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Measurement of the branching ratio of 16N, 15C, and 12B isotopes through the nuclear muon capture reaction in the Super-Kamiokande detector

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The Super-Kamiokande detector has measured solar neutrinos for more than 25 years.The sensitivity to solar neutrino measurement is limited by the uncertainties of energy scale and the background modeling. One of the major background events is the spallation products created by the cosmic ray muons in the detector water tank. Some of the negative muons stop in the tank and are captured by the oxygen nuclei. Decays of unstable isotopes with relatively long half-life through the nuclear muon capture, such as ^{16}N, ^{15}C, and ^{12}B, are detected as background events of solar neutrino observations.
In this study, we developed the method to form a pair of parent-stopping muon and decay candidate events and evaluated the production rates of such unstable isotopes. We then measured their branching ratio considering their production rates and the estimated number of nuclear muon capture.
The result of ^{16}N is the world-leading precision measurement at present and the results of ^{15}C and ^{12}B are the first branching ratio measurements of those isotopes.
These measurement results are useful for improving simulations for muon capture processes.

Collaboration you are representing

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