Study of saturation effects in GEM-3 with LEMON

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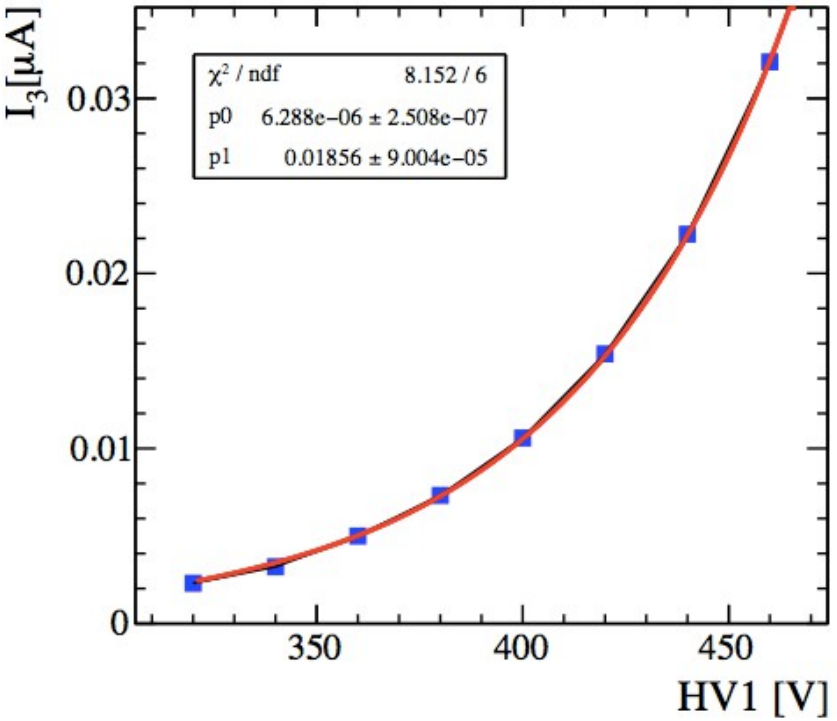
Measurement strategy

- Detector exposed to ^{55}Fe source, either collimated or uncollimated
- Current on GEM-2 (with GEM-3 off) and GEM-3 measured as the voltage through a resistor in the HV supply line
- Measurement taken varying HV of GEM-1 to have different charges arriving to GEM-2

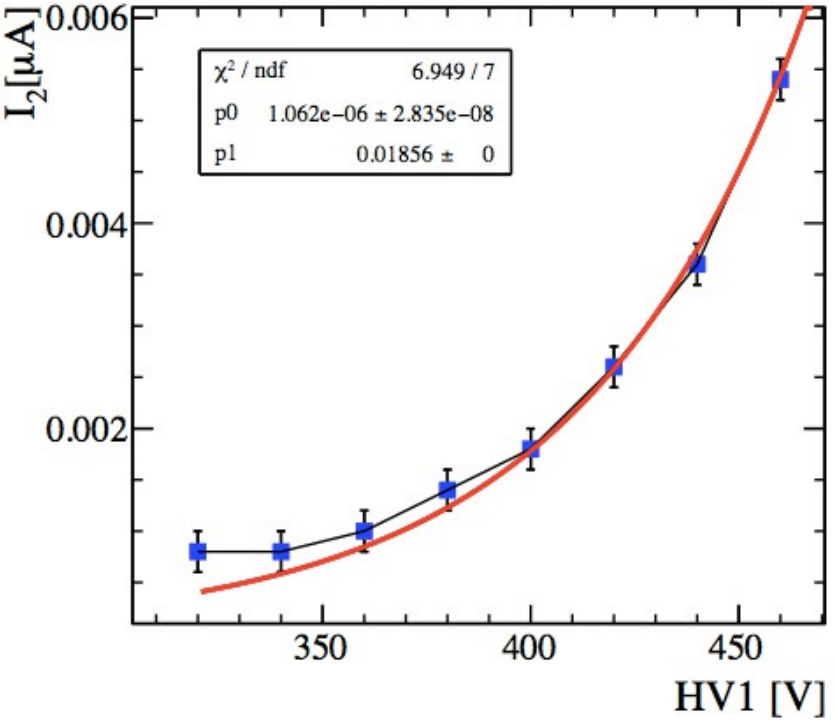
  → it simulates different energy deposits in the detector

GEM-2 current (I_2)

HV_2 = 460 V



w/o collimator

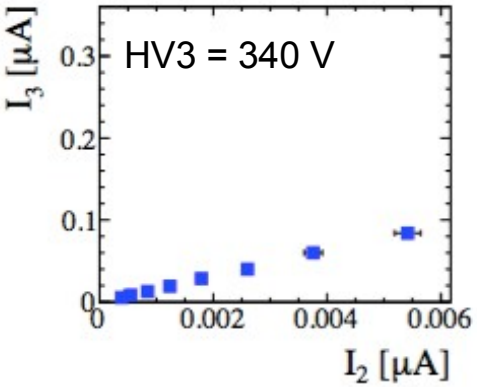


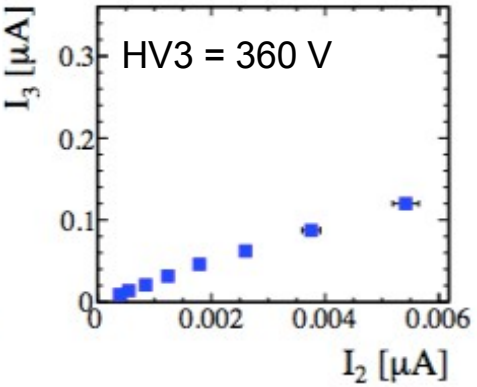
w/ collimator

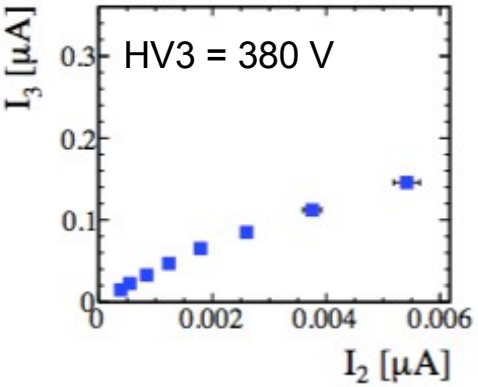
We avoided to take measurements without collimator on GEM-3 (large current, need large correction of HV)

We decided to use measurements of I_2 without collimator (more precise) scaled by the average ratio with respect to the measurement with collimator

GEM-3 current (I_3) vs. scaled I_2







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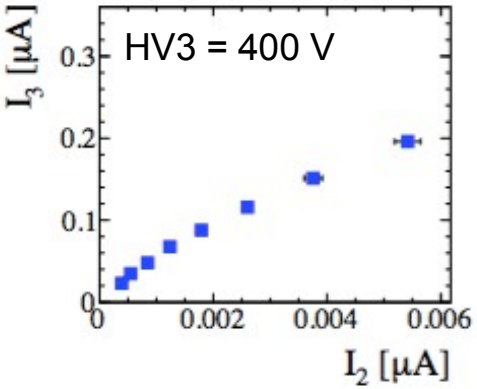
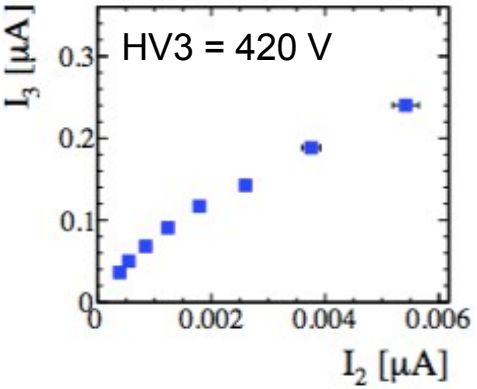
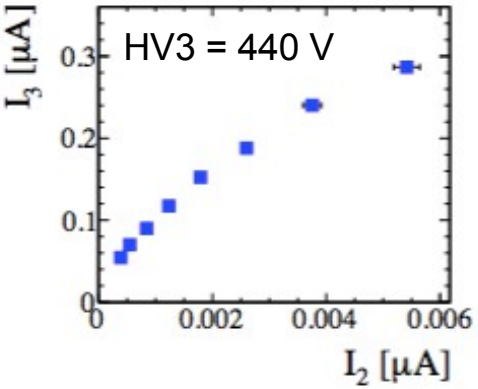
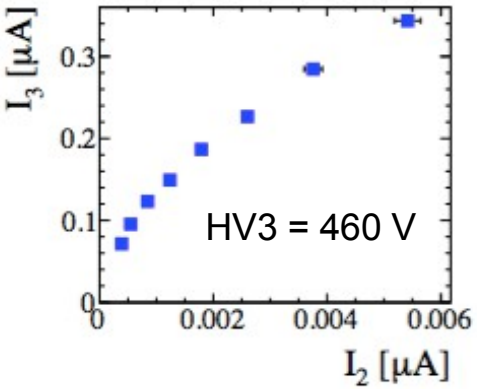




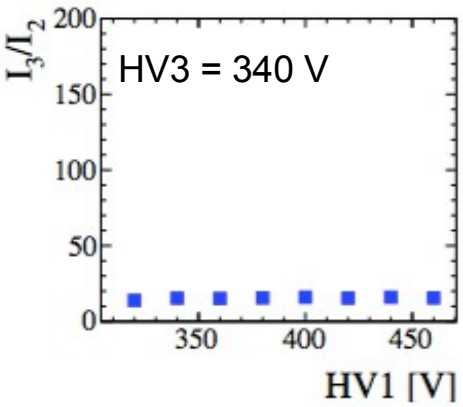


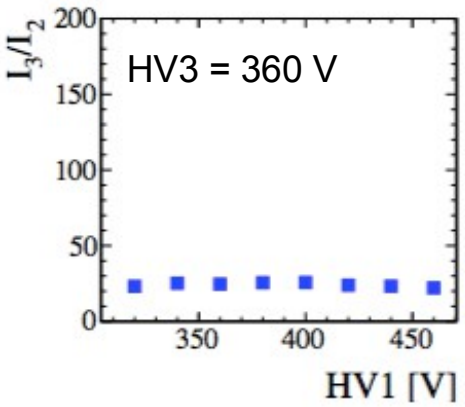


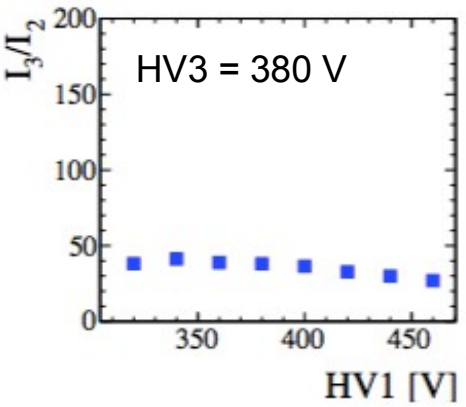
These plots give the charge coming out form GEM-3 as a function of the charge coming in

Good linearity only at HV_3 = 340 V

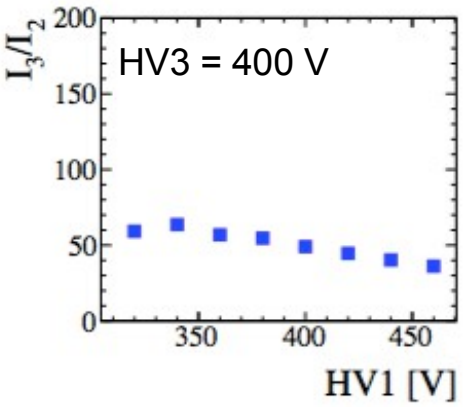
GEM-3 gain (I_3/I_2) vs. HV_1

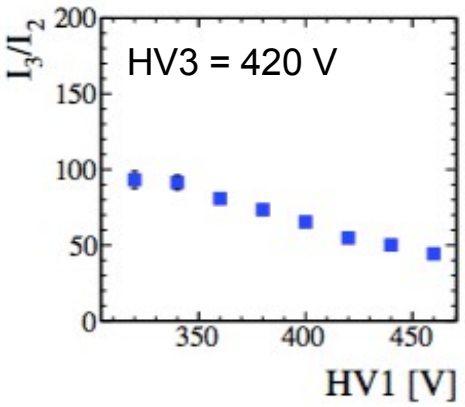


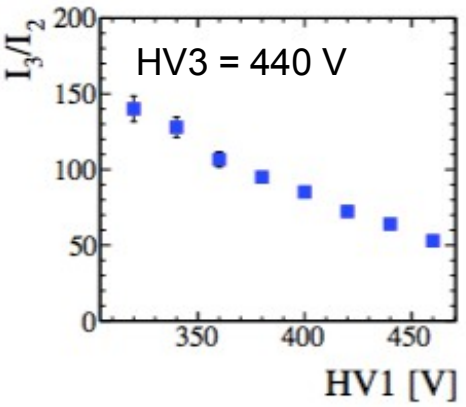


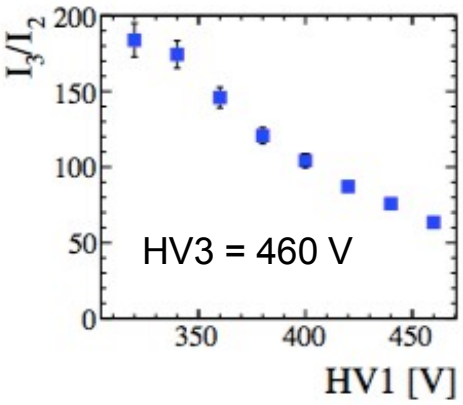


HV_2 = 460 V







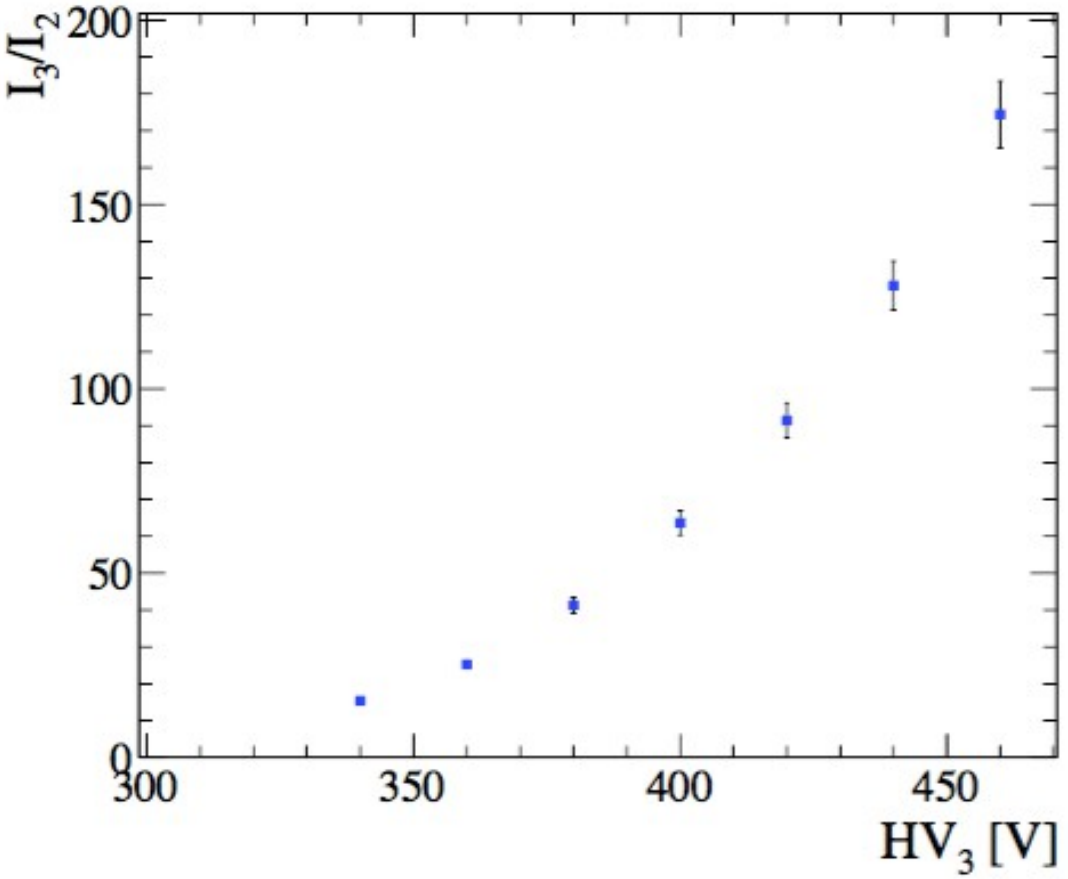


Gain is constant over all the range of HV_1 only at HV_3 = 340 V

A non-saturated configuration is 460 V / 460 V / 340 V

GEM-3 gain (I_3/I_2) vs. HV_3

Non-saturated configurations would be also 340 V / 460 V / < 460 V



Gain at 460 clearly too large

Most probably some problem in I_2 measurements with collimator (quite unstable)

→ trends in previous plots are ok, but don't trust the absolute values

Discussion

- We studied the saturation effect as a function of the charge reaching GEM-2 and GEM-3
- Is it possible to calibrate it?
  - not trivial: the effect is related to the **charge density**, not to the total charge
  - strategy under development