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A direct test of T symmetry in the neutral K meson system at KLOE-2

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This work presents prospects for conducting a novel direct test of time-reversal symmetry at the KLOE-2 experiment. Quantum entanglement of neutral K meson pairs uniquely available at KLOE-2 allows to probe the T symmetry directly and independently of CP violation. This is achieved by a comparison of probabilities for a transition and its inverse obtained through exchange of initial and final states. Such transitions between flavor and CP-definite states of the neutral kaons are only connected by the T conjugation which ensures the CP-independence of the test. While a similar measurement was performed by the BaBar experiment with neutral B mesons, the KLOE-2 detector can test T-violation in the neutral kaons system. Such a test requires i.a. reconstruction of the $KL \rightarrow 3\pi^0$ decay accompanied by $KS \rightarrow \pi^\pm l \bar{\nu}$ with good timing information. Therefore a new reconstruction method for this process is also presented which is capable of reconstructing the $KL \rightarrow 3\pi^0$ decay with decay time resolution of $O(1\tau_S)$.

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