DOSE MEASUREMENTS AND IDENTIFICATION OF PARTICLES

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The dosimetry pack for Discoverer XVIII was essentially the same as that for Discoverer XVII (1). The major changes were permitted by substitution of 2 ml. glass ampuls for the large heavy aluminum Rose chambers. The purpose of the dosimeters included in the pack was to obtain a meaningful dose measurement. As there was neither a power nor a telemetry apparatus available for use by the School of Aerospace Medicine, the entire information concerning the types of radiation, including the intensity and energy spectrum of each type, had to be obtained from the dosimeters inside the can.

It is fully recognized that the severe space, weight, time, and power limitations of the flight actually preclude completely satisfactory measurements. A truly meaningful measurement would require proton, electron, photon, and neutron (1) intensity, (2) energy spectrum, and (3) direction measurements as a function of time and space or orbit. At best, the results obtained by passive dosimeters will be an interpretation of the responses of a number of different systems using the laboratory calibration of the type or types of particles which most nearly approximate the conditions of the flight.

DESCRIPTION OF THE EXPERIMENT

As we fully realized that the results, at best, would be limited in their interpretation, the following dosimeters were employed. In each case, the dose range is given in rad equivalent 730 Mev protons.

1. Nuclear track plates. Ilford G-5 emulsion (range: up to 2×10^6 tracks per square centimeter).

2. Kodak neutron sensitive NTA film (range: up to 2×10^6 tracks per square centimeter).

3. Dupont 502 emulsion film (range: 0.4 to 20 rads).

4. Dupont 510 emulsion film (range: 2 to 100 rads).

5. Bausch and Lomb silver-activated glass rods (range: 10 to 10^4 rads).

6. Two-phase tetrachloroethylene chemical dosimeter (range: 15 to 10^6 rads).

7. Single-phase CO_2 free trichloroethylene chemical dosimeter (range: 25 to 250 rads).

8. Alanine (range: 10^2 to 10^5 rads).

9. Single-phase trichloroethylene chemical dosimeter (range: 150 to 10^6 rads).

10. Albumin (range: above 10^{11} free radicals per gram).

11. Gold foil (range:[1] above 2×10^3 neutrons per square centimeter per second).

Identification of the ionizing radiations was attempted from the study of tracks in the nuclear track plates and in the NTA film. The existence of x-rays was to be detected by using Dupont 502 and 510 emulsion film in step plates (region A, unshielded; region B, 0.020 in. Al shielding; region C, 0.020 in. Al plus 0.010 in. Cu; region D, 0.020 in. Al plus 0.020 in. Cu), and by using B&L glass rods in sets of three (one unshielded, one with an aluminum foil shield, and the third with a lead foil shield).

The Radiobiological Laboratory at Austin, Tex., supplied (and interpreted the response of) the chemical dosimeters, Kodak NTA film, half of the Dupont 502 and 510 film, and the

[1]Based on the most probable reactions that will occur at these energies (probably n, 2n or p, pn reactions).

gold foil. These results are presented in Report 62-41 of this series (2).

The distribution of the dosimeters is listed in Report 62-39 of this series (3) and is also shown in figures 1 and 2 of the same report. In addition to the planned shielding of specific regions on various films (step plates) and the shielding of the glass rods, the many biologic specimens also provided varying degrees of shielding.

DATA AND RESULTS

Only the most sensitive dosimeters had a measurable response. The response of the Dupont 502 film emulsion indicates the dose was between 310 and 350 mrad equivalent 730 Mev protons. The step-plate film did not reveal regions of measurable density difference. There was not a meaningful response variation in the film in various parts of the pack.

The nuclear track plates were carefully examined to determine type of particle, direction, and total number. No meaningful differences in the number of particles traveling in any specific direction were measured. The data clearly indicate that during the four days on orbit the accumulative flux can be described as omnidirectional. The track plates were arranged so that total flux counts could be made as a function of depth. No meaningful differences were found in depth distribution for the limited depth available. The total count per square centimeter of the 150μ emulsion thickness varied from about 50 to 130 $\times$ 10^4 tracks on each of the nuclear track plates.

CONCLUSIONS

The dose was between 310 and 350 mrad equivalent 730 Mev protons. The total flux per square centimeter of the 150μ emulsion thickness varied from about 50 to 130 $\times$ 10^4 tracks with no meaningful difference between the various NTP units as to the number or direction of the particles. No bremsstrahlung was detected.

REFERENCES

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