A. M. Gal'per, Yu. D. Kotov, and B. I. Luchkov. *The diffuse cosmic gamma radiation.* Substantial progress has been recorded in recent years in gamma astronomy, which observes the Universe in the most energetic part of the electromagnetic spectrum (quantum energies $\geqslant 10^5$ eV) (see, for example, the review in Ref. 1). This has resulted from the launching of special-purpose satellites with onboard gamma telescopes.[2,3] Among these satellites, the European COS-B has produced the most important result.[4]

The Galactic gamma radiation at energies from 70 to 5000 MeV has been studied in detail. It has been shown that nearly 90% of all the gamma radiation is diffuse and continuously distributed over the Milky Way, while only ~10% comes from discrete (point) sources.

The diffuse Galactic gamma radiation comes about basically as a result of interaction of cosmic rays with the interstellar gas, in electron-bremsstrahlung processes and when π^0 mesons are produced in nuclear collisions and subsequently decay into two gamma quanta.[5] This accounts for interest shown in study of the diffuse gamma radiation, the intensity of which is proportional to the cosmic-ray density and the column density of the interstellar gas along the line of sight.

Observational data can be used to calculate the distribution of the volume luminosity in gamma rays as a function of distance from the center of the Galaxy.[6,7] The calculation brings out a significant increase of luminosity at distances of 4–8 kpc, which correspond to the large Galac-Ring (Fig. 1). The most reasonable interpretation of this result is that a large amount of hydrogen in the molecular state is concentrated in this ring, its density being several times greater than that of the atomic hydrogen registered in the radio band at 21 cm.

This important result confirms data obtained by registering the emission from interstellar CO molecules, which are excited in collisions with molecular hydrogen.[8]

The distribution of gamma luminosity in the direction of the anticenter of the Galaxy has been used to estimate the density of the cosmic rays on the periphery of the Galaxy. It has been shown that the cosmic-ray density decreases toward the periphery, a fact that favors a Galactic origin for the cosmic radiation.[9]

The best agreement between the measured differential energy spectra of the diffuse gamma radiation from various parts of the Galaxy[10] (Fig. 2) and the calculated spectra is obtained when the content of the cosmic-ray electronic component is increased. A 100:5 nuclear-to-electronic ratio is obtained (curve 2) instead of the 100:1 that prevails near the Earth (curve 1).

Finally, a word on the isotropic metagalactic gamma radiation, which can be distinguished when high Galactic latitudes are observed. Recently, the tendency has been to explain the metagalactic gamma radiation as the aggregate of the radiation from discrete extragalactic sources of the type of the Seyfert galaxy NAC 4151.[11] This makes it possible to account for the inhomogeneities in the energy spectrum of the metagalactic gamma radiation in terms of the irregular spectra of the discrete sources.

We note in conclusion that the results obtained depend strongly on the angle and energy resolutions of the telescopes. This pertains primarily to separation of the discrete-source contribution and determination of the fraction of electrons in the cosmic rays from the γ radiation in the 10–50 MeV range. Therefore further

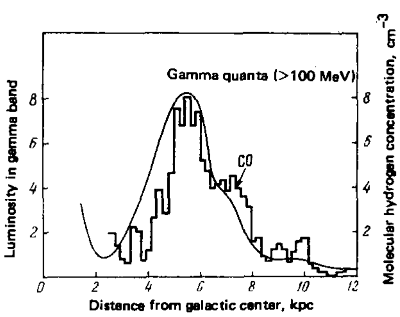

FIG. 1. Radial distributions of volume γ luminosity[7] and volume luminosity in 2.64-mm line of Co molecule.[8]

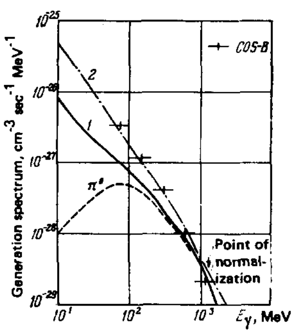

FIG. 2. Differential energy spectrum of Galactic γ radiation. Showing the spectrum of γ quanta from π^0-meson decay and summed spectra from electron bremsstrahlung and π^0-meson decay at various ratios of nuclear and electronic components. Experimental[4] and calculated spectra normalized at $E = 400$ MeV. 1—the "usual" e/p ratio; 2—number of electrons increased by a factor of 5.5.

advances in observational gamma astronomy will come with the development of improved telescopes.

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