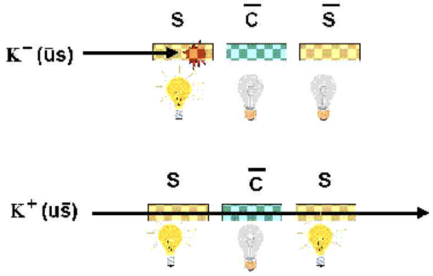
https://cplear.web.cern.ch/cplear/newtransparencies/cplear_25.html

Rate Normalization

The reconstruction efficiency for $K^0 \to \pi^+\pi^-$ and $\overline{K}^0 \to \pi^+\pi^-$ are identical BUT the initial (t = 0) number of K^0 and $\overline{K}^0$ mesons recorded on tape are different ! The reasons are related to the strangeness tagging using charged kaons:

- left and right curved track are reconstructed differently because of deviations from the cylinder geometry
  ideal solution: change frequently polarity of magnetic field
  OK
- positive and negative charged kaons are reconstructed with different efficiency because of different strong interactions with the detector material



ideal solution: use also detector made of antimatter
not possible

Principles of the CPLEAR Experiment

Measurement of time dependent decay rate asymmetries:

$$A_f(\tau) = \frac{R_{\overline{K}^0 \to \overline{f}}(\tau) - R_{K^0 \to f}(\tau)}{R_{\overline{K}^0 \to \overline{f}}(\tau) + R_{K^0 \to f}(\tau)}$$

acceptances cancel

Production and Tagging:

$$p\bar{p} \text{ (at rest)} \to \begin{array}{ll} & \text{BR} \\ K^-\pi^+\overline{K}^0 & 2 \times 10^{-3} \\ K^+\pi^-K^0 & 2 \times 10^{-3} \end{array}$$

The *Strangeness* of the neutral kaon K^0 ($\overline{K}^0$) at time $\tau = 0$ is defined by the charged kaon K^- (K^+).

Tagging at decay time:

$K^0 \to e^+\nu\pi^-$ $\qquad$ $\overline{K}^0 \to e^-\overline{\nu}\pi^+$

The *Strangeness* of the neutral kaon K^0 ($\overline{K}^0$) at the decay time is defined by the charge of the lepton ($\Delta S = \Delta Q$).

The CPLEAR Physics Program

◇ $\mathcal{CP}$ violation

Precision measurements of $|\eta_{+-}|$ and φ_{+-}

Measurements of $|\eta_{00}|$ and φ_{00}

Improved limits on η_{+-0}, η_{000}

◇ $\mathcal{CPT}$ invariance

Direct measurement of $\Re e\,(\delta)$

Quantum Gravitation

◇ $\mathcal{T}$ violation

First measurement of

$$A_T \propto P(\overline{K}^0 \to K^0) - P(K^0 \to \overline{K}^0)$$

◇ Non $\mathcal{CP}$-Physics

Precision measurement of the
$K_L - K_S$ mass difference: Δm

Search for $\Delta S = \Delta Q$ forbidden decays

Measurement of $K_S \to \pi^+\pi^-\pi^0$

EPR Paradox, Test of Quantum Mechanics

Study of $p\bar{p}$ annihilation, Bose-Einstein ...