

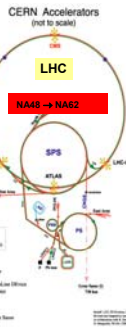
# The RICH detector of the NA62 experiment at CERN

INFN Firenze, INFN Perugia, CERN

## The CERN Accelerator Complex

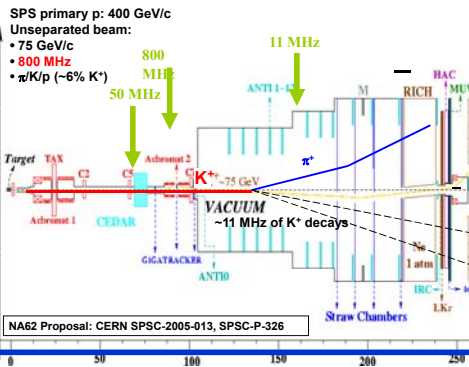
The SPS at CERN produces 400 GeV/c protons using either a fast or slow extraction system

The SPS is used as well as injector for the LHC accelerator

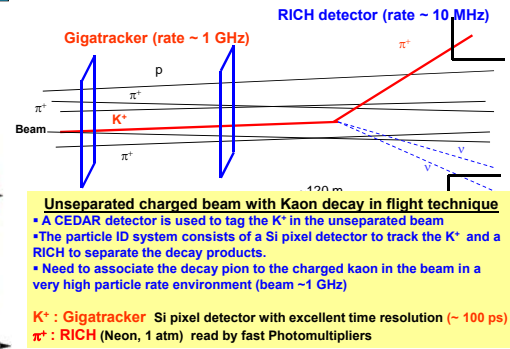


Note:  
NAYY  $\equiv$  Yth Experiment  
Installed in the North Area on a Beam extracted From the SPS accelerator

## NA62: a new experiment to measure the ultra-rare decay $K^+ \rightarrow \pi^+ \nu \bar{\nu}$



## NA62 Principle of Measurement



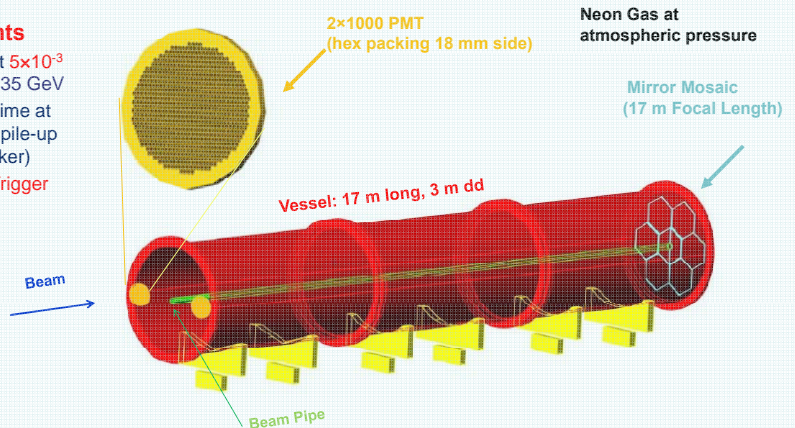
## THE NA62 DETECTORS

- CEDAR:** differential Cherenkov counter to tag the  $K^+$  in the beam (50 MHz)
- GIGATRACKER:** Beam spectrometer consisting of 3 Si micropixel stations preceding 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, 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:** The high-performance electromagnetic calorimeter built for the NA48 experiment acting as photon veto in the forward region
- IRC/SAC:** Photon veto at small and intermediate angles
- CH-ANTI:** a set of ring anticounters located after the last Gigatracker station to form a "guard ring" and a large ring around the beginning of the decay volume to veto charged particles coming from the collimator
- MUD:** hadron calorimeter and muon detector

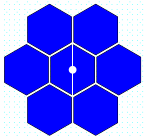
## The RICH detector

### Requirements

- Separate  $\pi$ - $\mu$  at  $5 \times 10^{-3}$  for  $15 \text{ GeV} < p < 35 \text{ GeV}$
- Measure track time at 100 ps (to avoid pile-up with the Gigatracker)
- Main charged Trigger



## The Mirrors

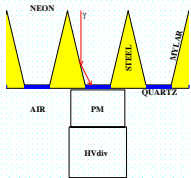


- Hexagonal Mirrors
- 17 m focal length
- 1 m diameter
- 2.5 cm thick glass
- $D_0 < 4 \text{ mm}$
- Aluminum deposit with  $\text{MgF}_2$  coat
- MARCON company
- piezo actuators for alignment

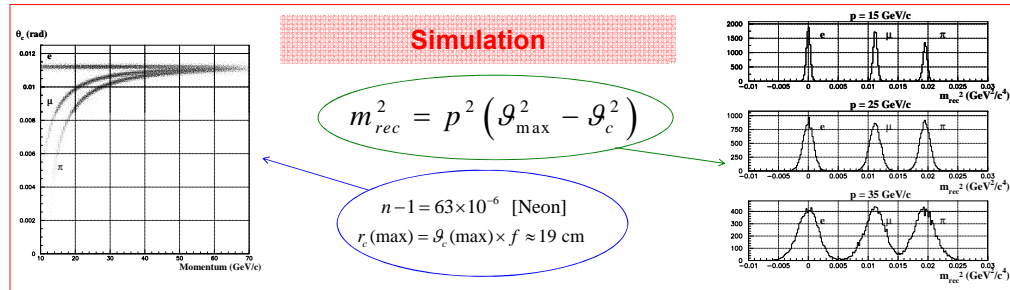
## The light collection

Winston Cones covered with Mylar:

- 22 mm high
- 18 mm wide (max)
- 7.5 mm wide (min)



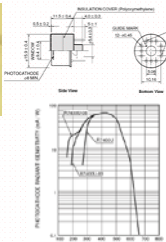
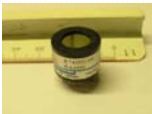
1 mm thick quartz window



## The Photomultipliers

Hamamatsu R7400 U03

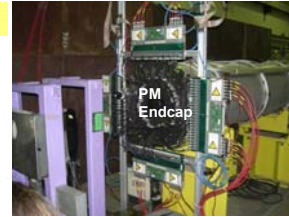
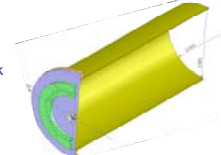
- Metal package tube
- 16 mm dd
- 8 mm active dd
- 185 nm - 650 nm
- 420 nm peak sensitivity
- UV glass window
- Bialkali cathode
- Gain:  $7 \times 10^6$
- Transit time 5.4 ns
- Transit time spread: 0.28 ns
- Number of dynodes: 8
- Applied Voltage: 800 V (1000 V max)



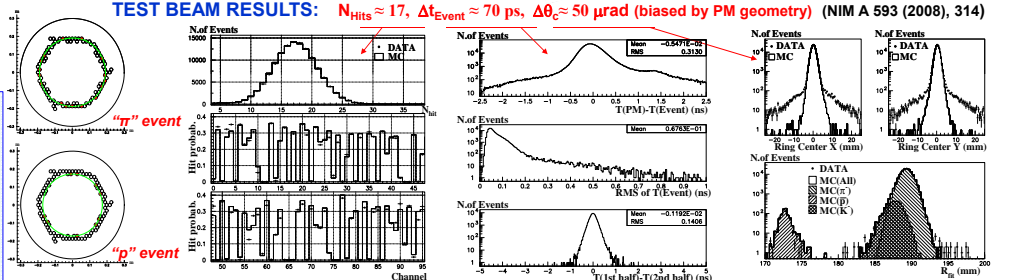
## RICH-100 prototype: the 2007 Test Beam

200 GeV/c negative hadron beam from CERN SPS (mainly  $\pi$ )

- 17 m long, 60 cm wide vessel
- Mirror by MARCON:
- $f = 17 \text{ m}$ ,  $d = 50 \text{ cm}$ , 2.5 cm thick
- 96 PMT Hamamatsu R7400
- Neon at atmospheric pressure

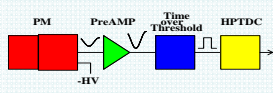


**TEST BEAM RESULTS:**  $N_{\text{Hits}} \approx 17$ ,  $\Delta t_{\text{Event}} \approx 70 \text{ ps}$ ,  $\Delta \theta_c \approx 50 \mu\text{rad}$  (biased by PM geometry) (NIM A 593 (2008), 314)



## Electronics and DAQ

Integrated Data Acquisition and Trigger with time resolution ~100 ps



- NINO ASIC as fast Time Over Threshold discriminator
- HPTDC with 100 ps LSB
- TELL1 board (LHCb) final
- CAEN V1190 (128ch) for test beam

See M. Sozzi talk, this conference



Electronic board:

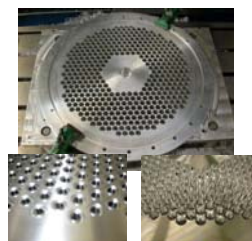
- 128 TDC channels, 100 ps resolution (HPTDC, CERN) control FPGA and static memory on-board.
- 10 layers PCB (16xLVDS with connectors, individual shielding)



## RICH-400 prototype: the 2009 Test Beam

Going on right now (may-june 2009) at CERN: soon results

- PM endcap changed
- 414 PMT (20% of final detector)
- Validate  $\pi$ - $\mu$  separation in  $15 < p < 35 \text{ GeV/c}$
- Improve PM cooling



PM holder and cooling system

