Members of Steering Committee and Participants

LBNE Reconfiguration Workshop April 24, 2012

Dear Members of Steering Committee and Friends,

Let me begin by saying that ,while, at present, we face strong budgetary constraints as laid down by DOE, we also happen to be in a very special situation that warrants probing deeper into a set of fundamental issues in physics. In particular, the prospects for making two major discoveries - proton decay as well as neutrino CP-violation - at a large underground detector ,coupled to a long baseline intense neutrino beam (LBNE), are now rather high.

That for discovering CP violation in the neutrino system has been enhanced significantly owing to the recent discovery at Daya Bay that the neutrino mixing angle theta-13 is sizable (about 10 degrees). Such an enhanced prospect is a special bonus from nature that surely we can not afford to miss.

The prospects for discovering proton decay- a central prediction of the idea of grand unification- have been high for some time owing to the successes of the idea of grand unification, which have accumulated over the years. These in particular include its predictions for (a) gauge coupling unification and (b) neutrino oscillations with mass-scales just as observed. Given these successes (and more), one can in fact argue, within a broad class of well-motivated models of grand unification, that proton decay should occur, both via the e+ pi-zero and nu-bar K+ modes, with lifetimes that are within about a factor of ten above the current SuperKamiokande limits*. This is why an improved search for proton decay is now most pressing. This would be possible only with a large detector, built deep underground. Discovery of proton decay would lead to a paradigm-shift in our understanding of nature at the deepest level.

Such a large detector, being deep underground, can, of course simultaneously study sensitively supernova neutrinos, which would be of great importance to particle physics, nuclear physics and astrophysics. And it can determine accurately the parameters of atmospheric and solar neutrino oscillations, in particular the angle theta-23 as well as neutrino mass-ordering.

In accord with the requirements of the DOE for an affordable phased approach, it seems that even with such constraints it would be desirable to take the first step in the right direction, which would keep the door open for realizing the major physics goals in the near future, as and when budget would permit, rather than close it from the start.

With this in view, it seems to many of us that it would be much better to have a deep underground detector, even of a reduced size (though not less than half the size of the recently considered 34kt Liquid Argon detector), coupled to LBNE, in the first phase, than to have a more economical but compromised alternative, such as an over-the-surface detector coupled to an existing beam.

The former, consisting of a deep underground LAr detector of a decent size coupled to LBNE, would already provide the scope for discovering neutrino CP violation, determining accurately the angle theta-23 and neutrino mass -ordering, and simultaneously searching sensitively for proton decay (better than SuperK for the nu-bar K+-mode) as well as supernova neutrinos. Most importantly, such an underground

project of phase 1 would keep the door open for addition of one or eventually two modules to be made in the future which would put US in the leadership position in the world in the studies of underground science. This would in fact significantly enhance the chances for discovering both proton decay and neutrino CP-violation, if they have not been discovered yet in phase 1.

The latter- that is the over-the-surface detector coupled to an existing beam-would be able to probe into the issues of CP Violation and mass-ordering in the neutrino system, both of which would be valuable, but it would essentially close the door for the US to be a leader by probing into a set of fundamental issues mentioned above. In particular, being over the surface, it won't be able to study proton decay, supernova neutrinos, and atmospheric and solar neutrino oscillations.

In summary, a large underground detector coupled to LBNE, even if built in stages, will do monumental science. The opportunities for discovering both proton decay and neutrino CP violation, which it would provide, are too precious to be missed.

Thank you for your attention.

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*For a discussion of proton decay lifetimes , expected within models of grand unification, see for example my talk at the FPIP workshop (Dec 2011) and references therein.