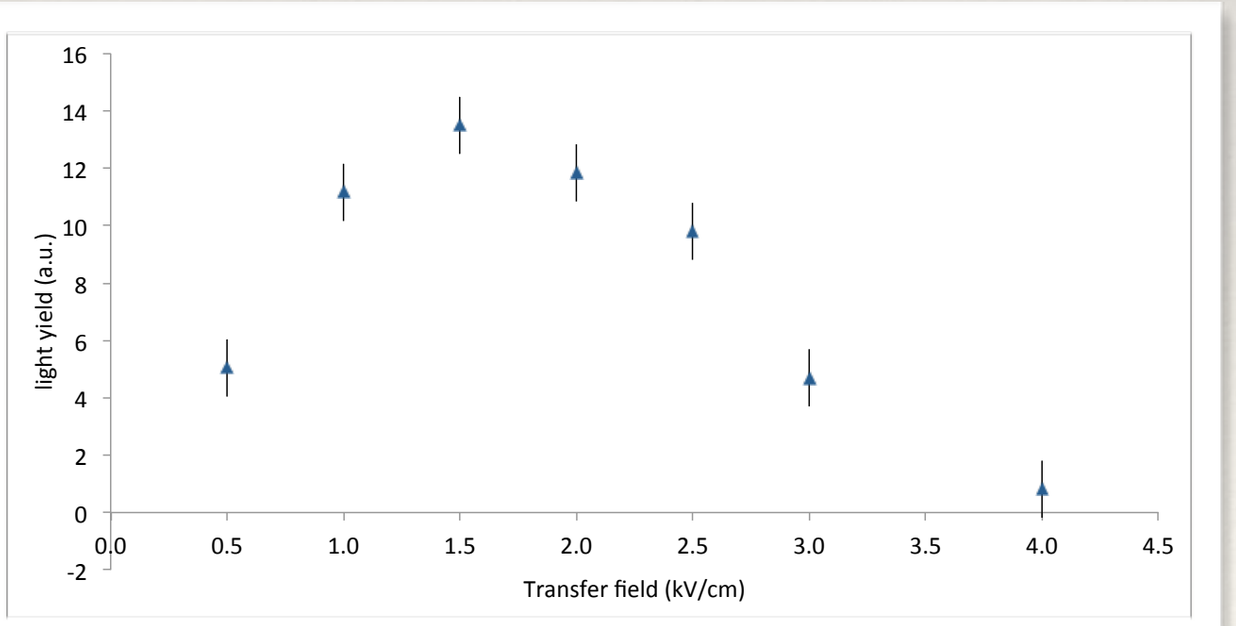
Waveforms were acquired by a 10 GS/s scope;

Test with cosmic rays

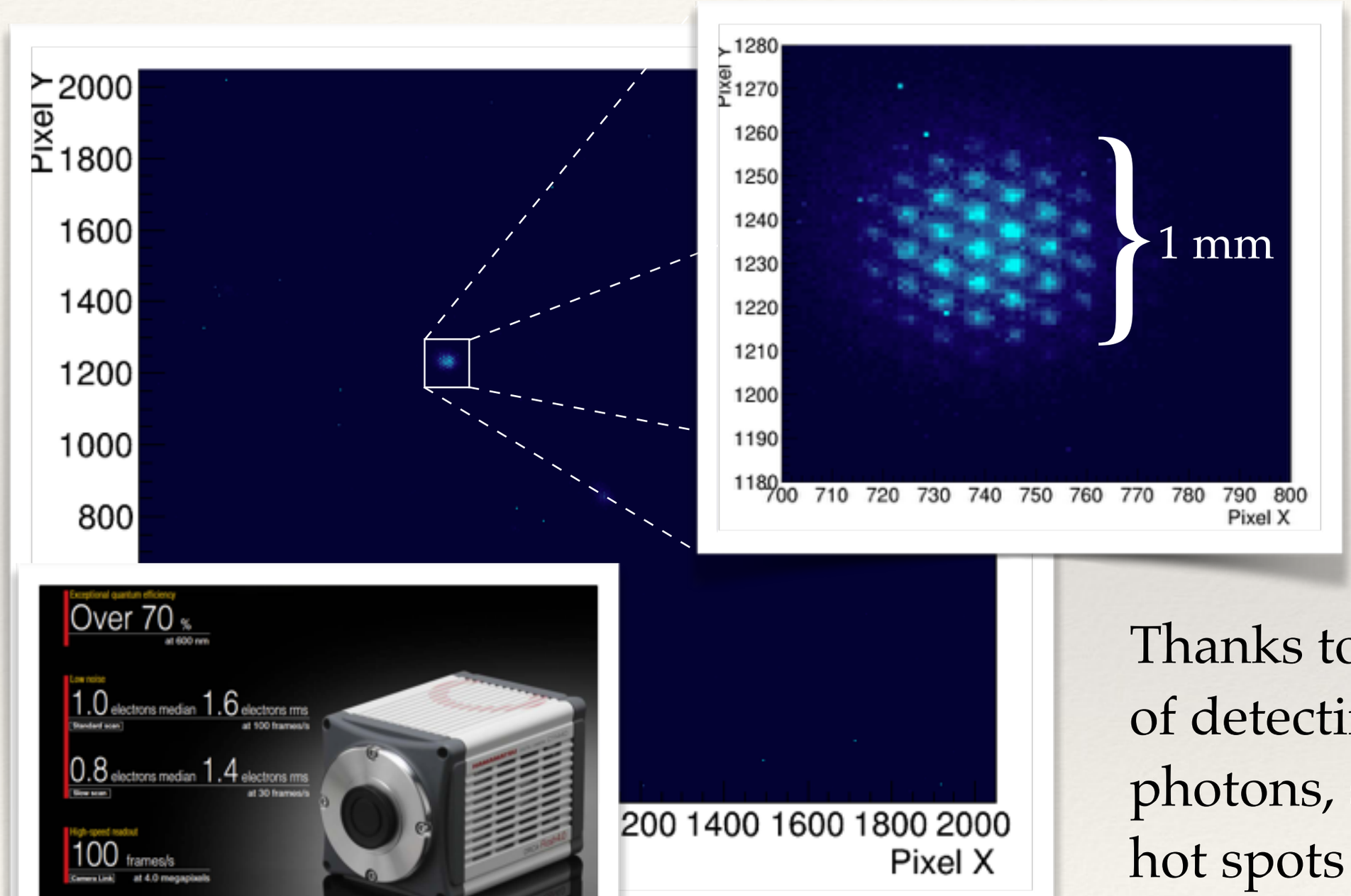
The amount of light is almost stable for drift fields 0.5 - 1.5 kV/cm while a transfer field around 1.5 kV/cm maximises the light production.

At maximum about 150 p.e. were collected in very good agreement with expectations.





First measurements with camera



The fine structure of the GEM holes is visible.

Thanks to the possibility of detecting very few photons, small continuos hot spots were found in the triple-GEM detector.