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P3.079 Geochemical determination of the pp-Neutrino Flux with ^{205}Tl – LOREX: A progress report

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on behalf of LOREX collaboration

Intensive research from the 1970's to 1990's towards geochemical detection of solar neutrinos using ^{205}Tl , ^{98}Mo and ^{81}Br has left ^{205}Tl the only viable candidate. LOREX (LORandite EXperiment) is based on determining the solar (pp) neutrino flux for the period of 4.3 Ma from the reaction $^{205}\text{Tl} + \nu_e \rightarrow ^{205}\text{Pb} + e^-$, the lowest threshold (52 keV) for neutrino capture. The ratio of $^{205}\text{Pb}/^{205}\text{Tl}$ in lorandite (TlAsS_2) depends also on contributions from fast muon cosmic radiation. The latter is a function of paleo-depth, including the eroded layer over 4.3 Ma, determined using cosmogenic nuclides (^{26}Al , ^{36}Cl , ^3He and ^{21}Ne) in the ore body Crven Dol (Tl-As-Sb-S) in Allchar (Macedonia). The results give a lower limit of paleo-depth of 490mwe and an upper limit of 2300mwe. From this the ratios $^{205}\text{Pb}_{\text{ve}}/^{205}\text{Pb}_{\text{tot}}$ are estimated as 2:8 and 6:4, respectively.

Identification of the ^{205}Pb nuclei in the lead sample extracted from the lorandite mineral requires 10^{-10} to 10^{-11} overall detection sensitivity for $^{205}\text{Pb}/\text{Pb}$ and comparable suppression of the ^{205}Tl isobar. This is proposed by full stripping of ^{205}Pb at high energy (345MeV/u) at the RIKEN-RIBF ion-beam facility. ^{205}Tl isobar separation is already largely achieved by chemical Pb-Tl separation by the overall sample preparation. Samples with a higher concentration ($^{205}\text{Tl}/\text{natPb}=1\%$) are necessary for a guide-beam and initial accelerator tuning. A sample with a considerably lower level of about 10^{-8} is needed for control of the beam analysis system with ^{205}Tl ions, in the presence ultimately of a lighter guide beam, to limit the in-beam production of ^{205}Pb by the (p,n) reaction on ^{205}Tl in the energy-loss and ion-stripping steps in the accelerator and the subsequent BigRIPS/Mass-Ring experimental apparatus. The relative cross sections between full stripping of ^{205}Pb and (p,n) on ^{205}Tl is estimated as 10^5 . Test experiments to verify the various aspects of the proposed approach at the RIBF are under preparation.