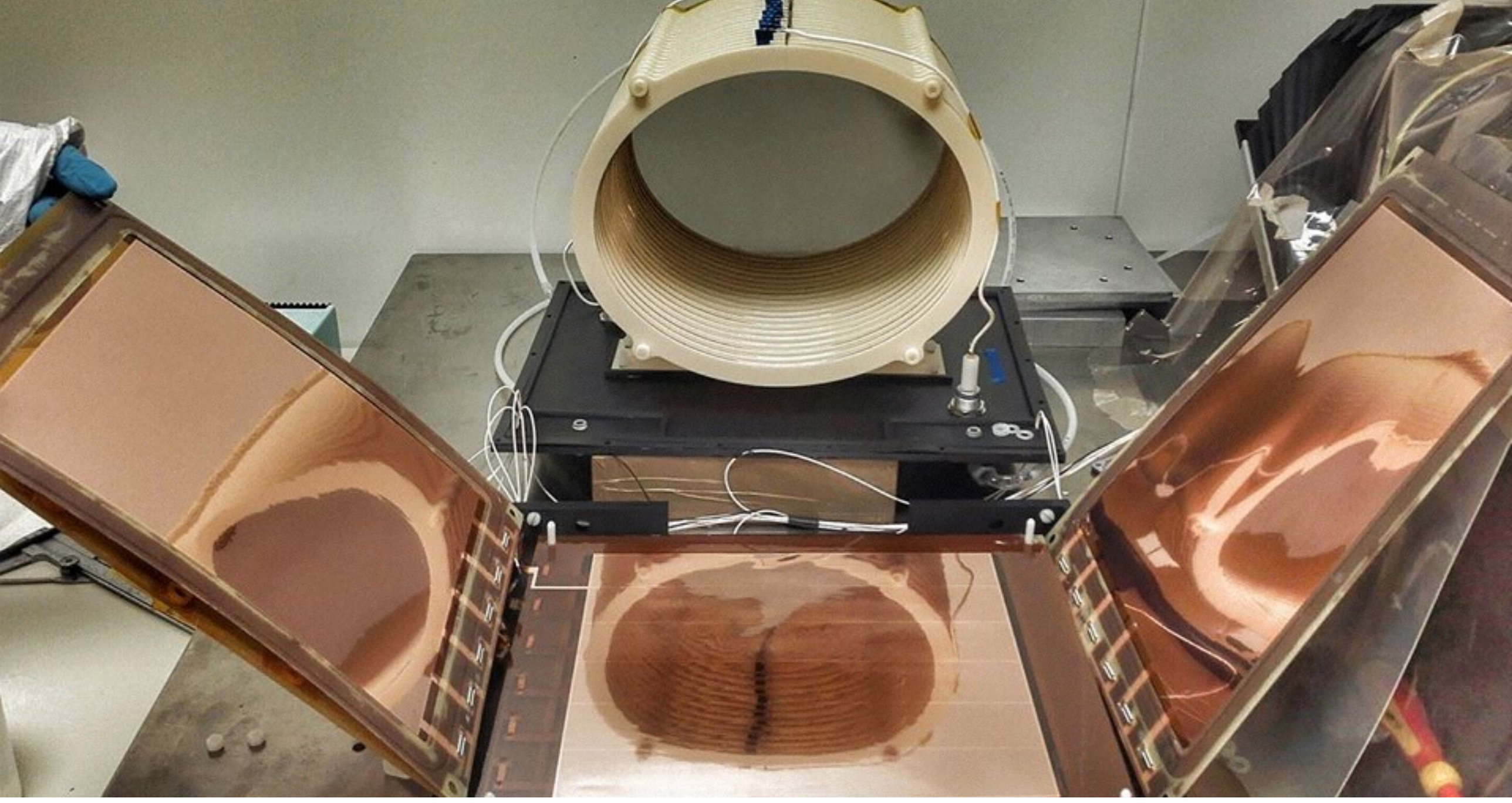


Study of the operation stability of a prototype for the CYGNO experiment

Francesco Renga
for the CYGNO Collaboration

Introduction

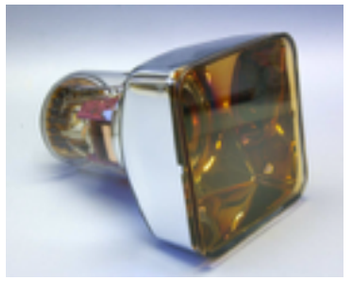
- The operation stability of a 3-GEM TPC with He:CF4 at atm. pressure and optical readout was tested for ~ 8 days of (almost) continuous run

- Different mixtures tested

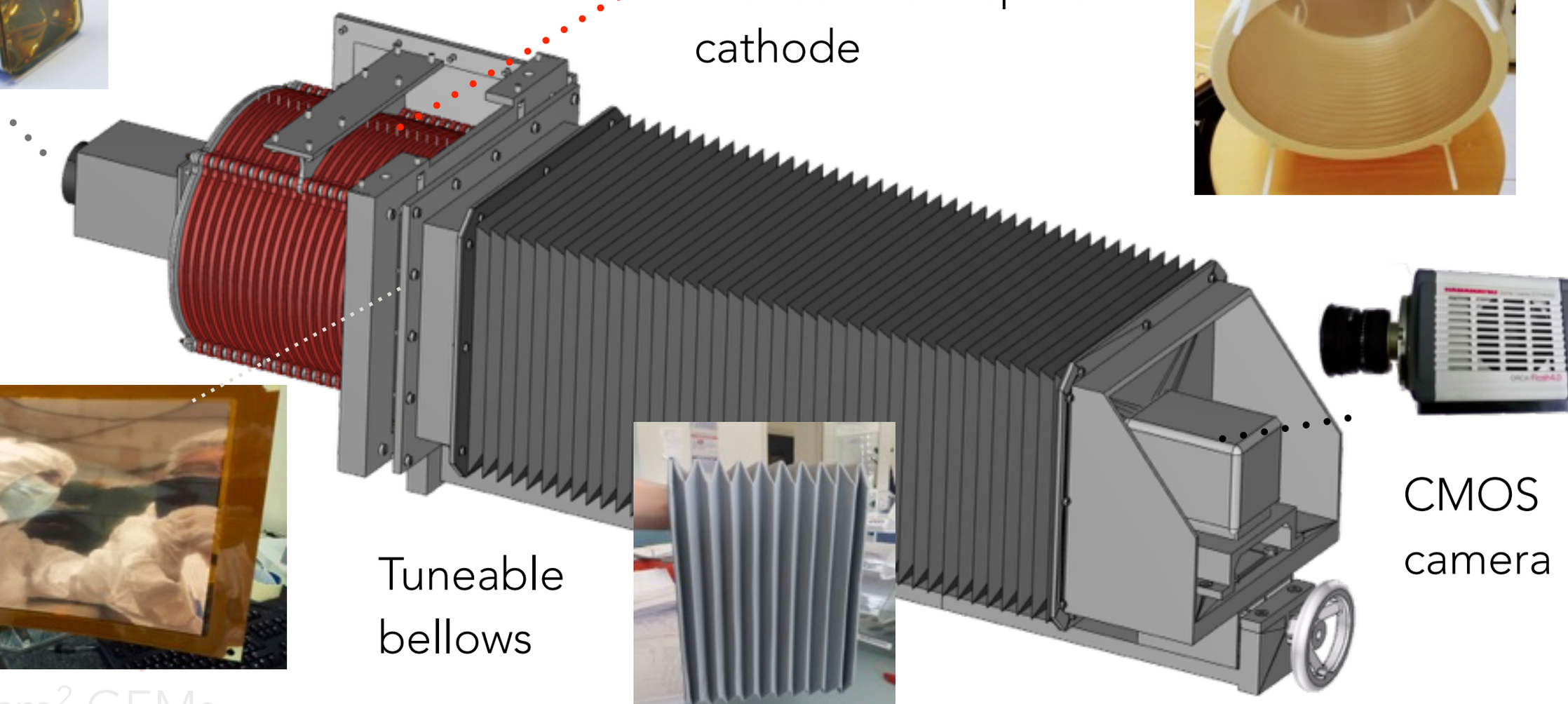
- GEM current and HV stability monitored with and without exposing the detector to an intense ^{55}Fe source (1 MBq)

The LEMON prototype (I)

- 7-liter sensitive volume (LEMOn: Large Elliptical Module Optically readout).



7x7 cm^2 PMT



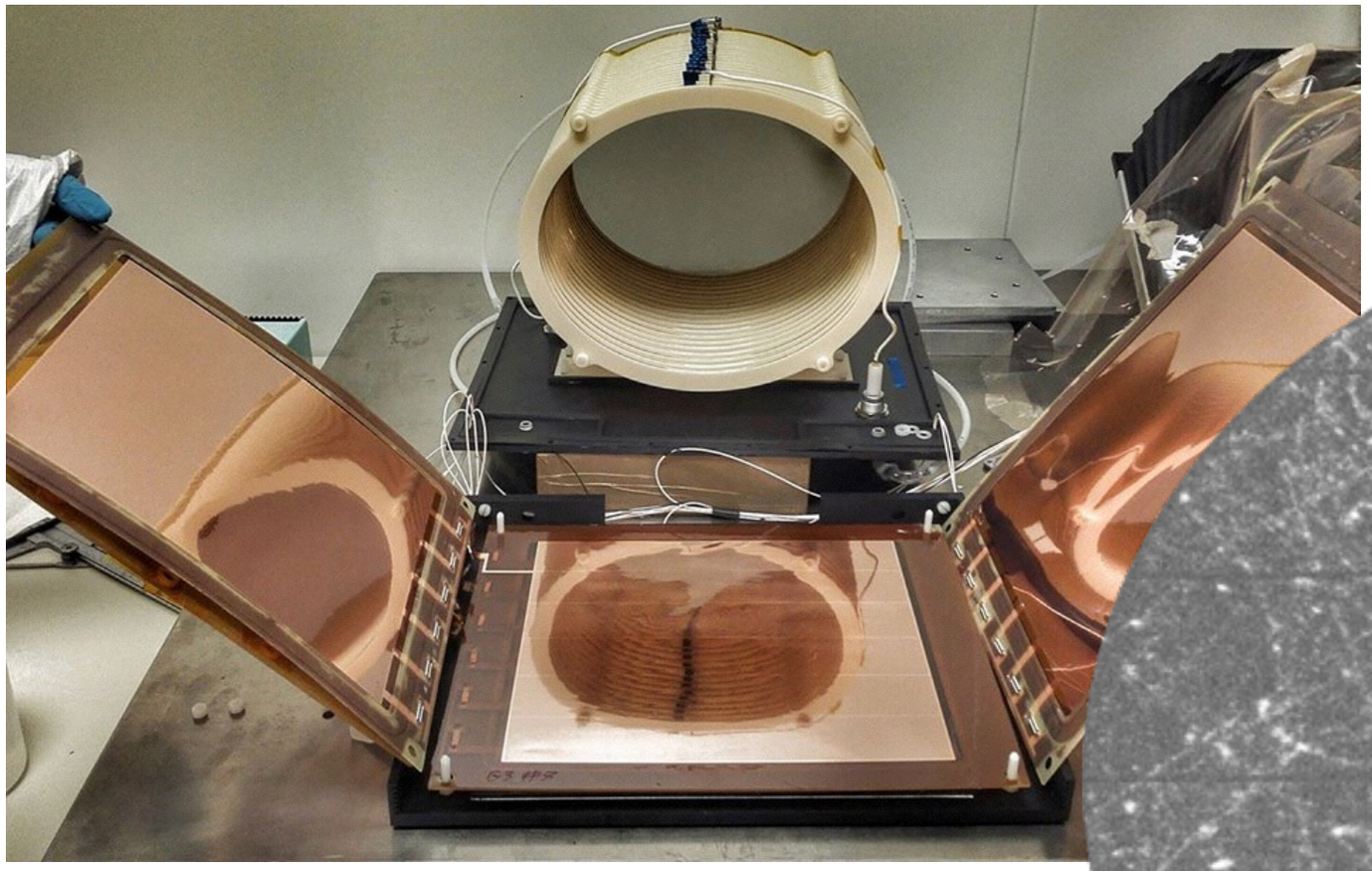
Elliptical field cage with semi-transparent cathode

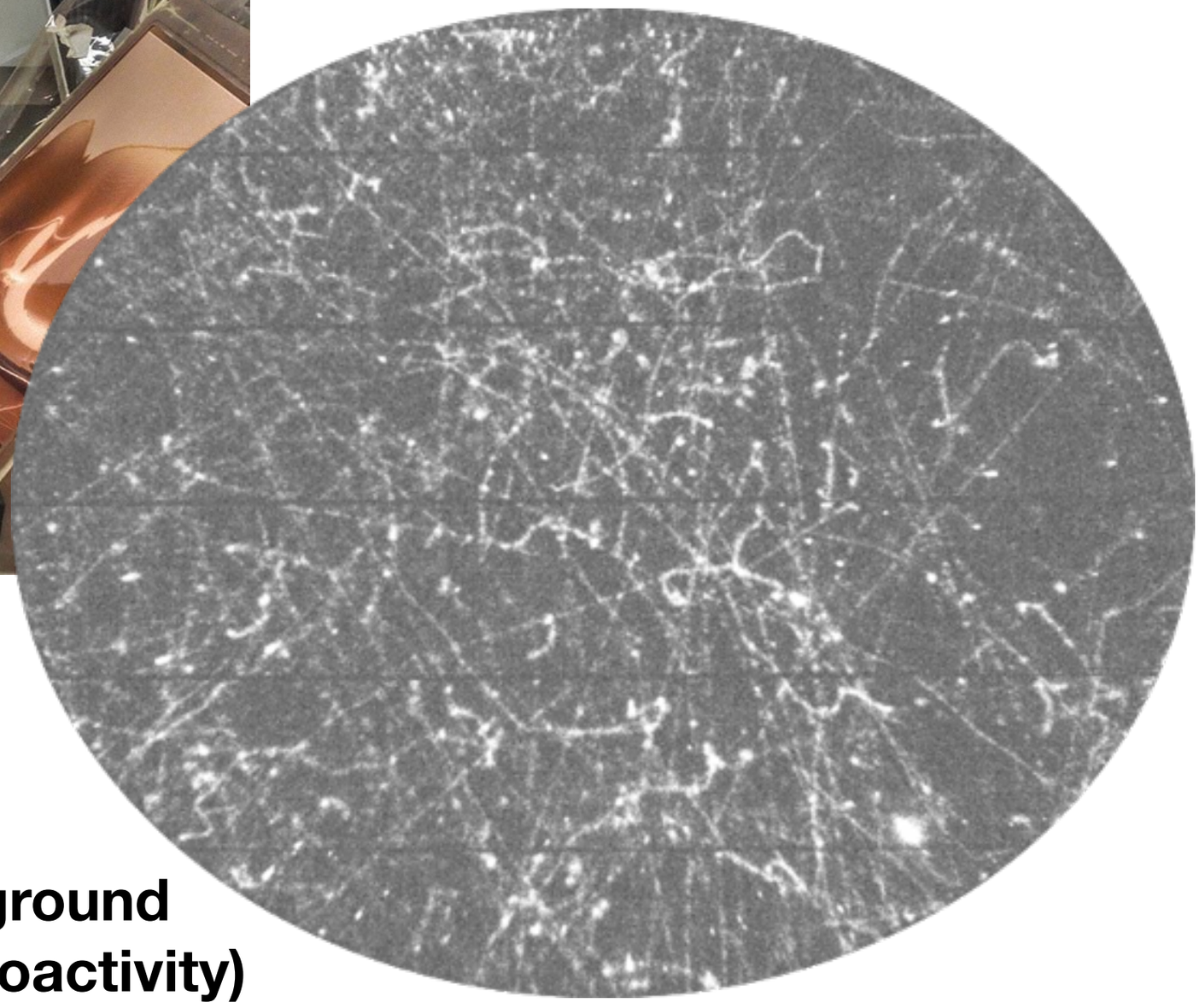
20x24 cm^2 GEMs

Tuneable bellows

CMOS camera

The LEMON prototype (II)





5s of natural background
(cosmics, natural radioactivity)

Experimental Setup

- 200 cc/min gas flow (~ 2 volume exchanges per hour)

- HV provided by CAEN systems (main frame + 1 board for the GEMs, NIM HV module for the cathode)

  - 455 V in the GEMs (for He:CF_4 60:40) + 2.5 kV/cm transfer fields, with 20 nA current sensitivity per channel

  - 500 V/cm drift field

  - Automatic recovery procedure for discharges and hot spots (see later)

- Room temperature monitoring, atmospheric pressure from meteorological data

Data Acquisition

- HV voltage and current data taken from the CAEN system and stored in the HV control PC

- Run and DAQ control based on the MIDAS data acquisition framework (https://midas.triumf.ca)

  - 30 consecutive frames with long exposure (10s) every hour —> total light monitoring

  - 100 consecutive frames with short exposure (100ms) for ^{55}Fe analysis

- Analysis still on going, partial results shown here

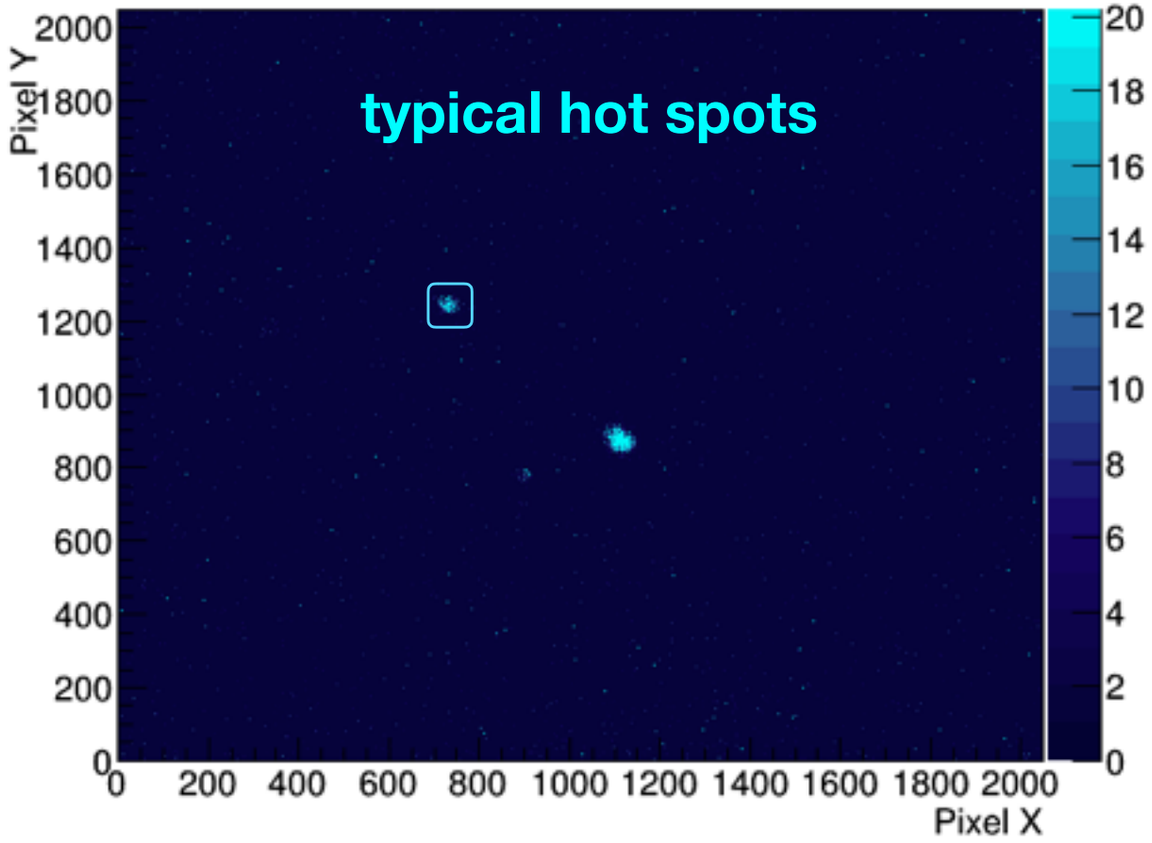
HV recovery procedure (I)

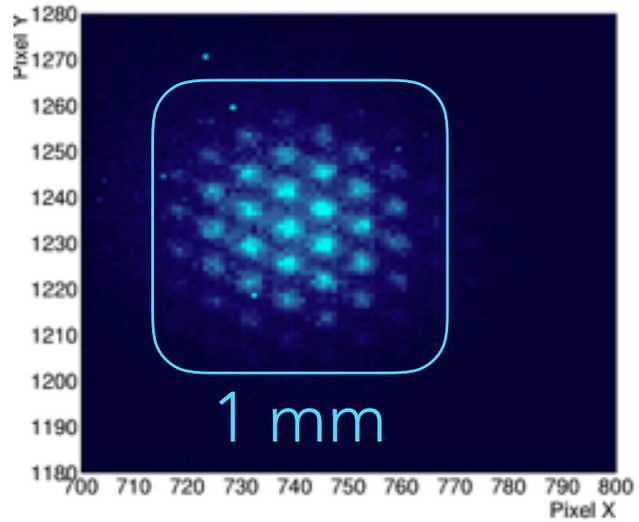
- Two HV current threshold:

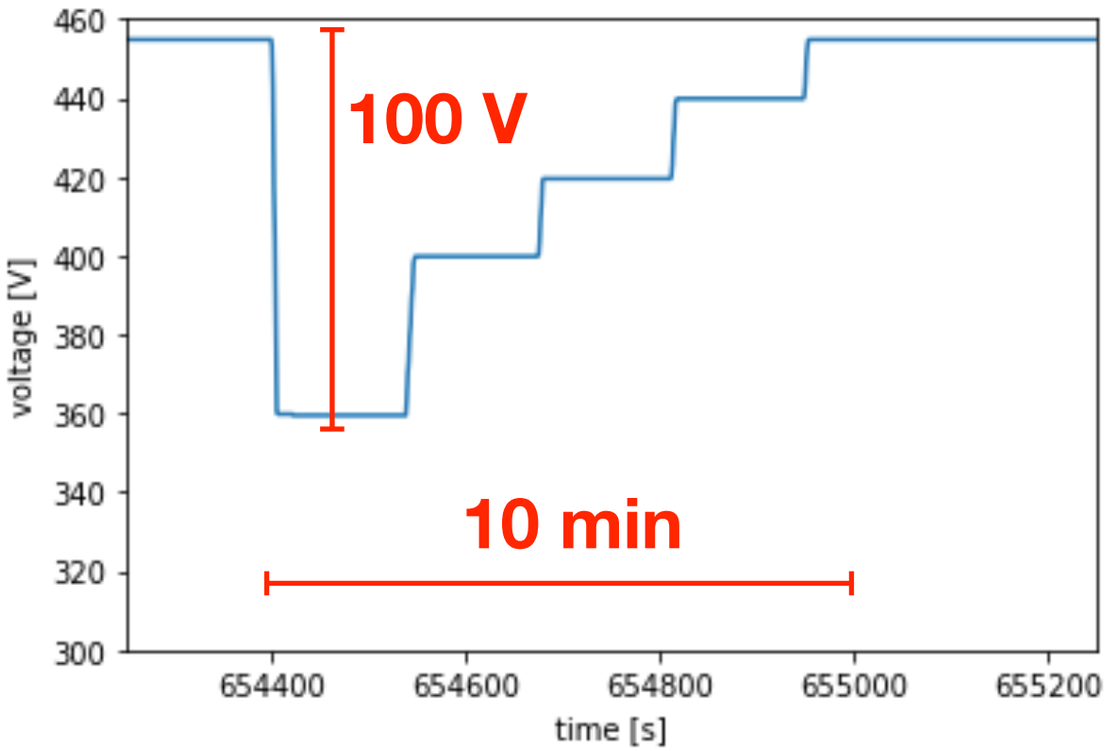
  - 2 μA —> indicates a discharge happening, voltage is lowered by the HV system to keep the current constant until the discharge is recovered

  - 0.6 μA —> indicates that some **hot spots** appeared, voltage is lowered by 100 V and slowly raised back (~ 10 minutes dead time)

HV recovery procedure (II)



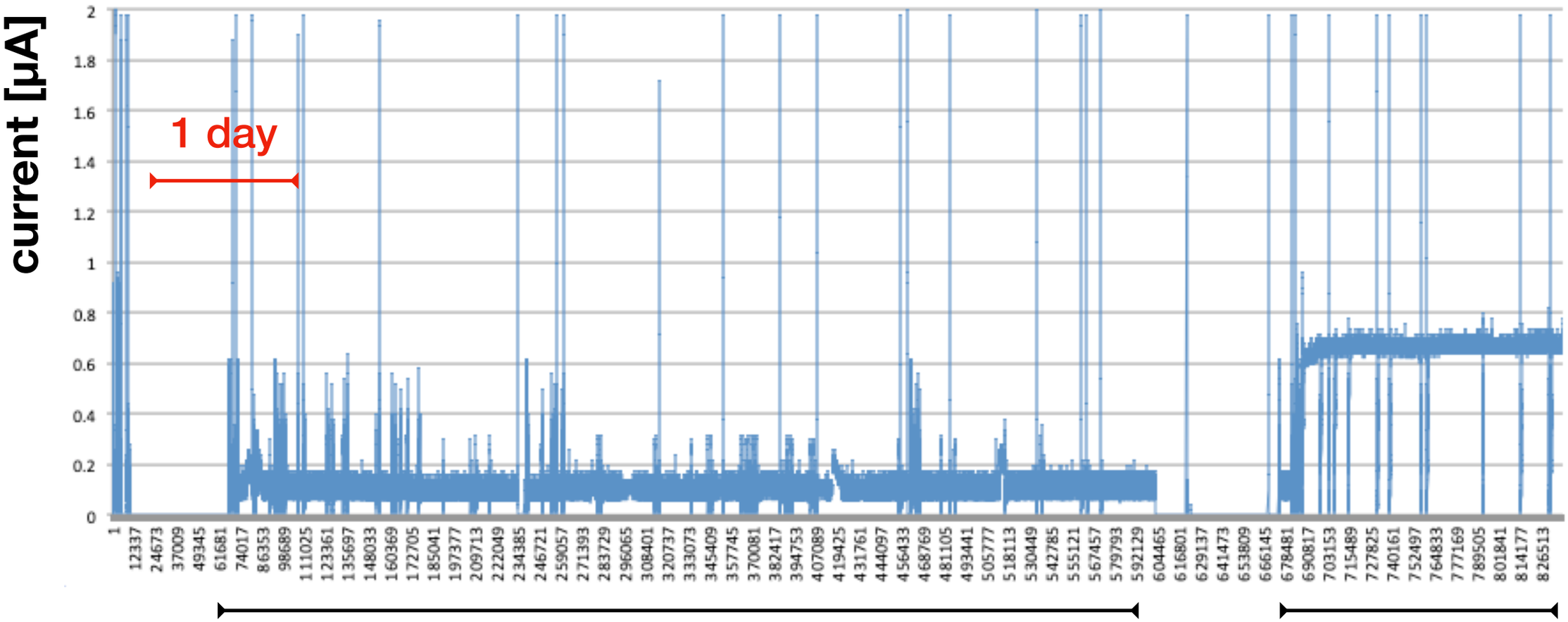




Alice Apponi, Francesca Pucci, Giuseppe Rossi

GEM current & HV stability

He:CF4 60:40
~ 8 days of operation

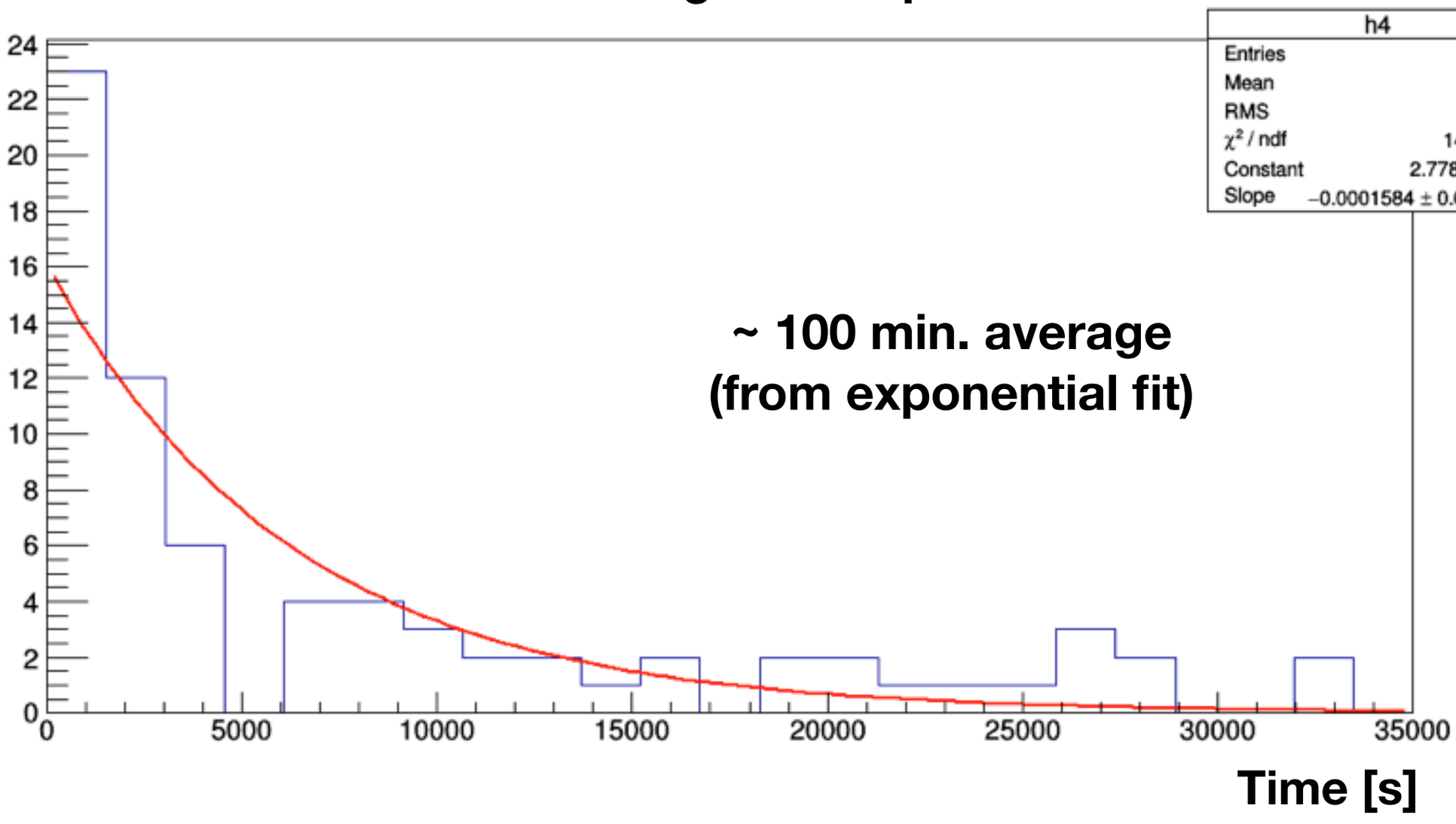


30 discharges + 98 recovery events
—> 6% dead time

Alice Apponi, Francesca Pucci, Giuseppe Rossi

GEM current & HV stability

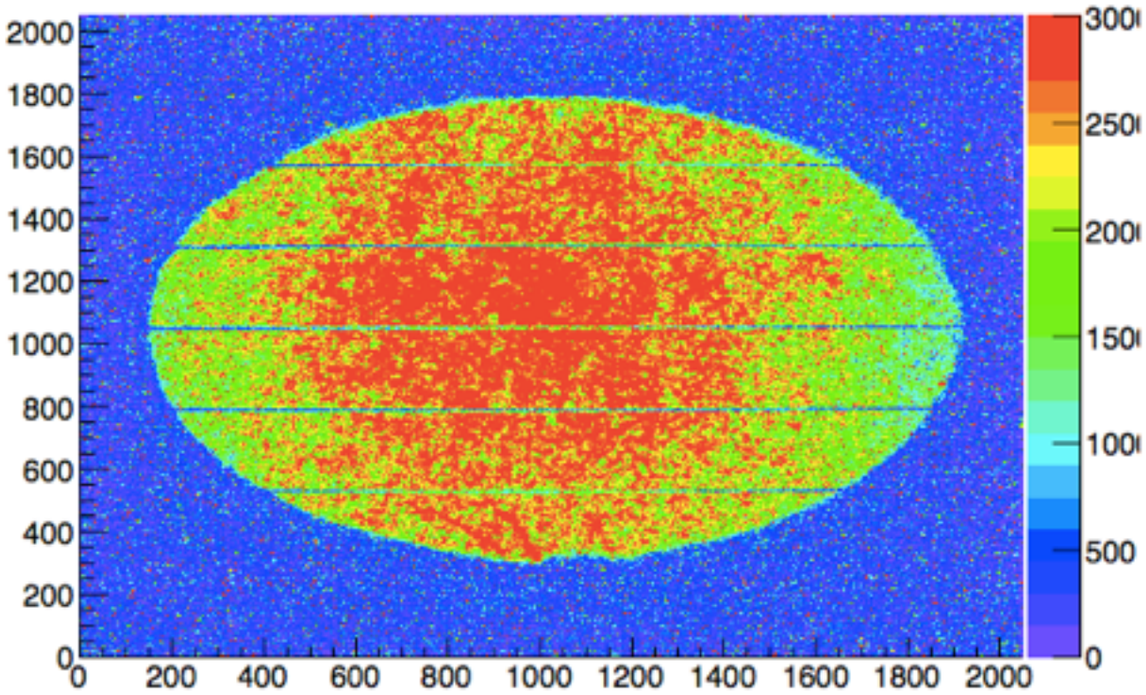
Time between two consecutive discharges/hot spots



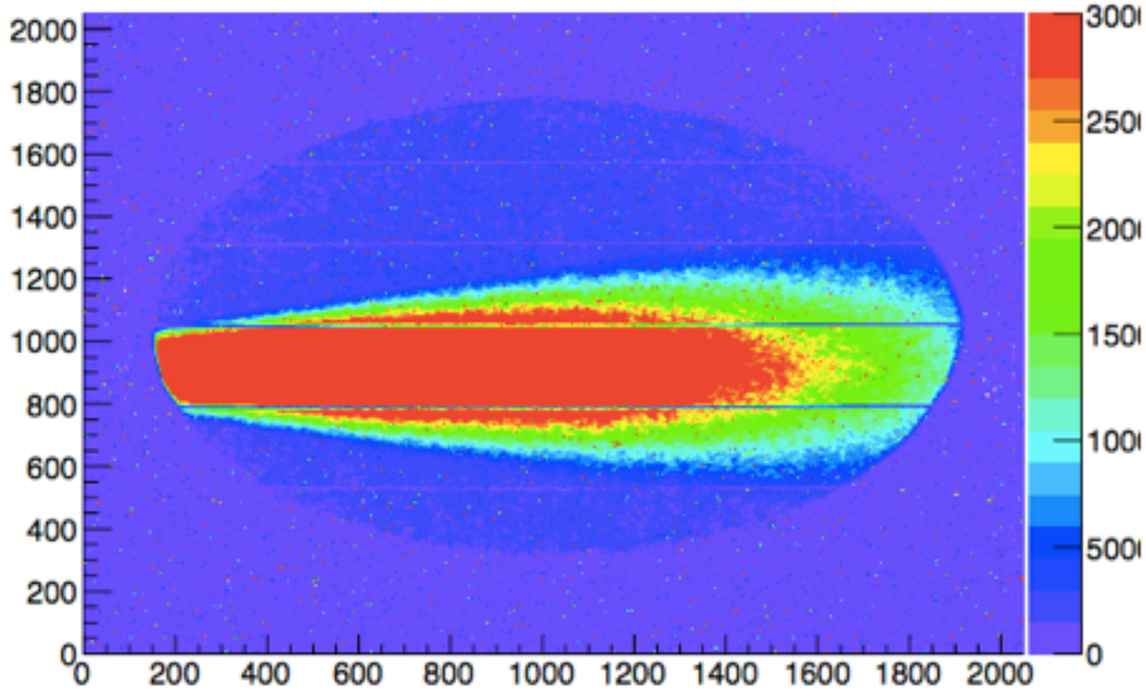
Alice Apponi, Francesca Pucci, Giuseppe Rossi

Detector response

10s pictures



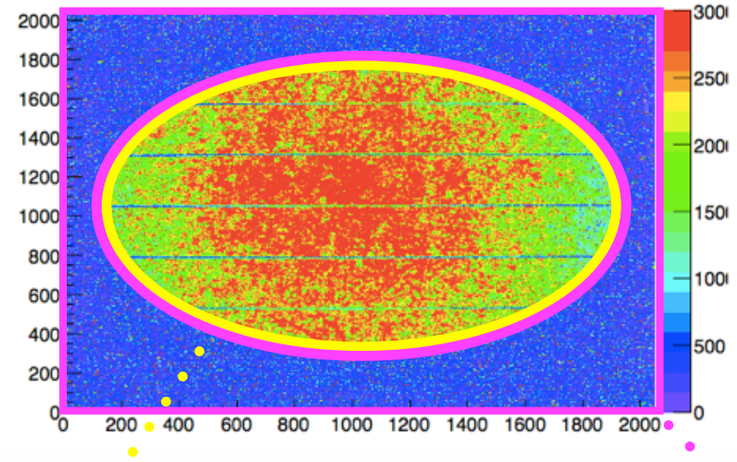
without ^{55}Fe

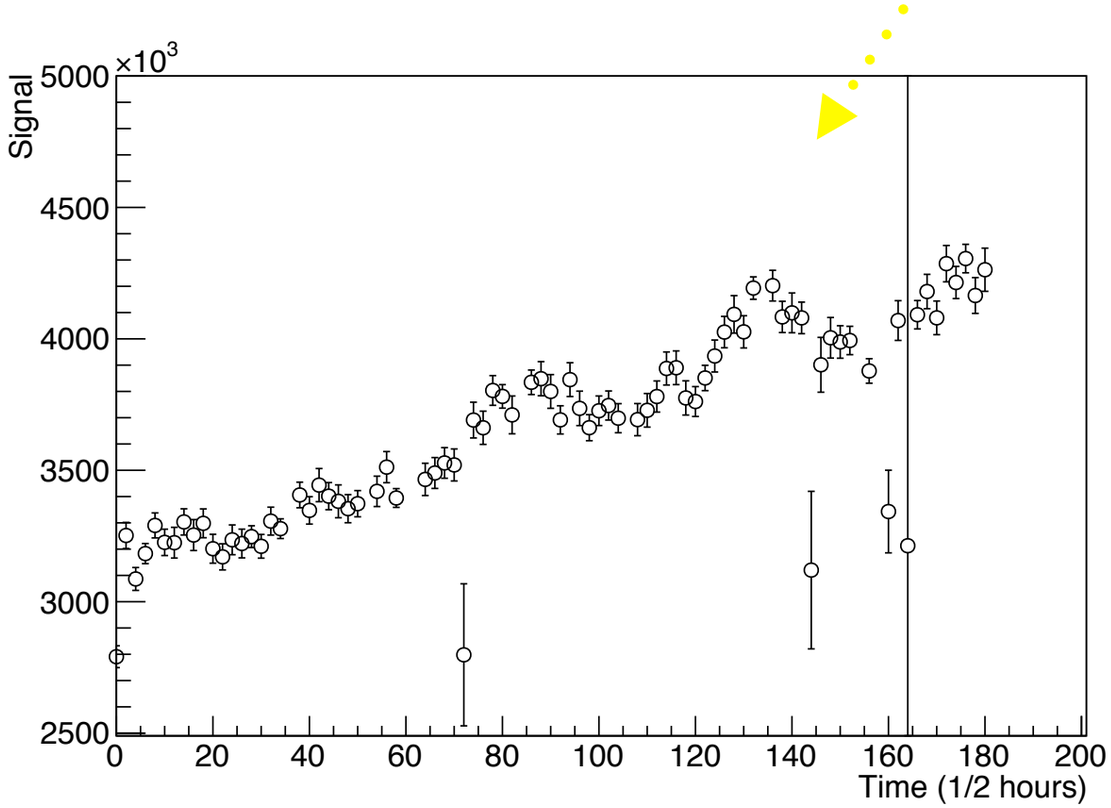


with ^{55}Fe

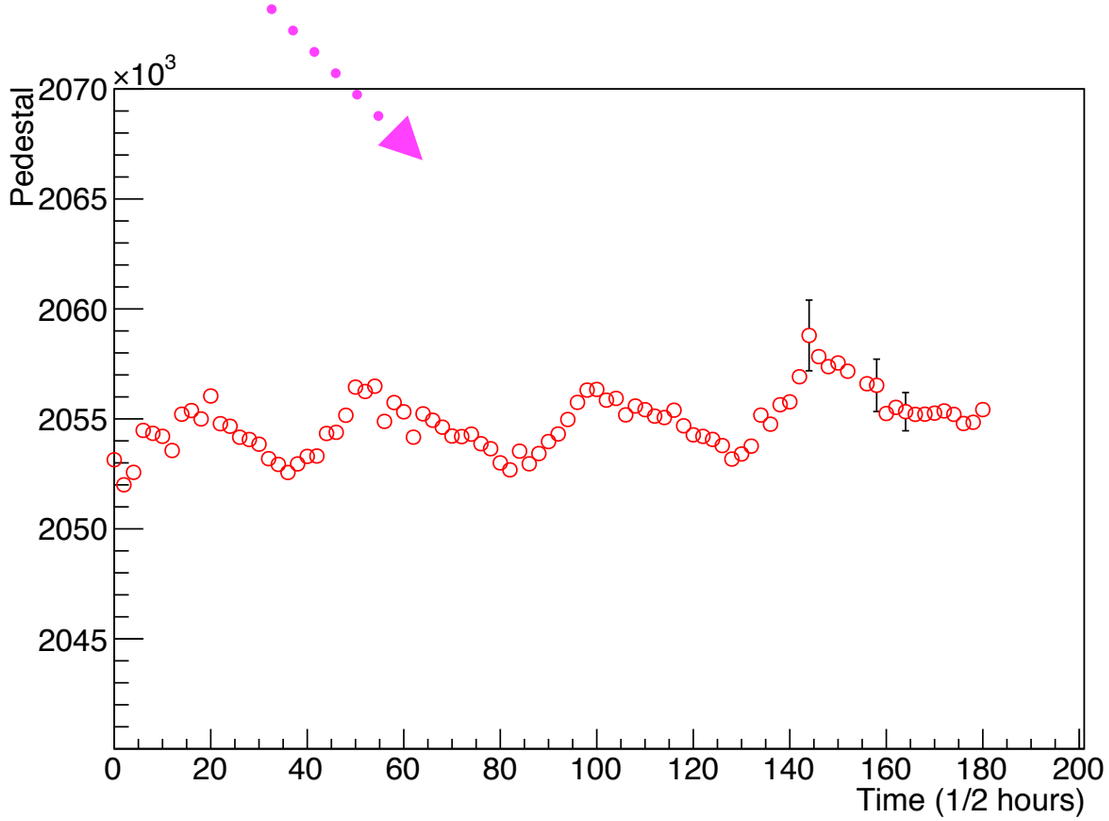
Detector response

He:CF4 60:40
No source



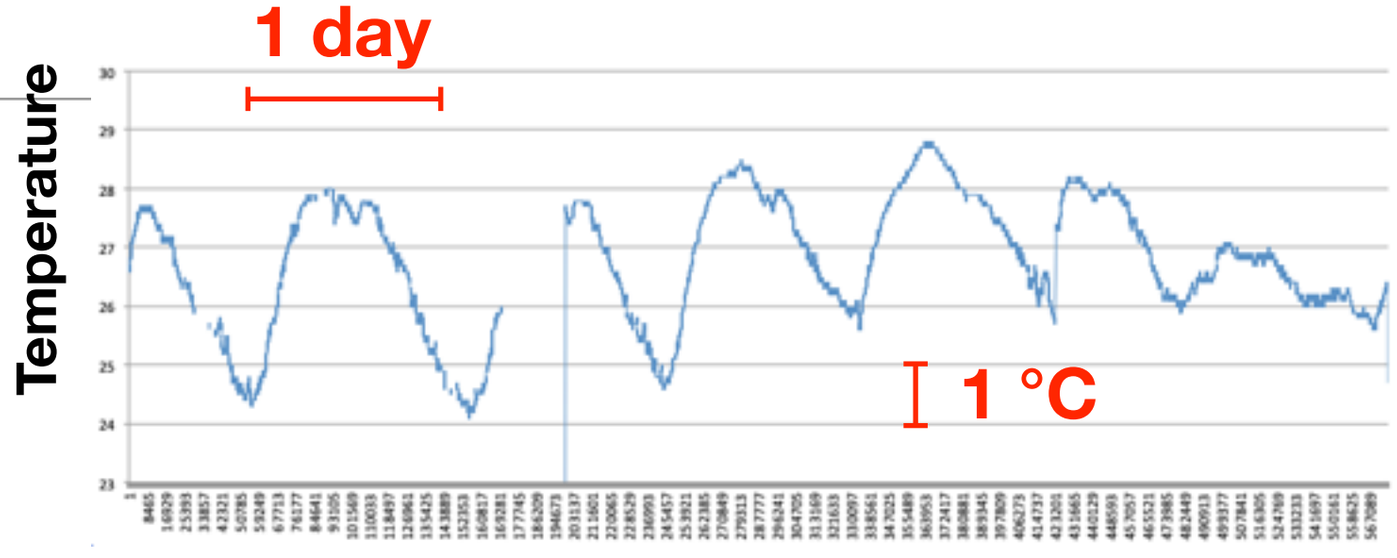


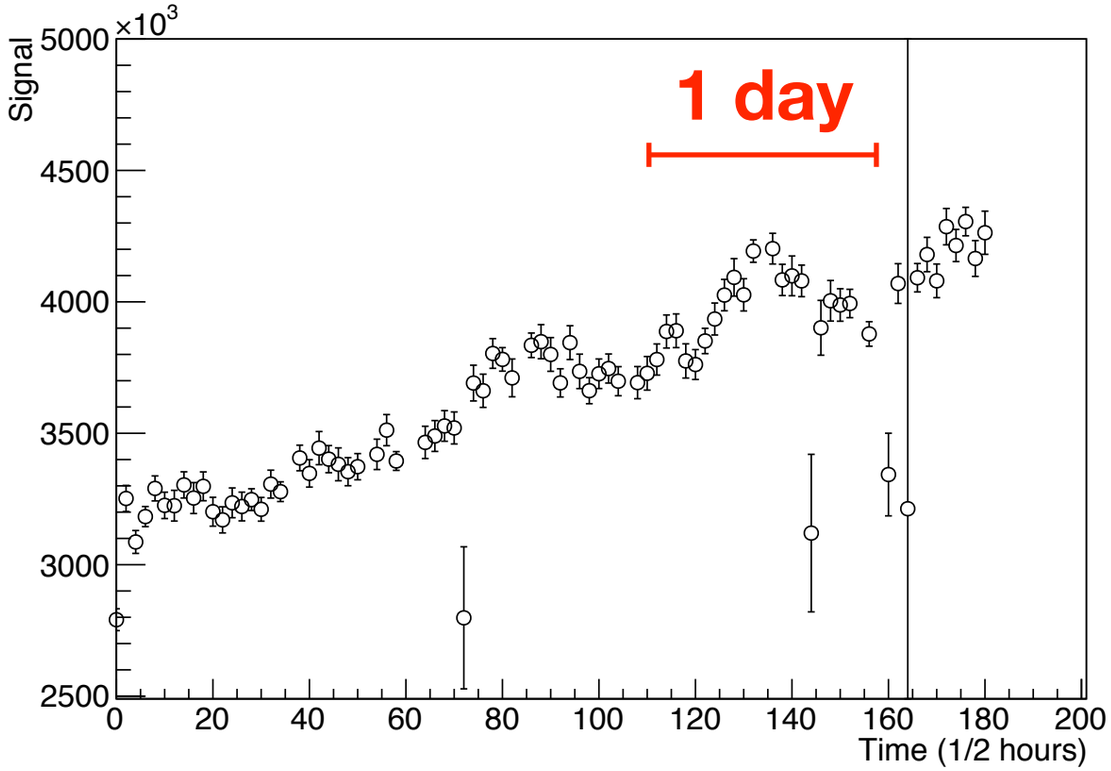
Total light



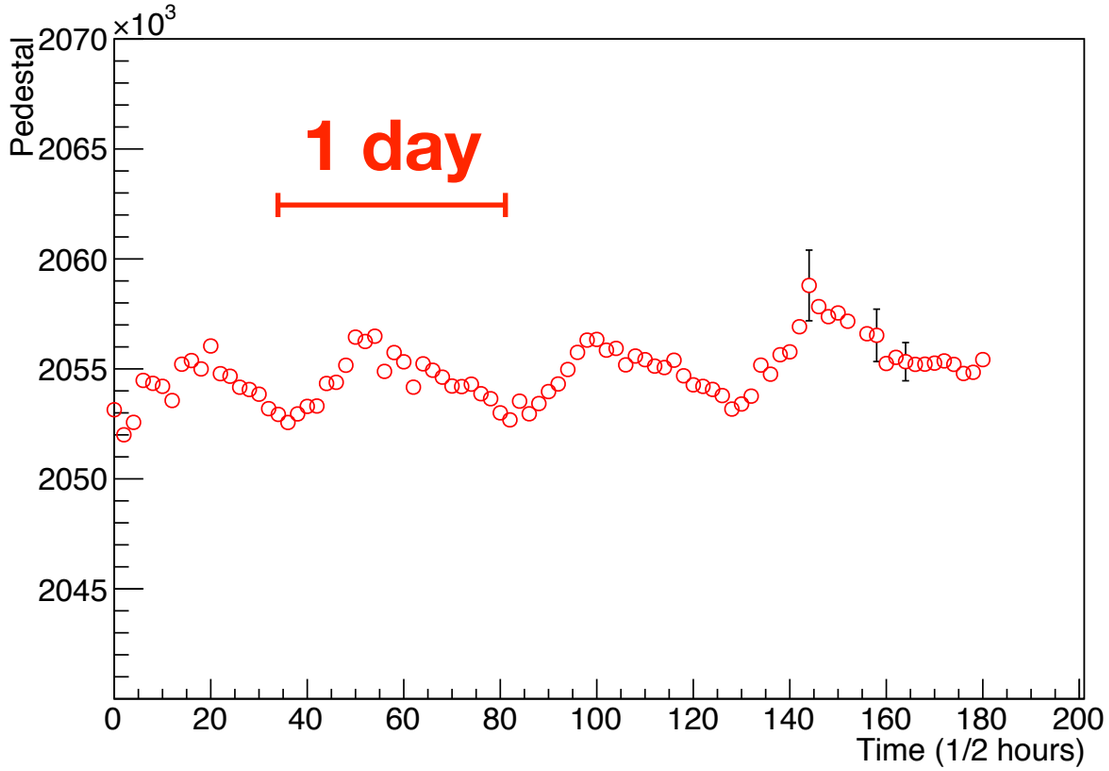
Pedestal

Detector response



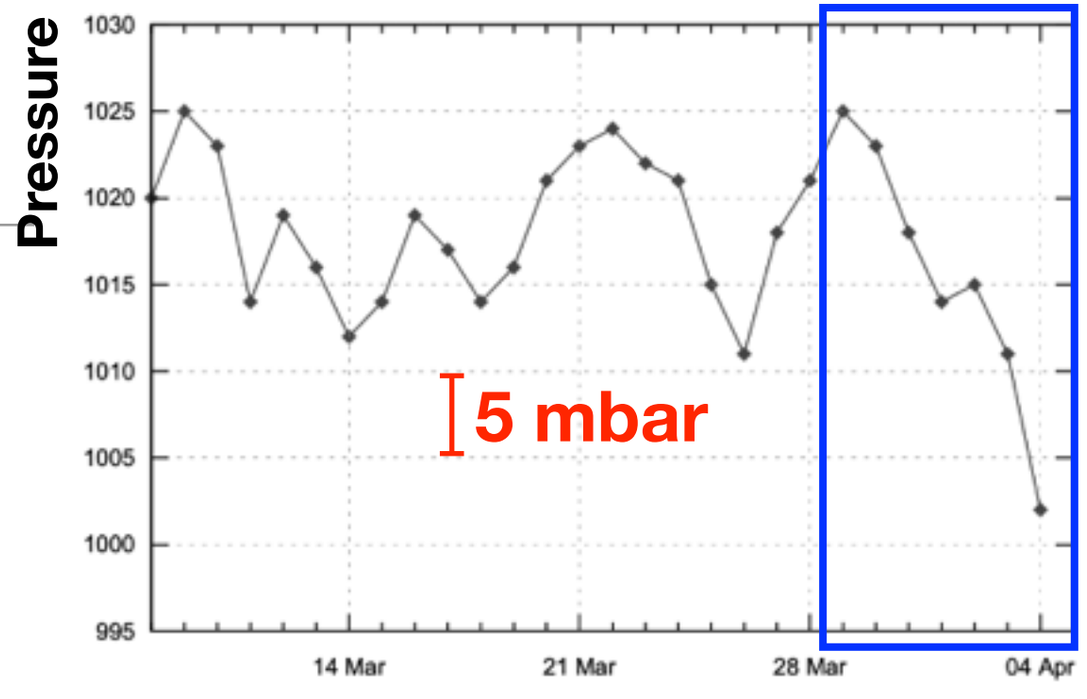


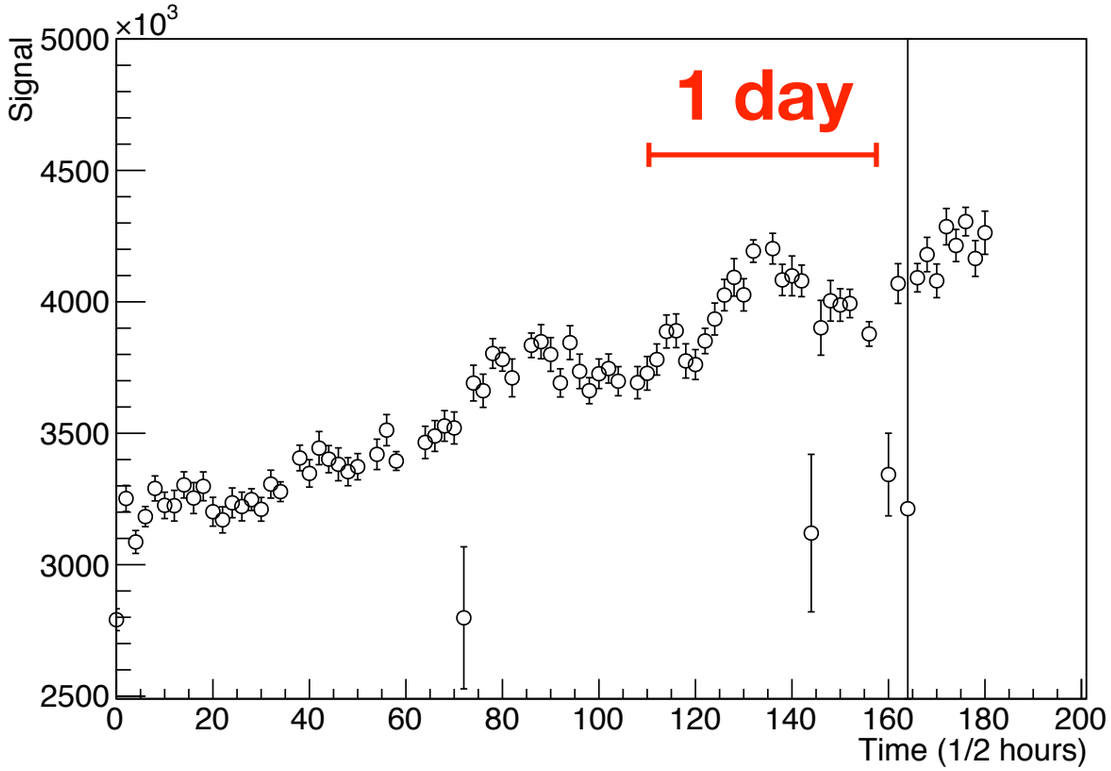
Total light



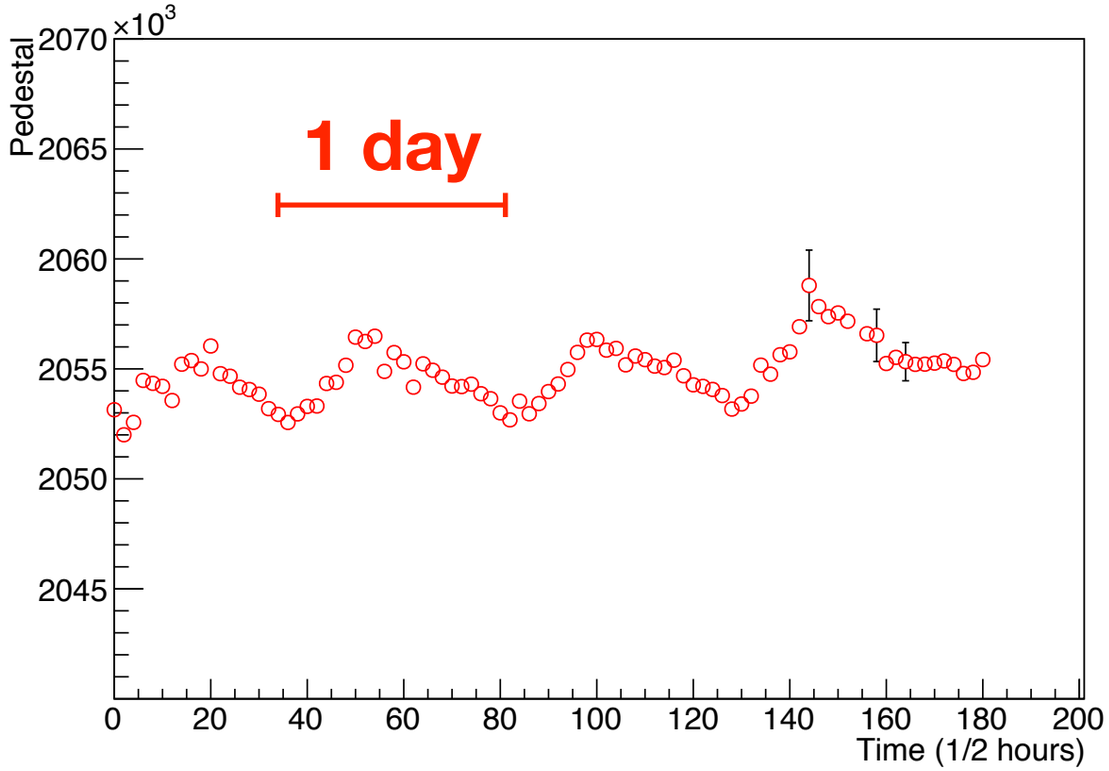
Pedestal

Detector response





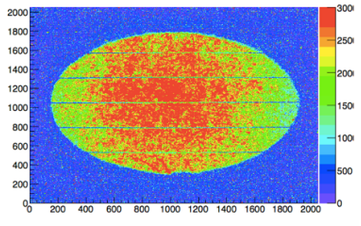
Total light



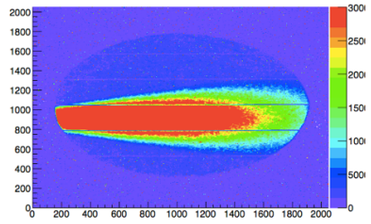
Pedestal

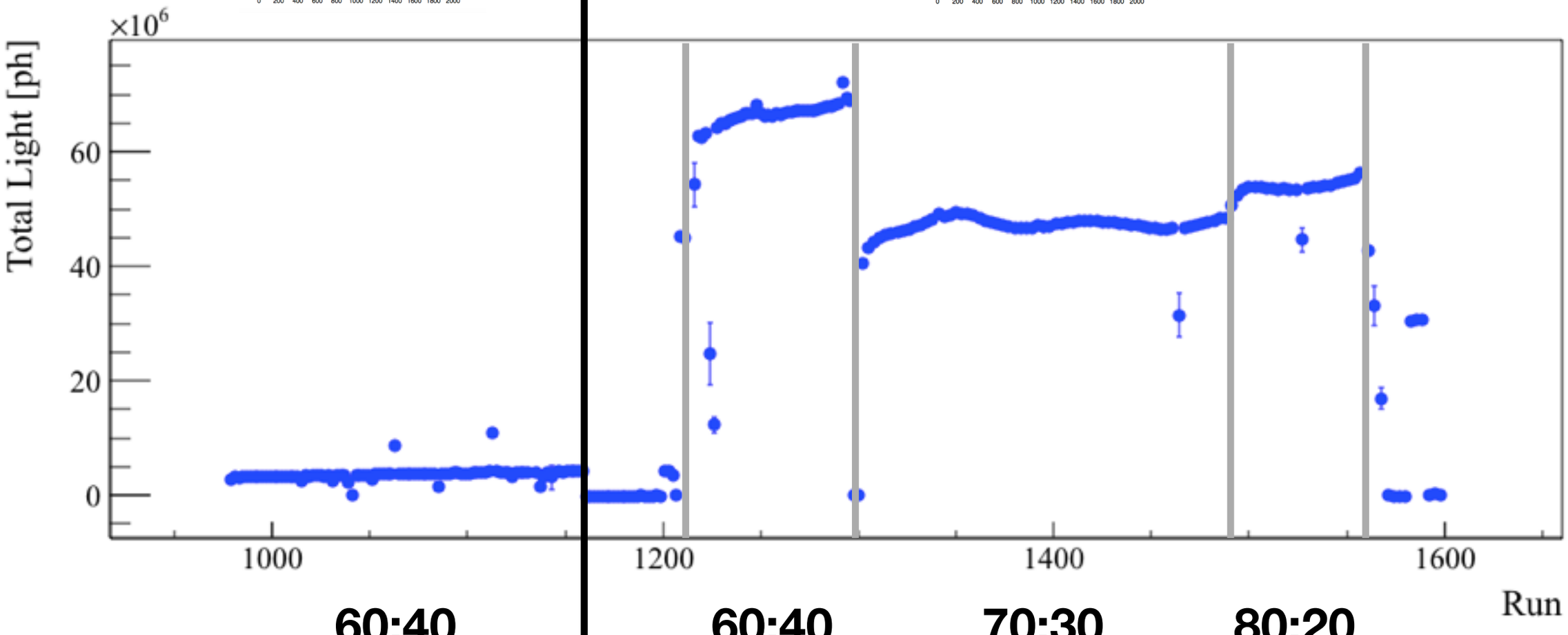
Detector response

no source



^{55}Fe





Conclusions

- The stability of a GEM TPC prototype over 1 week of operation was tested

- 6% dead time due to discharges and hot spot
  - recovery strategy to be improved —> large room for improvements

- Stability of detector response (accounting for changes is environmental conditions) under study