ESAC Science Archives and VO Team

Pedro Osuna
Head of the *Science Archives and VO Team (SAT)*
Science and Robotic Exploration directorate (SRE)
Science Operations Department (SRE-O)
European Space Astronomy Centre, ESAC
02/10/2012

European Space Astronomy Centre

1. ESAC default location for:

2. Science operations,
    a. long history with astronomical missions
    b. Now also solar system missions

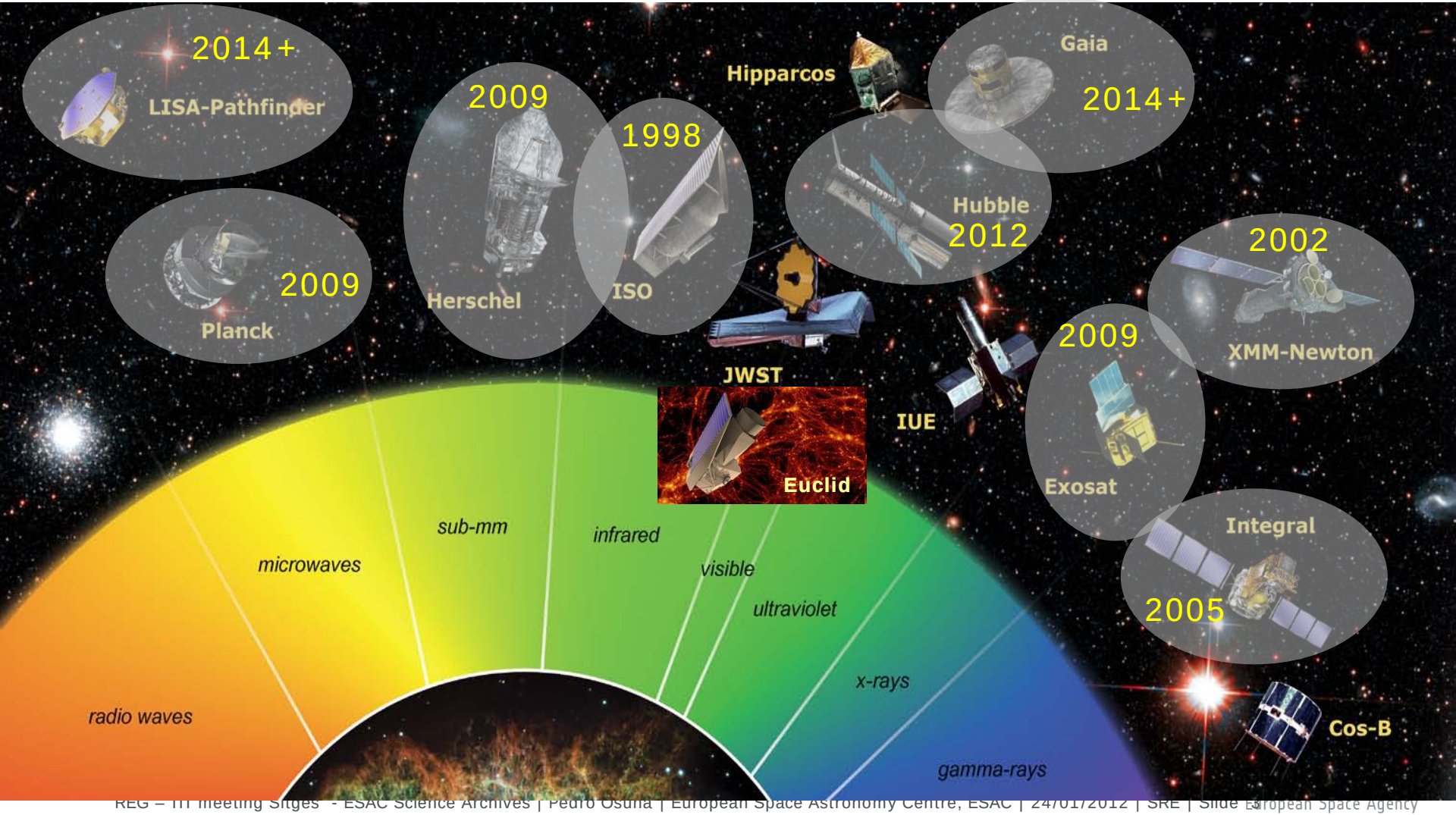
3. Science archives,
    a. Astronomy
    b. Planetary and Solar Systems
    c. Solar and Heliospheric Missions

4. ESA VO activities, IPDA activities
    a. ESAC as member of all international endeavors for interoperability, e.g., IVOA, IPDA, Euro-VO, …

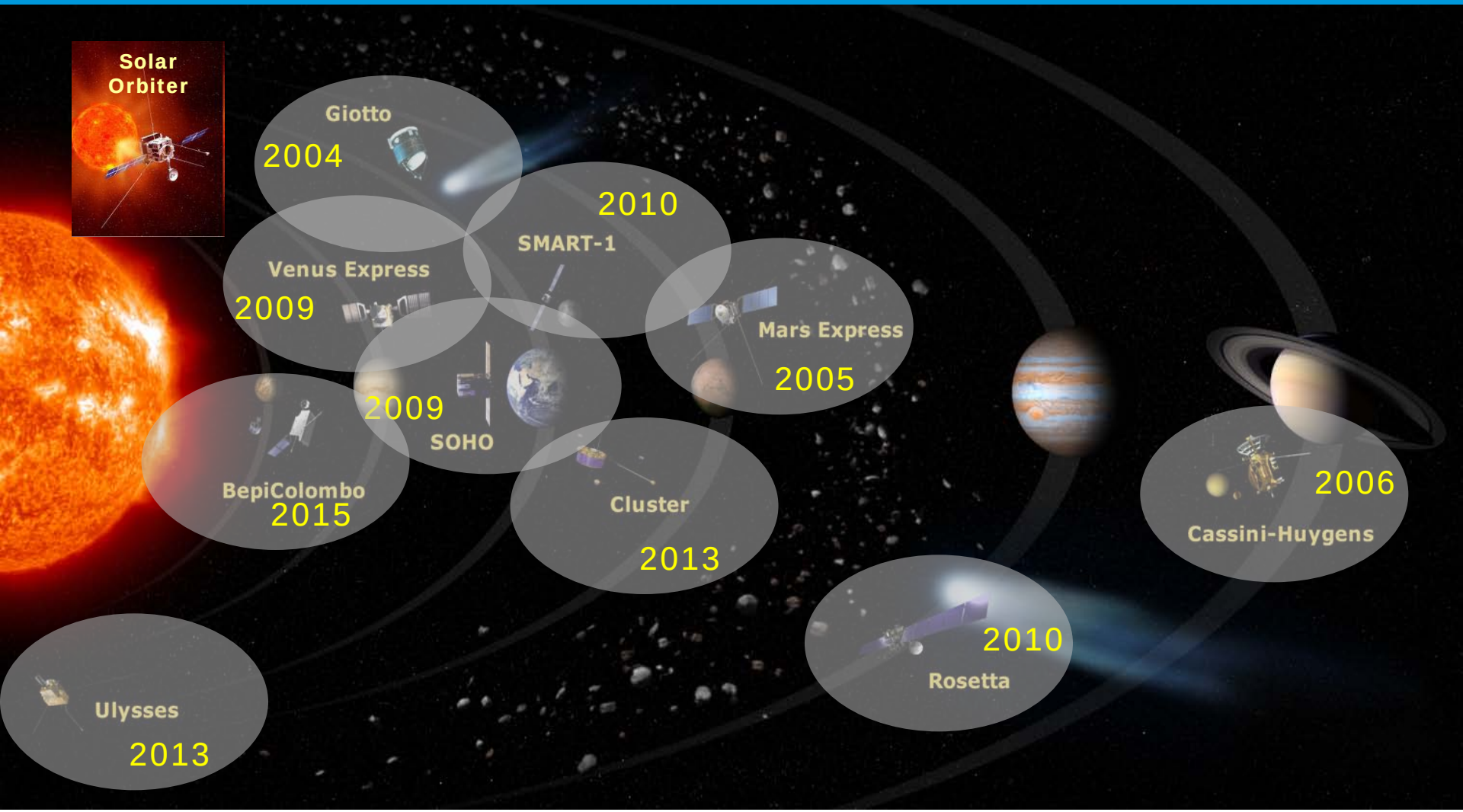
http://www.esa.int/SPECIALS/ESAC/

Located near Madrid, Spain

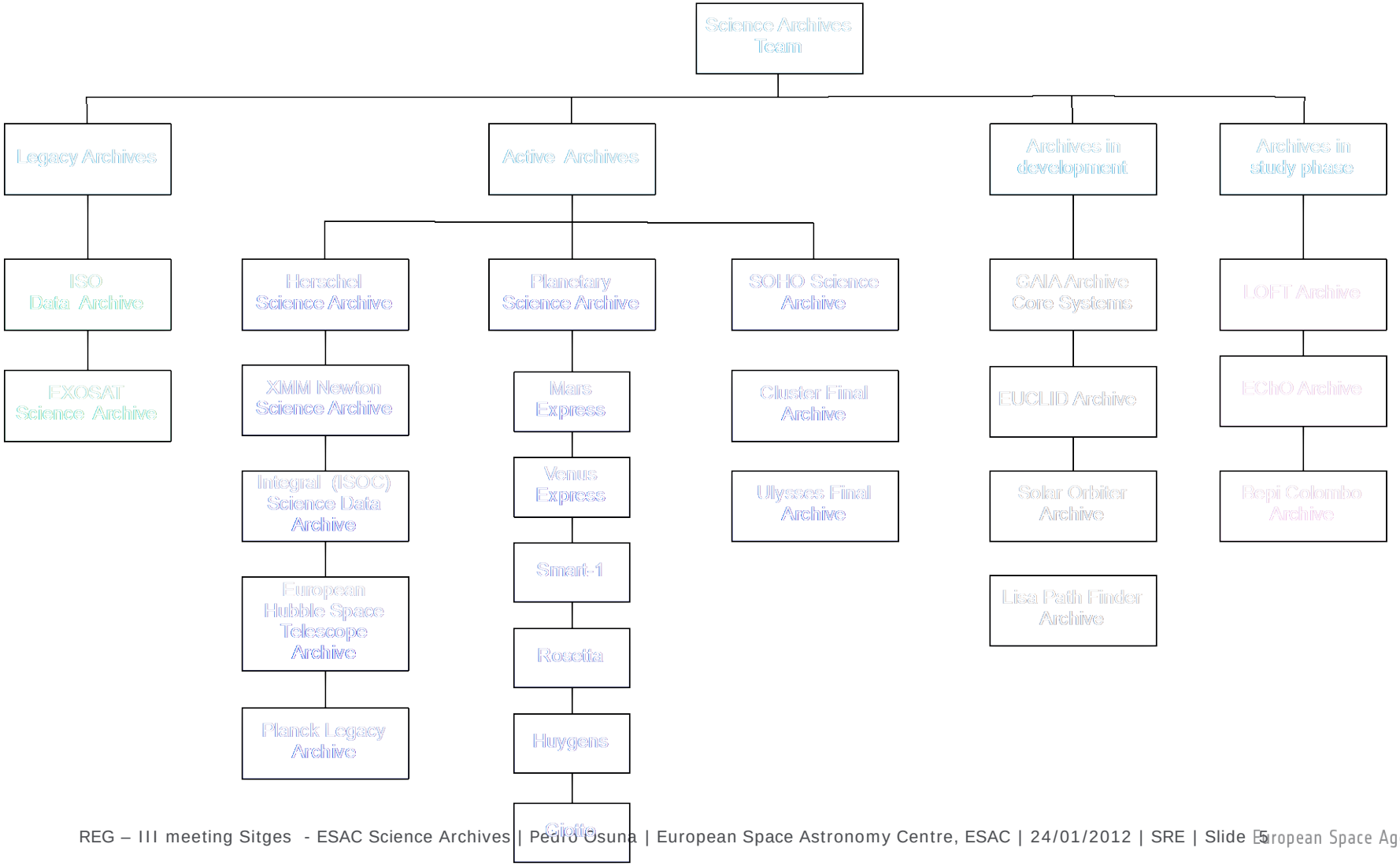
Astronomy Archives at ESAC



Solar Systems Archives at ESAC



ESAC Archives and “phases”



Science Archives Team

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

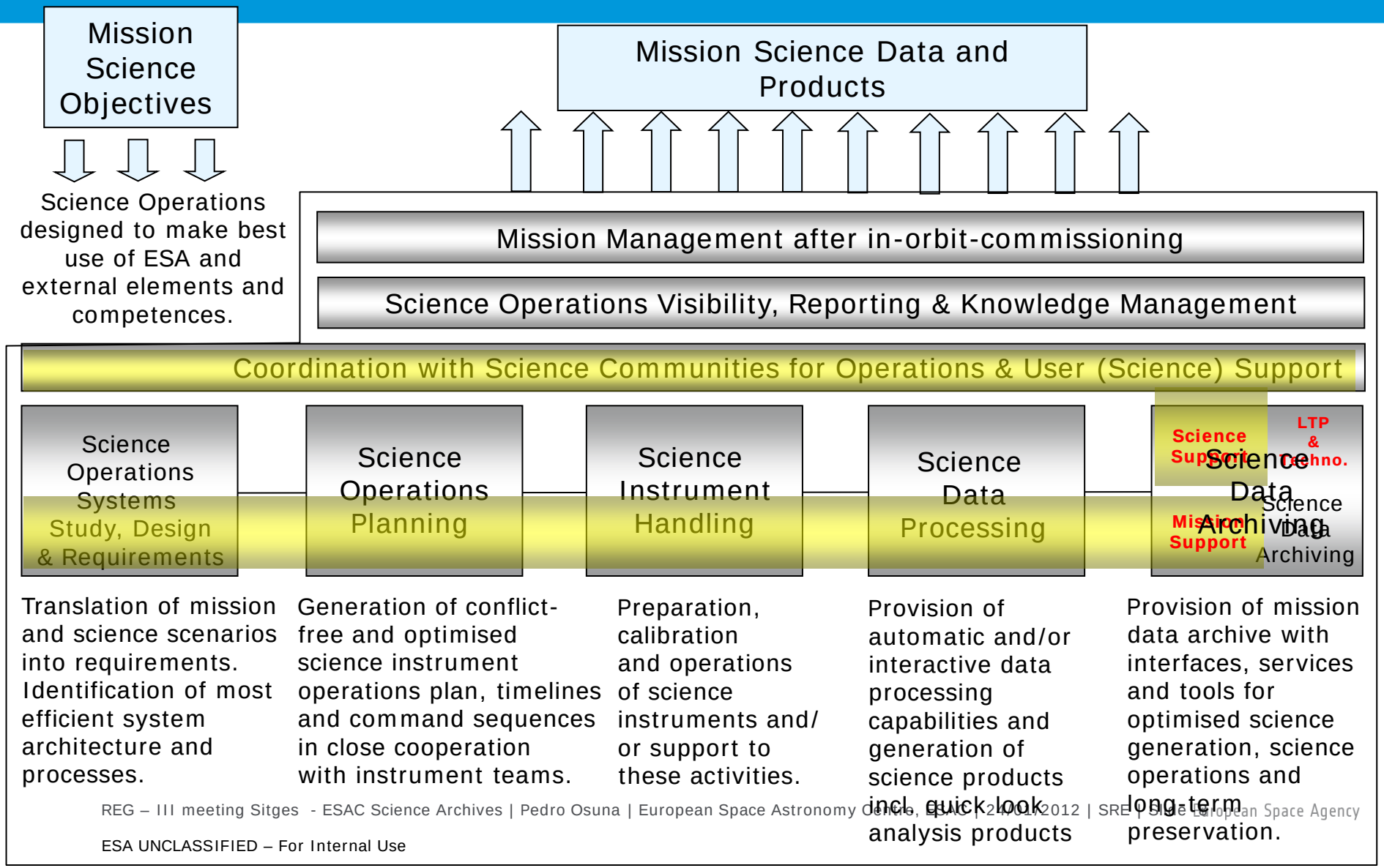
SAT Resources for GAIA

1. Three FTEs (full time equivalent) assigned to Gaia work within the Science Archives Team:

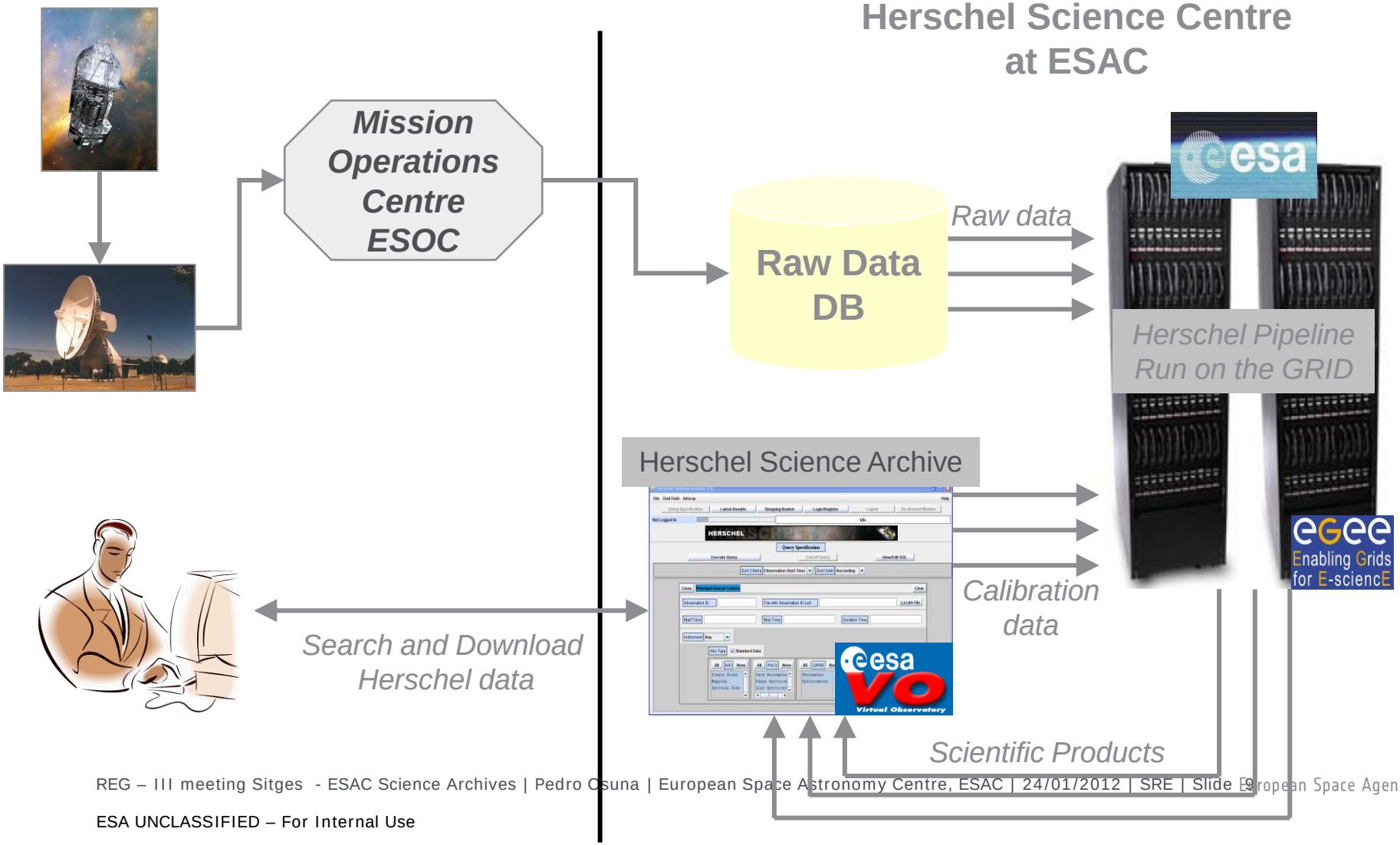
    a. Jesús Salgado – SAT Gaia Team Coordinator (50%)
    b. Daniel Tapador - 100%
    c. Raúl Gutiérrez – 100%
    d. Juan González – 50%

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



(*Slides 10 to 17 left here for further reference*)

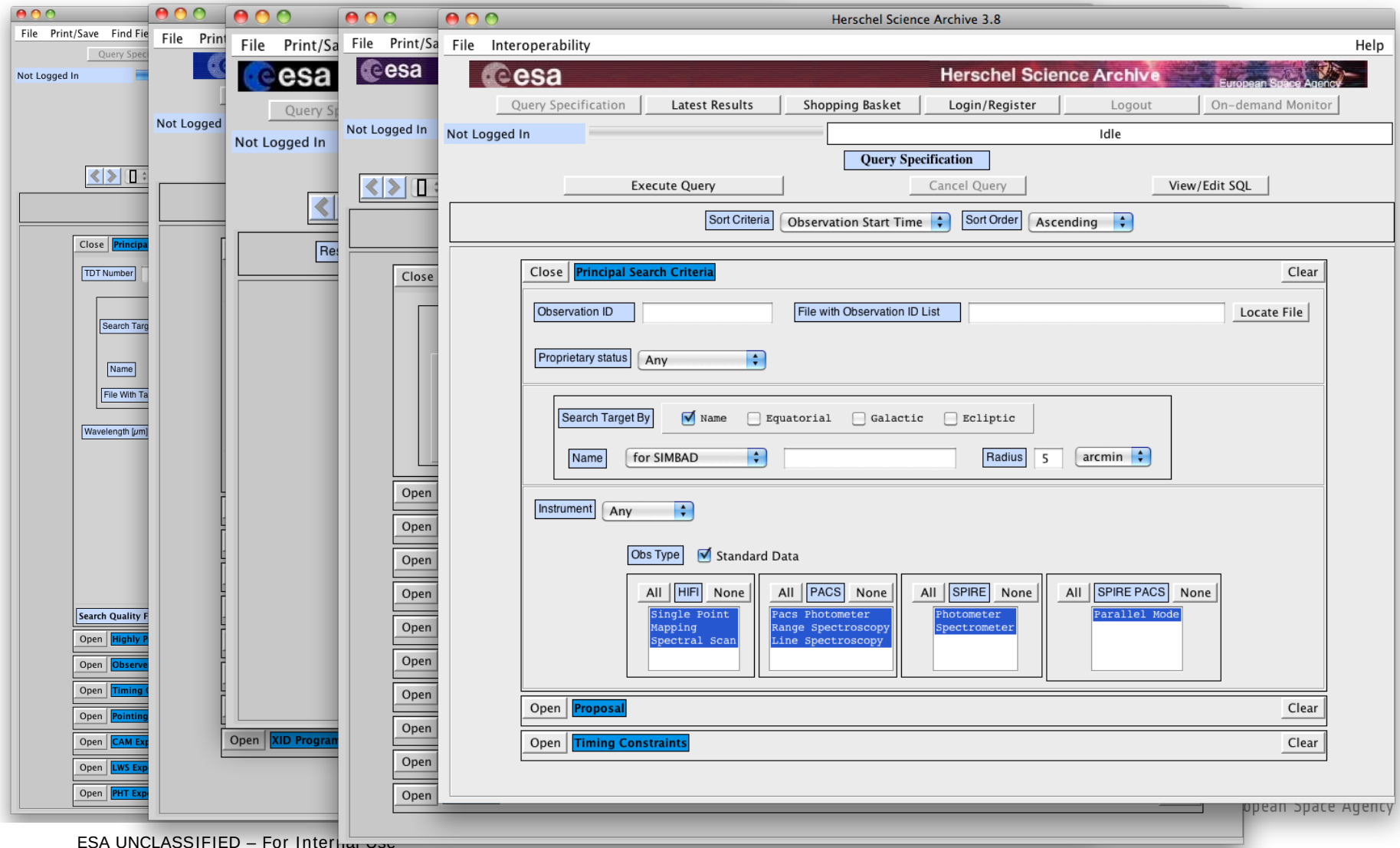
First Generation Archives

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)

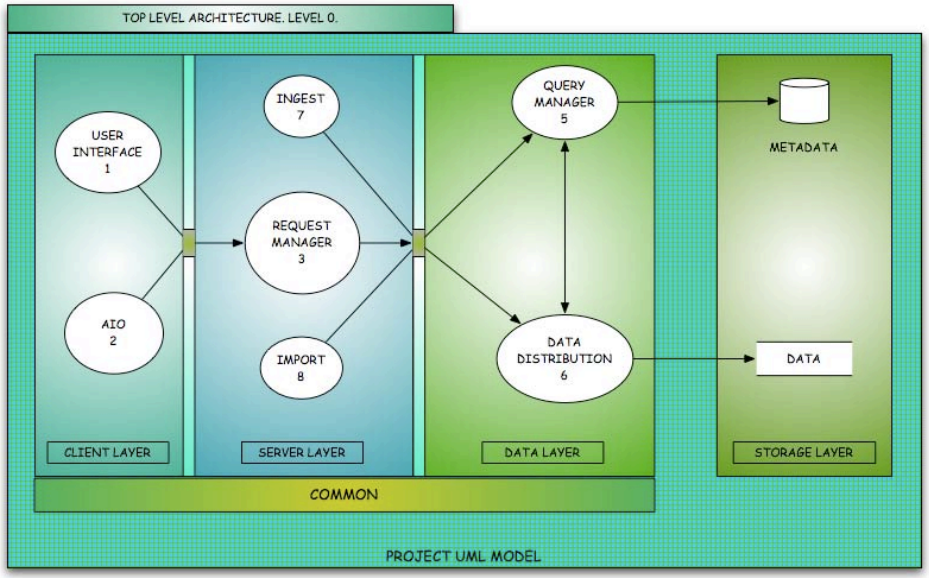
2. Continued with:
    a. XMM-Newton Science Archive (XSA) - 2002
    b. Planetary Science Data Archive (PSA) - 2004
    c. ISOC Integral Science Data Archive (ISDA) - 2005
    d. Herschel Science Archive (HSA) - 2007
        – Now migrated to 2nd generation

First Generation Archives L&F



Second Generation Archives

1. Re-engineering study leading to archive technology evolution
    a. Building on experience and strengths from 1st 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 a
    g. Higher code reusability between
    h. Rich client and thin layer GUIs



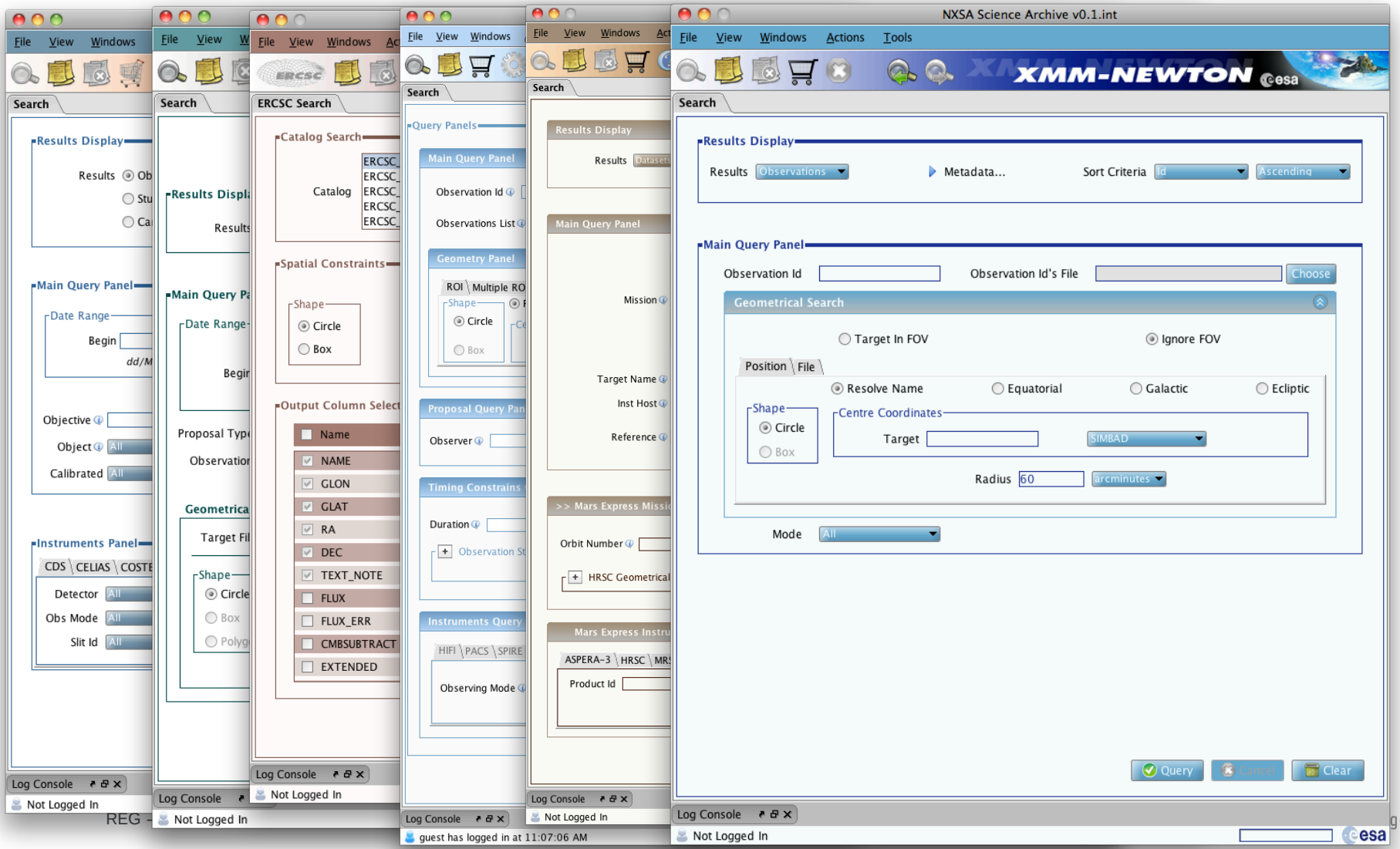
Second Generation Archives (II)

1. Started as technology demonstrator
    a. Exosat Science Archive – 2009
    b. Soho Science Archive – 2009

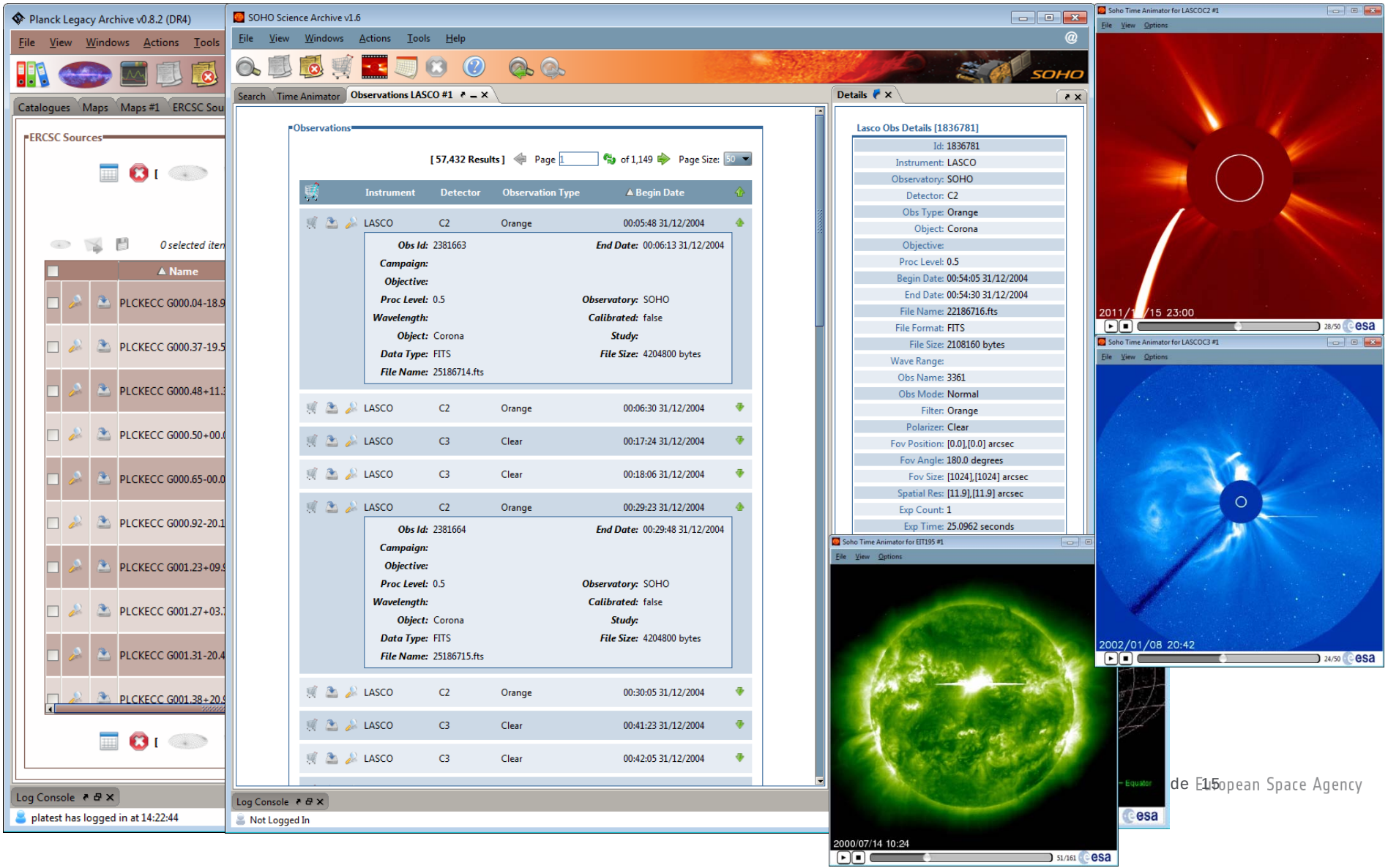
2. All new archives built since then
    a. Planck Interim (and then Legacy) Archive – 2009
    b. Cluster Final Archive – to be released early 2013
    c. Ulysses Data Archive - to be released early 2013

3. 1st generation Archives being migrated
    a. Herschel Science Archive – May 2012
    b. XMM-Newton Science Archive – late 2012
    c. Planetary Science Archive - 2013

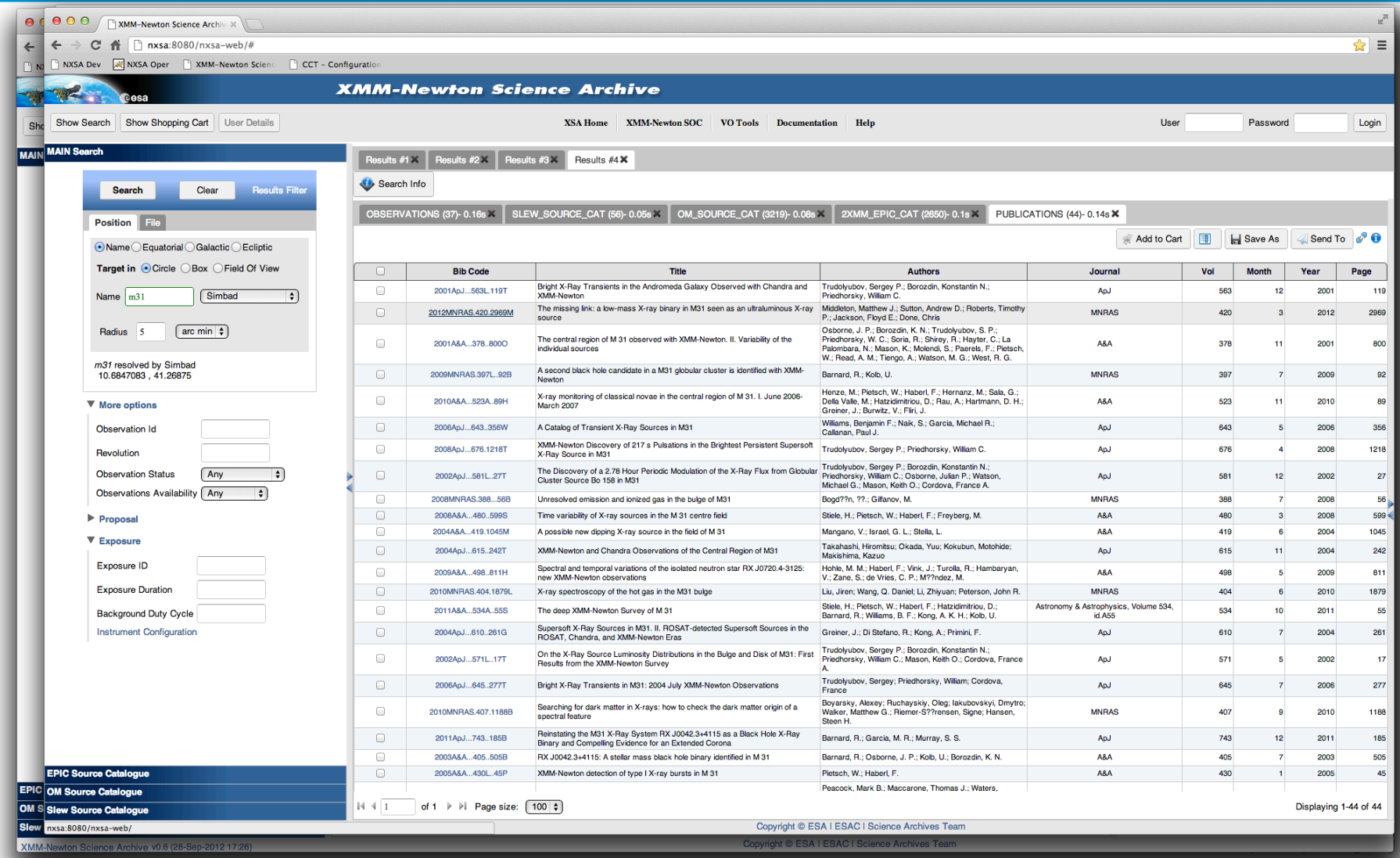
Second Generation Archives L&F



Second Generation L&F II : Planck and Soho



Third Generation User Interfaces: XMM-Newton

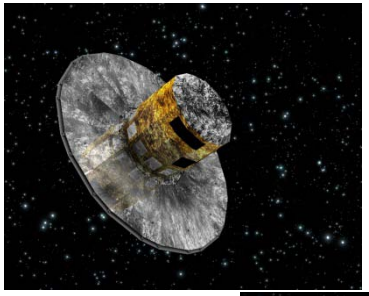


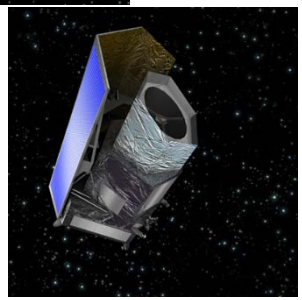
Bib Code	Title	Authors	Journal	Vol	Month	Year	Page
2001ApJ...563L.119T	Bright X-Ray Transients in the Andromeda Galaxy Observed with Chandra and XMM-Newton	Trudolyubov, Sergey P.; Borozdin, Konstantin N.; Priedhorsky, William C.	ApJ	563	12	2001	119
2012MNRAS.420.2969M	The missing link: a low-mass X-ray binary in M31 seen as an ultraluminous X-ray source	Middleton, Matthew J.; Sutton, Andrew D.; Roberts, Timothy P.; Jackson, Floyd E.; Done, Chris	MNRAS	420	3	2012	2969
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
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
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.; Hernanz, 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
2006ApJ...643..356W	A Catalog of Transient X-Ray Sources in M31	Williams, Benjamin F.; Naik, S.; Garcia, Michael R.; Callanan, Paul J.	ApJ	643	5	2006	356
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
2002ApJ...581L..27T	The Discovery of a 2.78 Hour Periodic Modulation of the X-Ray Flux from Globular Cluster Source Bo 158 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
2008MNRAS.388...56B	Unresolved emission and ionized gas in the bulge of M31	Bogd??n, ??.; Gilfanov, M.	MNRAS	388	7	2008	56
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
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
2004ApJ...615..242T	XMM-Newton and Chandra Observations of the Central Region of M31	Takahashi, Hiromitsu; Okada, Yuu; Kokubun, Motohide; Makishima, Kazuo	ApJ	615	11	2004	242
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.; M??ndez, M.	A&A	498	5	2009	811
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
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
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.; Primini, F.	ApJ	610	7	2004	261
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
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
2010MNRAS.407.1188B	Searching for dark matter in X-rays: how to check the dark matter origin of a spectral feature	Boyarsky, Alexey; Ruchayskiy, Oleg; Iakubovskyi, Dmytro; Walker, Matthew G.; Riemer-S??rensen, Signe; Hansen, Steen H.	MNRAS	407	9	2010	1188
2011ApJ...743..185B	Reinstating the M31 X-Ray System RX J0042.3+4115 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
2003A&A...405..505B	RX J0042.3+4115: 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
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
		Peacock, Mark B.; Maccarone, Thomas J.; Waters,					

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

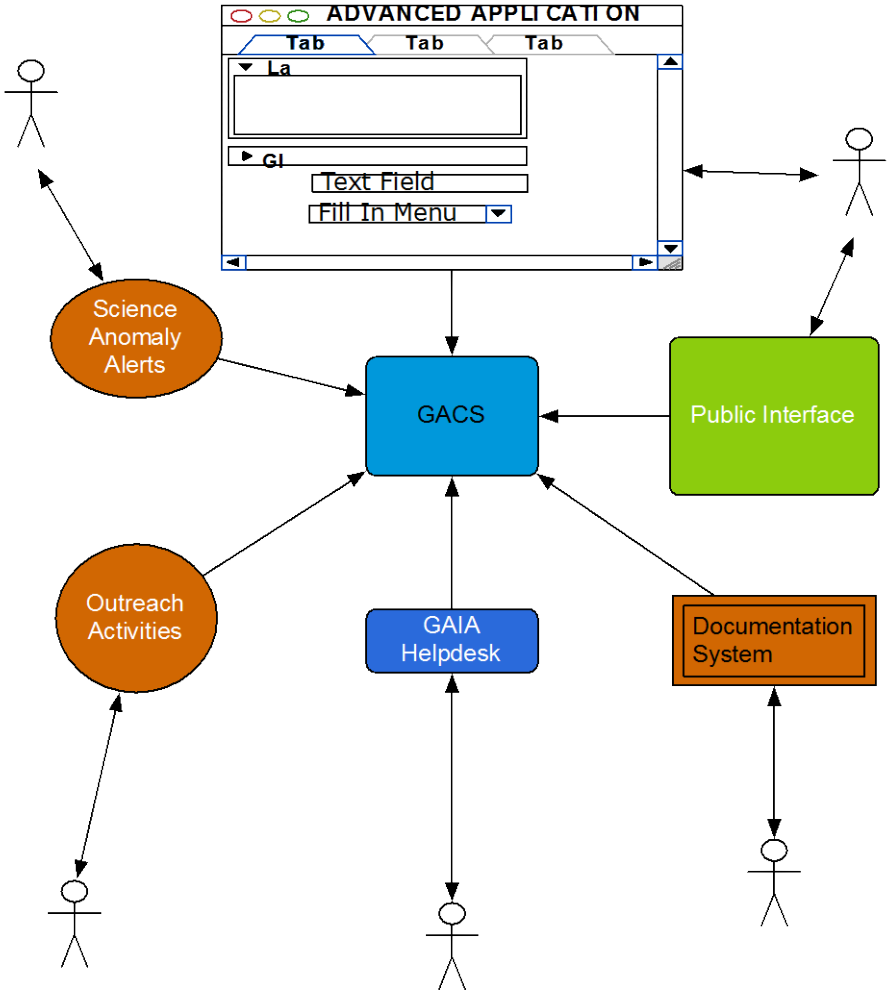




2. Investigating how to cope with big databases:
    a. Hadoop/Map reduce
    b. SciDB
    c. Cache
    d. GreenPlum
    e. Parallel databases in general

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 througout 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