Contribution ID: **338** Type: **Oral report**

The Potential to Probe Solar Neutrino Physics with LiCl Water Solution

Wednesday, 10 August 2022 08:30 (15 minutes)

Lithium chloride water solution is a good option for solar neutrino detection. The ν_e charged-current (CC) interaction cross-section on ^{7}Li is evaluated with new B(GT) experimental measurements. The total CC interaction cross-section weighted by the solar ^{8}B electron neutrino spectrum is 3.759×10^{-42} cm^2, which is about 60 times that of the neutrino-electron elastic scattering process. The final state effective kinetic energy after the CC interaction on ^{7}Li directly reflects the neutrino energy, which stands in sharp contrast to the plateau structure of recoil electrons of the elastic scattering. With the high solubility of LiCl of 74.5 g/100 g water at 10°C and the high natural abundance of 92.41%, the molarity of ^{7}Li in water can reach 11mol/L for safe operation at room temperature. The CC event rate of ν_e on ^{7}Li in the LiCl water solution is comparable to that of neutrino-electron elastic scattering. In addition, the ν_e CC interaction with the contained ^{37}Cl also contributes a few percent of the total CC event rate. The contained ^{35}Cl and ^{6}Li also make a delay-coincidence detection for electron antineutrinos possible. The recrystallization method is found to be applicable for LiCl sample purification. The measured attenuation length of 11 ± 1 m at 430nm shows that the LiCl solution is practicable for a 10−m diameter detector for solar neutrino detection. Clear advantages are found in studying the upturn effect of solar neutrino oscillation, light sterile neutrinos, and Earth matter effect. The sensitivities in discovering solar neutrino upturn and light sterile neutrinos are shown. More details of the work can be found in arxiv:2203.01860.

Summary

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Session Classification: Parallel Session III (5)：Particle Detector Technology

Track Classification: 粒子物理实验技术