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Solar neutrino observation based on fluoride scintillation crystals

We propose to develop future detectors to verify the MSW effect on the oscillation in solar neutrinos. We have focused on inorganic scintillation crystals, which have a potential to be high energy-resolution detectors because their light yield is higher than that of liquid scintillation or water Cherenkov light. However, the background noise from radioactive impurities in the crystal and environmental radioactivity made neutrino observations impractical compared to previous detector designs based on inorganic crystals. Fluorine-19 captures electron neutrinos, then produces a Neon-19 and an electron. The Neon-19 decays with a half lifetime of 17 seconds and emits a positron. The positron forms positronium and emits two gamma rays. In other words, using a pixelated detector design and the coincidence techniques for the four particles, the electron-neutrino events can be identified with strong evidence. On the other hand, it has been reported that when positive muons are stationary in a fluoride crystal, they form an F-μ-F state. If the same is true for positrons, they may not be able to form positronium and their apparent lifetime may be extended. This is fatal to delayed coincidence measurements because it allows background noise to enter. In this study, the apparent lifetime of positronium has been measured using small fluoride crystals. On this basis, we simulated the feasibility of solar neutrino observations with fluoride scintillation crystals. In this presentation, we will detail the detector design, the detection mechanism.

Collaboration(s)

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