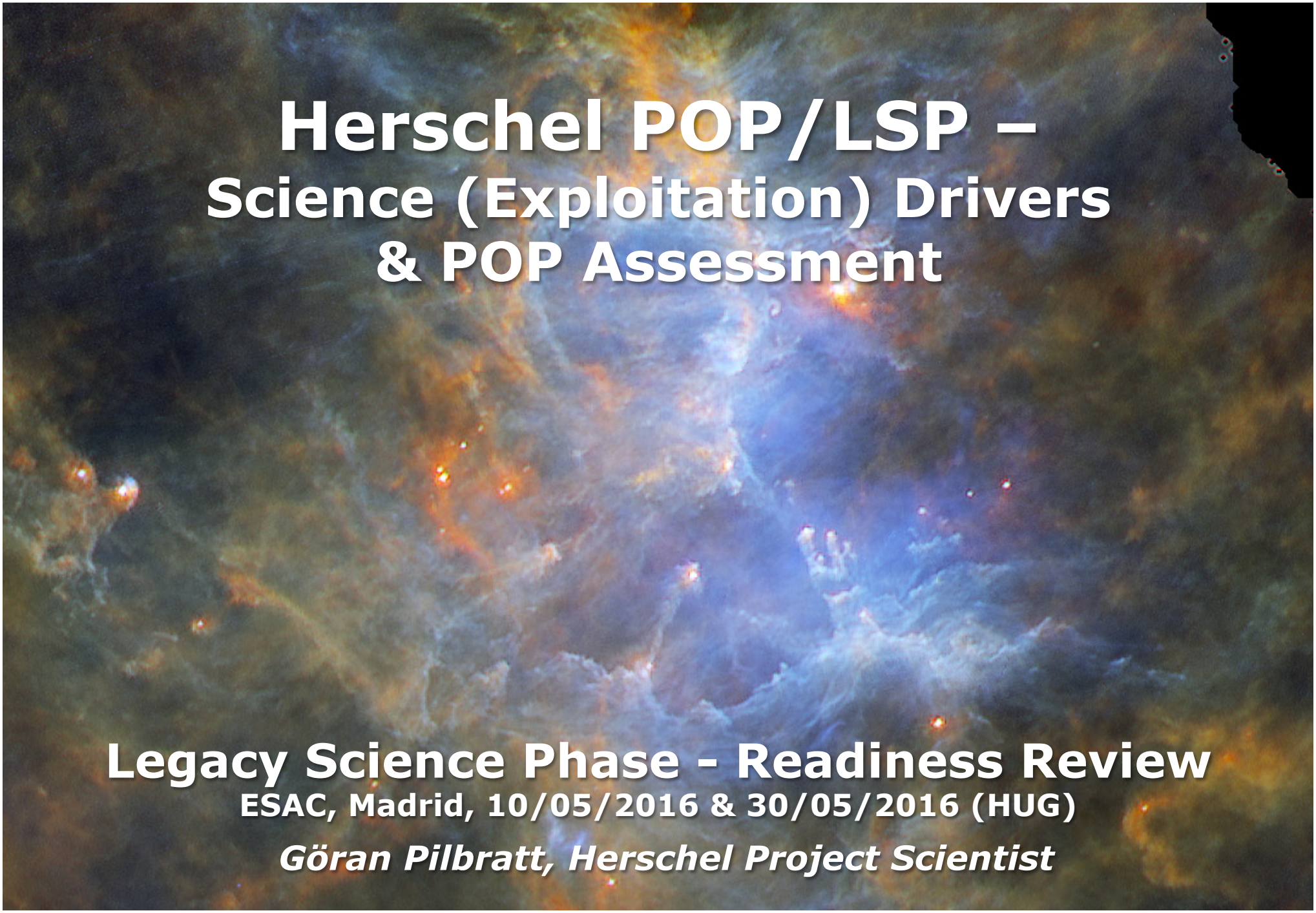

Herschel POP/LSP –
Science (Exploitation) Drivers
& POP Assessment

Legacy Science Phase - Readiness Review

ESAC, Madrid, 10/05/2016 & 30/05/2016 (HUG)

Göran Pilbratt, Herschel Project Scientist

Topics

Herschel Legacy Science Phase – Readiness Review

- Mission Phases & Game-Changers
  - Herschel (also generic)
- Background: POP Plans & Readiness Review
  - Objectives
  - Beyond POP – LSP
  - Board Assessment
- SGS 'Paris meeting'
  - Essentially 'internal SGS mid-course review'
- Present: POP Science Assessment
- Future: Legacy Science Phase Readiness Review
  - Science background
  - Science/data exploitation drivers and needs
- Summary

HERSCHEL SPACE OBSERVATORY

Mission Phases & Game-changers

Herschel (but 'generic') mission phases – simplified

- **Study phase(s) – 1982/1990-1997/2001**
  - Science objectives & mission definition/consolidation
- **Implementation phase – 1997/2001-2009**
  - Retain/optimise science objectives and mission capabilities
- **In-flight operations phases (CoP, PVP, RSP) – 2009-2013**
  - Game-changer: You have what you have: s/c, instruments
  - Use what you have best possible way
  - Observations, data products, science exploitation
- **Post-Operations Phase (POP) – 2013-2017**
  - Game-changer: You have what you have: observations
  - Data products, science exploitation – formal end of (funded) mission
- **Legacy Science Phase (LSP) – 2018-**
  - Game-changer: You have what you have: observations, data products
  - Science exploitation … post-mission, no funding

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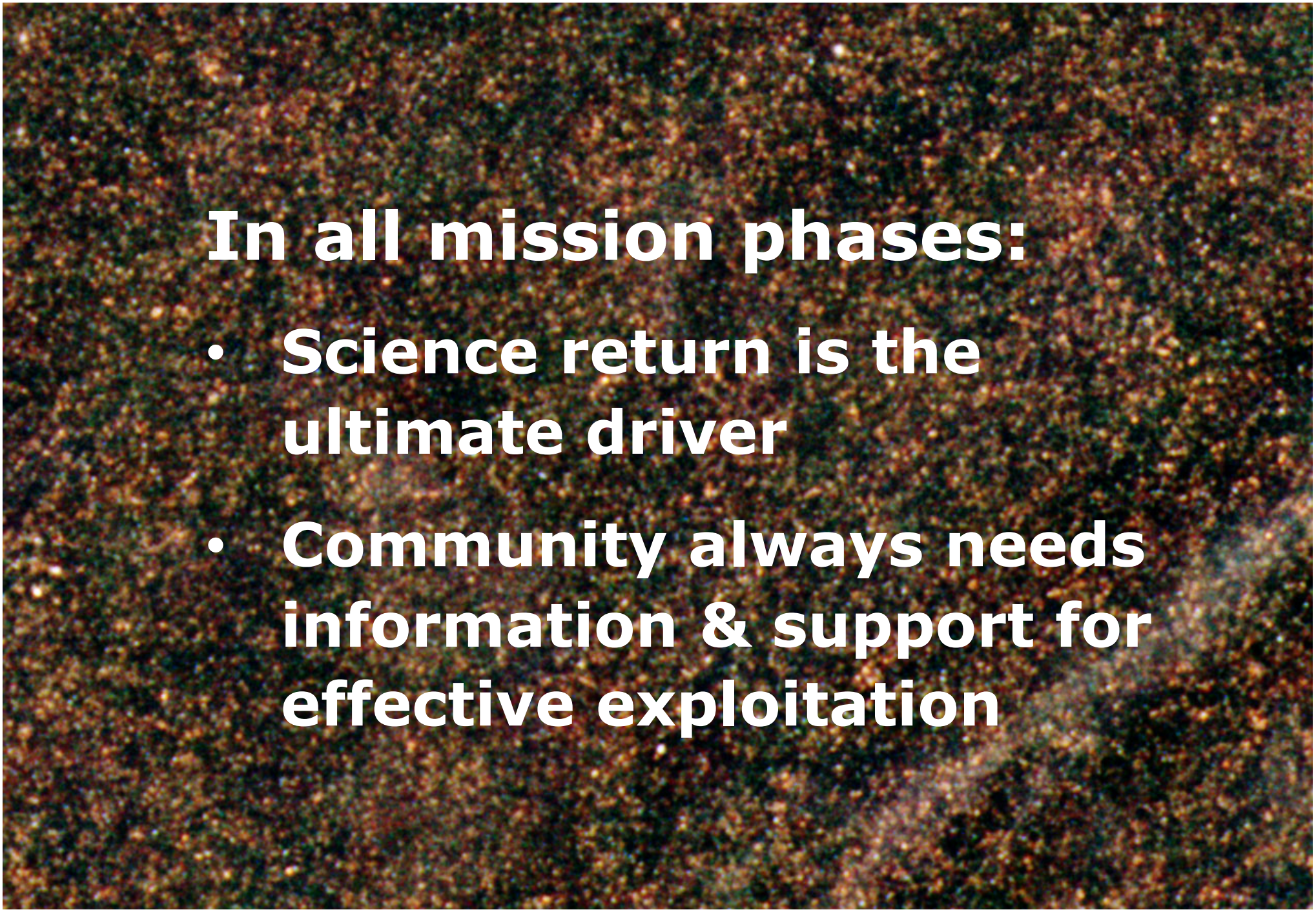
In all mission phases:
• Science return is the ultimate driver
• Community always needs information & support for effective exploitation

Mission Phases & Game-changers

- from POP Readiness Review 30/10/2012

Post-Operations Phase – Mission Level Objectives

HERSCHEL SPACE OBSERVATORY

Beyond EoHe: Post-Operations Phase

- from POP Readiness Review 30/10/2012

End observing not end of Herschel mission!

Post-Operations Phase – 3-5 years

- POP Pillars:
  - Community support for ongoing data exploitation
  - Create, advertise, and deliver the Herschel Legacy
  - Derive lessons learned and items for future use
  - Enable personnel to perform their own science exploitation

Beyond POP – the Legacy Science Phase

- The Herschel legacy archive will be maintained 'indefinitely'
- No 'Herschel-specific' activities are funded
- End of POP is end of Herschel mission

Spacecraft "disposal"

- Outside scope of this meeting – decision expected by end of 2012

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Post-Operations Phase

- from POP Readiness Review 30/10/2012

The POP is – and always was! – an integral part of the Herschel mission!

POP 'history':

- SMP 1997 (as approved by SPC): POP 3.25 years
- SIRD 2001: POP 5.25 years – "TBC 'post-launch'"
  - Now taking 'lessons learned' from ISO fully into account
- SIP (responding to SIRD) 2002: POP 5.25 year
  - POP Headings as accepted with Project and 'funded':
    - Management & support functions
    - Research and science support (science research, satellite characterisation, cross-calibration, community support, information, PR & communications support)
    - Archive (consolidation, upgrades & reprocessing, Planck data archiving, 'transfer' to Legacy archive)
    - Software maintenance

HERSCHEL SPACE OBSERVATORY

POP – Mission Level Objectives

- from POP Readiness Review 30/10/2012

Mission level objectives – the four 'pillars' as worded in the HSC POP Plan

Towards the Herschel observers and the general scientific community:

- Maintain high quality community support for the ongoing Herschel data exploitation
- Create, advertise, and eventually deliver the Herschel Legacy for posterity

In addition, in parallel:

- Derive lessons learned and identify items for possible future re-use
- Enable personnel to perform their own data exploitation

Presented and discussed in HST & HUG repeatedly

HERSCHEL SPACE OBSERVATORY

POP – Mission Level Objectives (i)

- from POP Readiness Review 30/10/2012

(i) Maintain high quality community support for the ongoing Herschel data exploitation

- Community support – Helpdesk, mailings, workshops …
- Information provision – web, documentation, meetings …
- Calibration, X-calibration, pointing, PSF, radiation, …
- Data processing SPG/IA improvements / HIPE updates
- Archive & archive population updates, bulk reprocessings, 'user' & 'expert' provided data products, 'added values'
- Organisation of science conferences & workshops
- *Provision of support to 'Communications' activities*

Most of above is ongoing work – a few comments:

- Annual HIPE releases & bulk reprocessings (now 6-monthly)
- Provision & integration of 'User' & 'Expert' provided products + generation of archive 'added values' in infancy
- *Provision of 'Communications' support is very much ongoing*

HERSCHEL SPACE OBSERVATORY

POP – Mission Level Objectives (ii)

- from POP Readiness Review 30/10/2012

(ii) Create, advertise, and eventually deliver the Herschel Legacy for posterity

- Capturing of feedback from science community (e.g. through HUG, HIPE Forum & workshops, Helpdesk, symposia) for incorporation in consolidation activities
- Incremental consolidation of 'performance' knowledge, e.g. calibration, X-calibration, PSF, pointing, …
- Archive population, including bulk reprocessing, user & expert provided products consolidation to final state
- Consolidation of 'added values' – links, metadata sharing, …
- Consolidation of 'documentation' (web, documentation, Helpdesk, tool help, ….) of all kinds
- Conduct Mid-term & Legacy Readiness Reviews

Most of above will be 'final wrap-up' of ongoing work

HERSCHEL SPACE OBSERVATORY

POP – Mission Level Objectives (iii) & (iv)

- from POP Readiness Review 30/10/2012

(iii) Derive lessons learned and identify items for possible future re-use

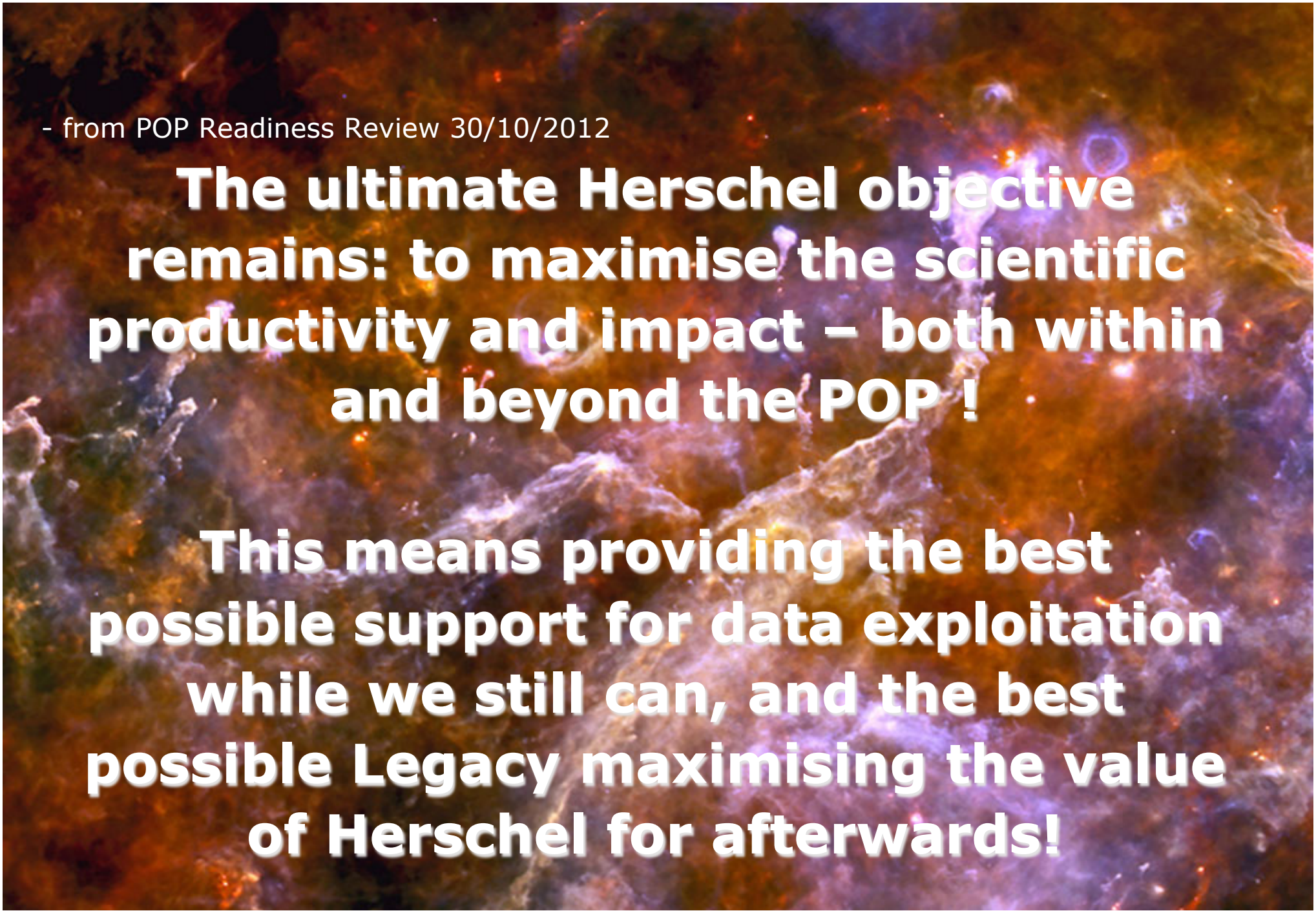
- Organise dedicated activities for capturing lessons learned,
- and for identifying items (tools/concepts) for possible reuse
- Documenting & circulating output of above

(iv) Enable personnel to perform their own data exploitation

- Enable personnel to perform their own data exploitation
- Making use of special skills for 'own' science,
- and potentially the production of 'expert' provided data products

(iii) has commenced & (iv) is ongoing at a low/lowish level

HERSCHEL SPACE OBSERVATORY


- from POP Readiness Review 30/10/2012
The ultimate Herschel objective remains: to maximise the scientific productivity and impact – both within and beyond the POP !
This means providing the best possible support for data exploitation while we still can, and the best possible Legacy maximising the value of Herschel for afterwards!

POP – Readiness Review Board Report

- from POP Readiness Review Board report 30/11/2012 (my boldfacing)

Board Assessment of SGS POP Plans

- The Board considers that the **planning** in place for the Post-operations Phase is in a **good state, adequately detailed** for this stage and **essentially credible**
- The Board **supports the fundamental approach** to the Post-operations Phase, in which **effort is focussed primarily on the derivation of the best possible set of legacy science data products** to become the ultimate content of the archive
- At the same time the Board **recognises the importance of the Data Processing software** itself
- The Board **affirms the importance of clear and comprehensive documentation to support and permit interpretation of the science products** in the archive

HERSCHEL SPACE OBSERVATORY

Herschel Ground Segment Meeting 2014 @ CEA-Saclay / IAP, Paris

(12-14 May 2014)

Registration

- Target audience:
  - everyone currently working for Herschel at any of the various centres involved in Post-Operations: HSC/ICC/NHSC
  - anyone interested in contributing to the success of Herschel POPs
- Click here to register.
- Note that there will be a **small registration fee of 50 Euro**. The money will be collected **in cash** on Monday 12 May

Vision & Legacy

- plenary intro CEA, Saclay 12 April 2014

Herschel Legacy Software: Status and Plans (plenary session)

Coffee Break

Herschel Legacy Calibration: Status and Plans (plenary session)

Herschel Legacy Data Products: Status and Plans (plenary session)

Herschel Legacy Documentation: Status and Plans (plenary session)

Lunch break

Herschel and the community (plenary session)

Herschel in 2017 and beyond (plenary session)

Wrap-up (plenary session)

HERSCHEL SPACE OBSERVATORY

Vision & Legacy

- plenary intro CEA, Saclay 12 April 2014

Herschel Legacy Software: Status and Plans (plenary session)

Coffe

Hers

Hers

Hers

Lunc

Herschel and the community (plenary session)

Herschel in 2017 and beyond (plenary session)

Wrap-up (plenary session)

The buzz-word is LEGACY!

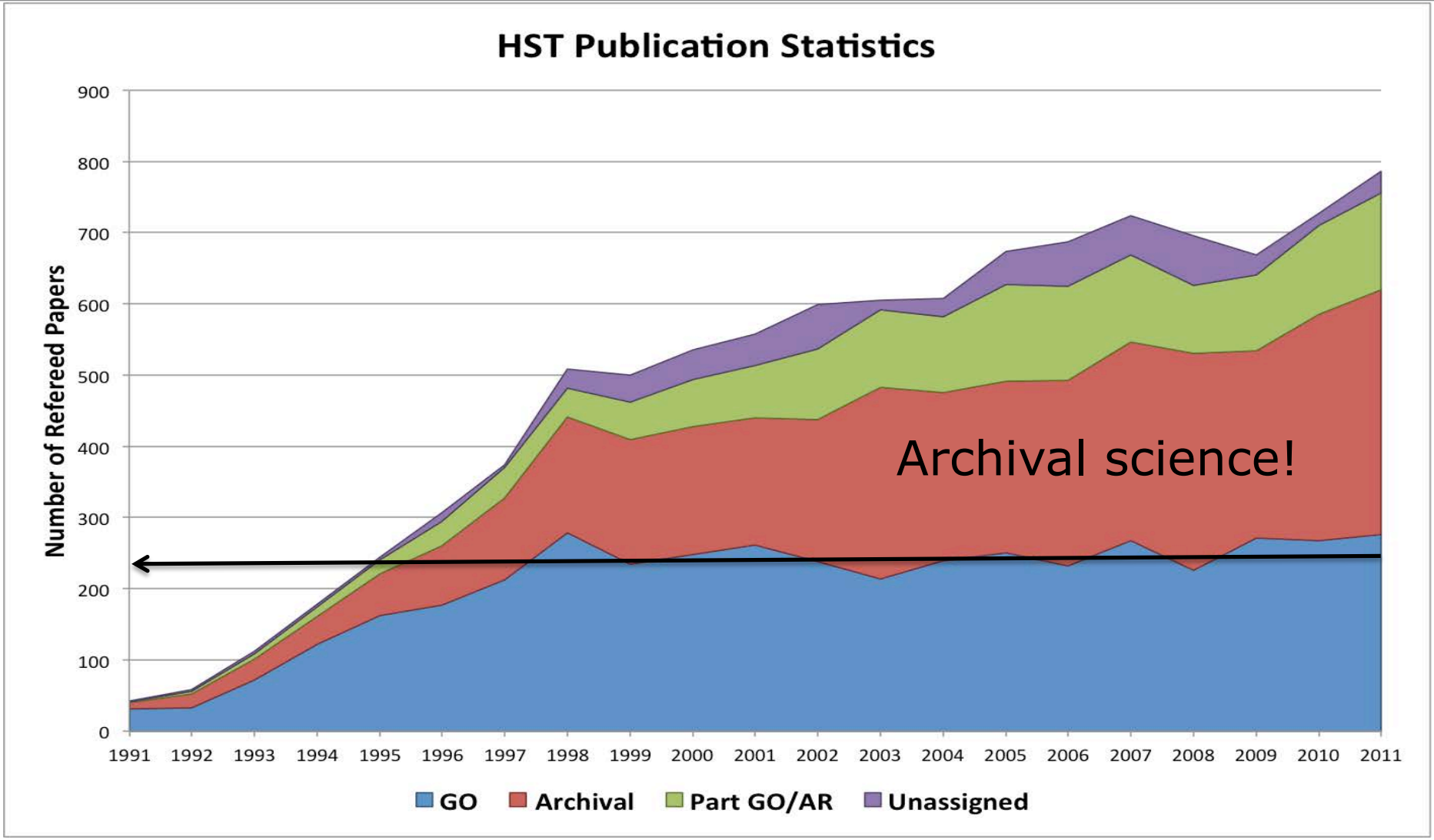
- When we turn off the light and go home ….
- … what is there is 'forever' is what we are working on now!
- We are here to discuss the work ahead of us!

- The ultimate objective is maximizing the SCIENCE RETURN
- I have a ~~dream~~ VISION!

HERSCHEL SPACE OBSERVATORY

Hubble – importance of archive

- plenary intro CEA, Saclay 12 April 2014



HERSCHEL SPACE OBSERVATORY

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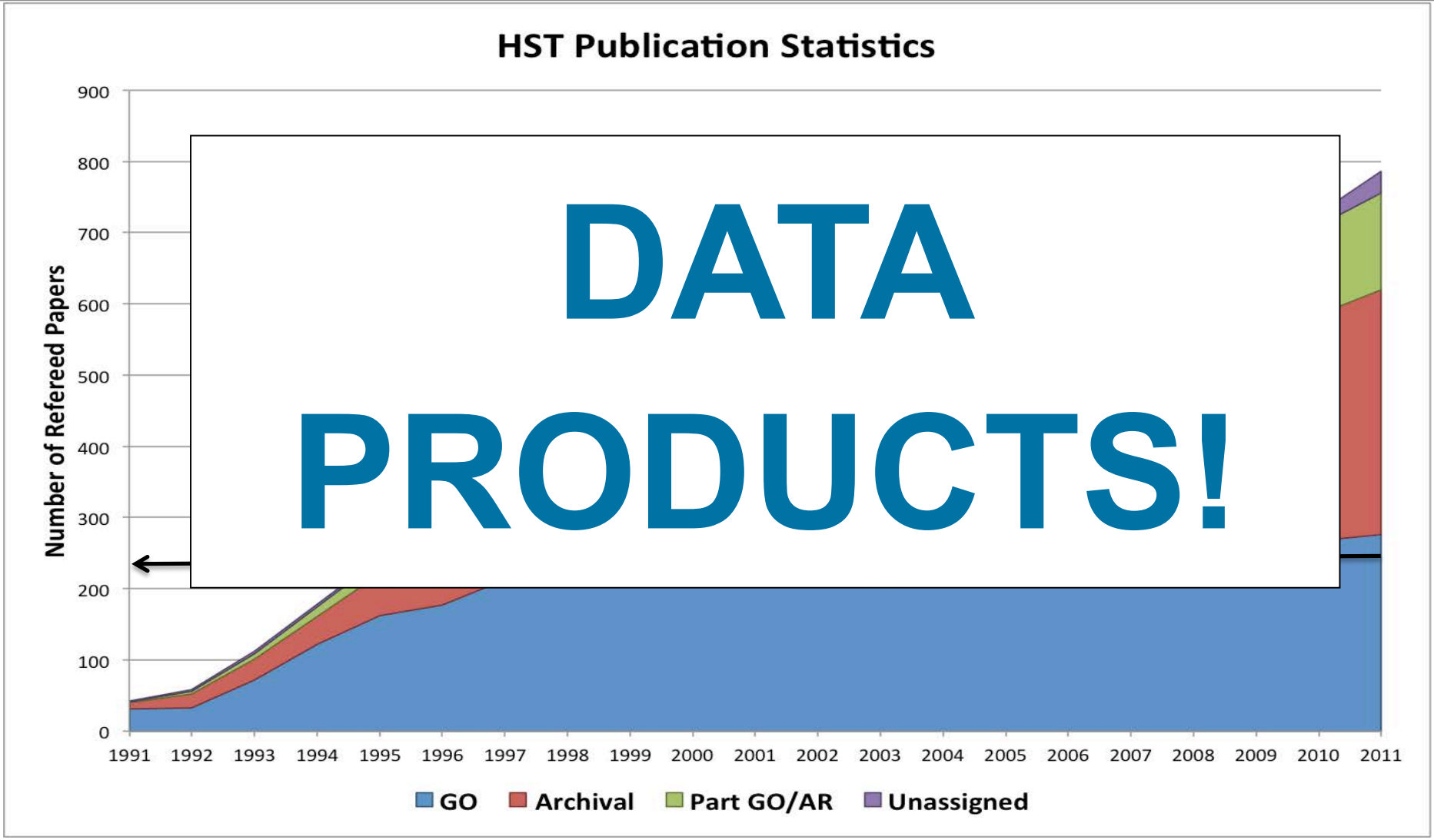


HERSCHEL SPACE OBSERVATORY

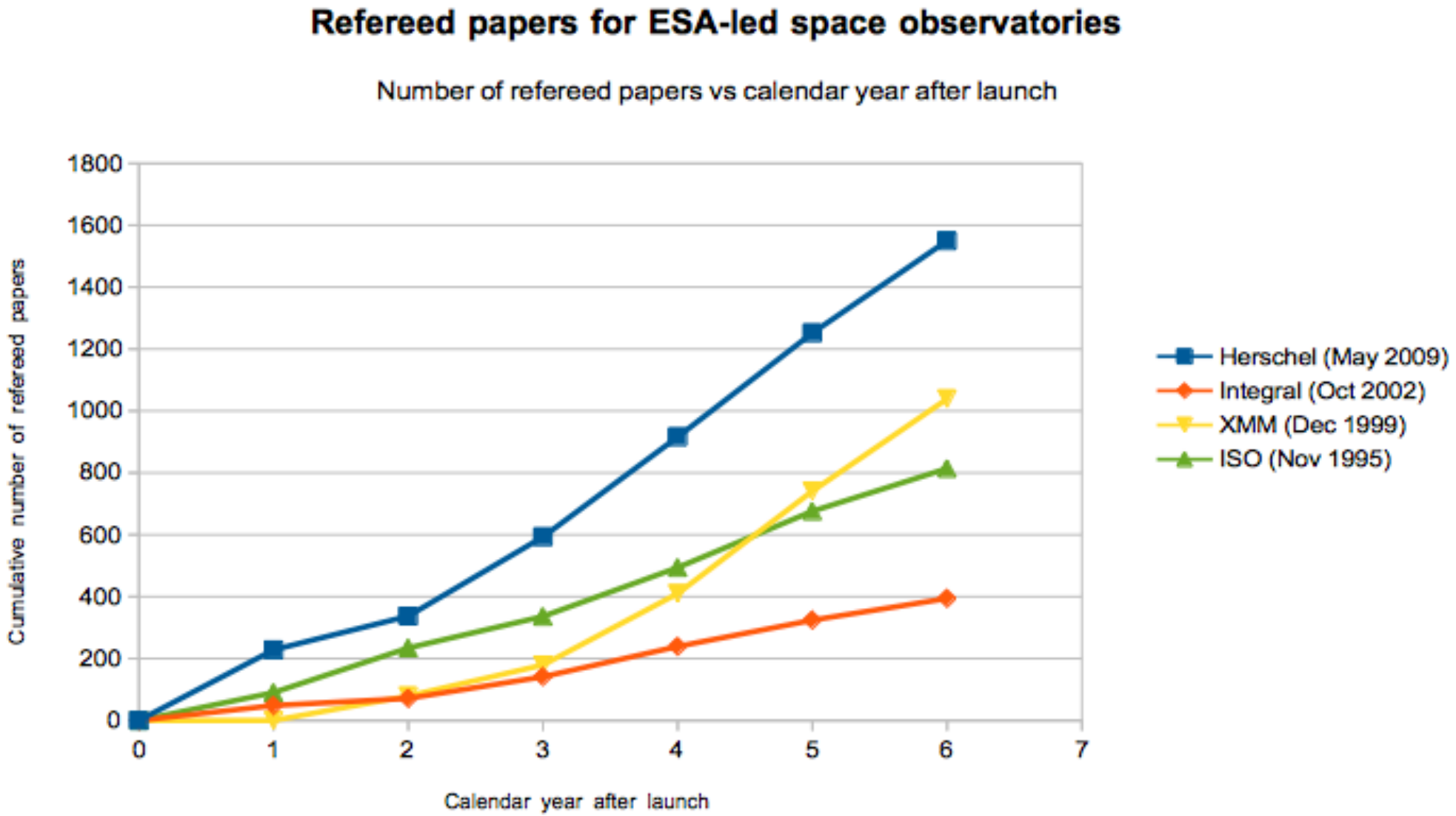
Emphasis on data products for cont'd science exploitation:

- Supported by:
  - HST
  - HUG
  - Internally in SGS (mostly)
  - POP-RR Board Report

POP – taking stock:

- Science exploitation assessment
- Additional aspects
  - Later presentations

#Pubs vs #calendar years after launch



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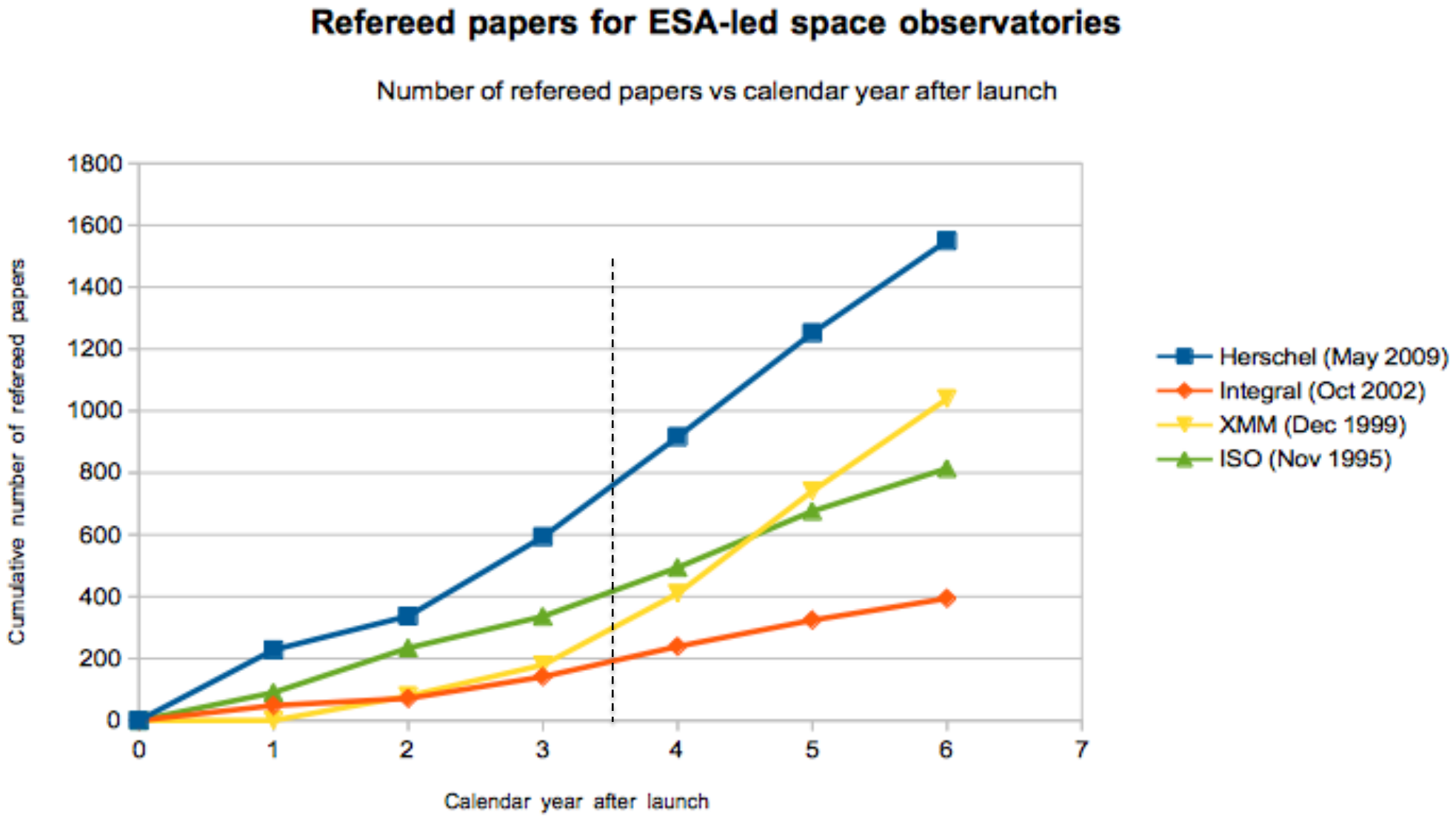
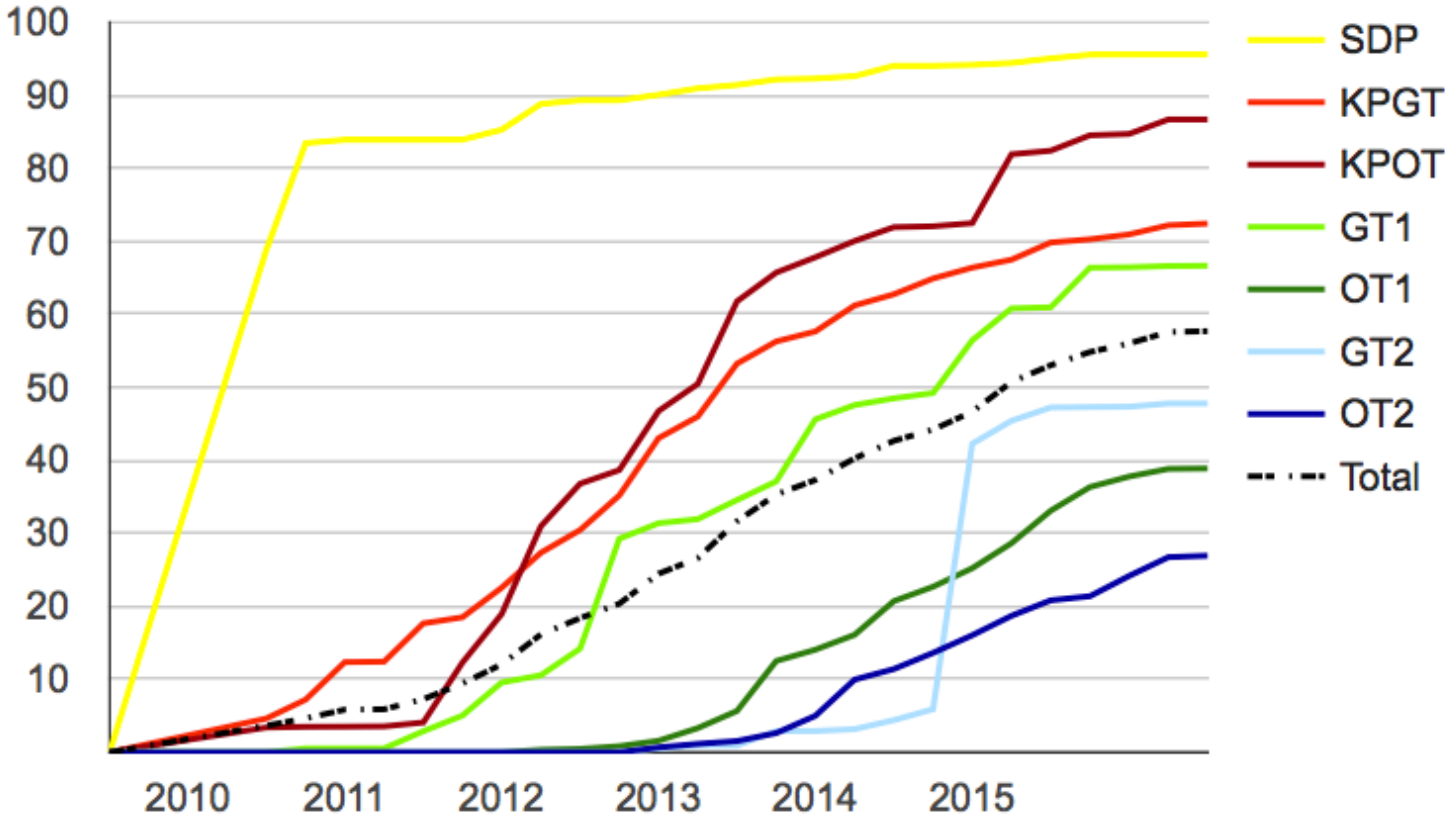


Publications evolution vs calls
– based on 1661 pubs

HOTAC awarded time published – total >57%

- Pubs ‘linked’ to OBSIDs – add up the observing times of all ‘linked’ observations



- SDP observed Nov-Dec 2009, KP early 2010-, AO1 early 2011-, AO2 early 2012-

HERSCHEL SPACE OBSERVATORY

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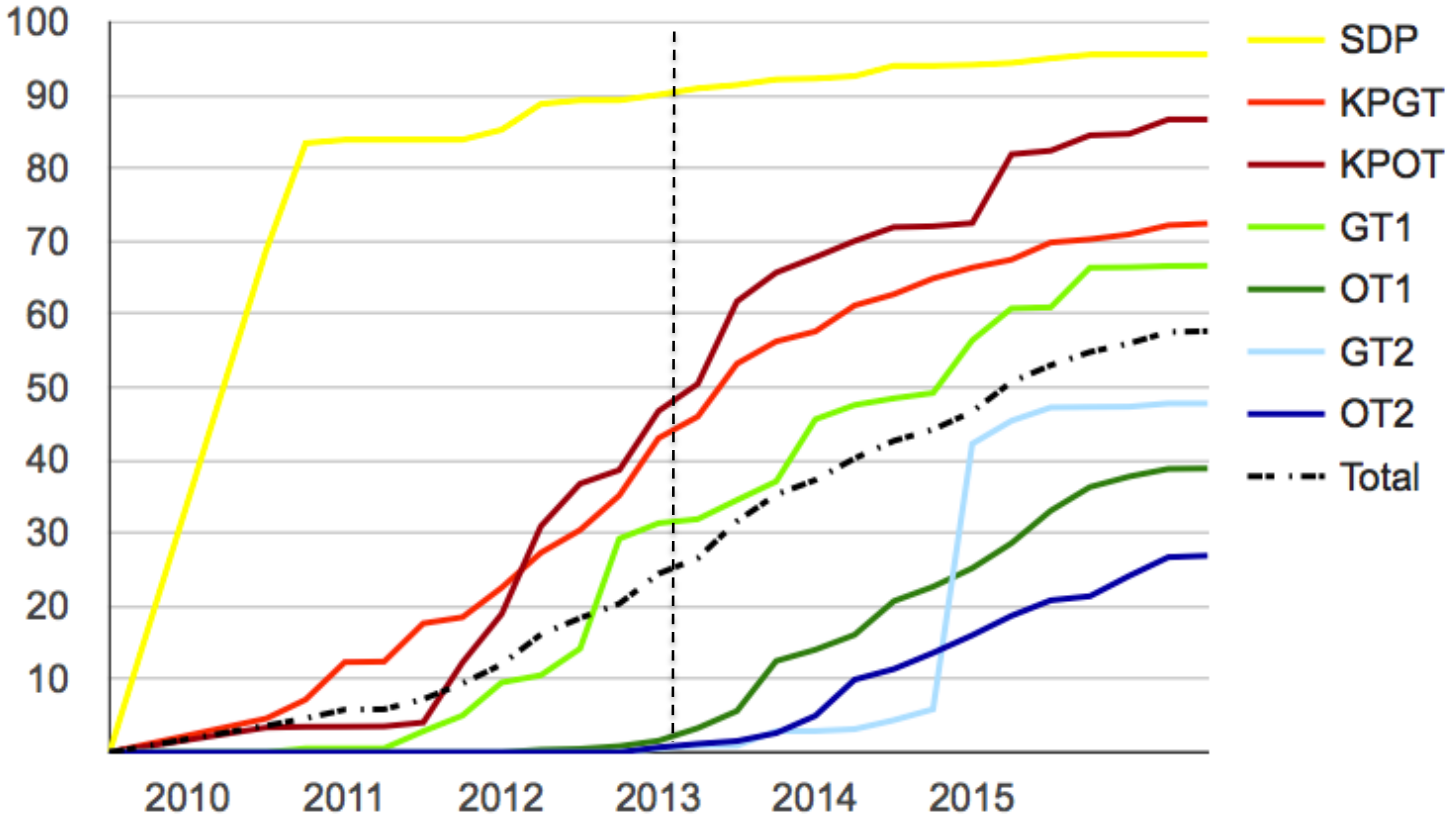

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HERSCHEL SPACE OBSERVATORY

Publications evolution vs sub-instr
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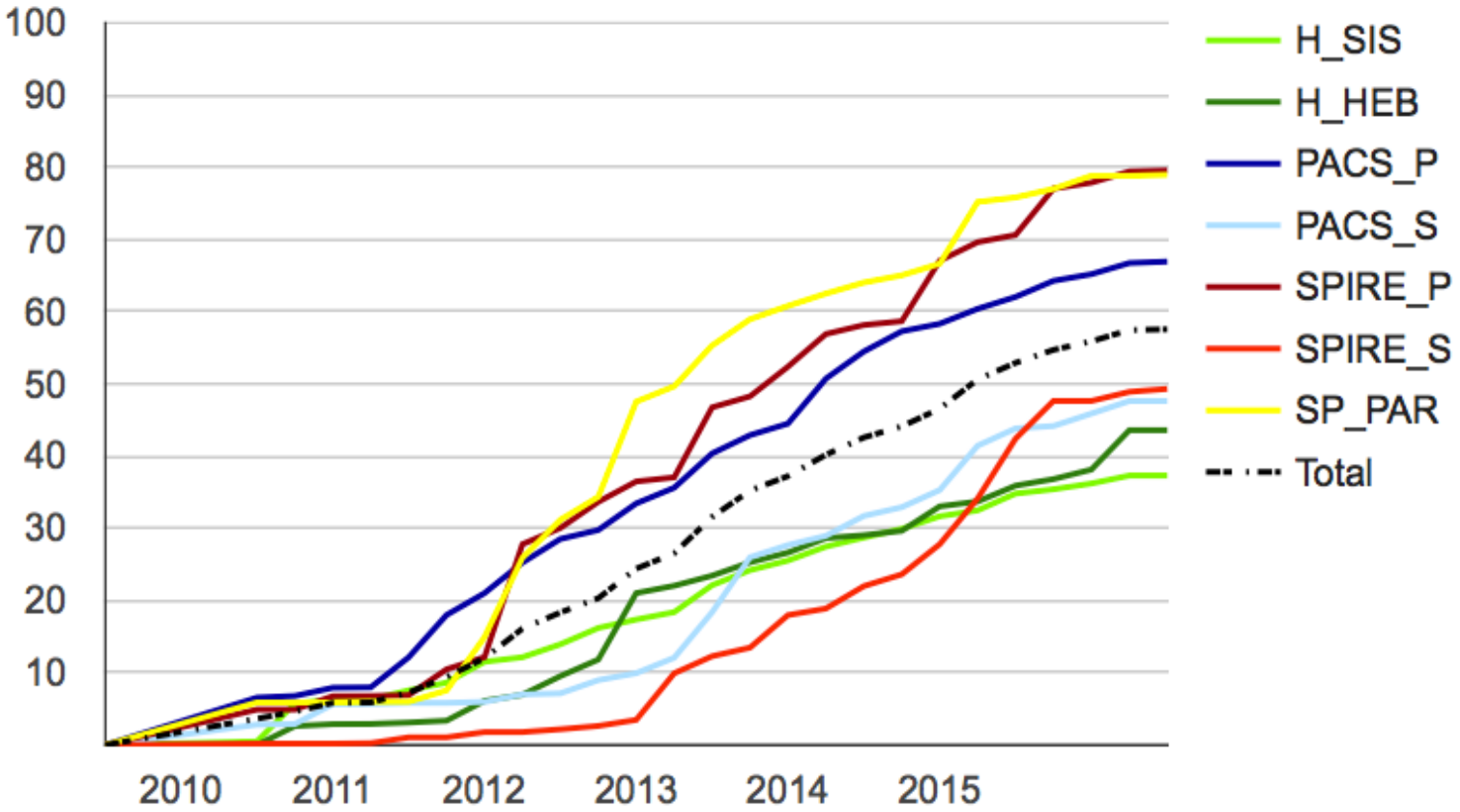

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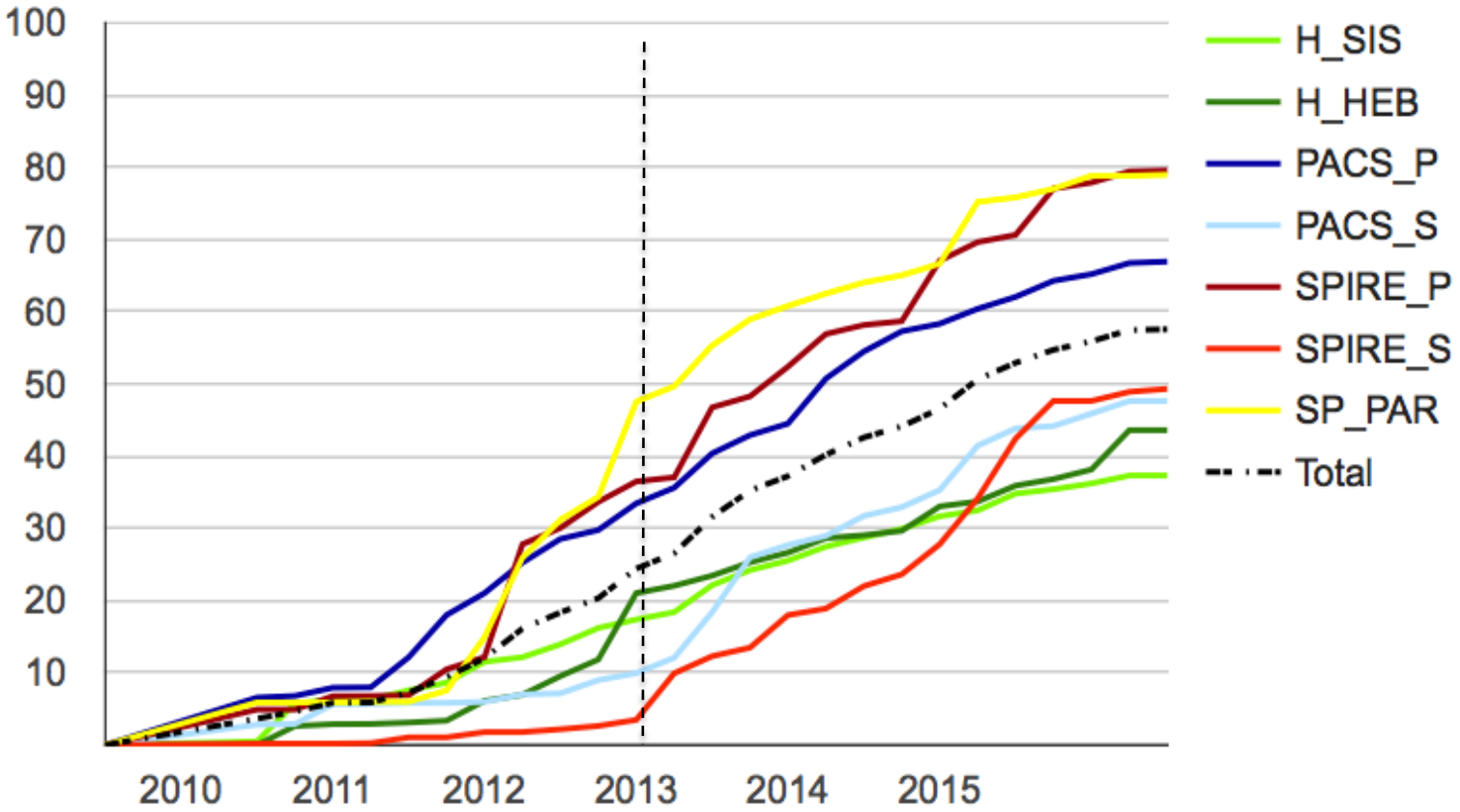

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Publications - archival
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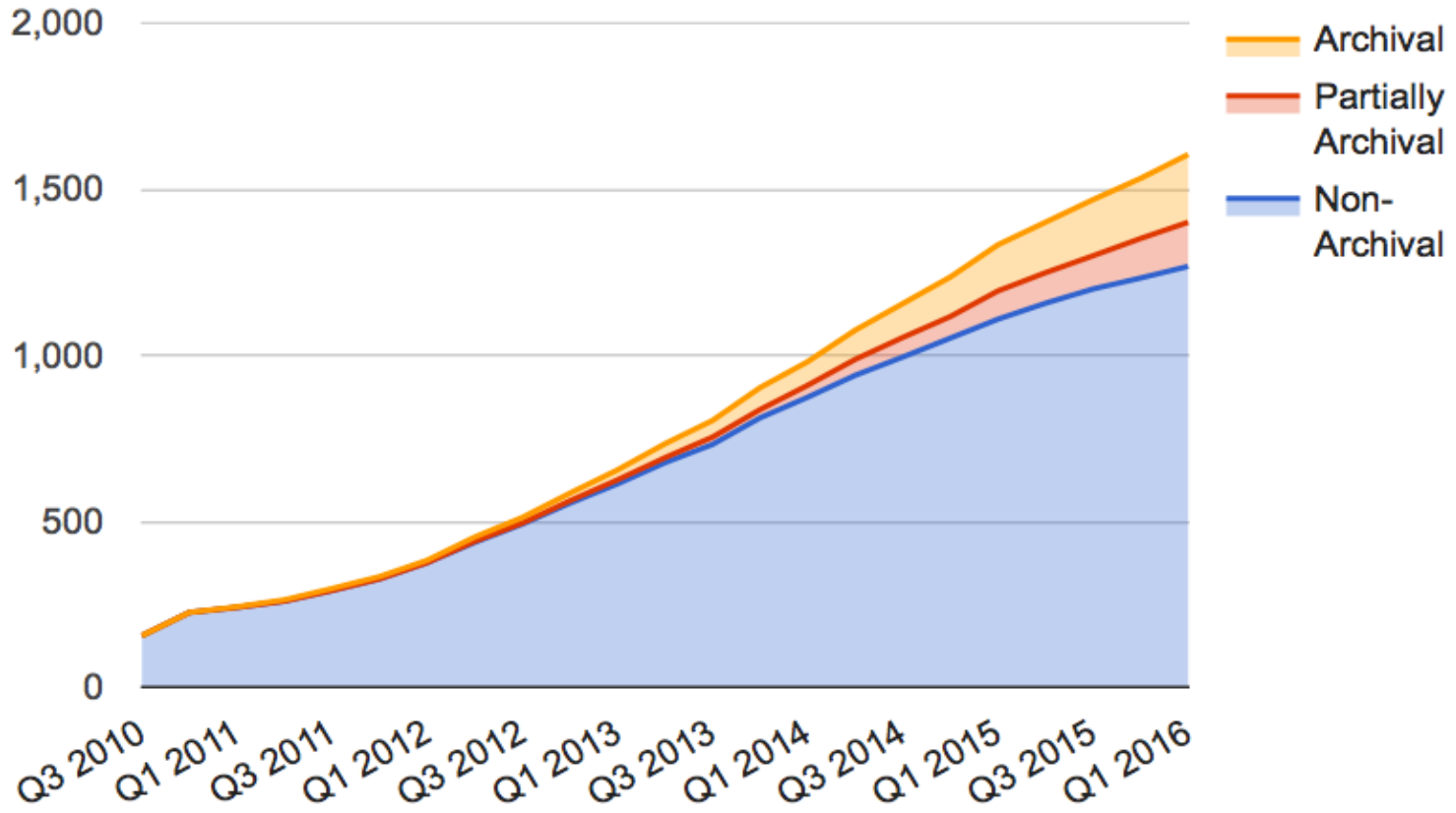

- Gradually increasing amount of archival science exploitation in POP

HERSCHEL SPACE OBSERVATORY

Publications - archival
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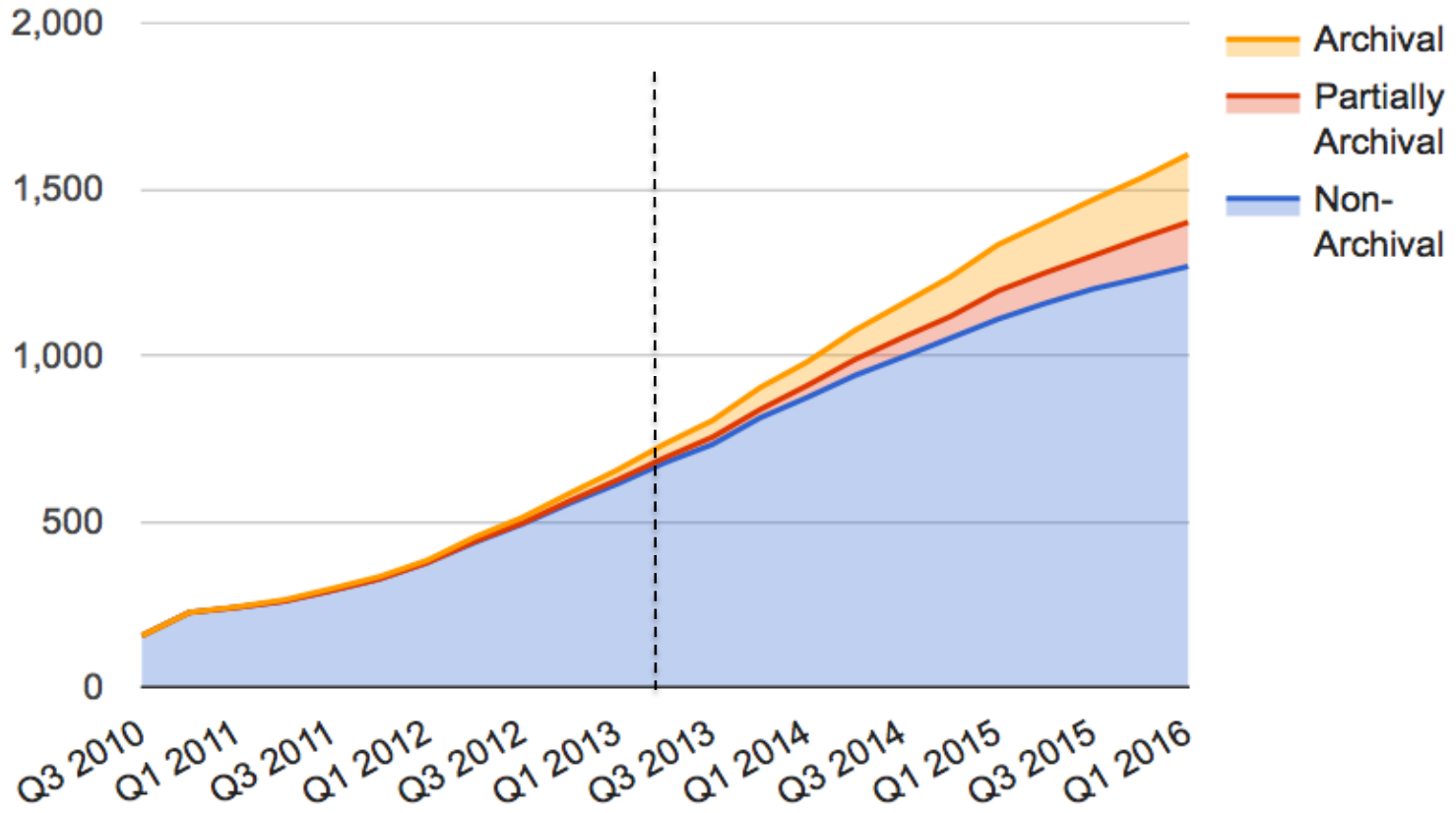


- Gradually increasing amount of archival science exploitation in POP

HERSCHEL SPACE OBSERVATORY

D/SRE Key Performance Indicators

ESA/SPC(2015)14, 10 June 2015

In practice, the KPIs used to define the performance of the Science Programme are:

- KPI-S1: Currently Estimated Cost at Completion (ECaC) vs. ECaC at the time of adoption (note that this is comparable to the KPI-9 defined in the ESA Performance Report);
- KPI-S2: Actual development schedule and currently estimated launch date vs. reference ones (note that this is comparable to the KPI-10 in the ESA Performance Report).
- KPI-S3: Number of refereed papers produced by the scientific community using data from ESA-led missions.
- KPI-S4: "Impact factor" of ESA-led missions.
- KPI-S5: Fraction of refereed papers from all ESA missions, over the total number of refereed astrophysics papers in a given year.

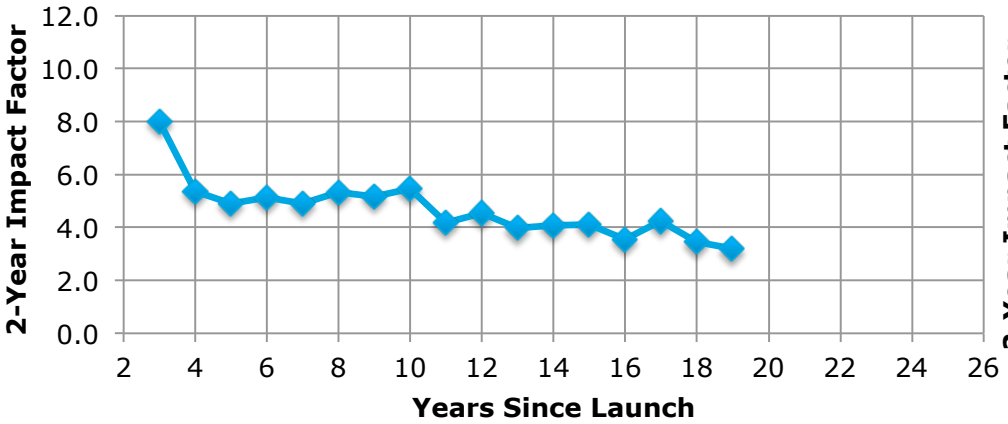
KPI-S4: For year n, the total # of citations to papers from the years (n-1)+(n-2), divided by total # of these papers

HERSCHEL SPACE OBSERVATORY

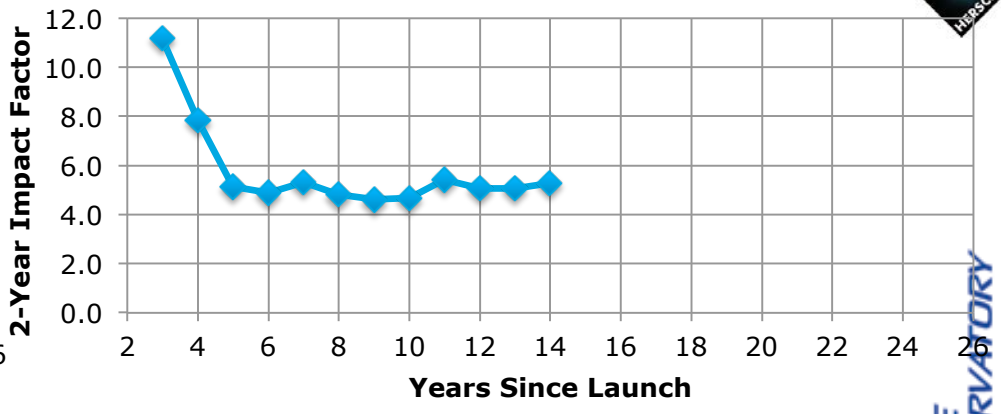
ESA-led Missions	(2) Launch	(3) End of Operations	(4) 2014 Publications	(5) Total Publications	(6) MS/Total First Authors	(7) Number of Citations	(8) Unique Names	(9) Impact Factor
COS-B	1975	1982		174	0.83	4,800	240	
IUE	1978	1996	15	3,994	0.42	110,000	9,000	
Exosat	1983	1986	2	734	0.67	23,950	1,060	
Hipparcos	1989	1993	51	2,453	0.43	75,650	4,840	4.5
Ulysses	1990	2009	32	1,672				
ISO	1995	1998	3	1,543				
SOHO	1995		206	4,982	0.38	120,300	5,840	3.8
Huygens	1997	2005	5	208	0.43	4,550	780	3.1
XMM-Newton	1999		306	4,015	0.53	110,250	9,880	5.4
Cluster	2000		154	2,104	0.43	29,000	3,020	3.4
INTEGRAL	2002		47	852	0.76	25,400	2,420	3.5
SMART-1	2003	2006	7	79	0.75	650	400	1.6
Mars Express	2003		64	819	0.66	16,700	1,980	2.6
Rosetta	2004		41	395	0.80	3,750	1,820	2.2
Venus Express	2005	2014	44	442	0.65	4,250	1,240	1.7
Herschel	2009	2013	336	1,382	0.66	31,450	5,900	8.9
Planck	2009	2013	328	629	0.54	20,000	3,540	6.7
PROBA-2	2009		13	55	0.62	350	240	3.4
Gaia	2013		32	49	0.73	160	220	
Non ESA-led								
HST	1990		822	12,903	0.37	563,406	13,850	8.0
Cassini	1997		127	1,790	0.36	37,200	3,380	3.1
Double Star	2003	2007	4	139	0.43	1,200	480	5.4
Suzaku	2005		78	762	0.19	15,050	2,820	4.1
AKARI	2006	2011	29	301	0.28	6,000	1,360	2.5
Hinode	2006		96	924	0.36	21,100	1,520	4.8
IRIS	2013		22	39	0.41	250	200	

ESA-led Observatory KPIs

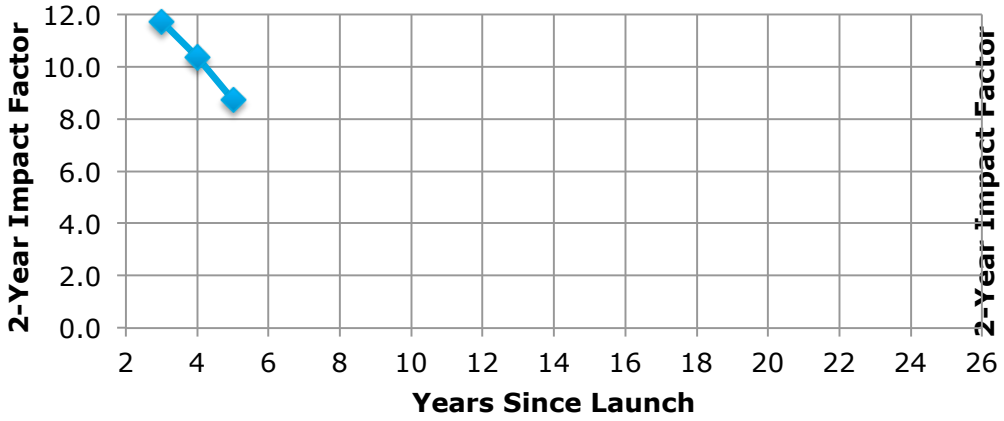
ISO



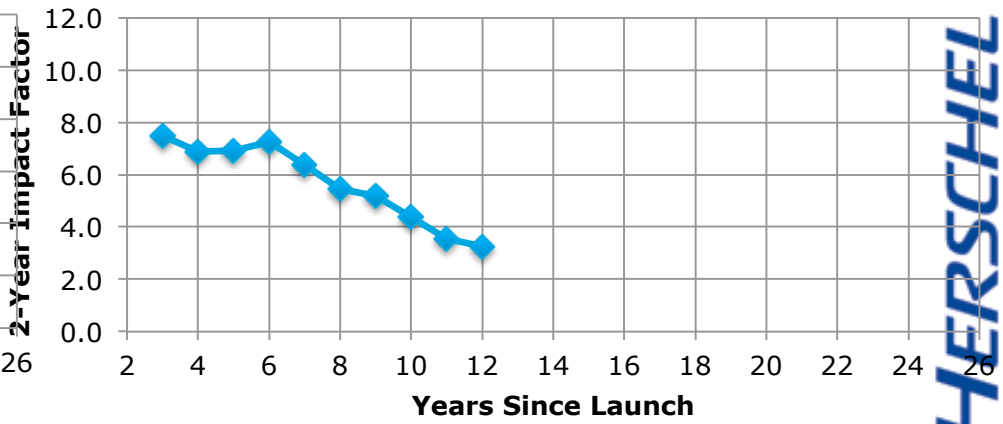
XMM-Newton



Herschel



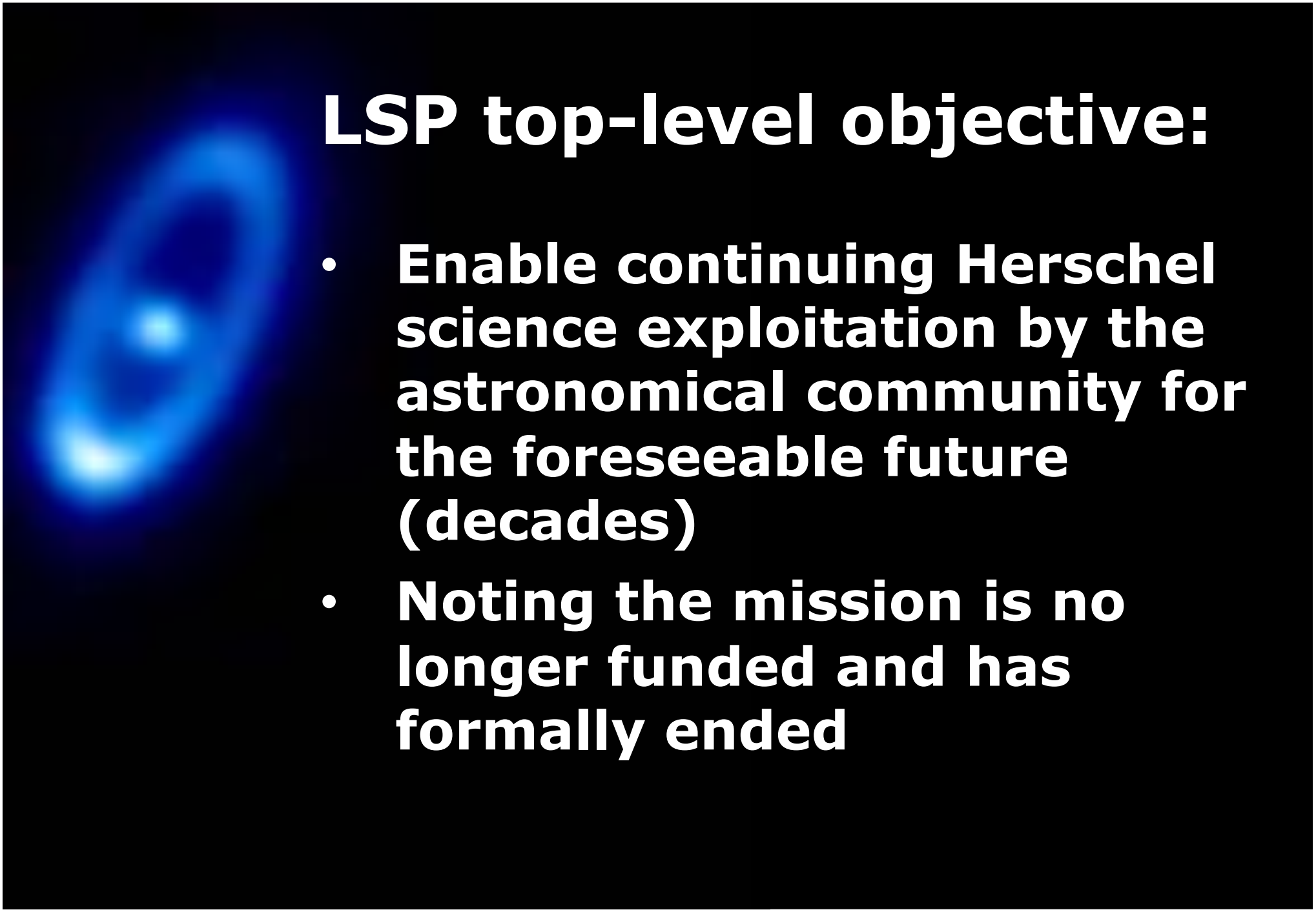
INTEGRAL



Herschel science assessment:

- Outstanding among ESA observatories – so far


LSP – looking towards the future:
• Science exploitation
• Additional aspects
• Later presentations

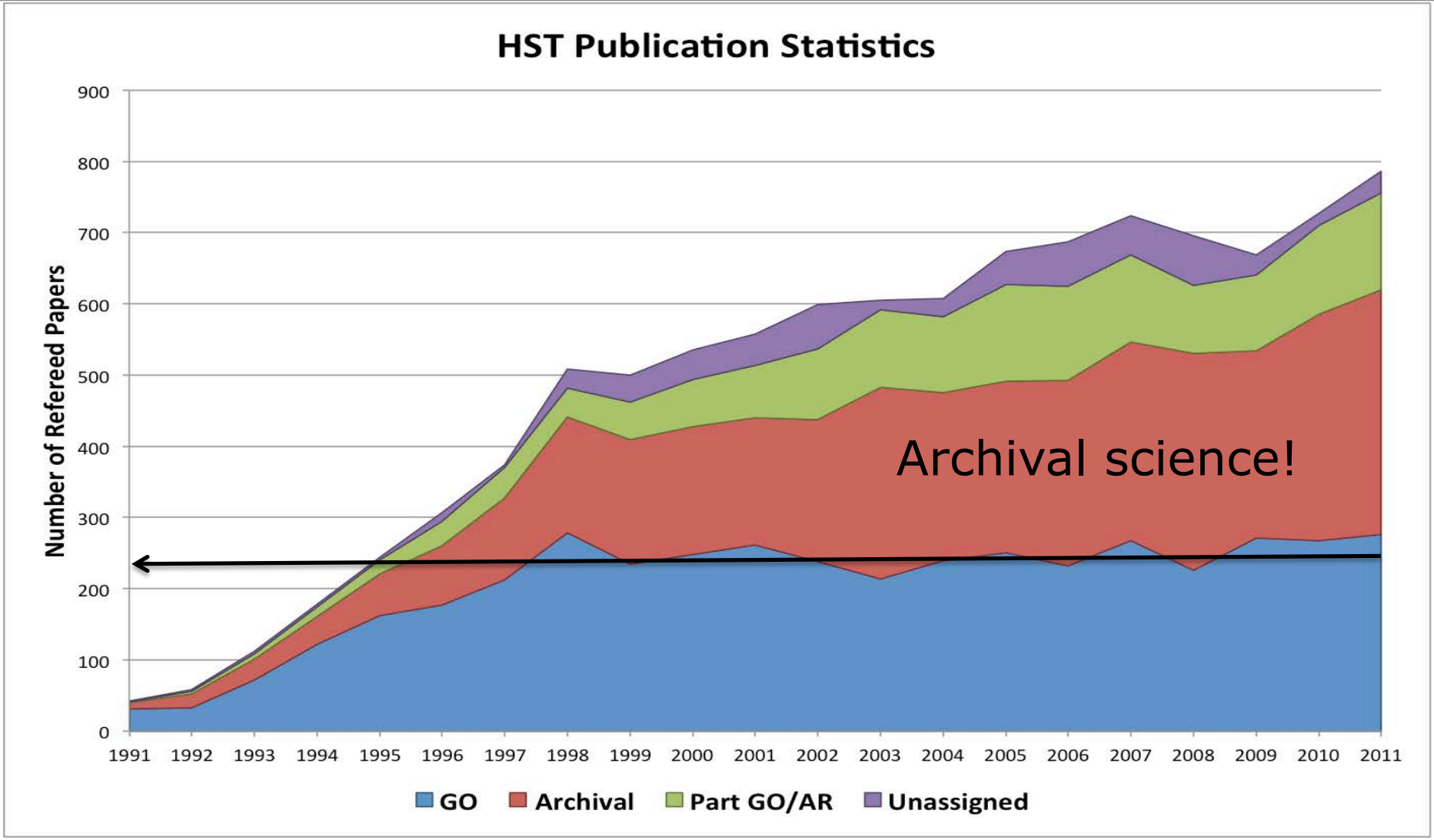


LSP top-level objective:

- **Enable continuing Herschel science exploitation by the astronomical community for the foreseeable future (decades)**
- **Noting the mission is no longer funded and has formally ended**

Reminder: Hubble – importance of archive

- plenary intro CEA, Saclay 12 April 2014

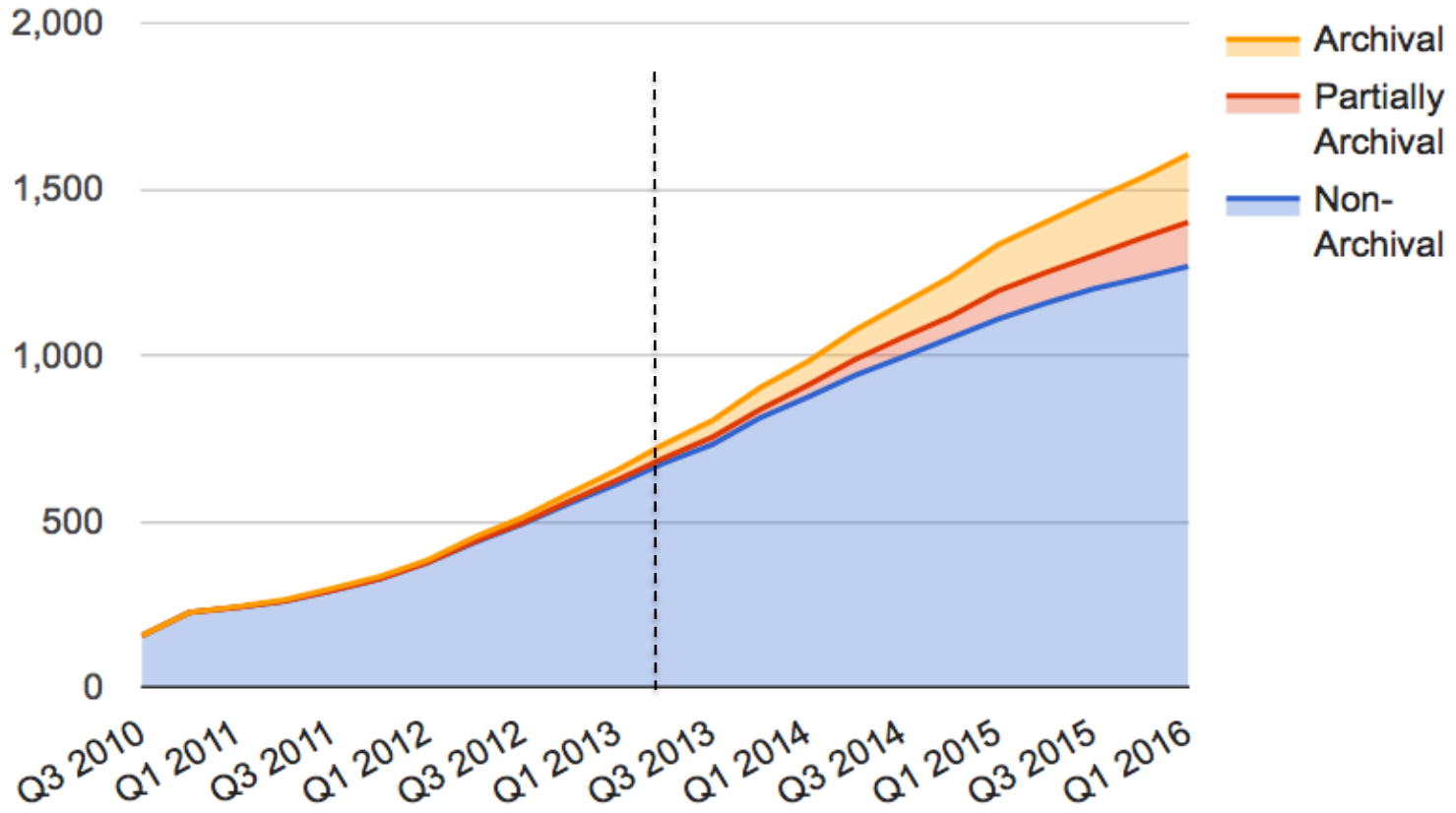


HERSCHEL SPACE OBSERVATORY

Publications - archival
– based on 1661 pubs

HOTAC awarded time published – total >57%

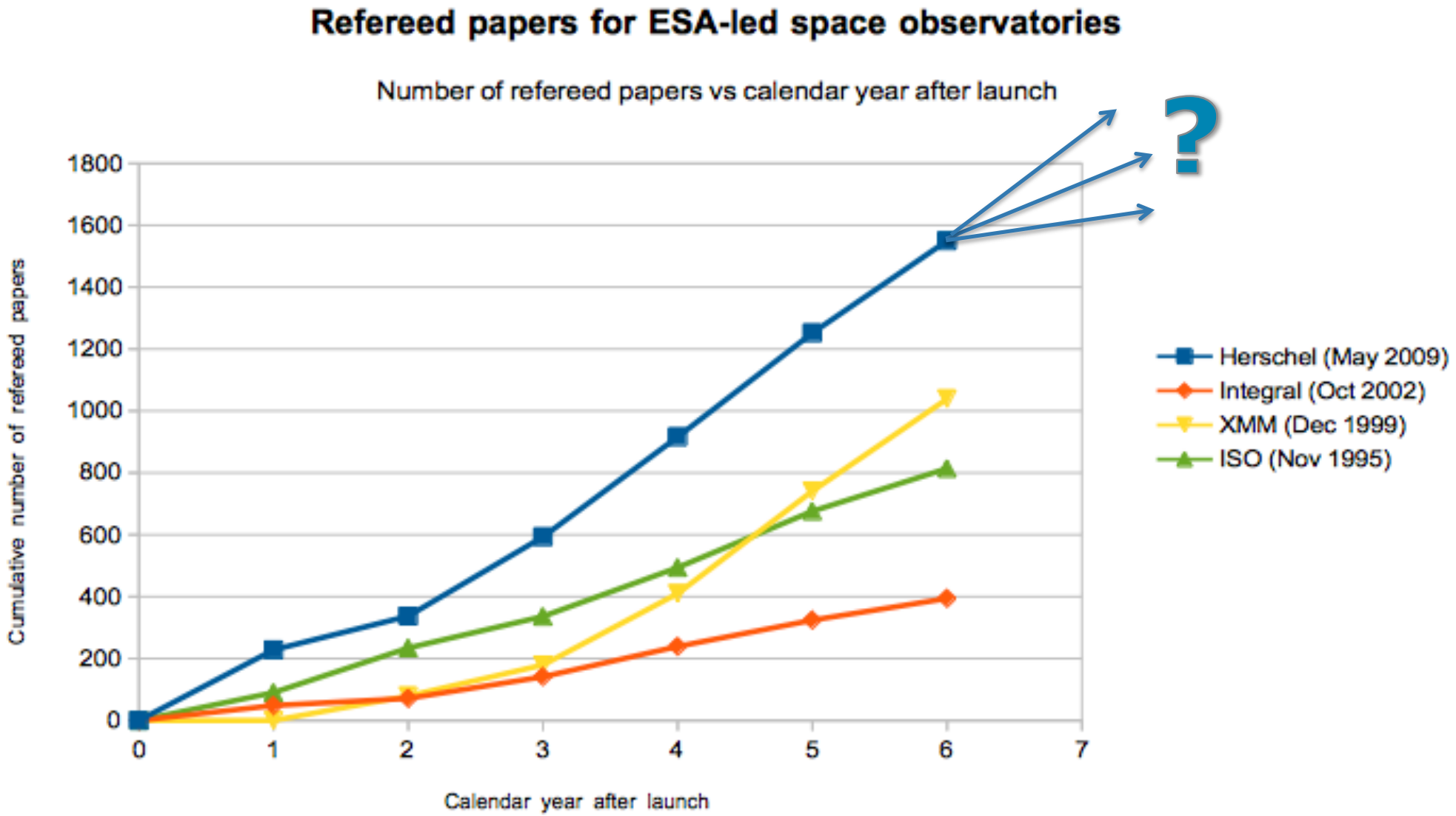
- Pubs ‘linked’ to OBSIDs – add up the observing times of all ‘linked’ observations



- Gradually increasing amount of archival science exploitation in POP

HERSCHEL SPACE OBSERVATORY

#Pubs vs #calendar years after launch



The LSP is – and always was! – foreseen beyond the Herschel mission! (Initially (in the SMP) called 'Historical' archive phase, but the raison-d'être is continuing science exploitation, not history…)

Overall LSP objective:

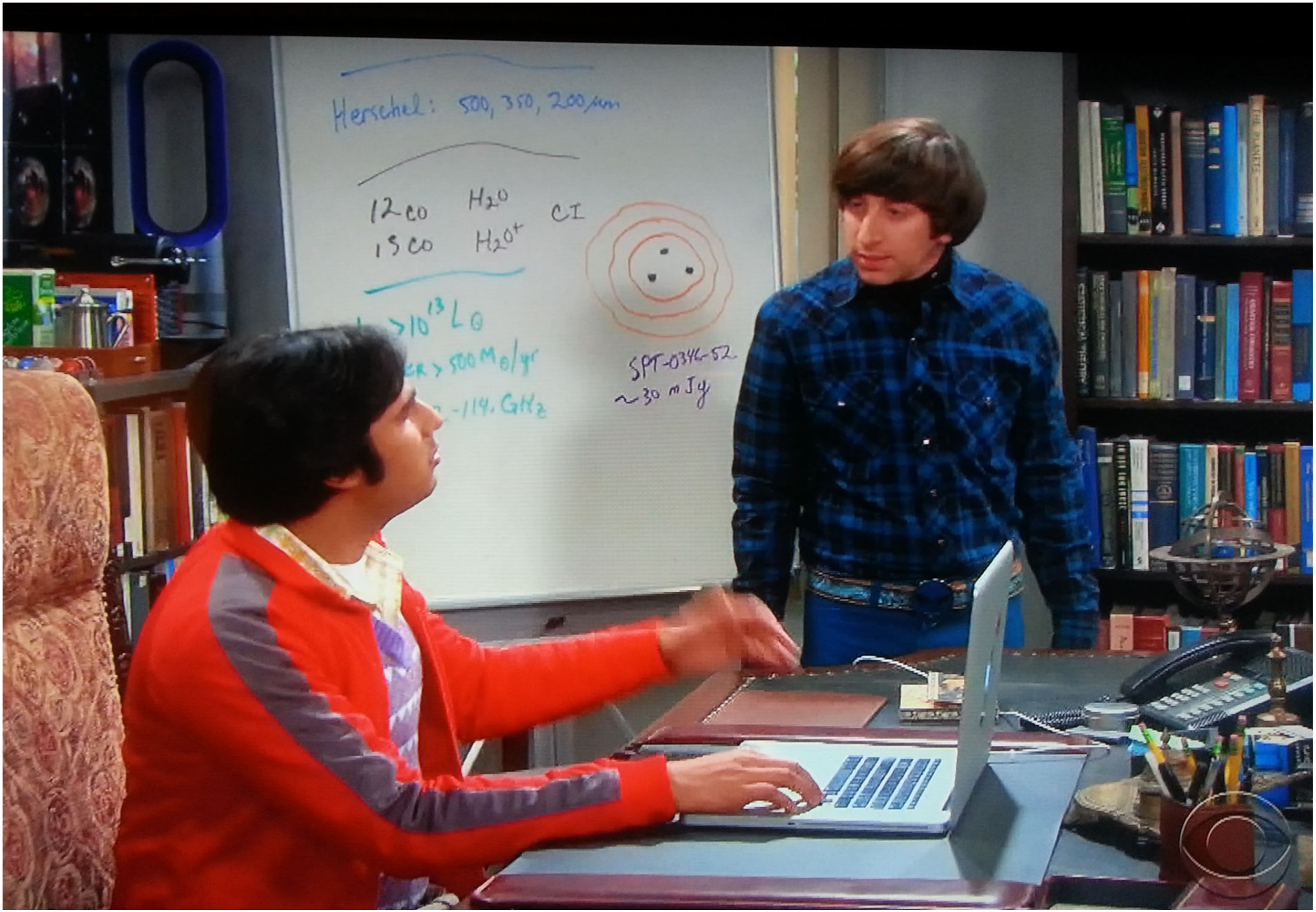
- Enable continuing Herschel science exploitation by the wider astronomical community for the foreseeable future (decades)

What does it take? The community will need:

- Access to Herschel data & data products
- Access to information, tools, and support

Enabling continuing efficient science exploitation will increase the value of the investment made in Herschel, by extension to the Directorate of Science, and ultimately to the brand of ESA

HERSCHEL SPACE OBSERVATORY


Herschel: 500, 350, 200 μm
12 CO
13 CO
H_2O
H_2O^+
CI
$>10^{13} L_\odot$
SPT-0346-52
~30 mJy

A Step Back to: Vision & Legacy

- plenary intro CEA, Saclay 12 April 2014

Data products

- **SPG, UPDPs, HPDPs, ALPs,…**

Data products ‘guidance’

- **Meta-data, quality info, recommended product?**
- **Robust for a life after HIPE**

Archive(s) & Tool(s)

- **HSA, other archives & tools e.g. ESASky, IRSA, SIMBAD, ViZier, ADS,…**

Calibration

- **Information**

Software

- **HIPE, virtualised HIPE, other packages, …**

Documentation

- **Very important, needs to be captured ‘in one place’**

HERSCHEL SPACE OBSERVATORY

A Step Back to: Vision & Legacy

- plenary intro CEA, Saclay 12 April 2014

Data products

- SPG, UPDPs, HPDPs, ALPs,…

Data products 'guidance'

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Calibration

- Information

Software

- HIPE, virtualised HIPE, other packages, …

Documentation

- Very important, needs to be captured 'in one place'

+ Availability

- **Needs to be kept made available for the community!!**

HERSCHEL SPACE OBSERVATORY

Reiterating, efficient long-term science exploitation requires => the plan to deliver

- Providing Herschel Legacy **data and data products** (SPGs, UPDPs, HPDPs, …)

=> through provision of **HSA** (incl associated ftp repositories)

- Providing Herschel Legacy **documentation** (HES, HELL, webpages, etc)

=> through provision of **Cosmos website**

- Providing Herschel Legacy **software** and **tools** (virtualised HIPE, HSpot)

=> through provision of **Cosmos website**

- Maintaining the Herschel **Helpdesk** (at 'best effort' basis)

=> through use of **Kayako** tool

- Maintaining the Herschel **Refereed Publications Library**

=> through use of **ADS** tool

- Maintaining **Publications-OBSIDs linking**

=> through use of **Publications Tool**

HERSCHEL SPACE OBSERVATORY

This implies populating & maintaining:

- **HSA** (incl associated ftp repositories)

=> needs to be **populated in POP**
=> needs to be **maintained beyond POP 'as is'**

- HSC **Cosmos website**

=> needs to be 'made' and **populated in POP**
=> needs to be **maintained beyond POP 'as is'**

- HSC **Kayako tool**

=> needs to be **maintained beyond POP**
=> needs to be **'best effort' attended to (SCI-O/S)** by ex-Herschel staff

- Herschel **Refereed Publications Library**

=> needs **ADS** to be **maintained beyond POP (NASA/external)**
=> needs to be **regularly updated (SCI-S)** staff assigned by H/SCI-S

- Herschel **Publications Tool**

=> needs **Publications Tool** to be **maintained beyond POP**
=> needs to be **regularly attended to (SCI-O)** by ex-Herschel staff

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In summary, efficient long-term science exploitation requires:

- In addition to HSA, Cosmos, & Kayako in effect already are ‘Corporate tools’
- In practice Helpdesk ‘best effort’ done already for e.g. ISO

=> A **commitment** to **maintenance of Cosmos & Kayako is <u>needed</u>**

  - But note information & Helpdesk are the keys - not the tools as such

- The PS is regularly asked but unable to provide this commitment to the HST, the HUG, or to members of the community
  - Awkward for me as a person & and in my view
  - Unacceptable for ESA as organisation
- Is it the intention of the ESDC to provide data products without the associated documentation?
  - Nobody would want to think so
- The **Publications-OBSIDs linking** is becoming a **standard task**(?)
  - Note: Also used to generate information for reporting

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Additional useful activities could include:

- Capture and ingestion of Herschel (and ancillary) data products from dying archives elsewhere, e.g. from
  - HeDaM (HerMES, GOODS-Herschel, Herschel Ref Survey)
  - (Key) Observing Consortia,
  - and e.g. EU funded efforts (e.g. HELP, Vialactea, Dustpedia, …)
- Functionality improvements to HSA in line with 'active' archives and interfaces to MM/ESA-Sky and VO
  - Generic (as opposed to Herschel-specific) improvements
  - One size does not fit all, could some specific tasks be considered?
- Science promoters
  - Enabling science exploitation is fine, enabling & promoting is better
  - Promoting use of archival data – eventually for 'all' missions but Herschel could be guinea pig for such activity
  - Think outside the box – should this be an SCI-S activity!?

HERSCHEL SPACE OBSERVATORY

Summary:

- Outstanding science return – so far, enable and promote continuation!
- Clear path towards & for LSP
  - Data products & 'documentation' drivers, add Helpdesk
- Current level of formal 'Corporate' commitments for LSP need to be relooked at – and augmented
- Higher level of ambition!?
  - Promote use of archives!


THANK
YOU!...!


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