Experience with readout of Micromegas for NA62
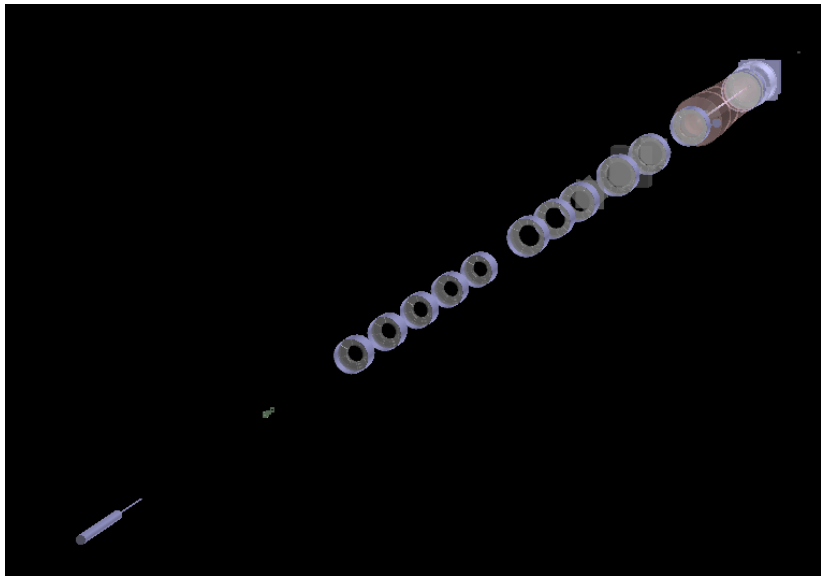
Antonino Sergi

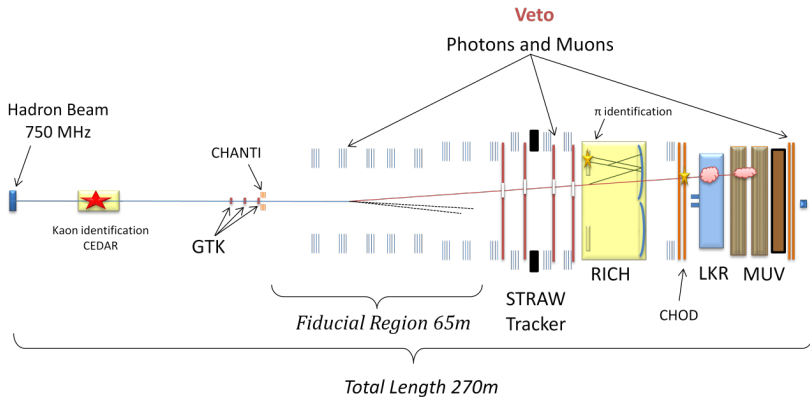CERN

November 2011

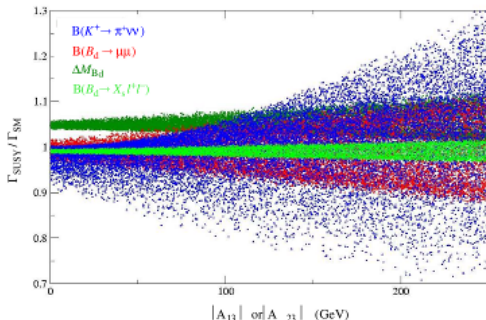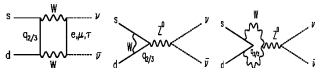# NA62 layout

Veto

Photons and Muons

π identification

Hadron Beam
750 MHz

CHANTI

Kaon identification
CEDAR

GTK

STRAW
Tracker

RICH

CHOD

LKR

MUV

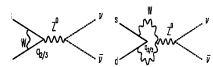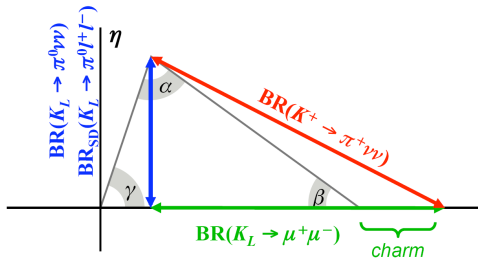*Fiducial Region 65m*

Total Length 270m

Ultra rare decay

- FCNC process forbidden at tree-level

- Very clean theoretical prediction:
  hadronic matrix element extracted from $BR(K \to \pi e \nu)$
- $BR_{SM} = (8.5 \pm 0.7)10^{-11}$ @ NLO
- Current existing measuremen based on 7 events (E787/949):
  $(1.73^{+1.15}_{-1.05})10^{-10}$
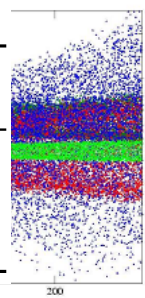- Measurement of $V_{td} \approx 7\%$
- Example of SUSY scenario:

Ultra rare deca

- FCNC pr
- Very clea
  hadronic
- BR_{SM} =
- Current e
  $(1.73^{+1.1}_{-1.0}$
- Measuren
  $V_{td} \approx 7\%$
- Example
  SUSY sce

$\rightarrow \pi e \nu)$

E787/949:

|	Γ_{SD}/Γ	Irreducible theory err. (amp)	SM BR
$K_L \rightarrow \pi^0 \nu\nu$	>99%	1%	3×10^{-11}
$K^+ \rightarrow \pi^+ \nu\nu$	88%	3%	8×10^{-11}
$K_L \rightarrow \pi^0 e^+ e^-$	38%	15%	3.5×10^{-11}
$K_L \rightarrow \pi^0 \mu^+ \mu^-$	28%	30%	1.5×10^{-11}

$|A_{13}|$ or A_{21} (GeV)

STRAW Spectrometer
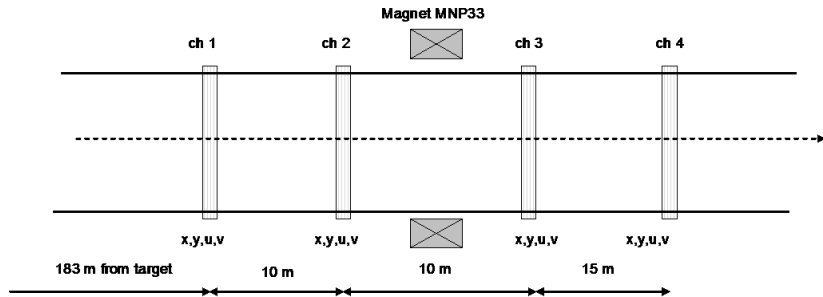
- Dipole magnet 0.36T (270MeV/c p_T kick)
- In vacuum ($< 10^{-6}$mbar)
- 7168 mylar straws
- ArCO$_2$ 70%:30%
- $< 4 \times 0.5\% X_0$

- $\sigma_p/p < 1\%$
- $\sigma_\theta < 60\mu$rad
- $\geq 99\%$ hit efficiency
- leakrate $< 10^{-1}$mbar l/s

STRAW Chamber

- 4 views (u,v,x,y)
- $\oslash = 2.1$m acceptance
- $\oslash \approx$12cm beam hole
- Track angle coverage $\pm 3^o$
- 30μm gold-plated W wire
- 100μm straw straightness
- 200μm wire position acccuracy
- $\sigma < 130\mu$m single view
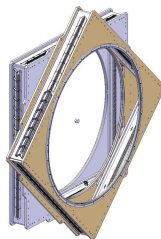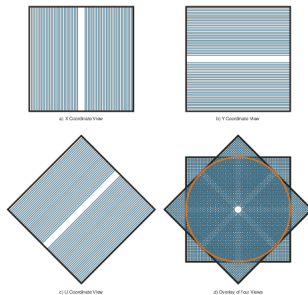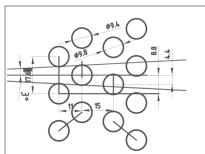
Straws

- 36μm thick mylar
- $\oslash = (9.75 \pm 0.05)$mm
- Cu-Au metalization (50-20nm)
- Ultrasonic welding
- To be operated in the vacuum tank with 1 bar overpressure
- 1.5Kg pretension
- > 500kHz capable (few straws closest to the beam passage)

- Anode resistance 50Ω
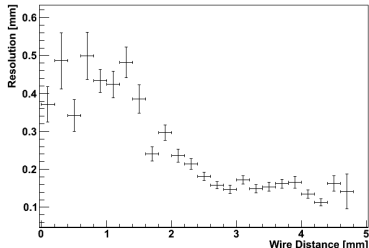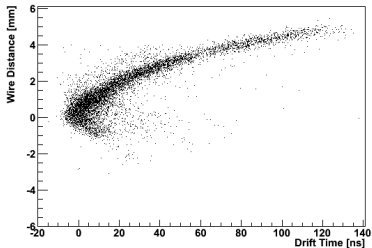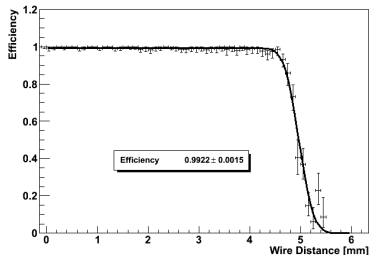- Cathode resistance 70Ω

62
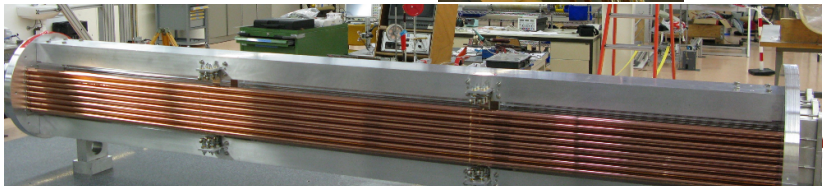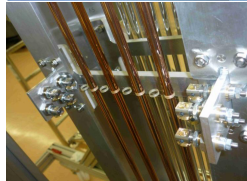
First module construction

- u,v views of 1st chamber
- Straws production complete
- Frame vacuum tested
- Straws installation in progress
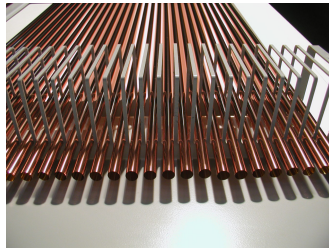
Test Beam (2010)

- 64 straws prototype

- Final mechanics

- Vacuum proof vessel

- CARIOCA based FE

- 120GeV π beam

- We bought 4 micromegas (R15?)
    - spark resistant
    - 10cm×10cm active area
    - 360 strips (1 dimension $\rightarrow$ 4 chambers)
    - 30-40 microns resolution
    - dedicated readout (SRS, 1536 channels)
    - provided with DAQ software
- It took some time to start seeing some meaningful data
- 2 of them were rebuilt because of faulty production
- Ar:CO_2 93:7
- currently under test with cosmics (still 1 with problems)

Some adjustmens

A little bit of fine tuning
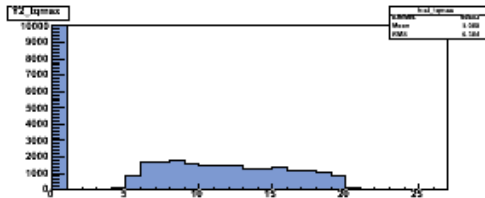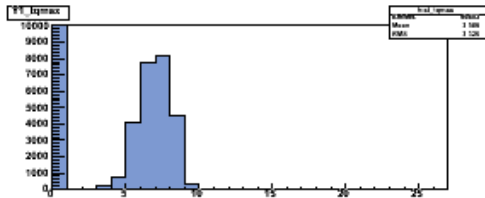
- Trying to exploit the full readout window
- It could work in TPC mode to measure angles
- If resolution is good enough it's a cross check tool

SRS

Setup:

- 1 mini-crate
- 1 FEC
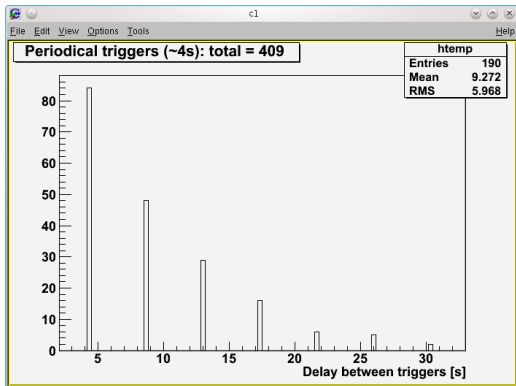- APVs: 3 masters + 3 slaves
- Using the NIM trigger input
- Configure using SRS DCS program
- Readout using mmdaq software

Behaviour:

- Some unstable connection HDMI-APV
- Inefficient detection of trigger signal
- Quite slow in this configuration ($< 1kHz$), without zero suppression

Trigger detection

Curious behaviour

- Internal clock period 25 ns

- External NIM signal 40 ns wide

- Full efficiency with > 100 ns signal

- Sliding readout window up to several clock cycles, i.e. time bins $\rightarrow$ problems in TPC mode

- Zero suppression in the firmware is needed to have a viable tracker for test beams (> 10 kHz)
- To "easily" syncrhonize SRS with an independent readout all events, even if empty, must be saved
- An option in mmdaq to save empty events would be useful
- Trigger detection efficiency must be 100%
- Event timestamping could help, but usually there are troubles with drifting clocks ... nevertheless it could help to identify missing events

Conclusions

- Micromegas seem to work almost as expected
- Still some detail to be understood
- 2 faulty were rebuilt
- Investigation of the usage in TPC mode in progress
- Actual readout rate still not enough (waiting for zero suppression)
- Readout to be synchronized with other readouts
- Trigger detection inefficiency could be annoying

NA62