Preparatory Work for the Monte Carlo Simulation of the Neutron and Photon Background in the Secondary Experimental Area

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During February 2002 there has been an intense coordinated effort from CIEMAT, ITN and UPC, in the preparation of the Monte Carlo simulation of the neutron and photon background in the secondary experimental area. A highly detailed and realistic geometry of the complete nTOF tunnel has been produced for the MCNPX code [1]. The technical details were extracted mainly from the existing nTOF CAD drawings [2], updated to the actual nTOF tunnel status with photographs [3] and the unknown parts completed with an existing geometry for FLUKA [4]. The MCNPX geometry has been especially adapted to allow variance reduction techniques that will hopefully reduce the CPU times to reasonable time scales. However, it should be emphasised that the computing time for a full simulation on CIEMAT's - SGI Origin 3000 (with 96 RISC processors) will still be of the order of weeks.

The use of the realistic MCNPX geometry has allowed a preliminary study of the possible weaknesses in the shielding based on "neutrography" plots similar to the ones obtained with FLUKA [5]. As an example, Figure 1 and 2 show the attenuation suffered by 1 MeV neutrons at different places in the tunnel (see figure captions for details).

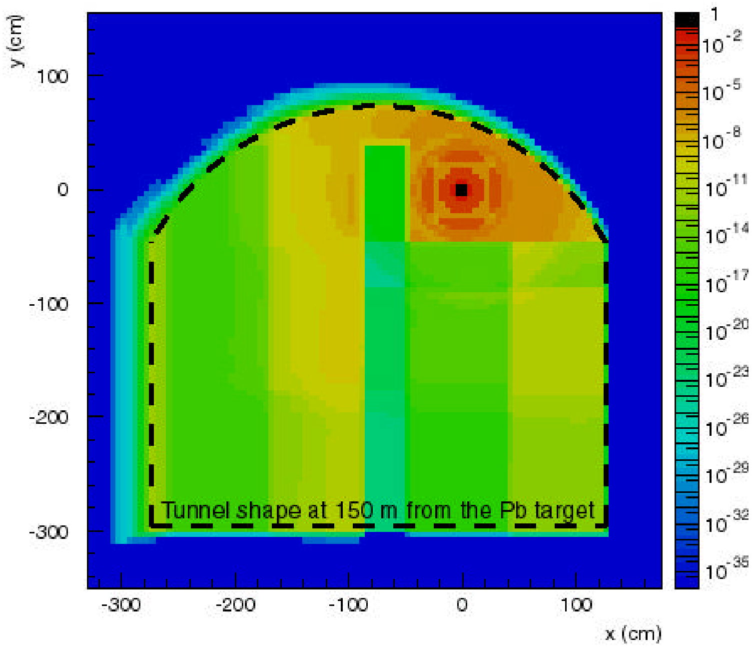

Figure 1. Attenuation factors for neutrons of 1 MeV, generated isotropically from the Pb target within a cone of 1º, upstream to 150 m (beginning of the secondary experimental area). The densities of the materials have been divided by 10 and the neutrons where generated with the proper spatial distribution.

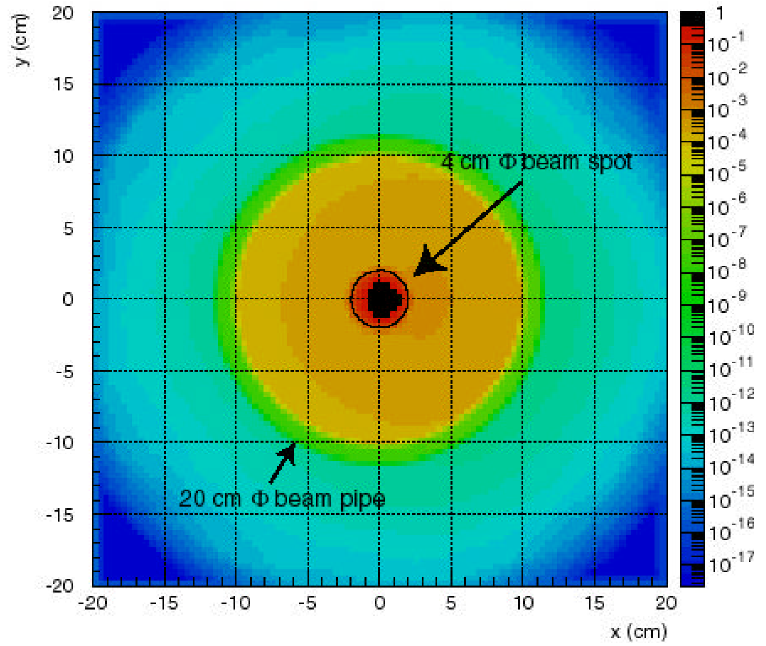

Figure 2. Attenuation factors for neutrons of 1 MeV, generated isotropically from the Pb target within a cone of 1º, upstream to 185.5 m (experimental area). The densities of the materials have been divided by 10 and the neutrons where generated with the approximated spatial distribution (from FLUKA simulations).

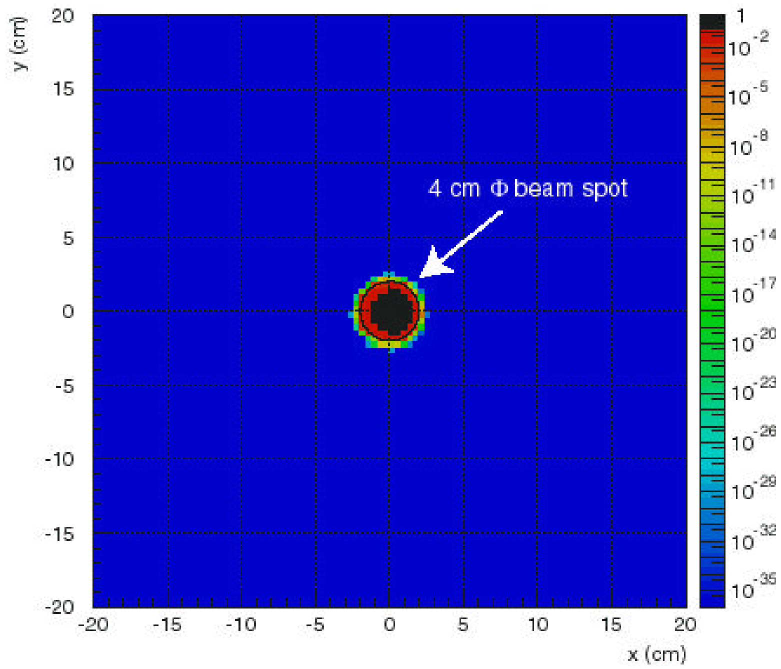

Figure 3. Attenuation factors for neutrons of 1 MeV, generated isotropically from the Pb target within a cone of 1º, upstream to 185.5 m (experimental area). The densities of the materials are the real ones and the neutrons where generated with the approximated spatial distribution (from FLUKA simulations).

For the calculations shown in Figures 1 and 2, the densities of all the materials have been reduced by a factor of 10. This allows a better visualisation of the attenuation factors but forces to interpret them correctly. Figure 3 is analogous to Figure 2 but showing the real attenuation factors (i.e. real densities).

In order to perform the full simulations, additional information is required from the "Fission Working Group". In particular:

- a tentative but realistic design (accomplishing safety rules) of the secondary experimental area.
- dimensions of the involved shielding elements.
- description of the possible third collimator.
- geometric description + final position of the sweeping magnet.

The simulations could start few days after the necessary information is provided.

[1] H.G. Hughes, R.E. Prael and R.C. Little, MCNPX – The LAHET/MCNP Code Merger, XTM-RN(U)97-012, LA-UR-97-4891, Los Alamos National Laboratory (April 1997)
[2] CERN – CDD and several P. Cennini private communications.
[3] http://fachp1.ciemat.es/ntofmc/photos
[4,5] V. Vlachoudis and A. Ferrari, FLUKA simulations