

Infrastrutture software ad alte prestazioni per il supporto, le operazioni e i test delle attività scientifiche

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Head of SpaceStream Strategic Business Unit



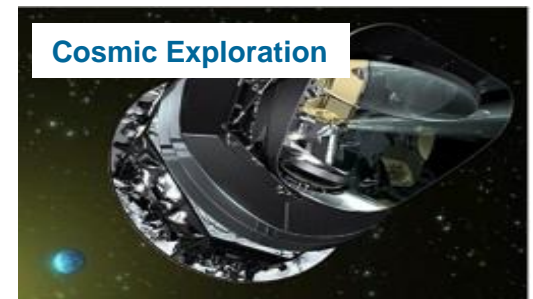
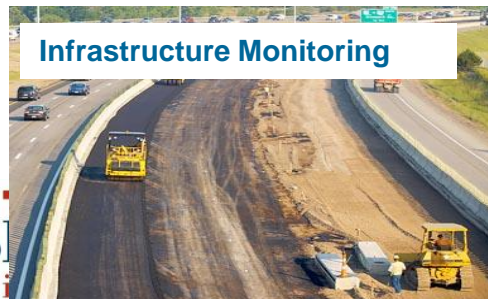
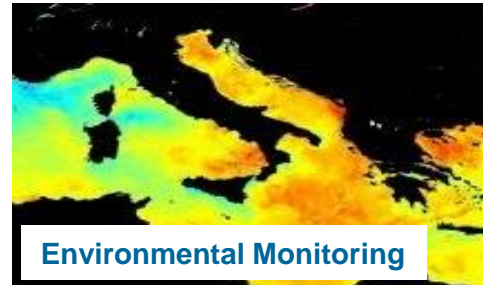
Planetek Group

Our Premises

Bari – Athens - Rome



Planetek Activities



Partnership

products



Master Dealer Italy



GeoMedia, Erdas Imagine,
Imagine Photogrammetry,
ER Mapper, Smart M.App,
Apollo

Dealer



WorldView-3, WorldView-2,
WorldView-1, GeoEye-1,
QuickBird, IKONOS



Spot, TerraSAR-X,
Pléiades

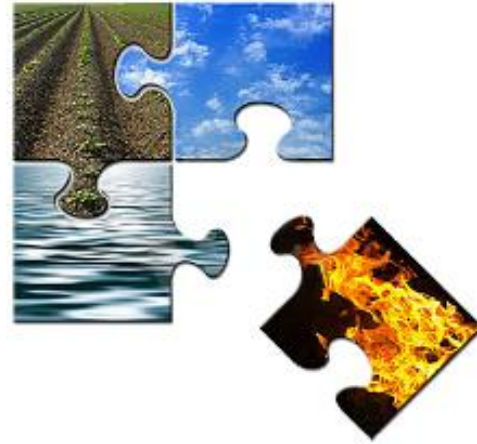


Cosmo-SkyMed



RapidEye

Simplifying the complexity of space



Dove si trova la complessità?

On Board Software

- OBP Data Processing
- Real Time and Accurate processing

Ground Support Equipment

- Numerosità dei test e dei loro risultati

Ground and User Segment

- PDGS processing pipelines
- System infrastructure
- Accesso al dato

Come rispondiamo

On Board Software

- Analisi algoritmica di dettaglio
- Analisi informatica a basso livello
- Semplificazione delle interfacce HW

Ground Support Equipment

- Automazione dei test
- Semplificazione della verifica dei test

Ground and User Segment

- Valorizzazione delle nuove tecnologie
 - basate su GPU
 - di virtualizzazione

On Board Software and Payload Data Processing

On Board Software

OBP Data Processing and Compression

spacePDP – Payload Data Processing

- Available for different operational conditions, both for SW (RTEMS and VxWorks) and HW (LEON2 and 3, DSP, ARM)
- specifically designed IDE (Integrated Development Environment)
- Compression and Compressive sensing
- Clouds detection, Feature & Event detection, Debris Assessment, Autonomous tasking

- spaceOP3C – **On-board** Processing for hyperspectral **Compression** and Clouds Classification (*Patented*)

Attitude Determination and Control Systems

spaceADM - Attitude Determination Module

- Real time algorithm to evaluate satellite attitude
- High precision estimates for different kind of satellites
- Both on board and on ground

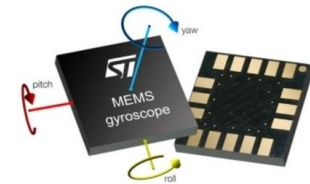
(Patent Pending)



Innovative ADCS for mini and nano satellite and its applications

Algorithm based on the Unscented Kalman Filter

precisione	assi	EKF	SpaceADM
30arcsec	roll	69.92%	99.05%
	pitch	64.61%	99.31%
	yaw	69.27%	98.85%
20arcsec	roll	64.38%	93.70%
	pitch	58.39%	94.55%
	yaw	63.95%	93.77%
10arcsec	roll	57.77%	78.27%
	pitch	52.50%	78.78%
	yaw	58.19%	78.58%

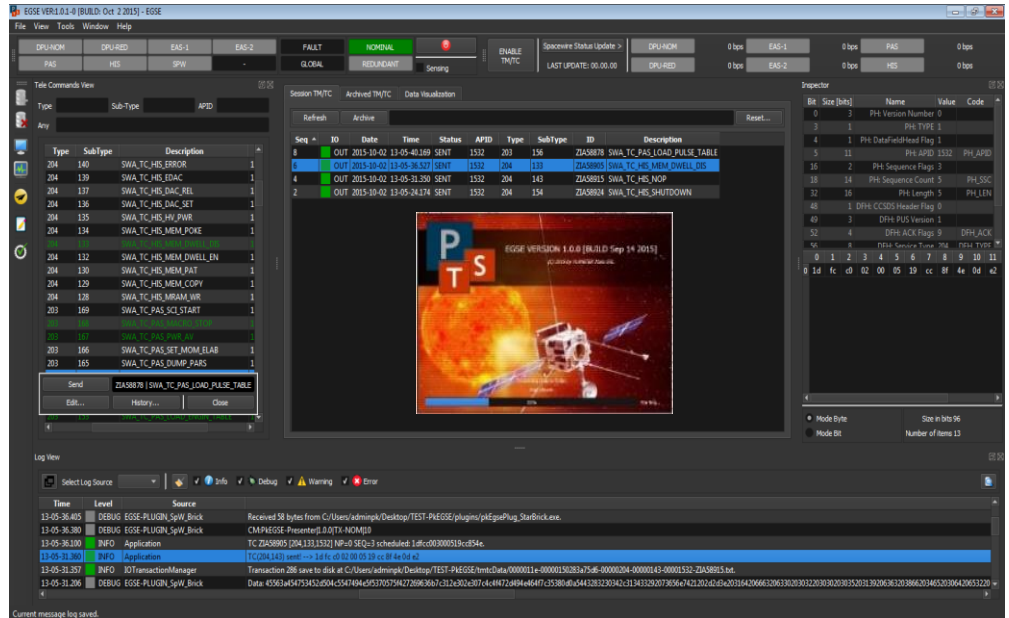


Ground Support Equipment

Ground Support Equipment

EGSE SW Front-End for Integration, Verification & Validation

- space Payload Test System
 - Off-the-shelf SW solution providing full front-end functionalities on top of a commercial HW platform
 - Native integration into a Central Check-out System (CCS)
 - Relied on the SCOS 2000 MIB
 - Supported languages: Python and Td/Tk



Ground Support Equipment

EGSE, GSE, Simulator & SCOE



SpacePTS V2.00.0-00 (BUILD: Mar14 2016) - SpacePTS

File View Tools Window Help

STOP POWER DISABLE TM/TC DPU-NOM NCH-ON RED-ON SPW FAULT SPW-NCH SPW-RED Sensing

Decoded: 0 Tot.App Nack: 0 Tot.Events: 0 Tot.TM: 59 Tot.Eve Nack: 0 SessionID: 857

Session TM/TC Archived TM/TC Scripting MoD

N	Date	Time	ID	Description	Program	SSC	APID	Type	SubType	Status	ID
61	2016-03-15	09:51:34.724	IN	SWA_TM_SCL_EAS1_STRAH_COMPR_DATA		2	1532	21	6	RECEIVED	58712
59	2016-03-15	09:51:34.620	IN	SWA_TM_PAS_HK		320	1540	3	25	RECEIVED	58033
58	2016-03-15	09:51:34.508	IN	SWA_TM_EAS2_HK		319	1540	3	25	RECEIVED	58032
56	2016-03-15	09:51:34.396	IN	SWA_TM_EAS1_HK		318	1540	3	25	RECEIVED	58031
57	2016-03-15	09:51:34.280	IN	SWA_TM_DPU_HK		313	1540	3	25	RECEIVED	58030
56	2016-03-15	09:51:34.182	IN	SWA_TM_CMD_EXE		1	1585	1	7	RECEIVED	57069
55	2016-03-15	09:51:34.079	IN	SWA_TM_CMD_ACP		0	1585	1	1	RECEIVED	56997
54	2016-03-15	09:51:33.959	IN	SWA_TM_SCL_EAS1_STRAH_COMPR_DATA		0	1532	21	6	RECEIVED	58711
53	2016-03-15	09:51:33.747	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		47	1548	21	6	RECEIVED	58709
52	2016-03-15	09:51:33.643	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		45	1548	21	6	RECEIVED	58708
51	2016-03-15	09:51:33.531	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		44	1548	21	6	RECEIVED	58707
50	2016-03-15	09:51:33.421	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		43	1548	21	6	RECEIVED	58706
49	2016-03-15	09:51:33.314	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		42	1548	21	6	RECEIVED	58705
48	2016-03-15	09:51:33.203	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		41	1548	21	3	RECEIVED	58704
47	2016-03-15	09:51:33.103	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		37	1548	21	6	RECEIVED	58704
46	2016-03-15	09:51:33.099	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		1	1532	204	134	SENT	5714
45	2016-03-15	09:51:32.986	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		16	1548	21	6	RECEIVED	58704
44	2016-03-15	09:51:32.878	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		15	1548	21	6	RECEIVED	58704
43	2016-03-15	09:51:32.763	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		14	1548	21	6	RECEIVED	58704
41	2016-03-15	09:51:32.669	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		13	1548	21	6	RECEIVED	58704
40	2016-03-15	09:51:32.559	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		12	1548	21	6	RECEIVED	58704
39	2016-03-15	09:51:32.443	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		11	1548	21	6	RECEIVED	58704
38	2016-03-15	09:51:32.229	IN	SWA_TM_SCL_EAS1_FULID_COMPR_DATA		10	1548	21	6	RECEIVED	58704

Log View

Seq Date Time Level Source Message

642 2016-03-15 09:51:34.834 INFO EGSE-PLUGIN_SpW_Brick RED -> TM(21.6) received Seq. Counter = 2, Len = 472

634 2016-03-15 09:51:34.724 INFO EGSE-PLUGIN_SpW_Brick RED -> TM(3.25) received Seq. Counter = 318, Len = 96

625 2016-03-15 09:51:34.620 INFO EGSE-PLUGIN_SpW_Brick RED -> TM(3.25) received Seq. Counter = 318, Len = 84

616 2016-03-15 09:51:34.508 INFO EGSE-PLUGIN_SpW_Brick RED -> TM(3.25) received Seq. Counter = 318, Len = 84

604 2016-03-15 09:51:34.396 INFO EGSE-PLUGIN_SpW_Brick RED -> TM(3.25) received Seq. Counter = 311, Len = 130

594 2016-03-15 09:51:34.182 INFO EGSE-PLUGIN_SpW_Brick RED -> TM(3.25) received Seq. Counter = 1, Len = 20

Current message log saved.

TM/TC Management & Control

SpacePTS V2.00.0-00 (BUILD: Mar15 2016) - SpacePTS

File View Tools Window Help

STOP POWER DISABLE TM/TC DPU-NOM NCH-ON RED-ON SPW FAULT SPW-NCH SPW-RED Sensing

Decoded: 0 Tot.App Nack: 0 Tot.Events: 0 Tot.TM: 0 Tot.Eve Nack: 0 SessionID: 857

Session TM/TC Archived TM/TC Scripting MoD

Filter by PID Filter by Status Filter by Sensor

ID	Type	SubType	Description
ZIA58933	204	178	SWA_TC_HLS_DSCH_READ
ZIA58932	204	177	SWA_TC_HLS_DSCH_WRITE
ZIA58931	204	176	SWA_TC_HLS_HK_PUT
ZIA58930	204	175	SWA_TC_HLS_MACRO_CALL
ZIA58929	204	174	SWA_TC_HLS_STIM_DIS
ZIA58928	204	173	SWA_TC_HLS_AC_LINK
ZIA58927	204	170	SWA_TC_HLS_SVR
ZIA58926	204	166	SWA_TC_HLS_STRA_EN
ZIA58925	204	158	SWA_TC_HLS_OPTO
ZIA58924	204	154	SWA_TC_HLS_SHUTDOWN
ZIA58923	204	151	SWA_TC_HLS_RAM_LOAD
ZIA58922	204	149	SWA_TC_HLS_TABLE_LOAD

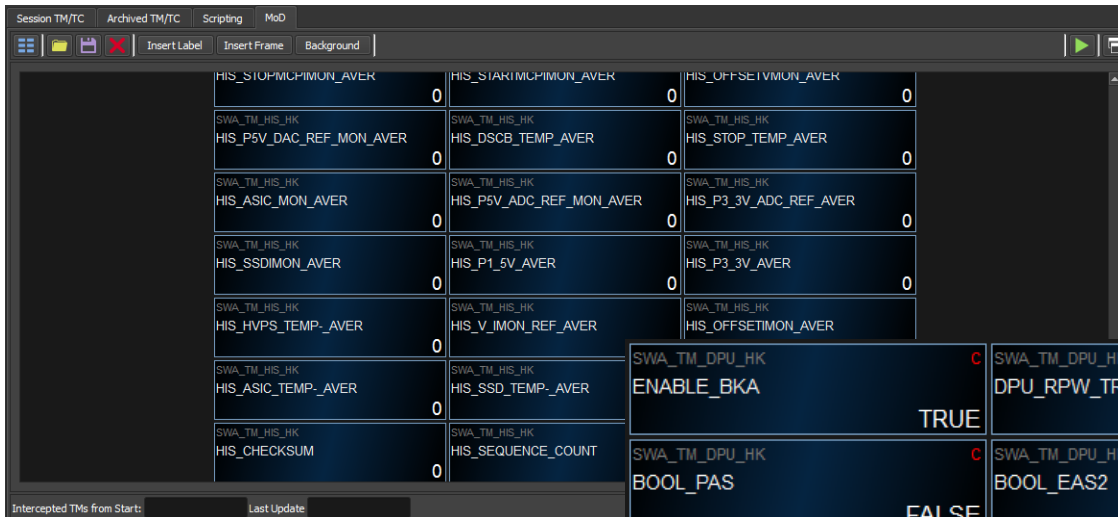
Archive is up to date.

ID	Type	SubType	APID	Name	Descr	Id
1	I	45	2016-03-15	11:25:58.571	21	6
2	I	44	2016-03-15	11:25:58.316	21	6
3	I	43	2016-03-15	11:25:58.200	21	6
4	I	42	2016-03-15	11:25:58.086	21	6
5	I	41	2016-03-15	11:25:58.957	21	6
6	I	17	2016-03-15	11:25:58.834	21	6
7	I	16	2016-03-15	11:25:58.719	21	6
8	I	15	2016-03-15	11:25:58.594	21	6
9	I	14	2016-03-15	11:25:58.475	21	6
10	I	13	2016-03-15	11:25:58.352	21	6
11	I	12	2016-03-15	11:25:58.234	21	6
12	I	11	2016-03-15	11:25:58.113	21	6
13	I	10	2016-03-15	11:25:58.002	21	6
14	I	9	2016-03-15	11:25:57.882	21	6
15	I	8	2016-03-15	11:25:57.756	21	6
16	I	7	2016-03-15	11:25:57.638	21	6
17	I	6	2016-03-15	11:25:57.502	21	6
18	I	5	2016-03-15	11:25:57.270	21	6
19	I	4	2016-03-15	11:25:57.152	21	6
20	I	3	2016-03-15	11:25:57.020	21	6

Current message log saved.

Ground Support Equipment

EGSE, GSE, Simulator & SCOE



Parameters Display

SWA_TM_DPU_HK ENABLE_BKA TRUE	SWA_TM_DPU_HK DPU_RPW_TRIGG TRUE	SWA_TM_DPU_HK DPU_COMPRESS_REQ FALSE
SWA_TM_DPU_HK BOOL_PAS FALSE	SWA_TM_DPU_HK BOOL_EAS2 FALSE	SWA_TM_DPU_HK BOOL_EAS1 FALSE
SWA_TM_DPU_HK vBM_EAS1 1	SWA_TM_DPU_HK SPARE 0	SWA_TM_DPU_HK BOOL_HIS FALSE
SWA_TM_DPU_HK vBM_EAS2 3	SWA_TM_DPU_HK tElapsed_EAS1 0	SWA_TM_DPU_HK avvBM_EAS1 Kbps 2
SWA_TM_DPU_HK vBM_HIS 5	SWA_TM_DPU_HK tElapsed_EAS2 0	SWA_TM_DPU_HK avvBM_EAS2 4

STOP
POWERENABLE
TM/TC

DPU-RED

NOM-ON

RED-ON

SPW

FAULT

SPW-NOM



[V]

Discarded

0

Tot.Acp Nack

EAS-1

EAS-2

PAS

HIS

TRAFFIC IN

SPW-RED

Sensing

[A]

Tot.TM

0

Tot.Exe Nack

Session TM/TC

Archived TM/TC

Scripting

MoD

▶ | ● RUNNING



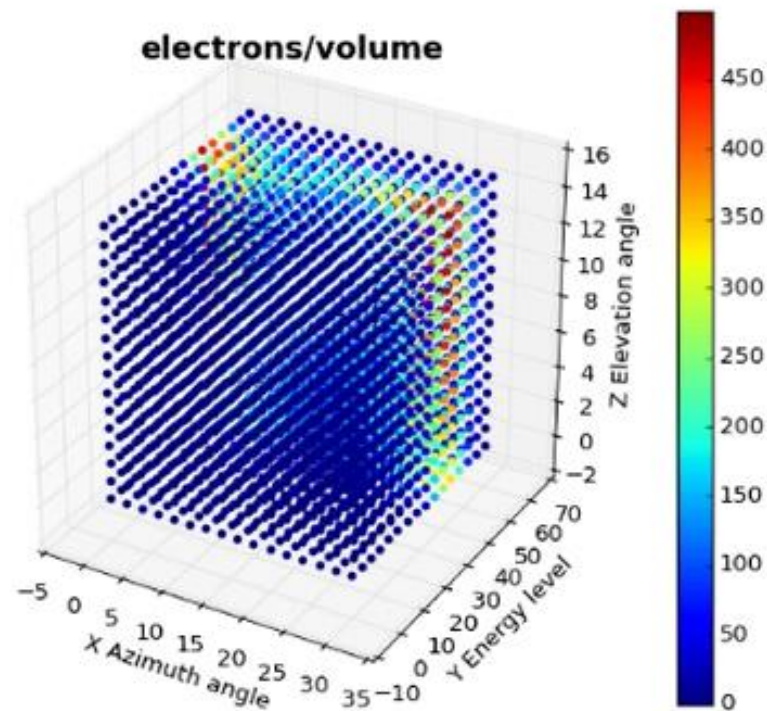
Save As

C:/SWA-DPU_EGSE/pyProcedures/PK_plotting_py27.py

```
1 """
2 Created on 06/ott/2015
3
4 @author: adminpk
5 """
6 from parsing import line
7 import numpy
8 from mpl_toolkits.mplot3d import Axes3D
9 import matplotlib.pyplot
10 from matplotlib import cm, matplotlib_fame, pyplot
11 import matplotlib
12
13
14 def plotting(path_file):
15     infile=open(path_file,mode='r')
16     endfile=True
17
18     size_elevation=16
19     size_energy=64
20     size_azimuth=32
```

Transferring script to plugin...
Script running...

Figure 1



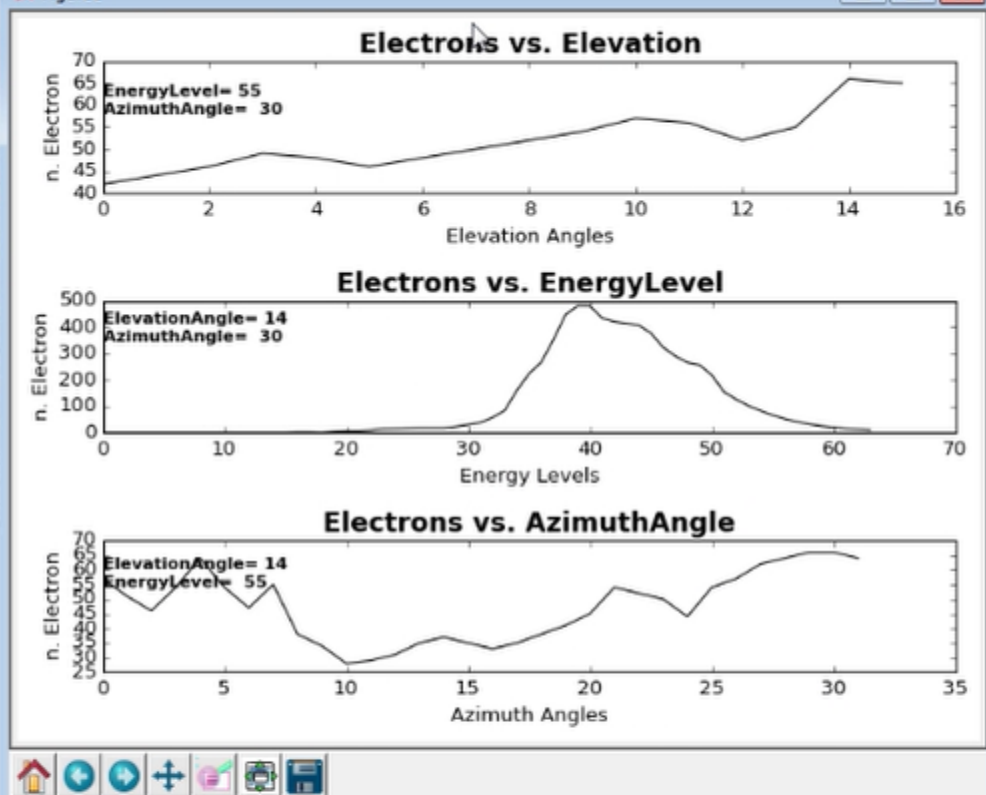
Transferring script to plugin...
Script running...

4 [V] Discarded 0 Tot.A

Sensing [A] Tot.TM 0 Tot.E

Save As

Figure 3



Transferring script to plugin...
Script running...

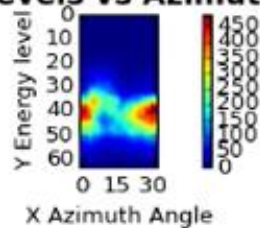
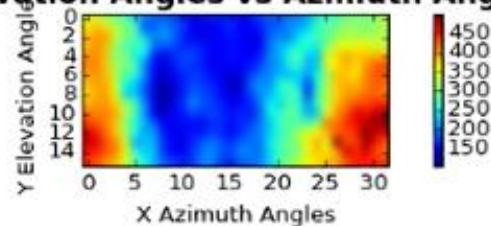
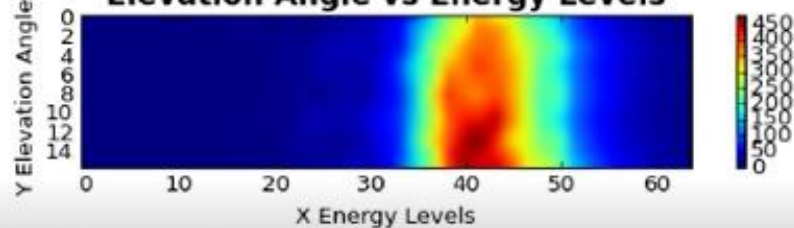
Log View

Info Debug Warning Error

Seq Date Time Level Source Message

Figure 1

76 Figure 2

Energy Levels vs Azimuth Angle**Elevation Angles vs Azimuth Angle****Elevation Angle vs Energy Levels**

Transferring script to plugin...
Script running...

Ground and User Segment

Gli elementi chiave del Ground Segment

Interoperability

- Different Catalog, Data format, semantics, protocols....

Modularity & Scalability

- From the prototype to the continuous growth

Reliability

- From experimental to operational activities

Maintainability & Flexibility

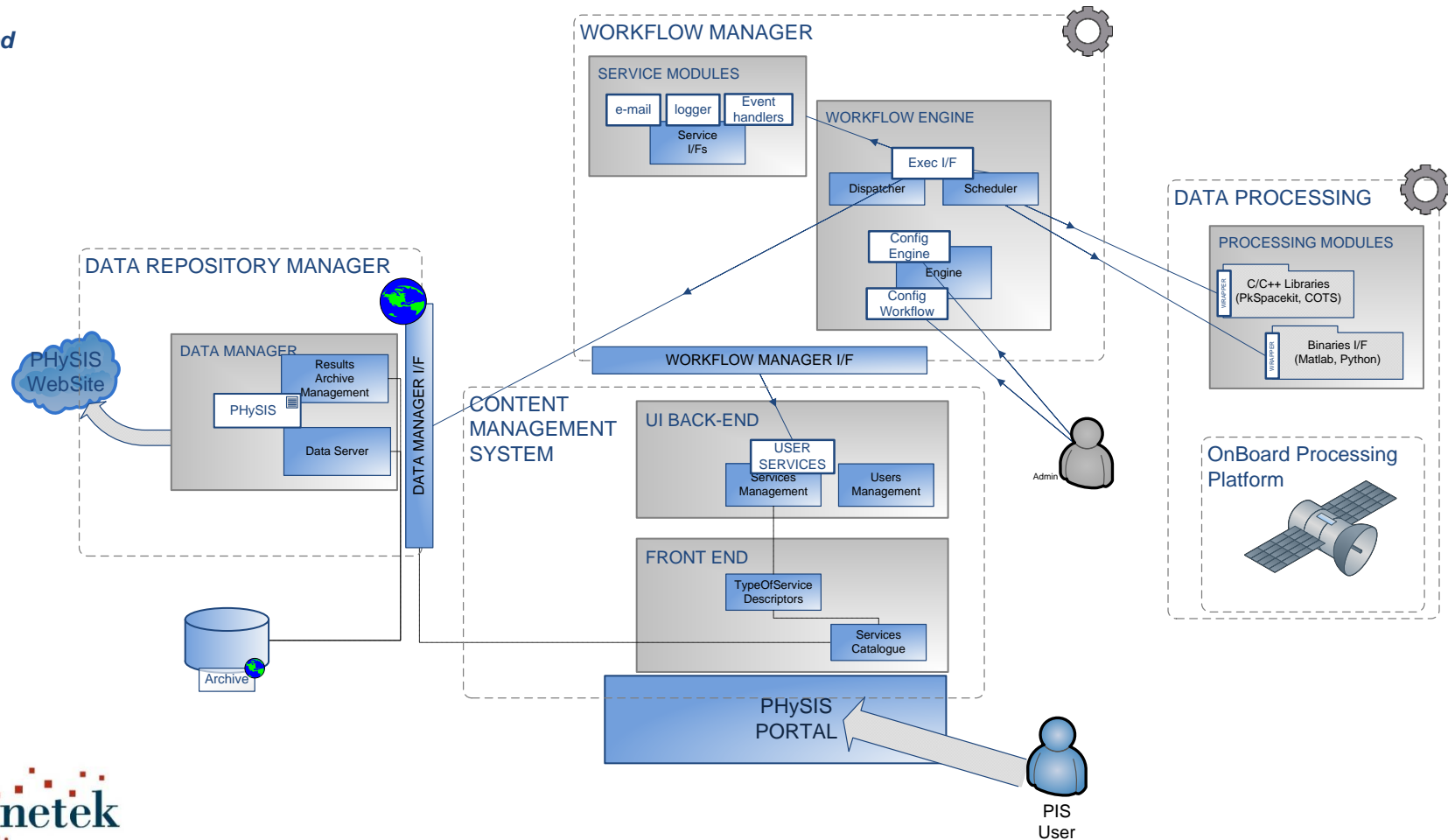
- Design first

User Experience

- To take care of the user happiness; sometimes in real time. Big Data matter

...Simplify the complexity of the Overall System...

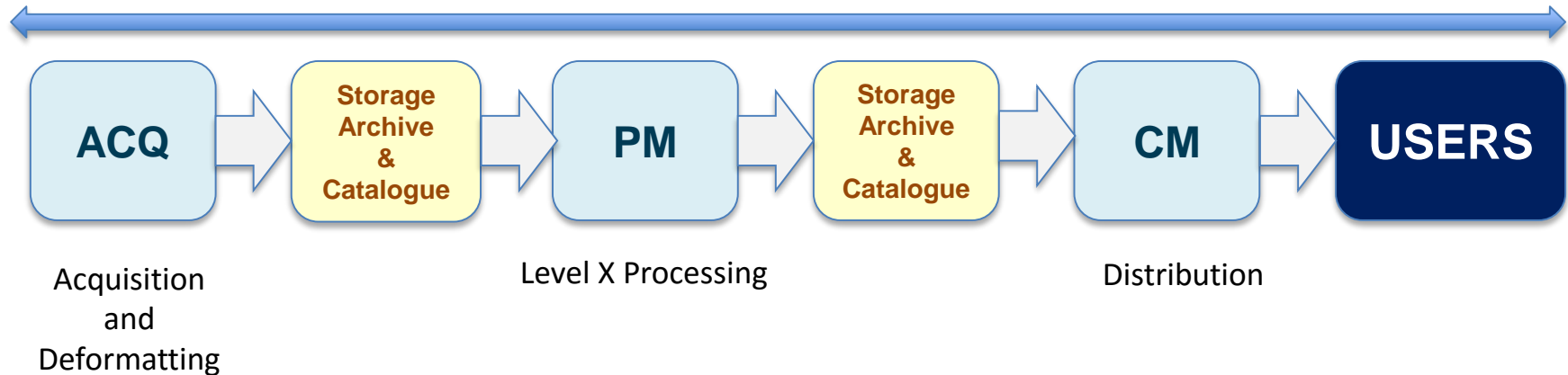
PhySIS
Integrated
System
(PIS)



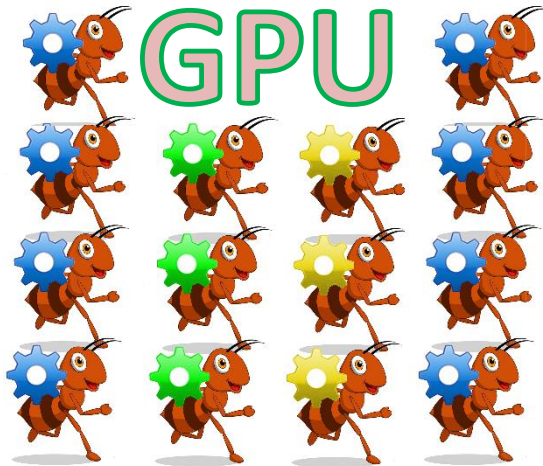
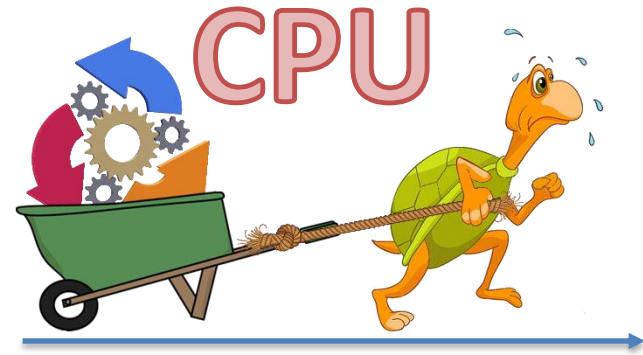
Real Time?

■ SAR PDGS workflow

30 seconds of acquisition need **60 minutes** of processing -> **target ONE minute**



GPGPU is a solution!

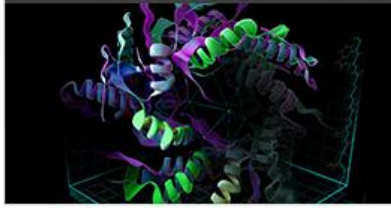


Compute capability	Thread processors	Clock (MHz)	Memory (MiB)	GFLOPs Single Precision	GFLOPs Double Precision
3.5	2880	745	12288	4290	1430

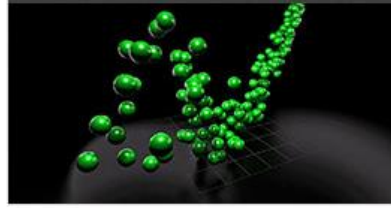
Our Goal

To promote the development of a community and of an EO SW library based on the use of GPU

BIOINFORMATICS



COMPUTATIONAL CHEMISTRY



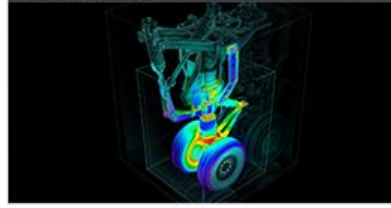
COMPUTATIONAL FINANCE



COMPUTATIONAL FLUID DYNAMICS



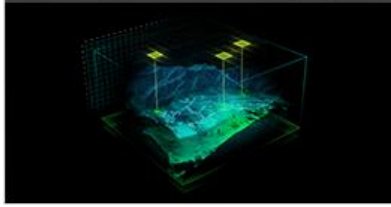
COMPUTATIONAL STRUCTURAL MECHANICS



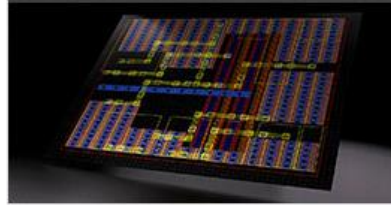
DATA SCIENCE



DEFENSE



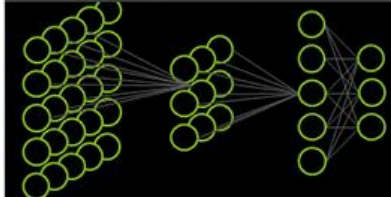
ELECTRONIC DESIGN AUTOMATION



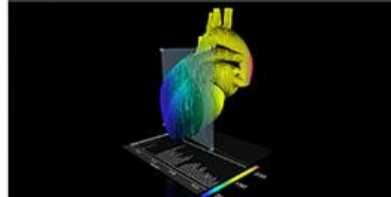
IMAGING & COMPUTER VISION



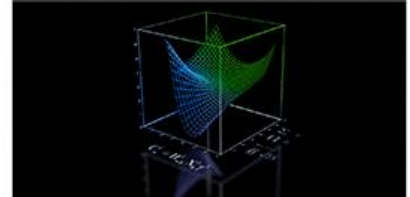
MACHINE LEARNING



MEDICAL IMAGING



NUMERICAL ANALYTICS



IV ASI SME Tender: Navigation and Earth Observation

FAST4MAP

Fast & Advanced SAR Techniques for Monitoring & Alerting
Processes

The GOAL of FAST4MAP

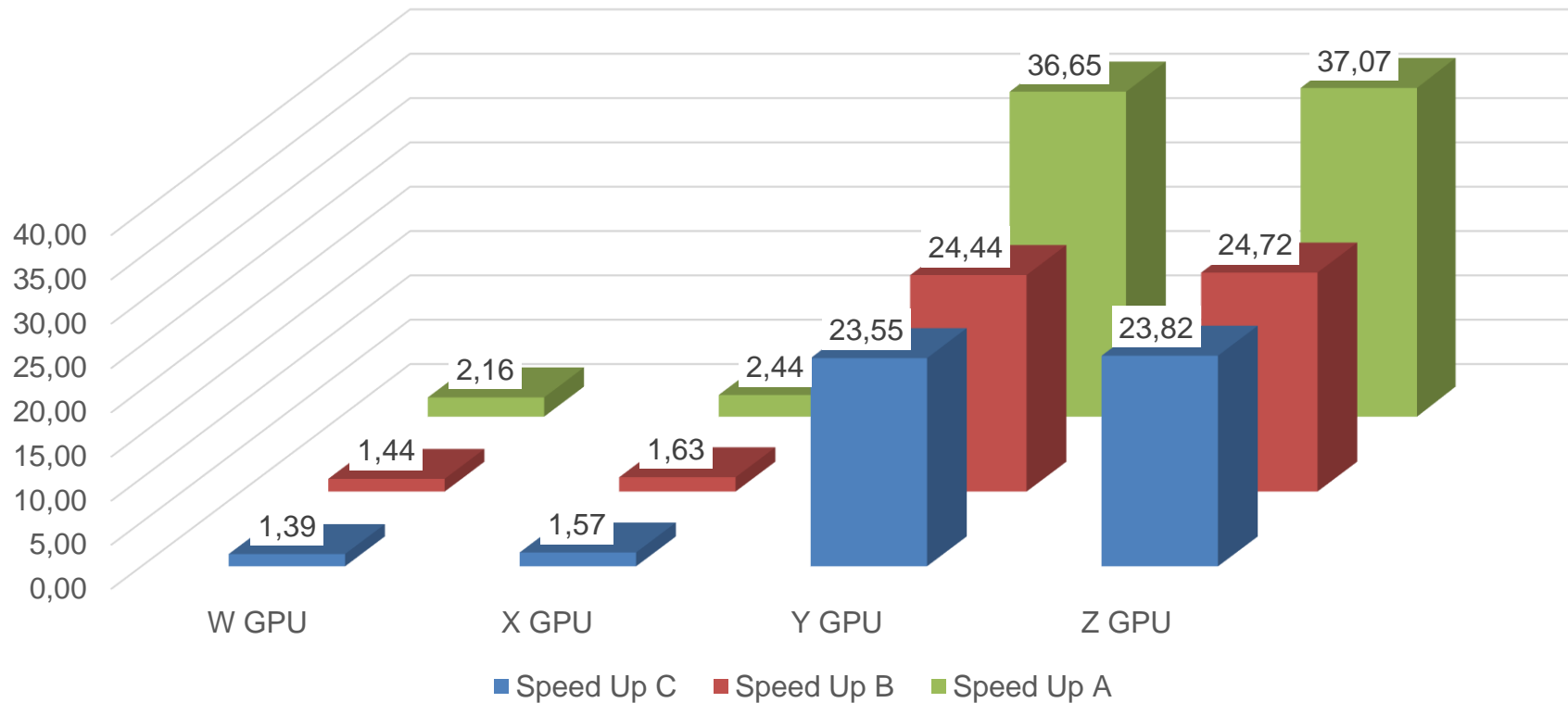
- To develop a GPU based library for Earth Observation Data processing and application
- To develop a **Transportable High Performance Computing Box** (HW plus SW)
 - Design and prototype at your home
 - Operate at Data Home -> **Data Centric Processing**

The Testing Platforms

CPU				N°core	RAM
A	E5-2603	1.80 GHz	64 bit	2	16,0 GB
B	i7-4510U	2.60 GHz	64 bit	4	8,0 GB
C	E5-2650L	1.70 GHz	64 bit	2 socket 10 core per socket	264,0 GB

GPU Fermi		Multi Processor Count	maxThreads PerMultiProcess or	maxThre adsPerBl ock	maxGridSize	clockRate
W	GeForce 820M	2	1536	1024	65535	625 MHz
X	Quadro K2000	2	2048	1024	$2^{31}-1$	954 MHz
Y	Tesla K20c	13	2048	1024	$2^{31}-1$	706 MHz
Z	Tesla K40m	15	2048	1024	$2^{31}-1$	745 MHz

To reach 100 times faster...



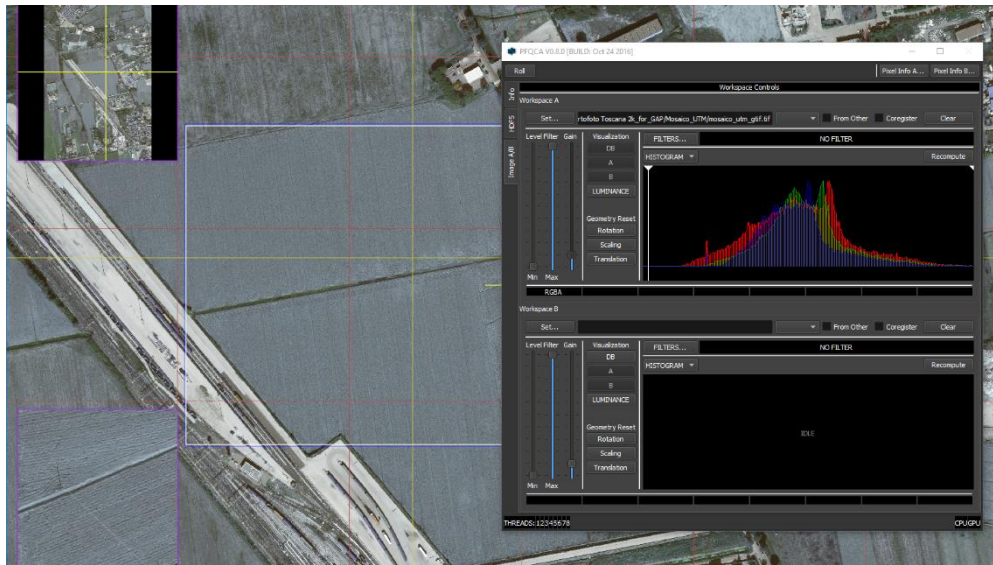
SpaceBIT

Very Big Image Tool based on GPU



- Desktop application
- Big Image & Data visualization (HDF5 & Tiff)
- GPU based acceleration Engine (OpenGL, Vulkan, OpenCL, Metal) for real-time visualization, graphical operation, image filtering and processing
- Multi-display support
- Plugin architecture
- Open to other image formats
- Open to other image processing tool

spaceBIT video



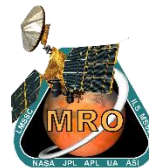
Cosmic Exploration

- spaceSVT—space Science Value Tool 
- *Science Archive Publication System (SAPS)*



*The whole archive of ESA
Scientific Missions*

- spaceSDI—space Spatial Data Infrastructure 
- *Planetary Geosciences Information System*
- *Planetary Radar Operational Center*
- *Moon WebGIS*
- *PLAAVI*



ESA SAPS - SpaceSVT

EUROPEAN SPACE AGENCY  SCIENCE & TECHNOLOGY 

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1. doi: 10.1088/0004-6256/137/1/383

Globular Cluster Populations in Four Early-Type Poststarburst Galaxies

Mayhate, Aparna; Goudfrooij, Paul; Carter, David; Schweizer, François; Puzia, Thomas H.

2009, The Astronomical Journal

[HST](#) [153 observations](#) [4 citations](#)

2. doi: 10.1086/592319

Star Formation Rates in Lyman Break Galaxies: Radio Stacking of LBGs in the COSMOS Field and the Sub- μ Jy Radio Source Population

Carilli, C. L.; Lee, Nicholas; Datta, A.; Yun, M. S.; Smolčić, V.; Schinnerer, E.; Taniguchi, Y.; Lee, K. -S.; Capak, P.; McCracken, H.; Scoville, N.; Urry, C. Megan; Giavalisco, M.

2008, Astrophysical Journal

[HST](#) [2958 observations](#) [53 citations](#)

3. doi: 10.1051/0004-6361:200810137

Stellar abundances and ages for metal-rich Milky Way globular clusters. Stellar parameters and elemental abundances for 9 HB stars in NGC 6352

Feltzing, S.; Primas, F.; Johnson, R. A.

2009, Astronomy & Astrophysics

[HST](#) [235 observations](#) [8 citations](#)

4. doi: 10.1088/0004-637X/693/1/174

X-Ray Microlensing in RXJ1131-1231 and HE1104-1805

Dai, X.; Poindexter, S.; Garmire, G.; Chartas, G.; Kochanek, C. S.

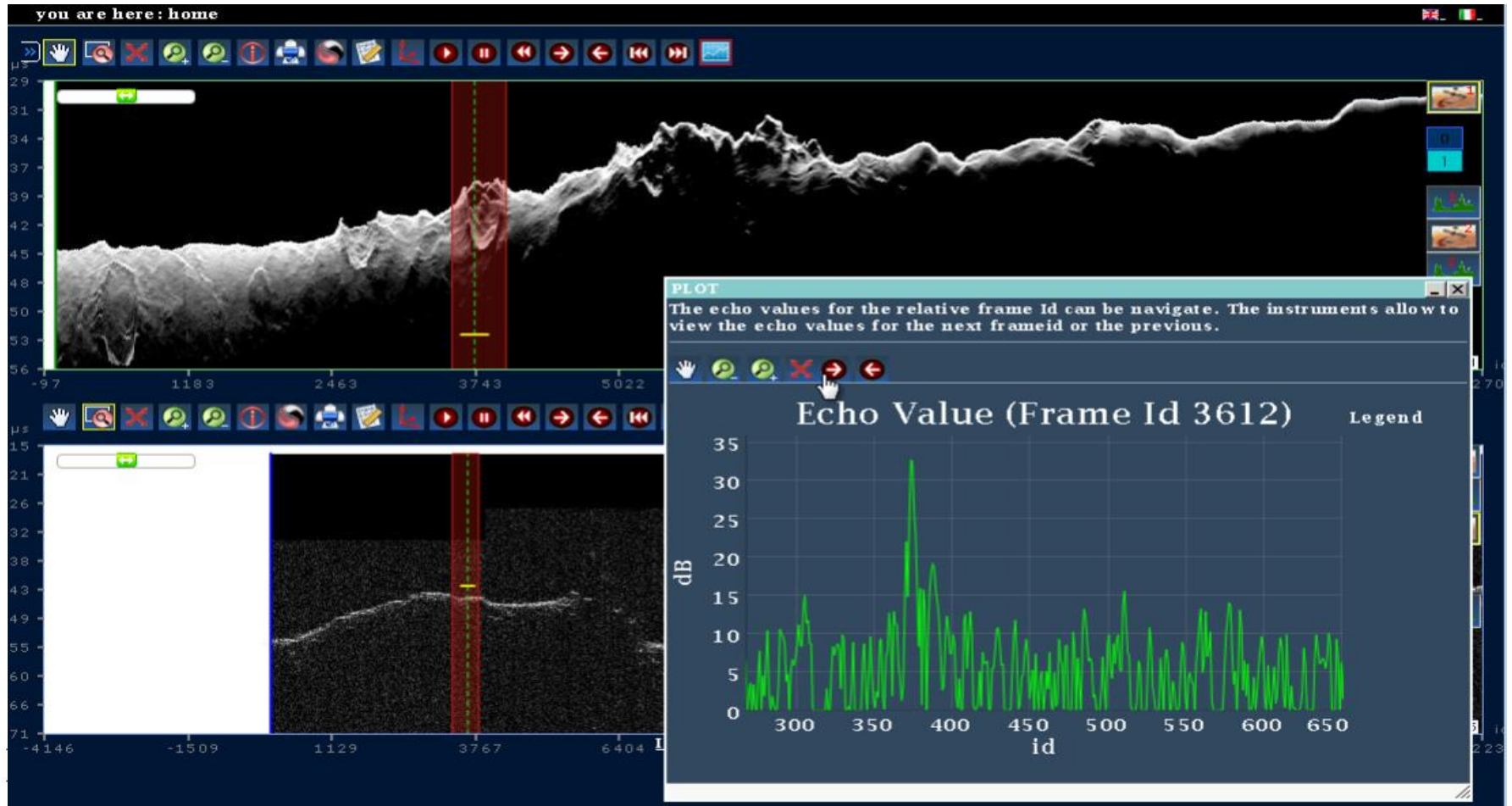
2009, Astrophysical Journal

[HST](#) [392 observations](#) [78 citations](#)

ESA SAPS - SpaceSVT

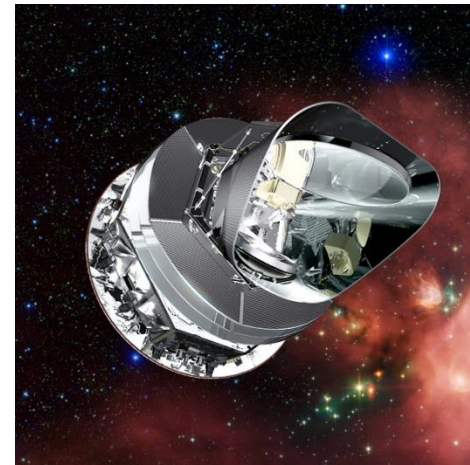


PROC (Planetary Radar Operational Center)



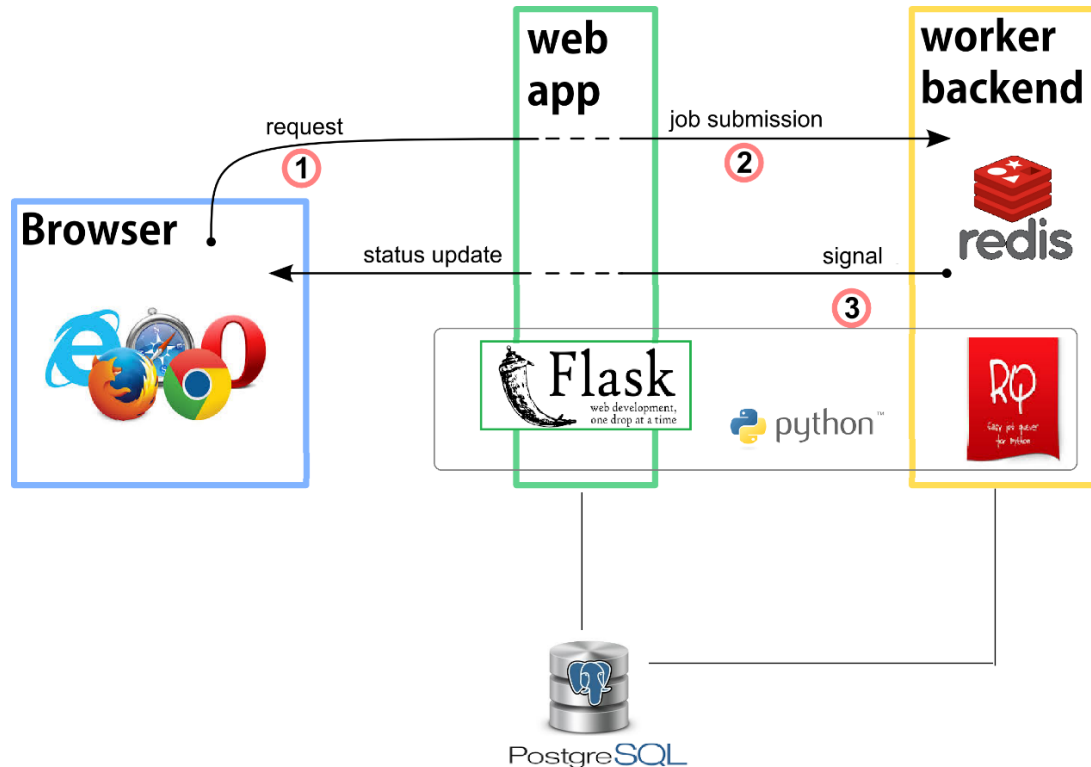
PLAAVI (Planck Legacy Archive Added Value Interface)

- Develop a **Web Application Portal** (front-end and back-end services) to provide additional functionality to the already existing Planck Dataset
- Develop 7 Added Value Interfaces:
 - Noise Map Cut-out
 - Effective Beam Averaging on Map Cut-out
 - Unit Conversion
 - Colour Correction
 - Planck Sky Model (PSM)
 - Map-making
 - Component separation



System Design – Functions and Technologies

1. Users send requests through web browser
2. Web application layer submits jobs to remote server, decoupling client interface from backend worker
3. Backend worker responds to client layer enqueueing job and updating request status



Flask → web microframework for building web applications with Python

Redis → key-value storage database can be used to host queues

RQ (Redis Queue) → simple Python library for queueing jobs and processing them in the background with workers

Thank you!

For further information

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