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Gamma Ray Extragalactic Excess in Coma direction

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Abstract: In the present work, with analyzing EGRET data, considering a gamma ray flux for Virgo supper cluster and a detailed analysis on our postulates, with a new method a gamma ray flux in Coma direction results. First, we have noted some points about Gamma Ray flux in Virgo direction, from other's works. We have used here, A-Model from Wolfendale et al. [3] for calculating Gamma Ray flux in Virgo direction. The flux that we have calculated in Coma direction is considerable. Some analogy between the works has made before, is done. A flux index for Coma direction gamma rays has resulted which is in the favor of our information from Coma super cluster.

Introduction

Now, it is believed that from interactions of very high energy protons with microwave background (2.7° K), around the galactic clusters, originate halos of Gamma rays. The Coma supper-cluster, our candidate, has a stronger magnetic field in comparison to Virgo supper-cluster (i.e. 0.3-0.5 μG against 0.03 μG [3]), the point that let us be hope to find a considerable Gamma ray flux in Coma direction although the supper-cluster itself is located about 100 Mpc from the Galaxy.

By using putative models for produced Gamma ray in the galaxy [1], a model for Gamma rays from Virgo supper-cluster [3], noun-cosmological model [4] and experimental data from EGRET, we calculated diffuse Gamma ray excess in Coma supper-cluster direction.

Here, we have accepted A-model from Wolfendale et al. [3]. After computing Virgo flux and subtracting it from Gamma ray excess, the remained excess in Coma direction in compare with galactic background was considerable.

Methods

In the present work, first we have used the model presented by Osborne, Wolfendale and Zhang [1]. Here we need some postulates. It follows that the cosmic background is a constant in the world or at least as far as few hundred mega parsecs from the Galaxy, the cosmic rays with extragalactic origin are mainly protons. Out of the Galaxy the Gamma rays are produced from interactions of very high energy protons and cosmic background and galactic Gamma ray intensity is proportional to the column density of gas. So the extragalactic excess, if exists, could be calculated. One could see in fig.1 parts of the used data.

By using semblable data, it is possible to compute diffuse extragalactic Gamma rays excess in a quarter. The straight line in the fig.1 shows produced Gamma rays in the galaxy versus column density, so the left end indicates just galactic edge. The points here are from EGRET data, in principle it is possible to compute Gamma rays extragalactic excesses in each energy band and for each of the quarters.

As the two important supper-clusters, i.e. Virgo and Coma, which are candidates for diffuse high energy Gamma rays are located in b>60° (i.e.

galactic latitude), we have used b<-60° data as extragalactic background.
By Virgo in the forth quarter and Coma in the third quarter, we need to assume one of them as strongest source, and with a look to the primer works [2,3] we assumed here that Virgo is the main source and A-model is held for it.

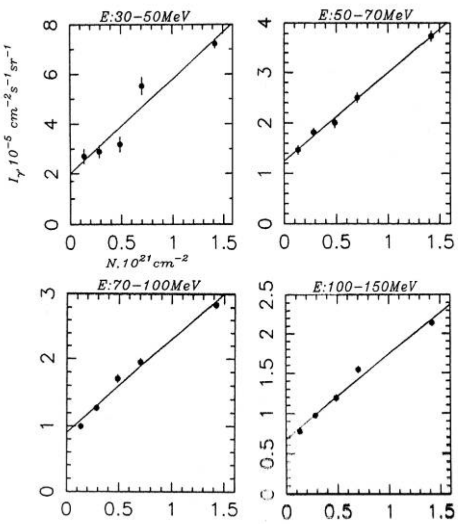

Figure 1: Gamma Ray flux as a function of column density. Quarter I, b>60° [1]

As we noted before, Coma supper-cluster is located in third quarter and by considering the Virgo as the strongest source, observed Gamma ray excess in third quarter could be from Virgo supper-cluster as well as Coma supper-cluster. So we need to compute possible Gamma ray excess from Virgo in third quarter. We have done it by using A-model [3] (fig. 2).
By using A-model and noun-cosmological model [4] (fig. 3) it is possible to compute the Gamma ray flux from Virgo supper-cluster in third quarter. After subtract it from observed excess, we have Gamma ray excess in Coma supper-cluster direction.
We have shown the results in fig. 4.

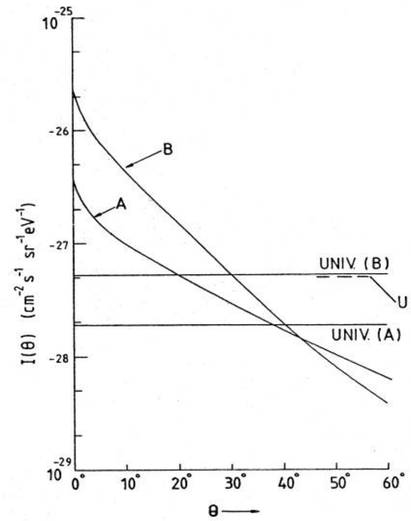

Figure 2: Predicted Gamma ray intensity at 1014eV with respect to the angular deviation θ from direction of Virgo. A denotes the situation where $D = 10^{35} E_{20} cm^2 s^{-1}$ and B: $D = 10^{34} E_{20}^{1/2} cm^2 s^{-1}$ [3]

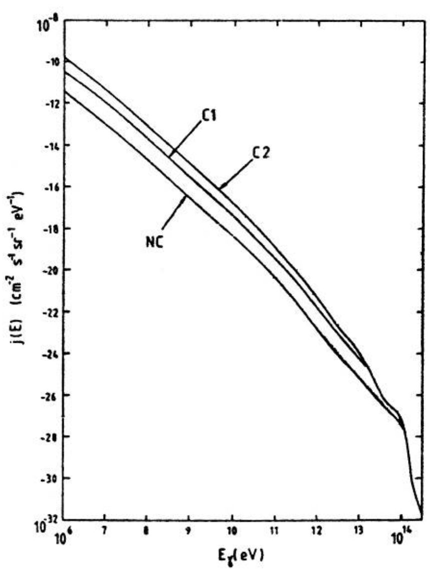

Figure 3: Noun-cosmological model for Gamma ray production (NC) [4]

Discussion

B. P. Houston et al. [7] did a review on Gamma rays from galaxy clusters; they claimed that a significant Gamma ray signal from galaxy clusters out of a distance about 590 Mpc is detectable. They also mentioned that the intensity of extragalactic Gamma rays above $35\ MeV$ is approximately

$$5\times10^{-5}\ \ cm^{-2}s^{-1}sr^{-1}$$

So the contribution from galaxy clusters to the extragalactic Gamma ray flux is important.
P. Blasi, Dermer and Rephaeli[8] predicted Gamma ray fluxes for $E_\gamma > 100\ MeV$ from Coma cluster up to about

$$10^{-7}\ \ cm^{-2}s^{-1}sr^{-1}$$

A. Dar [9,10] assumed a power law spectrum for Gamma rays from extragalactic sources and concluded a power index between 1.4 and 3 with values between 1.8 and 2 being most common.
C. Scharf and R. Mukherjee[11] used data obtained in 1991 – 2000 by the Compton Gamma ray observatory spacecraft. They found a “fog” of Gamma rays associated the galaxy clusters. They also mentioned that the majority of Gamma rays outside of our Galaxy are likely emitted by galaxy clusters and other massive structures which are the origin of the universe’s Gamma ray background.

Conclusions

One can see in fig. 4 our results. We have shown here extragalactic observed flux in quarter III, Virgo super-cluster flux in this region and Coma direction excess.
Also, our computations show total flux:

$$I(E > 30MeV) \simeq 1.9\times10^{-6} cm^{-2}s^{-1}$$

in Coma supper -cluster direction.
Total observed excess in quarter III is about:

$$I_{Total}(E > 30MeV) \simeq 8.3\times10^{-6} cm^{-2}s^{-1}$$

and so we have about $\simeq 22.9\%$ of total flux from Coma direction.
If we assume an exponential form, ($I(E)\propto E^{-\gamma}$), and assume that Coma is the source of these Gamma rays; we have:

$$\gamma = 1.8 \pm 0.4$$

for Coma supper-cluster direction.

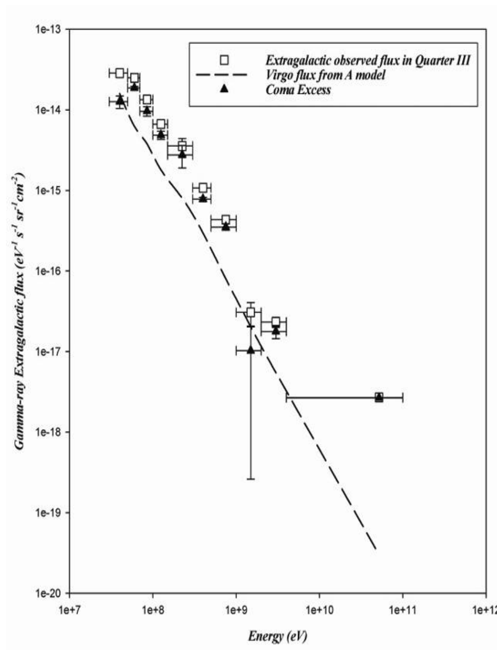

Figure 4: Observed Gamma ray excess in quarter III. Computed Gamma ray flux from A-model for Virgo and Gamma ray excess in Coma direction

References

[1] J. Phys. G: Nucl. Part. Phys. 20 (1994) 1089-1101

[2] J. Phys. G: Nucl. Part. Phys. 6 (1980) 1561-1573

[3] J. Phys. G: Nucl. Part. Phys. 16 (1990) 1399-1407

[4] Astrophys. J. 349 (1990) 35-40

[5] Astroparticle Physics 7 (1997) 21-25

[6] J. Phys. G: Nucl. Part. Phys. 22 (1996) 1089

[7] J. Phys. G: Nucl. Phys. 10 (1984) 1587-1598
[8] Astrophys. J. 329 (1988) 687
[9] arXive : astro-Ph/0607479 (2006)
[10] Phys. Rev. Lett. 75 (1995) 3052-3055
[11]http://www.colombia.edu/cu/news/02/08/gamma_rays.html