

# Measurement of the CP violation parameter $|\eta_{+-}|$ and the charge asymmetry in $K^\pm \rightarrow 3\pi$ decays by NA48 and NA48/2

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The main goal of the NA48 experiment at the CERN SPS has been the search for direct CP violation (CPV) in kaon decays. The observable  $\eta_{+-}$  is related to the parameters of indirect and direct CPV ( $\eta_{+-} = \varepsilon + \varepsilon'$ ) and defined as the CP violating amplitude ratio of the neutral kaon decaying into two charged pions:  $\eta_{+-} = A(K_L \rightarrow \pi^+\pi^-)/A(K_S \rightarrow \pi^+\pi^-)$ . NA48 has determined  $|\eta_{+-}|$  via the measurement of the ratio of decay rates  $\Gamma(K_L \rightarrow \pi^+\pi^-)/\Gamma(K_L \rightarrow \pi e \nu)$ . The data were taken during a dedicated run in 1999 using a pure  $K_L$  beam. The analysis is based on 47000  $K_L \rightarrow \pi^+\pi^-$  and five million  $K_L \rightarrow \pi e \nu$  decays.

Complementary with  $\varepsilon'/\varepsilon$ , the observable in the charged kaons sector is the asymmetry  $A_g = (g^+ - g^-)/(g^+ + g^-)$  of the linear slope parameter  $g$  in the Dalitz plot of  $K^\pm \rightarrow 3\pi$  decays. Any non-zero value of  $A_g$  would reflect evidence for direct CPV. SM predictions for the charge asymmetry give an upper limit of a few  $10^{-5}$ , while theoretical calculations involving processes beyond the SM do not exclude substantial enhancements of  $A_g$ . The NA48/2 experiment used simultaneous  $K^+/K^-$  beams, and from the data samples taken in 2003 and 2004,  $3.11 \times 10^9 K^\pm \rightarrow \pi^\pm \pi^+ \pi^-$  and  $9.13 \times 10^7 K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$  were selected. The charge asymmetry parameter  $A_g$  was determined with a total uncertainty of  $\sim 2 \times 10^{-4}$  for each mode, ten times more accurate than previous measurements.

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