Results of a prototype imaging system using the FGLD technology and self-triggering discharge-protected readout electronics

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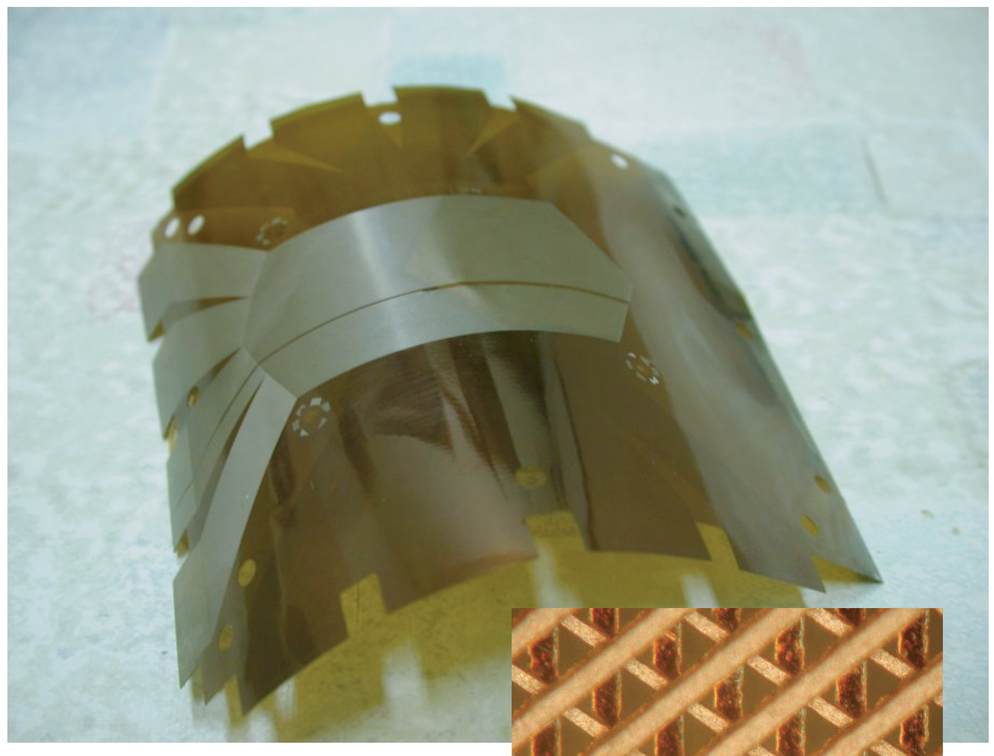
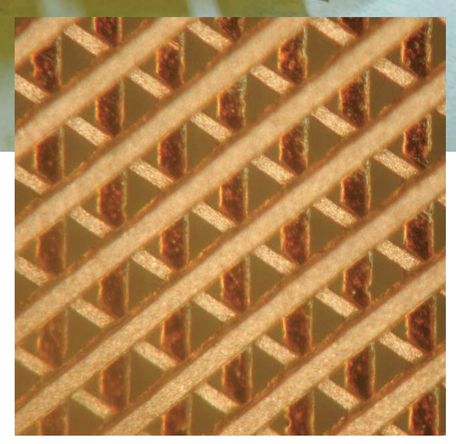
FGLD TECHNOLOGY

Produced using standard PCB maunfacturing techniques and patented by CERN, this detector combines a 3-axis readout and gas amplification in a single flexible polyimide foil of only 100um thickness.

Features:

- very low capacitance due to the crossing configuration of strips
- 150um pitch strip-to-strip
- 100um single flexible polyimide foil
- 3-axis readout for reducing high-rate ambiguities
- up to 6000 gas gain in Ar:CO2(15%)





PROTOTYPE IMAGING SYSTEM

Comprises of 3 intermediate boards each with 2 GP5 chips, ADCs, and HV decoupling digital readout connected to a central DAQ for 3-axis coincidental data-taking and communication by USB 2.0 to a PC. Labview is presently used for the aquisition and analysis software.

GP5

- 128-channel charge preamp
- high dynamic range (up to 3pC)
- 250ns shaping time on analogue readout
- self-triggering (40ns fast shaping)

Diode Protection / Pitch Adaptor

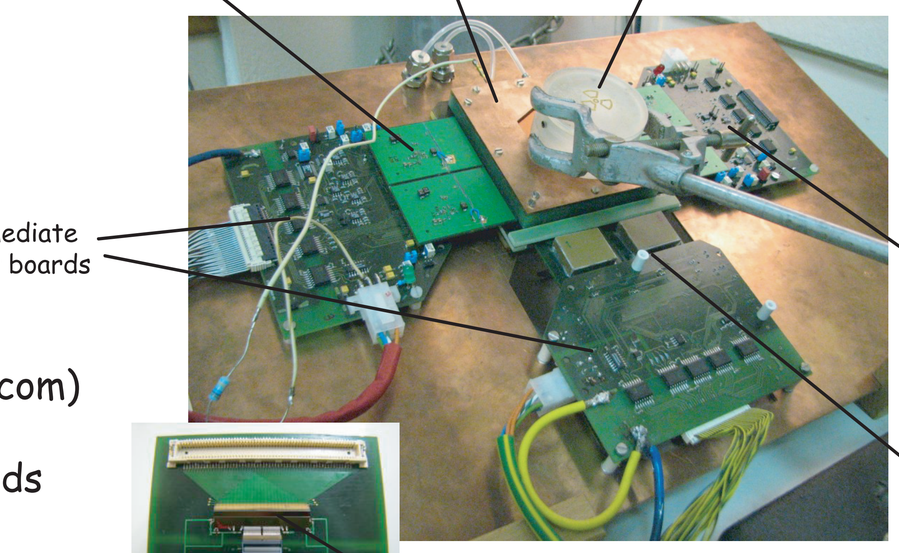
- built for TOTEM-GEMs

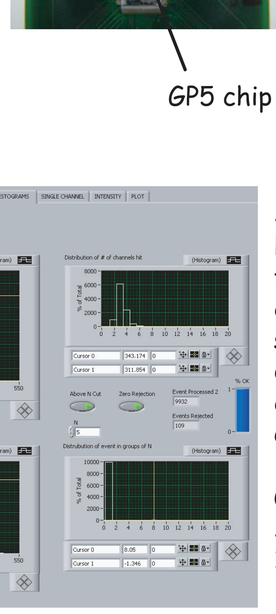
Test-DAQ

- based on QuickUSB module (www.quickusb.com)
- Altera FPGA
- controls up to 3 intermediate readout boards

Intermediate Readout Board

- 2 channel 16-bit ADCs
- 8 DACs for trigger thresholds and chip biasing

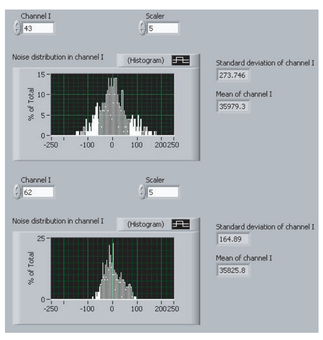




Spectrum of an Fe-55 source from 5 triggered channels. Also shown is the distribution of channels hit per event.

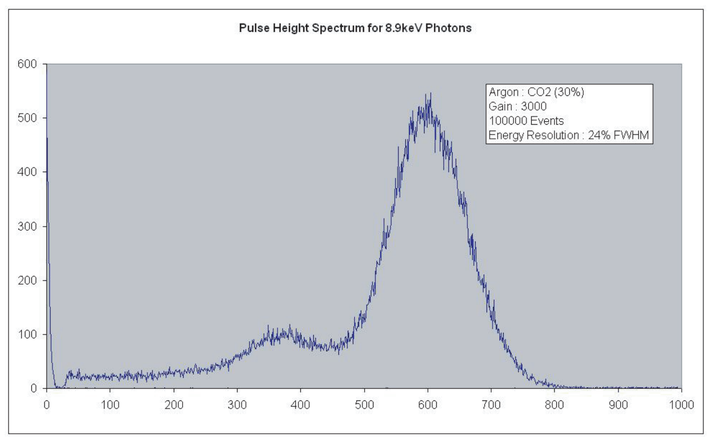
Gain : 200
Ar : CO2 (15%)
10000 events

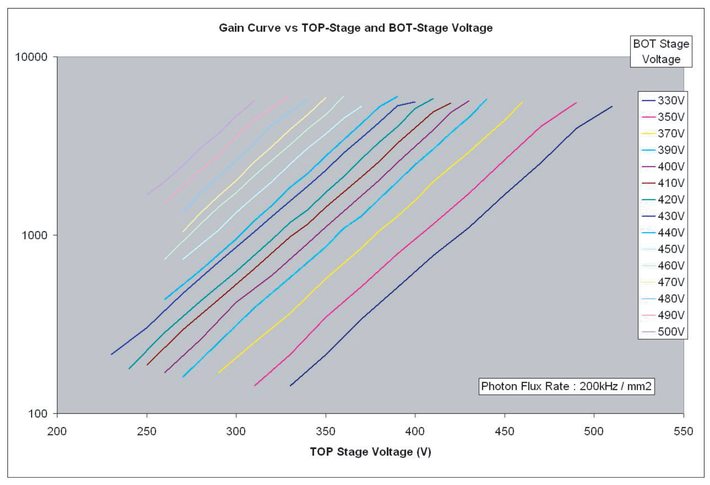
SYSTEM PERFORMANCE

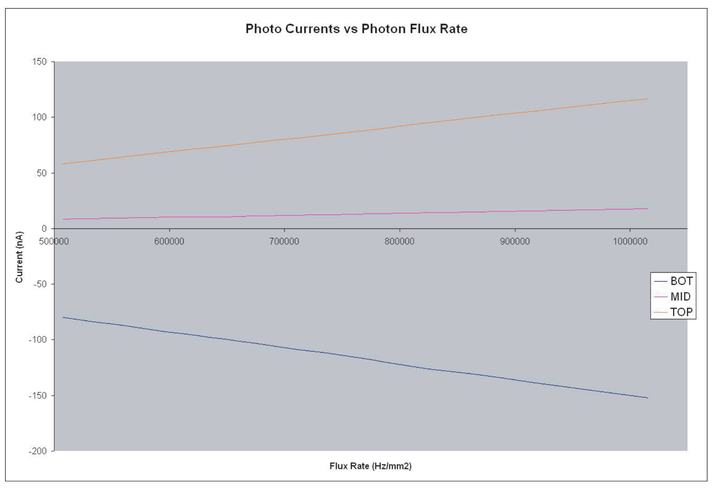


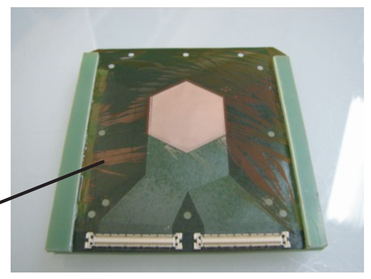
Noise spectrum of 1000 events on a channel connected to detector (above) and a channel not bonded to diode protection chip (below).

DETECTOR PERFORMANCE

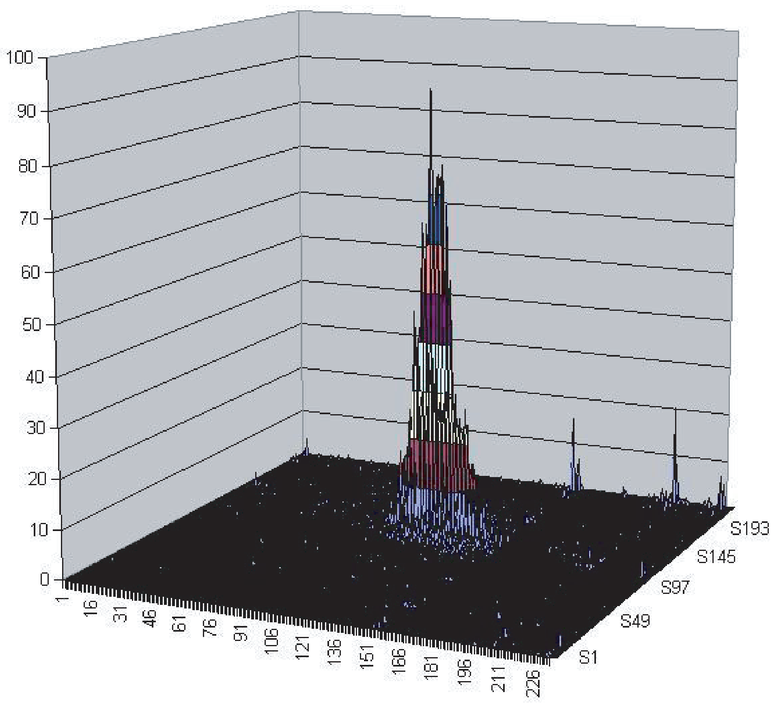








Intensity of X-rays from a 1mm collimated Fe-55 source



3D intesity plot of an Fe-55 source collimated to 1mm. The reconstruction is very simple: the event position is taken as the location of the maximum channel hit.

Gain: 200
Ar : CO2 (15%)
10000 events

SUMMARY

The following conclusions can be made regarding the prototype imaging system:

1. GP5 chips with diode protection is working well during discharge and no channels are destroyed.
2. GP5 threshold is working well for 6keV from Fe-55 with detector operating at low gain of 200 (trigger noise < 7fC).
3. With current board-to-board connection from electronics to detector, additional noise from detector is not significant. Majority of noise in system is coming from diode protection chip and fan-out to connector.

FUTURE DEVELOPMENTS

1. Build a 10x10cm FGLD detector in which all the electronic readout components are "hidden" behind the gas chamber.
2. Simplified software for high-rate data taking and fast position reconstruction algorhythm.
3. Peak recognition made directly "onboard" the intermediate board in a separate FPGA.