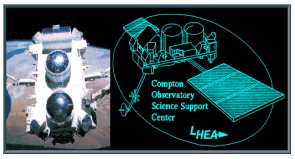
The Contributions of GRBs and Cen A-like Radio Galaxies to the Cosmic Gamma-ray Background



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Recent observations of the Cosmic Gamma-ray Background (CGB) in the MeV regime suggest a smooth power law continuum (Weidenspointner 1999, Watanabe et al. 1999a). Here we estimate the contributions from Gamma Ray Bursts (GRBs) and Cen A-like (FRI) radio galaxies to the CGB. The major contribution to the CGB at lower energies (< 300 keV) is due to unresolved Seyfert galaxies (Zdziarski 1996)., while cosmological SNIa dominate at 1 MeV (The et al. 1993,Watanabe et al. 1998 & 1999b). There is a significant gap between these two regimes. We show that GRBs and Cen A-like (FRI) radio galaxies contribute some flux in this window, but probably not enough.

Data Analysis

GRBs

We utilized High Energy Resolution (HER) data obtained with the Burst And Transient Source Experiment (BATSE) aboard the Compton Gamma-ray Observatory (CGRO). Data from the 4th BATSE catalog available online from http://cossc.gsfc.nasa.gov/cossc/batse/4Bcatalog/ were used to generate an average GRB spectrum. Using the FTOOLS CGRO sub-package and XSPEC, the GRB energy spectra with background subtraction are constructed. The HER data obtained from a detector which received the brightest gamma-ray among the BATSE's eight detectors for each GRB have been selected. The products of the each spectrum and its corresponding T90 are summed over. The contribution to the CGB, in the units of *photons/cm2/s/ster/keV*, is obtained by dividing the summation by the number of the spectra, one day in seconds and all sky (4π).

Cen A-like galaxies

The BATSE occultation data for Cen A available online from http://cossc.gsfc.nasa.gov/cossc/batse/hilev/CEN_A/cen_a.html/ have been used. An average Cen A spectrum was obtained by using the FTOOLS CGRO sub-package and XSPEC. The extrapolated average spectrum has been used as a template for all the Cen A-like (FRI) radio galaxies. The current FRI galaxy density of 2.0e-6 galaxies/Mpc3 was adopted from Canosa, et al. 1999, Colina, et al., 1995, & Colla, et al., 1975. The contribution of the Cen A-like (FRI) radio galaxies to the CGB: F_e (photons cm^{-2} s^{-1} keV^{-1} sr^{-1}) is calculated by $F_e = n(z)\, L_H D^{-2} \int dz\, N^{'}(E_\gamma \times (1+z))\, E(z)$, where n(z) accounts for density evolution $n(z)=n_0(1+z)^m$ with n_0= 2.0e-6 Mpc^{-3} of local density and different values (3,2,1,0,-1,-2,-3) of m, L_H is the Hubble length, D is distance to Cen A (3.4 Mpc), $N^{'}$ is observed Cen A spectrum(photons cm^{-2} s^{-1} keV^{-1}), the function E(z) represents the evolution of the Hubble Constant adopted from eq. [13.3] in Peebles 1993. The calculation was performed to z=3. Fig 1 shows the results.

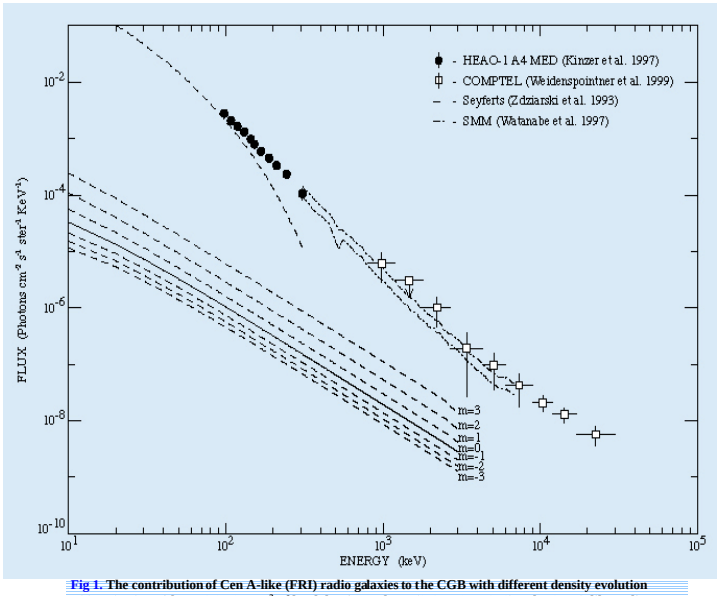

Fig 1. The contribution of Cen A-like (FRI) radio galaxies to the CGB with different density evolution $n(z)=n_0(1+z)^m$ with n_0= 2.0e-6 Mpc^{-3} of local density and m = (3, 2, 1, 0, -1, -2, -3). The Cen A-like radio galaxies could contribute to the CGB up to 10%.

Results

Fig 2. shows the contribution of GRBs and Cen A-like (FRI) radio galaxies to the CGB in comparison to the contributions from SNIa and SNII (Watanabe et al. 1999a). The data are from (Kinzer et al.1997, Weidenspointner 1999, Watanabe et al. 1997). At low energies the contribution from Seyferts dominates (e.g., Zdziarski et al. 1993), while Blazars dominate above ~ 100 MeV (Sreekumar et al. 1998). Supernovae (mostly of type Ia) dominate the MeV regime, where GRBs and FRI radio galaxies with no density evolution model can account for about 1% of the observed flux. The forthcoming INTEGRAL mission will provide crucial data about the FRI radio galaxies.

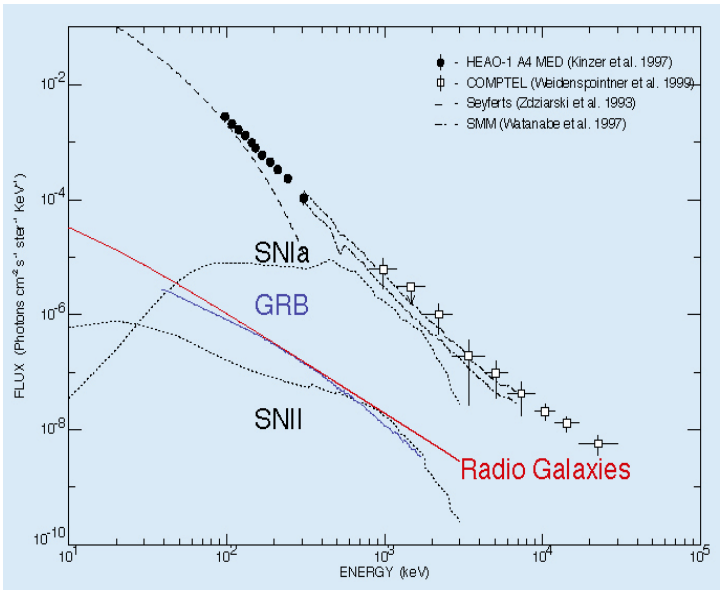

Fig 2. The observed CGB and its possible contributors.

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