Update on GEMs @ UVa

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Outline

- Construction of Two first SBS Back Tracker GEM modules
  - Preliminary tests
  - Readout strips quality and Charge sharing

- Studies of the APV25 signal peak position with SBS GEM modules
  - Fermilab test beam data with SBS 50x50 cm2 prototype
  - Effect of the gas flow rate on the signal peak position
  - Gas flow rate and bending of the readout strip honeycomb support

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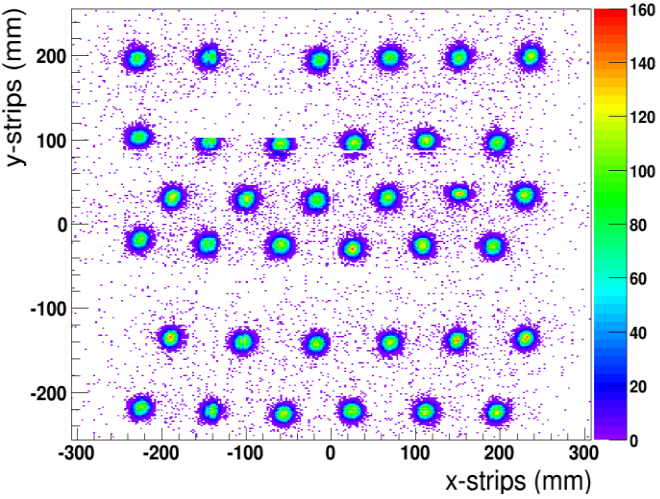
Assembly of the first two SBS Back Tracker GEM modules

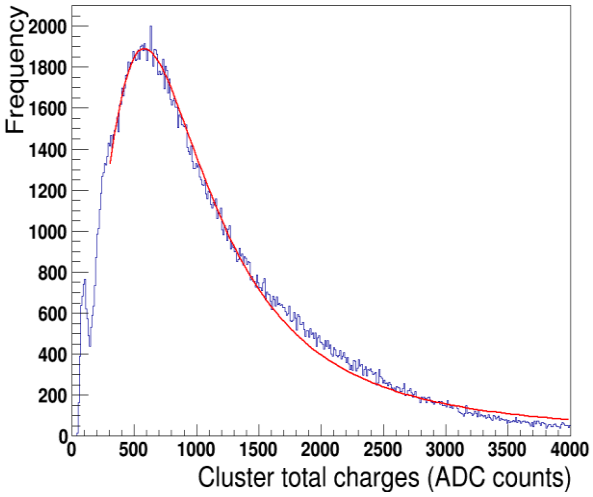
- 2 modules sbs60x50Prod1 and sbs60x50Prod2 assembled during the period of Mai - June 2014
- 1st module has been on the test bench (cosmic and Sr90 test) for the last two weeks
  - Working fine and preliminary results on the readout strips charge sharing are very good
- 2nd module has been just completed – pass post assembly tests
  - Will be put on the cosmic test bench in July

Characterization of sbs60x50Prod1

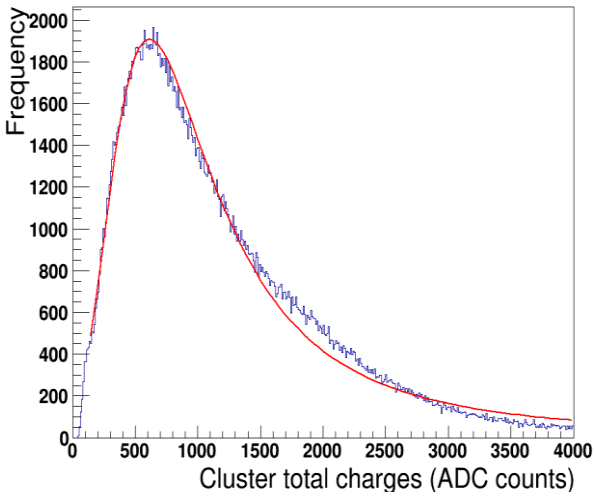
Sr90 position scan



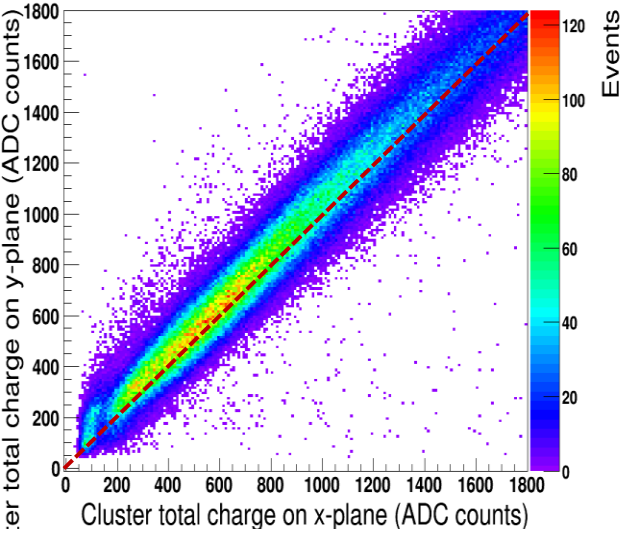
ADC distr. X-strips



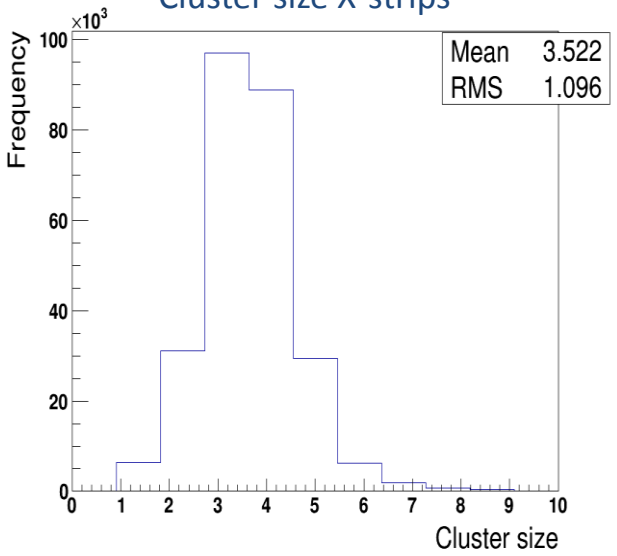
ADC distr. Y-strips



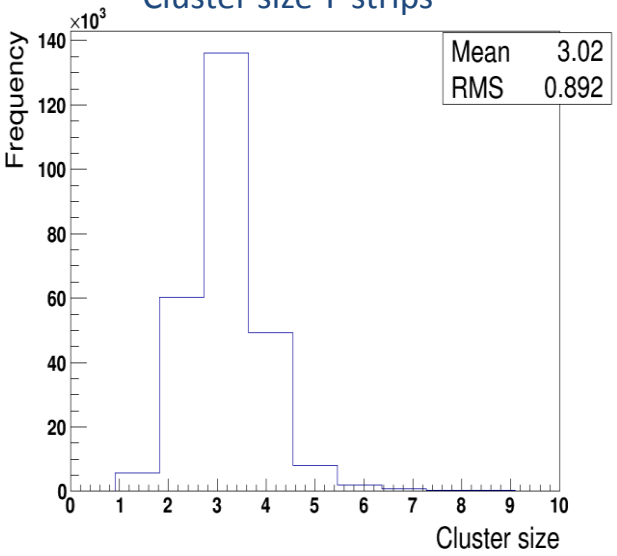
X-Y charge correlation



Cluster size X-strips

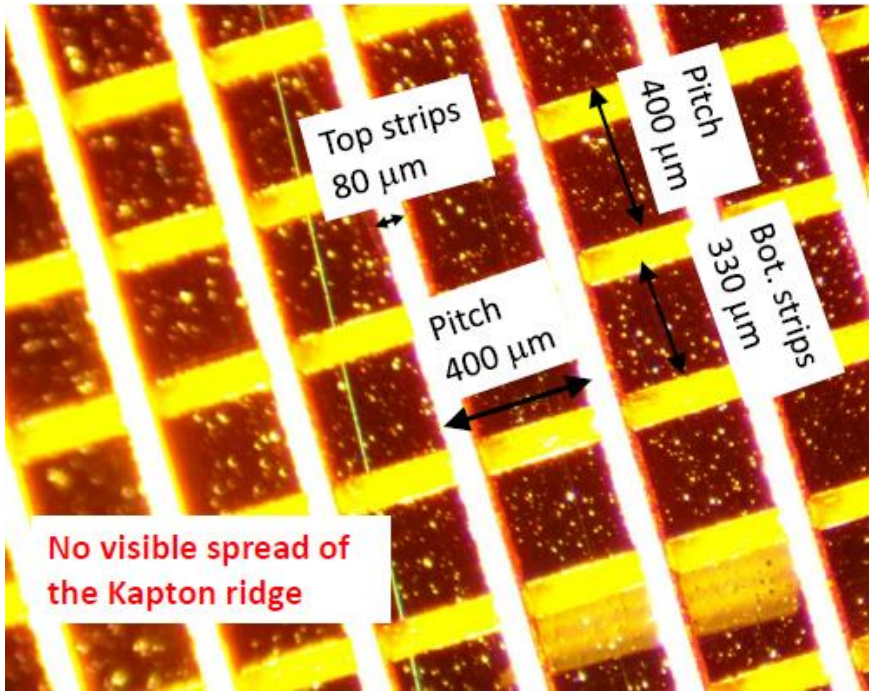


Cluster size Y-strips



New readout board scheme: (quality of production)

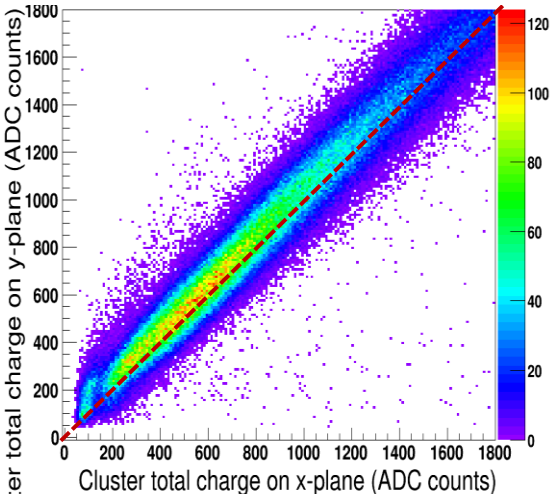
- Microscope view of the production SBS GEM readout board from the first batch (April 2014)
- No Kapton extending out from under the readout strips
- Actual strips and pitch dimensions certified by COMPASS for equal charge sharing
- Inspection of the 3 readout boards are all good, preliminary test very encouraging (see next slide)
- Final and most critical test with X-ray source for high rate is planned.



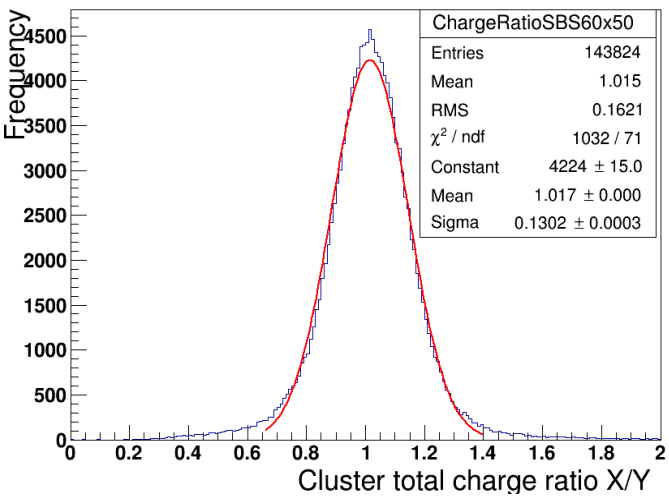
X-Y strips charge sharing with the new readout scheme

- Very good charge sharing all across the chamber
- Ratio ~ 1 and sigma ~ 0.13
- No significant change at different gas flow rate into the chamber
  - **Flow = 10 units ~ 2 V / h**
  - **Sbs60x50 volume V = 3.6 L**

X vs. Y ADC charge correlation

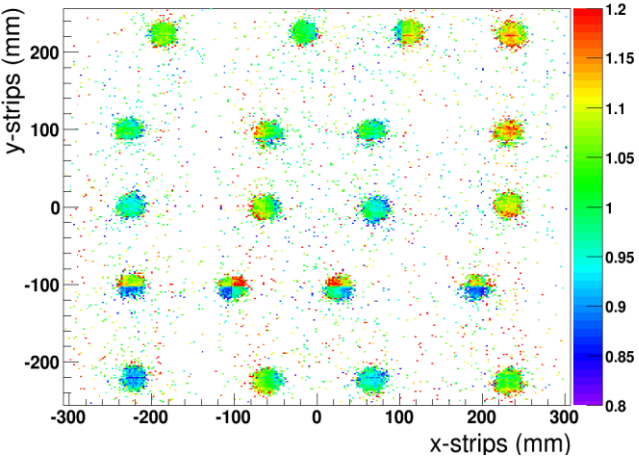


X/Y ADC charge ratio

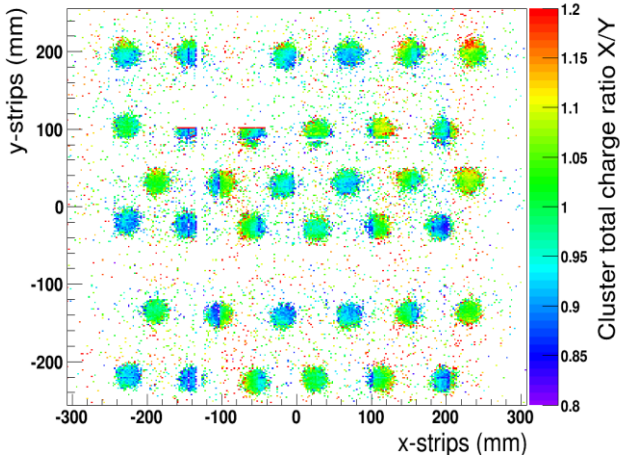


X/Y ADC Charge sharing ration vs. cluster position at different gas flow rate

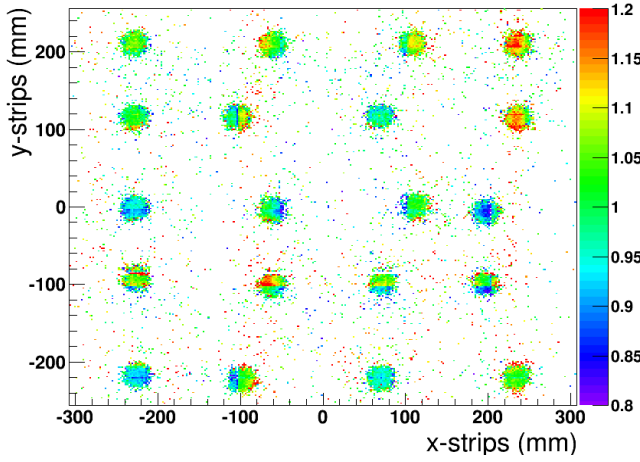
Gas flow = 5 units



Gas flow = 10 units



Gas flow = 15 units



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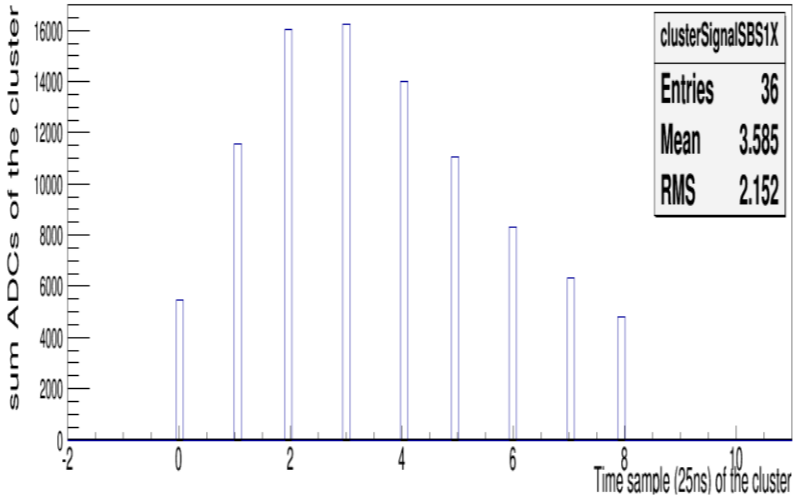
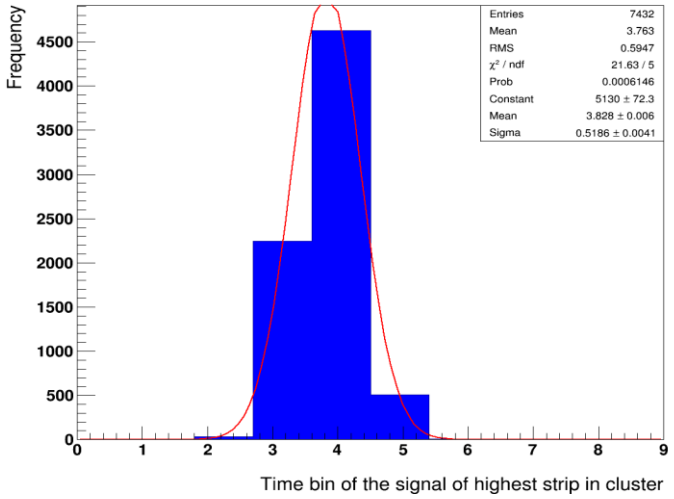
APV25 signal peak position: Fermilab Test beam data

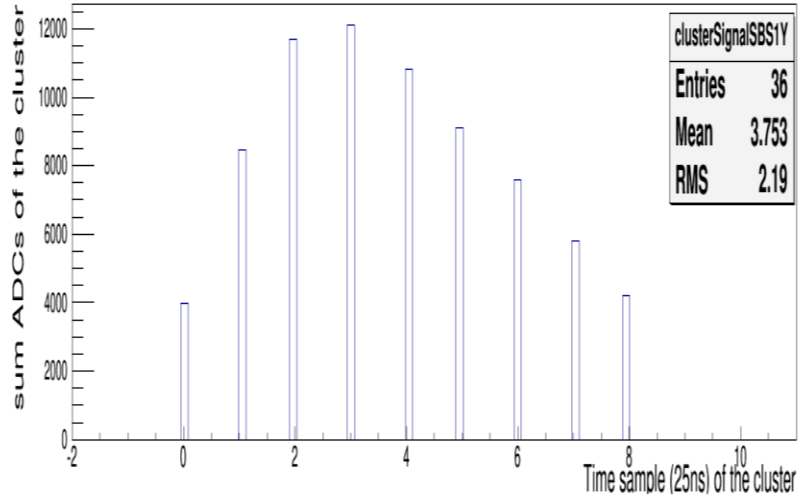
X-cluster's signal timing evolution



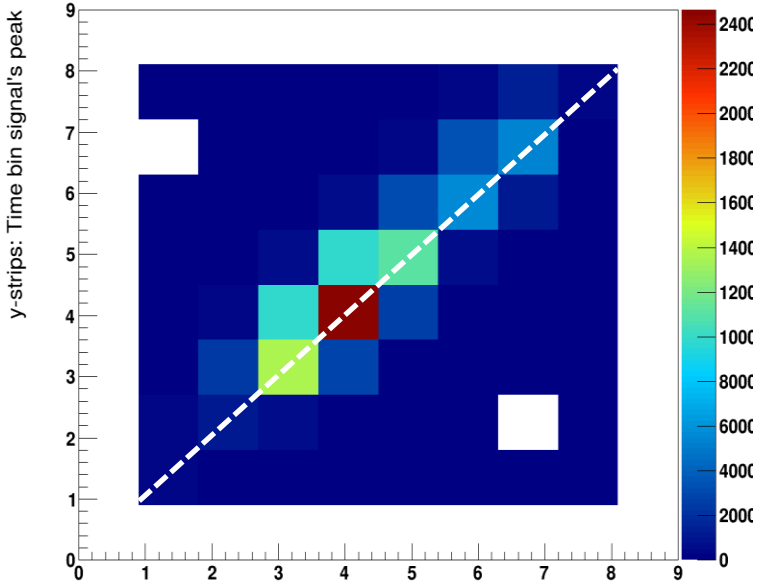
Distribution of the peak position of the signal



Y-cluster's signal timing evolution



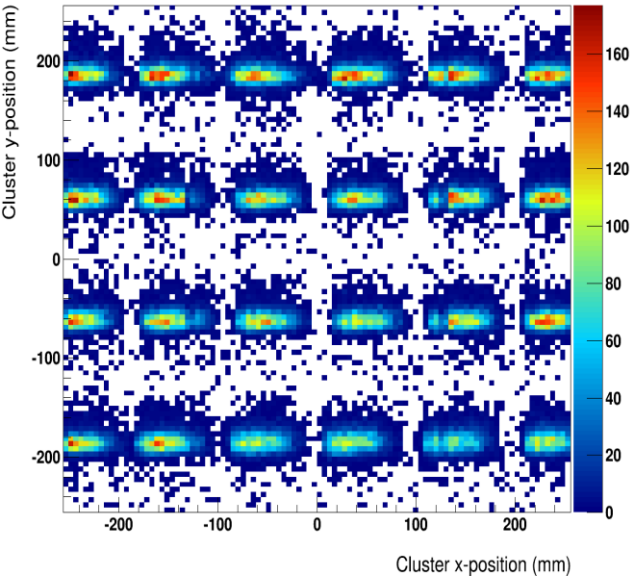
Peak position correlation X-clusters vs. Y cluster



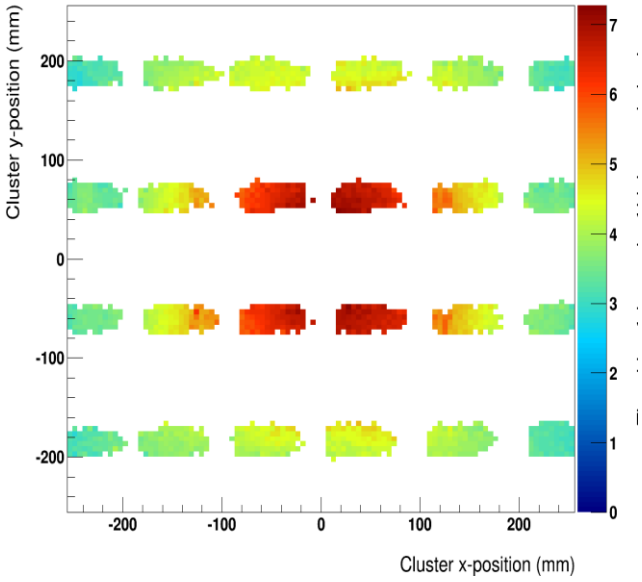
APV25 signal peak position: Fermilab Test beam data

- SBS 50x50 cm2 GEM prototype Data during the Test beam at Fermilab (Oct. 2013)
- Gas flow from one side to the other side (Evaristo's original design)
- Strong spatial non uniformity of the signal peak position, higher value at the center of the chamber
- Gas flow was very high during the FNAL test beam (but we did not measure it)
- Strong correlation between the peak position and the gain non uniformity (Average ADC distribution)

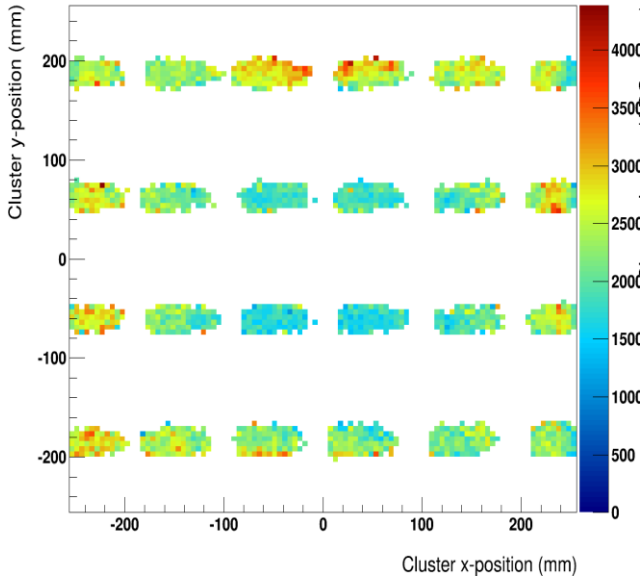
Beam position



Average signal peak position



Average ADC

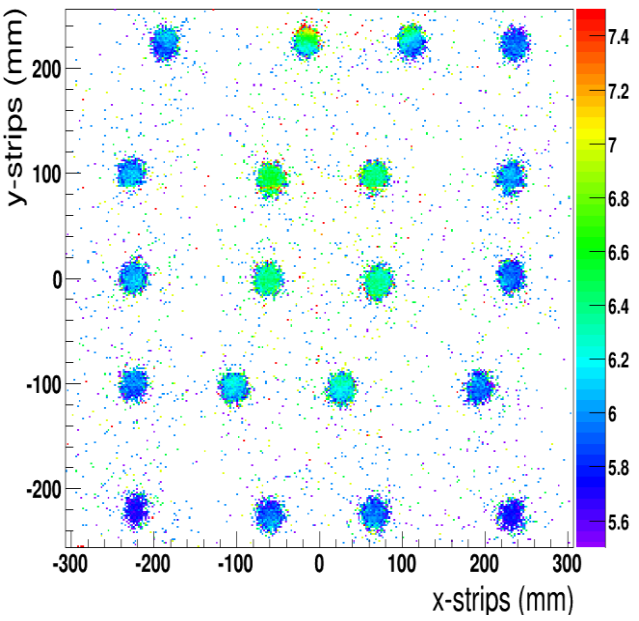


APV25 signal peak position: Effect of the gas flow

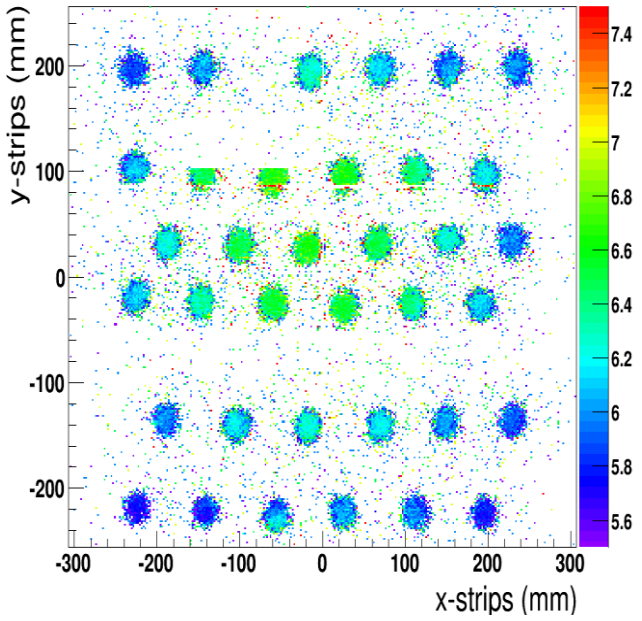
- Scan the newly built 60x50 GEM module with Sr90 source for different flow rates.
- A gas flow = 10 units represent 2 volumes (V) change / hour in the GEM chamber (V = 3.6 L)
- Clear dependence of the signal peak spatial non uniformity with gas flow

Signal peak position (time sample) vs. cluster position at different gas flow rate

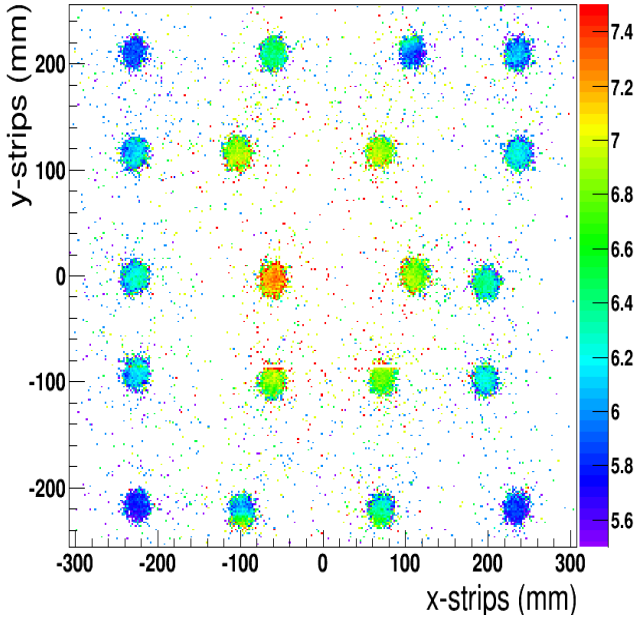
Gas flow = 5 units



Gas flow = 10 units



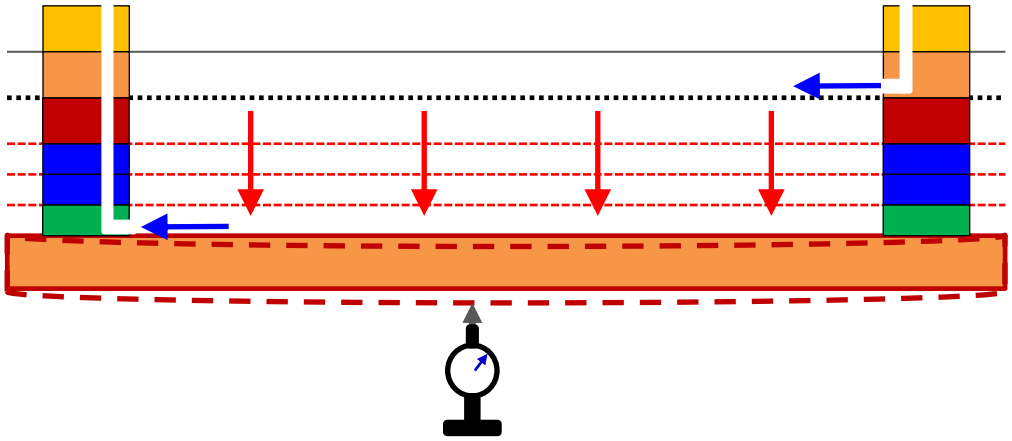
Gas flow = 15 units

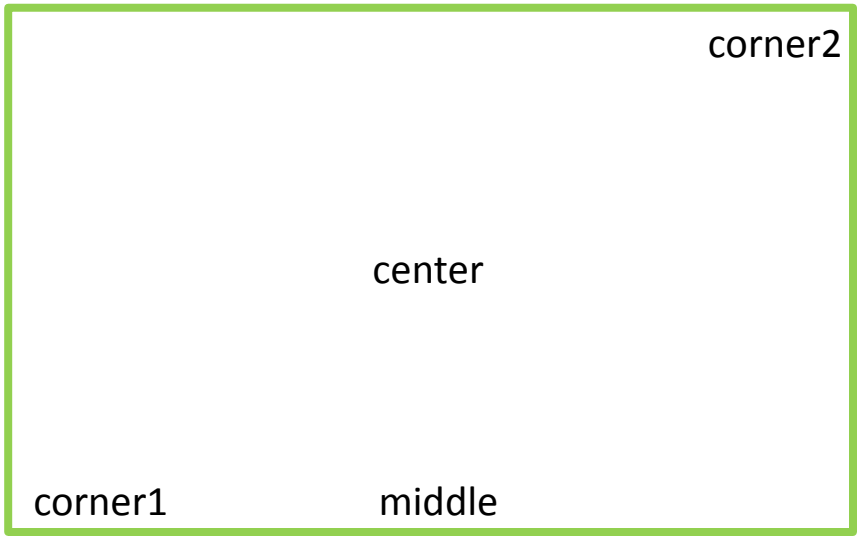


Bending of readout strip board vs. gas flow rate

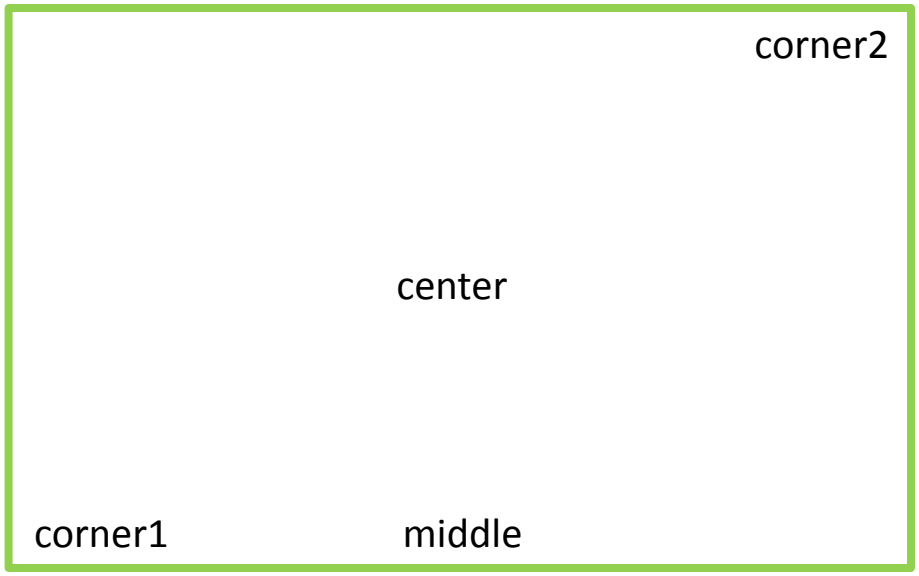
(Data taken by Chau Dao)

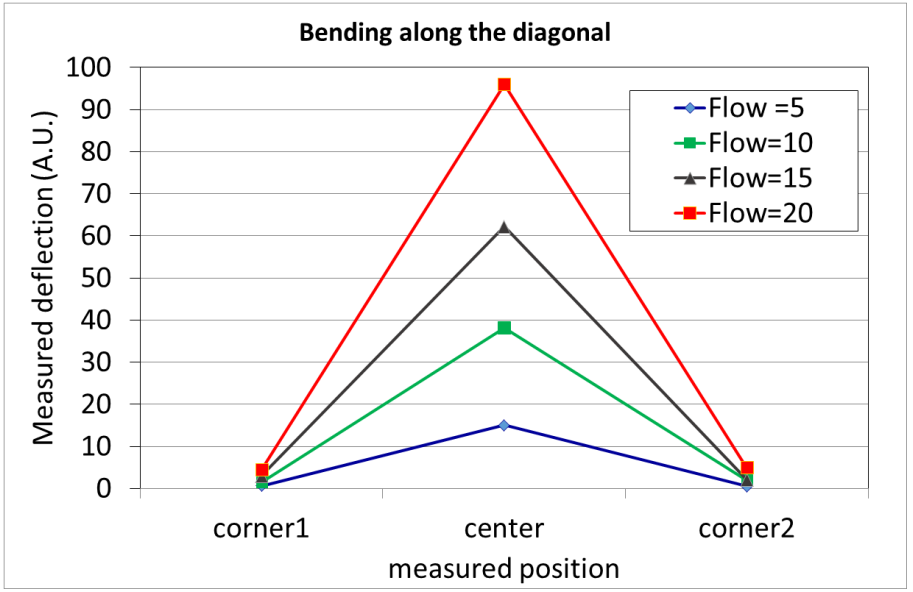
- Setup of a test (see cartoon below) to measure how the readout board (honeycomb support) is deformed with the flow rate inside the chamber
- Measurement were taken at 4 location on the bottom side of the honeycomb support
- The measured deflection of 100 units is equivalent to 2.5 mm

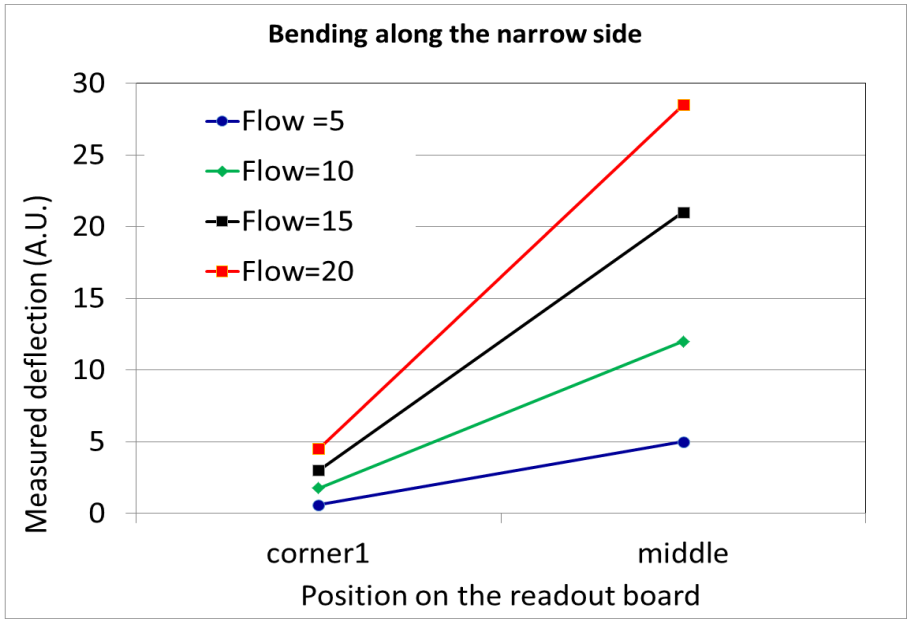


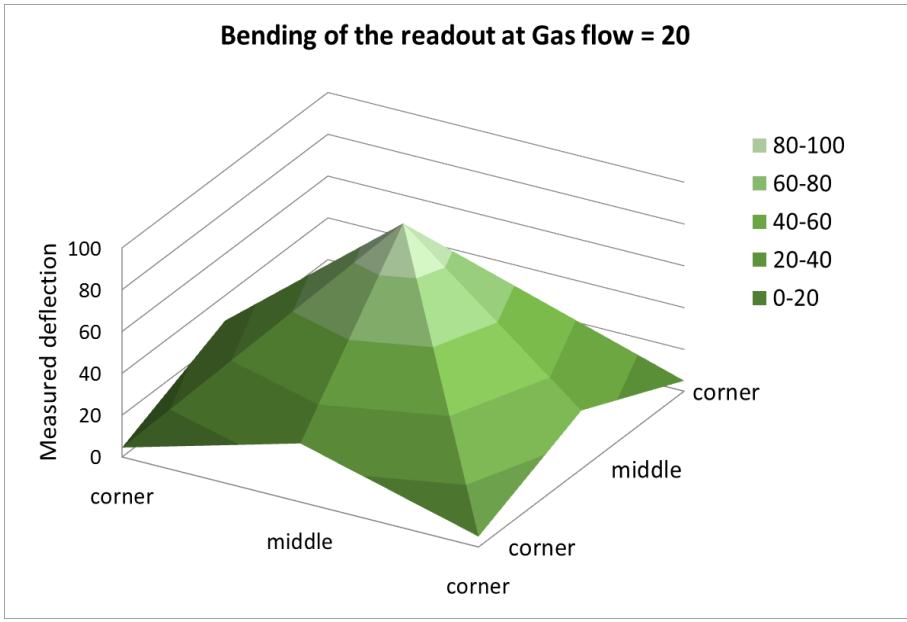


Measurement of the bending of readout strip board with the gas flow





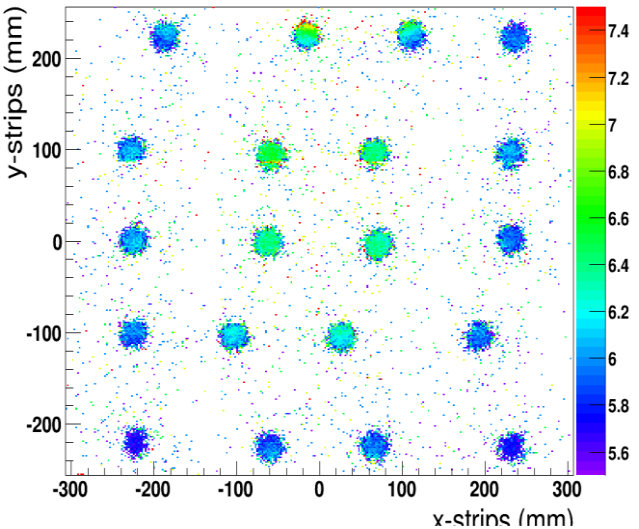




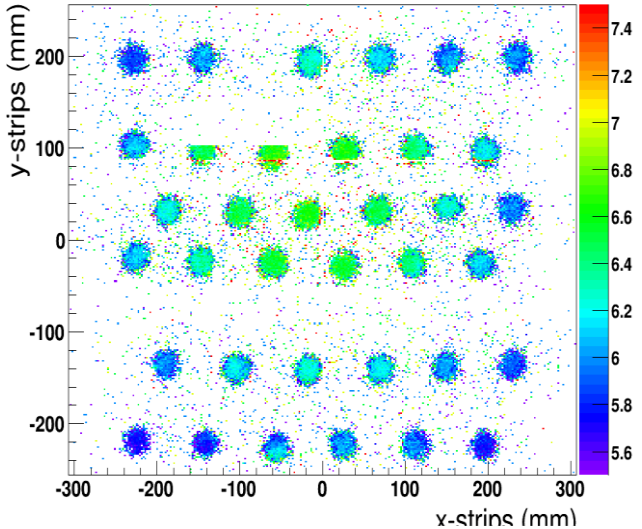
APV25 signal peak position vs. bending of readout board

Signal peak position (time sample) vs. cluster position at different gas flow rate

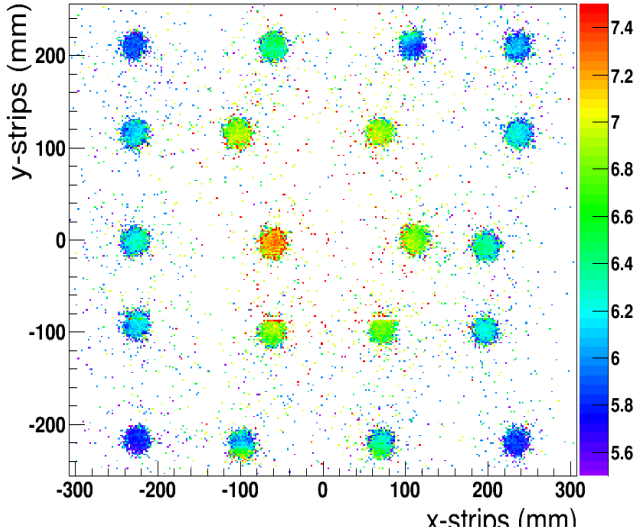
Gas flow = 5 units



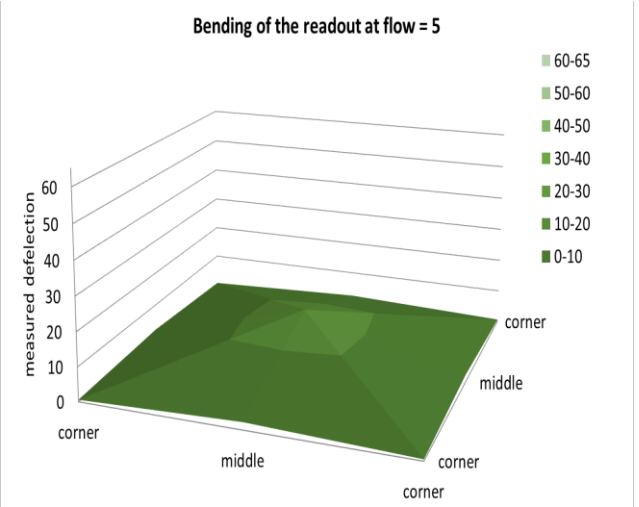
Gas flow = 10 units

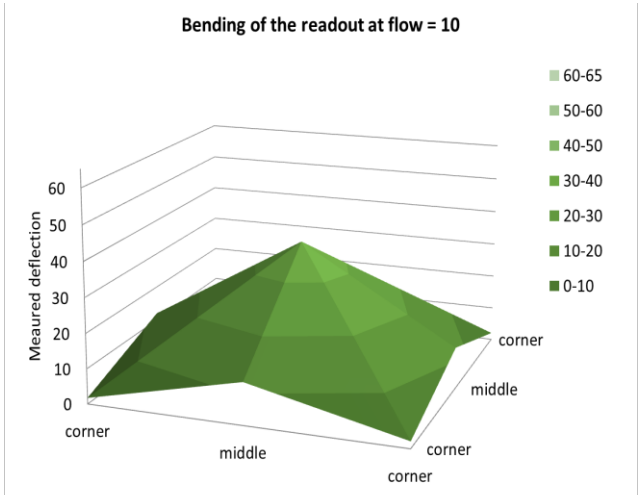


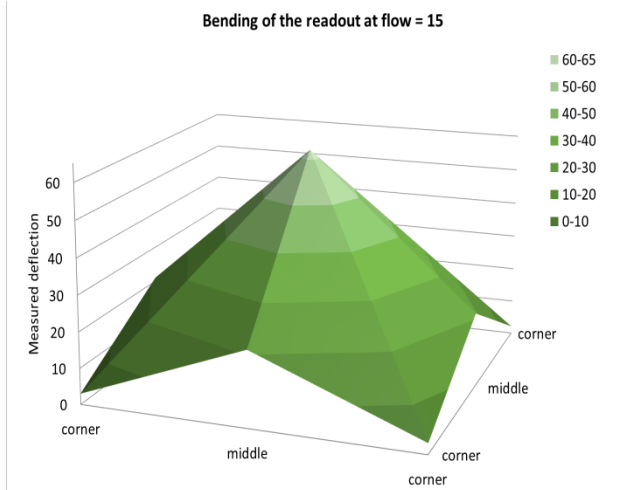
Gas flow = 15 units



bending of readout strip board with the gas flow rate

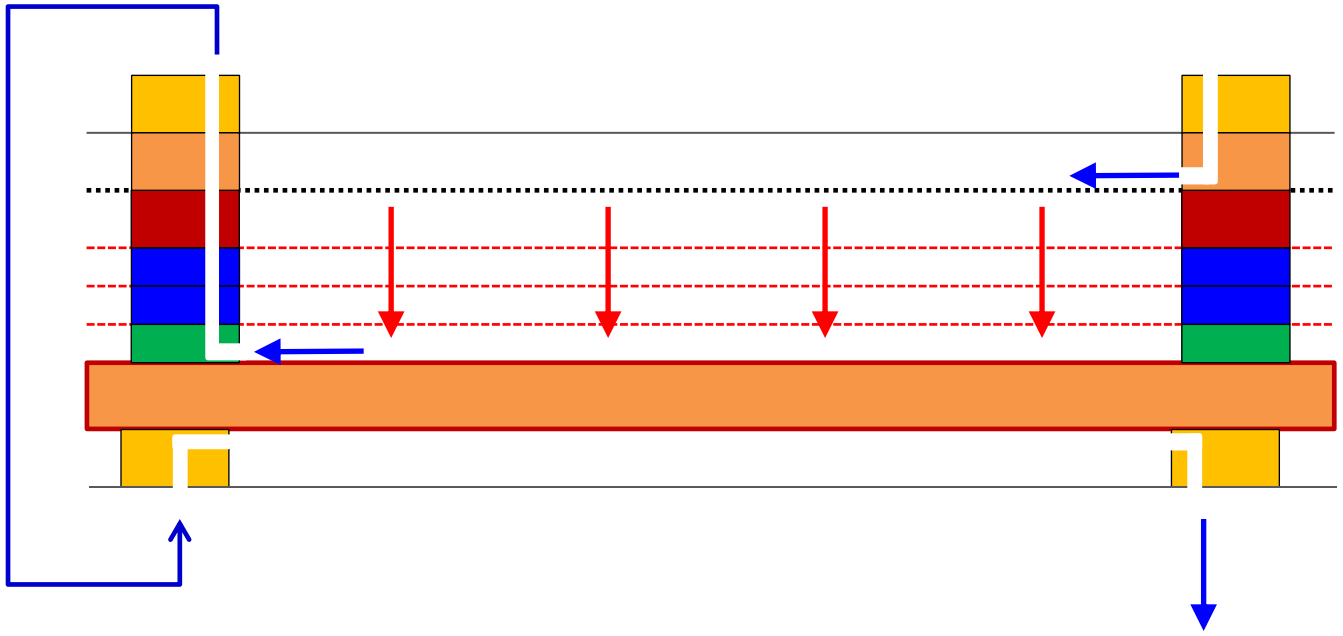






Next step: Simple idea to explore to correct of the bending of the readout

- Clear correlation between the bending and the displacement of the signal peak position
- Idea to test is to add a 25 μm Kapton foil gas window at bottom of the chamber and flow the gas inside to compensate the overpressure inside the chamber.
- Very easy idea to implement and we could quickly test the signal peak position against gas flow with it to validate it



Summary

- We built 2 first SBS 60x50 production GEM modules (sbs60x50Prod1 and sbs60x50Prod2)
  - sbs60x50Prod1 is on the cosmic test bench and performing well for 2 weeks
  - sbs60x50Prod2 assembly is completed and initial tests to validate assembly is good
  - Issue with charge sharing between top and bottom strips seem solved need validation at high rate
- APV25 signal peak position (latency) is shows non uniformity at different location of the chamber
  - Non uniformity increases with the gas flow rate in the chamber
  - The effect is likely due to the bending of the readout with the pressure induced by high flow rate
  - The problem could be solved by flowing gas at the back of the chamber to compensate the overpressure built inside the chamber
  - The test of the principle is going to be performed very soon