The Kaon identification system of the NA62 CERN experiment

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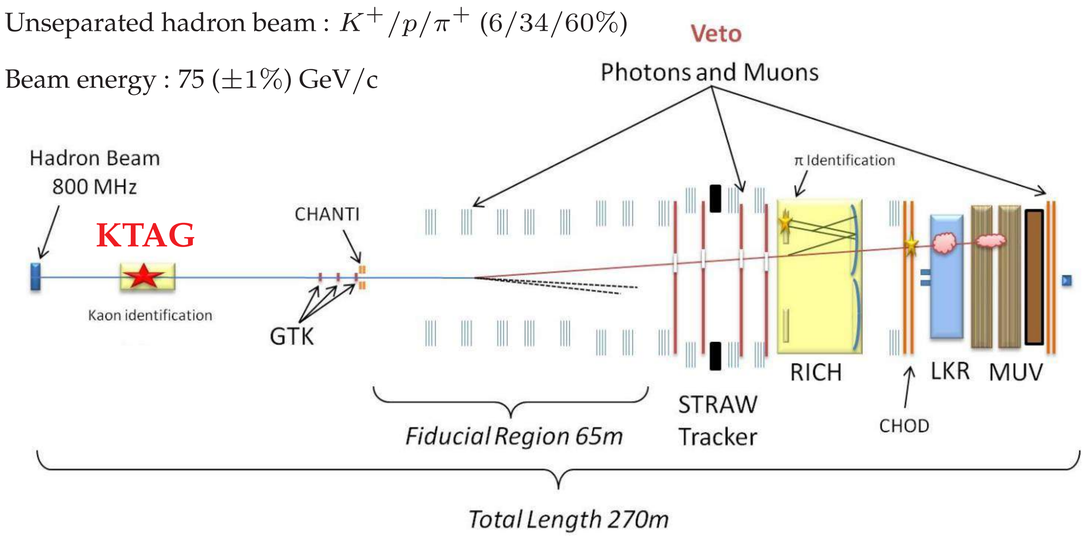
On behalf of the NA62 Collaboration

NA62 CERN EXPERIMENT

Unseparated hadron beam : $K^+/p/\pi^+$ (6/34/60%)

Beam energy : 75 ($\pm$1%) GeV/c



2012 - 2014	Detector installation – Technical run in 2012
Oct - Dec 2014	Pilot run
2015 - 2018	Physics Run

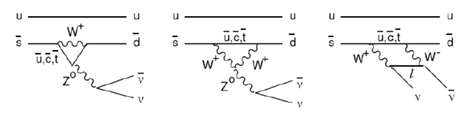
KAON PHYSICS : $K^+ \to \pi^+\nu\overline{\nu}$

NA62 main goal : $K^+ \to \pi^+\nu\overline{\nu}$

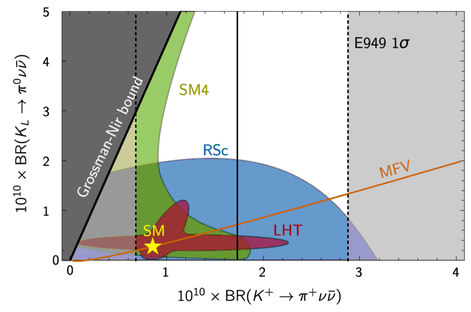
- FCNC process forbidden at tree-level
- Constraint on CKM matrix element V_{td}
- Theoretically clean prediction

$$BR_{SM} = (9.11 \pm 0.72) \times 10^{-11}$$

Buras, Buttazo, Girrbach-Noe, Knegjens : arXiv:1503.02693



- Previous measurement from 7 events
  E787/949 : BR= $(17.3^{+11.5}_{-10.5}) \times 10^{-11}$
  PRL101 (2008) 191802, arXiv:0808.2459



→ Sensitive to New Physics

→ Still complementary to LHC searches

NA62 aims to measure $BR(K^+ \to \pi^+\nu\overline{\nu})$ with 10 % accuracy

→ 100 $K^+ \to \pi^+\nu\overline{\nu}$ with $S/B = 10$ to be achieved in $2-3$ years

KAON IDENTIFICATION SYSTEM : KTAG

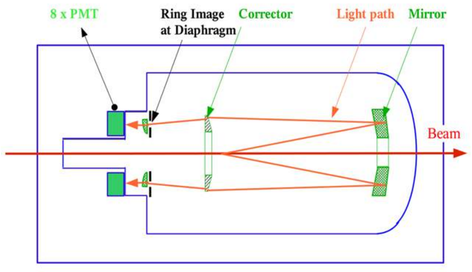
Suppression of the accidental non-kaon background
Definition of offline timestamp for all subdetectors

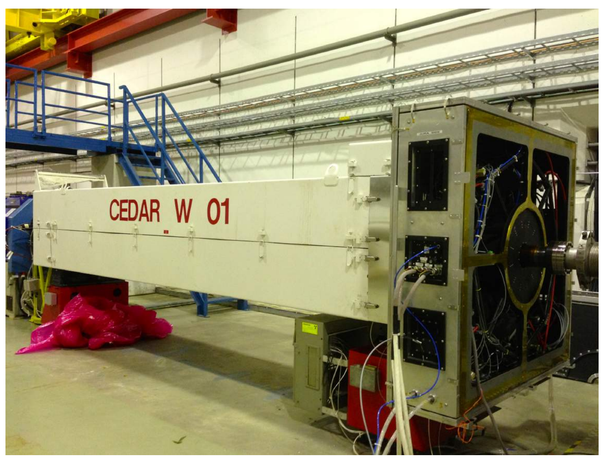
NA62 challenges

- Identification of K^+ with $\geq 95\%$ efficiency
- Time resolution < 100 ps
- Particle misidentification $< 10^{-4}$
- Huge illumination : 45 MHz K^+, with $\sim 200\ \gamma/K$

Existing Beam CEDAR W counter

- Ring imaging optics
- Set up to detect Cherenkov light from K^+



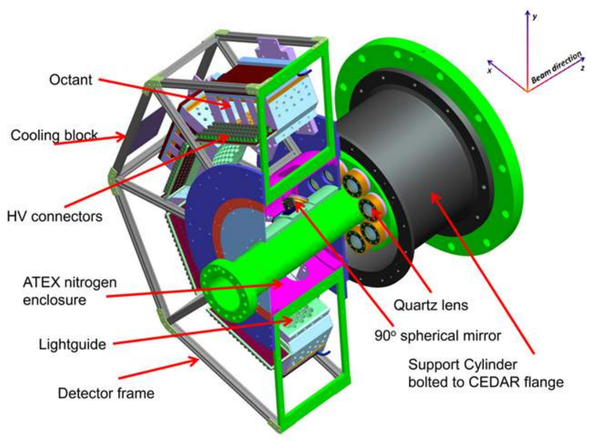


KTAG : CEDAR + new photon detectors and read-out system

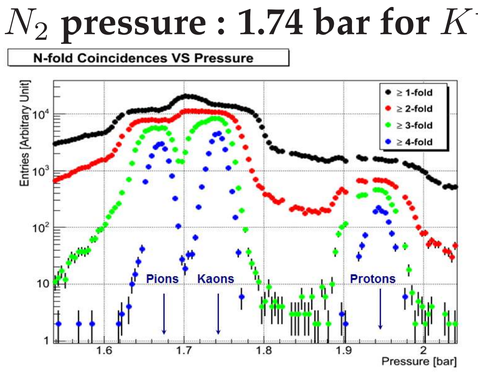
Cherenkov light detected in 8 Light boxes

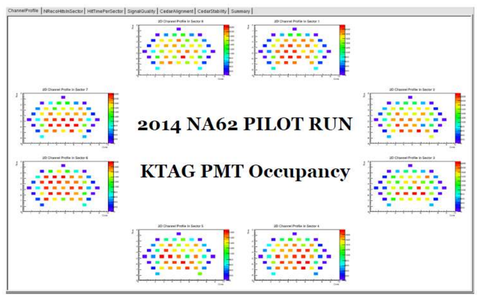
1 Light box contains :
32 R9880 Hamamatsu PMTs
16 R7400 Hamamatsu PMTs
Fast readout electronics

Light box is in an insulated cooled Faraday enclosure flushed with N_2

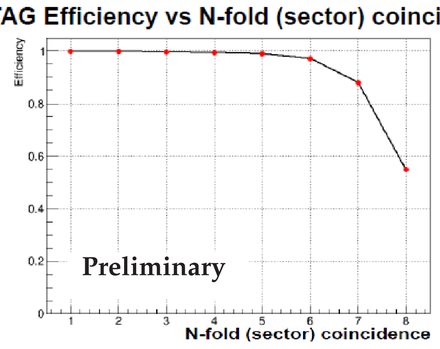


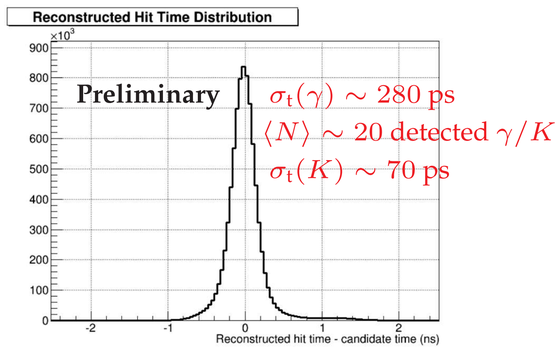
N_2 pressure : 1.74 bar for K^+





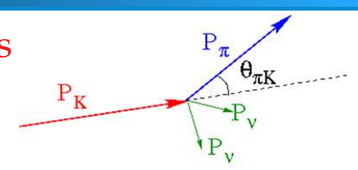
KTAG Efficiency vs N-fold (sector) coincidence



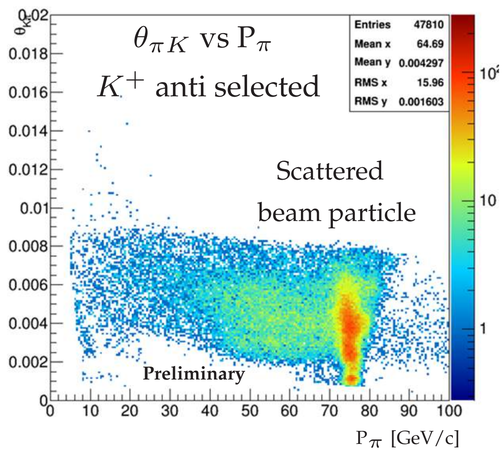


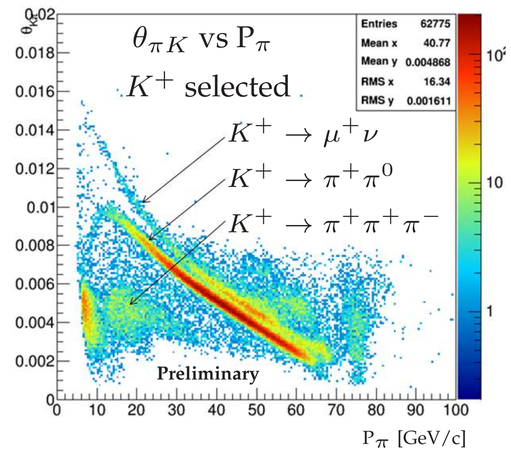
KTAG PERFORMANCE AND PHYSICS

KTAG is essential to NA62 physics



Single track study with KTAG



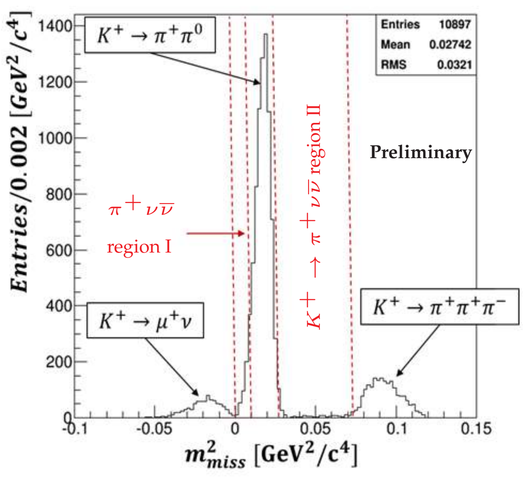


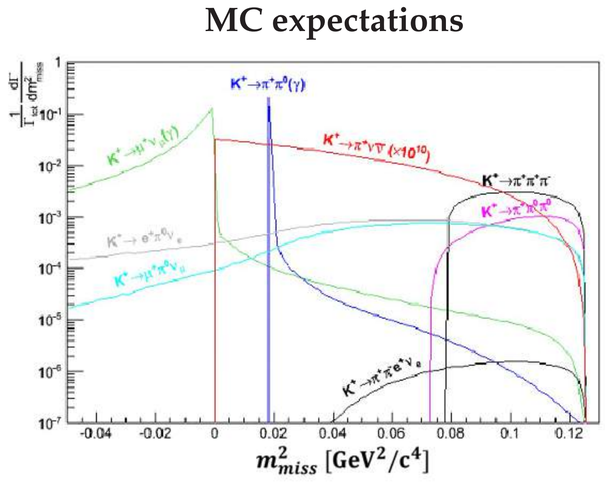
Towards the measurement of BR($K^+ \to \pi^+\nu\overline{\nu}$)

Preliminary analysis : $M^2_{\text{miss}} = \left(P^+_K - P^+_\pi\right)^2$

- K^+ timing (KTAG), nominal momentum and direction (no GTK)
- π^+ momentum in [15; 35] GeV/c (STRAW tracker using only Pt kick)
- Decay vertex in fiducial region

MC expectations





Resolution improvement expected from :

- GTK kaon spectrometer information
- Fine STRAW spectrometer alignment with detailed B field map

Background rejection improvements from :

- RICH particle identification ($\pi/\mu/e$)
- Photon rejection (LKr, LAV, IRC, SAC)
- Muon rejection (MUV)

CONCLUSIONS AND PERSPECTIVES

KTAG : Fully commissioned
KTAG preliminary performance evaluation within expectations :
Time resolution $\sigma_t(K^+) \sim 70ps$
Identification efficiency $\geq 95\%$
NA62 detector commissioned and ready for physics !
Nominal intensity in 2015 - 2018 → NA62 promising physics program

EPS-HEP 2015, Vienna, Austria, 22 – 29 July 2015