High Energy INAF Science Archives

Matteo Perri

(INAF-OAR & ASI-SSDC)

On behalf of Massimo Cappi (INAF UTG-III)

Talk Outline

- Description of INAF UTG-III National Division
- The Space Science Data Center (SSDC)
- Overview of INAF Archives for High Energy Astrophysics

INAF UTG-III National Division

INAF UTG-III:

- **National Division for High Energy Astrophysics of the INAF Scientific Directorate**

***High Energy*: X-ray + Gamma-ray energy bands (from 0.1 keV to 300 TeV)**

INAF UTG-III Projects can be divided in:

- **Space Missions (e.g. ASI, ESA, NASA)**
- **Ground-based Observatories (Cherenkov Telescopes)**

These include:

- **Past Observatories (archive-based science)**
- **On-going observatories (present and hopefully >2025 time frame)**
- **Future Observatories: >2025 time frame**

INAF UTG-III Projects (1)

Past and present High Energy Space Missions:

- *Beppo*SAX (X-rays, ASI)
- Chandra (X-rays, NASA)
- XMM-Newton (X-rays, ESA)
- INTEGRAL (Hard X-rays, ESA)
- Swift (X-rays, NASA)
- NuSTAR (Hard X-rays, NASA)
- AGILE (Gamma-rays, ASI)
- Fermi (Gamma-rays, NASA)

INAF UTG-III Projects (1)

Past and present High Energy Space Missions:

• *BeppoSAX*	(X-rays, ASI) (Ground Segment)
• Chandra	(X-rays, NASA)
• XMM-Newton	(X-rays, ESA) (EPIC Co-I, calibration)
• INTEGRAL	(Hard X-rays, ESA) (IBIS PI, SPI Co-I)
• Swift	(X-rays, NASA) (data analysis software, X-ray optics)
• NuSTAR	(Hard X-rays, NASA) (data analysis software, calibration)
• AGILE	(Gamma-rays, ASI) (PI, Ground Segment)
• Fermi	(Gamma-rays, NASA) (data analysis software, calibration)

Major role of INAF in science archives management

INAF UTG-III Projects (2)

Future High Energy Space Missions:

- IXPE (X-rays polarimetry, NASA)
- ATHENA (X-rays, ESA)
- Theseus (Hard X-rays, ESA)
- Hermes (Hard X-rays, ASI)
- eXTP (Hard X-rays, ASI)
- SVOM (Hard X-rays), CAS-CNES)

Present and future (Very) High Energy Ground Telescopes:

- MAGIC (TeV)
- ASTRI/Mini Array (TeV)
- CTA (TeV)

INAF UTG-III Projects (2)

Future High Energy Space Missions:

- IXPE (X-rays polarimetry, NASA) (data analysis sw, detectors, calibration)
- ATHENA (X-rays, ESA) (X-IFU Co-I, calibration)
- Theseus (Hard X-rays, ESA) (PI, XGIS instrument)
- Hermes (Hard X-rays, ASI) (PI)
- eXTP (Hard X-rays, ASI)
- SVOM (Hard X-rays), CAS-CNES)

Present and future (Very) High Energy Ground Telescopes:

- MAGIC (TeV)
- ASTRI/Mini Array (TeV) (optics, detector, data analysis software)
- CTA (TeV) (data analysis software)

Major role of INAF in science archives management

The Space Science Data Center (SSDC)

INAF UTG-III archive activities for High Energy Astrophysics based at the SSDC

The Space Science Data Center (SSDC): Research Infrastructure managed by the Italian Space Agency (ASI) together with INAF and INFN

The Space Science Data Center (SSDC)

INAF UTG-III archive activities for High Energy Astrophysics based at the SSDC

The Space Science Data Center (SSDC): Research Infrastructure managed by the Italian Space Agency (ASI) together with INAF and INFN

SSDC main mission:

- **acquire, manage, process and distribute data from (mainly) space based mission (scientific data return enhancement)**
- **ensure long term preservation of archives**

The Space Science Data Center (SSDC)

INAF UTG-III archive activities for High Energy Astrophysics based at the SSDC

The Space Science Data Center (SSDC): Research Infrastructure managed by the Italian Space Agency (ASI) together with INAF and INFN

SSDC main mission:

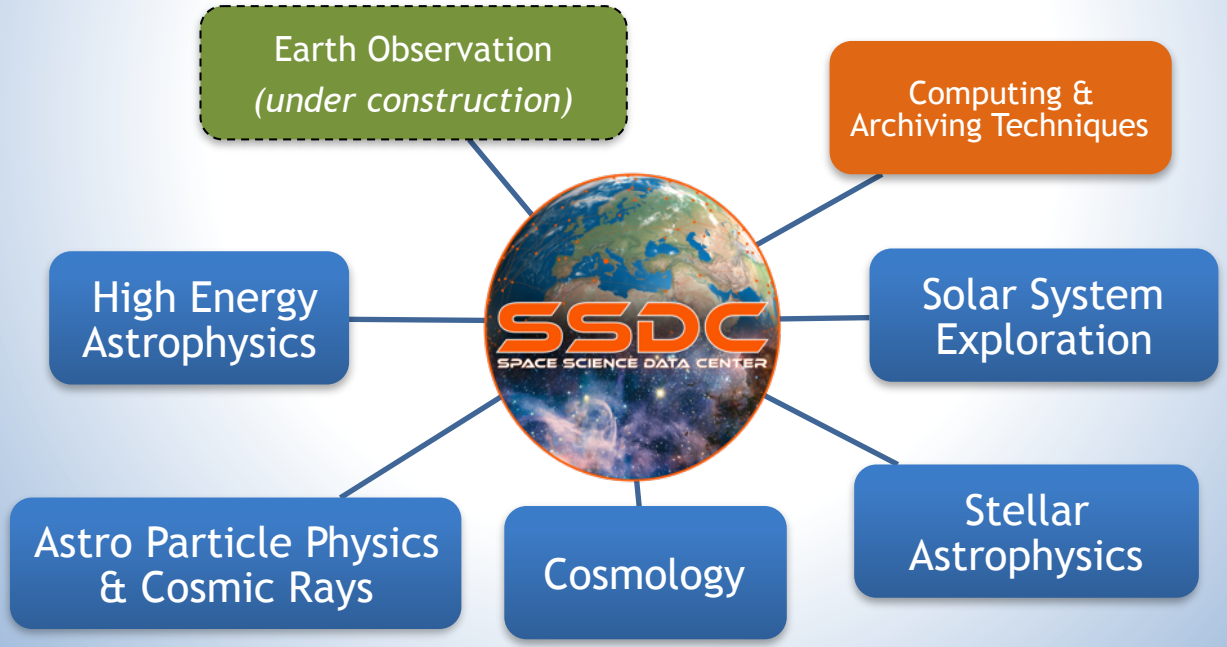
- acquire, manage, process and distribute data from (mainly) space based mission (scientific data return enhancement)
- ensure long term preservation of archives

Founded in 2000 (formerly ASDC) after the experience acquired by the *BeppoSAX* Science Data Centre in 1990s.

Operational scientific support to more than 25 space missions (significant fraction of high energy astrophysics missions)

THE SSDC SCIENTIFIC EXPERTISE

SSDC team involves around 40 people: scientists from ASI, INAF, INFN and SW engineers from Telespazio & SERCO, expert in different fields.



Effective approach: Developers and Users belong to same communities.

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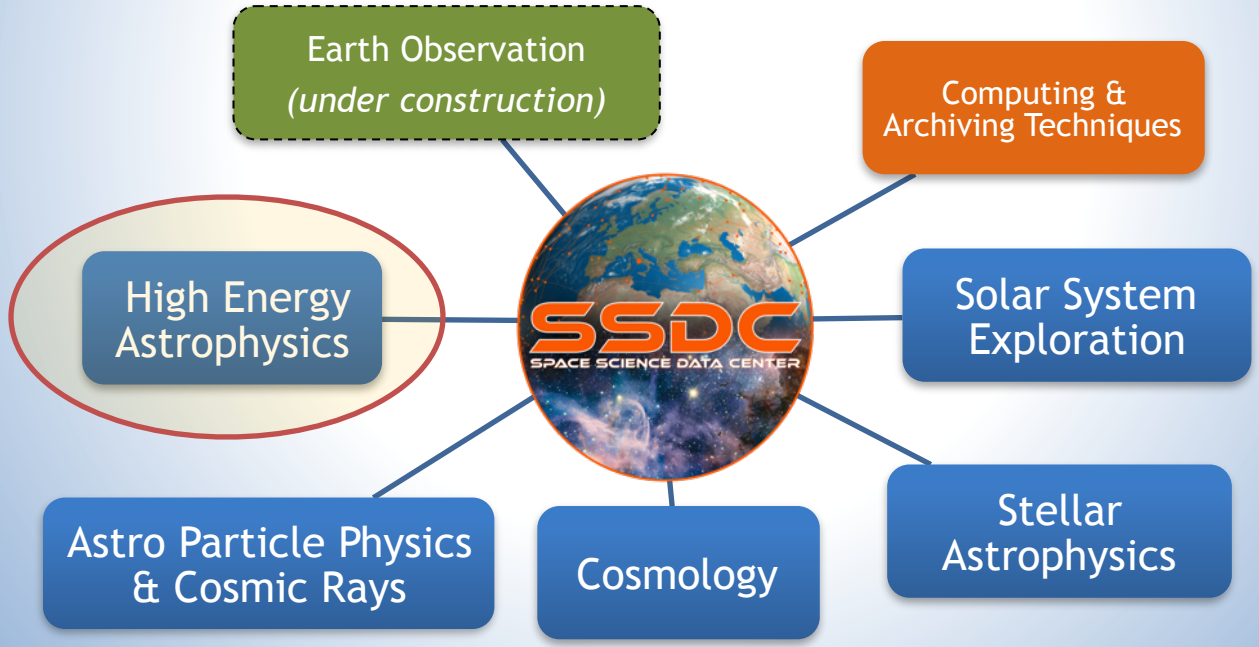


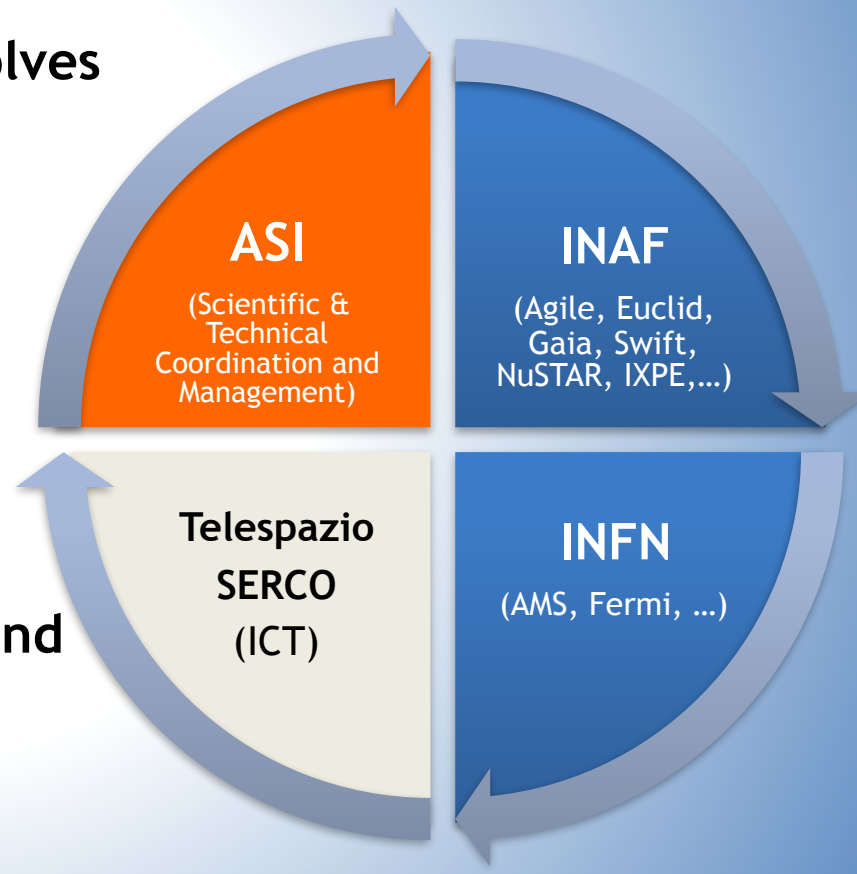
Effective approach: Developers and Users belong to same communities.

THE SSDC ORGANIZATION

SSDC management and organization involves several Research Institutes:

- ASI – Italian Space Agency
- INAF – National Institute for Astrophysics
- INFN – National Institute for Nuclear Physics

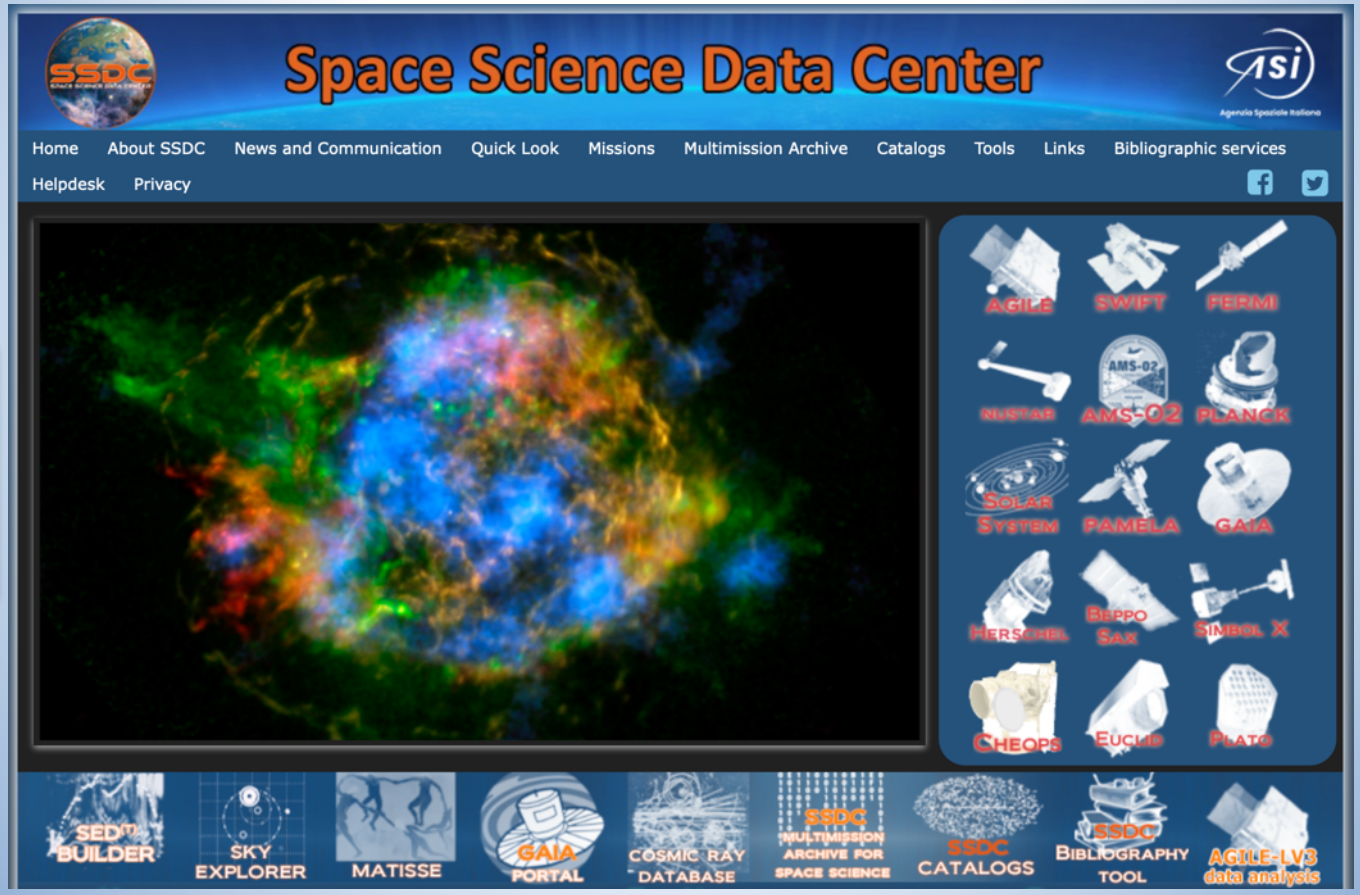
Industries are involved for Information and Communication Technology supports.



Over 15 INAF-OAR scientists operating at the SSDC (including 9 staff)

THE SSDC SCIENCE GATEWAY

Science Tools for on-line access to data in a multifrequency environment



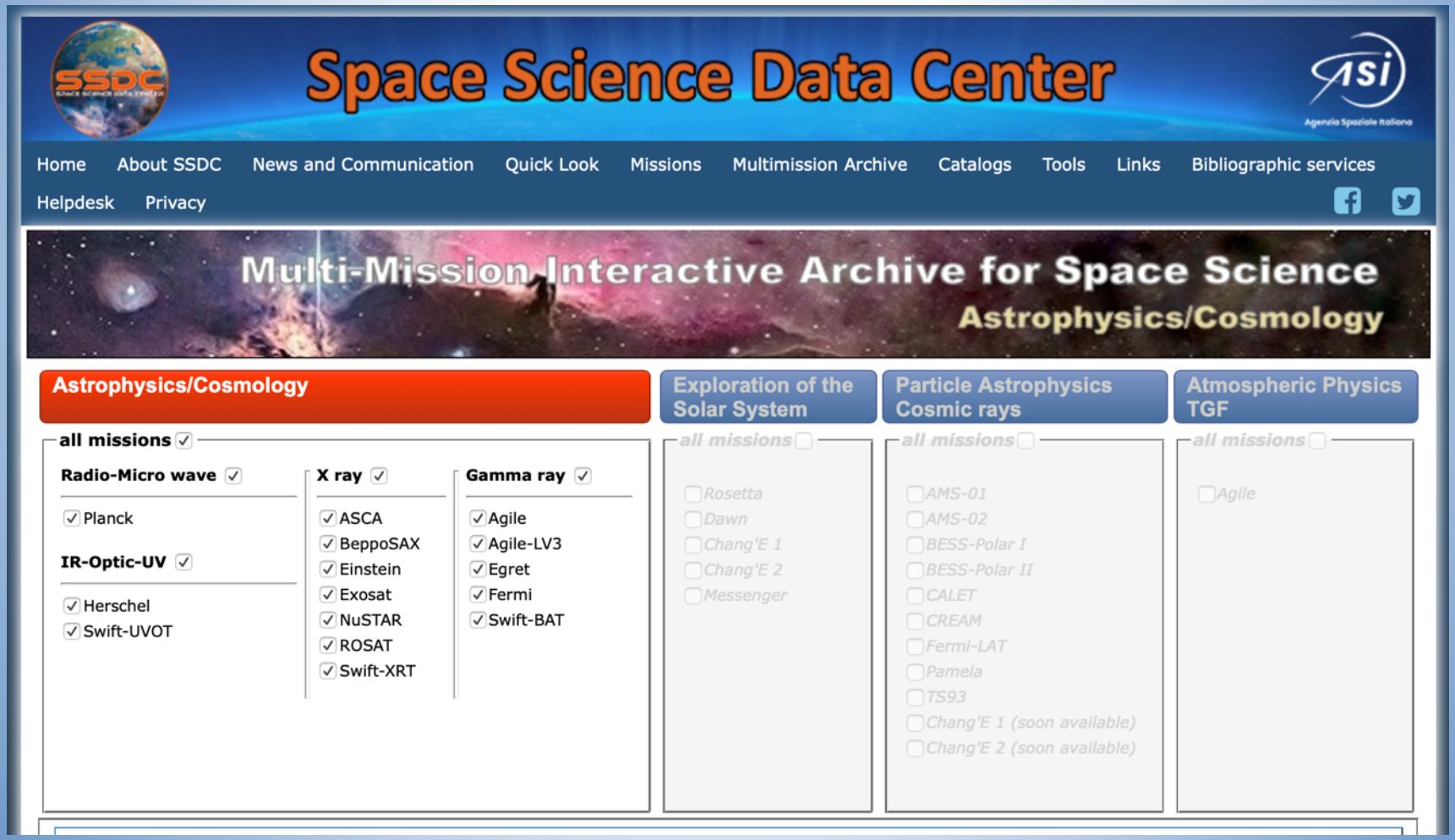
On-line Access to Space Missions Data Archives

THE SSDC SCIENCE GATEWAY

Science Tools for on-line access to data in a multifrequency environment

On-line Access to Space Missions Data Archives

THE SSDC MULTI-MISSION ARCHIVE



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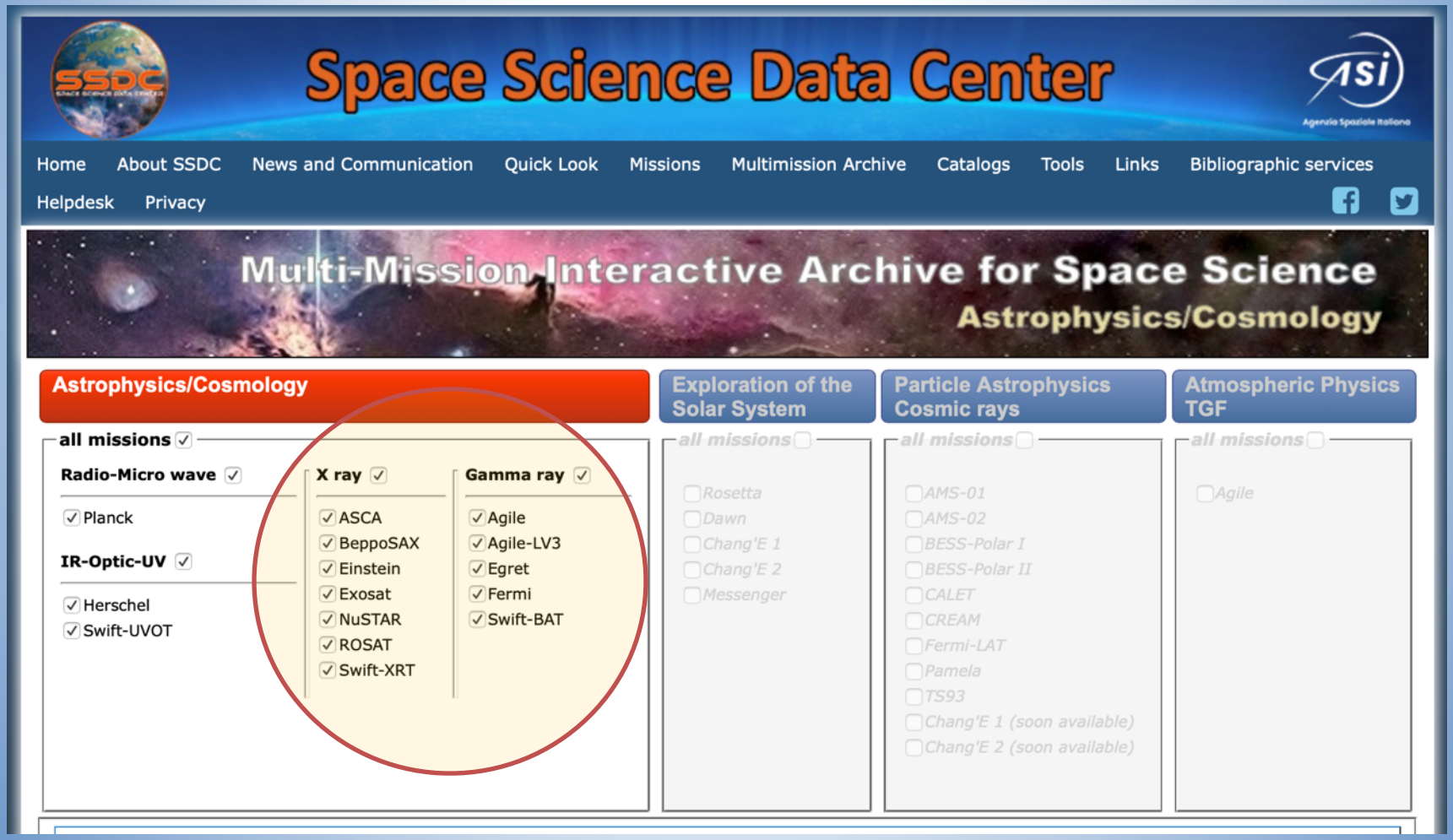
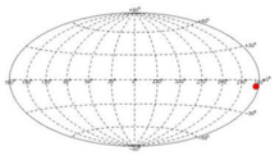


THE SSDC MULTI-MISSION ARCHIVE

Multi-Mission Interactive Archive

Query results for: **CRAB**
RA = **83.63321** (deg); DEC = **22.01447** (deg); EQUINOX = **2000**
Source name resolved by **SSDC**



Source Names

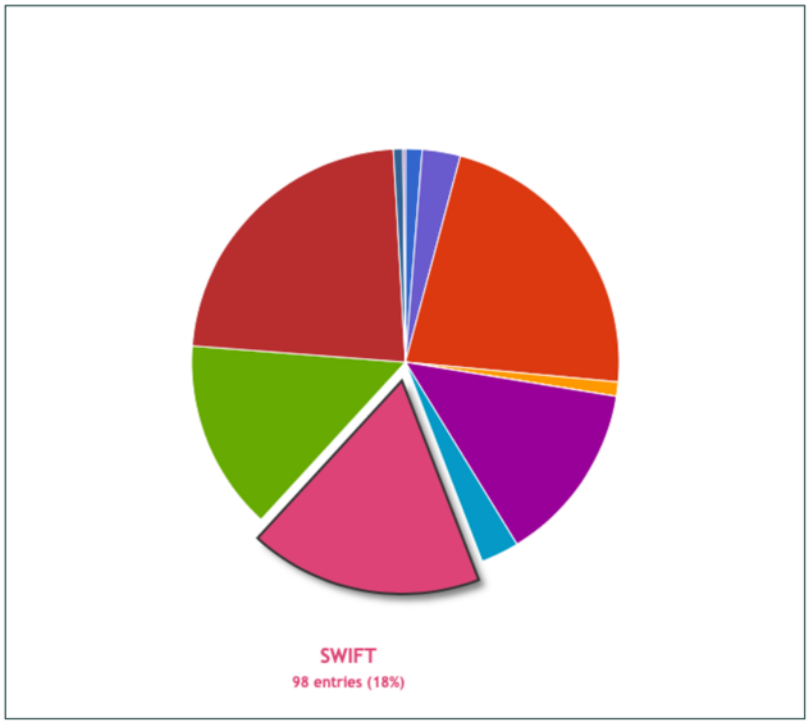
Bibliographic search

PKSB0531+219

in time range between 1900 and 2019

By name via NED

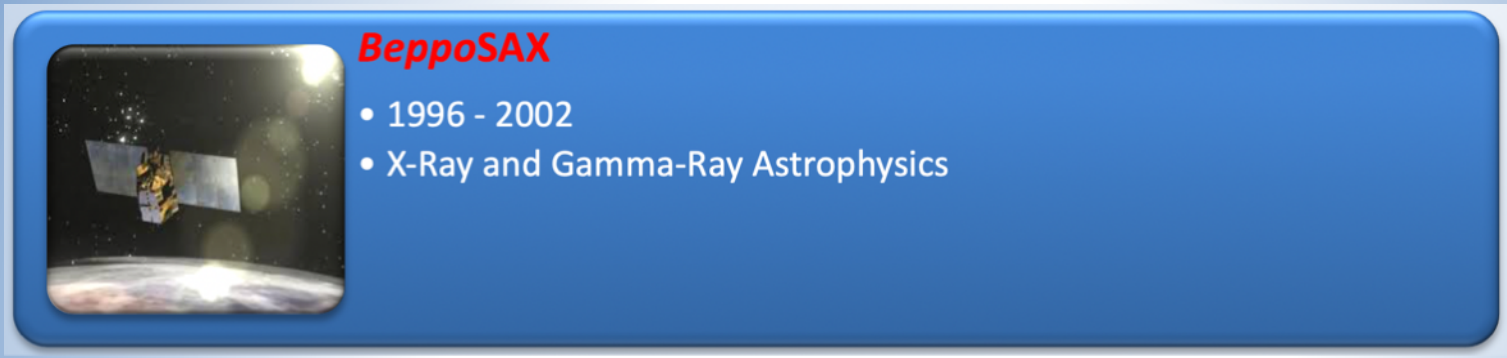
By coordinates via ADS



MISSION	ENTRIES
ASCA	7
BeppoSax NFI	16
BeppoSax WFC	124
EINSTEIN	6
EXOSAT	0
NUSTAR	76
ROSAT	16
SWIFT	98
AGILE	80
AGILE-LV3	127
EGRET	4
FERMI	1

- **Uniform User Interface**
- **Direct Data Access**
- **Preview of High Level Data Products**
- **On-line Interactive Scientific Analysis tools to enhance the data scientific return**

BeppoSAX Science Archive



Archive available at the SSDC since beginning of the mission

- About 1,500 pointed observations
- Scientific data for both Narrow Field Instruments (LECS, MECS, PDS, HPGSPC) and Wide Field Cameras (WFC)
- Standard Scientific Analysis Preview (images, spectra, light-curves)
- Interactive Analysis Tools for LECS and MECS instruments

BeppoSAX Science Archive

Entry number Selection mode: Include All		Archive	Interactive Analysis		Target Name	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	obs_code Stats	start_date Stats
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	SSDC Products Preview	Crab (calibrati	05 34 31.79	+22 00 51.01	3028100110	1997-04-11
2 Select	SSDC Data Explorer	Data Access	Interactive Analysis	SSDC Products Preview	Crab	05 34 31.9	+22 00 51.01	3050100200	1998-10-13
3 Select	SSDC Data Explorer	Data Access	Interactive Analysis	SSDC Products Preview	CRAB	05 34 31.9	+22 00 51.01	3102300300	1999-09-25
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13 Select	SSDC Data Explorer	Data Access	Interactive Analysis	SSDC Products Preview	CRAB_cal_NFI	05 34 31.9	+22 00 51.01	3105100200	2000-10-01
14 Select	SSDC Data Explorer	Data Access	Interactive Analysis	SSDC Products Preview	Crab_2001_NFI	05 34 31.9	+22 00 51.01	3139100100	2001-09-28

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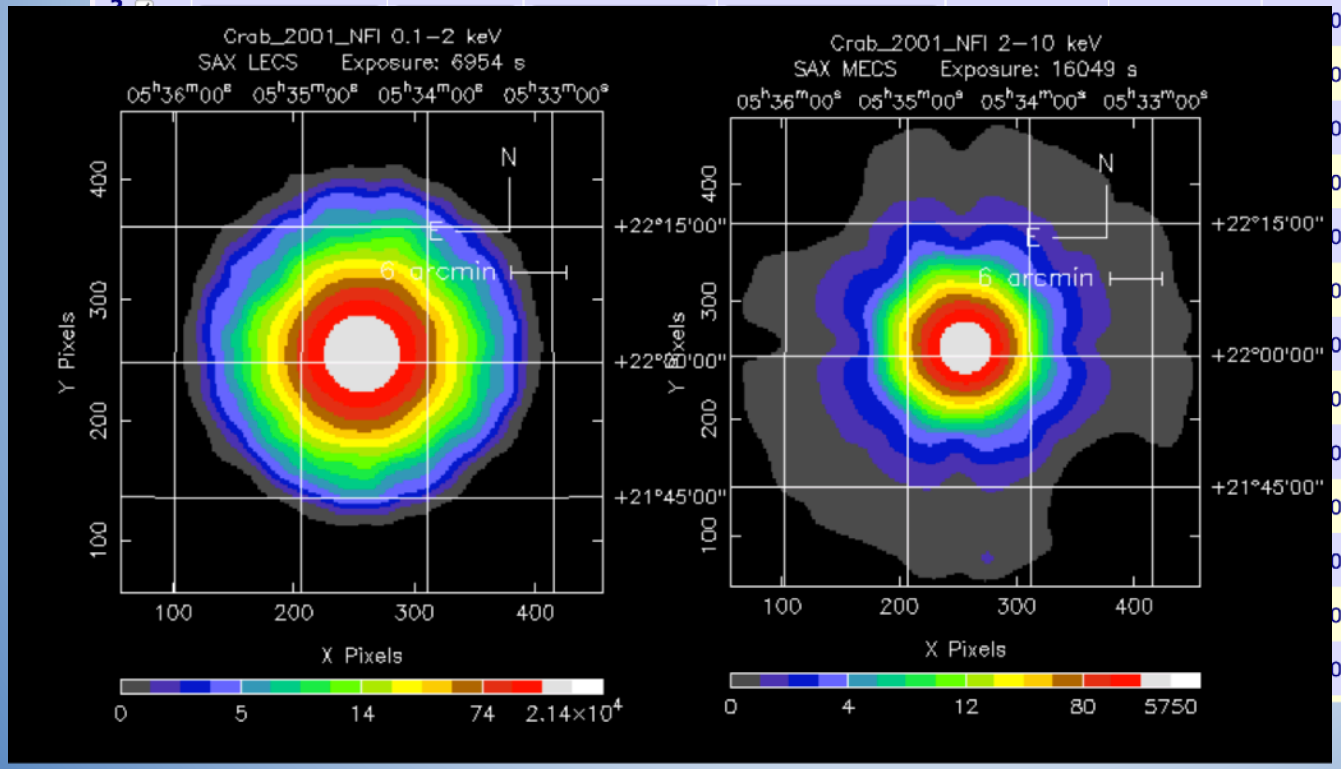

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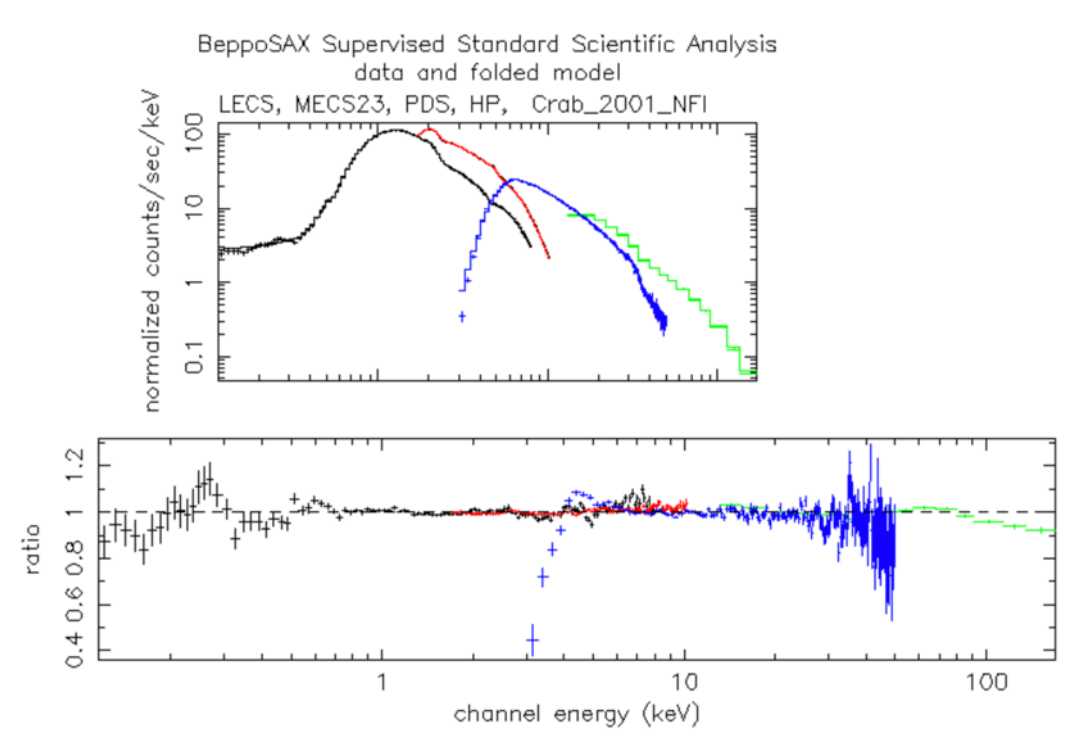

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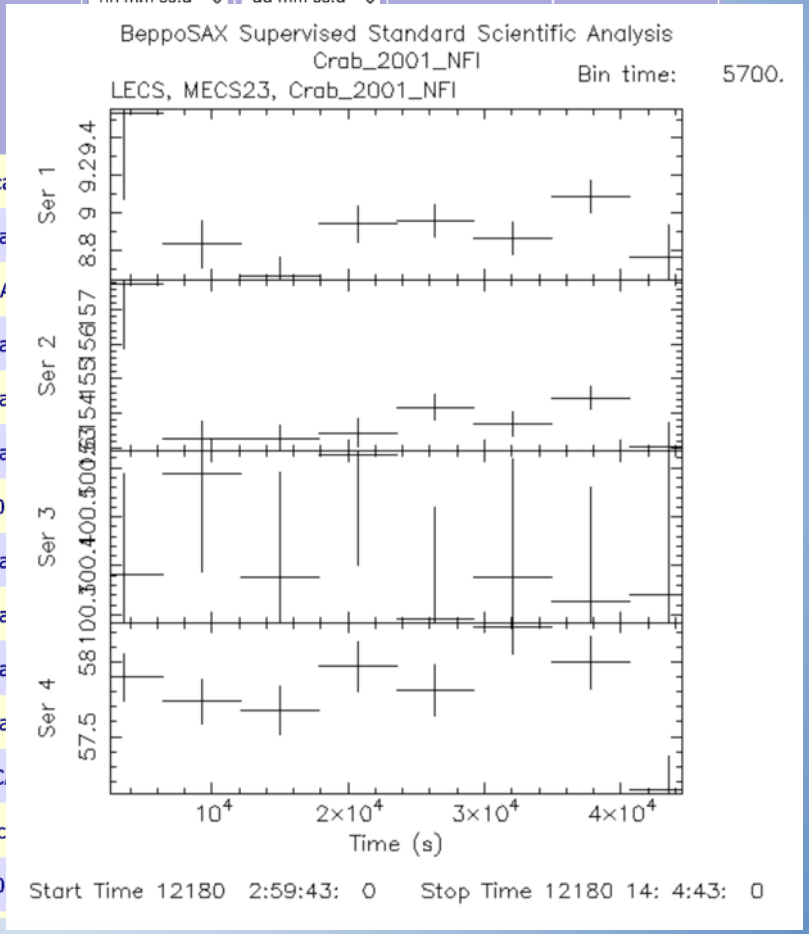

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9									9-09-25
10									8-04-06
11									6-08-31
12									0-04-10
13									0-10-01
14									1-09-28

Image Centered On:

RA (deg)	83.63	Dec (deg)	22.00
LII (deg)	184.56	BII (deg)	-5.79

Source name: Search

Image half size (pixel)	250
Emin (PHA)	44
Emax (PHA)	200

Catalog Overlay

Radio | IR | X-Ray | Gamma | Sources cats

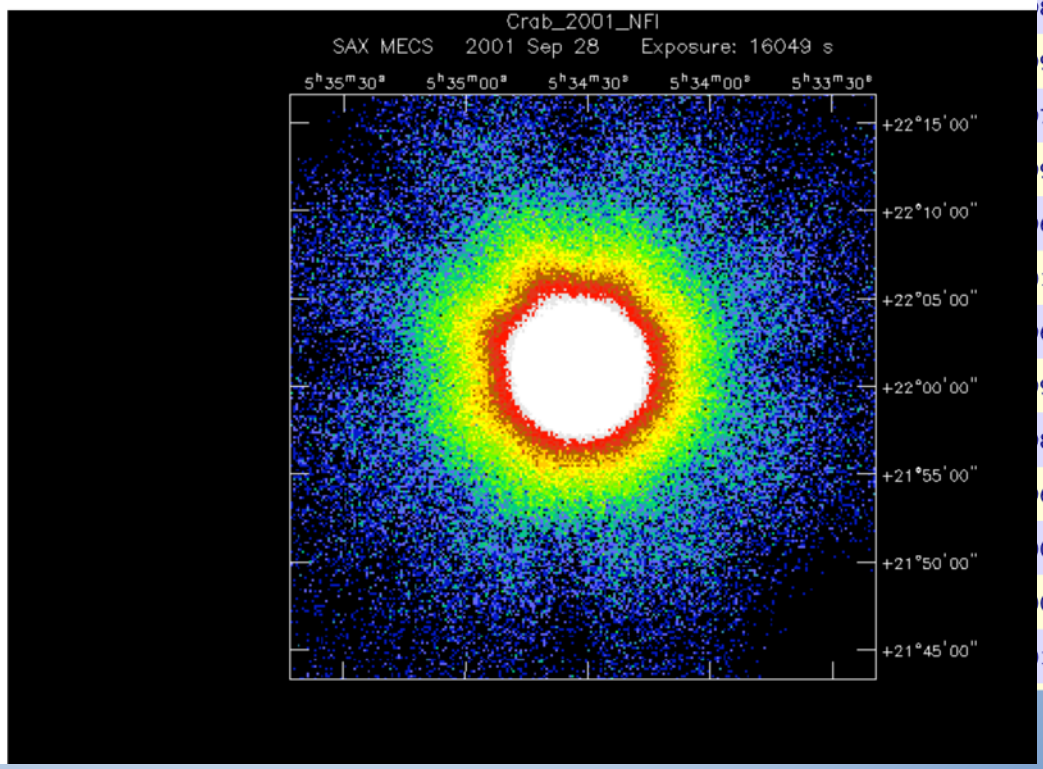
AT20G
ATCAPMN
B3
CRATES

JS9 display:

Run (JS9) Reset to default

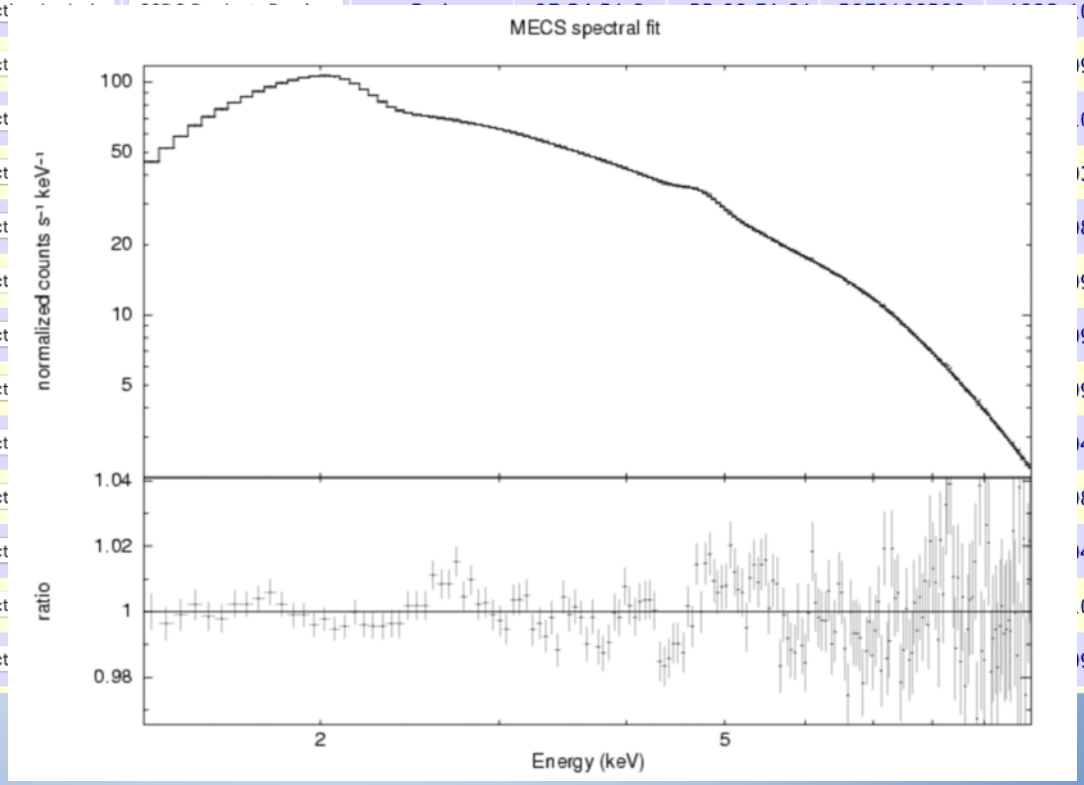
Ximage display parameters:

Color	blubase
Color scaling	log
Minimum level displayed	1
Maximum level displayed	100
Skygrid	Off

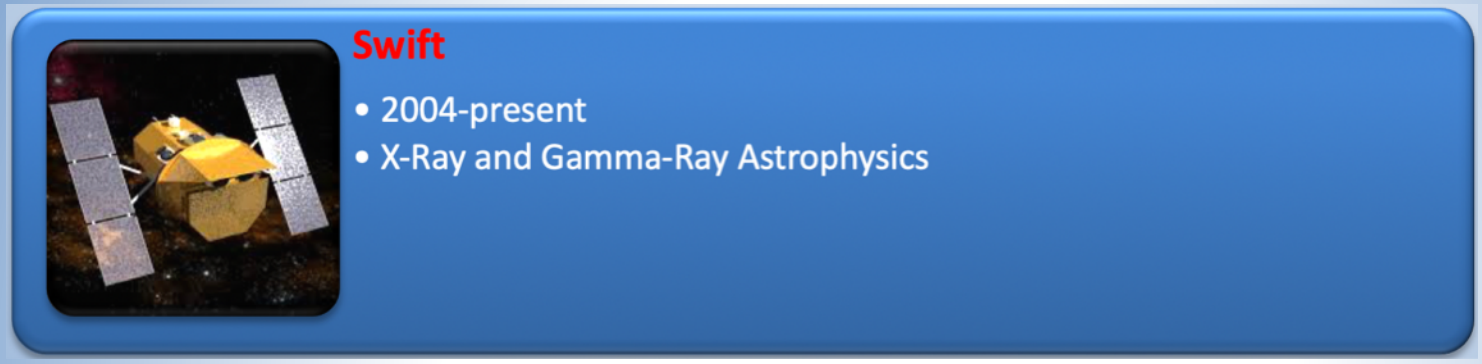


BeppoSAX Science Archive

Entry number Selection mode: Include All		Archive	Interactive Analysis		Target Name	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	obs_code Stats	start_date Stats
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	SSDC Products Preview	Crab (calibrati	05 34 31.79	+22 00 51.01	3028100110	1997-04-11
2 Select	SSDC Data Explorer	Data Access	Interact						0-13
3 Select	SSDC Data Explorer	Data Access	Interact						9-25
4 Select	SSDC Data Explorer	Data Access	Interact						0-08
5 Select	SSDC Data Explorer	Data Access	Interact						3-09
6 Select	SSDC Data Explorer	Data Access	Interact						8-31
7 Select	SSDC Data Explorer	Data Access	Interact						9-28
8 Select	SSDC Data Explorer	Data Access	Interact						9-06
9 Select	SSDC Data Explorer	Data Access	Interact						9-25
10 Select	SSDC Data Explorer	Data Access	Interact						4-06
11 Select	SSDC Data Explorer	Data Access	Interact						8-31
12 Select	SSDC Data Explorer	Data Access	Interact						4-10
13 Select	SSDC Data Explorer	Data Access	Interact						0-01
14 Select	SSDC Data Explorer	Data Access	Interact						9-28



SWIFT SCIENCE ARCHIVE



Official Mirror Archive available at the SSDC since beginning of the mission

- About 200,000 pointed observations
- Scientific data for 3 scientific instruments: Burst Alert Telescope (BAT), X-Ray Telescope (XRT), Ultra Violet-Optical Telescope (UVOT)
- Interactive Analysis Tools for XRT and UVOT telescopes
- Almost real-time Quick Look archive (~30 minutes time scale)
- SSDC responsible of the ground scientific data processing software for XRT (XRTDAS package)

SWIFT SCIENCE ARCHIVE

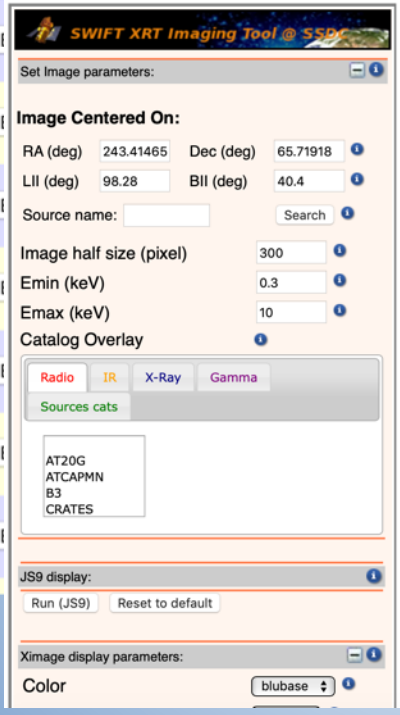
Entry number Selection mode: Include All		Interactive Analysis		Archive	Target Name	obsid	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	start_time
		XRT	UVOT			Stats			
1 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050300001	16 13 56.58	+65 41 48.83	Dec 23, 2004 00:12:00
2 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050301001	16 15 34.71	+65 41 49.3	Dec 25, 2004 00:23:00
3 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050300005	16 13 39.51	+65 43 09.04	Jan 26, 2005 00:34:00
4 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050301002	16 15 32.87	+65 42 05.14	Jan 27, 2005 21:54:00
5 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050300004	16 13 37.62	+65 42 49.64	Mar 1, 2005 23:59:00
6 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050302001	16 14 27.77	+65 42 32.86	Mar 8, 2005 02:05:00
7 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050302002	16 14 46.05	+65 42 50.0	Mar 9, 2005 00:31:00
8 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050303001	16 14 53.1	+65 43 03.71	Mar 9, 2005 08:53:00

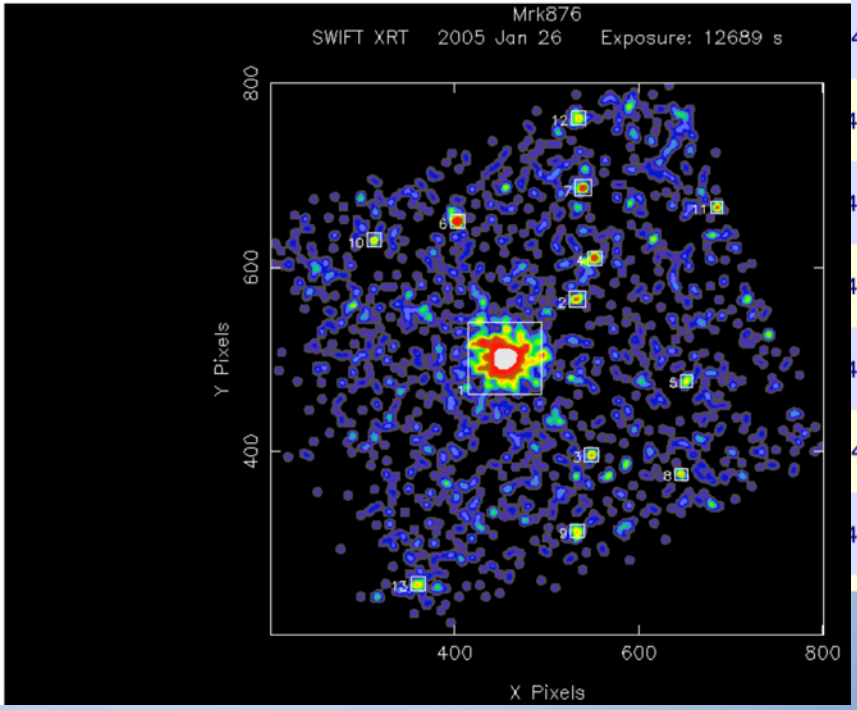
SWIFT SCIENCE ARCHIVE

Entry number Selection mode: Include All		Interactive Analysis		Archive	Target Name	obsid	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	start_time
		XRT	UVOT			Stats			
1 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050300001	16 13 56.58	+65 41 48.83	Dec 23, 2004 00:12:00
2 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050301001	16 15 34.71	+65 41 49.3	Dec 25, 2004 00:23:00
3 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050300005	16 13 39.51	+65 43 09.04	Jan 26, 2005 00:34:00
4 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050301002	16 15 32.87	+65 42 05.14	Jan 27, 2005 21:54:00
5 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050300004	16 13 37.62	+65 42 49.64	Mar 1, 2005 23:59:00
6 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050302001	16 14 27.77	+65 42 32.86	Mar 8, 2005 02:05:00
7 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050302002	16 14 46.05	+65 42 50.0	Mar 9, 2005 00:31:00
8 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050303001	16 14 53.1	+65 43 03.71	Mar 9, 2005 08:53:00

SWIFT SCIENCE ARCHIVE

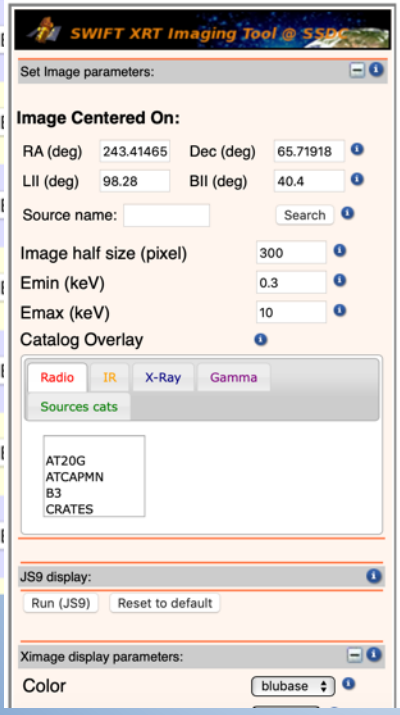
Entry number Selection mode: Include / All		Interactive Analysis XRT	 UVOT	Archive	Target Name	obsid Stats	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	start_time
1 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050300001	16 13 56.58	+65 41 48.83	Dec 23, 2004 00:12:00
2 Select	SSDC Data I							41 49.3	Dec 25, 2004 00:23:00
3 Select	SSDC Data I							43 09.04	Jan 26, 2005 00:34:00
4 Select	SSDC Data I							42 05.14	Jan 27, 2005 21:54:00
5 Select	SSDC Data I							42 49.64	Mar 1, 2005 23:59:00
6 Select	SSDC Data I							42 32.86	Mar 8, 2005 02:05:00
7 Select	SSDC Data I							42 50.0	Mar 9, 2005 00:31:00
8 Select	SSDC Data I							43 03.71	Mar 9, 2005 08:53:00

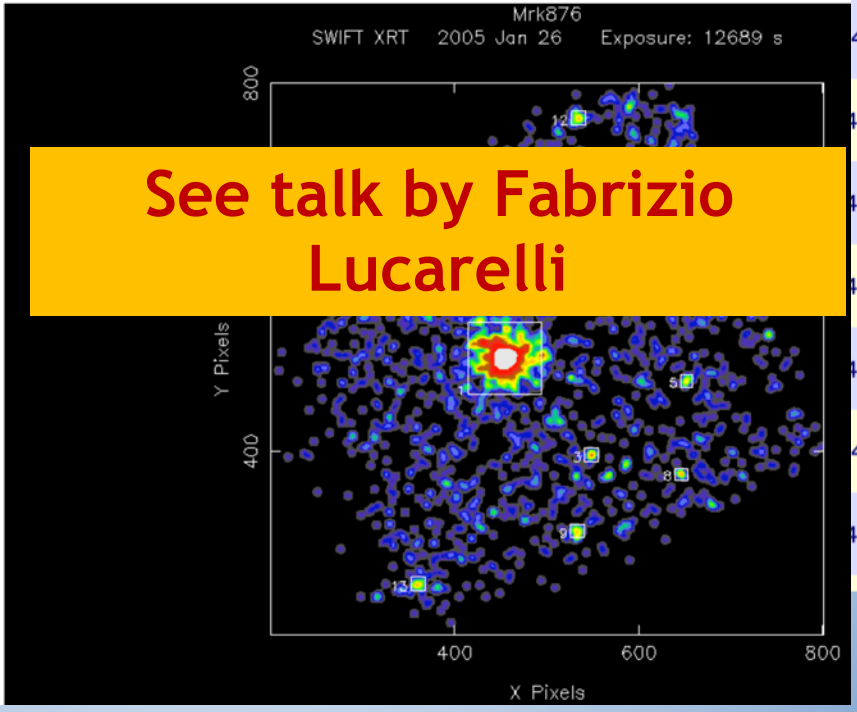




SWIFT SCIENCE ARCHIVE

Entry number / Selection mode: Include / All		Interactive Analysis: XRT	Interactive Analysis: UVOT	Archive	Target Name	obsid	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	start_time
1 Select	SSDC Data Explorer	XRT Interactive Analysis	UVOT Interactive Analysis	Data Access	MRK876	00050300001	16 13 56.58	+65 41 48.83	Dec 23, 2004 00:12:00
2 Select	SSDC Data I							41 49.3	Dec 25, 2004 00:23:00
3 Select	SSDC Data I							43 09.04	Jan 26, 2005 00:34:00
4 Select	SSDC Data I							42 05.14	Jan 27, 2005 21:54:00
5 Select	SSDC Data I							42 49.64	Mar 1, 2005 23:59:00
6 Select	SSDC Data I							42 32.86	Mar 8, 2005 02:05:00
7 Select	SSDC Data I							42 50.0	Mar 9, 2005 00:31:00
8 Select	SSDC Data I							43 03.71	Mar 9, 2005 08:53:00





See talk by Fabrizio Lucarelli

NuSTAR Science Archive

Official Mirror Archive available at the SSDC since beginning of the mission

- Over 2,700 pointed observations
- Scientific data for the 2 hard X-rays telescope (Focal Plane Module A and Focal Plane Module B) (FPMA and FPMB)
- Interactive Analysis Tools for both telescopes
- SSDC responsible of the ground scientific data processing software for FPMA and FPMB (NuSTARDAS package), used by NASA to generate the archive

NuSTAR Science Archive

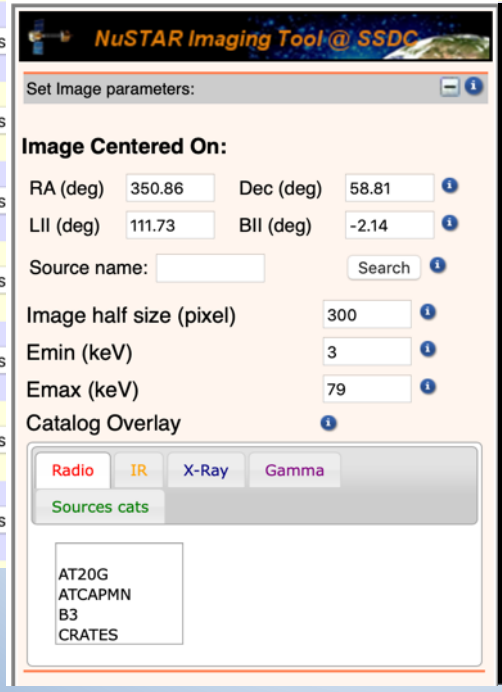
Entry number Selection mode: Include All		Archive	Interactive Analysis	Target Name	obsid Stats	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	time	public_date	exposure_a Stats
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A	40001019002	23 23 21.04	+58 49 19.2	Aug 18, 2012 19:46:00	Sep 23, 2014 00:00:00	293673.6108
2 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS2	40021002002	23 23 14.83	+58 48 41.03	Nov 23, 2012 17:36:00	Sep 23, 2014 00:00:00	288404.9947
3 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_TI1	40021011002	23 23 27.64	+58 49 28.55	Oct 30, 2013 08:01:00	Sep 23, 2014 00:00:00	245844.6137
4 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_TI2	40021012002	23 23 12.19	+58 47 54.24	Nov 27, 2013 16:36:00	Sep 23, 2014 00:00:00	238849.5534
5 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS3	40021003003	23 23 40.82	+58 49 53.76	May 28, 2013 23:58:00	Sep 23, 2014 00:00:00	233253.7978
6 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS1	40021001005	23 23 03.21	+58 48 33.83	Oct 7, 2012 18:21:00	Sep 23, 2014 00:00:00	227773.6114
7 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS2	40021002008	23 23 40.94	+58 46 50.87	Mar 5, 2013 09:26:00	Sep 23, 2014 00:00:00	225932.51
8 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS1	40021001002	23 23 08.16	+58 50 50.64	Aug 27, 2012 01:16:00	Sep 23, 2014 00:00:00	189677.6606

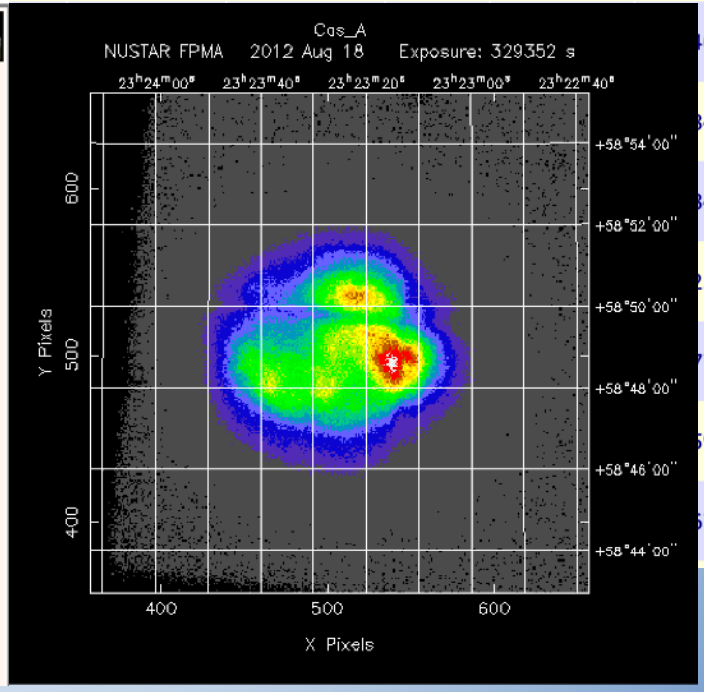
NuSTAR Science Archive

Entry number Selection mode: Include All		Archive	Interactive Analysis	Target Name	obsid Stats	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	time	public_date	exposure_a Stats
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A	40001019002	23 23 21.04	+58 49 19.2	Aug 18, 2012 19:46:00	Sep 23, 2014 00:00:00	293673.6108
2 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS2	40021002002	23 23 14.83	+58 48 41.03	Nov 23, 2012 17:36:00	Sep 23, 2014 00:00:00	288404.9947
3 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_TI1	40021011002	23 23 27.64	+58 49 28.55	Oct 30, 2013 08:01:00	Sep 23, 2014 00:00:00	245844.6137
4 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_TI2	40021012002	23 23 12.19	+58 47 54.24	Nov 27, 2013 16:36:00	Sep 23, 2014 00:00:00	238849.5534
5 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS3	40021003003	23 23 40.82	+58 49 53.76	May 28, 2013 23:58:00	Sep 23, 2014 00:00:00	233253.7978
6 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS1	40021001005	23 23 03.21	+58 48 33.83	Oct 7, 2012 18:21:00	Sep 23, 2014 00:00:00	227773.6114
7 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS2	40021002008	23 23 40.94	+58 46 50.87	Mar 5, 2013 09:26:00	Sep 23, 2014 00:00:00	225932.51
8 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS1	40021001002	23 23 08.16	+58 50 50.64	Aug 27, 2012 01:16:00	Sep 23, 2014 00:00:00	189677.6606

NuSTAR Science Archive

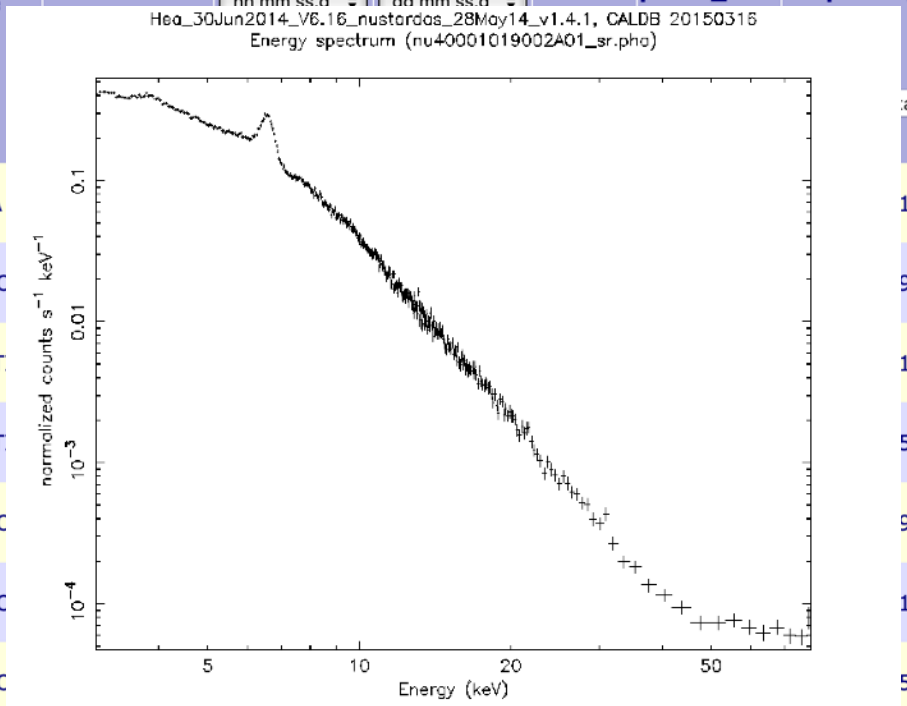
Entry number Selection mode: Include All		Archive	Interactive Analysis	Target Name	obsid Stats	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	time	public_date	exposure_a Stats
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A	40001019002	23 23 21.04	+58 49 19.2	Aug 18, 2012 19:46:00	Sep 23, 2014 00:00:00	293673.6108
2 Select	SSDC Data Explorer	Data Acces								404.9947
3 Select	SSDC Data Explorer	Data Acces								344.6137
4 Select	SSDC Data Explorer	Data Acces								349.5534
5 Select	SSDC Data Explorer	Data Acces								253.7978
6 Select	SSDC Data Explorer	Data Acces								773.6114
7 Select	SSDC Data Explorer	Data Acces								5932.51
8 Select	SSDC Data Explorer	Data Acces								577.6606



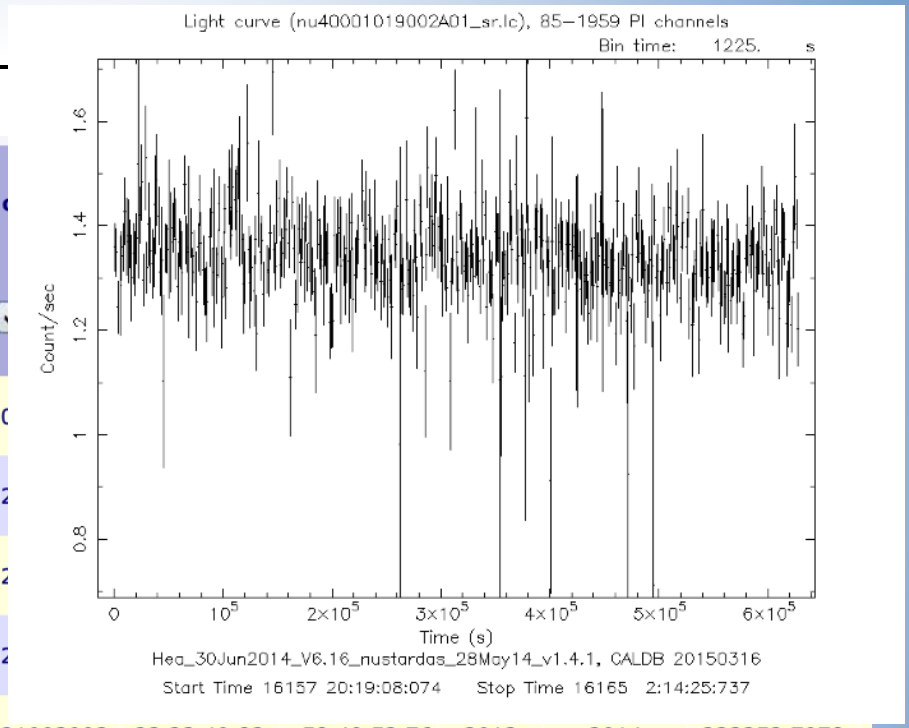


NuSTAR Science Archive

Entry number Selection mode: Include All		Archive	Interactive Analysis	Target Name	obsid	RA (J2000) hh mm ss.d	Dec (J2000) dd mm ss.d	time	public_date	exposure_a
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A						108
2 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MO						947
3 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_T						137
4 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_T						534
5 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MO						978
6 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MO						114
7 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MO						51
8 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS1	40021001002	23 23 08.16	+58 50 50.64	Aug 27, 2012 01:16:00	Sep 23, 2014 00:00:00	189677.6606

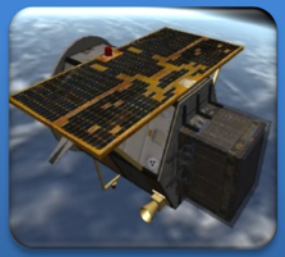


NuSTAR Science Archive



Entry number Selection mode: Include All		Archive	Interactive Analysis	Target Name						
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A	4000					
2 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS2	4002					
3 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_TI1	4002					
4 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_TI2	4002					
5 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS3	40021003003	23 23 40.82	+58 49 53.76	2013 23:58:00	2014 00:00:00	233253.7978
6 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS1	40021001005	23 23 03.21	+58 48 33.83	Oct 7, 2012 18:21:00	Sep 23, 2014 00:00:00	227773.6114
7 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS2	40021002008	23 23 40.94	+58 46 50.87	Mar 5, 2013 09:26:00	Sep 23, 2014 00:00:00	225932.51
8 Select	SSDC Data Explorer	Data Access	Interactive Analysis	CAS_A_MOS1	40021001002	23 23 08.16	+58 50 50.64	Aug 27, 2012 01:16:00	Sep 23, 2014 00:00:00	189677.6606

AGILE Science Archive



AGILE

- 2007-present
- X-Ray and Gamma-Ray Astrophysics

Archive available at the SSDC since beginning of the mission

- AGILE Data Center located at the SSDC
- Scientific data for the Gamma-ray (30 MeV-50 GeV, GRID) and hard X-ray (18-60 keV, SuperAGILE) instruments
- Quick Look archive
- Level 3 archive (pre-compiled exposure, count and diffuse background maps
- Interactive Analysis Applications

AGILE Science Archive

Entry number Selection mode: Include ☑ All		GRID LV3 data retrieval	GRID Interactive Analysis	START DATE	STOP DATE	RA (J2000) hh mm ss.d	DEC (J2000) dd mm ss.d	MEAN EXP (cm² s sr) Stats
1 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-01-21 12:00:00	2008-02-18 12:00:00	04 36 06.62	+17 42 29.52	863.166
2 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-03-17 12:00:00	2008-04-14 12:00:00	04 36 06.62	+17 42 29.52	1773.82
3 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-06-09 12:00:00	2008-07-07 12:00:00	04 36 06.62	+17 42 29.52	163.635
4 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-07-07 12:00:00	2008-08-04 12:00:00	04 36 06.62	+17 42 29.52	1343.54
5 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-08-04 12:00:00	2008-09-01 12:00:00	04 36 06.62	+17 42 29.52	2135.34
6 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-09-01 12:00:00	2008-09-29 12:00:00	04 36 06.62	+17 42 29.52	1761.88
7 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-09-29 12:00:00	2008-10-27 12:00:00	04 36 06.62	+17 42 29.52	235.119
8 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-11-24 12:00:00	2008-12-22 12:00:00	04 36 06.62	+17 42 29.52	129.364
9 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-12-22 12:00:00	2009-01-19 12:00:00	04 36 06.62	+17 42 29.52	742.372
10 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-01-19 12:00:00	2009-02-16 12:00:00	04 36 06.62	+17 42 29.52	860.439
11 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-02-16 12:00:00	2009-03-16 12:00:00	04 36 06.62	+17 42 29.52	645.714
12 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-03-16 12:00:00	2009-04-13 12:00:00	04 36 06.62	+17 42 29.52	1138
13 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-05-11 12:00:00	2009-06-08 12:00:00	04 36 06.62	+17 42 29.52	128.689
14 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-06-08 12:00:00	2009-07-06 12:00:00	04 36 06.62	+17 42 29.52	509.995

AGILE Science Archive

Entry number Selection mode: Include ☑ All		GRID LV3 data retrieval	GRID Interactive Analysis	START DATE	STOP DATE	RA (J2000) hh mm ss.d	DEC (J2000) dd mm ss.d	MEAN EXP (cm² s sr) Stats
1 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-01-21 12:00:00	2008-02-18 12:00:00	04 36 06.62	+17 42 29.52	863.166
2 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-03-17 12:00:00	2008-04-14 12:00:00	04 36 06.62	+17 42 29.52	1773.82
3 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-06-09 12:00:00	2008-07-07 12:00:00	04 36 06.62	+17 42 29.52	163.635
4 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-07-07 12:00:00	2008-08-04 12:00:00	04 36 06.62	+17 42 29.52	1343.54
5 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-08-04 12:00:00	2008-09-01 12:00:00	04 36 06.62	+17 42 29.52	2135.34
6 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-09-01 12:00:00	2008-09-29 12:00:00	04 36 06.62	+17 42 29.52	1761.88
7 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-09-29 12:00:00	2008-10-27 12:00:00	04 36 06.62	+17 42 29.52	235.119
8 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-11-24 12:00:00	2008-12-22 12:00:00	04 36 06.62	+17 42 29.52	129.364
9 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-12-22 12:00:00	2009-01-19 12:00:00	04 36 06.62	+17 42 29.52	742.372
10 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-01-19 12:00:00	2009-02-16 12:00:00	04 36 06.62	+17 42 29.52	860.439
11 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-02-16 12:00:00	2009-03-16 12:00:00	04 36 06.62	+17 42 29.52	645.714
12 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-03-16 12:00:00	2009-04-13 12:00:00	04 36 06.62	+17 42 29.52	1138
13 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-05-11 12:00:00	2009-06-08 12:00:00	04 36 06.62	+17 42 29.52	128.689
14 ☑ Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-06-08 12:00:00	2009-07-06 12:00:00	04 36 06.62	+17 42 29.52	509.995

AGILE Science Archive

Entry number Selection mode: Include All		GRID LV3 data retrieval	GRID Interactive Analysis	START DATE	STOP DATE	RA (J2000) hh mm ss.d	DEC (J2000) dd mm ss.d	MEAN EXP (cm² s sr) Stats
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-01-21 12:00:00	2008-02-18 12:00:00	04 36 06.62	+17 42 29.52	863.166
2 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-03-17 12:00:00	2008-04-14 12:00:00	04 36 06.62	+17 42 29.52	1773.82
3 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-06-09 12:00:00	2008-07-07 12:00:00	04 36 06.62	+17 42 29.52	163.635
4 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-07-07 12:00:00	2008-08-04 12:00:00	04 36 06.62	+17 42 29.52	1343.54
5 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-08-04 12:00:00	2008-09-01 12:00:00	04 36 06.62	+17 42 29.52	2135.34
6 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-09-01 12:00:00	2008-09-29 12:00:00	04 36 06.62	+17 42 29.52	1761.88
7 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-09-29 12:00:00	2008-10-27 12:00:00	04 36 06.62	+17 42 29.52	235.119
8 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-11-24 12:00:00	2008-12-22 12:00:00	04 36 06.62	+17 42 29.52	129.364
9 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-12-22 12:00:00	2009-01-19 12:00:00	04 36 06.62	+17 42 29.52	742.372
10 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-01-19 12:00:00	2009-02-16 12:00:00	04 36 06.62	+17 42 29.52	860.439
11 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-02-16 12:00:00	2009-03-16 12:00:00	04 36 06.62	+17 42 29.52	645.714
12 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-03-16 12:00:00	2009-04-13 12:00:00	04 36 06.62	+17 42 29.52	1138
13 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-05-11 12:00:00	2009-06-08 12:00:00	04 36 06.62	+17 42 29.52	128.689
14 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2009-06-08 12:00:00	2009-07-06 12:00:00	04 36 06.62	+17 42 29.52	509.995

AGILE Science Archive

Entry number Selection mode: Include / All		GRID LV3 data retrieval	GRID Interactive Analysis	START DATE	STOP DATE	RA (J2000) hh mm ss.d	DEC (J2000) dd mm ss.d	MEAN EXP (cm² s sr) Stats
1 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-01-21 12:00:00	2008-02-18 12:00:00	04 36 06.62	+17 42 29.52	863.166
2 Select	SSDC Data Explorer	Data Access	Interactive Analysis	2008-03-17 12:00:00	2008-04-14 12:00:00	04 36 06.62	+17 42 29.52	1773.82
3 Select	SSDC Data Exp							85
4 Select	SSDC Data Exp							64
5 Select	SSDC Data Exp							84
6 Select	SSDC Data Exp							88
7 Select	SSDC Data Exp							19
8 Select	SSDC Data Exp							64
9 Select	SSDC Data Exp							72
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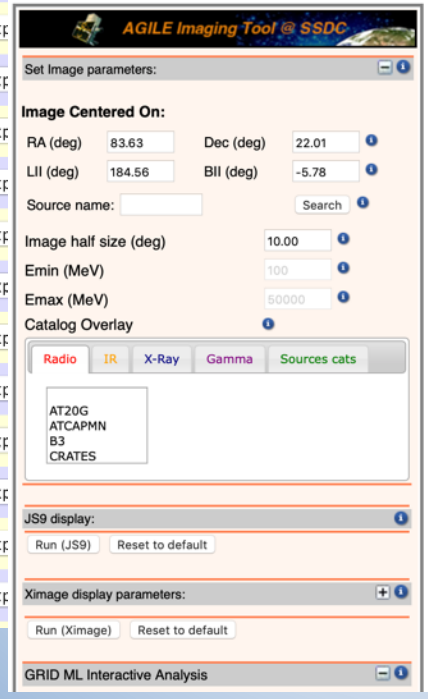
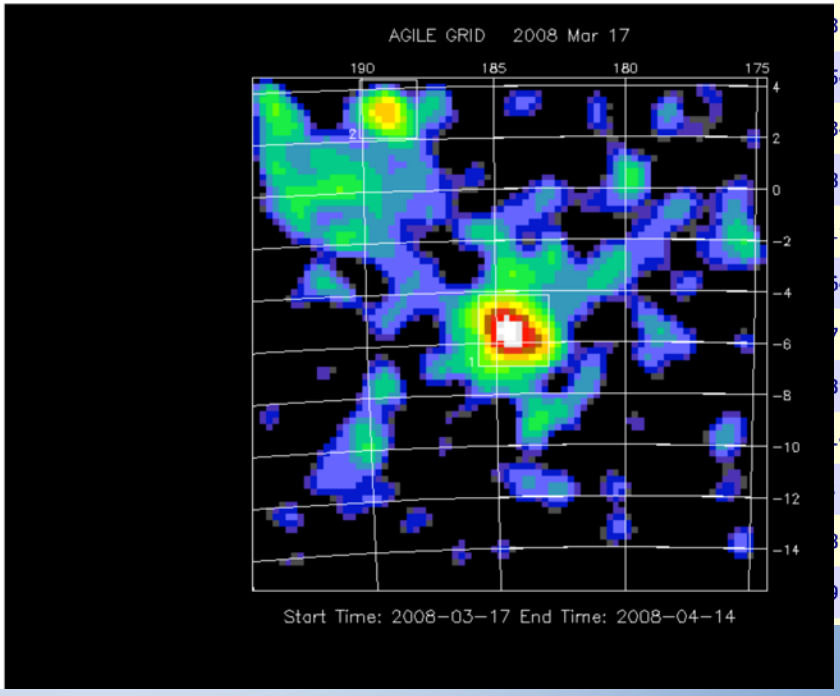
12 Select	SSDC Data Exp							
13 Select	SSDC Data Exp							89
14 Select	SSDC Data Exp							95





AGILE Science Archive

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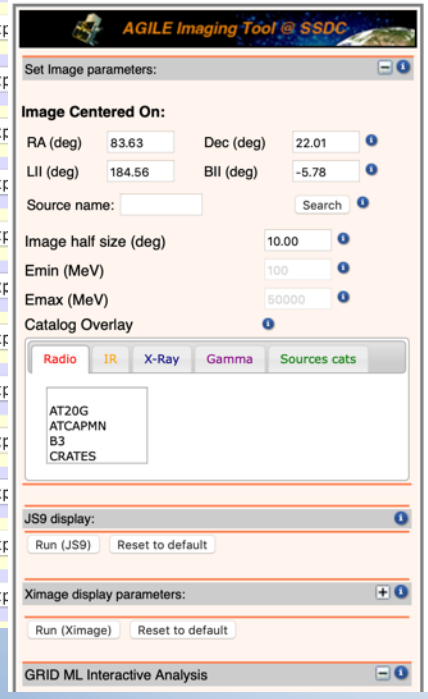
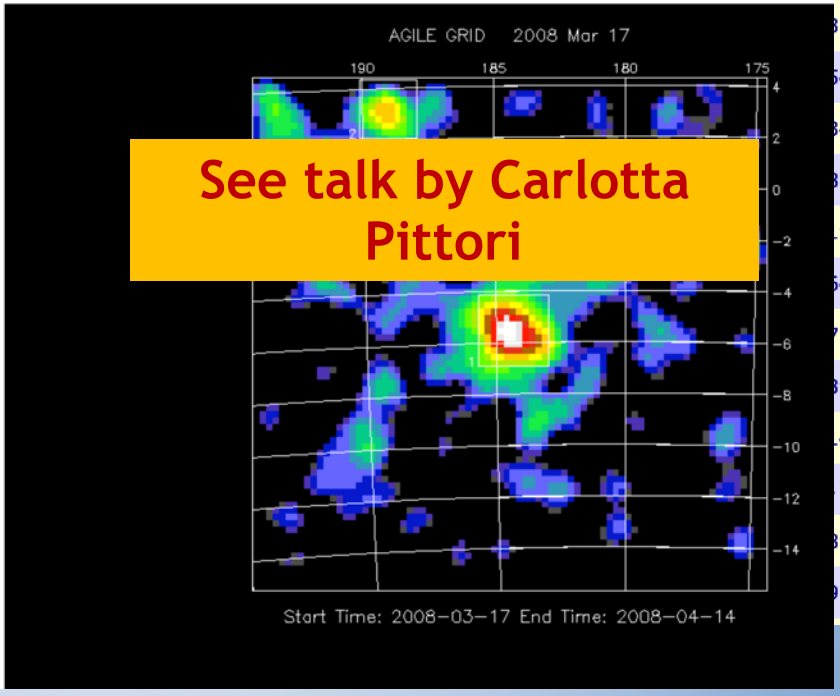
13 Select	SSDC Data Exp							89
14 Select	SSDC Data Exp							95





See talk by Carlotta Pittori

FERMI SCIENCE ARCHIVE

Archive available at the SSDC since beginning of the mission

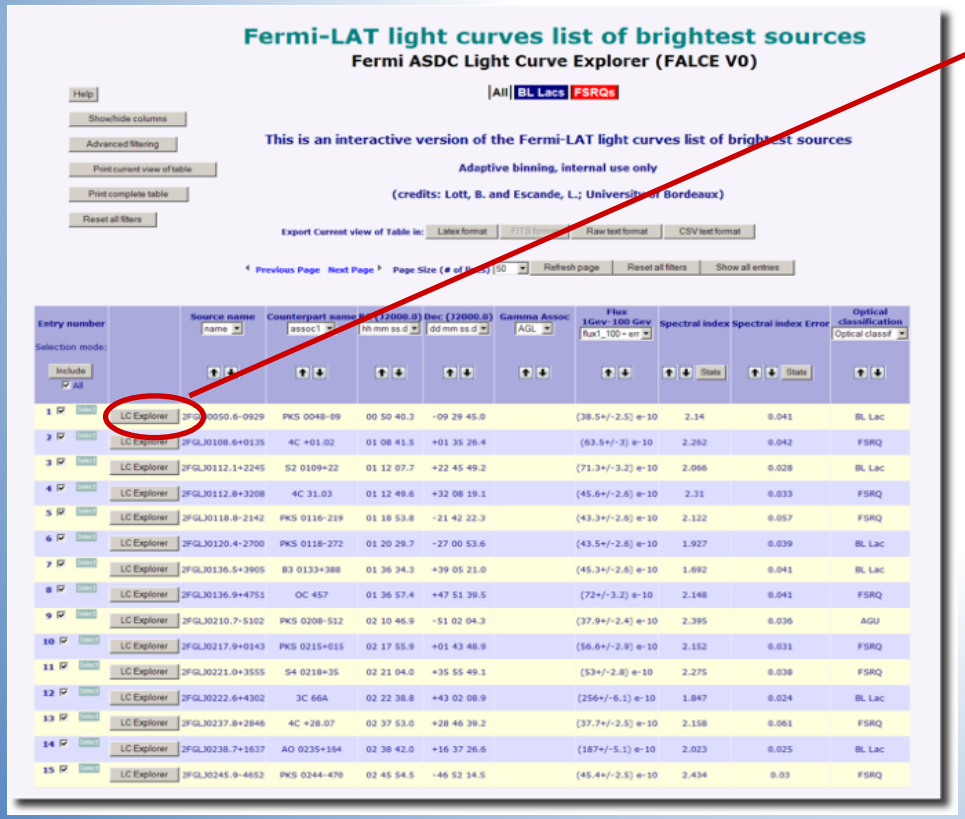
- **LAT public data archive: photon database currently holds 1,218,564,703 photons**
- **Quick Look archive (new data available in 2-3 hours)**
- **sky position cone query (region of interest), data preview (imaging count maps)**
- **Online LAT data analysis (unbinned likelihood on selected time intervals)**
- **Aperture photometry light-curve generation**

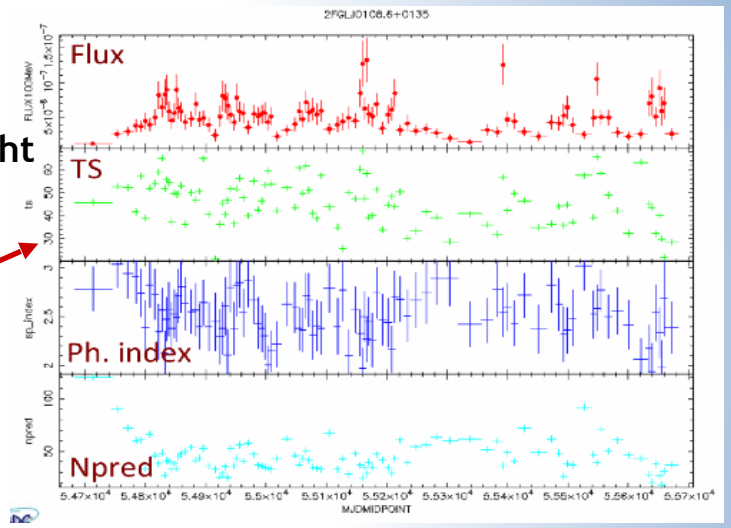
FERMI SCIENCE ARCHIVE

Fermi SSDC Light Curve Explorer:

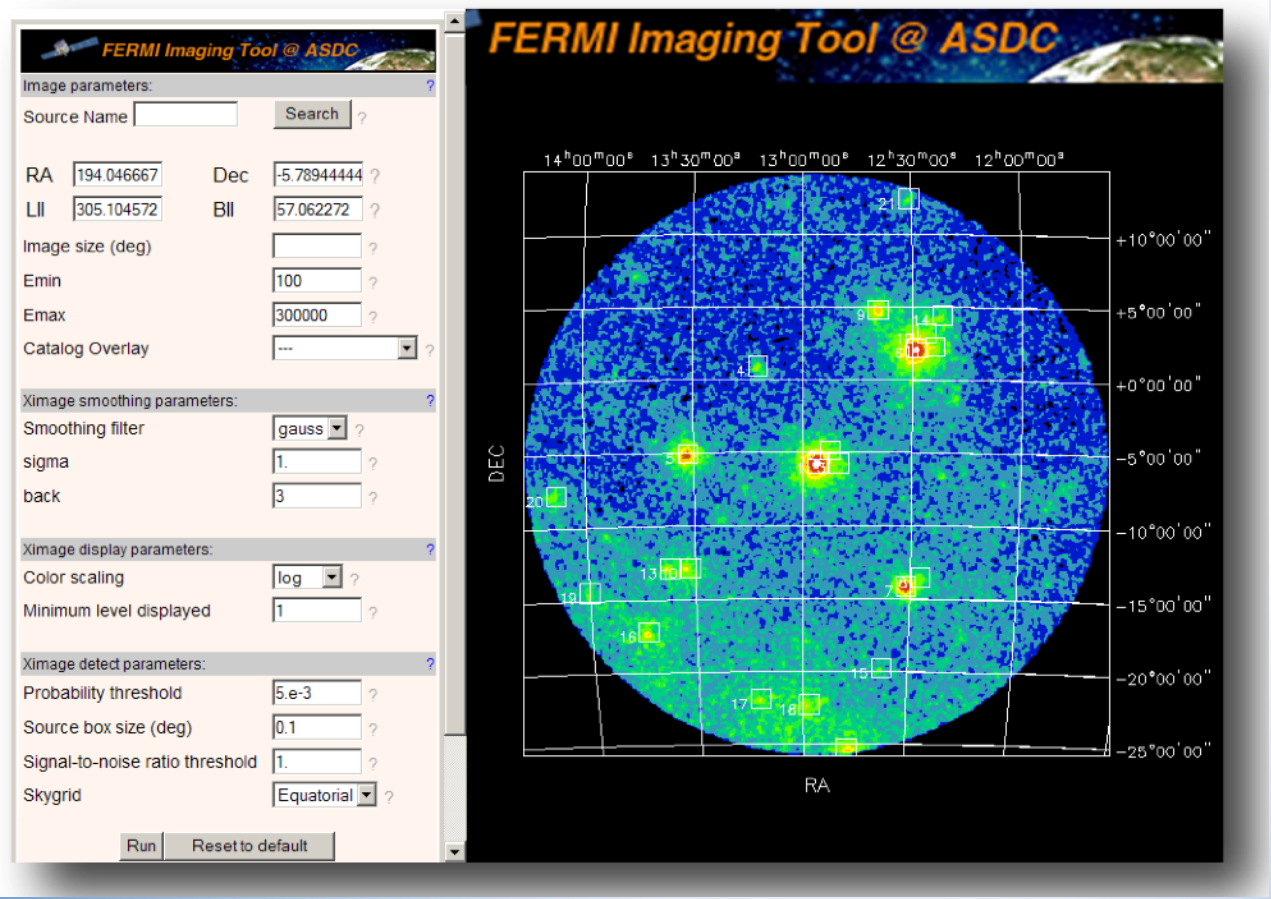
1) interactive display of catalogued Fermi LAT light curves

2) on-line basic temporal analysis on the displayed light curve





FERMI SCIENCE ARCHIVE



Photon data in circular region retrieval and data preview with MW catalogs overlay.

ASTRI/MINI-ARRAY SCIENCE ARCHIVES

ASTRI is an INAF end-to-end project aimed at the realization of a prototype of a dual-mirror Cherenkov Telescope and of a mini array of 9 of such a telescopes. The Project is inclusive of a complete *Data Handling System* and foresees an **ASTRI Data Center**.

Data Acquisition

On-site Archive
RAW, CAL, TECH, LUT, EVT, SCI

LEVEL A ANALYSIS (On-line/On-site Analysis)

LEVEL B ANALYSIS (Off-line/On-site Analysis)

OBSERVATORY

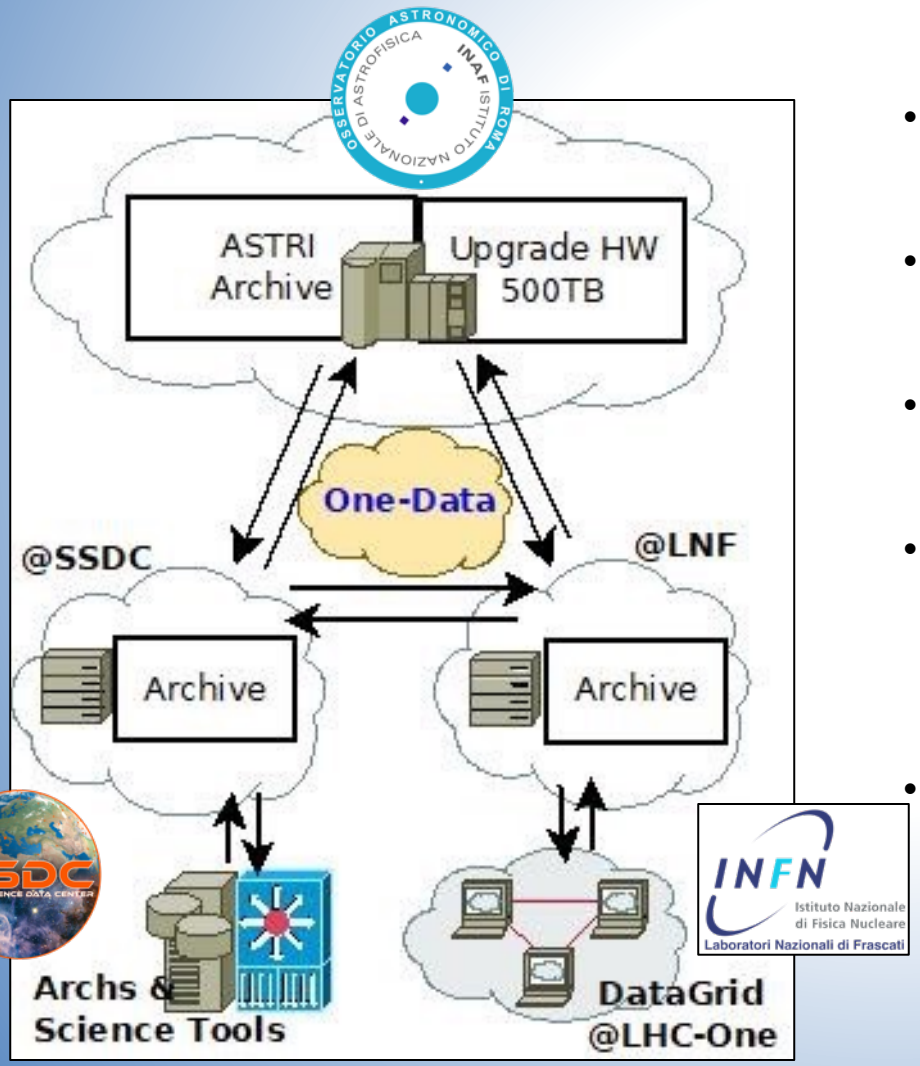
DATA CENTER (Rome)

ASTRI GATEWAY

Off-Site Archive
RAW, CAL, TECH, MC, EVT, SCI, VO

LEVEL C ANALYSIS (Off-line/Off-site Analysis)

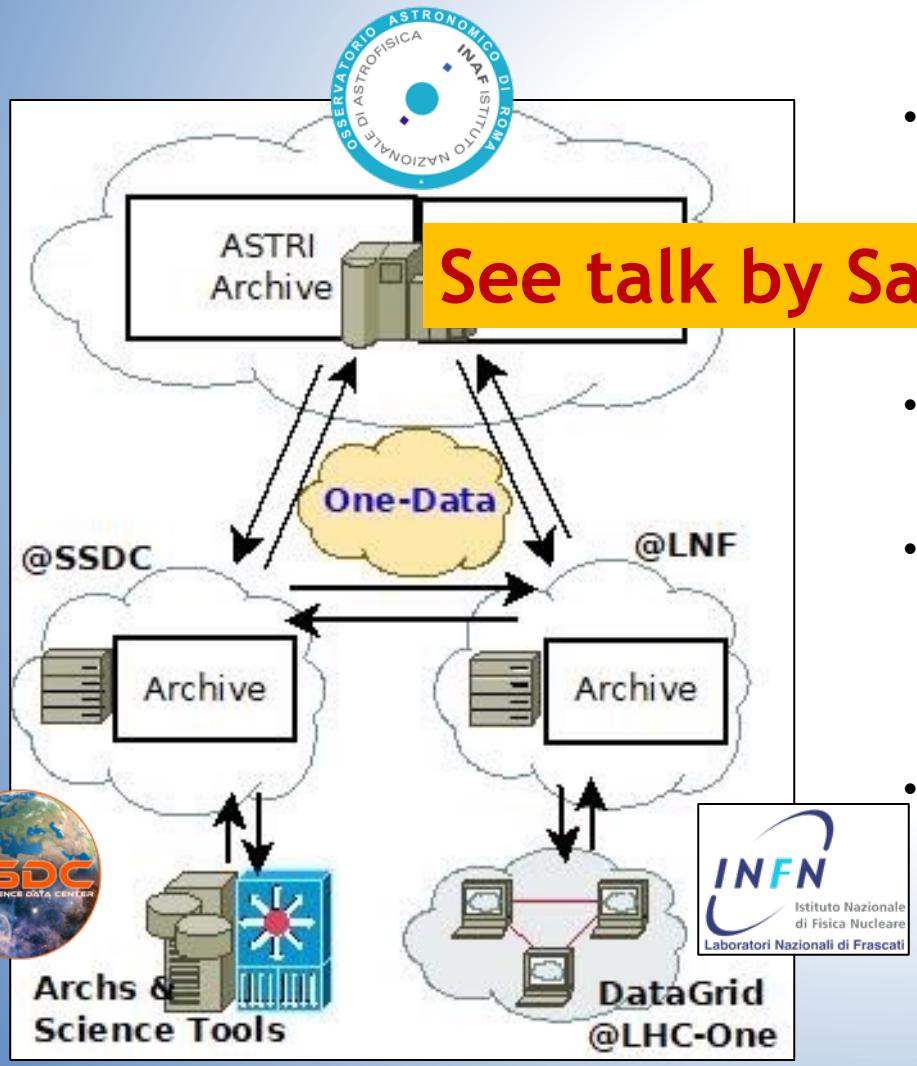
ASTRI/MINI-ARRAY SCIENCE ARCHIVES



ASTRI Data Center

- **Pipelines** developed in INAF and SSDC also within **H2020 Project ASTERICS** in a end-to-end approach.
- **Archive concept:** developed within the **H2020 Project INDIGO-DataCloud** as a distributed archive.
- Data already present in the Archive: ASTRI MC data, real data from ASTRI prot., scientific simulations from ACDC.
- **3 sites involved: @INAF-OAR** (as main archive of ASTRI prototype), **@INFN-LNF** to access the GRID, **@SSDC-ASI** to provide final user with a data access in a scientific & MWL environment.
- **Science Gateway:** to provide access to users from the preparation and submission of Observing Proposals to final scientific data.

ASTRI/MINI-ARRAY SCIENCE ARCHIVES



ASTRI Data Center

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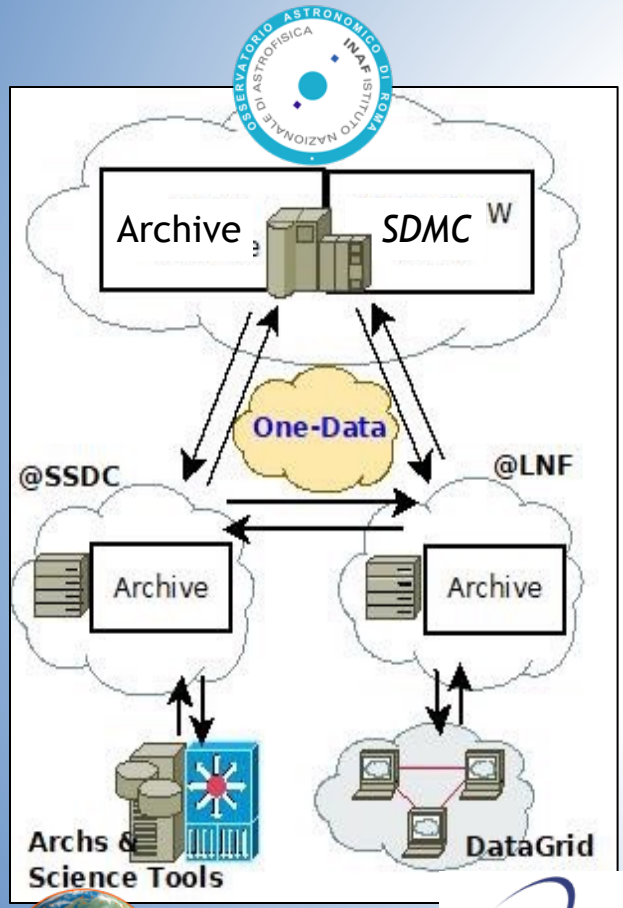
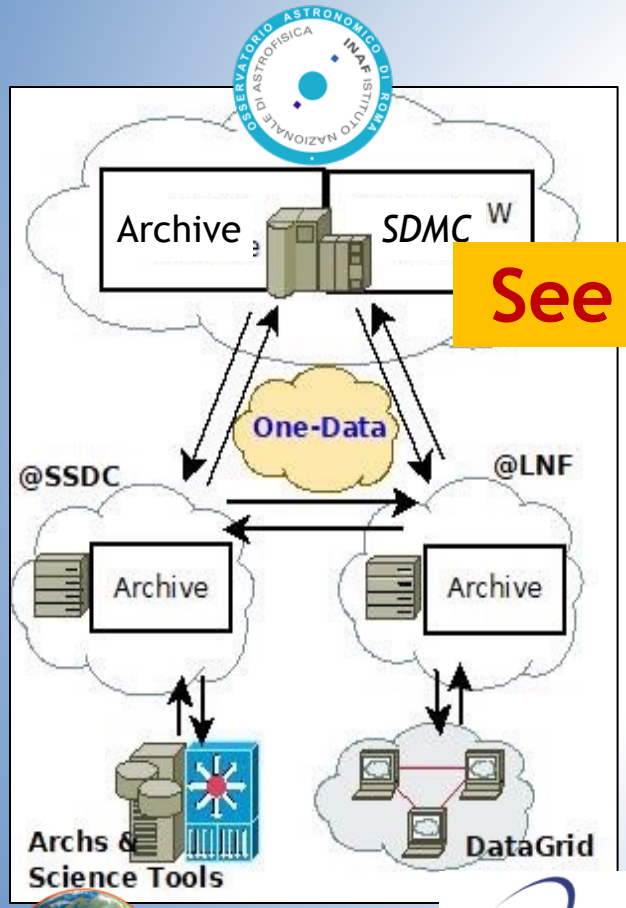
See talk by Saverio Lombardi

CTA Science Archive



- The concept for a **Distributed Archive** has been developed within the **H2020 Project INDIGO-DataCloud** for the ASTRI/CTA and is under testing by using both the INAF prototype and the mini-array data.
- **3 sites: @INAF-OAR** as SDMC, **@INFN-LNF** to be on the GRID, **@SSDC-ASI** to provide data access in a scientific & MWL environment.
- **CTA clients & End Users** will be able to access to the three-node federated storage with One Data interfaces → export repository with **Users A&A** provided by **INAF OACT**

CTA Science Archive



- The concept for a **Distributed Archive** has been developed within the **H2020 Project INDIGO-DataCloud** for the ASTRI/CTA and is under testing by using both the INAF prototype

See talk by Stefano Gallozzi

- **3 sites: @INAF-OAR** as SDMC, **@INFN-LNF** to be on the GRID, **@SSDC-ASI** to provide data access in a scientific & MWL environment.

- **CTA clients & End Users** will be able to access to the three-node federated storage with One Data interfaces → export repository with **Users A&A** provided by **INAF OACT**

SUMMARY

- INAF, through the National Division for High Energy Astrophysics of the Scientific Directorate (UTG-III) is widely and deeply involved in space and ground based projects
- INAF UTG-III archive activities for High Energy Astrophysics based at the ASI Space Science Data Center (SSDC) in Rome
- SSDC hosts the science archives of several high energy observatories (e.g. *Beppo*SAX, Swift, NuSTAR, AGILE, Fermi, ASTRI) with the mission to ensure their long term preservation and distribution to the astronomical community
- The SSDC Multi-Mission Archive offers a uniform user interface to provide 1) direct data access, 2) a preview of high level scientific products and 3) several on-line applications for the interactive scientific analysis (→data scientific return)