Search for Solar hep Neutrinos in the Sudbury Neutrino Observatory

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The Sudbury Neutrino Observatory (SNO) is designed to measure the flux of solar neutrinos and to determine the shape of the solar neutrino spectrum. Neutrinos from the beta-decay of $^8$B dominate the solar neutrino spectrum between 5-15 MeV. The shape of the neutrino energy spectrum from a single beta-decaying source is well known and independent of solar physics to an accuracy of 1 part in $10^6$. A measurement of the shape of the solar neutrino energy spectrum is a direct test of the minimal electroweak model and can be used to constrain models of neutrino flavor transformation.

Near the $^8$B endpoint the solar neutrino spectrum is very sensitive to any underlying background, including neutrinos with energies above 15 MeV from other sources than $^8$B-decay. In a rare branch of the pp-chain in the Sun, $^3$He and proton fuse forming the reaction $^3$He + $p \rightarrow ^4$He + $e^+ + \nu_e$. This hep process produces the highest energy solar neutrinos with an energy of up to 18.77 MeV.

Standard Solar Model calculations predict a hep neutrino flux three orders of magnitude smaller than the flux of $^8$B neutrinos. Although the hep neutrino flux is a negligible contribution to the total neutrino flux measured in SNO it can significantly distort the $^8$B neutrino spectrum near the endpoint if the hep S-factor is much larger than the existing estimates. The reliable estimation of the hep cross-section has been a long-standing challenge in nuclear physics and a direct measurement of the flux of hep neutrinos has not been done.

SNO recently determined the energy spectrum of solar neutrinos from the measurement of the electron spectrum in the process $\nu_e + d \rightarrow e^- + p + p$ above a kinetic energy of 5 MeV. The SNO solar neutrino spectrum is now analyzed for the contribution from solar hep neutrinos. We report on the status of the search for solar hep neutrinos in the Sudbury Neutrino Observatory.