Why study $K^+ \to \pi^+\nu\bar{\nu}$?

- FCNC processes with loops dominated by top quark.
- Hadronic matrix element from BR($K^+ \to \pi^+\nu\bar{\nu}$).

Theory:

$$BR = (8.22 \pm 0.69) \times 10^{-11}$$

Experiment:

$$BR = (17.3 \pm 6.0) \times 10^{-11}$$

Preliminary tests have been done with cosmic rays using the first CHANTI station.

The signal is digitized as Time Over Threshold (TOT) as for the LAV.

Measurement offers NP sensitivity.

The CHANTI detector is composed by 6 stations which are hermetic to charged particles produced by GTK-3 between 49 and 1.31 rad.

The ChCND is also required in order to reduce the critical background induced by inelastic interactions of the beam with the target and the Gigatracker (GTK) stations. The most critical events are the ones in which the inelastic interaction takes place in the last GTK station (GTK-3). In such cases, pions, or other particles produced in the interaction, if emitted at low angle, can reach the straw tracker and mimic a K-decay in the fiducial region. If no other track is detected, these events can appear as a signal event, one single $\pi^+$ in the final state.

A GEANT 4 simulation has shown that kaon inelastic interactions with GTK-3 happen in about 5/100 cases. So the combined rejection factor of the analysis cuts and the CHANTI veto must lead to a remaining inefficiency of $2 \times 10^{-6}$.

The CHANTI detector is composed by 6 stations which are hermetic to charged particles produced by GTK-3 between 49 mrad and 1.31 rad.

The expected rate is about 2 MHz, more than 1 MHz due to muon halo. CHANTI is also required in order to tag beam halo background immediately close to the beam. Even if it is not intended as a trigger veto at L0, time resolution is smaller than 2 ns to keep the random veto rate at an acceptable level.

CHANTI Front-End Electronics and preliminary tests

Each scintillator bar is coupled individually to a SiPM. The bias voltage, settled with a precision of few mV, is brought to the SiPM inside and the signal are carried out from the vacuum tube using appropriate vacuum tight flanges.

The CHANTI board provides fast amplification, 20 gain. The FEE also provide precision of few mV, is brought to the board. The bias voltage, settled with a precision of few mV, is brought to the SiPM inside and the signal are carried out from the vacuum tube using appropriate vacuum tight flanges.

Preliminary tests have been done with cosmic rays using the first prototype station and the FEE prototype board. External trigger has been used. About 120 photoelectrons have been collected for each layer.

Time measurements, corrected for time slewing using TOT measurement, have shown a resolution of the order of 800 ps.

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