

# Gain Calibration of Small Prototypes

CMS GEM Upgrade Workshop III

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## Introduction

Prototype name	Mask technology	Active area (cm <sup>2</sup> )	Gap size (all in mm)	Gas mixtures
<b>Single GEM</b>	Single	10x10	3-2	Ar/CO <sub>2</sub> (50/50), (70/30), (80/20), (90/10)
<b>Timing GEM</b>	Double	10x10	3-1-2-1	Ar/CO <sub>2</sub> (70/30) Ar/CO <sub>2</sub> /CF <sub>4</sub> (45/15/40)
GE1/1_I	Single	99x(22-45)	3-2-2-2	Ar/CO <sub>2</sub> (70/30) Ar/CO <sub>2</sub> /CF <sub>4</sub> (45/15/40)
GE1/1_II	Single	99x(22-45)	3-1-2-1	Ar/CO <sub>2</sub> (70/30) Ar/CO <sub>2</sub> /CF <sub>4</sub> (45/15/40)
<b>Single Korean GEM</b>	Double	6x6	3-2	Ar/CO <sub>2</sub> (70/30), (80/20)
Single Korean GEM	Single	10x10	3-2	Ar/CO <sub>2</sub> (70/30)
Triple Korean GEM	Double	6x6	3-2-2-2	Ar/CO <sub>2</sub> (70/30)
<b>Triple GEM</b>	Single	10x10	3-2-2-2	Ar/CO <sub>2</sub> (70/30)
Honeycomb	Double	10x10	3-2-2-2	Ar/CO <sub>2</sub> (70/30) Ar/CO <sub>2</sub> /CF <sub>4</sub> (45/15/40)
NS1 10x10	Single	10x10	3-2-2-2	Ar/CO <sub>2</sub> (70/30) Ar/CO <sub>2</sub> /CF <sub>4</sub> (45/15/40)
<b>NS2 30x30</b>	Single	30x30	3-1-2-1	Ar/CO <sub>2</sub> (70/30) Ar/CO <sub>2</sub> /CF <sub>4</sub> (45/15/40)

L. Franconi - Coffee Seminar - Mar 9, 2012

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## Gain Calibration Procedure

- Count rate measurement
- Output current measurement

$$G = \frac{I_{output}}{rate \times \#_p \times e}$$

$\#_p$  Pairs created by one photon

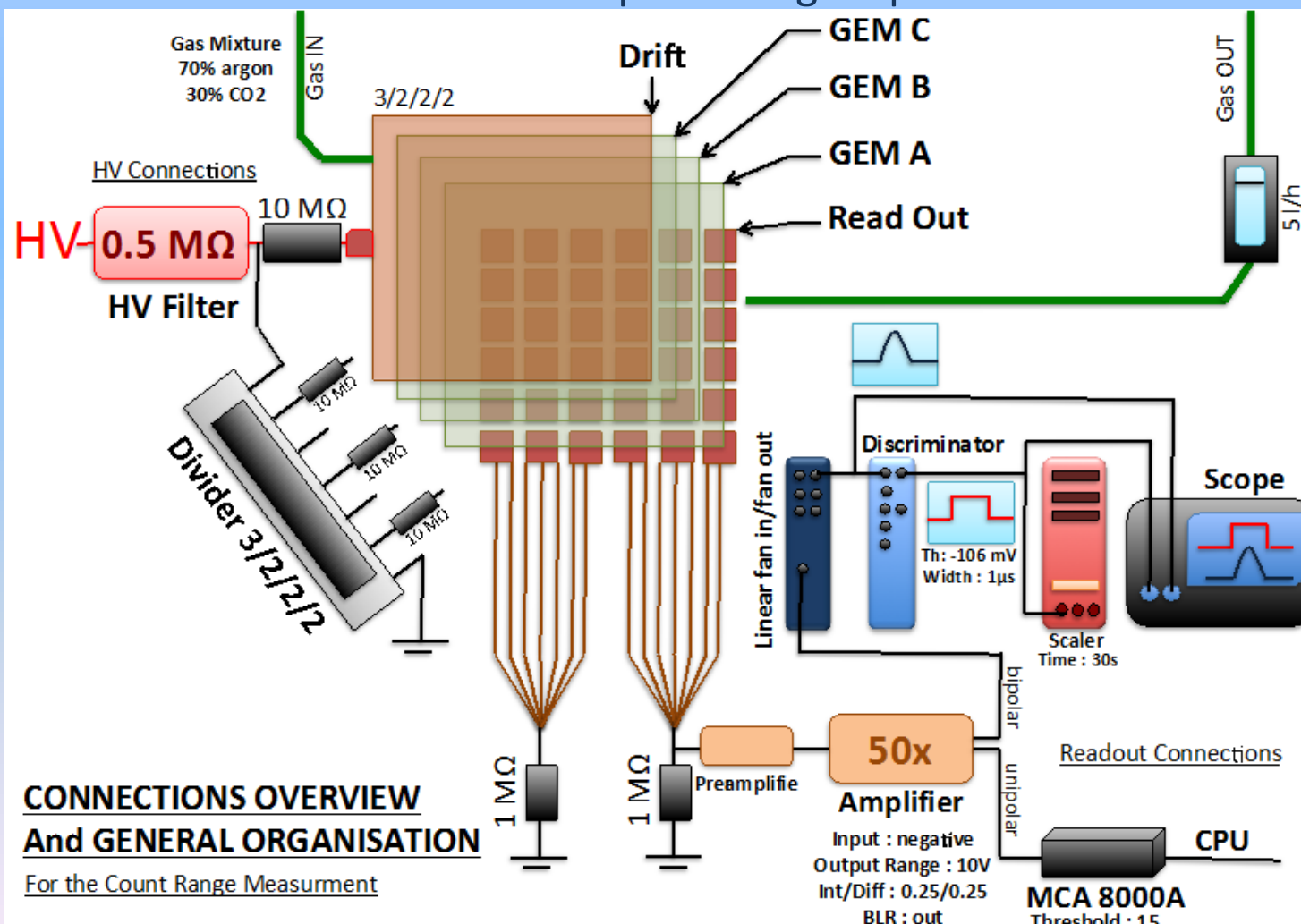
$$\#_p = E_\gamma \left( \frac{70\%}{w(Ar)} + \frac{30\%}{w(CO_2)} \right)$$



288 Pairs created by one photon

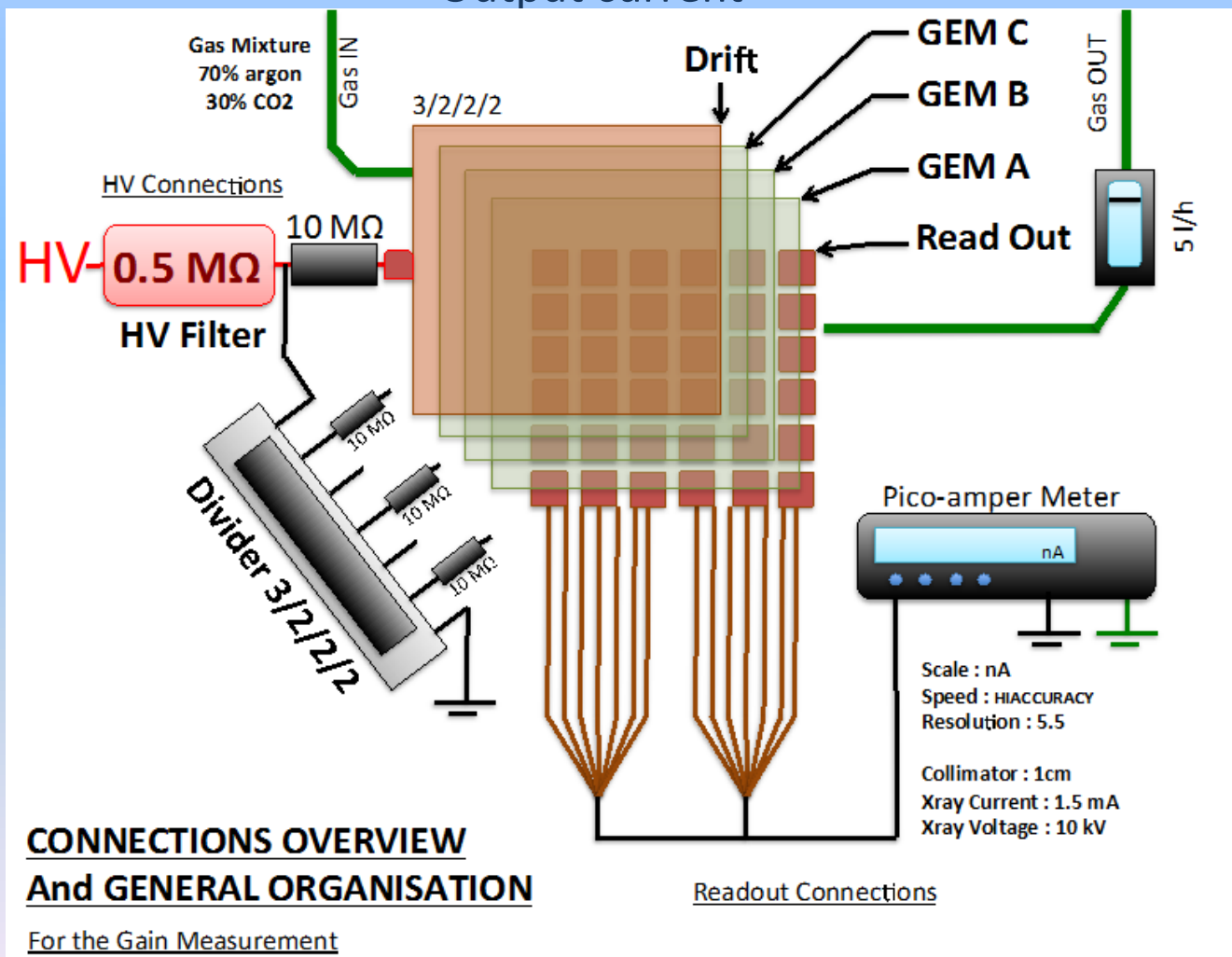
# Set up

rate and pulse-height spectrum

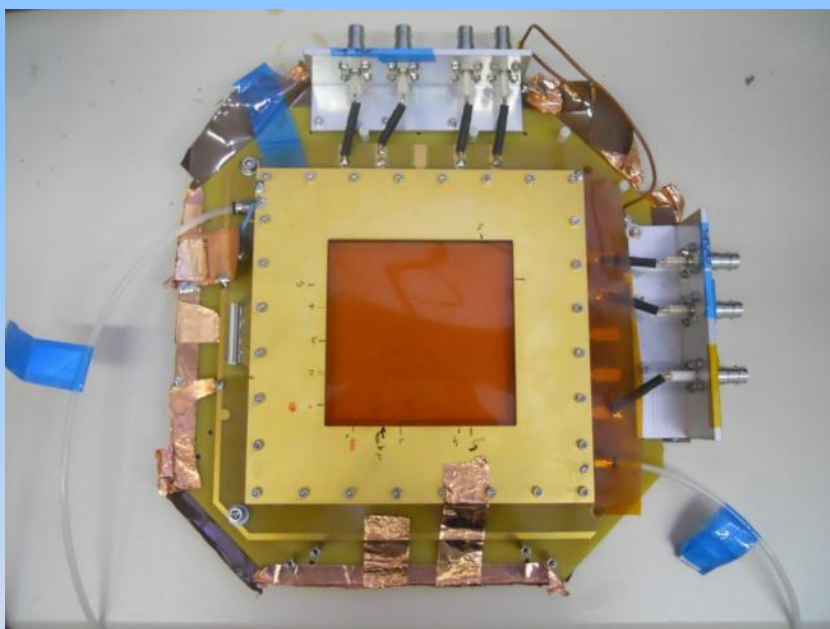


# Set up

## Output current

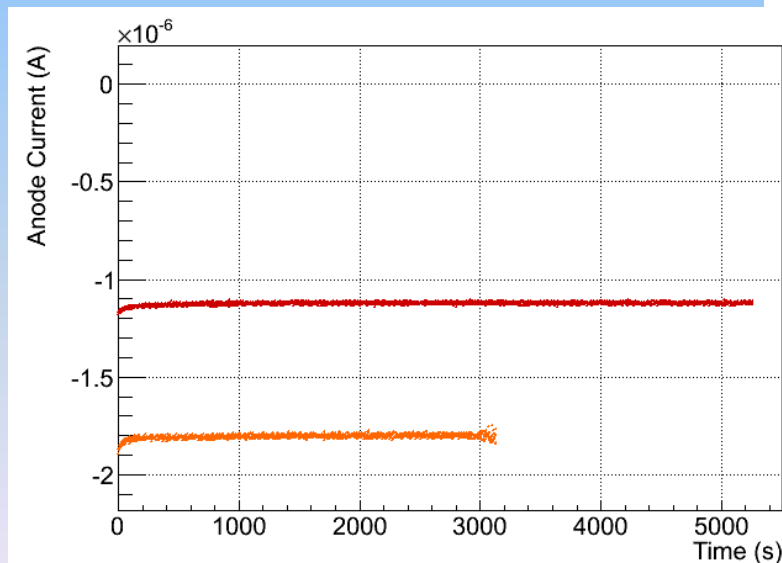
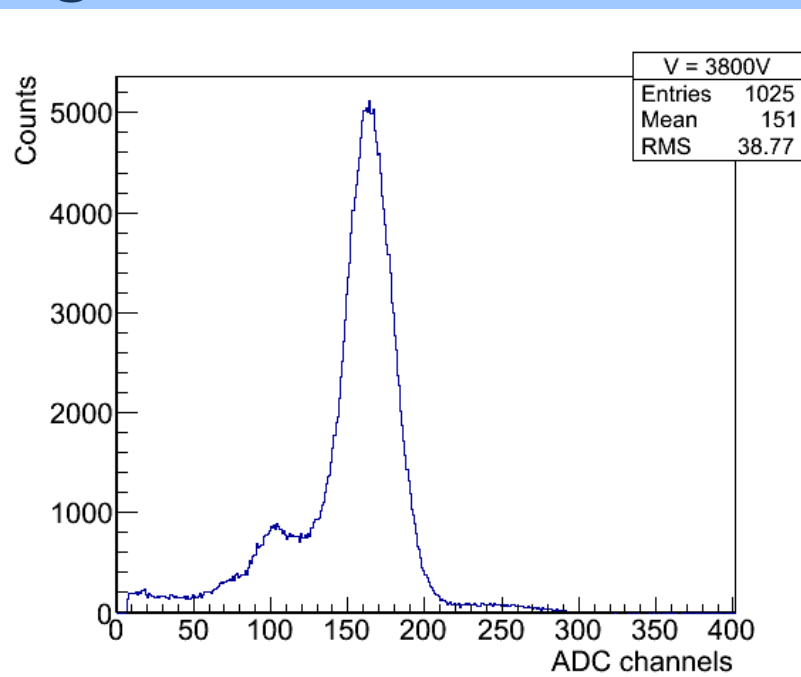


# Timing GEM



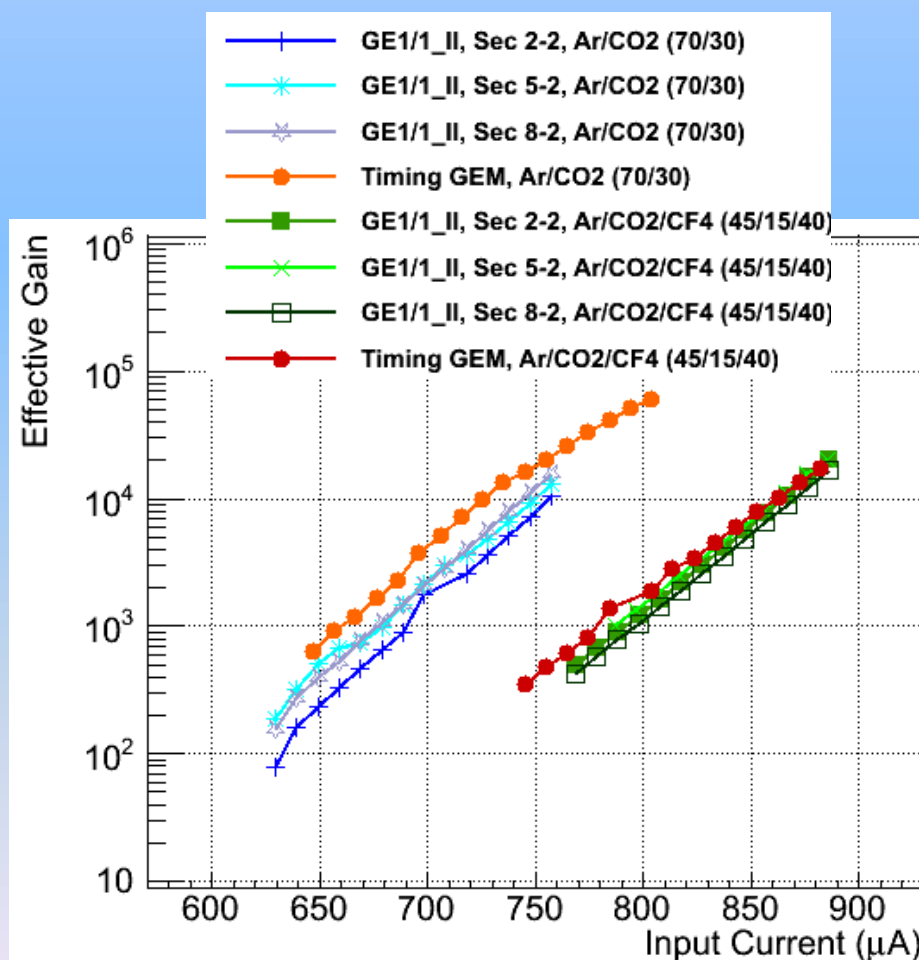
- 3 double-mask foils
- 3-1-2-1 standard gap configuration
- reference detector for beam tests

## Timing GEM





# Timing GEM



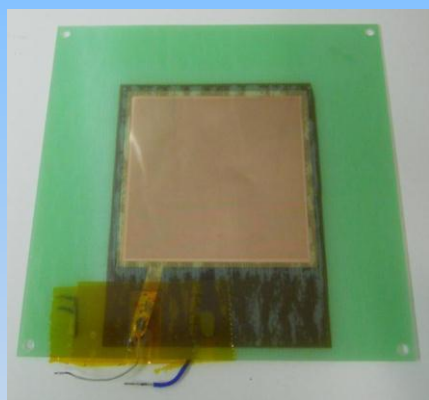


## Korean GEM

Cost for the production of GEM foils at CERN too high



Solution: Newflex (korean GEM)



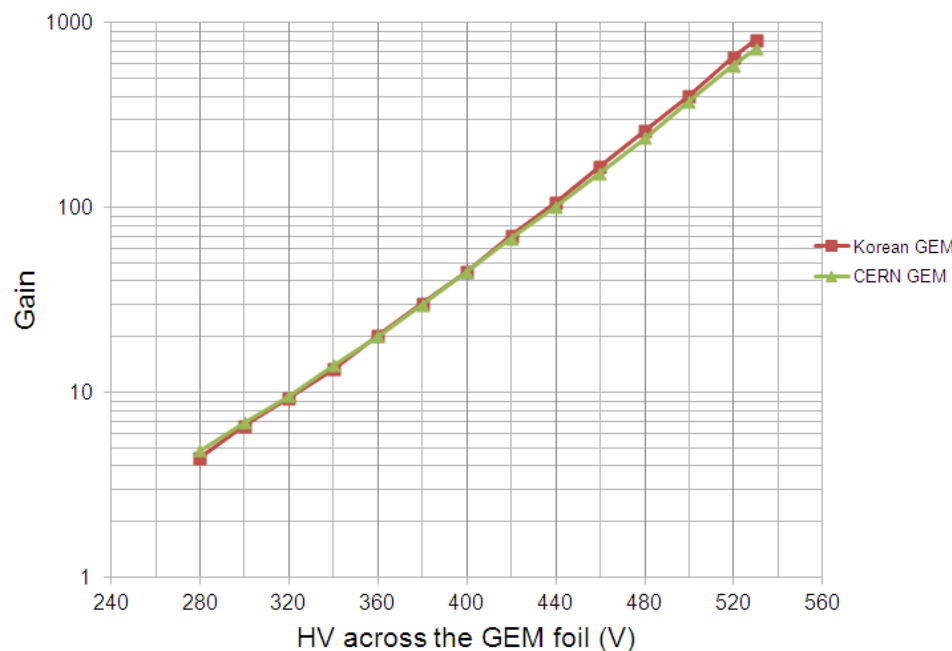
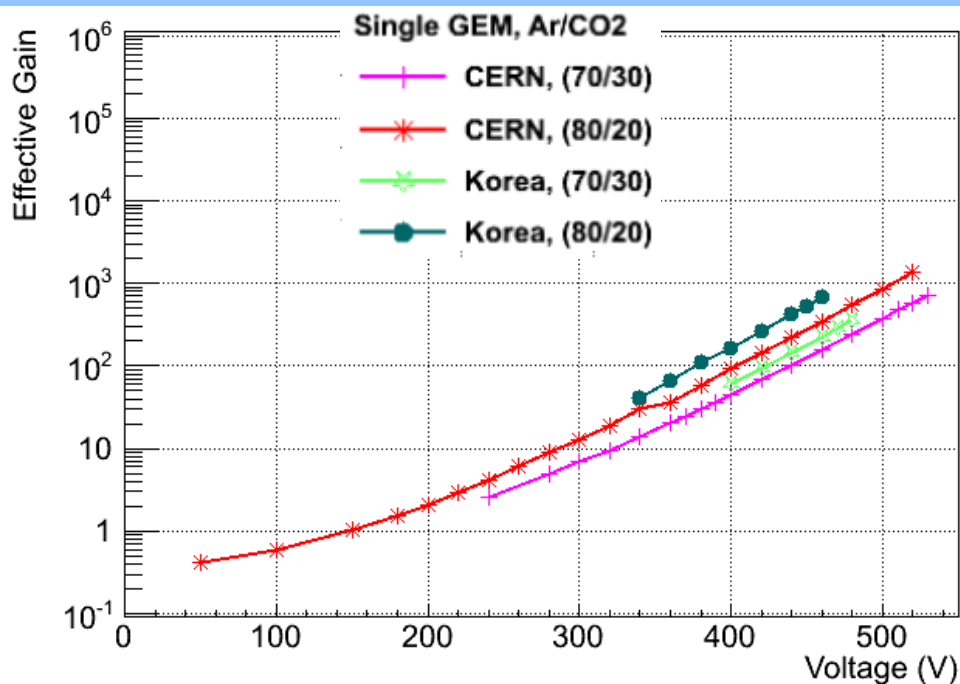
(6x6)cm<sup>2</sup> double-mask  
Korean GEM foil



New Flex provided to CERN

- (6x6)cm<sup>2</sup> double-mask GEM foils
- (10x10)cm<sup>2</sup> single-mask GEM foils

## Korean GEM



(6x6)cm<sup>2</sup> double-mask single GEM

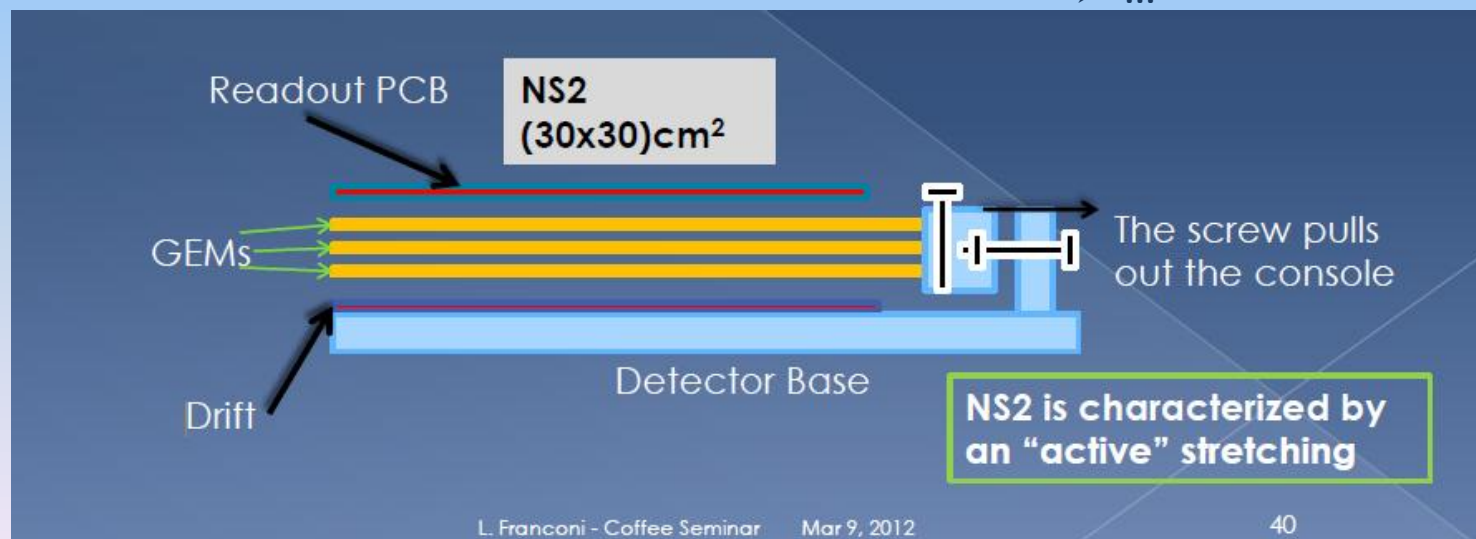
(10x10)cm<sup>2</sup> single-mask single GEM

## NS2 new stretching method

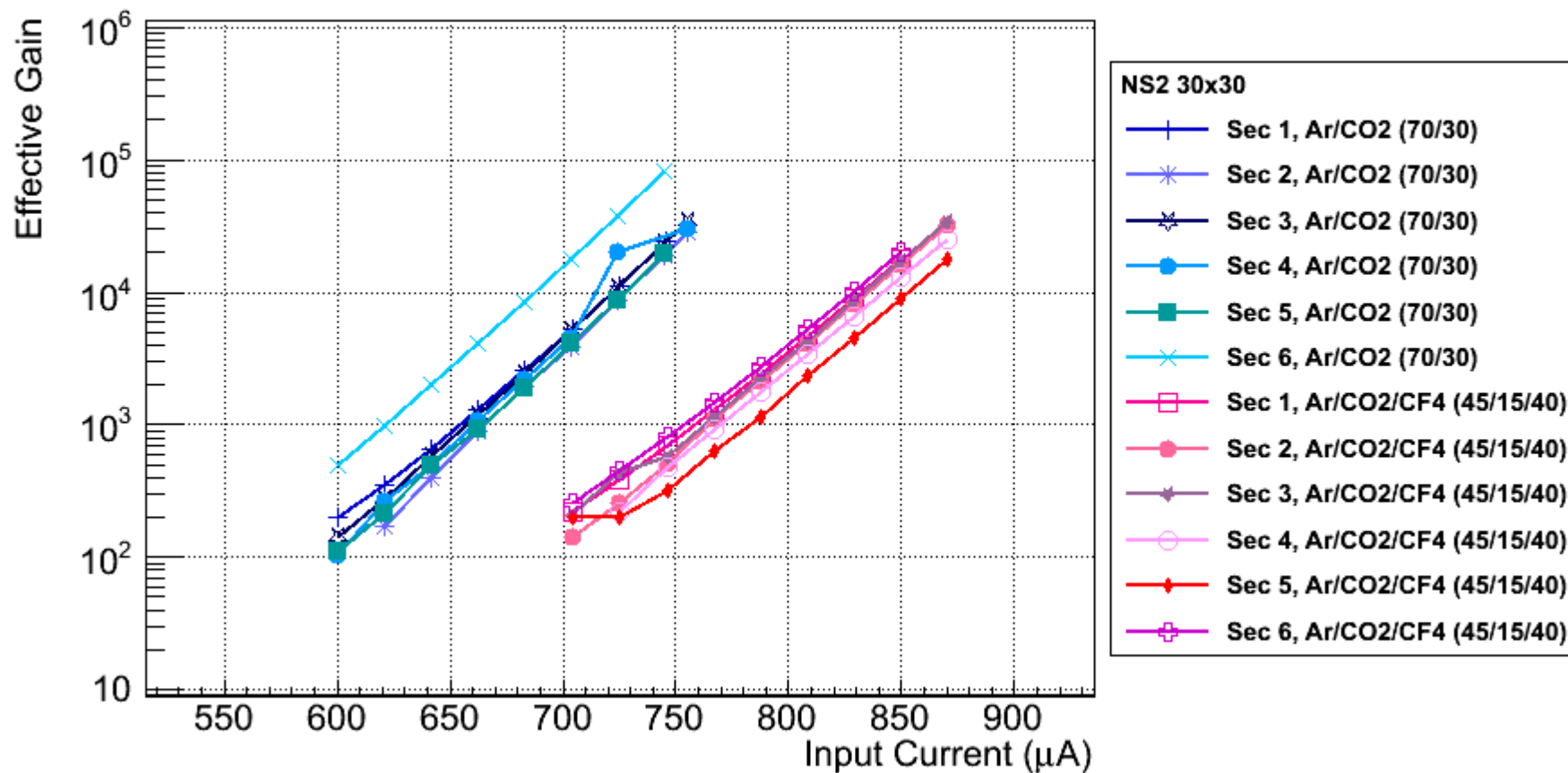
Previous stretching method (Thermal stretching) is a very long process.  
=> More than 24h, oven, glue...



- ½ h for (10x10) cm<sup>2</sup> detector (1 technician)
- 2 hours for (1x0.6) m<sup>2</sup> detector (1 technician)
- No gluing, no soldering
- Re-opening possible
- ...



## NS2



## conclusion

- Korean GEMs 6x6 double mask and 10x10 single mask work properly.
- New stretching technic NS2 very promising, production of large prototypes in progress.



# THANK YOU