$$q = \frac{d\Omega_{eff}}{2\pi}\frac{1}{N_o}\int_{v}^{v+v_{lim}} N(v)\,dv \sim \frac{v}{v_{lim}}.$$

When $v = 2 \times 10^3$ m/sec we have q = 300.

In conclusion, the authors are sincerely grateful to Yu. A. Merkul'ev and V. E. Solodilov for help with the work and M. I. Podgoretskii for a fruitful discussion of the problem and for valuable advice. The authors are also grateful to A. I. Isakov, D. A.Kirzhnits, F. L. Shapiro, and I. V. Shtranikh for interest in the work and useful remarks.

[1] A. I. Akhiezer and I. Ya. Pomeranchuk, Nekotorye voprosy teorii yadra (Certain Problems in Nuclear Theory), OGIZ, 1948.
[2] A. I. Akhiezer and I. Ya. Pomeranchuk, Zh. Eksp. Teor. Fiz. 18, 495 (1948).
[3] Ya. B. Zel'dovich, ibid. 33, 1488 (1957) [Sov. Phys.-JETP 6, 1148 (1958)].
[4] K. V. Vladimirskii, ibid. 39, 1062 (1960) [12, 740 (1961)].
[5] F. L. Shapiro, Usp. Fiz. Nauk 95, 146 (1968) [Sov. Phys.-Usp. 11 (1969)].
[6] B. Alefeld et al., Neutronenleiter, Preprint, KFA Bericht, JUL-294-NP.
[7] P. D. Miller et al., Phys. Rev. Lett. 19, 381 (1967).
[8] V. I. Lushchikov, Yu. N. Pokotilovskii, et al. ZhETF Pis. Red. 9, 40 (1969) [JETP Lett. 9, 23 (1969).
[9] I. I. Gurevich and L. V. Tarasov, Fizika neitronov nizkikh energii (Physics of Low-energy Neutrons), Nauka, 1965.

CONCERNING THE NATURE OF THE COSMIC ISOTROPIC X-RADIATION

I. L. Rozental' and I. B. Shukalov
Submitted 20 January 1969
ZhETF Pis. Red. 9, No. 5, 312 - 314 (5 March 1969)

The energy spectrum of the cosmic isotropic x-radiation shows a break at an energy $E_\gamma \sim 20 - 40$ keV. The soft part of the spectrum ($E_\gamma < 20$ keV) was interpreted many times as the radiation from the heated intergalactic plasma [1 - 4]. In the very latest papers, the very soft part of the spectrum ($E_\gamma \sim 0.3$ keV) is interpreted as the manifestation of discrete x-ray sources (cf., e.g., [5]). It seems to us that it is advantageous to explain the entire spectrum of the isotropic x-radiation by means of a single mechanism in the entire observed range (with the exception of the point $E_\gamma \sim 0.3$ keV [4]).

The proposed mechanism is the inverse Compton effect of the metagalactic electrons on the relict radiation (this process has been used many times to explain the short-wave part of the spectrum).

To verify this hypothesis, it is advantageous to compare three quantities: 1) the power exponent of the elctron and x-ray spectra before the kink; 2) the exponents of the electron and x-ray spectra after the kink, and 3) the energies of the electrons (E_{e0}) and of the x-rays ($E_{\gamma 0}$) at the "points" of the kinks of the spectra.

The exponents γ_e of the electron spectra can be determined from the averaged values of the spectral index α of the radio emission, assuming in first approximation that the energy spectra of the electrons are the same in the galxy and in the metagalaxy. Using the values of the spectral index α for a large number of radiogalaxies, given in [6], and the well known relation $\gamma_e = 2\alpha + 1$, we can obtain the values of γ_e listed in Table 1.

Table 1

E_e	$E_e < E_{eo}$	$E_e > E_{eo}$
γ_e	2.5	3.3

Table 2

E_γ	$\gamma_{\gamma\,\mathrm{exp}}$	$\gamma_{\gamma\,\mathrm{theor}} = (\gamma_e + 1)/2$
$E_\gamma < E_{\gamma o}$	1.7 [3]	1.75
$E_\gamma > E_{\gamma o}$	2.4 ±0.2 [7]	2.15

Table 3

E_{eo}, eV from x-ray spectrum		E_{eo}, eV from radio spectrum	
$z_i << 1$	$z_i \sim 3$	$H \sim 10^{-4}$ Oe	$H \sim 10^{-5}$ Oe
$5 \cdot 10^9$	$2 \cdot 10^9$	$2 \cdot 10^9$	$5 \cdot 10^9$

Table 2 lists values of γ_γ determined directly by experiment and calculated in accord with the hypothesis of the decisive role of the inverse Compton effect. In Table 3 are gathered some data on the electron-spectrum "kink" points calculated under various assumptions concerning the magnitudes of the magnetic fields in the radiogalaxies and their evolution. In this table, z_i is the effective value of the red shift for the electron sources; the calculation was made for $E_{\gamma 0}$ = 30 keV and a radio-emission frequency of 1000 MHz at the kink. As seen from Tables 1 - 3, the hypothesis of a single mechanism producing the isotropic x-rays via the inverse Compton effect leads to compatible results. This offers independent indirect evidence favoring the cosmological origin of the relict radiation.

The authors thank V. N. Kuril'chik for valuable discussions.

[1] R. Weymann, Astrophys. J. 145, 560 (1966); 147, 887 (1967).
[2] L. A. Vainshtein, V. G. Kurt, S. L. Mandel'shtam, et al., Kosmicheskie issledovaniya (Cosmic Research) 6, 242 (1968).
[3] L. A. Vainshtein and R. A. Sunyaev, ibid. 6, 635 (1968).
[4] R. C. Henry, G. Fritz, J. E. Meekins, H. Friedmann, and E. T. Byram, Atrophys. J. 153L, 11 (1968).
[5] R. A. Sunyaev, N. P. M. Preprint, November 1968.
[6] V. N. Kuril'chik and E. E. Lekht, Astron. zh. 45, 485 (1968) [Sov. Astron. AJ 12, 386 (1968)].
[7] I. A. M. Bleeker et al., Can. J. Phys. 46, No. 10, Part 3, p. 461.

DENSITY OF RELICT PARTICLES WITH ZERO REST MASS IN THE UNIVERSE

V. F. Shvartsman
Institute of Applied Mathematics, Moscow State University
Submitted 20 January 1969
ZhETF Pis. Red. 9, No. 5, 315 - 317 (5 March 1969)

So far, one cannot exclude the possible existence in the universe of a large number of difficult-to-observe particles with zero rest mass (DZP), left over from the superdense phase (neutrinos, gravitons, etc). Estimates of their density, based on the gravitational influence during the later expansion stages, leads to a value [1]

$$\rho_{m=0} < 3\rho_c \approx 5\times10^{-29}\ \mathrm{g/cm^3}$$

(ρ_c = critical density). On the other hand, the gravitational action of similar particles in