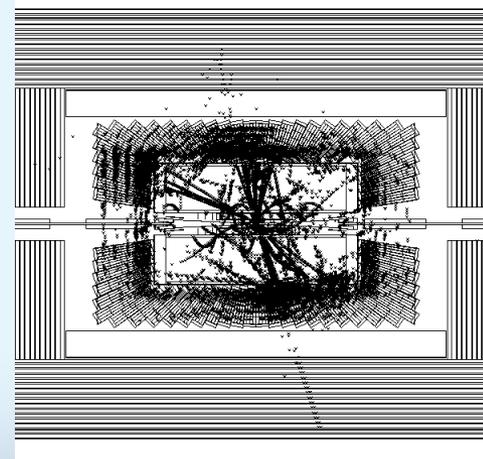
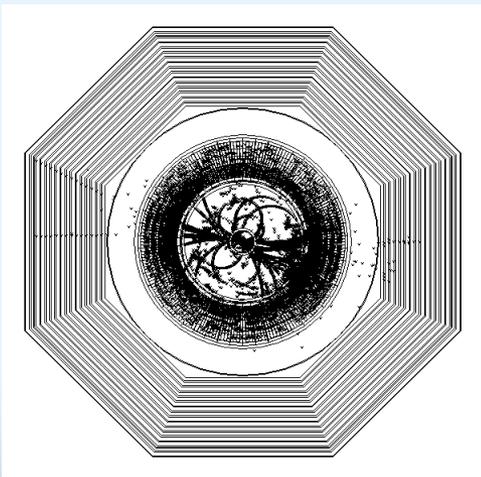


World Wide R&D review

Muon system



Marcello Piccolo
SLAC, Jan. 2004



The RPC option for the muon detector

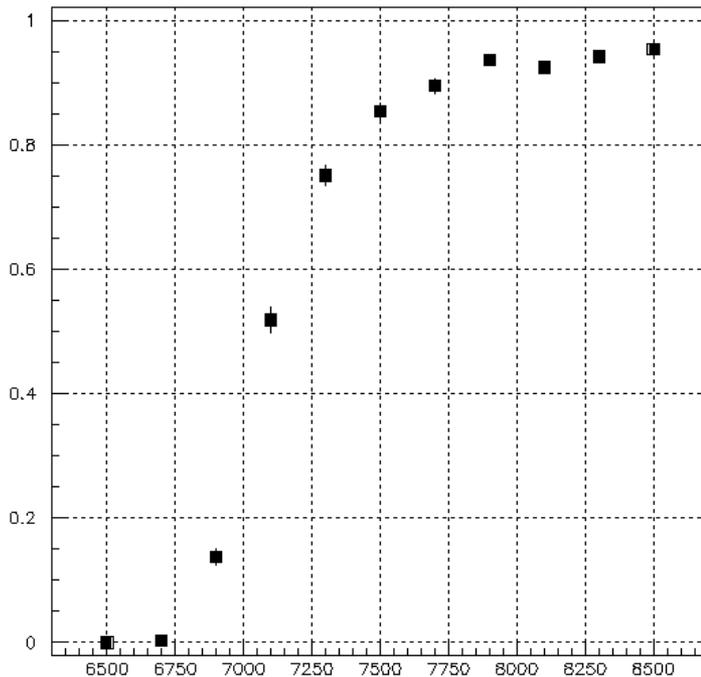
- RPC's do provide a viable detector for the muon system of a LC set-up.
 - Long term reliability and construction procedures (Q.C. and Q.A)
 - Performances check
 - Test beam data
 - Cosmic data

New RPC production (the CAPIRE collaboration)



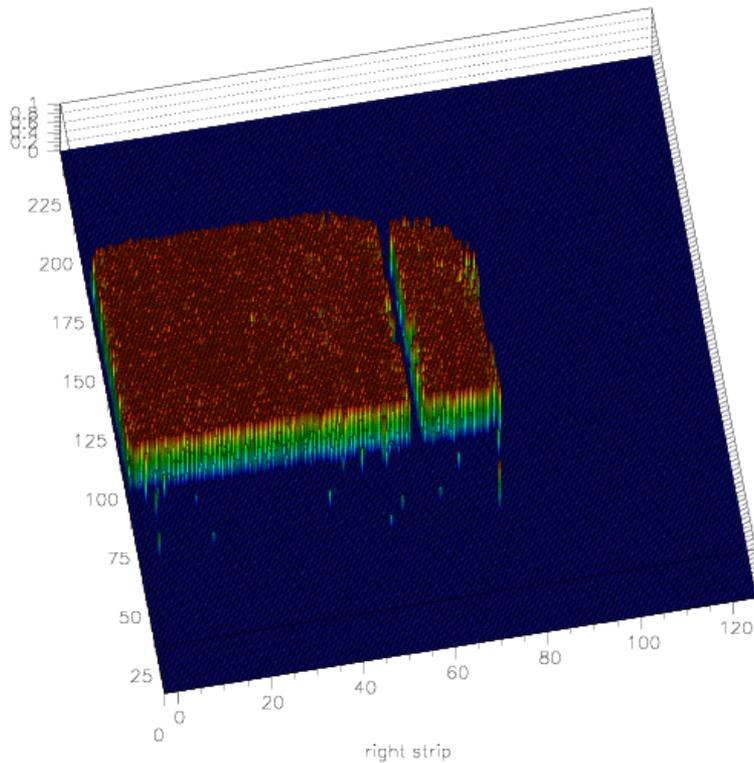
Screen printed resistive coating

A cosmic plateau



- Cosmic plateau for the 0.5x0.5 m² chamber.
- Standard mix 48/48/4
- 5,000 triggers/point.
- Streamer mode
- Spatial consistency and tracking used .

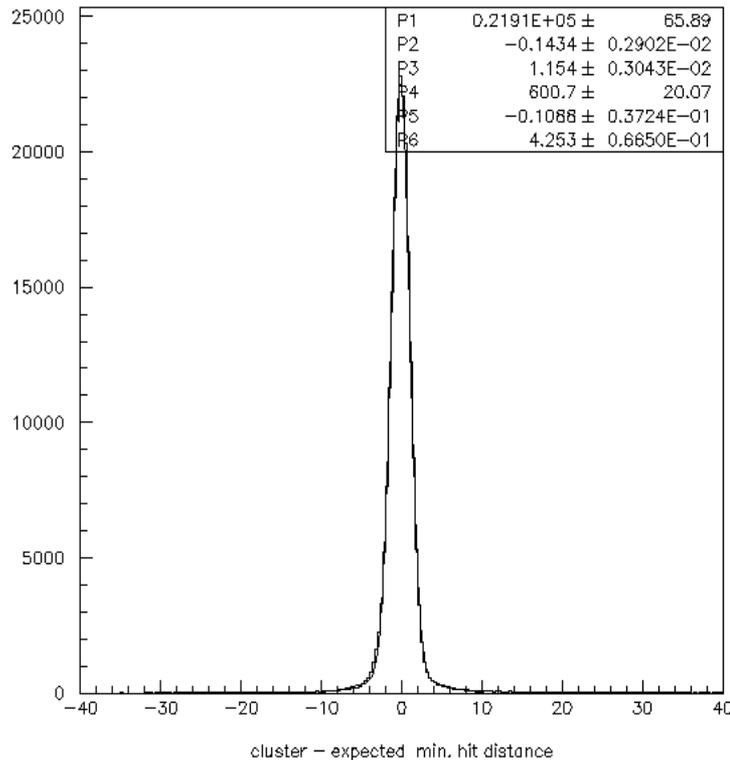
Efficiency map



- Efficiency map for 1 m² chambers.
- The valley is due to a (on purpose) disconnected strip .
- The color code assigns >85% efficiency to red.
- As a matter of fact the average efficiency is about 95%.

Spatial resolution

A good bakelite RPC



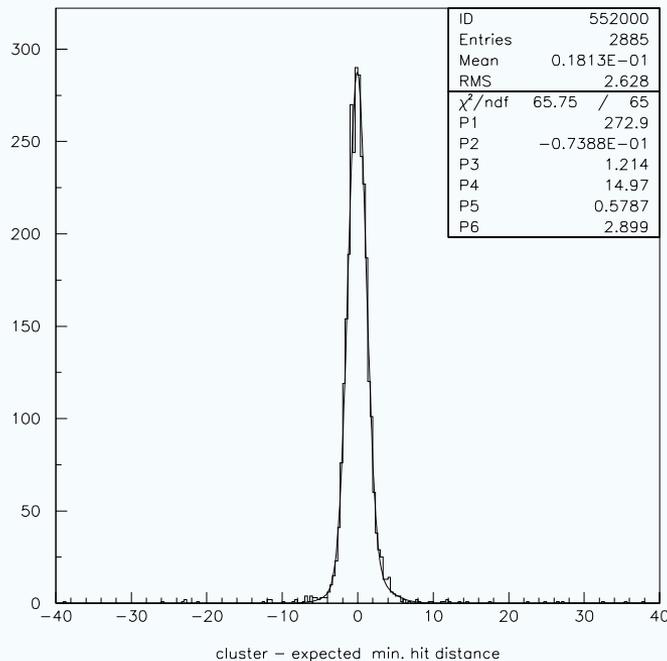
Resolution of single RPC of the order of 7.0 mm.

The actual value for the spatial resolution is set by the strip pitch.

Fit with two Gaussian distributions lead to a ratio narrow/wide 20:1.

Spatial resolution

A good glass RPC



Resolution of single RPC of the same order as the bakelite one.

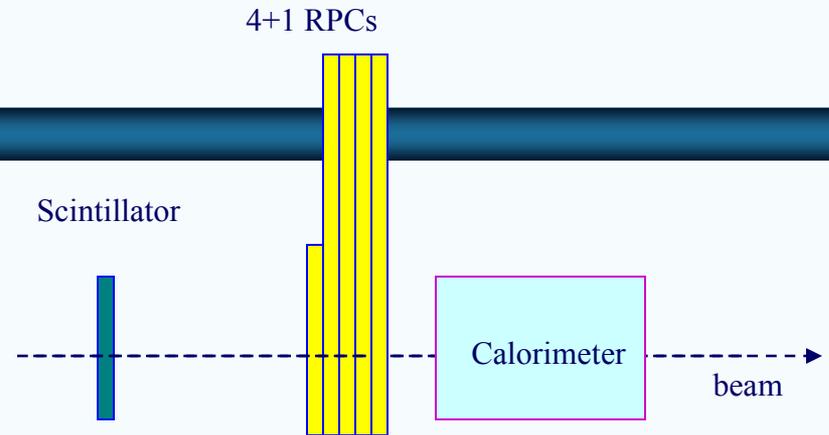
Here too the actual value of the spatial resolution is set by the strip pitch.

Fit with two Gaussian distributions lead again to a ratio narrow/wide 20:1.

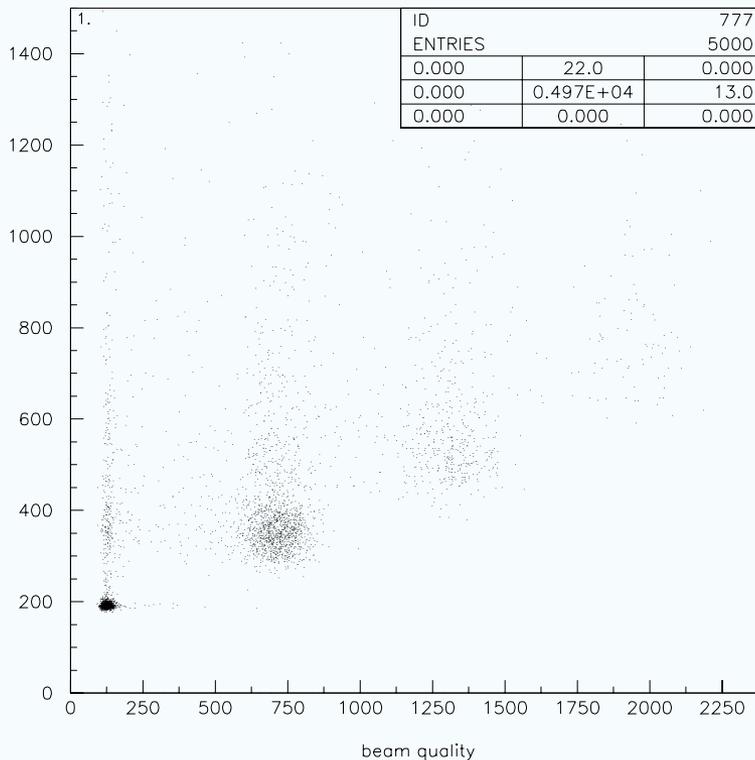
Beam tests

- The idea of using RPC's for calorimetric purposes or to detect MIP in jets, naturally leads to evaluate performances of these detectors in situation of high local crowding.
- The case for the linear collider is somehow different from the situation in which test have been carried out for the LHC experiments.
- Here is instantaneous rate that is relevant....
- We tried to reproduce the LC situation running at the Frascati TBF (a linac based facility) that can ship a bucket of particles (tunable in number) on an adjustable area.

Test @ BTF

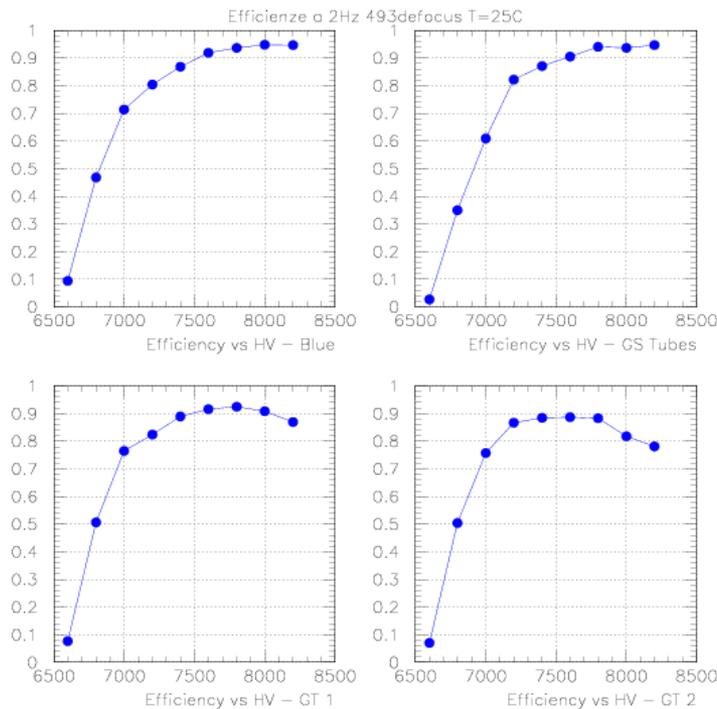


Beam characteristics



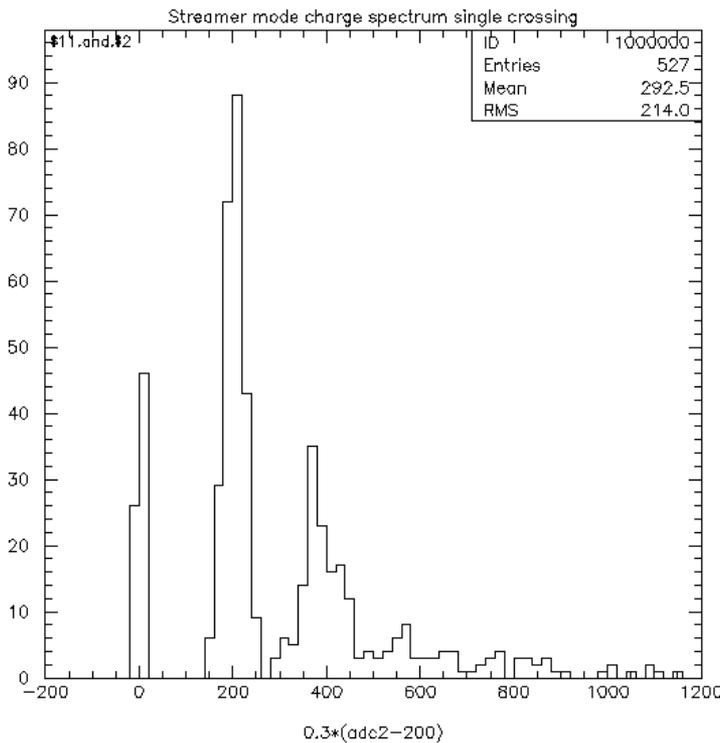
- Here is the correlation of a beam counter vs a total absorption calorimeter.
- The separation between 0, 1 and 2 particles is evident.
- The beam spot is round: in the focused mode the sigma of each of the two dimensions is 2 mm.
- Unfocused beams have spots roughly 60-100 times bigger.
- Beam frequency ranges between 1 and 25 Hz.

Typical plateau curve



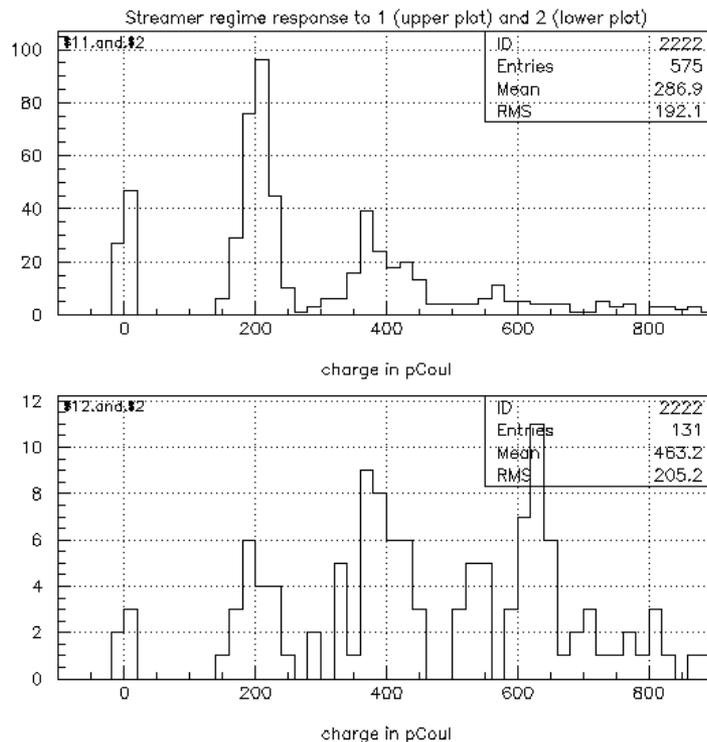
- **Plateau curves for our standard mix (48/48/4) (Ar/Fr/Is).**
- **Four different 1m² chambers .**
- **The beam was hitting the lower left corner of the detectors**
- **A fast area scan did not show any anomalies.**

The single particle response



- Here is the charge spectrum in streamer mode for a single track crossing.
- The gas mix is 48/48/4
- The Linac frequency is 1Hz.
- H.V. is 7800 V, that is safely after the plateau knee

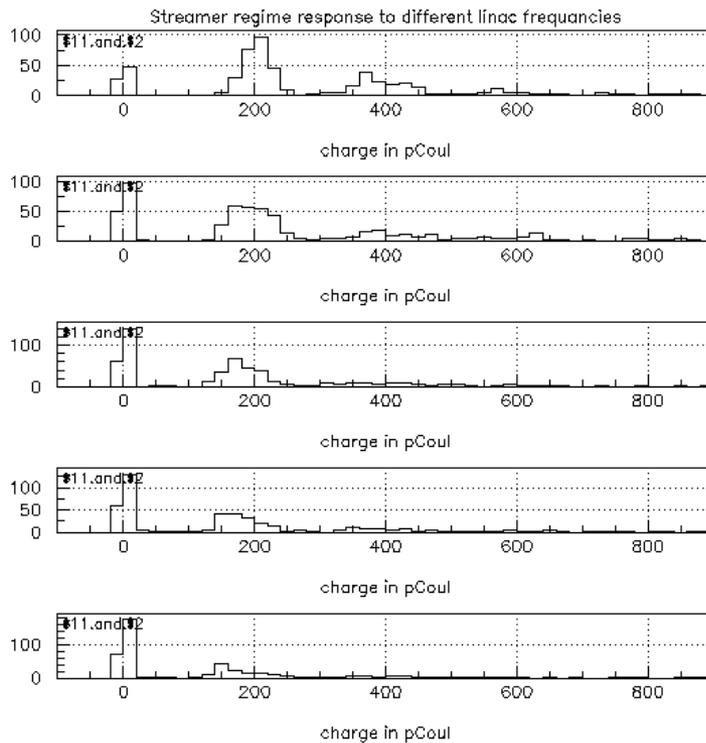
One and two particle response



- The two plots refer to 1 or 2 particles (selected via calorimetric response) hitting the test RPC's .
- One readily notice :
 - The non-complete quenching
 - Some inefficiency
- Operating voltage was 7800V
- The beam was in the defocused mode @ 1 Hz.

Efficiency vs local rate

Ar/C₂H₂F₄/i-C₄H₁₀=48/48/4

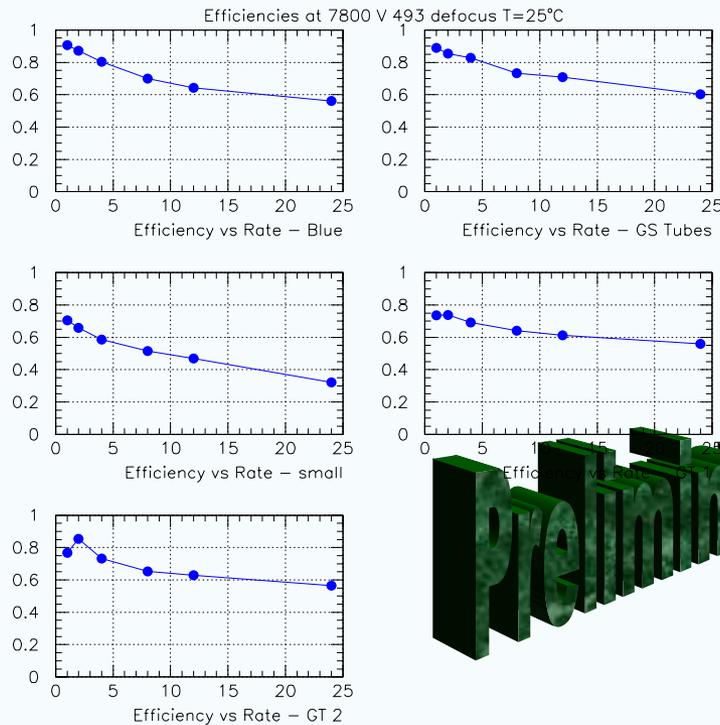


$\sigma_{beam} \approx 1.2 \text{ cm}$
1 500MeV e⁻
HV =7800 V

I ~2 $\mu\text{A}/\text{m}^2$ @
7800V

Efficiency vs local rate

Ar/C₂H₂F₄/i-C₄H₁₀=48/48/4

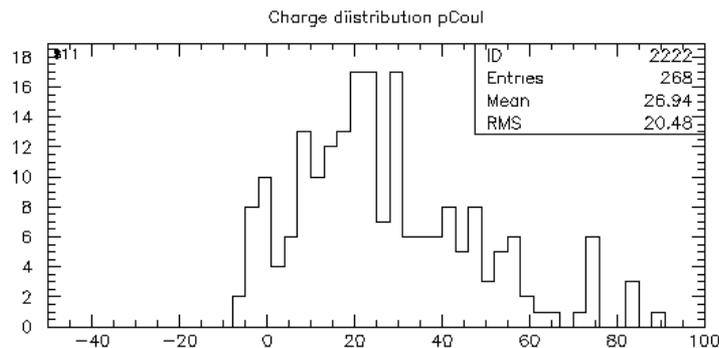
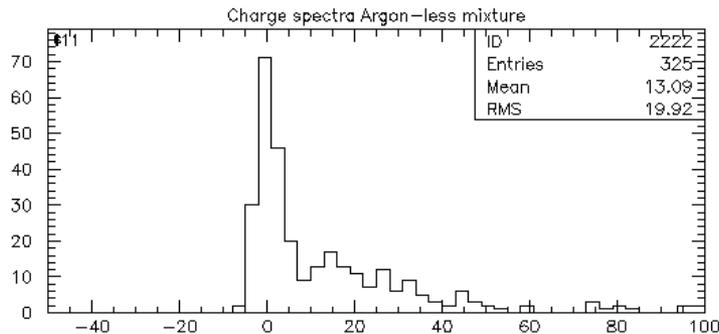


$\sigma_{beam} \approx 1.2 \text{ cm}$
 1 500MeV e⁻
 HV =7800 V

PRELIMINARY

I ~2 μA/m² @
 7800V

Saturated avalanche regime



- Here is the saturated avalanche charge signal at 9400 and 9800 V with a mix 95% Freon 5% Isob.
- At 9400 V it seems that the charge doesn't change very much, but efficiency is seriously degraded.

Conclusions and outlook

- Glass RPC have been produced and their performances are being evaluated both with cosmic and at beam facilities.
 - New procedures and ideas are being put forward and tested.
- First results are encouraging.
- Response in the streamer mode at high local rate seems a bit marginal at this time.