GAMMA RAYS FROM GALAXY CLUSTERS

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In our recent work (Giler et al., 1980a) we have shown that a good model for the highest energy cosmic rays is one where they are generated in clusters of galaxies with a relatively flat production spectrum and then propagate with an energy dependent diffusion coefficient. There is evidence for a similar flat production spectrum ($\gamma \simeq 2.1$) for both protons and electrons in our own Galaxy (Giler et al., 1980b). Here we assume that the spectrum for clusters (specifically the VIRGO cluster) is independent of energy and an evaluation is made of the likely flux of γ-rays.

Figure 1 shows the derived γ-ray flux from the VIRGO cluster assuming that the mean gas density in the cluster is $5 \times 10^{-4} cm^{-3}$ and that p|e at production is 10. Also shown are upper limits from the SAS II experiment of Fichtel et al. (1975) and various Cerenkov EAS experiments. Insofar as the angular diameter of the whole VIRGO

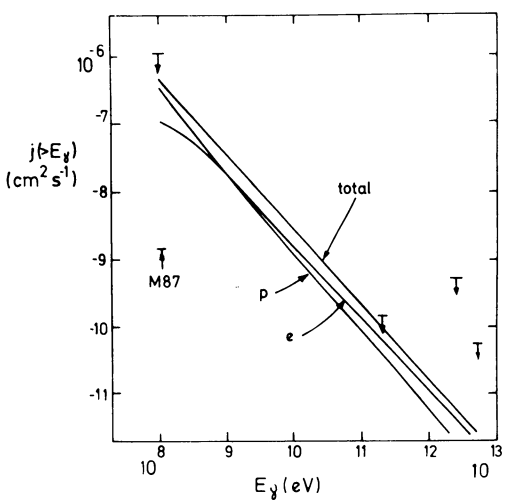

Figure 1. Gamma ray flux from the VIRGO cluster.

G. Setti, G. Spada, and A. W. Wolfendale (eds.), Origin of Cosmic Rays, 333–334.

source is larger than the resolution of the Cerenkov detectors the upper limits should be raised (by ~ 5). The expected flux from M87 alone has also been calculated using its radio emissivity. Inspection of Figure 1 indicates that the VIRGO cluster should be detectable in γ-rays with the next generation of γ-ray detectors.

If all clusters of galaxies are similar sources of cosmic rays to the VIRGO cluster, a significant contibution to the intensity of diffuse γ-rays will result. Our estimate is given in Figure 2.

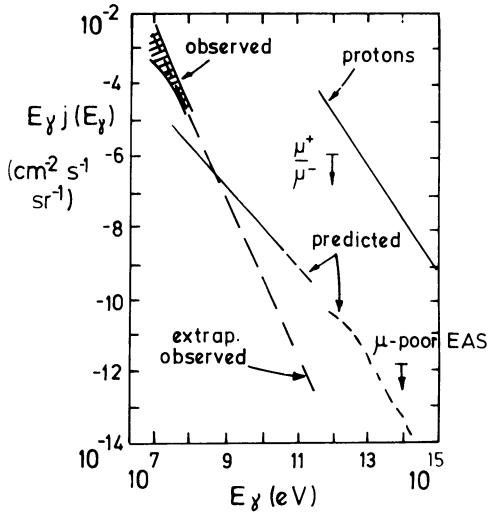

Figure 2. Diffuse isotropic background of γ-rays. The shaded area denotes experimental measurements (Fichtel et al., 1977).

The γ-rays above 10^{12}eV come mainly from the e-γ cascade resulting from high energy cosmic ray interactions with the 2.7K radiation (for details see Wdowczyk et al., 1972). It is interesting to note that the prediction crosses an extrapolation of low energy measurements by 10^9eV and should thus be amenable to experimental check quite soon.

REFERENCES

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