### The Kaon identification system of the NA62 CERN experiment

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**NA62 CERN EXPERIMENT**

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

Beam energy: \( 75 \text{ (±1\%) GeV/c} \)

- **Fly**
- **Veto**

Hadron Beam 800 MHz

**KTAG**

- **K**
- **AON**
- **CERN EXPERIMENT**
- **NA62**

**Set up to detect Cherenkov light**

- **Ring imaging optics**
- **Existing Beam CEDAR W counter**
- **Set up to detect Cherenkov light from \( K^+ \)**

**2012 - 2014**

- **Detector installation – Technical run in 2012**
- **Pilot run**
- **Physics Run**

**2015 - 2018**

- **Total Length 270m**

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**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: \( 45 \text{ MHz } K^+ \), 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 \( \text{N}_2 \)

**\( N_2 \) pressure : 1.74 bar for \( K^+ \)**

**KTAG Efficiency vs N-fold (sector) coincidence**

- **Preliminary**
- \( \approx 280 \text{ ps} \) (NS) \( \approx 20 \text{ detected } \gamma/K \)
- \( \approx 70 \text{ ps} \)

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**Kaon Physics : \( K^+ \rightarrow \pi^+ \nu \bar{\nu} \)**

**NA62 main goal : \( K^+ \rightarrow \pi^+ \nu \bar{\nu} \)**

- FCNC process forbidden at tree-level
- Constraint on CKM matrix element \( V_{ud} \)
- Theoretically clean prediction

\( BR_{\text{NA62}} = (9.11 \pm 0.72) \times 10^{-11} \)

- Previous measurement from 7 events

**KTAG : Fully commissioned**

- **KTAG** is essential to NA62 physics
- **Single track study with KTAG**

**Towards the measurement of \( BR(K^+ \rightarrow \pi^+ \nu \bar{\nu}) \)**

Preliminary analysis: \( M^2_{\text{max}} = \left( \frac{P^+}{K} - P_{\pi^+} \right)^2 \)

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

**Resolution improvement expected from :**

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

**Background rejection improvements from :**

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

**Conclusions and Perspectives**

- **KTAG** is essential to NA62 physics
- **NA62 aims to measure \( BR(K^+ \rightarrow \pi^+ \nu \bar{\nu}) \) with 10% accuracy**
- \( 100 \text{ K}^+ \rightarrow \pi^+ \nu \bar{\nu} \) with \( S/B = 10 \) to be achieved in 2 – 3 years

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