## 2.5 MOON(Mo Observatory Of Neutrinos) for Low Energy Neutrino Physics

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Measurements of two correlated $\beta$ rays from $^{100}$Mo are shown to make it possible to perform both spectroscopic studies of neutrinoless double $\beta$-decay ($0\nu\beta\beta$) with a sensitivity of the order of $< m_\nu > \sim 0.03$ eV and real-time exclusive studies of the low energy solar and supernova $\nu$'s by inverse $\beta$ decays.[1] The fine localization in time and in space is crucial for reducing BG rates in realistic detectors. Several options are under investigation for detector readout, a) sheets of Mo between plastic scintillator sheets with wavelength-shifter (WLS) fiber readout, b) scintillator-fiber detection and readout, c) liquid scintillators, and, d) cryogenic calorimetric readout. A test of prototype detector for a) is in progress at RCNP, Osaka. It is composed of 8 layers of plastic and WLS-fiber ensembles ; each 4-layer group is covered by a different type of reflector for comparison. One layer has the dimension of $20 \times 20 \times 0.25$ cm. Light outputs are collected by a 16-anode PMT through 64 WLS fibers with 2.5 cm interval for the x direction at the front side of the plane and the same for y at the back side, each with 1 mm square size.

An attractive approach offering higher energy resolution to reduce the intrinsic two neutrino double $\beta$-decay ($2\nu\beta\beta$) coming into the $0\nu\beta\beta$ window is low temperature bolometry, being investigated at UW. Previously, the use of oxide compounds, which substantially increase Debye temperature and consequently decrease the heat capacity, such as lead molybdate ($PbMoO_4$) was tested for a molybdenum bolometer/scintillator below 100 K.[2] However, it contains $^{210}$Pb radioactivity and the scintillation light of lead molybdate is only 16 % of that of NaI(Tl). Recently the specific heat of molybdenum was measured down to 0.2 K and the superconducting transition occurred at about 1 K. [3] E. Fiorini and T. O. Niinikoski also estimated the energy resolution at 5 mK for a mass of 1 kg molybdenum; that is 47 eV(FWHM)/ 3.034 MeV$\sim$ 0.0015% and molybdenum is in principle a good candidate for the high energy resolution bolometer.[4] However, in practice the transfer of heat from broken Cooper pairs to the lattice is very slow. MOON requires good radiochemical purity and the chemistry of Mo lends itself to the same type of purification through the carbonyl as has been used for Ni for the Sudbury Neutrino Observatory. The estimation of cosmogenic backgrounds induced by muons and fast neutrons is in progress for the required depth underground.

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