Carlotta Pittori, on behalf of the AGILE Data Center
The AGILE Payload: the most compact instrument for high-energy astrophysics: only ~100 kg ~ 60 x 60 cm

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…

- **HARD X-RAY IMAGER (SUPER-AGILE)**
  - Energy Range: 18–60 keV

- **SILICON TRACKER**
  - Energy Range: 30 MeV - 30 GeV

- **(MINI) CALORIMETER**
  - Energy Range: 0.3–100 MeV

- **ANTICOINCIDENCE**
April 23, 2007: Launch!

Equatorial orbit: 550 Km, < 3º inclination angle
AGILE orbital parameters
Baseline equatorial orbit: 550 Km, 3° 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)
AGILE Telemetry raw data (Level-0) are down-linked every \( \textless 100 \) 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 \( \textless 5 \) 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

INPUT : Row data (TM Level-0)

Preprocessing : Level-1 data

Primary data generation: Quicklook & Standard analysis Level-2 data (photon list and logfile)

Scientific analysis: Level-3 data

OUTPUT : High level data products (count maps, spectra, light curves …)
AGILE Data Center at ASDC today:

Carlotta Pittori *coordinator* (INAF), Patrizia Santolamazza e Francesco Verrecchia (INAF) + Fabrizio Lucarelli (INAF, since dec 2009), G. Fanari and S. Stellato (Telespazio)

Paolo Giommi
ASDC Director

F. Tamburelli
(AGILE in calibrazione @ LNF)
First AGILE GRID light
ADC 24/5/2007

Commissioning Phase:
AGILE Vela PSR Count Map
(\sim 20000 \text{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)
The First AGILE GRID Catalogue of γ–ray Sources
Period July 2007 -- June 2008

Pulsars
Blazars+candidates
SNRs
HMXRB
Unidentified
CWBs

Flux>200 X10^{-8}phcm^{-2}s^{-1}
80<Flux<200
50<Flux<80
Flux<50

The First AGILE-GRID Catalog of High Confidence Gamma-Ray Sources


The First AGILE Catalog includes sources detected by using AGILE-GRID data from July 9, 2007, and of the satellite Commissioning phase, to June 30, 2008. Users can also download the First AGILE Catalog in FITS format here.

Refined analysis of compact regions of the Galactic plane yielded a new list of 47 high-confidence sources, compared to the 40 sources of the first version. Previous preliminary versions were published on this webpage to allow AGILE AGO guest observers to benefit of the Catalog in the preparation of their proposals.

If the AGILE Catalog data are used in publications, please acknowledge the AGILE Collaborations efforts by the following sentence:

"We acknowledge the use of the First AGILE Catalog of High Confidence Gamma-ray Sources, C. F. Ittori et al. 2009, A&A 506, 1563-1574 (2009), and the most recent version provided by the AGILE web pages at ASDC."
The ASDC SED Builder

Radiotelescops

Planck
Swift
AGILE and Fermi/CTA

\[ \text{sed-1229p0202 Ra}=187.27542(\text{deg}) \ \text{Dec}=2.04342(\text{deg}) \ \text{(NH}=1.7E20(\text{cm}^{-2}) \ ]

\[ \begin{align*}
\text{Log } L(\nu) &\quad \text{erg cm}^{-2} \text{ s}^{-1} \\
\text{Log } \nu (\text{Hz}) &
\end{align*} \]

- KUEHR
- PKSCAT90
- DIXON
- GB6
- NVSS
- FIRST
- VLSS
- CRATES
- PMN
- NORTHC20CM (flux 20 cm)
- NORTHC20CM (flux 6 cm)
- NORTHC20CM (flux 80 cm)
- Ned
- WMAP3 (Freq. 23e9)
- WMAP3 (Freq. 33e9)
- WMAP5 (Freq. 23e9)
- WMAP5 (Freq. 33e9)
- WMAP5 (Freq. 41e9)
- IPCSLEV
- JFC
- RASS
- WGAACAT2
- WFCAT
- KRTSRC
- EGRET
- BAT39MCAT (15-30 keV)
- BAT39MCAT (14-150 keV)
- Fermi1FGL (200 Mev)
- Fermi1FGL (600 Mev)
- Fermi1FGL (2 Gev)
- Fermi1FGL (5 Gev)
- Fermi1FGL (60 Gev)
- EBISSG4CAT (20-40 keV)
- EBISSG4CAT (40-100 keV)
- 3C273_simultaneous
- 3C273_BATejello
- 3C273_AGILE
- 3C273_simu12
- 3C273_GASP
- 3C273_SAGILE
- GTLIKE_P5v3
- RATAN
- OVRO_MAX_MIN
- 3C273_Claudia_Unefolding_16M
- swift_obs00035017500
- Fermi_1yr

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 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=53290.

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


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

<table>
<thead>
<tr>
<th>Entry number</th>
<th>Light Curve</th>
<th>Target Name</th>
<th>RA (J2000)</th>
<th>Dec (J2000)</th>
<th>Latest Observation Time</th>
<th>Flux (cts cm^-2 s^-1)</th>
<th>Flux error (cts cm^-2 s^-1)</th>
<th>Detection Significance</th>
<th>Exposure (sec)</th>
<th>Orbit number</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td></td>
<td>Sec X-1</td>
<td>16 10 56.2</td>
<td>-16 38 34.8</td>
<td>2011-09-16T10:00:03</td>
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<td>0.0139</td>
<td>24.19</td>
<td>12872</td>
<td>023711</td>
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<tr>
<td>2</td>
<td></td>
<td>Crab</td>
<td>05 34 30.9</td>
<td>+22 01 04.8</td>
<td>2011-09-16T10:00:03</td>
<td>0.102</td>
<td>0.0088</td>
<td>29.67</td>
<td>16111</td>
<td>023711</td>
</tr>
</tbody>
</table>

50 X-ray (18-60 keV) validated sources, up to September 2011
SuperAGILE public light curves (pointing + spinning mode data)
SuperAGILE detected sources including spinning mode data
AGILE AO-4

The Italian Space Agency (ASI) announces the release of the fourth Announcement of Opportunity to solicit proposals for the Guest Observer Program (GOP) of the AGILE mission.

This announcement solicits proposals for observations to be carried out during the observing time beginning on December 1st, 2010, and lasting twelve months.

Proposals may be submitted at any time during the period starting June 1, 2011 and ending June 30, 2011.

AGILE-GRID data for sources not reserved to the AGILE Team can be requested within the AGILE Guest Observer Program. AO4 Guest Observers can request data for:

- specific 1AGL, 1FGL and 3EG catalogue sources;
- pulsars;
- Active Galactic Nuclei.

Top level documentation regarding the AO4 can be found here:

- Agile AO4 Approved Targets
- Agile AO4 Policies and Procedures
- Agile AO4 Team Reserved Sources

Proposals may be prepared and submitted using a set of dedicated ASDC GOP on-line services (Proposal Preparation).
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: completedproprietary
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 interactive on-line analysis tool in MMIA developed at the ASDC for AGILE public data preview:

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.
New interactive on-line analysis tool developed at the ASDC for AGILE public data preview:
Warning: use imaging tool only as a preview of the AGILE $\gamma$-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

<table>
<thead>
<tr>
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<th>Name</th>
<th>Last modified</th>
<th>Size</th>
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</tr>
</thead>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>22-Nov-2011 16:56</td>
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<td>22-Nov-2011 16:57</td>
<td>346M</td>
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<td></td>
</tr>
</tbody>
</table>

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 $T_0 + 45 \text{ min (SA)}$ and $T_0 + 100 \text{ min (GRID)}$

• 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
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/IASF 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)

As specified in the Announcement of Opportunity Cycle-4, it is not possible to propose for ToO observations in response to AGILE Announcement of Opportunity.
**ADC Quick-Look Interface**
(from AGILE Services restricted area)

### Processamenti QL Scientifiq

**Legend**
- **R.A. or Galactic Longitude:**
- **Dec or Galactic Latitude:**
- **Equinox:**
- **Coordinates:**
  - Celestial (RA-Dec)
  - Galactic (l,b)

### Quick Access to QL Data Results

#### Details:
- Declination and Galactic coordinates can be entered either as degrees and decimal fraction (format ddd.ddd) or as degrees, minutes, seconds (dd:mm:ss format).
- Right ascension can be entered either as degrees and fraction (ddd.ddd) or as hours, minutes, seconds (hh:mm:ss format).

### Record List for AgileQLCat

<table>
<thead>
<tr>
<th>Config ID</th>
<th>Config Name</th>
<th>Duration</th>
<th>Run Status</th>
<th>Start</th>
<th>Stop</th>
<th>QL Image</th>
<th>QL Table</th>
<th>IoqFilePath</th>
<th>LinkData</th>
<th>Status</th>
<th>Type</th>
<th>Filter Type</th>
<th>Start Processing</th>
<th>Stop Processing</th>
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<td>Global_XImage AM</td>
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<td>2011-12-11 01:00:00</td>
<td>[Image 0x0]</td>
<td>TBO</td>
<td>Log File</td>
<td>Data File</td>
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<td>QL,V</td>
<td>FM</td>
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<td>328</td>
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<td>2011-12-09 02:21:00</td>
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<td>Log File</td>
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<td>QL,V</td>
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<td>2011-12-11 05:22:23</td>
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<td>304</td>
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<td>Log File</td>
<td>Data File</td>
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<td>QL,V</td>
<td>FM</td>
<td>2011-12-11 05:32:55</td>
<td>2011-12-11 05:38:58</td>
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<tr>
<td>310</td>
<td>B19 QL Variability Spinning FT3ab TEST (190.0)</td>
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<td>2011-12-11 02:40:00</td>
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<td>QL Catalog</td>
<td>Log File</td>
<td>Data File</td>
<td>OK</td>
<td>QL,V</td>
<td>FT3ab</td>
<td>2011-12-11 05:33:27</td>
<td>2011-12-11 05:38:59</td>
</tr>
<tr>
<td>311</td>
<td>B19 QL Variability Spinning FM TEST (190.0)</td>
<td>2</td>
<td>Actual</td>
<td>2011-12-09 02:40:00</td>
<td>2011-12-11 02:40:00</td>
<td>[Image 0x0]</td>
<td>QL Catalog</td>
<td>Log File</td>
<td>Data File</td>
<td>OK</td>
<td>QL,V</td>
<td>FM</td>
<td>2011-12-11 05:38:38</td>
<td>2011-12-11 05:44:17</td>
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<tr>
<td>307</td>
<td>B19 QL Variability Spinning FT3ab TEST (250, 45)</td>
<td>2</td>
<td>Actual</td>
<td>2011-12-09 02:40:00</td>
<td>2011-12-11 02:40:00</td>
<td>[Image 0x0]</td>
<td>QL Catalog</td>
<td>Log File</td>
<td>Data File</td>
<td>OK</td>
<td>QL,V</td>
<td>FT3ab</td>
<td>2011-12-11 05:38:39</td>
<td>2011-12-11 05:47:48</td>
</tr>
</tbody>
</table>
ASDC Data Explorer Tool
Quick Look AGILE database and automatic light curves

Variability

Available parameters:
- Name
- RA, Dec
- Gal, Dec
- Cnt, Cnts
- Err.
- Sqrt(TS)
- XimageId
- Flux, Err
- Distance from FOVCent.
- Ximage
- SNR
- Sp_Index
- Err_sp_index
- Other_name1
- Other_name2
- Other_name3

Access to agile data products
Error circle EXPLORER
Source Details

Entry details:
- R.A. (J2000) = 06 34 44.2 (98.8842 deg)
- Dec (J2000) = +18 16 07.5 (18.2688 deg)
- Galactic nH = 3.32E+21 (cm^-2)

Variability data for AGILE sources:

<table>
<thead>
<tr>
<th>Entry number</th>
<th>AGILE name</th>
<th>RA (J2000.0)</th>
<th>Dec (J2000.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AGL J0634+1816</td>
<td>194.78</td>
<td>4.67</td>
</tr>
<tr>
<td>2</td>
<td>AGL J1049+8055</td>
<td>128.53</td>
<td>34.83</td>
</tr>
<tr>
<td>3</td>
<td>AGL J0832-1236</td>
<td>236.49</td>
<td>15.75</td>
</tr>
</tbody>
</table>
Selected alerts sent via email, sms

Daily time scale (twice a day)

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

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

![AGILE spinning sky view](image)

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 $\sim 1/5$ of the entire gamma-ray sky (FoV $\sim 2.5$ 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.
• > 25680 orbits, April 14, 2012, 21:40 UT
• Pointing observation mode up to October 18, 2009 and spinning observation mode since October 2009.
• Very good scientific performance, especially at $\sim 100$ MeV
• Guest Observer Program open to the scientific community:
  Cycle-5: on-going data taking
AGILE DISCOVERY OF THE CRAB NEBULA VARIABILITY IN $\gamma$-RAYS

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

Fermi confirmation:
Abdo et al., Science, 331, 739 (2011)
The variable Crab Nebula!

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

Science Express (6 January 2011)
Sect. 6.1
Notes on individual sources:

<table>
<thead>
<tr>
<th>Flare date</th>
<th>Duration</th>
<th>Peak $\gamma$-ray flux</th>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2007</td>
<td>~ 15 days</td>
<td>$\sim 6 \cdot 10^{-6}$ ph cm$^{-2}$ s$^{-1}$</td>
<td>AGILE</td>
</tr>
<tr>
<td>February 2009</td>
<td>~ 15 days</td>
<td>$\sim 4 \cdot 10^{-6}$ ph cm$^{-2}$ s$^{-1}$</td>
<td>Fermi</td>
</tr>
<tr>
<td>September 2010</td>
<td>~ 4 days</td>
<td>$\sim 5 \cdot 10^{-6}$ ph cm$^{-2}$ s$^{-1}$</td>
<td>AGILE, Fermi</td>
</tr>
<tr>
<td>April 2011</td>
<td>~ 2 days</td>
<td>$\sim 30 \cdot 10^{-6}$ ph cm$^{-2}$ s$^{-1}$</td>
<td>Fermi, AGILE</td>
</tr>
</tbody>
</table>

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