Update on testing and assembly of GEMs

Deepali Sharma for the Weizmann group

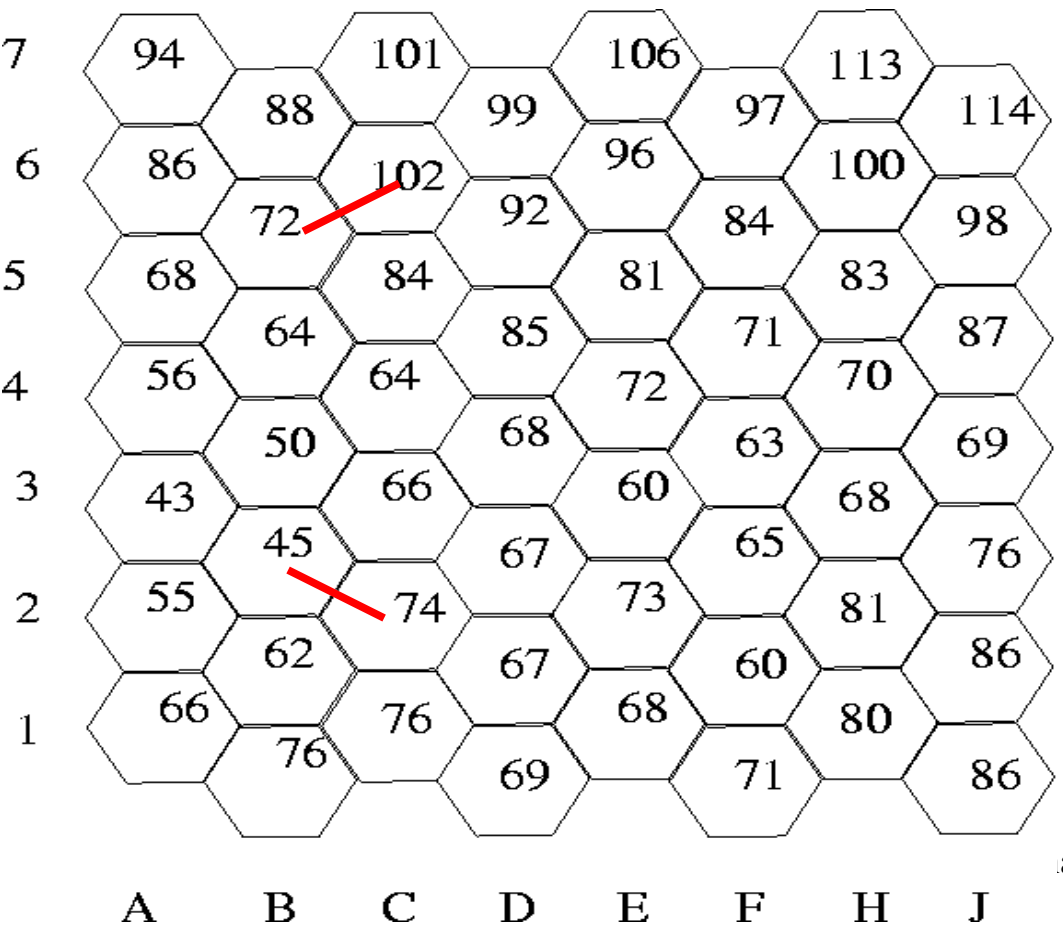
Pre testing of GEMs

- So far we have assembled 2 modules and tested both of them with Fe^{55} inside a SS vessel with CF_4 at nominal voltages. The PCB consisted of 56 hexagonal pads. The gain map of the two modules is shown below. Large gain variations can be seen.

Module #1

A_{mean} = 77.27,

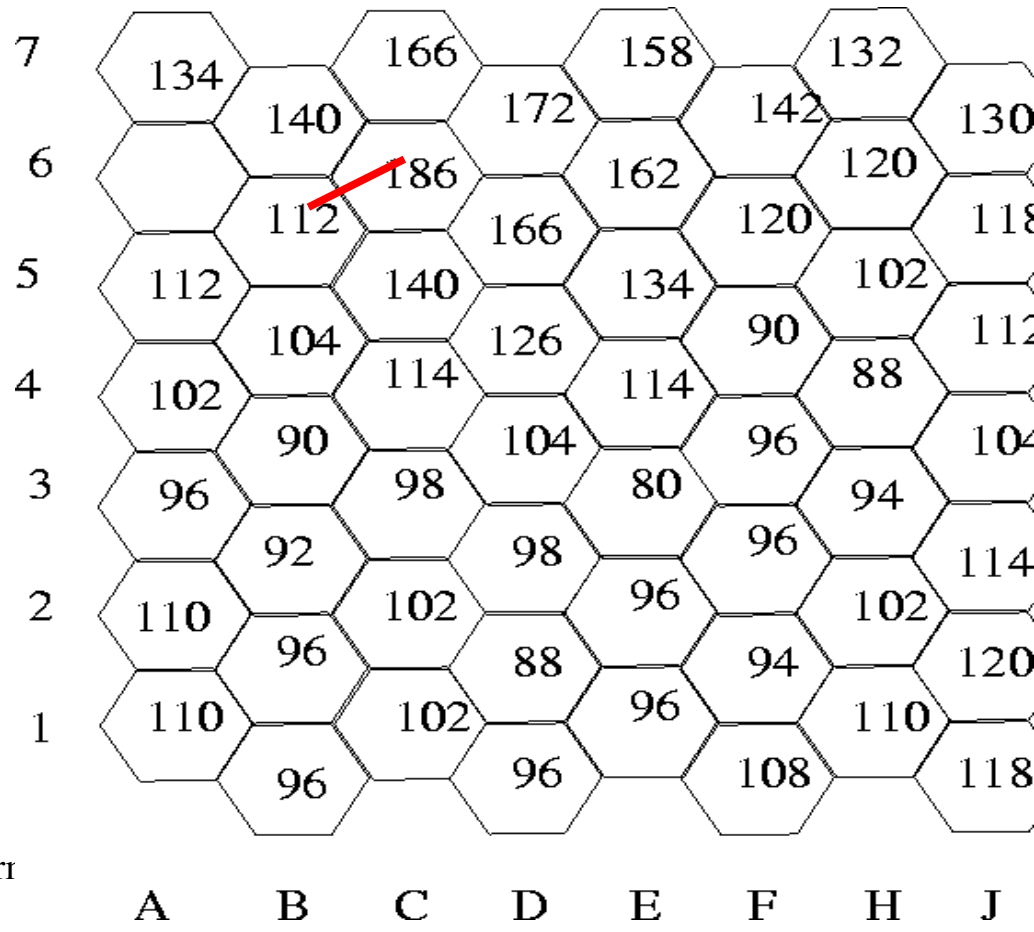
δA_{min} = 44%, δA_{max} = 47%



Module #2

A_{mean} = 112.5,

δA_{min} = 28%, δA_{max} = 65%



Possible reasons

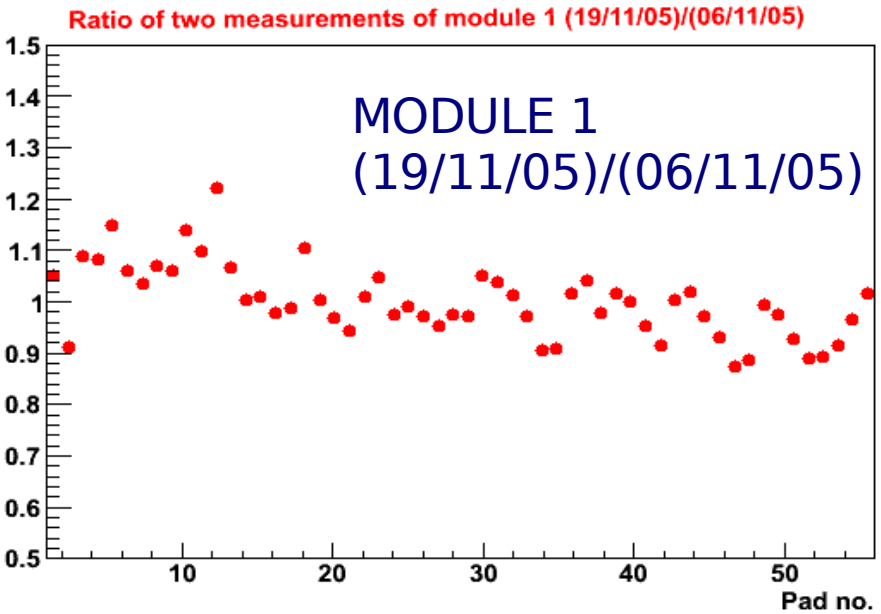
- **Problems with the assembly.**
- **GEMs might have local gain variations**

To check if it is an assembly problem, we performed a set of measurements on the two modules.

Module 2	**29/10/2005**	**1st measurement**	
Module 2	**31/10/2005**	**2nd measurement**	**to check reproducibility**
Module 2	**02/11/2005**	**3rd measurement**	**tightening the screws.**
Module 2	**03/11/2005**	**4th measurement**	**changing mesh orientation.**
Module 1	**06/11/2005**	**1st measurement**	
Module 1	**19/11/2005**	**2nd measurement**	**reassembled the module**

All the measurements reproduced the similar pattern. Shown is the ratio of two measurements of module #1. The gain maps are the same within 20%.

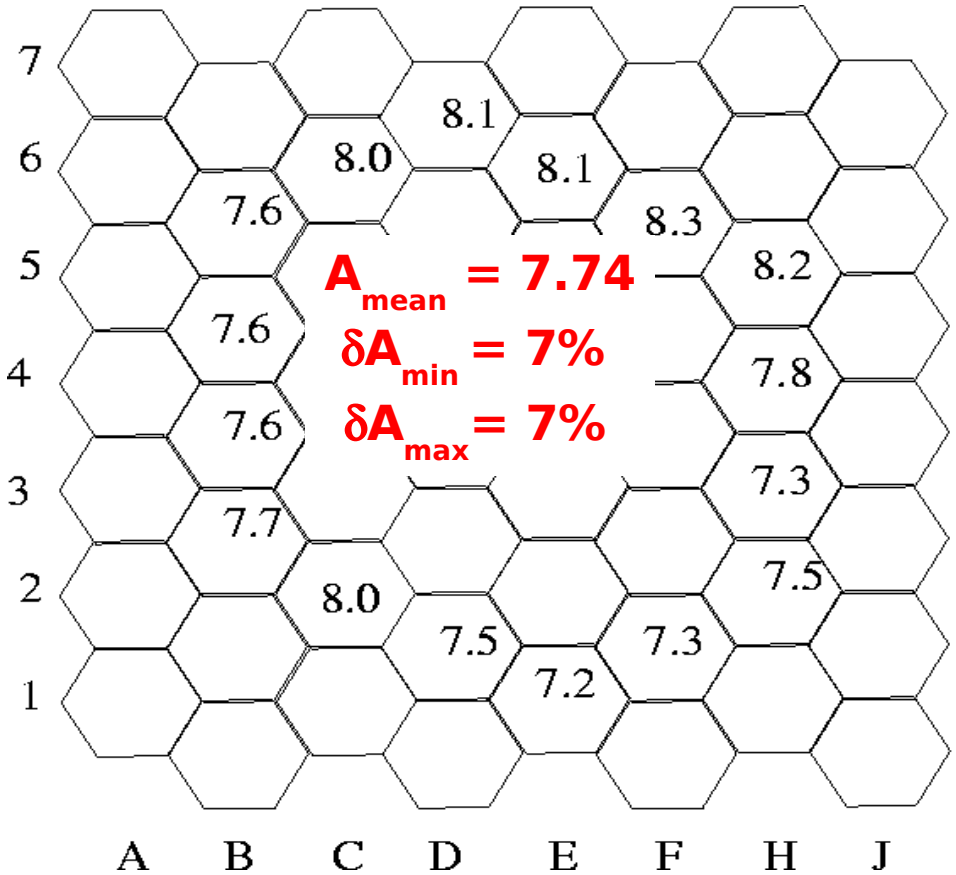
Not an assembly problem !



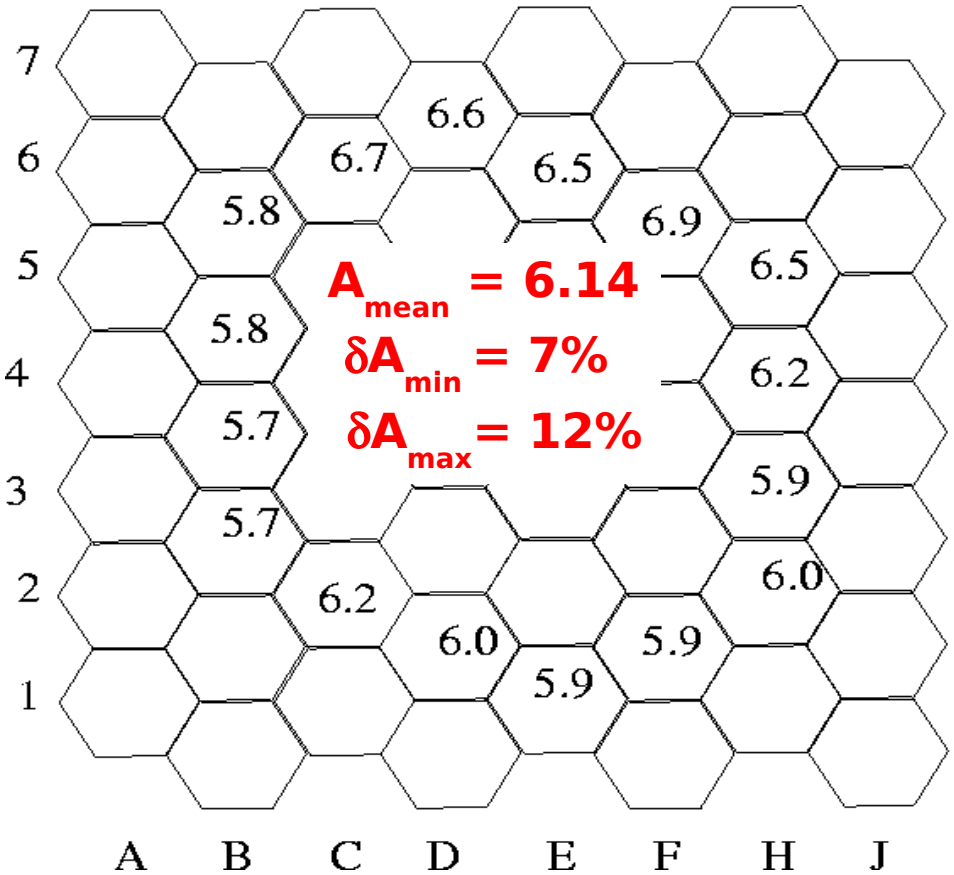
Gain measurements in single GEMs

To check whether there are local gain variations, we measured each single GEM of module # 1 with a collimated Fe^{55} source in $Ar/C0_2$ at a gain of 500. 16 pads in each GEM were scanned and within each pad 6 -7 measurements were made. The average amplitudes in the 16 scanned pads are given below.

Gem # 15 Bottom (G3)



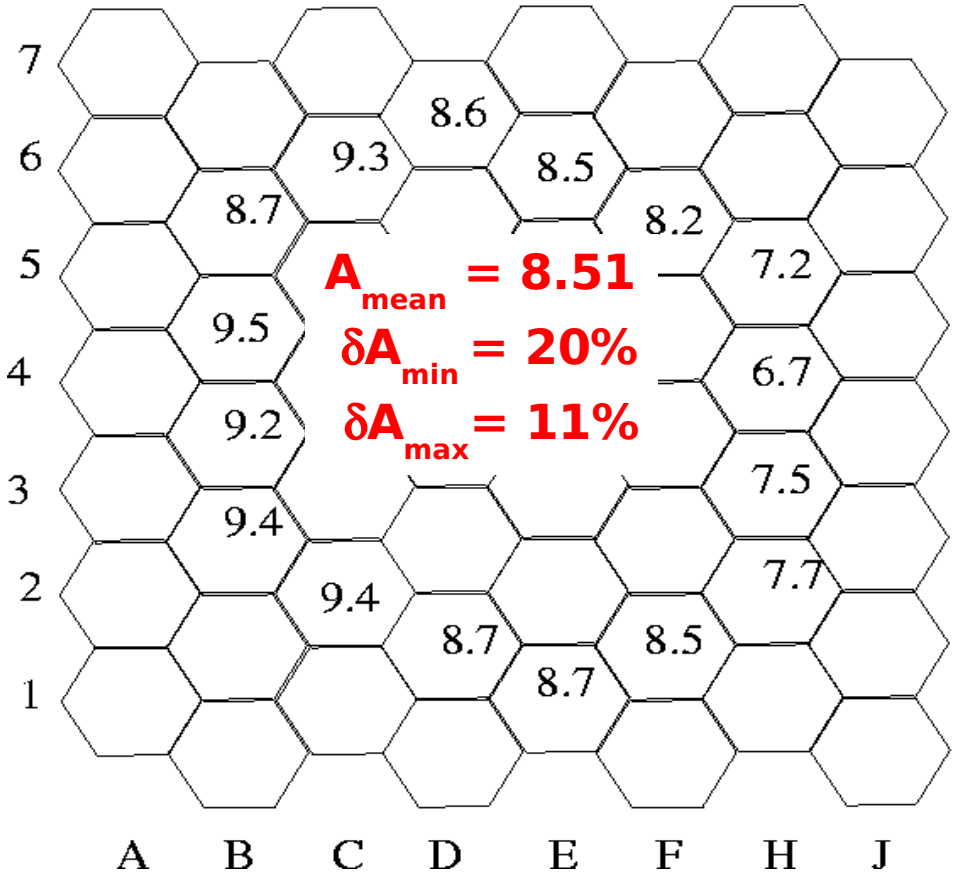
Gem # 14 Middle (G2)



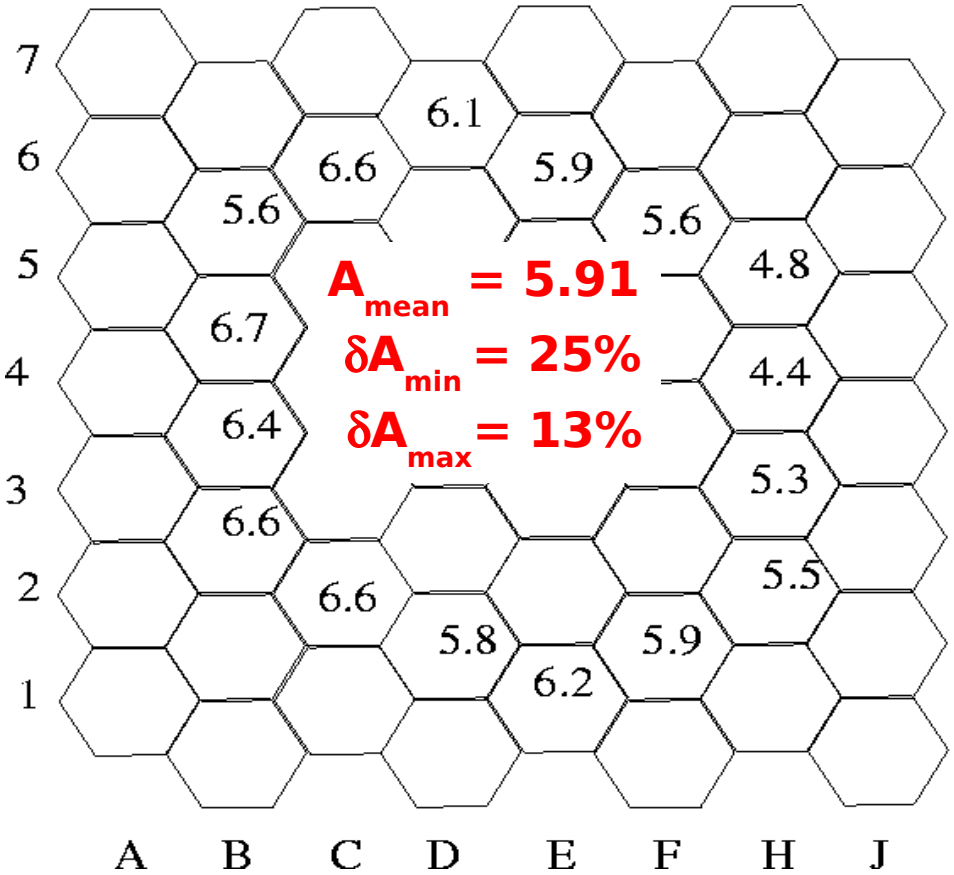
Gain measurements in single GEMs

The Top GEM was measured twice.This is a Au plated GEM. The 2nd measurement was done with a reduced induction field.

Gem #2 Top (G1) measurement 1

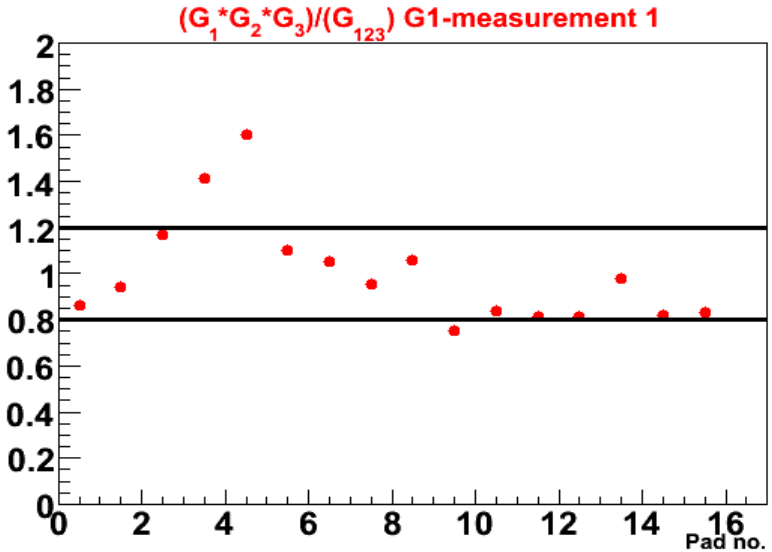


Gem #2 top (G1) measurement 2

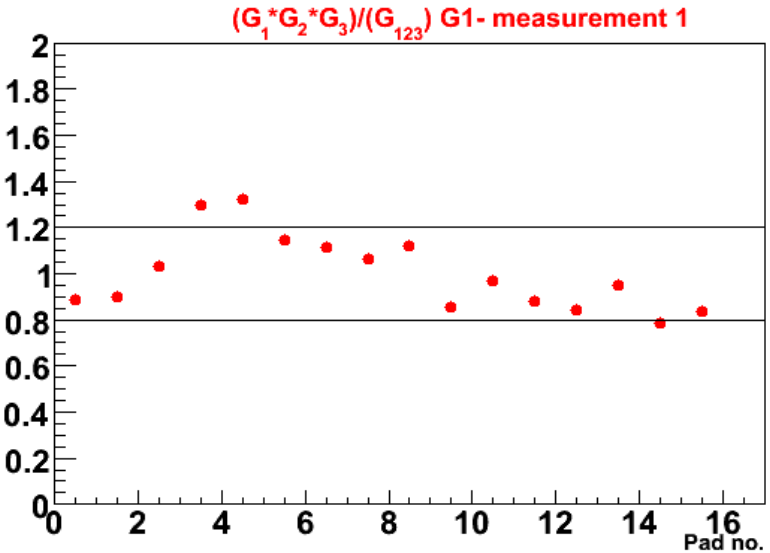


Comparison of (G_1*G_2*G_3) to the module gain G_{123}

Module #1



G_{123} as measured on 06/11/05



G_{123} as measured on 19/11/05

Shown above is the ratio of the product of pad gains from the three individual single GEM measurements to that of triple GEM detector.

This shows that small non-uniformities add to a larger effect in the triple GEM module.

Summary

- The small variations in individual GEMs accumulate in the triple GEM module leading to large gain variations.
- A possible solution is to measure the gain map for each individual GEM and find a combination of GEMs that will minimize the variations on the triple GEM (on the basis of minimum variations of $G_1*G_2*G_3$).
- We have started to do so with all the existing GEMs.
- The GEMs production has been resumed again.