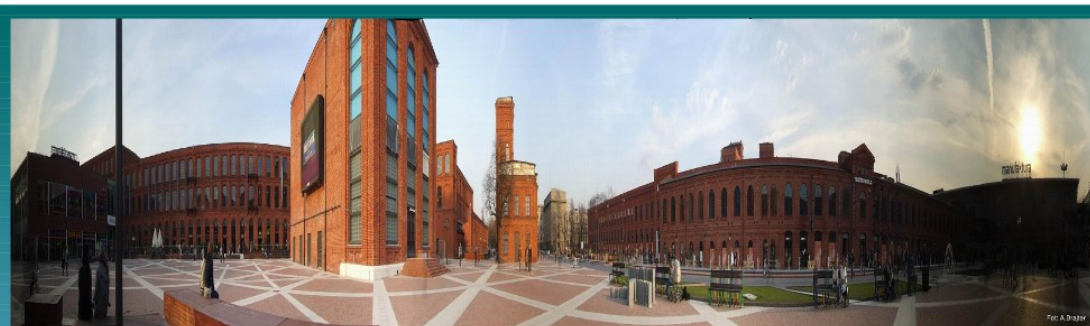


# International Cosmic Ray Conference 2009

resumé par  
Nukri Komin



## 31<sup>st</sup> International Cosmic Ray Conference 7-15 July 2009, Łódź, Poland

Under the auspices of the International Union of Pure and Applied Physics

Organized by the University of Łódź  
Department of High Energy Astrophysics and Department of Astrophysics  
and  
The Andrzej Sołtan Institute for Nuclear Studies  
Division of Cosmic Ray Physics in Łódź

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31<sup>st</sup> ICRC Łódź Poland 2009

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# De quoi s'agit-il?

---

- conférence sur les Rayons Cosmiques tous les deux ans
  - 2009 à Łódź [woodge], Pologne
  - 10 jours,  $O(1000)$  abstracts
  - présentations invitées (cosmologie, LHC, ...)
  - high light talks (Fermi, Antares, ...)
  - Hess lecture par Sir Arnold Wolfendale "Cosmic Rays and Climate"
  - 3 sessions (en parallèle):
    - OG: Low Energy Cosmic Rays, X-rays, Gamma rays, Neutrinos
    - HE: High Energy Cosmic Rays, Astroparticle Physics, Cosmology
    - SH: Solar and Heliosphere
  - merci aux rapporteurs:  
Sinnis, Torres, Montaruli, Hong Bo, Fukushima, Heber, Moraal
  - aujourd'hui: personal highlights
-

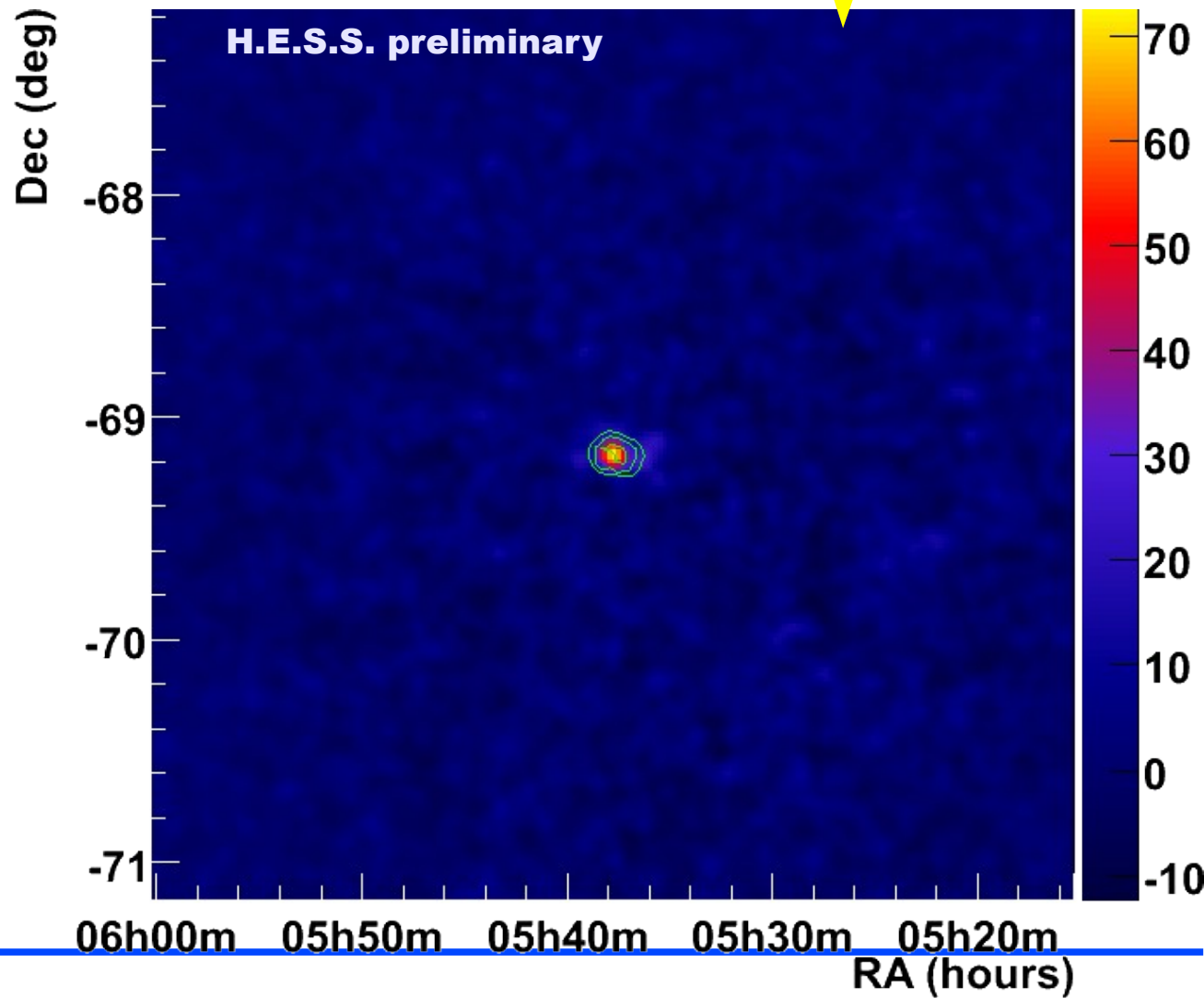
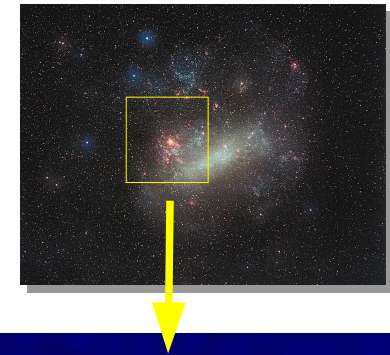




# Nébuleuse de Pulsar Extra-Galactique

- Komin et al. (HESS collaboration)
- Grand Nuage de Magellan à 50 kpc  
nébuleuse de pulsar autour de PSR J0537-6910,  
le pulsar le plus puissant connu

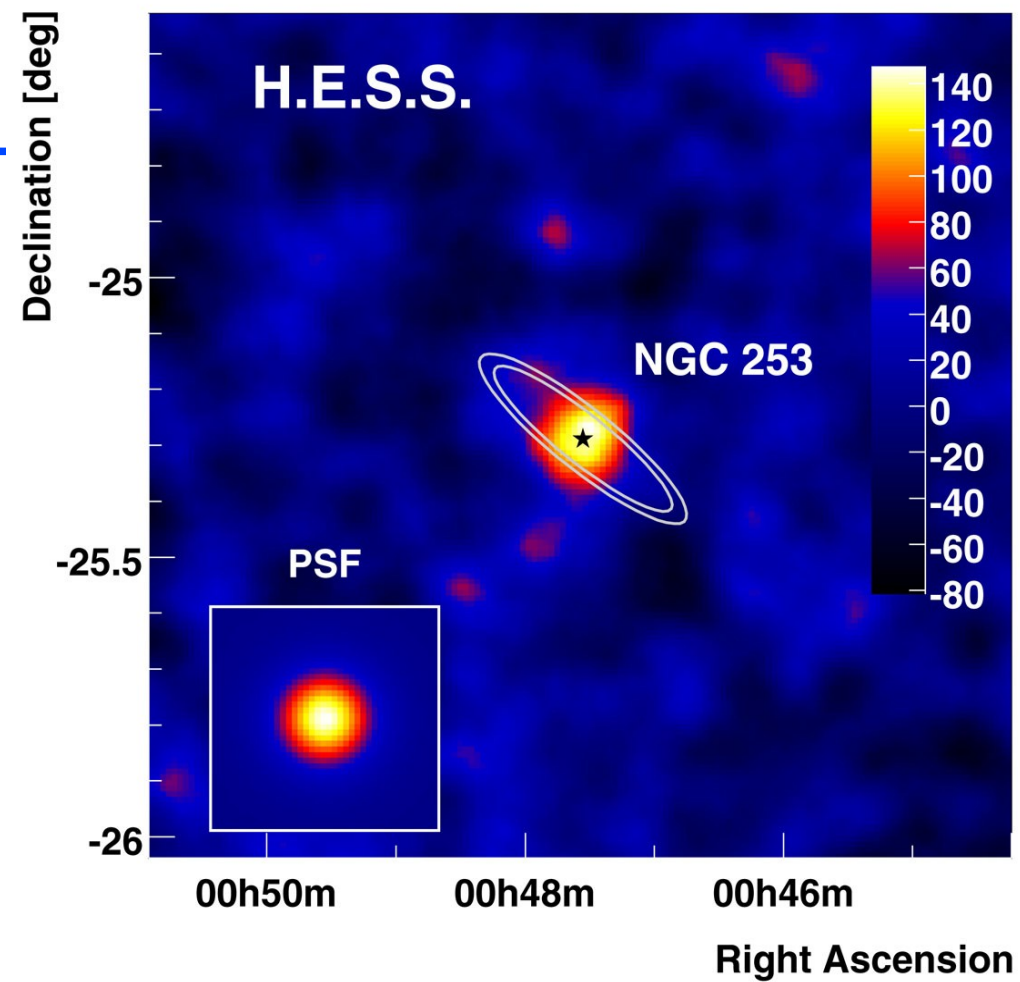
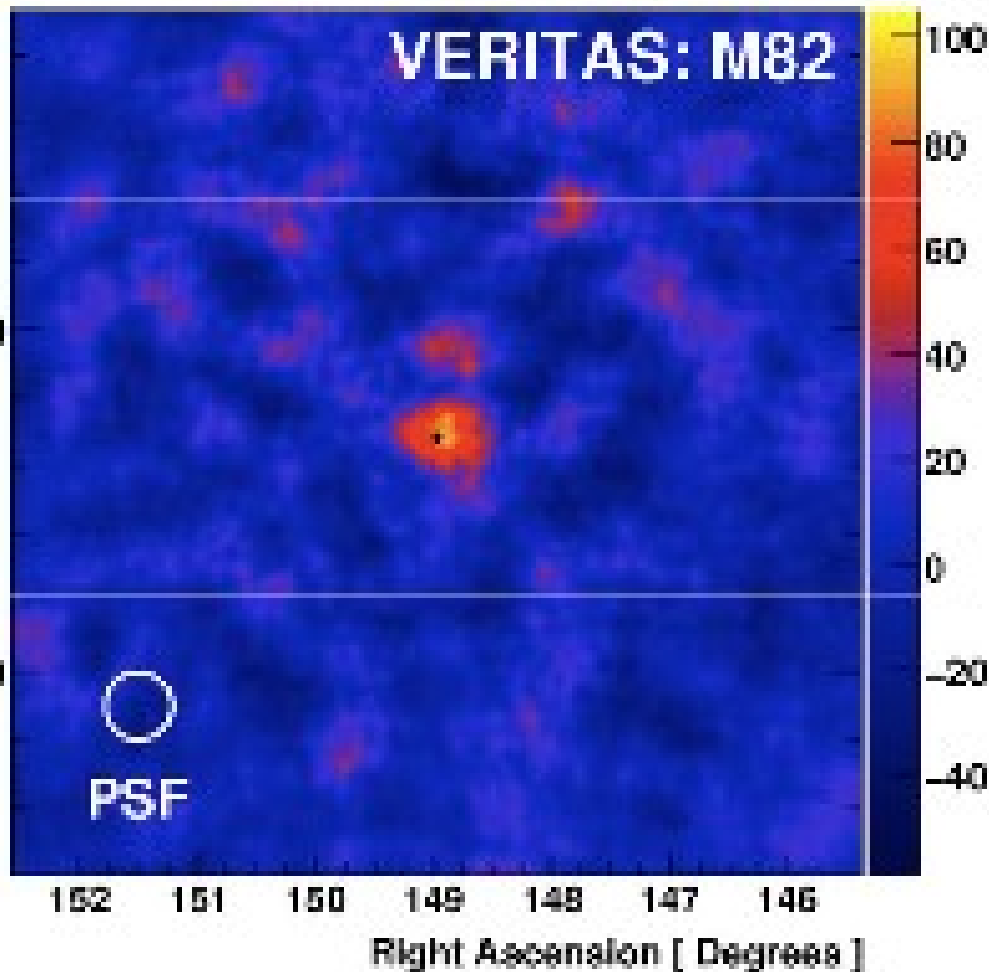
- remmenant de supernova
- accélération dans le choc alimenté par le pulsar
- **le PWN le plus distant**
- **la première source en TeV qui n'est pas un AGN**
- noyau actif de galaxie
- trous noir super-massif
- accceleration des particules dans les jets relativisitique





# Star Burst Galaxies

- taux de formation d'étoiles élevé
- durée de vie courte
- nombreuses supernovae
- **nouveau type de source TeV!!**



- NGC 253 (HESS): 119h obs
  - Science
- M 82 (Veritas): 137h obs
  - Nature

# Radio Galaxies

- AGN mais pas blazar
- M 87:
  - études MWL par HESS, Veritas, MAGIC, VLBA
- Cen A
  - détection par HESS (115 h)

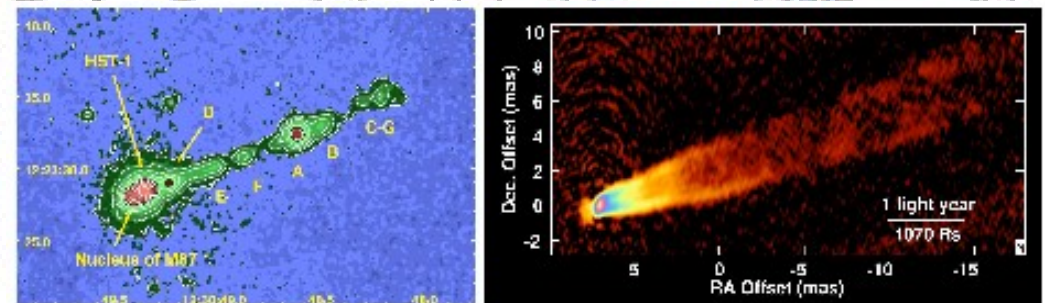
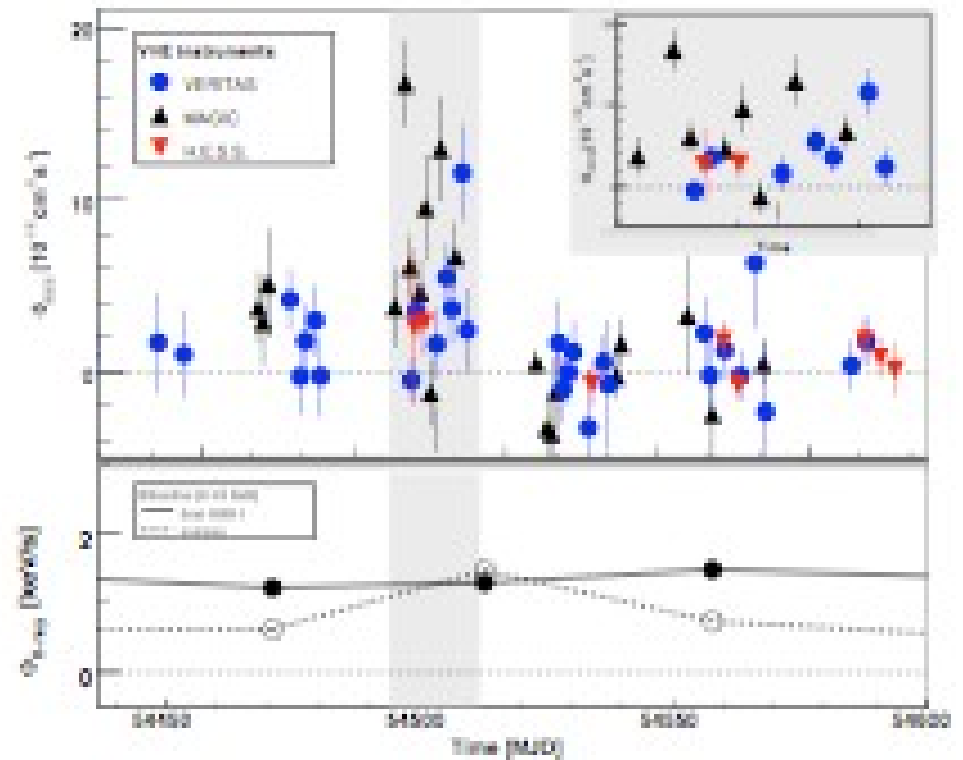
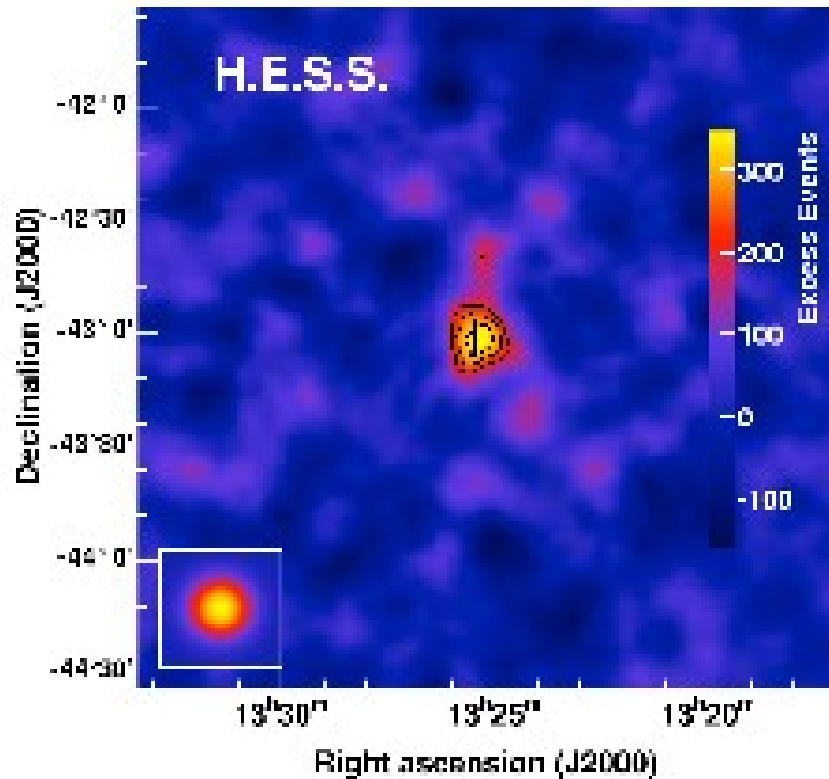


Fig. 3. Image of the M87 jet with high resolution instruments: Large-scale jet in X-ray obtained with Chandra (left). Inner jet in radio (43 GHz) obtained with VLBA (right).

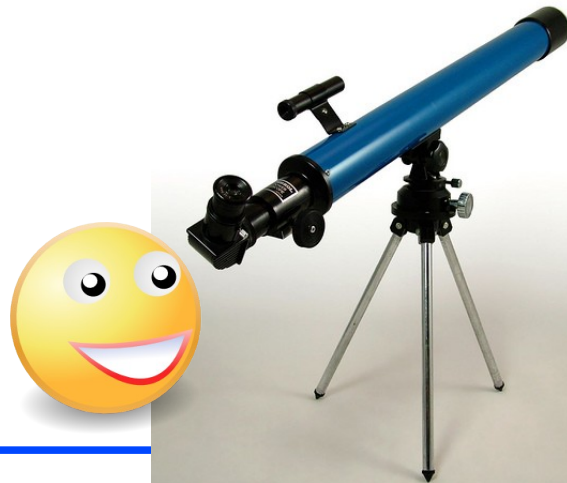
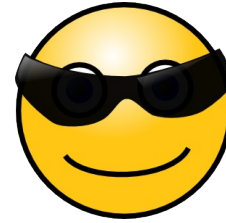
**source potentiel des  
Rayons Cosmiques UHE**

# Résultat TeV extragalactique

---

- sources type galactiques dans LMC
- star burst galaxies
  - nouvel type de source
- radio galaxies

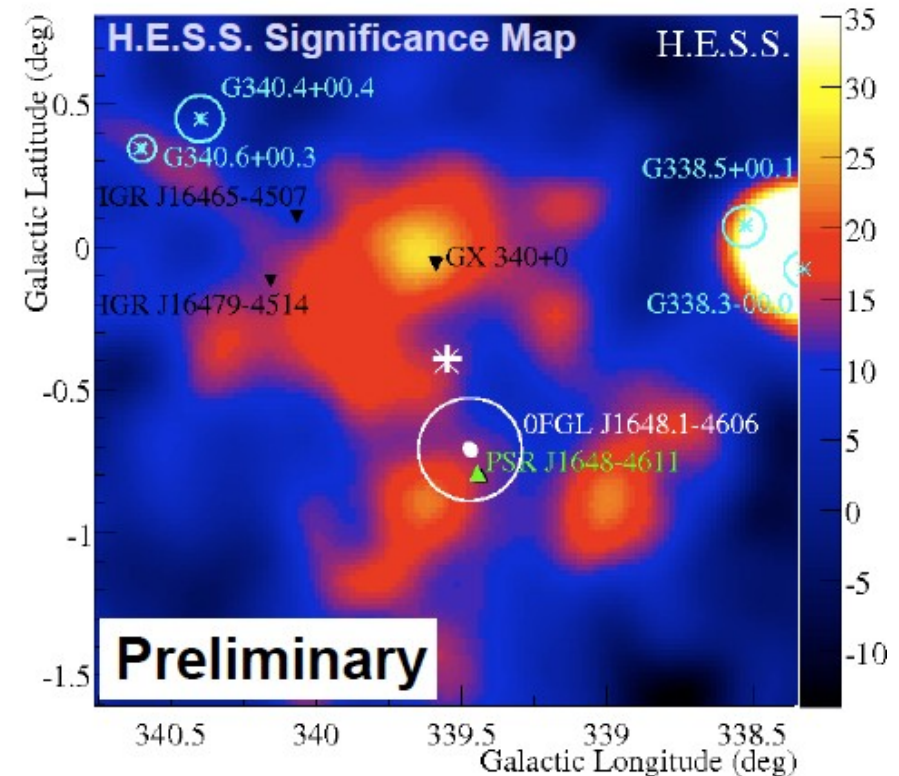
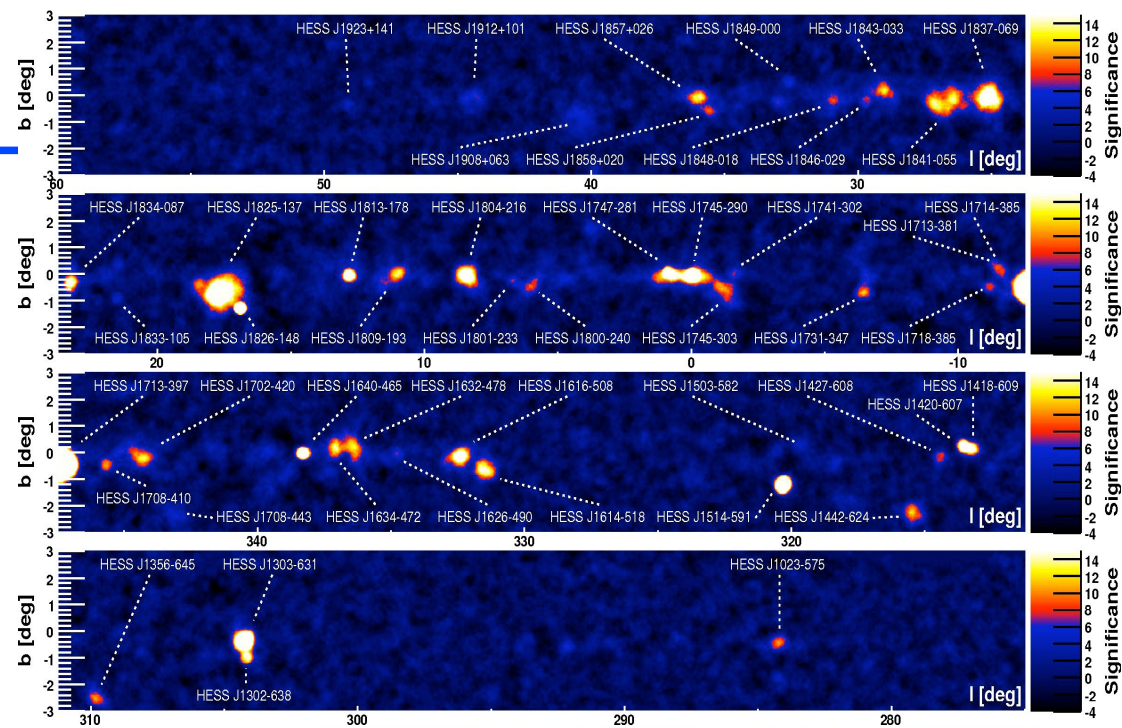
- **Les Blazars ne sont plus les seules sources extragalactiques!!**



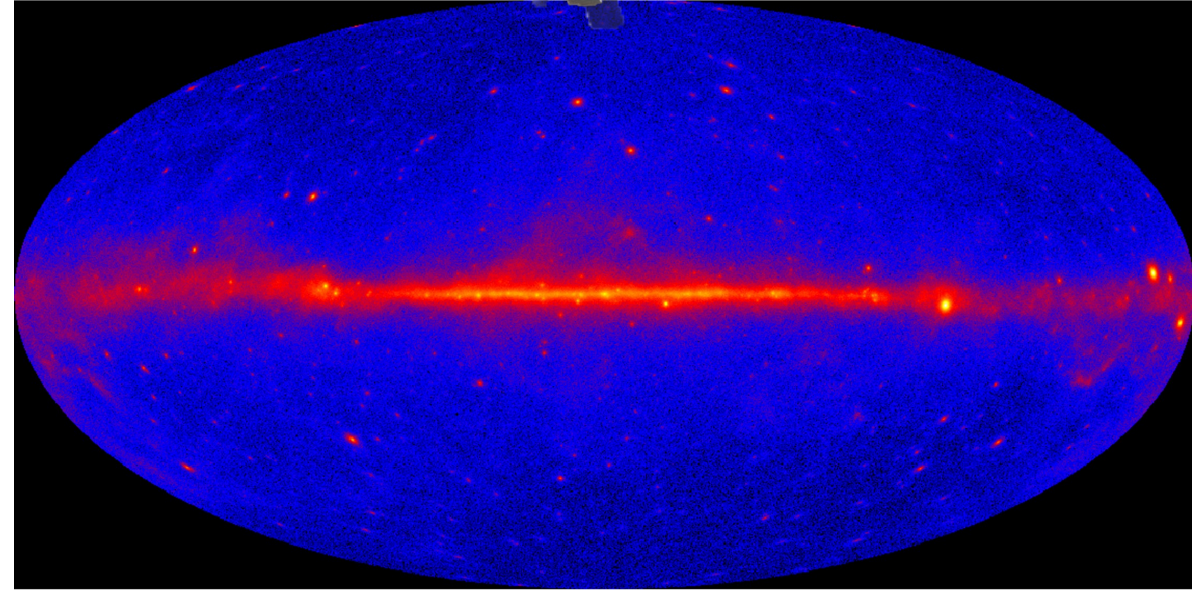
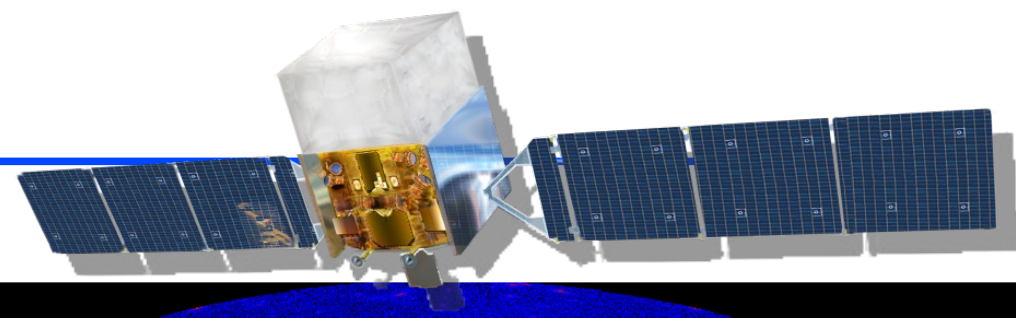


# TeV Galactique

- HESS Galactic survey
  - hémisphère sud
  - nouvelles sources:
    - 2eme star cluster Westerlund 1
    - sources non-identifiées
- Veritas survey
  - 140h
  - hémisphère nord
  - rien a plus que 5 sigma!! ~3% Crab
- **Il y a moins des sources dans l'hémisphère nord (significatif)!**



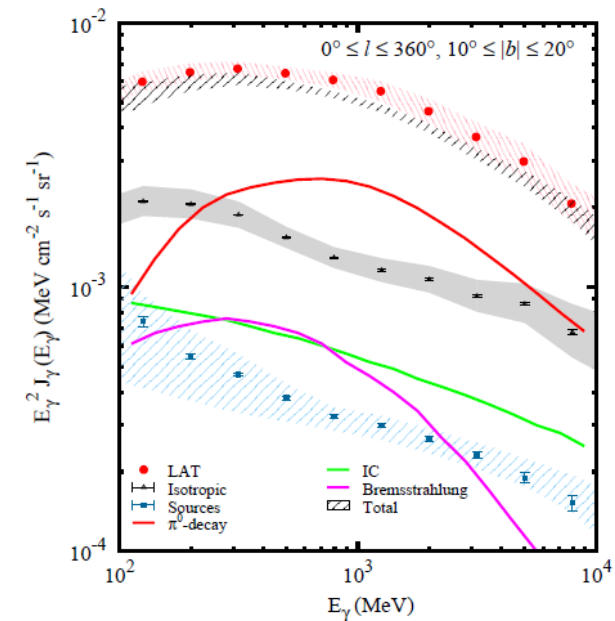
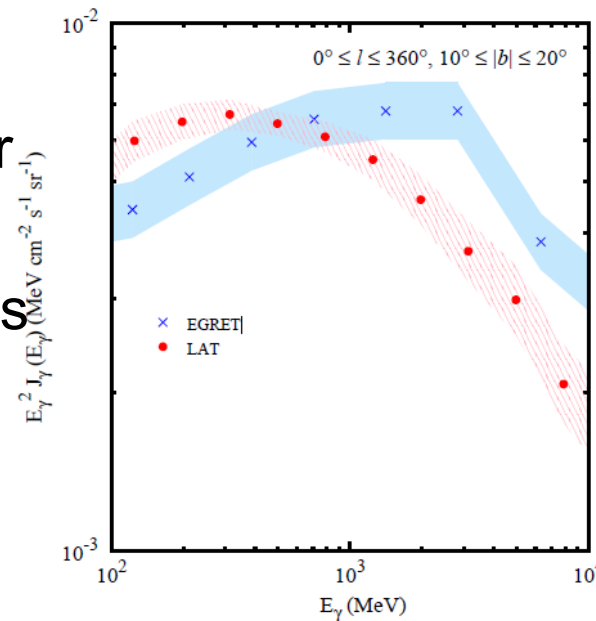
# Fermi



- lancement Juin 2008
- 9 mois des données
- gamma-rays  
50 MeV ... 300 GeV
- all sky survey
- émission diffuse

## – pas de confirmation de EGRET GeV bump

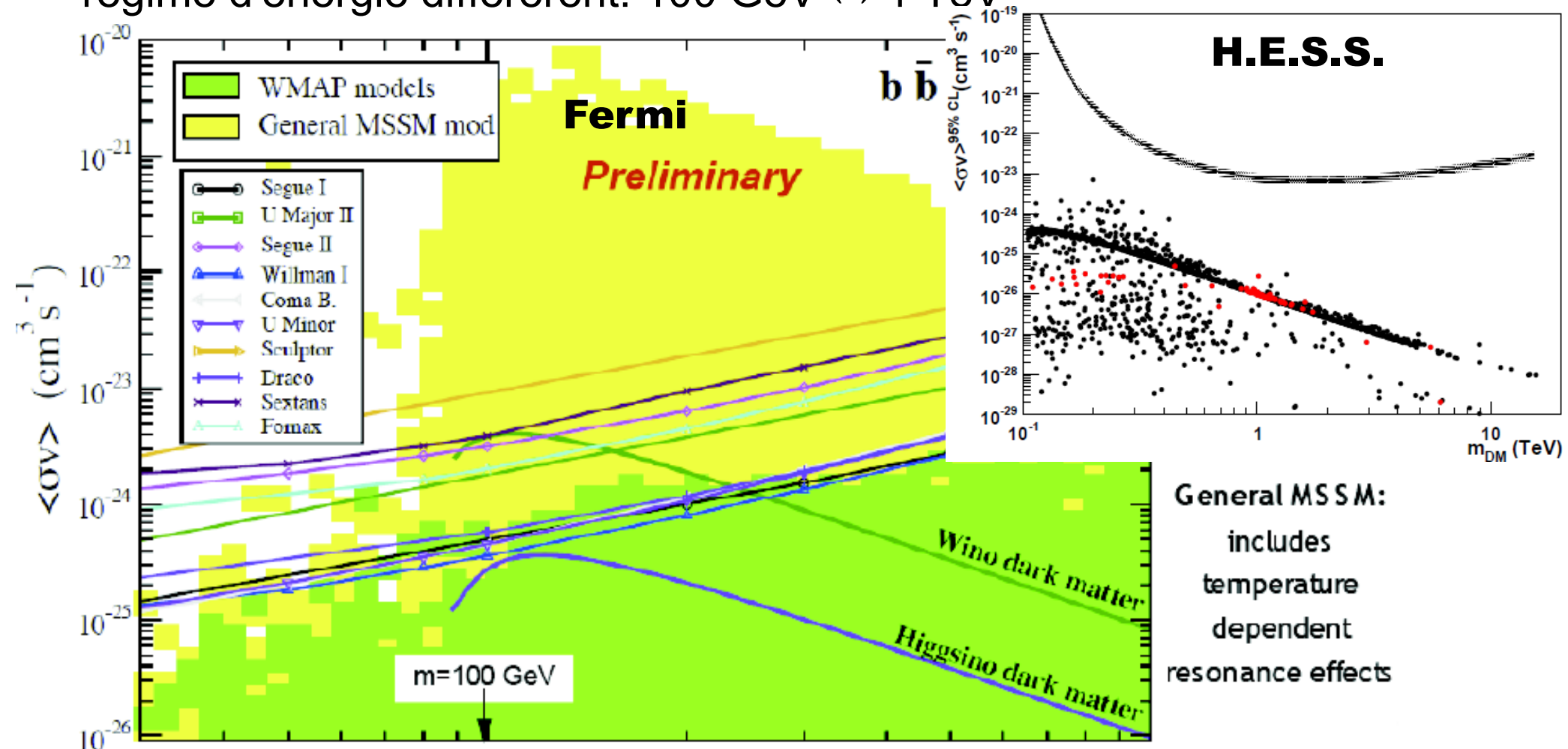
- exclusion de modèle de Boer de la matière noire
- compatible avec des modèles propagation et interactions des Rayons Cosmiques





# Fermi – Matière Noire

- annihilation de la matière noire dans les cœurs des galaxies sphéroïdales
- pas de signal, très compétitive avec HESS
- régime d'énergie différent: 100 GeV  $\leftrightarrow$  1 TeV

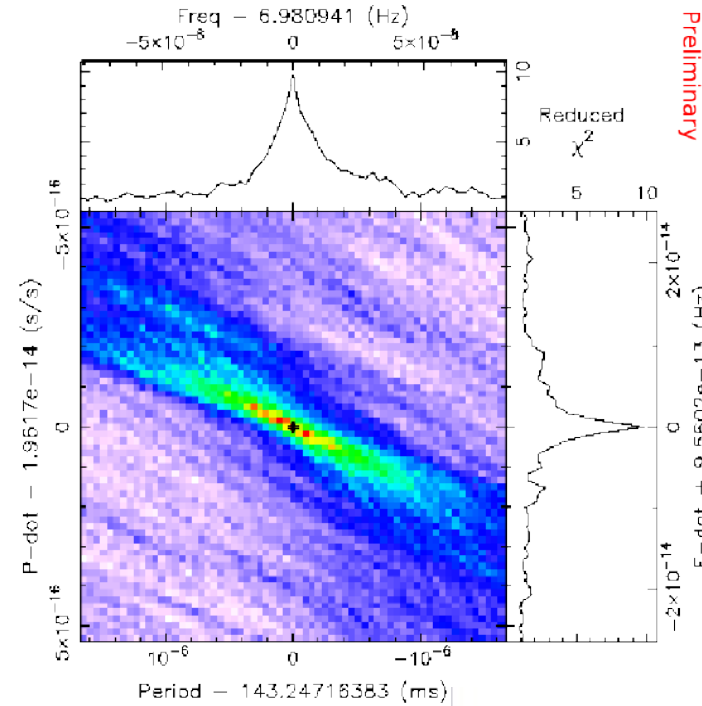
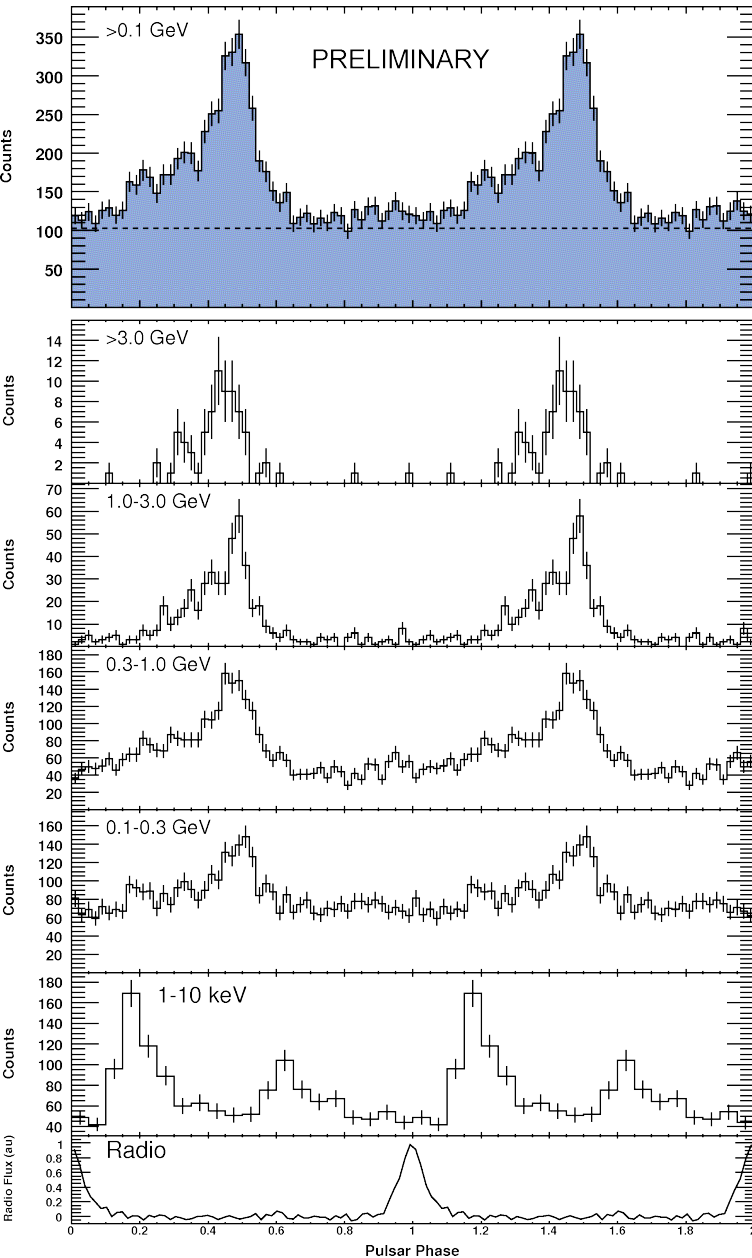


Flux upper limits are beginning to constrain some thermally produced WIMP models with the right relic density (NFW, no substructure).



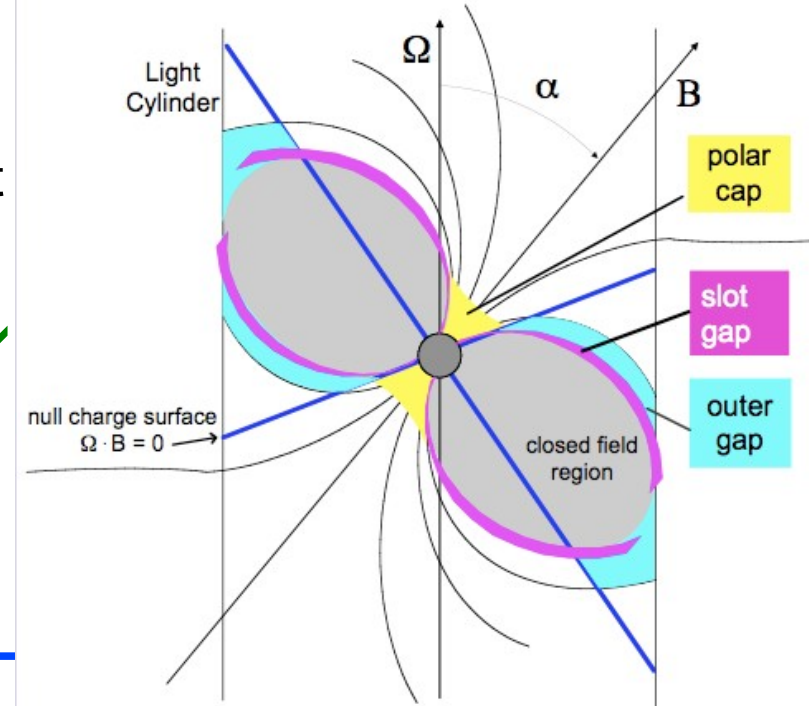
# Fermi – Sources ~ Pulsars

identifié par le pulse radio



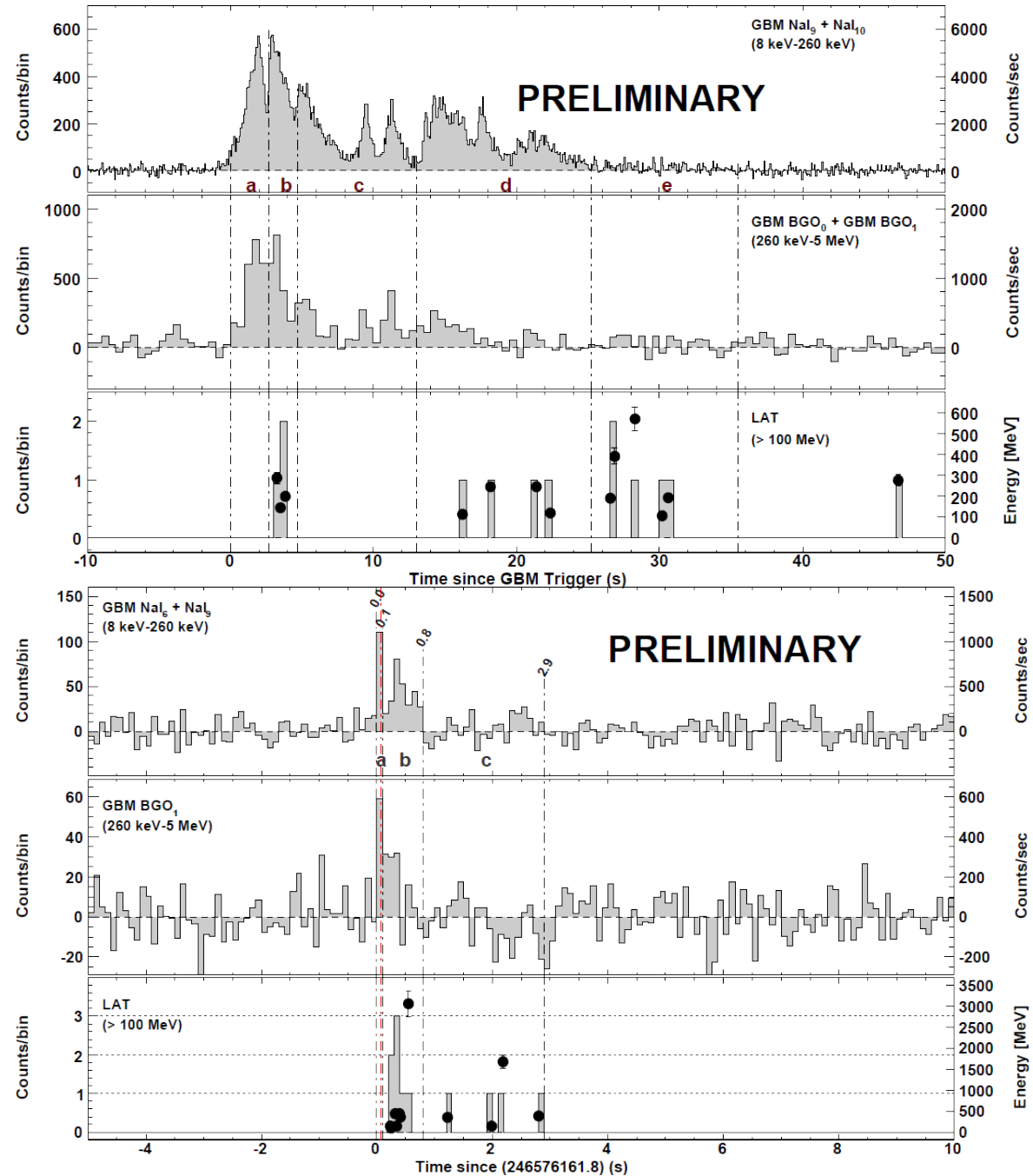
blind search

- presque tous les sources EGRET non-identifiées sont des pulsars Fermi
- modèle outer gap ✓
- polar cap ✗



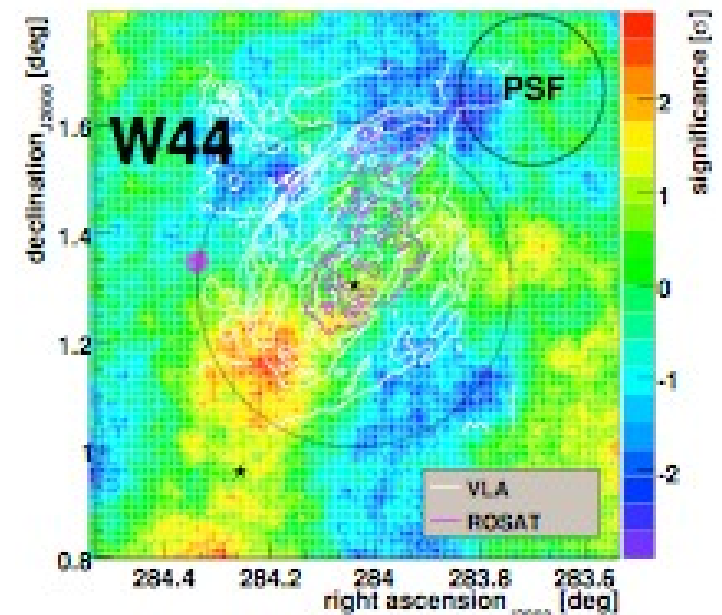
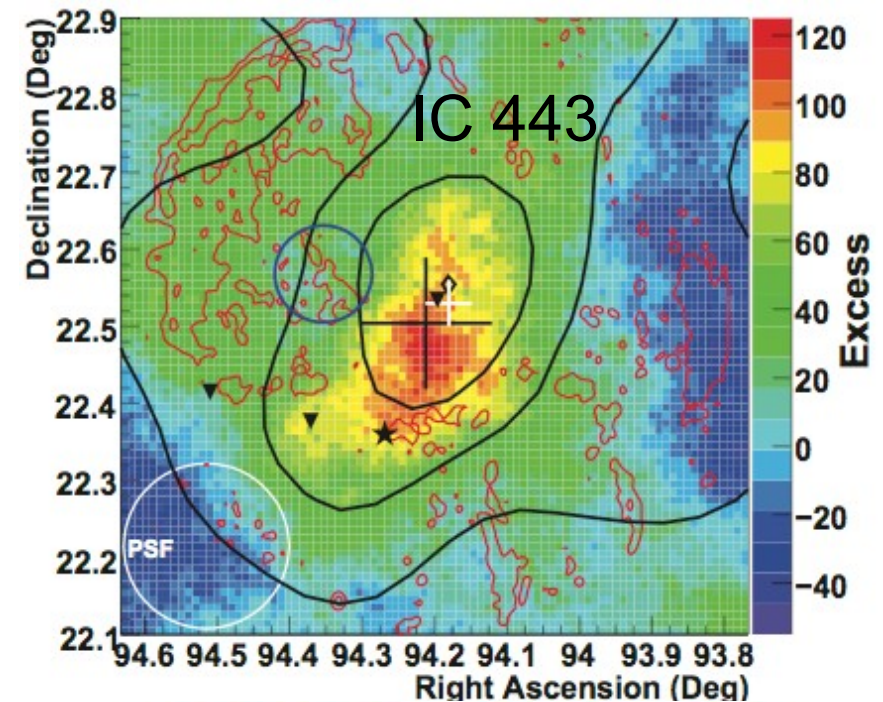
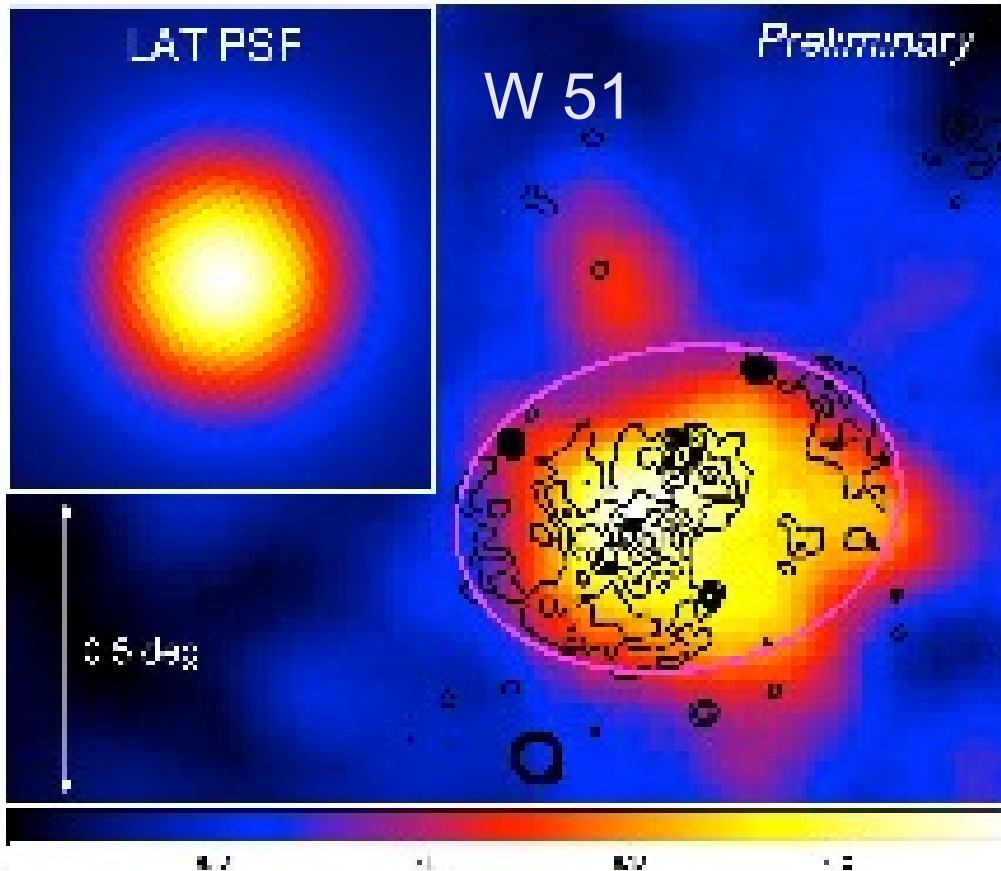
# Fermi – GRBs

- 241 détecté par GBM
- 129 in LAT FoV
- 9 détectés par le LAT
- **GeV retardé par rapport keV ou corrélé avec deuxième peak**
- pas de détection TeV mais observation >60s après trigger



# Connexion GeV/TeV – SNRs

- détection des SNRs en TeV (HESS, Veritas) et GeV (Fermi, AGILE)
- SNR en interaction avec nuage moléculaire





# Upgrades de Instruments Cherenkov

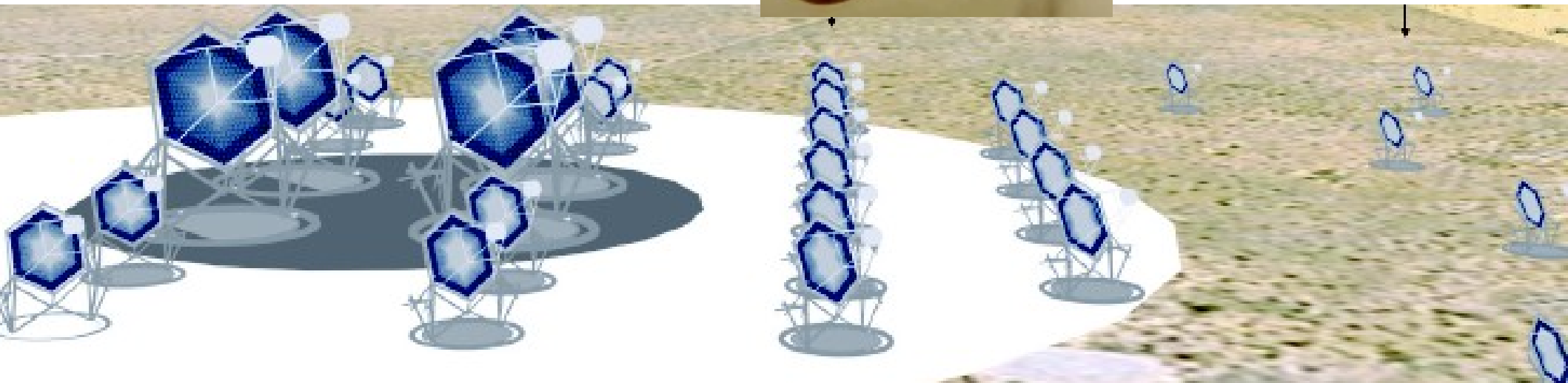
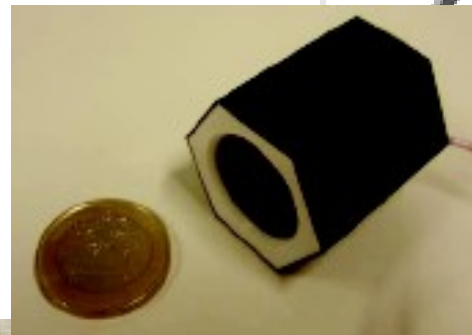
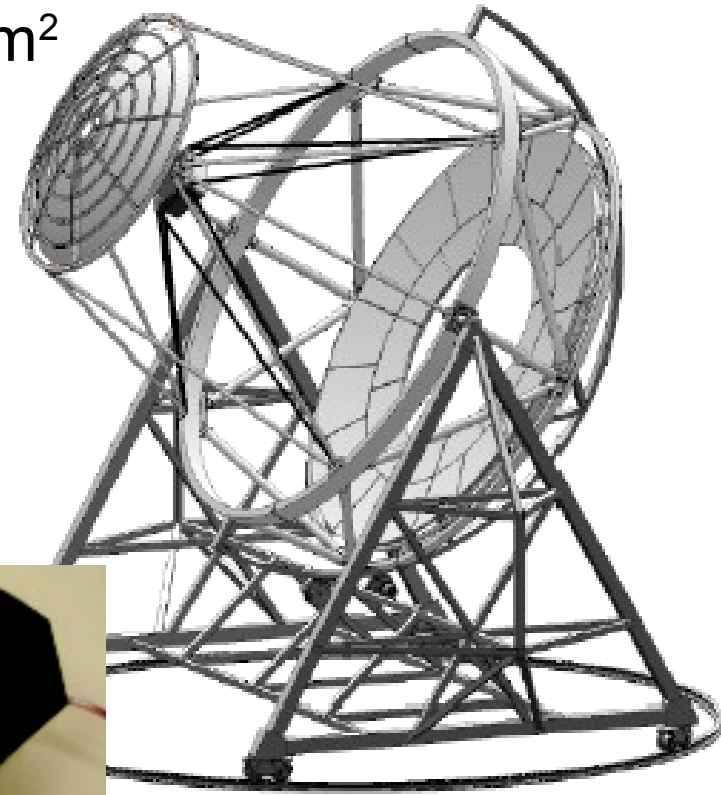
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- MAGIC
  - deuxième télescope opérationnel
- Veritas
  - déplacement de un télescope cet été
- HESS II
  - en construction



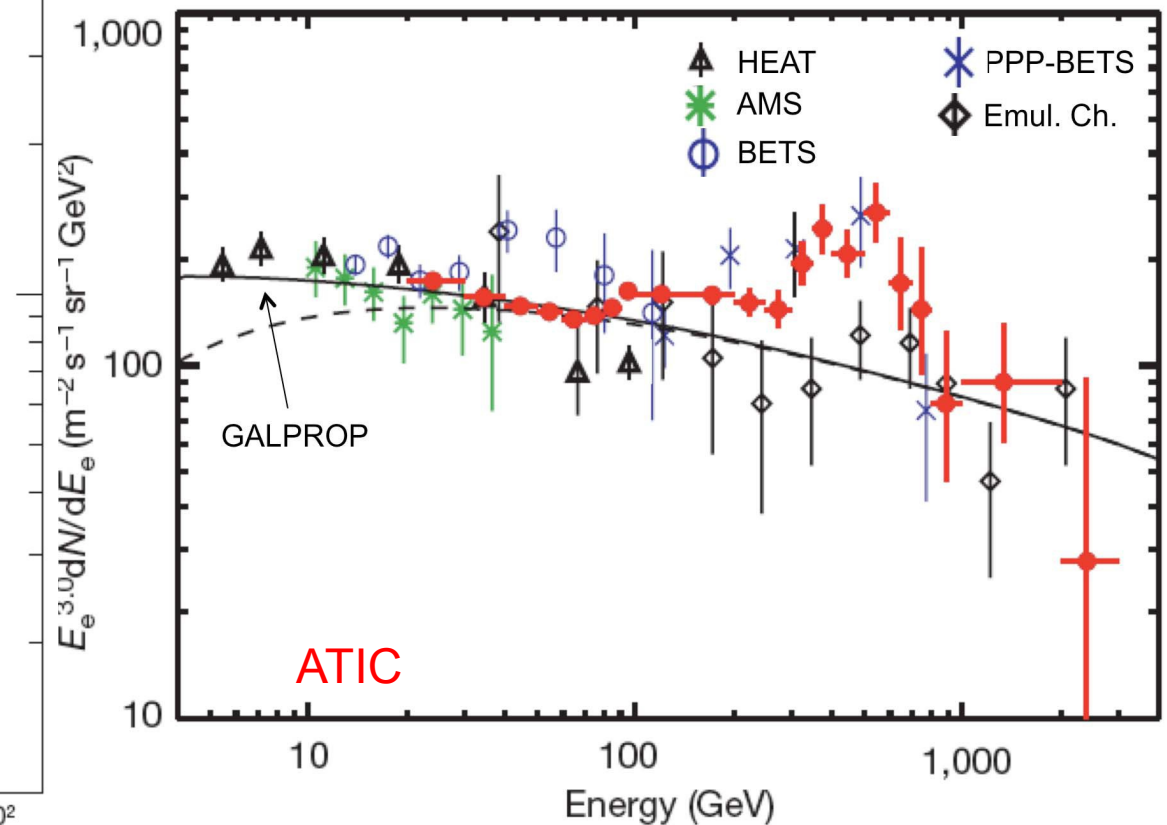
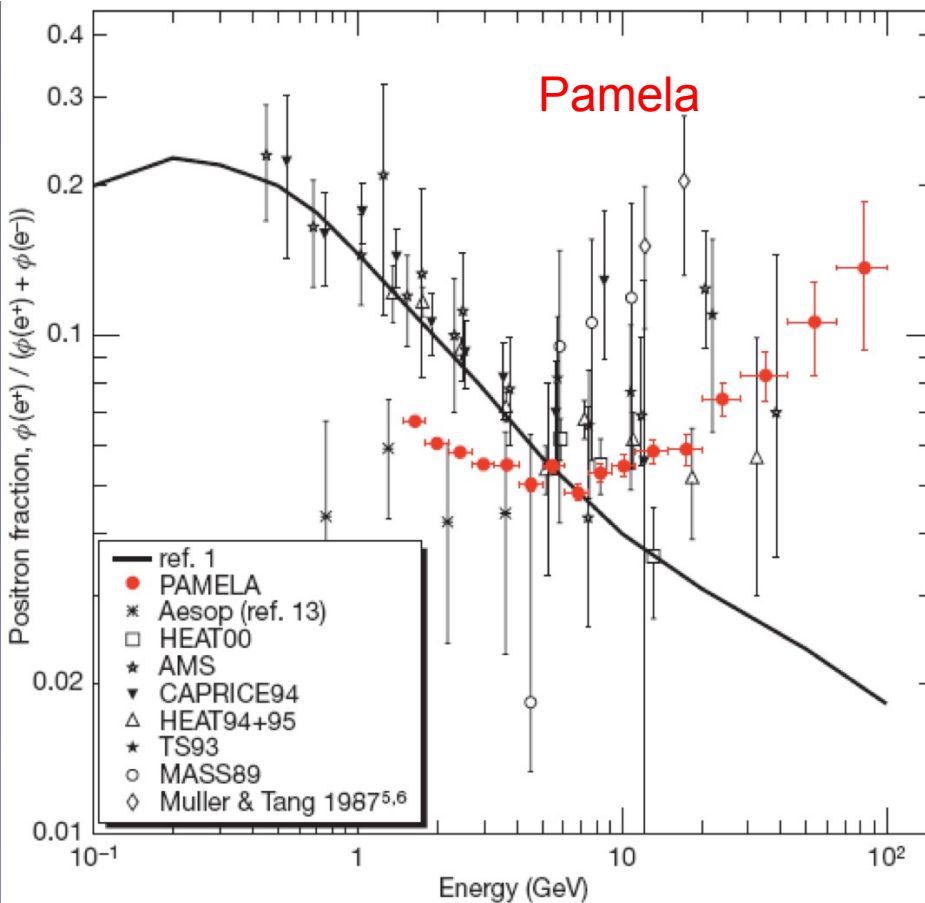
# le Futur

- telescope array sur grande surface  $\sim 10000 \text{ km}^2$
- CTA: Europe, AGIS: Etats-Unis
- AGIS nord / CTA sud?, collaboration possible
- AGIS design avec miroir secondaire (?)
- nouvel technique de camera avec photodiodes à avalanche?
- CTA début construction 2012?



# Pamela/ATIC Peak

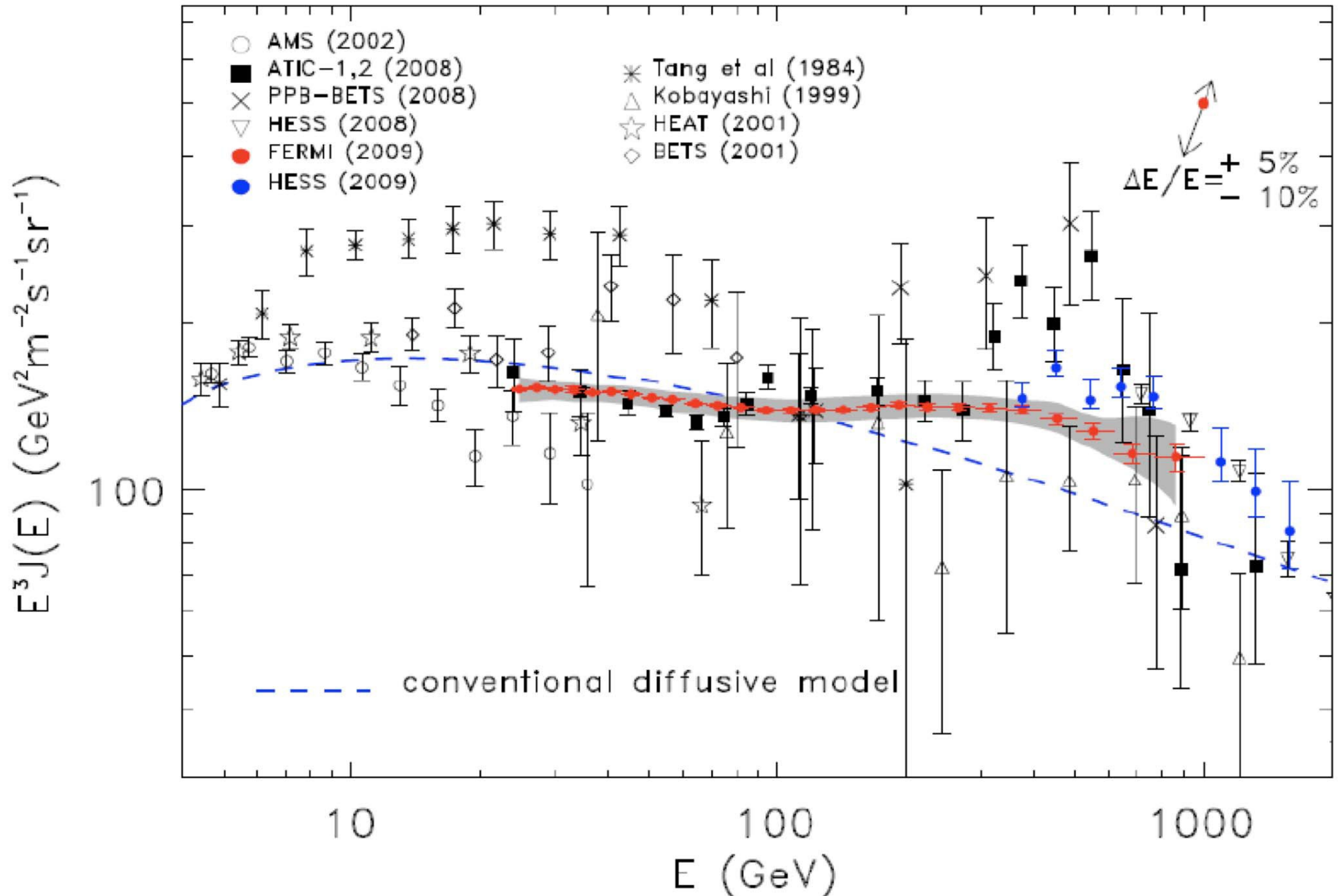
- augmentation de rapport positron/electron 10...100 GeV (Pamela)
- excès en flux  $e^-+e^+$  (ATIC)
- ne pas compatible avec les modèles simples d'émission diffuse galactique





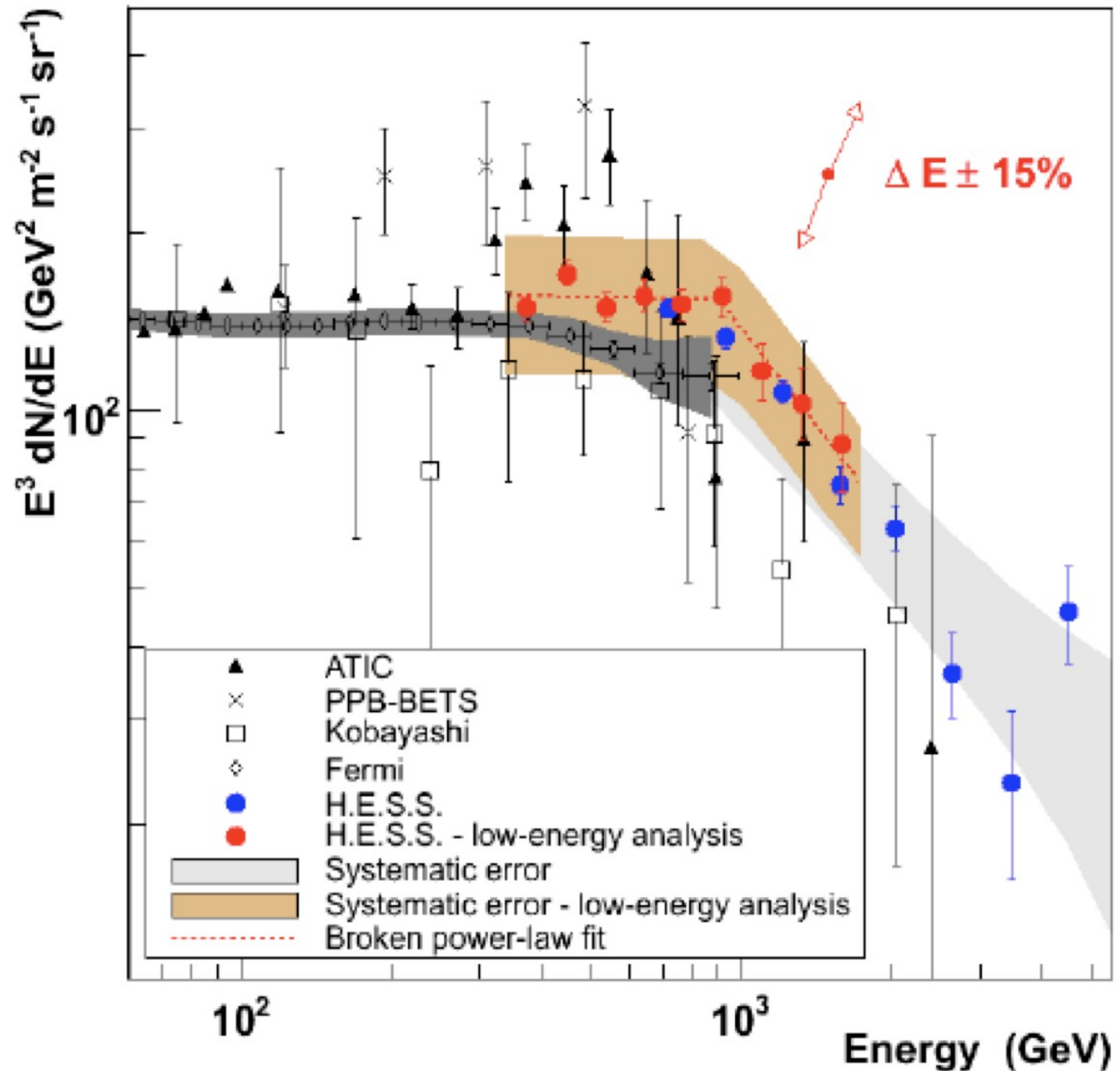
# ATIC Peak avec Fermi

- compatibilité avec ATIC? → résolution en énergie 15% vs. 3%



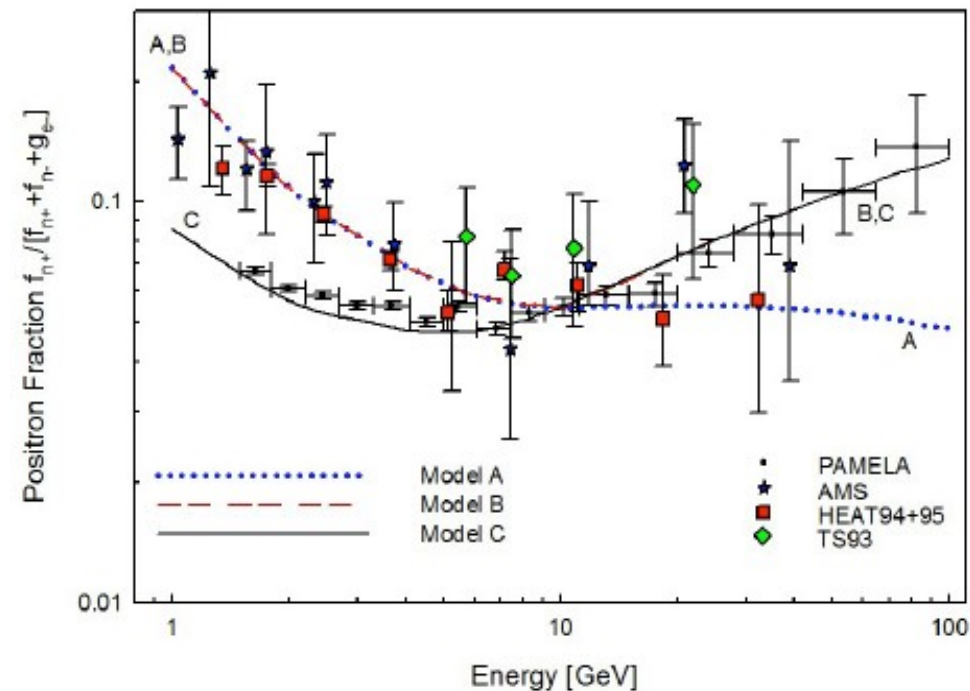
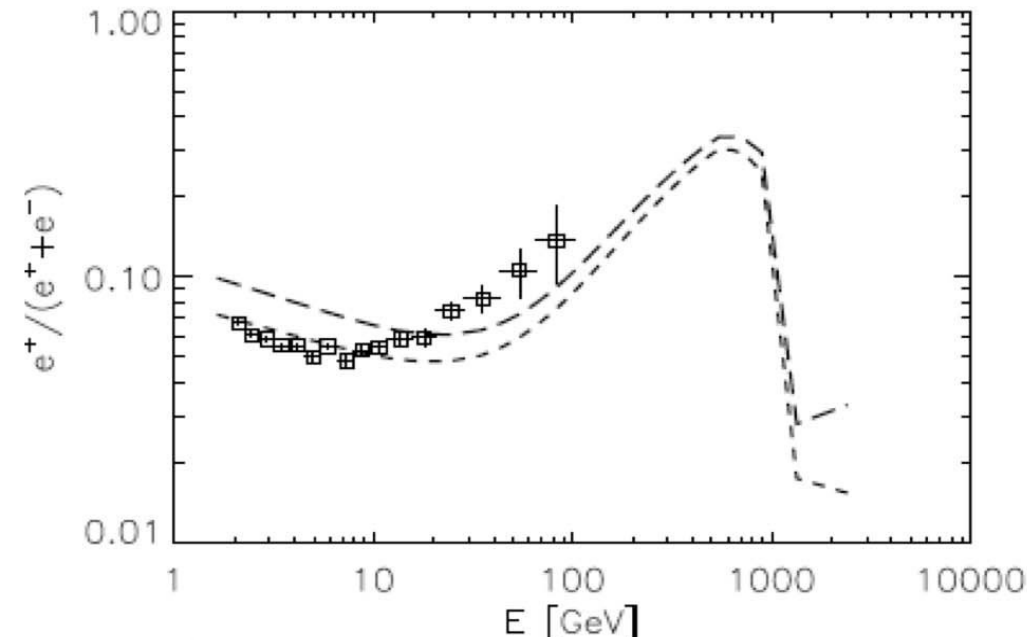
# ATIC Peak avec H.E.S.S.

- broken power law
- compatible avec Fermi et ATIC
- erreur systématique sur la normalisation



# Pamela/ATIC Peak – Théorie

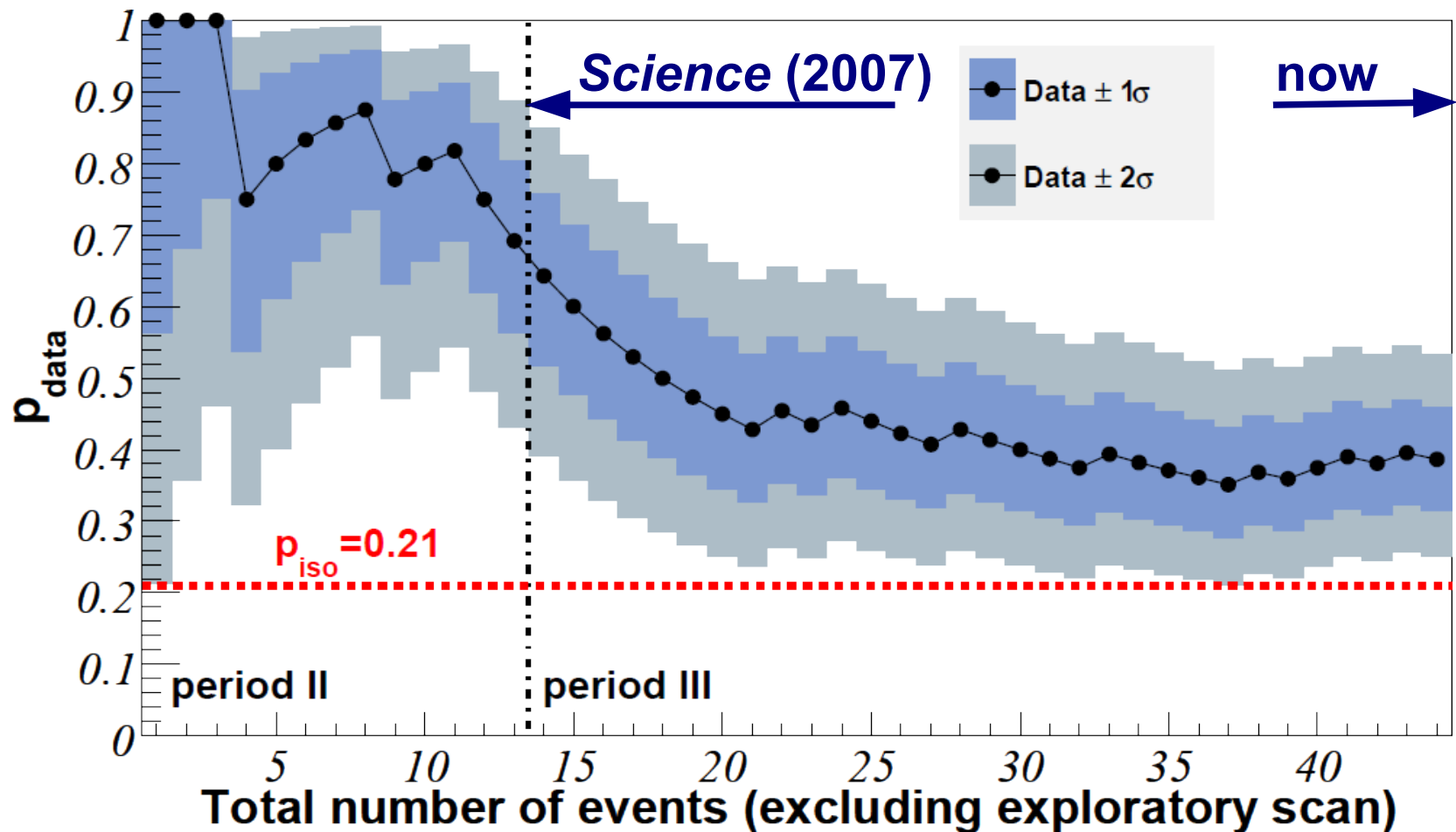
- pulsars et leur nébuleuses
  - sources proche de positrons
  - 2 pulsars proche
    - Monogem, Geminga
- propagation des Rayons Cosmiques
  - modèle préféré:
    - nested leaky box
- matière noire?
  - aucune présentation!!





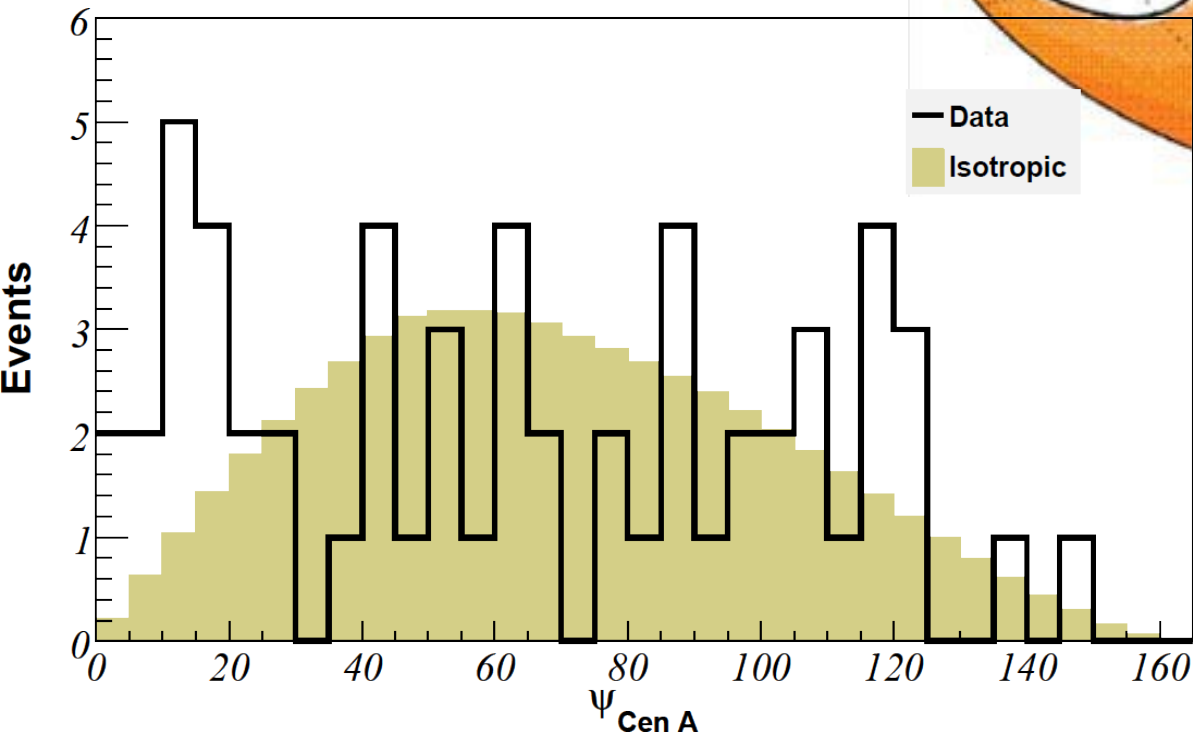
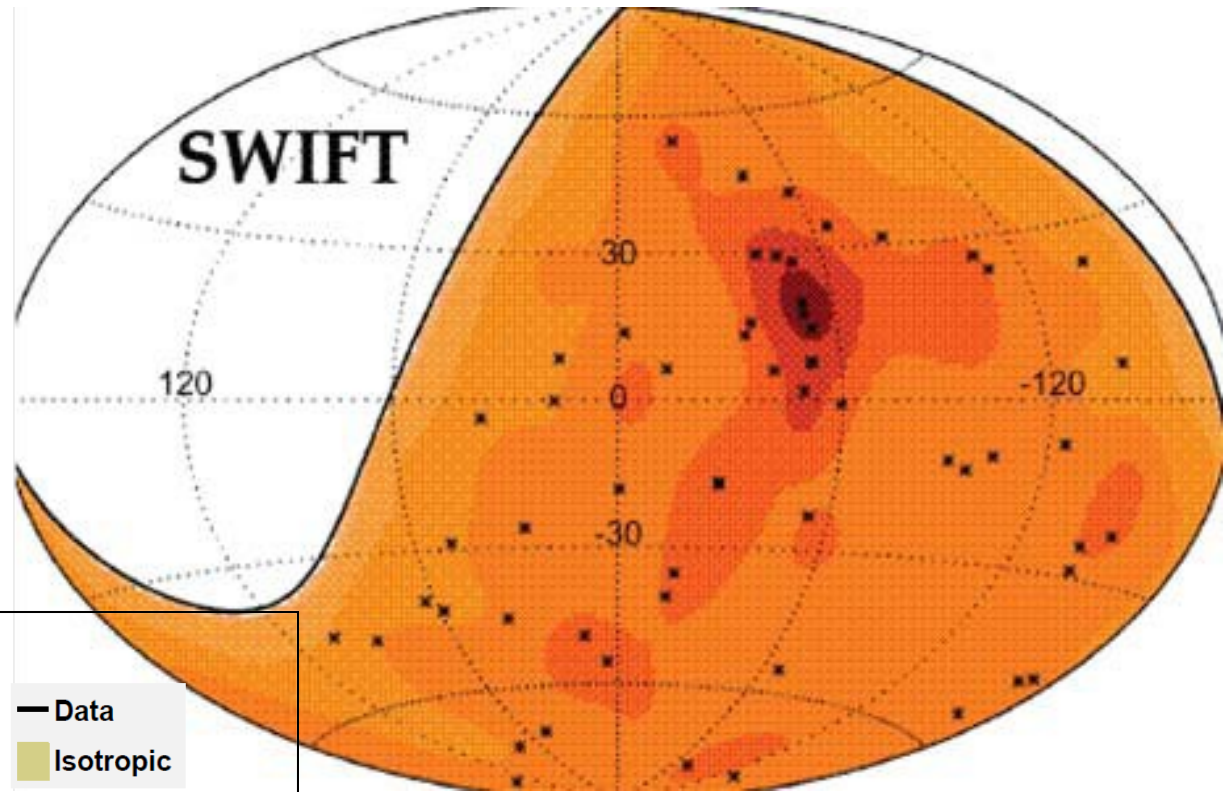
# AUGER – Les RC à énergie ultra-haute

- Rayons Cosmiques  $>55$  EeV ne sont pas isotropes
- corrélation avec catalogue Véron-Cetty&Véron (AGN, quasars) moins significatif
- VCV – le meilleur catalogue?



# AUGER – Sources des Rayons Cosmiques?

- corrélation avec autres catalogues:
  - SWIFT (261 Seyfert, AGN)
  - 2MRS (23000 galaxies)
  - HIPASS (3000 galaxies)
  - 2MASS

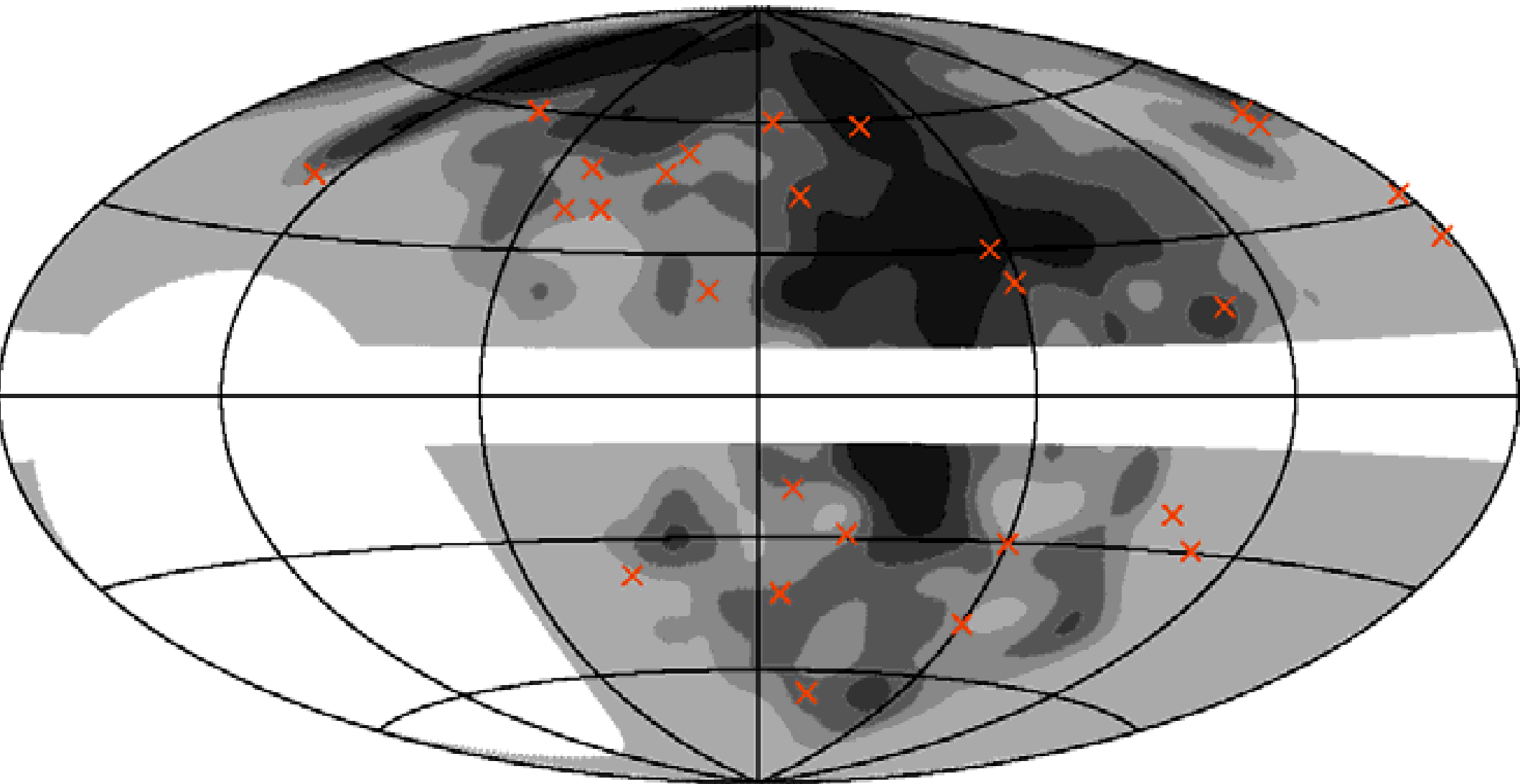


- excès pour Cen A
- 2% chance prob. pour isotropie

# HiRes – Sources des UHECR Nord?

---

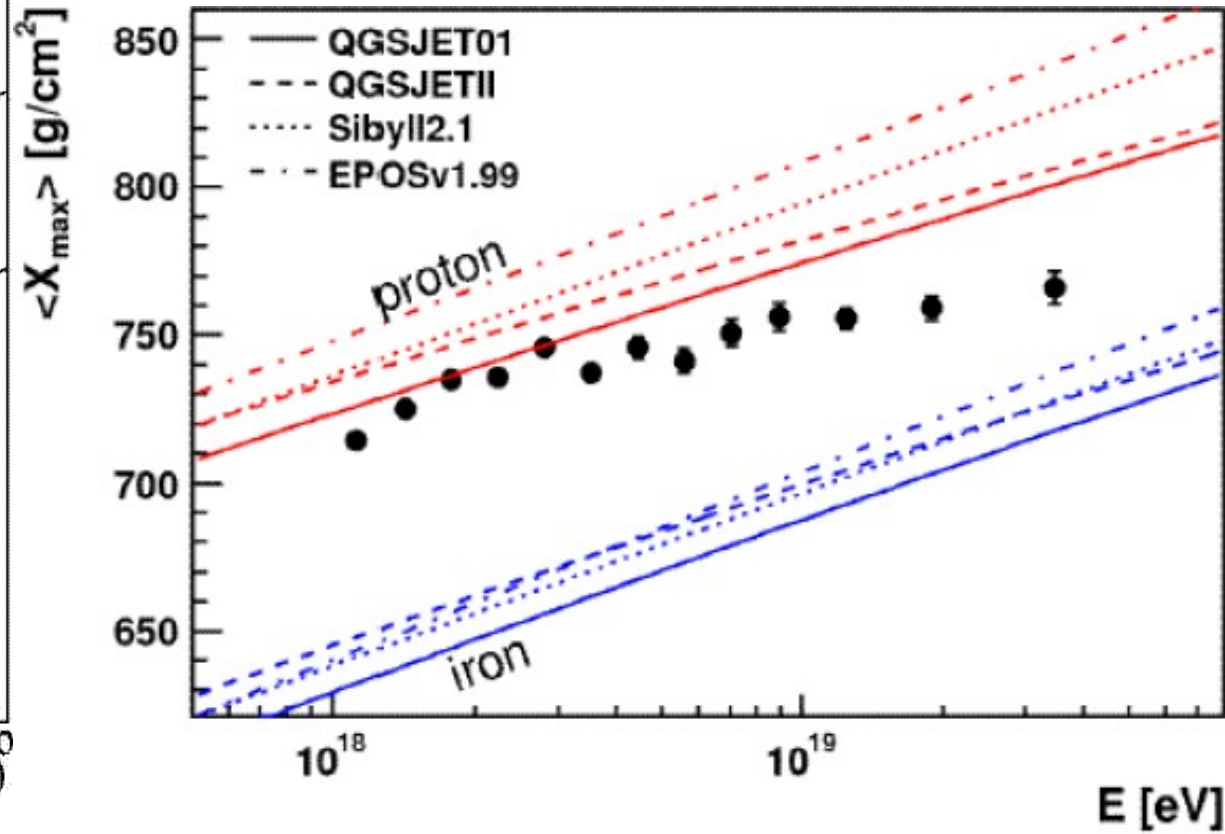
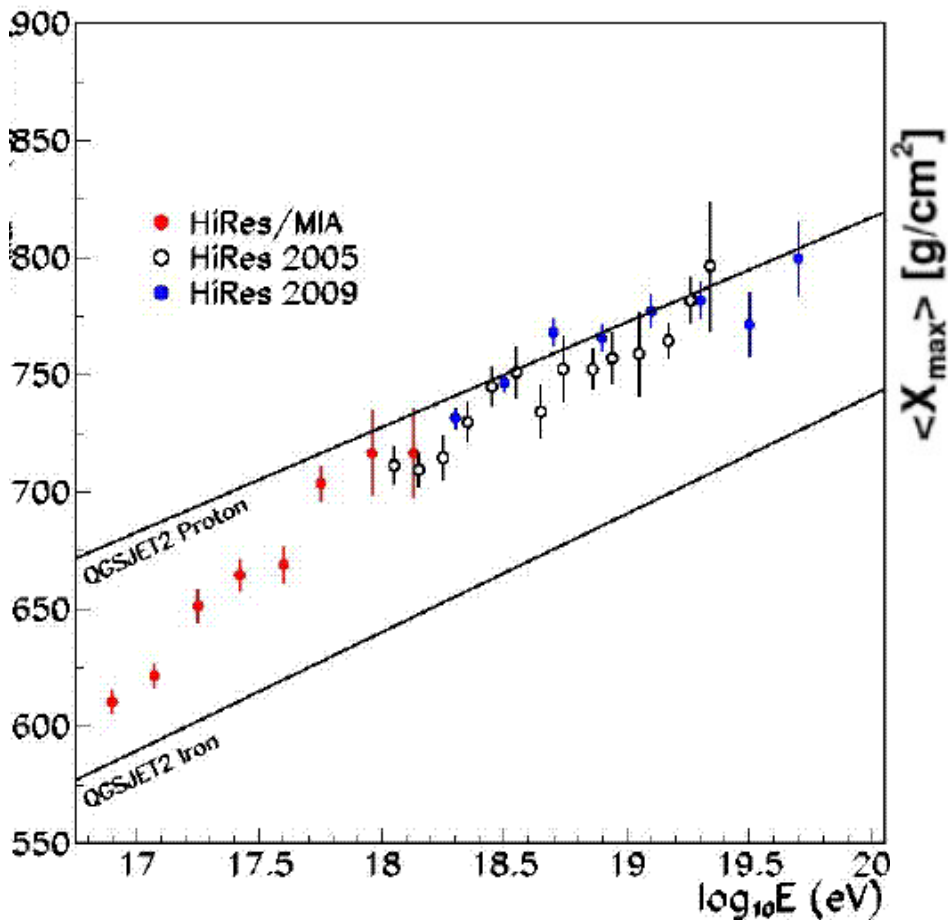
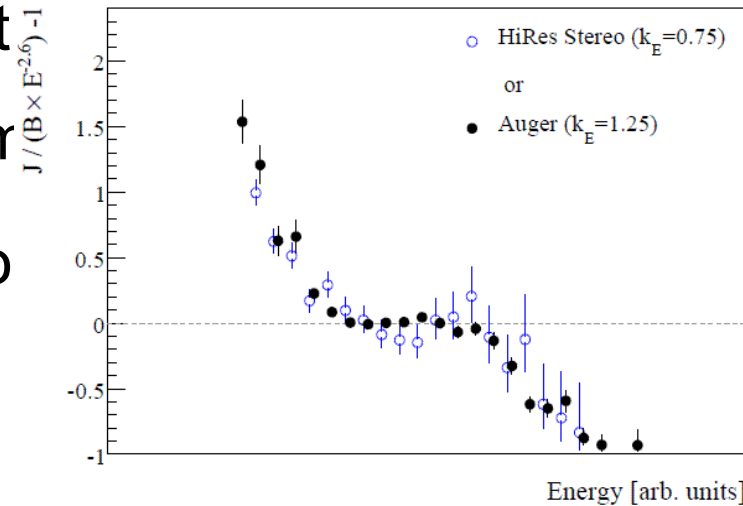
- fluorescence detector dans l'hémisphère nord
- corrélation avec 2MRS exclue 95% CL



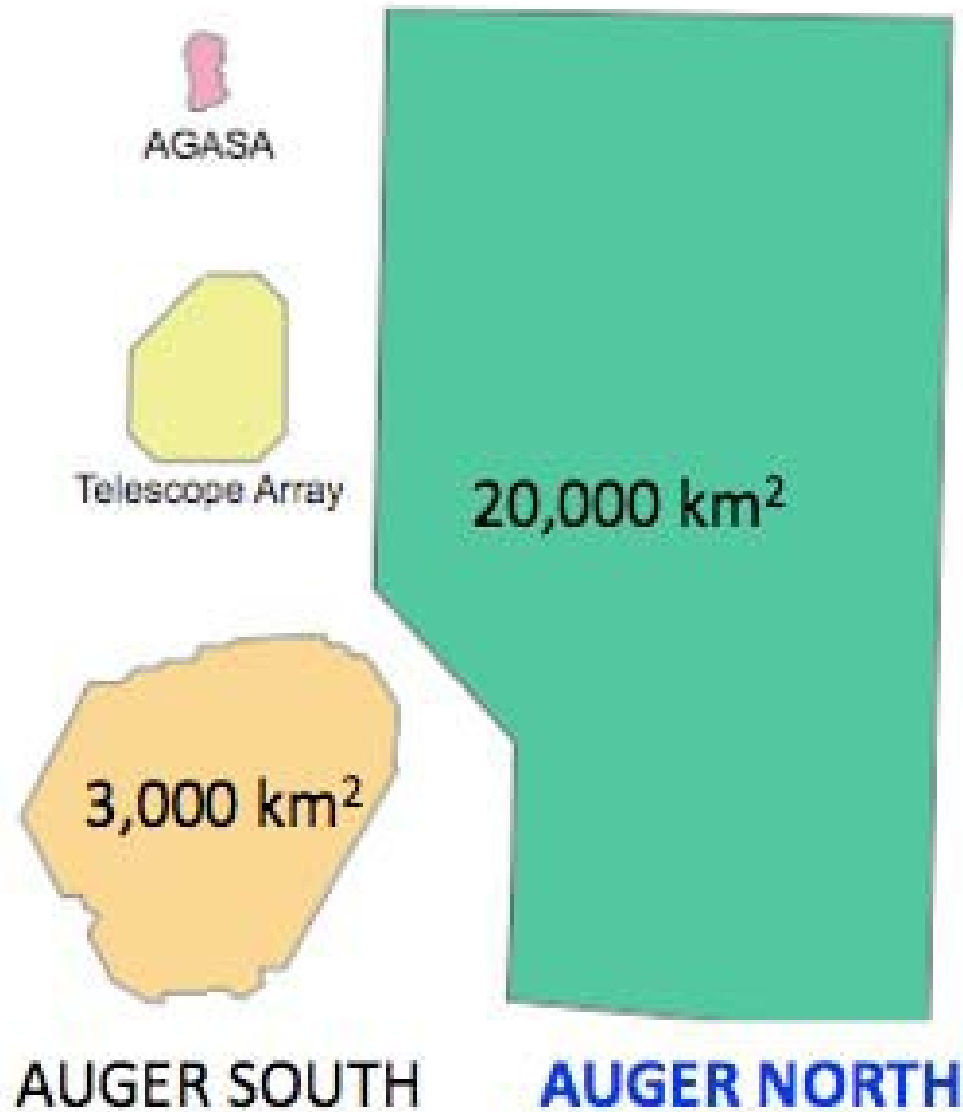


# UHECR – Composition GZK

- GZK détecté, systématique entre AUGER et
- composition mesuré par le shower maximum
- HiRes: proton, AUGER: transition vers les io
- **différence significative des hémisphères?**



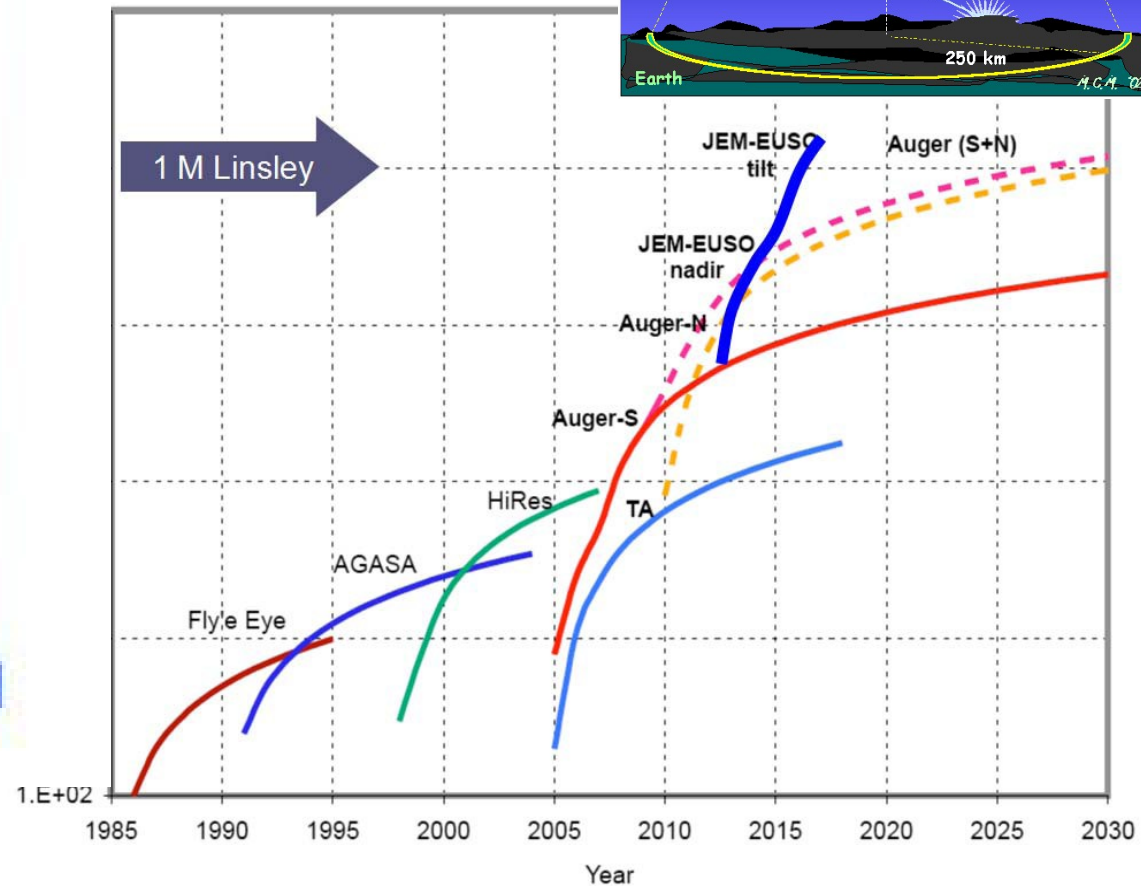
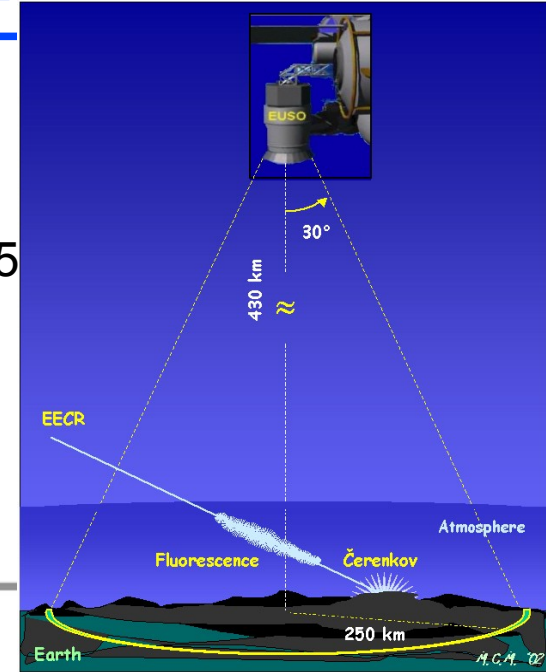
# Future: Plus grand et dans l'espace



## JEM-EUSO

sur ISS

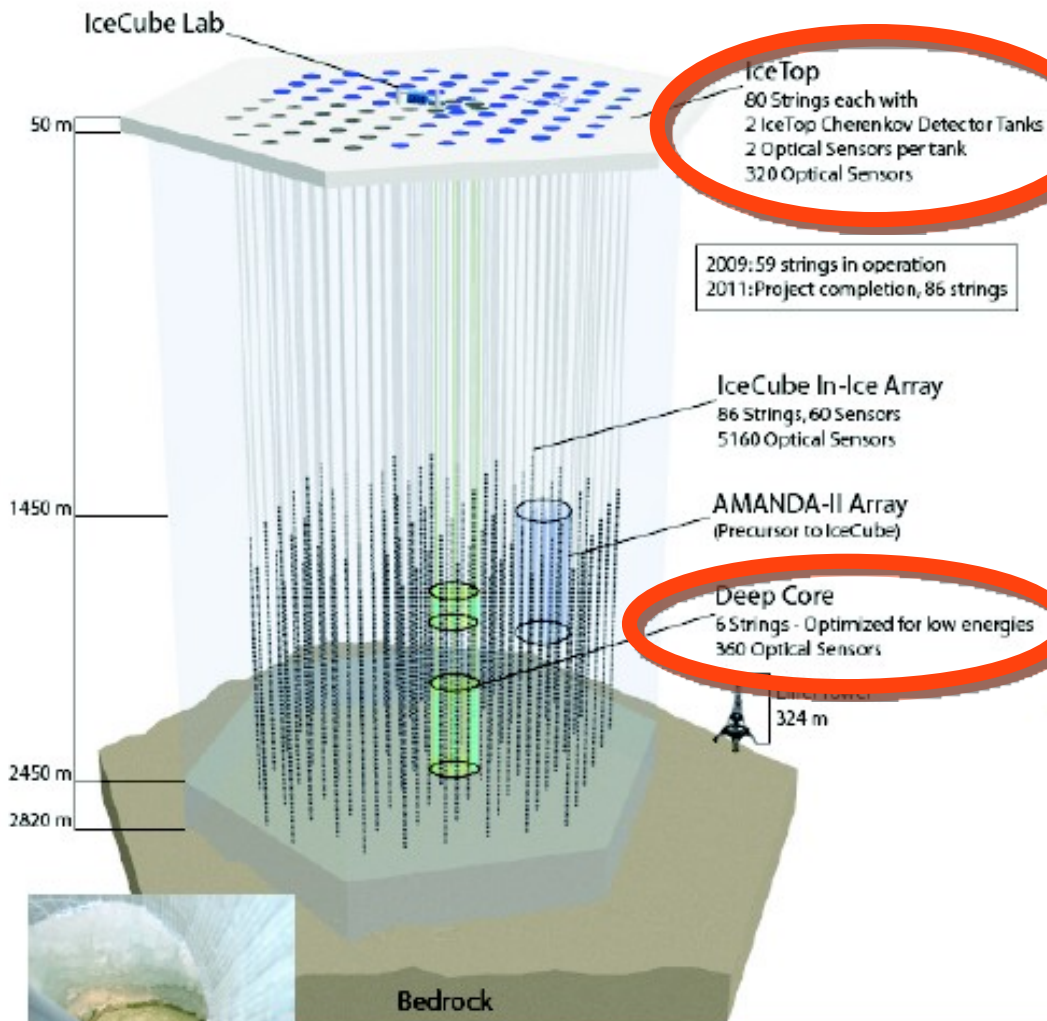
lancement 2013-2015



Karle HL talk  
 HE 2.2 atm neutrinos:  
 0466, 0785, 1311, 1336, 1418  
 HE 2.3 DM: 0834, 1356  
 OG 2.5 (Deep Core & reco) 0708, 1237, 1352

# IceCube and ANTARES

OG 2.5 (reco, DAQ, R&D, Callb) 0239  
 0315, 0471, 1045  
 OG 2.7 0178, 1184 (callb)  
 HE 2.3 (DM) 0031, 0695



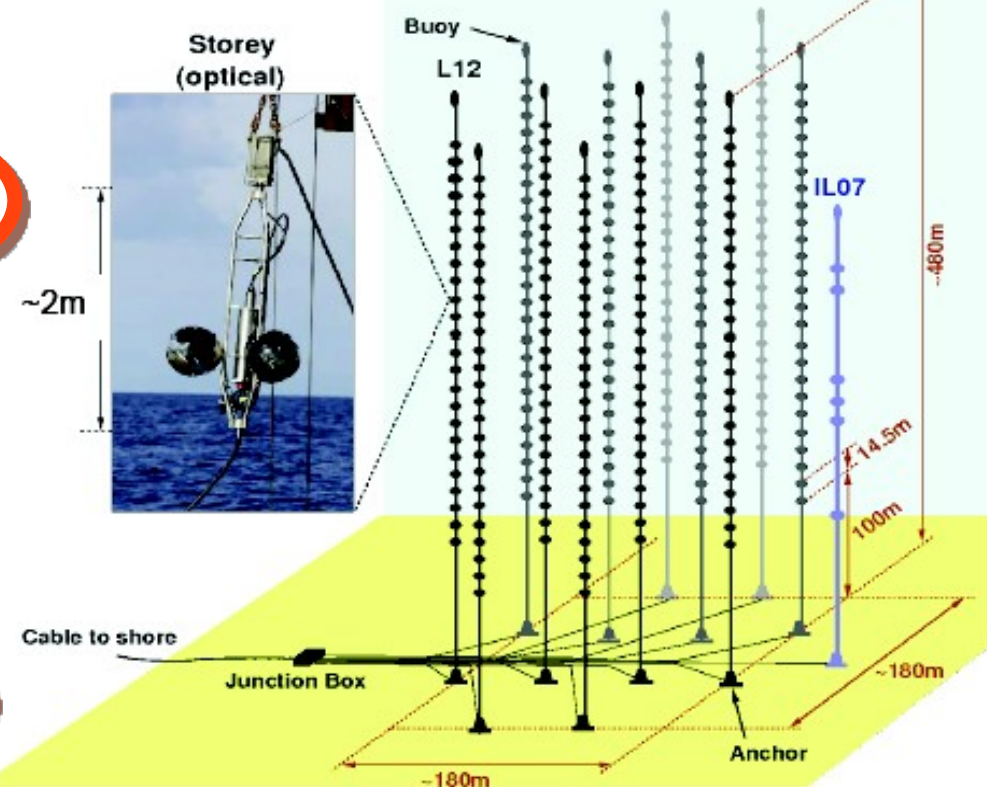
**IceTop**  
 80 Strings each with  
 2 IceTop Cherenkov Detector Tanks  
 2 Optical Sensors per tank  
 320 Optical Sensors

2009: 59 strings in operation  
 2011: Project completion, 86 strings

IceCube In-Ice Array  
 86 Strings, 60 Sensors  
 5160 Optical Sensors

AMANDA-II Array  
 (Precursor to IceCube)

**Deep Core**  
 6 Strings - Optimized for low energies  
 360 Optical Sensors



12 lines with 25 storeys each; total of 884 PMTs  
 2.5 km deep, 40 km offshore  
 First lines in 2006, **completed 30 May, 2008**

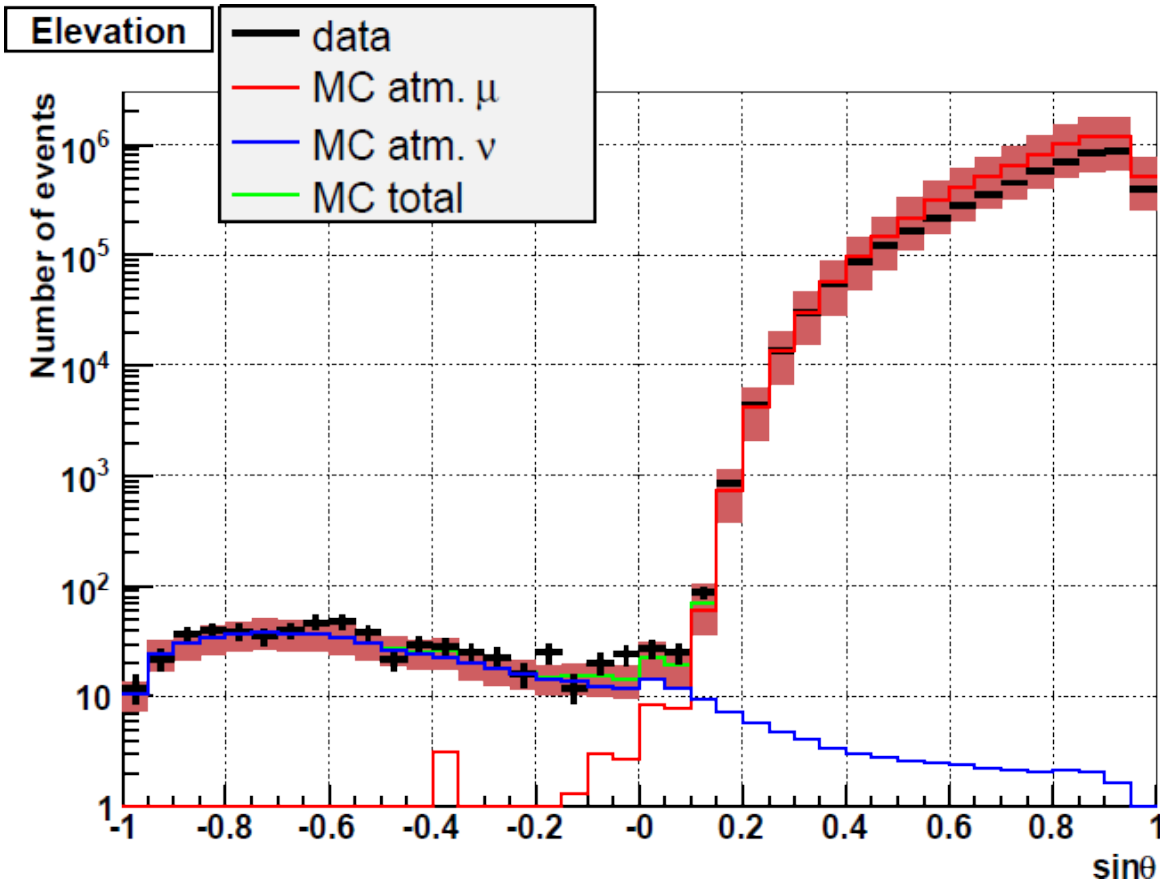


85 strings, 60 OMs/string  
 17 m between OMs, 125 m between strings  
 IceTop: 80 stations of 2 tanks with 2 modules

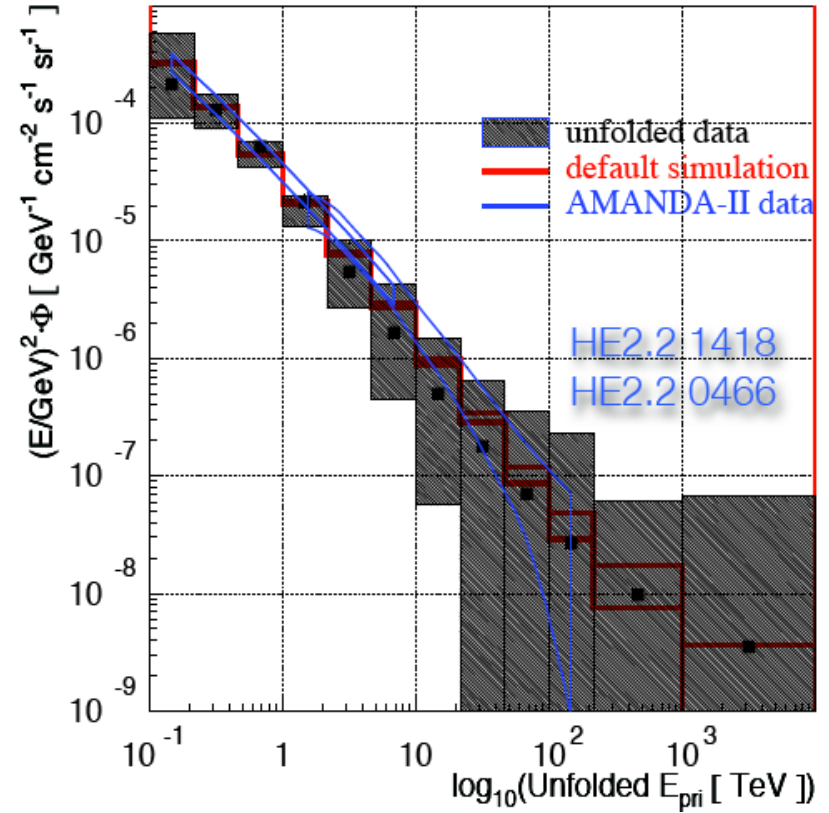




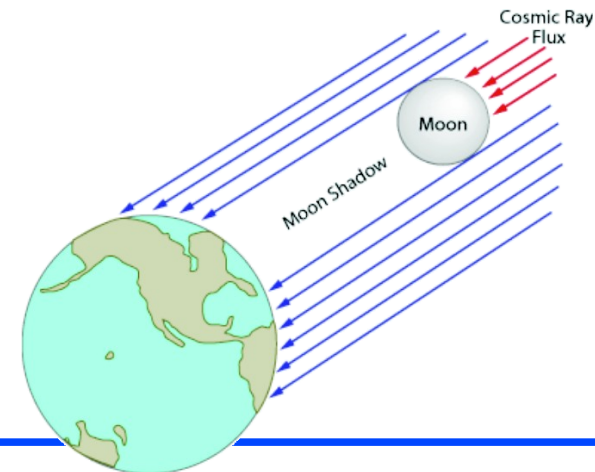
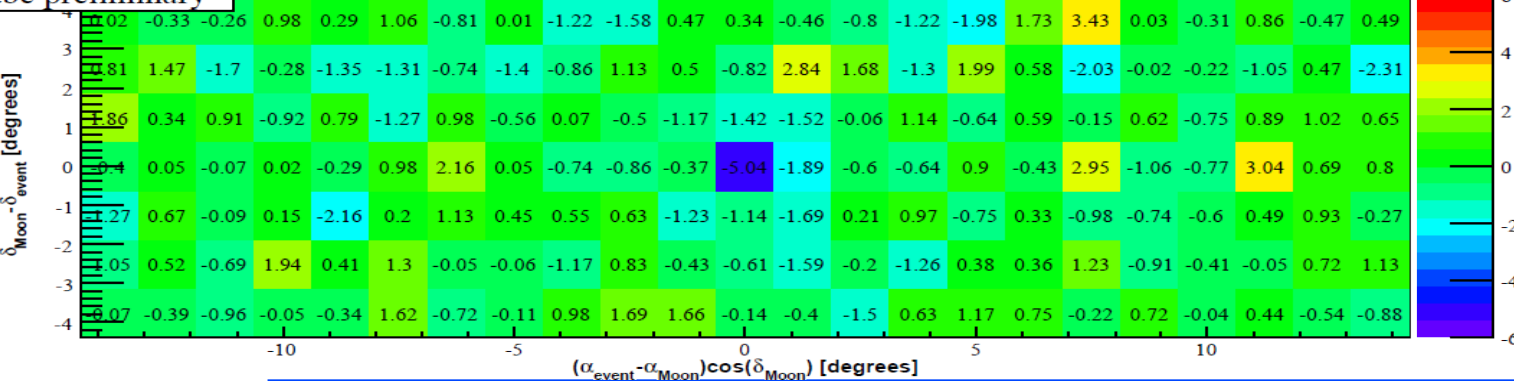
# Atmospheric Neutrinos



Main systematic error: ice vs depth  
4492 events at SBM=1.2



be preliminary





# Supernova Neutrinos

- **IceCube**

- $10^5$  événements de un SN à 10kpc

- 5 sigma de LMC

- ToO programs

- nu / optique

- IceCube/ROTSE

- Antares/TAROT

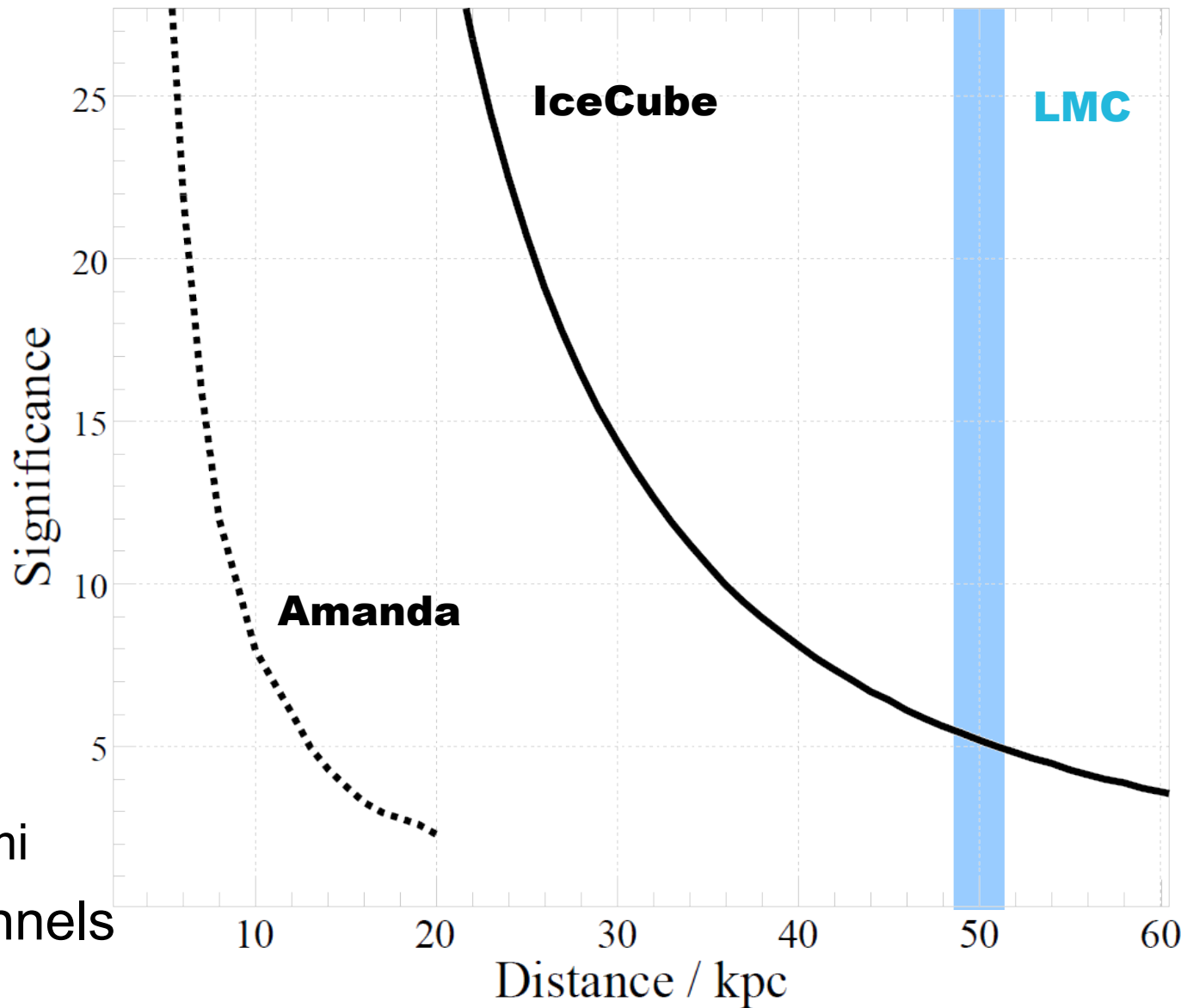
- nu / gamma

- IceCube/  
MAGIC, Veritas, Fermi

- nu / ondes gravitationnels

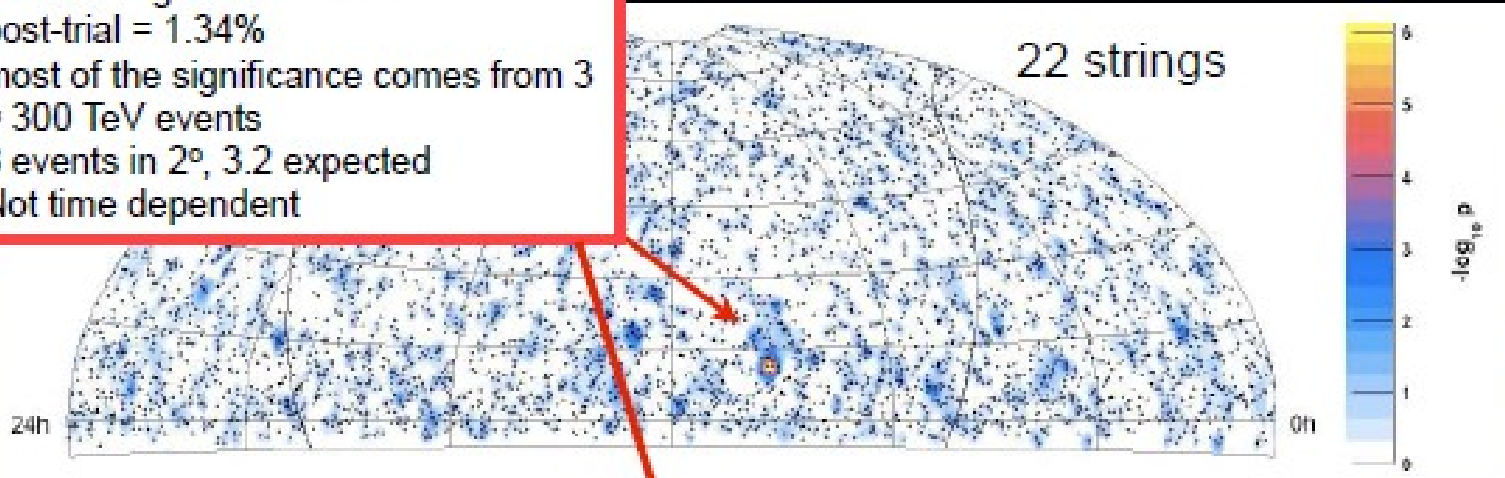
- Antares/VIRGO

- IceCube / LIGO



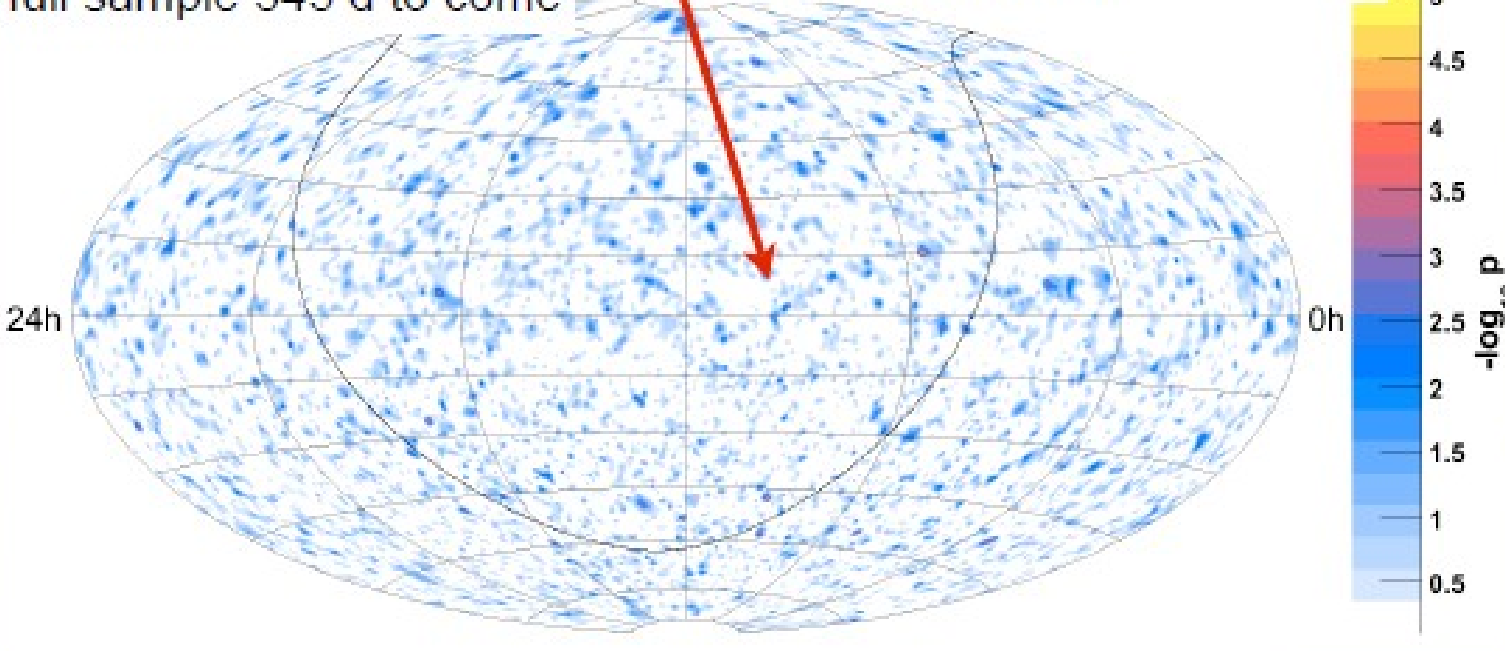
# IceCube Sky Maps

nsrc = 7.7 gamma = -1.65  
 post-trial = 1.34%  
 most of the significance comes from 3  
 ≈ 300 TeV events  
 8 events in 2°, 3.2 expected  
 Not time dependent



40 strings/175.5 d  
 full sample 345 d to come

Hot spot in IC40 3 events < 2°  
 Bkg expected events: 4.7



Neutrino Flux needed  
 for this significance  
 ( $\text{TeV}^{-1} \text{cm}^{-2} \text{s}^{-1}$ )

$E^{-2} \quad 2.2 \times 10^{-11}$   
 $E^{-1.65} \quad 3.6 \times 10^{-12}$

5114 events/276 days  
 = 18  $\nu$  events/day

arXiv:0905.2253

17777 events/175.5 d in  
 the map

6796 up-going  $\nu$  events  
 = 39/day  
 10981 high energy  
 down-going atm muons

False Discovery Risk  
 minimized by usage of  
 scrambled data samples

Neutrino telescopes FoV extended to full sky

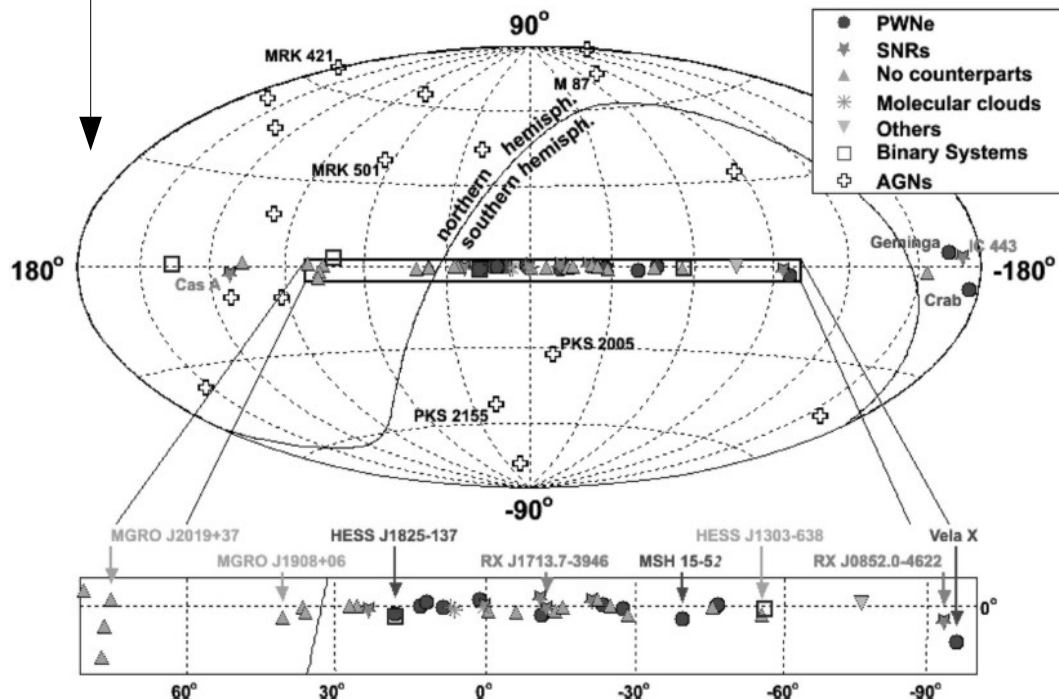
OG2.5 0653

# Neutrinos des Sources Galactiques

- hémisphère sud
- Antares search for point sources
- IceCube Deep Core
  - neutrinos à basse energie (1TeV)
  - down-going, veto par IceCube



Source name	$\delta$ ( $^{\circ}$ )	RA ( $^{\circ}$ )	P-value	$\phi_{90}$
PSR B1259-63	-63.83	195.70	1	3.1
RCW 86	-62.48	220.68	1	3.3
ESO 139-G12	-59.94	264.41	1	3.4
HESS J1023-575	-57.76	155.83	0.004	7.6
CIR X-1	-57.17	230.17	1	3.3
HESS J1614-518	-51.82	243.58	0.088	5.6
PKS 2005-489	-48.82	302.37	1	3.7
GX 339	-48.79	255.70	1	3.8
RX J0852.0-4622	-46.37	133.00	1	4.0
Centaurus A	-43.02	201.36	1	3.9
RX J1713.7-3946	-39.75	258.25	1	4.3
PKS 0548-322	-32.27	87.67	1	4.3
H 2356-309	-30.63	359.78	1	4.2
PKS 2155-304	-30.22	329.72	1	4.2
Galactic Centre	-29.01	266.42	0.055	6.8
1ES 1101-232	-23.49	165.91	1	4.6
W28	-23.34	270.43	1	4.8
LS 5039	-14.83	276.56	1	5.0
1ES 0347-121	-11.99	57.35	1	5.0
HESS J1837-069	-6.95	279.41	1	5.9
3C 279	-5.79	194.05	0.030	9.2
RGB J0152+017	1.79	28.17	1	7.0
SS 433	4.98	287.96	1	7.3
HESS J0632+057	5.81	98.24	1	7.4
IC22 hotspot	11.00	153.00	1	9.1





# Conclusion

- Astronomie Gamma
  - 4 array Cherenkov opérationnel
  - nouvel vu sur l'extragalactique
  - Fermi ~1 ans de données
  - pulsars, diffuse, SNR, ...
- Pamela/ATIC peak reste intéressant
  - résultats par Fermi et HESS
- UHECR
  - anisotrope, corrélé avec des catalogues
  - hémisphère nord et sud différent?
- Neutrinos
  - Antares opérationnel, IceCube 86%
  - neutrinos cosmiques en 2011?



**Beijing 2011**



*IRIS Photo Gallery*