

ATLAS Micromegas Project

--- an update ---

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MAMMA Collaboration

Arizona, Athens (U, NTU, Demokritos), Brandeis, Brookhaven, CERN, Carleton, Istanbul (Bogaziçi, Doğuş), JINR Dubna, MEPHI Moscow, LMU Munich, Naples, CEA Saclay, USTC Hefei, South Carolina, Thessaloniki

Activities since Kobe

New chambers:

Construction efforts concentrate now on simplification and cost reduction issues

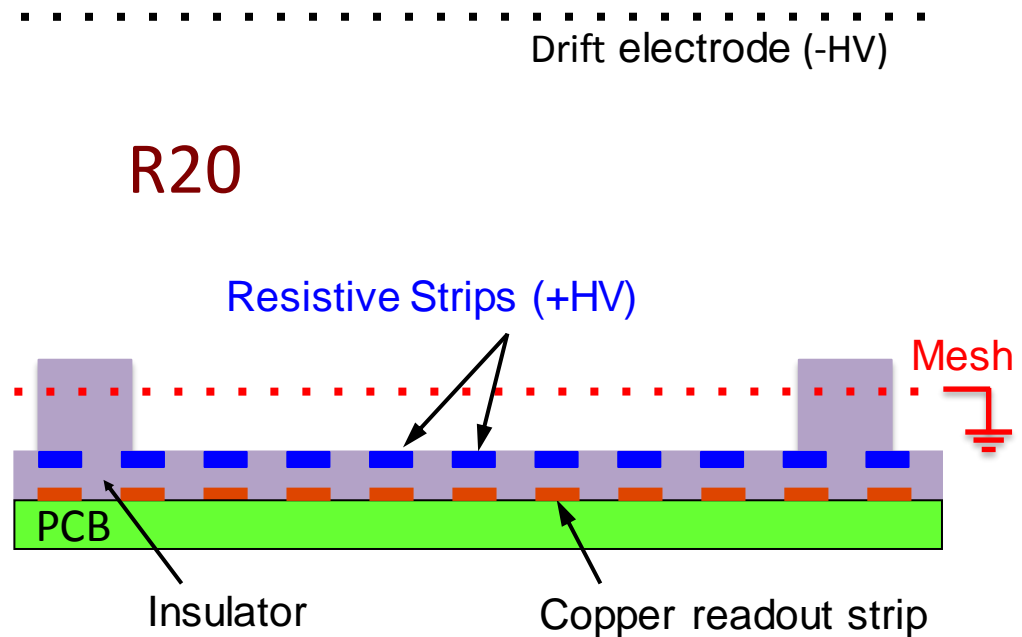
- R21 following inverted HV scheme of R20 (R strips on +HV potential, mesh at ground potential); x-y readout strips, new structure
- MBT0: two-gap chamber to be installed in ATLAS in front of the electromagnetic calorimeter this winter shutdown
- CR4: 1.2 x 0.5 m² resistive-strip chamber, with mesh at Ground and R strip on +HV potential

Test beam activities:

- H6 (October 12–22)
- Neutron beam at Garching (Munich)

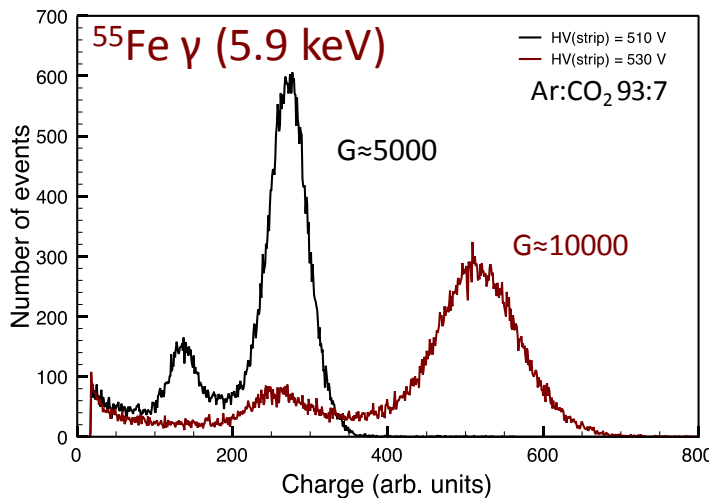
R20 (inverted HV schema)

- Resistive strip chamber with inverted HV scheme
- Single coordinate (x) with 250 μm strip pitch
- Fairly high resistivity values
 - $R_{\text{GND}} \approx 200 \text{ M}\Omega$
 - $R_{\text{strip}} \approx 150 \text{ M}\Omega/\text{cm}$

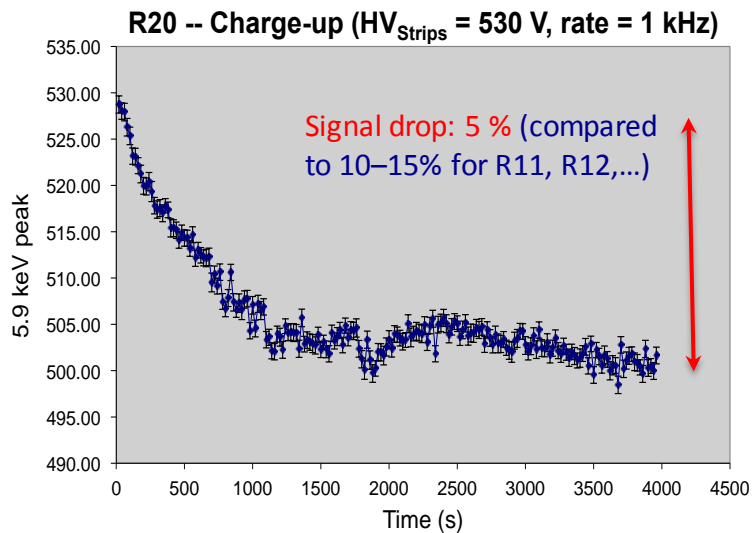
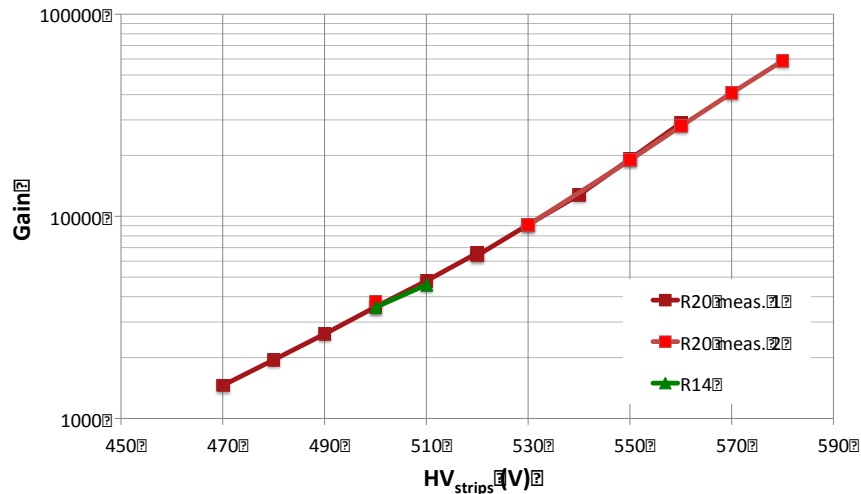


Inverting the HV connection scheme with the mesh on ground potential and the resistive strips on +HV leads to a considerable simplification of the manufacturing process

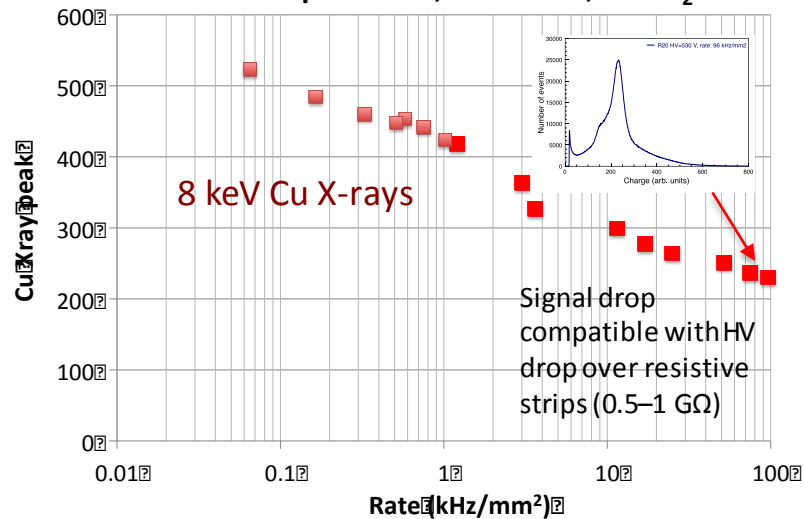
Performance of R20 (+HV on strips)



R20 (mesh at GND) -- Gain vs R-strip HV Ar:CO₂ (93:7)

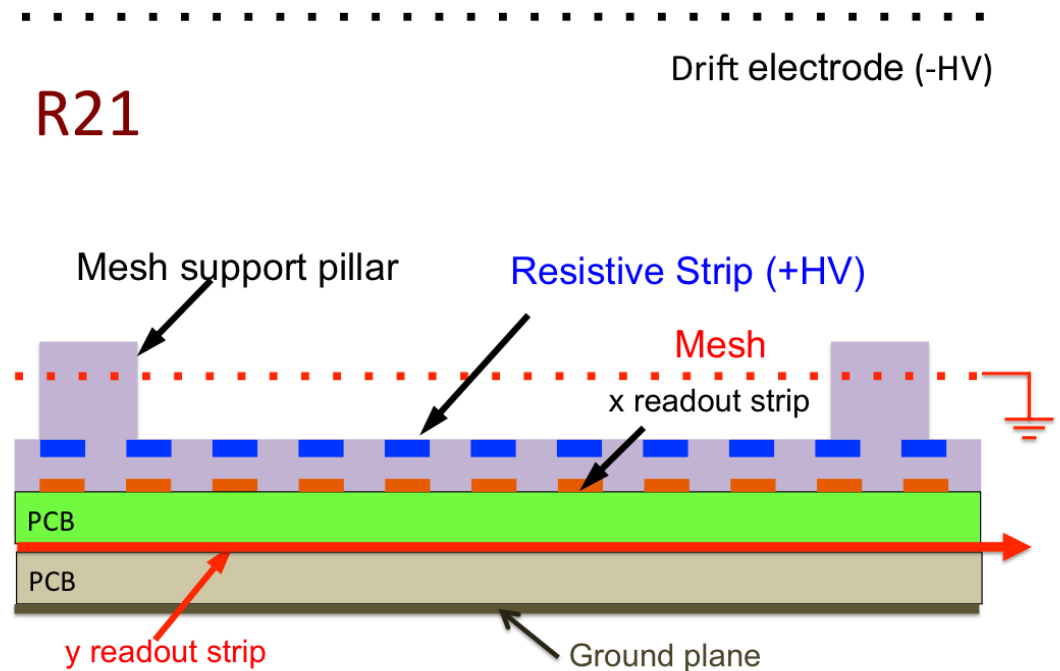


R20 -- Rate dependence, $G \approx 10000$, Ar:CO₂ 93:7



R21 (x-y readout coordinates)

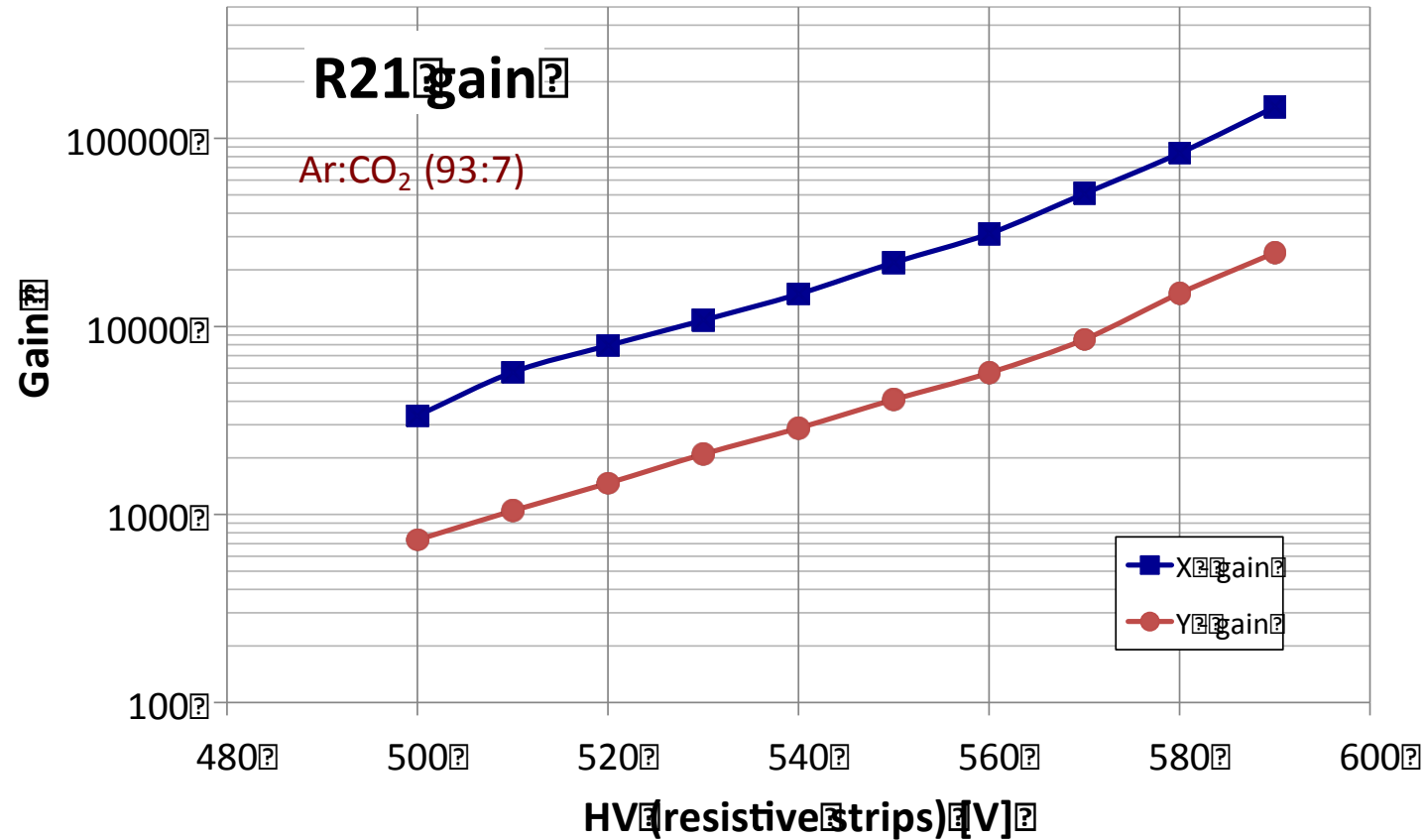
- Readout strips on two sides of thin PCB (0.8–1 mm) carrying the MM structure
- No through holes; connectors on both sides of the PCB
- Avoids multi-layer PCBs
- Simplification of production and cost reduction
- Strips
 - x pitch = 0.5 mm (0.1 mm)
 - Y: pitch = 1 mm (0.9 mm)
 - PCB = 1 mm
- Resistivity values too high
 - $R_{\text{GND}} \approx 250 \text{ M}\Omega$
 - $R_{\text{strip}} \approx 150 \text{ M}\Omega/\text{cm}$



Charge sharing not (yet) well matched

- $Q(x):Q(y) \approx 5:1$

R21 gain measurement



Chamber extremely quiet

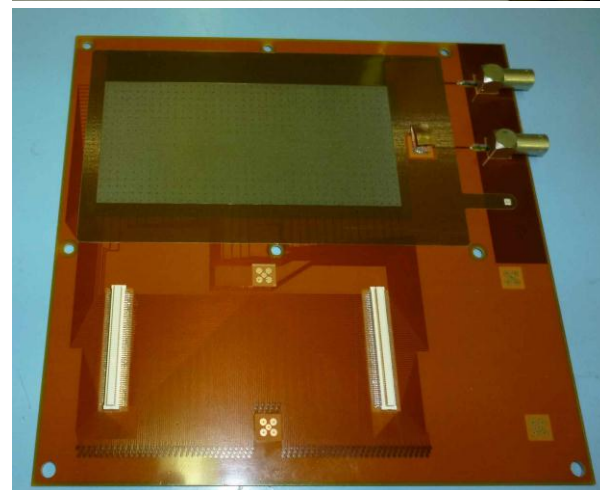
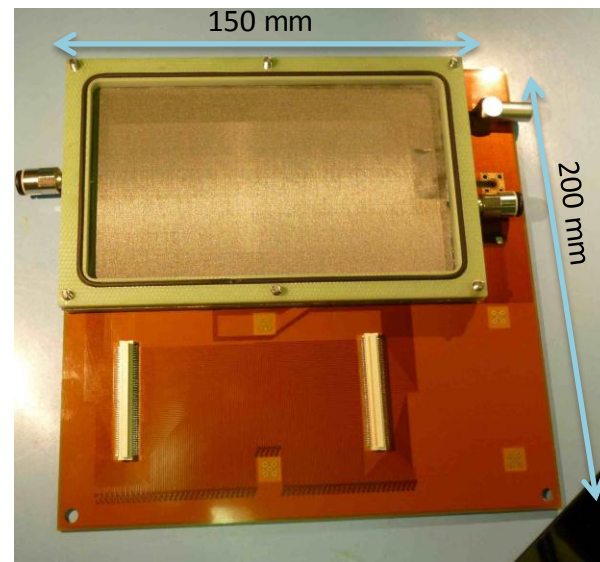
Gains above 10^5 for x strips

Charge sharing not (yet) well matched

■ $Q(x):Q(y) \approx 5:1$

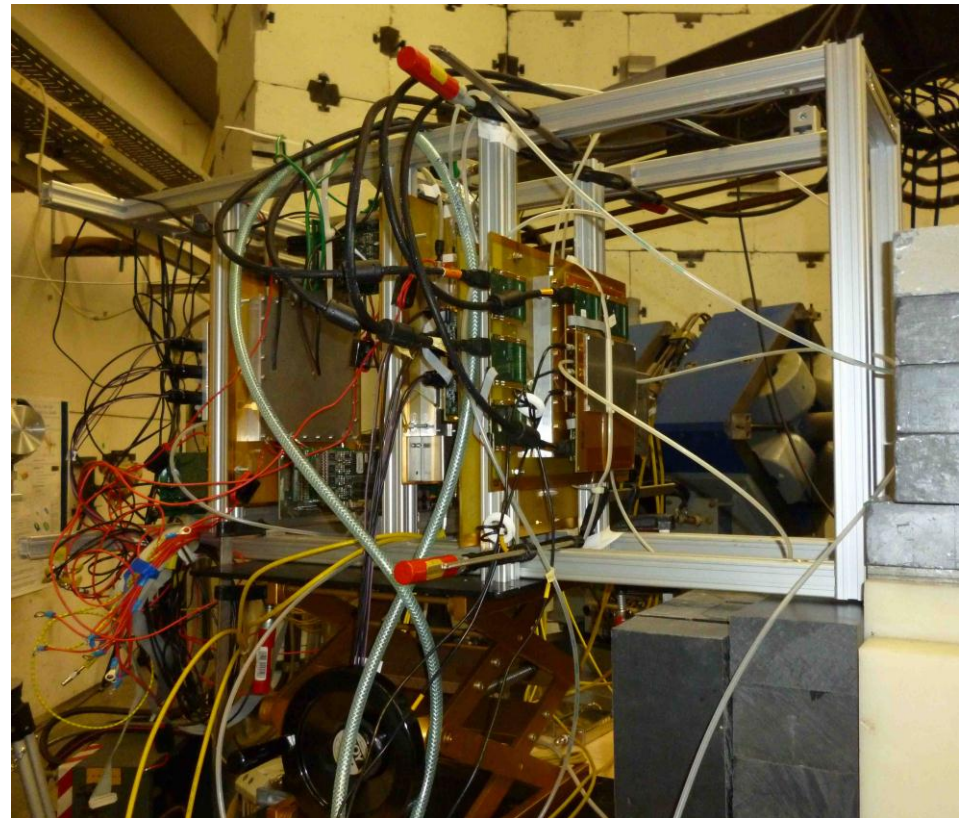
Other recent chambers: MBT0

- Small chamber to be installed in ATLAS in front of the electromagnetic calorimeter, at the outer rim of the MBTS
 - Expected particle rates: 1 MHz/cm²
- Double gap chamber with x and u (v) readout strips
 - 190 x strips: 0.5 mm pitch
 - 66 u(v) strips: 1.5 mm pitch
- Readout planes face-to-face
- Common drift electrode
- Inverted HV scheme
- Thickness 16 mm



Recent test beam activities

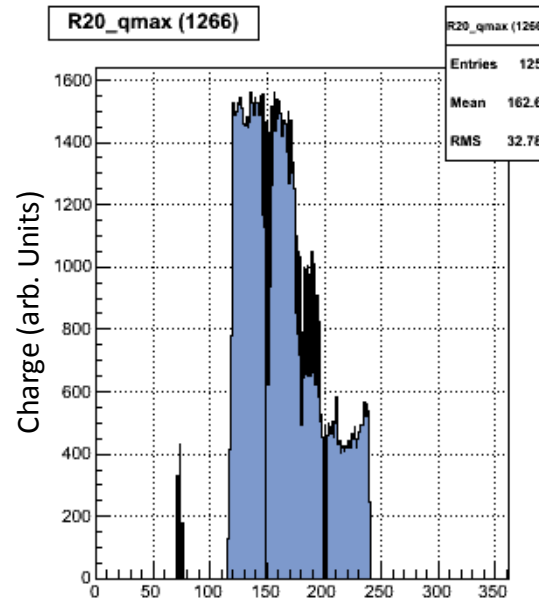
- 13-22 Oct.: H6 test beam at CERN (120 GeV pions)
 - Five chambers tested: R18, R19, R20, R21, MBT0, CR2 (large MM)
 - Rate and resolution studies
- 3-9 Nov.: 2.4 MeV neutron beam at Garching/Munich (up to 1.5×10^6 n/cm²/s)
 - Three chambers exposed: R20, R21, MBT0
 - All chambers worked nicely
 - Took successfully data with cosmics and random triggers to study the interaction probability of neutrons and photons



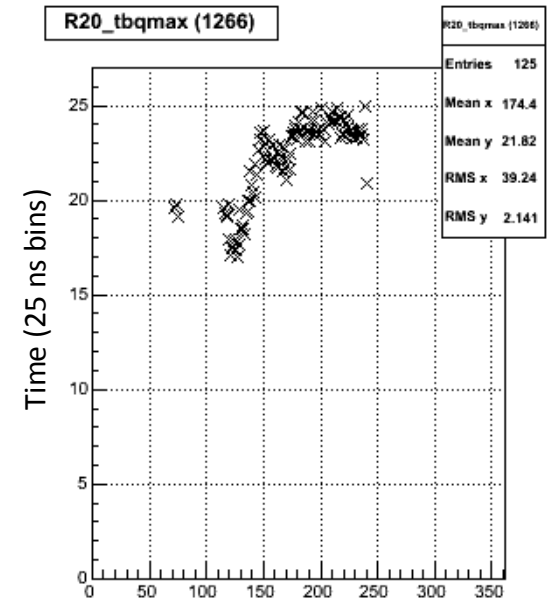
Test setup in neutron beam at Garching (Nov 2011)

Neutron interaction ?

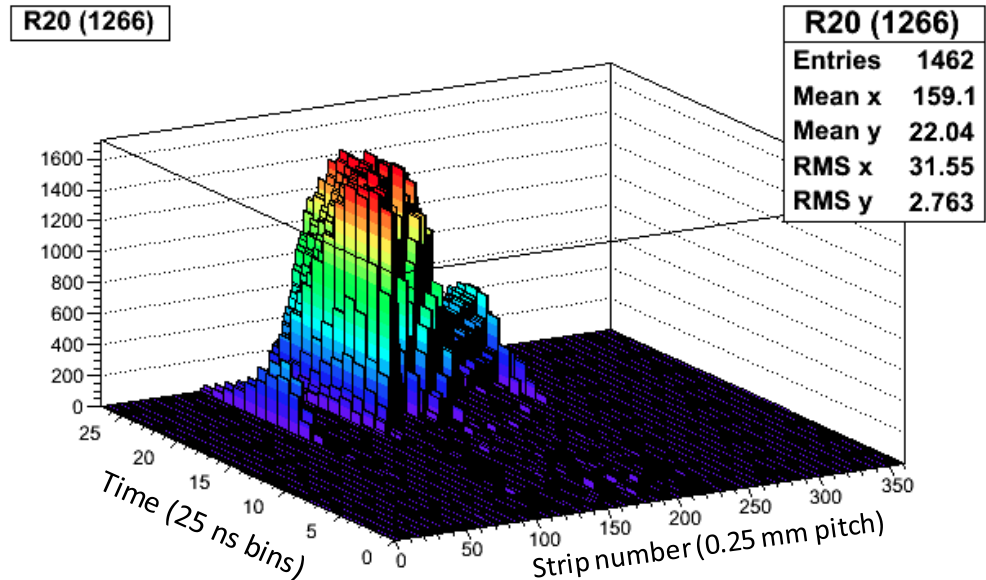
The charge in strips 110 – 170 exceeding the dynamic range of the APV25; the ADC is in overflow



Strip number (0.25 mm pitch)



Strip number (0.25 mm pitch)

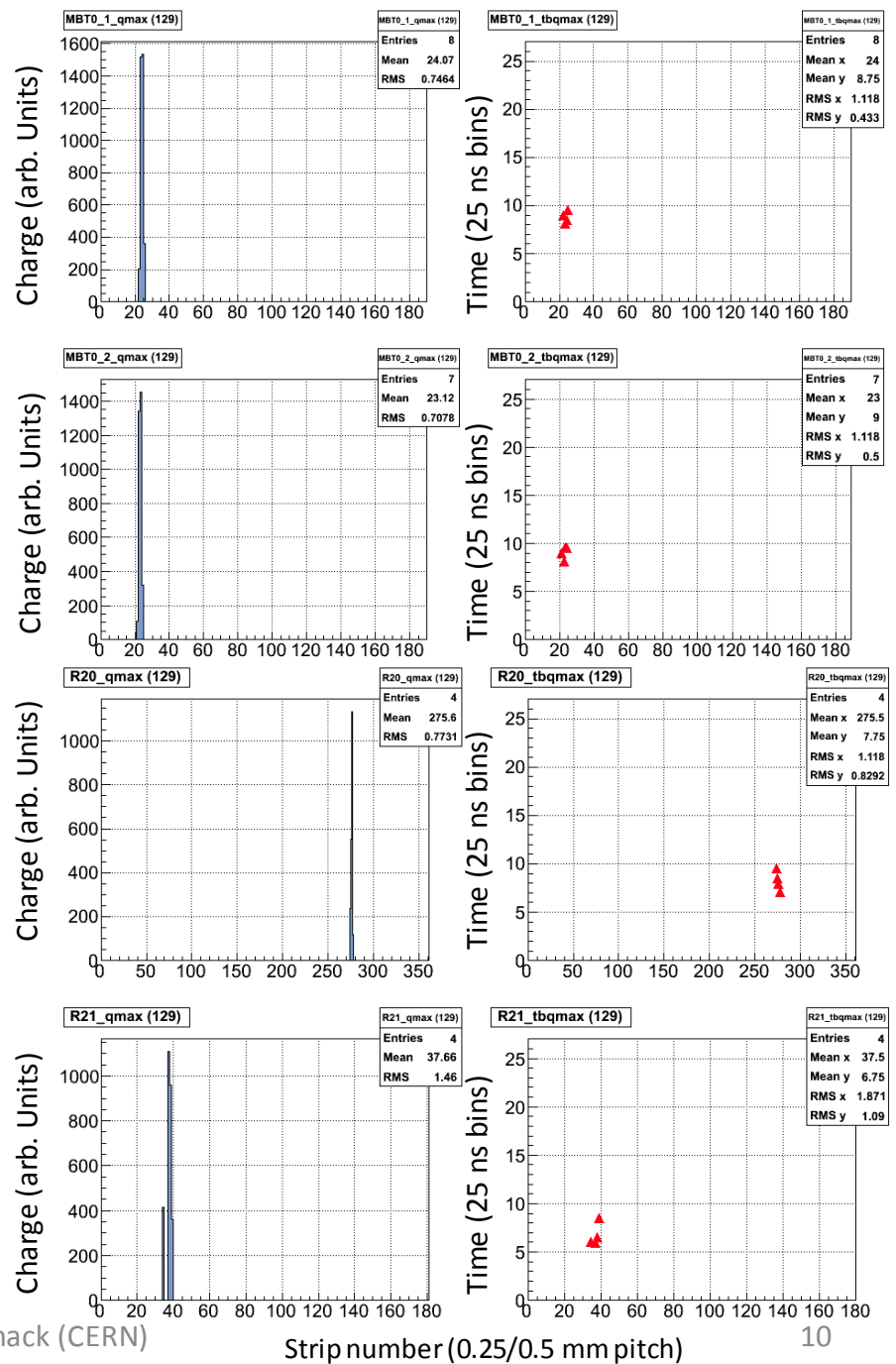


Cosmic track during neutron beam (100 nA)

Chambers are not well aligned.

Strip pitch in MBT0 and R21 is 0.5 mm, R21 has 0.25 mm pitch.

R20 and R21 are back-to-back, i.e. strip no. 360 in R20 and strip no. 1 in R21 are at the position in x.



The large-area MM chambers

Assembly of 1st large resistive MM in March 2011



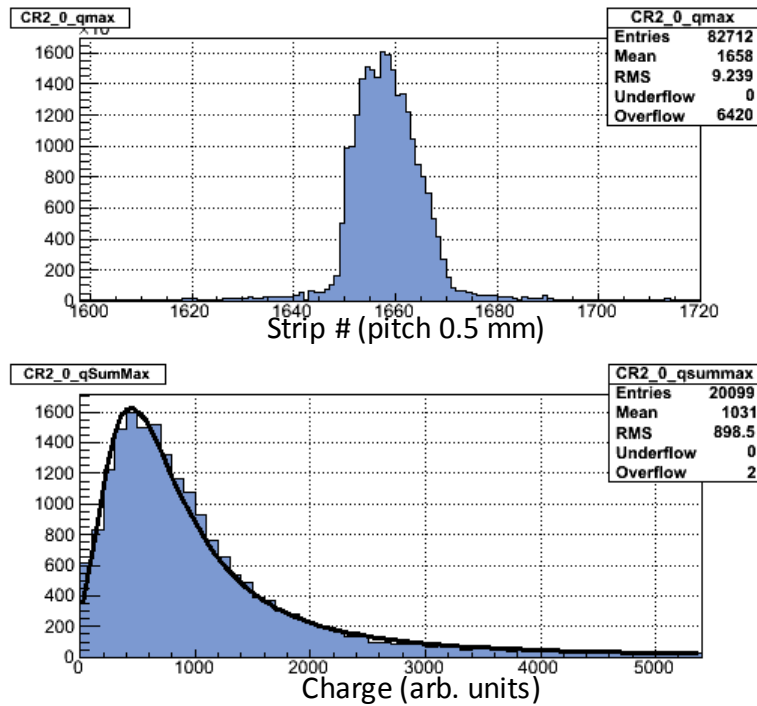
- Size: 1.2 x 0.6 m²
- 2048 circular strips
- Strip pitch: 0.5 mm
- 8 connectors with 256 contacts each
- Mesh: 400 lines/inch
- 5 mm high frame defines drift space
- O-ring for gas seal
- Closed by a 10 mm foam sandwich panel serving at the same time as drift electrode

Chamber in H6 test beam (July 2011)

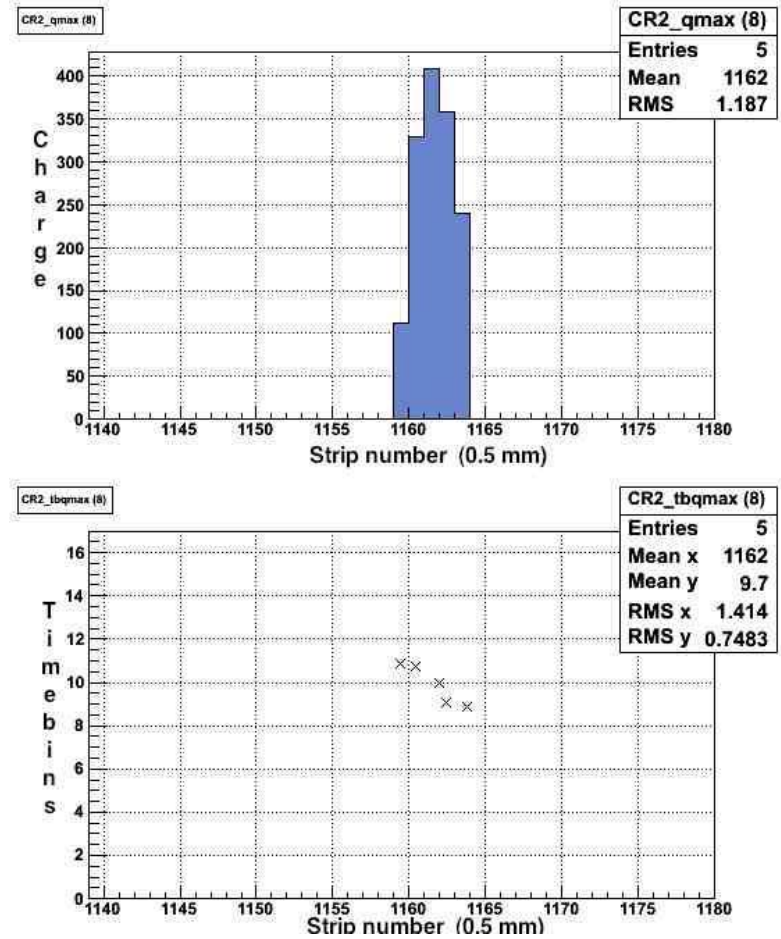


Experience with large (1.2 x 0.6 m²) MM

- The large MM with resistive strips and 0.5 mm pitch has been successfully tested in July and November in the H6 beam
- Stable operation and clean data

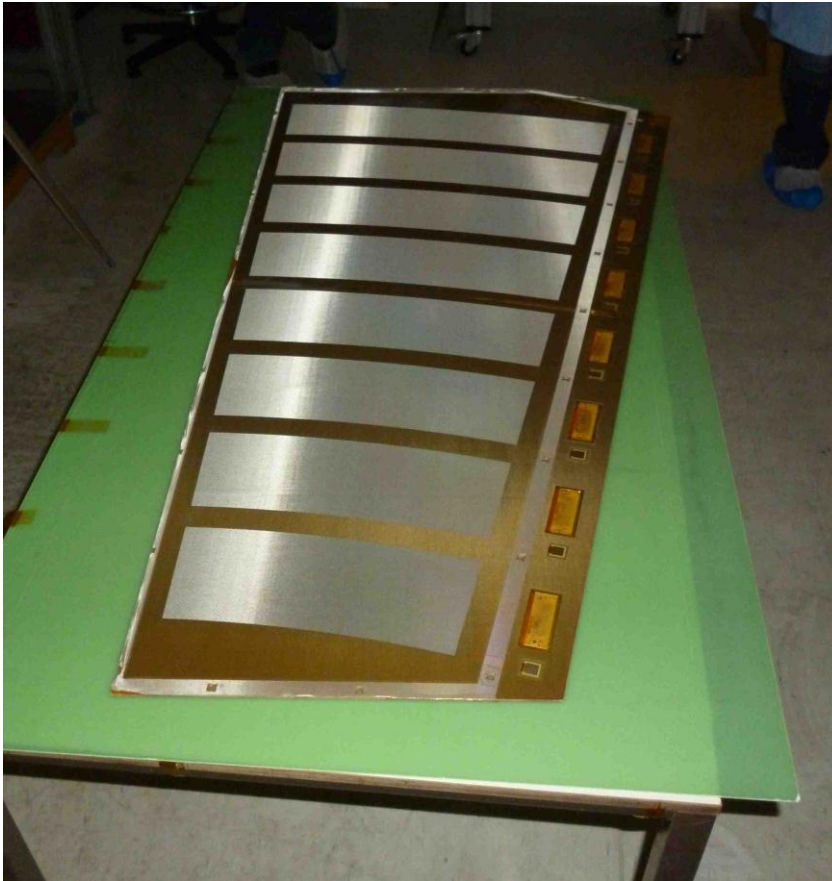


Hit map showing the beam profile (top) and charge spectrum (bottom)



Event display showing a track traversing the CR2 chamber under 20 degree

The 2nd large resistive chamber



- Chamber was completed end of last week
- Waiting to be assembled
- Electrical tests are OK
- Chamber employs the new HV scheme with the mesh on ground potential and the resistive strips on +HV

Next steps

- Qualify the 2nd large chamber with cosmics and possibly in a neutron beam (spring 2012 at Demokritos/Athens)
- Installation of MBT0 chamber in ATLAS during Xmas shutdown
- Construction of four 1.2 x 0.5 m² large chambers, assembled into a multilayer, to be installed during the Xmas shutdown in Sector 9, side A on the large CSC on the Small Wheel
 - Each plane will have x and u strips with pitches 0.5 and 1.5 mm
 - Design is completed; construction is expected to be finished by end of 2011
 - Work on integration of data readout into ATLAS DAQ started
- Go to 1 m wide chambers (after the completion of the upgrade of the CERN PCB workshop, early 2012 ?)