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**Central Data Processing Facility of the Oak Ridge Gaseous Diffusion Plant.

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Abstract

Using the straight-ahead approximation, nucleon-meson cascade calculations have been carried out for a particular solar-flare proton spectrum incident on a shield. The shielding material has approximately the properties of aluminum. Both spherical-shell and slab geometries are considered.

I. Introduction

In two previous reports[1,2] (hereinafter referred to as 1 and 2, respectively) nucleon-meson cascade calculations were carried out and results were given for a variety of cases of interest in the shielding of manned space vehicles. In this report similar calculations showing the attenuation of a particular solar flare by an aluminum shield are presented.

The method of calculation, the data used to describe the shielding medium, and the notation are the same as used in 2.

II. Flare Spectrum and Results

The proton flare spectrum used in the calculations has the form*

$$P(E,0) = \frac{1.26 \times 10^{12}}{E^{3.12}} \quad \frac{\text{protons}}{\text{Mev}\cdot\text{cm}^2\cdot\text{ster}} \quad , \quad 32 \text{ Mev} \leq E \leq 2 \text{ Gev}.$$

As in 2 it is arbitrarily assumed that the flare contains no particles with energy less than 32 Mev or greater than 2 Gev.

In Fig. 1 the particle doses at the center of a spherical shell when the flare is incident isotropically on the shell are plotted as a function of shell thickness, r. The dose as calculated here is the surface dose and includes a contribution from nonelastic reactions in the tissue as well as a crude estimate of the contribution from low-energy particles.[3] In Fig. 2 the particle doses behind a slab when the flare is incident isotropically on the slab are plotted as a function of slab thickness, x.

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1. R. G. Alsmiller, Jr., and J. E. Murphy, Space Vehicle Shielding Studies: Calculations of the Attenuation of a Model Solar Flare and Monoenergetic Proton Beams by Aluminum Shields, ORNL-3317 (1963).

2. R. G. Alsmiller, Jr., and J. E. Murphy, Space Vehicle Shielding Studies II: The Attenuation of Solar Flares by Aluminum Shields, ORNL-3520 (in press).

3. R. G. Alsmiller, Jr., and J. E. Murphy, ORNL-3317, op. cit., p. 8.

* The calculations reported here were done at the request of I. M. Karp of the Lewis Research Center in order that he might compare the results with similar calculations he has done. This form of the flare was suggested by Mr. Karp as being an appropriate one for the comparison.

In both figures the smallest shield thickness considered is 1.6 g/cm^2 for the primary dose and 2.3 g/cm^2 for the secondary doses. A thickness of 1.6 g/cm^2 is slightly greater than the range of a 32-Mev proton. At shield thicknesses smaller than this, those incident protons with energy less than 32 Mev which have been neglected will contribute to the dose.

In both figures, as in 2, the dose due to secondary particles does not become comparable to the primary dose until rather large shield thicknesses are considered. As one goes to thick shields, the primary dose rapidly becomes negligible and the dose is due primarily to secondary neutrons. Note that for very thick shields (Fig. 1) the dose is decaying nearly exponentially and at all shield thicknesses the pions and muons are negligible.

Acknowledgement

We would like to thank the members of the Data Processing Facility of the Oak Ridge Gaseous Diffusion Plant, particularly R. G. Mashburn, for their work in carrying out the numerical computation.

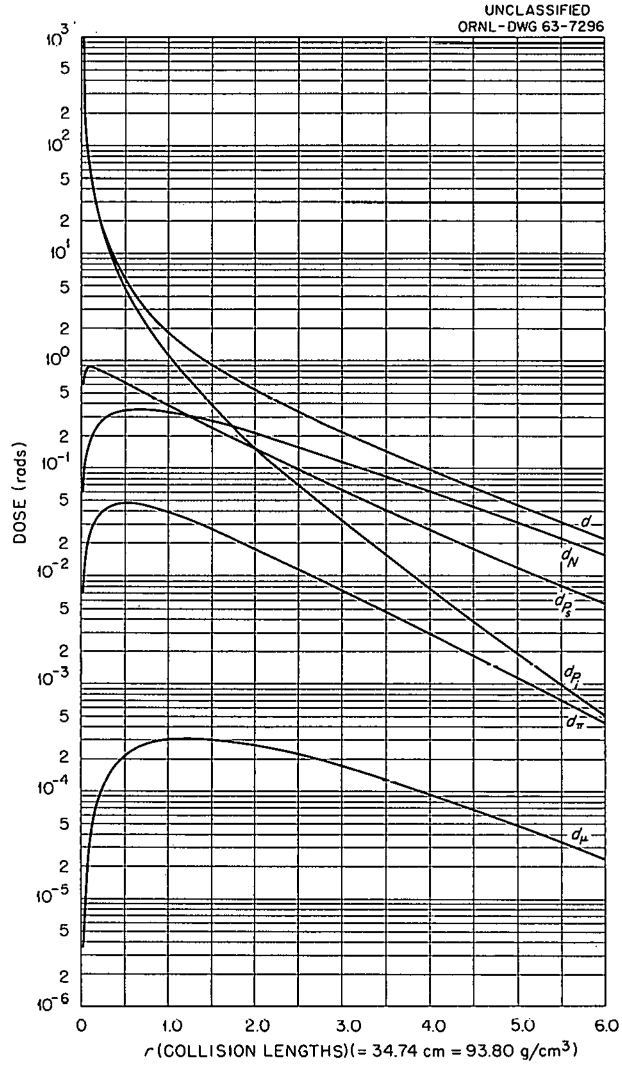

Fig. 1. Dose vs. Shell Thickness.

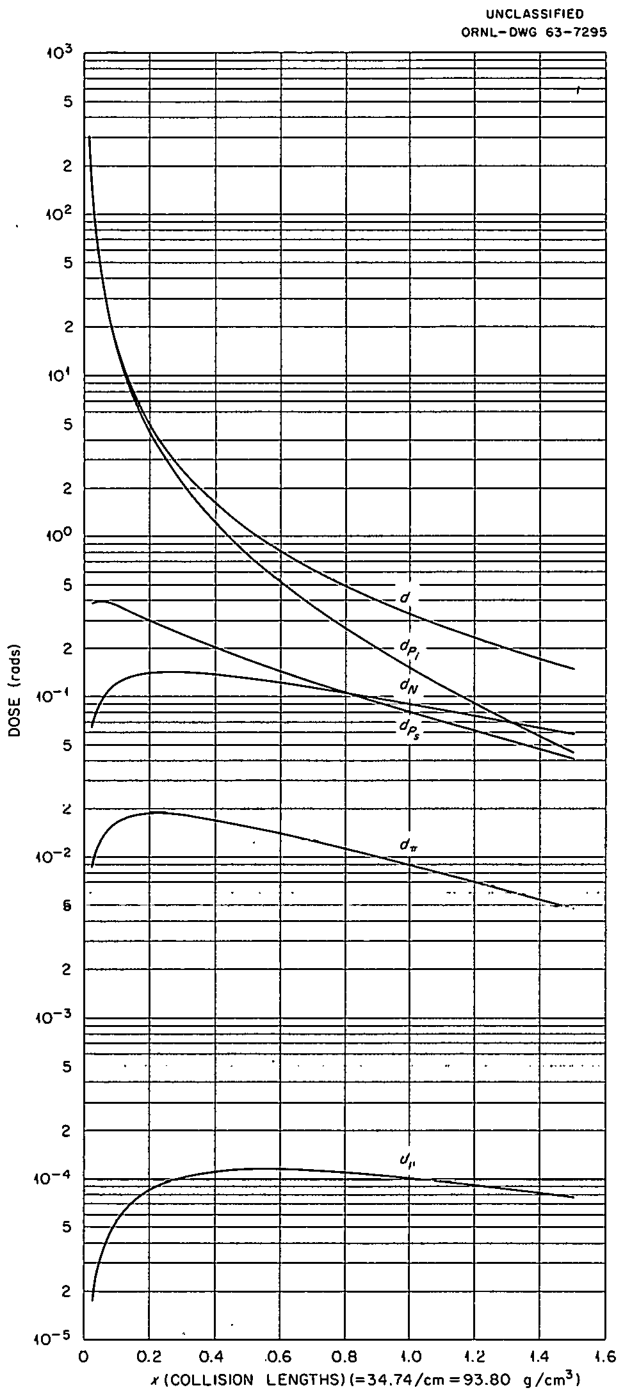

Fig. 2. Dose vs. Slab Thickness.

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