

KLEVER: An experiment to measure $\text{BR}(K_L \rightarrow \pi^0 \nu \bar{\nu})$ at the CERN SPS

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Precise measurements of the branching ratios (BRs) for the flavor-changing neutral current decays $K \rightarrow \pi \nu \bar{\nu}$ can provide unique constraints on CKM unitarity and, potentially, evidence for new physics. It is important to measure both decay modes, $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ and $K_L \rightarrow \pi^0 \nu \bar{\nu}$, since different new physics models affect the rates for each channel differently. The NA62 experiment at the CERN SPS is currently collecting data and will measure $\text{BR}(K^+ \rightarrow \pi^+ \nu \bar{\nu})$ to within 10%. We are designing the KLEVER experiment to measure $\text{BR}(K_L \rightarrow \pi^0 \nu \bar{\nu})$ to $\sim 20\%$ using a high-energy neutral beam at the CERN SPS starting in LHC Run 4. The boost from the high-energy beam facilitates the rejection of background channels such as $K_L \rightarrow \pi^0 \pi^0$ by detection of the additional photons in the final state. On the other hand, the layout poses particular challenges for the design of the small-angle vetoes, which must reject photons from K_L decays escaping through the beam pipe amidst an intense background from soft photons and neutrons in the beam. We present findings from our design studies, with an emphasis on the challenges faced and the potential sensitivity for the measurement of $\text{BR}(K_L \rightarrow \pi^0 \nu \bar{\nu})$.

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