PERFORMANCE OF WATER-BASED LIQUID SCINTILLATOR

D.Beznosko[1*], M.Diwan[2], S.Hans[3], D.Jaffe[2], S.H.Kettell[2], R.Rosero[3], H.Themann[2], B.Viren[2], E.Worcester[2], M.Yeh[3], C.Zhang[2]

[1]SST, Physics Dept., Nazarbayev University, Astana, Kazakhstan; *dmitriy.beznosko@nu.edu.kz; [2]Physics Department, Brookhaven Nat'l Laboratory, Upton, NY, USA; [3]Chemistry Department, Brookhaven Nat'l Laboratory, Upton, NY, USA

INTRODUCTION.

In large water detectors, the Cherenkov radiation produced by a charged particle above the threshold can be used for particle identification, and the reconstruction of its direction and energy [1]. However, all charged particles below the Cherenkov threshold are missed. Detecting these below-threshold particles is important for various applications. For example, in the search of the proton decay, in the p+ ® K+ $\overline{\nu\nu}$ channel, where K+ is mostly below Cherenkov threshold and is invisible in a water detector. The use of the Water-based Liquid Scintillator (WbLS) makes the kaon visible and allows for the separation of K+, m+ and e+ signals using timing, and reduces the background for this decay channel.

MATERIALS AND METHODS.

The Water-based Liquid Scintillator (WbLS) is a new material currently under development. It is based on the idea of dissolving the organic scintillator in water using special surfactants. This material strives to achieve the novel detection techniques by combining the Cherenkov rings and scintillation light, as well as the total cost reduction compared to pure liquid scintillator (LS). It can preserve the particle identification for the particles above the Cherenkov threshold, and detect the charged particles below the threshold via the scintillation light.

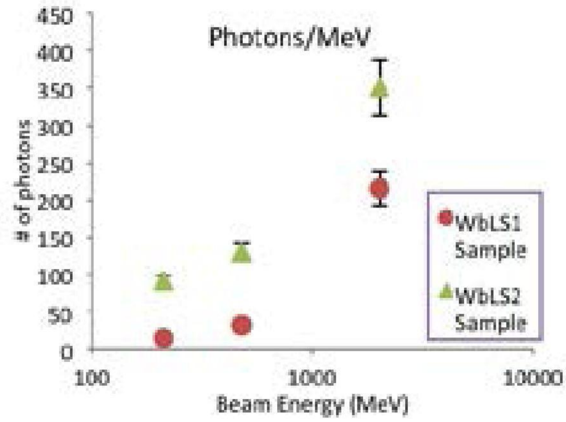

Figure 1. WbLS light yield from proton Beam.

RESULTS AND DISCUSSION.

In order to successfully use both detection techniques with the WbLS, a minimum of about 100 optical photons per MeV of deposited energy should be produced. A test was carried out with the high-energy proton beam using 2 different WbLS formulations to assess the availability of such a light yield (LY) for this material at beam energy of 475MeV. The results of this test are shown in Figure 1.

CONCLUSIONS.

The LY for the water, pure LS and two formulations of the WbLS have been measured successfully. The 0.99% WbLS sample yields ~1% light of the pure LS, implying that the goal of 100 photons/MeV has been achieved, assuming that typical LY of LS is 10000 optical photons per MeV. Therefore, the WbLS that satisfies the requirements can be fabricated.

REFERENCES.

1. M. Fechner *et.al.* (2009). (The Super-Kamiokande Collaboration), `Kinematic reconstruction of atmospheric neutrino events in a large water Cherenkov detector with proton identification', Phys. Rev. D 79, 112010, arXiv:0901.1645