The lower dashed curve is calculated for M_A = 1.05 GeV, corresponding to the data of the latest neutrino experiment [8]. The upper dashed curve corresponds to F_A = 1.

The solid curve on Fig. 3 is the result of calculation in accordance with the present work. To be able to compare with the experimental data far from threshold we have introduced phenomenologically the amplitude of the resonant M1 transition. As seen from Fig. 3, the agreement of the last calculation and experiment is good.

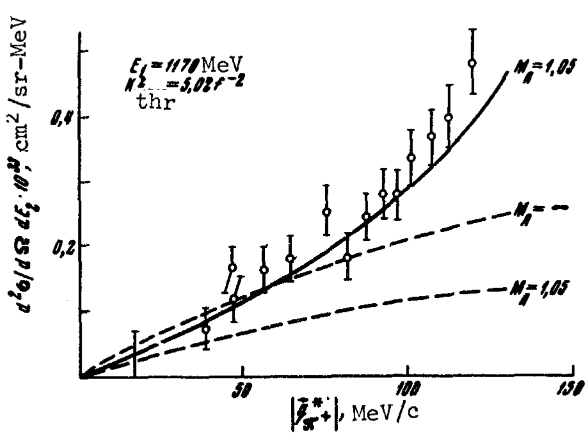


Fig. 3

The authors are grateful to M.P. Rekalo, A.P. Klyucharev, P.V. Sorokin, and I.I. Miroshnichenko for interest in the work and for useful discussion.

[1] B.de Tollis and F. Nicolo, Nuovo Cim. 48A, 281 (1967).
[2] A.M. Gleeson, M.G. Gundzik, and J.G. Kuriyan, Phys. Rev. 173, 1708 (1968).
[3] A.I. Vainshtein and V.I. Zakharov, Usp. Fiz. Nauk 100, 225 (1970) [Sov. Phys.-Usp. 13, 73 (1970)].
[4] Yu.N. Titov, N.F. Severin, R.V. Akherov, et al. PTE No. 2, 69 (1970).
[5] L.W. Mo and J.S. Tzai, Rev. Mod. Phys. 41, 193 (1969).
[6] Ph. Salin, Nuovo Cim. 32, 521 (1964).
[7] M.S. Bhatia, Narayanaswamy, Phys. Rev. 172, 1742 (1968).
[8] R.L. Kustom, D.E. Lundquist, T.B. Novey et al. Phys. Rev. Lett. 22, 1014 (1969).

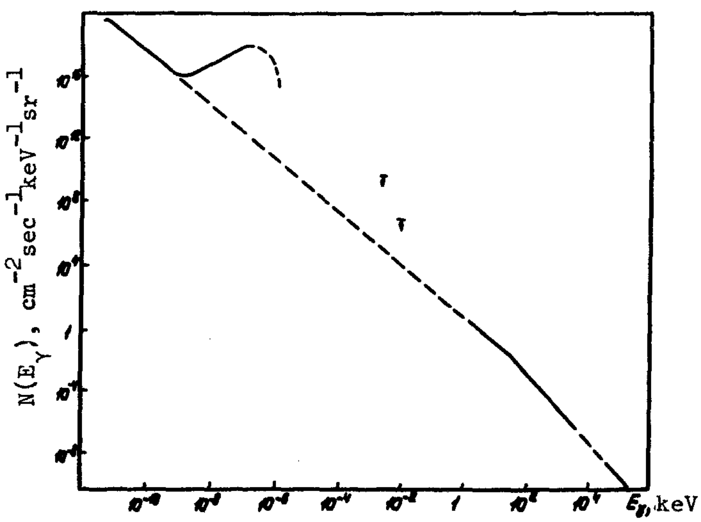
SYNCHROTRON HYPOTHESIS OF THE ORIGIN OF BACKGROUND RADIATIONS

O.F. Prilutskii and I.L. Rozental'
Moscow Engineering-physics Institute
Submitted 28 January 1970
ZhETF Pis. Red. 12, No. 4, 189 - 191 (20 August 1970)

Recently much progress has been made on the research of isotropic cosmic radiation in a wide range of energies. The figure shows the summary experimental data on background isotropic radiation, borrowed from [1 - 6]. Investigation of the background radiations has acquired particular interest in connection with their probable connection with the radiation in the universe. In many papers (see, e.g., [7]), the soft (radio) part with $V \lesssim 1000$ MHz was interpreted as a consequence of synchrotron radiation of cosmic electrons in the sources, and the hard (x-ray) part as a manifestation of the inverse Compton effect of these electrons on the relict radiation.

However, the curve shown in the figure has an important singularity: if we interpolate the energy dependences of the radio emission and of the x-ray background with energy 1 - 20 keV, then the interpolation curve (in a logarithmic scale) will be, with good accuracy, a straight line that is a continuation of both sections[1]. This circumstance leads to an alternate assumption, namely that the non-equilibrium background radiation is produced by a single

[1]It should be noted, nonetheless, that the accuracy and reproducibility of the experimental data are low.



mechanism in a tremendous energy interval. Obviously, such a mechanism cannot be the inverse Compton effect or π^0-meson decay. It is therefore natural to assume that in the entire interval 10^{-6} - 10^4 eV the background radiation is bremsstrahlung or electrons in a magnetic field.

This raises the question of the origin of the radiation in the 10^5 - 10^8 eV region[2]. Assuming that at $E_\gamma < 10^4$ eV the radiation is due to a single synchrotron mechanism, we should conclude that at $E_\gamma > 10^4$ eV the radiation is produced by the same mechanism. Otherwise it is difficult to understand the cutoff in the region $E_\gamma \sim 10^4$ - 10^5 eV in the radiation spectrum due to the π^0 decay or the inverse Compton effect.

Let us consider, within the framework of the synchrotron hypothesis, the question of the sources of the background radiation.

The main contribution cannot be made by the ordinary galaxies, since the experimental data show that the energy spectrum of their radio emission cannot be represented as a rule by a single power-law curve [8].

Thus, such sources cannot be weak and medium radiogalaxies. The basis for such a statement are calculations showing that in the absence of evolution of the sources the contribution of all the radiogalaxies to the radio background is smaller than 15 - 20% [9, 10].

Thus there remain powerful radiogalaxies or quasars, which can explain the observed radio background, if we assume a strong evolution for them in accordance with the experimental data (concerning the need for introducing evolution see [11, 12]). To verify the synchrotron hypothesis, it is important to know the characteristics of the radiation in the sources. Out of the three reliably identified extra-galactic sources in the x-ray band, two (Virgo-A and the quasar 3C273) satisfy the synchrotron hypothesis, and the spectrum of Cygnus-A does not agree with it.

The synchrotron hypothesis can withstand apparently (although this question calls for a more thorough study) also a comparison with the quasar radiation spectra. A considerable number of these sources reveal no breaks of the spectra in a relatively broad energy interval ($V \sim 10^8$ - 10^{15} Hz) [13].

The most difficult aspect of the synchrotron hypothesis is the existence of a break in the spectrum of the x radiation in the region 10 - 100 keV, since this break cannot be easily reconciled with a single power-law spectrum of the electrons in the sources. One can attempt to explain the observed break from the following points of view: a) The gas density in the source is so high that part of the energy of the electrons is consumed in bremsstrahlung.

---

[2] The interval 10^4 - 10^5 eV is a transition region in which the exponent γ_γ in the power-law approximation changes from a value $\gamma_\gamma \simeq 1.7$ ($E_\gamma \lesssim 10^4$ eV) to $\gamma_\gamma \simeq 2.2$ ($E_\gamma \gtrsim 10^5$ eV).

In this case, however, there should be a considerable excess of γ quanta in the region $E_\gamma \sim 100$ MeV, something apparently not observed. b) The quanta in the energy region >50 keV experience, as a result of the direct Compton effect, absorption within the sources or in the intergalactic space.

However, since the cross section of the Compton effect decreases with energy like $\sim \ln E_\gamma/E_\gamma$ (at $E_\gamma >> mc^2$), this effect will be negligibly small when $E_\gamma >> mc^2$, and consequently should not affect the energies $E_\gamma \sim 100$ MeV, where the observations do not contradict the representation of the spectrum by a single power-law curve in the entire interval 0.1 - 1000 MeV. Nor is it helpful that at $E_\gamma > 2mc^2$ pair production sets in, in which photons are also absorbed, since the cross section of this process on hydrogen is smaller than the Thompson cross section by more than one order of magnitude. The question of the break in the region $E_\gamma \sim 10 - 100$ keV calls for an additional analysis.

[1] S.L. Mandel'shtam and I.I. Tindo, ZhETF Pis. Red. 6, 796 (1967) [JETP Lett. 6, 251 (1967)].
[2] G.C. Fazio, Ann. Rev. Astron. Astrophys. 5, 481 (1967).
[3] L.G. Bratolibova-Tsulukidze, N.L. Grigorov, L.F. Kalinkin, A.S. Melioranskii, E.A. Pryakhin, and I.A. Savenko, Proceedings, Sixth All Union School on Cosmophysics, Part 1, p. 124, Apatity, 1969.
[4] A.M. Romanov, ibid. p. 110.
[5] R.A. Syunyaev, ibid. p. 58.
[6] G.W. Clark, G.P. Garmire, and W.L. Kraushaar, Astrophys. J. 153, 203 (1968).
[7] K.R. Lang and I. Terzian, Astrophys. J. Lett. 3, 29 (1969).
[8] G.B. Sholomitskii, Astron. Zh. 44, 939 (1967); 45, 478 (1968) [Sov. Astron.-AJ 11, 256 (1968); 12, 381 (1968)].
[9] V. Petrossian, Astrophys. J. 155, 1029 (1969).
[10] M.S. Longair, Usp. Fiz. Nauk 99, 229 (1969) [Sov. Phys.-Usp. 12, 673 (1970)].
[11] M. Schmidt, Astrophys. J. 151, 393 (1968).
[12] N. Kardashov, V. Soglasnova, and V. Soglasnov, Supplement to the translation of the book "Quasistellar Objects" by G. and M. Burbidge, Mir, 1969.

VERIFICATION OF THE MODELS OF THE ASYMPTOTIC BEHAVIOR OF THE AMPLITUDES OF $K^{\pm}p$ SCATTERING

O.V. Dumbrais and N.M. Queen[1)]
Joint Institute for Nuclear Research

Submitted 14 July 1970
ZhETF Pis. Red. 12, No. 4, 191 - 193 (20 August 1970)

Experimental data on the total cross section of K^-p scattering above 20 GeV [1] do not agree with extrapolation of the parametrizations at lower energies, obtained on the basis of a sum of several Regge poles [2, 3]. Recently proposed models make it possible to parametrize properly the new data, but call for the presence of either Regge cuts [4] or for terms that violate the Pomeranchuk theorem [5 - 8]. Consequently, there is at present great ambiguity in the theoretical description of the $K^{\pm}p$ scattering at high energies. It is shown in the present paper that by using a simple sum rule it is possible to limit considerably the number of different parametrizations.

Let $F_{\pm}(\omega)$ be the amplitudes of forward $K^{\pm}p$ scattering in the laboratory system, satisfying the optical theorem

1) University of Birmingham, England.