Report on the paper EPJC041122

1. general comment

This paper contains 2 parts: the optimization of the SPL neutrino beam in order to maximize the neutrino flux and the sensitivity to $\sin^2 2\theta_{13}$ with such an optimized beam and a Megaton type water cerenkov detector.

The results from the first part is made in a way which is not easy to understand (many figures and tables) and a more synthetic summary would be useful.

The validity of the hypothesis which drive the sensitivity study, mainly systematical errors and background rejection, as well as the statistical analysis method are not demonstrated.

2. Beam simulation

a. Target simulation (p. 2, paragraph 2) : what is the expected pulse to pulse variation with a mercury target with respect to the number of interactions as well as for the re-interaction of hadrons. Can this increase the uncertainty?
   Could you give a number for the discrepancy on the number of ν_μ ,ν_e from the 2 generators (FLUKA and MARS) for the energy bin corresponding to the maximum of the oscillation.

b. Kaon production (p. 4, paragraph 3) : the title of the histograms ' energy of protons that create a Kaon, Pion' does not seem appropriate. What is the uncertainty on the Kaon production rate?
c. Horn simulation (p. 5, paragraph 4) : the Horn/reflector geometry is optimized in order to get the 600 MeV/c Pions well focused. So as a conclusion of this part I would like to see the variation of the number of Pions at 600 MeV/c as a function of the proton beam energy (at 4 MW fixed beam power), with an error bar corresponding to the uncertainties from the various models. The same would be useful for electron neutrino contribution.
d. Simulated fluxes (p. 7 , paragraph 5.3) : it is quite difficult to read the table 5. It would help in adding 2 columns on the left containing the length and the radius of the decay tunnel.

2. Sensitivity computation

In the analysis program referenced in [37] the used detector is a liquid scintillator (Mini-BooNE like), but in this work the authors are referring to a water cerenkov (UNO like): so there is no way to cross check the validity of the reconstruction algorithms as well as of the background reduction algorithms used. In addition no uncertainties are taken into account for the background estimate: the validity of this assumption has to be demonstrated. It seems that the reconstruction package is used as a black box.

The significance parameter (formula 1 and reference 37) has to be validated; it is not homogenous in the denominator. In addition this significance parameter does not take into account the uncertainties on the background. Also the method used to obtain the various contour is not explained.

So more details are needed in order to understand the validity of the absolute value of the sensitivity which is quoted in this paper. The relative effect, quite small as we can expect from the conclusions of the beam simulation, could be meaningful.

3. Conclusions

The study of the optimization of the Super-beam is interesting but the sensitivity analysis is not convincing.