SNO+ double beta decay experiment

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The unique location of the Sudbury Neutrino Observatory experiment [1] 2 kilometres underground and the high radiopurity of the materials used in the construction of the detector, allowed to perform very accurate measurement of the spectral and flavour composition of the ^{8}B solar neutrino flux [2]. The SNO+ experiment [3] is the follow up of SNO, in which the detector will be filled with 780 tons of liquid scintillator (Linear Alkyl Benzene - LAB). LAB was chosen as scintillator for the SNO+ experiment due to its chemical compatibility with acrylic, its high light yield (about 10,000 pe/MeV), the good optical transparency and low scattering. Moreover, high purity levels are easily available directly from the manufacturer and, due to the fast decay, it is possible to discriminate between beta and alpha particles, allowing a background rejection.

Two main phases of the SNO+ experiment are planned. One phase, with pure liquid scintillator, aims to study solar neutrinos, in particular *pep* and *CNO* neutrinos. Along these, geo-, supernovae and reactor neutrinos can also be detected. The second phase will be the neutrinoless double beta decay phase. The liquid scintillator will be initially loaded with 0.1% of natural Neodymium. ^{nat}Nd contains, with an isotopic abundance of 5.6%, ^{150}Nd, one of the candidates for the neutrinoless double beta decay. Beside the high natural abundance, ^{150}Nd has a high Q-value of 3.37 MeV, which is above most backgrounds from natural radioactivity, and the largest phase space factor of all double beta decay isotopes.

Background sources in the energy window for the $0\nu2\beta$ are the $2\nu2\beta$ decay of ^{150}Nd, ^{208}Tl, ^{214}Bi, and ^{8}B neutrinos. Tagging techniques under developments have shown that a >99% rejection on ^{214}Bi, and a 90% rejection on ^{208}Tl, are achievable. In three years of data taking, this will give a sensitivity on the effective neutrino mass of 100-200 meV (90% C.L.) The SNO+ goal is to increase the concentration to the optimized amount of 0.3% ^{nat}Nd loading. Despite the decrease of a factor 2 in the light yield, in fact, the sensitivity in the half-life will increase by 70%.

The experiment is fully funded and it will start taking data with the pure liquid scintillator in 2013. The 0.1% loading Nd phase is foreseen for 2014.

References

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