

SM2 Micromegas Modules in the LMU Cosmic Ray Facility

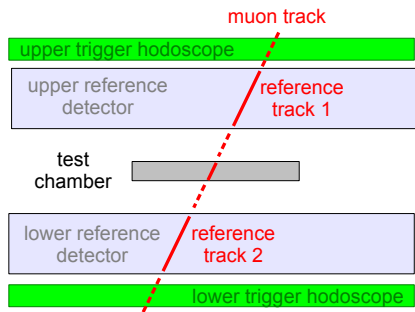
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Muon Week 06.02.2019

- 1 Cosmic Ray Facility
- 2 Noise Study with preliminary APV25 Electronics
- 3 Reconstruction of Readout Board Alignment
- 4 Ar:CO₂ Gas Mixture Studies

Cosmic Ray Facility

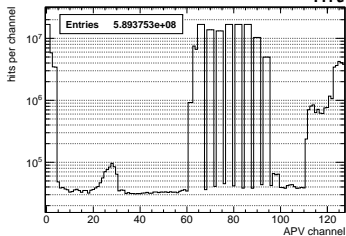


trigger	scintillator hodoscope
track reconstruction	$2 \times$ Monitored Drift Tube chambers (MDTs)
active area	$2.2 \text{ m} \times 4 \text{ m}$
angular acceptance	$\pm 30^\circ$
energy cut	iron absorber (32 cm)
readout (full SM2)	12288 channels
	→ 96 APVs (frontend electronics)
	→ 6 FECs (scalable readout system)
readout rate	100 Hz (online zerosuppression)
	→ 70 Hz for 1.5 Modules

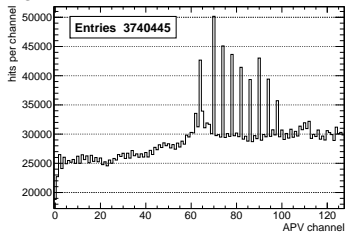
Noise Study with preliminary APV25 Electronics

Intrinsic APV Noise

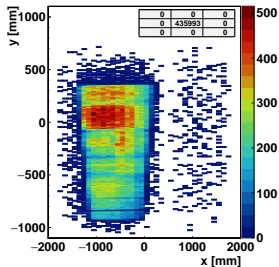
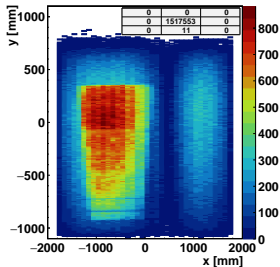
event-wise zero-suppression



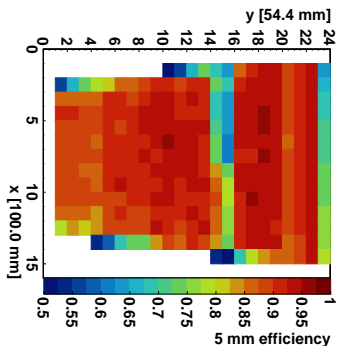
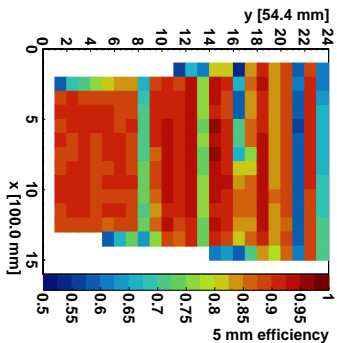
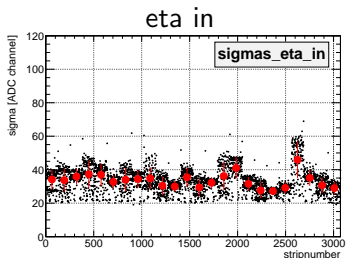
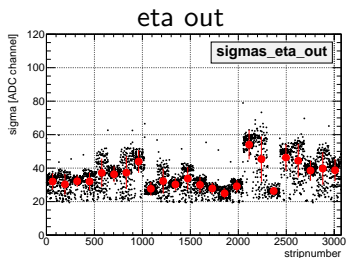
averaged sigma (10k trigger)



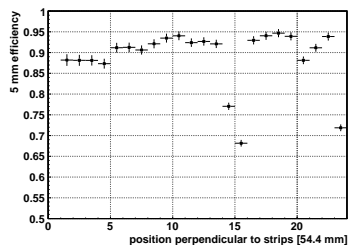
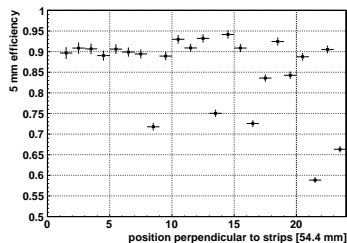
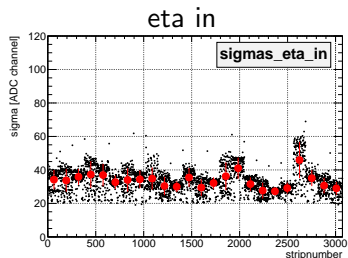
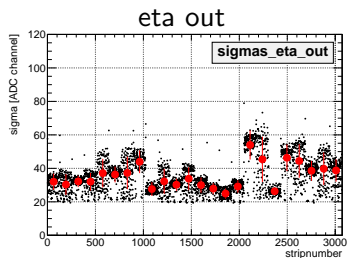
hit distribution



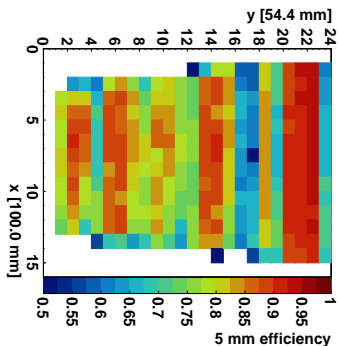
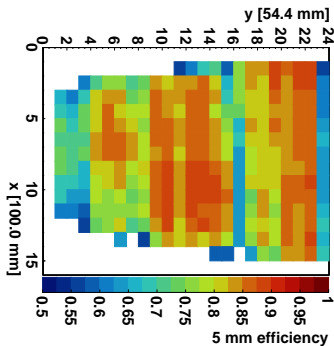
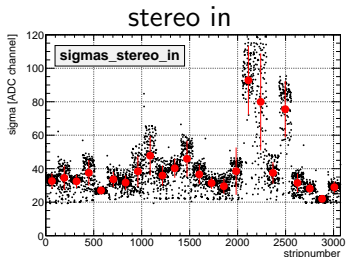
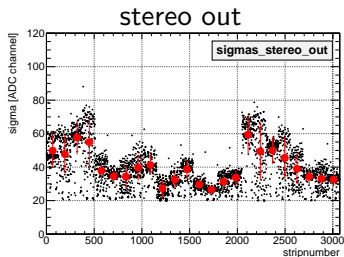
Influence of APV Noise on Efficiency (M7 eta layers)



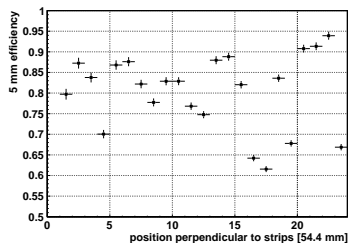
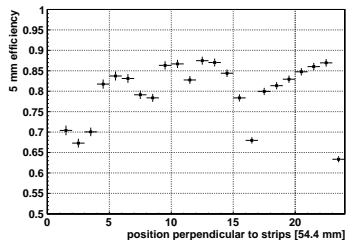
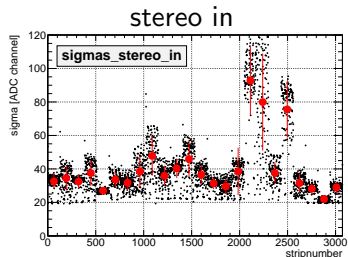
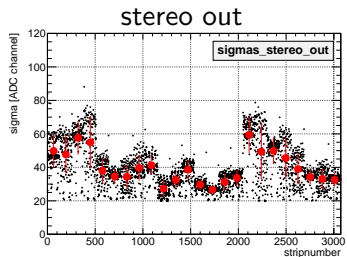
Influence of APV Noise on Efficiency (M7 eta layers)



Influence of APV Noise on Efficiency (M7 stereo layers)



Influence of APV Noise on Efficiency (M7 stereo layers)

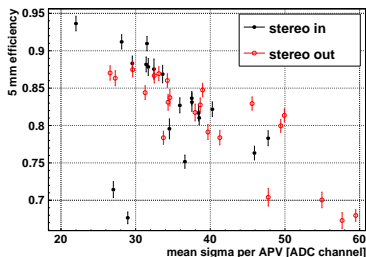
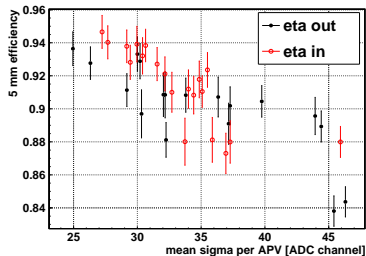


Correlation of APV Sigma and Efficiency

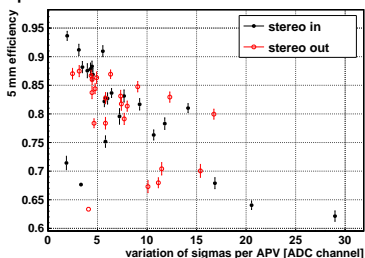
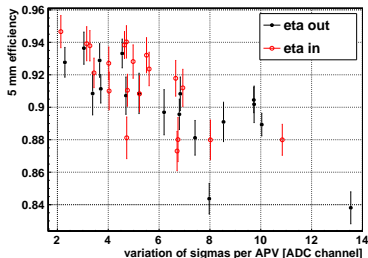
etas

stereos

mean sigma per APV

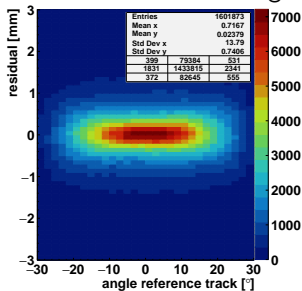


variation of sigmas per APV

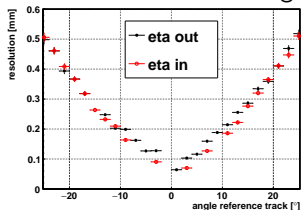


Reconstruction of Readout Board Alignment

centroid residual VS angle

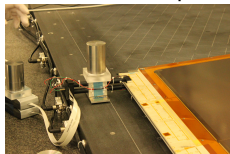


centroid resolution VS angle



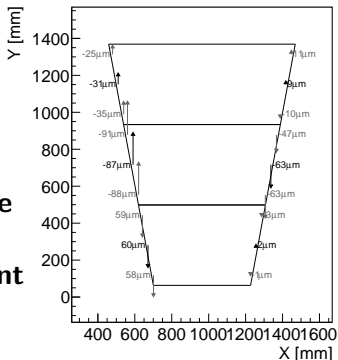
⇒ good resolution achievable

rasfork setup



shifts between sides of eta3

Rasfork: RS2E00003 (top side: GS1)

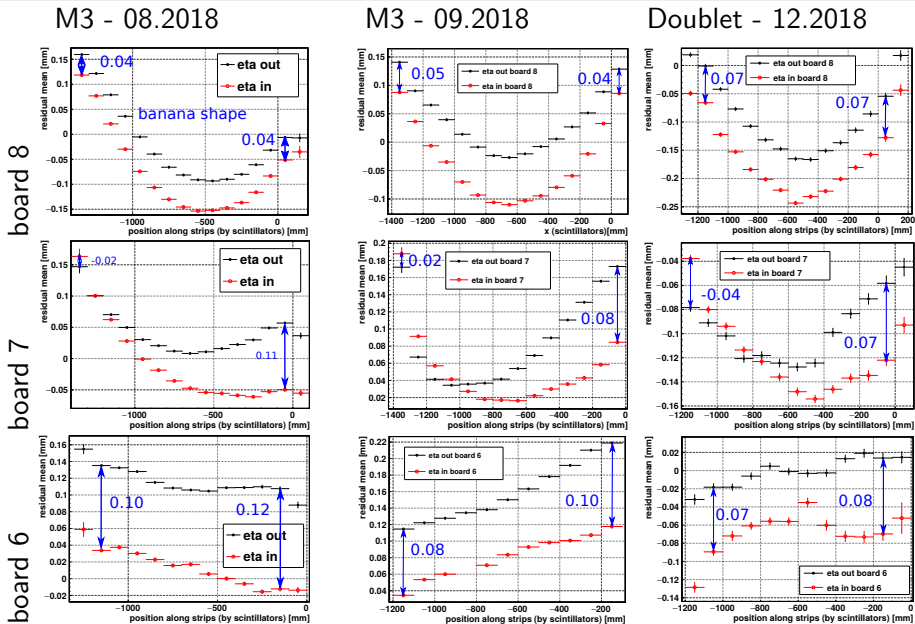


compare

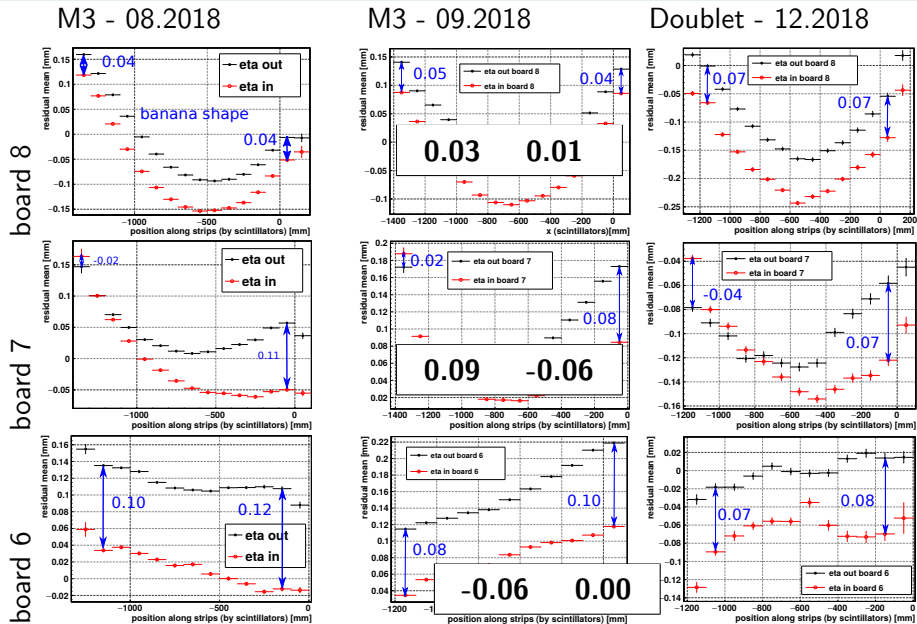


alignment

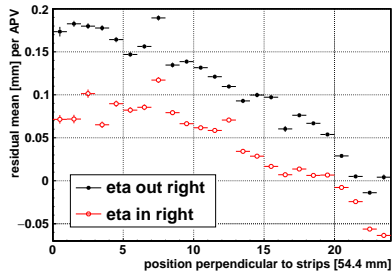
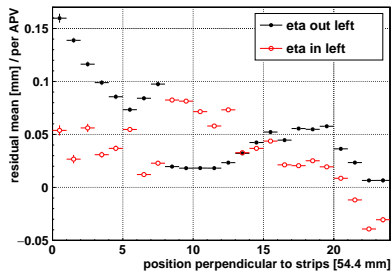
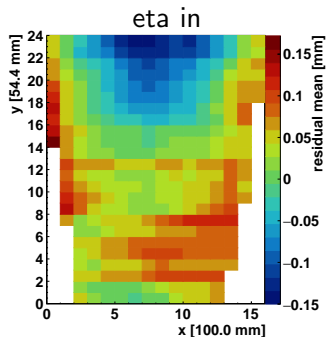
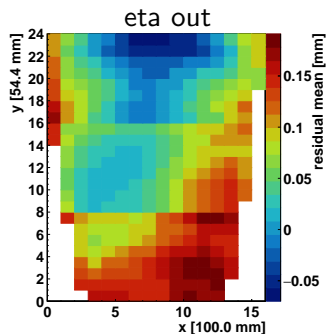
Residual Mean VS Position Along Strips for Eta3



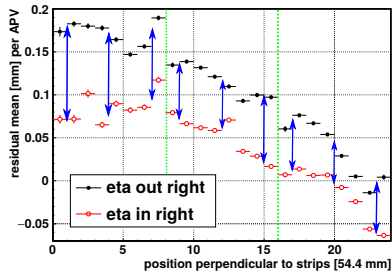
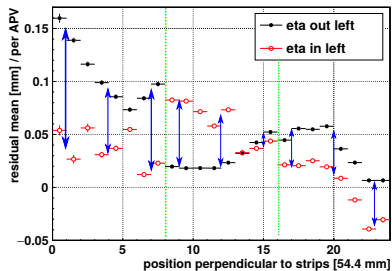
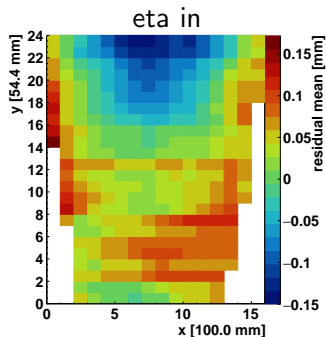
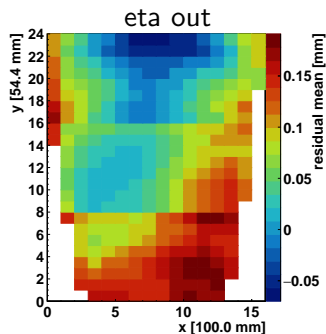
Residual Mean VS Position Along Strips for Eta3



Mean Residual Per Partition



Mean Residual Per Partition



Comparison with each Marker (in $10\ \mu\text{m}$)

board	left		right	
	rasfork	cosmics	rasfork	cosmics
8	3	4	1	5
	3	3	1	5
	4	3	-1	6
7	9	1	-5	7
	9	-4	-6	6
	9	-6	-6	6
6	-6	8	0	7
	-6	6	0	10
	-6	11	0	11

\Rightarrow no correlation observable
crucial impact of strip shape on reconstruction

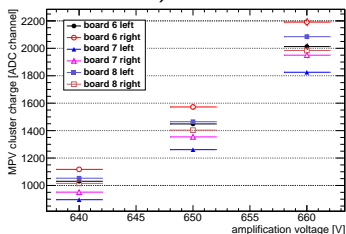
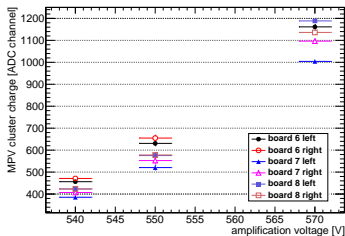
Ar:CO₂ Gas Mixture Studies

Comparison of Pulse Height and Efficiency

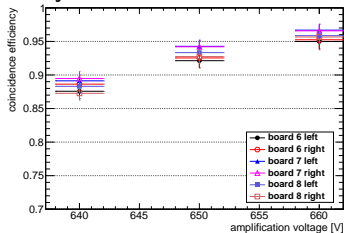
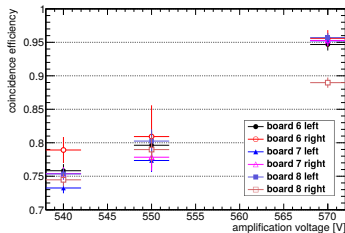
Ar:CO₂ 93:7 vol%

Ar:CO₂ 80:20 vol%

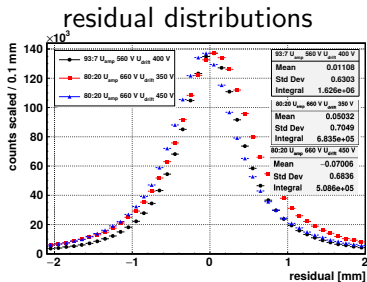
MPV cluster charge (not same scale!)



coincidence efficiency



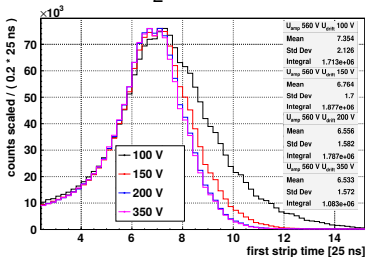
Comparison of Position and Time Resolution



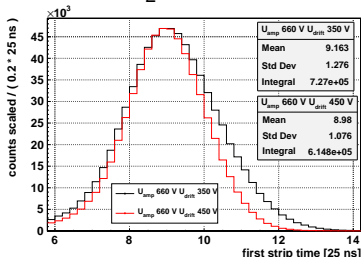
⇒ comparable residuals for both mixtures and drift voltages

⇒ better time resolution for 80:20

first strip time
Ar:CO₂ 93:7 vol%



Ar:CO₂ 80:20 vol%



Summary

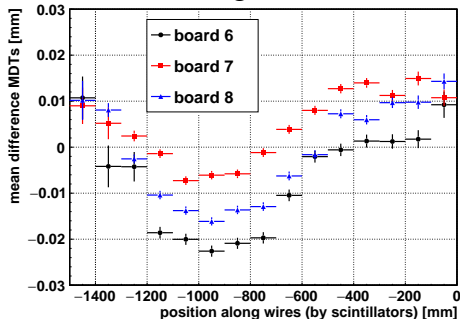
- noise of preliminary APV electronics limits efficiency
⇒ improve grounding for next measurements
- no concluding comparison of alignment measurements
⇒ more statics will improve understanding of systematics
- very good behavior with different gas mixture of Ar:CO₂ 80:20 vol%
⇒ resolution (position and time) has to be further investigated

Backup

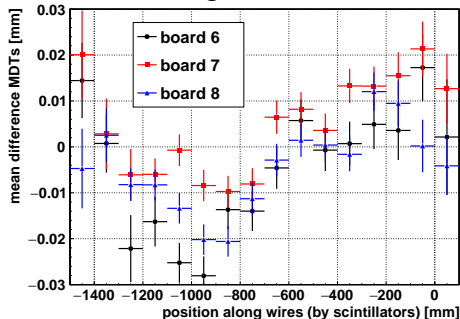
CRF systematics

systematics due to different placement in CRF
⇒ investigate effect of CRF tracks

during M3

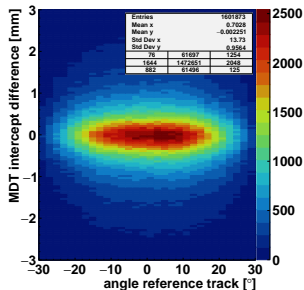


during Doublet

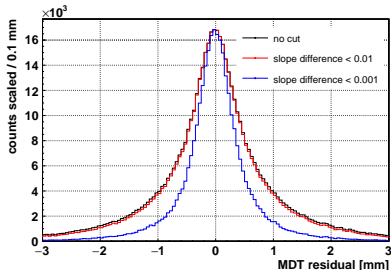
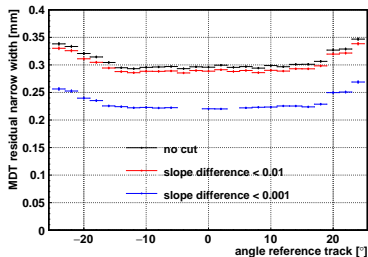
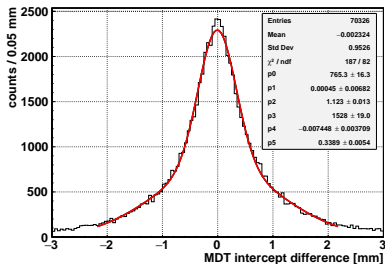


Influence of Multiple Scattering on MDT Track Prediction

MDT difference VS angle



MDT difference, angle $\in [0^\circ, 2^\circ]$



Reconstruction of Readout Board Alignment (Single Layer, example M0 - eta in)

