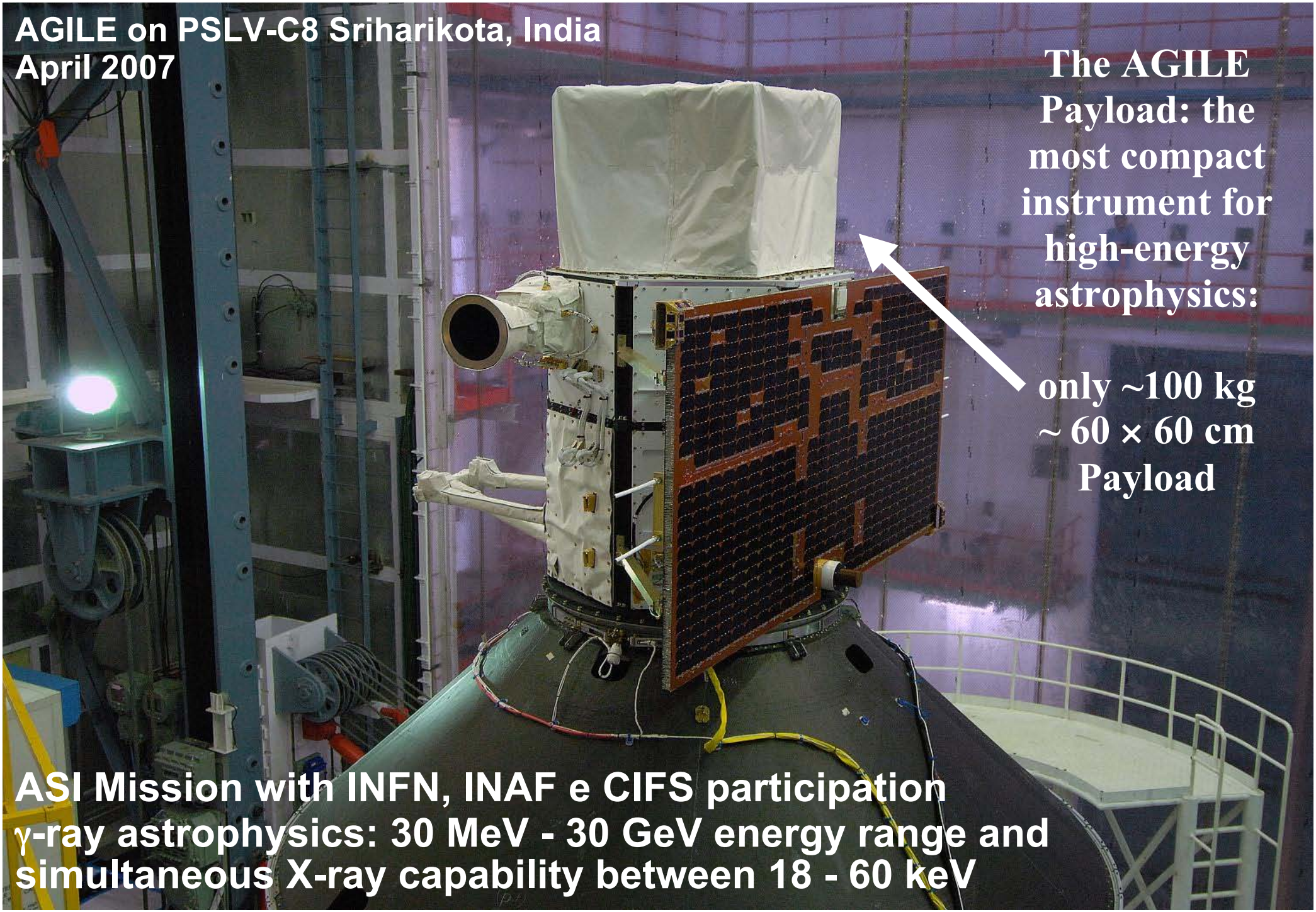
asdc
ASI Science Data Center

AGILE Data Center @ ASDC and AGILE Highlights

SciNeGHE 2012
9th Workshop on Science with the New Generation of High Energy Gamma-ray Experiments
From high energy gamma sources to cosmic rays, one century after their discovery
20-22 June 2012 , Lecce (Italy)

Carlotta Pittori, ***on behalf of the*** **AGILE** ***Collaboration***

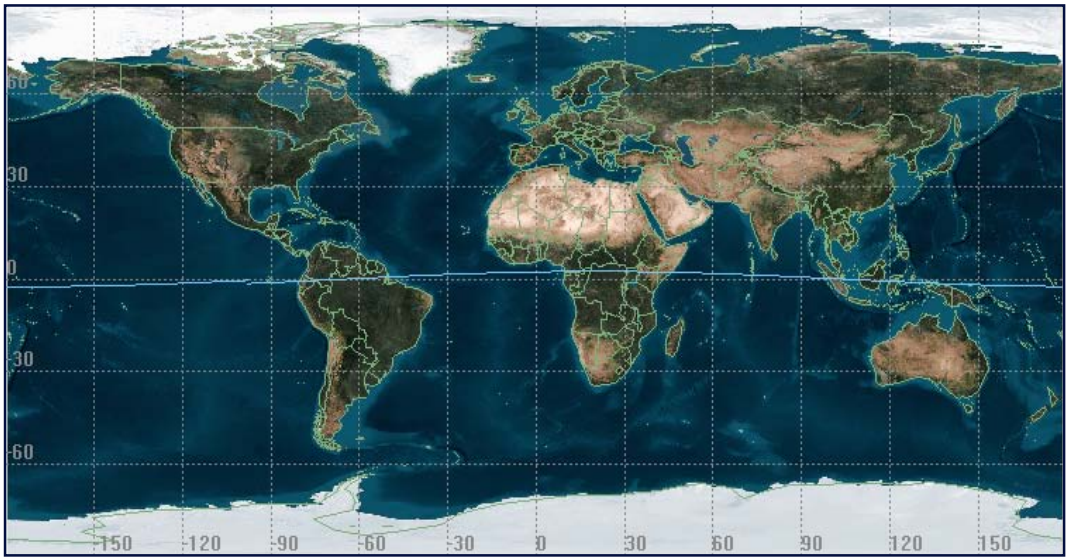

AGILE on PSLV-C8 Sriharikota, India
April 2007
The AGILE Payload: the most compact instrument for high-energy astrophysics:
only ~100 kg
~ 60 × 60 cm
Payload
ASI Mission with INFN, INAF e CIFS participation
γ-ray astrophysics: 30 MeV - 30 GeV energy range and simultaneous X-ray capability between 18 - 60 keV

AGILE: inside the cube…

AGILE orbital parameters

Launch: April 23, 2007 from India
Baseline equatorial orbit: 550 Km, 3º inclination

Semi-major axis: 6922.5 km (± 0.1 km)
Requirement: 6928.0 ± 10 km



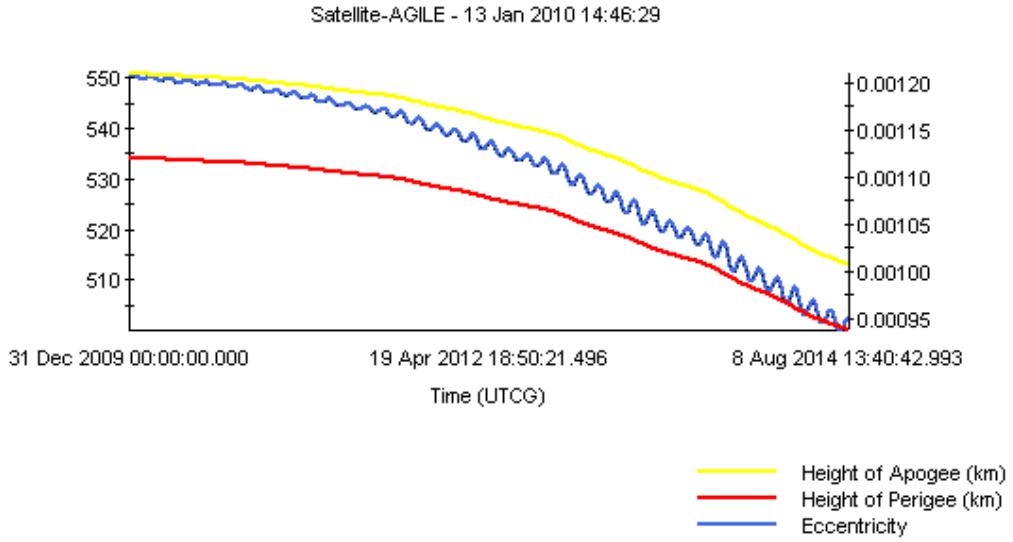
Inclination angle: 2.48° (±0.04°)
Requirement: < 3°

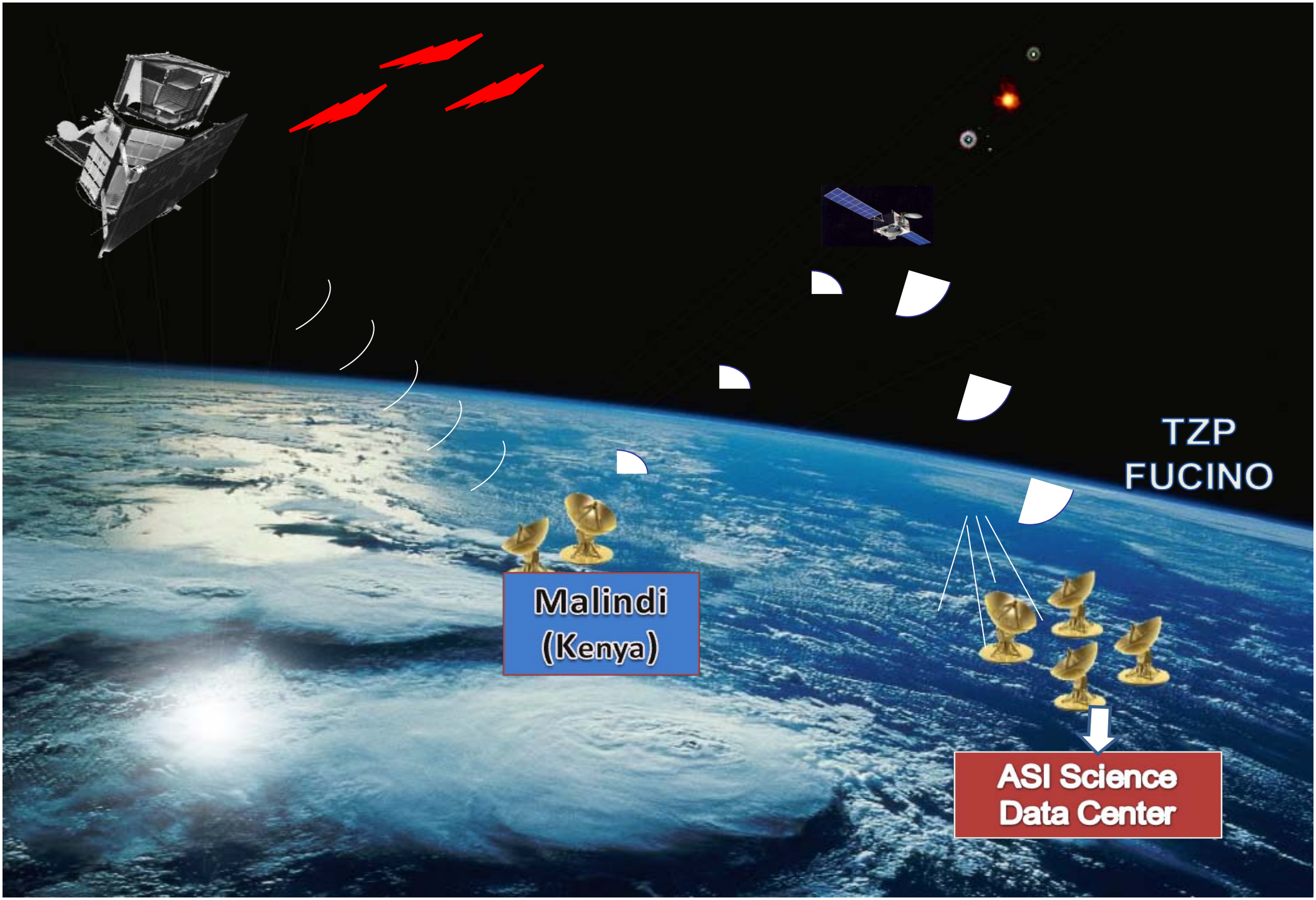
Eccentricity: 0.002 (±0.0015)
Requirement: < 0.1°

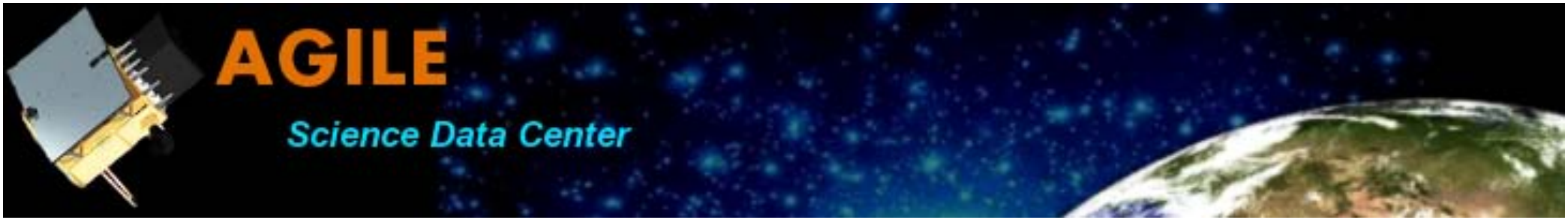
TPZ orbital decay estimate:

Height < 500Km **08 Agosto 2014**

(Jan 13, 2010 estimate, using solar flux "Schatten" forecasts + 2σ)



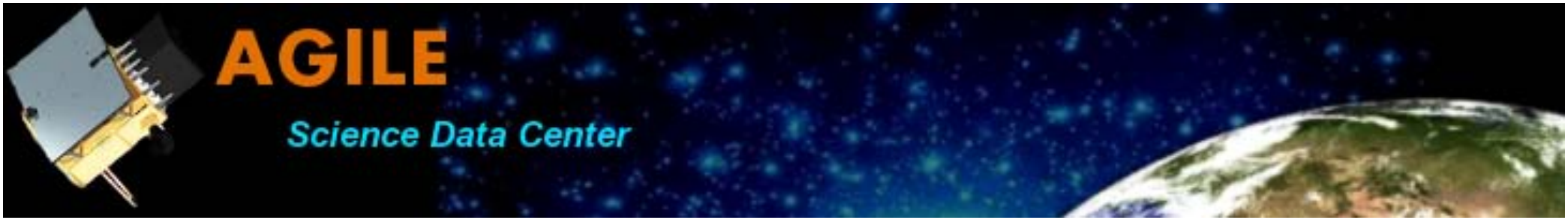

TZP
FUCINO
Malindi
(Kenya)
ASI Science
Data Center



AGILE Telemetry raw data (Level-0) are down-linked every ~ 100 min to the ASI Malindi ground station in Kenya and transmitted first to the Telespazio Mission Control Center at Fucino, and then to the AGILE Data Center (ADC). Raw data are routinely received at ADC within ~ 5 min after the end of each contact.

ADC main tasks are:

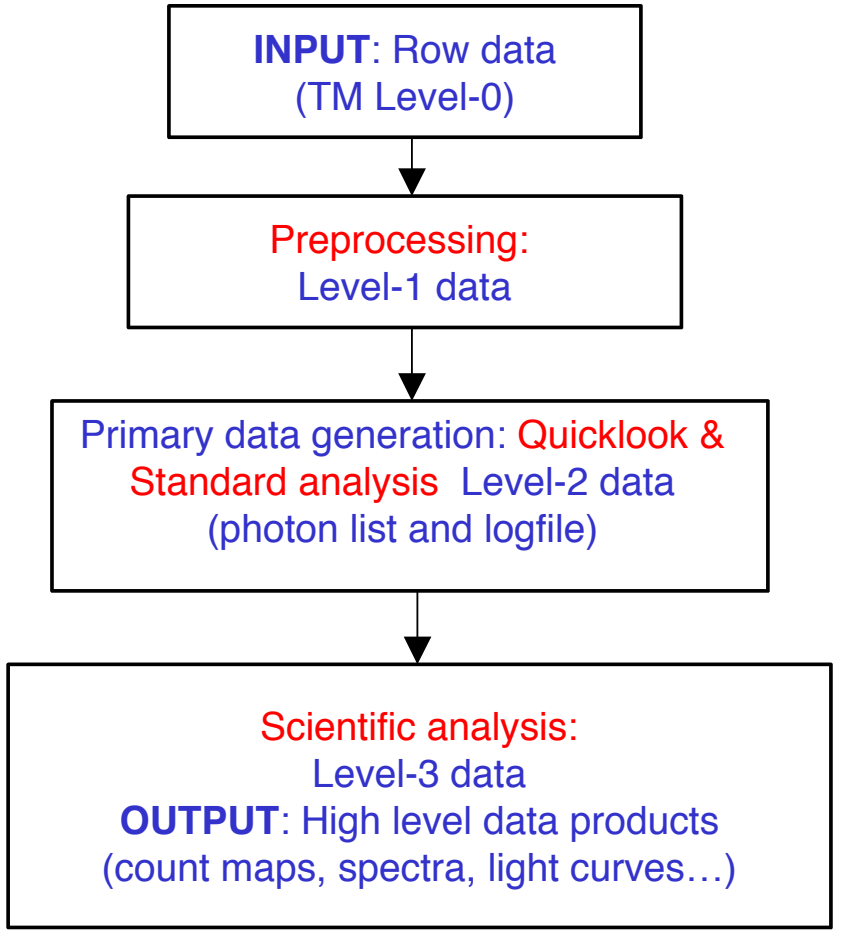
- data processing (real-time and reprocessing) and production of the data archives (from raw data to scientific level data through calibration level data),
- preliminary data analysis (Quick Look Analysis),
- management of the Guest Observer Program and of the AOs
- management of the Mission Planning (Long Term Plan preparation and emission),
- data and software distribution to the scientific community



- The ADC, based at ASDC-ESRIN, is in charge of all the scientific oriented activities related to the analysis and archiving of AGILE data:

From scientific telemetry (TM) Level–0:

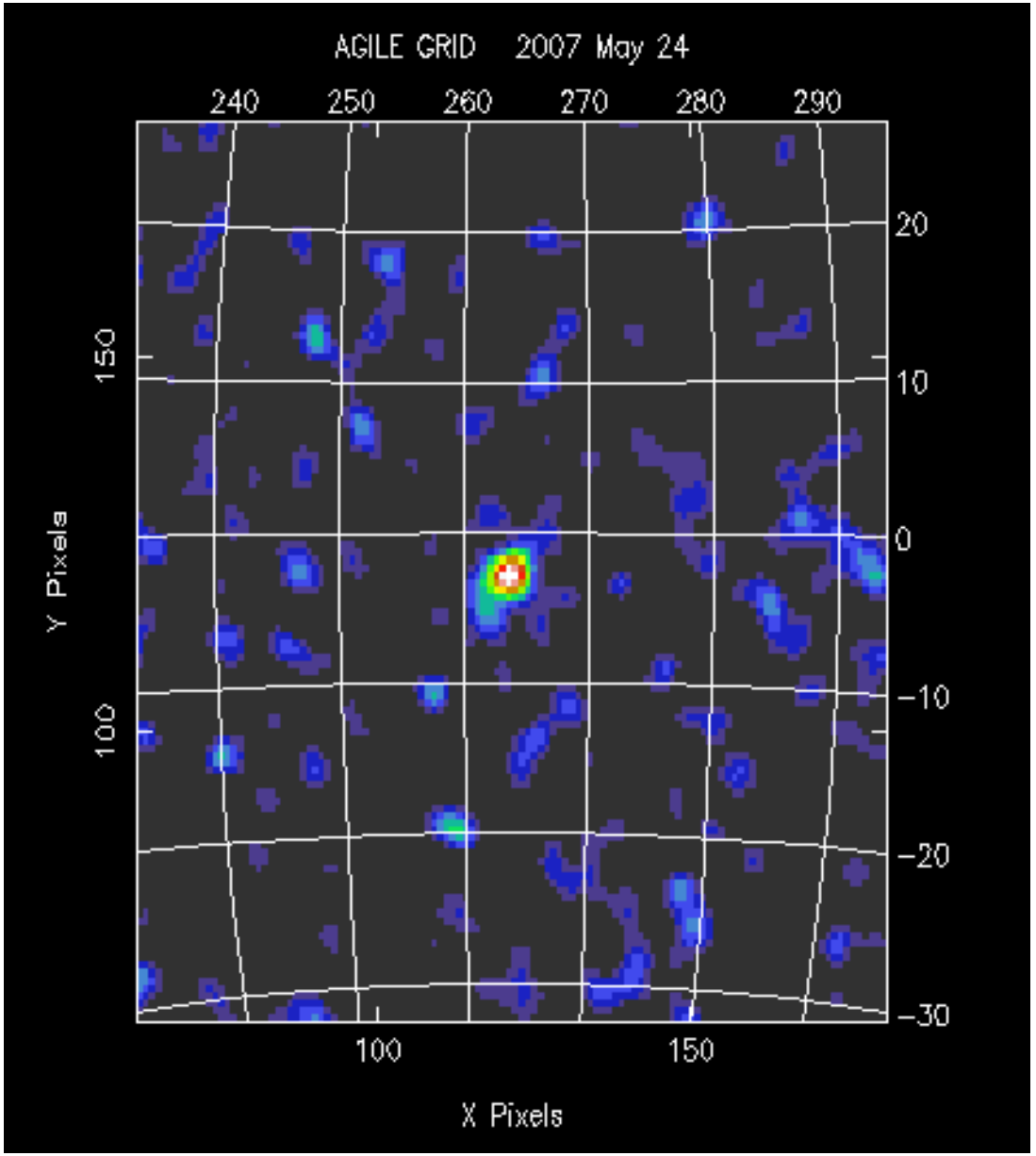
- ✓ Preprocessing → Level-1 data
- ✓ Quick-Look Analysis (transient detection)
- ✓ Standard analysis → Level-2 data (photon list)
- ✓ Scientific analysis (source detection, diffuse gamma-ray background)
- ✓ Archiving and distributing all scientific AGILE data



First AGILE GRID light
ADC 24/5/2007

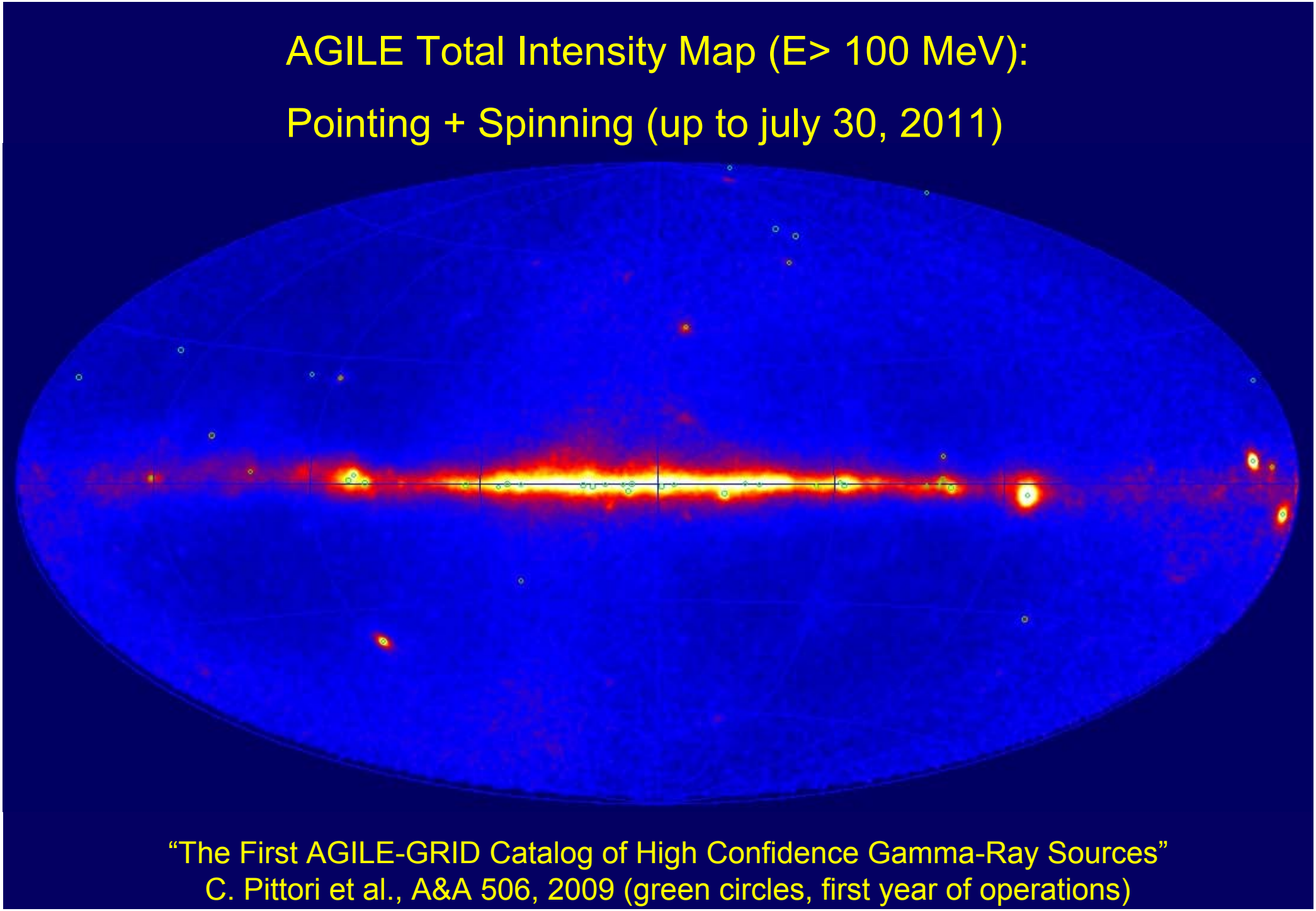
Commissioning Phase:
AGILE Vela PSR Count Map

(~ 20000 s)

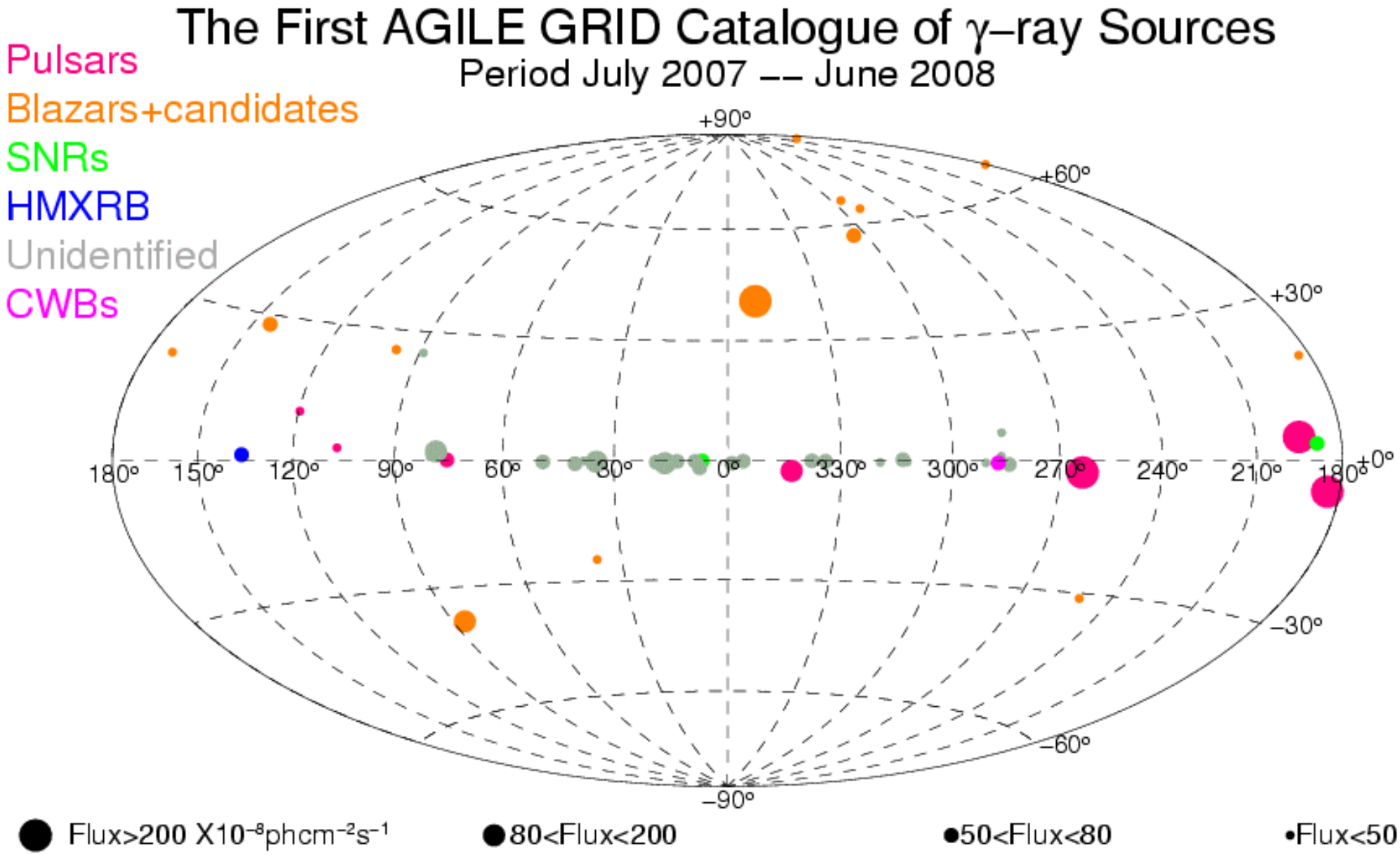


AGILE Total Intensity Map (E> 100 MeV):

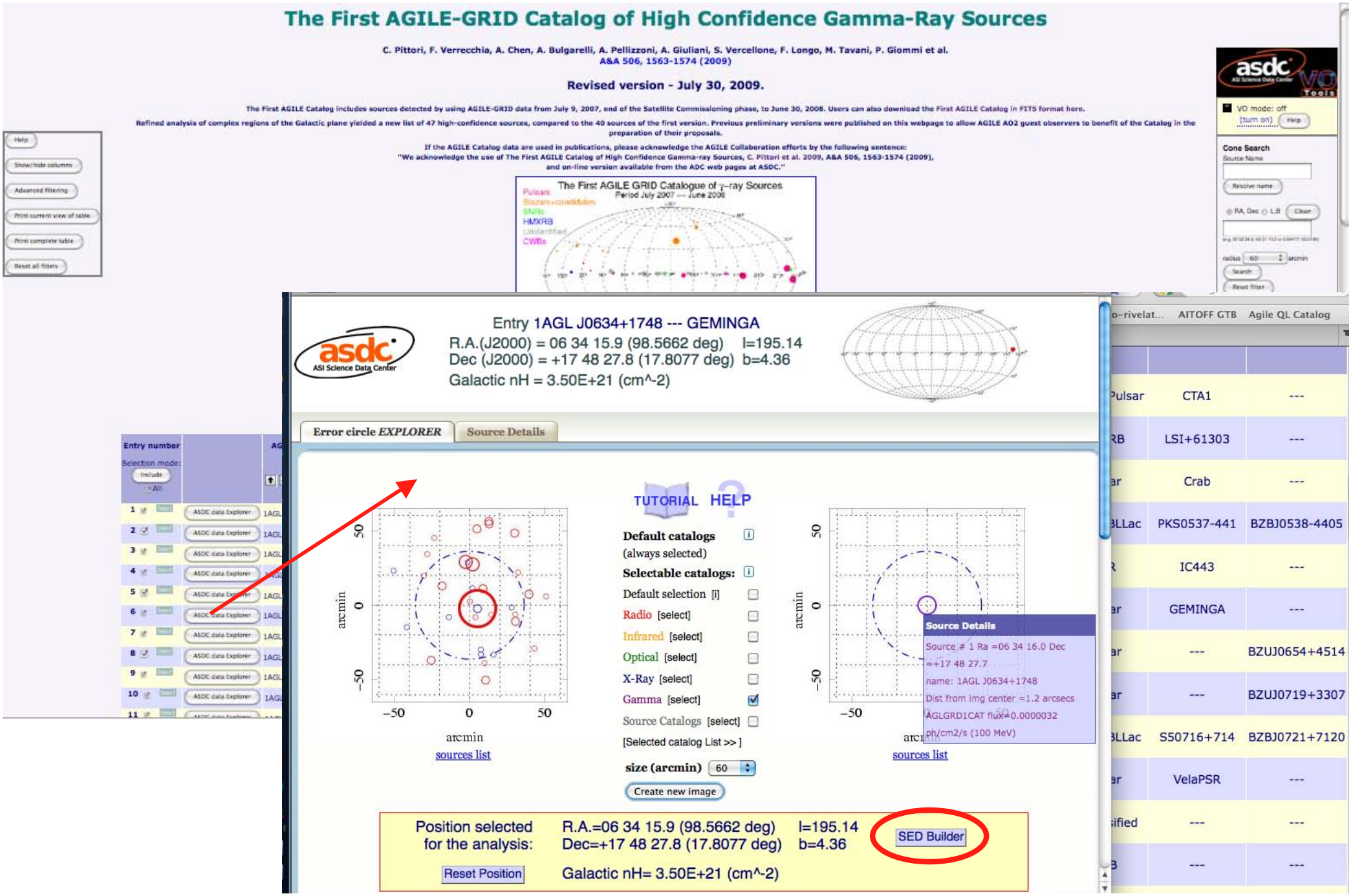
Pointing + Spinning (up to july 30, 2011)



"The First AGILE-GRID Catalog of High Confidence Gamma-Ray Sources"
C. Pittori et al., A&A 506, 2009 (green circles, first year of operations)



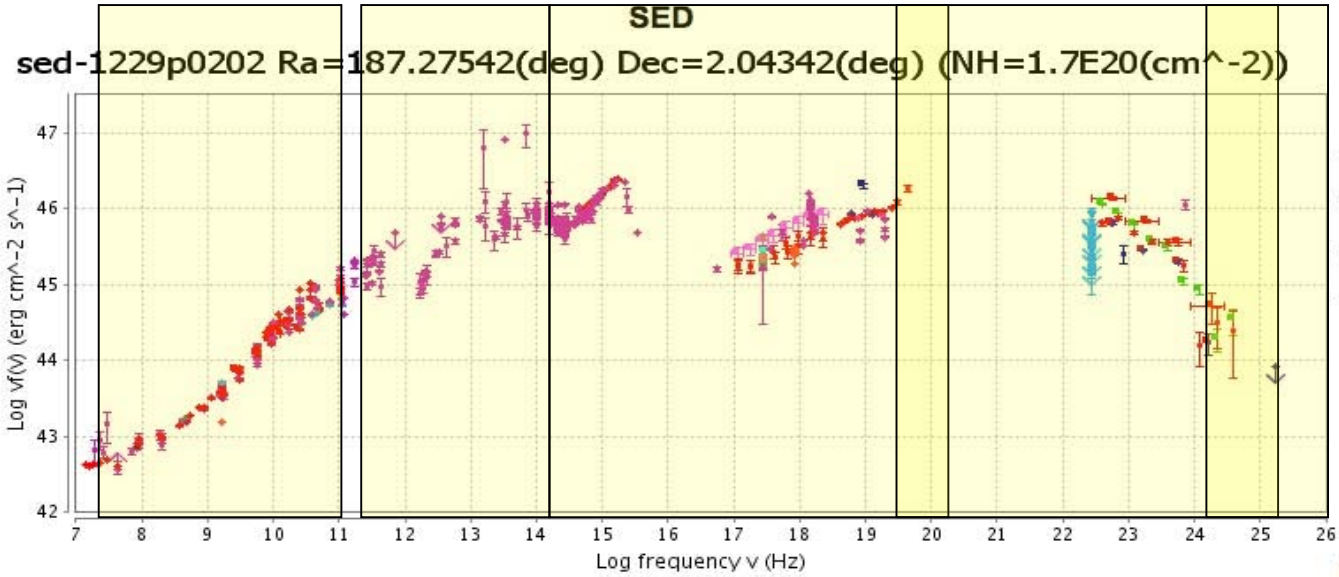
- **C. Pittori et al., A&A 506, 2009 - arXiv:0902.2959**

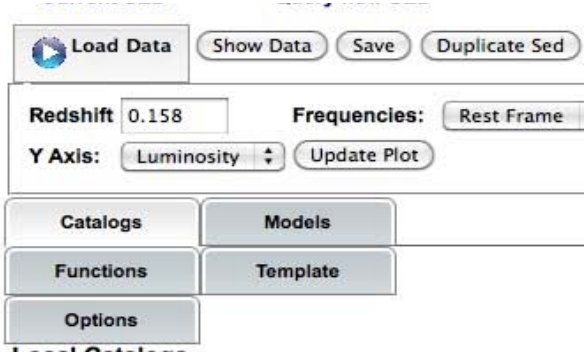


ASDC interactive catalogs webpages

The ASDC SED Builder

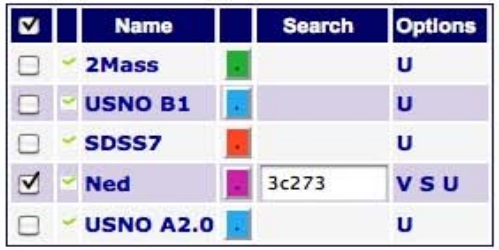
Radiotelescopes and Planck Swift AGILE and Fermi TeV/CTA



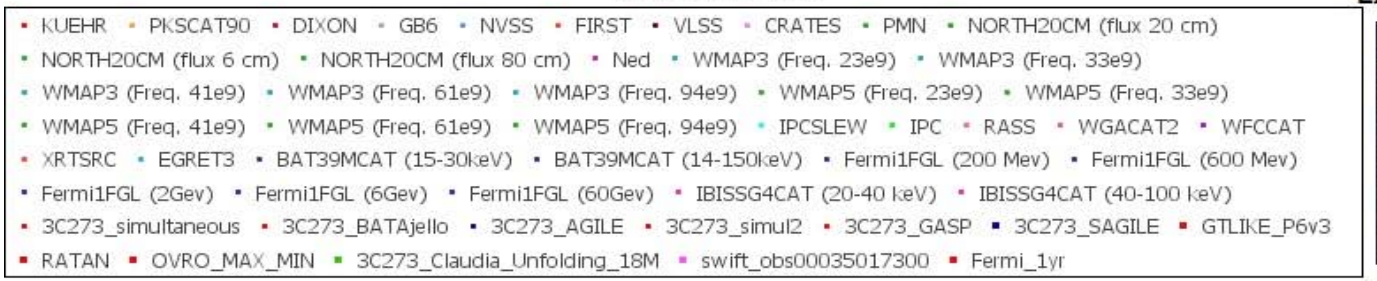


Local Catalogs

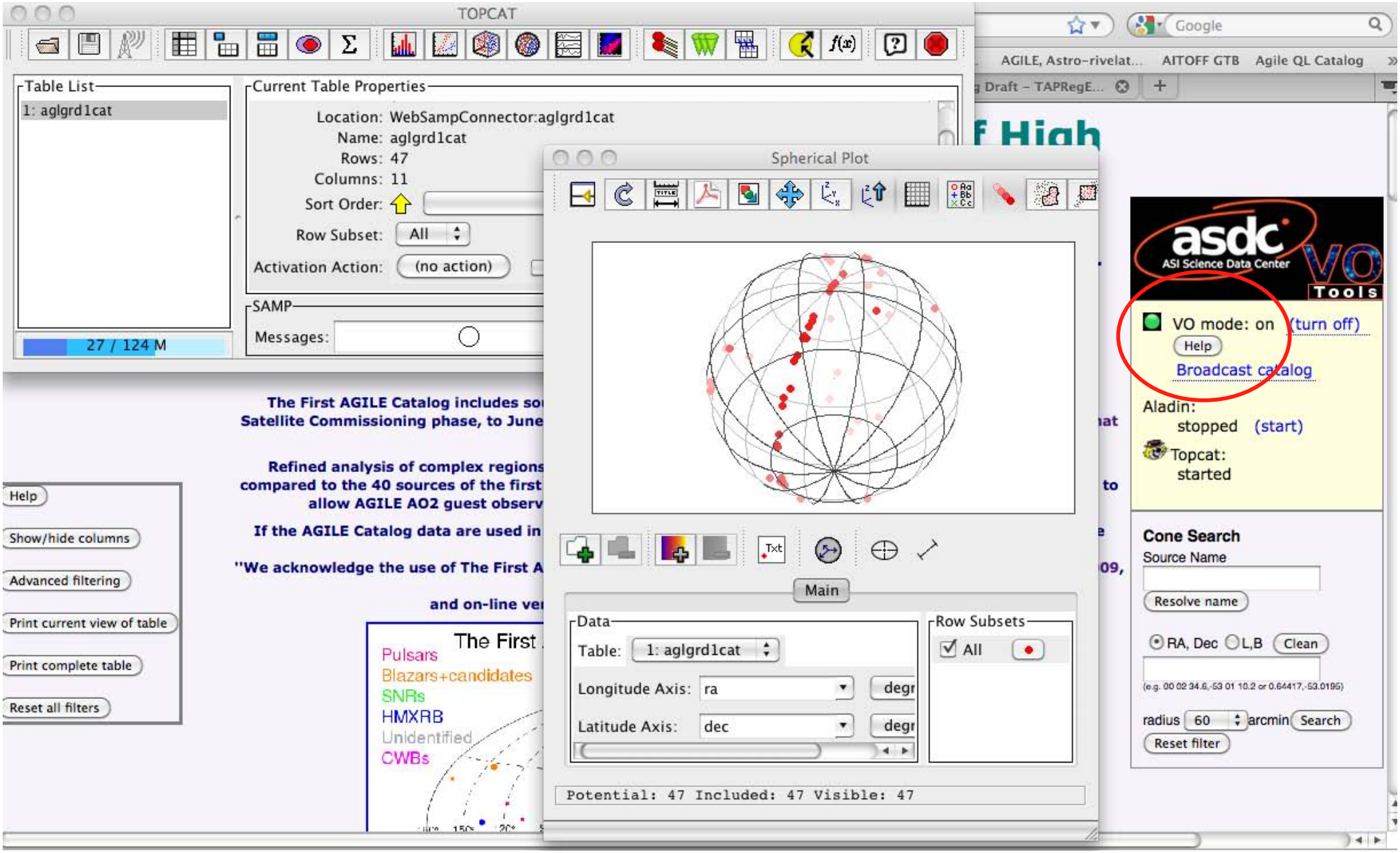
External Catalogs



User Catalogs



Virtual Observatory Standards (*in progress*) and Tool for OPerations on Catalogues And Tables (**Topcat**)

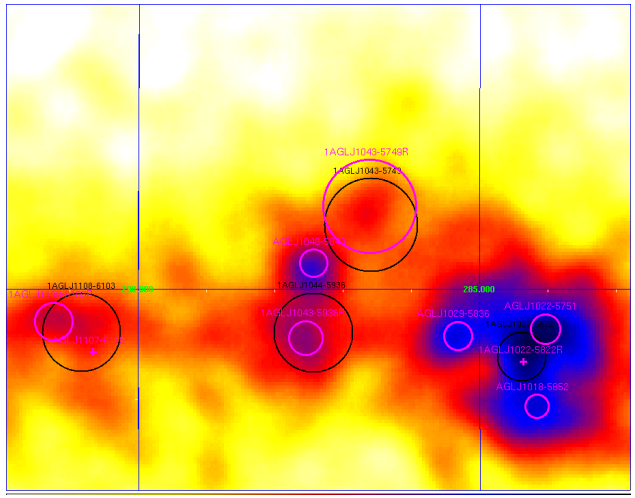


WORK IN PROGRESS:

- **The AGILE Pointed Variability Catalog (F. Verrecchia et al.)**

Variability study of an improved 1AGL source list (55 sources) on the timescale of the AGILE pointed observations (Observation Blocks)

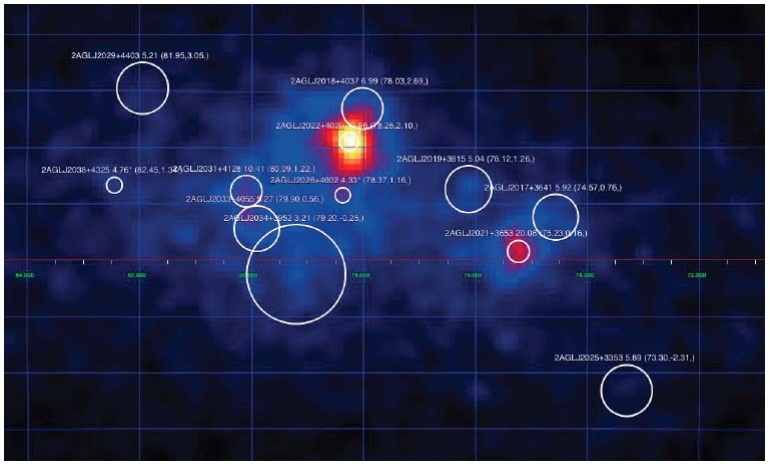
Refined positioning of some 1AGL sources: the Carina region →



- **The second AGILE Catalog (A. Bulgarelli et al.)**

New AGILE-GRID source catalog over the whole period of AGILE pointed observations (2.3 years), with improved event filter and updated calibrations.

More than 180 sources on the galactic plane only: the Cygnus region →

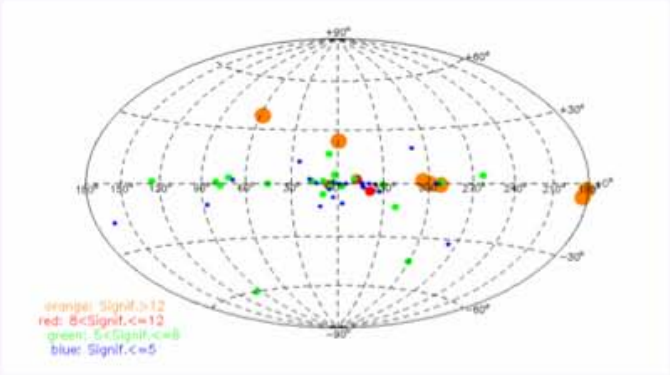


The X-ray imager SuperAGILE: public source list from interactive pages at ADC:

SuperAGILE Source Catalog: POINTING + SPINNING

NOTICE: This page contains the light curves of a set of X-ray sources as measured by the SuperAGILE detector on-board the AGILE satellite both in "pointing observing mode" from July 2007 to October 2009, and in "spinning observing mode" from January 4, 2010 onward. In nominal pointing conditions, the fluxes were estimated with an exposure of about 3 ks while, in spinning mode, longer integration times are required to obtain equivalent exposures.
The light-curve time binning is of one satellite orbit (~ 100 minutes) in pointing mode and of one week in spinning mode, from MJD=55200.

Help
Show/hide columns
Advanced filtering
Print current view of table
Print complete table
Reset all filters



asdc ASI Science Data Center VO Tools

Cone Search
Source Name
Resolve name
RA, Dec L,B Clean
radius 5 arcmin
Search
Reset filter

SuperAGILE in the SPINNING OPERATIVE MODE: E. Del Monte et al., SPIE 7732 (2010), section 4.

Monitoring the hard X-ray sky with SuperAGILE M. Feroci et al., 2010, A&A 510,A9, arXiv:0910.4895

NOTE for the proper user of the pointing data contained on this Webpage

Export Current view of Table in: Latex format | FITS format | Raw text format | CSV text format

Previous Page Next Page Page Size (# of lines) 50 Refresh page Reset all filters Show all entries

Entry number Selection mode: Include All		Light Curve	Target Name	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	Latest Observation Time	Flux (cts cm^-2 s^-1) Stats	Flux error (cts cm^-2 s^-1) Stats	Detection Significance Stats	Exposure (sec) Stats	Orbit number Stats
1	ASDC data Explorer	Show	Sco X-1	16 19 55.2	-15 38 34.8	2011-09-18T10:00:03	0.155	0.0139	24.19	12872	022711
2	ASDC data Explorer	Show	Crab	05 34 30.9	+22 01 04.8	2011-09-18T10:00:03	0.102	0.0088	29.67	16111	022711

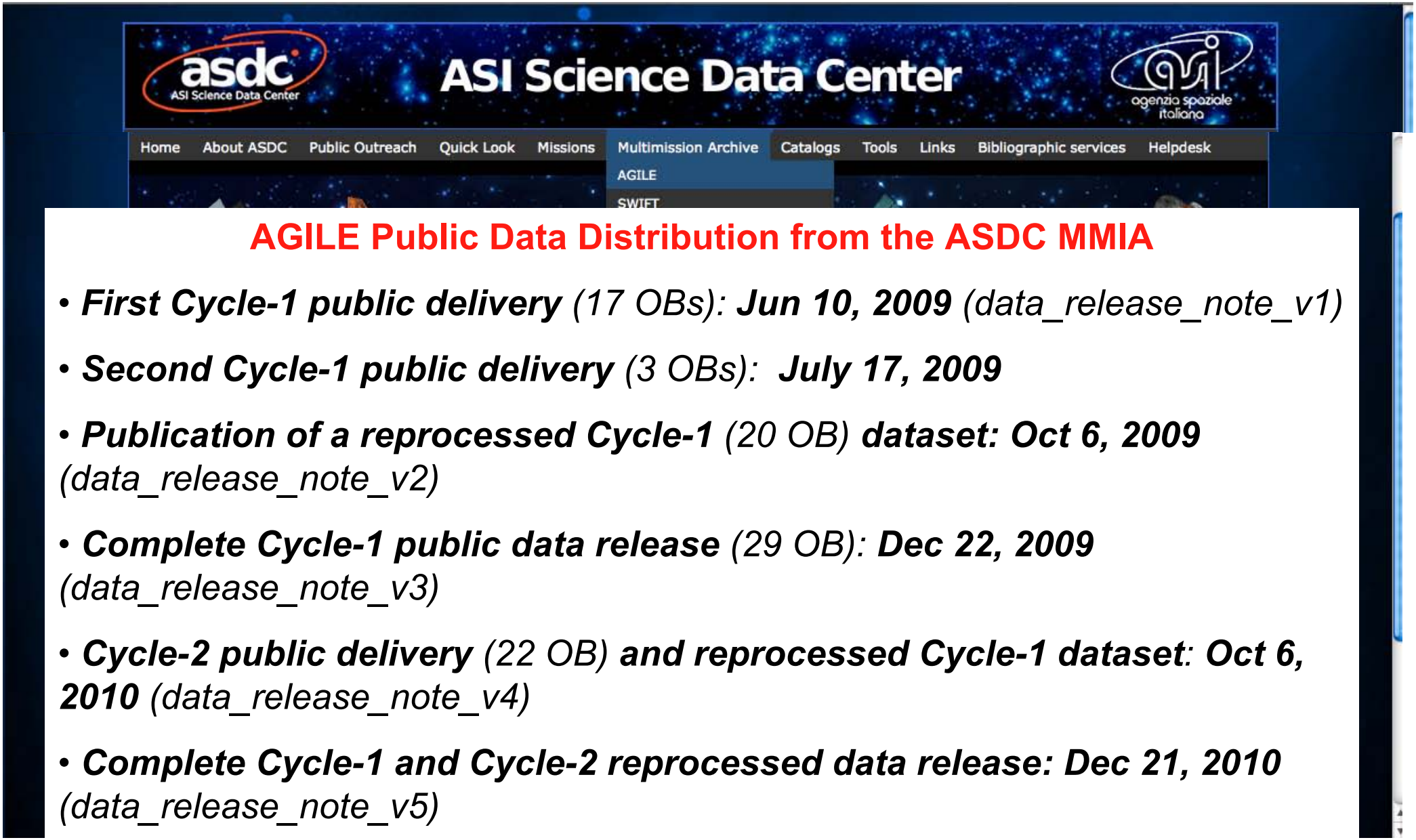
50 X-ray (18-60 keV) validated sources, up to September 2011

AO1: Dec 1, 2007 - Nov 30, 2008
Status AGILE AO1: completed/public
Submitted proposals: 29
Approved/P. Approved: 24
Requested Targets: 122
Approved Targets: **100**
Pulsars: 39
AGN: 31
3EG sources: 30

AO2: Dec 1, 2008 - Nov 30, 2009
Status AGILE AO2: completed/public
Submitted/Approved proposals: 15
14 PI, 74 co-PI
Requested/Approved Targets: **93**
Pulsars: 21
AGN: 62
3EG sources: 10

AO3: Dec 1, 2009 - Nov 30, 2010
Status AGILE AO3: completed/public
Submitted/Approved proposals: 11
11 Proposals,
10 PI, 78 co-PI
Requested/Approved Targets: **67**
Pulsars: 13
AGN: 37
3EG sources: 7
1FGL Sources: 10

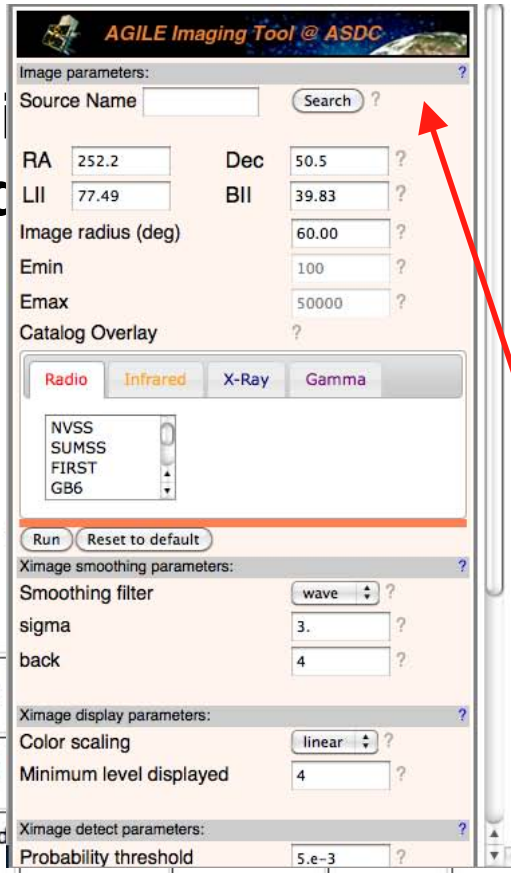
AO4: Dec 1, 2010 - Nov 30, 2011
Status AGILE AO4: completed/proprietary
Submitted/Approved proposals: 18
16 PI, 69 co-I
Requested/Approved Targets: **123**
Pulsars: 43
AGN: 50
3EG sources: 5
1FGL Sources: 24
1AGL Sources: 1

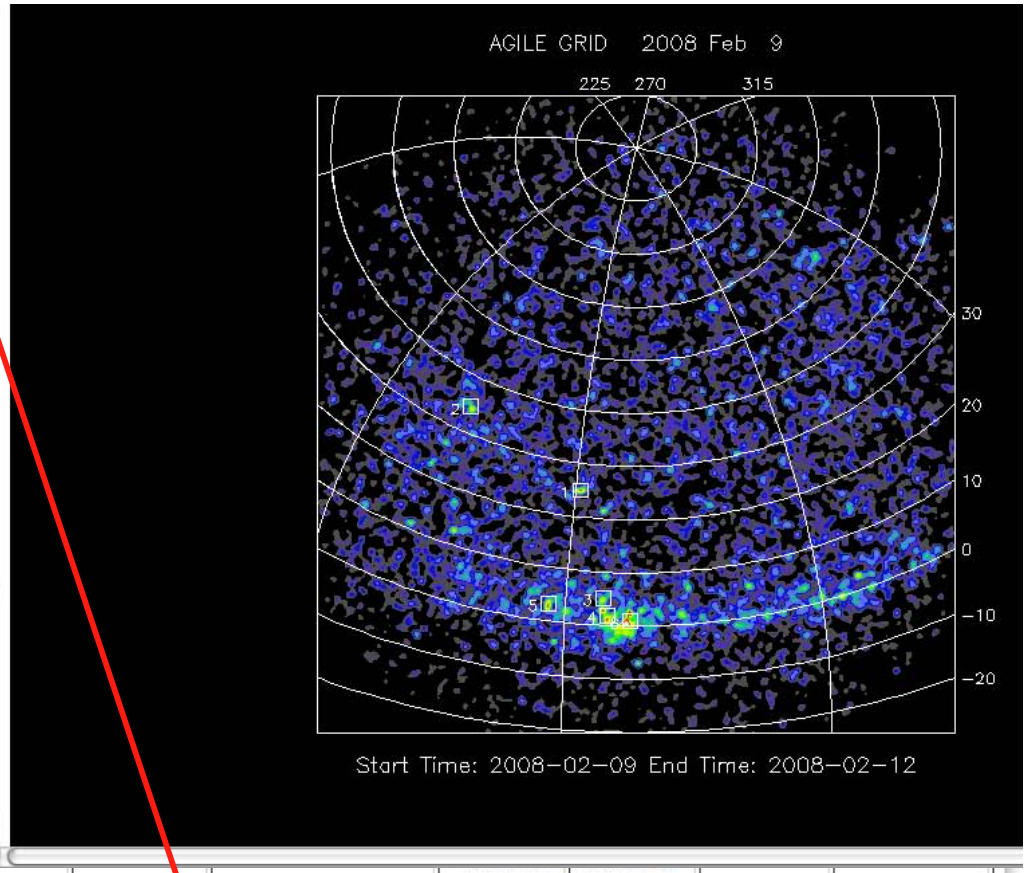


AGILE Public Data Distribution from the ASDC MMIA

- ***First Cycle-1 public delivery*** *(17 OBs):* ***Jun 10, 2009*** *(data_release_note_v1)*
- ***Second Cycle-1 public delivery*** *(3 OBs):* ***July 17, 2009***
- ***Publication of a reprocessed Cycle-1*** *(20 OB)* ***dataset: Oct 6, 2009*** *(data_release_note_v2)*
- ***Complete Cycle-1 public data release*** *(29 OB):* ***Dec 22, 2009*** *(data_release_note_v3)*
- ***Cycle-2 public delivery*** *(22 OB)* ***and reprocessed Cycle-1 dataset****:* ***Oct 6, 2010*** *(data_release_note_v4)*
- ***Complete Cycle-1 and Cycle-2 reprocessed data release: Dec 21, 2010*** *(data_release_note_v5)*
- ***Cycle-3 (spinning) public delivery*** *(22 OB):* ***Nov 9, 2011*** *(data_release_note_v6)*

New
developed





Available parameters

OB Number OB Name RA_PNT ERR_RAP DEC_PNT ERR_DECP RA_SUN (degrees) ERR_RAS DEC_SUN (degrees) ERR_DECS GRID Data Retrieval GRID Interactive Archive OB start date OB end date Processing version Mean OB Exposure (cm² s) Related SuperAGILE Entries Notes

GO

Entry number		OB Number	OB Name									
Selection mode: inclusive												
1	Data Explorer	4900	Cygnus Field 1									
2	Data Explorer	4910	Cygnus Field 1 b<0	21 54 00.0	+38 00 00.0	-	-	Public access	On-line Analysis	2007-12-05 09:00:00	2007-12-15 12:00:00	18604859	Partial Repointing
3	Data Explorer	4920	Cygnus Field 1 Extended	22 16 00.0	+37 54 00.0	-	-	Public access	On-line Analysis	2007-12-15 12:00:00	2007-12-16 12:00:00	1741245	ToO
													Baseline
													Baseline
													Baseline
													ToO
													Baseline

Ximage sw package adapted to gamma-rays

Allows web users to have a preview of the AGILE public data fields and perform an interactive preliminary analysis around a chosen sky position.

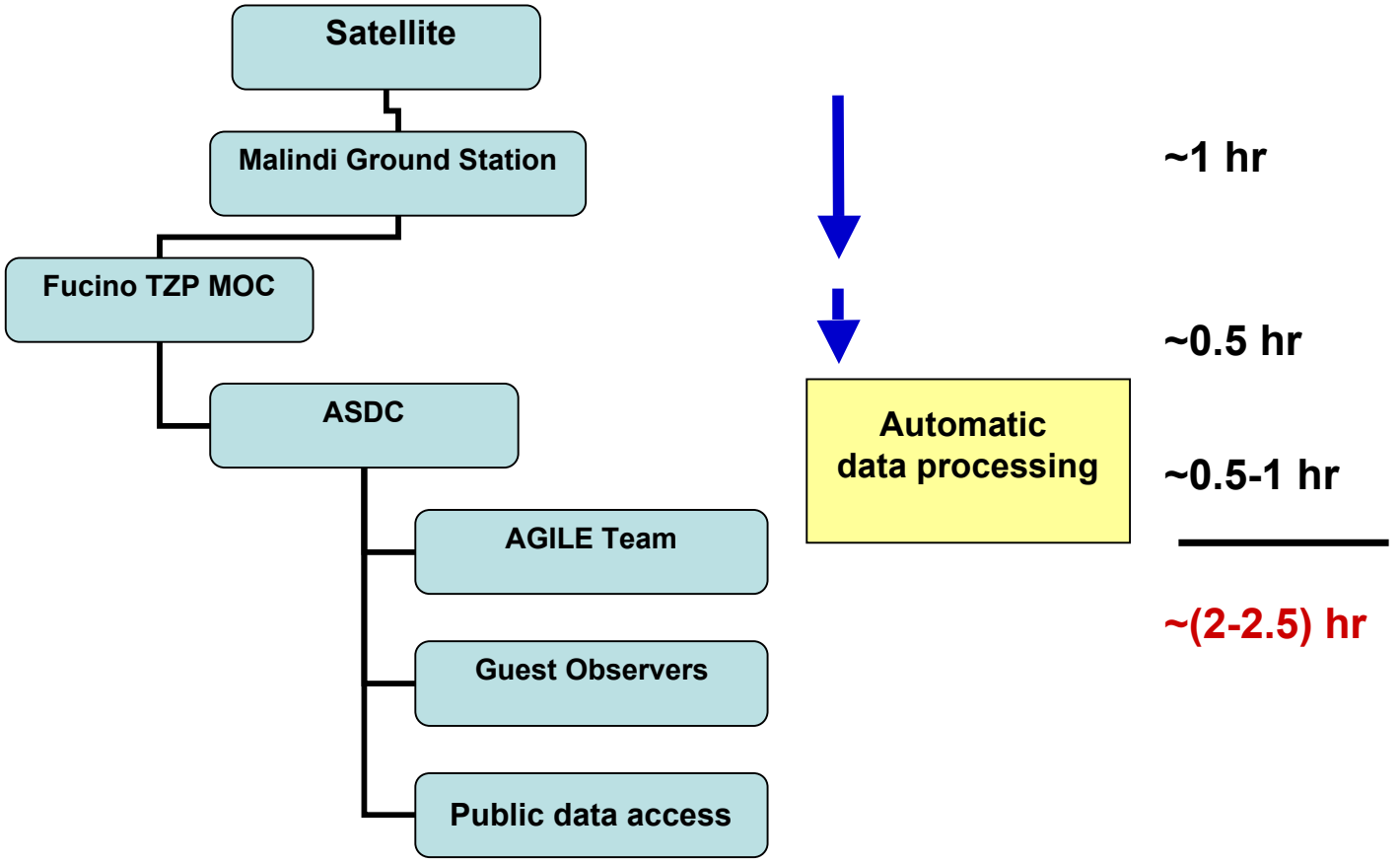
Warning: use imaging tool only as a preview of the AGILE γ-ray field.
To perform your own scientific analysis, please **download data and use the official public AGILE software** available at:
http://agile.asdc.asi.it/public/ following the AGILE Software User Manual

Index of /public/AGILE_SW_5.0_SourceCode

Icon	Name	Last modified	Size	Description
[DIR]	Parent Directory		-	
[ ]	AGILE-IFC-OP-009 Build-21.pdf	22-Nov-2011 18:24	928K	
[ ]	BUILD GRID 5.0.tgz	22-Nov-2011 16:56	121M	
[TXT]	SoftwareReleaseNote 5.0.txt	25-Nov-2011 16:01	16K	
[TXT]	readme 5.0.txt	22-Nov-2011 16:57	5.2K	
[ ]	test dataset 5.0.tgz	22-Nov-2011 16:57	346M	

Apache Server at agile.asdc.asi.it Port 80

AGILE: “very fast” Ground Segment (with contained costs)



Record for a gamma-ray mission!

AGILE Science Alert System

- The system is distributed among the ADC @ ASDC and the AGILE Team Institutes (Trifoglio, Bulgarelli, Gianotti et al.)

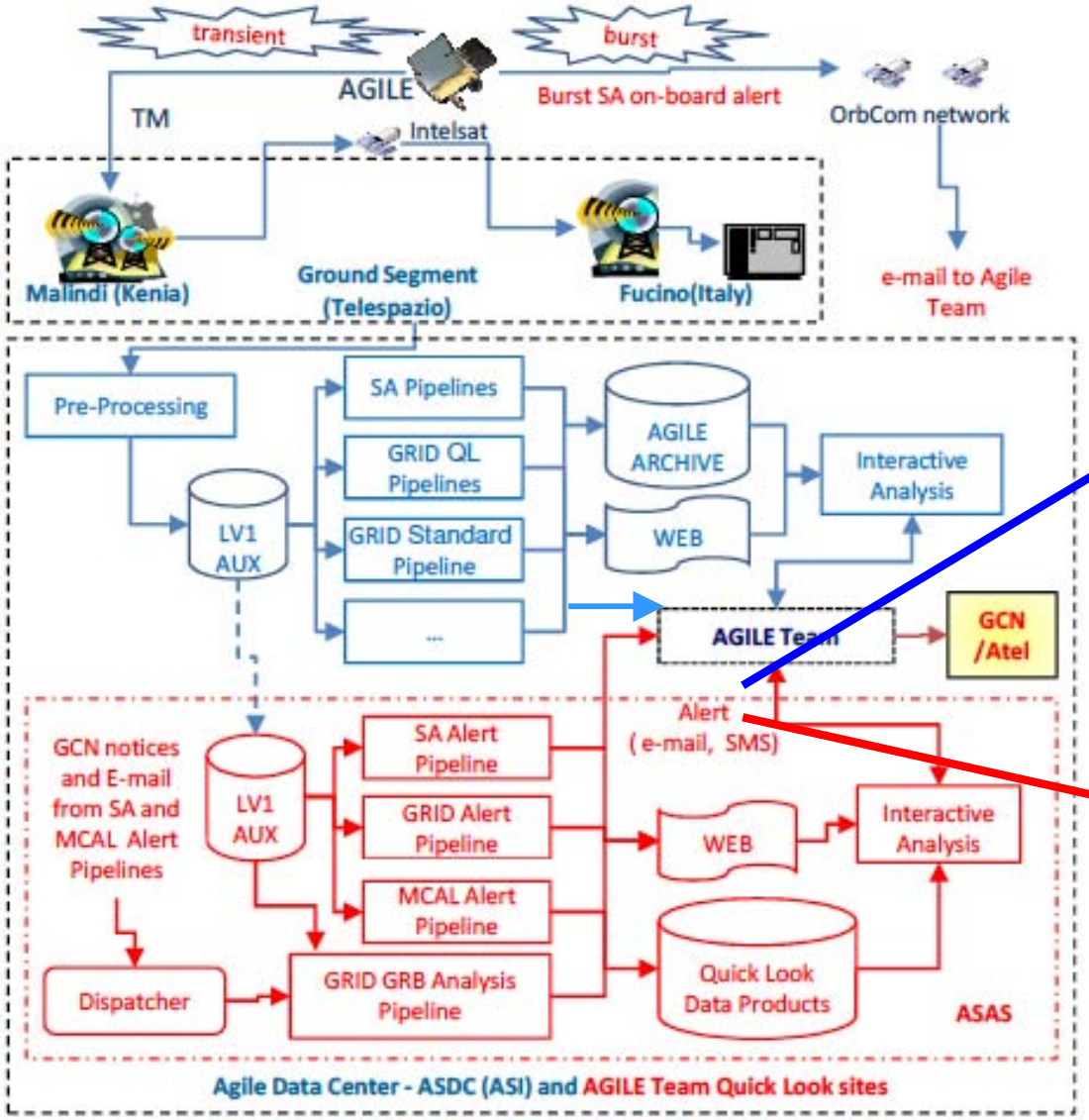
- Automatic Alerts to the AGILE Team are generated within **T_0 + 45 min (SA) and T_0 + 100 min (GRID)**

- GRID Alerts are sent via email (and sms) both on a contact-by-contact basis and on a daily timescale

- Refined manual analysis on most interesting alerts performed every day (daily monitoring)

- **98 ATel** (42 in pointing + 56 in spinning) and **37 GCN** published up to March, 2012

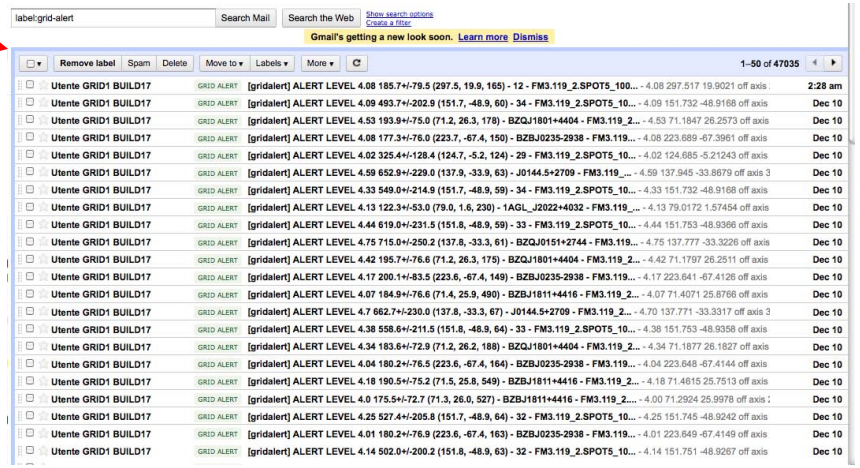
Selected **alerts** sent via email, sms



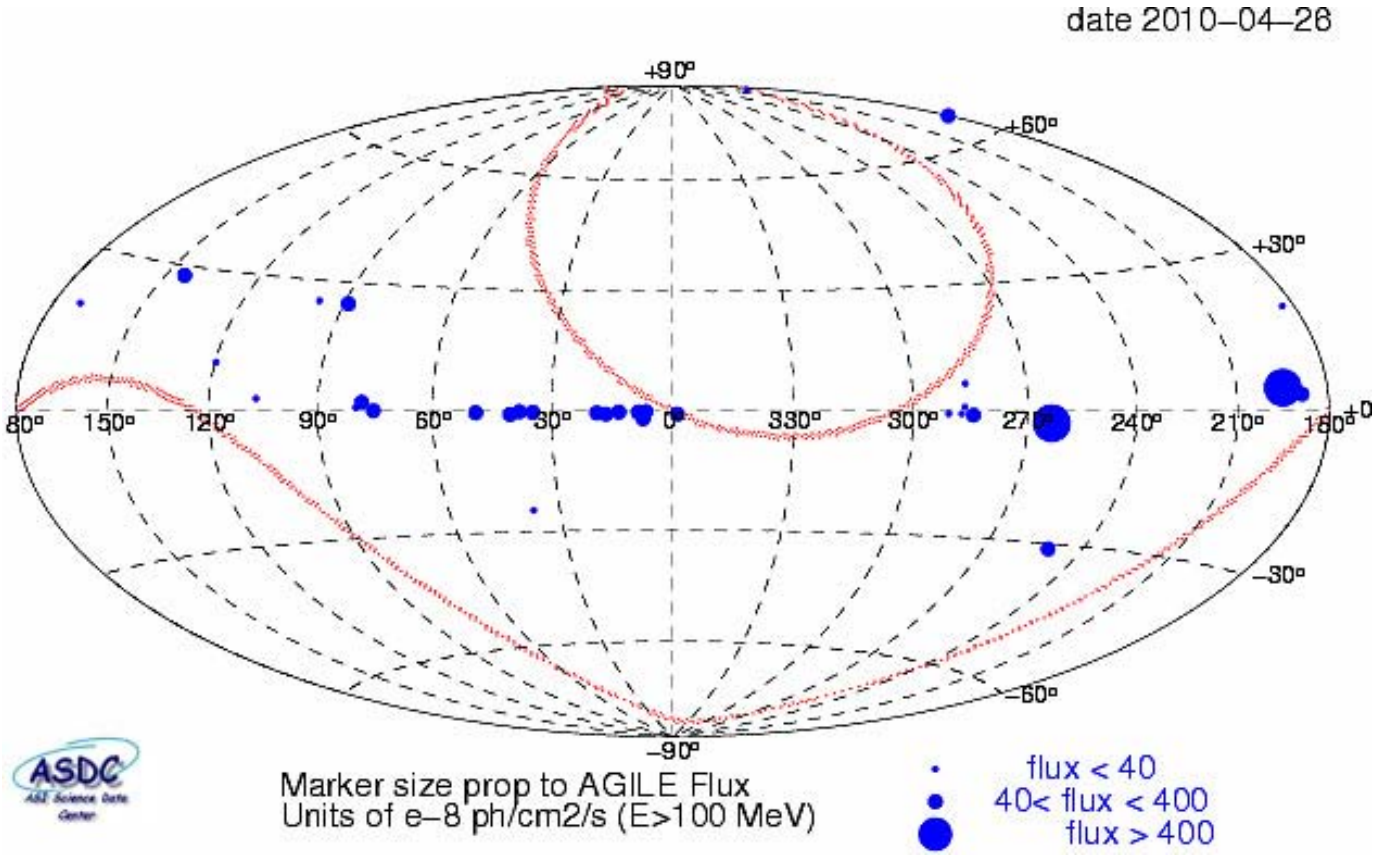
(Figure adapted from **M. Trifoglio et al.**)

Daily time scale (twice a day)

Contact-by-contact time scale (~100 min)



Since November 4, 2009, AGILE is operating in a **spinning observing mode** and it is now surveying a large fraction of the sky every day. AGILE spinning sky view on a particular day:



All ADC functionalities and data processing promptly adapted to the new spinning configuration at no extra costs!

On December 3-4, 2009 the AGILE satellite detected the strongest γ-ray flare ever observed (E > 100 MeV). The flaring γ-ray source is in the active galaxy 3C454.3 ($z=0.859$, $F_\gamma > 2 \times 10^{-5}$ ph cm^{-2} s^{-1}, $L_{iso} = 6 \times 10^{49}$ erg s^{-1})

AGILE: 5th year in orbit

- AGILE demonstrates for the first time the covering of ~ 1/5 of the entire gamma-ray sky (FoV ~ 2.5 sr) with excellent angular resolution and competitive sensitivity.
- AGILE shows for the first time an optimal performance of its gamma-ray and hard X-ray imagers.
- **> 26300 orbits, May 28, 2012**
- **Pointing observation** mode up to October 18, 2009 and **spinning observation mode** since October 2009.
- **Very good scientific performance, especially at ~ 100 MeV**
- **Guest Observer Program open to the scientific community:**
  - **Cycle-1: completed, Dec. 1, 2007 – Nov 30, 2008**
  - **Cycle-2: completed, Dec. 1, 2008 – Nov 30, 2009**
  - **Cycle-3: completed, Dec. 1, 2009 – Nov 30, 2010**
  - **Cycle-4: completed, Dec. 1, 2000 – Nov 30, 2011**
  - **Cycle-5: on-going data taking**

AGILE: Gamma-Rays
MAIN DISCOVERIES
AND SURPRISES!

- **Carina region: γ-ray detection of the colliding wind massive binary system η-Car with AGILE**

  Tavani et al., ApJ, 698, L142, 2009 (arXiv:0904.2736)

- **Cygnus region microquasars:**
  - **AGILE observations of Cygnus X-1 gamma-ray flares**

    Sabatini et al., ApJ 2010, Del Monte et al., A&A 2010

  - **AGILE detects several gamma-ray flares from Cygnus X-3, and also weak persistent emission above 100 MeV**

    Tavani et al., Nature 462, 620, 2009 (arXiv:0910.5344)

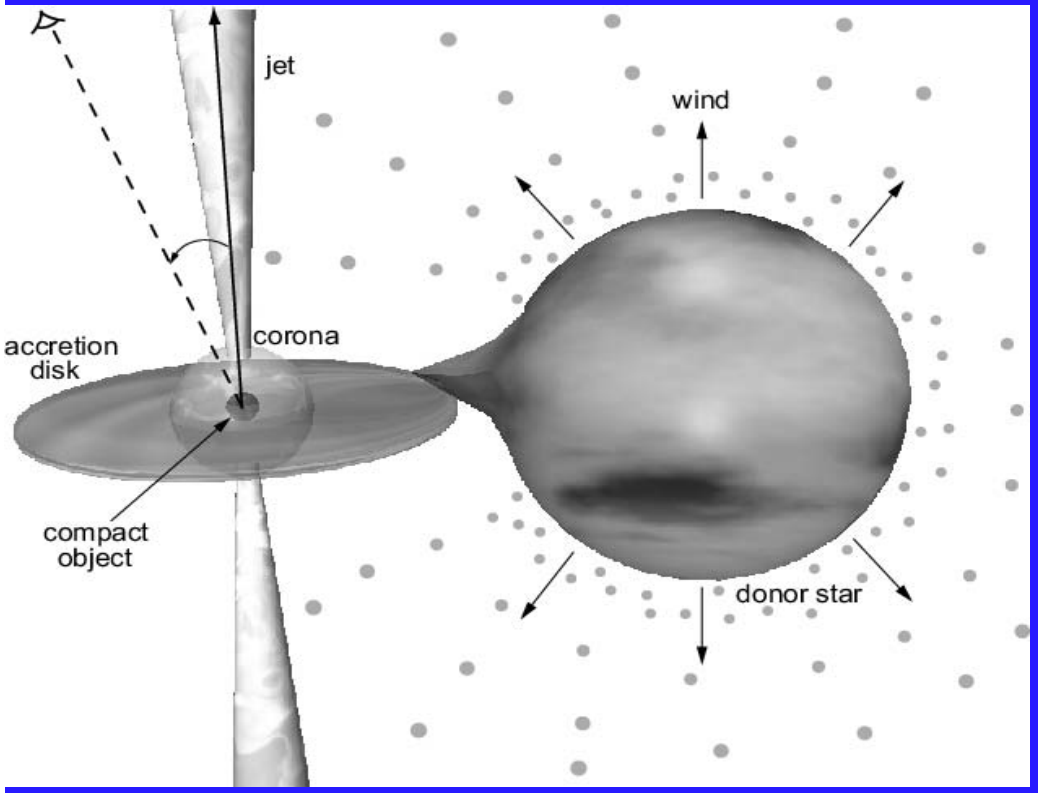
- **Detection of Gamma-Ray Emission from the Vela Pulsar Wind Nebula with AGILE**

  Pellizzoni et al., Science 327, 2010

- **Neutral pion emission from accelerated protons in the SNR W44** See Giuliani talk

  Giuliani et al., ApJ, 742, 2011

Microquasars



Open questions (pre-AGILE):

- **Can jet formation accelerate relativistic particles?**
- **Can the jet emit γ-rays above 100 MeV?**

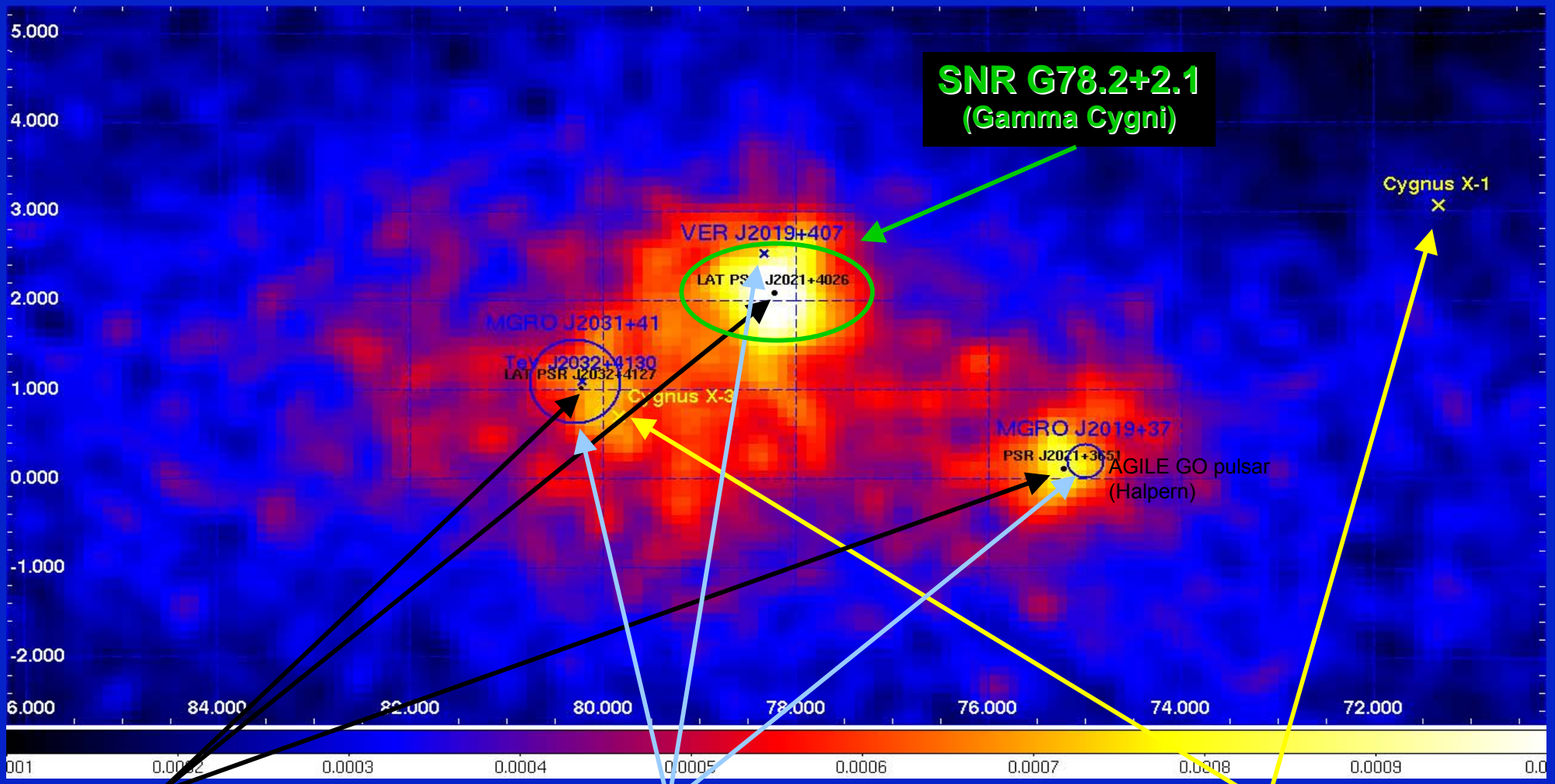
The discovery of the γ-ray activity from Cygnus X-3 is the proof of extreme particle acceleration in microquasars.

Slide adapted from G. Piano, 9th AGILE WS, April 2012

The Cygnus region in γ-rays:

AGILE Intensity Map (100 MeV-10 GeV)

Pointing Mode: Nov. 2007 – Oct. 2009, ~13 Ms net exposure time



Slide adapted from G. Piano, 9th AGILE WS, April 2012

The γ-ray detection of Cygnus X-3: brief story of a discovery

- December 2, 2009:

  The AGILE-*GRID* detects 4 γ-ray flares from C

  ("*Extreme particle acceleration in the microquasar Cygnus X-3*", Tava

  - γ-ray flaring-fluxes greater than 1 order of magnitude with
  - coincident with **prominent minima** of the hard X-ray flux
  - a few days before major radio flares

- December 11, 2009:

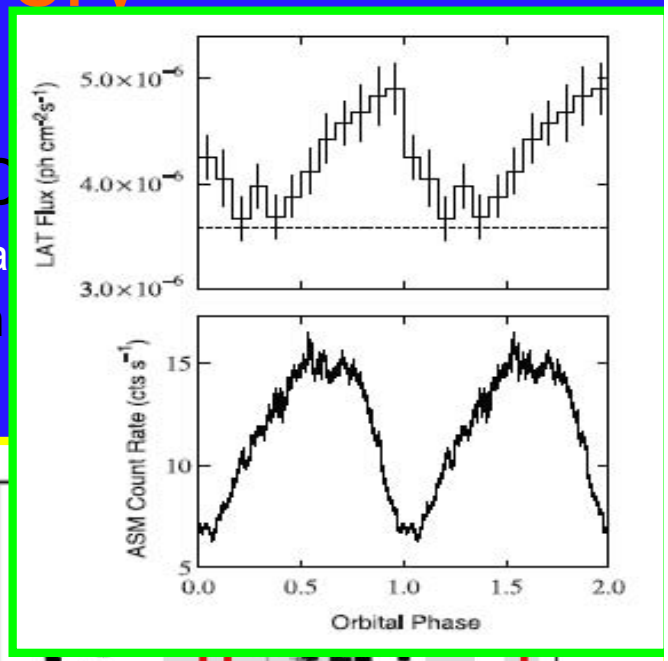
  Fermi-LAT confirms AGILE det

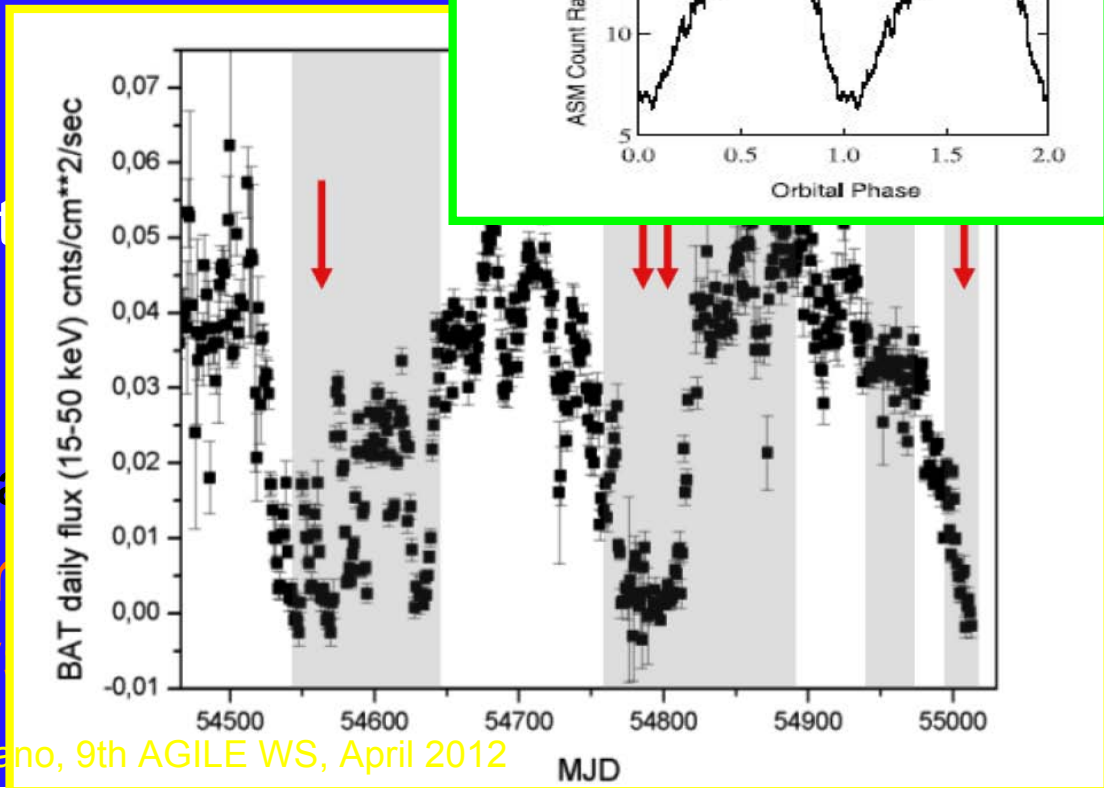
  ("*Modulated High-Energy Gamma-Ray Emission*

  - γ-ray detection of the **orbital period** microquasar

In 9 days a long-lasting mystery ha

Cygnus X-3 is able to accele energies and to emit γ-ray





Slide adapted from G. Piano, 9th AGILE WS, April 2012

Major gamma-ray flares in special transitional states in preparation of radio flares!

- Gamma-ray flares tend to occur in the **rare** low-flux/pre-flare radio states.

- For all gamma-ray flaring episodes, the radio and hard-X-ray fluxes are low or very low, while the soft X-ray flux is large

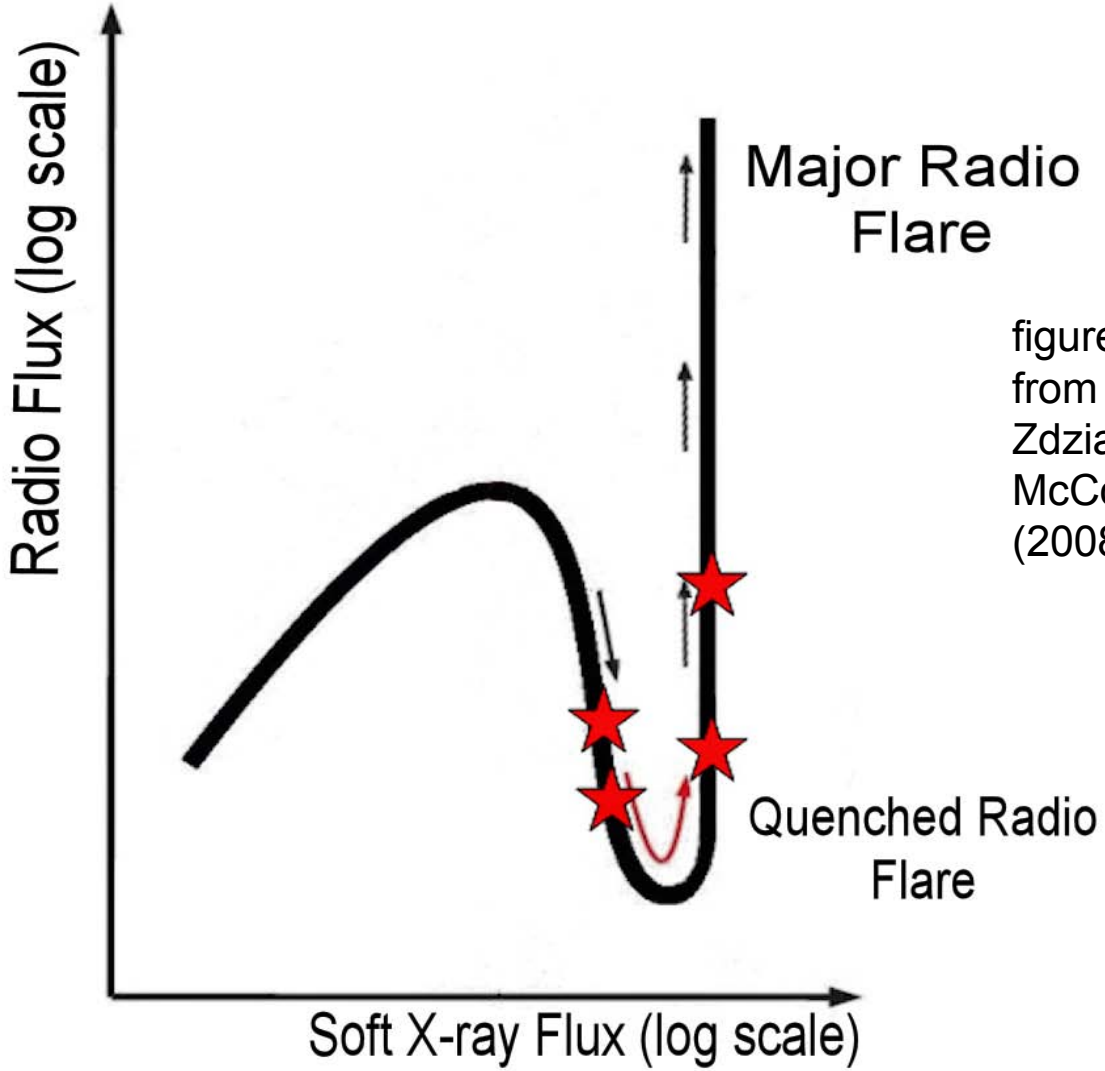


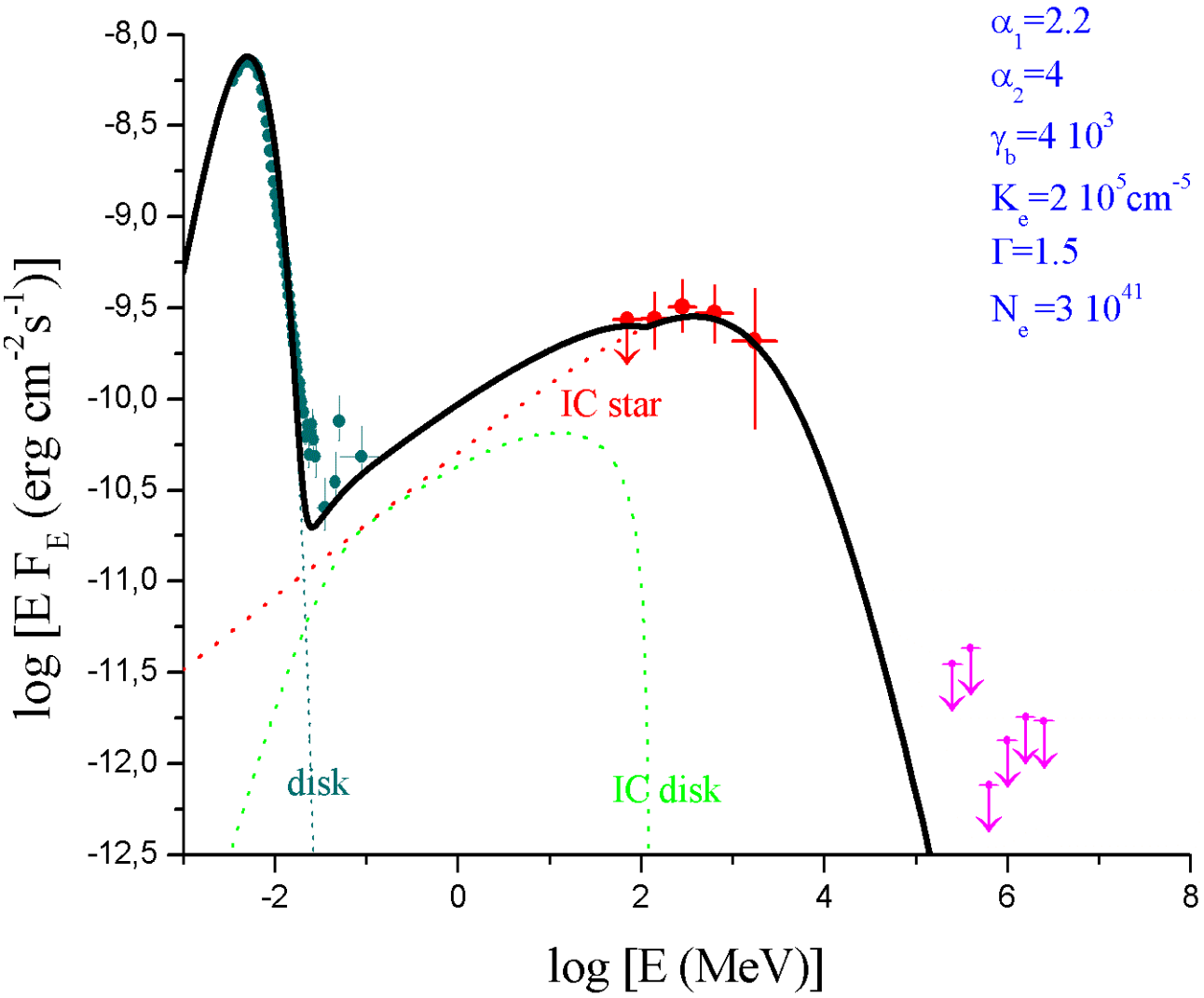
figure adapted from Szostek Zdziarski & McCollough (2008)

Cygnus X-3 lessons:

- Direct evidence that extreme particle acceleration (above 100 MeV) and non-thermalized emission can occur in microquasars with a repetitive pattern
- Emission must be produced not to far away from the central object (4,8 hours orbital modulation revealed by Fermi!)
- Cyg X-3 is capable of accelerating particles by a very efficient mechanism leading to photon emission at energies thousands of times larger than the maximum energy previously detected (E ~ 300 keV)
- Comptonization models (thermal and non-thermal) that reproduce the spectral states up to 300 keV must take into account the new data above 100 MeV

Cyg X-3 AGILE gamma-ray flaring spectrum

Leptonic model favored but hadronic model not excluded (very high jet kinetic power required). **Piano et al., 2012, Submitted to A&A**



Evidence of proton acceleration in the Supernova Remnant W44

A. Giuliani et al., ApJ 742, 2011

SNR W44

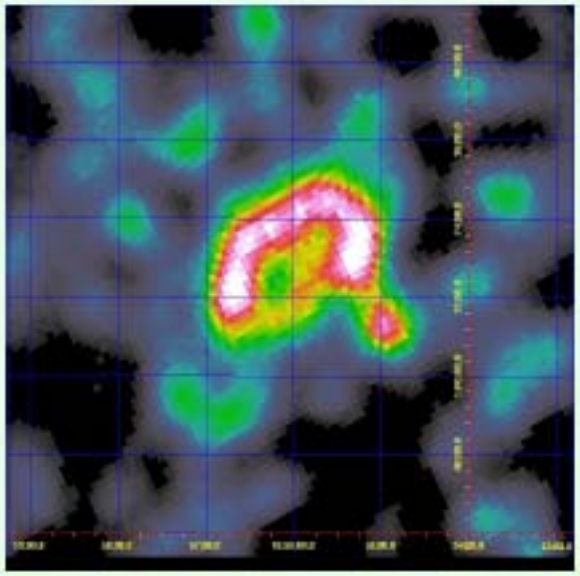


Fig 1 : SNR W44 as seen by AGILE for energies greater than 400 MeV

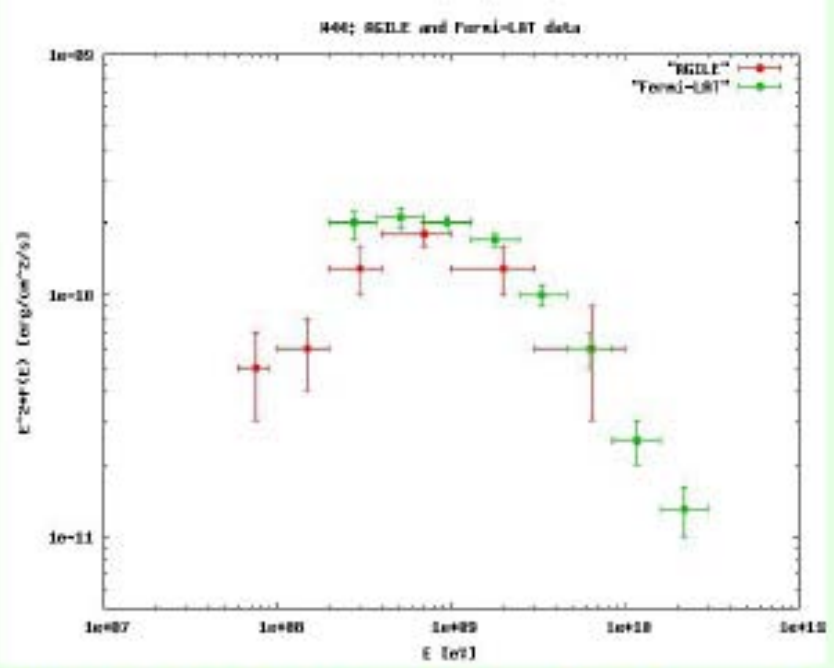


Fig 3 :combined AGILE (red) and Fermi/LAT (green) spectra energy distribution (SED) for SNR W44. AGILE points are in the range 50 MeV- 10 GeV divided in six energy intervals. Fermi/LAT data span the energy range 0,2-30GeV (from Abdo et al, 2010)

(See A. Giuliani talk, 21 June, 12:15)

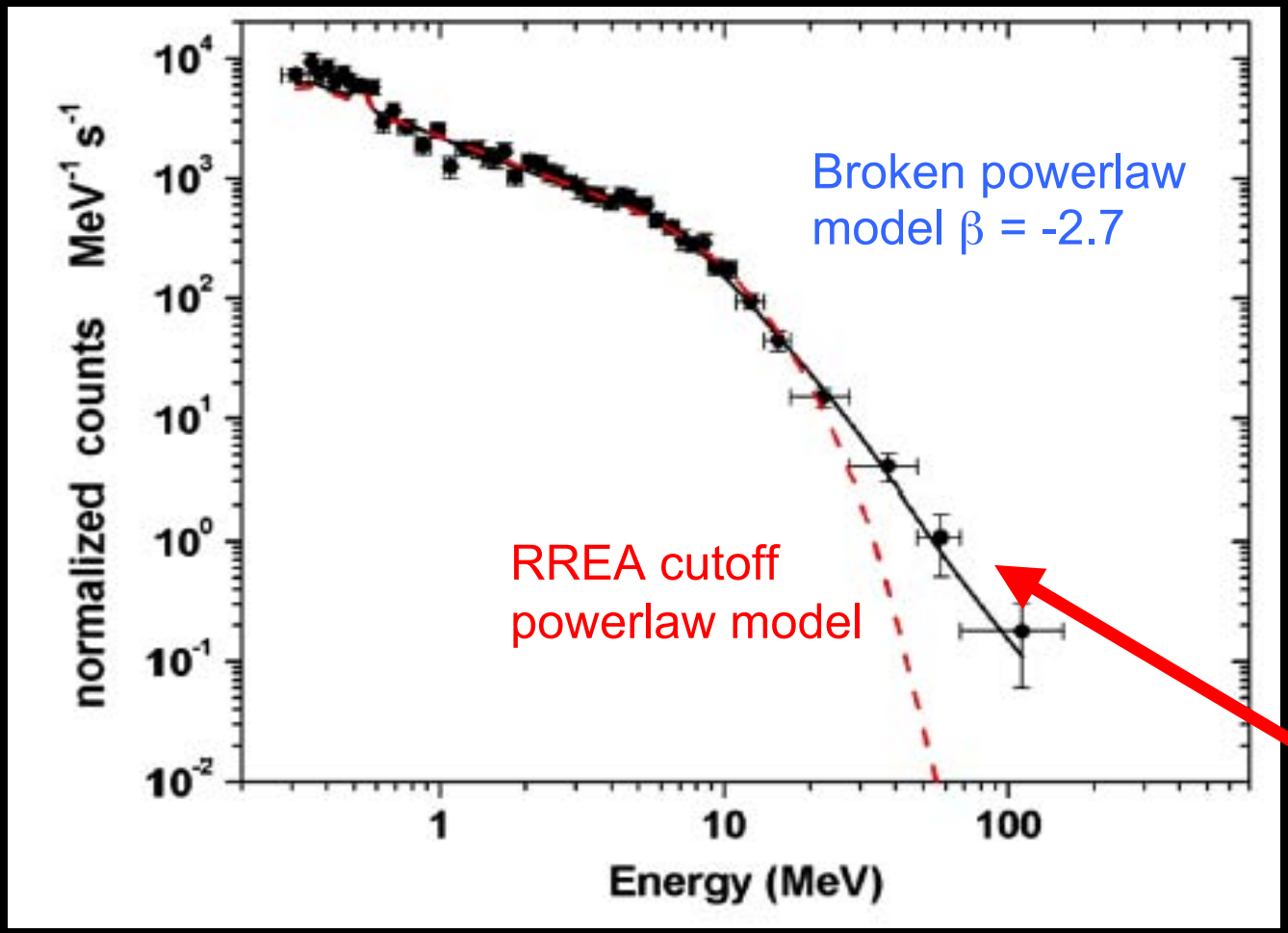
Impulsive events: GRBs and TGFs

- **SuperAGILE** has detected several GRBs in its energy band (18-60 keV) at a rate of about **1 per month** while the AGILE **Minicalorimeter** (MCAL) observes about **1 GRB per week** in the energy range 0.7-1.4 MeV on several time scales (Marisaldi et al.). **GRID energies: only three confirmed GRBs up to now with HE component E > 50 MeV. Delayed HE emission.**
- **GRB 111211A: a new Gamma-ray Burst associated to a Supernova discovered by SuperAGILE**

- The AGILE Minicalorimeter also detects **Terrestrial gamma-ray flashes up to 100 MeV on timescales < 5 ms** (Marisaldi et al., JGR 115, A00E13, 2010, available online from ADC webpage, and Marisaldi et al., Phys. Rev. Lett. 105, 2010)

TGF Cumulative spectrum

110 TGFs 1806 photons 142 γ E> 10 MeV 26 γ E> 20 MeV

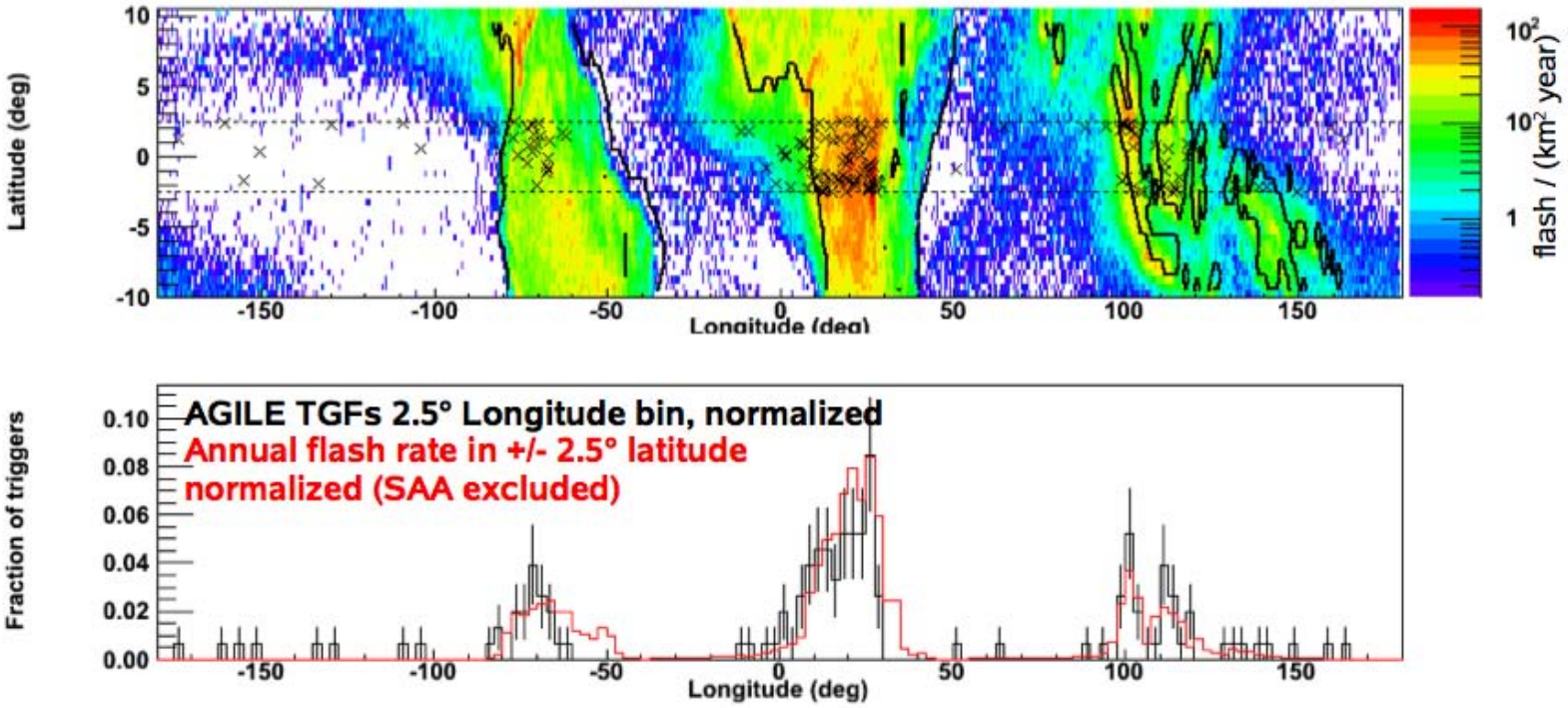


Significant detection of γ >40 MeV!! Uneplained by standard RREA model: challenge for emission models

AGILE-MCAL crucial spectral contribution up to 100 MeV!!

Tavani et al., Phys. Rev. Letters 106, 018501 (2011)

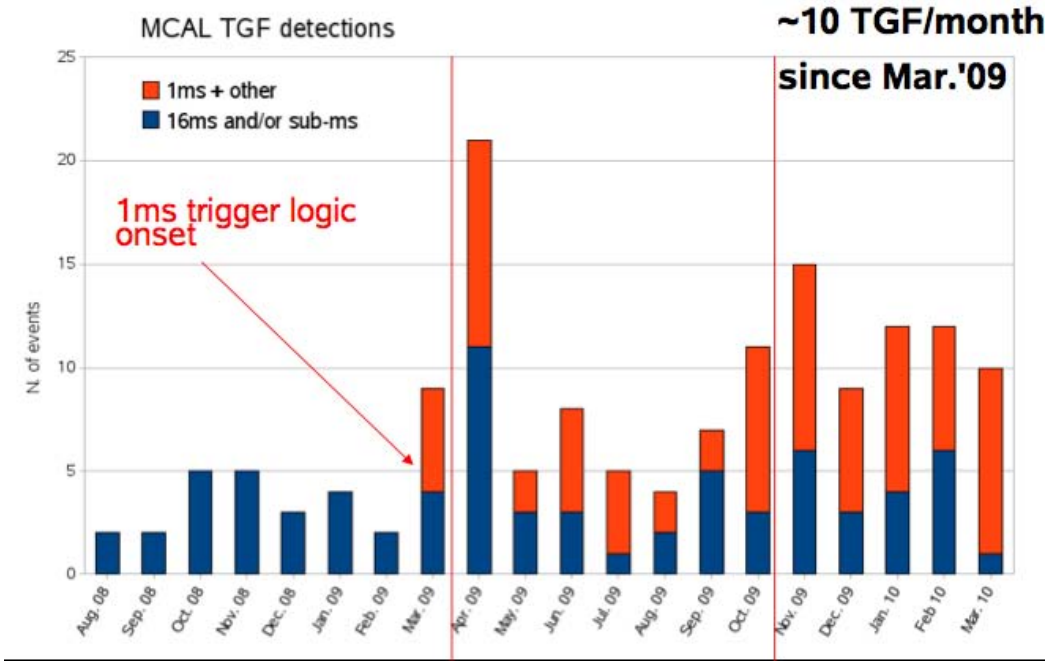
Slide adapted from M. Marisaldi, 10th AGILE WS



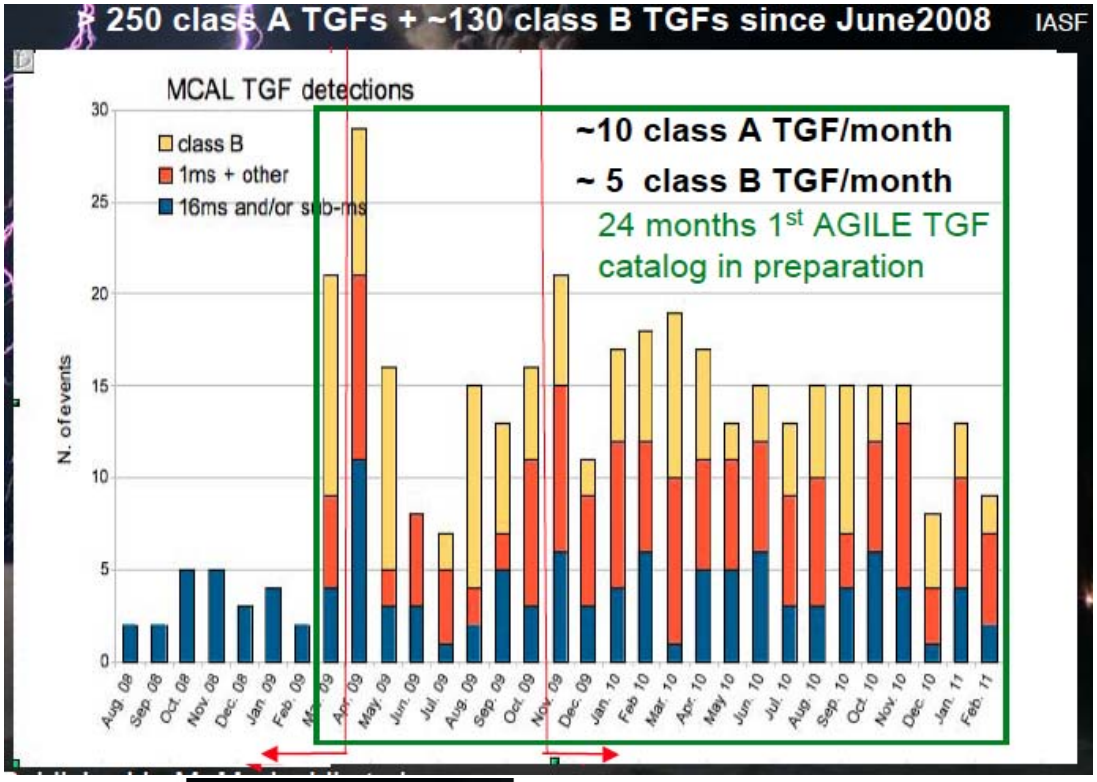
Good match between AGILE TGF pattern and lightning map

34 TGFs Published in **M. Marisaldi et al., J. Geoph. Res., 115, A00E13, 2010**

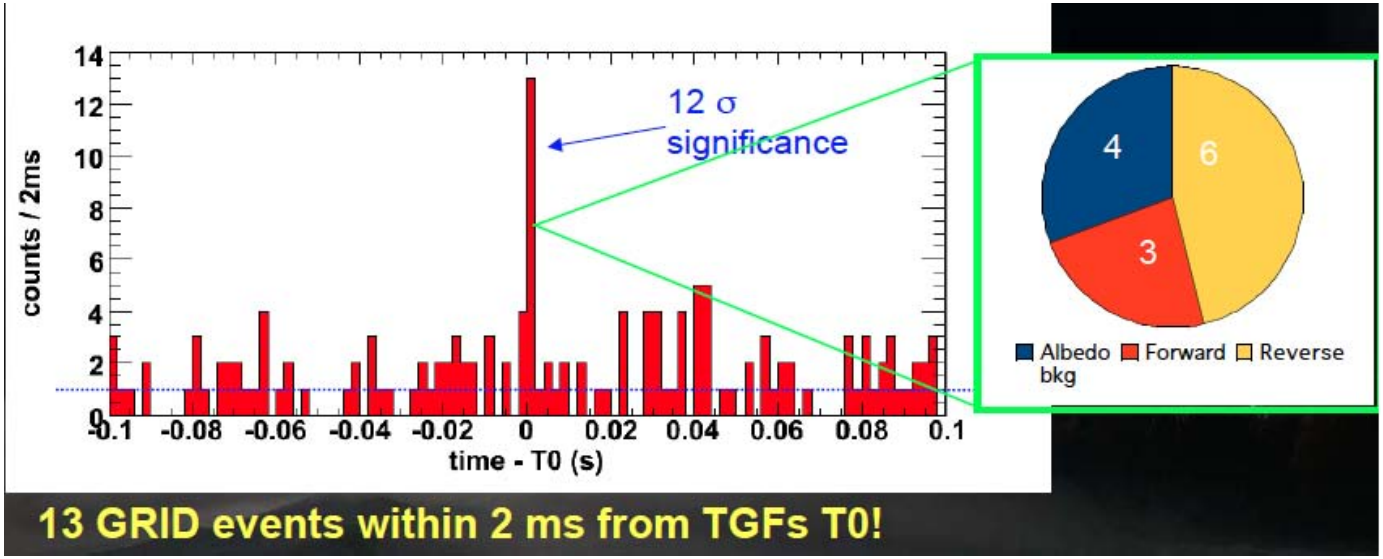
153 good candidates between June '08 and Mar. '10



AGILE TGF 2010 updates:

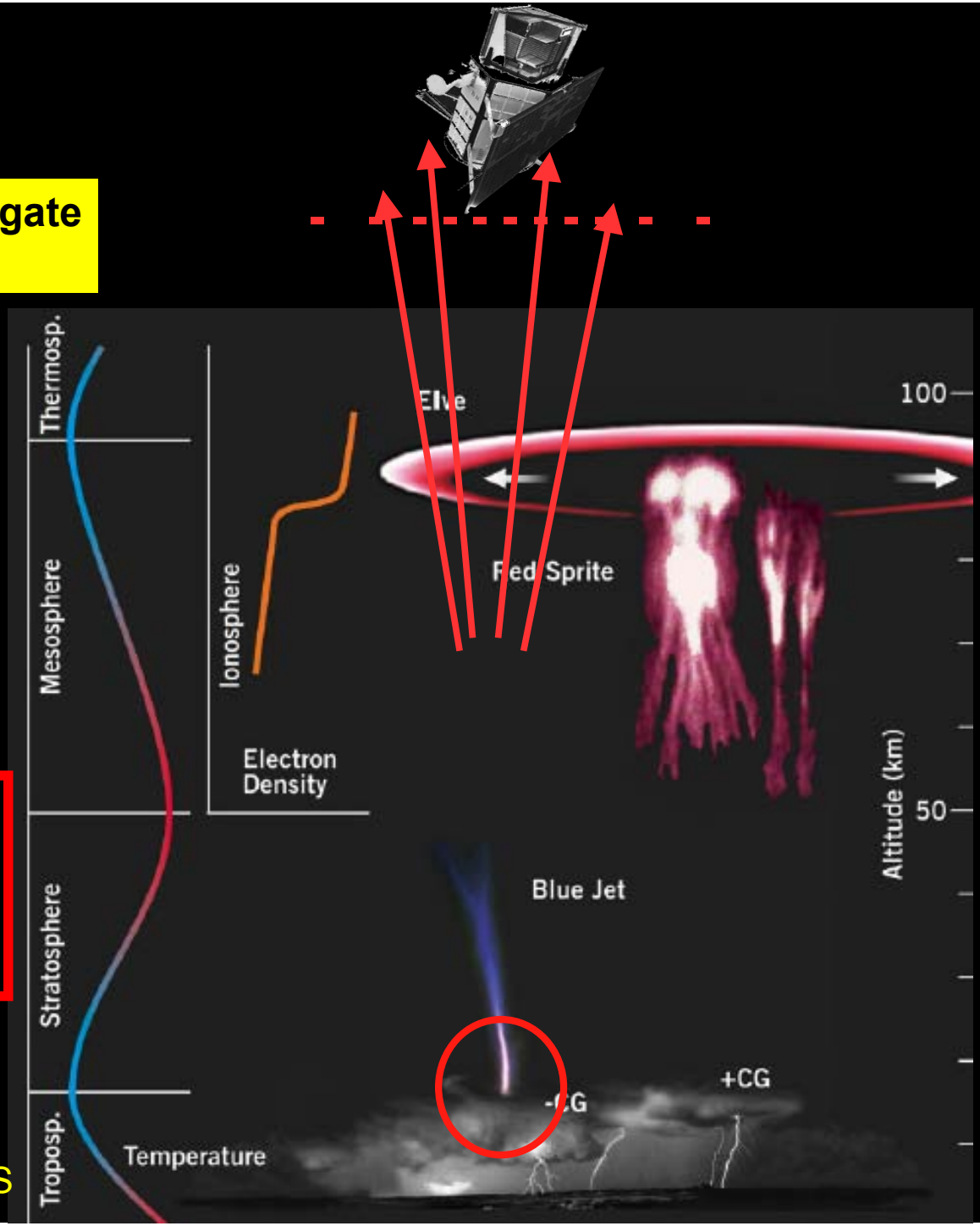


13 AGILE-GRID events:



Marisaldi et al., Phys. Rev. Letters 105 (2010)

Not easy to propagate up to 550 km



550 km

50-100 km

10-20 km

TGFs originate at ~ 10-20 km

Slide adaped from Tavani, 10th AGILE WS

- Normal lightnings involve a potential difference ~ 500 kVolts
- **Terrestrial Gamma-Ray Flashes (TGF) involve DV > 100 MVolts !**
- Models??: **Relativistic Runaway Electron Avalanche** (RREA) with relativistic feedback (Dwyer 2008). Bremsstrahlung + Compton scattering. *Much theoretical work in progress*
- RHESSI cumulative spectrum compatible with a production altitude of 15-21 km (just above tropical thunderstorms)

AGILE MCAL: an optimal detector for TGF

- MCAL energy range is extended **up to 100 MeV**
- Efficient trigger at **ms and sub-ms time scale** (the TGF time scale)
- AGILE **equatorial orbit** at 2.5° inclination is optimal for mapping the equatorial region, where most of the events take place
- A real-time monitoring and alert system can be implemented for correlation with other meteo resources (work in progress)

LATEST UNEXPECTED NEWS FROM THE γ-RAY SKY:

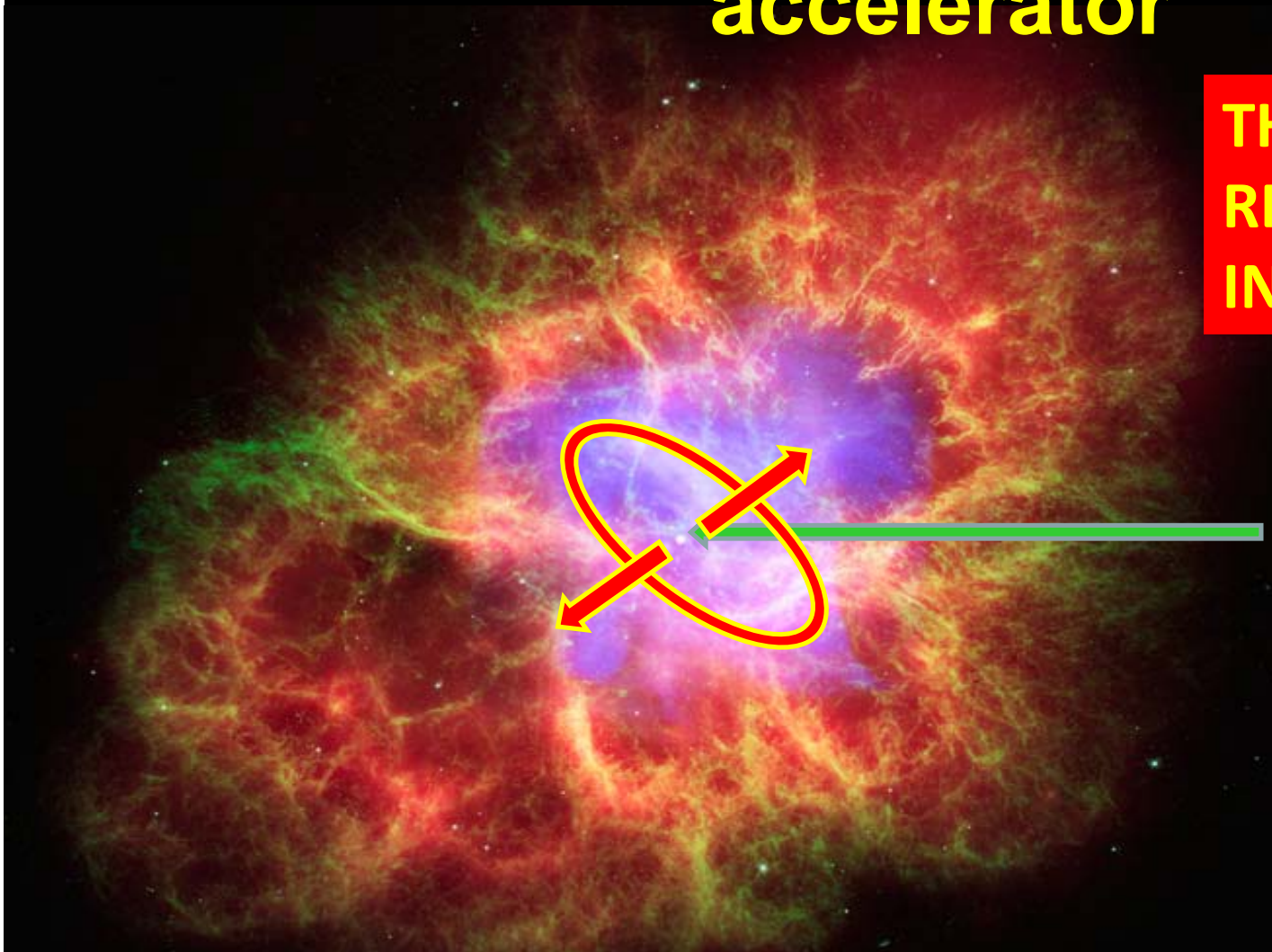
AGILE DISCOVERY OF THE CRAB NEBULA VARIABILITY IN γ-RAYS

Tavani et al., Science, 331, 736 (2011)

Fermi confirmation:

Abdo et al., Science, 331, 739 (2011)

The Crab Nebula: a spectacular cosmic accelerator



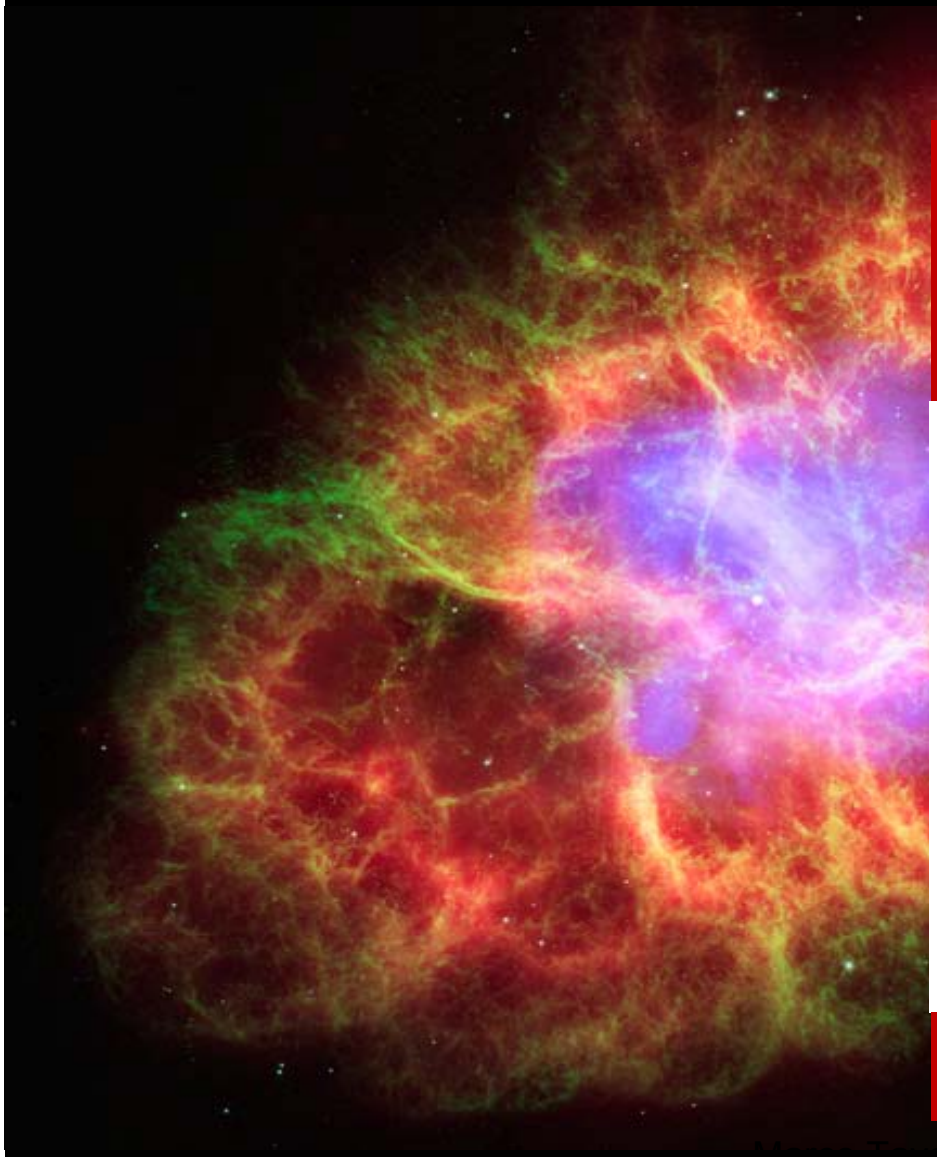
THE STANDARD REFERENCE SOURCE IN ASTROPHYSICS

POWERFUL PULSAR (Neutron Star rotating 30 times a sec)

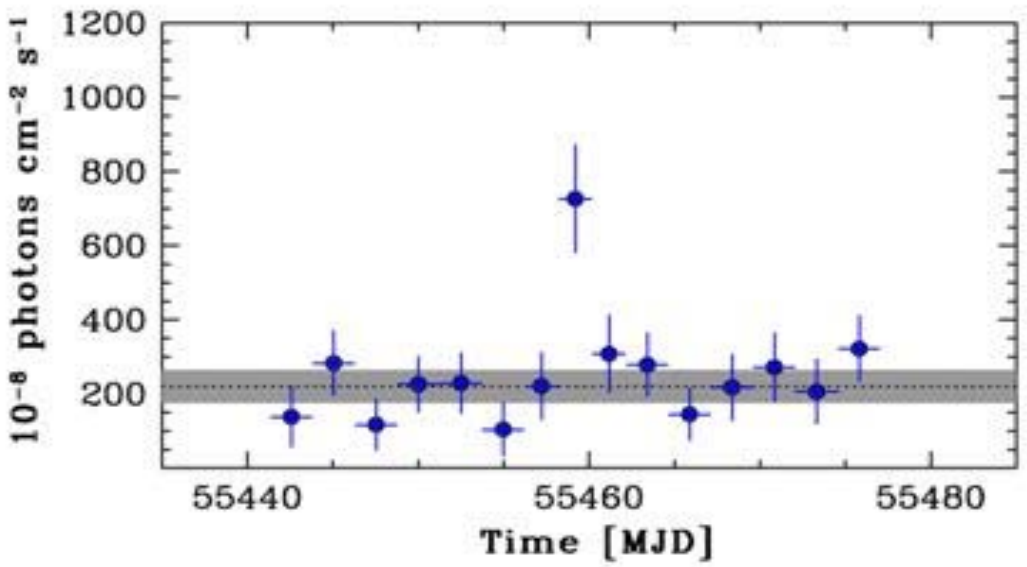
NEBULA SHOCKED BY THE PULSAR WIND

Crab Nebula: a remnant of a supernova that exploded in AD 1054 (Chinese astronomers). X-ray data from Chandra (light blue), visible light data from Hubble (dark blue and green) and infrared data from Spitzer (red), 31/1/2001

The variable Crab Nebula!



FIRST PUBLIC ANNOUNCEMENT
Sept. 22, 2010: AGILE issues the Astronomer's Telegram n. 2855



Science Express **(6 January 2011)**

A&A 506, 1563–1574 (2009)
DOI: 10.1051/0004-6361/200911783
© ESO 2009

Astronomy & Astrophysics

First AGILE catalog of high-confidence gamma-ray sources

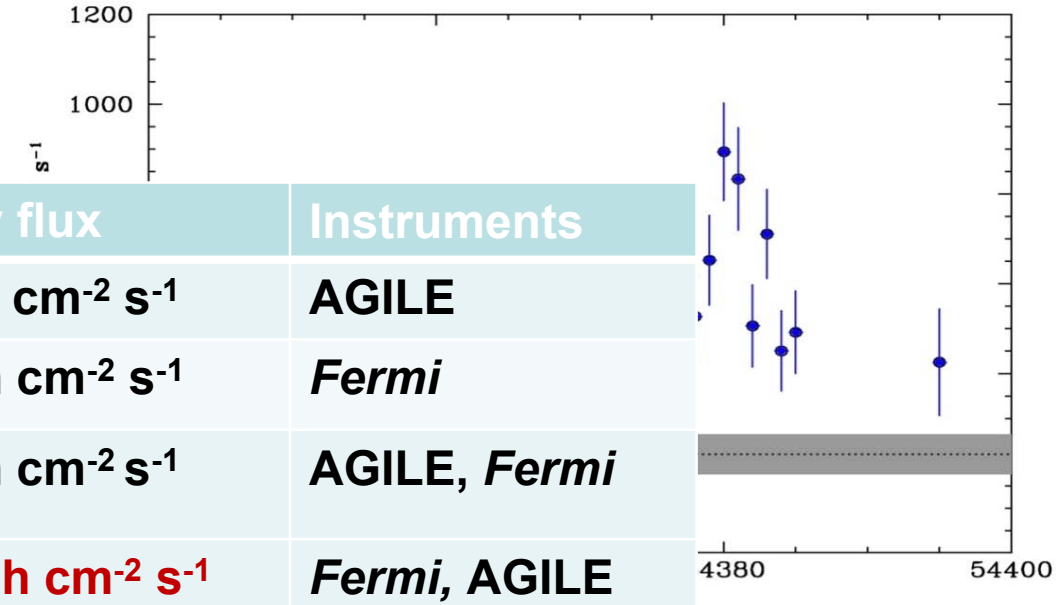
C. Pittori[1], F. Verrecchia[1], A. W. Chen[2,3], A. Bulgarelli[4], A. Pellizzoni[5], A. Giuliani[2,3], S. Vercellone[6], F. Longo[7,8], M. Tavani[9,10,11,3], P. Giommi[1,12], G. Barbiellini[7,8,3], M. Trifoglio[4], F. Gianotti[4], A. Argan[9], A. Antonelli[13], F. Boffelli[14], P. Caraveo[2], P. W. Cattaneo[14], V. Cocco[10], S. Colafrancesco[1,12], T. Contessi[2], E. Costa[9], S. Cutini[1], F. D'Ammando[9,10], E. Del Monte[9], G. De Paris[9], G. Di Cocco[4], G. Di Persio[9], I. Donnarumma[9], Y. Evangelista[9], G. Fanari[1], M. Feroci[9], A. Ferrari[3,15], M. Fiorini[2], F. Fornari[2], F. Fuschino[4], T. Froysland[3,11], M. Frutti[9], M. Galli[16], D. Gasparrini[1], C. Labanti[4], I. Lapshov[9,17], F. Lazzarotto[9], F. Liello[9], P. Lipari[18,19], E. Mattaini[2], M. Marisaldi[4], M. Mastropietro[9,21], A. Mauri[4], F. Mauri[14], S. Mereghetti[2], E. Morelli[4], E. Moretti[7,8], A. Morselli[11], L. Pacciani[9], F. Perotti[2], G. Piano[9,10,11], P. Picozza[10,11], M. Pilia[22,2,5], C. Pontoni[3,8], G. Porrovecchio[9], B. Preger[1], M. Prest[8,22], R. Primavera[1], G. Pucella[9], M. Rapisarda[20], A. Rappoldi[14], E. Rossi[4], A. Rubini[9], S. Sabatini[10], P. Santolamazza[1], E. Scalise[9], P. Soffitta[9], S. Stellato[1], E. Striani[10], F. Tamburelli[1], A. Traci[4], A. Trois[9], E. Vallazza[8], V. Vittorini[9,3], A. Zambra[2,3], D. Zanello[18,19], and L. Salotti[12]

AGILE first detection of a strong gamma-ray flare in Oct. 2007
reported in the First AGILE source catalog as possible short unexpected flux increase

Sect. 6.1
Notes on individual sources:

1AGL J0535+2205 and 1AGL J0634+1748 (Crab and Geminga). These two well known strong γ-ray pulsars, together with the Vela pulsar, were used for in-flight AGILE calibrations. We report the flux values obtained during calibration subperiods. These values agree with pulsed flux values reported in (Pellizzoni et al. 2009). We note, however, that we observed higher flux values, over 1σ from the reported mean flux, for both sources when merging all the data, including shorter (1 day) integration periods during 2007. This point is under investigation.

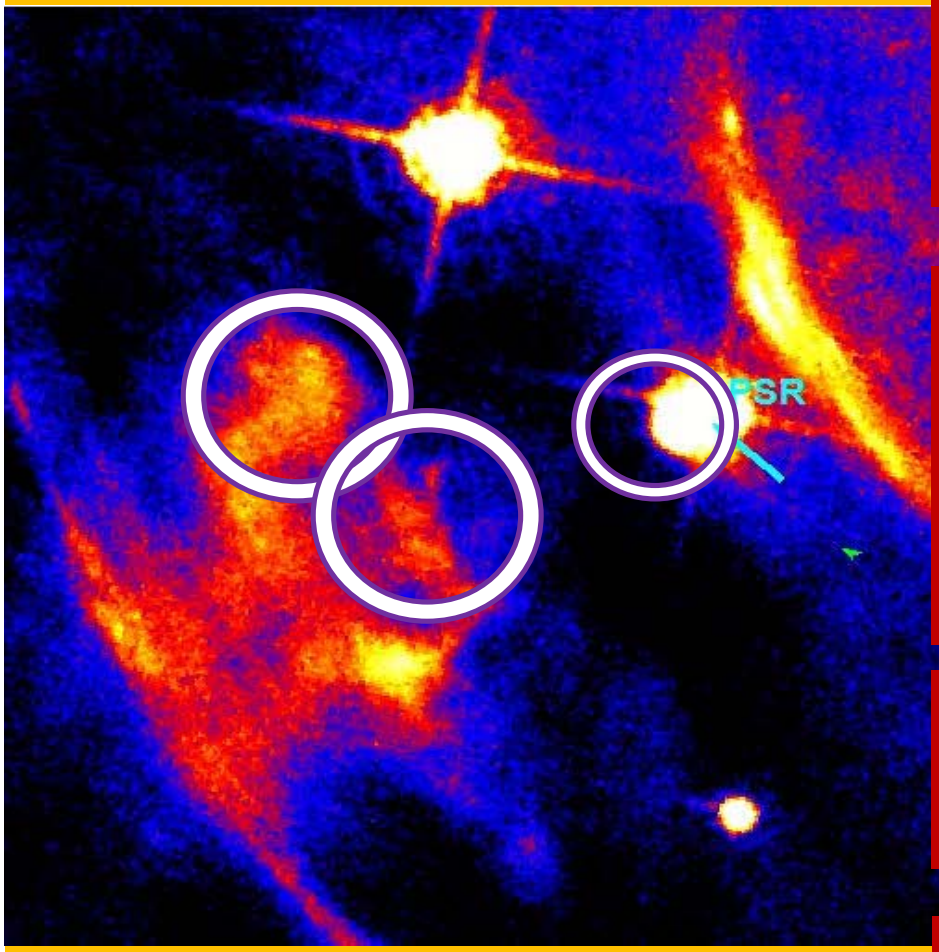
1AGL J0617+2236. This AGILE detection provides an im-



Flare date	Duration	Peak γ-ray flux	Instruments
October 2007	~ 15 days	~ $6 \cdot 10^{-6}$ ph cm^{-2} s^{-1}	AGILE
February 2009	~ 15 days	~ $4 \cdot 10^{-6}$ ph cm^{-2} s^{-1}	*Fermi*
September 2010	~ 4 days	~ $5 \cdot 10^{-6}$ ph cm^{-2} s^{-1}	AGILE, *Fermi*
April 2011	~ 2 days	~ $30 \cdot 10^{-6}$ ph cm^{-2} s^{-1}	*Fermi*, AGILE

- **a big theoretical challenge: the Crab Nebula is not a standard candle in gamma-rays!**

Hubble (optical) Oct. 2, 2010



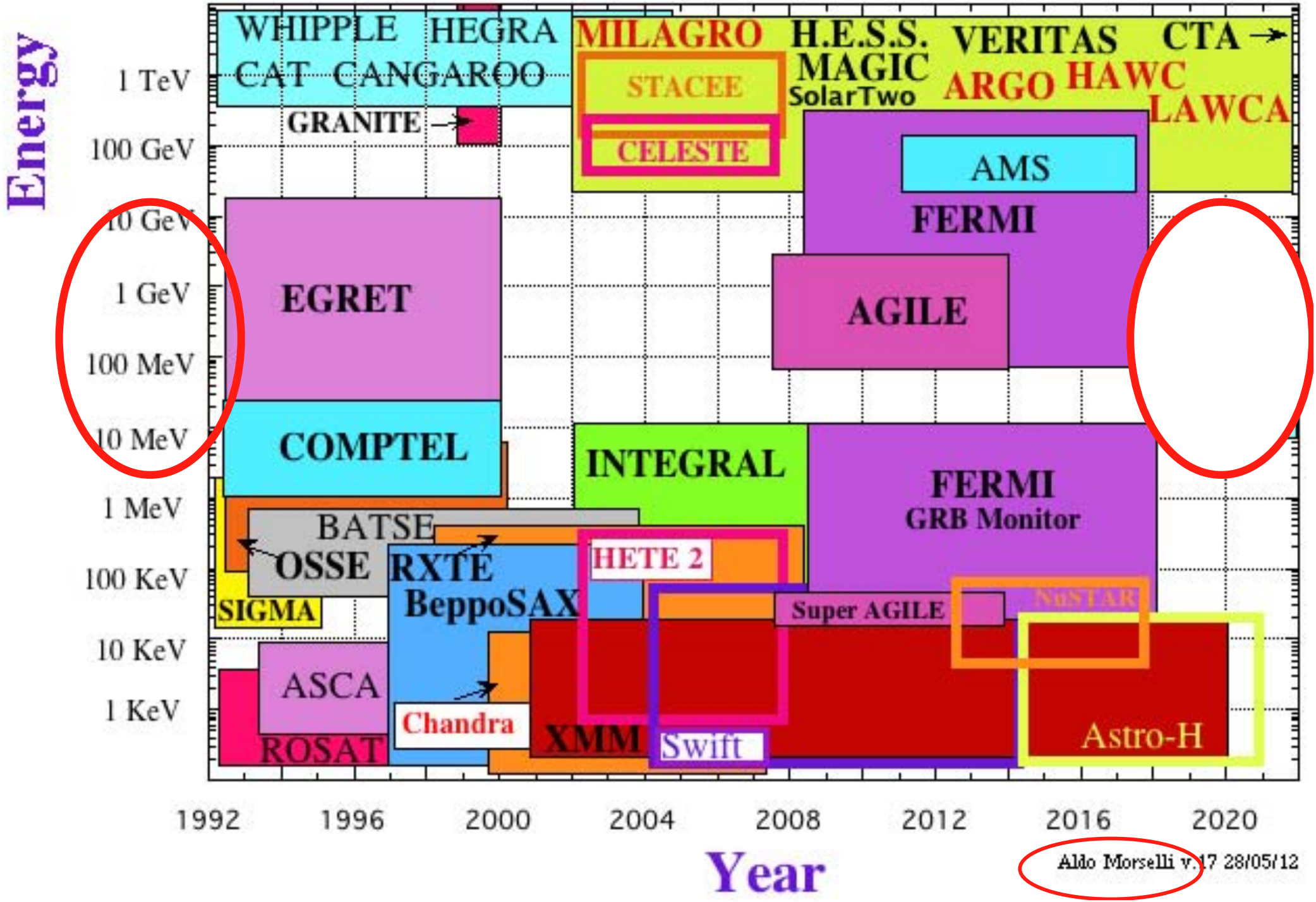
PUZZLING ACCELERATION:

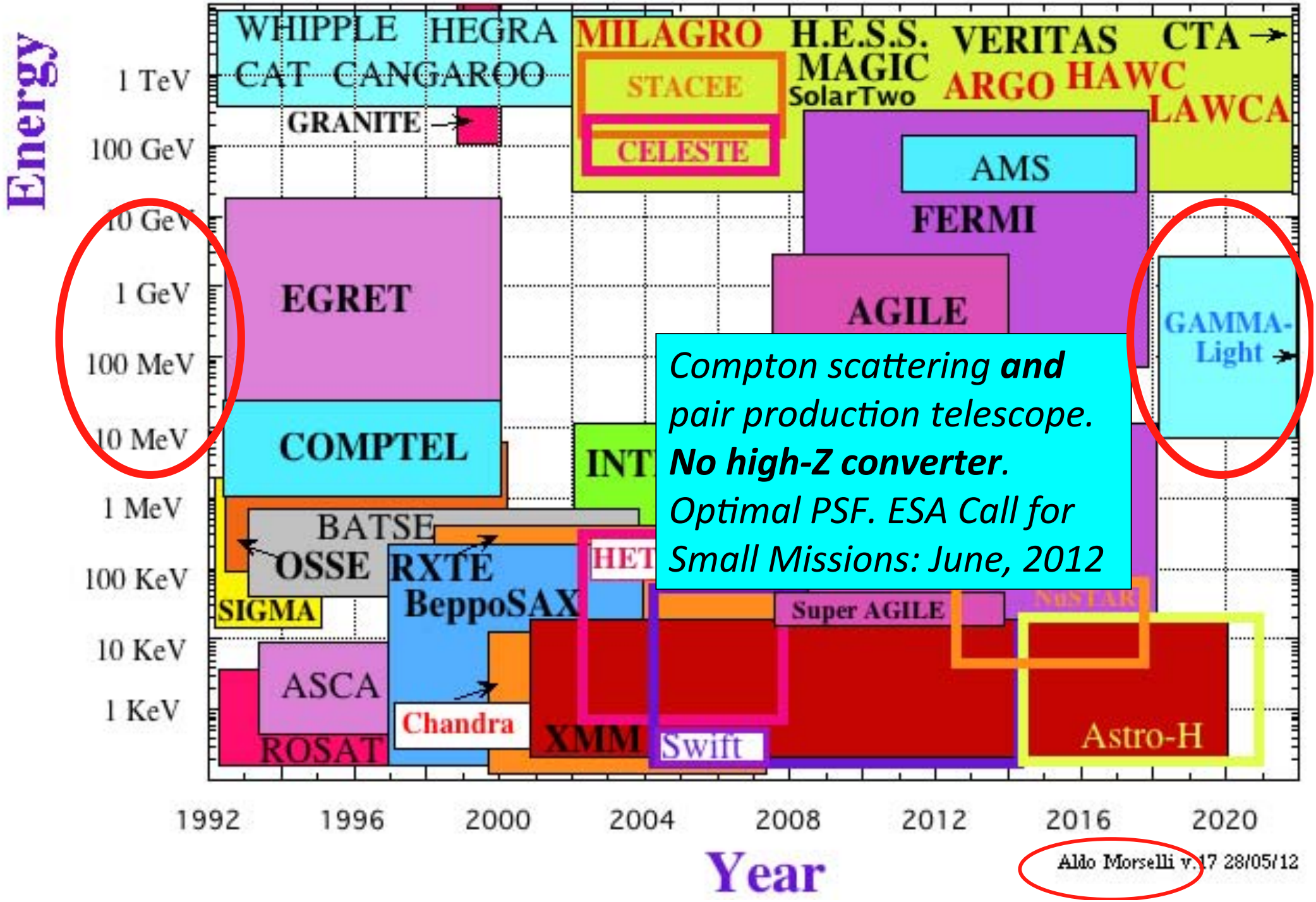
- fast flares imply VERY EFFICIENT particle acceleration at shocks, and "small" emission sites

- *FAST ACCELERATION inconsistent with "slow" diffusion processes, a challenge to shock acceleration theory !*

- acceleration up to 10^{15} eV, 1000 times larger than Tevatron or LHC

- shock structures might be the sites of transient gamma-rays, HST and Chandra candidates


Energy
1 TeV
100 GeV
10 GeV
1 GeV
100 MeV
10 MeV
1 MeV
100 KeV
10 KeV
1 KeV
WHIPPLE
HEGRA
CAT
CANGAROO
GRANITE
MILAGRO
STACEE
CELESTE
H.E.S.S.
MAGIC
SolarTwo
VERITAS
CTA
ARGO
HAWC
LAWCA
AMS
FERMI
EGRET
AGILE
COMPTEL
INTEGRAL
FERMI
GRB Monitor
BATSE
OSSE
RXTE
BeppoSAX
HETE 2
SIGMA
Super AGILE
NuSTAR
ASCA
Chandra
XMM
Swift
Astro-H
ROSAT
1992
1996
2000
2004
2008
2012
2016
2020
Year
Aldo Morselli v.17 28/05/12


Energy
1 TeV
100 GeV
10 GeV
1 GeV
100 MeV
10 MeV
1 MeV
100 KeV
10 KeV
1 KeV
WHIPPLE
HEGRA
CAT
CANGAROO
GRANITE
MILAGRO
STACEE
CELESTE
H.E.S.S.
MAGIC
SolarTwo
VERITAS
CTA
ARGO
HAWC
LAWCA
AMS
FERMI
EGRET
AGILE
GAMMA-Light
COMPTEL
INT
BATSE
OSSE
RXTE
BeppoSAX
HET
SIGMA
Super AGILE
NuSTAR
ASCA
ROSAT
Chandra
XMM
Swift
Astro-H
1992
1996
2000
2004
2008
2012
2016
2020
Year
Compton scattering and pair production telescope.
No high-Z converter.
Optimal PSF. ESA Call for Small Missions: June, 2012
Aldo Morselli v.17 28/05/12

9th and 10th AGILE Workshops, ASDC April 16-18, 2012

On-line presentations available at http://agile.asdc.asi.it