

High resolution timing for muon detectors at future colliders

Roberto Cardarelli, INFN section of Roma Tor Vergata

Sub-nanosecond time measurements are potentially very important for experiments at future accelerators.

Main detectors suitable for time measurement.

Semiconductor detectors

Cherenkov detectors

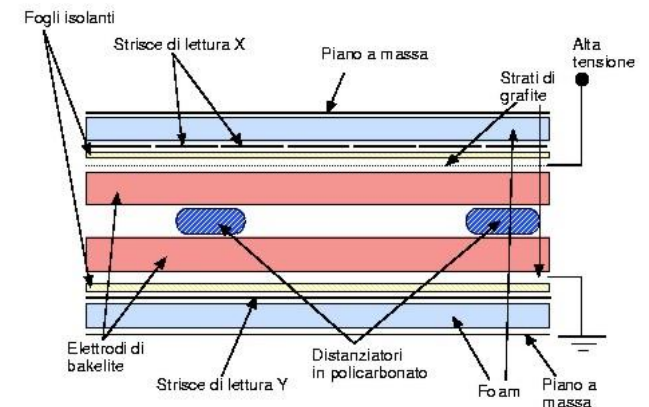
Scintillators

Resistive Plate Chambers

- In the barrel region and also in endcap, for moderately high eta values, **the gas detectors** still remain, at the present status of the detection techniques, **the most suitable choice**.
- The **RPCs timing** is adequate to fulfil the requirement of the future accelerators.

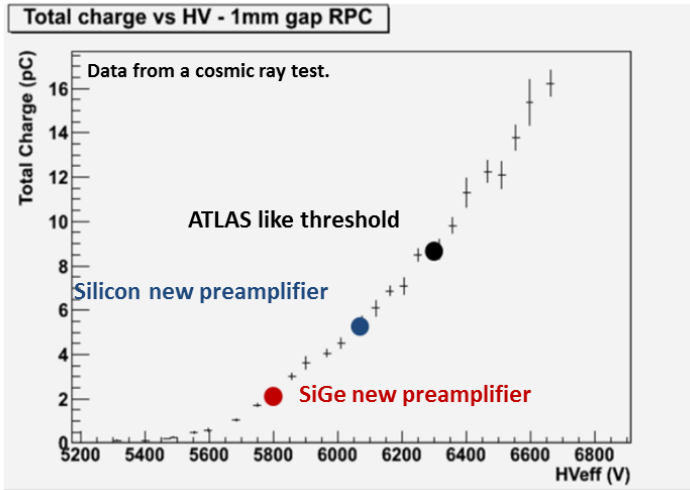
Gaseous detectors with planar geometry: Resistive Plate Chambers

- ATLAS RPCs have a time resolution of about 1 ns . They are operated in saturated avalanche mode and reach full efficiency at a rate of $\sim 1 \text{ kHz/cm}^2$. Space resolution is limited by the strip pitch, and is of the order of 9 mm .
- The target of the R&D was to develop a detector capable of a time-space resolution of about $100 \text{ ps} * 100 \text{ }\mu\text{m}$ while operating at a rate of the order of 50 kHz/cm^2 .



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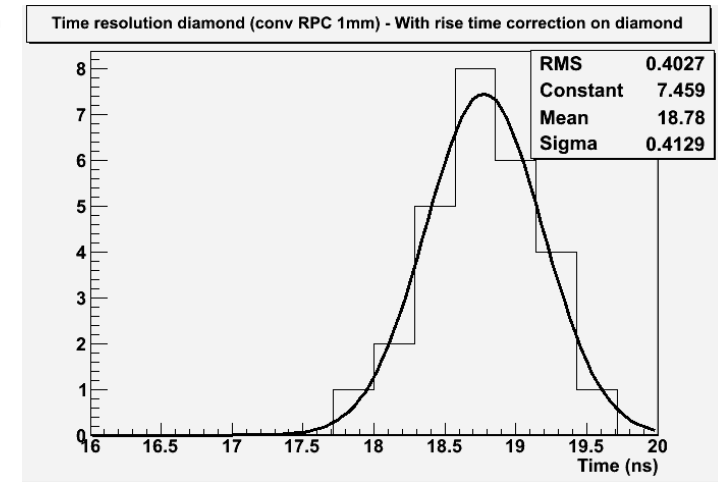
Total delivered charge per count in the detector. The working point with different front ends is shown.



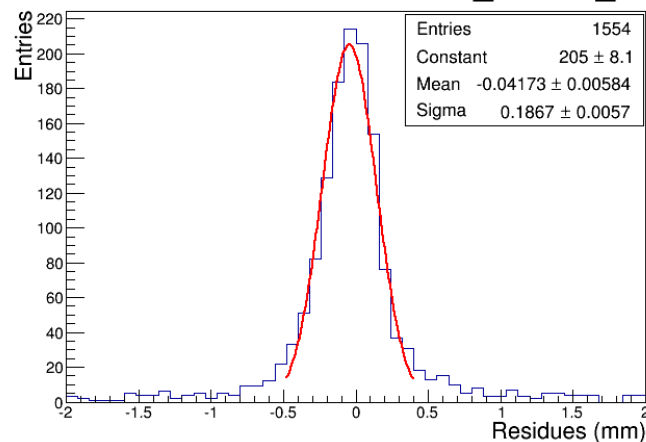
- The reduction on total charge per count leads to an improvement of **rate capability** up to 50 kHz/cm².

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- A **time resolution** of 400 ps can be achieved with a fully efficiency single gap RPC.



Residues distribution RPC_0-RPC_1



- The RPC shows an intrinsic **space resolution** better than 100 μm with the charge centroid method.