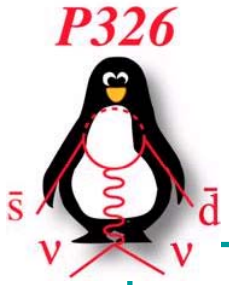

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The GigaTracker System: Overview

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Design review of the NA62 GTK ASIC demonstrator circuits

Experiment's Motivation

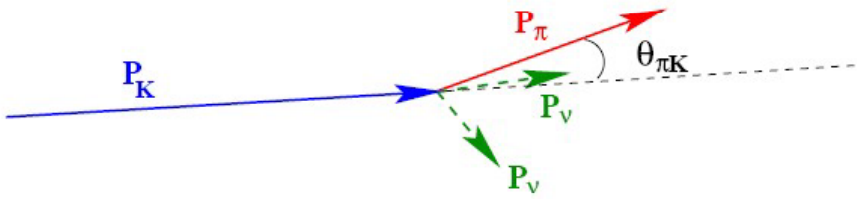
- Main goal of the experiment is to study the very rare decay $K^+ \to \pi^+ \nu \bar{\nu}$ in order to increase the knowledge of the Standard Model
- A preliminary measurement has been performed at Brookhaven by AGS E787 and E949 Collaborations (1995-2002). The measured BR, based on 3 events is:

$$BR(K^+ \to \pi^+ \nu \bar{\nu}) = 1.47^{+1.3}_{-0.89} \times 10^{-10}$$

- The NA62 experiment aims to collect about 80 events, with a signal to background ratio S/B = 10:1
- The NA62 will use the same cavern (ECN3) at CERN SPS North Area, where now NA48 is located and part of this detector will be reused (liquid krypton e.m. calorimeter LKR) or upgraded

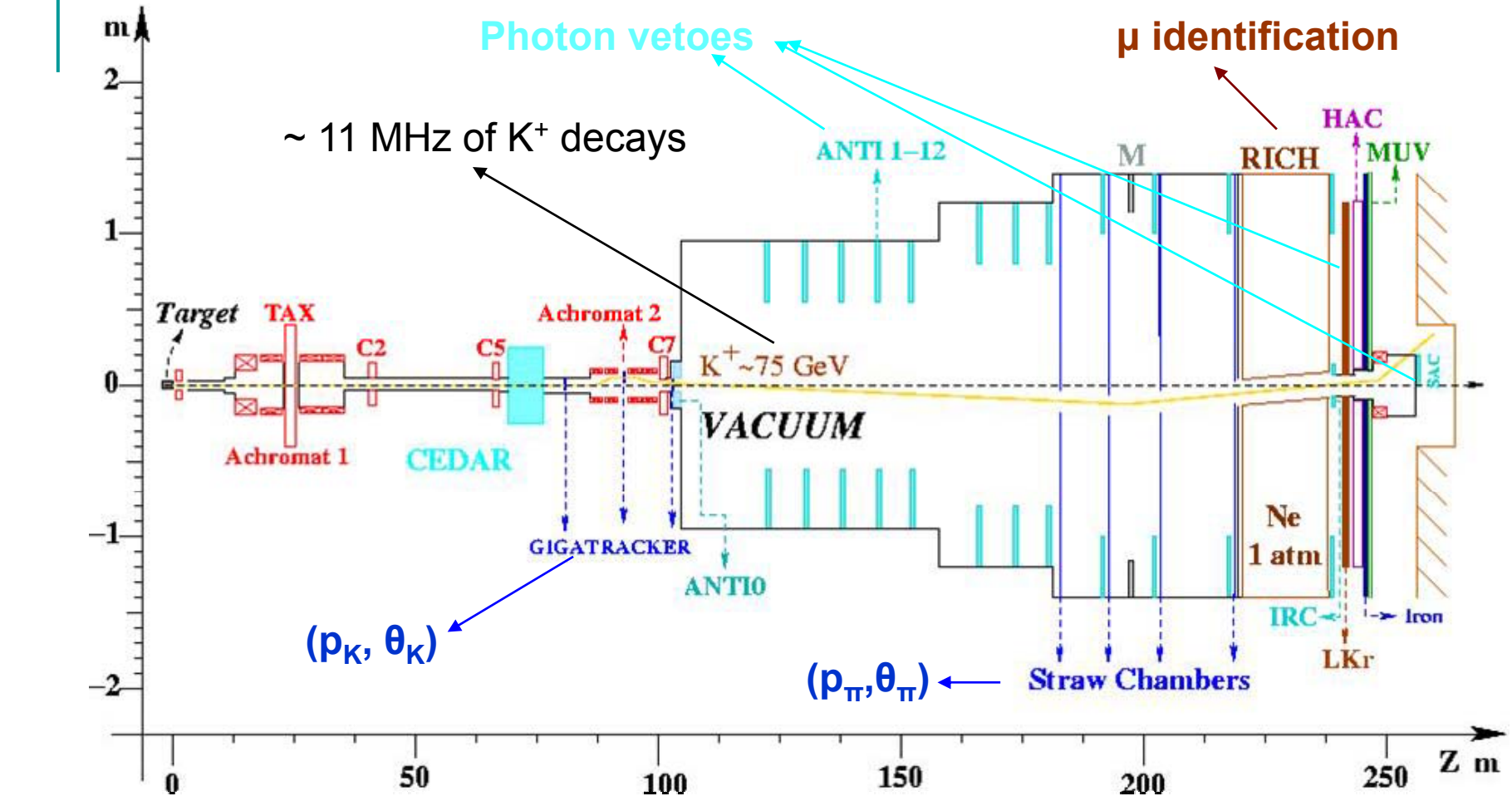
Experiment's strategy

- To reach a S/B= 10:1 the system performs redundant measurements on the kinematics event and background rejection (photons and muons vetoes)



- The momentum of the incoming kaon P_K, the momentum of the outgoing pion P_π and the angle between them $\theta_{\pi K}$ are the measurable quantities
- Products of background decays have BR 10^{10} times larger than signal (photons and muons)

Detector's view

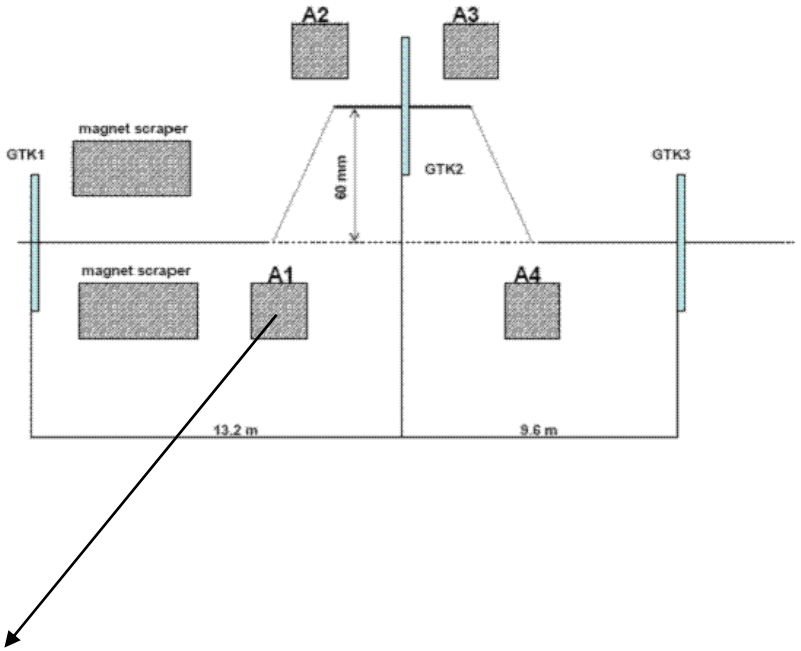


GigaTracker overview

- The beam spectrometer (GTK) is a crucial detector which has to provide precise measurements on the beam particles: momentum, direction and timing
- Due its position the GTK has to operate under an high rate environment (~1.5 MHz/mm^2), but π and p (background) are 17 time higher than K (useful particles)
- While the spatial resolution is not a critical issue, the timing resolution and efficiency are extremely important to associate the right K candidate in the GTK with the π track measured in the downstream spectrometer

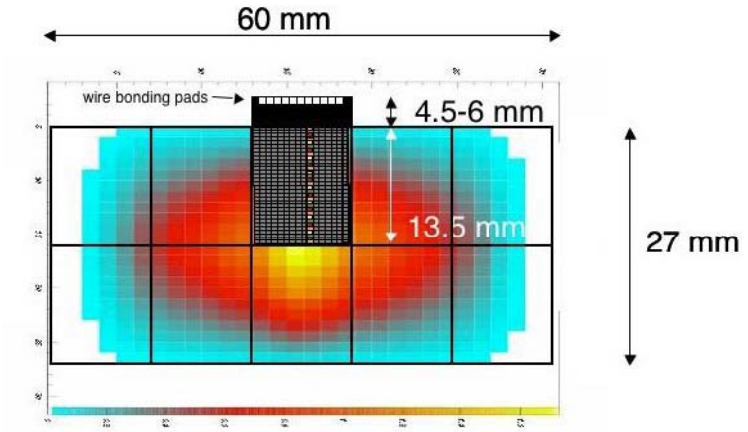
GigaTracker overview

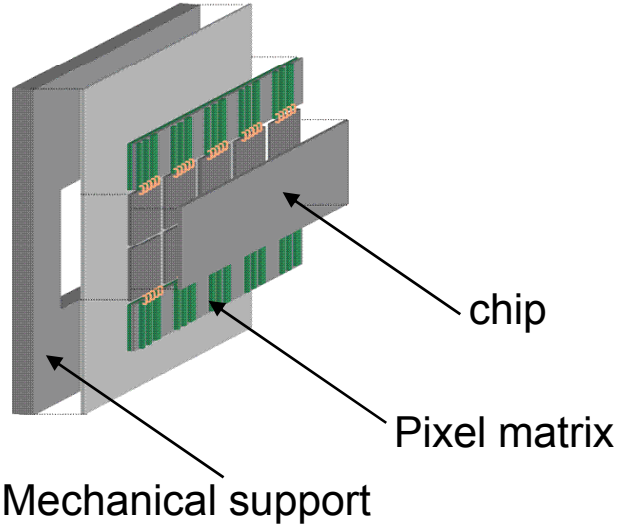
- NA62 GigaTracker (GTK) consists of three silicon pixel stations installed over the beam line. It will provide several measurements of the beam particles (K^+): timing, direction, momentum
- Each station cover an area of 60(X) x 27(Y) mm^2. Each pixel 300 μm x 300 μm
- The maximum beam particle intensity it will be ~1.5 MHz/mm^2 (**1 GHz** over the whole detector, thus the name GigaTracker)
- The required track time resolution is ~ **200 ps** (rms) per station (~ **150 ps** the whole GTK) and space resolution ~ **100 μm** (rms) over the whole system
- A material budget of 0.5% X_0 is target for each pixel station (sensor thickness : 200 μm, read-out chip thickness : 100 μm)



A1÷A4: dipole magnets to provide the momentum selection and recombination

GigaTracker read-out





- Two rows of five readout chips (0.13 μm CMOS technology) are bump bonded to the sensor elements. Each chip reads a matrix of 40x45 pixels
- Maximum particle intensity per chip: 130 MHz
- Maximum particle intensity per pixel: 140 kHz
- Total dose in 1 year: 10^5 Gy. Thus the system should be cooled at 5 ^oC or less and GTK stations replaced after a runtime of 60 days under optimum beam conditions
- Dissipated heat produced by the 10 readout chips is estimated to be 2 W/cm^2 (32 W in total)