

# Report on very preliminary measurements of 10x10cm<sup>2</sup> Triple-GEM detectors with New Single Mask technique

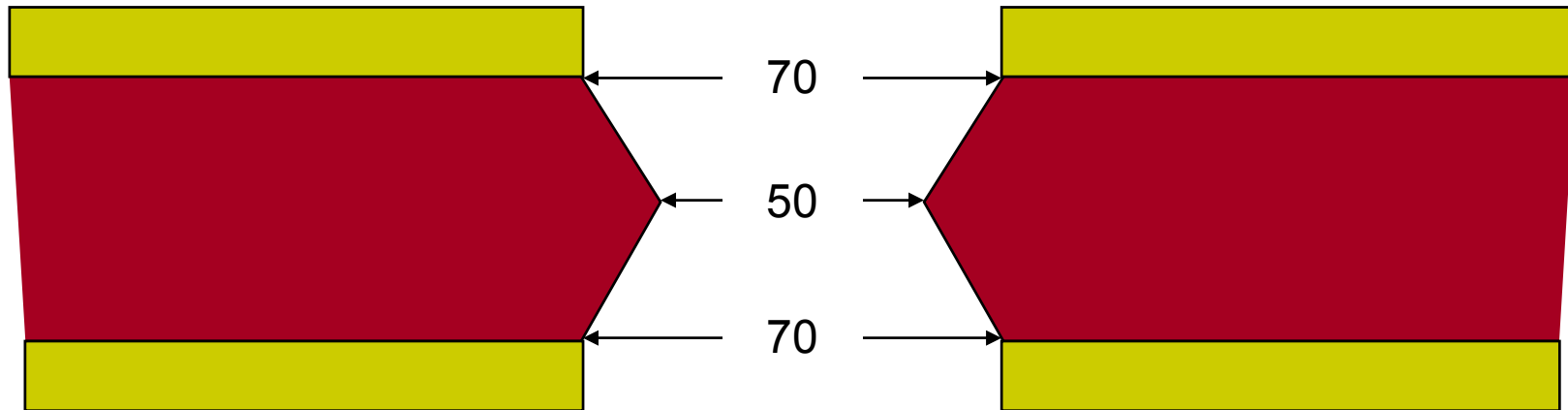
## Overview

- Hole geometry
- Experimental setup
- Transparency and gain measurements
- Leakage currents and discharges
- Charging up measurement

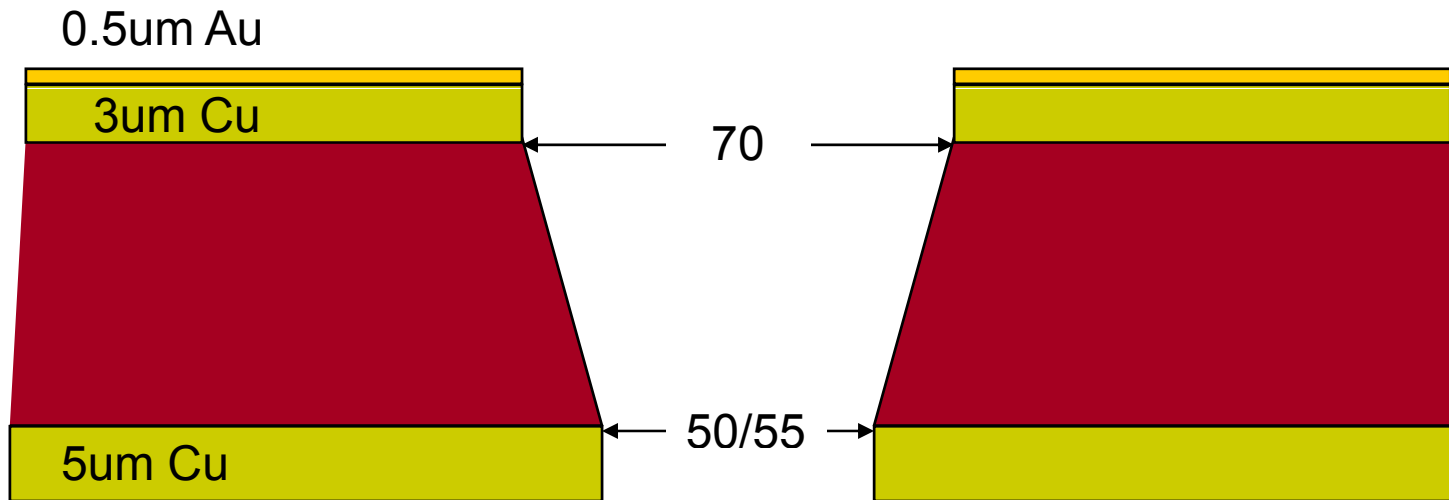
Danilo Domenici

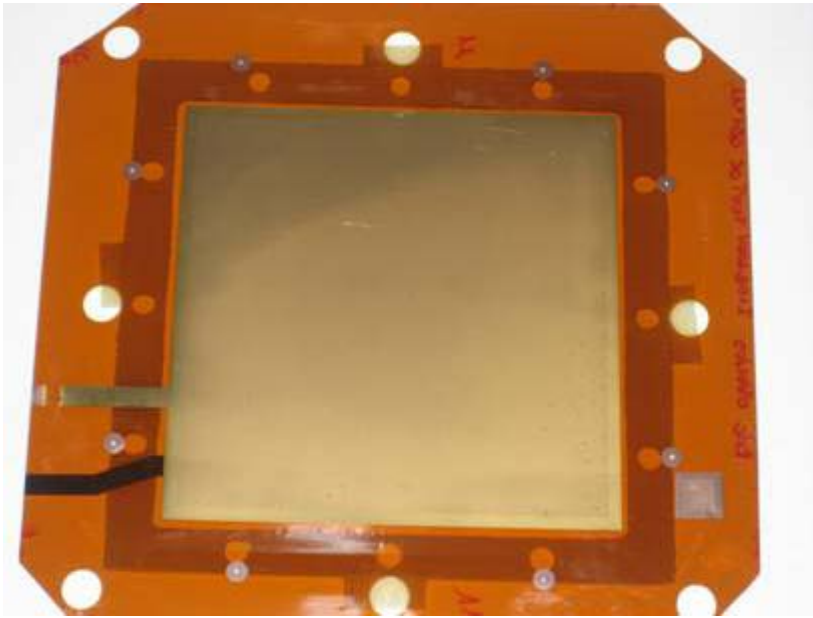
Laboratori Nazionali di Frascati - INFN

## STD GEM



## NEW GEM



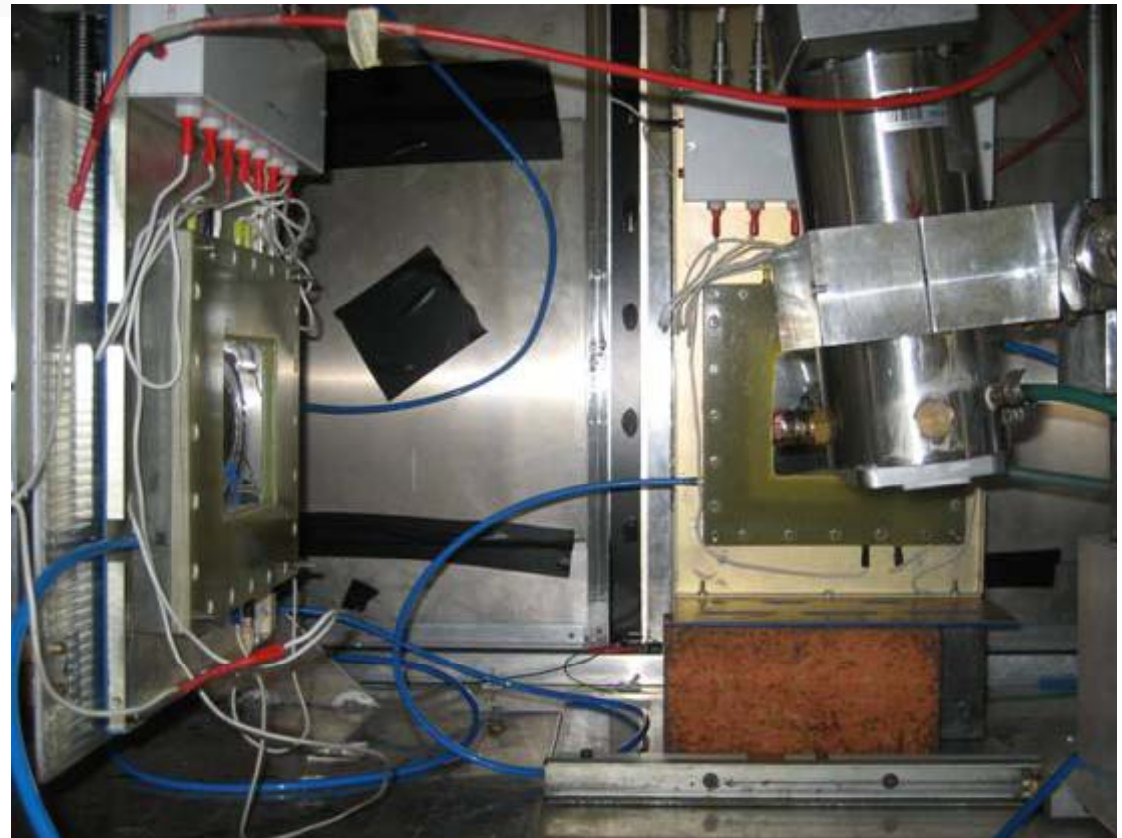


10x10cm<sup>2</sup> NEW GEM with gold on the top mounted on FR4 frame

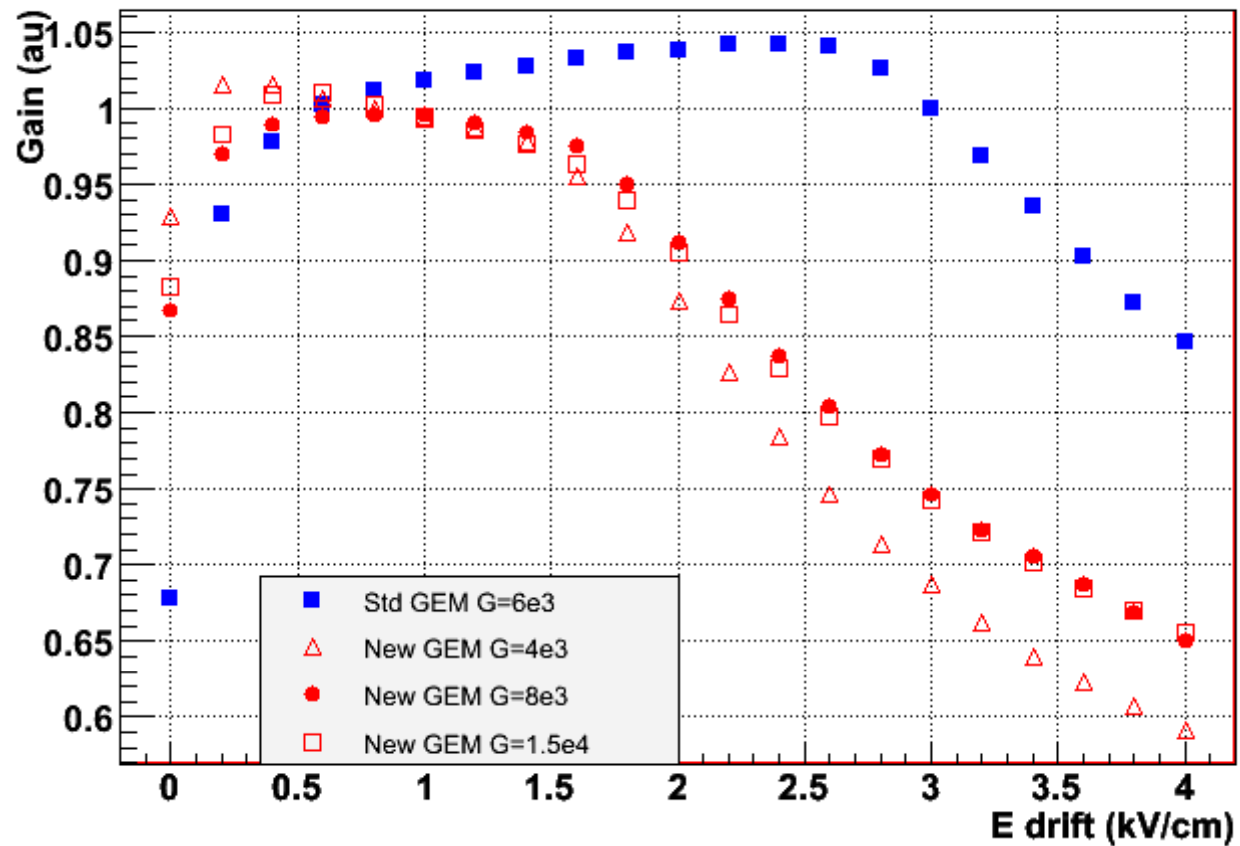
GEM2 not well performing  
(discharge voltage in N<sub>2</sub> 560 V)

GAS: Ar/CO<sub>2</sub> 70/30

Experimental setup  
6 keV X-ray system with  
front and side guns



## Relative gain vs Drift field



$V_{GEM_{STD}} = 1080 \text{ V}$

$V_{GEM_{NEW}} = 1110, 1140, 1170 \text{ V}$

NEW GEM have more narrow plateau

Very small  $E_d$  value needed

## Relative gain vs Transfer fields

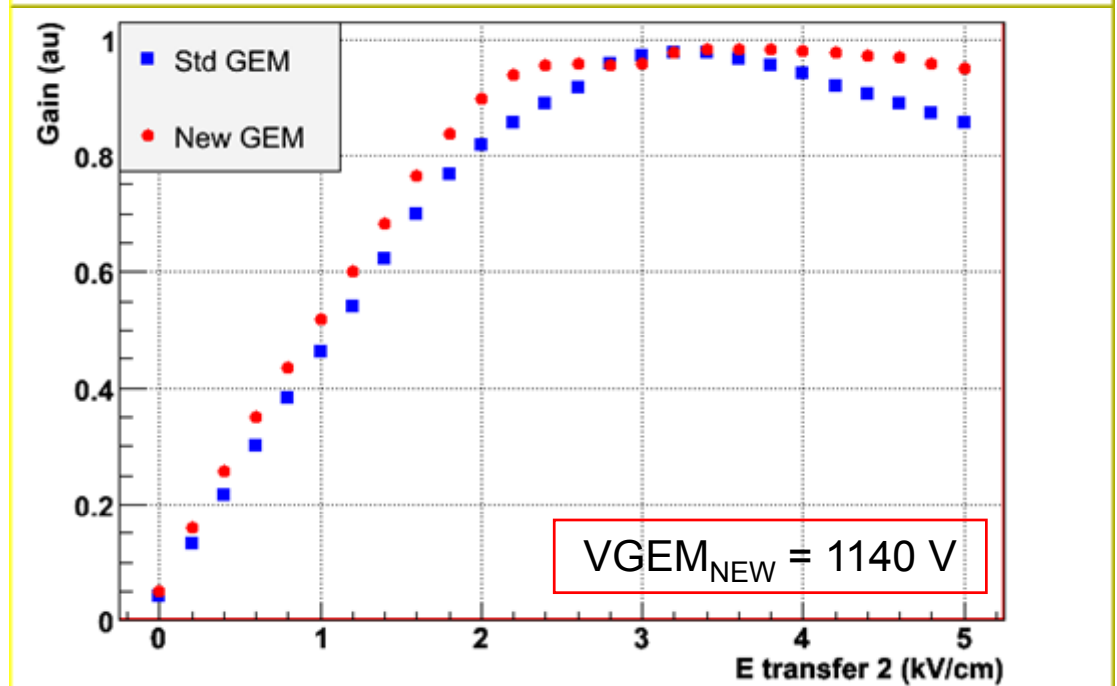
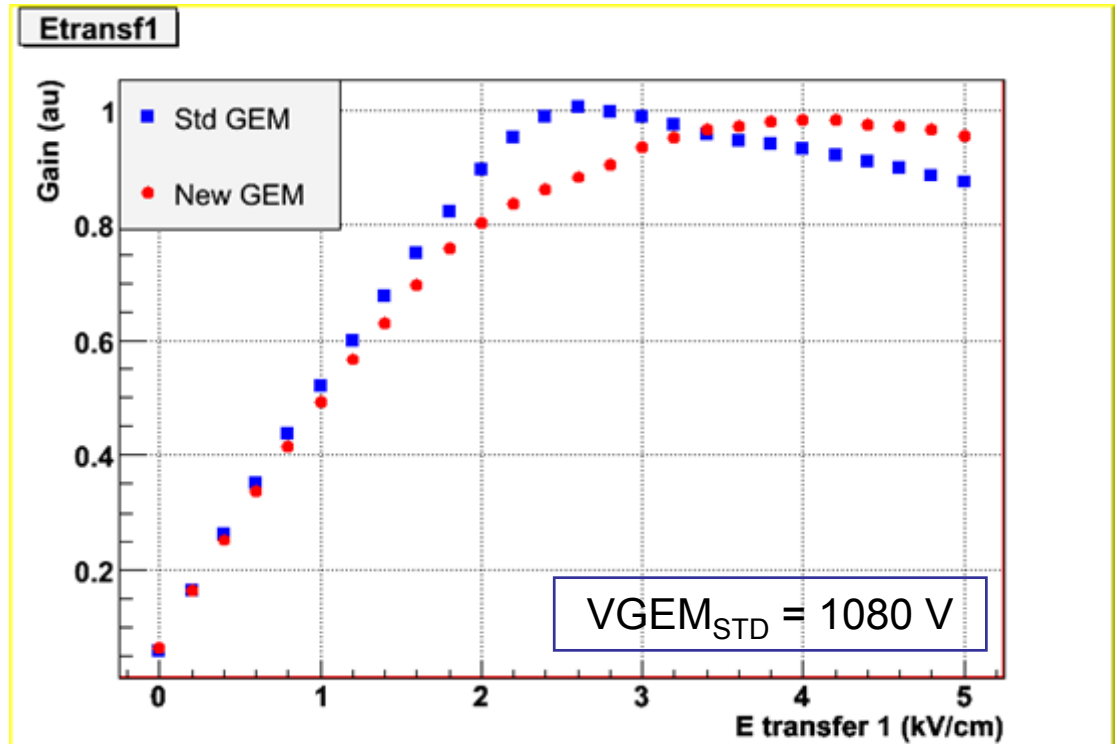
Transfer Field 1 peak value:

STD GEM:  $E_{t1}=2.5$  kV/cm

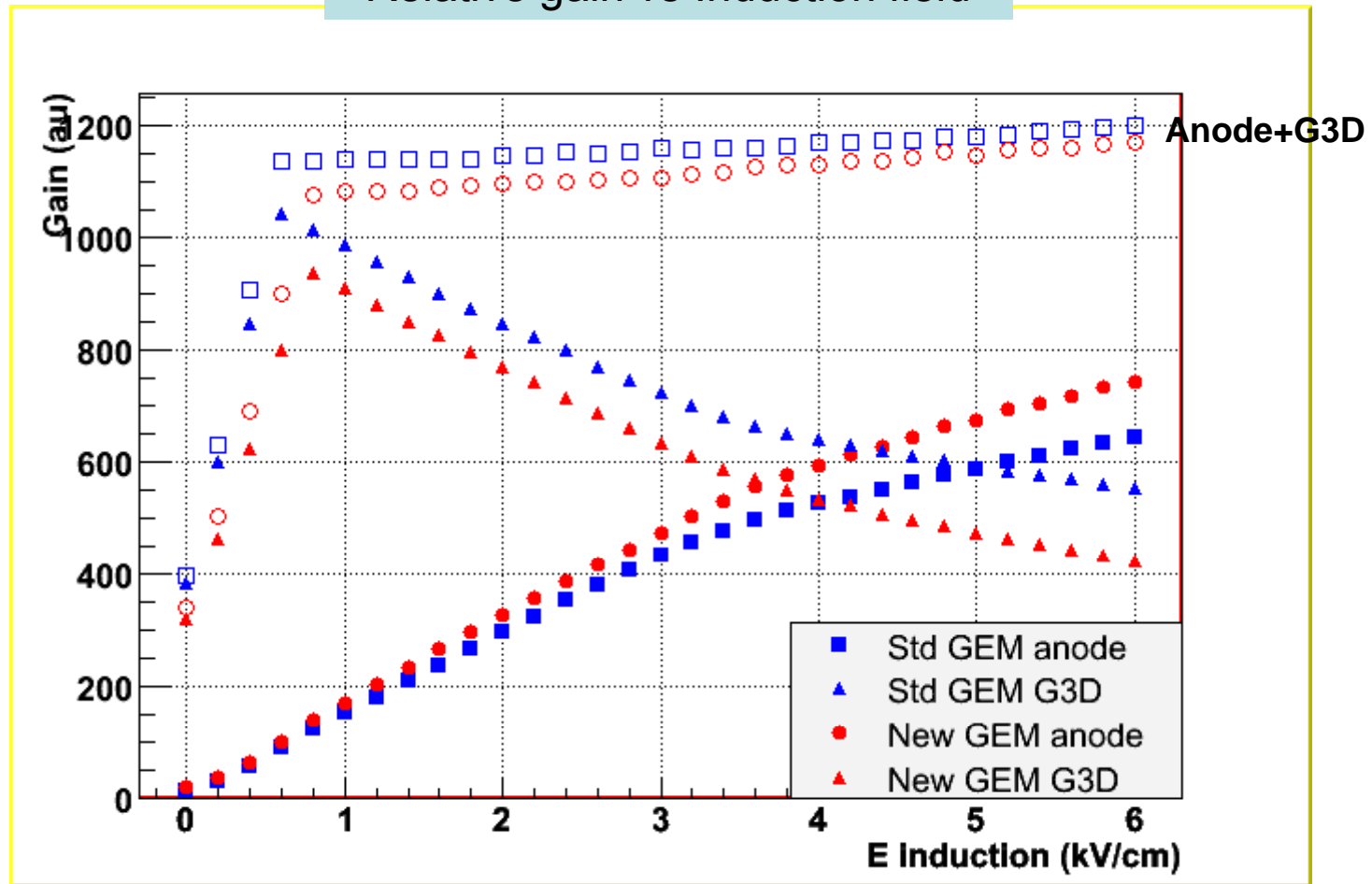
NEW GEM:  $E_{t1}=4$  kV/cm

Transfer Field 2 dependance quite similar

NEW GEM have a larger plateau



## Relative gain vs Induction field



Equal sharing of charge:

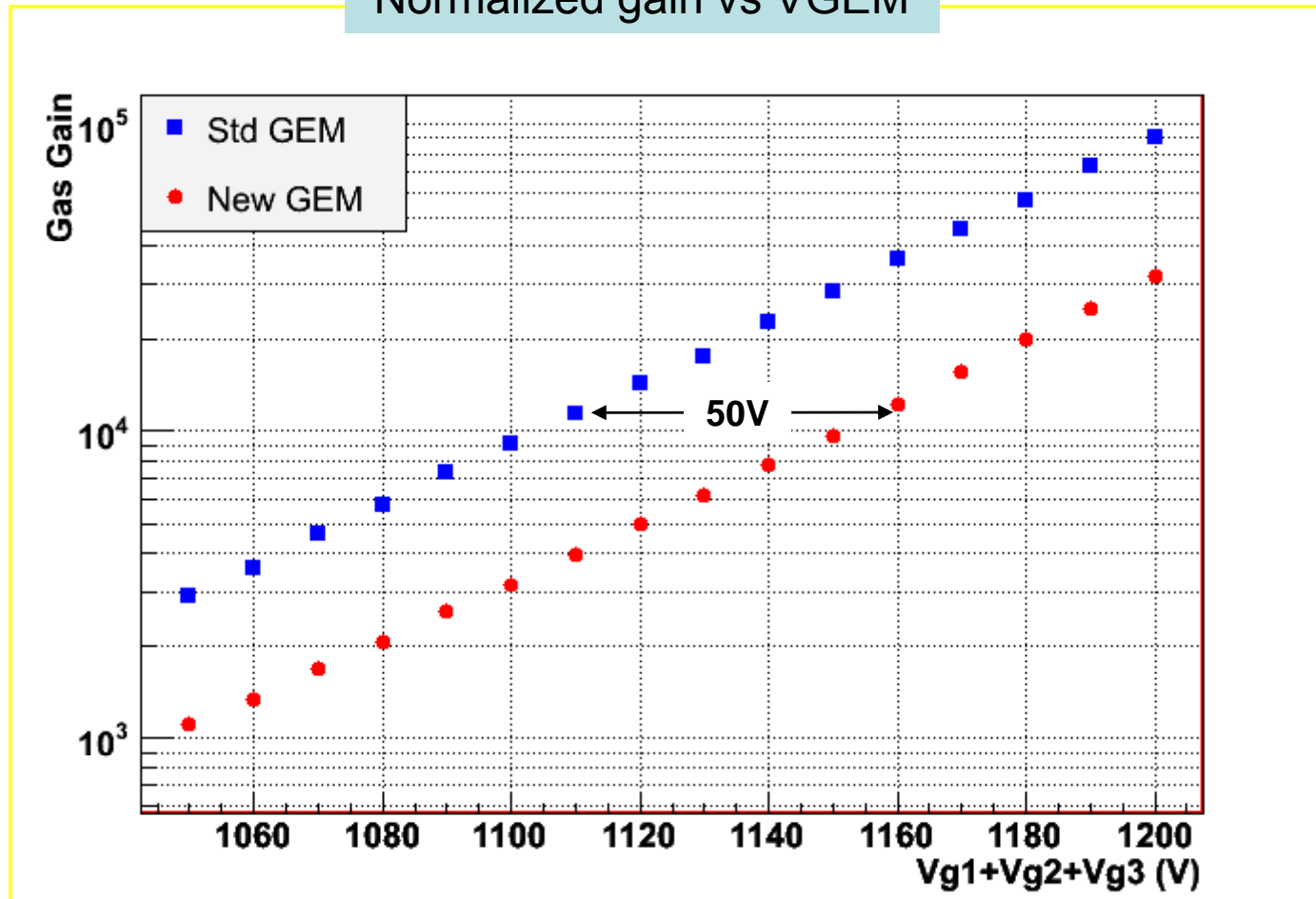
STD GEM:  $E_i=5$  kV/cm

NEW GEM:  $E_i=3.5$  kV/cm

$$VGEM_{STD} = 1080 \text{ V}$$

$$VGEM_{NEW} = 1140 \text{ V}$$

## Normalized gain vs VGEM



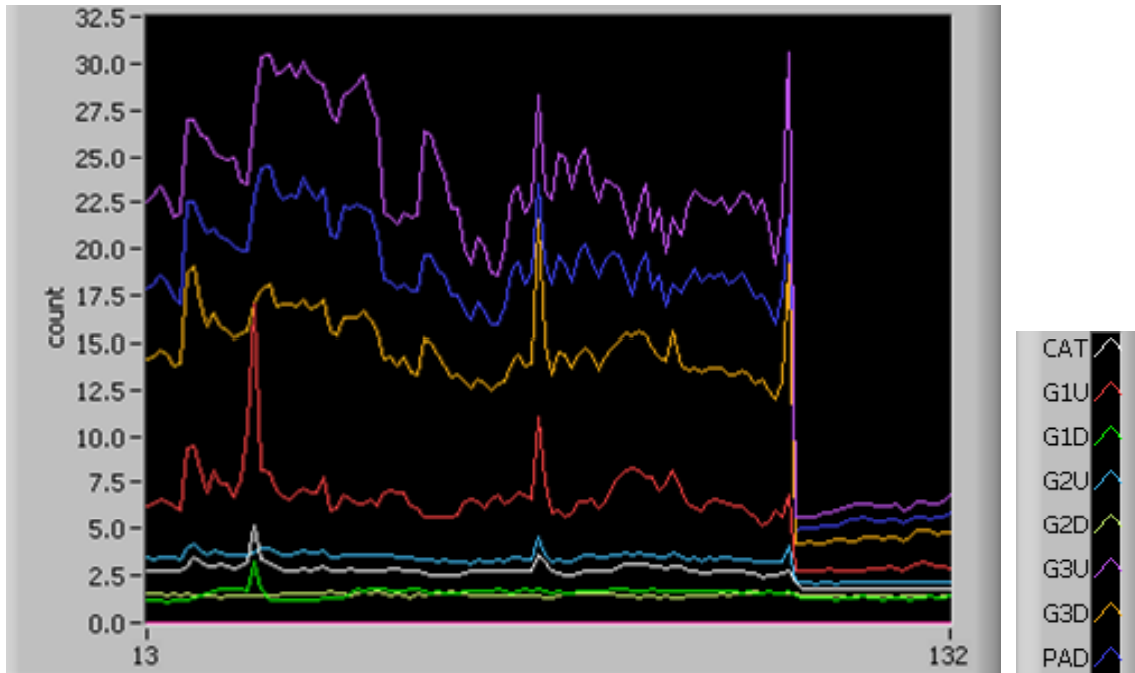
Data normalized to previous Absolute gain measurements with Ar/CO<sub>2</sub> 70/30

Optimized fields:

STD GEM:  $E_d=1.5 - E_{t1}=2.5 - E_{t2}=3.0 - E_i=5.0$

NEW GEM:  $E_d=0.8 - E_{t1}=3.5 - E_{t2}=3.0 - E_i=3.5$

## Leakage currents



## NEW GEM

VGEM = 1220V

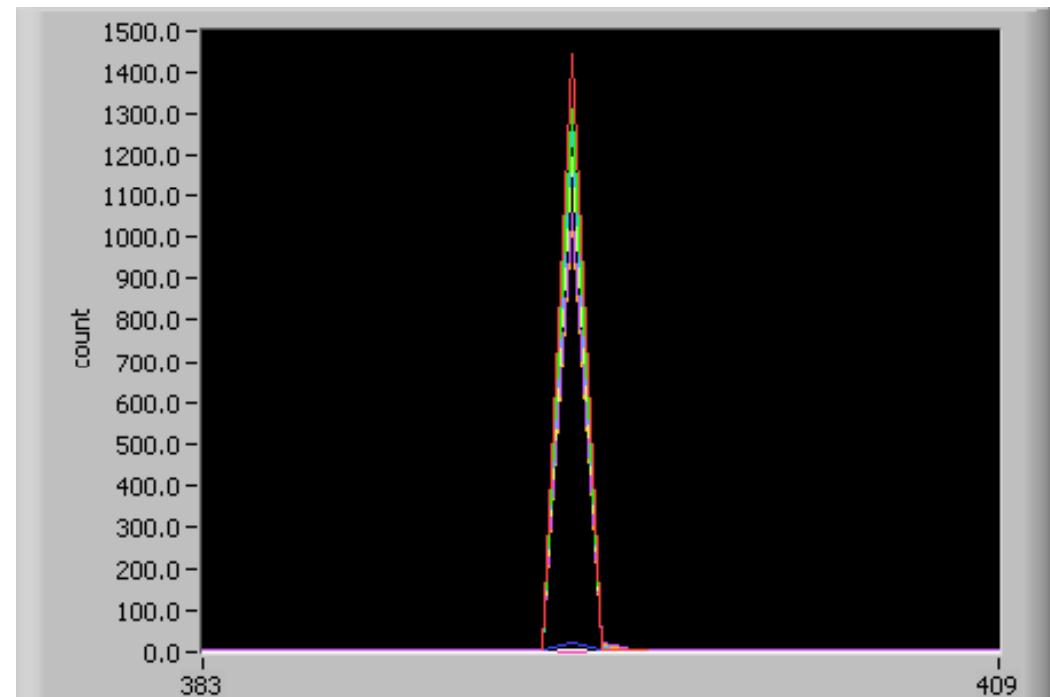
Extrapolated

**GAIN = 140000**

NO RADIATION

Leakage currents appear and suddenly reduce of a factor 5

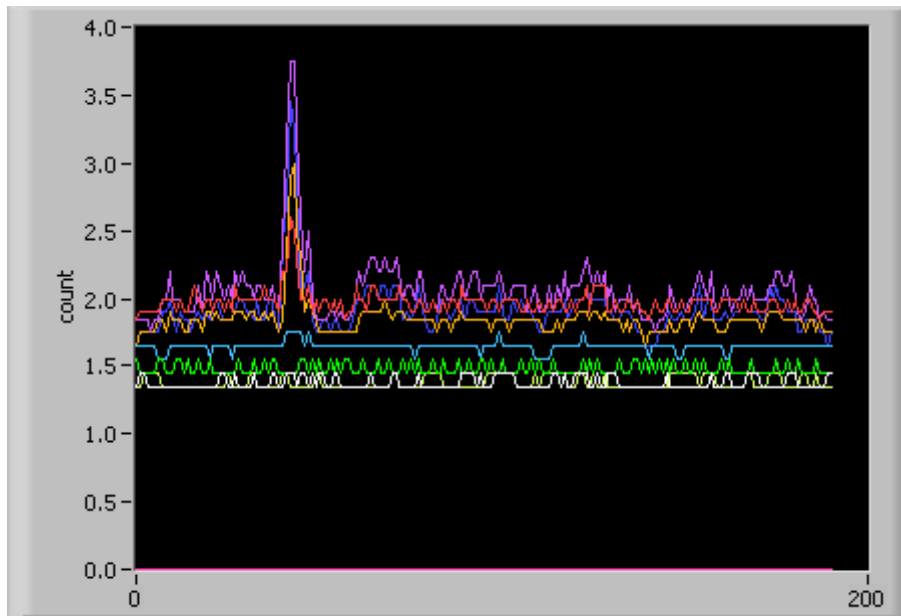
1 discharge in 10 minutes





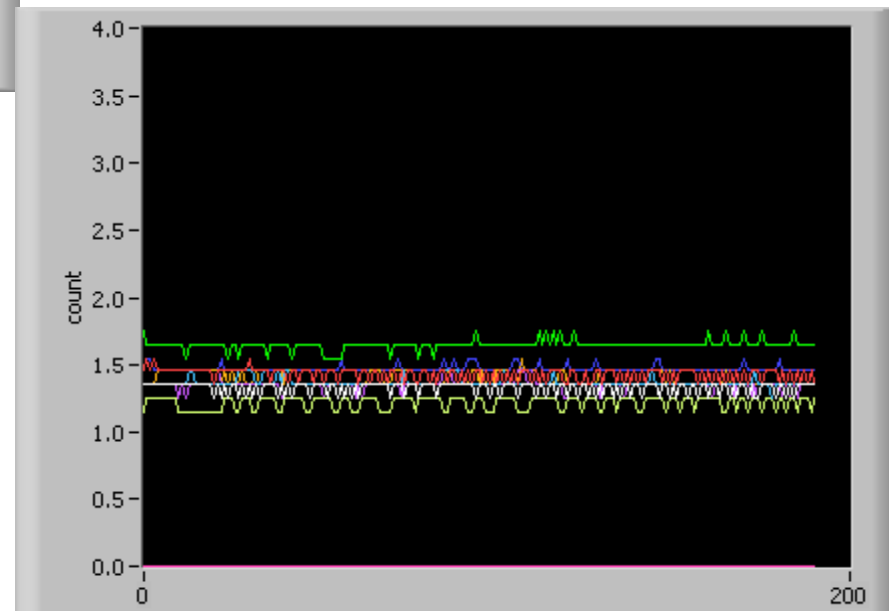
## Leakage currents

### NEW GEM

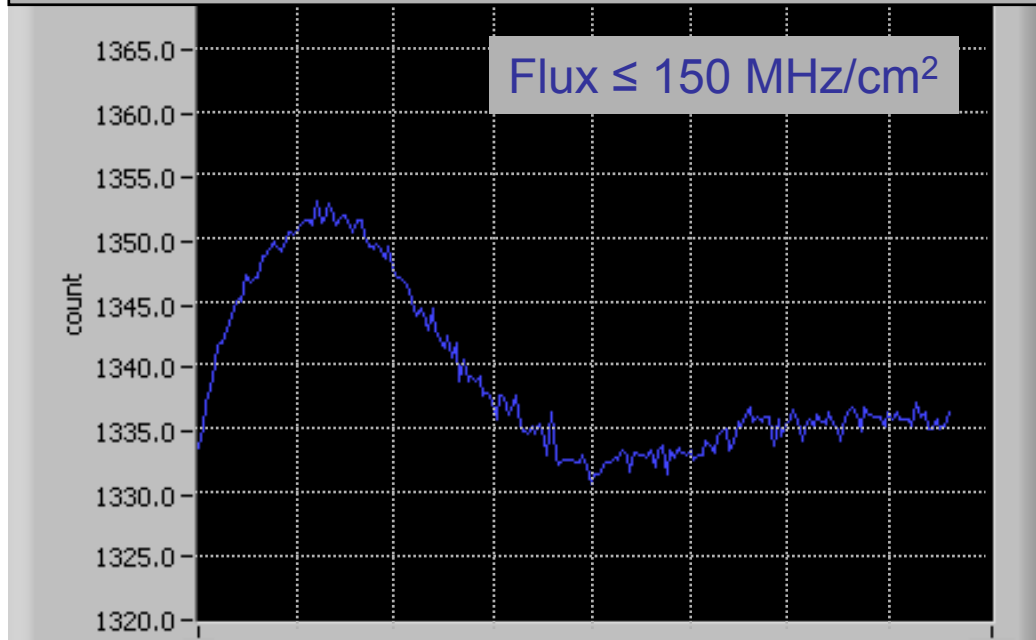
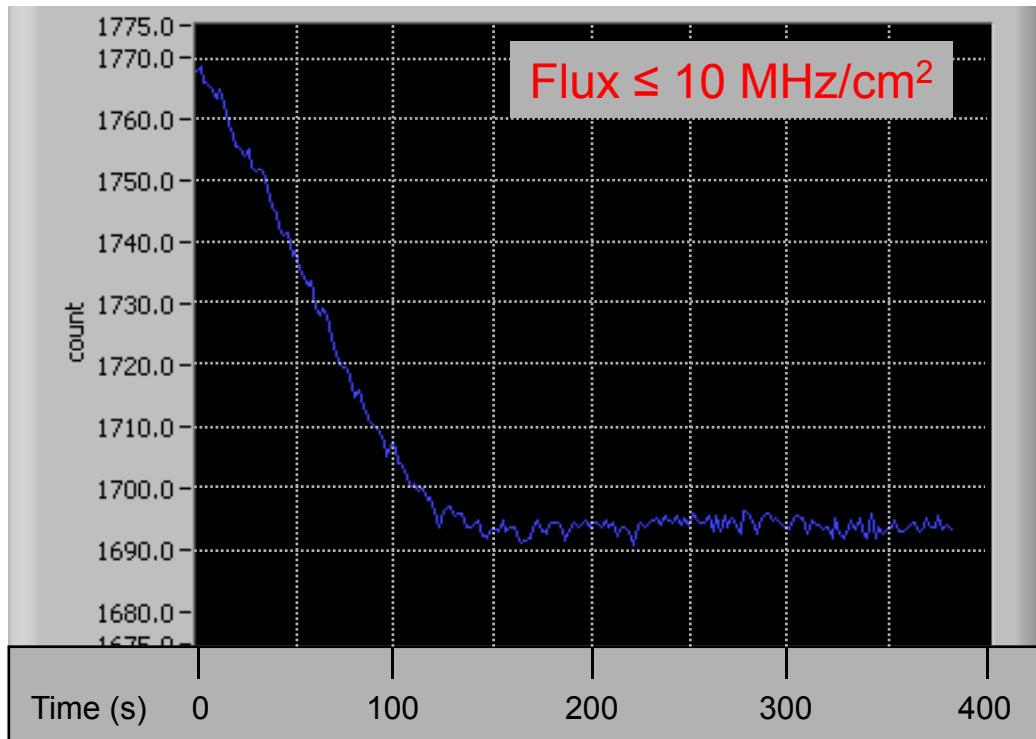


Same Gain 140000

### STD GEM



Both GEM have  
currents < 2.5 nA



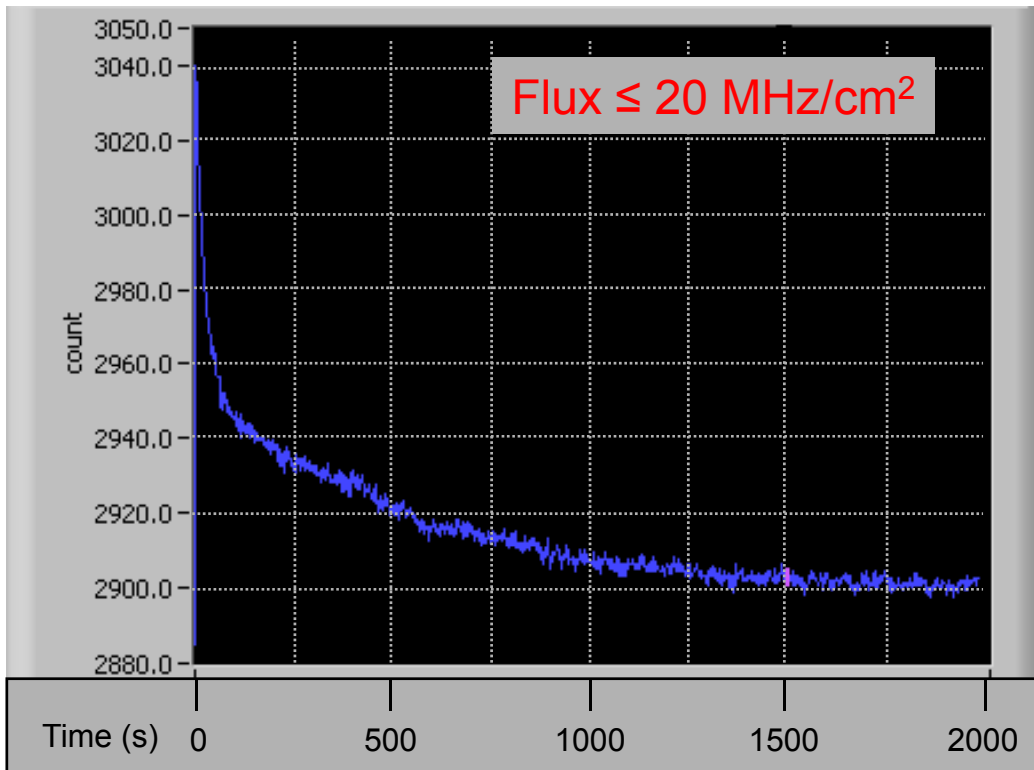
Charging up

Estimated Gain = 9000

Fluxes are rough estimation  
of upper limits

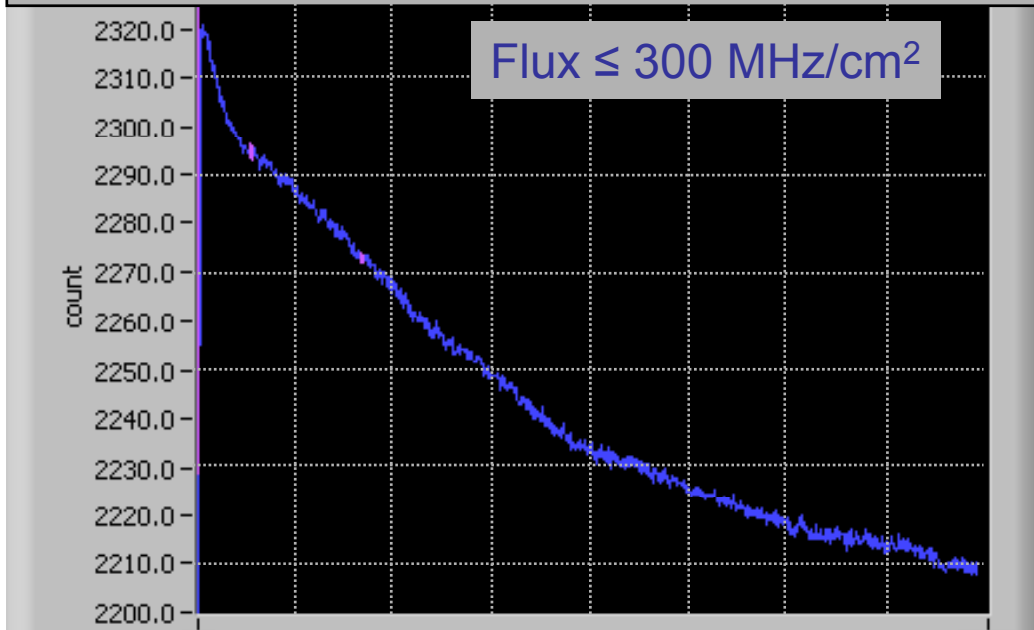
NEW: 4% in 150s

STD: 1% in 150s



Gain = 9000

NEW: 5% in 2000s



STD: 5% in 2000s ?

Long period test to be done with accurate monitoring of environmental parameters

## Conclusions (but we just got started...)

- New single mask technique is promising (how reproducible?)
- Lower Drift and Induction fields needed for gain optimization
- Gain in Ar/CO<sub>2</sub> is a factor of 3 lower
- 50 V is the increase in operating voltage to recover
- Charging up seems of the same order of STD GEM
- Discharge studies to be done
- New test must be done if any step of the production changes (Tin instead of Gold...)