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Variants of intensive antineutrino sources on the base of 8Li isotope

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The winning properties combination of the β−decayed 8Li isotope (short $T_{1/2}$= 0.84 s, hard and known antineutrino spectrum (with maximum at ~13 MeV and average energy = 6.5 MeV) and availability of lithium are the undoubted base to consider 8Li as the very perspective isotope for construction of the antineutrino source as the powerful instrument for different neutrino experiments. In spite of the high antineutrino flux from nuclear reactors the spectrum are characterized with significant errors ((4-6)% -precision at energy up to ~6 MeV) caused by unknown schemes of decays, time variations, presence of the spent nuclear fuel, that put together cause an unsolved puzzles in precision and interpretation of neutrino oscillation results 1.
The construction of the intensive antineutrino source is possible in different schemes basing as on the nuclear reactor (as neutron source for (n,γ)-activation of purified 7Li) as on the tandem scheme of the accelerator with neutron producing target plus lithium blanket (neutron converter) irradiated by $^7\mathrm{Li}(n,\gamma)^8\mathrm{Li}$ activation 2. In the source realized in transport regime (first variant) an activated 7Li is pumped in the close cycle through the active zone of the reactor; further (in cycle) it is delivered close to the neutrino detector. The scheme really allows to decrease the total spectrum errors in order of values 3. Another feature of this concept is high count rate ensured in the compact (about cubic meter) neutrino detector – ~10e+4 $(\bar{\nu}_e, p)$-events $(m^{-3}day^{-1}\mathrm{GW}^{-1})$ 4.
In the other perspective realization 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 8Li 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 8Li distribution in the blanket allows to propose an alternative approach of tandem schemes based on developed compact accelerators with proton energy about several tens of MeV that opens another important possibility - to construct a small-volume-antineutrino-source (of short dimension ~70 cm) that is exclusively important for search of sterile neutrinos in case of $\Delta m^2 \geq 1$ эВ^2 [5].

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The speaker is a student or young scientist

No

Section

1. Neutrino physics and nuclear astrophysics

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