Monte Carlo data on the $E > 1$ MeV photon absorption coefficient λ (refs 4, 11–13; Table 1) are in agreement. The difference of the calculated and Monte Carlo λ from λ_{min} can be explained by the effects of Compton scattering and multiple Coulomb scattering.

Comparison between the cascade curves for the various threshold energies has shown that the data tabulated in ref. 2

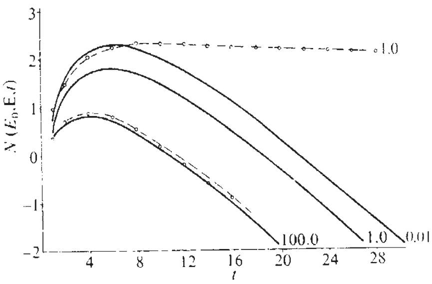

Fig. 1 The mean number of photons, $N(E_0, E, t)$ with energies exceeding E from a primary photon with $E_0 = 10$ GeV in carbon at depth t. The solid curves show the results of numerical integration, the dashed curves represent the data from ref. 2. The numerals on the curves indicate the threshold energy E in MeV.

agree with the results obtained using the numerical integration and momentum method[5,6] for $E > 10$ MeV in lead and $E > 100$ MeV in air. Figure 1 shows the typical cascade curves from Messel and Crawford's tables for air and those calculated in the present work. The results obtained cast doubt on the conclusion drawn by Porter[1] about the possibility to detect the bursts from supervonae with a mountain or sea-level detector, since the $E > 1$ MeV photon number in ref. 2 is overestimated by a factor of 10^2 at mountain level and by a factor of about 10^4 at sea level.

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1 Porter, N. A., *Nature*, **245**, 367 (1973).
2 Messel, H., and Crawford, D. E., *Electron–Proton Shower Distribution* (Pergamon, Oxford, 1970).
3 Belenky, S. Z., and Ivanenko, I. P., *Usp. fiz. Nauk*, **69**, 591 (1959).
4 Nagel, H. H., *Z. Phys.*, **186**, 319 (1965).
4 Ivanenko, I. P., and Samosudov, B. E., *Sov. nucl. Phys.*, **5**, 622 (1967).
6 Ivanenko, I. P., and Samosudov, B. E., *Izv. Akad. Nauk SSSR, ser. fiz.*, **30**, 1951 (1966).
7 Belyaev, A. A., and Ivanenko, I. P., *Vest. Mosk. gos. Univ., ser. fiz. i astr.* (in the press).
8 Thielheim, K. O., and Zöllner, R., *J. Phys. A.*, **5**, 1054 (1972).
9 Guzhavin, V. V., Ivanenko, I. P., and Levitan, A. E., *Can. J. Phys.*, **46**, 209 (1968).
10 Yuda, T., *et al. Nuovo Cimento*, **65A**, 205 (1970).
11 Völkel, U., *DESY Rep.* 65/6 Hamburg (1965).
12 Woischung, W., and Burmeister, H., *Z. Phys.*, **177**, 151 (1964).
13 Borkovsky, M. Ya., and Kruglov, S. P., Preprint FTI, No. 313 (Univ. Leningrad, 1971).

Solar flare X-ray polarisation

BROWN *et al.*[1] have argued that the "Intercosmos-1" and "Intercosmos-4" results of solar flare X-ray polarisation measurements are in error due to incorrect 'normalisation' procedure. The normalisation was made in order to eliminate the effect of possible differences in the sensitivity of the photon counters and it is based on the assumption that the X-ray flux is unpolarised during the decay stage of flare[2].

According to ref. 1 the Thompson scattering of intrinsically isotropic and unpolarised flare emission taking place in the lower parts of the solar atmosphere could give polarisation P up to some 30% of observed X-ray flux (the sum of primary and scattered radiation). This conclusion is based on consideration of the scattering at 90°. In fact, because of weak dependence of the Thompson cross section on the scattering angle χ the observed flux corresponds to a wide range of χ (Fig. 1). Integration over all possible χ gives a rather low value of P (ref. 3). The area of the photosphere just under the flare gives scattered flux polarised mainly in transverse direction ($P < 0$), while the flux from more remote areas has a preferentially radial electric vector ($P > 0$). The resulting value of P depends on the altitude of the flare $\tau = H/R_\odot$ and on the helicentric angle θ (Fig. 1).

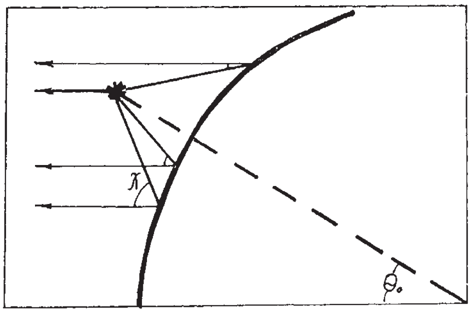

Fig. 1 Scattering of the flare X rays by the solar photosphere.

Detailed calculations of the back scattered radiation in the first order scattering approximation are given in ref. 3. For the total flare X-ray flux we always have $|P| \leq 2\%$ (ref. 3 and see Fig. 2). Multiple scattering could alter this value by as much as a factor of two (ref. 3). It was taken into account in the computation of solar X-ray albedo using the Monte Carlo method[4], but the

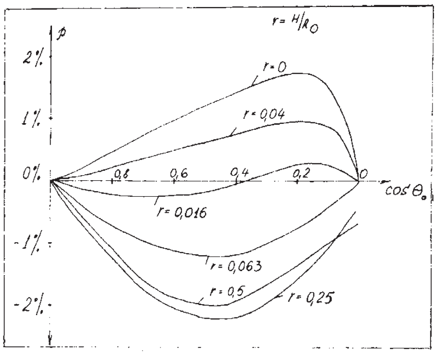

Fig. 2 Polarisation P of the total X-ray flux as function of heliocentric angle θ.

statistical significance achieved was too poor to determine the polarisation.

So inclusion of Thompson scattering effects cannot substantially influence the results of normalisation in ref. 2.

In further experiments[5] the scatterer and the counters were mounted on a rotating drum. This permits continuous checking of the relative sensitivities and thus eliminates the need for normalisation. Unfortunately, we were not able to obtain absolute values of P with the polarimeter on board "Intercosmos-7" because of the failure of one of its measuring channels. The polarimeter of "Intercosmos-11" has worked well and results obtained will be published elsewhere.

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1 Brown, I. C., McClymont, A. N., and McLean, I. S., *Nature*, **247**, 441 (1974).
2 Tindo, I. P., Ivanov, V. D., Mandel'stam, S. L., and Shuryghin, A. I., *Solar Phys.*, **14**, 204 (1970).
3 Beigman, I. L., *Astron. Zh.*, **51**, 1017 (1974).
4 Santangelo, N., Horstman, H., and Horstman-Moretti, E., *Solar Phys.*, **29**, 143 (1973).
5 Tindo, I. P., Mandel'stam, S. L., and Shuryghin, A. I., *Solar Phys.*, **32**, 469 (1973).

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