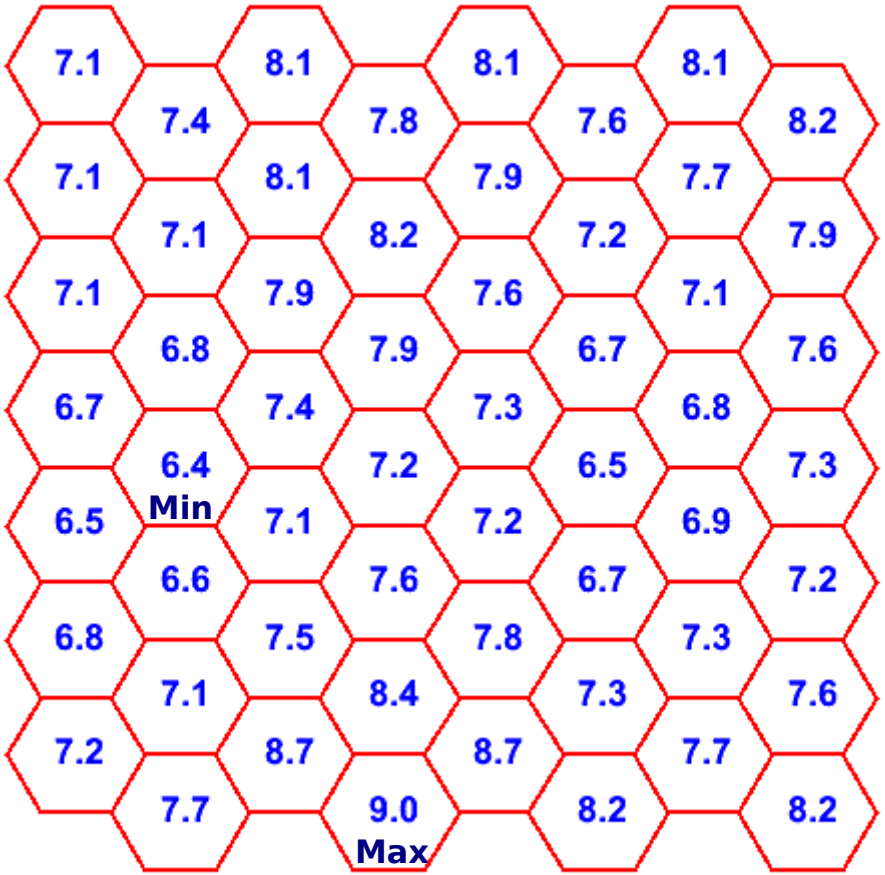
Update on testing and assembly of GEMs

Deepali Sharma for the Weizmann group

Single GEM gain measurements

- So far we have done full scan of 16 GEMs, 5 Au – plated and 11 - standard, using a SS vessel with an Fe^{55} source in Ar/CO_2 at a gain of 500, and a PCB with 56 pads.
- The gain variations are within 4.9 – 12 %. Shown below is a gain map and gain distribution for GEM #4.

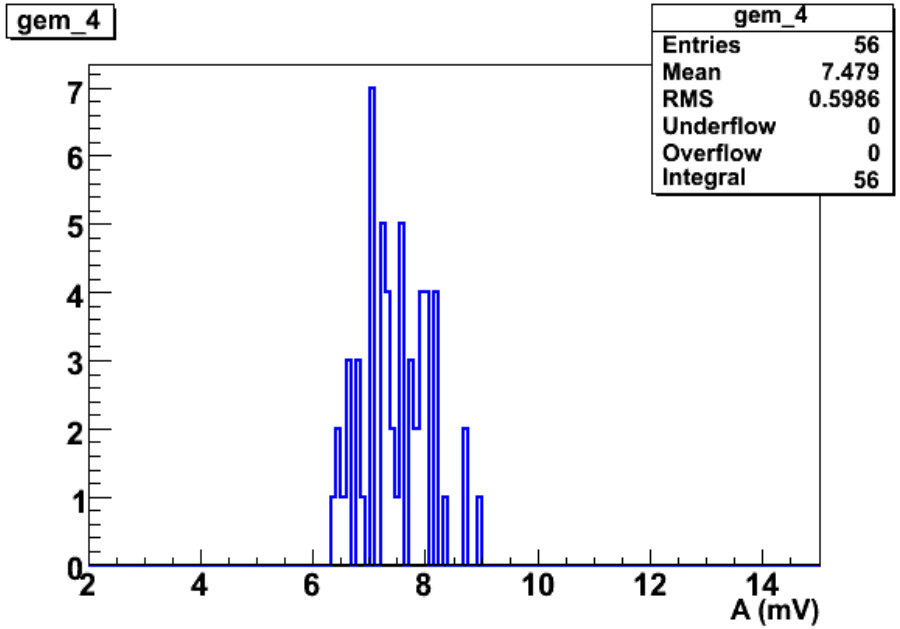


Mean Amp. = 7.48

Max. Amp. = 9.01

Min. Amp. = 6.36

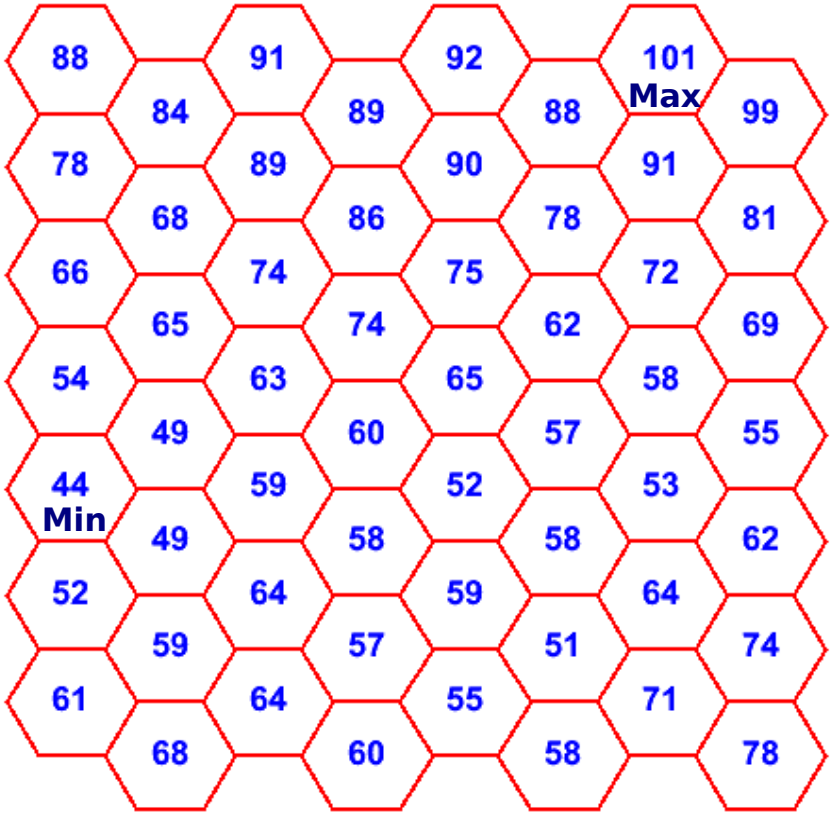
RMS/mean = 8.00 %



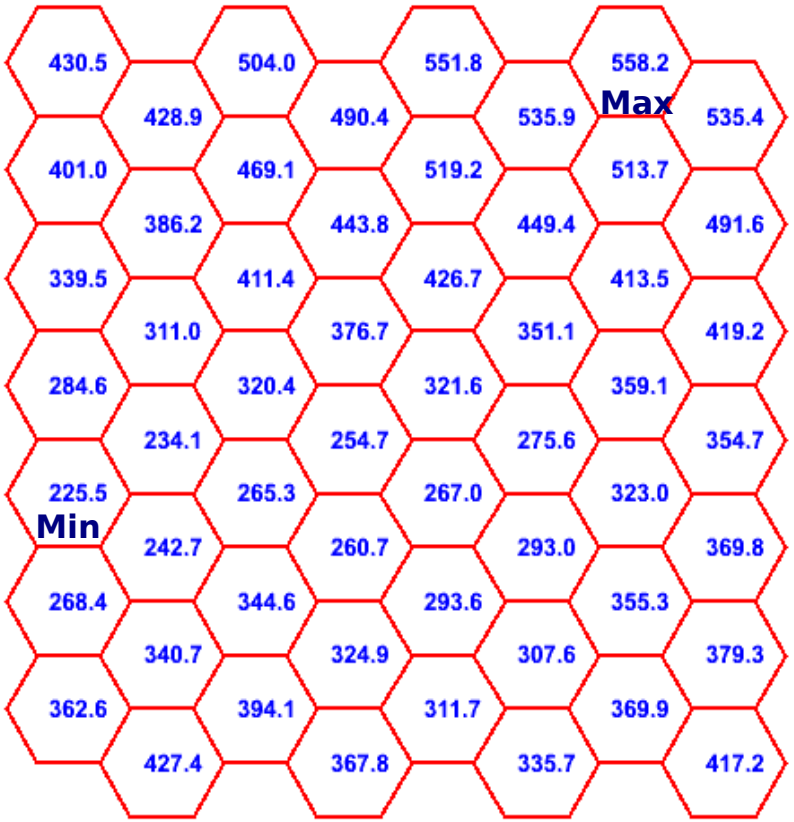
Comparison of $G_1*G_2*G_3$ to G_{123} for module #1 (2, 14, 15) - I

- A triple GEM module #1 (2, 14, 15) was assembled. Below is shown the gain map for this module (G_{123}) and the gain derived from the individual GEMs ($G_1*G_2*G_3$). The ratio of the derived gain from GEMs to gain of the module i.e. ($G_1*G_2*G_3/G_{123}$) is shown in the next slide.

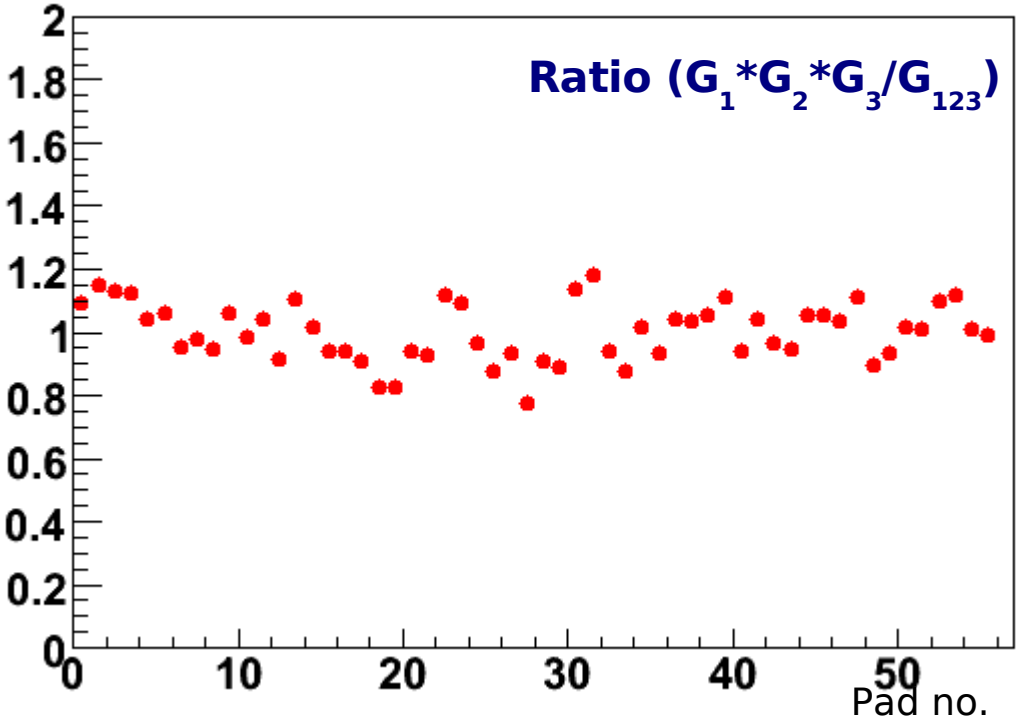
Module gain map G_{123}



Product $G_1*G_2*G_3$



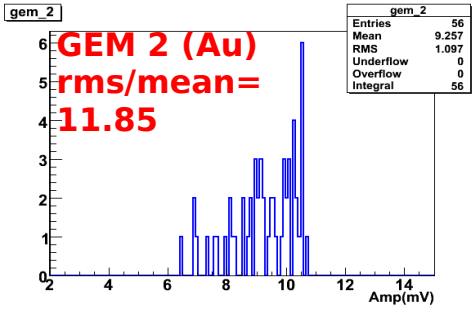
Comparison of $G_1*G_2*G_3$ to G_{123} for module #1 (2, 14, 15) - II

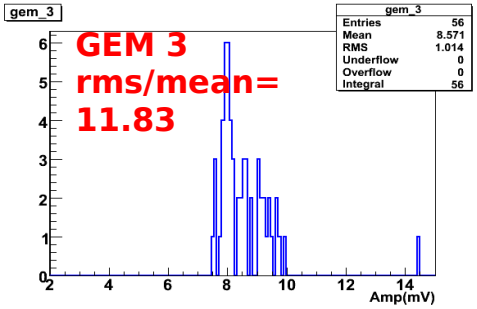


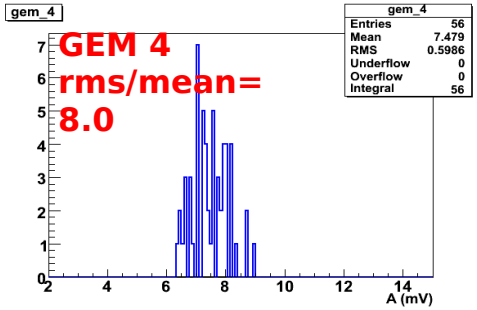
Conclusion: The flatness of distribution proves that the large gain variations in the triple GEM detector are not due to assembly. The non-uniformities in single GEMs add to a larger effect in the triple GEM module.

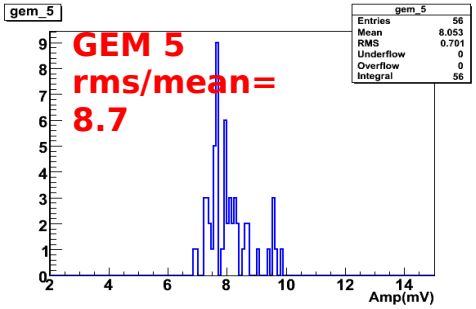
Strategy: A possible solution to minimize the gain variations in the triple GEM detector is to make all possible combinations of GEMs and to choose the combinations with minimum spread in RMS. For that the gain maps of each GEM (corrected for P/T variations) will be stored in a database.

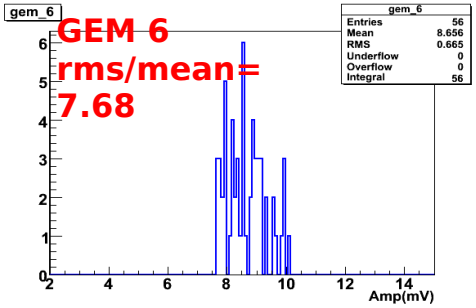
Gain distributions of the 16 scanned GEMs

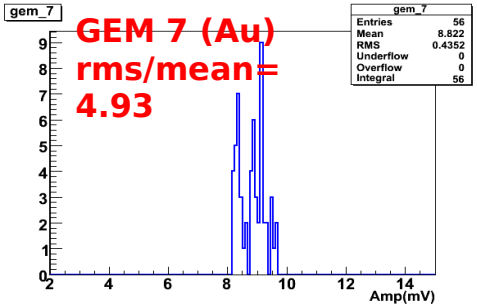


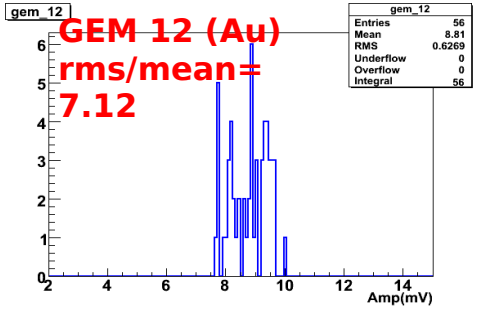


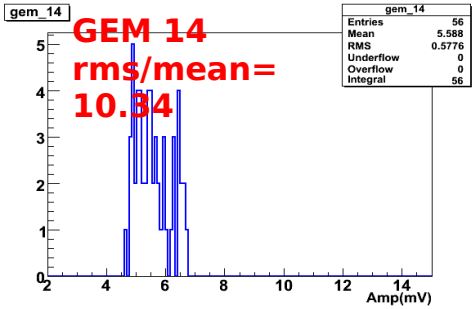


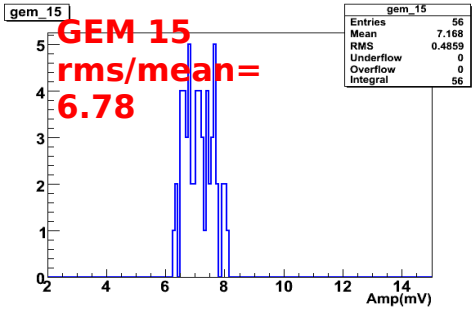


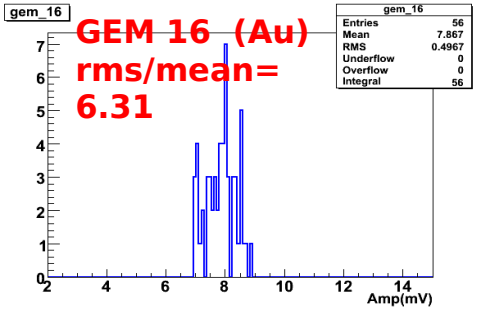


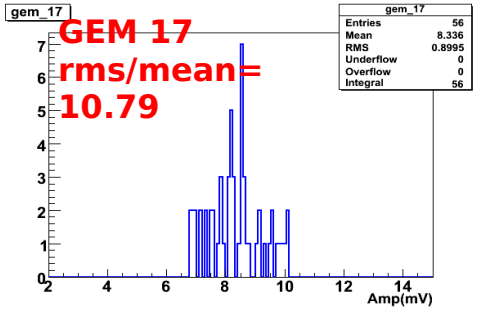


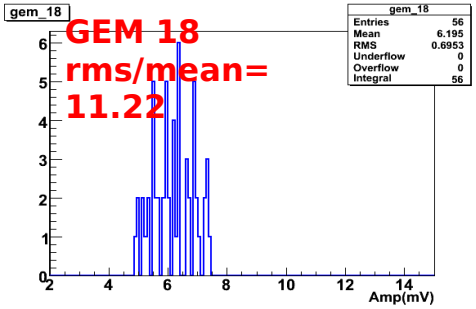


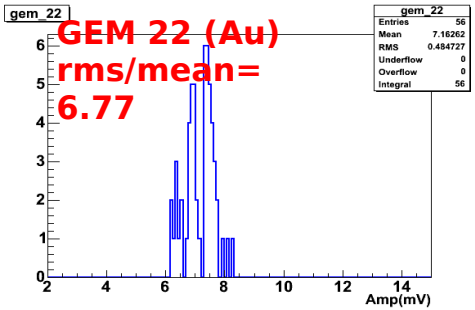


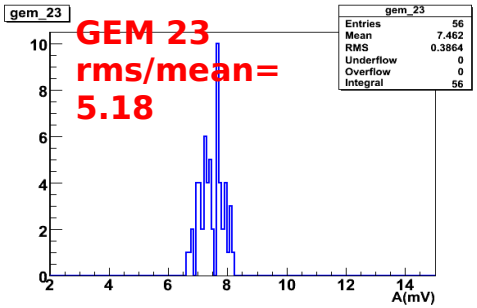












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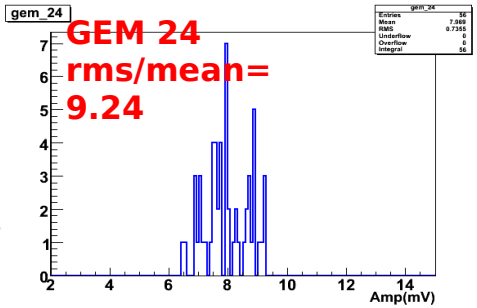
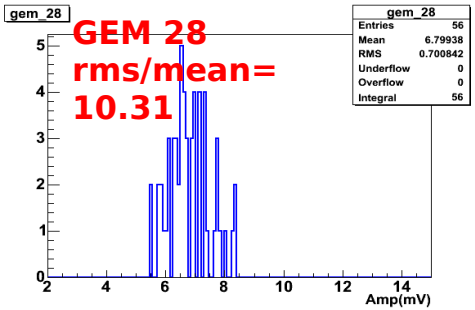


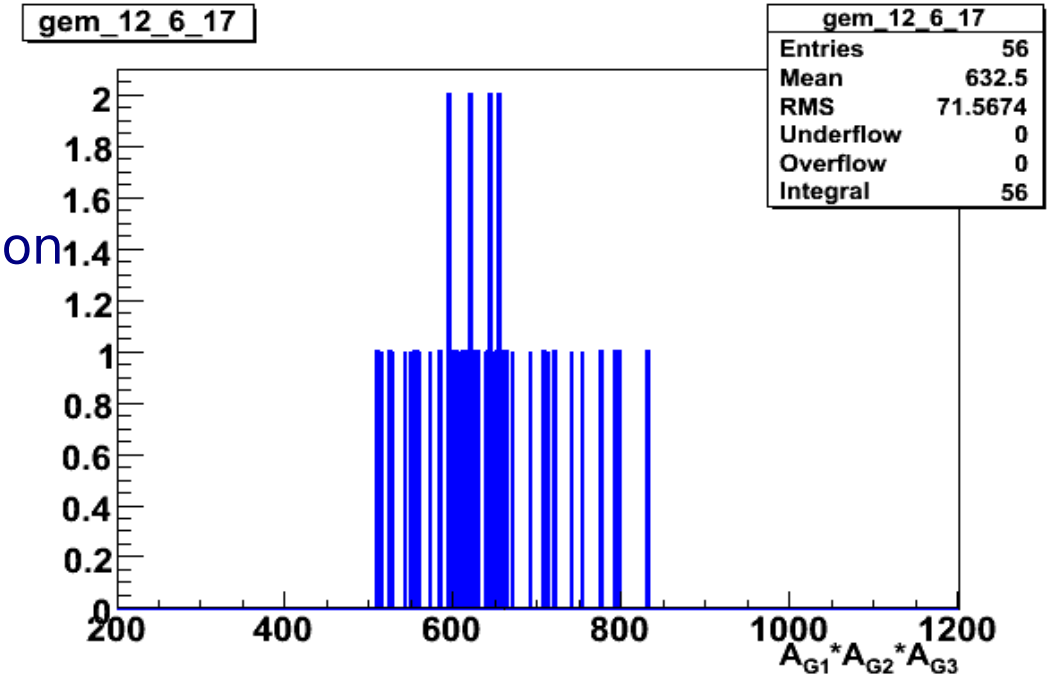


Different possible combinations of GEMs

- We made all possible combinations (275) from these 16 GEMs and stored the RMS/mean for each combination. The combinations with the least values of RMS/mean are selected for the triple GEM assembly.
- The best combinations found out of these scanned GEMs are as follows

1) 12, 6, 17 (G_1*G_2*G_3) RMS/mean = 11.32 %
2) 7, 15, 23 (G_1*G_2*G_3) RMS/mean = 14.07%
3) 22, 14, 18 (G_1*G_2*G_3) RMS/mean = 16.78%
4) 16, 4, 5 (G_1*G_2*G_3) RMS/mean = 18.95%
5) 2, 24, 28 (G_1*G_2*G_3) RMS/mean = 25.06%

The fig. shows the distribution of derived gain for the best combination 12, 17, 22



Summary

- The best combinations thus found will be assembled next and tested for gain variations.
- 26 GEMs from the first batch have been glued and 16 GEMs have been scanned fully for gain variations.
- Second batch of GEMs expected to be shipped from CERN in 1 – 2 weeks.