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Precision tests of Quantum Mechanics and CPT symmetry with entangled neutral kaons at KLOE

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The quantum interference between the decays of entangled neutral kaons is a very powerful tool for testing the quantum coherence of the entangled kaon pair state. The studied process φ ⟶ KS KL ⟶ π+ π− π+ π− exhibits the characteristic Einstein–Podolsky–Rosen correlations that prevent both kaons to decay into π + π − at the same time. The newly published result is based on data sample collected with the KLOE detector at DAΦNE and corresponds to an integrated luminosity of about 1.7 fb−1 , i.e. to ~ 1.7 × 10^9 φ ⟶ KS KL decays. From the fit of the observed time difference distribution of the two kaon decays, the decoherence and CPT violation parameters of various phenomenological models are measured. A stringent upper limit on the branching ratio of the φ ⟶ KSKS, KLKL decay is also derived. Independently, the comparison of neutral meson transition rates between flavour and CP eigenstates allows direct and model independent tests of time-reversal T and CPT symmetries, through ratios of rates of two classes of processes:$K_S K_L \to \pi^{\pm} e^{\mp} \nu, 3\pi^0$ and $K_S K_L \to \pi^+ \pi^-, \pi^{\pm} e^{\mp} \nu$. In addition to this a straightforward extension to the case of CPT symmetry was performed providing us with the first model independent test of CPT symmetry violation in transitions of neutral kaons.

In-person participation

Yes

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