



AGILE and TeV Sources

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On behalf of the AGILE team



Outline

- **The AGILE Mission**
 - **Scientific Objectives**
- **Selected AGILE results and specific TeV sources**
 - **Mkn 421 , W Comae, 3C 454.3, PG 1553+113**
 - **IC 443, SNR W28**
 - **Cygnus X1**
 - **Cygnus X3**
 - **Vela X, Crab Nebula**
- **Preparing the second AGILE catalog**
 - **Status**
- **Systematic Search for TeV counterparts**
 - **Fully automated search**



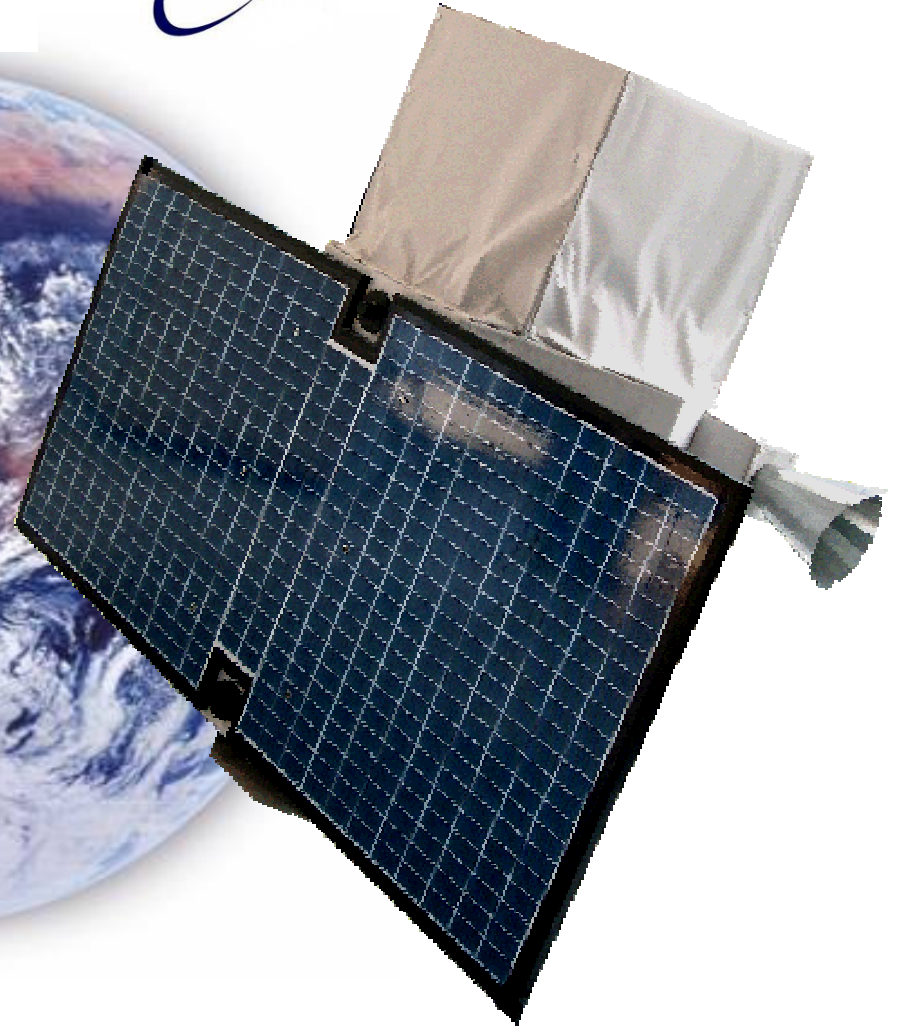
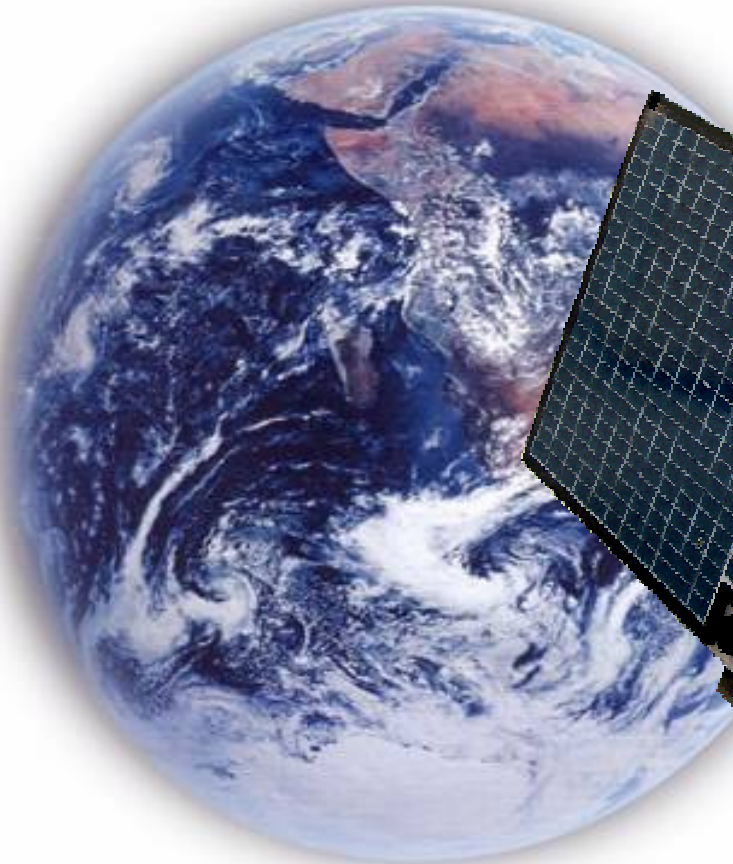
AGILE



AGILE

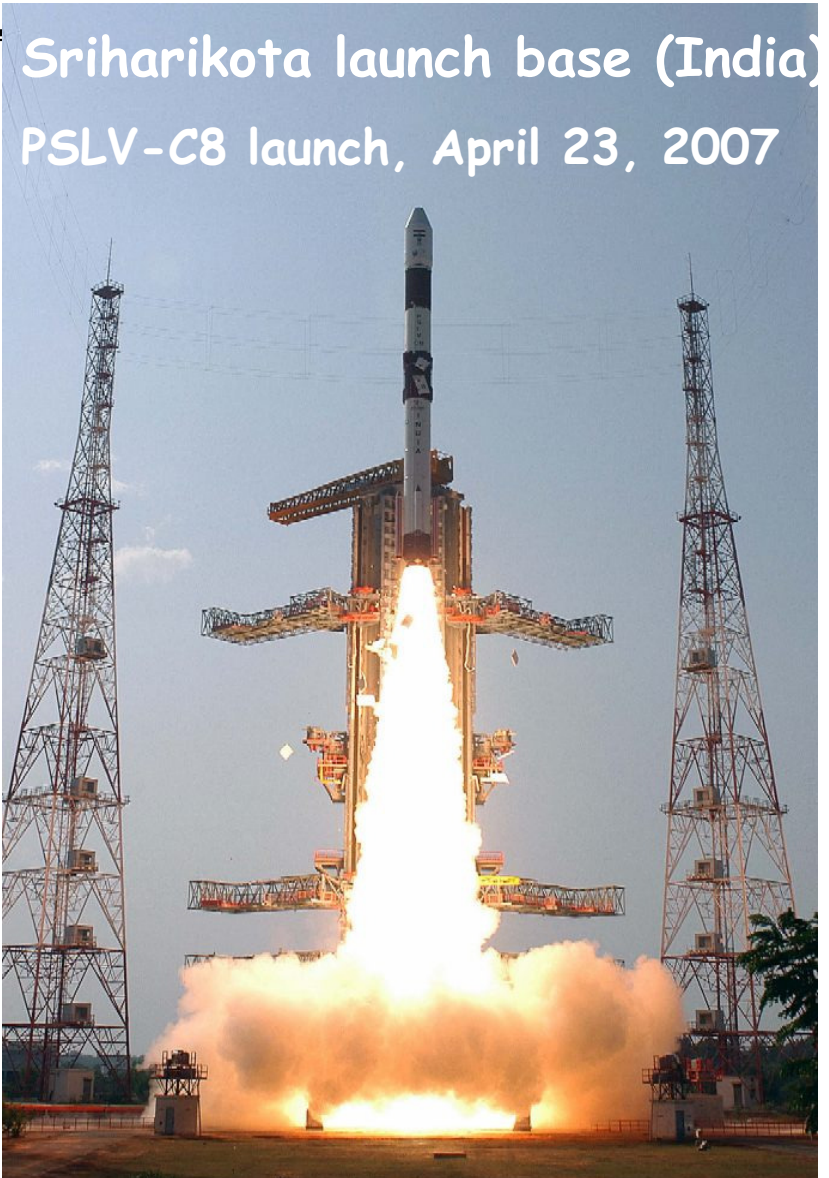


INAF



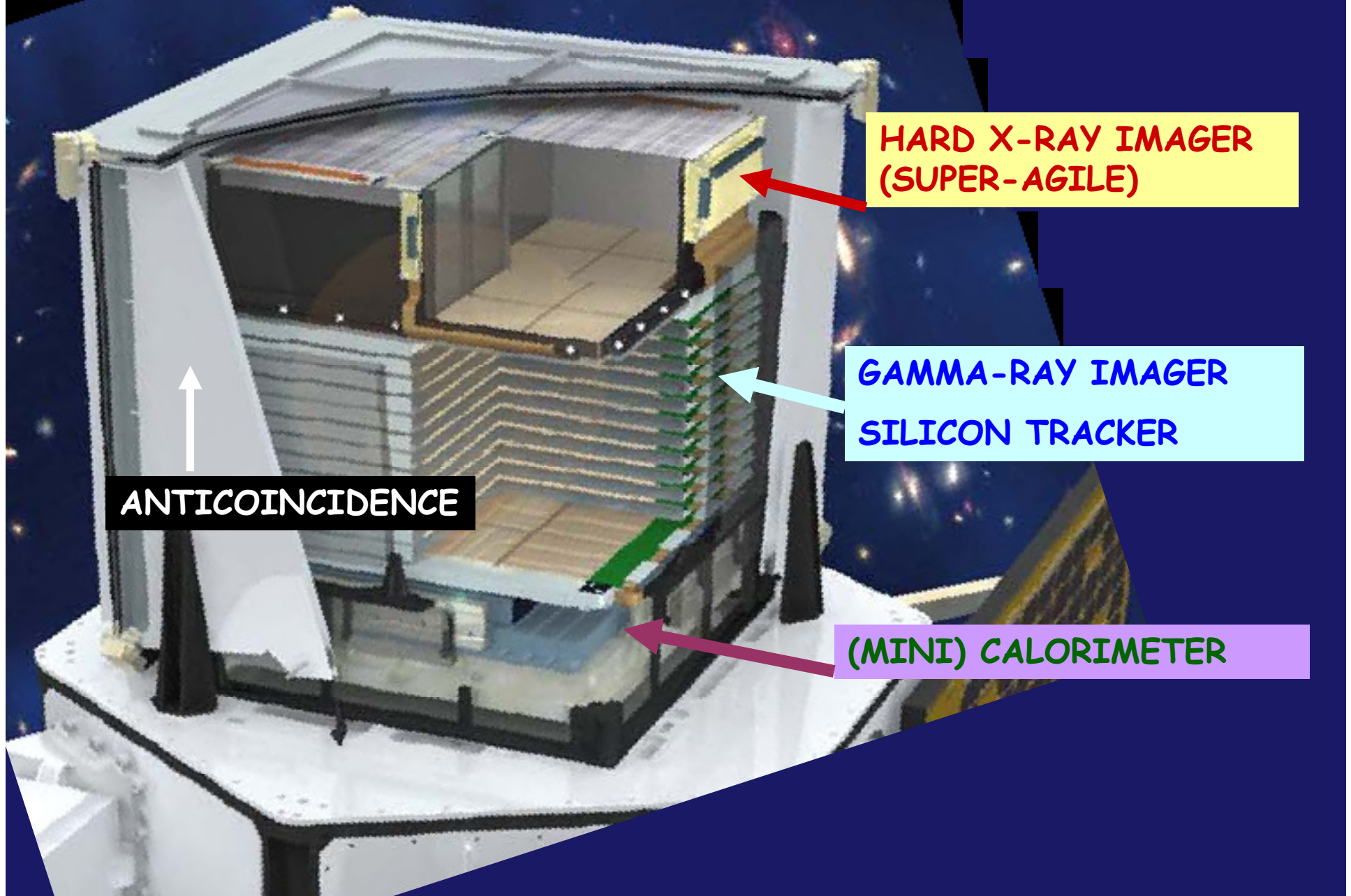


The AGILE launch



Sriharikota launch base (India)
PSLV-C8 launch, April 23, 2007

AGILE: inside the cube...



HARD X-RAY IMAGER
(SUPER-AGILE)

GAMMA-RAY IMAGER
SILICON TRACKER

ANTICOINCIDENCE

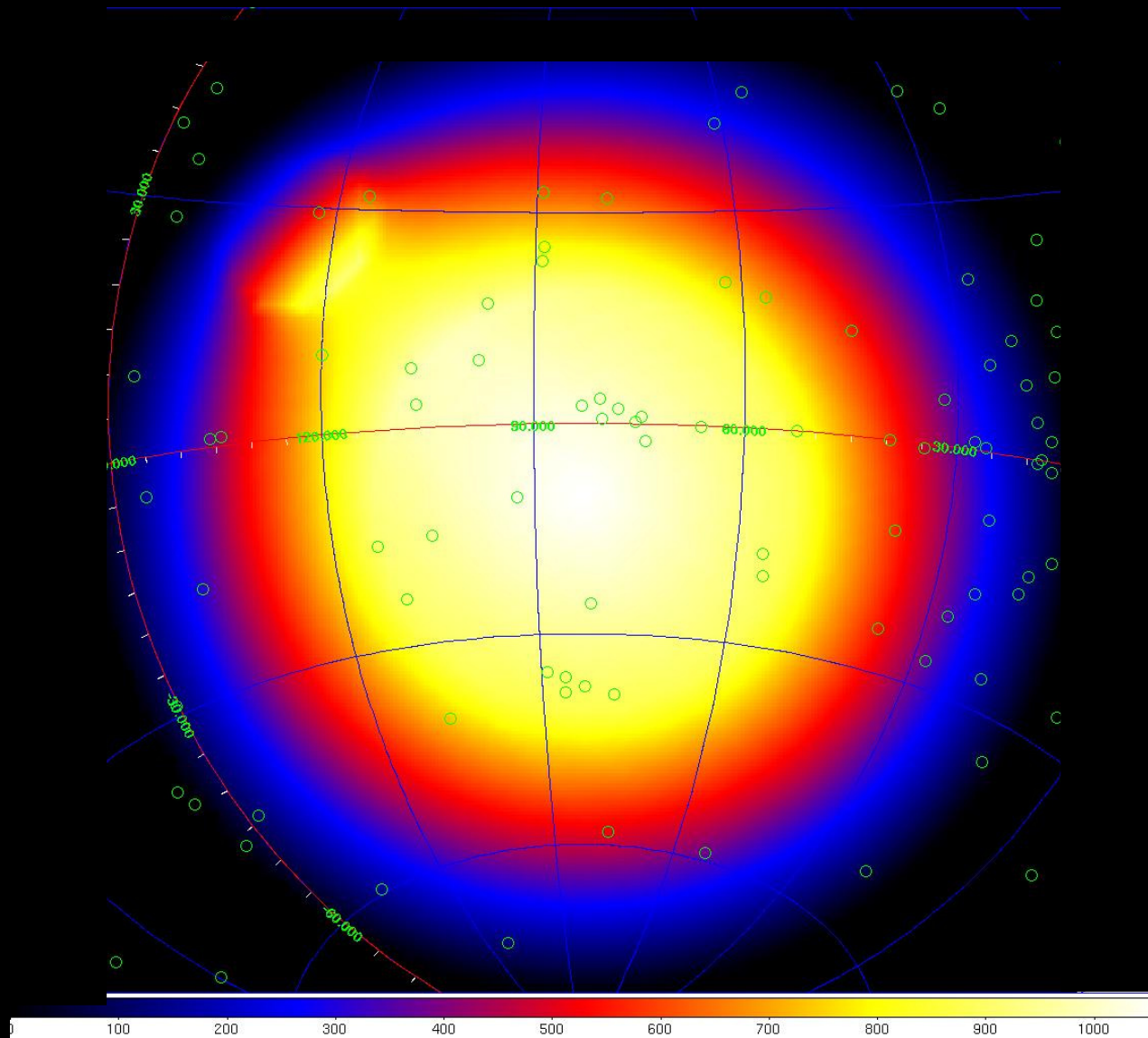
(MINI) CALORIMETER



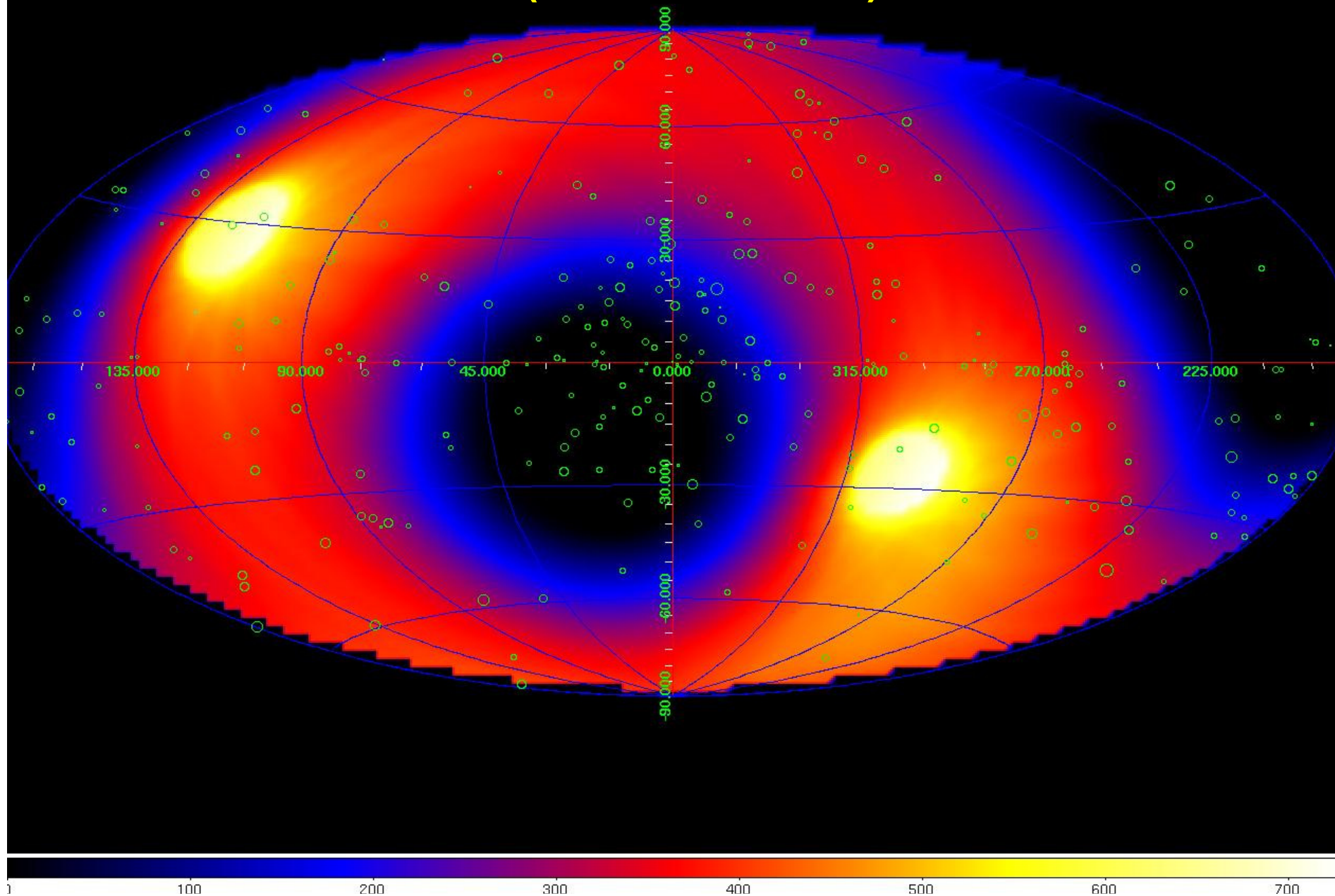
AGILE two phases ...

	AGILE-1	AGILE-2
time period	Jul.07 – Oct.09	Nov. 2009 - today
attitude	fixed	variable (spinning, 1°/sec)
sky coverage	1/5	~ 70-80 %
source livetime fraction	~ 0.5	~ 0.2
single source 1- day exposure (≤ 30 degree off-axis, 100 MeV)	~ 2 10⁷ (cm² sec)	(0.5-1) 10⁷ (cm² sec)

AGILE-1: 1-day exposure (E > 100 MeV) (30 Nov. 2008)

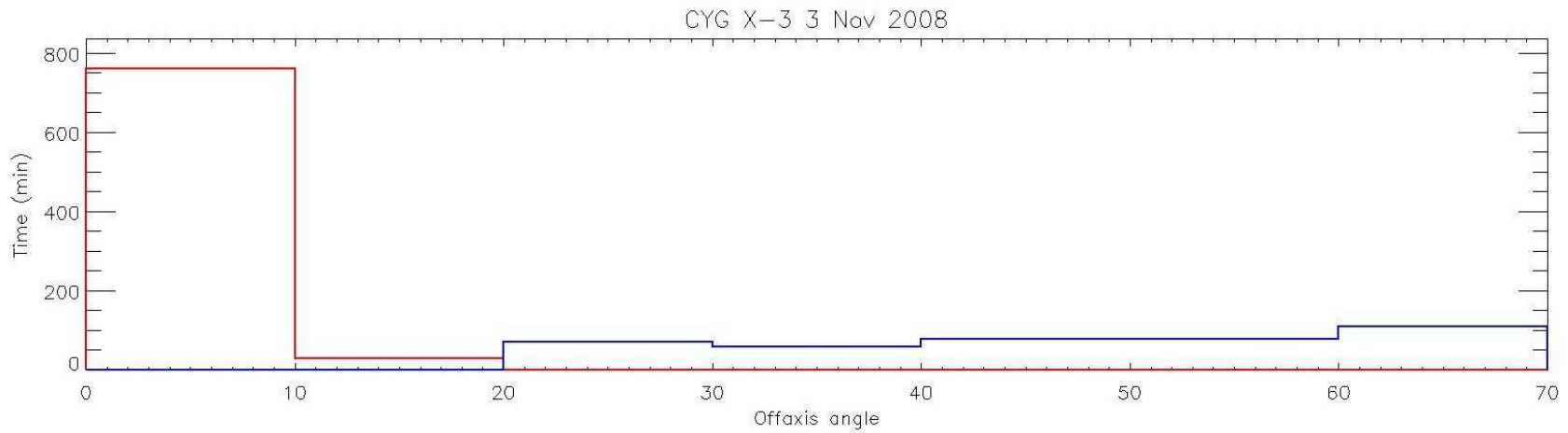
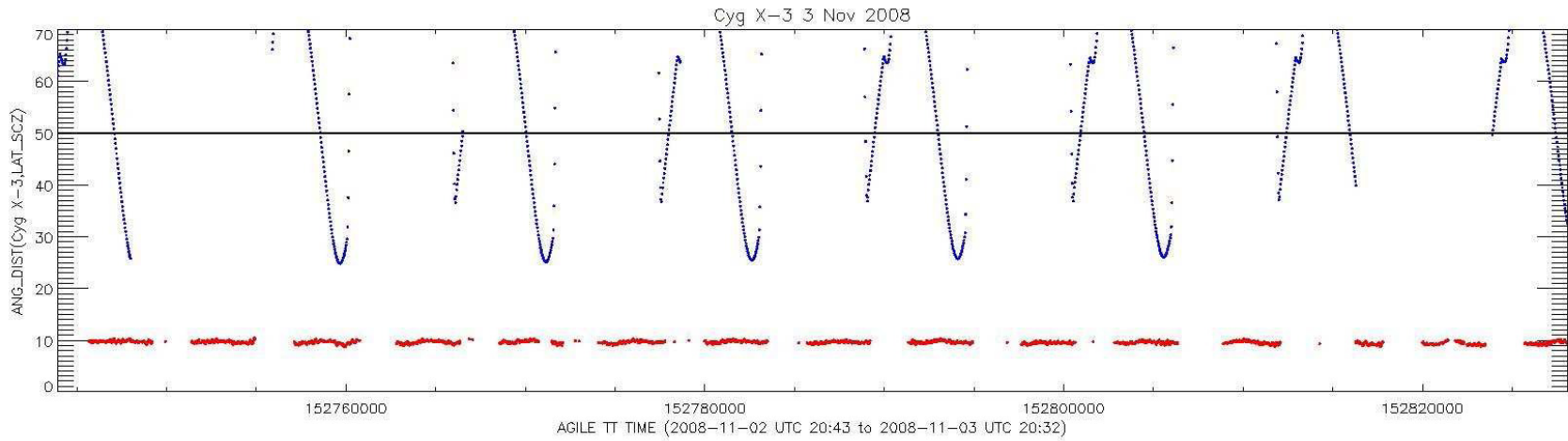


AGILE-2: 2-day exposure ($E > 100$ MeV) (10-11 Jan. 2010)



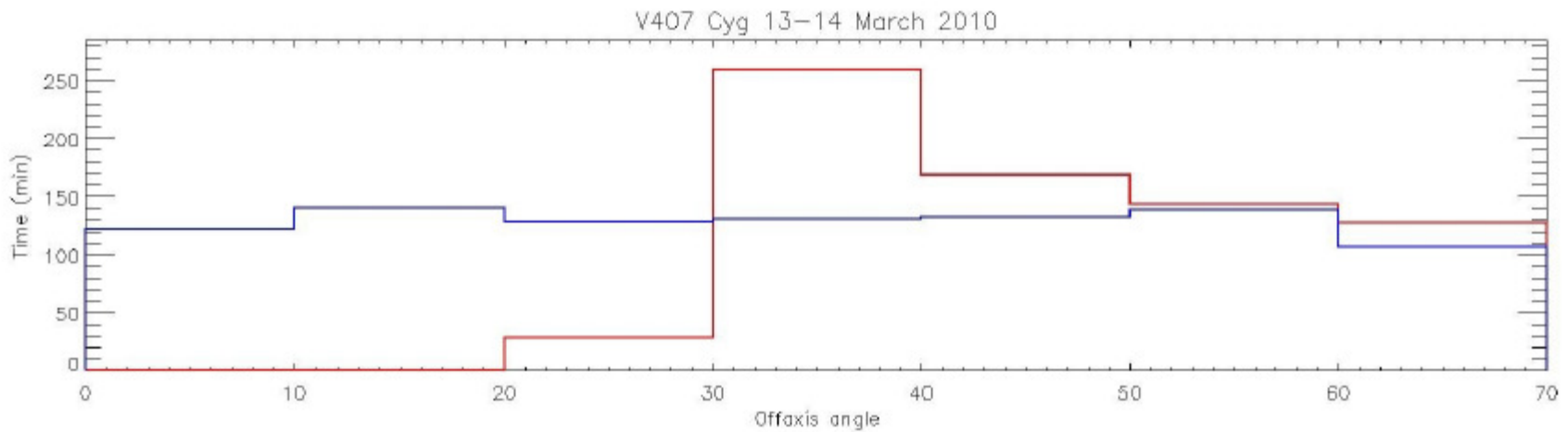
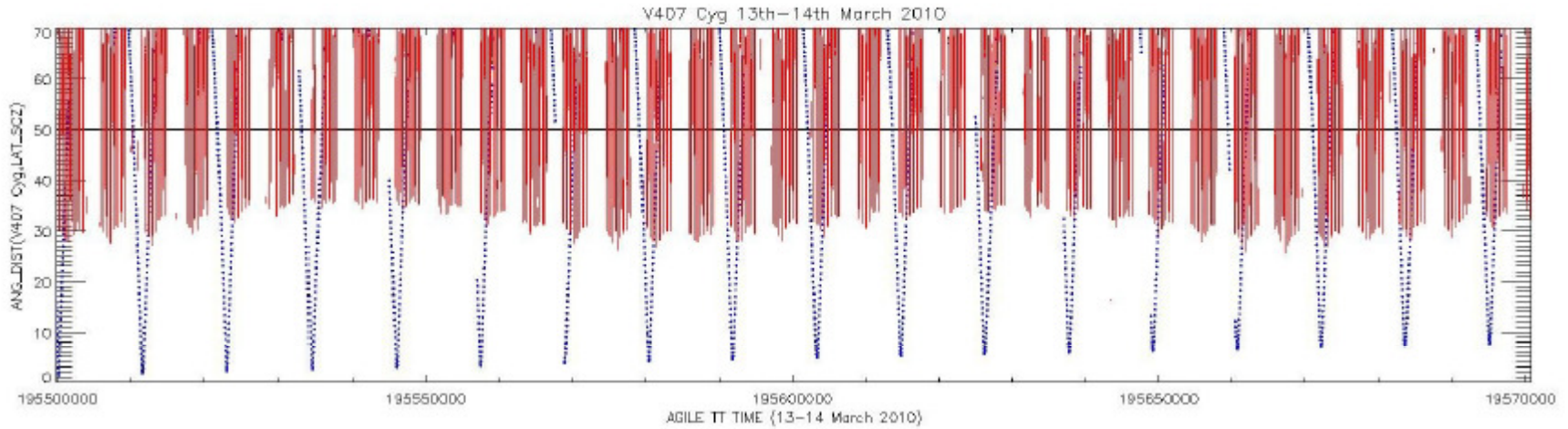


AGILE Pointing Phase





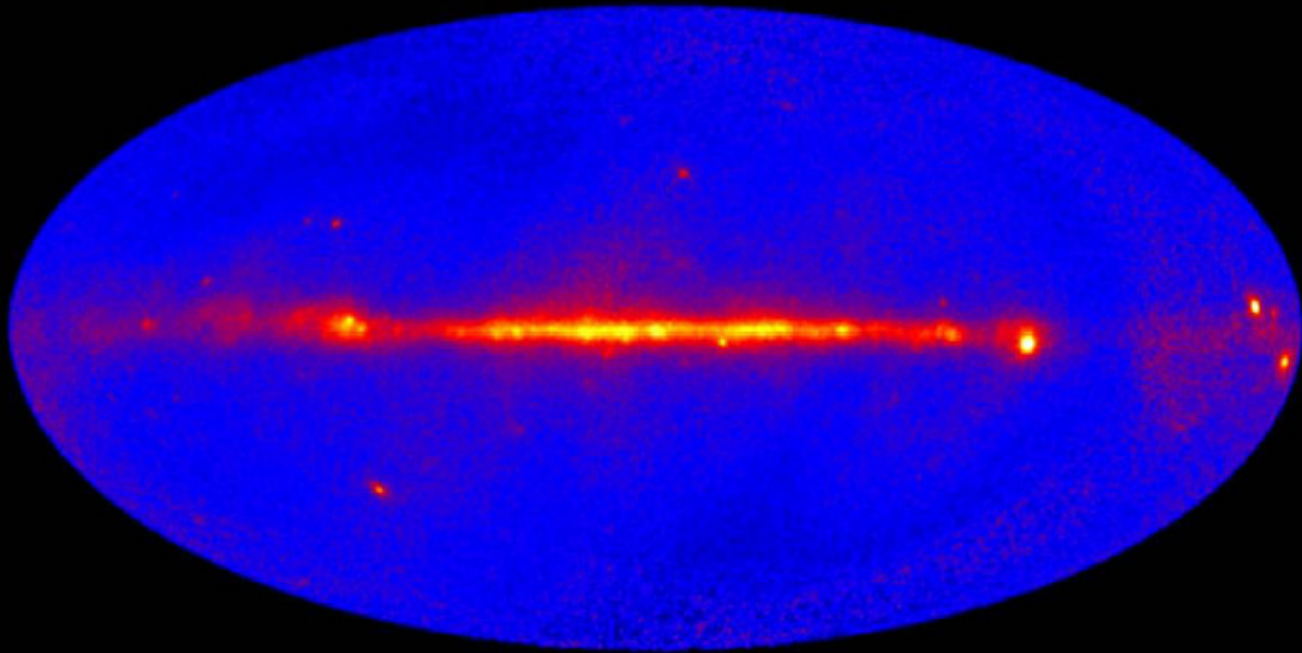
AGILE Spinning Phase





The AGILE sky

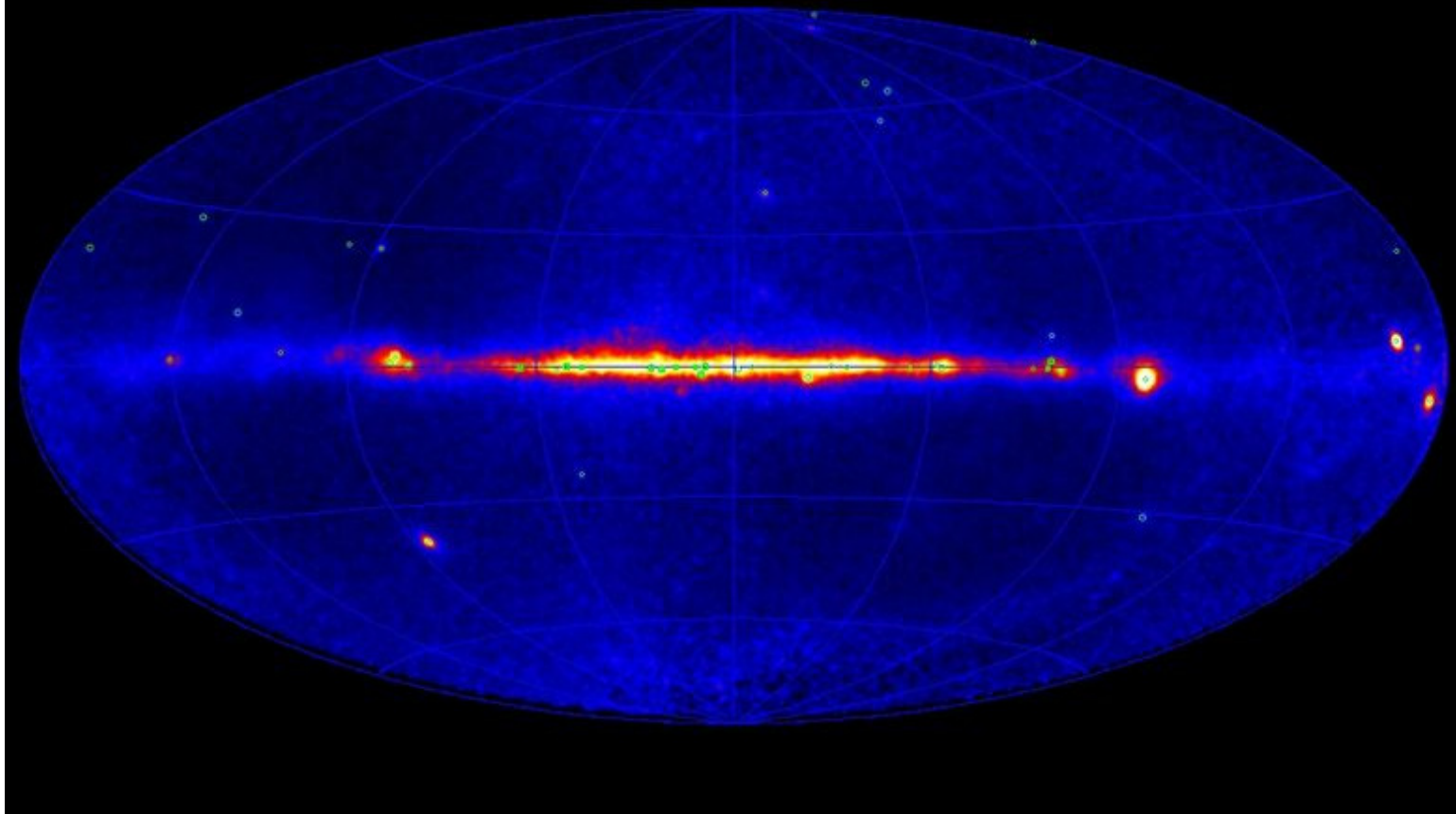
The AGILE gamma-ray sky ($E > 100$ MeV)
2 year exposure: July 2007 – June 2009





The AGILE sky

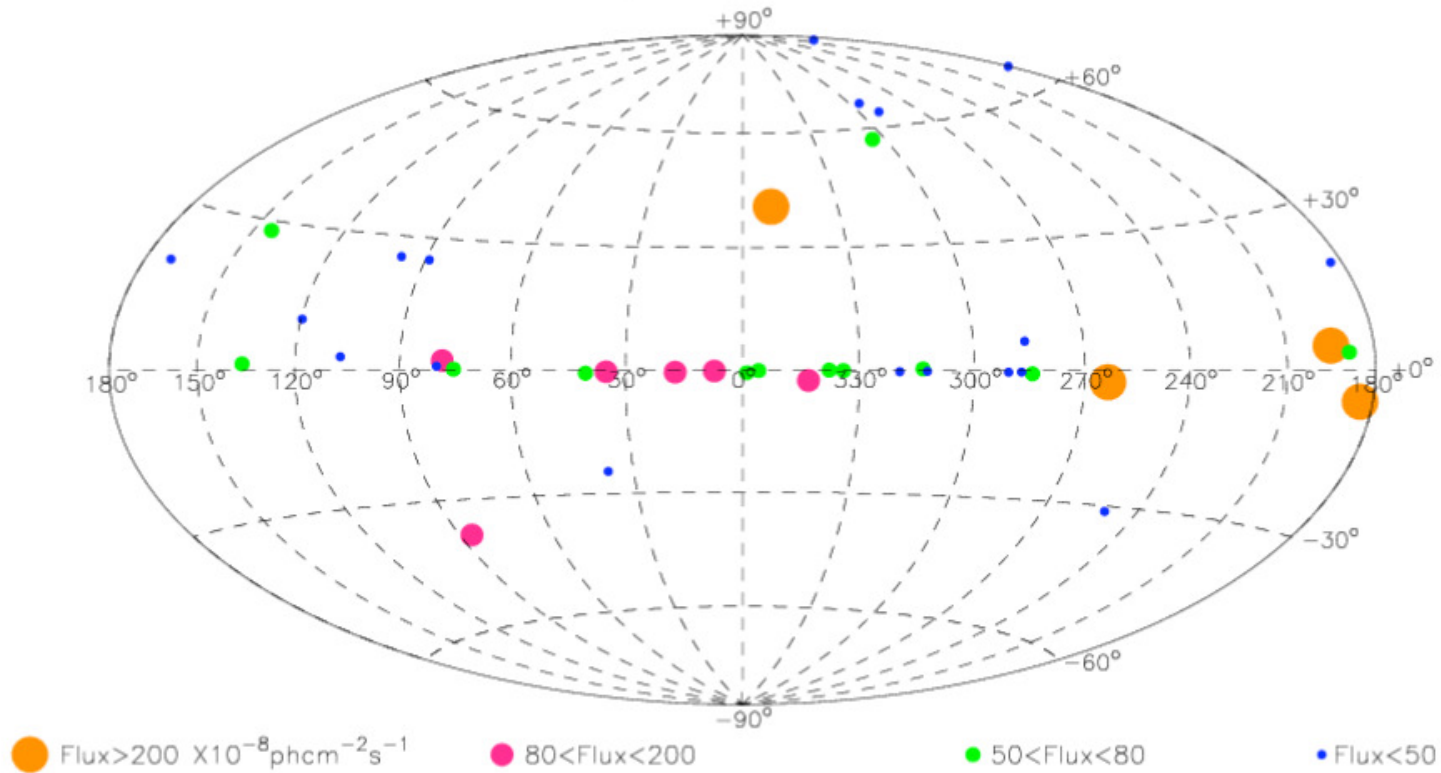
AGILE Total Intensity Map: Pointing + Spinning (up to Oct 15, 2010)





AGILE sources

AGILE GRID First Source Catalogue
Period July 2007 -- June 2008



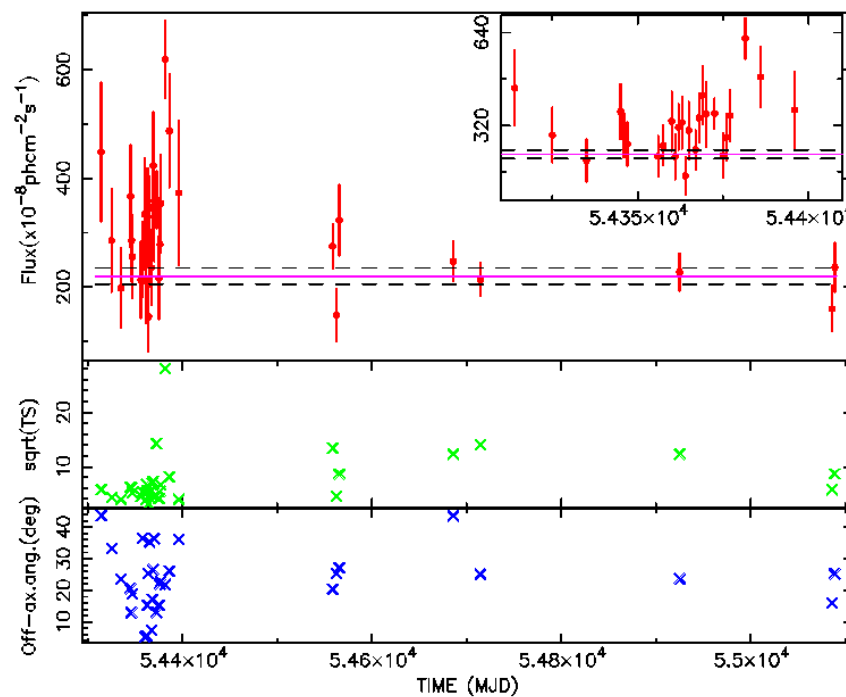
Pittori et al. 2009



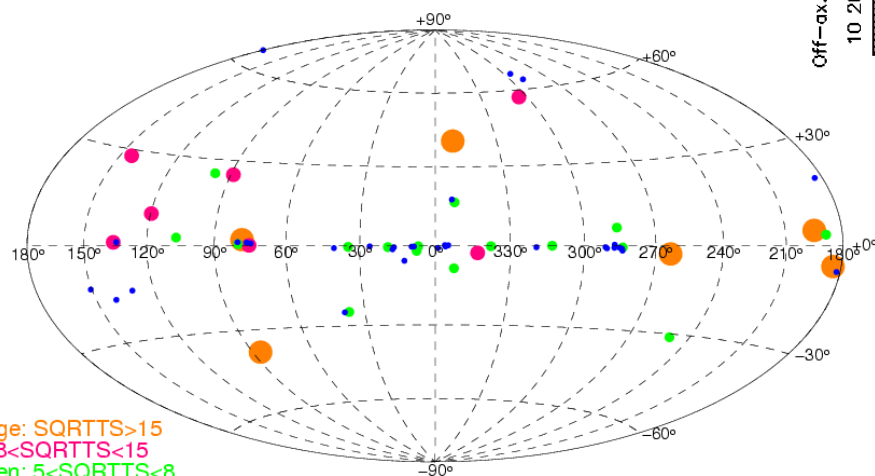
The 1AGL Variability Catalog

See Verrecchia et al # Catalog S1.N6

Crab, OB Processing



PRELIMINARY



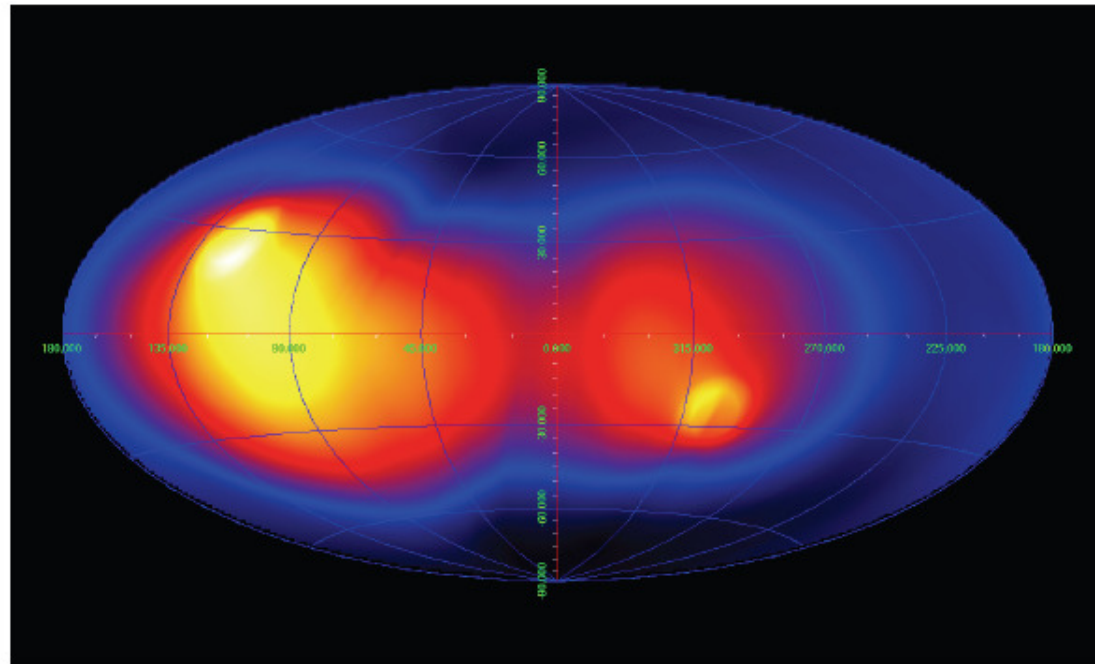
orange: $\text{SQRTTS} > 15$
 red: $8 < \text{SQRTTS} < 15$
 green: $5 < \text{SQRTTS} < 8$
 blue: $\text{SQRTTS} < 5$



The 2nd AGILE catalog

See Bulgarelli et al # Catalog S1.N1

PRELIMINARY



The preliminary version of 2AGL Catalog, that covers the first 2.5 years of AGILE, consists of **180 AGILE sources** for $E > 100$ MeV in the Galactic plane ($|b| < 10^\circ$) and **~150 sources** outside the Galactic plane. In the poster we report only a preliminary list of sources detected by AGILE with no 1FGL counterparts.



AGILE Scientific Objectives

- **Active Galactic Nuclei**
- **Gamma-Ray Bursts**
- **Pulsars**
- **TeV sources**
- **SNR** and origin of cosmic rays
- **Diffuse Galactic gamma-ray background**
- **Unidentified gamma-ray sources**
- **Microquasars**
- **Galactic Neutron Stars and Black Holes**

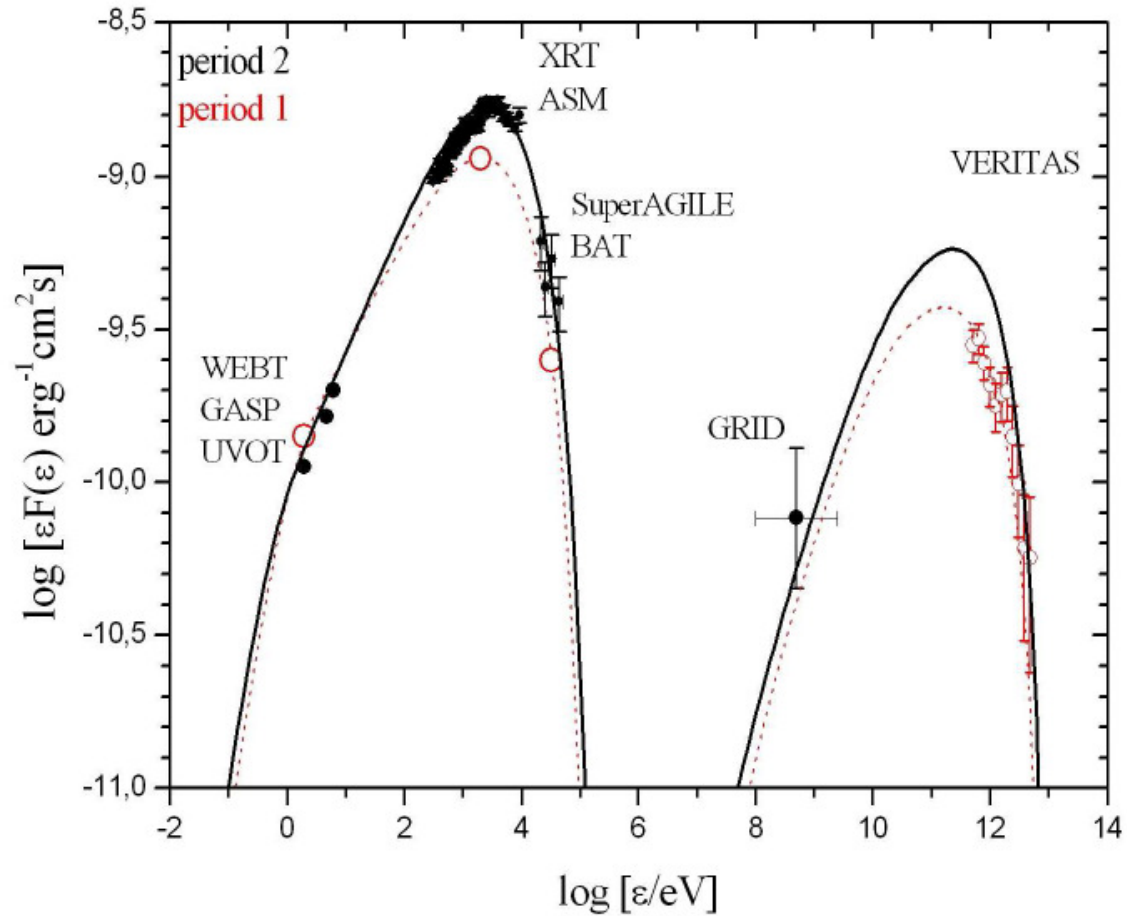


Selected AGILE and multi- λ results on TeV sources



AGILE and TeV AGN – 1

Mkn 421

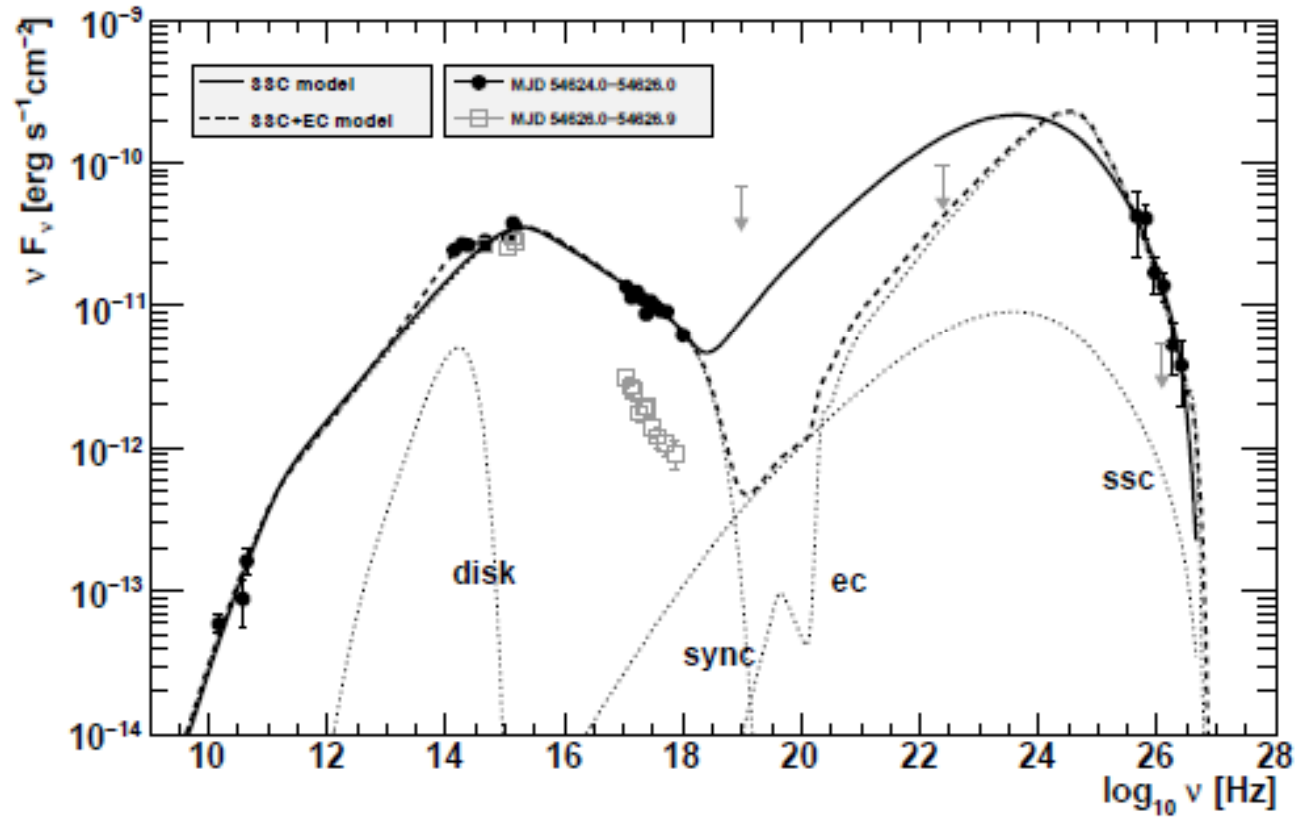


Donnarumma et al. 2009



AGILE and TeV AGN – 2

W Comae

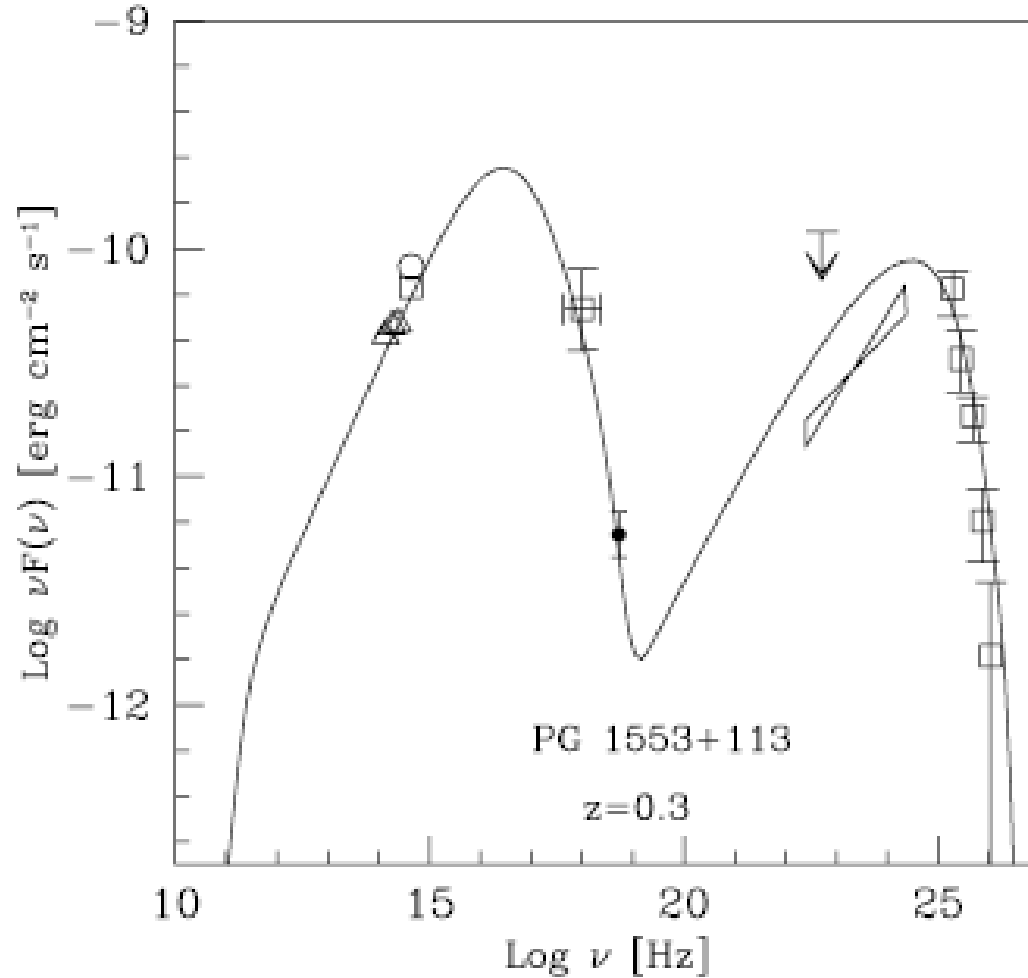


Acciari et al. 2009



AGILE and TeV AGN – 3

PG 1553+113

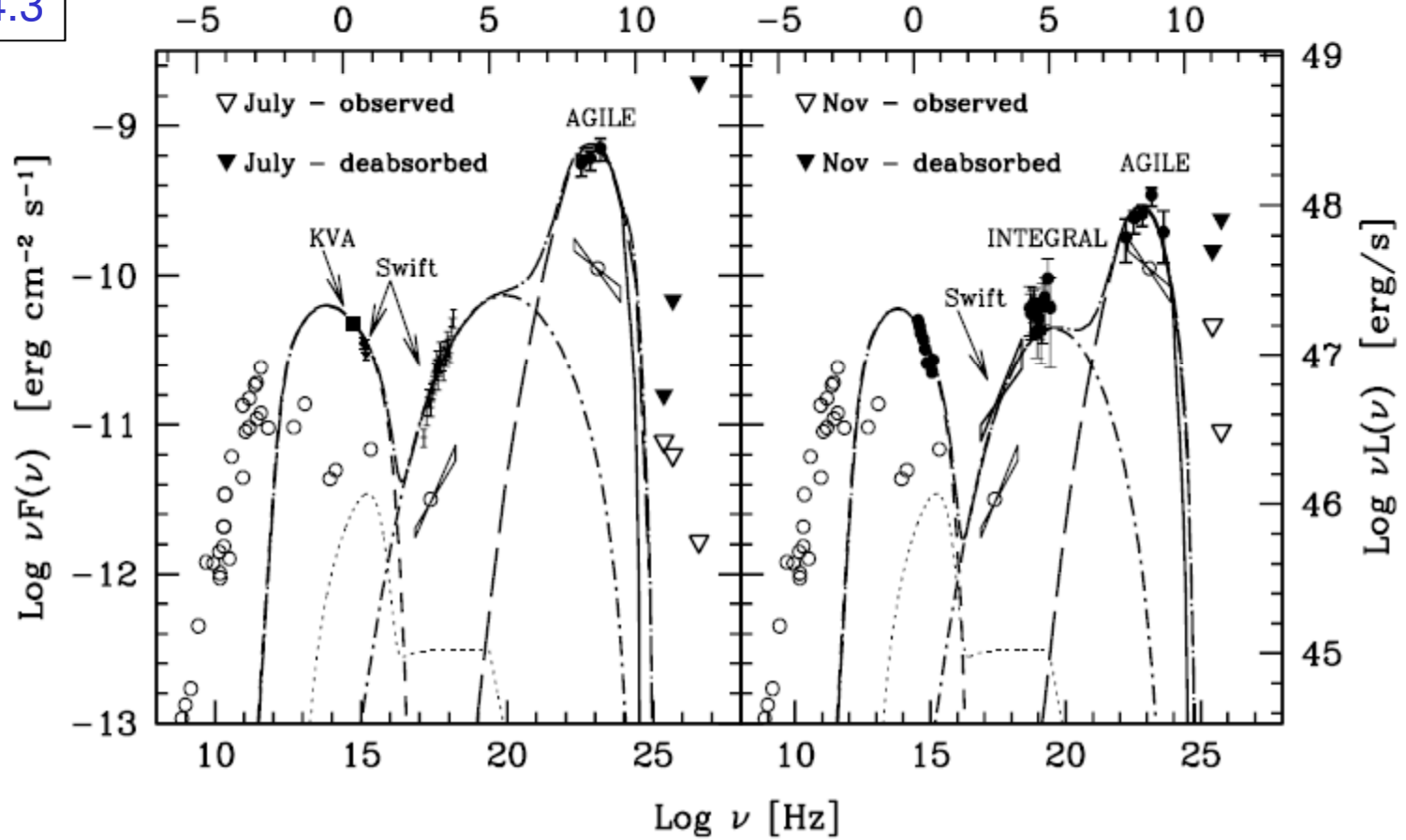


Aleksic et al. 2010



AGILE and TeV AGN – 4

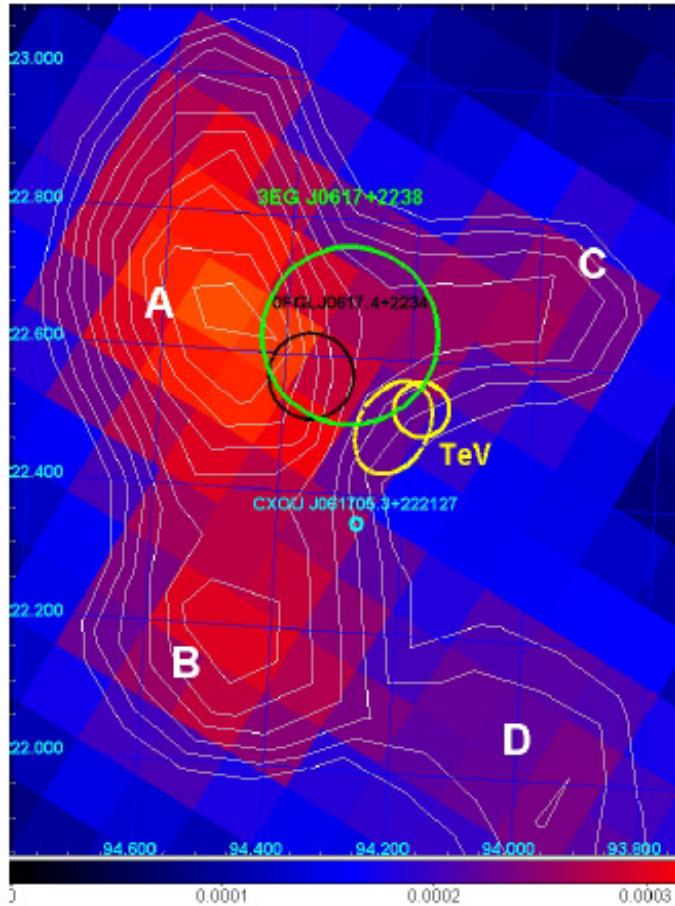
3C 454.3



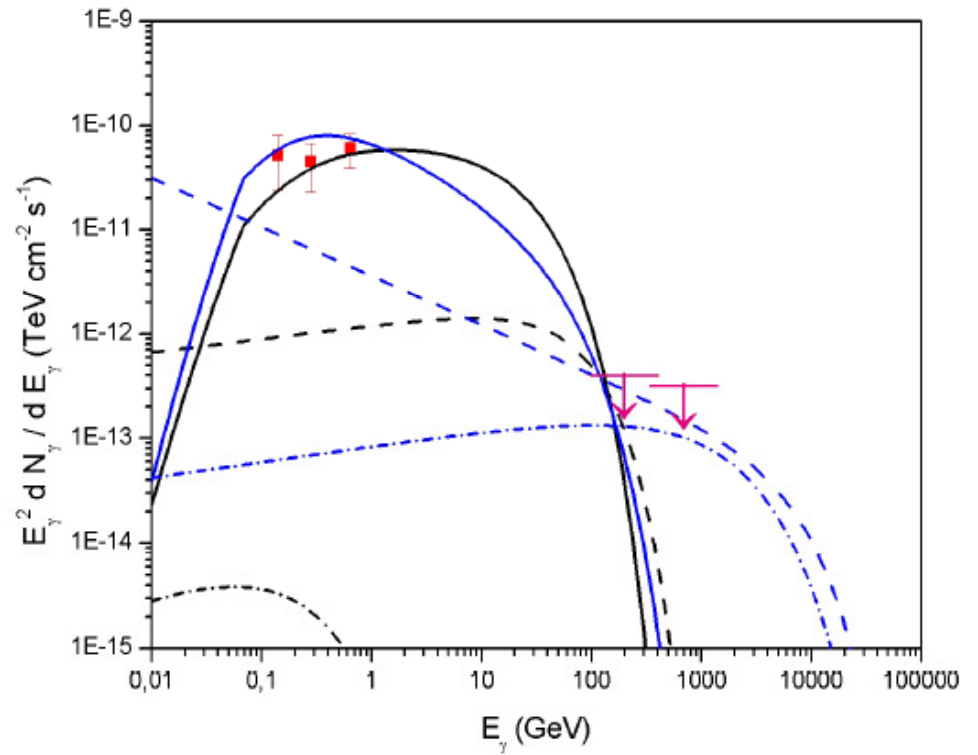
Anderhub et al. 2009



AGILE and TeV Galactic Sources – 1



IC 443

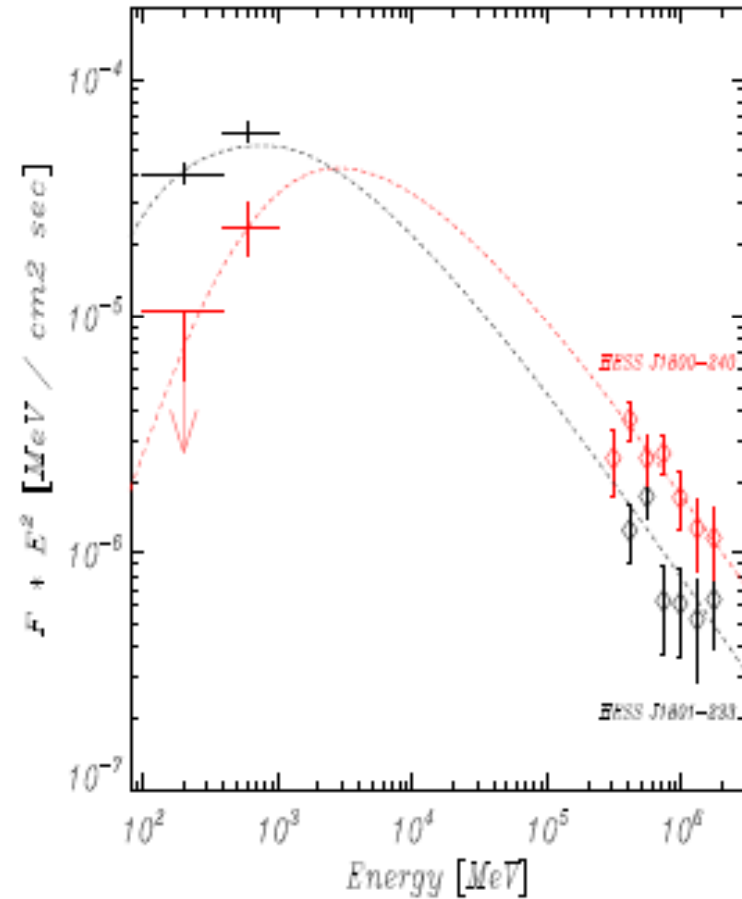
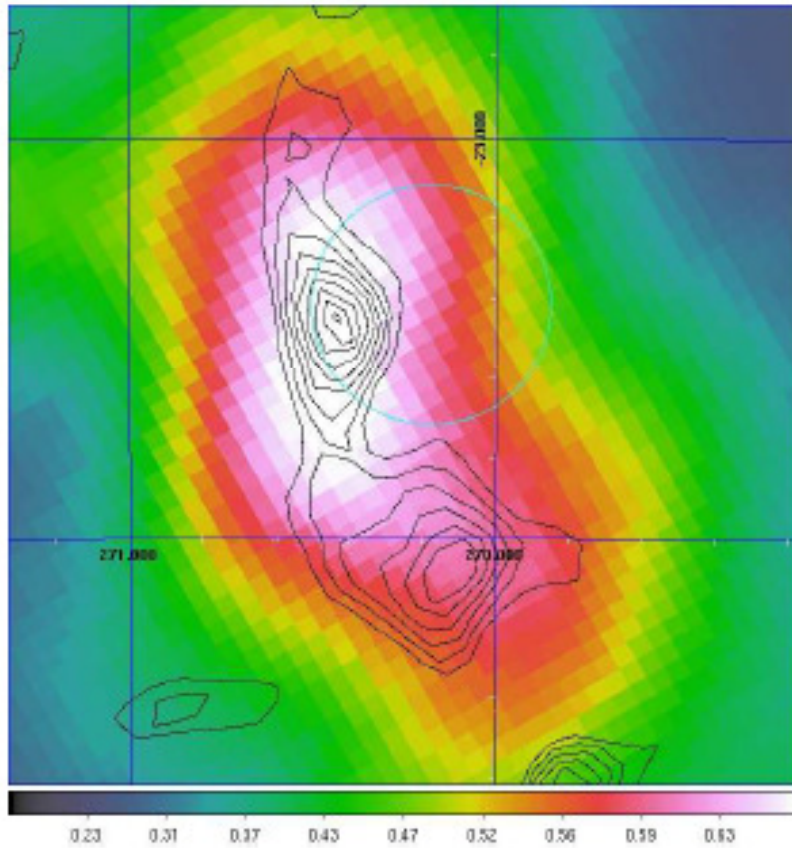


Tavani et al. 2010



AGILE and TeV Galactic Sources – 2

W28

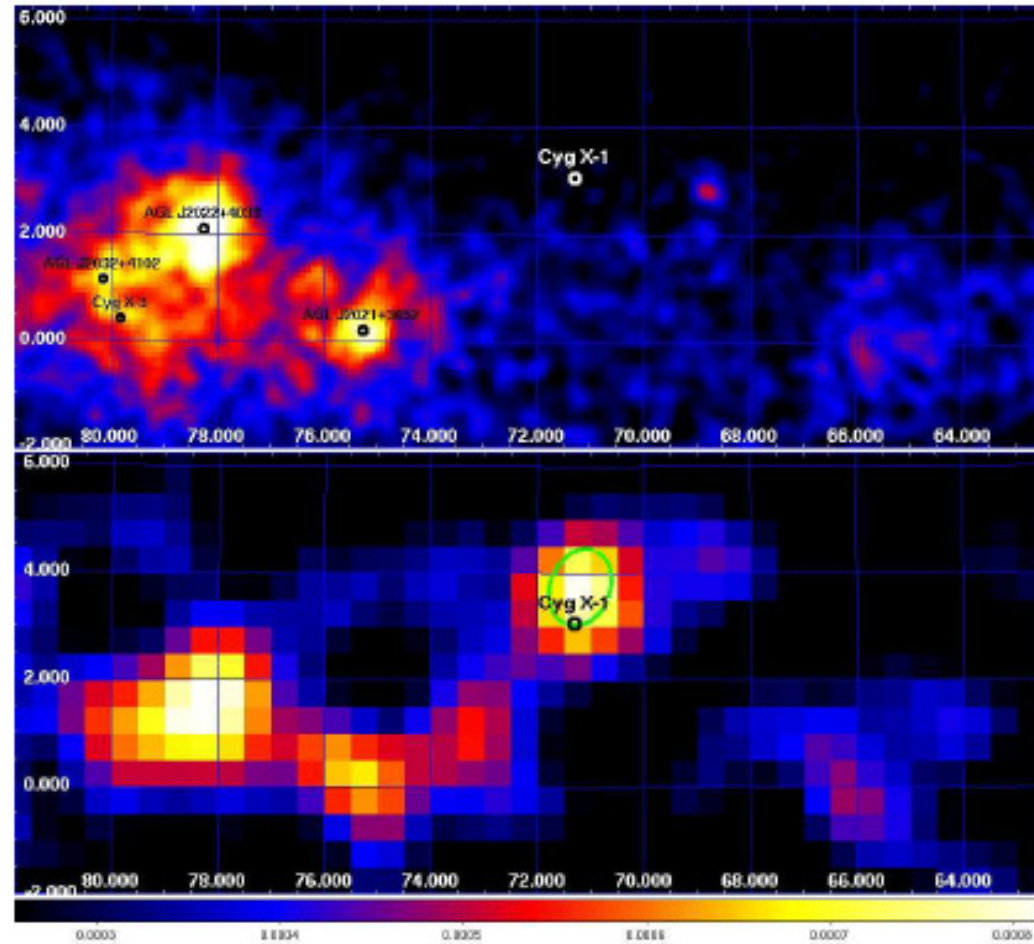


Giuliani et al. 2010



AGILE and TeV Galactic Sources – 3

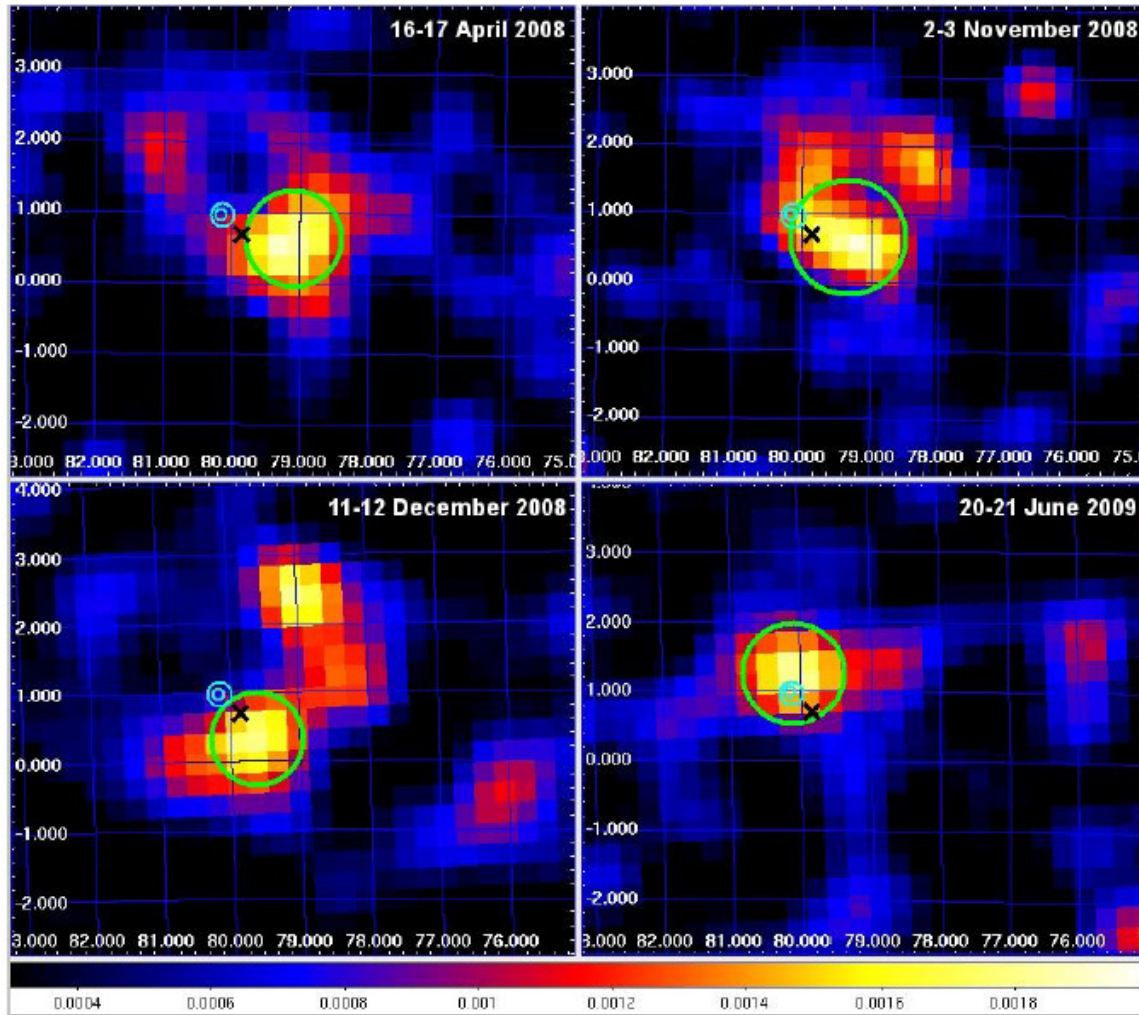
Cygnus X1



Sabatini et al. 2010, Del Monte et al 2010



AGILE and TeV Galactic Sources – 4

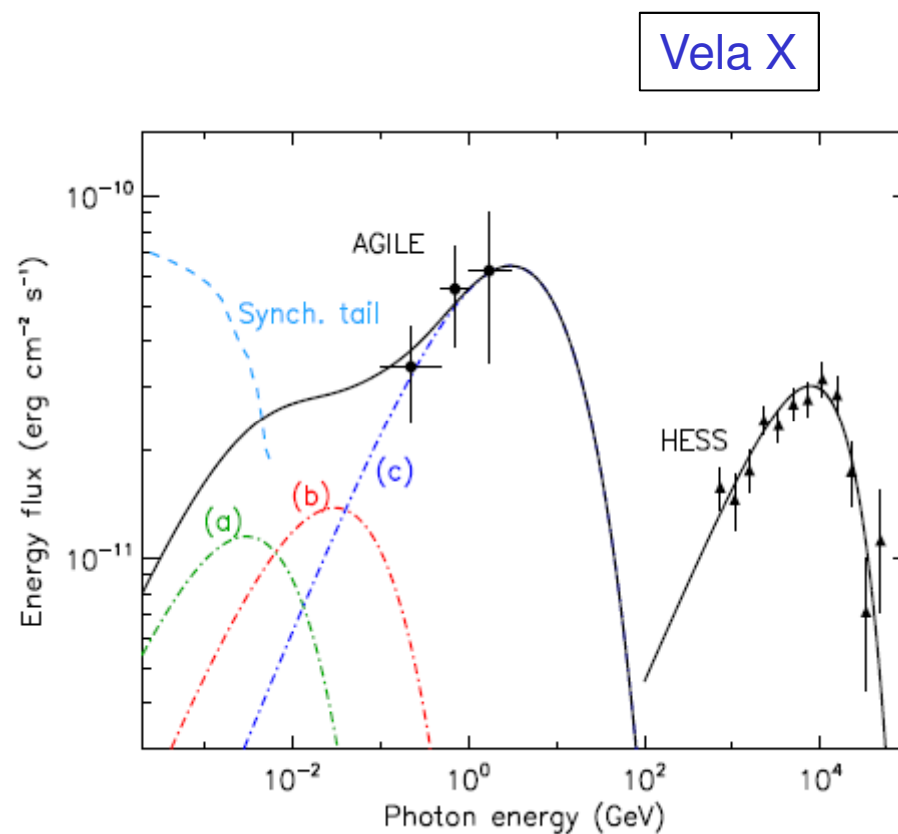
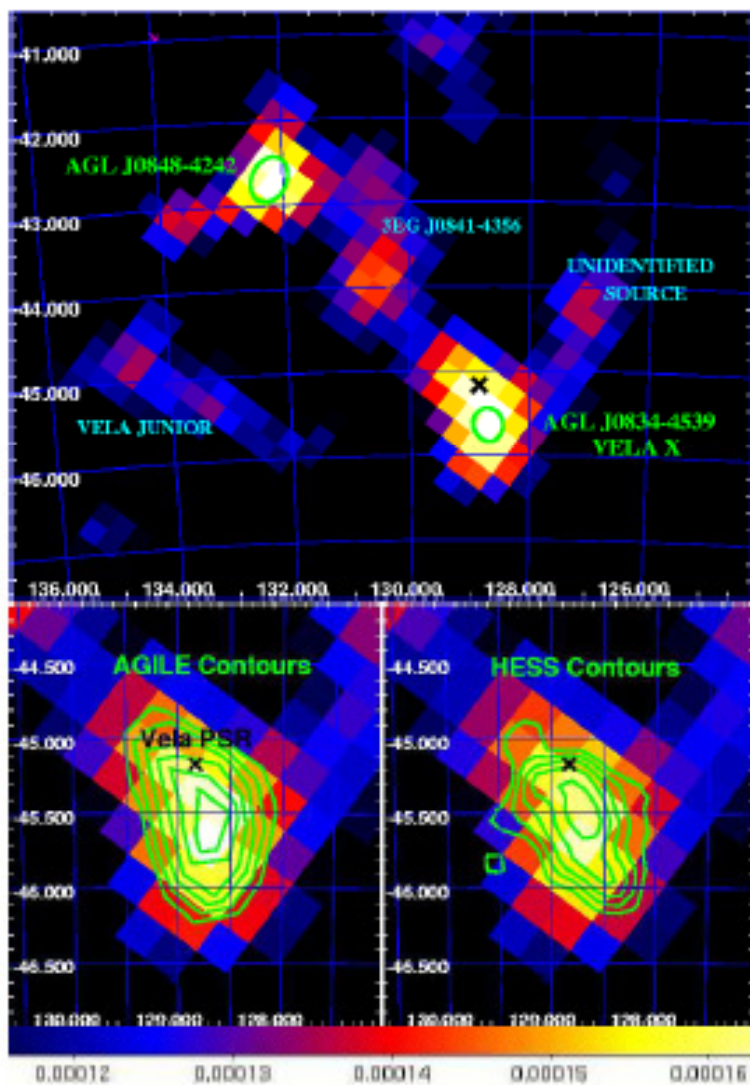


Cygnus X3

Tavani et al 2009



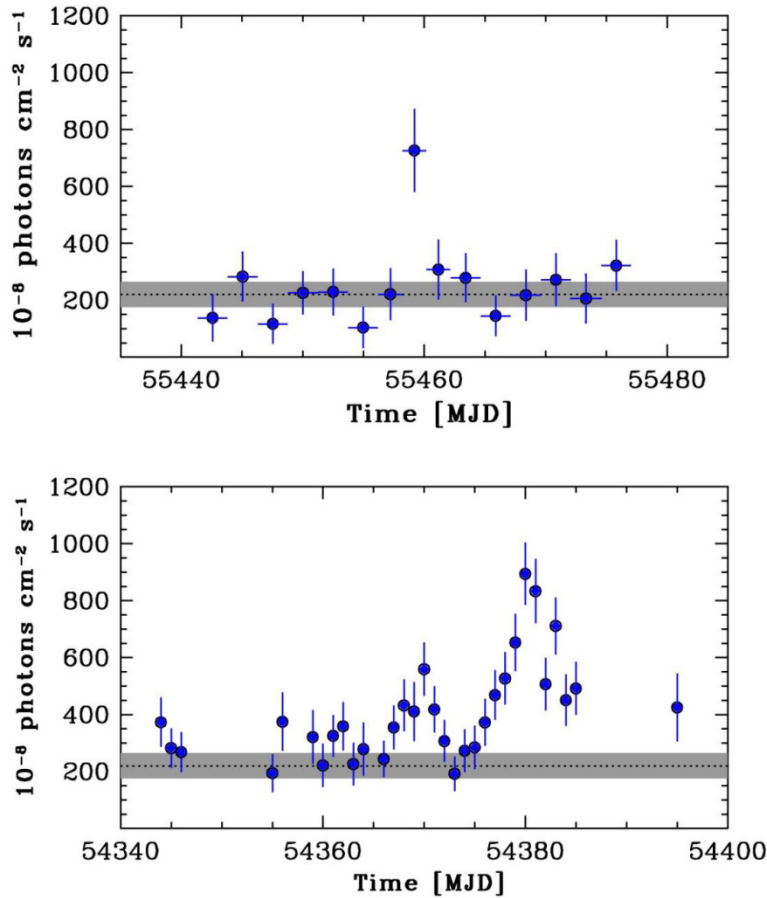
AGILE and TeV Galactic Sources – 5



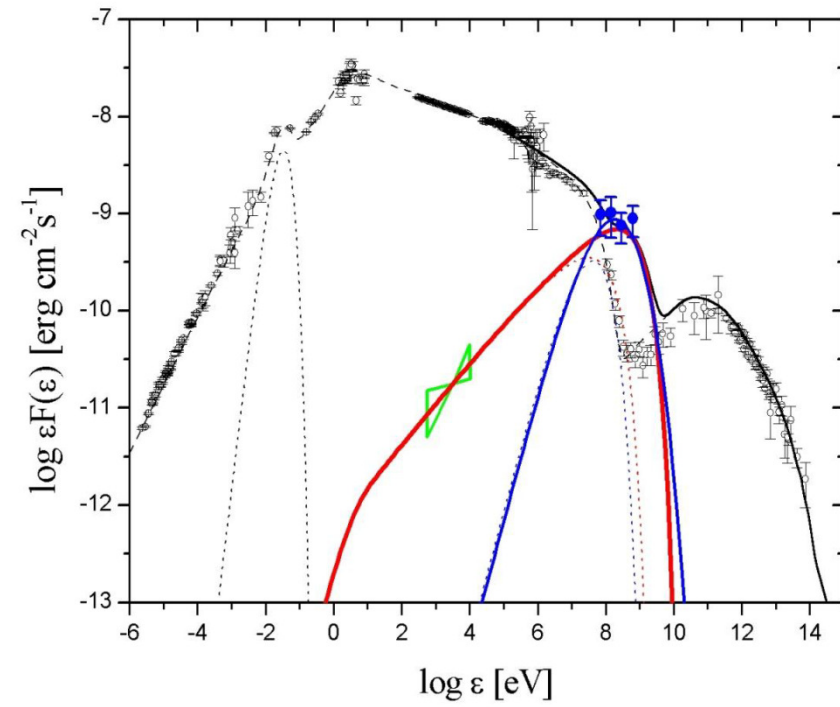
Pellizzoni et al 2010



AGILE and TeV Galactic Sources – 6



Crab Nebula



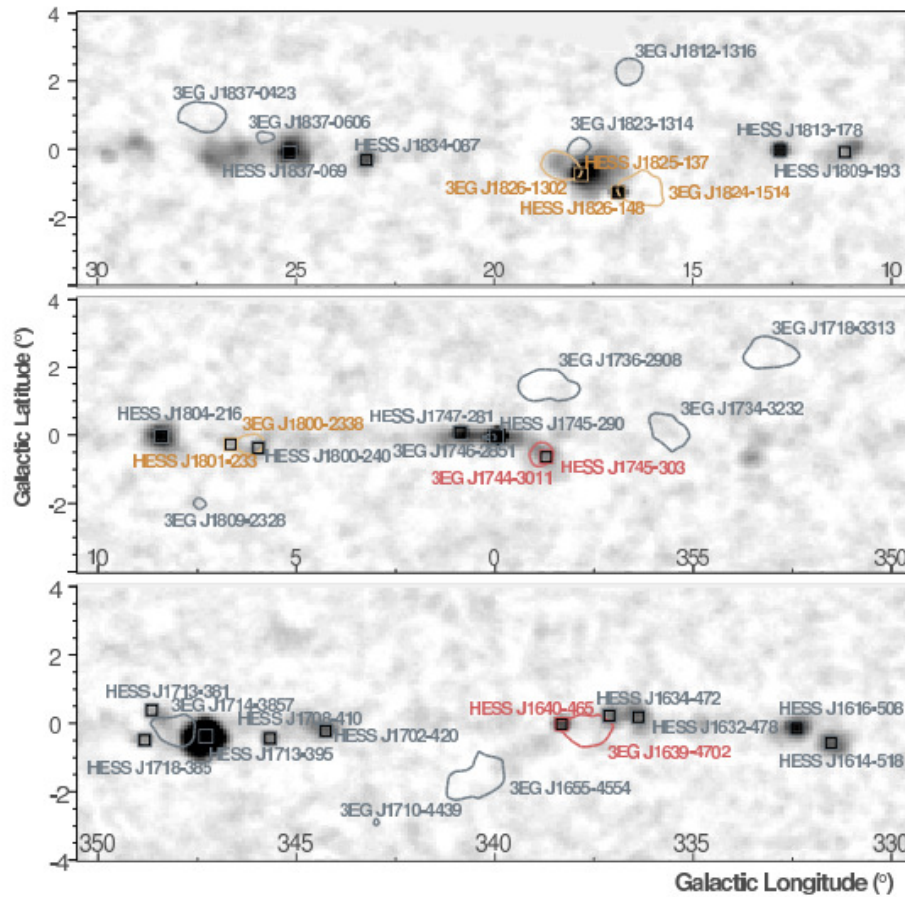
Tavani et al. 2011



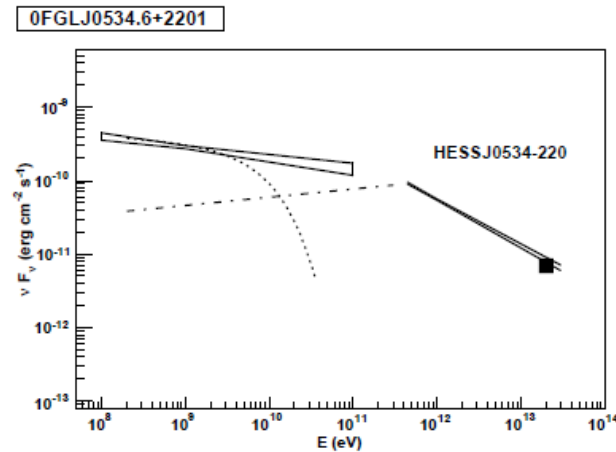
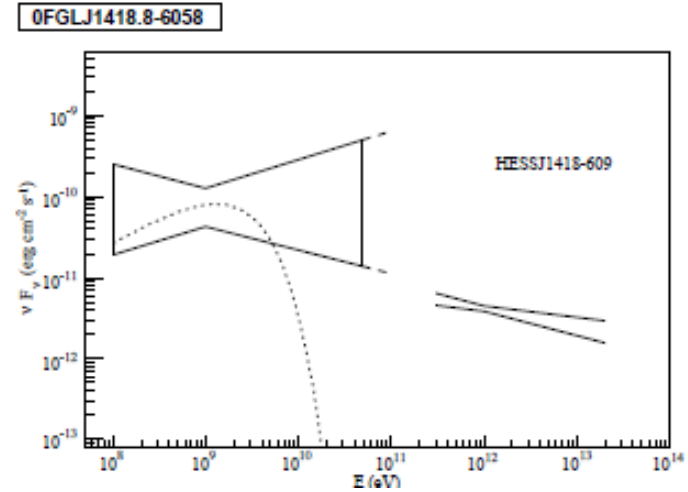
Search for GeV Counterparts of TeV sources



GeV – TeV Sources Correlation



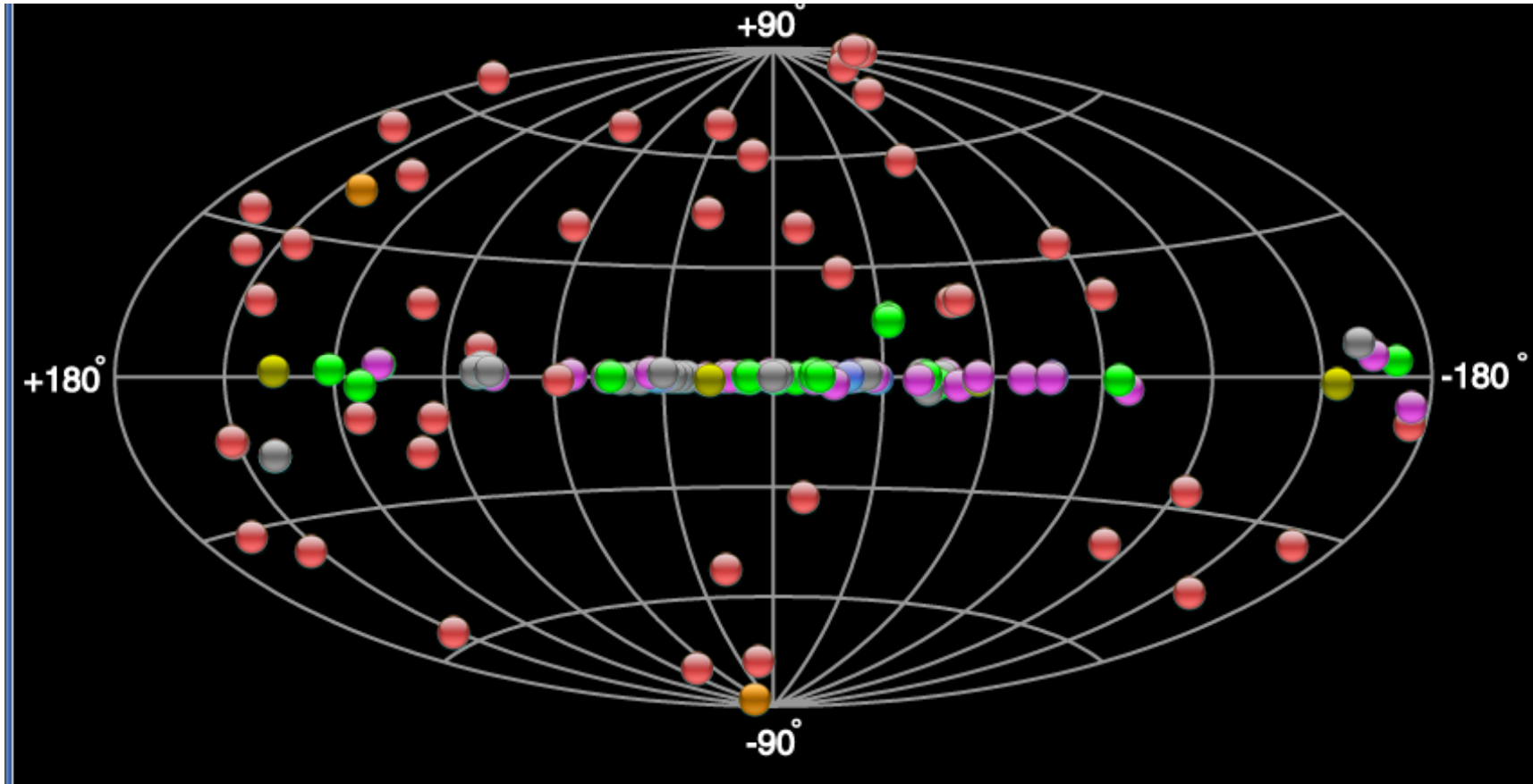
Funk et al 2008



Tam et al 2010



Search for TeV Counterparts



<http://tevcat.uchicago.edu/>



The TeV Catalog

Table Control Map Control Tools Lege...

- PWN
- Starburst
- HBL, IBL, FRI, FSRQ, LBL, AGN
(unknown type)
- Star Forming Region, uQuasar,
Cat. Var., Massive Star Cluster,
BIN, WR
- Shell, SNR/Molec. Cloud
- DARK, UNID, Other
- XRB, PSR, Gamma BIN

Export Black Export White

PWN 24
Starburst 2
AGN 45 (HBL 29)
Other Galact 3
SNR /MC 14
UNID/DARK 25
PSR, XRB 3

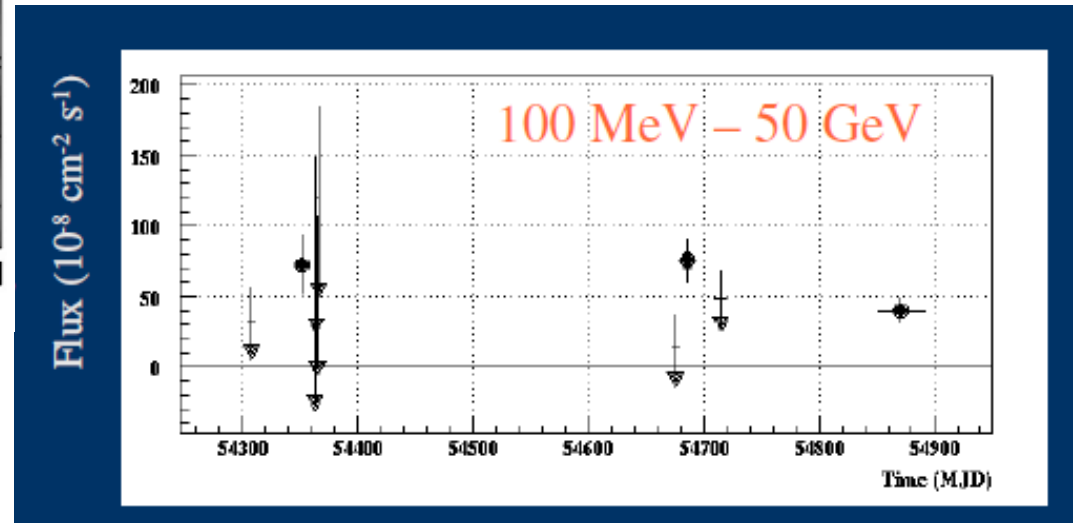
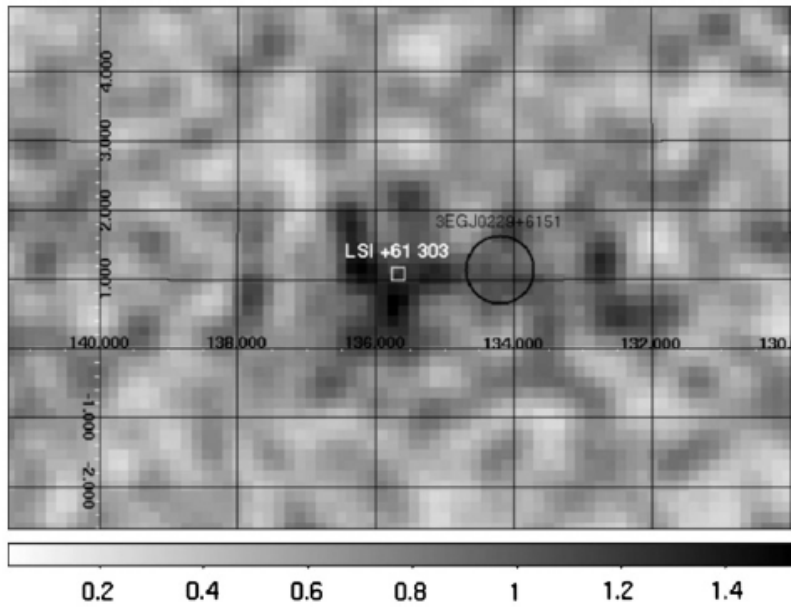
with correct TeV positions made at @ ASDC
(F.Lucarelli, A.Antonelli, A.Carosi)

<http://tevcat.uchicago.edu/>



Preliminary Results (RICAP 2009)

Eg. LSI +61 303 analysis



Rappoldi et al. 2011



The Search Criteria

- **Only Pointing Period: 09.07.2007 – 31.10.2009**
- **$E > 100$ MeV**
- **I0010 response matrix**
- **Deep Maps ($40^\circ \times 40^\circ$) binned at 0.1°**
- **FM Gamma Filter**
- **Multi4 Likelihood Analysis**
 - **All 1AGL Sources in the Field (within 10 Degrees)**
 - **2 steps**
 - **Determination of Gal, Iso Components**
 - **Source to be associated with TeV left free in flux and position within 1°**
- **Complete automated analysis → Detailed analysis to follow**
- **To be improved using 2AGL sources**



Preliminary Results

Source Class	TeV Catalog	Detection sqrt(TS>4)
AGN (HBL)	45 (29)	15 (6)
Starburst	3	--
PWN	24	10
SNR	14	8
XRB	3	1
UNID/Dark	25	11
Other Galactic	3	1



Conclusions

- **AGILE is in orbit since 4 years**
- **Its scientific results are remarkable !**
- **Specific analysis on TeV Sources**
 - **Spectral Analysis during flare states for HBL**
 - **Detection, Localization and Spectral Analysis for SNR/PWN**
 - **Flaring Objects**
- **The Second Catalog is in preparation – Stay Tuned !**
- **Systematic and Automated Search of TeV candidates provided interesting preliminary results**
 - **~ 1/3 of TeV sources have an AGILE associated source**
 - **Variability studies to come**
- **See preliminary results of this work in Rappoldi et al. (2011)**



AGILE poster contributions

- **AGN S1.N22 Donnarumma, I. The remarkable gamma-ray activity of the gravitationally lensed blazar PKS 1830-211**
- **AGN S1.N60 Lucarelli, F. Extra-galactic transient sources observed in the first year of the AGILE satellite in spinning mode**
- **AGN S1.N76 Pacciani, L. The unusual gamma-ray flare of AGLJ 1238+0406**
- **AGN S1.N80 Pittori, C. The major gamma-ray flare of the blazar 4C +21.35 on June 17-19, 2010: AGILE data analysis and multiwavelength follow up observations**
- **AGN S1.N98 Vercellone, S. A success story: 3C454.3 in the gamma-ray energy band**
- **Catalog S1.N1 Bulgarelli, A. The Second AGILE Catalog of Gamma-Ray sources**
- **Catalog S1.N6 Verrecchia, F. A study of the AGILE first Catalog galactic gamma-ray sources on the 2.3 years Agile-GRID data**
- **AGN S1.N87 Rügamer, S. MAGIC and Multi-Frequency Observations of three HBLs in 2008 (with AGILE data)**



AGILE poster contributions

- **GRB S2.N18 Longo, F. The observation of GRBs with AGILE: upper limits and detections**
- **Microquasar S2.N1 Piano, G. AGILE monitoring of the microquasar Cygnus X-3**
- **OtherGal S2.N10 Sabatini, S. AGILE monitoring of Cyg X-1**
- **PSR S2.N3 Chen, A. W. AGILE Studies of the gamma-Cygni source**
- **SNR/PWNe S2.N11 Giuliani, A. AGILE observations of SNRs**
- **SNR/PWNe S2.N25 Striani, E. AGILE observations of gamma-ray flares of the Crab Nebula**
- **TGF S2.N4 Fuschino, F. Correlation of AGILE TGFs and global lightning activity across the equatorial belt**



Where to find data?

ASDC ASI Science Data Center **ASI** agenzia spaziale italiana

Home About ASDC Public Outreach Quick Look Missions Multimission Archive Catalogs Tools Links Bibliographic services

AGILE Science Data Center

AGILE Home About AGILE ASI HQ AGILE AGILE News AGILE Data Archive Public Software AGILE Pointings AGILE Catalogs Restricted Area
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Welcome to the AGILE Data Center Home Page at ASDC

These pages provide updated information and services in support to the general scientific community for the mission AGILE, which is a small Scientific Mission of the Italian Space Agency (ASI) with participation of INFN, IASF/INAF and CIFS .

AGILE is devoted to gamma-ray astrophysics and it is a first and unique combination of a gamma-ray (AGILE-GRID) and a hard X-ray (SuperAGILE) instrument, for the simultaneous detection and imaging of photons in the 30 MeV - 50 GeV and in the 18 - 60 keV energy ranges.

The AGILE Mission Board (AMB) has executive power overseeing all the scientific matters of the AGILE Mission and is composed of:

- AGILE Principal Investigator: Marco Tavani, INAF/IASF Rome (Chair)
- ASI Project Scientist: Paolo Giommi, ASDC
- ASI Mission Director: Giovanni Valentini, ASI
- Former ASI Mission Director: Luca Salotti, ASI (up to September 20, 2010)
- AGILE Co-Principal Investigator: Guido Barbiellini, INFN Trieste
- 1 ASI representative: Elisabetta Tommasi di Vignano
- Former ASI representative: Sergio Colafrancesco (up to June, 2010)

AGILE current spinning sky view

(Click here for previous pointing details)

Click here to access to AGILE Spinning FOV plotter

AGILE Events

AGILE **AO3 closed**
March 30 - April 30, 2010

<http://agile.asdc.asi.it/>



AGILE Guest Observers AO

- **Cycle – 1 (Dec 2007 – Nov 2008)**
 - **39 PSR, 31 AGN, 30 Other 3EG**
- **Cycle – 2 (Dec 2008 – Nov 2009)**
 - **21 PSR, 62 AGN, 10 Other 3EG**
- **Cycle – 3 (Dec 2009 – Nov 2010)**
 - **12 PSR, 37 AGN, 7 Other 3EG, 10 1FGL**
- **AGILE A04 to be opened soon !**

