

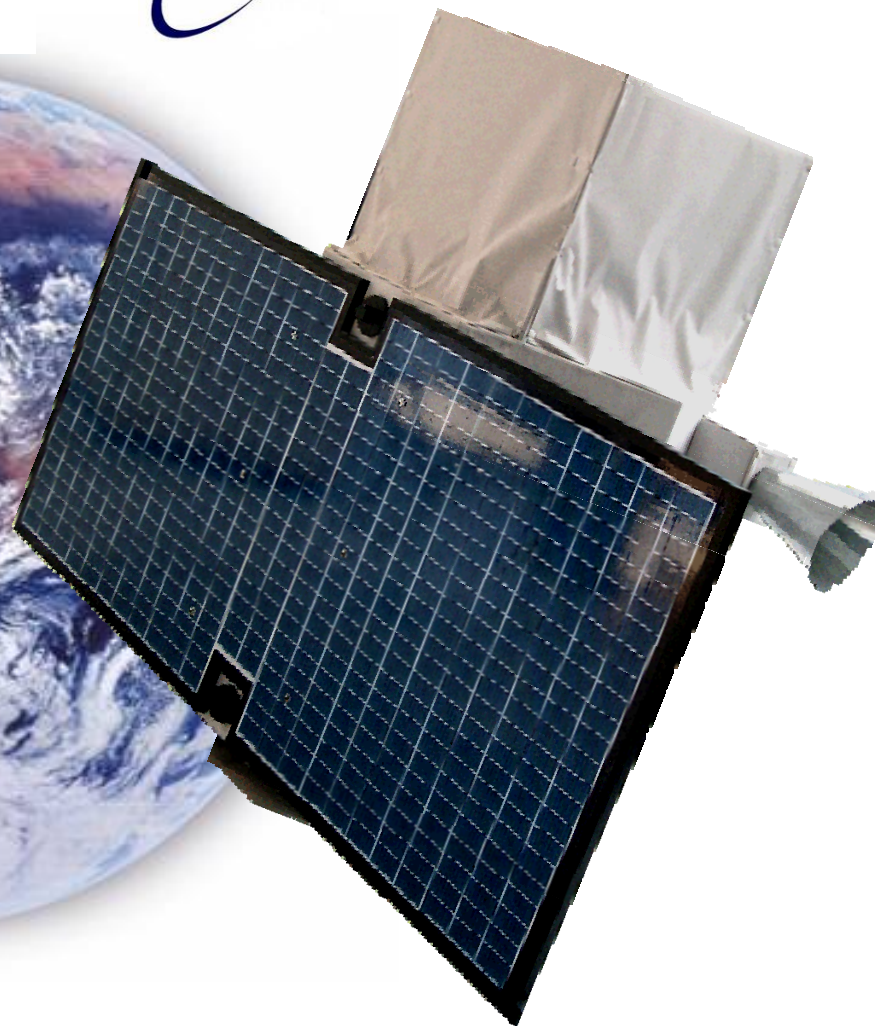
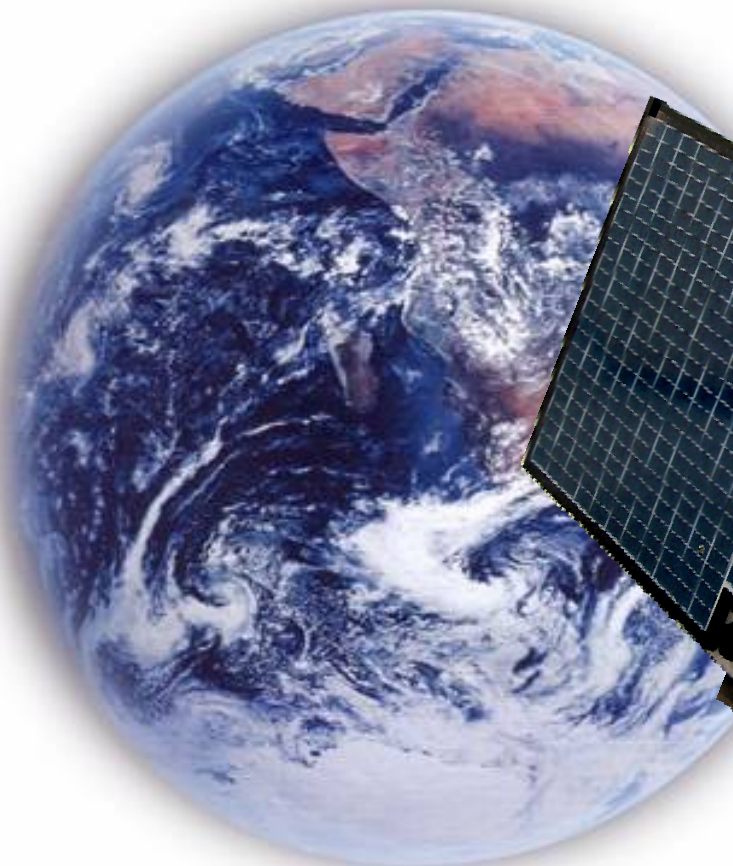
ASI and bi/multilateral Space Astronomy Facilities

Paolo Giommi
Italian Space Agency, ASI

AGILE: an Italian Small Mission




INAF



AGILE: an Italian small scientific mission



- **Devoted to high-energy astrophysics**
- **Optimized for a low-cost/high efficiency of scientific performance**
- **Launched on April 23, 2007 from India**
- **Active in synergy with other satellites and observatories around the world**
- **Very important scientific results**
- **An observatory also for Terrestrial phenomena**



The AGILE Payload: the most compact instrument for high-energy astrophysics

It combines for the first time

- a gamma-ray imager (30 MeV- 30 GeV) with a
- hard X-ray imager (18-60 keV)

with large FOVs (1-2.5 sr) and optimal angular resolution



AGILE: 2 and 1/2 years in orbit...

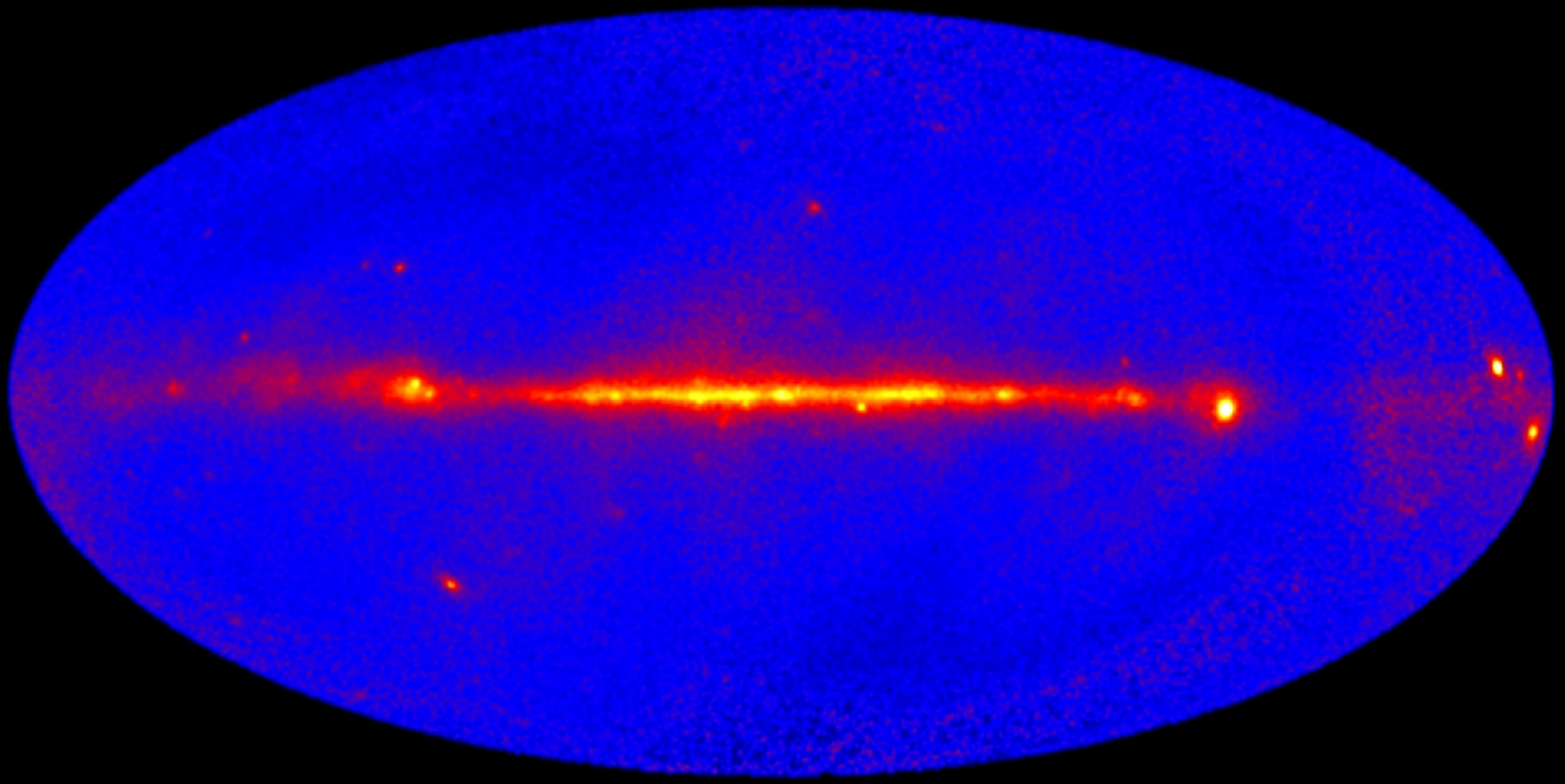
- **~ 14.500 orbits, February 9, 2010.**
- **Very good scientific performance**
- **Cycle-1: Dec. 2007- Nov. 2008**
- **Cycle-2: Dec. 2008- Nov. 2009**
- **Cycle-3: Dec. 2009- Nov. 2010**
- **Approved funding : end of 2010, mission extension to 2012 requested**

The data becomes public after 1 year

AGILE's scientific strengths

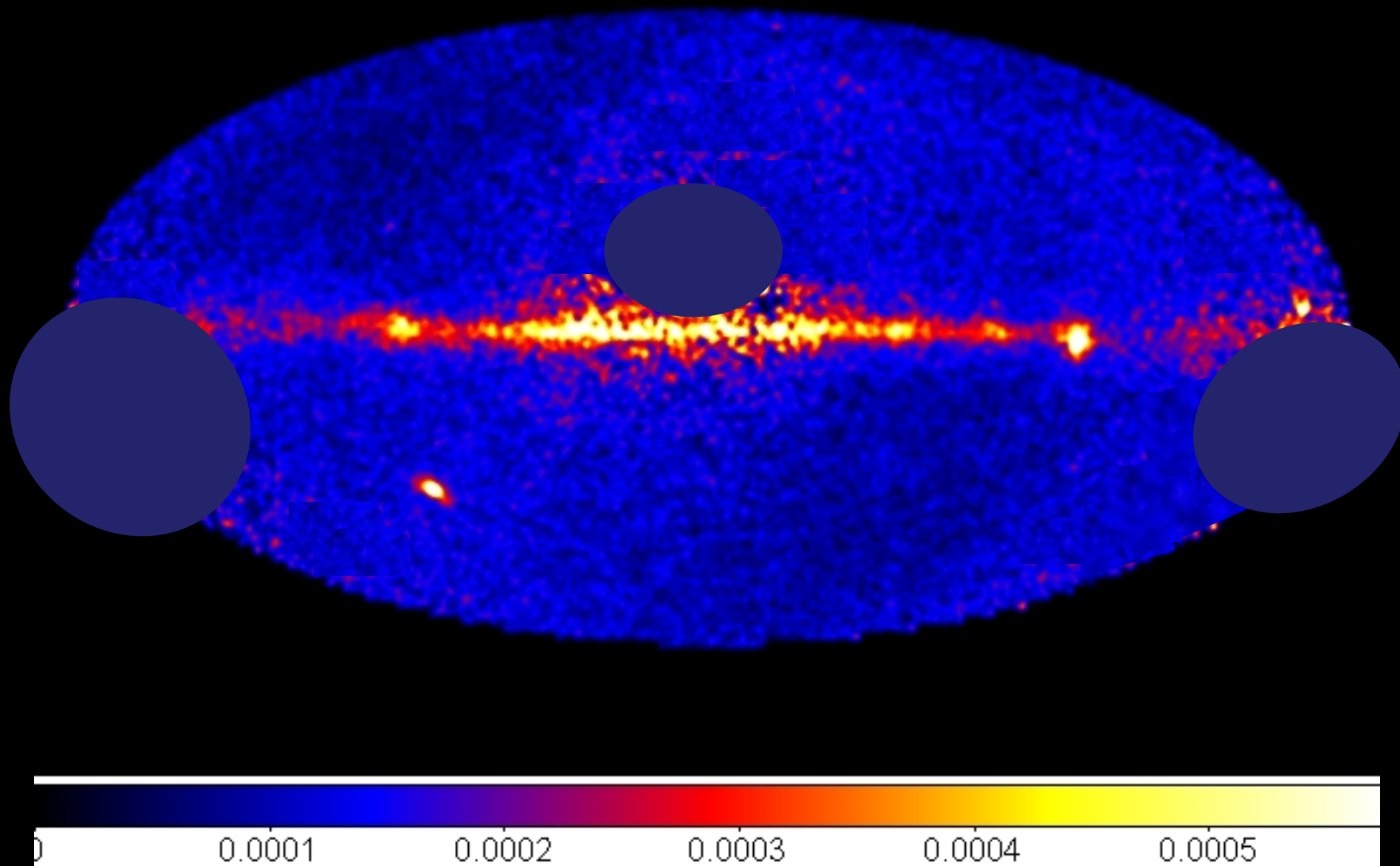
- **Combination of co-aligned gamma-ray (50 MeV – 5 GeV) and hard X-ray (20-60 keV) imagers**
- **Optimal sensitivity near 100 MeV**
- **Millisecond data acquisition**
- **Cosmic and Terrestrial phenomena studied by the same Mission**

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



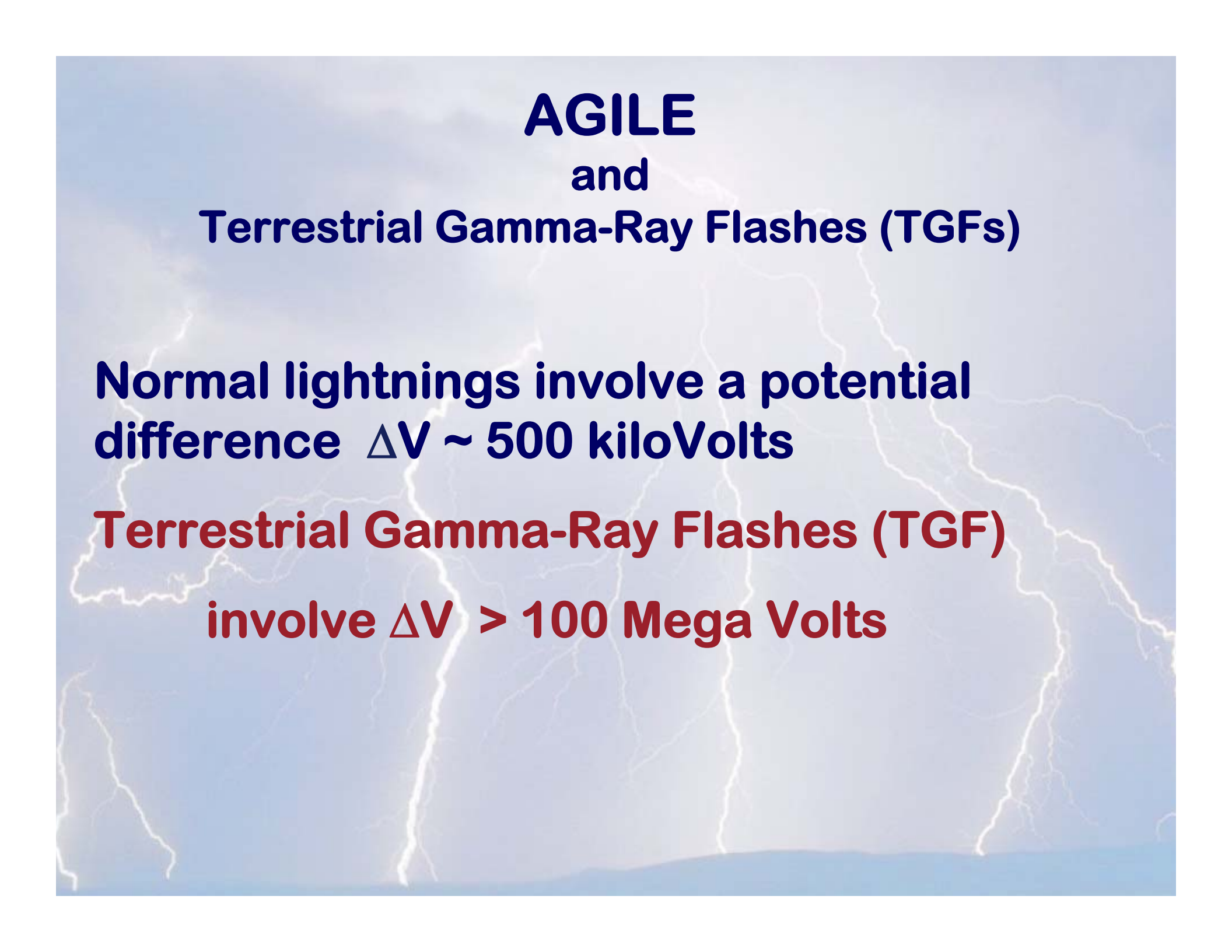


AGILE-2: 2-month intensity map ($E > 100$ MeV) (Nov.- Dec. 2009) preliminary



Main scientific discoveries

- **The brightest gamma-ray blazars:
(3C 454.3, PKS 1510-089, TX 0716+714, Mrk 421,...)**
- **Several (~10) new Pulsars and PWNs**
- **Discovery of gamma-ray transients in the Galaxy**
- **Discovery of gamma-ray emission from Cygnus X-3**
- **Microquasar studies, Gal. compact objects**
- **SNRs and origin of cosmic rays, evidence for proton acceleration**
- **Gamma-Ray Bursts, delayed emission, short GRBs**
- **Detection of the very large energy events in the atmosphere from Terrestrial Gamma-Ray Flashes**



AGILE

and

Terrestrial Gamma-Ray Flashes (TGFs)

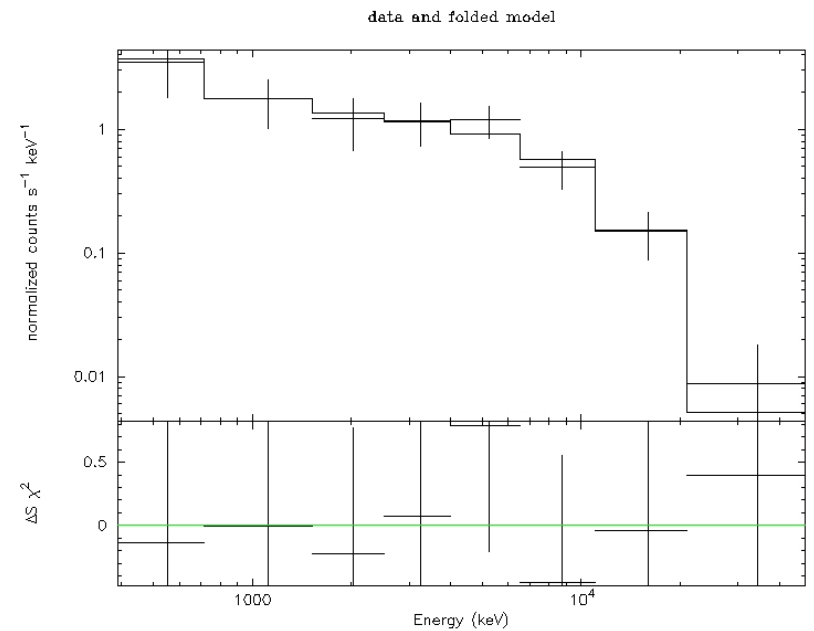
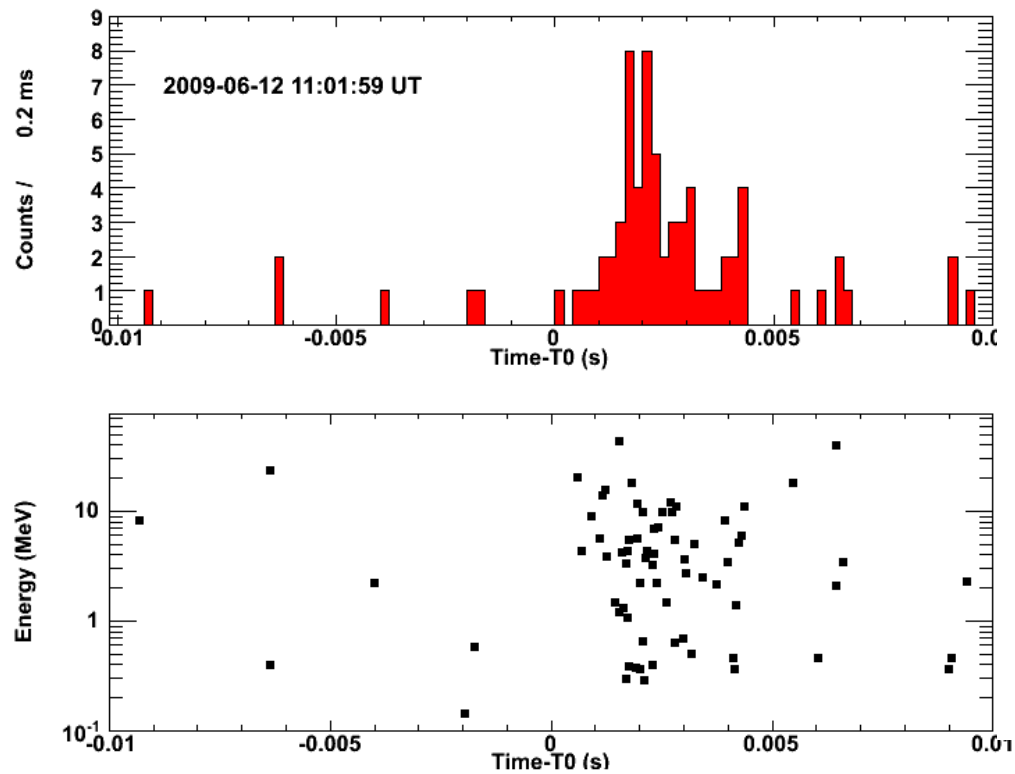
Normal lightnings involve a potential difference $\Delta V \sim 500$ kiloVolts

Terrestrial Gamma-Ray Flashes (TGF)
involve $\Delta V > 100$ Mega Volts

AGILE: what makes MCAL unique for TGFs:

- **Only instrument in equatorial orbit**
 - TGF on the equator
 - low-background
- **Only instrument with sub-msec trigger capability**
- **Instrument with the best capability at $E > 30\text{-}40$ MeV**

Example of a TGF detected by AGILE



AGILE - Conclusions



- **AGILE is a very successful Mission of the Italian Space Agency**
- **It is operating in synergy with other international space missions, in particular the NASA gamma-ray mission *Fermi***
- **Many scientific discoveries in the Galaxy and in deep space**
- **Also working as an observatory for Terrestrial high-energy phenomena !**
- **Very cost effective**



Swift

Launched on November 20, 2004

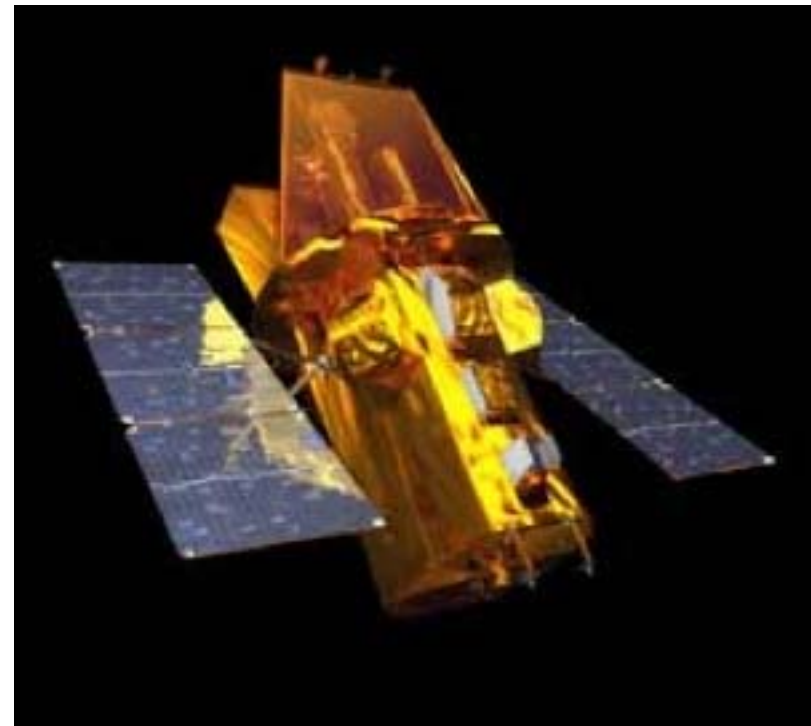
Swift is a NASA-MIDEX mission with participation of Italy and UK.

Mission extension approved until 2012.

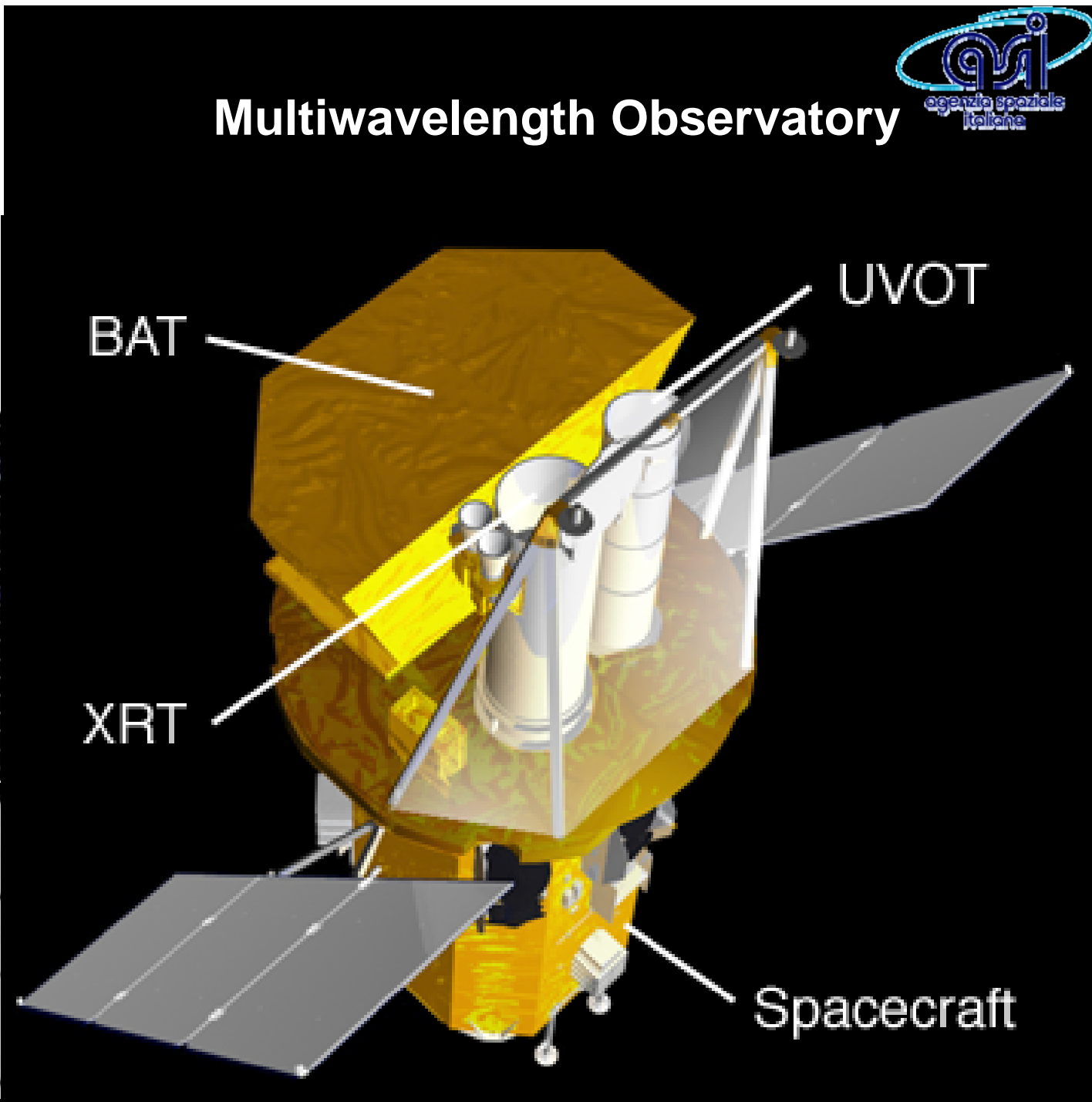
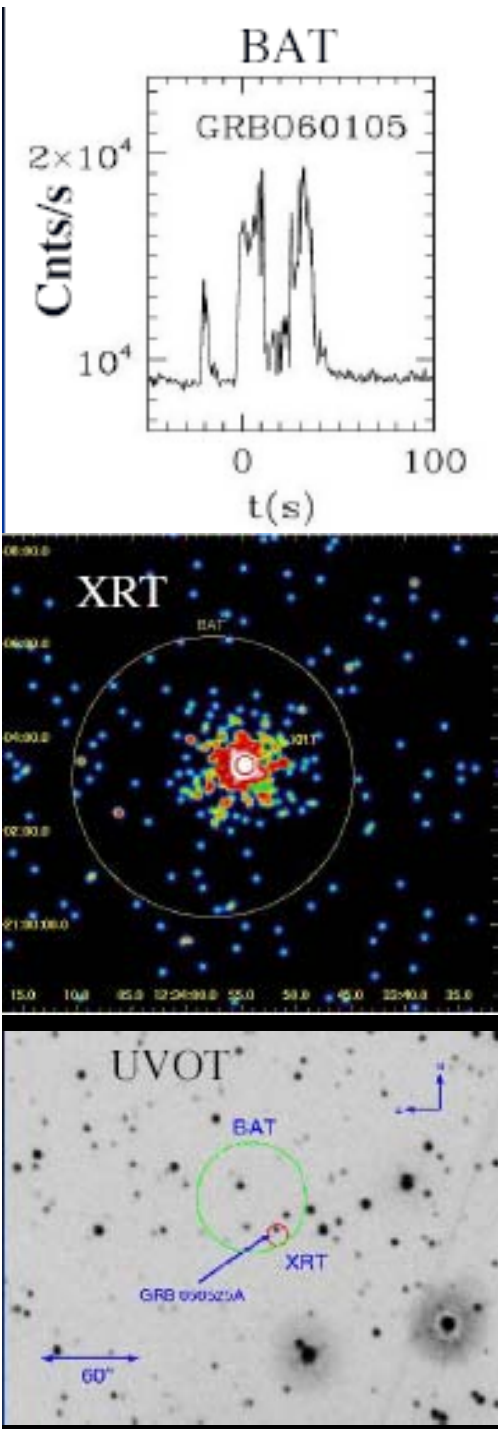
Further extension to 2014 proposed

Italian contribution:

- **Malindi Ground Station (ASI)**
- **X-ray mirror and calibration (INAF - Brera Astronomical Observatory)**
- **INAF science team**
- **XRT data reduction software and archive (ASI Science Data Center)**



Multiwavelength Observatory

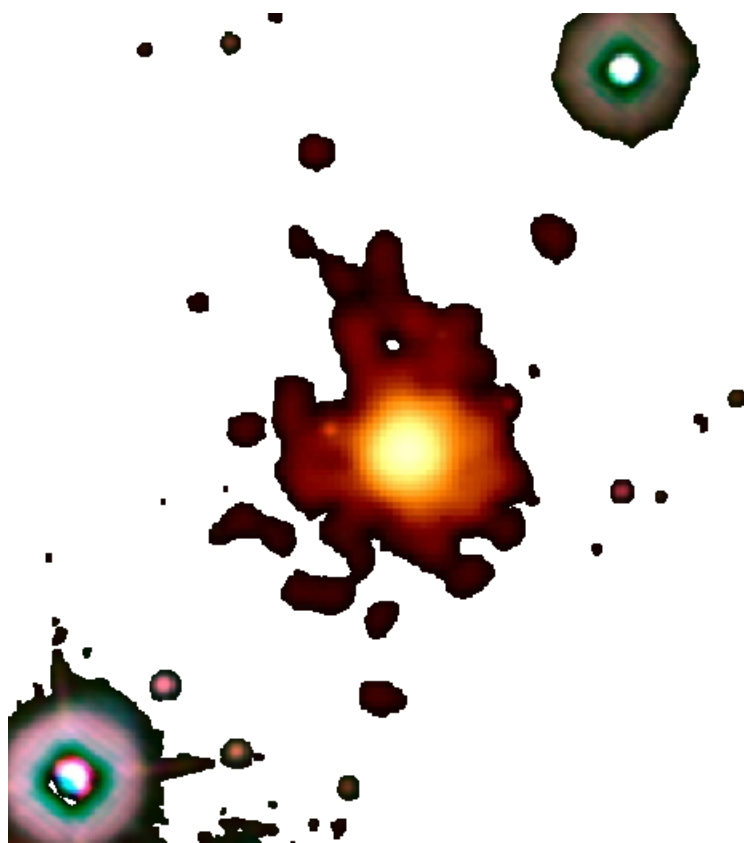


The most distant object known : GRB 090423

discovered by Swift on 23 April 2009

Optical/UV telescope

X-ray telescope

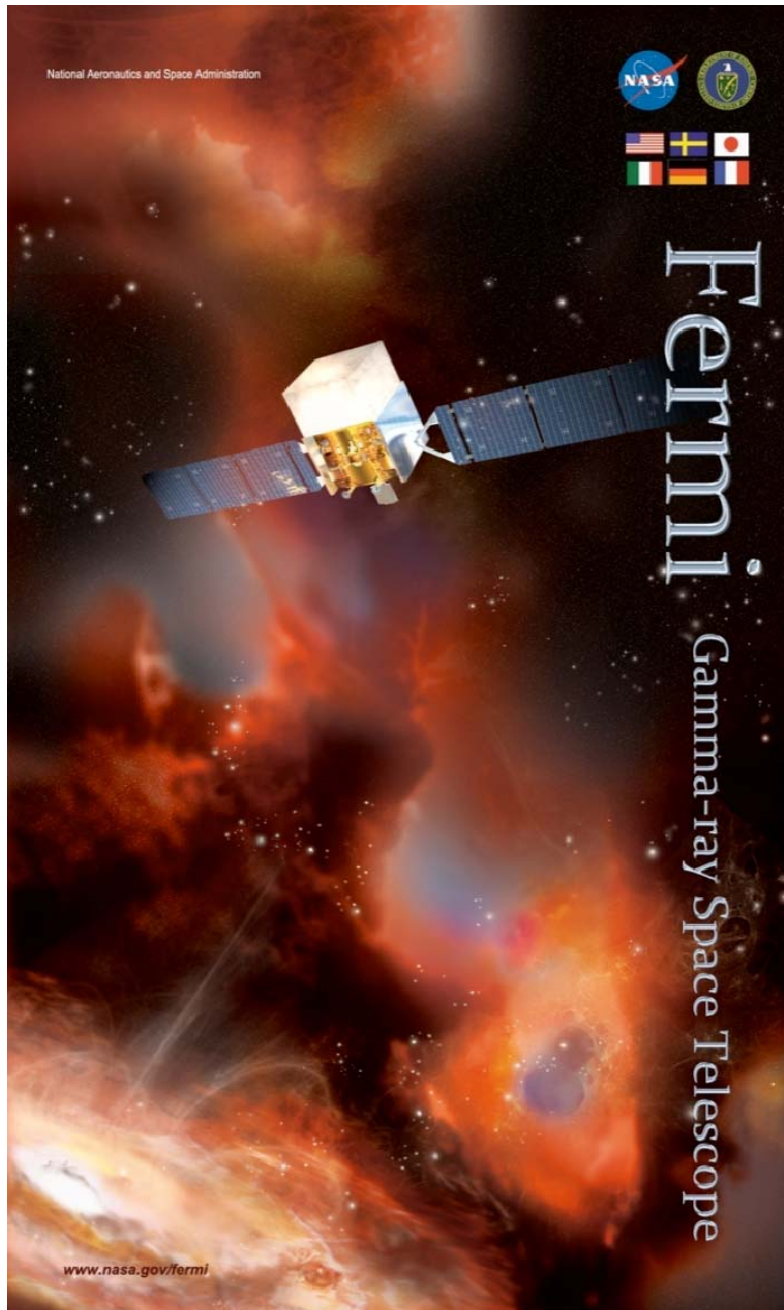


QuickTime™ e un
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sono necessari per visualizzare quest'immagine.

The Andromeda Galaxy (M31)

UV image from Swift UVO Telescope (30 cm)



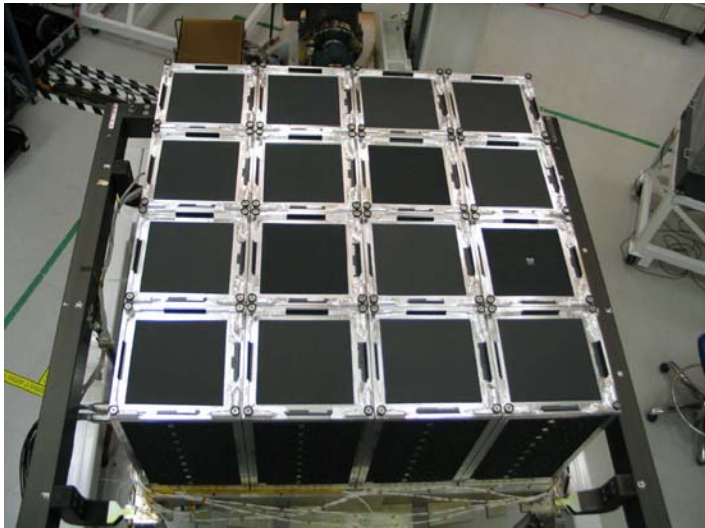


Fermi: Launched 11 June 2008

Italian participation

- **LAT instrument**
- **Archive & Scientific Software (ASDC)**
- **Science teams from INFN and INAF**

Payload (LAT) at Spectrum-Astro for integration in September 2006

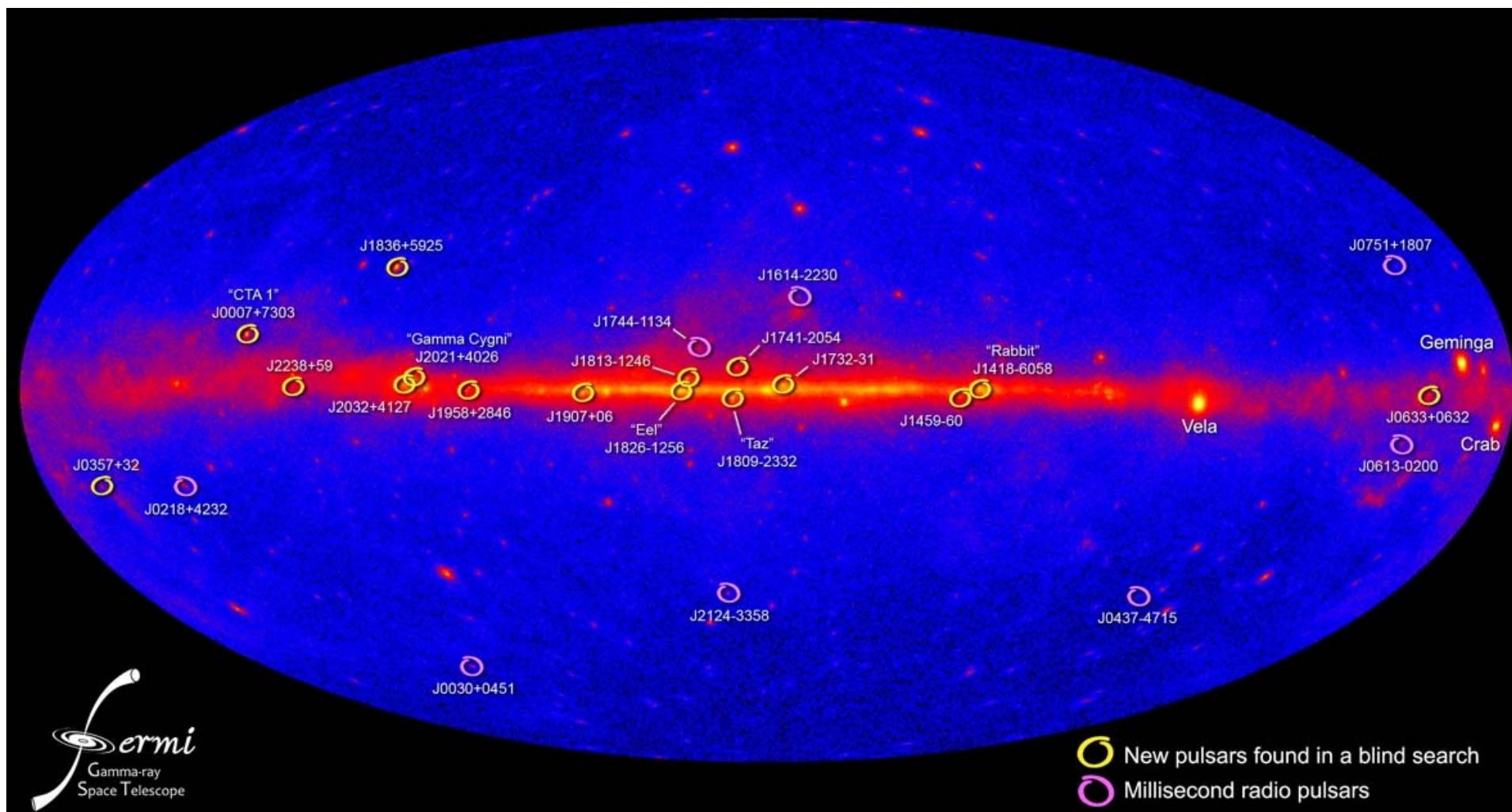




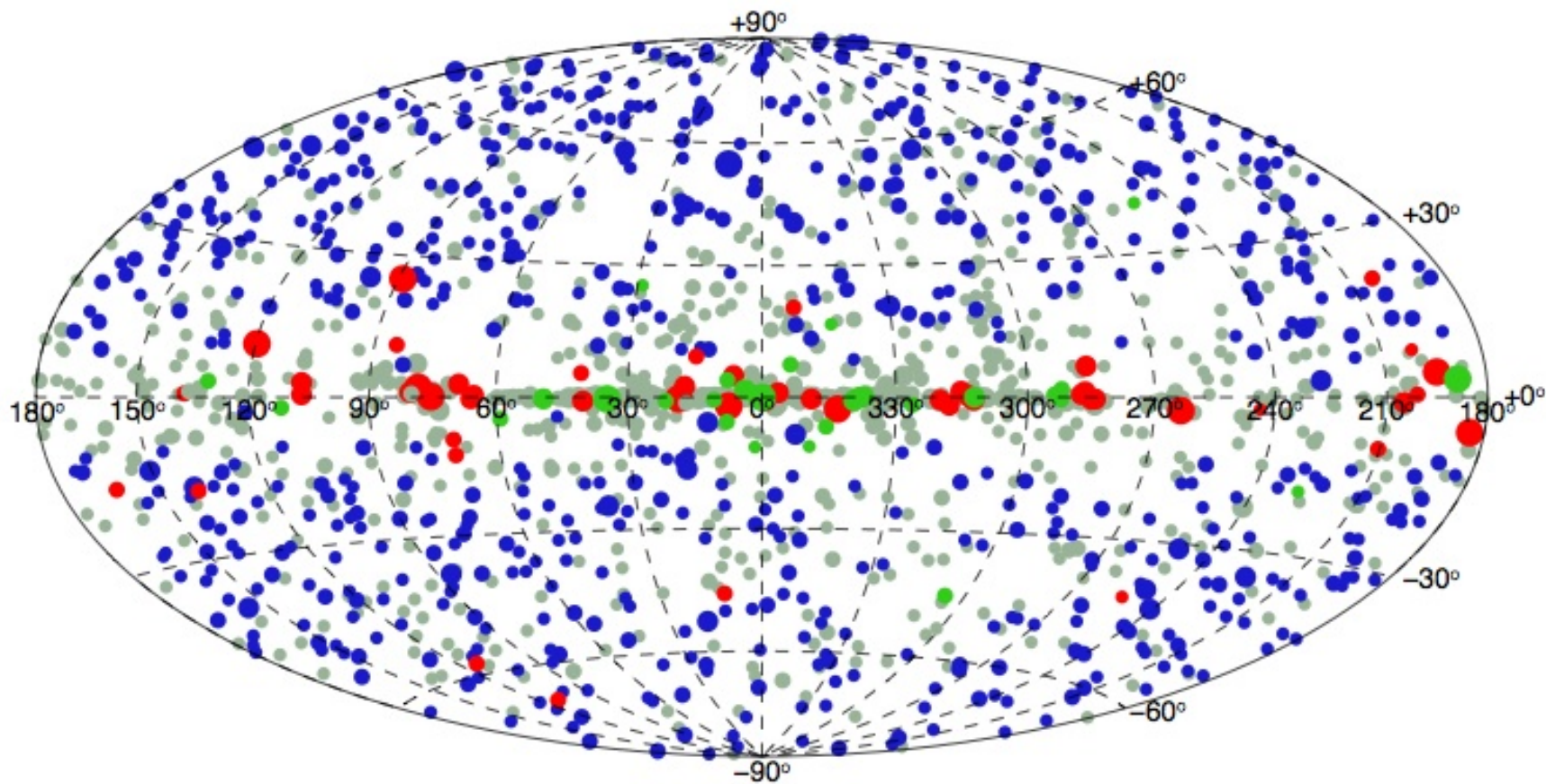
The *Fermi* sky after 1 year of data acquisition

QuickTime™ e un
decompressore
sono necessari per visualizzare quest'immagine.

Fermi detected pulsars



The first *Fermi* catalog of gamma-ray sources (1 year data)



The Malindi Broglio Space Center.

An ASI facility for BeppoSAX, HETE-2, Swift, AGILE, NuSTAR and other future scientific missions





ASI SCIENCE DATA CENTER



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AGILE



SWIFT



FERMI



HERSCHEL



BeppoSAX



NUSTAR



OLIMPO



SIMBOL-X

Astrophysics and Cosmology

Exploration of the Solar System

Astroparticle Physics

The **ASI Science Data Center** for
space astrophysics and cosmology,
astroparticle physics
 and
solar system exploration

The ASDC is located at the European Space Agency's establishment of ESRI, Frascati, Italy



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NEWS

- February 3, 2010: AGILE confirmation of the new gamma-ray flaring source J0109+6134 near the Galactic plane
- January 25, 2010: AGILE detection of AGL J2206+6203, a new unidentified

EVENTS

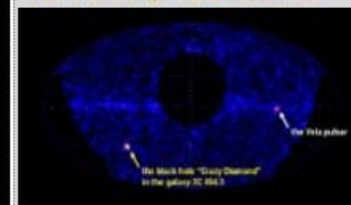
Workshop New Hard X-ray Mission

12-13 Novembre 2009

ASDC and Related Conferences

- AGILE 7th Workshop (29 September - 1 October 2009)

TOP RESULTS/PRESS RELEASES



- December 3, 2009: AGILE detects an extraordinary gamma-ray activity from the FSRQ 3C 454.3
- November 12, 2009: AGILE science operations resumed on November 4th, 2009
- September 17, 2009: Swift makes the highest-resolution ultraviolet image of Andromeda Galaxy
- September 17, 2009: PLANCK first light survey completed
- May 4, 2009: Swift discovers the most distant object in the Universe

Conclusions

- **ASI built and operates AGILE
(in cooperation with Italian institutions)**
- **Participates to highly successful bi/multilateral projects
(Swift and Fermi, next is NuSTAR with launch foreseen for
February 2012)**
- **Provides multi-mission infrastructures (Malindi and ASDC)**
- **Very cost-effective approach.**