

Synergy between Archives, VO and the GRID at ESAC

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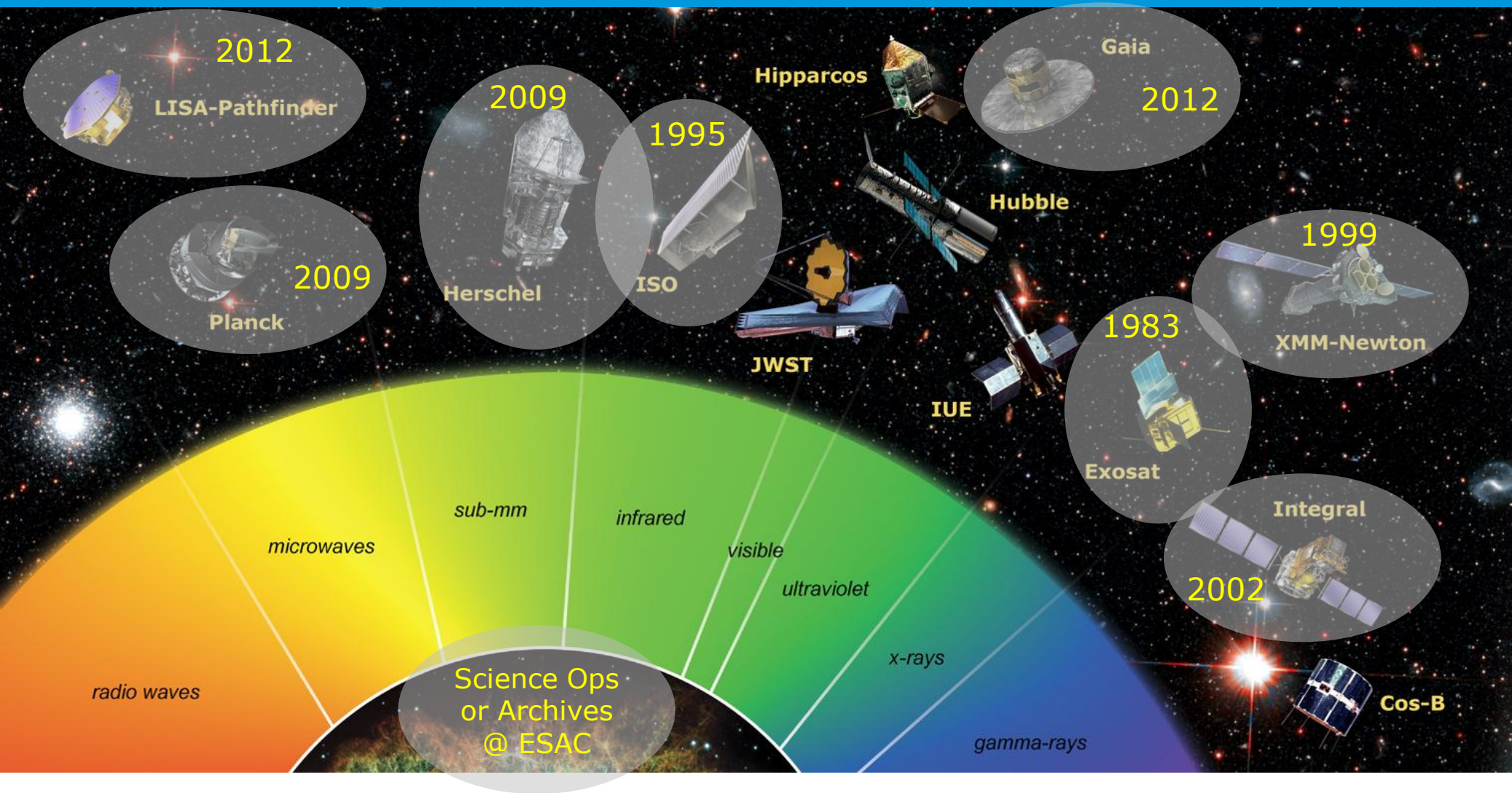
ADASS XX

Boston, 10th of November 2010

Astronomy and fundamental physics missions and Archives at ESAC



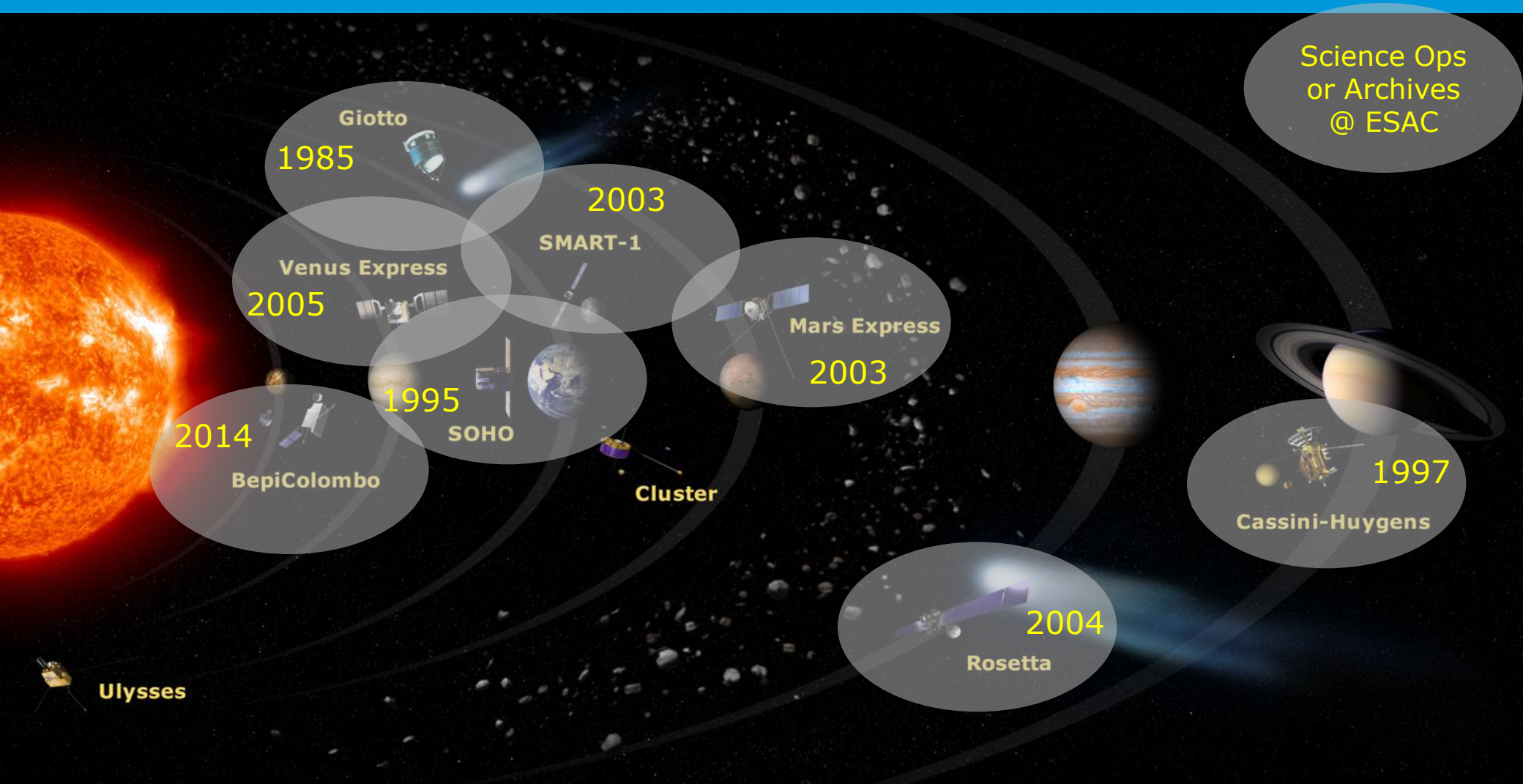
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Solar Systems Missions and Archives at ESAC



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- ESAC to be a Data Centre and a Data Processing Centre
 - Natural link between Science Archives, GRID and VO

- ESAC Scientists to use the GRID for their daily science tasks
 - Must be easy to use (“my homedir on the GRID”, “gridlogin”)
 - User support to port their software to the GRID
 - New massive computing facilities to substitute user workstation

- GRID in support to the projects
 - Project Standard Data Processing
 - On-the-fly reprocessing from the Archives
 - Instruments calibration monitoring and trend analysis
 - HPC (High Performance Computing) in the GRID

- Collaboration with other GRID partners / organizations



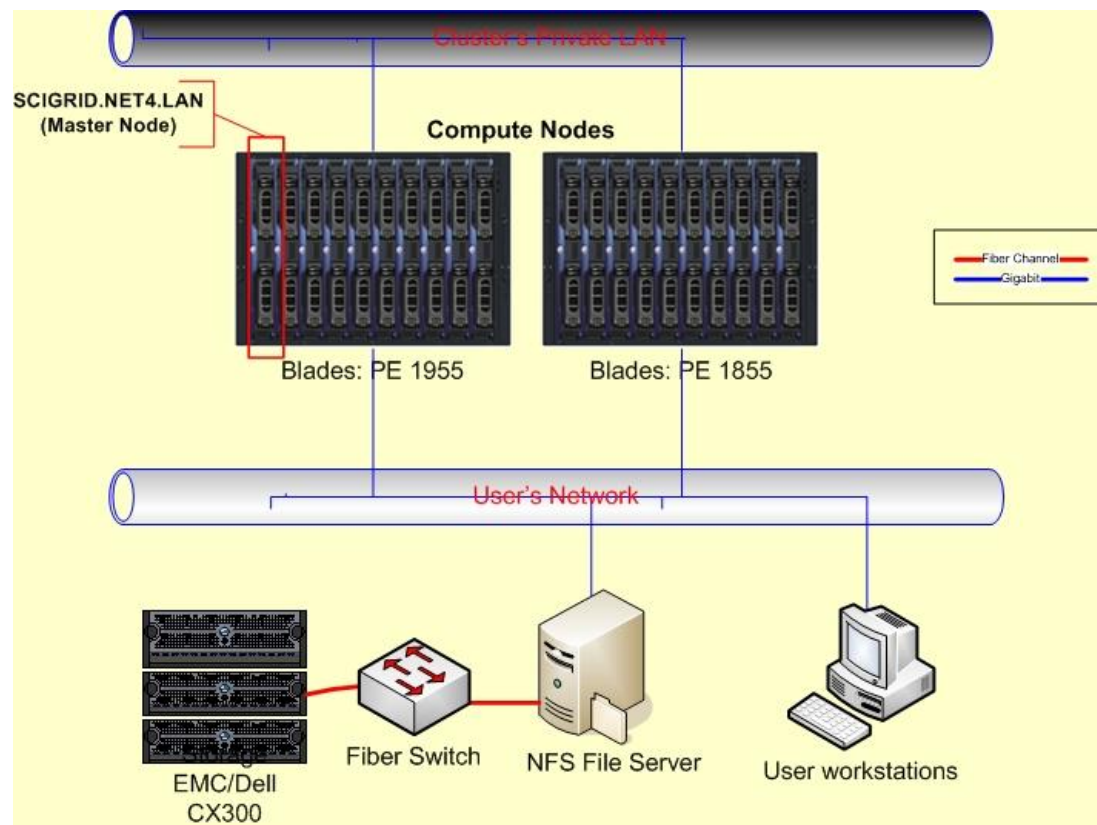
SCIGRID

- On ESAC Intranet, fully integrated in users' network environment
 - Globus based

- Cluster nodes mount through NFS
 - Daily science software
 - User's home directories

- Transparent access
 - Launch tasks to the Grid
 - Interactive session to the Grid ("glogin")

- In production since 2004



- 36 blades
- ~250 cores
- ~700 GB RAM
- RedHat

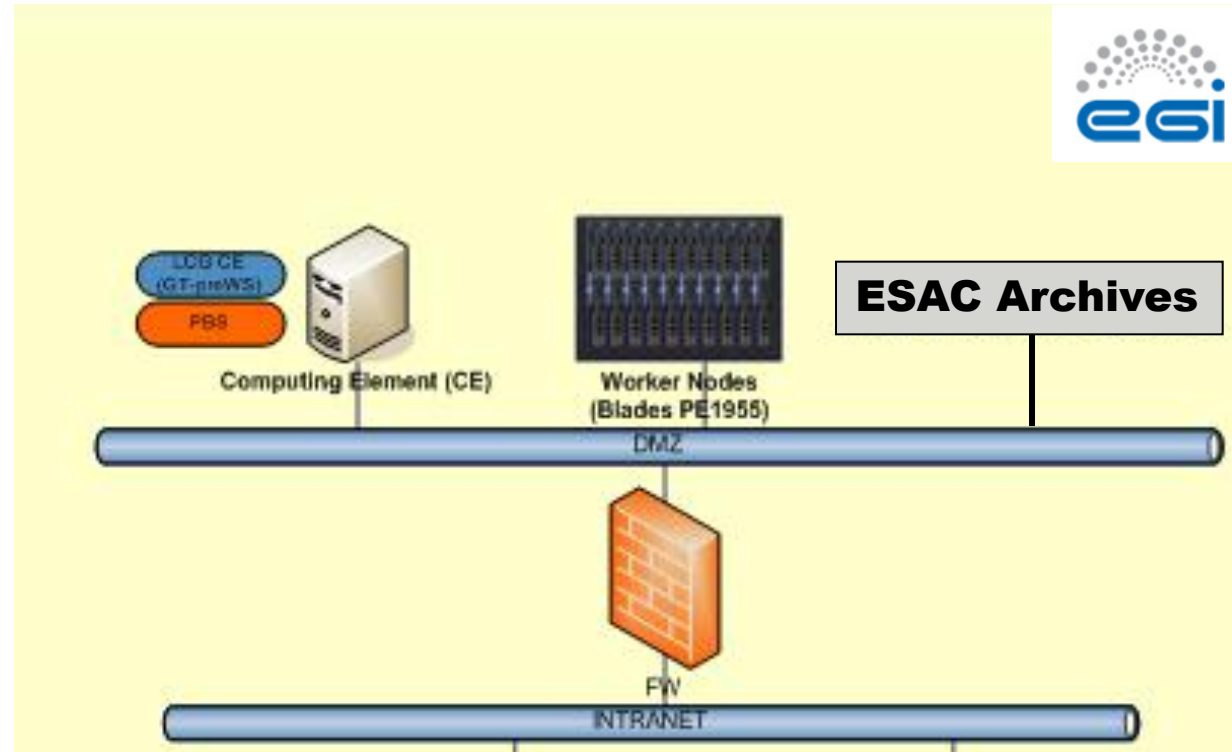
ESACGRID

- On ESAC DMZ
- Part of EGI, gLite based
- SGE job scheduler
- Scientific Linux

- Close to ESAC Science Archives
 - Faster access to the science data

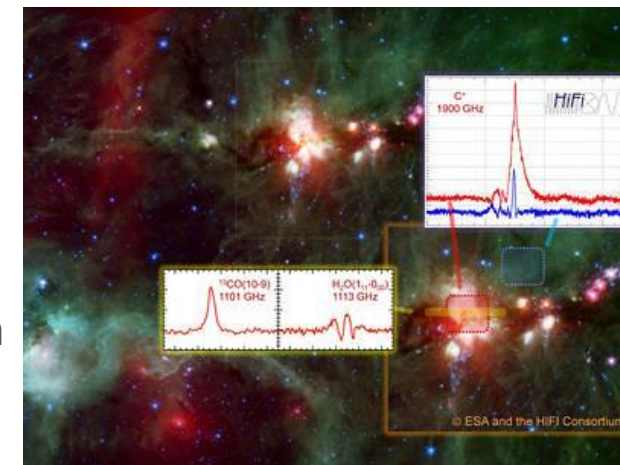
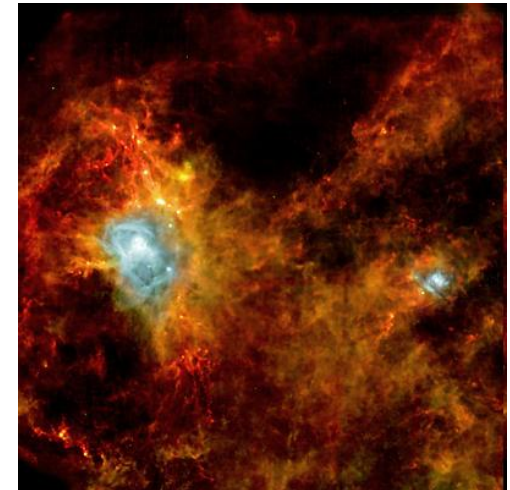
- 56 blades
- ~400 cores
- ~1372 GB RAM

- In production since 2007

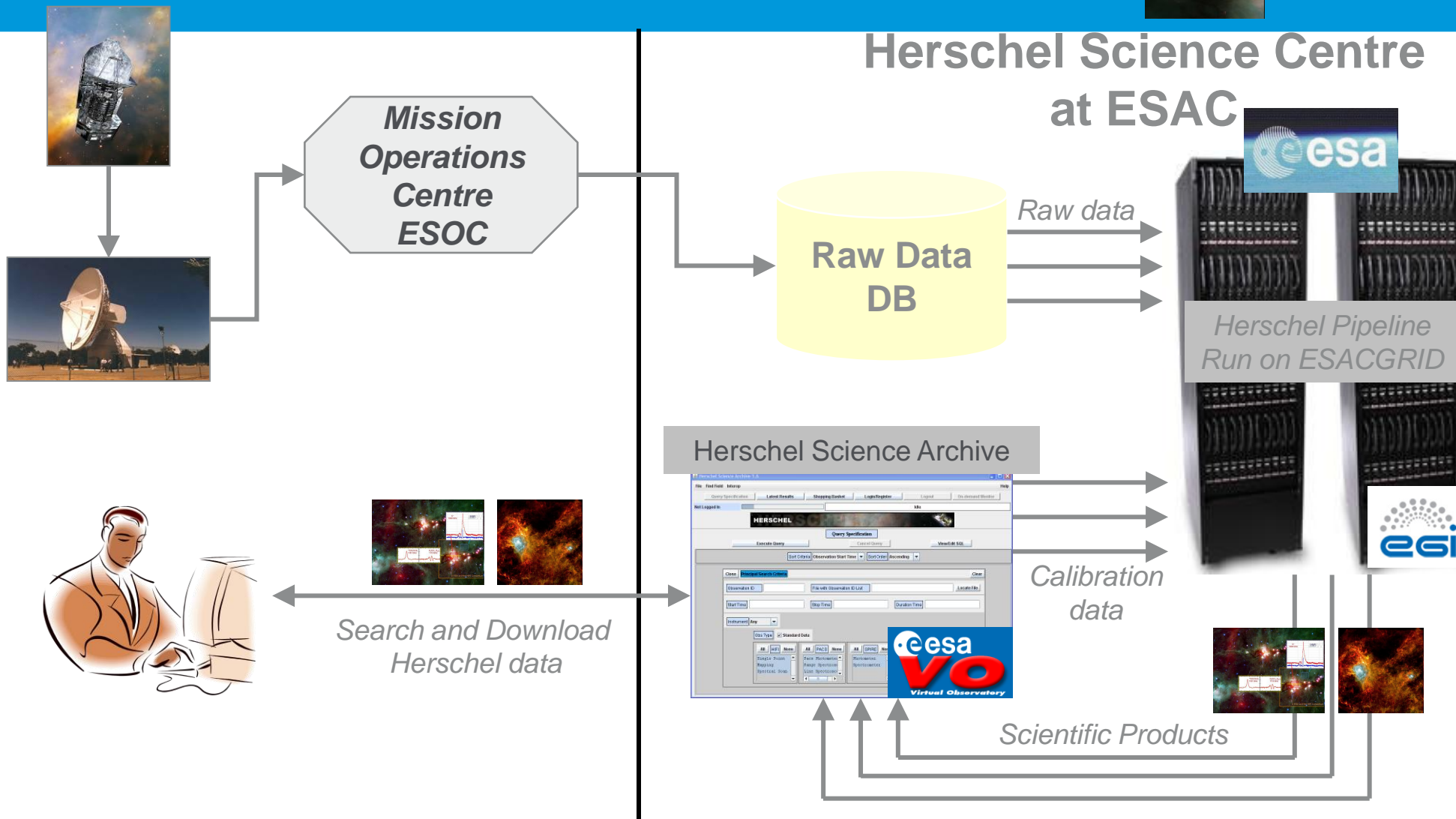




- Herschel is ESA's far Infrared observatory, launched in 2009
- Herschel Science Operations Centre @ ESAC is responsible of
 - Herschel Data Processing
 - Development with the instrument teams
 - Processing all Herschel raw data into science products
 - Data Quality Control
 - More on P020, Ott et al.
 - Herschel Science Archive (HSA)
 - (many other things)
- Herschel Data processing (raw data into science) requires
 - Systematic daily processing
 - On-the-fly reprocessing from the HSA
 - Regular bulk reprocessing of all raw data since launch
 - Goal : being able to process up to 10 days of data in 24h



Herschel Pipeline Data Processing

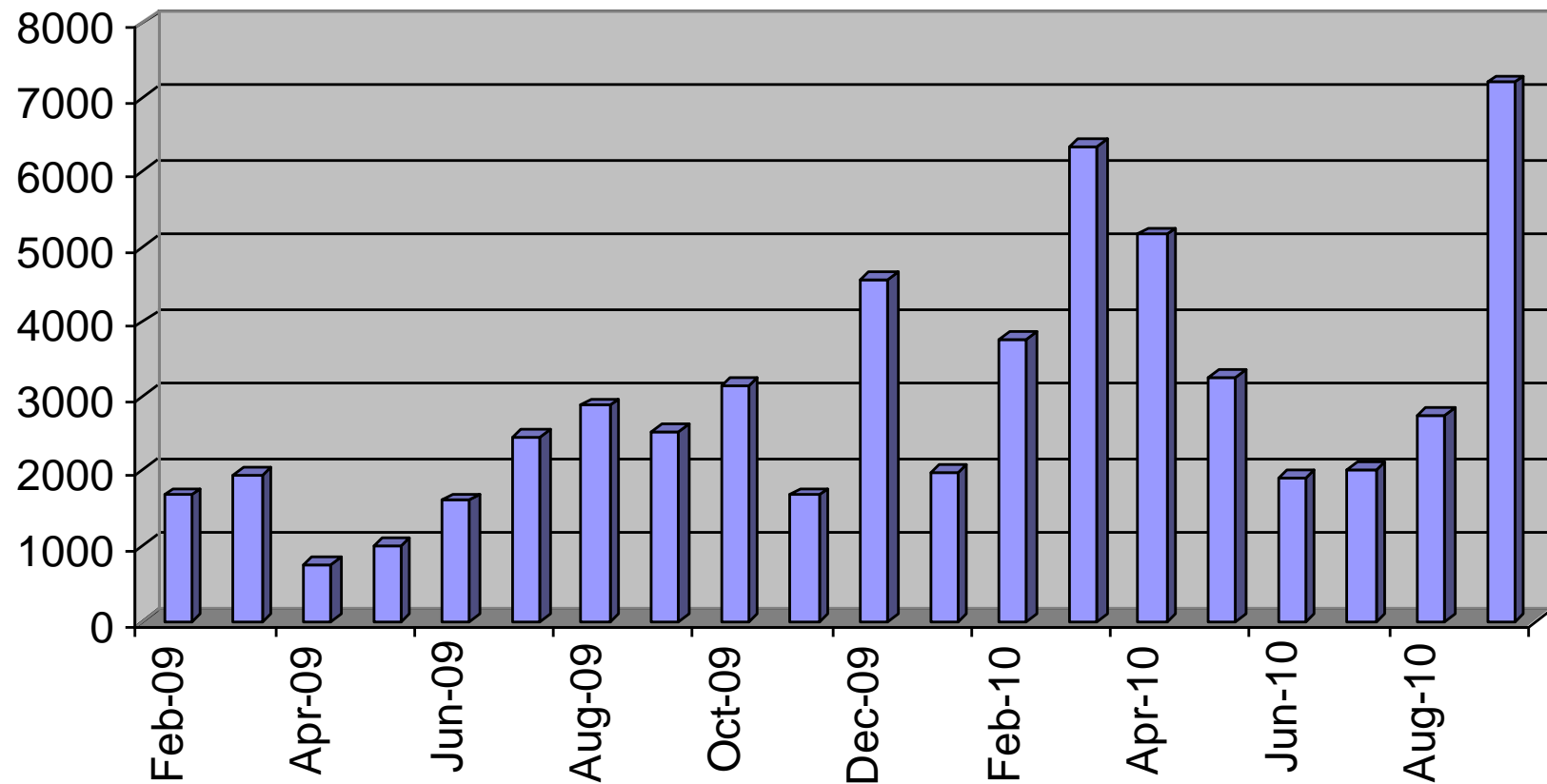


- Parallelization of tasks
 - Each observation can be sent on a GRID node
 - Many observations, days can be sent in parallel

- Prioritization and resource management
 - Allow different queues with different nodes configuration (ie big RAM)
 - Systematic/automatic processing, everyday with highest priority
 - On-demand request second
 - Bulk and automatic testing as a "background task" when the nodes were available.
 - "Herschel DP nightly tester" - an automatic regression testing on different release tracks that is performed 3 times/day

- Scalability
 - Grid can cope with standard processing, on-the-fly and bulk reprocessing
 - If more resources are required, we can add new Grid nodes

Herschel Data Processing Jobs



Traditional XMM-Newton SAS Workflow (SAS)

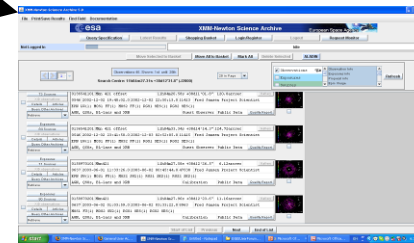
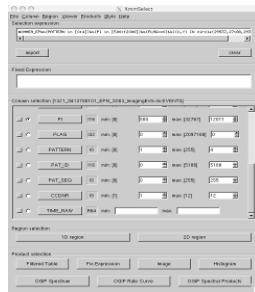
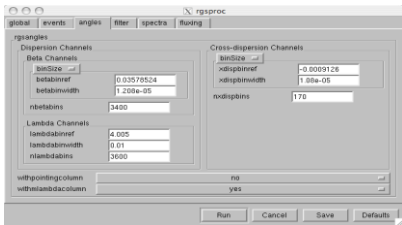
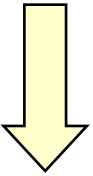
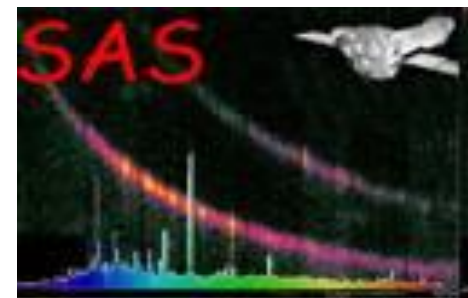


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ESAC

Download and Install SAS,
Calibration DB,
3rd party SW, libraries, ...

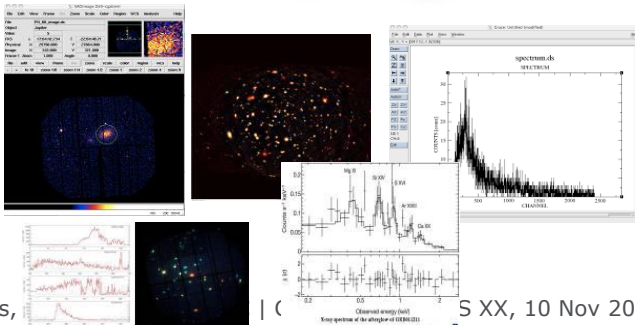
Search and download data
from XMM-Newton Archive



Run SAS tasks and
Store results
On Local computer



Visualize data



- Run XMM-Newton SAS as a web services on the GRID
 - No need for the user to download and install SAS on his/her desktop
 - Automatic access to large HW and SW resources (ESAC Grid)
 - Access and process the data close to where they are (XMM-Newton Science Archive at ESAC, close to the ESAC Grid)
 - Usage of Virtual Observatory (VO) standards and tools

- SAS easier to use for the end users
 - Predefined workflows

- Potential reduction of SAS SW maintenance effort
 - Support required only to fewer platforms

- More on P127, Ibarra et al.

- XMM- Newton EPIC-pn X-Ray imager Long-Term CTI (Charge Transfer Inefficiency) Analysis
 - The CTI is an important instrumental characteristic for event energy reconstruction. It increases during the instrument life time, basically due to accumulated radiation damage.
 - Careful monitoring since launch (1999) up till present is required
 - Build a calibration model of source line energies

- Analysis of ~900 calibrations observations
 - ~7.2 Ms or 83 days of observing time
 - Parameters are derived and tweaked through several iterations of the whole process

- Each dataset processing : ~3hrs
- 900 datasets processing : $900 \times 3 = 112.5 \text{ days} = 3.75 \text{ months}$

- Using the GRID (full capacity)
 - $(900 \times 3) / 160 \text{ processors} < 1 \text{ day} !!!$

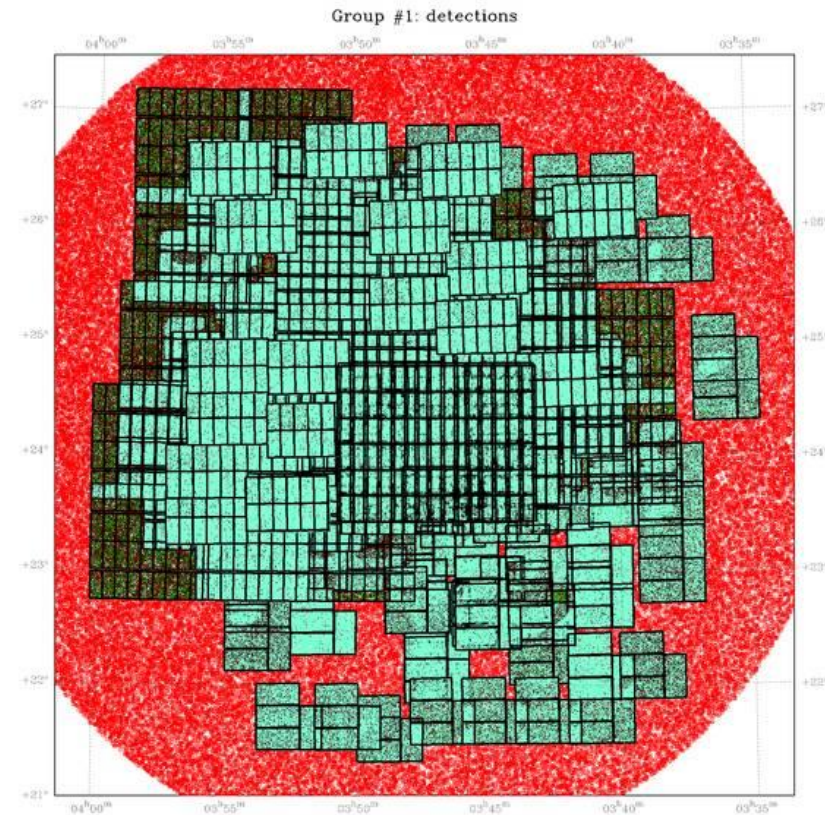
- GRID setup allows many iterations, hence making the whole exercise possible !

- How many stars are in the Pleiades besides the famous ones?



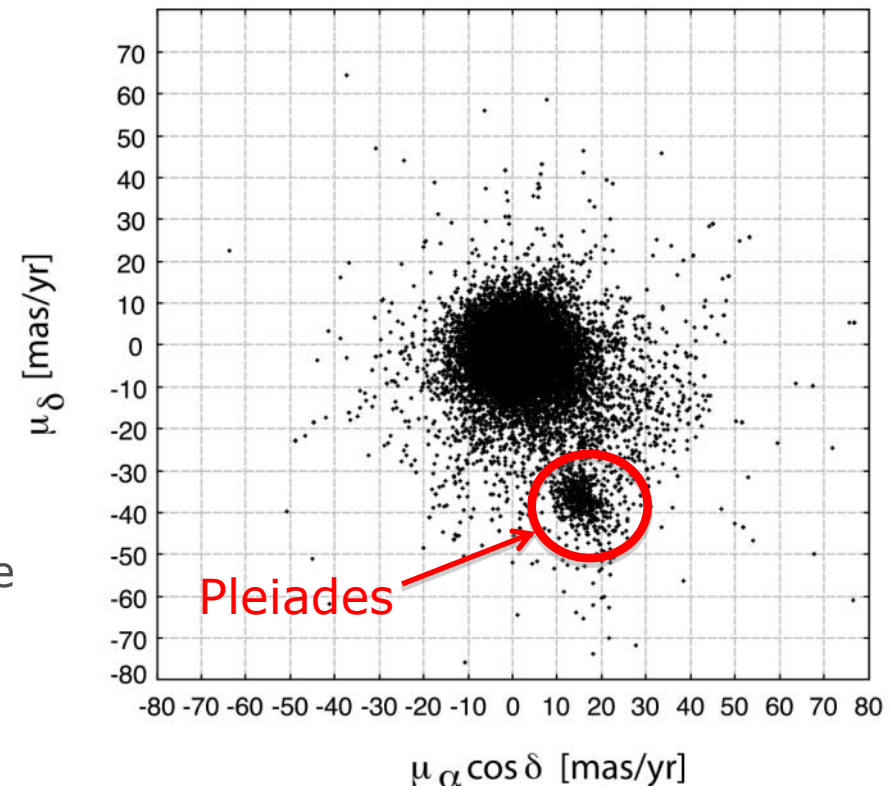
- Difficult to tell just from the right image
- The only good way to find out is to look for common transverse motion

- Use of Scigrad to process 520Gb of wide field images obtained from various space and ground based telescopes (Subaru, HST, CFHT, Isaac Newton Telescope) over a 12 years period
- The multi-epoch images were used to derive the transverse motion of every star (~ 730.000 in total) present in the 6deg x 6deg field of view of our observations
- The usage of Scigrad was critical, as it requires:
 - vast amount of storage
 - fast multi-threaded computers to extract the source photometry and astrometry
 - fast multi-threaded computers and vast amounts of RAM to cross-match
 - the multi-epoch catalogs and derive the kinematics of each star



H.Bouy et al

- The result is a vector point diagram of the motion of all 730.000 stars located in the Pleiades cluster. The diagram shows the field and background objects are distributed randomly around (0,0) mas/yr, while the Pleiades members are all co-moving and form the locus near (15,-35)
- This allowed to unambiguously identify several thousands of members (when less than 1000 were known to date) down to the planetary mass regime.
- The scientific outcome will be extremely valuable and rich, from refining the mass function of the cluster, identifying planetary mass objects, and detailed studies of the internal dynamics.
- This new technique could be repeated for other regions of the sky



motion in RA (x-axis) and Dec (y-axis)
H.Bouy et al

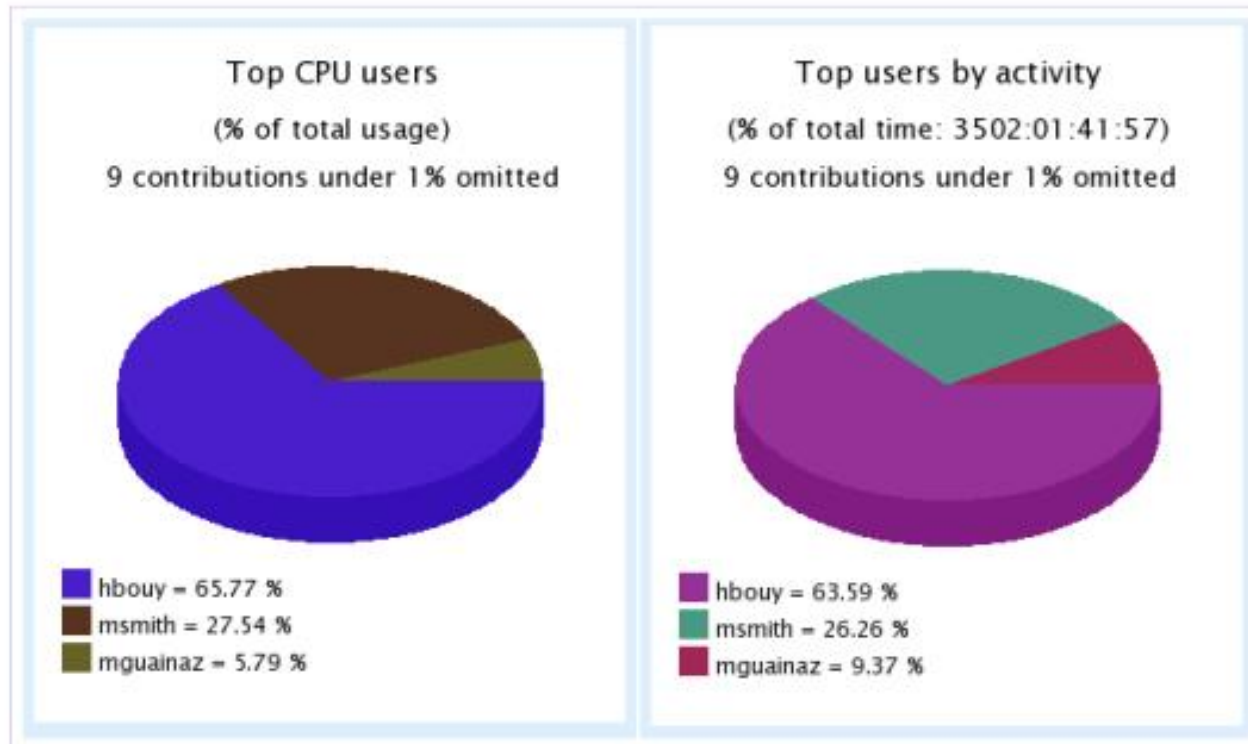


Table sorted by CPU usage time. To sort the columns, please click on the headers.

Rank	User	Total jobs	Total execution time	CPU time	RAM usage	Host
1	hbouy	29289 (33.95% of all jobs)	2226:22:10:41	2090:05:33:08	56.140825 TB	scigrid
2	msmith	25851 (29.97% of all jobs)	919:14:42:08	875:10:42:31	11.226931 TB	scigrid
3	mguainaz	29212 (33.86% of all jobs)	328:01:16:40	184:02:36:57	10.709227 TB	scigrid
4	icalle	645 (0.75% of all jobs)	8:03:39:15	8:01:22:05	471.514 GB	scigrid
5	jvallejo	3 (0% of all jobs)	7:11:00:56	7:10:41:47	19.742 GB	scigrid

- Investigating Cloud concepts, while keeping the existing infrastructure
 - Cloud and GRID co-existence, internally and externally
 - Virtualization infrastructure already since several years (60 virtual servers)

- 1. Deploy an internal private cloud at ESAC
 - Allow easier and more flexible redeployment of hardware resources (for GRID and non GRID usage)
 - Deploying on-demand ESAC GRID worker nodes on internal private cloud at ESAC when more Grid resources are required (build on existing GRID infrastructure)

- 2. Use public cloud to access more hardware resources
 - Deploy complete ESAC applications on public cloud (eg Gaia proof of concept)
 - Deploying on-demand extra worker nodes on public (eg Amazon) cloud using a VPN (only valid for ESAC GRID, not SCIGRID)
 - Need to pay on demand

Acknowledgments



- ESAC Computer Support Group
- ESAC Science Archives and Virtual Observatory Team
- ESAC XMM-Newton SAS Team
- ESAC Herschel Data Processing Team
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