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^{8}B production in the reaction $^{6}Li(^{3}He,n)^{8}B$ via neutron angular distribution measurement

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The aim of the EUROnu Design Study [1] is to perform a comparative study of three possible future neutrino oscillation facilities (Super Beams, Neutrino Factory and Beta Beams) for Europe. In particular, Beta Beams can produce well collimated pure electron neutrino or antineutrino beams to explore primarily neutrino oscillation physics. The Beta Beam produces neutrinos from the decay of radioactive isotopes with suitable decay time and reaction Q-values. The $^{3}He + ^{6}Li \rightarrow ^{8}B + n$ and $^{7}Li + d \rightarrow ^{8}Li + p$ reactions have been proposed in the work by C. Rubbia et al. [2] to produce the isotope pair ^{8}B and ^{8}Li. Cross sections and angular distributions are fundamental to design the tabletop accelerator and the other necessary equipment that will be used for the production of these isotopes, in particular to assess the performance of an internal target that also serves as a stripper and an absorber for ionization cooling of the circulating beam as proposed in [2].

The total cross section of the ^{8}B production in the $^{6}Li(^{3}He,n)^{8}B$ reaction was measured in the past using the positron decay technique [3]. On the other hand, an earlier measurement of neutron angular distribution [4] reported a larger value for the integrated cross section by about a factor of 3. For this reason we performed a new measurement with higher accuracy using the ^{3}He beam delivered by the Van De Graaf CN accelerator at LNL. The emitted neutrons were measured via the Time-of-Flight (ToF) techniques by using 8 large volume BC501 liquid scintillation detectors of the RIPEN modular array [5]. High statistics was collected through digital processing and pulse shape analysis (PSA) of the electronics signals.

In the neutron ToF spectra the peak due to the population of the ^{8}B ground state was identified. In addition, the population of the ^{8}B first excited state at 0.78 MeV that immediately decay by proton emission, was observed with a very good statistics allowing for the first time an accurate angular distribution measurement.

Results were interpreted in the framework of the Zero Range Knock-out Distorted Wave Born Approximation (ZR-KO-DWBA) using the code DWUCK4 [6] showing a nice agreement with ref. [4]. DWUCK4 calculations extending the projectile energy range up to 25 MeV showed a strong disagreement with the positron decay experiments [3] that needs to be understood performing neutron angular distribution measurement at ^{3}He beam energy above 10 MeV.

[1] http://euronu.org/
[2] C. Rubbia, A. Ferrari, Y. Kadi, and V. Vlachoudis, Nucl. Inst. Meth. A 568, 475 (2006).
[3] C.R. McClenahan and R.E. Segel, Phys. Rev. C 11, 370 (1975) and ref. therein.
[4] P. Van der Merwe, W.R. McMurray, and I.J. Van Heerden, Nucl. Phys. A 103, 474 (1967).
[5] N. Colonna, et al., Nucl. Inst. Meth. A 381, 472 (1996).
[6] P.D. Kunz, University of Colorado, The Code DWUCK4, extended version of J.R. Comfort, unpublished.