

# ESAC Science Archives and VO Team

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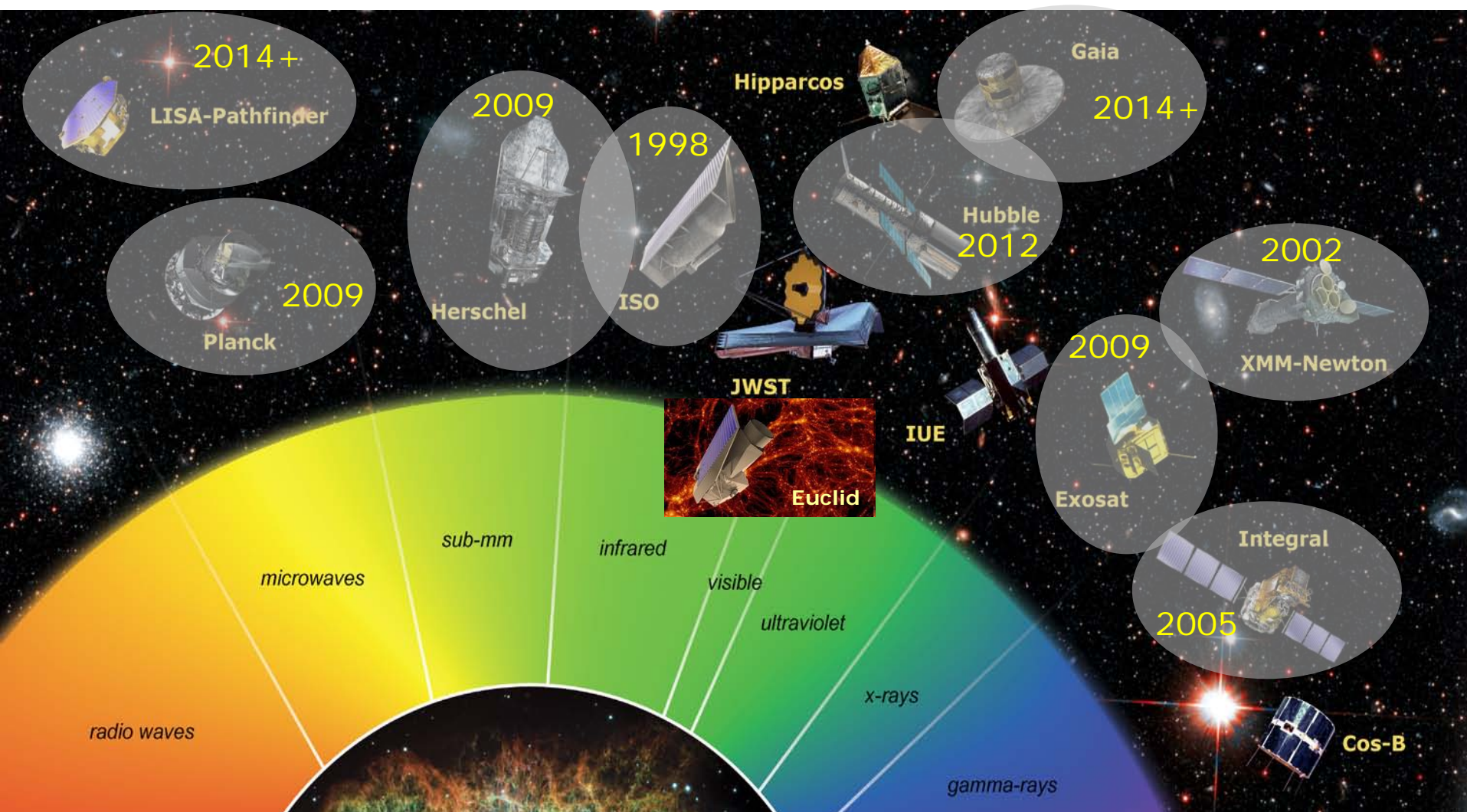
02/10/2012

1. ESAC default location for:
2. Science operations,
  - a. long history with astronomical missions
  - b. Now also solar system missions
3. Science archives,
  - a. Astronomy
  - b. Planetary and Solar Systems
  - c. Solar and Heliospheric Missions
4. ESA VO activities, IPDA activities
  - a. ESAC as member of all international endeavors for interoperability, e.g., IVOA, IPDA, Euro-VO, ...

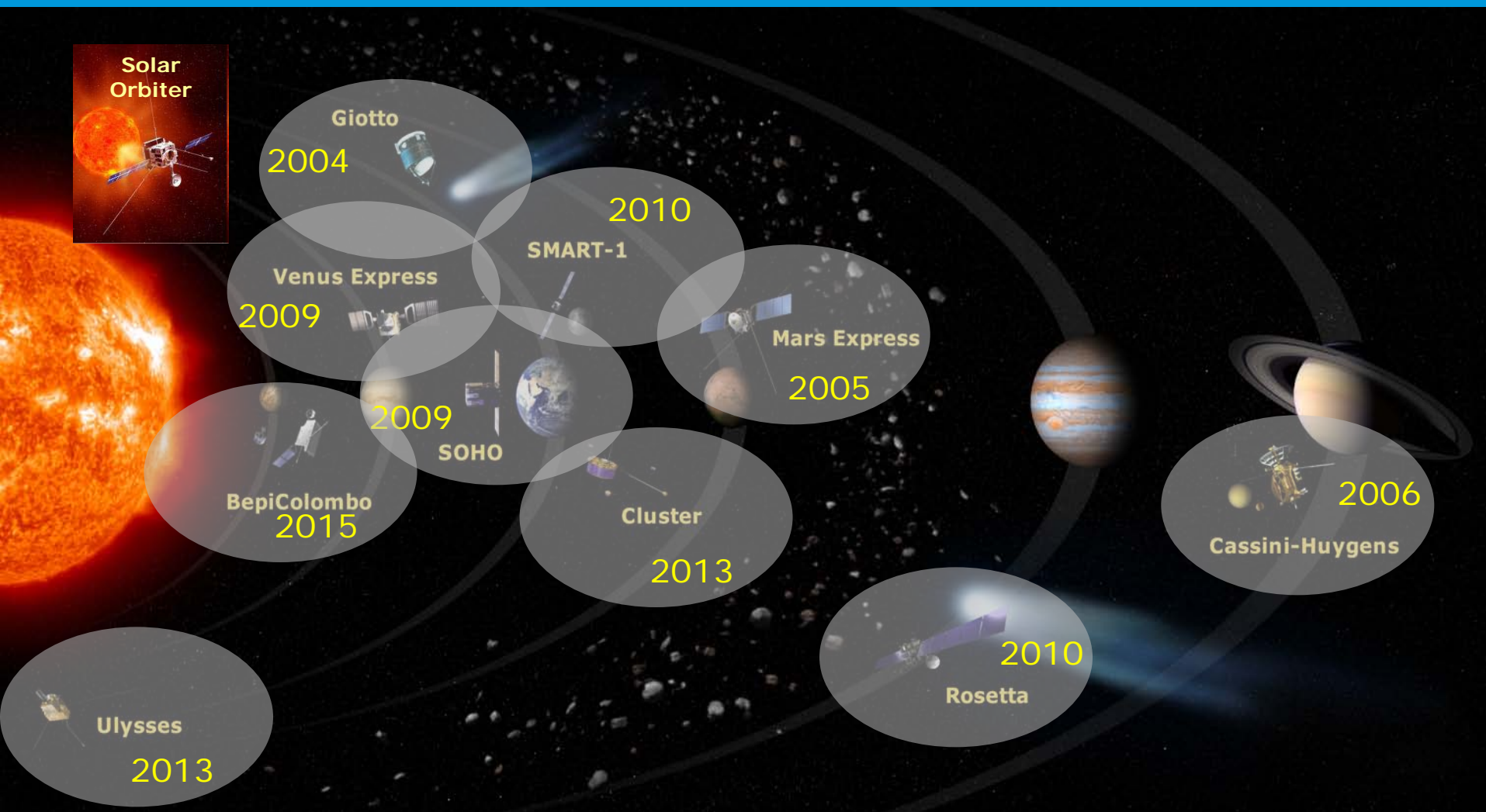


<http://www.esa.int/SPECIALS/ESAC/>  
**Located near Madrid, Spain**

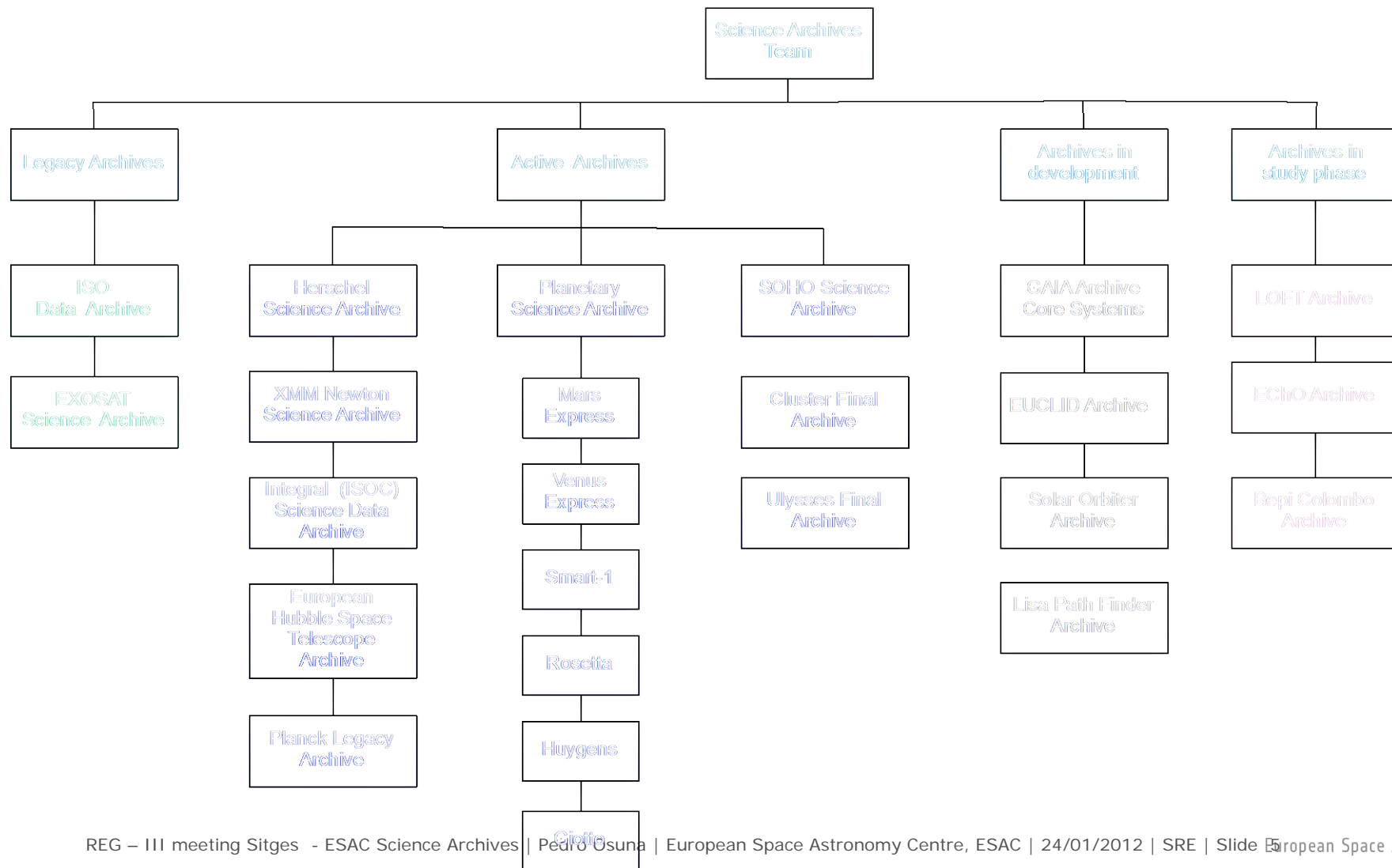
# Astronomy Archives at ESAC



# Solar Systems Archives at ESAC



# ESAC Archives and “phases”



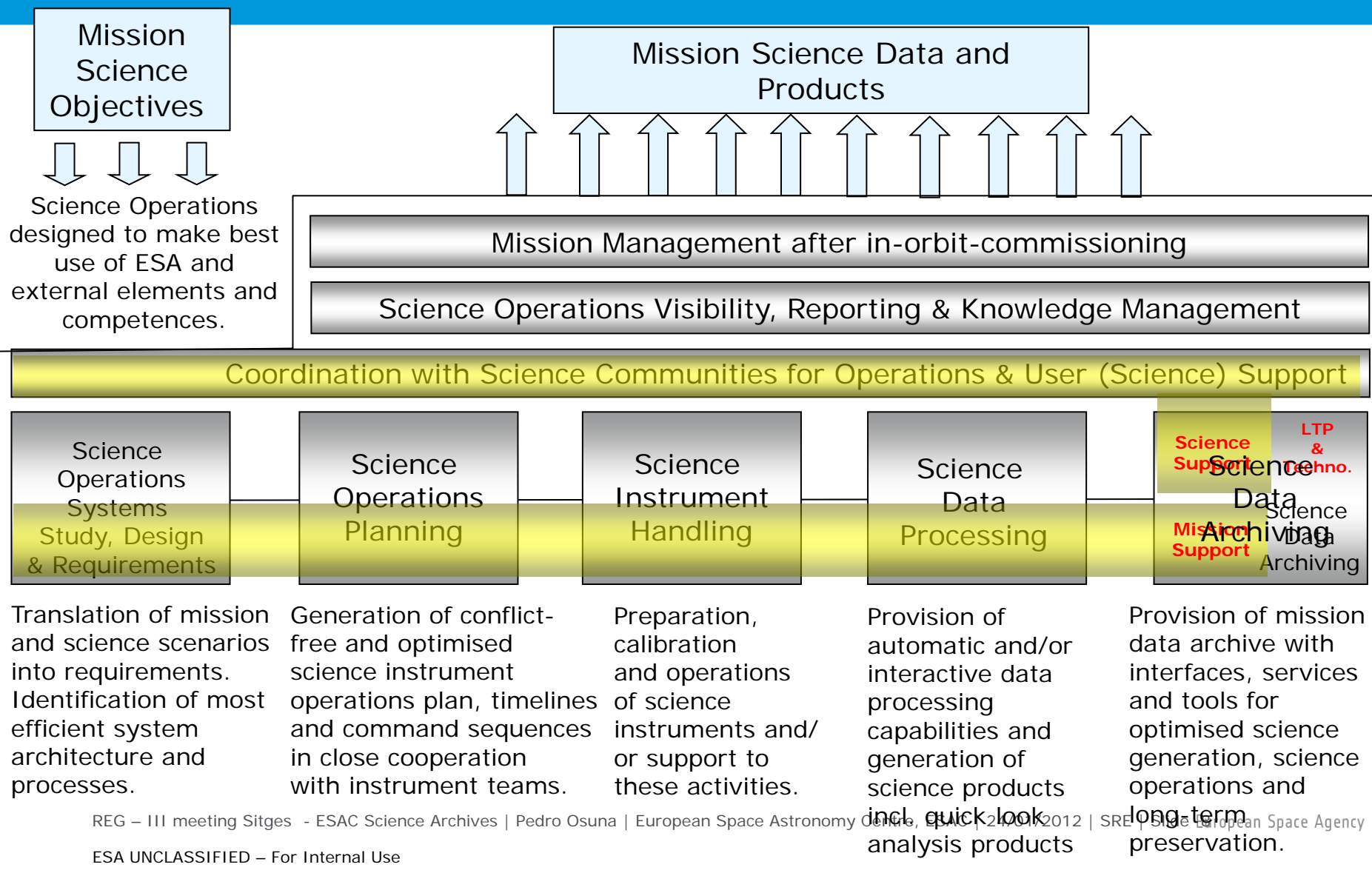
1. A core Science Archives and VO Team (~21 people) in ESAC
  - a. Support many projects (seen in previous presentation)
  - b. Organized per project:
    - But keeping knowledge share
    - Within the same infrastructure
    - Allows to move people from one project to another when necessary
  - c. <http://archives.esac.esa.int/>



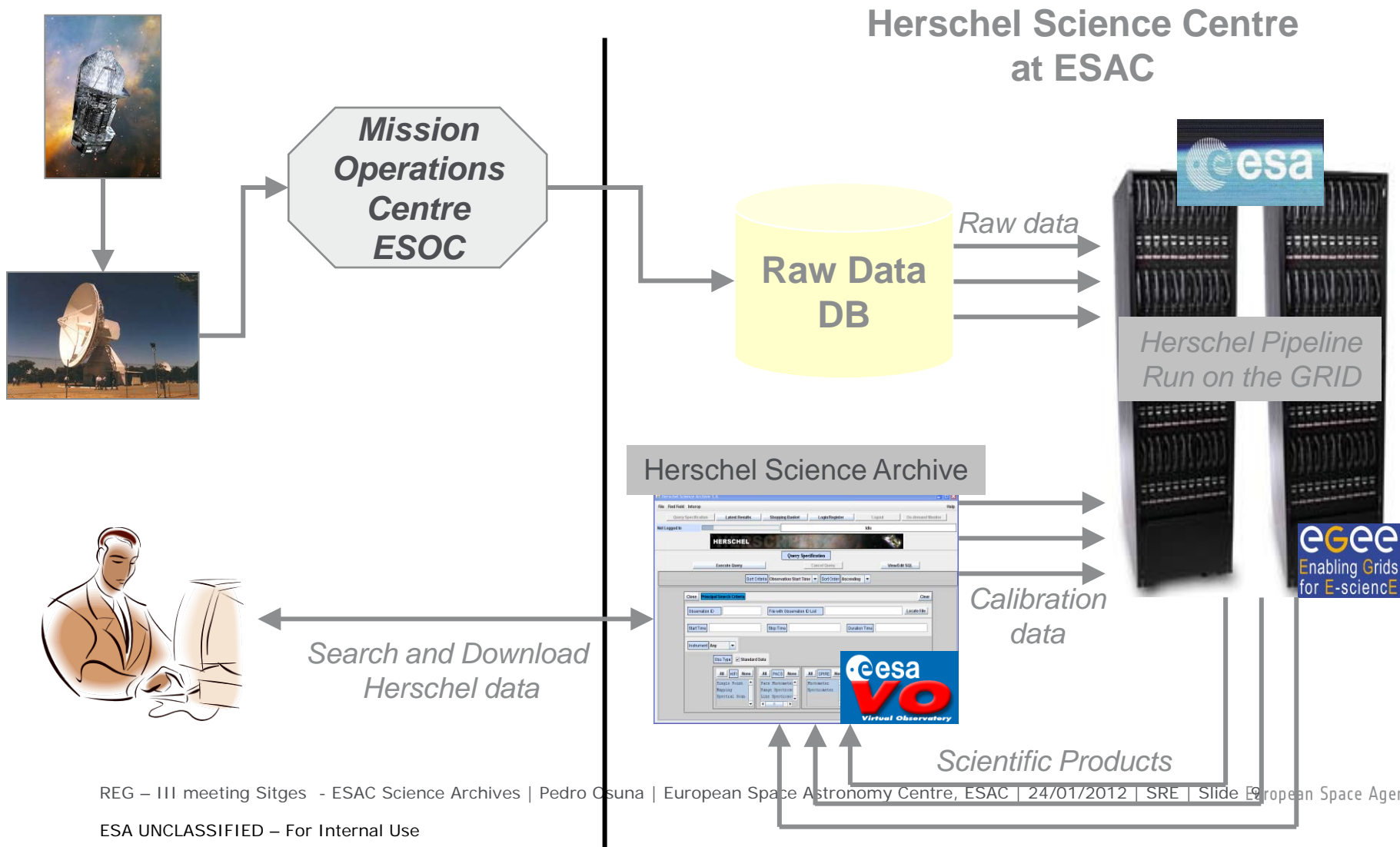
2. Close collaboration with Archive Scientist (1 per project)
  - a. Expert of the science field, close to the community
  - b. Consolidate user requirements, Set development priorities
  - c. Final acceptance tests
3. Close collaboration with SOC System Engineer
  - a. Expert on the SOC components
  - b. Gives requirements for the SOC-Archive interactions

1. Three FTEs (full time equivalent) assigned to Gaia work within the Science Archives Team:
  - a. Jesús Salgado – SAT Gaia Team Coordinator (50%)
  - b. Daniel Tapador - 100%
  - c. Raúl Gutiérrez – 100%
  - d. Juan González – 50%
2. Assignments might/will vary with time and requirements (see later roadmap)

# Archives as a Core Component of ESA Science Operations



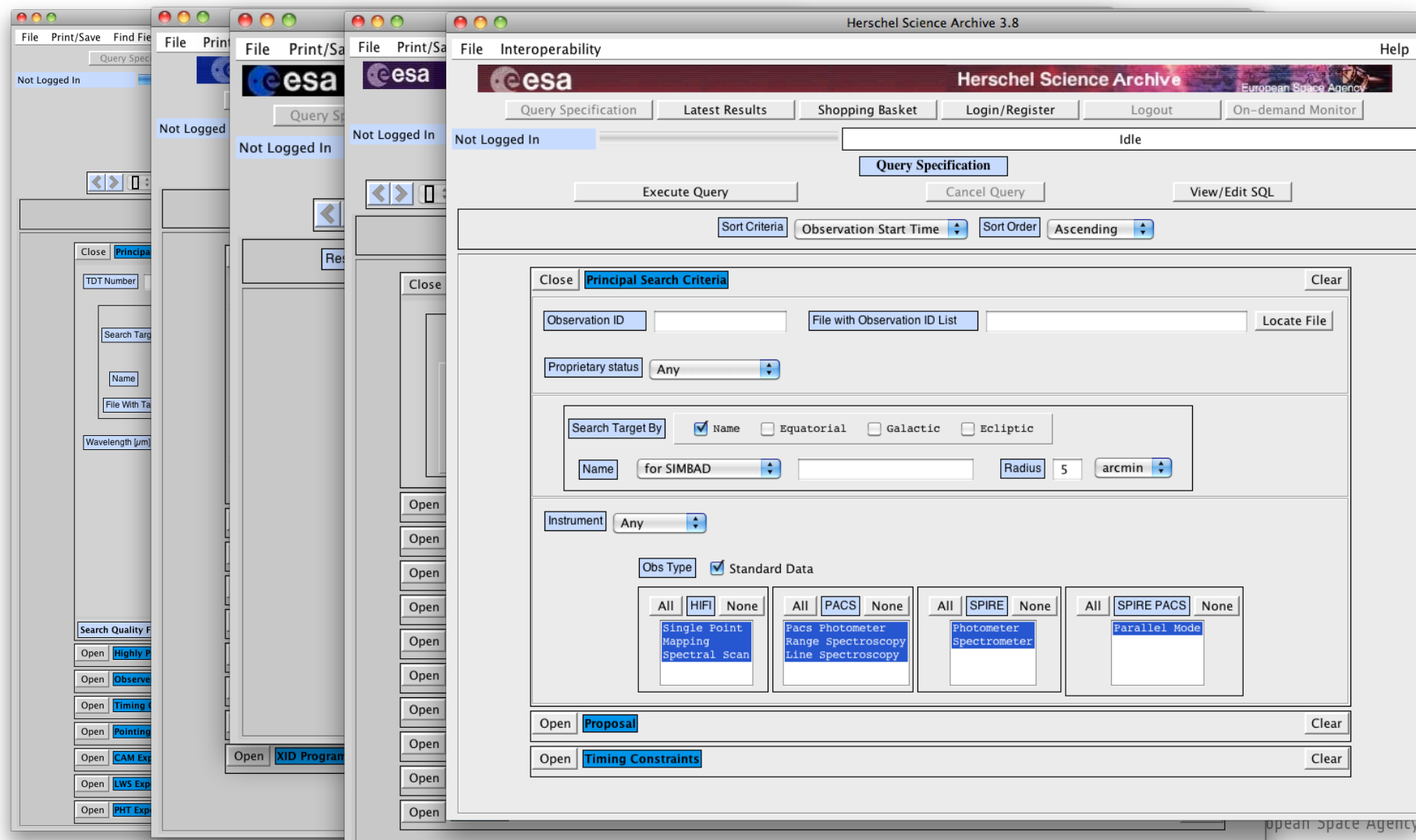
# An example of an Archive used for operations: the Herschel case



# First Generation Archives

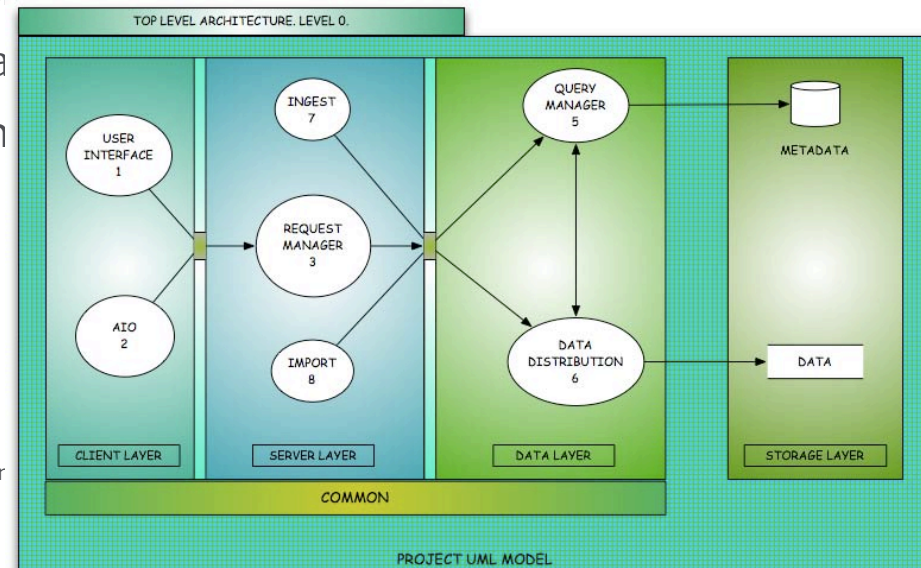
1. First archive released in 1998 (ISO Science Archive, IDA)
  - Pioneer with 3-tier flexible and modular architecture, Java, XML, rich web client + web services + VO access to query and access data, fully automatic system (no archive operator)
    - a. “Web” development could not satisfy User Requirements for our archives at that time
    - b. Technology at an early stage of development (also in Java)
2. Continued with:
  - a. XMM-Newton Science Archive (XSA) - 2002
  - b. Planetary Science Data Archive (PSA) - 2004
  - c. ISOC Integral Science Data Archive (ISDA) - 2005
  - d. Herschel Science Archive (HSA) - 2007
    - Now migrated to 2<sup>nd</sup> generation

# First Generation Archives L&F



# Second Generation Archives

1. Re-engineering study leading to archive technology evolution
  - a. Building on experience and strengths from 1<sup>st</sup> generation
  - b. More state of the art technologies, more modern GUIs
  - c. Drastic performance improvements to handle bigger amount of data,
  - d. Re-using now existing open source software and libraries (open source database with geometrical searches add-ons, GUI components, application server, ...),
  - e. Better transport protocol to overcome firewall issues
  - f. VO interoperability to external archives
  - g. Higher code reusability between archives
  - h. Rich client and thin layer GUIs

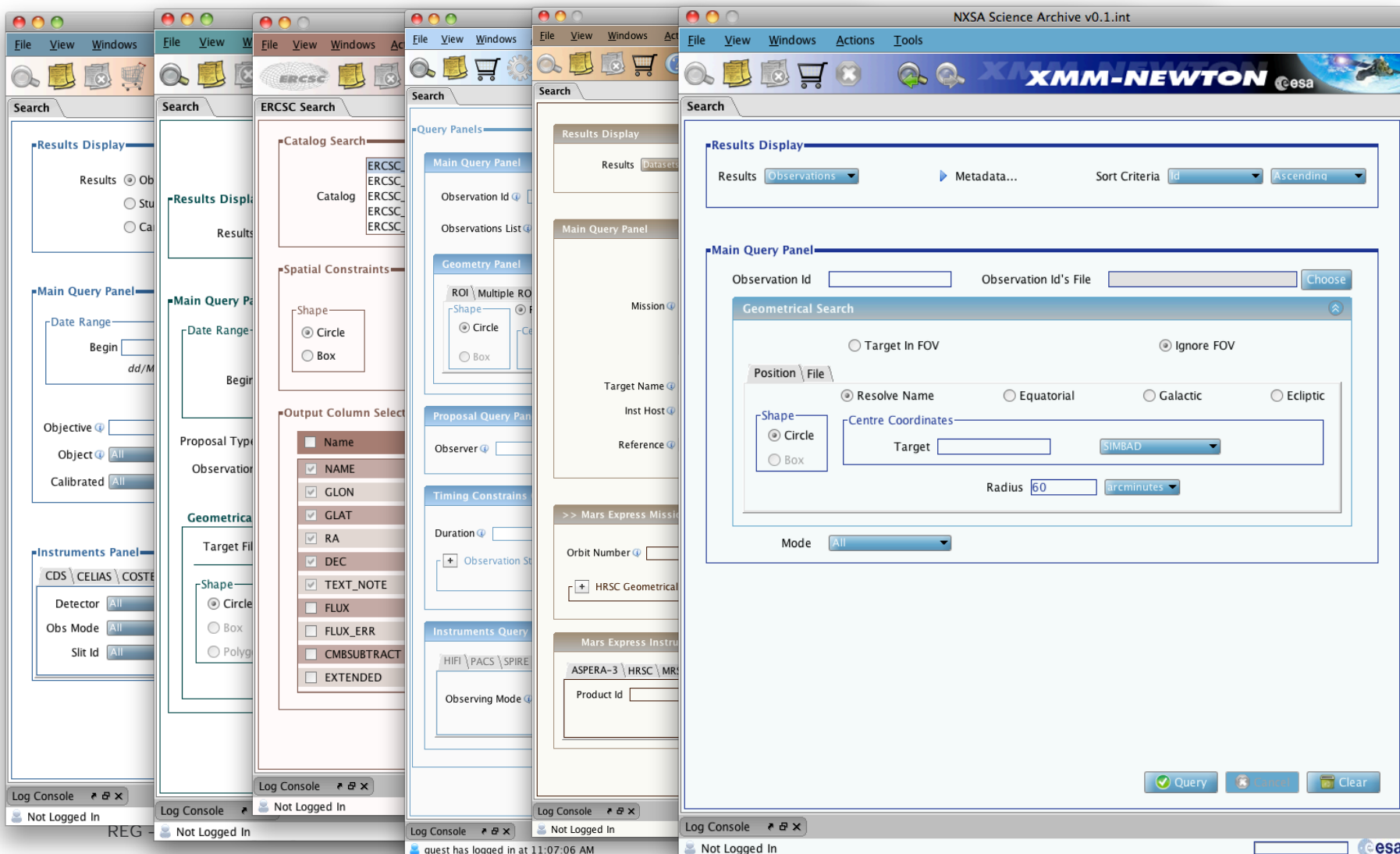


# Second Generation Archives (II)



1. Started as technology demonstrator
  - a. Exosat Science Archive – 2009
  - b. Soho Science Archive – 2009
  
2. All new archives built since then
  - a. Planck Interim (and then Legacy) Archive – 2009
  - b. Cluster Final Archive – to be released early 2013
  - c. Ulysses Data Archive - to be released early 2013
  
3. 1<sup>st</sup> generation Archives being migrated
  - a. Herschel Science Archive – May 2012
  - b. XMM-Newton Science Archive – late 2012
  - c. Planetary Science Archive - 2013

# Second Generation Archives L&F



# Second Generation L&F II : Planck and Soho



The screenshot displays the SOHO Science Archive v1.6 interface, which is divided into several panels. The main panel shows a list of observations with columns for Instrument, Detector, Observation Type, and Begin Date. A details panel on the right provides information for a specific observation (Id: 1836781), including Instrument (LASCO), Observatory (SOHO), Detector (C2), and various parameters like Proc Level, Begin Date, End Date, File Name, File Format, File Size, Wave Range, Obs Name, Obs Mode, Filter, Polarizer, Fov Position, Fov Angle, Fov Size, Spatial Res, Exp Count, and Exp Time.

Below the observation list, there are three time animators showing different views of the Sun:

- Top Right:** SOHO Time Animator for LASCO2 #1, showing a red image of the Sun's corona with a white circle indicating the field of view. The date is 2011/11/15 23:00.
- Bottom Right:** SOHO Time Animator for LASCO3 #1, showing a blue image of the Sun's corona with a white circle indicating the field of view. The date is 2002/01/08 20:42.
- Bottom Center:** SOHO Time Animator for EIT195 #1, showing a green image of the Sun's surface with a white circle indicating the field of view. The date is 2000/07/14 10:24.

The interface also includes a Planck Legacy Archive v0.8.2 (DR4) panel on the left, a Log Console at the bottom, and a status bar at the bottom right indicating the user is logged in at 14:22:44.

Instrument	Detector	Observation Type	Begin Date
LASCO	C2	Orange	00:05:48 31/12/2004
LASCO	C2	Orange	00:06:30 31/12/2004
LASCO	C3	Clear	00:17:24 31/12/2004
LASCO	C3	Clear	00:18:06 31/12/2004
LASCO	C2	Orange	00:29:23 31/12/2004
LASCO	C2	Orange	00:30:05 31/12/2004
LASCO	C3	Clear	00:41:23 31/12/2004
LASCO	C3	Clear	00:42:05 31/12/2004

**Observation Details (Id: 1836781):**

- Instrument: LASCO
- Observatory: SOHO
- Detector: C2
- Obs Type: Orange
- Object: Corona
- Objective:
- Proc Level: 0.5
- Begin Date: 00:54:05 31/12/2004
- End Date: 00:54:30 31/12/2004
- File Name: 22186716.fits
- File Format: FITS
- File Size: 2108160 bytes
- Wave Range:
- Obs Name: 3361
- Obs Mode: Normal
- Filter: Orange
- Polarizer: Clear
- Fov Position: [0.0],[0.0] arcsec
- Fov Angle: 180.0 degrees
- Fov Size: [1024],[1024] arcsec
- Spatial Res: [11.9],[11.9] arcsec
- Exp Count: 1
- Exp Time: 25.0962 seconds

# Third Generation User Interfaces: XMM-Newton



XMM-Newton Science Archive

Search Results: 119

Position: File

Target in: ☒ Name ☐ Equatorial ☐ Galactic ☐ Ecliptic

Target in: ☒ Circle ☐ Box ☐ Field Of View

Name:  Simbad

Radius:  arc min

m31 resolved by Simbad  
10.6847083, 41.26875

More options

Observation Id:

Revolution:

Observation Status:

Observations Availability:

Proposal

Exposure

Exposure ID:

Exposure Duration:

Background Duty Cycle:

Instrument Configuration

EPIC Source Catalogue

EPIC OM Source Catalogue

OM Slew Source Catalogue

Slew: nxsa:8080/nxsa-web/

XMM-Newton Science Archive v0.6 (28-Sep-2012 17:26)

Results #1 X Results #2 X Results #3 X Results #4 X

Search Info

OBSERVATIONS (37)- 0.16s X SLEW\_SOURCE\_CAT (56)- 0.05s X OM\_SOURCE\_CAT (3219)- 0.08s X 2XMM\_EPIC\_CAT (2650)- 0.1s X PUBLICATIONS (44)- 0.14s X

Add to Cart Save As Send To

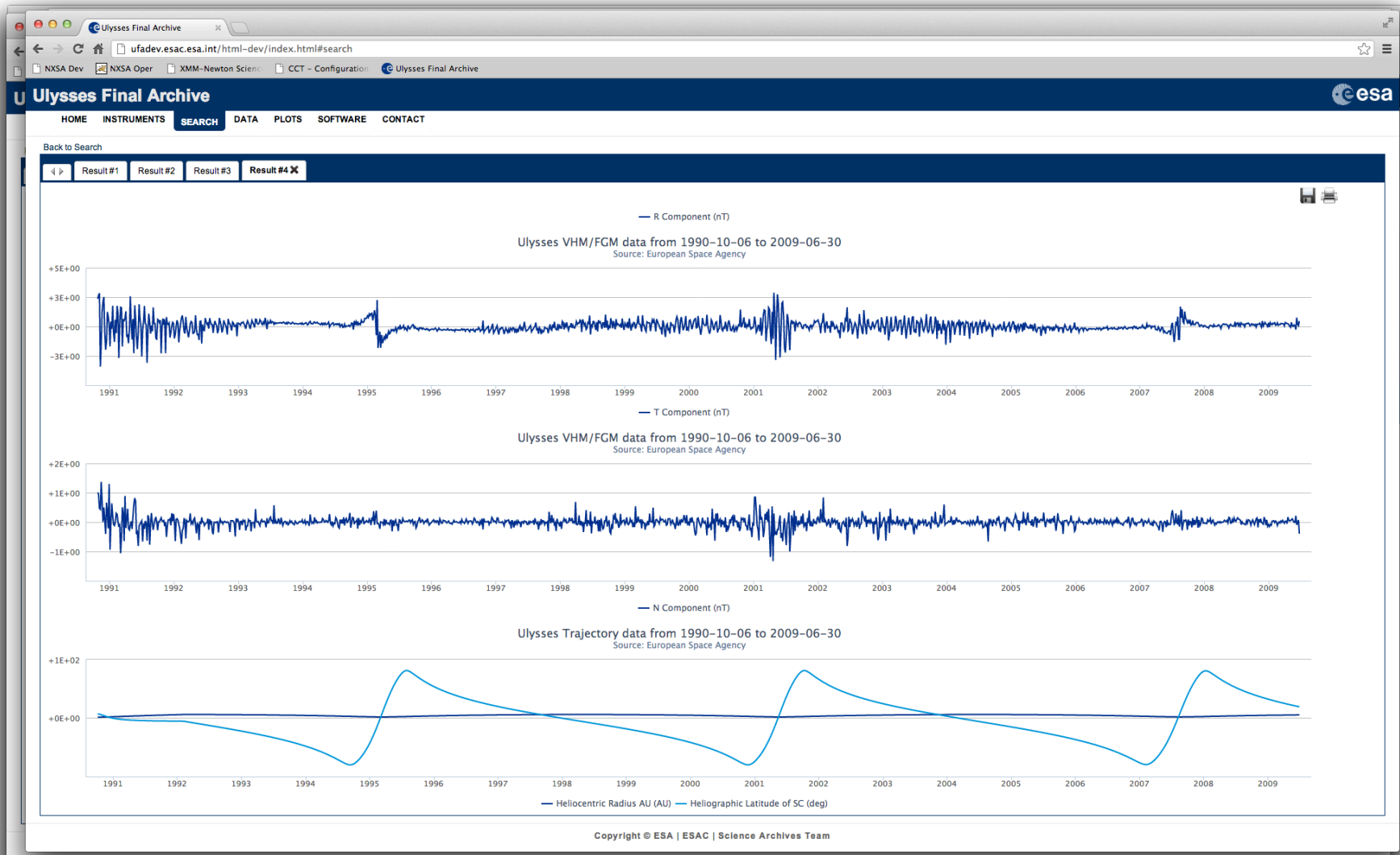
	Bib Code	Title	Authors	Journal	Vol	Month	Year	Page
<input type="checkbox"/>	2001ApJ...563L.119T	Bright X-Ray Transients in the Andromeda Galaxy Observed with Chandra and XMM-Newton	Trudolyubov, Sergey P.; Borozdin, Konstantin N.; Priedhorsky, William C.	ApJ	563	12	2001	119
<input type="checkbox"/>	2012MNRAS...420.2969M	The missing link: a low-mass X-ray binary in M31 seen as an ultraluminous X-ray source	Modjaz, Matthew J.; Sutton, Andrew D.; Roberts, Timothy P.; Jackson, Floyd E.; Done, Chris	MNRAS	420	3	2012	2969
<input type="checkbox"/>	2001A&A...378..800O	The central region of M 31 observed with XMM-Newton. II. Variability of the individual sources	Osborne, J. P.; Borozdin, K. N.; Trudolyubov, S. P.; Priedhorsky, W. C.; Soria, R.; Shirey, R.; Hayter, C.; La Palombara, N.; Mason, K.; Molendi, S.; Paerels, F.; Pietsch, W.; Read, A. M.; Tiengo, A.; Watson, M. G.; West, R. G.	A&A	378	11	2001	800
<input type="checkbox"/>	2009MNRAS...397L..92B	A second black hole candidate in a M31 globular cluster is identified with XMM-Newton	Barnard, R.; Kolb, U.	MNRAS	397	7	2009	92
<input type="checkbox"/>	2010A&A...523A..89H	X-ray monitoring of classical novae in the central region of M 31. I. June 2006-March 2007	Henze, M.; Pietsch, W.; Haberl, F.; Hernandez, M.; Sala, G.; Della Valle, M.; Hatzidimitriou, D.; Rau, A.; Hartmann, D. H.; Greiner, J.; Burwitz, V.; Fliri, J.	A&A	523	11	2010	89
<input type="checkbox"/>	2006ApJ...643..356W	A Catalog of Transient X-Ray Sources in M31	Williams, Benjamin F.; Nak, S.; Garcia, Michael R.; Callanan, Paul J.	ApJ	643	5	2006	356
<input type="checkbox"/>	2008ApJ...676.1218T	XMM-Newton Discovery of 217 s Pulsations in the Brightest Persistent Supersoft X-Ray Source in M31	Trudolyubov, Sergey P.; Priedhorsky, William C.	ApJ	676	4	2008	1218
<input type="checkbox"/>	2002ApJ...581L..27T	The Discovery of a 2.78 Hour Periodic Modulation of the X-Ray Flux from Globular Cluster Source 40 in M31	Trudolyubov, Sergey P.; Borozdin, Konstantin N.; Priedhorsky, William C.; Osborne, Julian P.; Watson, Michael G.; Mason, Keith O.; Cordova, France A.	ApJ	581	12	2002	27
<input type="checkbox"/>	2008MNRAS...388..56B	Unresolved emission and ionized gas in the bulge of M31	Bogdan, T. T.; Gilfanov, M.	MNRAS	388	7	2008	56
<input type="checkbox"/>	2008A&A...480..599S	Time variability of X-ray sources in the M 31 centre field	Stiele, H.; Pietsch, W.; Haberl, F.; Freyberg, M.	A&A	480	3	2008	599
<input type="checkbox"/>	2004A&A...419.1045M	A possible new dipping X-ray source in the field of M 31	Mangano, V.; Israel, G. L.; Stella, L.	A&A	419	6	2004	1045
<input type="checkbox"/>	2004ApJ...615..242T	XMM-Newton and Chandra Observations of the Central Region of M31	Takahashi, Hiromitsu; Okada, Yui; Kokubun, Motohide; Makishima, Kazuo	ApJ	615	11	2004	242
<input type="checkbox"/>	2009A&A...498..811H	Spectral and temporal variations of the isolated neutron star RX J0720.4-3125: new XMM-Newton observations	Hohle, M. M.; Haberl, F.; Vink, J.; Turolla, R.; Hambaryan, V.; Zane, S.; de Vries, C. P.; M77ndez, M.	A&A	498	5	2009	811
<input type="checkbox"/>	2010MNRAS...404.1879L	X-ray spectroscopy of the hot gas in the M31 bulge	Liu, Jiren; Wang, Q. Daniel; Li, Zhiyuan; Peterson, John R.	MNRAS	404	6	2010	1879
<input type="checkbox"/>	2011A&A...534A..55S	The deep XMM-Newton Survey of M 31	Stiele, H.; Pietsch, W.; Haberl, F.; Hatzidimitriou, D.; Barnard, R.; Williams, B. F.; Kong, A. K. H.; Kolb, U.	Astronomy & Astrophysics, Volume 534, id A55	534	10	2011	55
<input type="checkbox"/>	2004ApJ...610..261G	Supersoft X-Ray Sources in M31. II. ROSAT-detected Supersoft Sources in the ROSAT, Chandra, and XMM-Newton Eras	Greiner, J.; Di Stefano, R.; Kong, A.; Primi, F.	ApJ	610	7	2004	261
<input type="checkbox"/>	2002ApJ...571L..17T	On the X-Ray Source Luminosity Distributions in the Bulge and Disk of M31: First Results from the XMM-Newton Survey	Trudolyubov, Sergey P.; Borozdin, Konstantin N.; Priedhorsky, William C.; Mason, Keith O.; Cordova, France A.	ApJ	571	5	2002	17
<input type="checkbox"/>	2006ApJ...645..277T	Bright X-Ray Transients in M31: 2004 July XMM-Newton Observations	Trudolyubov, Sergey; Priedhorsky, William; Cordova, France	ApJ	645	7	2006	277
<input type="checkbox"/>	2010MNRAS...407.1188B	Searching for dark matter in X-rays: how to check the dark matter origin of a spectral feature	Boyarisky, Alexey; Ruchayskiy, Oleg; Iakubovskiy, Dmytro; Walker, Matthew G.; Riener-Sørensen, Signe; Hansen, Steen H.	MNRAS	407	9	2010	1188
<input type="checkbox"/>	2011ApJ...743..185B	Reinstating the M31 X-Ray System RX J0423.4+1115 as a Black Hole X-Ray Binary and Compelling Evidence for an Extended Corona	Barnard, R.; Garcia, M. R.; Murray, S. S.	ApJ	743	12	2011	185
<input type="checkbox"/>	2003A&A...405..505B	RX J0423.4+1115: A stellar mass black hole binary identified in M 31	Barnard, R.; Osborne, J. P.; Kolb, U.; Borozdin, K. N.	A&A	405	7	2003	505
<input type="checkbox"/>	2005A&A...430L..45P	XMM-Newton detection of type I X-ray bursts in M 31	Pietsch, W.; Haberl, F.	A&A	430	1	2005	45
<input type="checkbox"/>			Peacock, Mark B.; Macaroni, Thomas J.; Waters,					

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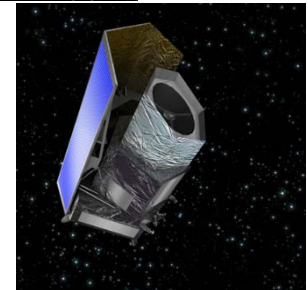
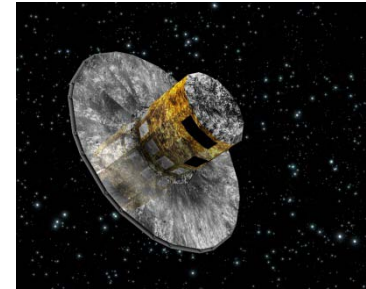
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# Examples of Third Generation User Interfaces: Ulysses



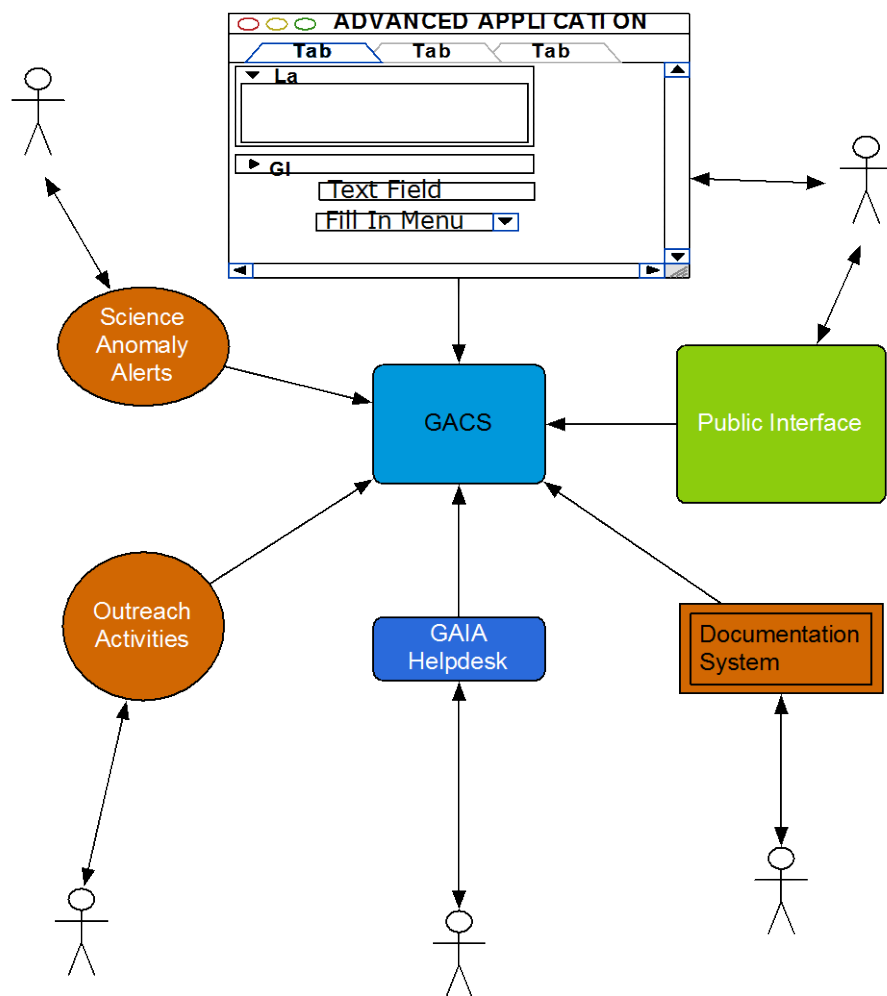
# Third Generation Archives

1. Huge datasets with new access requirements
  - a. 1PB for Gaia, several PB for Euclid
2. Investigating how to cope with big databases:
  - a. Hadoop/Map reduce
  - b. SciDB
  - c. Cache
  - d. GreenPlum
  - e. Parallel databases in general
3. Will implement Thin Layers over them
4. Existing Archive software infrastructure expandable to cope with new requirements and data sizes
5. VO TAP Interfaces to be built over flexible and –over all- scalable data repositories and databases



# Third Generation Archives: GAIA

## Archive Core System (GACS) example



- This architecture will allow the science community to write added value tools that will access the GAIA data through proper interfaces with the GACS (e.g., the extended TAP interface).
- These tools could range from specialized visualization tools (like 3D visualization) to Outreach activity tools, public user interfaces to the data or any other applications making use of GAIA data

# GACS (Gaia Archive Core Systems) Roadmap



1. Roadmap covering 2010-2021 built.
2. Very difficult not having yet final requirements, but covering all different possibilities
3. Will polish it as we progress throughout the mission
4. Maps to CU9 initial Work Packages (and will be updated to match the AO response Work Packages)
5. Roadmap review
6. GACS Architecture and tests