



New Extended GeV Sources in the Galactic Plane Found in a Search of the Pass 8 data from Fermi-LAT

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on behalf of the Fermi-LAT collaboration

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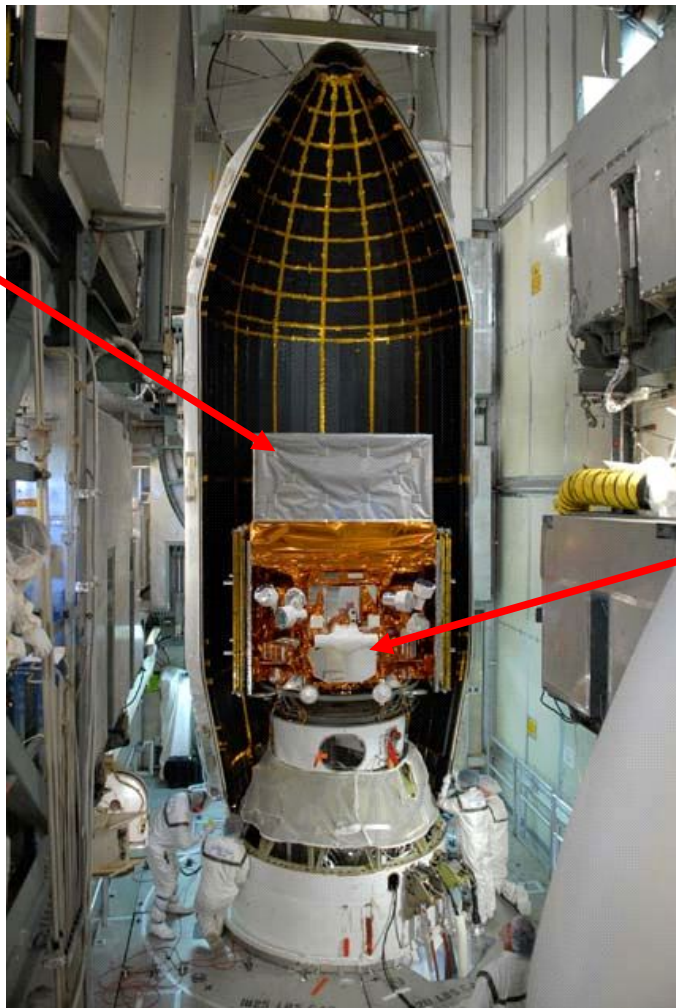
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Fermi in a nutshell



Large Area Telescope (LAT) :

- 20 MeV – >300 GeV
(including unexplored region 10 GeV – 100 GeV)
- 2.4 sr field of view
(scans the entire sky every ~3 hrs)



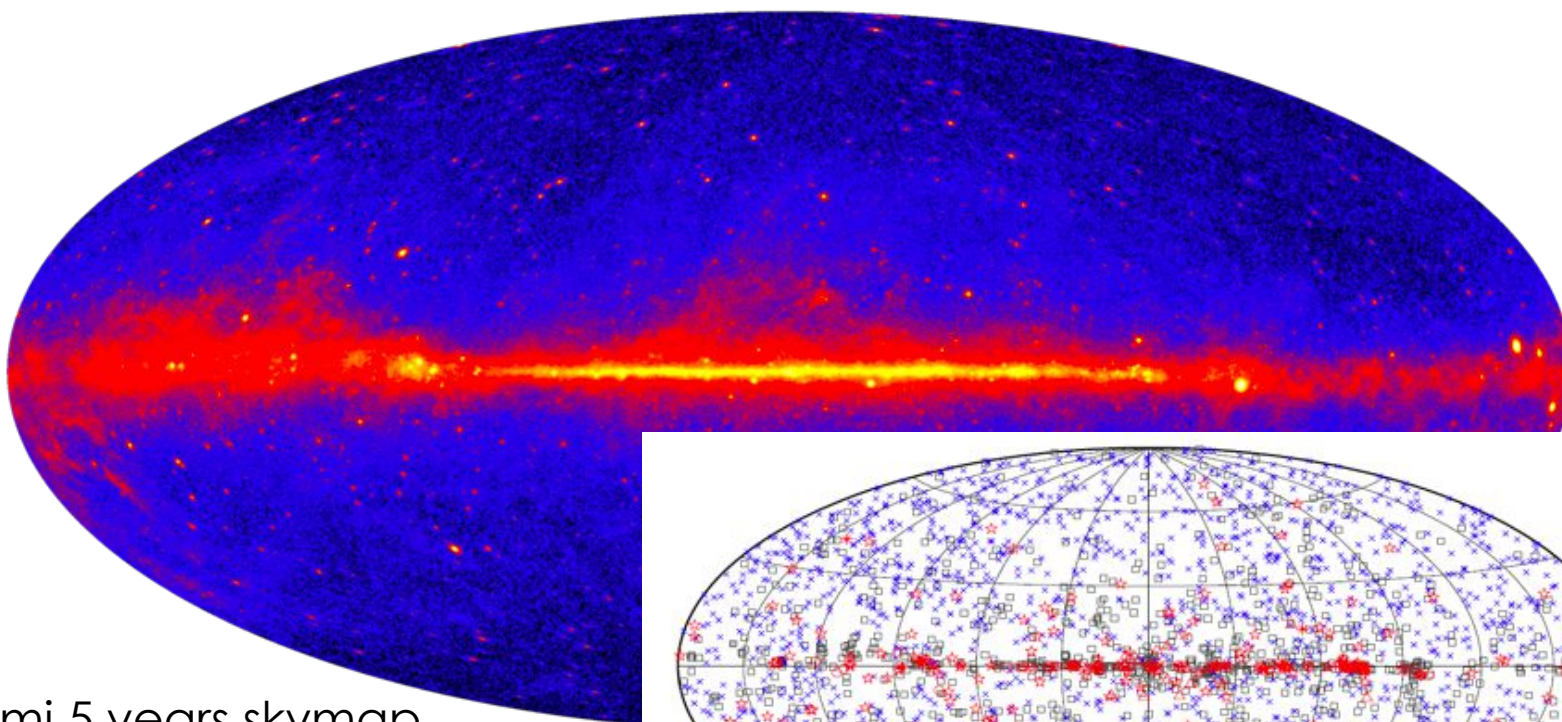
Gamma-ray Burst Monitor (GBM) :

- 8 keV – 40 MeV
- views entire unocculted sky

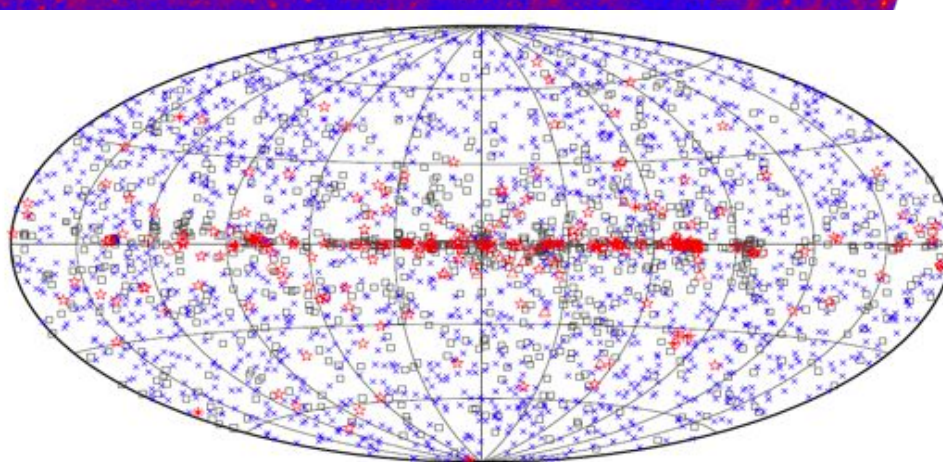
Fermi-LAT sky above 100 MeV



- 1900 sources after 2 years
- **3033 sources** after 4 years (*3FGL, Acero et al., ApJS 218, 23, 2015*)
- ~50% sources along the Galactic plane



Fermi 5 years skymap
above 1 GeV



□ No association	■ Possible association with SNR or PWN	✱ AGN
☆ Pulsar	△ Globular cluster	◇ PWN
✱ Binary	+ Galaxy	● SNR
● Star-forming region		● Nova

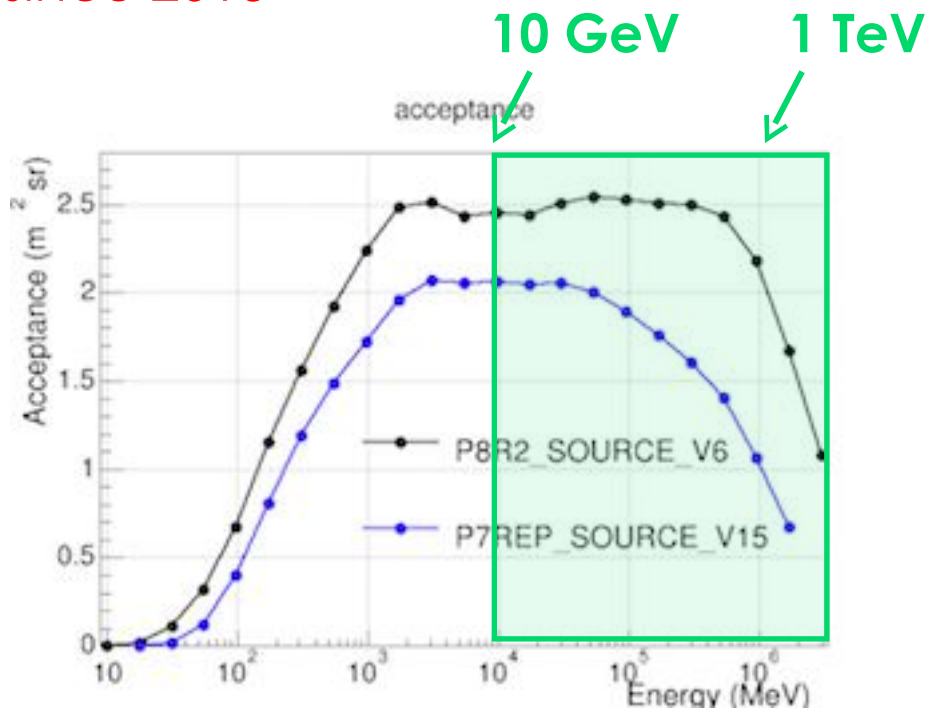
Reconstruction improvement

New event reconstruction : **Pass 8** (*Atwood et al., arXiv:1303.3514*)

=> Acceptance:

- multiplied by ~ 2 at 100 MeV
- Improvement by $\sim 30\%$ at 1 GeV

Data public since 2015



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Lowering the energy threshold

Going down from 50 GeV to 10 GeV :

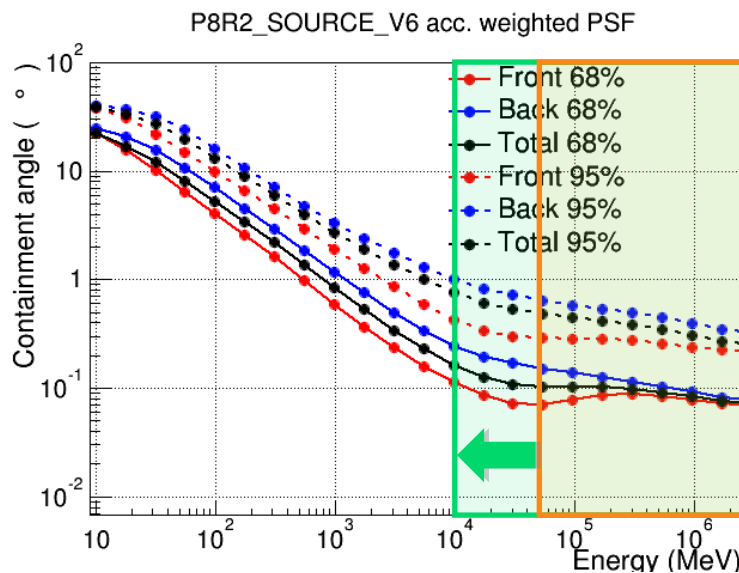
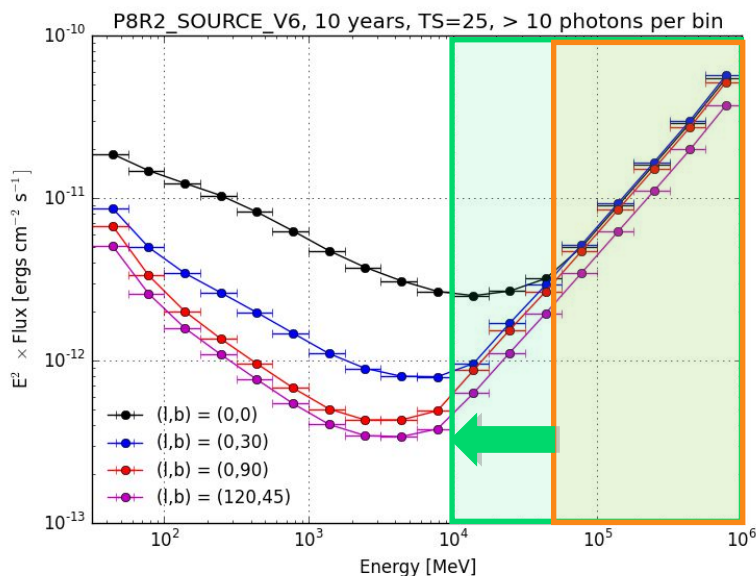
- **Enhanced sensibility** => more statistics

(650000 in the whole sky, **~10x more photons**)

- **Still good angular resolution**

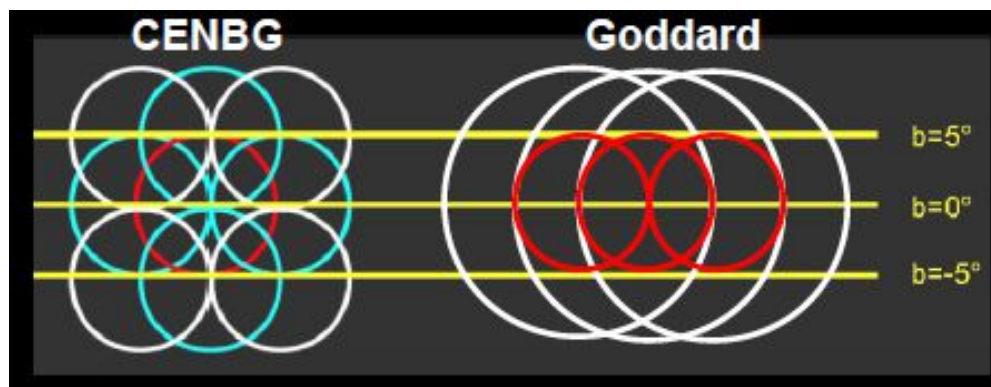
(0.11°, 68% containment angle)

=> **high capability to resolve and detect extended sources**



Analysis method

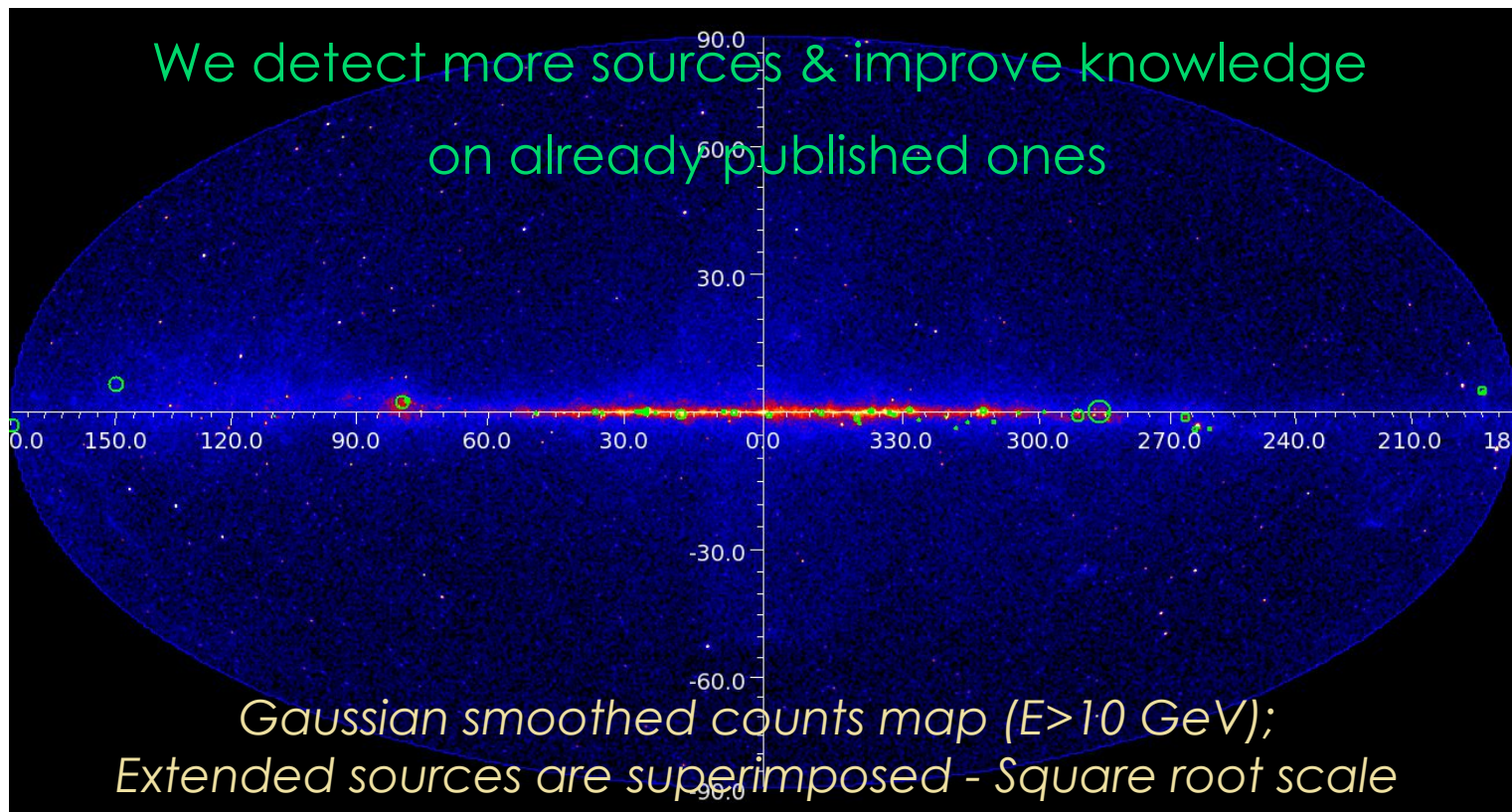
- 80 months of Pass 8 data
- Energy : 10 GeV – 2 TeV
- Start from 3FGL source positions
- Scan the Galactic plane with overlapping regions covering **latitudes from -7° to $+7^\circ$: two independant pipelines (CENBG vs GFSC)**



- Test candidates for position, extension, alternate hypotheses (2 pt. sources vs 1 ext. source) and spectral curvature
- Extended sources : $TS > 25$ & $TS_{\text{ext}} > 16$ & $TS_{2\text{pts}} < TS_{\text{ext}}$

Results

- More than 40 extended sources are detected
 - > 15 have different morphology than 3FGL
 - > 10 are new extended sources

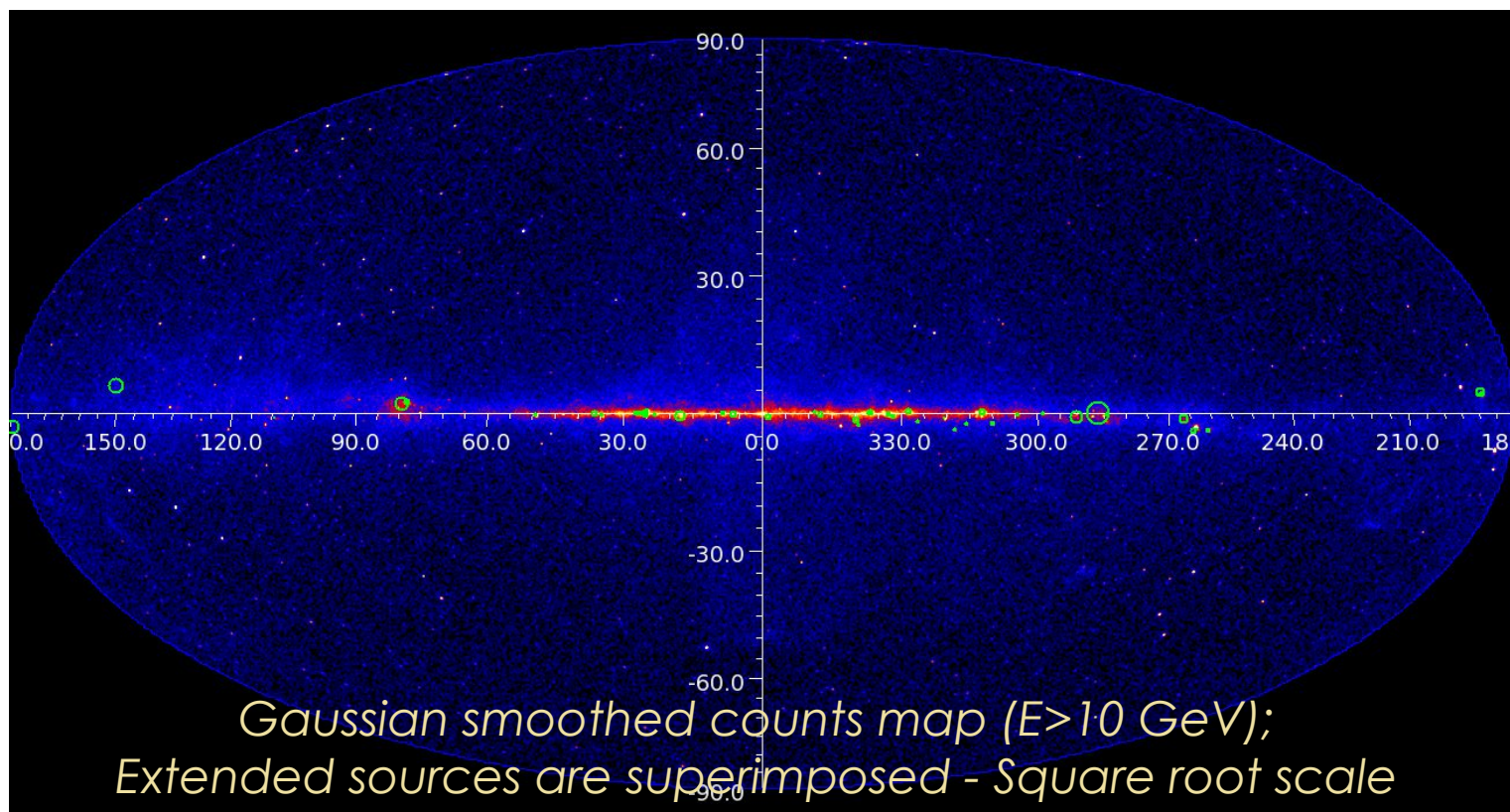


Results



Cases can be distinguished in :

- A. Agreement
- B. Improvement
- C. New extended sources



Conclusions

- Paper by the Fermi collaboration to be submitted this summer :
 - > 40 extended sources
 - > 10 new extended sources
 - Some statistics :
 - Average spectral index : ~ 2.1
 - Average disk radius : $\sim 0.5^\circ$
 - **Dominant fraction of identified sources : SNRs**
 - All PWNe detected in this work are coincident with TeV sources

This analysis has resolved sources that were previously unknown to be spatially extended or in some cases were confused at GeV energies, thus helping for the identification or the modeling.



Perspectives

- Fermi's HE catalogs are extremely useful for the TeV community
 - LAT large FoV avoids biases with respect to usual observation programs
 - Large SNR (such as SNR G150.3+4.5) are difficult to detect at TeV
- Aim of this work : perform a comparison with the TeV sources and see which sources are good candidates in the future for TeV instruments

=> Going beyond HE catalogs is a good preparation for CTA science



