

# Attività' in Astroparticle Physics

Origine e Propagazione dei  
Raggi cosmici di Altissima  
Energia

**PB (OAA)**  
**D. De Marco (Genova)**  
**C. Ferrigno (Palermo)**  
**R. Aloisio (LNGS)**  
**C. Isola (Firenze)**  
**A.V. Olinto**  
**E.W.(Rocky) Kolb (FNAL)**

**Progetto Auger**

**Extreme Universe  
Space Observatory (EUSO)**  
(PB membro di entrambi i  
SOWG)

Accelerazione da shock  
newtoniani e relativistici

**PB (OAA)**  
**E. Amato (OAA)**  
**M. Vietri (Pisa, SNS)**  
**S. Gabici (Firenze)**

Fenomeni non-termici nella  
formazione di strutture su  
Grande scala

**PB (OAA)**  
**G. Brunetti (Bologna)**  
**S. Gabici (Firenze)**

**GLAST** (PB membro dei  
working groups su diffuse  
sources and extragal. sources)

Luce da Materia Oscura non  
Barionica

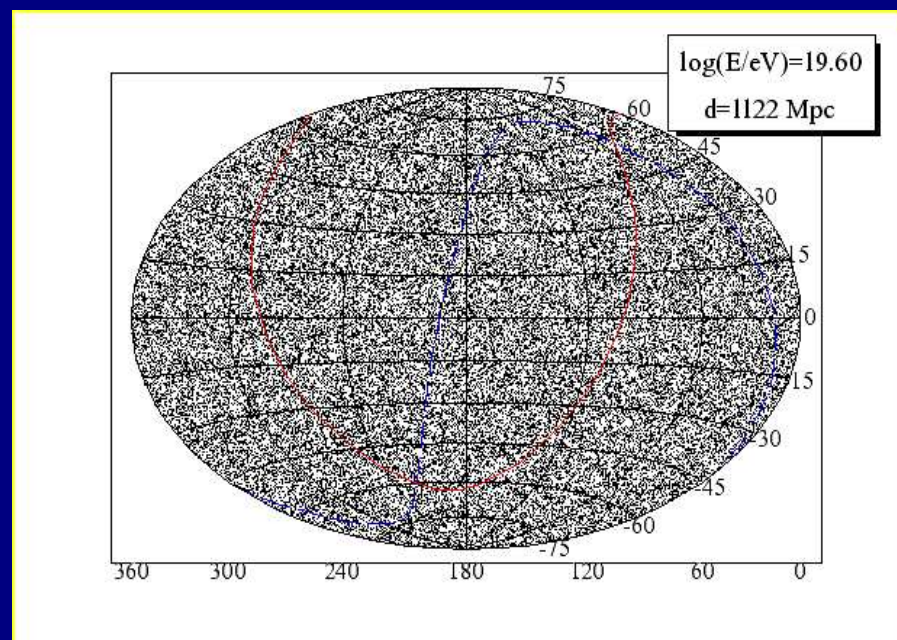
**PB (OAA)**  
**A.V. Olinto (Chicago)**  
**C. Isola (Firenze)**  
**R. Aloisio (LNGS)**

**GLAST** (PB membro dei  
working group su multifreq.  
observations of dark matter)

# ORIGINE E PROPAGAZIONE DI RAGGI COSMICI DI ALTISSIMA ENERGIA

Ci sono due grossi dilemmi legati agli UHECRs:

- 1) Capire come queste particelle siano originate
- 2) Capire se la ben nota soppressione GZK dovuta all'interazione di protoni di alta energia con la radiazione cosmica di fondo sia oppure no presente e se lo è, quali sono le sue caratteristiche



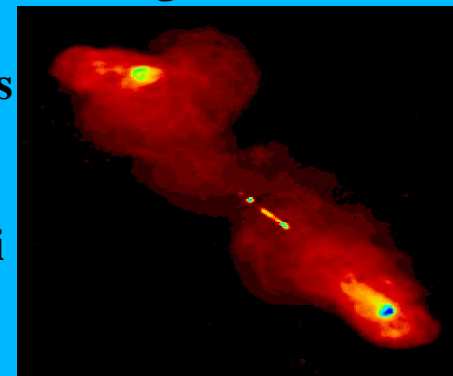
**Sviluppo di simulazioni MC per la propagazione di UHECRs in ambiente cosmologico (in coll. con D. De Marco e A.V. Olinto):**

**Valutazione della significatività statistica dei risultati di AGASA ed HiRes**

**Simulazione dei risultati attesi da esperimenti futuri (Auger ed EUSO)**

**Simulazione di UHECRs da sorgenti burst**

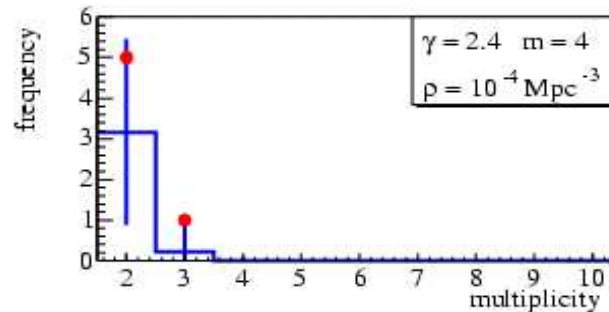
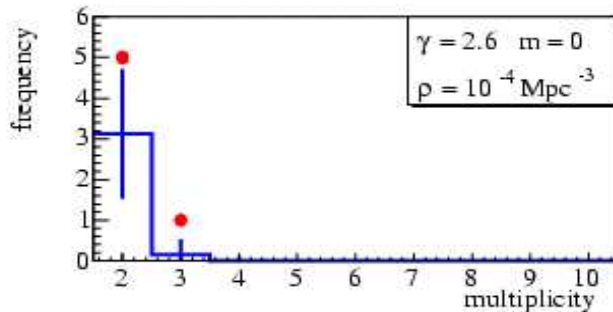
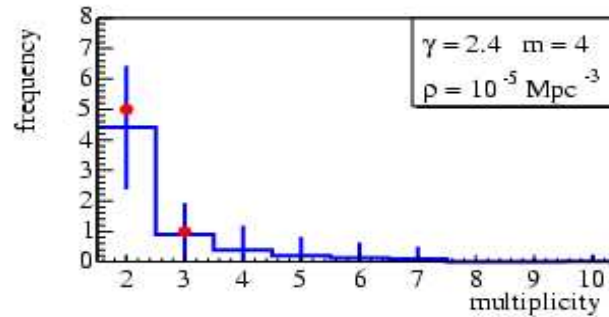
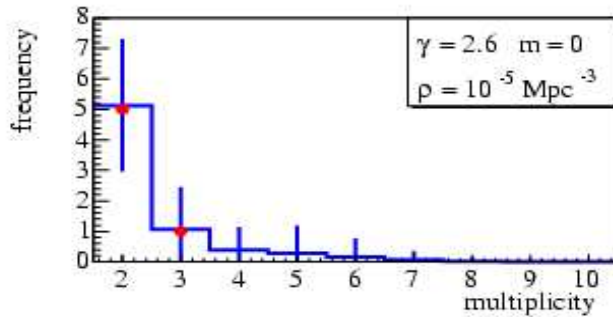
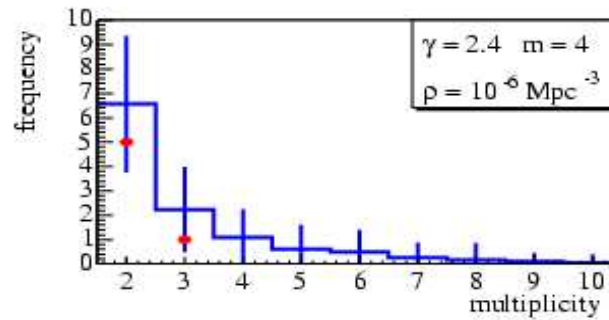
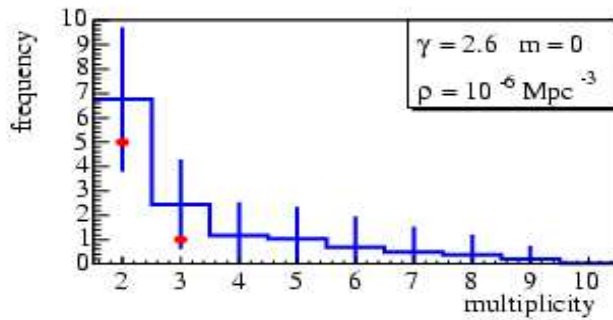
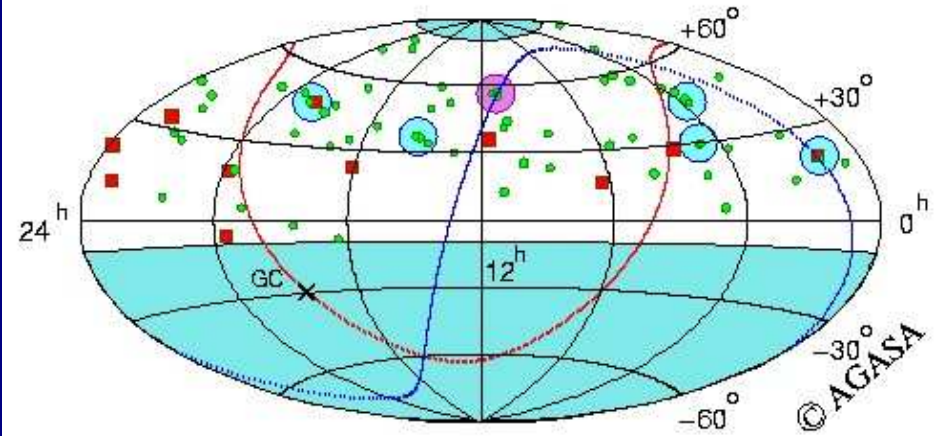
**Segnature gamma della propagazione, possibilmente rivelabili da telescopi gamma Cerenkov (in coll. con D. De Marco e C. Ferrigno)**



**Studio dettagliato delle anisotropie su piccola scala: PRIMA INFORMAZIONE SULLE SORGENTI! (in coll. con D. De Marco)**

# Funzione di Correlazione a due punti per AGASA

## Prima evidenza di sorgenti astrofisiche



PB & De Marco (2003)

BEST FIT DENSITY:

$10^{-5} \text{ Mpc}^{-3}$

First time we got  
an idea of what the  
sources might be!!!



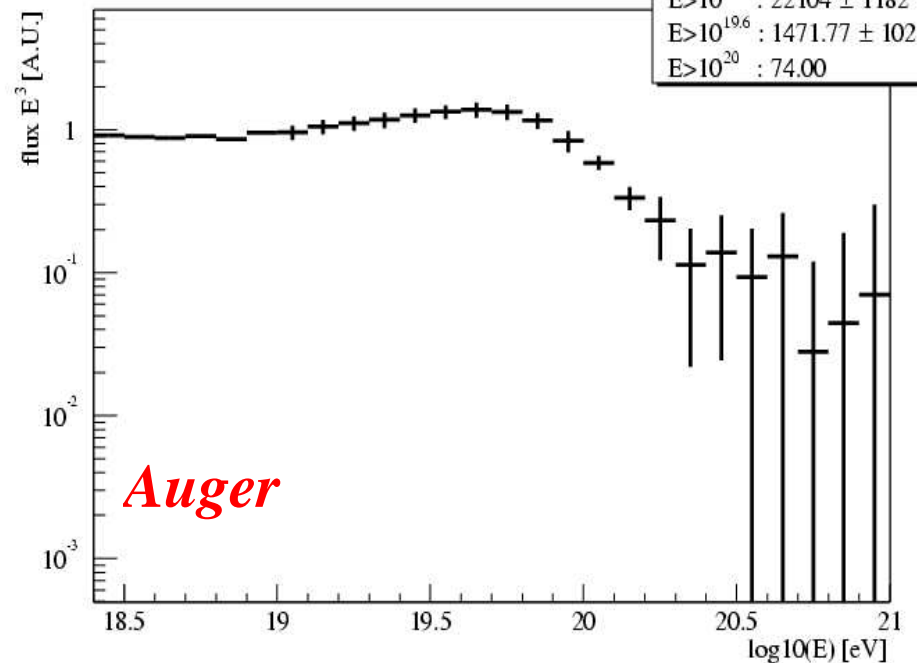
**The Auger Array is on the way...  
In a few years it will be possible to  
see the first scientific results.**

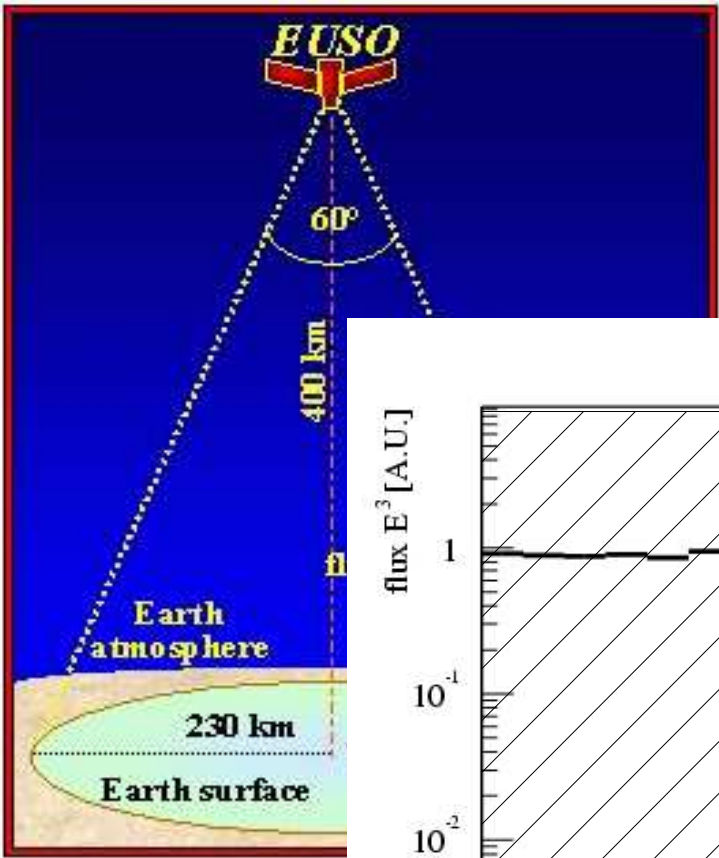
**BUT there are already plenty of  
data and even horizontal showers**

**The north part of Auger is the  
evaluation/funding stage in the  
US.**



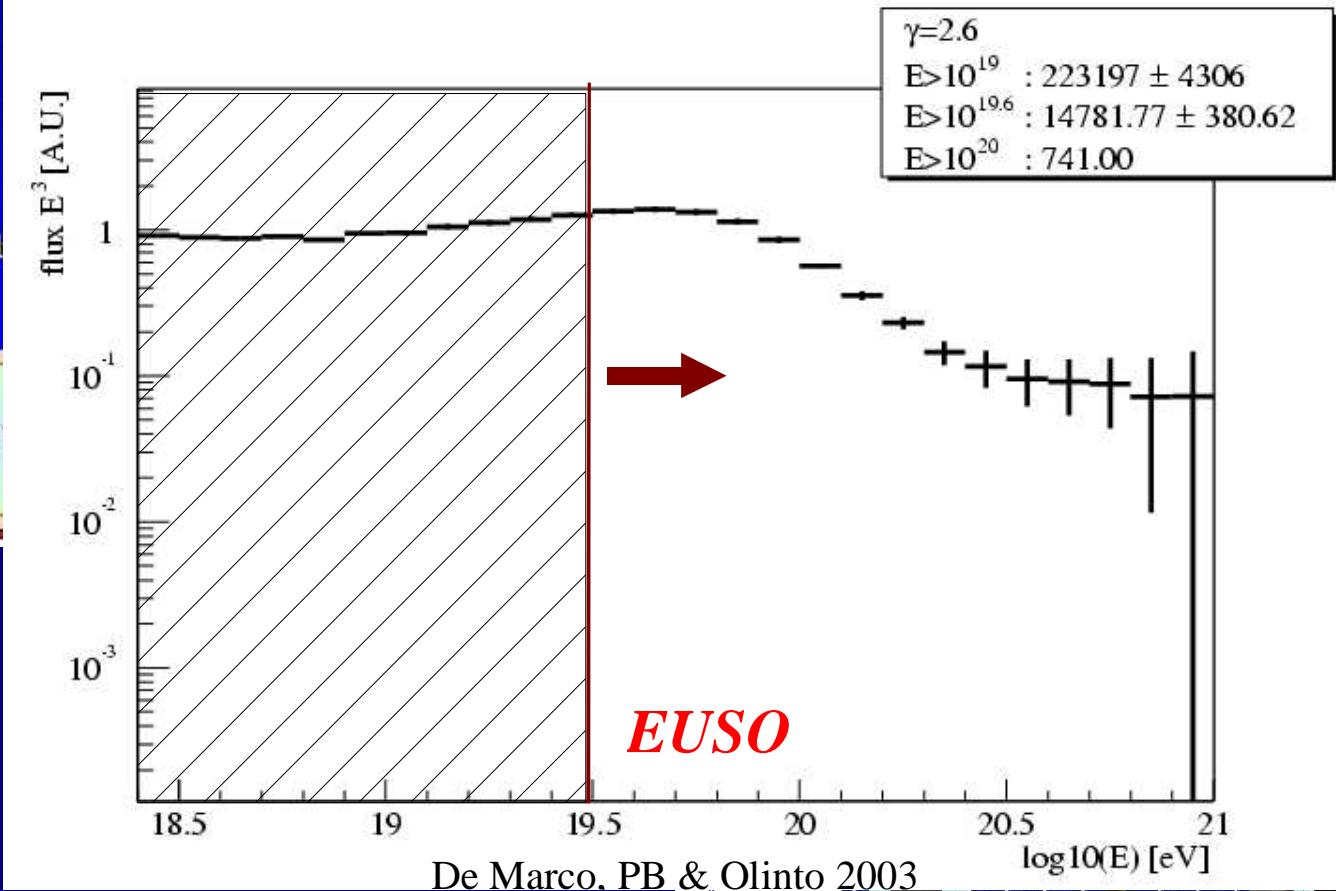
**De Marco, PB & Olinto 2003**



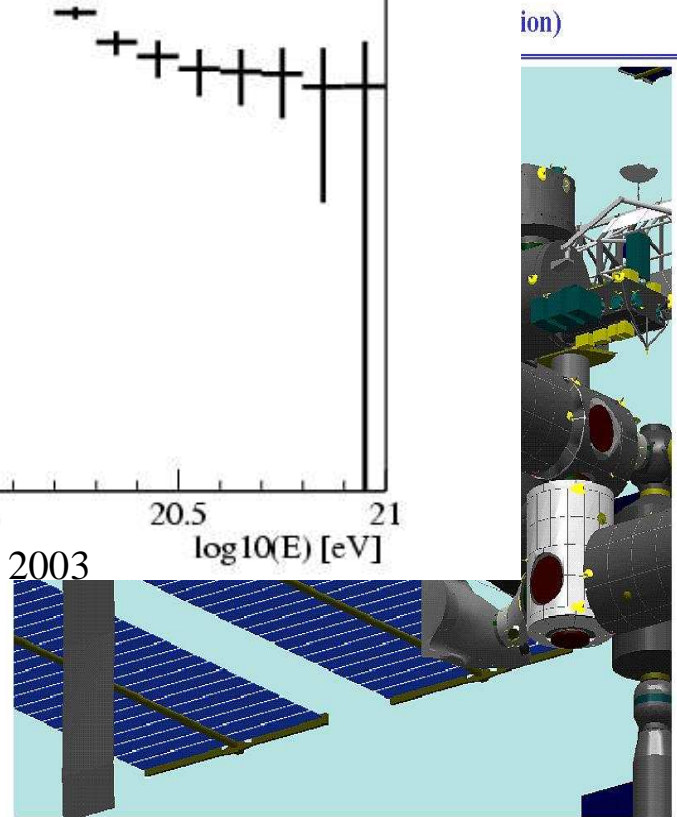


**EUSO should start operation in 2008–2010 in good time coincidence with the late Auger.**

**EUSO will sit on the ISS and detect the fluorescence atmosphere**



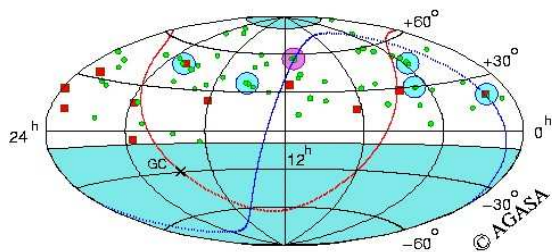
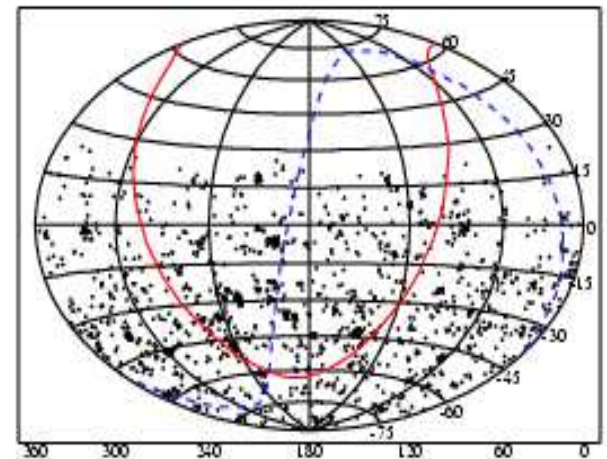
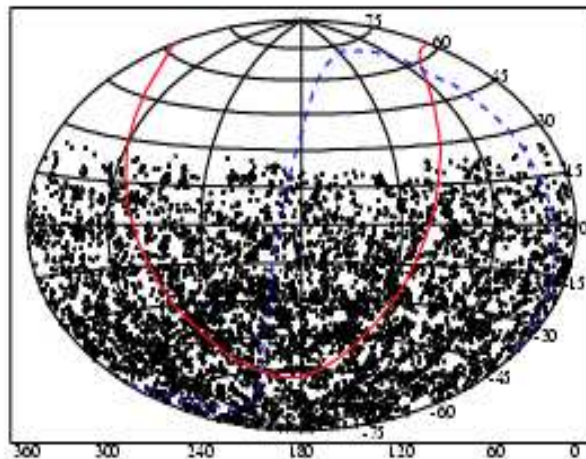
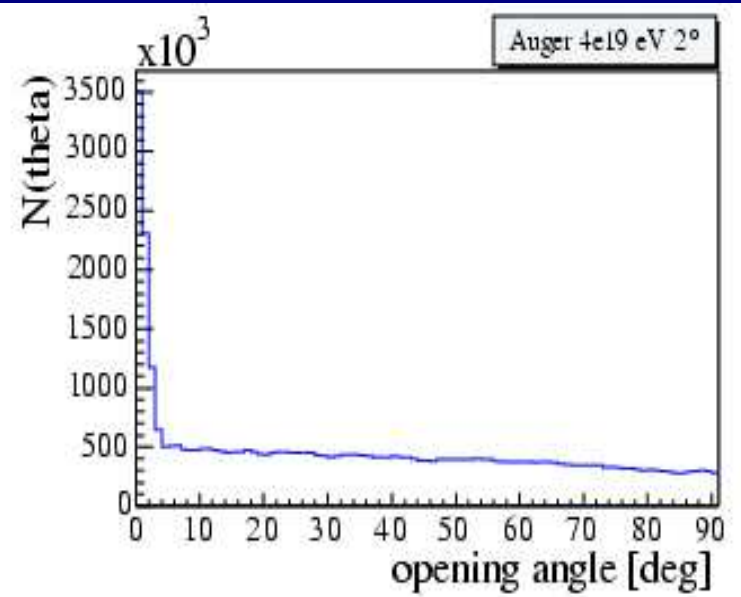
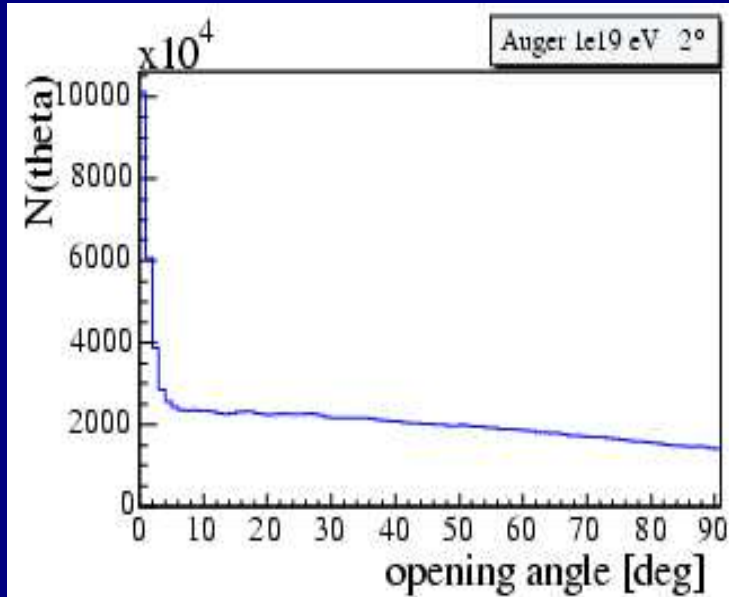
De Marco, PB & Olinto 2003



## Auger and EUSO in numbers

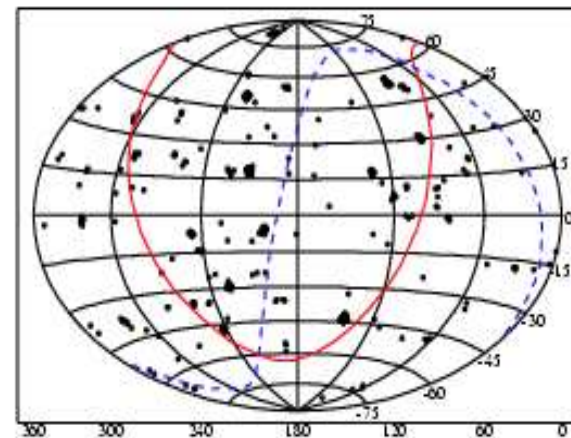
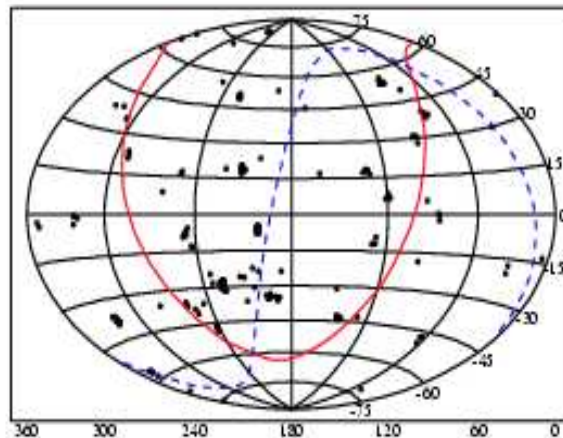
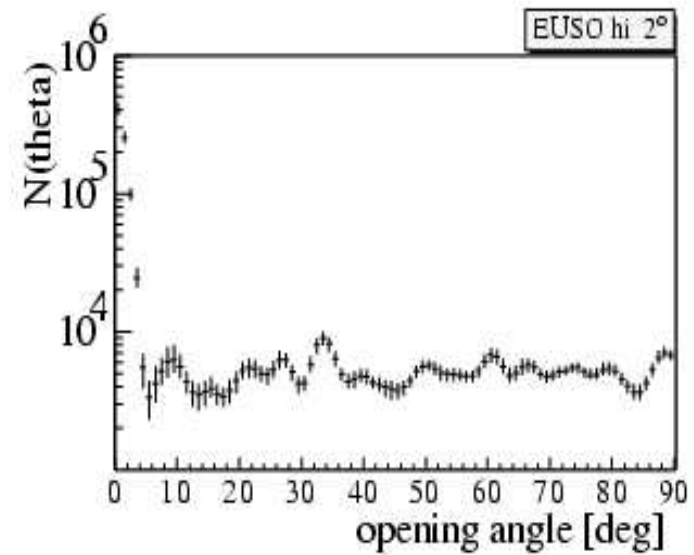
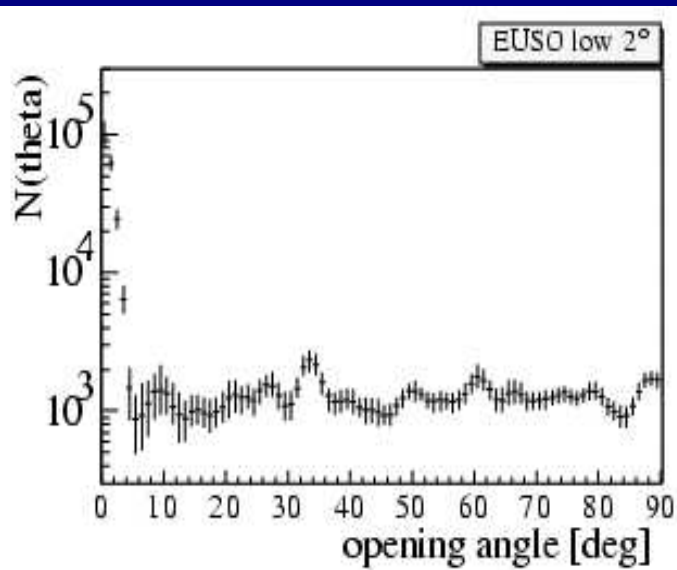
	AUGER	EUSO
Acceptance	7000 km <sup>2</sup> sr	35000–70000 km <sup>2</sup> sr
Events >4 10 <sup>19</sup> eV	1500	depends on trigger
Events >10 <sup>20</sup> eV	50 –80 (in 5 yrs)	200 –400 (in 3 yrs)
	<b>Theoretical: FULL PROPAGATION</b>	

# The two point correlation function for Auger (simulated)



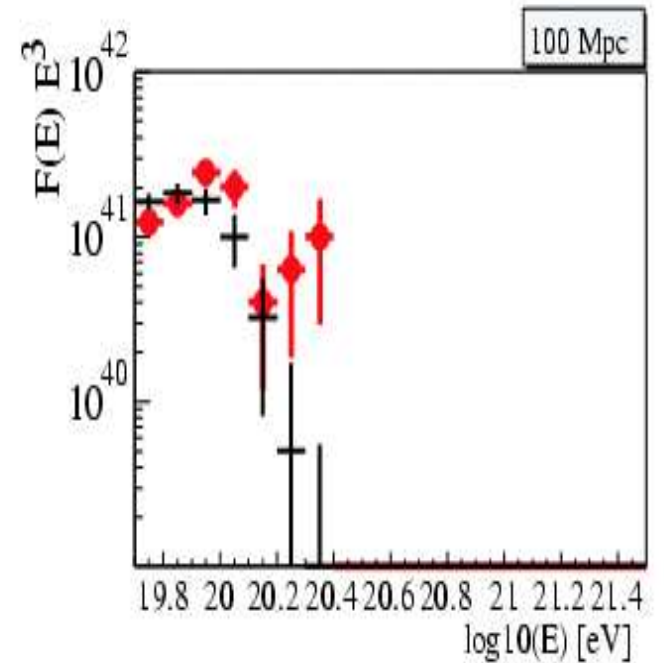
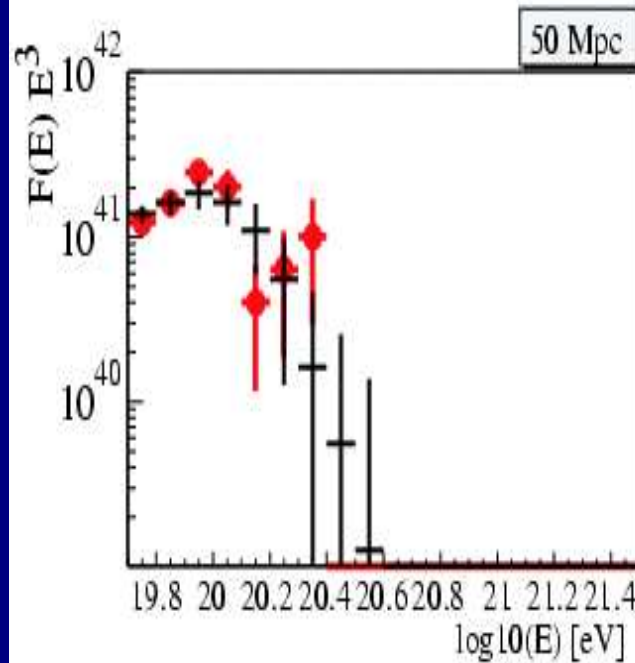
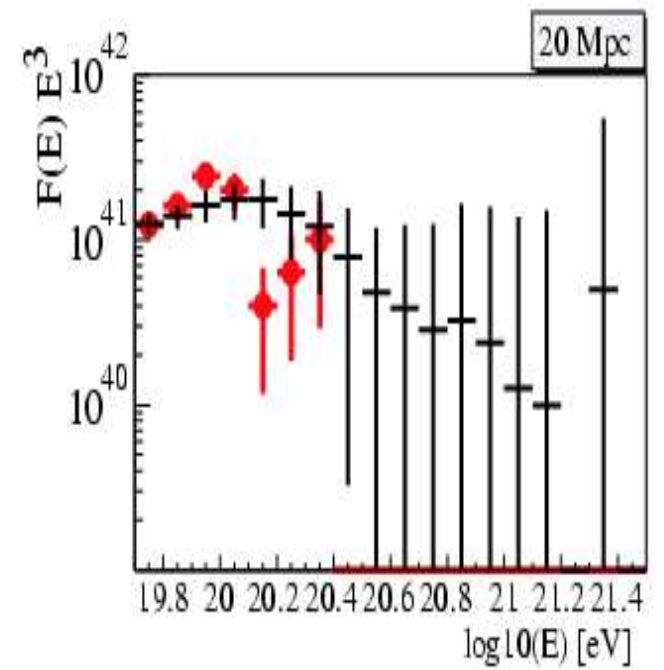
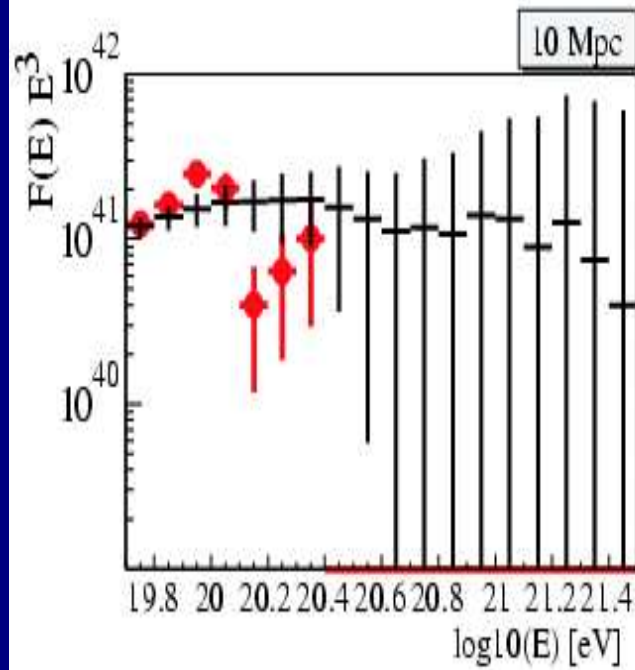
PB & De Marco 2003

# Two point correlation function for the EUSO statistics above $10^{20}$ eV



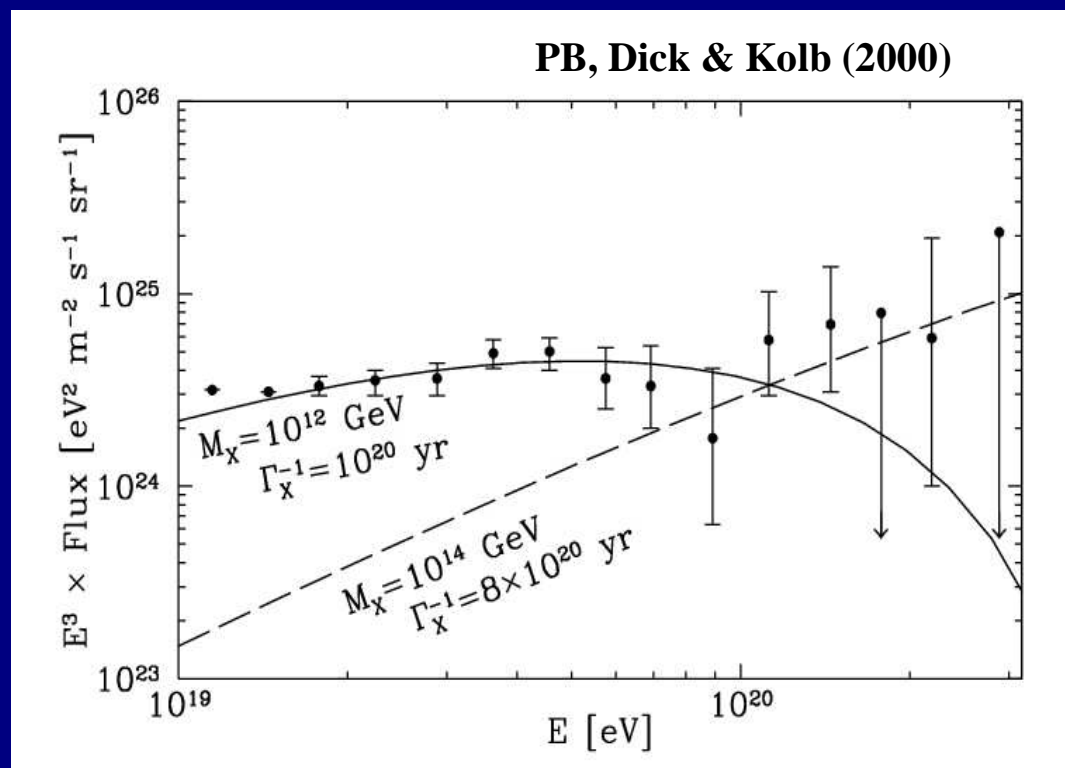
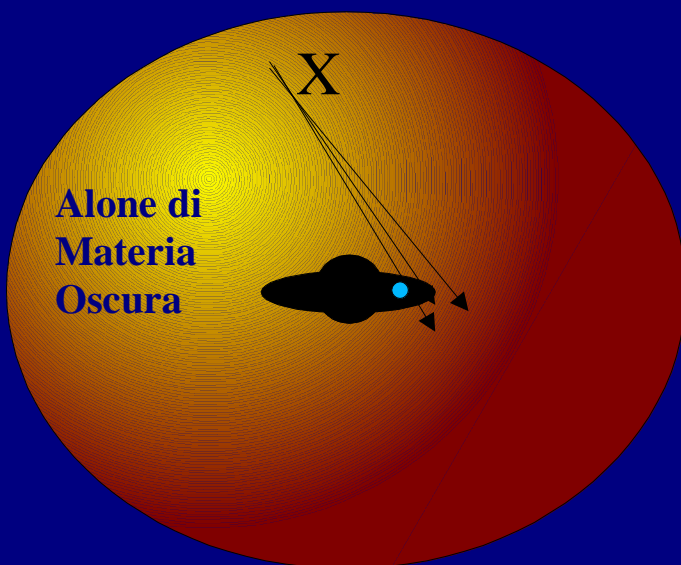
PB & De Marco (2003)

*Seeing the single sources with EUSO*



## Enorme Potenziale di scoperta di Nuova Fisica

1. Generazione di UHECRs dal decadimento di particelle supermassive prodotte durante il Big Bang (*UHECRs potrebbero essere la luce di cui brilla la materia oscura*)
2. Rivelazione di neutrini di energia molto elevata (test della fisica delle particelle elementari in condizioni estreme): sarebbe l'apertura di una finestra osservative rimasta chiusa sinora!
3. Usare la posizione della soppressione GZK per porre limiti senza precedenti alla possibile violazione di simmetrie fondamentali della Natura, anche a scale dell'ordine della grande unificazione

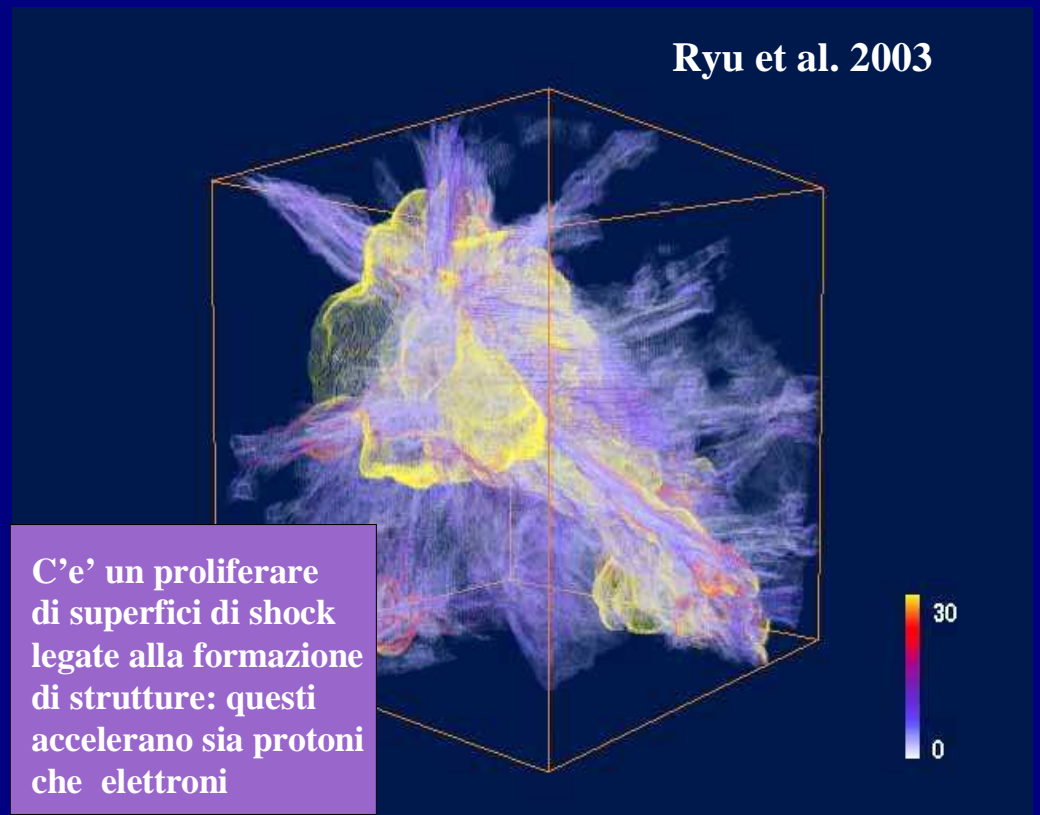
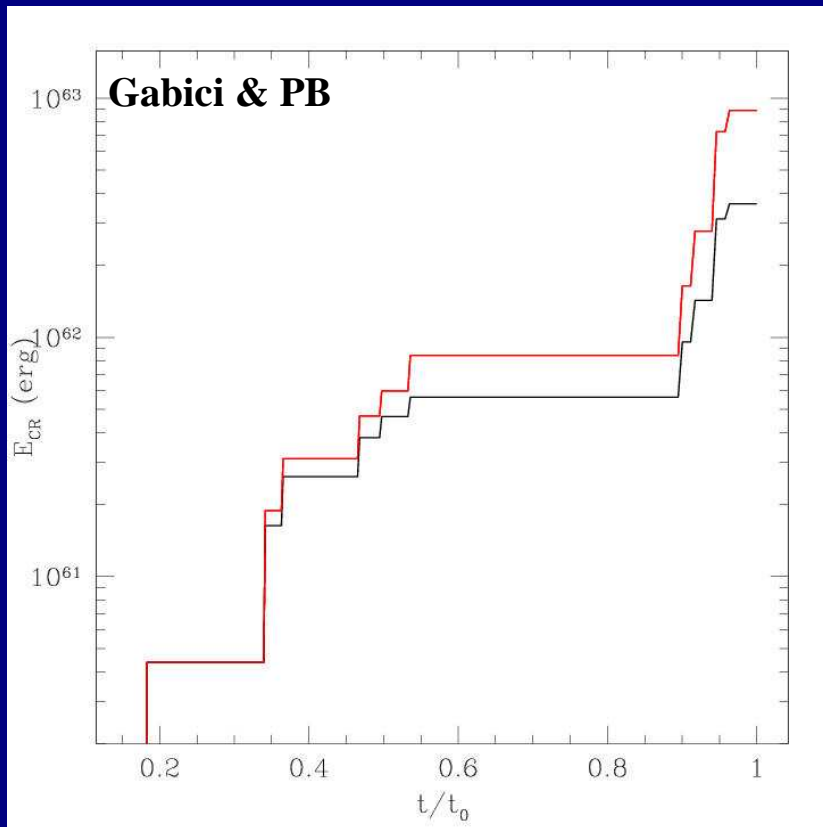


# Radiazione gamma dalla formazione di strutture

(in coll. con S. Gabici e G. Brunetti (BO))

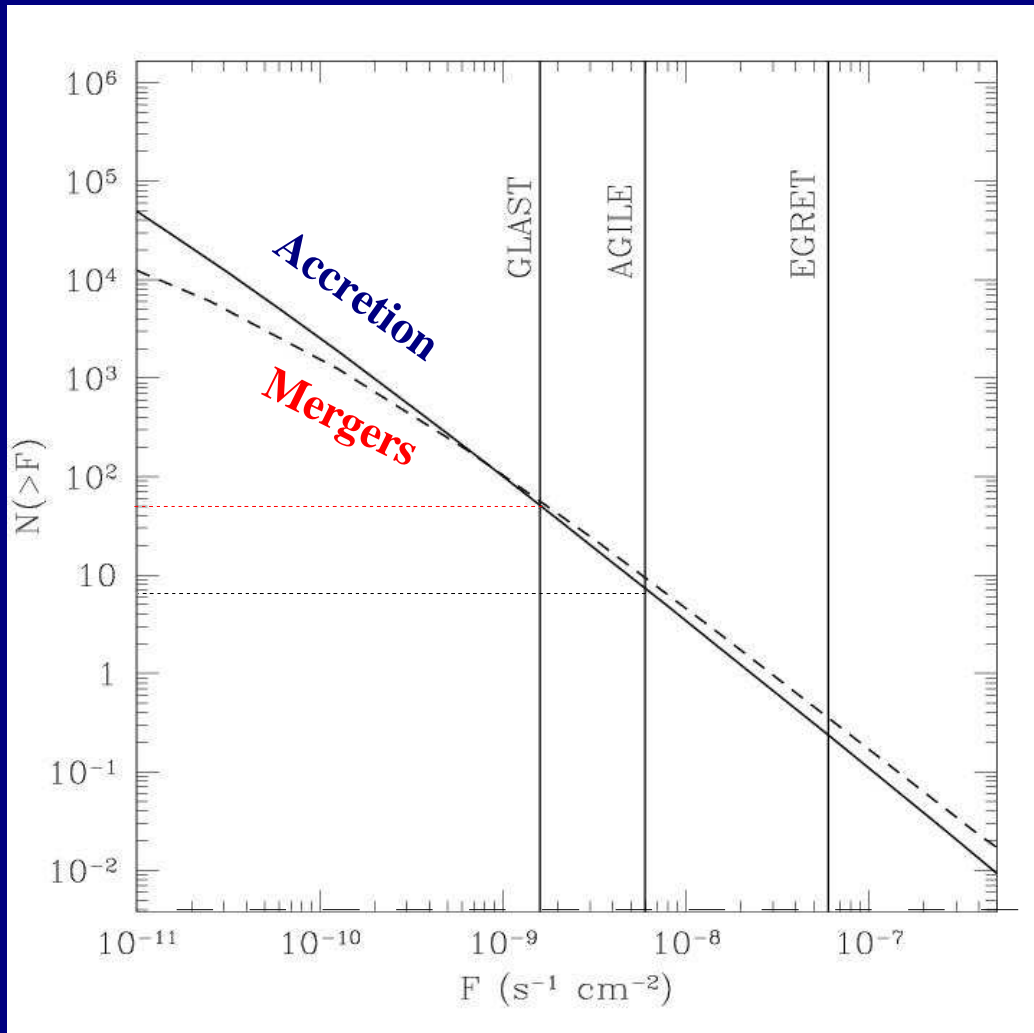
Osservazioni **radio ed X (BeppoSAX)** hanno mostrato che gli ammassi di galassie sono sedi di fenomeni non termici, oltre ad essere delle enormi buche di potenziale gravitazionale virializzate a temperature dell'ordine di diversi keV.

**1997:** Berezhinsky, PB & Ptuskin dimostrarono l'importante fenomeno del Confinamento di raggi cosmici in ammassi → Grandi implicazioni per la gamma astronomia



# LogN-LogS for Clusters of Galaxies

50-100  
Sources with  
GLAST



Gabici & PB 2003

