# Search of MeV-GeV counterparts of TeV sources with AGILE in pointing mode

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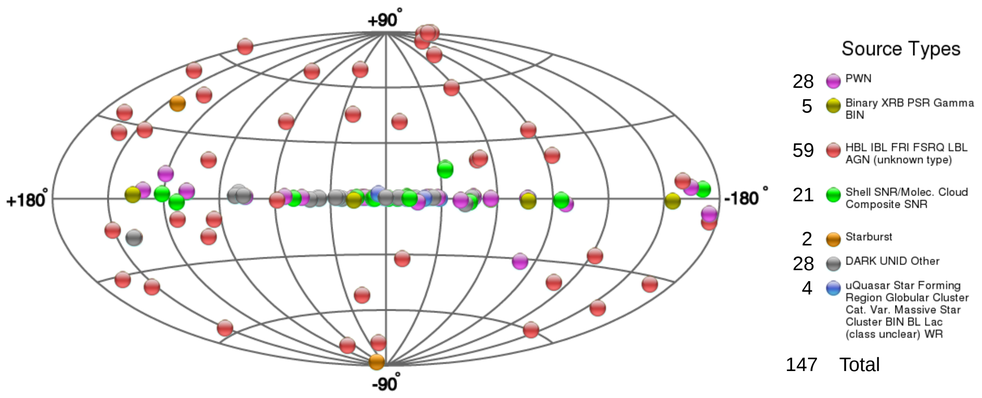
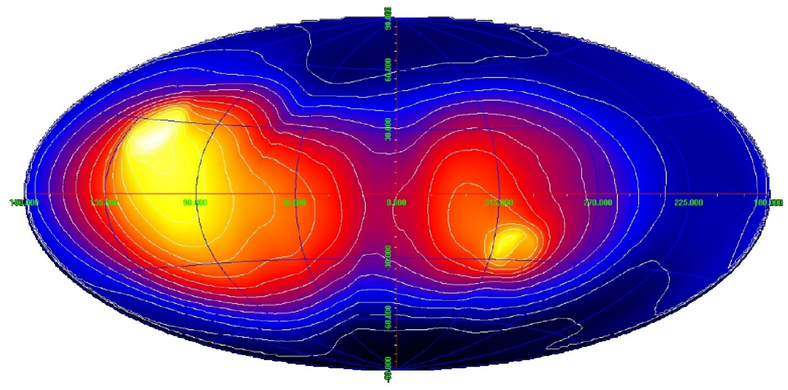
A systematic study of the TeV sources described on TeVCat catalog (`http://tevcat.uchicago.edu`) has been performed

**147** source positions have been analyzed



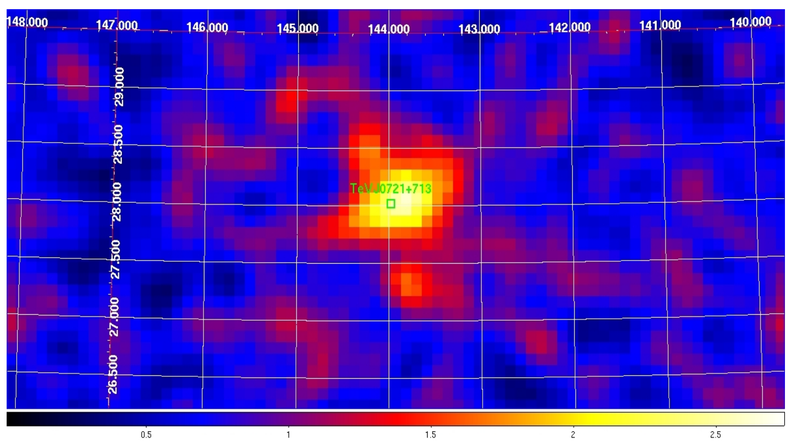

The analysis has been carried out using the AGILE data acquired during the pointing phase (from July 9, 2007 to October 18, 2009) with a consequent non-uniform coverage of the sky



Exposure map

Due to the large number of source positions to be analyzed, an automatic iterative procedure has been used

First, for each TeV sources, the maps of photon counts, exposure and diffused background are generated, centering them in the position of the TeV source. All these maps have 40x40 bins of 0.1°x0.1° size.



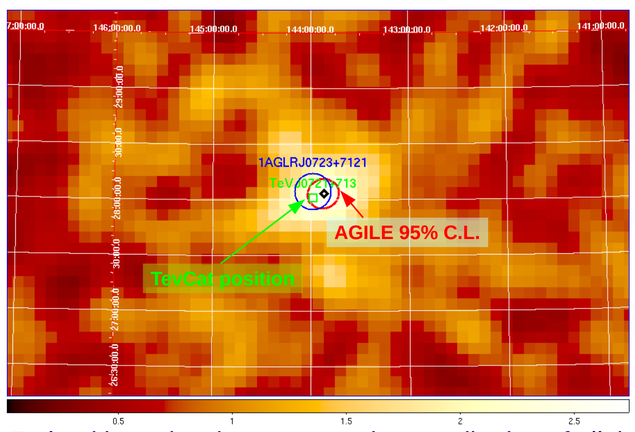

Parameters used for maps generation:

| | |
|---|---|
| Data archive: | ASDCSTDe |
| Initial and final time (mission time): | 111067134 s ÷ 182951934 s |
| Energy range: | 100 MeV ÷ 50 GeV |
| SW release, filter, matrices: | BUILD21, FM3.119, I0023 |

Then, a source detection and localization procedure, based on a *Maximum Likelihood Estimator* algorithm (MLE) is used in 2 different modes:

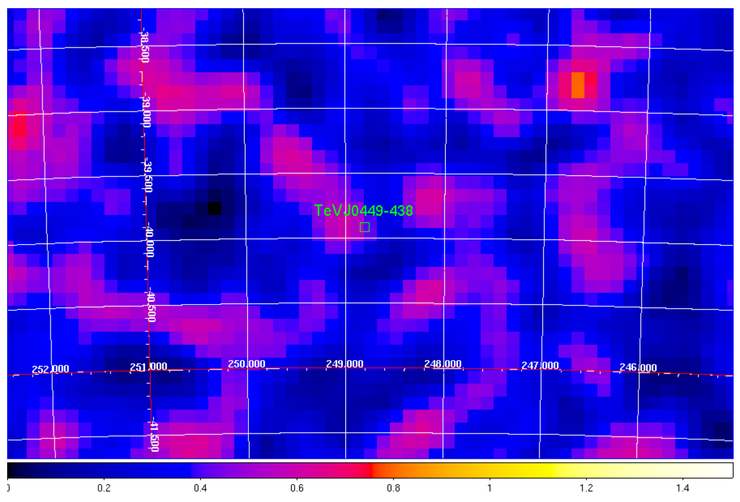
- fixed position (at TeVCat coordinates): return best estimate of flux
- free position (near the starting one): return optimized flux and position

The source is considered detected if $\sqrt{(TS)} \geq 4$




The MLE algorithm takes into account the contribution of all the known AGILE source (shown here with a blue circle).
The red line represents the 95 % C.L. contour of the localization algorithm and the balck diamond show the found *best-fit* position.

In the case where $\sqrt{(TS)} < 4$ the calculated flux is considered as the *upper limit* (U.L.)




Example of source below the detection threshold: TeVJ0449-438 (PKS0447-439)

## detection results

In total, **52** TeV sources show a significant *count excess* in the AGILE data covering the pointed observation period, corresponding to **35%** of the original sample

Among them, **26** have a spatial association with already known AGILE sources from 1AGL/1AGLR catalogs (within 95% C.L. *error radius*): 15 galactic, 6 extra-galactic, 5 unassociated

The other **26** detections represent new AGILE sources (with respect to the reference catalogs): 15 galactic, 7 extra-galactic, 4 unidentified

## source classification

| *Source Type* | *Detected / Total* | *Source Class* | *Detected / Total* |
|---|---|---|---|
| Extra-galactic | 13 / 61 (21%) | Blazar | 0 / 1 (0%) |
| | | HBL | 5 / 44 (11%) |
| | | IBL | 2 / 5 (40%) |
| | | LBL | 2 / 3 (67%) |
| | | FSRQ | 2 / 3 (67%) |
| | | Sbs | 0 / 2 (0%) |
| | | FRI | 2 / 3 (67%) |
| Galactic | 30 / 58 (52%) | PWN | 11 / 28 (39%) |
| | | SNR | 7 / 11 (64%) |
| | | PWN/SNR | 2 / 2 (100%) |
| | | SNR/MC | 5 / 8 (63%) |
| | | BIN/XRB | 3 / 5 (60%) |
| | | GC | 1 / 1 (100%) |
| | | WR | 1 / 3 (33%) |
| Unidentified | 9 / 28 (32%) | --- | --- |

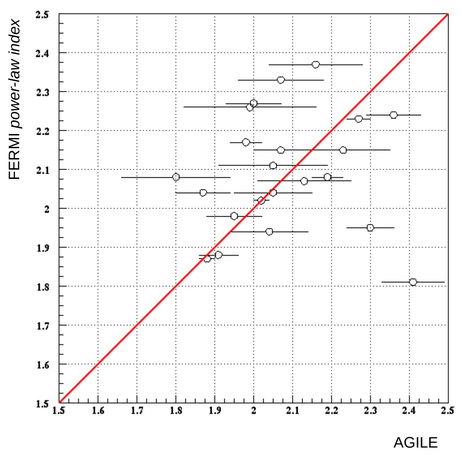
## spectral analysis

The spectral analysis has been performed on the most significant sources detected in this analysis (24 sources) with $\sqrt{(TS)} \geq 5$ and |b| ≤ 30°

The spectral index has been calculated over 5 energy bands:

- 100 - 200 MeV
- 200 - 400 MeV
- 400 - 1000 MeV
- 1 - 3 GeV
- 3 - 50 GeV

The resulting spectral indexes are in agreement with the ones given for the 3FGL TeV conterparts (22 sources)




## Next steps...

The publication of a paper (in preparation) is proposed

This kind of analysis could be extended to the most recent AGILE data (*spinning mode*) and to any other VHE γ-sources...