

Studies of resistive detectors for CLAS12

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Content

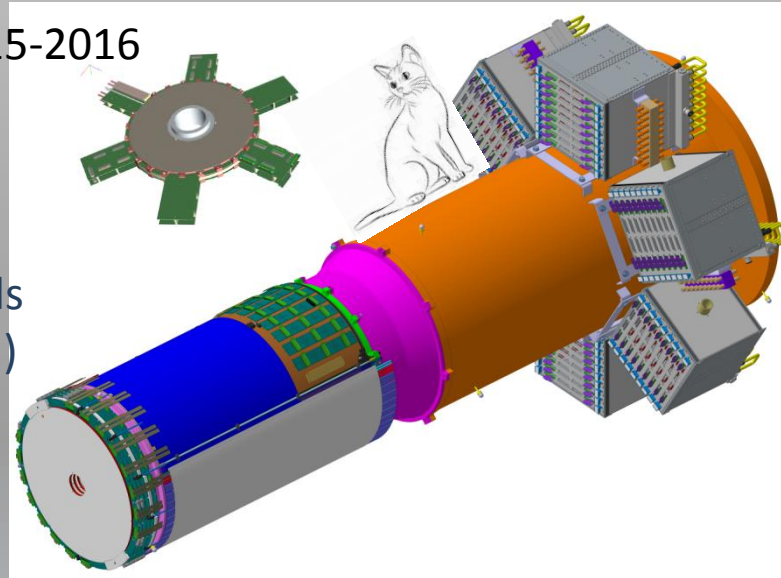
- CLAS12 Micromegas project
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CLAS12 Micromegas @ Jefferson Lab

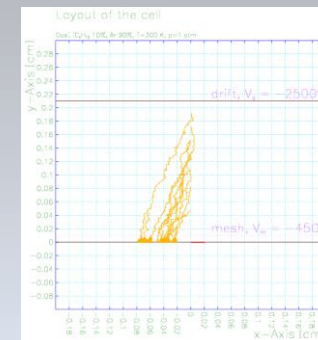
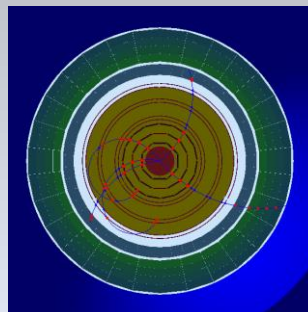
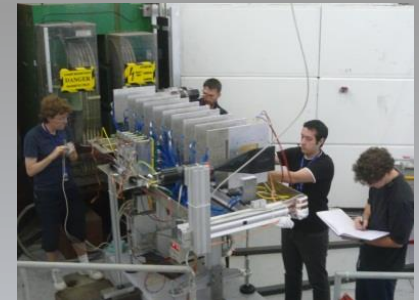
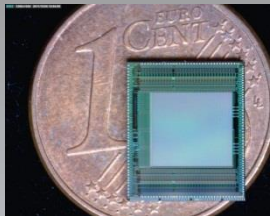
Study of the nucleon structure with high 12 GeV electron beam at high luminosity

4 m² to be installed in 2015-2016

- Barrel: 18 tiles
- Forward: 6 disks
- FT: 4 rings
- 24,000 readout channels
- Dedicated chip (DREAM)



- 1st curved Micromegas
- 1st use in 5T field
- 1st use of remote elec
- Resistive technology
- High rate (30 MHz)



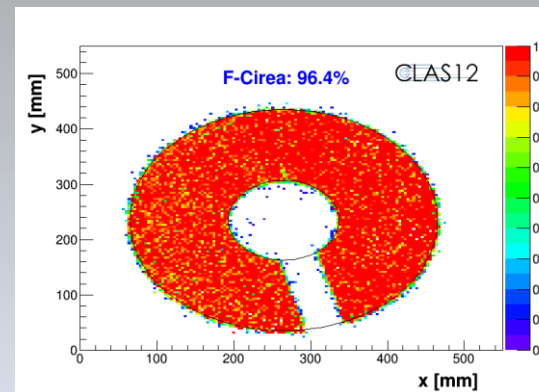
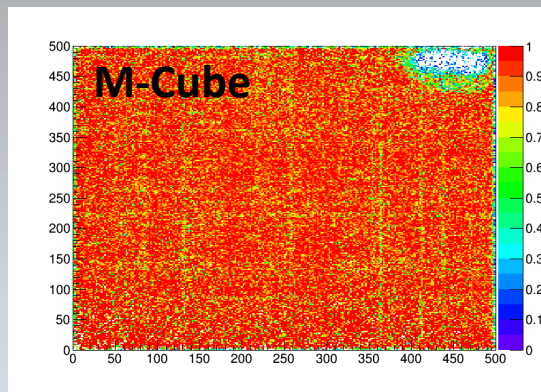
List of detectors tested

10 CLAS12 & M-Cube detectors were tested in our cosmic bench

→ 9 resistive + 1 non resistive

Detector	experiment	resistive	Active area	manufacturer	year	Drift frame
Forward prototype	CLAS12	Hand, no ladder	R=20 cm	ELVIA	2013	Epoxy
Forward preserie	CLAS12	Screen printing, ladders every 2 cm	R=18.5 cm	CERN	2014	?
Barrel preserie (x2)	CLAS12	Screen printing, ladders every 8 cm	45x37 cm ²	CERN	2014	Carbon ribs
Forward Tagger prototype	CLAS12	no	R=14.6 cm	CERN	2013	Epoxy
MultiGen 2D (4x)	M-Cube	Screen printing with ladders	50x50 cm ²	CERN	2014	Aluminum
MultiGen 2D	M-Cube	Screen printing with ladders	50x50 cm ²	CERN+ELVIA	2014	Aluminum

→ Detectors without current between resistive strips and mesh are perfectly fine...



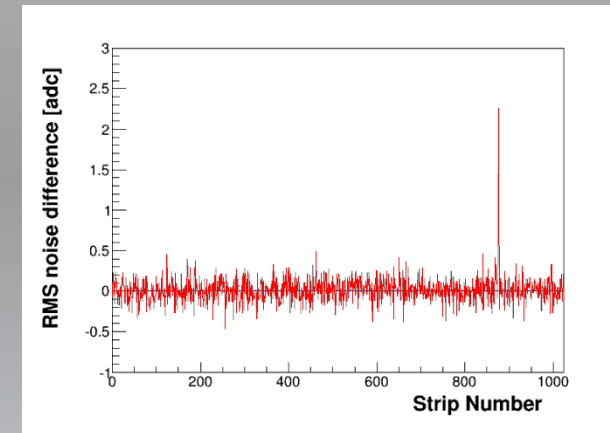
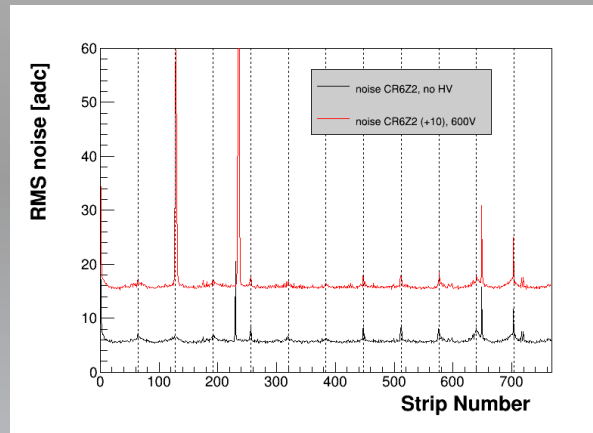
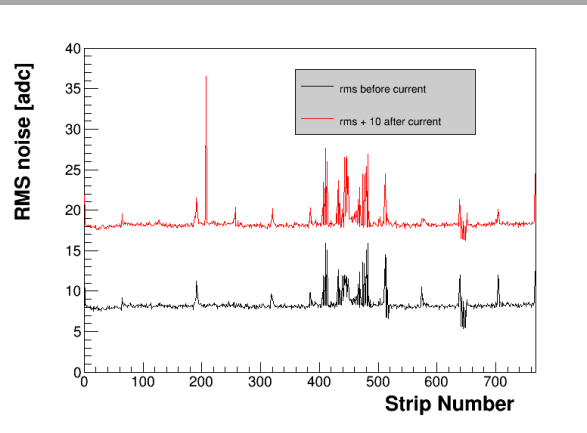
talk by S. Bouteille

Current & noise

4 detectors suddenly suffered from relatively high current after a few days of operation

- current typically ranges from 1 to 50 micro-Amps (!)
- data are available before and after current development

Observation 1: when current appears, significant noise is observed on individual strips



(... or HV dependent noise)

⇒ *suggests a localized defect, like dust or fragment*

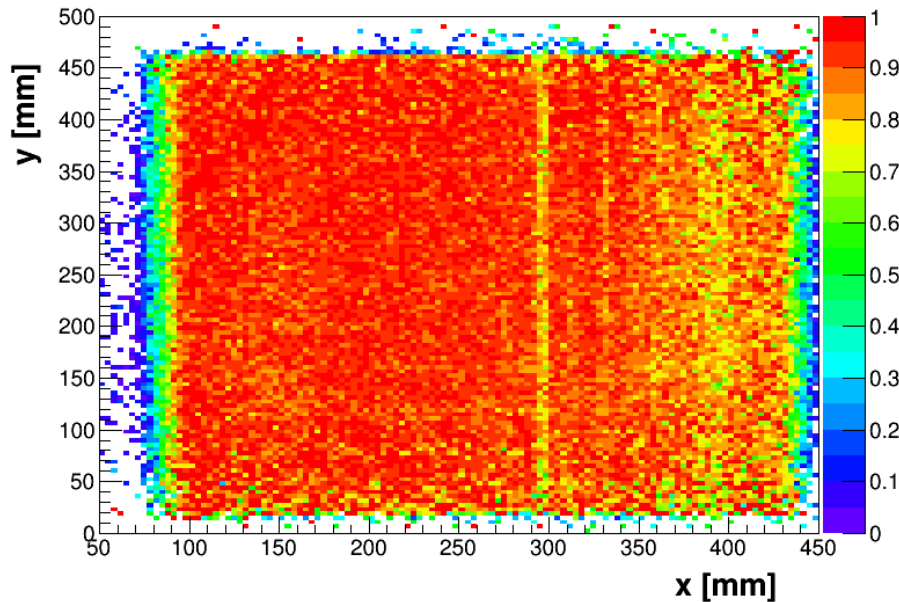
⇒ *noise measurement can easily give (1D) position of it*

Current & efficiency

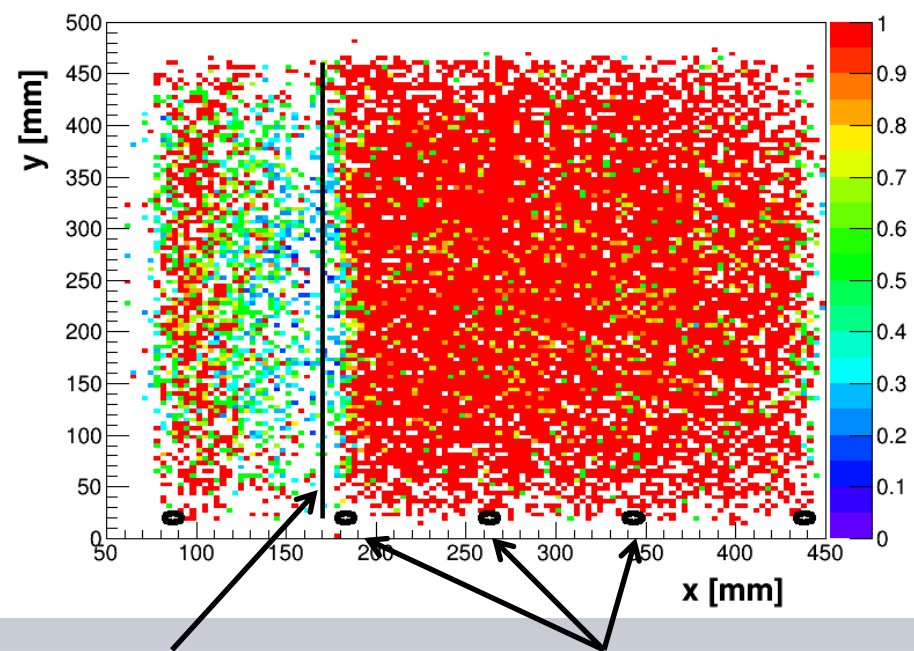
Observation 2: in the case of resistive detectors, this current affects the 2D efficiency in a relatively large region around the noisy strip(s)

→ case of the Barrel pre-serie

without current



with current



position of the noisy strip

position of resistive contacts

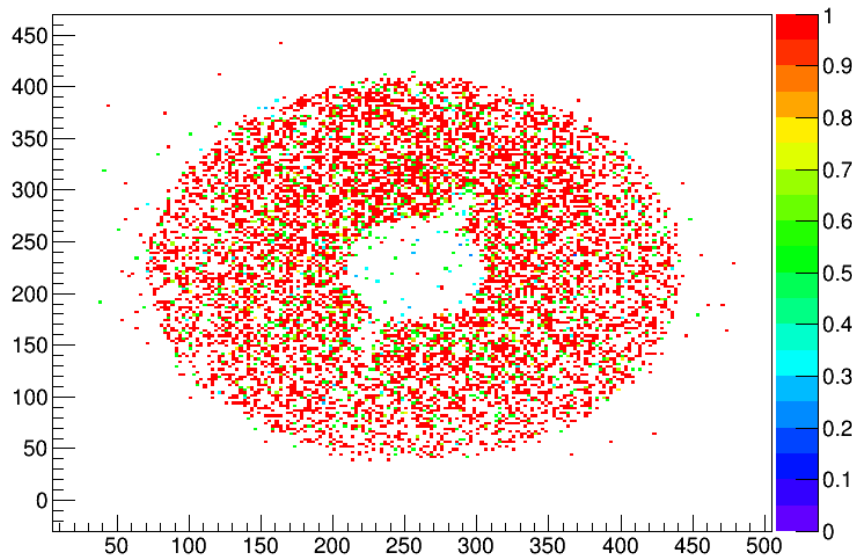
⇒ *resistive ladders seem to spread the current around the resistive noisy strip*

Current & efficiency

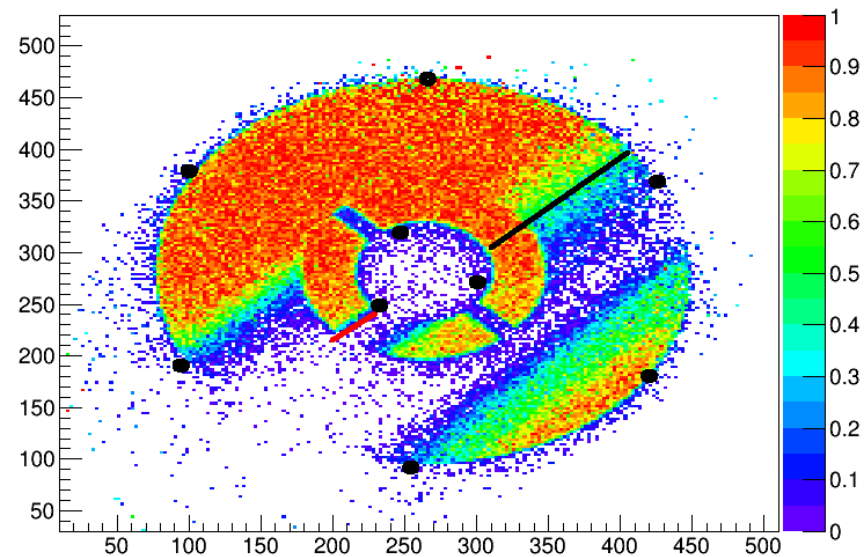
Observation 2: in the case of resistive detectors, this current affects the 2D efficiency in a relatively large region around the noisy strip(s)

→ case of the Forward pre-serie

without current



with current



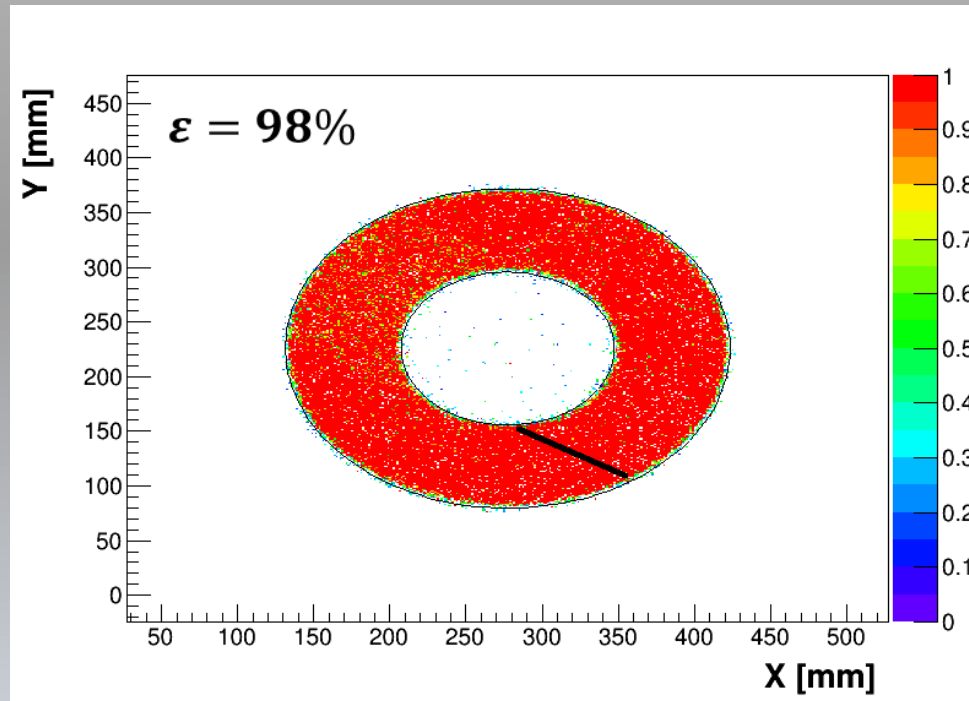
⇒ *unefficiency regions are determined by the position of the contacts to the resistive film*

Non resistive detectors

1 non resistive detector was found to have a similar, micro-Amp current

→ noisy strip was detected as for resistive detectors...

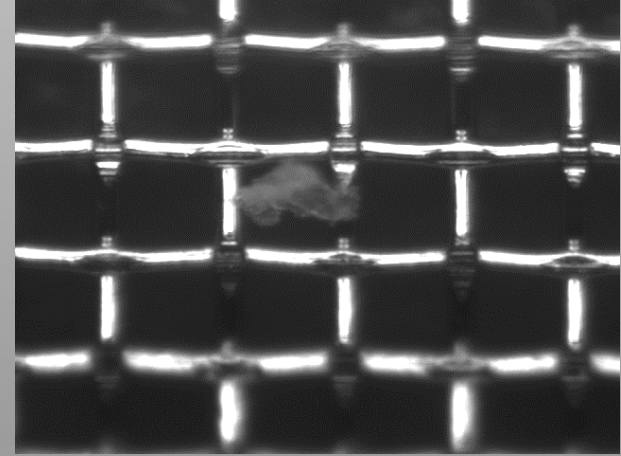
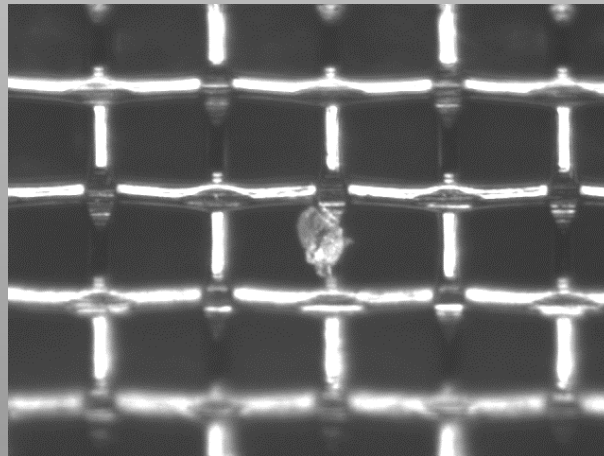
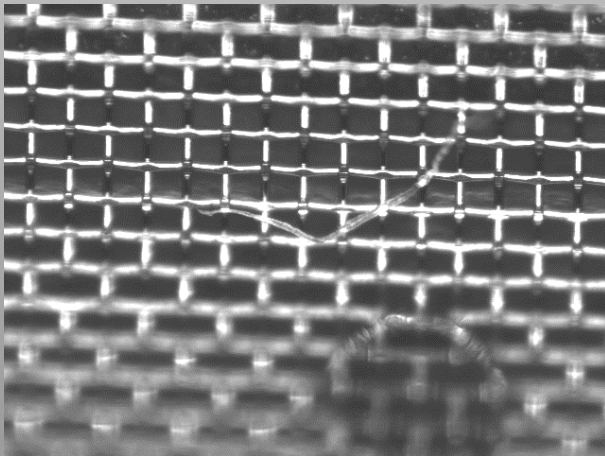
→ ... but no unefficiency observed



⇒ despite a strong urban legend, Micromegas can work perfectly well with very high current

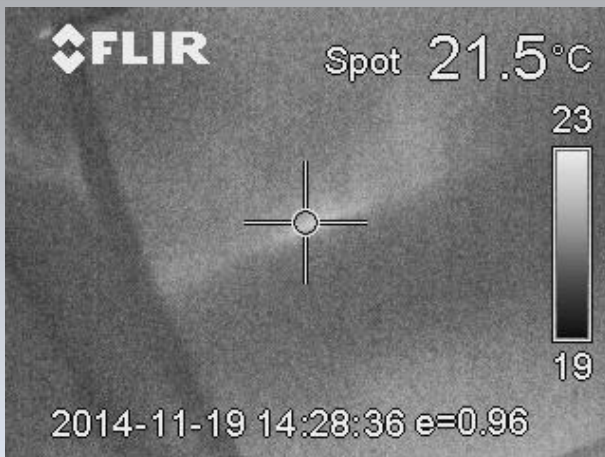
Localization attempts

Noisy strips were investigated with microscope



→ ... no evidence of a problematic zone or defect

Detectors were also checked with thermal cam (trying to detect heat from current)



→ spot observed @ very high current, but microscope investigations didn't reveal any suspicious defect

→ such defect may indeed not be visible if completely hidden by the mesh

Conclusion

Several resistive detectors developed large, unusual currents

- can still be operated, but affect the efficiency

Origin of the defect not clear

- very localized (dust, fragment)
- visible only on CLAS12 detectors, not a single M-Cube is affected

Strategy for CLAS12 production

- integration in cleaner room (100,000 => 10,000)
- increase the number of contacts in the resistive
- suppress ladders in Barrel and Forward outer (not strictly needed)
- change carbon frames for peek or Aluminum