RADIATION ENVIRONMENT IN THE TUNNEL OF A HIGH-ENERGY PROTON ACCELERATOR AT ENERGIES NEAR 1 TeV

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tively. We do not fully understand the differences between peaks but point out that the primary interactions that do not occur on N_2 most likely occur either on H_2 or He in cryogenic sections or with machine materials.

Monte-Carlo simulations performed by Gabriel et al. (not shown here) are in good agreement with the spectrum of Fig. 5 derived from slopes [3]. They furthermore indicate that about 80% of the neutrons at 200 cm from the beam line are albedo neutrons, *i.e.* , scattered from tunnel walls. This was tested experimentally by repeating certain runs at 39 cm from the beam line (Position 2, Fig. 2). The result was consistent with the expected radial distribution for the direct fluence, assuming that the albedo flucnce is uniform across the tunnel section.

Integration over the "slope" z-distribution of Fig. 4a and correcting for the albedo fluence gives a value 10 neutrons produced per 900-GeV proton passing A-17 and per g cm^{-2} of N_2 target. A similar calculation based on an integration over the intercept z-distribution (Fig. 4b) gives 5×10^{-9} neutrons produced per passing 900-GeV proton. We caution the reader that this latter value is not well understood, is subject to the vagueries of machine operation and will likely vary widely from place to place around a given accelerator ring.

The above observations suggest a common "filter" for the neutrons, regardless of the nature of the original interactions which produce the parent cascade. Prominent parts of the filter must be the iron magnet yokes as well as the concrete tunnel lining. The neutron field dominates the tunnel radiation field in terms of absorbed dose to tissue. Because of their capability of producing lattice defects and transmutations, neutrons of energy $E_n \geq 150$ keV are the most important potential cause of radiation damage to solid state electronic devices in accelerator tunnel environments similar to those studied [1].

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REFERENCES

[1] J. B. McCaslin, R.-K. S. Sun, W. P. Swanson, A. J. Elwyn, W. S. Freeman and P. M. Yurista, SSC Central Design Group, Report SSC-58, Lawrence Berkeley Laboratory (1986).

[2] W. S. Freeman, A. J. Elwyn, P. M. Yurista, J. B. McCaslin, R.-K. S. Sun and W. P. Swanson, Proc. 20th Midyear Topical Symposium of the Health Physics Society, Reno, NV, Feb. 8 - 12, 1987, Report No. CONF-8602106, p. 432 (1987).

[3] T. A. Gabriel, F. S. Alsmiller, R. G. Alsmiller, Jr., B. L. Bishop, O. W. Hermann and D. E. Groom, SSC Central Design Group, Report SSC-110, Lawrence Berkeley Laboratory (1986).

[4] R. L. Bramblett, R. L. Ewing and T. W. Bonner, Nucl. Instr. Meth. 9, 1 (1960).

[5] R. S. Sanna, U. S. AEC, Health and Safety Laboratory, Report HASL-267 (1973).

[6] J. T. Routti and J. V. Sandberg, Phys. Commun. 21, 119 (1980).

[7] H. T. Edwards, Ann. Rev. Nucl. Part. Sci. 35, 605 (Annual Reviews Inc., Palo Alto, CA, 1985).