MEASURING THE $^{14}$C CONTENT IN LIQUID SCINTILLATORS

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In order to detect low-energy neutrinos, for example the solar neutrinos from the pp-chain (with the maximum neutrino energy of approximately 400 keV) requires that the intrinsic $^{14}$C content in a liquid scintillator is at extremely low level. In the Borexino detector, a 300-ton liquid scintillation detector at Gran Sasso, Italy, the ratio of $^{14}$C to $^{12}$C of approximately $2 \times 10^{-18}$ has been achieved. It is the lowest value ever measured. The detector situates underground at the depth of 3200 mwe (1200 m).

$^{14}$C cannot be removed from liquid scintillators by chemical methods, or by other methods in large quantities (liters). In principle, the older is the oil or gas source that the liquid scintillator is made of and the deeper it situates, the smaller should be the $^{14}$C-to-$^{12}$C ratio. This, however, is not generally the case, and the ratio depends on the activity (U and Th content) in the environment of the source.

We have started a series of measurements where the $^{14}$C-to-$^{12}$C ratio will be measured from liquid scintillator samples. The measurements take place in two underground laboratories: in the Pyhäsalmi mine, Finland, at the depth of 4000 mwe (1400 meters) and at the Baksan Underground Laboratory, Russia at 4800 mwe, for reducing and better understanding systematical uncertainties. There will be about ten samples with the known origin, each of them 2 litres. The liquid scintillator vessel, light guides and low-active PMTs will be shielded with thick layers copper and lead. Nitrogen flow is used to reduce the radon background.

The aim is to measure ratios smaller than $10^{-18}$, if such samples exists. One measurement takes several weeks.