Answer to Referee Report on the paper EPJC041122

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Date : 14/10/2005

General comment

We appreciate that, after one year more or less, the EPJC Editorial Board has sent us some remarks on our paper. Since the submitting date, time as gone, the simulator has changed, and the statistical analysis has changed… This is no question to rewrite deeply this article. But based on the work done afterwards by the authors and co-workers, we can give some enlightenment on the paper. Basically, the conclusions of the article have been confirmed even if we still lack some experimental data to validate the production rates.

Beam simulation

a) **Target simulation: "[…] pulse to pulse variation […]"**. This is a good question but nobody at present has the answer for 4MW beam power. Currently, at CERN and BNL there are some simulations of the hydrodynamic aspects to understand the mercury jet explosion (eg. cavitations). There is also an experiment (nTOF) at CERN that will take place to study this kind of explosion. A presentation at the International Scoping Study at CERN 22-24/9/05 by J. Lettry (CERN) had summarized the present knowledge. It is also an issue for solid target as the number of e+e- pairs can reach unprecedented density and the dynamical aspects of the choc have certainly to be taken into account for the stress computations. Now, concerning the present simulations of solid/liquid targets for preliminary studies of possible optimizations of beam energy for a Neutrino Factory or SuperBeam (the current paper treats one of the item) everything is static (for instance M. Brook from RAL has presented at NuFact05 in June 05 some optimization for a Neutrino Factory with tantalum target with the same a priori).

   Target simulation: "neutrino production difference between FLUKA and MARS". At 2.2GeV kinetic beam energy and maximum oscillation neutrino energy, the FLUKA generator produces 45% more ν_μ and 45% more ν_e than the MARS generator. As the sensitivity is driven by the number of oscillated events divided by the squared root of the background events, it turns out that FLUKA has 20% better sensitivity than MARS on $\sin^2 2\theta_{13}$ (nb: We have referred to θ_{13} in the paper at the end of section 2 and we now translate it in term of $\sin^2 2\theta_{13}$ as this is the parameter used in section 7).

   Historically, MARS generator was run in an early stage of the work by a colleague from CERN, as we had no licence for this software, and it was used at only 2.2GeV beam energy and with no kaon production introduced. We note that both the software have now reviewed version.

b) **Kaon production: "title of fig. 4".** We agree that the title was not so clear and moreover we have now plots showing the number of particles per proton on target, so we will change this figure.

   "**Uncertainty on the kaon rate**". As mentioned previously the FLUKA version has changed recently and in the [3.5-4.5]GeV region both the kaon and the negative pion productions has dramatically changed. The dips have disappeared. Fortunately, we were cautious in our paper and this energy range was not used to determine a better optimization. So, the rates used in the paper for the optimization are still valid. Now, concerning the absolute normalisation of the kaon production, we have cited in our paper the HARP experiment (ref. [30]) that should give in a near future some measurements in the energy range of the SPL.

c) **Horn simulation. "Variation of the the 600MeV/c pions with respect to the beam energy".** These numbers are presented in the 2nd paragraph of the section 2 : "The horns are designed to focus the 600MeV/c pions (see section 4) and the variation of the number of such pion […]: 4.19 x 10^{13} π/s at 2.2GeV beam, […]".

   "Electron neutrino contribution…". The numbers are presented in Tab.7.

d) **Simulated fluxes: table 5.** We agree on the recommendation and we have updated the table.

Sensitivity computation

Pertinence of reference [37]. We agree that the reference quoted alone in the first paragraph of section 6 does not introduce the Water Cerenkov simulation and application of the method used. The simulation of the detector was done in the reference [25] (updated to take into account to published version of the arXiv paper). Reference [37] describes the algorithm to extract the contours independently from the detector used, and we had also reference [26] which uses the algorithm for Water Cerenkov application.

Significance parameter (formula 1). First of all the S-factor introduced in the paper is not used to obtain the various contours. They are obtained with a χ^2 analysis à la Feldman-Cousins. S is used as a guide line to indicate the optimal energy in Tab. 7. The term "significance" may be misleading and "quality factor" is more appropriate, we will change it.

Concerning the homogeneity of the formula 1. S is defined as the ratio of Number_signal/sigma_backgd and we define as usual sigma_backgd as sqrt(sigma_backgd_stat^2 + sigma_backgd_syst^2) with sigma_backgd_stat equal to sqrt(Number_backg) and sigma_backgd_syst equal to Number_bkg x relative-error-on_total-normalisation. So, we think that S has a correct definition.

Note

The statistical analysis used in this paper has been switched to the use of the GLoBES software (not available at the time of the paper writing) [http://www1.physik.tu-muenchen.de/~globes/]. This software clearly is a major advance in the concept of detailed statistical analysis and unification of project comparison (detector & neutrino beam). It will be used by the International Scoping Studies for Future Neutrino Factory and Super/Beta Beams mentioned previously. Although with M. Mezzetto and Th. Schwetz, we are preparing a new paper using this software, I can tell that the sensitivity contours presented in the paper submitted at EPJC are confirmed, validating the statistical analysis used at that time.