Recent results on radiative Kaon decays from NA48 and NA48/2.

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The analysis of $K^0 \to \pi^\pm e^\pm \nu\gamma$ ($K^0e3\gamma$) and $K^\pm \to \pi^\pm\pi^0\gamma$ radiative decays will be discussed.

Keywords: Internal Bremsstrahlung, Direct Emission.

1. Ratio of $K^0e3\gamma$ with respect to K^0e3.

Using data from a dedicated run in 1999 at the CERN SPS, the NA48 collaboration has measured the branching ratio of $K^0e3\gamma$ with respect to inclusive K^0e3.[1]
To avoid collinear and infrared singularities cuts have been imposed on the photon energy (E^*_γ >30 MeV) and on the angle between the photon and the electron ($\theta^*_{e\gamma}$ >20^0) in the kaon center of mass system.
Monte Carlo simulation has been used to compute the detector acceptance and the selection efficiency for both channels. Radiative corrections were taken into account by modifying the PHOTOS[2] program package in order to reproduce the $\theta^*_{e\gamma}$ distribution obtained in data. The main source of systematic uncertainty is the knowledge of the kaon spectrum. The result is based on 19000 $K^0e3\gamma$ decays and 5.6×10^6 K^0e3 decays:

$$BR(K^0 \to \pi^\pm e^\pm \nu\gamma, E^*_\gamma > 30MeV, \theta^*_{e\gamma} > 20^0)/BR(K^0e3) = (0.964 \pm 0.008(stat)^{+0.011}_{-0.009}(syst))\%$$

This is in good agreement with theoretical predictions, but at a variance with other experimental results.

2. The $K^{\pm} \to \pi^{\pm}\pi^{0}\gamma$ decay.

A subsample of 2003 NA48/2 data has been analyzed to measure the contribution of Direct photon Emission (DE) relative to Inner bremsstrahlung (IB) and detect the presence of interference (INT) between these two amplitudes in $K^{\pm} \to \pi^{\pm}\pi^{0}\gamma$ decays. About 124×10^{3} events have been reconstructed in the ranges $\mathrm{T}^{*}_{\pi} < 80$ MeV and $0.2 < \mathrm{W} < 0.9$, where T^{*}_{π} is the charged pion kinetic energy in the Kaon center of mass system and W^{2} is:

$$W^2 = \frac{(p_K p_\gamma)(p_\pi p_\gamma)}{m_\pi^2 m_K^2}$$

being p_K, p_π, p_γ the four-momenta of the kaon, charged pion and odd gamma, and m_π, m_K the charged pion and kaon masses.

An algorithm has been developed to reject $K^{\pm} \to \pi^{\pm}\pi^{0}\pi^{0}$ decays with two gammas overlapping in the detector. In addition, the reconstructed kaon mass is required to be within 10 MeV from its nominal value. These two conditions avoid the need of performing a lower cut on T^{*}_{π} , increasing the sensitivity to DE and INT terms with respect to previous measurements.[3]

The upper cut $T^{*}_{\pi} < 80$ MeV rejects $K^{\pm} \to \pi^{\pm}\pi^{0}$ decays. After all cuts, the background contamination has been estimated to be less than 10^{-4}.

Photon mistagging (i.e., choice of the wrong odd photon) has been kept smaller than the per mil level for all decay components.

The fractions of DE and INT with respect to IB present in data have been determined by fitting the proportions of simulated IB, DE and INT W distributions to reproduce the expetimental one, using a maximum likelihood method. The systematic error is dominated by the trigger efficiency. The results are:

$$\mathrm{Frac(DE)} = (3.35 \pm 0.35_{stat} \pm 0.25_{syst})\%$$

$$\mathrm{Frac(INT)} = (-2.67 \pm 0.81_{stat} \pm 0.73_{syst})\%$$

The correlation coefficient between these two parameters is -0.93.

References

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