Charged particles in the intermediate momentum range are identified in ALICE by the Time Of Flight (TOF) detector. The time measurement with the TOF, in conjunction with the momentum and track length measured by the tracking detectors is used to calculate the particle mass. A time resolution of 100 ps will provide \(3\sigma_{\pi/K}\) separation up to 2.2 GeV/c and \(K/p\) separation up to 4 GeV/c.

The goal is to study:
- The QCD thermodynamics via the measurement of \(\pi, K\) and \(p\) transverse momentum distributions and particle ratios on an Event-by-Event basis.
- Signatures of QGP formation via open charm and \(\phi\) meson production.

System Description

The TOF detector has a cylindrical shape, covering polar angles between 45 degrees and 135 degrees over the full azimuth. It has a modular structure with 18 sectors in \(\phi\); each of these sectors is divided into 5 modules along the beam direction. The modules contain a total of 1638 detector elements (MRPC strips), covering an area of \(160\) m\(^2\) with 157248 readout channels (pads).

Detector Description

The detector chosen for the ALICE TOF is the Multigap Resistive Plate Chamber (MRPC), developed within the CERN LAA project. The detector element is a long MRPC strip with an active area of \(7.4 \times 120\) cm\(^2\). It has 96 readout pads of 2.5 \(\times\) 3.5 cm\(^2\) arranged in two rows. As shown in the figure of the cross section, it consists of 2 stacks of glass, each with 5 gas gaps of 250 \(\mu\)m; spacers made of nylon fishing line keep the distance between the glass plates fixed.

Electronics

The signal from the MRPC must be amplified and discriminated and the time measured with an accuracy matching the intrinsic time resolution of the detector (ideally the charge needs to be measured in addition, to correct for slewing; however, the measurement of the time width of the signal is sufficient to achieve this). In order to meet the timing requirements, the electronics for the ALICE TOF will consist of the following basic components.

For the Front End the NINO ASIC, developed recently by the CERN-LAA project, which combines a fast amplifier, discriminator and stretcher. The photograph shows the NINO ASIC (8 channels) directly bonded on the PCB board (no packaging).

The MRPC Strips Construction

The MRPC is a stack of resistive glass plates. A high voltage is applied to the external surfaces of the stack. Further out there are pickup electrodes. A charged particle ionises the gas and the high electric field amplifies this ionization by an electron avalanche. The resistive plates stop the avalanche development in each gap; they are however transparent to the fast signal induced on the pickup electrodes by the movement of the electrons. So the total signal is the sum of the signals from all gaps (the reason for many gaps is to achieve high efficiency), whereas the time jitter of the signal depends on the individual gap width (the reason for narrow gaps is to achieve good time resolution).