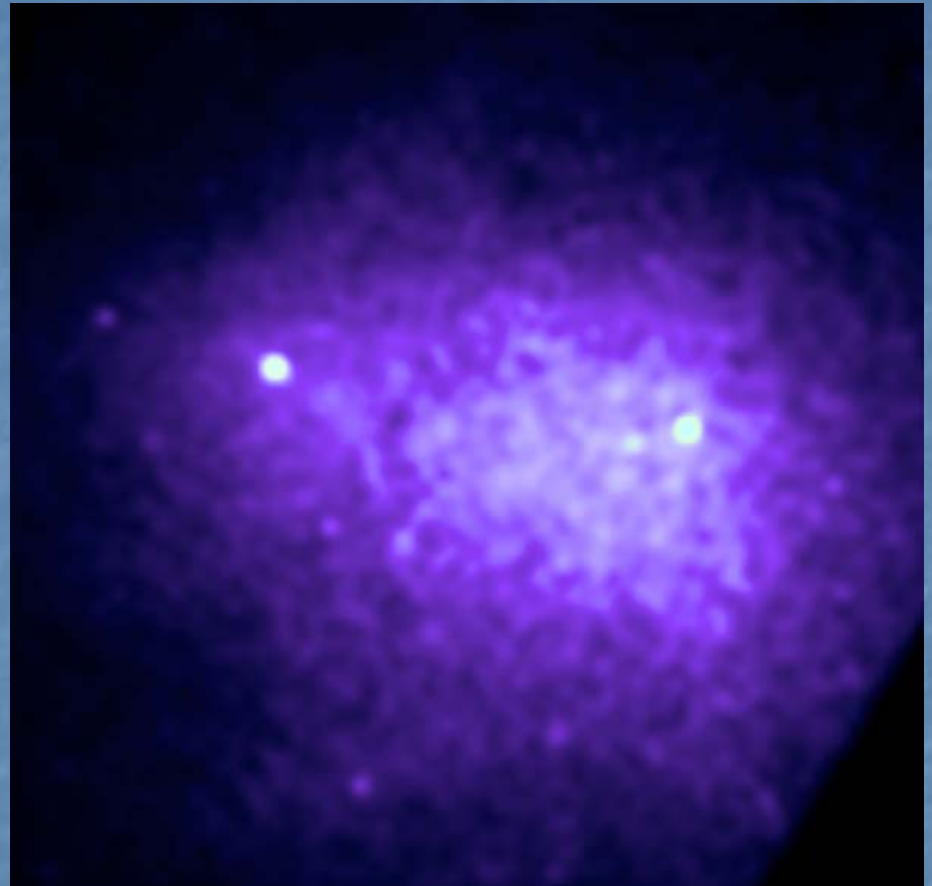


GALAXY CLUSTERS

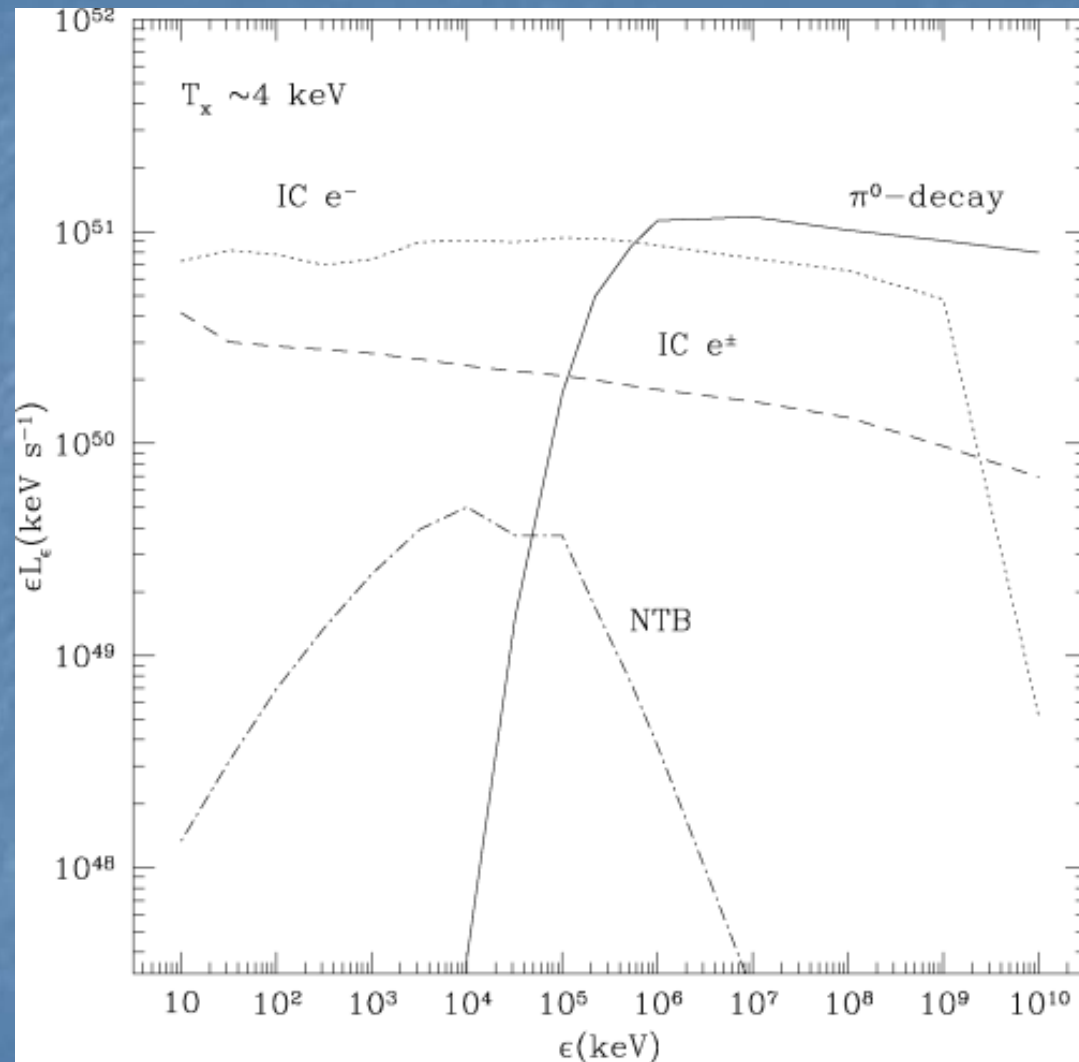
- Bright Radio Halos due to synchrotron emission
- Hard X-ray Halos due to Inverse Compton scattering on CMB
- Implied magnetic fields of $< \sim \mu\text{G}$
- Lots of energy plus shocks to accelerate cosmic rays



Chandra Image of Coma Cluster
(few Mpc diameter at 100 Mpc)

Galaxy Clusters as TeV γ -ray Sources

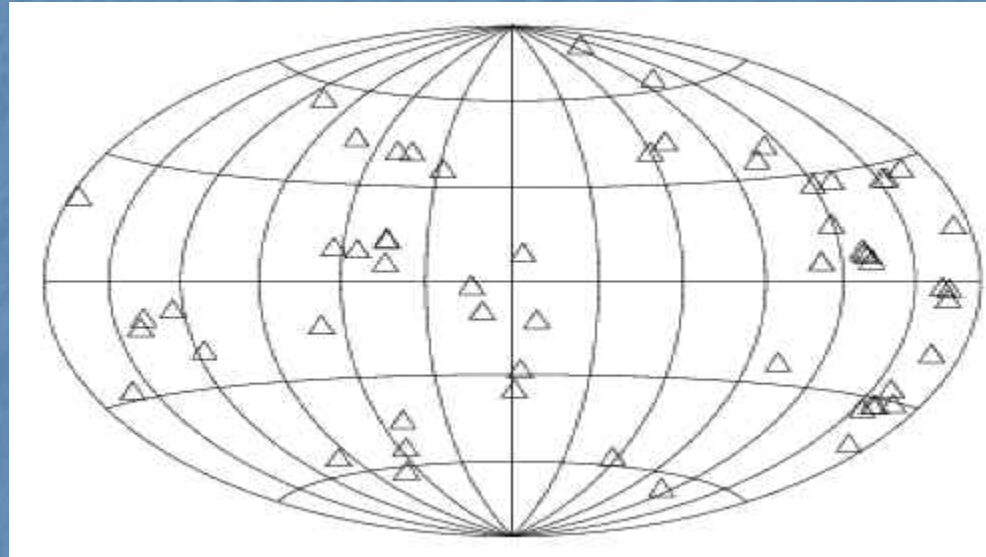
- Cosmic Ray Ions and Electrons are accelerated by accretion shocks
- Electrons Inverse Compton Scatter off CMB at the location of the shocks (outskirts)
- Ions make π^0 from collisions with Inter Galactic Matter at the core of the cluster and make secondary e^\pm which IC



EGRET Upper Limits

Reimer, Pohl, Sreekumar, Mattox
ApJ 588, 155, 2003

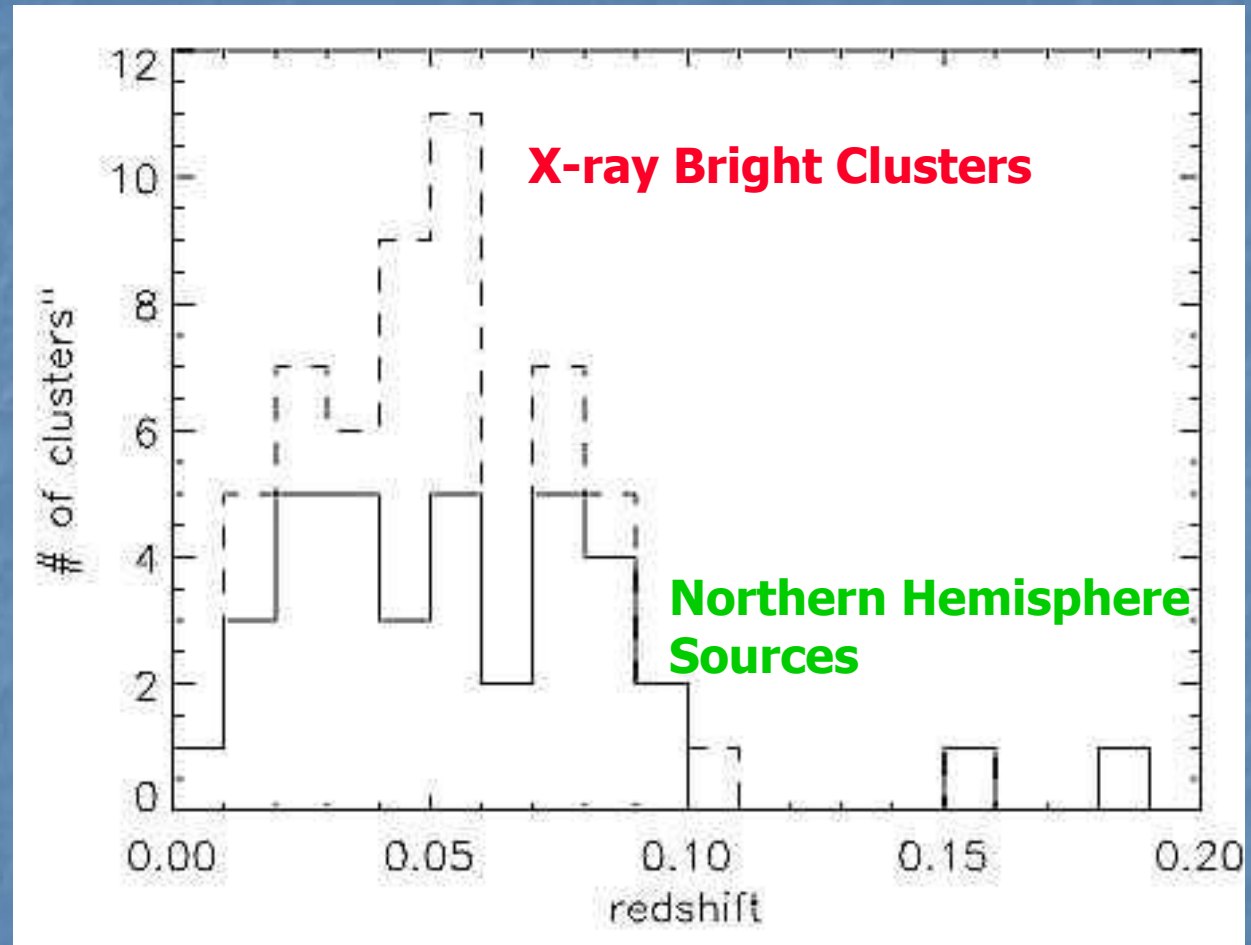
- Latest paper (and probably most reputable)
- Several earlier papers claimed $\sim 3 \sigma$ evidence of correlation with EGRET unidentifieds or of a stacked source detection
- 58 individual upper limits of a few $\times 10^{-8} \gamma/\text{cm}^2\text{sec} > 100 \text{ MeV}$
- Stacked upper limit of $6 \times 10^{-9} \gamma/\text{cm}^2\text{sec} > 100 \text{ MeV}$



**RA and Dec of the Clusters
Considered in this paper**

Good Milagro Targets

- Low Redshift
- Non Variable Sources
- Hard Spectrum of $dN/dE = KE^{-2}$
- Extended Sources of a few square degrees

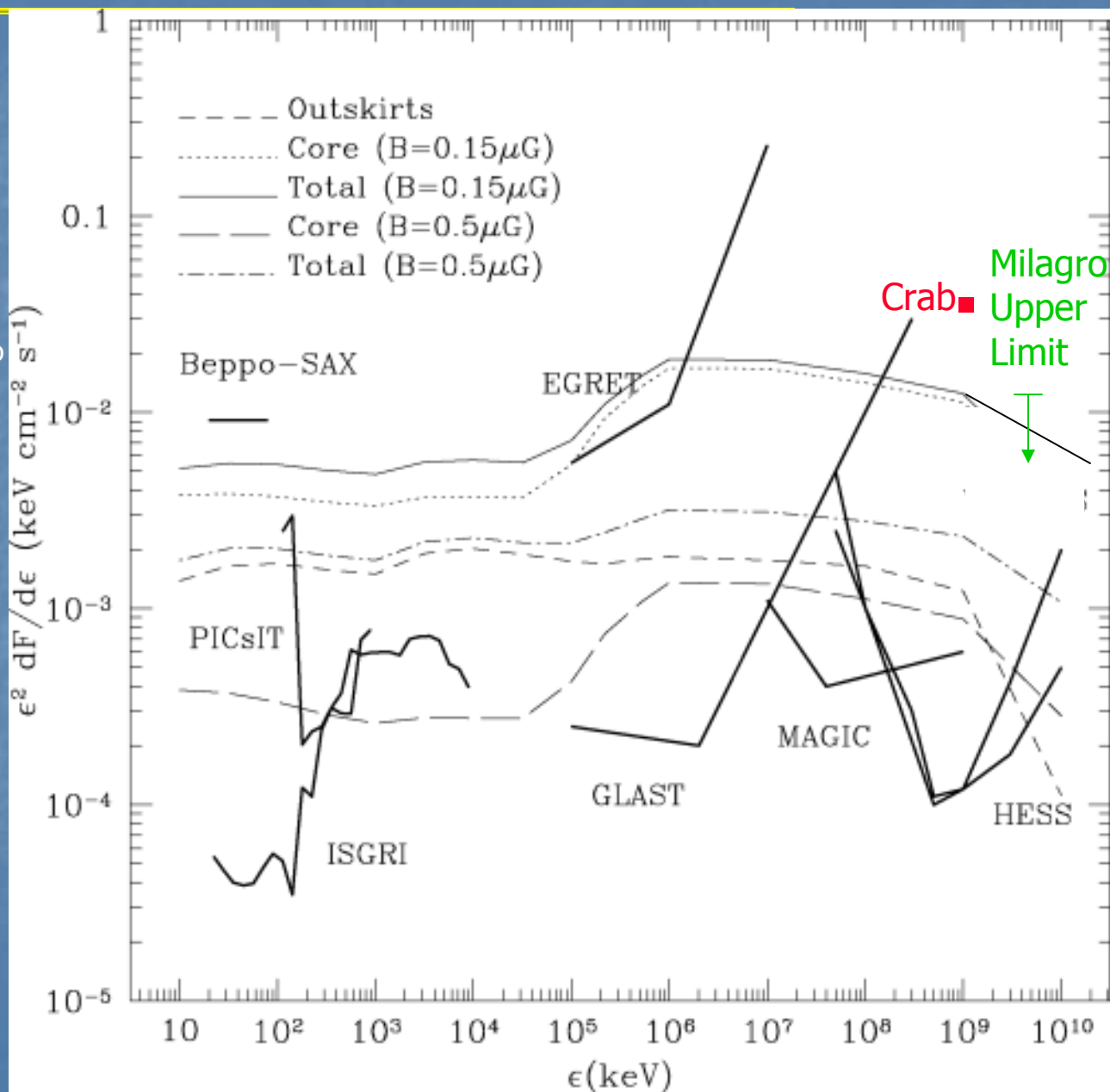


Coma Cluster Predictions

F. Miniati,
MNRAS, 342,
1009, 2003

Core is $r < 0.5^\circ$

Outskirts is
 $0.5^\circ < r < 1.5^\circ$



Outline of Milagro Paper

- I. Scientific Motivation
- II. Selection of Clusters
- III. Milagro Description and Analysis
- IV. Upper Limits of Individual Clusters
- V. Stacked Cluster Upper Limit