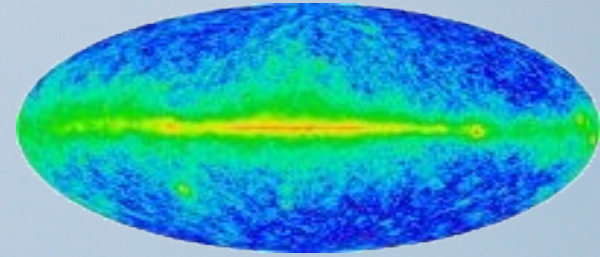


# The Fermi Gamma Ray Space Telescope (formerly GLAST)

**Christine Meurer**

*on behalf of  
the Fermi LAT collaboration*

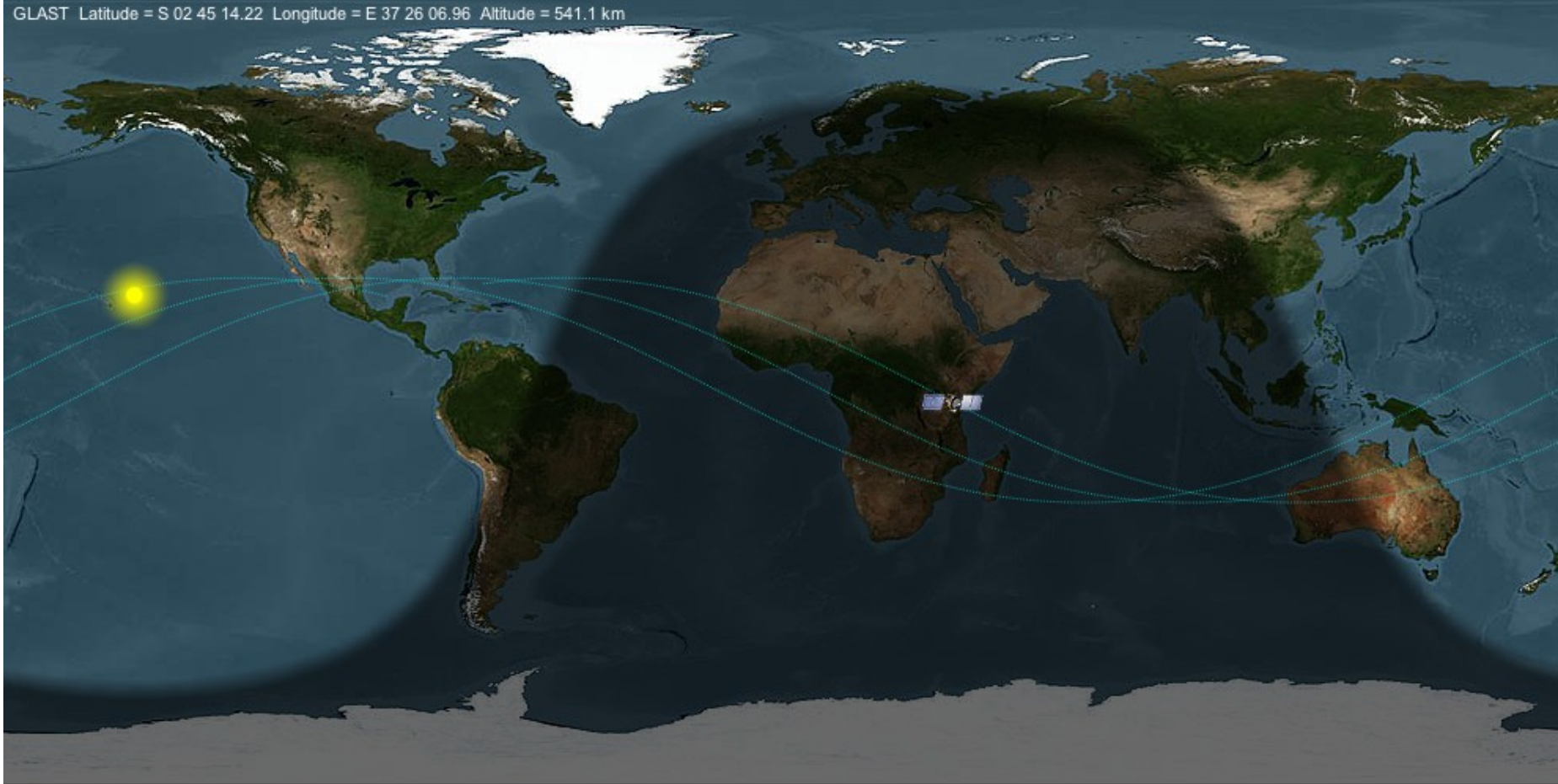


**Launched on June 11th, 2008**



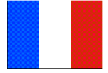
# Fermi's Orbit

GLAST Latitude = S 02 45 14.22 Longitude = E 37 26 06.96 Altitude = 541.1 km

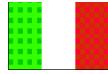


<http://observatory.tamu.edu:8080/Trakker/>

**Circular orbit, 565 km altitude (96 min period), 25.6 deg inclination**



**France:** IN2P3, CEA/Saclay



**Italy:** Universities and INFN of Bari, Perugia, Pisa, Roma Tor Vergata, Trieste, ASI, INAF



**Japan:** Hiroshima University, ISAS, RIKEN



**United States:** CSU Sonoma, UC Santa Cruz, Goddard, NRL, OSU, Stanford (SLAC and HEPL), Washington, St. Louis



**Sweden:** Royal Institute of Technology (KTH), Stockholm University, Kalmar University

Principal Investigator:

Peter Michelson (Stanford & SLAC)

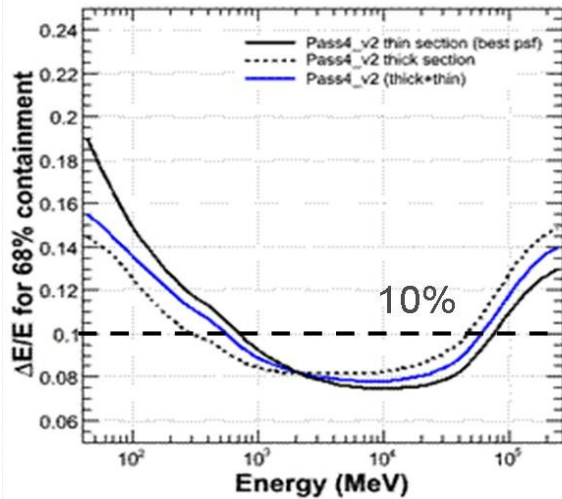
~270 Members

(includes ~90 Affiliated Scientists, 37 Postdocs,  
and 48 Graduate Students)

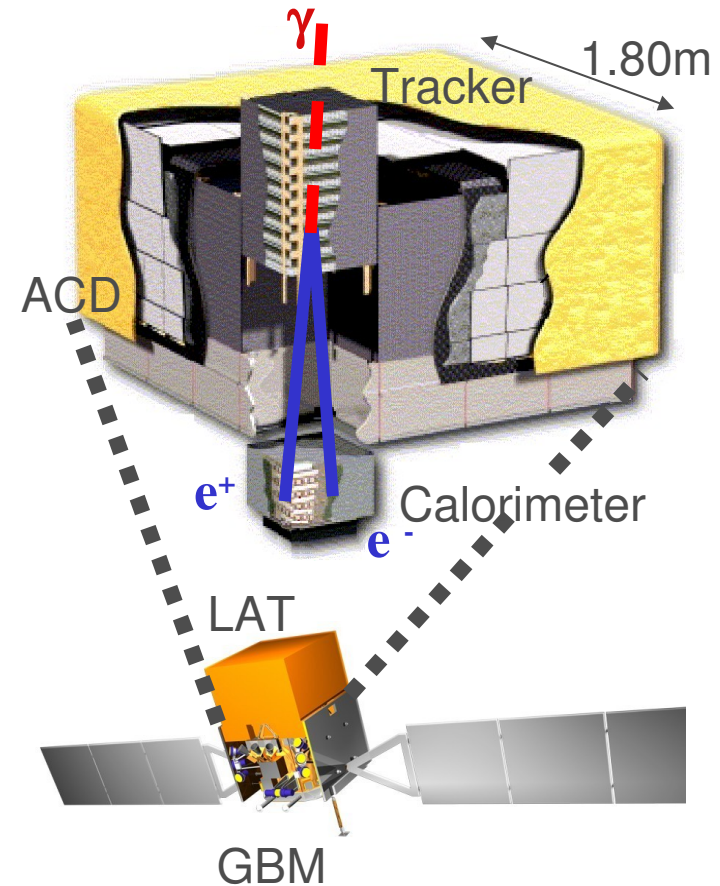
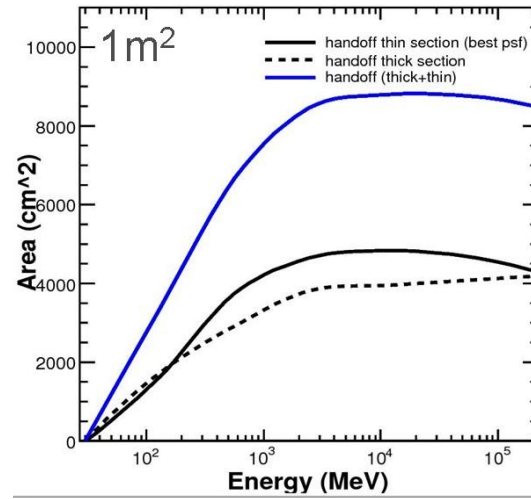
- Grant from the Wallenberg foundation KAW (20 MSEK, Bergström, Carlson, Svensson) providing the full set of CsI crystals for the calorimeter (1999), subsequently testing and qualification of the crystals (Bergenius et al., -2005)
- Today:
  - *Leading role in Dark Matter working group*
  - *Active role in GRB working group*
  - *Multi-wavelength observations of AGN*
  - *Participation in instrument analysis and beam test*
  - *Participation in governing bodies of Fermi*

<ul style="list-style-type: none"> <li>- L. Bergström (DM theory)</li> <li>- S. Carius (DM exp)</li> <li>- P. Carlson (DM exp)</li> <li>- J. Conrad (DM exp)</li> <li>- J. Edsjö (DM theory)</li> <li>- S. Larsson (GRB/AGN)</li> <li>- A. Pohl (DM exp)</li> <li>- F. Ryde (GRB/AGN)</li> </ul>	<p><b>PostDocs:</b></p> <ul style="list-style-type: none"> <li>- S. McGlynn (GRB)</li> <li>- C. Meurer (DM exp)</li> </ul> <p><b>PhD students:</b></p> <ul style="list-style-type: none"> <li>- M. Battelino (GRB)</li> <li>- A. Sellerholm (DM exp/theory)</li> <li>- T. Ylinen (DM exp)</li> </ul>	<p>... plus students/ seniors working with related issues ...</p>
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## Excellent energy resolution

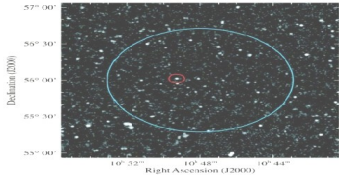


## Large effective area



- Broad energy range: 20MeV-300GeV
- Large field of view: 2.4sr, covers all sky in 2 orbits (3 hours)
- $\text{PSF}_{68\%} < 0.1^\circ$  at 10GeV

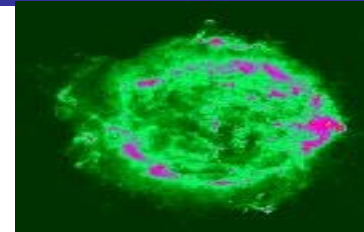
# The Science Goals of Fermi LAT



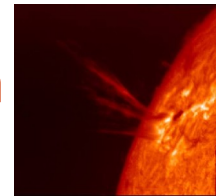
Unidentified  
sources



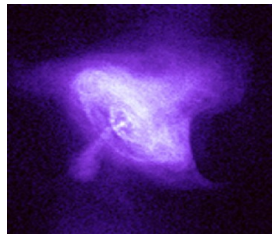
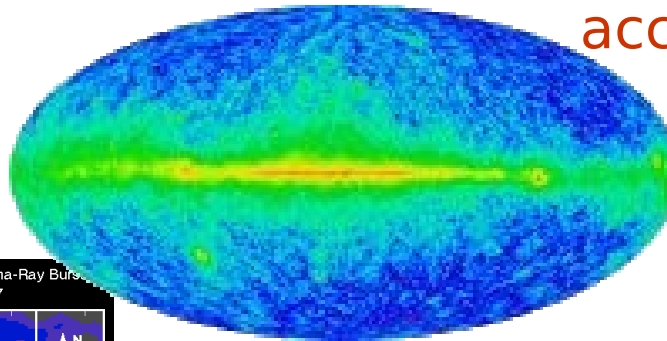
Active Galactic Nuclei



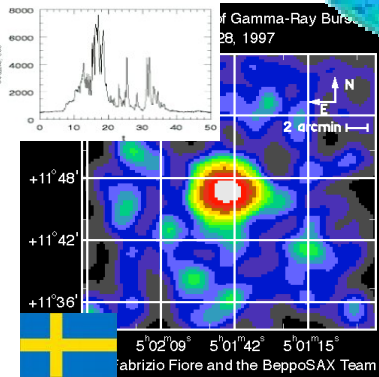
Cosmic ray  
acceleration



Solar flares

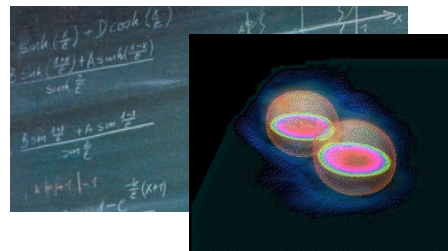


Pulsars

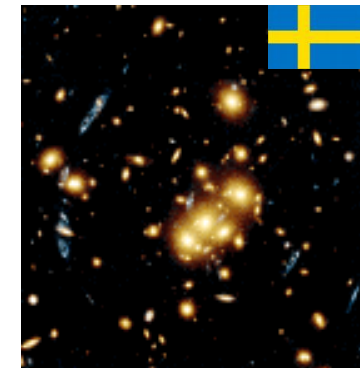


See Sinead's talk

at 14:40 Gamma Ray Bursts



Strange Quark  
Matter ?



Dark matter

0.01 GeV

0.1 GeV

1 GeV

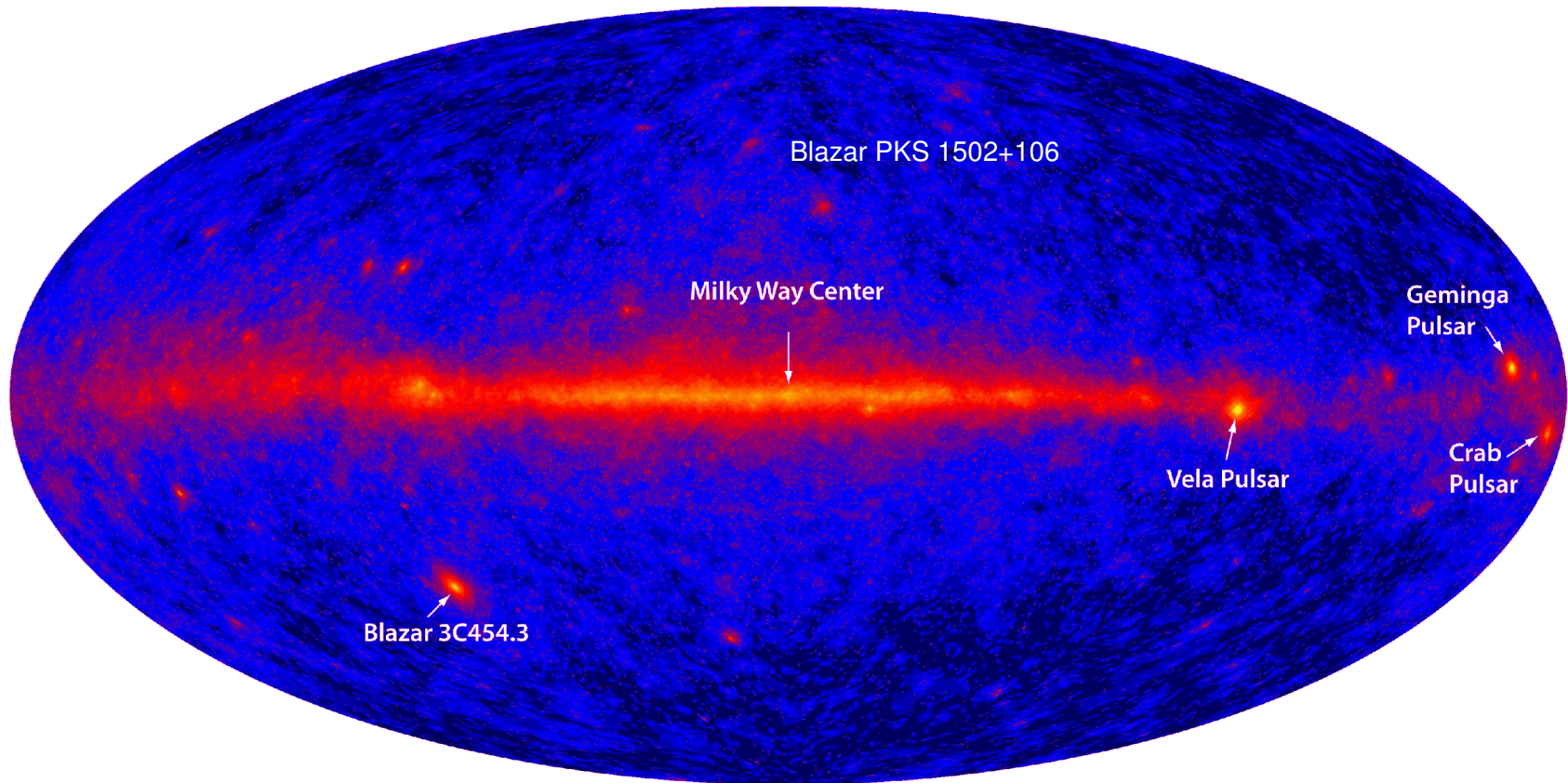
10 GeV

100 GeV

1 TeV

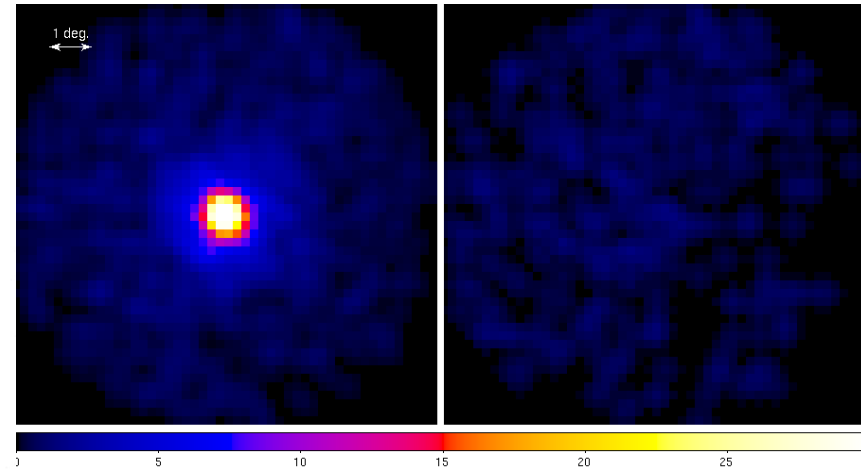
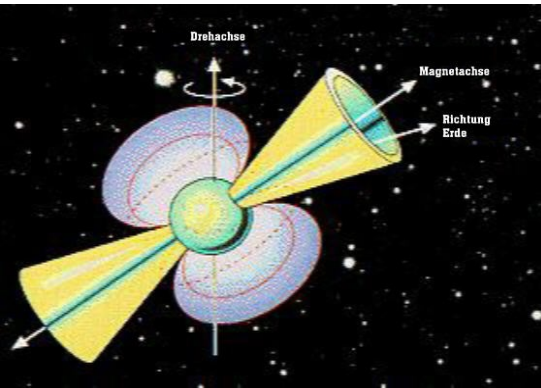
# First Light SkyMap – 95 hrs

Equivalent to EGRET's first year!

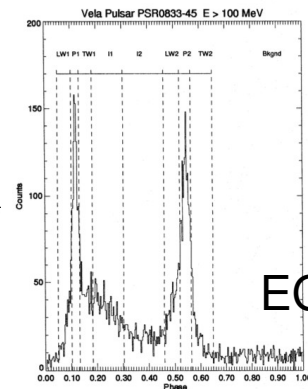
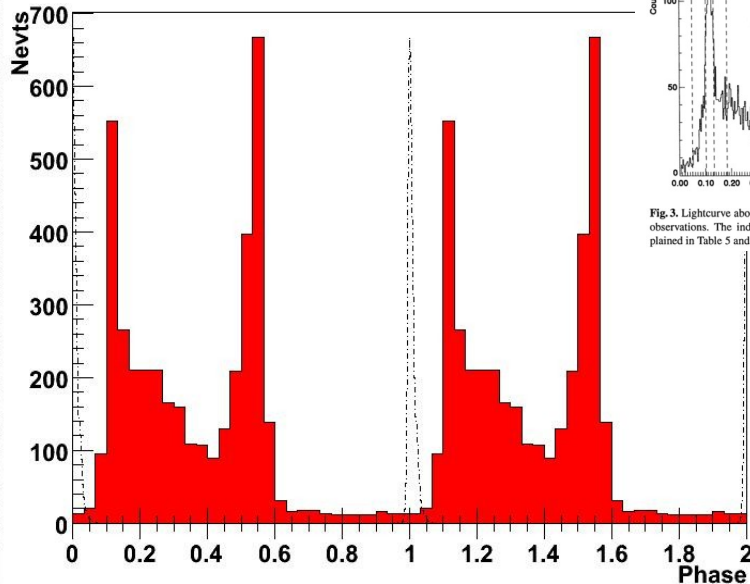


not exposure corrected

# The Vela Pulsar: PSR 0833-45



Fermi: light curve of Vela



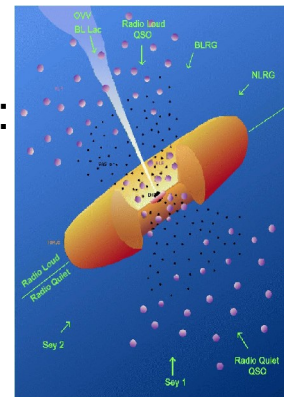
EGRET

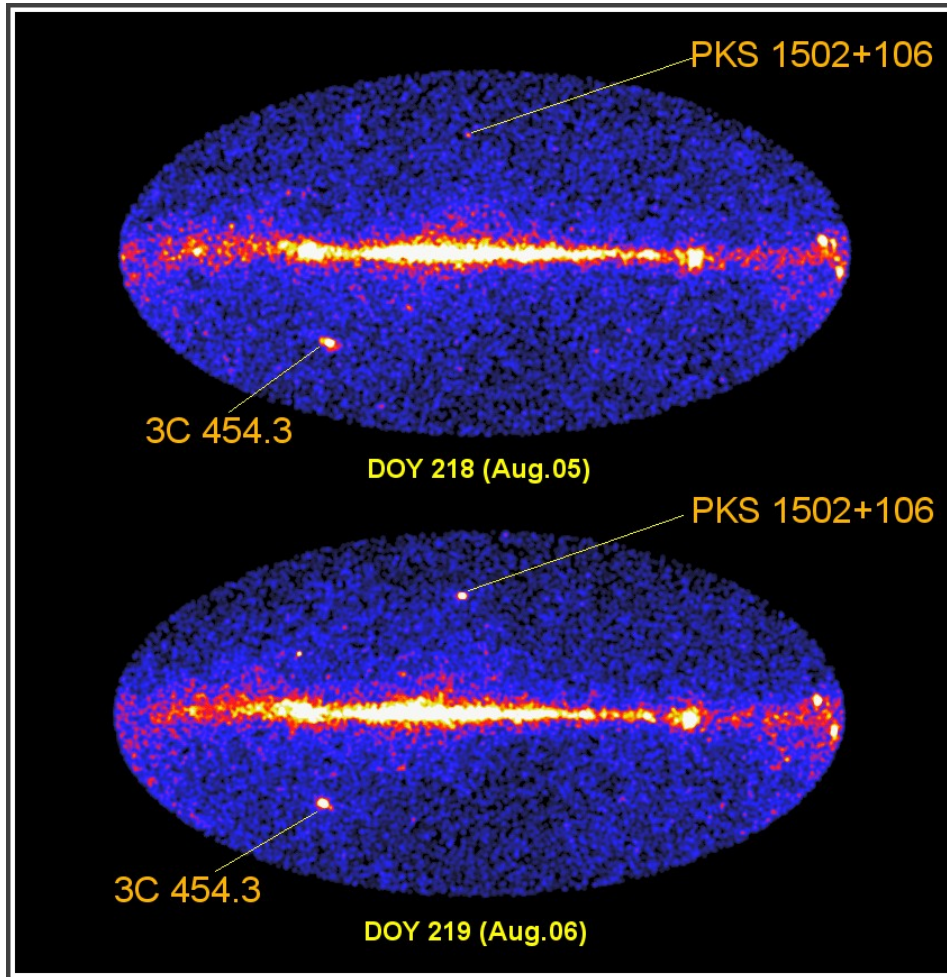
Fig. 3. Lightcurve above 100 MeV from the sum of all available Vela observations. The indicated phase intervals and definitions are explained in Table 5 and Sect. 6.2

Vela: The same data is shown twice (two rotations of the neutron star).  
The dotted line is the radio template provided by Dick Manchester using the Parkes radiotelescope.

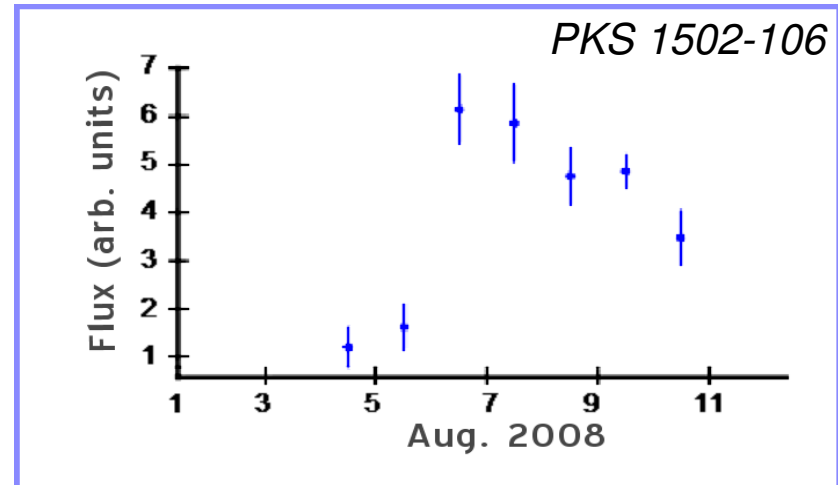


- **Jul 24th: GLAST-LAT detection of extraordinary gamma-ray activity in 3C 454.3 (blazar)**
- **Aug 8th: GLAST LAT detection of a possible new gamma-ray flaring blazar: PKS 1502+106**
- Sep 5th: Fermi LAT detection of a possible new gamma-ray flaring blazar: PKS 1454-354
- Sep 8th: Fermi LAT detection of 3C 273 in flaring state (radio quasar)
- Sep 26th: Fermi LAT observations of the PKS 1510-089 outburst (radio quasar)
- Sep 26th: Fermi LAT strong detection of blazar AO 0235+164 during outburst at Optical-to-Radio Wavelengths
- Oct 6th: Fermi LAT detections of gamma ray activity in three blazars: 3C 66A, PKS 0208-512, PKS 0537-441
- Oct 8th: Fermi LAT Detection of Brightening of the Galactic Plane Source 3EG J0903-3531



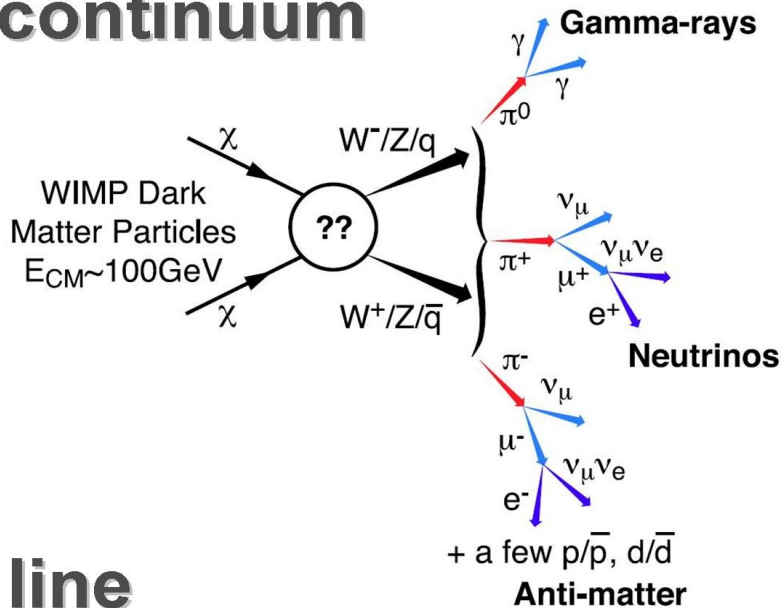


- The sky is dynamic, Fermi is monitoring the sky, catching flaring sources over different time scales.
- Atel #1628 (3C 454.3) and #1650 (PKS 1502-106) issued to announce these flares.

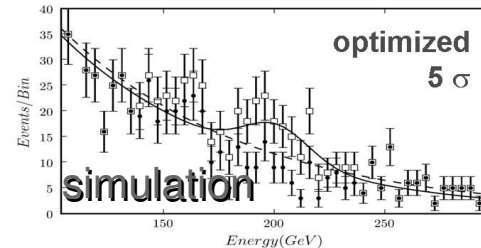
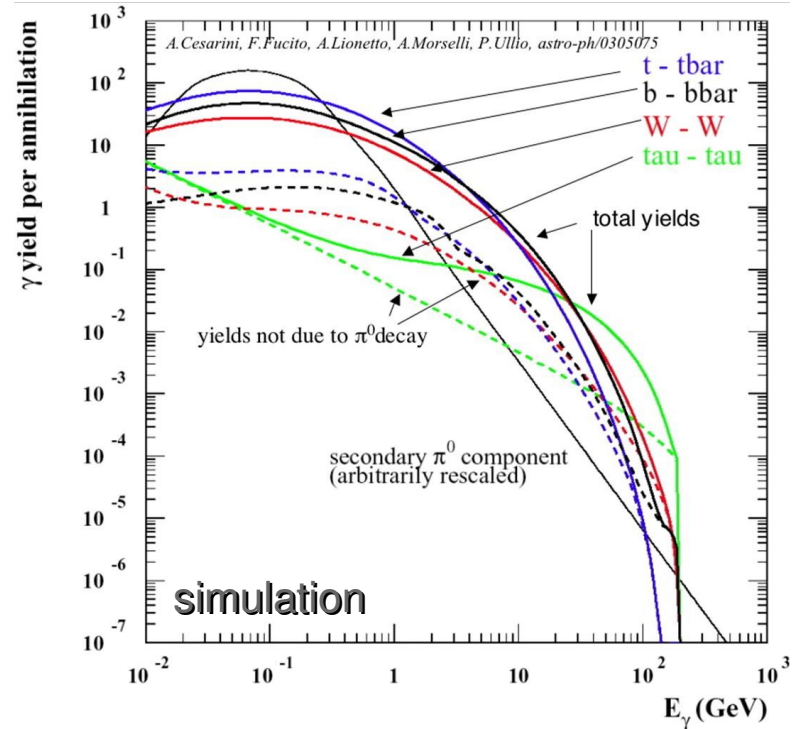
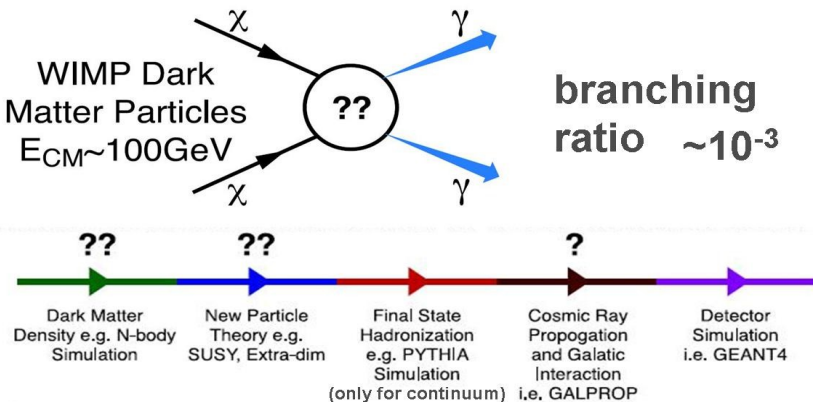


# Gamma Rays from Dark Matter

## continuum






## line

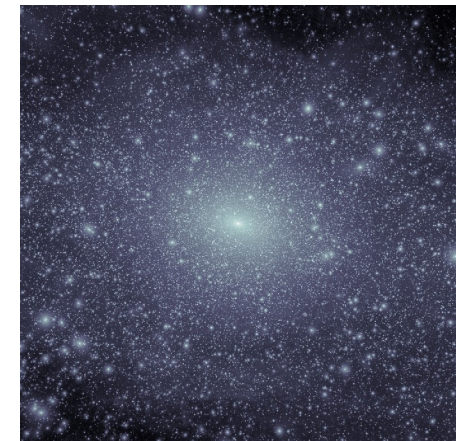


200 GeV  
WIMP



# Search for Dark Matter

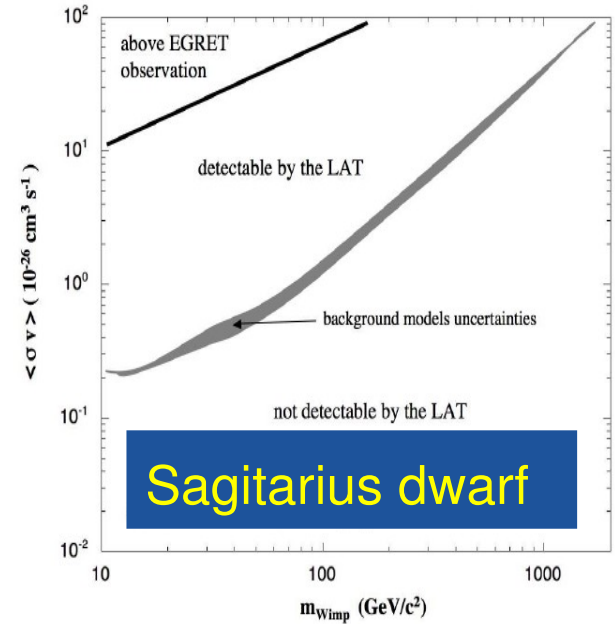
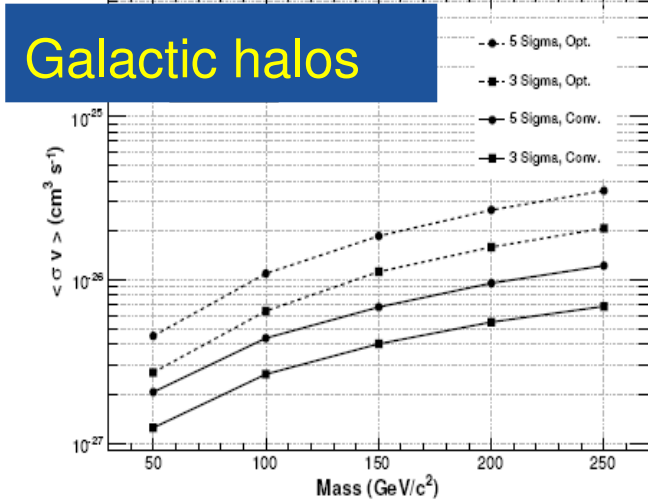
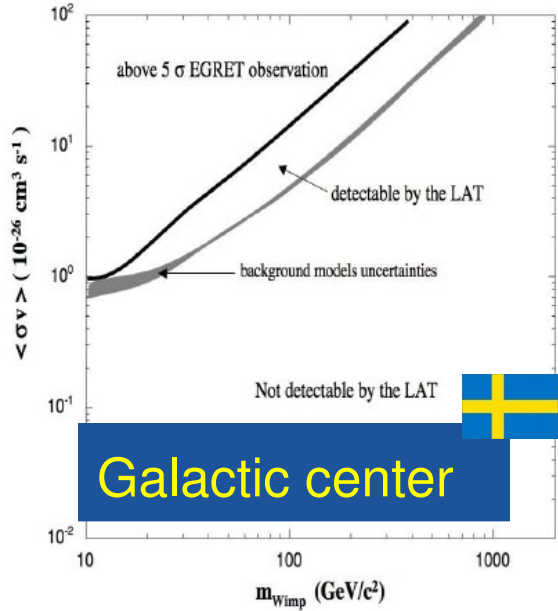
Search Technique	Advantages	Challenges
 Galactic Center	good statistics	source confusion/ diffuse background
Galactic Halo	very good statistics	galactic diffuse background
DM Satellites known dwarf gal.	low background, good source id	low statistics
 Spectral Lines	no astrophysical uncertainties, good source id	low statistics
 Cosmological	very good statistics	astrophysics, galactic diffuse background



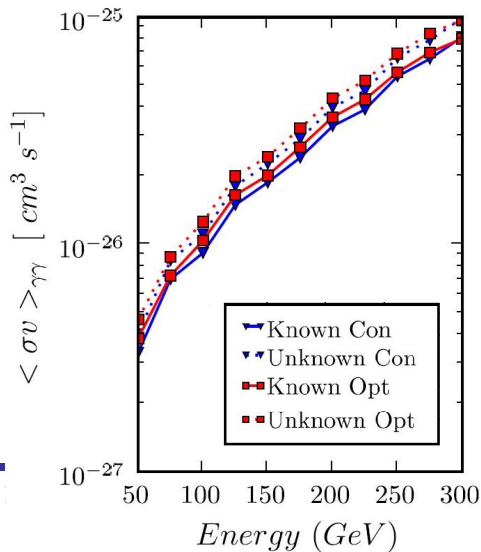
ViaLactea 2  
N-body simulation of  
Dark Matter distribution

# Sensitivity for Dark Matter

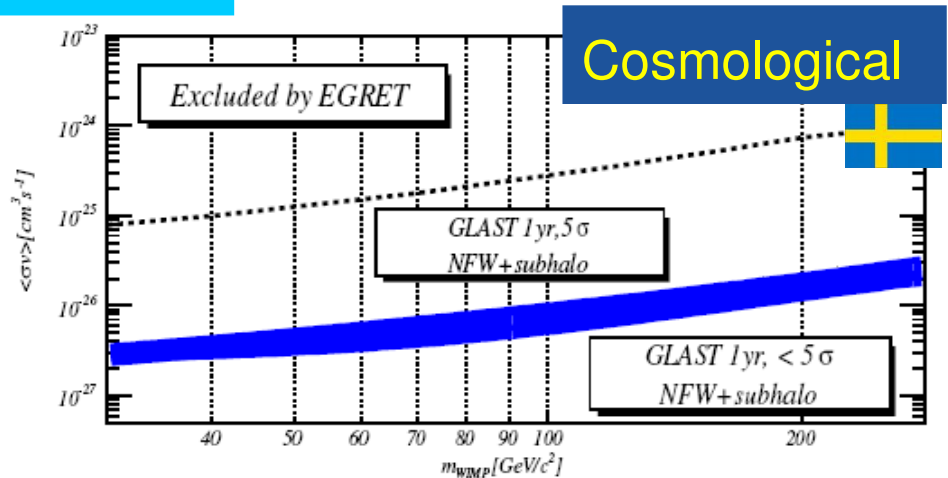
E. A. Baltz et al., JCAP 0807 (2008) 013 [arXiv:0806.2911 [astro-ph]]



line



$\sigma v \sim 10^{-26}$



# Conclusions and Outlook

- After 60 days of commissioning Fermi is now in routine science operations since August 11<sup>th</sup> 2008 and delivers continuously data
- Several discoveries already
  - hear more about GRBs in Sinead's talk this afternoon
  - radio-quiet pulsar in CTA1, Science paper published online today at 2pm EDT
- Detections of AGN flaring states
- Dark Matter searches:
  - Methods are tested on realistic simulations
  - Applying the analysis procedure to Fermi LAT data
  - Studying astrophysical sources, diffuse galactic background and charged particle background
  - First DM results soon (large number of DM paper intended for the first year)

# The End

# Year 1 Science Operations Timeline Overview

