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OPERATION OF THE TELESCOPE

Extreme
Energy
Events
Science inside Schools

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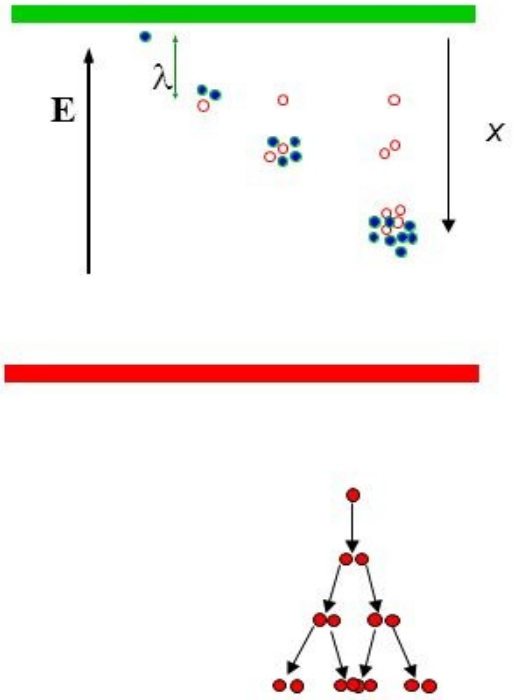
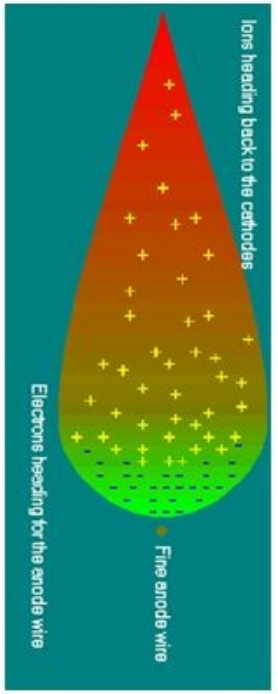
Planar geometry detectors

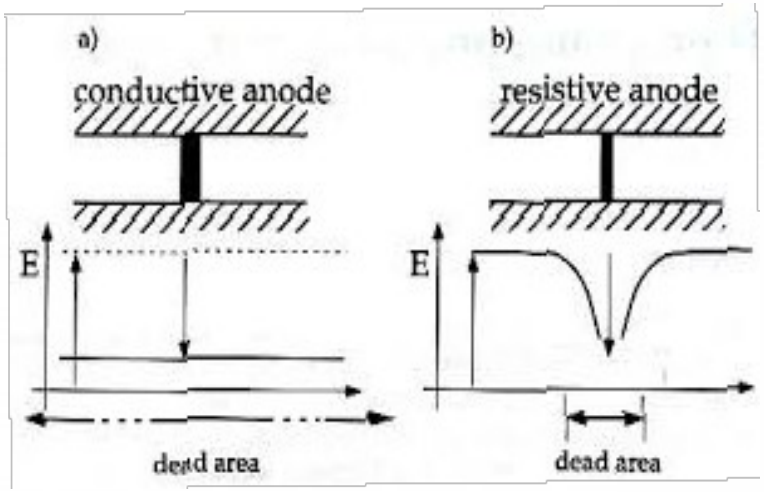
A parallel plans detector is constituted by two electrodes that contain a certain volume of gas. The passage of a particle creates couples ion positive-electron. In presence of an electric field they migrate toward the electrodes. The uniform electric field accelerates the electrons, and because of the difference of speed between electrons and positive ions, the distribution of the produced charge assumes the typical shape of drop. The movement of these charge produces a signal on the armors.





Conductive electrode chambers

They consist of two parallel metallic planes. Inside of this there is a volume filled with a mixture of argon and xylene.
The detector must be equipped with an external circuit to stop the tension for a certain period of time to allow the turning off of the spark. It is clear that a device of this type is limited in its activity phase.



Resistive electrode chambers

They replace conductive planes and guarantee the localized spread of charges. In this way, the charging time of the electrodes is about 1 ms, so there is a minimum tension which is restored directly from the power supply system. In this way the telescope does not need an external shutdown circuit.

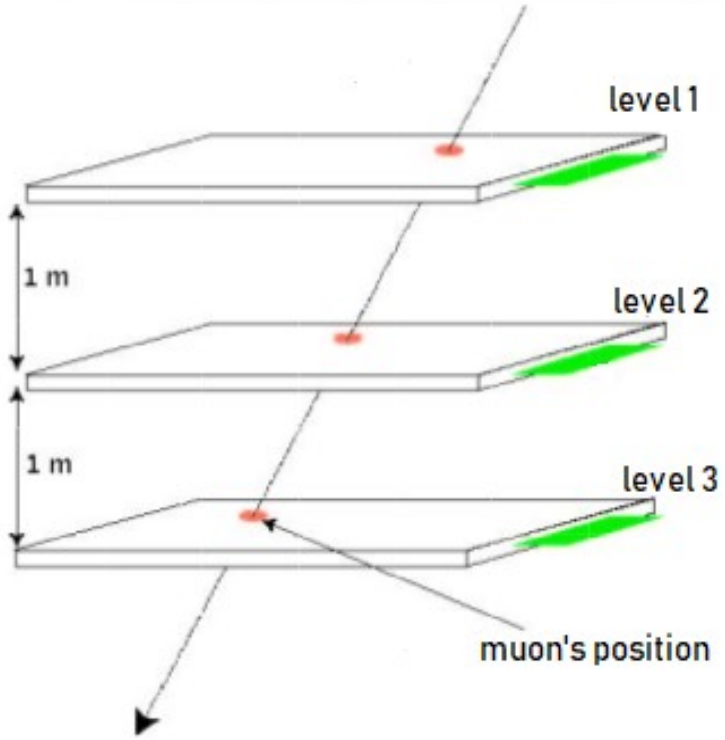
PSC and RPC

They are the first detectors ever built. However, the first ones are no longer in use due to mechanical restrictions. Contrarily, the PRCs, having a good spatial and temporal resolution, were able to replace them.
These last ones consist of two parallel 2 mm thick bakelite planes to which a potential difference is applied which creates a uniform electric field in the gas gap which contains a gas mixture at atmospheric pressure. These two plans are copper strips glued onto a PET substrate. The reading strips are separated one from each other by a distance of 2 mm.

MRPC

Developed after the PRC in order to meet the requirements of CERN, their production is given by the need of :

- increase the limit of sustainable frequency,
- improve time resolution,
- increase the gain but at the same time, stop the development of avalanches,
- limit the current between the two electrodes.



MRPC

An MRPC detector is essentially an RPC whose sensitive volume is divided into gaps: inside this, parallel and equidistant glasses are positioned, so as to divide the interval between the two electrodes in many independent sub-intervals and of equal size between them. These internal planes are not connected to the high voltage even if, they are electrostatically forced to take the value of the potential so that the applied voltage is equated for each gap.

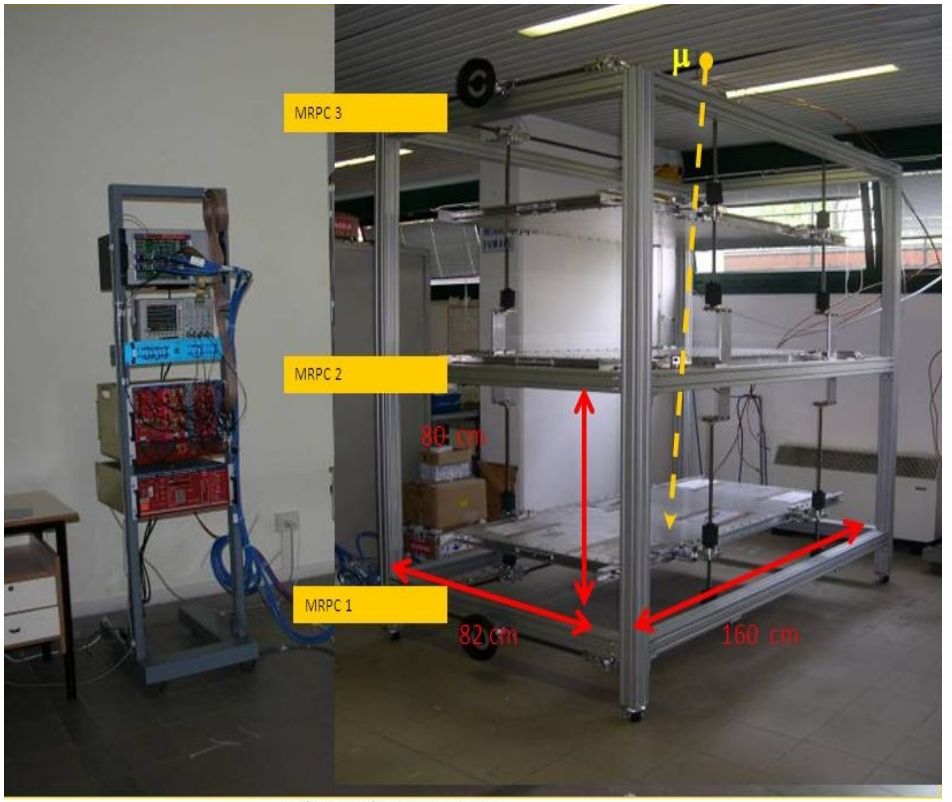
MRPC

With the inclusion of intermediate glass, important improvements are achieved:

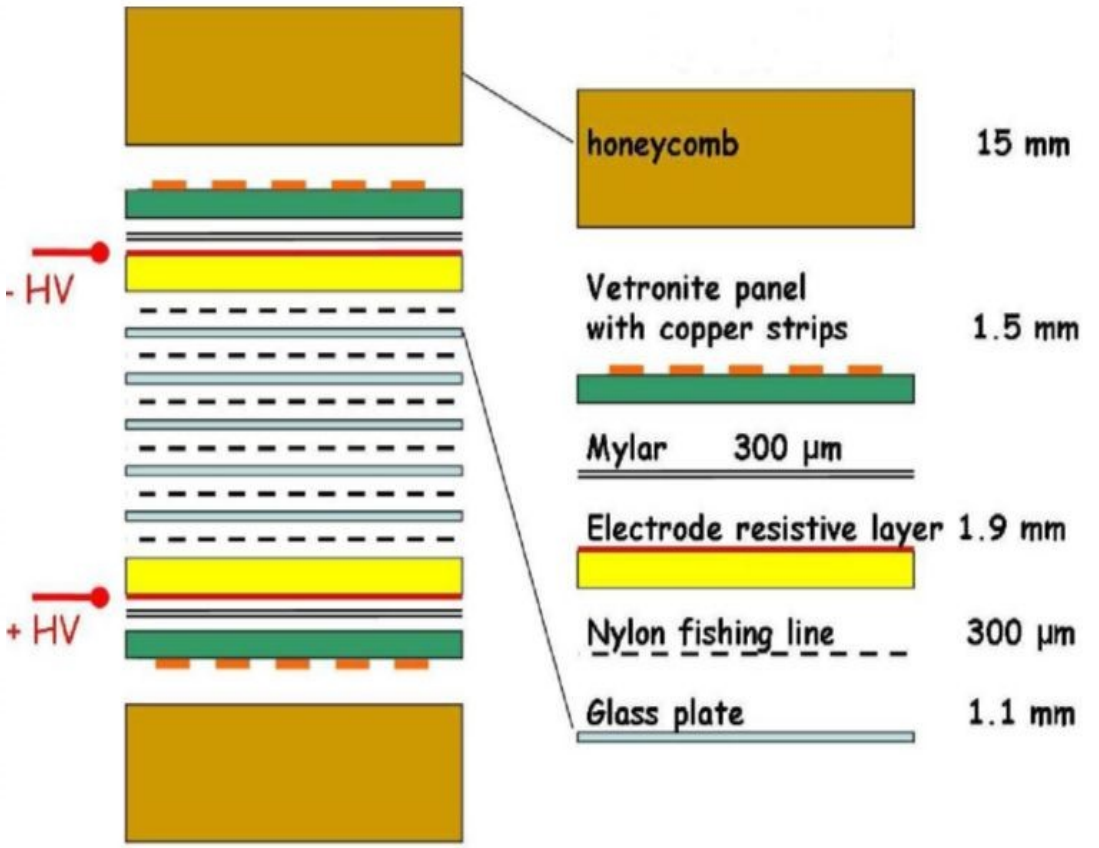
- The sensitive zone L in which the first ionization can take place is divided into n regions of length L / n: the intermediate planes in fact form barriers to the development of the avalanche, while in the single-gap PRC the avalanche dimensions grow exponentially;
- The signal obtained is the sum of n single signals
- The sensitive volume of the detector is defined as the sum of all the individual gaps: 100% efficiencies can therefore be obtained by increasing the number of gaps.

The MRPC forEEE project

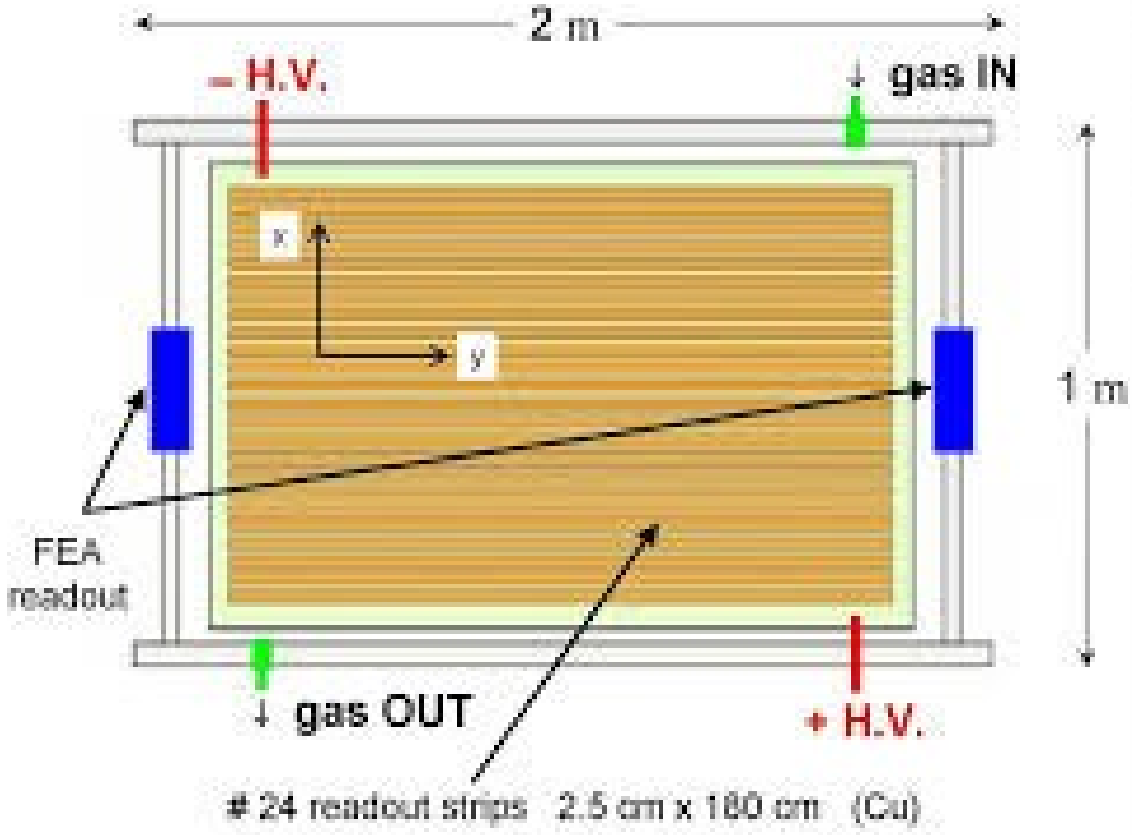
the MRPC designed for Extreme Energy Events project are detectors of advanced technology but of relatively simple construction:they have been buildt in such a way as to satisfy all the requiriments for a good identification of the muon passage point, but containing the costs and especially the construction difficulties.



Resistive electrode chambers in which is enclosed a mixture of Freon (98%) and sulfor hexafluoride (2%).
The gap between the cathode and the anode is divided into 6 small gap intervals from intermediate glass. To give stability to the structure the chamber is fixed to two rigid plans of composite material. The whole is enclosed in an aluminum box.



In the box the signal reading interfaces are placed on the two short sides, the gas couplings and the high voltage connectors are at opposite ends of the long sides of the chamber to facilitate the gaseous exchange.
Then, to satisfy the need to go back to the point of incidence of the muon with the sensitive plane, the electrodes must be segmented into strips from which the signal is taken.



We provide some technical details before analyzing the choice of ionizing gas and reading electronics:

- the electrodes consist of 2 1.9 mm glasses to which a varnish is applied;
- 24 strips of 180 cm × 2.5 cm apart from each other 0.7 cm made with adhesive copper tape;
-
- 5 intermediate glasses of 1.1 mm separated from each other by fishing line so as to form 6 gas gaps.

Gas choice

The choice of the gas used as an ionizing medium in the EPC Project MRPCs must take into account not only the physical characteristics and the advantages that a given mixture, but also the risks that this type of gas entails as the telescopes will be placed inside the premises. schools in close contact with the students.

Gas choice

Generally it's better to use mixtures containing Freon because they allow to reach higher efficiency values more easily.
In addition to these heavy gases, it is necessary to use both percentages of electronegative gases and percentages of hydrocarbons,
among which there is isobutane.
But, given that the telescope is addressed in schools, isobutane is eliminated as an in fl ammable gas and the mixture used is composed of:

- 98% SUVA, ecological Freon
- 2% sulfor hexafluoride , SF6