

Proton Decay

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Grand Unified Theories of elementary particles often predict that the proton has a finite lifetime and decays into a positron and a neutral pion. The Super-kamiokande is the world's largest proton decay detector holding about 22 kilotons of fiducial water volume. This volume contains 0.75×10^{34} protons, and in the case of proton's lifetime of 10^{34} years, we expect to detect three proton decays in 10 years by taking into account 40% detection efficiency. On the other hand, we suffer from 30,000 background events in 10 years by atmospheric neutrino interactions, and it is a critical task to eliminate the backgrounds. The invariant mass and total momentum of events reconstructed from proton decay products provide a strong way to reject the backgrounds. We expect that proton decay signals have the reconstructed invariant mass and momentum values consistent with source protons while neutrino background events tend to have a relatively small mass and large momentum due to the initial neutrino momentum. In the search for the proton decay into a positron and a neutral pion, we successfully suppressed the backgrounds to be 0.5 events/10 years. We observed no signal candidates in 10 years of data and set the limit on the proton's lifetime as 1.3×10^{34} years.

