

The 22nd international workshop on Next Generation Nucleon Decay and Neutrino Detectors (NNN23)



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II



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Comune di
Procida

Contribution ID: 85

Type: **Abstract for a Poster**

Recent results on proton decay searches in Super-Kamiokande

We would like to report on the recent results on proton decay searches in Super-Kamiokande (SK). We will cover the updated results since NNN19 using the pure water detector phase data, including the flagship modes: $p \rightarrow e^{+0}$, $p \rightarrow \mu^{+0}$, and $p \rightarrow K^{+}$.

There are many theories which predict different nucleon decay modes, and therefore it is important to experimentally search for various decay modes other than those flagship modes to determine the physics beyond the Standard Model of particle physics. Searches for $p \rightarrow \mu^{+} K^{0}$ and $p \rightarrow e^{+0}$ are updated by improving data analyses such as event reconstruction algorithms or systematic error estimations.

Some theory [1] predicts that the $p \rightarrow e^{+00}$ decay rate could be comparable to the $p \rightarrow e^{+} + \mu^{0}$ one in a model-independent manner. We searched for $p \rightarrow e^{+00}$ and $p \rightarrow \mu^{+00}$ for the first time in SK and the new results will be shown. We optimized the event selections with an additional 0 in the final state with respect to $p \rightarrow e^{+0}$, $p \rightarrow \mu^{+0}$. All the pure water phase data (SK I-V) were used in these searches.

[1] "Three-body decays of the proton", PRD 23 7 (1981).

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Session Classification: Poster Session and Aperitif