The RICH detector of the NA62 experiment at CERN

**The CERN Accelerator Complex**

- **SPS**: 800 MHz, 75 GeV/c proton beam
- **LHC**: 400 GeV, 200 MHz
- **NA62 Proposal**: CERN SPSC-2005-013, SPSC-326

**NA62 Principle of Measurement**

- Time over Threshold
- G10

**NA62: a new experiment to measure the ultra-rare decay K^+ → π^+νν**

- **SPS primary**: 400 GeV
  - Unseparated beam: 15 GeV
  - ρ/π (4%) K^+ decay

**The CERN Accelerator Complex**

- The SPS at CERN produces 400 GeV/c protons using either a fast or slow extraction system
- The SPS is used as well as injector for the LHC accelerator

**THE NA62 DETECTORS**

- **CEDAR**: differential Cherenkov counter to tag the K^+ in the beam (50 MHz)
- **GIGATRACKER**: Beam spectrometer consisting of 3 Si microstrip stations upstream the decay region (800 MHz) for K^+ tracking
- **STRAW**: magnetic spectrometer consisting of 4 chambers of straw tubes to measure direction and momentum of charged decay products (~10 MHz)
- **RICH**: Ring Image Cherenkov detector, providing muon/pion separation, measuring the pion crossing time and acting as fast trigger for charged tracks
- **LAV**: Anti-counters (Lead glass) surrounding the vacuum tank providing full coverage for photons at large angles
- **LKR**: High-performance electromagnetic calorimeter built for the NA48 experiment acting as photon veto in the forward region
- **MUD**: hadron calorimeter and muon detector

**The Photomultipliers**

- **Hamamatsu R7400 U03**: Quartz window (165-650 nm)
- **Hamamatsu R7400 U06**: Mirror Mosaic (17 m Focal Length)
- **Mirror by MARCON**: 17 m long, 60 cm wide vessel
- **Mirrors**: Hexagonal Mirrors
- **Winston Cones covered with Mylar**:
  - 22 mm high
  - 18 mm wide (max)
  - 7.5 mm wide (min)
- **1 mm thick quartz window**

**The Mirrors**

- **Beam pipa**
- **Beam extracted North Area**

**The light collection**

- **PreAMP**
- **Threshold discriminator**
- **NINO chip**
- **CAEN V1190 (128ch)**
- **NEON**
- **AIR PM**

**The RICH detector**

- **RICH detector (rate ~ 10 MHz)**
- **Neon at atmospheric pressure**
- **Unseparated charged beam with Kaon decay in flight technique**
  - **ACCENT** detector is used to tag the K^+ in the unseparated beam
  - The particle ID system consists of a Si pixel detector to track the K^+ and a RICH to separate the decay products
  - Need to associate the decay pion to the charged kaon in the beam in a very high particle rate environment (beam ~1 GHz)

**Requirements**

- Separate π-μ at 5×10^-10
  - for 15 GeV < p < 35 GeV
  - Measure track rate at 100 ps (to avoid pile-up with the Gigatracker)
  - Main charged Trigger
  - Separate K^+ to separate the decay products.
- HPTDC with 100 ps LSB
- Threshold discriminator
- NINO ASIC as fast Time Over Threshold discriminator
- HPTDC with 100 ps LSB
- TELL1 board (LHCb) final
- CAEN V1190 (128ch) for test beam

**The CERN Accelerator Complex**

- **Beam extracted North Area**

**Integrated Data Acquisition and Trigger with time resolution ~100 ps**

- **PM holder and cooling system**
- **Neon endcap changed**
- **Veto separated charged beam**
- **15p<35 GeV/c**
- **Improve PM cooling**

**RICH-100 prototype: the 2007 Test Beam**

- **200 GeV/c negative hadron beam from CERN SPS (mainly p)**
- **K+ : Gigatracker Si pixel detector with excellent time resolution (~ 100 ps)**
- **RICH detector (rate ~ 10 MHz)**

**RICH-400 prototype: the 2009 Test Beam**

- **Going on right now (may-june 2009) at CERN:**
- **soon results**
  - PM endcap changed
  - 414 PM (20% of final detector)
  - Validate π-μ separation
  - Improve PM cooling

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