ATLAS Micromegas Plans

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Micromega Studies in Magnetic Field at SPS/H4 (26.11.2014 to 15.12.2014)

- Micromegas studies in magnetic field of small prototype chambers and MMSW; Study the uTPC mode of micromegas in ***B***-field; baseline electronics: APV25 and SRS readout system

- Gas mixture studies; start with the baseline gas Ar+7%CO_2; test also Ar+10%CO_2

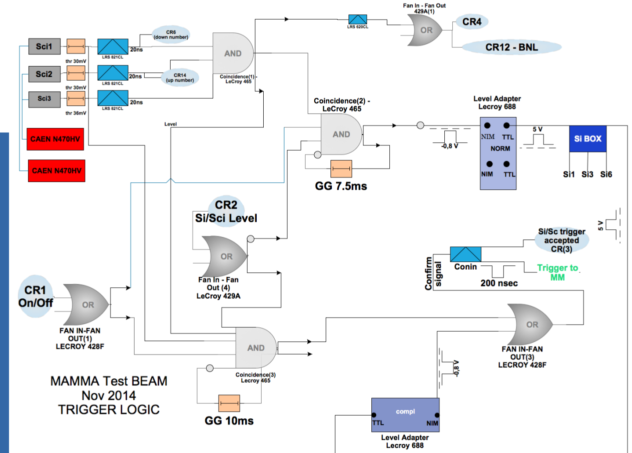
- First experience with VMM2 (R&D electronics for the New Small Wheel Upgrade)

Also we had the capability to track particles inside the magnet with the help of the Si tracker; Reference chambers with reduced drift gap and smaller effect of Lorentz angle.

Shared the Goliath magnet with the Frascati group, also during the LAPP/Demokritos running period as main users we had to keep the magnet off; This reduced our data taking 'efficiency'
But overall sharing with all groups was very nice and the 'environment' was friendly and ideal to work!
We would like to thank the RD51 collaboration, in particular Eraldo and Yorgos for the support provided for the preparation and during the run period! We are looking forward for the future plans hoping that you can let us use the Goliath/H4 line once more…

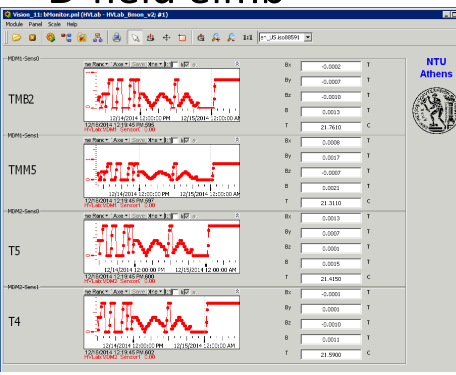
SPS/H4 DAQ/DCS Systems

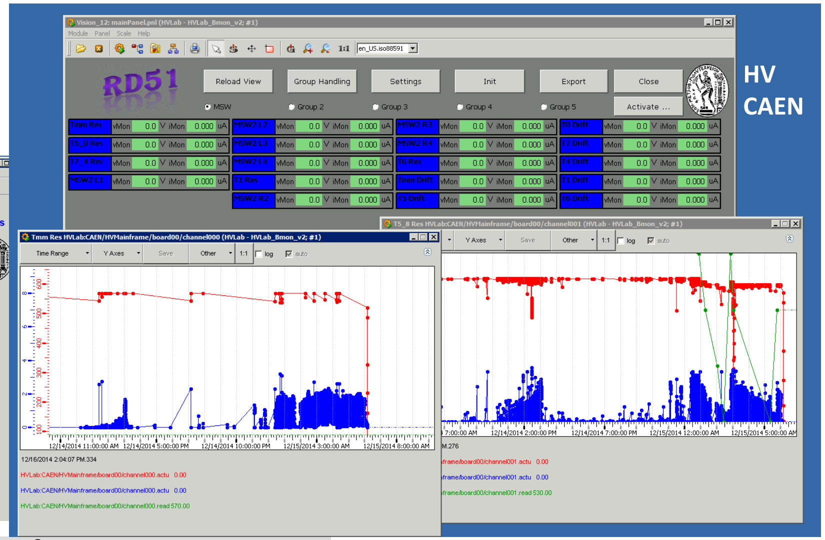
- ✓ Three DAQ systems (APV/SRS, BAT-Si , VMM2/SRS)
- ✓ DCS (WinCC for HV & B-field sensors, Gas mixer-labview)



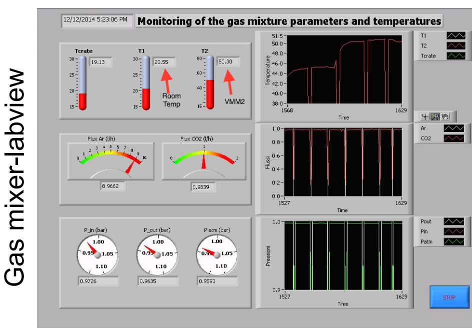
MAMMA Test BEAM
Nov 2014
TRIGGER LOGIC

B-field elmb



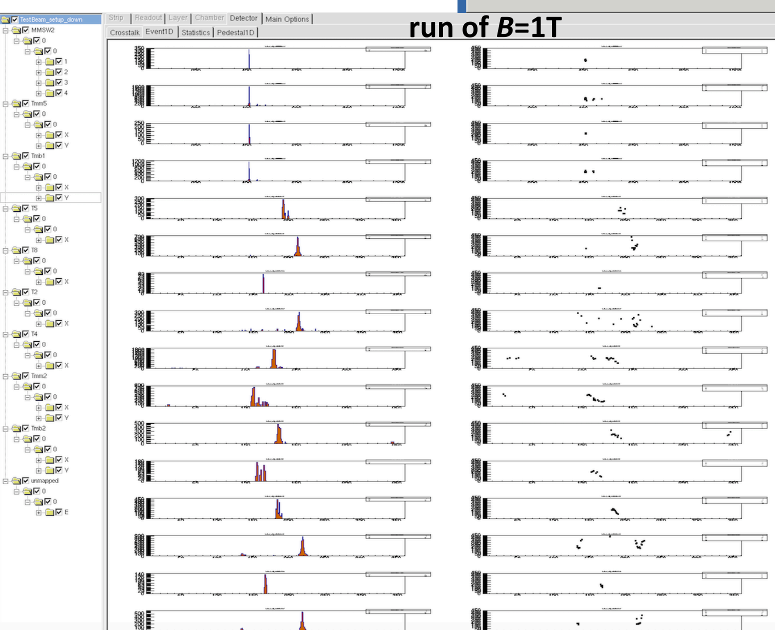


HV CAEN



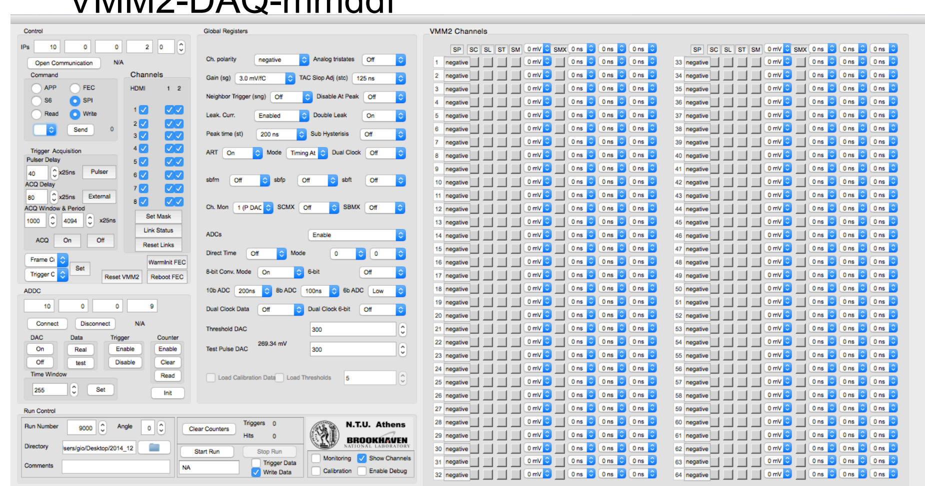
Gas mixer-labview

run of *B*=1T



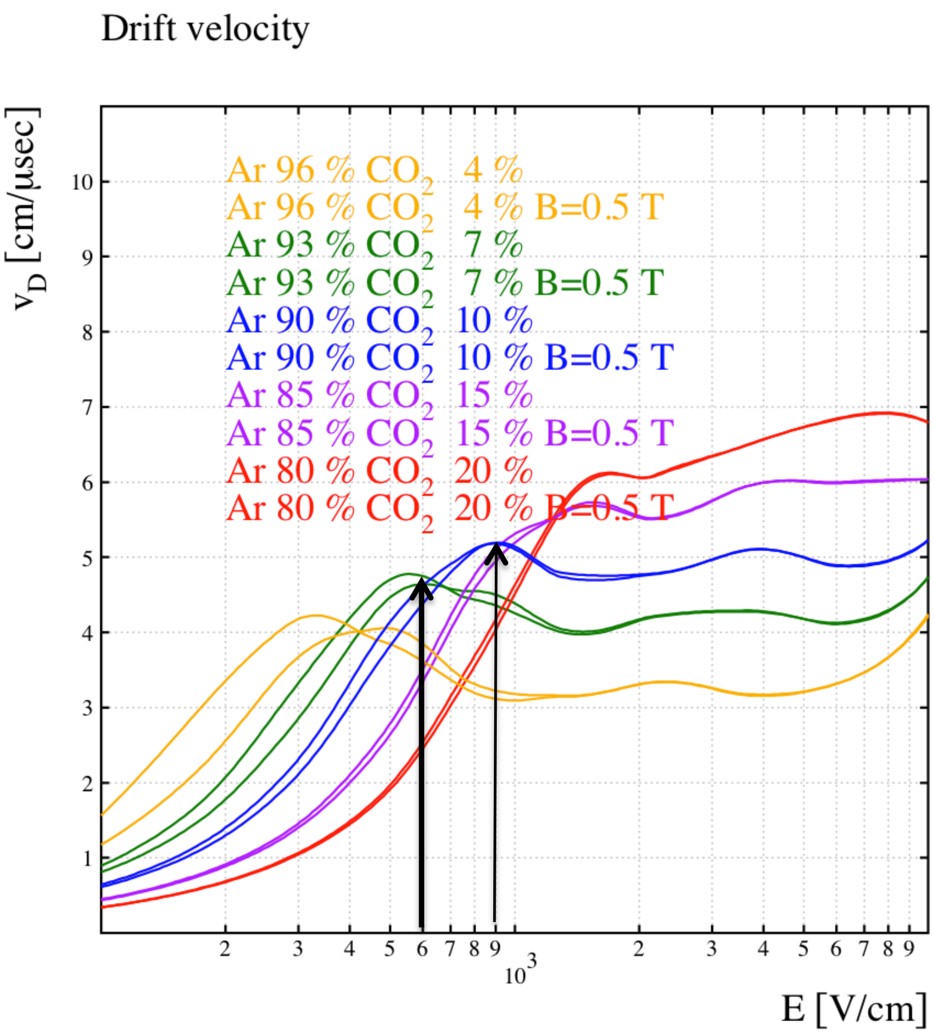
mm_daq

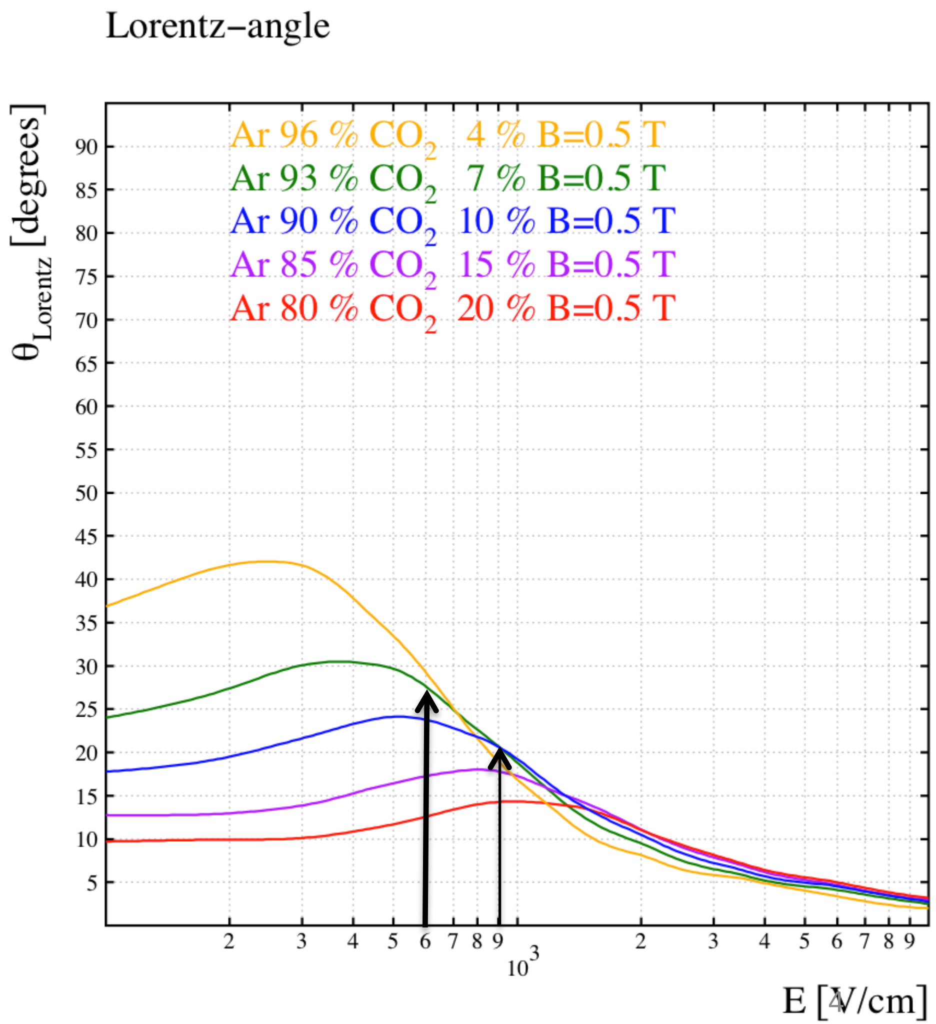
VMM2-DAQ-mmddf



Gas Simulation with Magnetic Field

Need to optimize the gas mixture;
Baseline gas: Ar+7%CO_2; Also study the Ar+10%CO_2

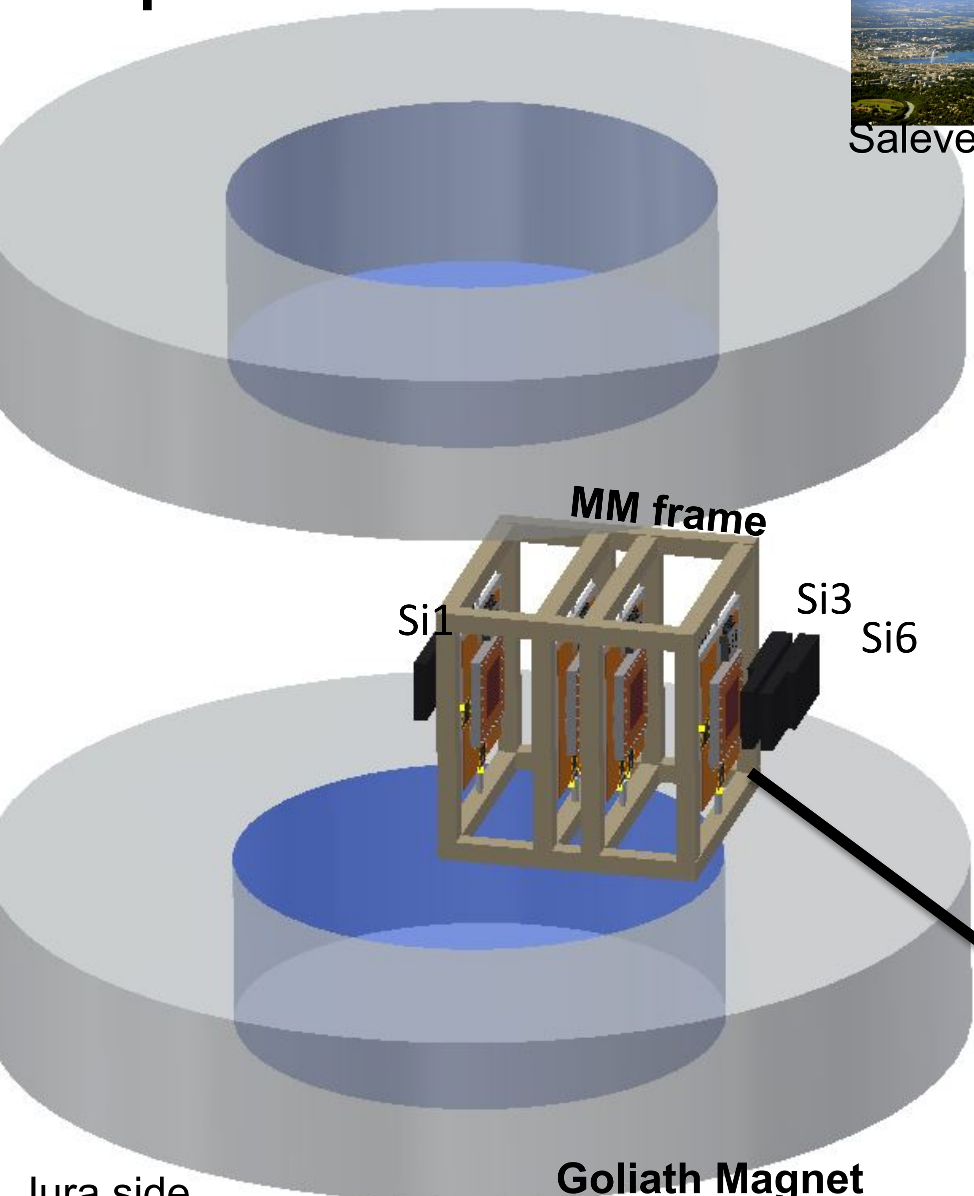


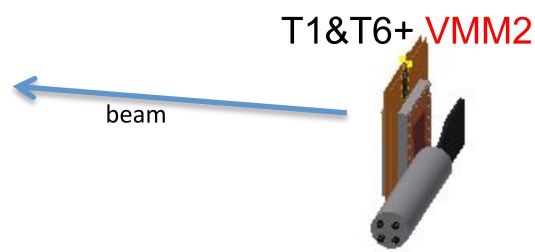


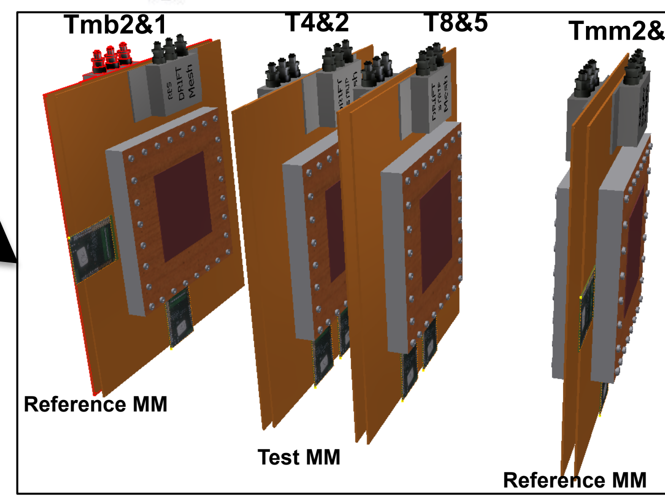
Setup in SPS/H4

Saleve side

- π/μ beams, with various settings (intensity, profile etc.)
- Test of small resistive prototypes with different magnetic field intensities and polarities
- 4 test chambers (1D readout, 0.4mm strip pitch, 5mm drift gap), 4 reference chambers (2D readout, 0.250mm strip pitch, 2.5mm drift gap)







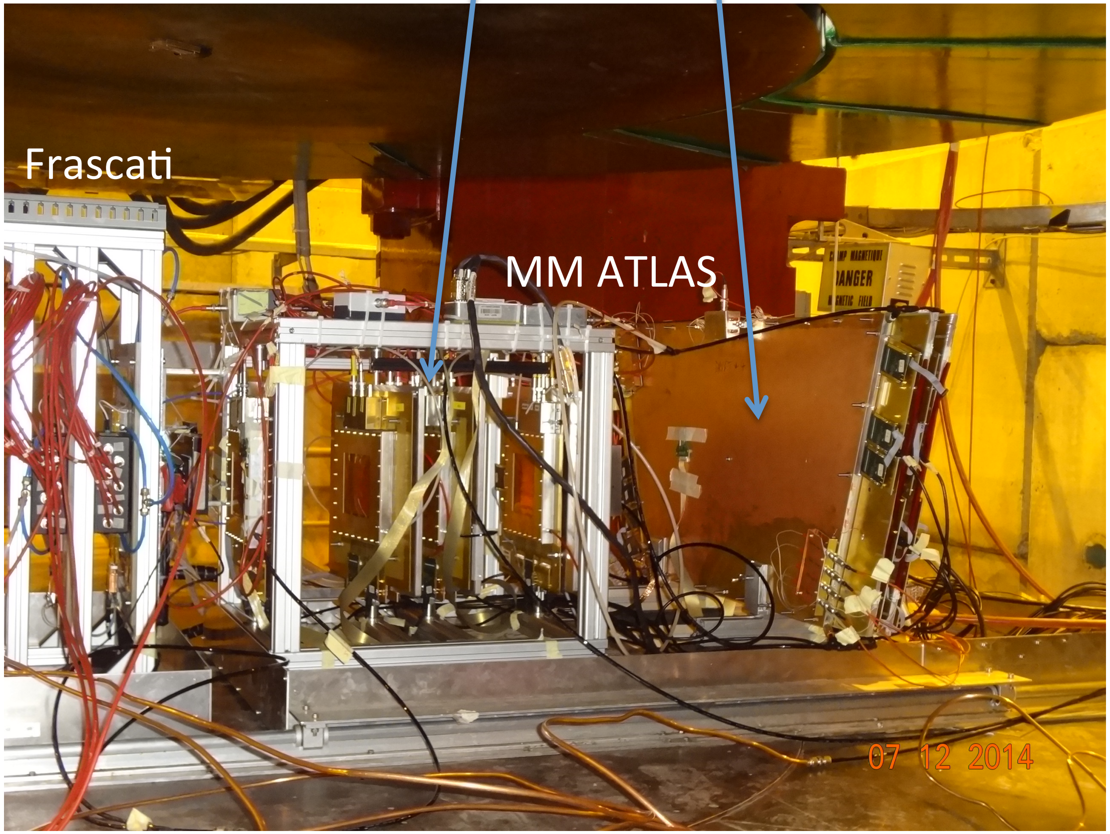
Jura side

Si = Silicon Detector;
3 planes x-y

Micromegas Performance in *B* at SPS/H4

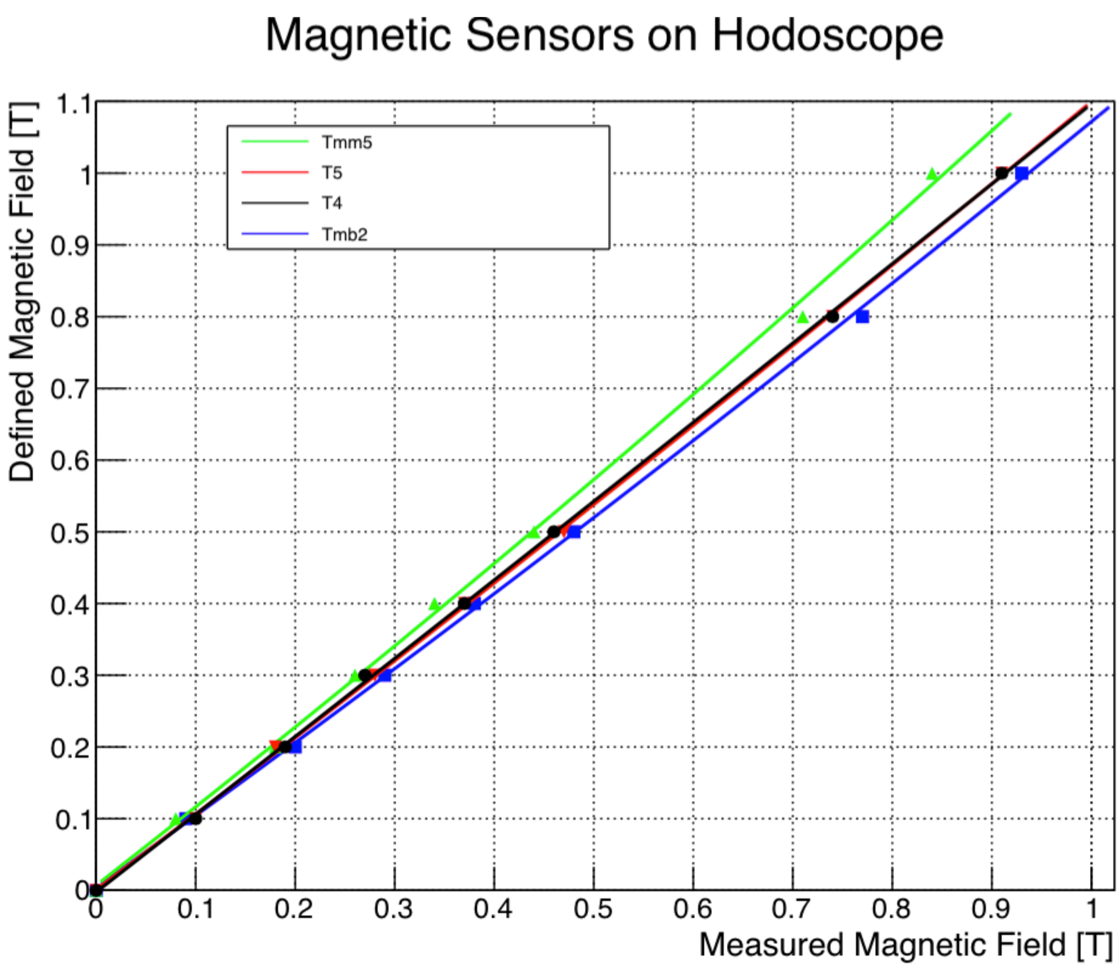
Set-up:

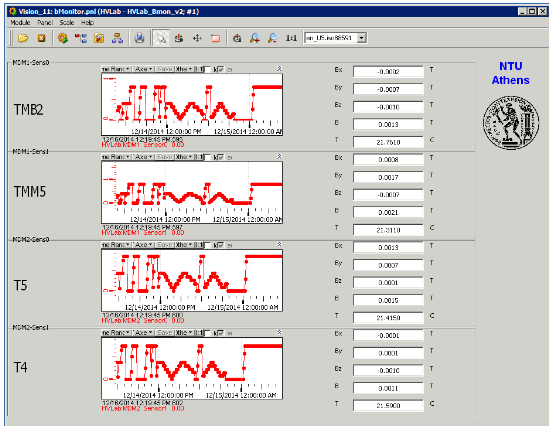
- Rectangular frame hosting up to 8 micromegas small prototypes
- Dimensions of the frame: 80 (in the beam direction)x50x50 cm^3
- The frame is located in the region of uniform field
- In addition there is the MMSW2 chamber: 8x120x50 cm^3. Frame and MMSW2 are equipped with ***B***-field sensors)

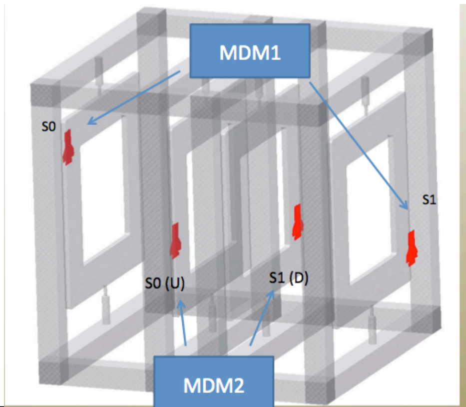


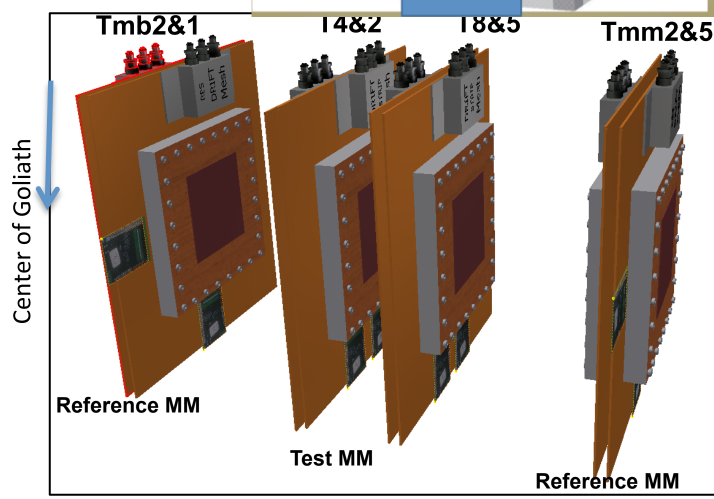
Goliath-magnet field

- Calibration curves for the 4 sensors on the small Freiburg Frame



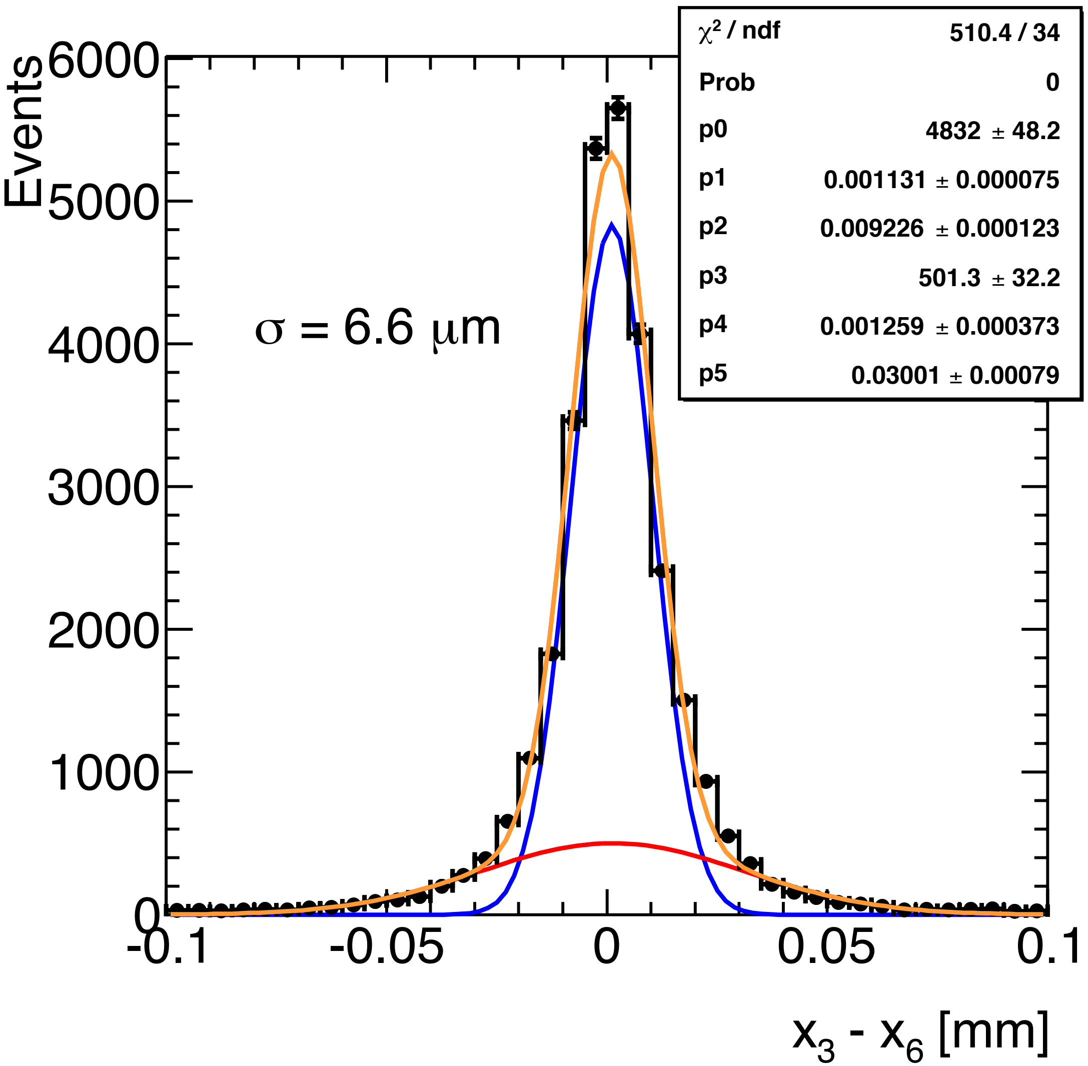


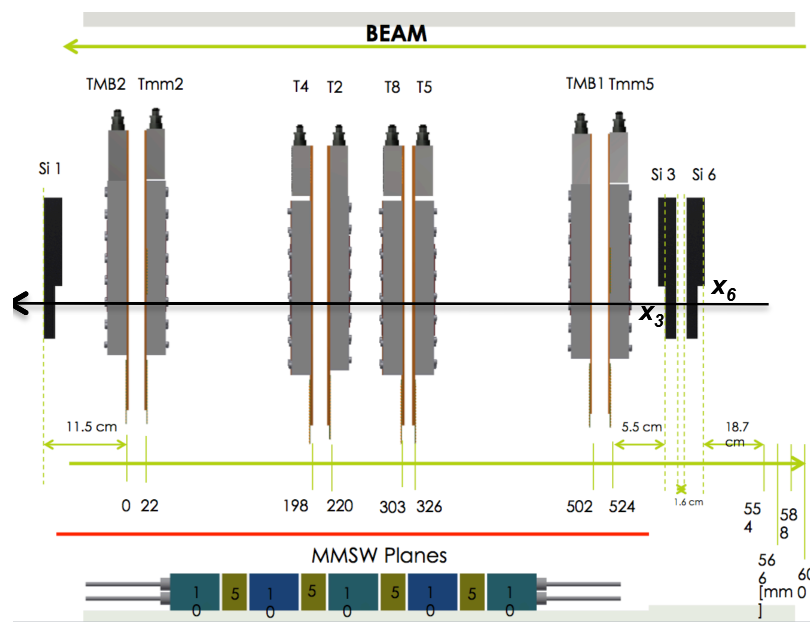




BAT-Si Tracker

BAT resolution looks good…

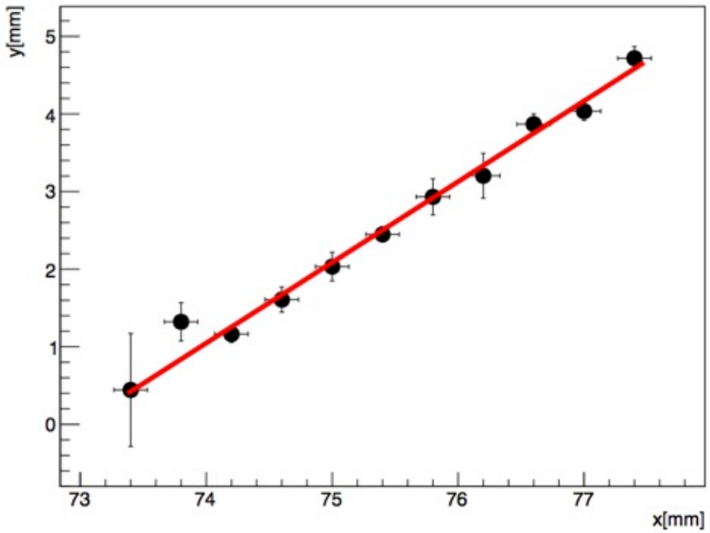




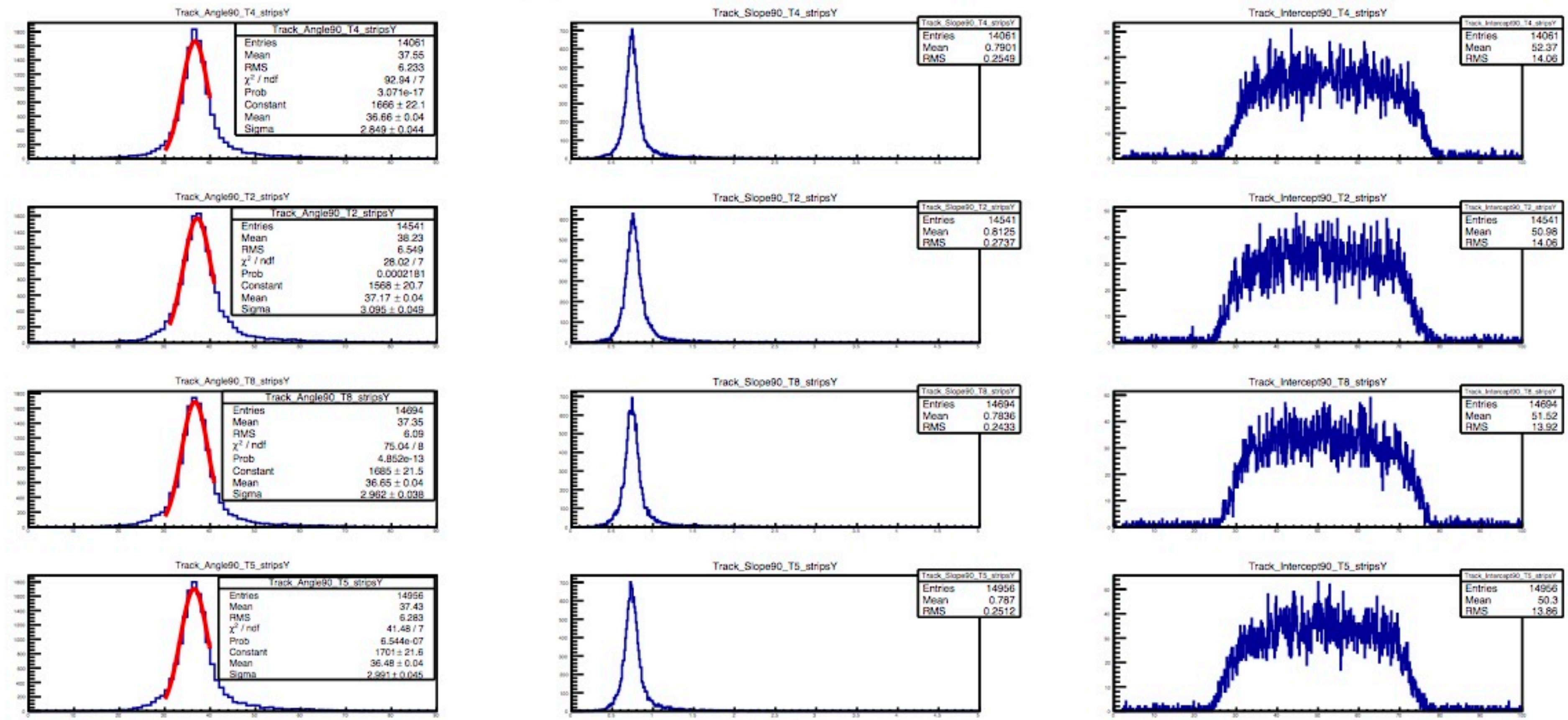
Evaluation of Micromegas in magnetic field is possible if:

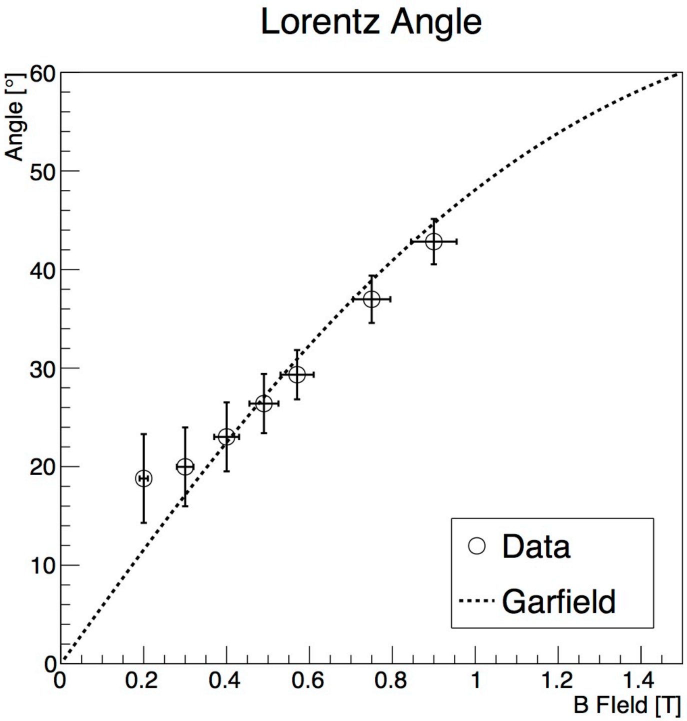
- Corrections based on the knowledge of the local field are applied to all points
- The back-to-back configuration of the doublets is exploited by defining “SuperPoints” (no need to know the magnetic field *B*)

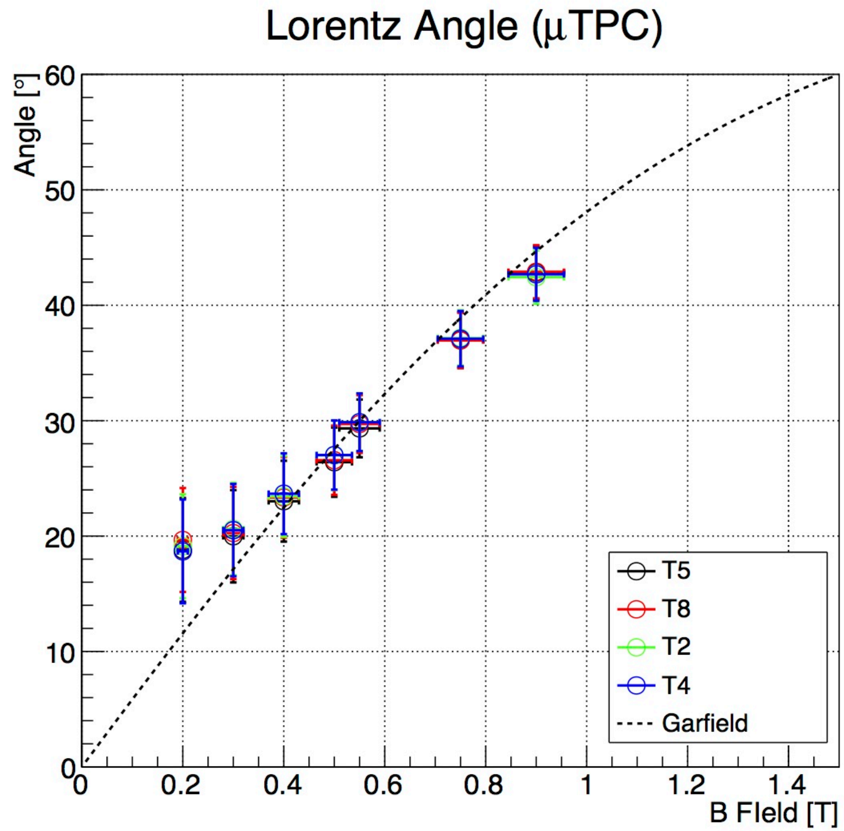
<u>Exploit both methods</u>

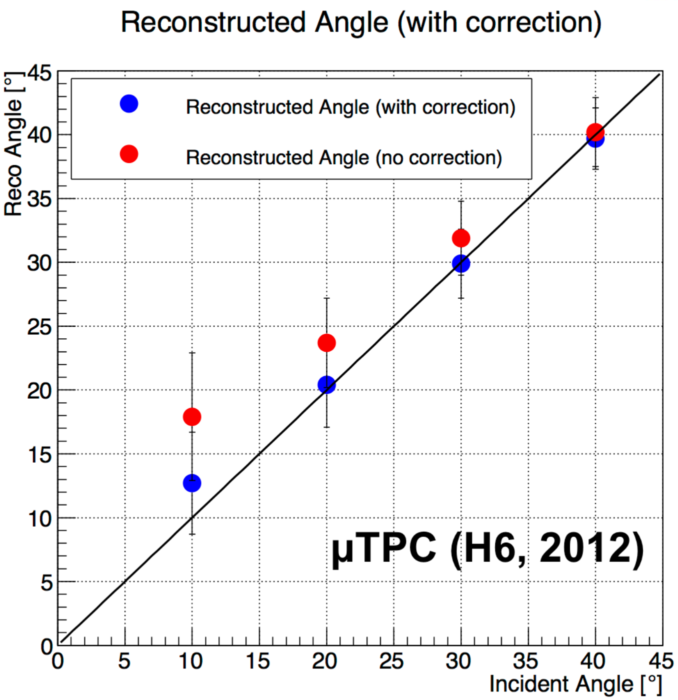


- Use runs with zero inclination for Lorentz angle measurements (example for B=0.8 T)
- Using the drift velocity component along E filed to transform time to distance ($\theta_{reco}=\theta_{lorentz}$)
- Apply µTPC recipe to measure the Lorentz angle

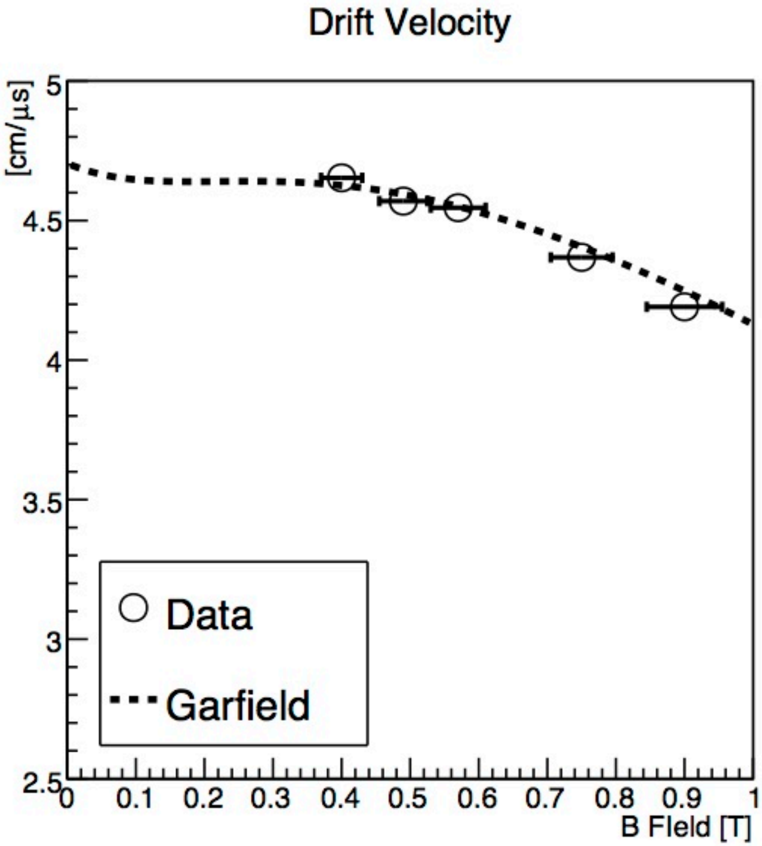


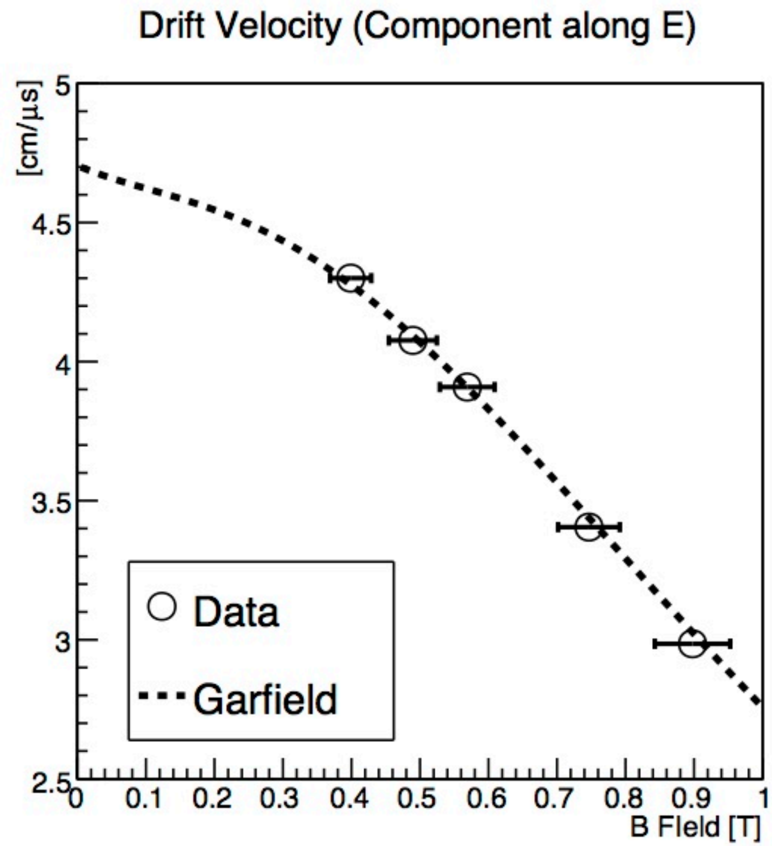


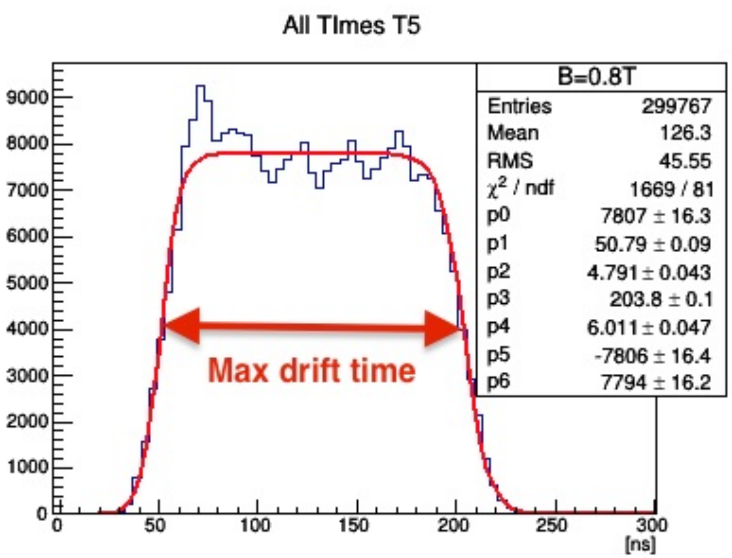




- Relatively good measurement of the Lorentz angle with TPC (for $\theta_{lorentz} > 20^{\circ}$)
- Bias in small angles similar to the one observed on μTPC angles for B = 0T (capacitive coupling)
- X errors represent the uncertainty of the B field
- Y errors correspond to the angular resolution (σ of the angular distribution)

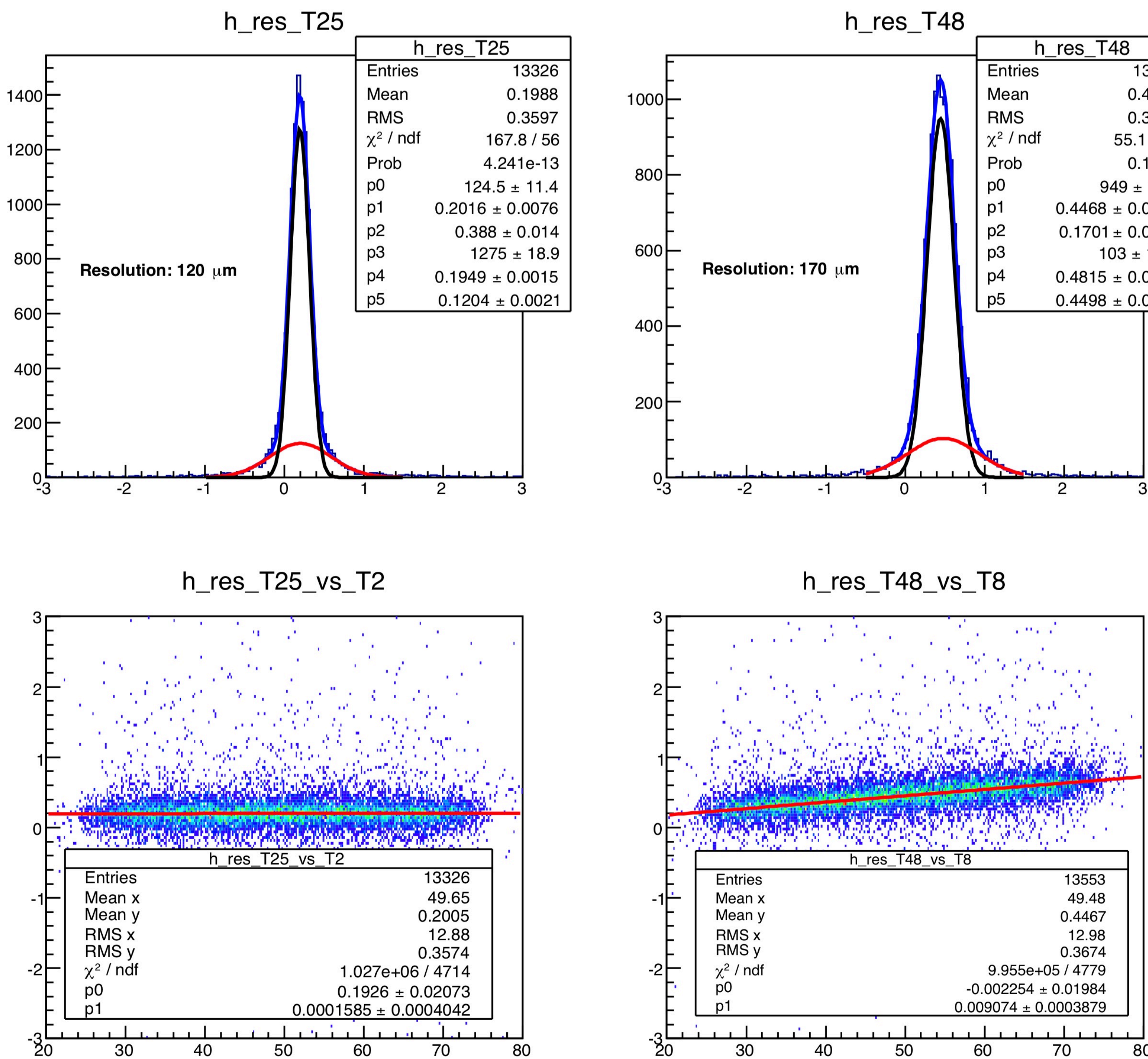




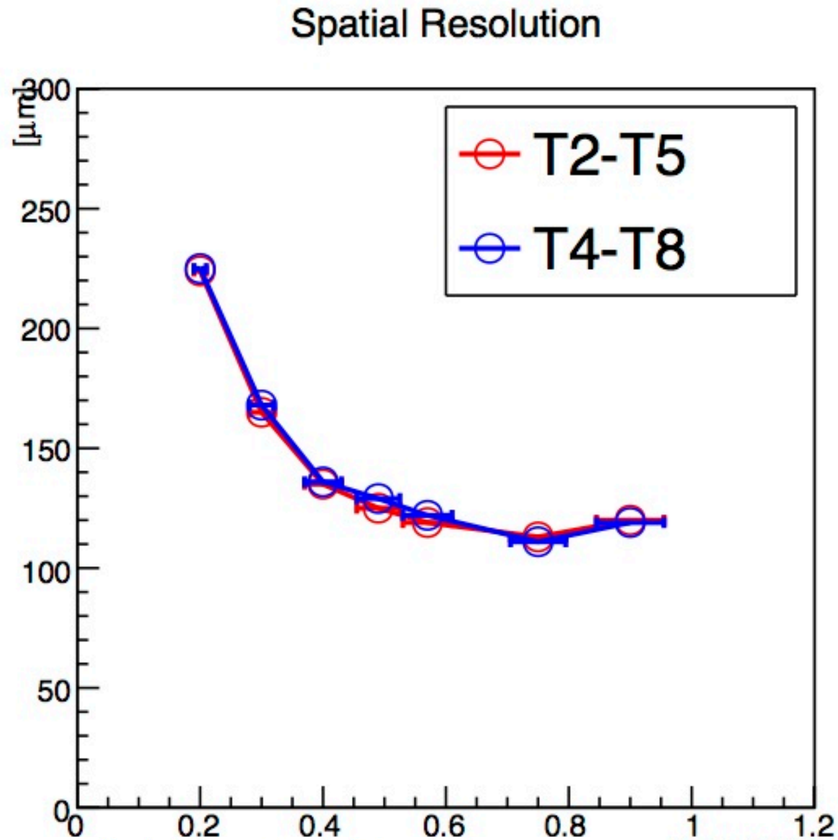


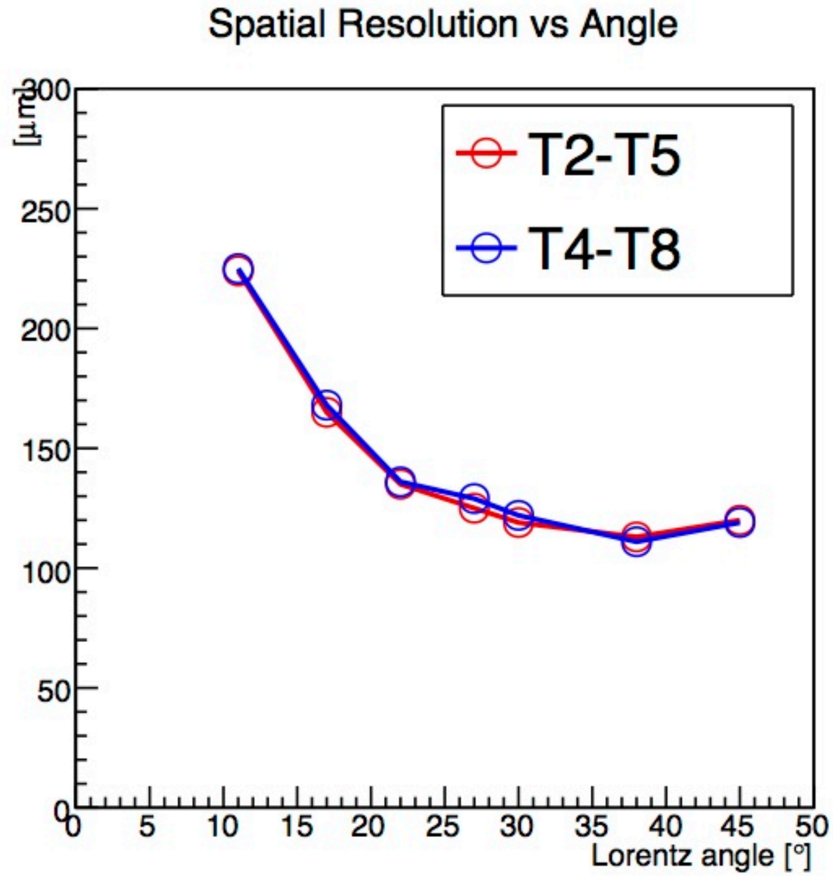
- Measure maximum drift time from time distribution (all times for one chamber)
- Using the drift gap size we determine the component along the *E* field lines of the v_{drift}
- Using also the Lorentz angle we calculate the v_{drift}

B = 0.6T, $\vartheta_{lorentz} \simeq 30^o$ (20k events: # of strips>2)

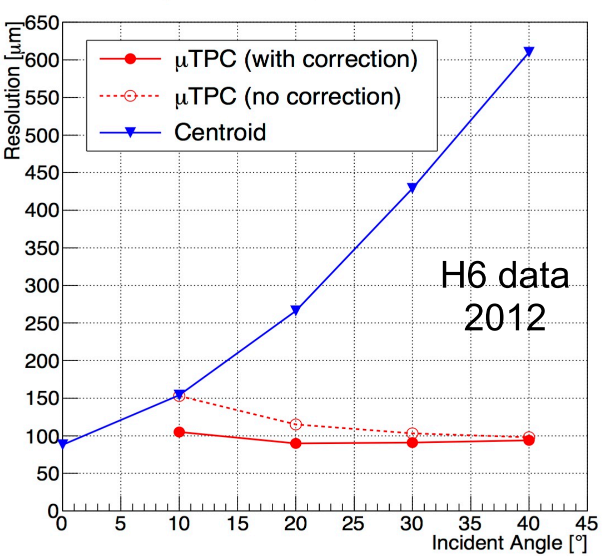


- Observe correlation in the residuals for a pair of chambers
- After correction, we extract the resolution

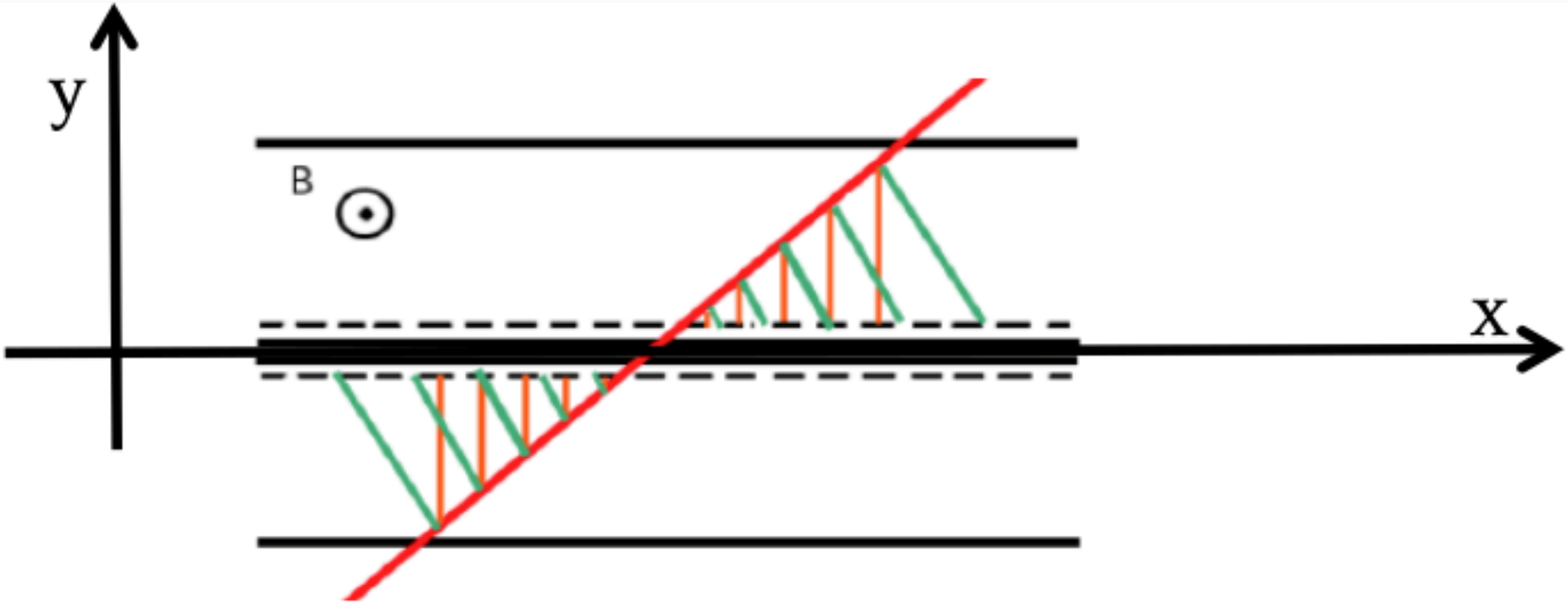




Single Plane Spatial Resolution



- TPC spatial resolution follows the "known trend" for increasing B field (increasing Lorentz angle)
- Values are slightly larger that the expected for TPC with no *B* field but recipe is not yet optimized for the magnetic field data:
- Use correct value of the v_{drift} (proper *B* Field)
- E_{amp} = 500 V in the runs analyzed was low (loss of some primary e degrades TPC performance)



In doublet-mode operation a ***SuperPoint*** coordinate x_{SP} is defined by:

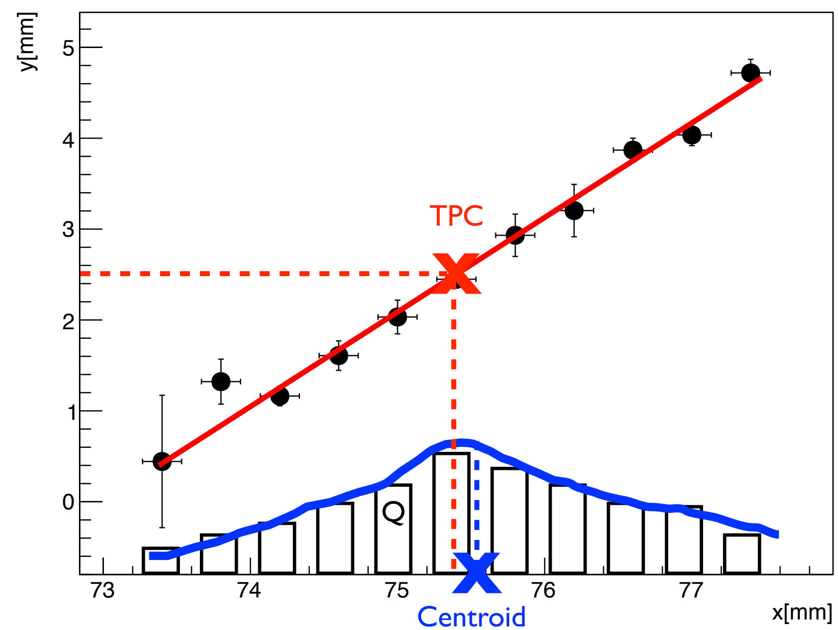
$$x_{SP} = (x_1 + x_2)/2$$

where x_1 and x_2 are either ***centroids*** or µ***TPC*** (***x_{half}***) precision coordinates. x_{SP} is "***B-free***" provided:

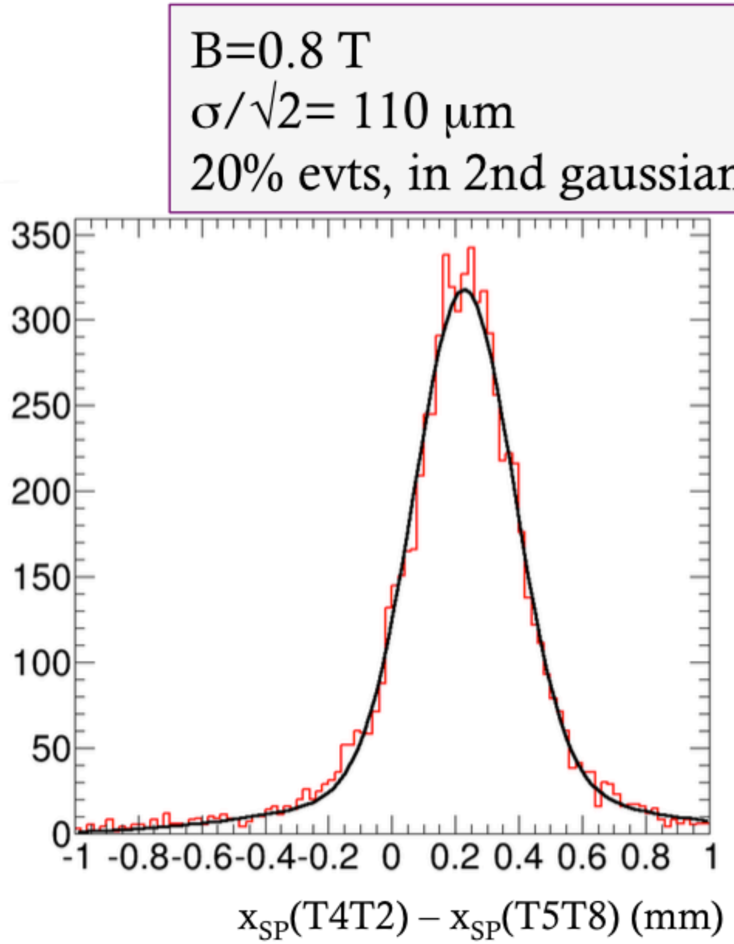
✎ *B* is the same in both gaps

✎ *E* is the same in both gaps

✎ the drift gap size *L* is the same in both gaps (this affects mostly centroids)



SuperPoint Resolution



B (T)	σ (μm) (central)
0.4	131
0.6	116
0.8	110
1.0	101

Plans for 2015 testbeam at SPS/H4

- As NSW ATLAS upgrade, we plan several long periods of combined tests of Micromegas+sTGC (NSW configuration), Module0 at SPS/H8 and at GIF++ in addition to the request within RD51

- In particular the RD51 plan includes:

Repeat the lorentz angle effect studies using the new VMM electronics

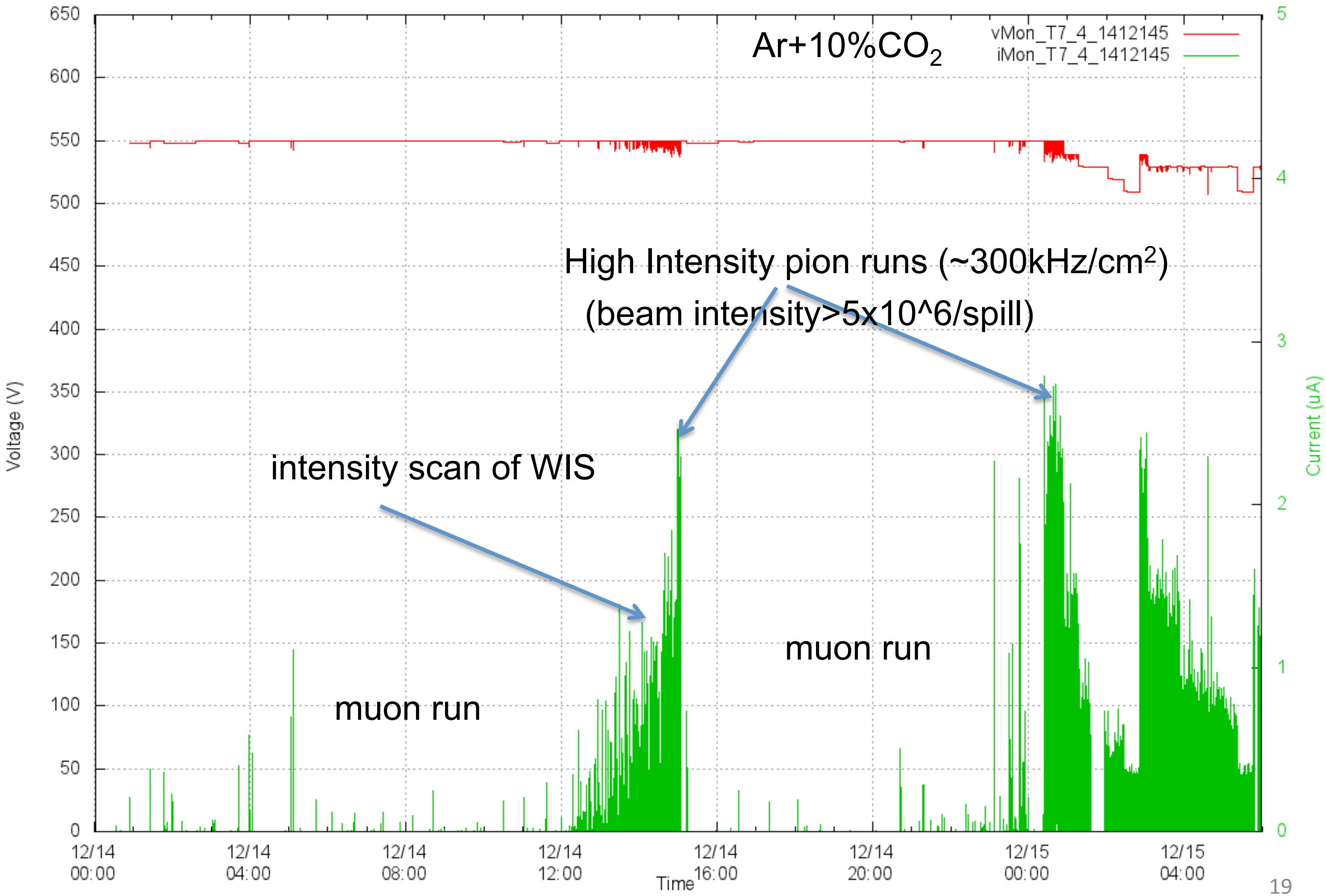
For this magnet studies, we'll use:

- Prototype micromegas chambers

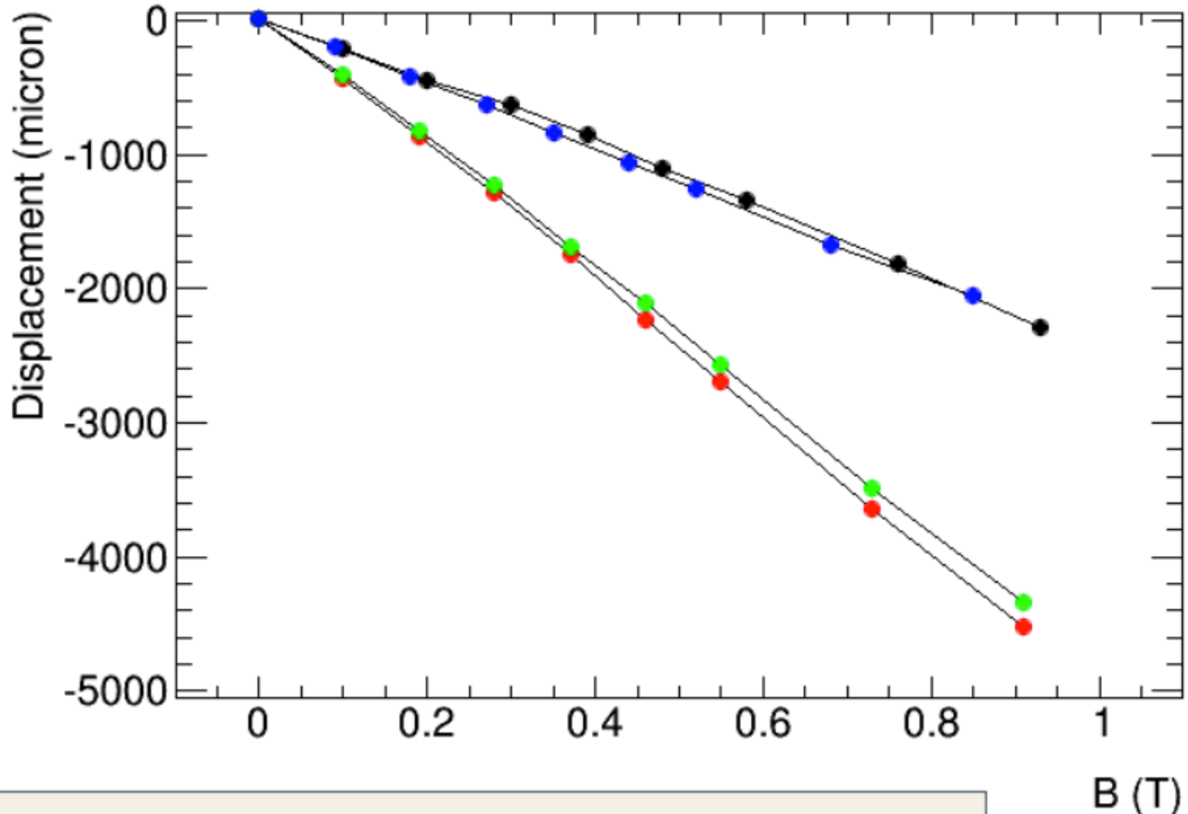
- Large scale chambers, MMSW

Backups

Chamber currents



Back-to-Back displacements vs. B



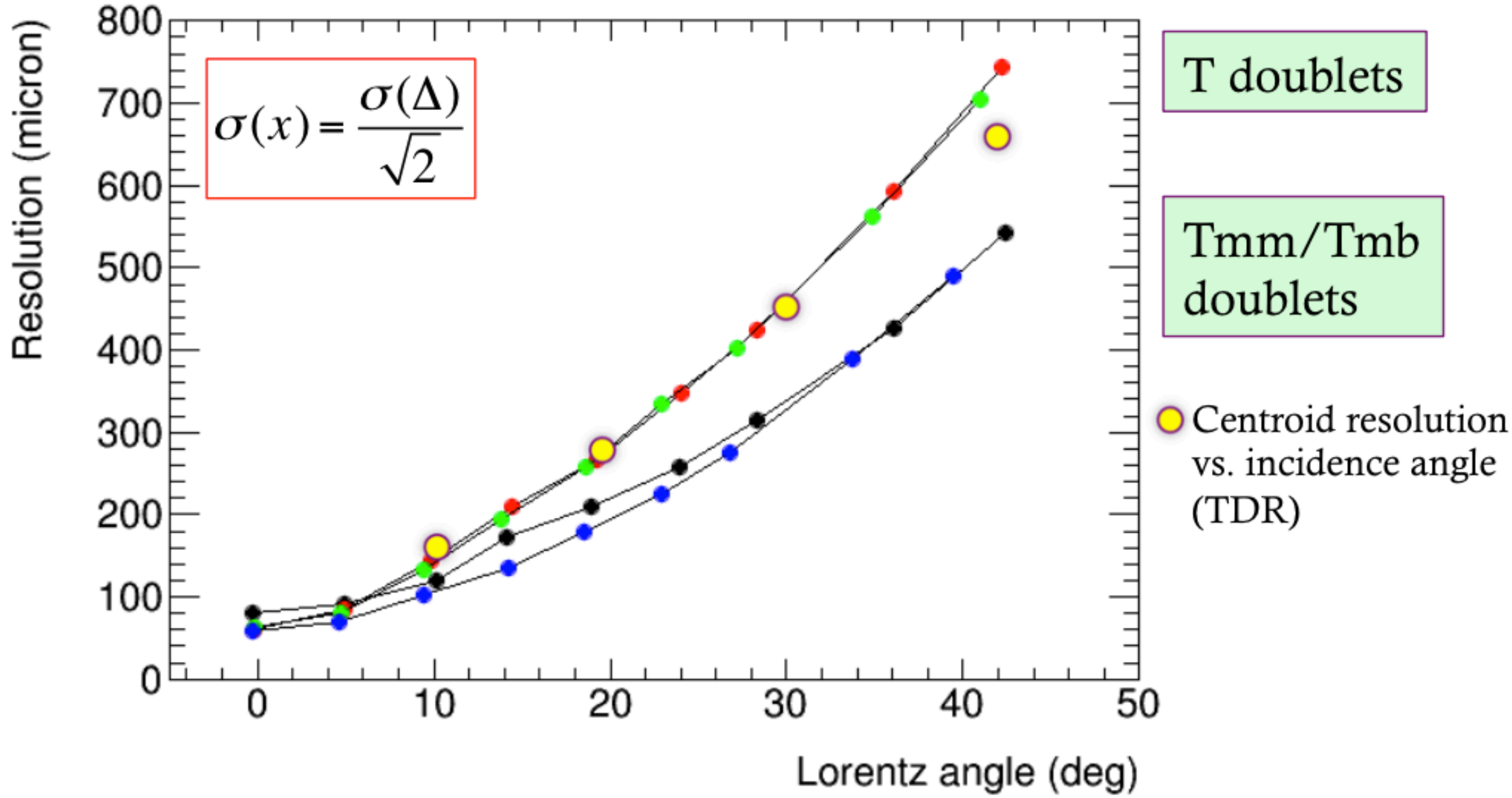
Tmm/Tmb doublets

T doublets

NB: displacements of O(mm) for B<0.3T (NSW values)

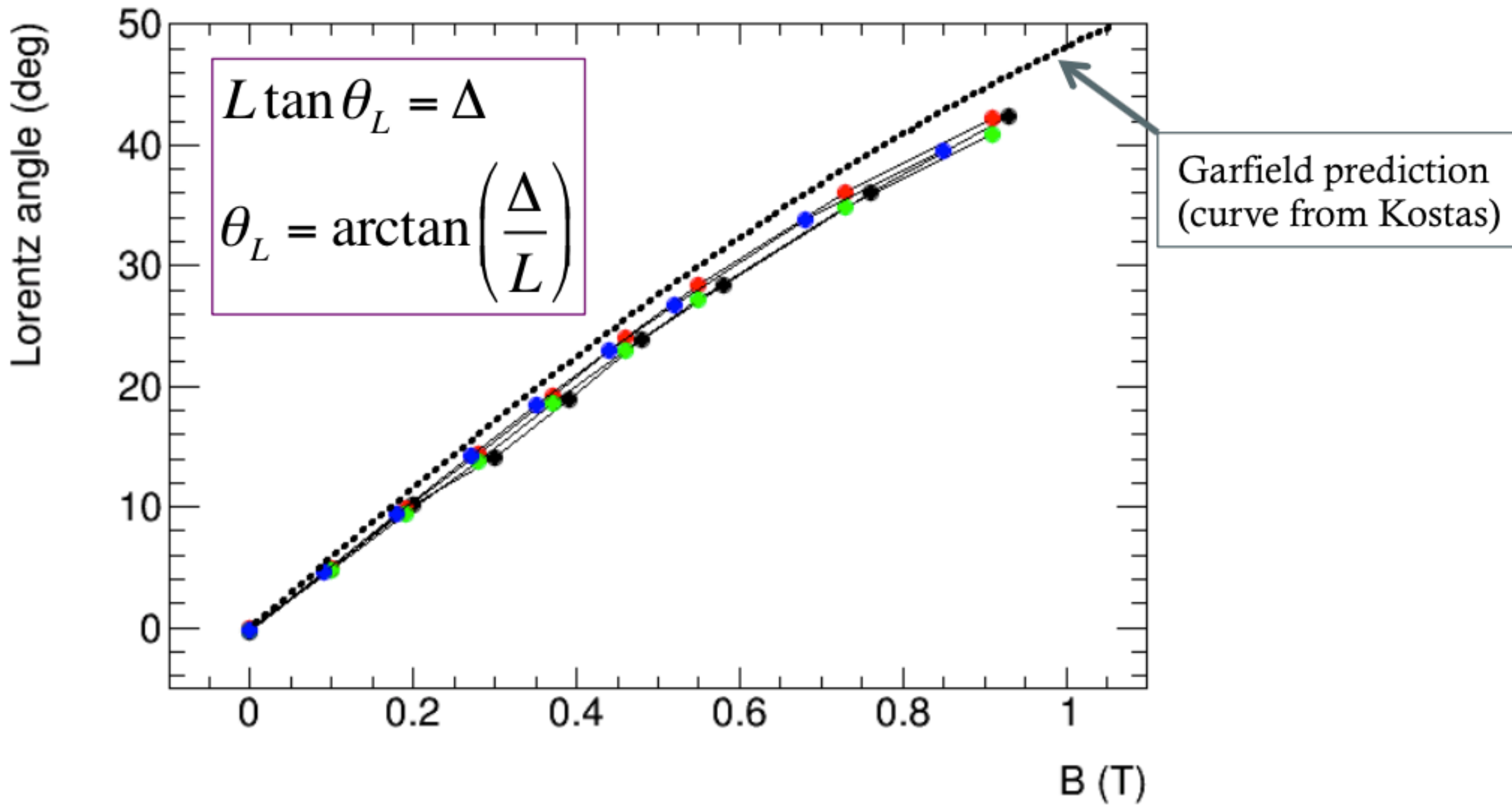
Centroid Resolution vs. Lorentz angle

Resolution obtained from the gaussian σ of centroid displacement *Δ*



Lorentz Angle vs. B

Lorentz Angle θ_L obtained from centroid displacement Δ and gap size L



$\approx$ 5% below Garfield prediction but qualitative agreement