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Observation of the $K^+ \to \pi^+\nu\bar{\nu}$ decay and measurement of its branching ratio at NA62

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The $K^+ \to \pi^+\nu\bar{\nu}$ decay is a golden mode for flavour physics. Its branching ratio is predicted with high precision by the Standard Model to be less than 10^{-10}, and this decay mode is highly sensitive to indirect effects of new physics up to the highest mass scales. A new measurement of the $K^+ \to \pi^+\nu\bar{\nu}$ decay by the NA62 experiment at the CERN SPS is presented, using data collected in 2021 and 2022. This dataset was collected after modifications to the beamline and detectors and at a higher instantaneous beam intensity with respect to the previous 2016–2018 data taking. Using the NA62 datasets from 2016–2022, a new measurement of $\mathcal{B}(K^+ \to \pi^+\nu\bar{\nu}) = \left(13.0^{+3.3}_{-2.9}\right) \times 10^{-11}$ is reported, and for the first time the $K^+ \to \pi^+\nu\bar{\nu}$ decay is observed with a significance exceeding 5σ. This is the rarest particle decay observed and the first involving the third generation of leptons ($\nu_\tau\bar{\nu}_\tau$).

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