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HIGH FLUX ELECTRON ANTINEUTRINO SOURCES BASED ON LI-8 ISOTOPE. THE POSSIBILITY TO CONSTRUCT THE COMPACT VARIANT

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The creation of the artificial MeV-energy electron antineutrino sources moves forward the serious demands for used isotopes and nuclear reactions for realization of the task: well defined and hard neutrino spectrum (taking in mind the proportionality of the cross section to square energy); availability and purity of the chosen isotope. The Li-7 (92.5% in the natural lithium) isotope fully satisfies to these requirements: at (n,gamma)-activation of the high purity Li-7 isotope in the high neutron flux the created Li-8 is β-decayed (T1/2= 0.84 s) with escape of hard and known electron antineutrino spectrum (E(max)= 13 MeV and E(average)= 6.5 MeV). The spectrum of nuclear reactors traditionally used as intensive neutrino sources are characterized with significant errors [(4-6)% -precision at energy up to ˜6 MeV] caused by unknown decay schemes, change of fuel isotopes parts in time, spent nuclear fuel close to reactors, that put together cause an unsolved puzzles in interpretation of neutrino oscillation [1]. The critical problem of the spectrum precision can be solved basing on the Li-7 isotope. The construction of the intensive electron antineutrino-source is possible in different schemes (ensured with intensive neutron flux) on the base of: nuclear reactors, in the accelerator scheme with neutron producing target plus Li-7-blanket [2]. Realization of the first variant is possible in the transport regime (when an activated Li-7 is pumped in the continuous close cycle through the active zone of the reactor). The strong advantages of the sheme is possibility: to ensure the high neutrino flux in the compact volume (˜cubic meter) of the detector (close to the loop) [3] and to decrease the total spectrum errors in order of values [4]. In the accelerator scheme the proton beam strike into the heavy-element-target and produces the significant neutron yield for the lithium blanket irradiation. The scheme is considered for energies up to ˜600 MeV for different heavy targets (W, Pb, Vi, Ta). The density of Li-8 creation is simulated in details that allowed to propose an effective blanket scheme with central lithium containing volume enclosed by carbon (acting as an effective neutron reflector) and outer thick water layer for diminish the neutron escape. The analysis of Li-8 distribution in the blanket allows to construct a small-volume elecytron antineutrino source (with dimension ˜70 cm) that is exclusively important for search of sterile neutrinos in case of Delta_m2 ˜ 1 eV2 [5] scale.

1. C. Giunti, Y.F. Li, C.A. Ternes, and Z. Xin. arXiv:2110.06820 (2022).
2. V.I. Lyashuk & Yu.S. Lutostansky. Bull. Russ. Acad. Sci. Phys. 79, 431–436 (2015). https://doi.org/10.3103/S106287381504022X
3. V.I. Lyashuk. JHEP06 (2019)135. DOI: 10.1007/JHEP06(2019)135
4. V.I. Lyashuk. Results Phys. 7, 1212 (2017). https://doi.org/10.1016/j.rinp.2017.03.025.
5. J. Kopp, M. Maltoni and T. Schwetz, Phys. Rev. Lett. 107, 091801 (2011). DOI:https://doi.org/10.1103/PhysRevLett.107.091801

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