



plato

WP 38

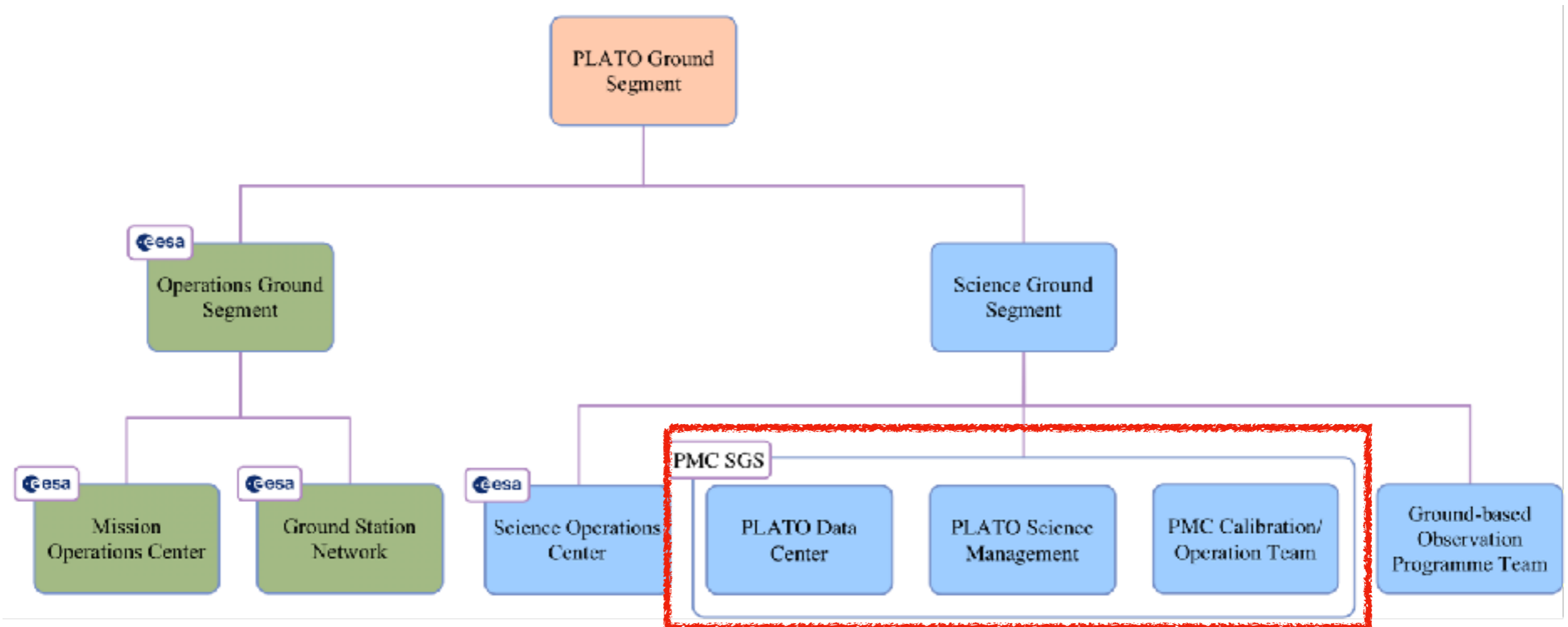
Data Analysis Support Tools

PLATO STESCI III - Barcelona - 11.21.2019

Patrick Gaulme - WP leader
[Max Planck Institute for Solar System Research]

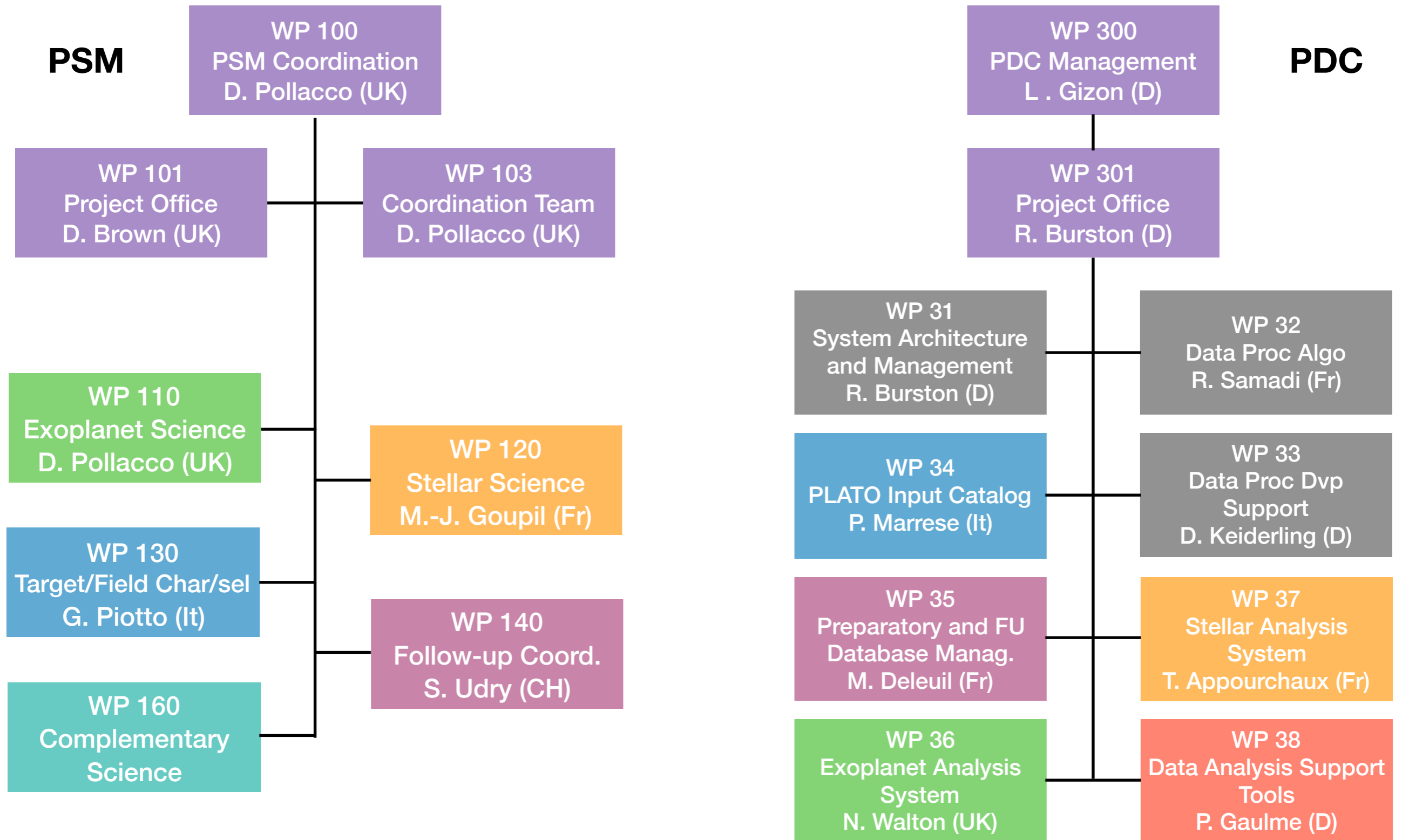
PMC SGS

- Plato ground segment > Plato Mission Consortium (PMC)



PLATO Science Management (PSM)

PLATO Data Center (PDC)



WP38: main requirements

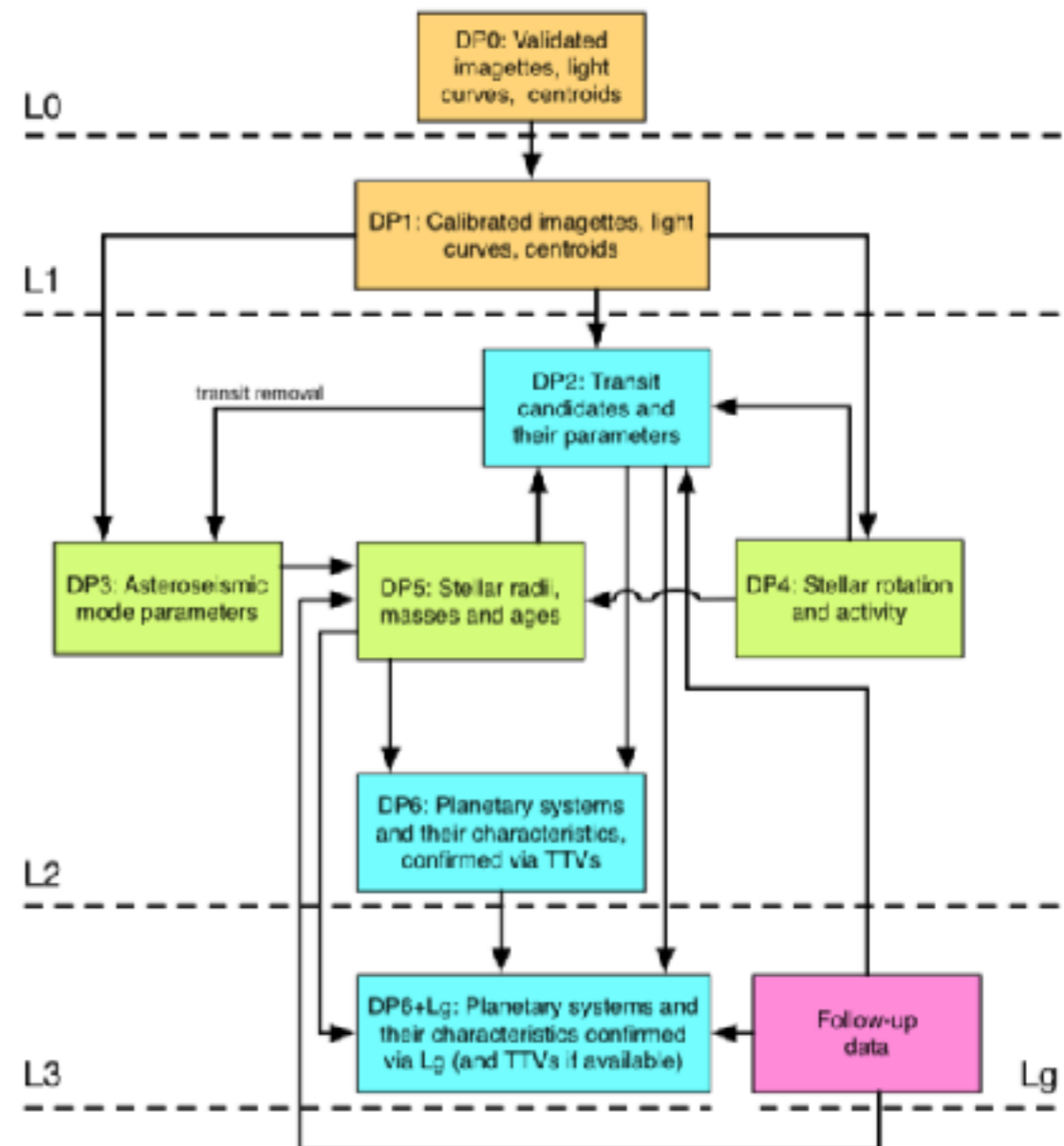
- Main
 - Assist the PMC and PSWT to inspect and to scientifically validate the PLATO data product *
 - (Possibly) Provide users with a web interface to the PDC-DB and other relevant databases **
- Other misc.
 - Call for proposal to be delivered to SOC
 - Selection of tools will be made public by ESA
 - VO format compatible

* According to the Science Implementation Requirement Document (SIRD)

** According to the Science Implementation Plan (SIP)

PLATO Data Products

- DP0 validated light curves, imagerettes centroids
- DP1: calibrated DP0
- For Stellar Science
 - DP3: oscillations
 - DP4: surface rotation, activity
 - DP5: M, R, ages



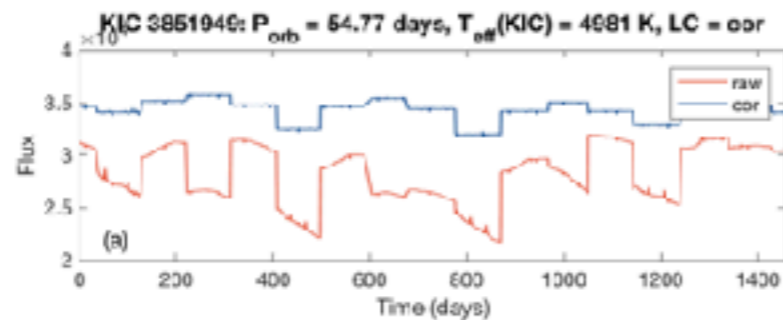
Validating Data Products

- [\[PSIRD-Devpt- DAST-001\]](#) “Based on PSM specifications, the PDC shall design, develop, integrate, test, and technically validate the data analysis support tools.”
- Data products
 - Pipeline produce them (peakbagging, spot modeling, evolutionary track)
 - How do we validate a DP?
 - Plotting output on top of data (eg peakbagging on power spectrum)
 - Replaying pipeline with different inputs
 - Sending feedback
- Need for requirements
 - Which functionalities are needed?
 - Mandatory vs nice to have
 - Technical specifications: display O-C with XX resolution

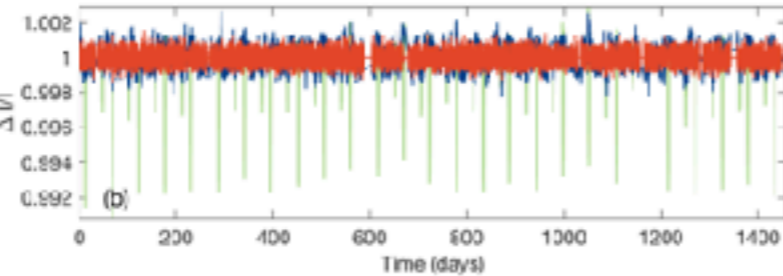
Example of quick look tool

- Vetting sheet: interested in transits (DP2) + oscillations (DP3)

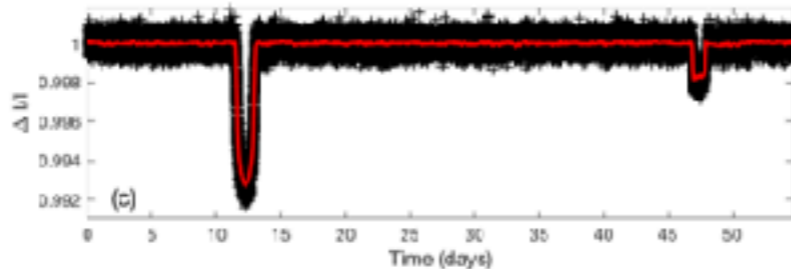
Level 0 time series



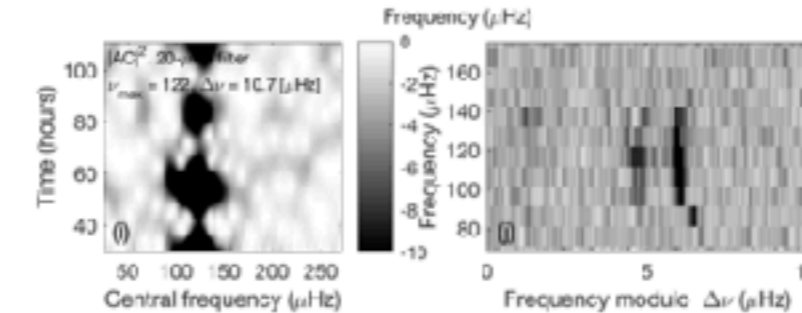
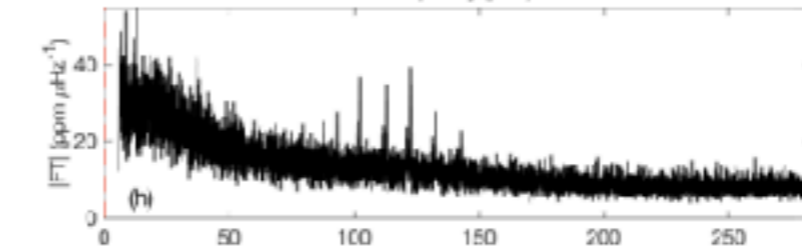
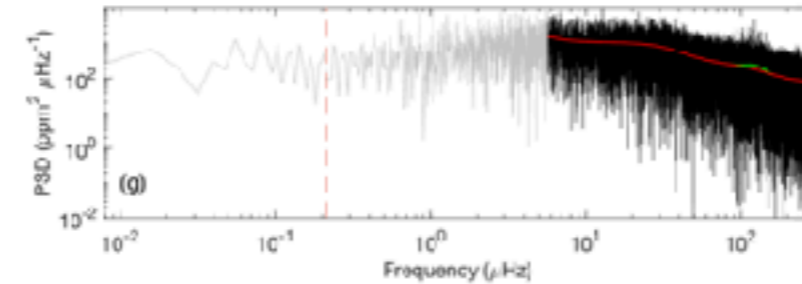
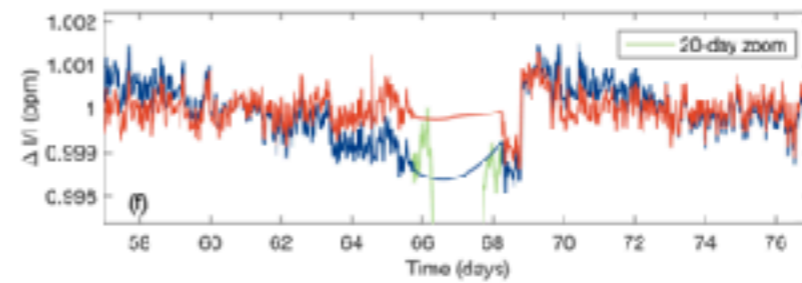
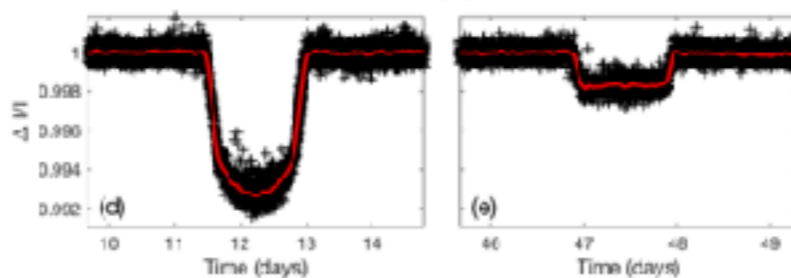
Level 1 time series



Folded time series over orbital period



Zoom on primary and secondary eclipses/transits



Zoom to inspect variability (here 20-day window)

Power spectrum (log-log scale)
Background fitting

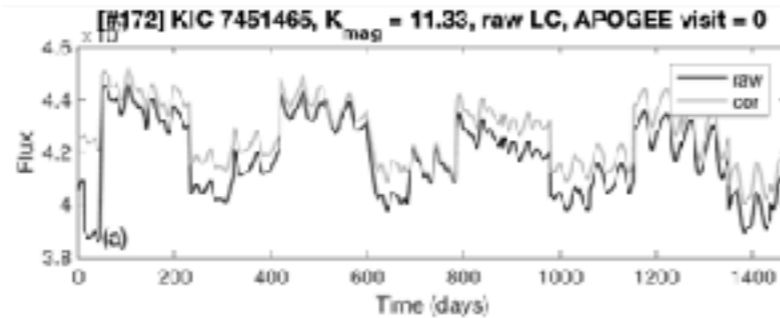
Power spectrum

Left: envelope of autocorrelation
Right: échelle diagram

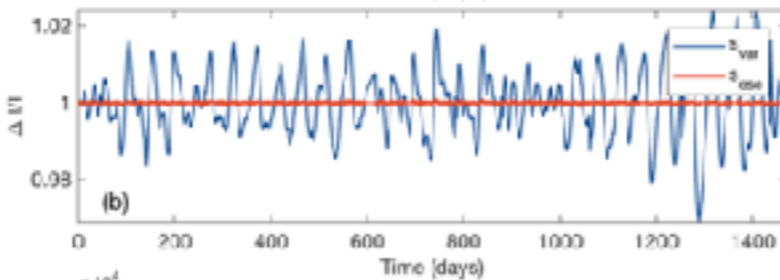
Example of quick look tool

- Vetting sheet: interested in oscillations (DP3) and rotation (DP4)

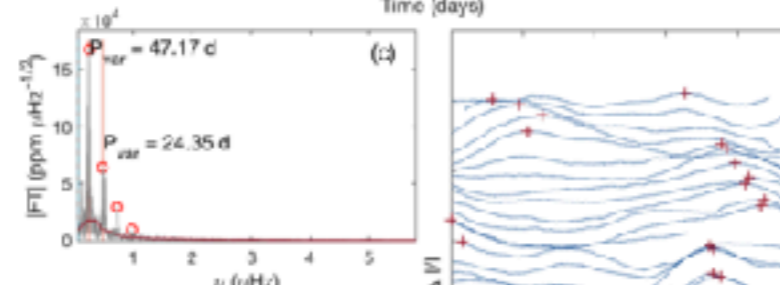
Level 0 time series



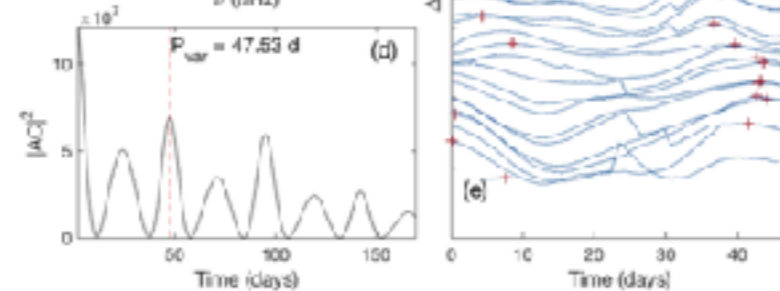
Level 1 time series



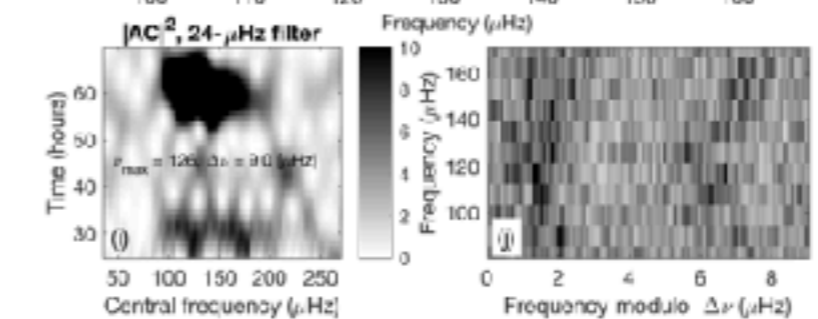
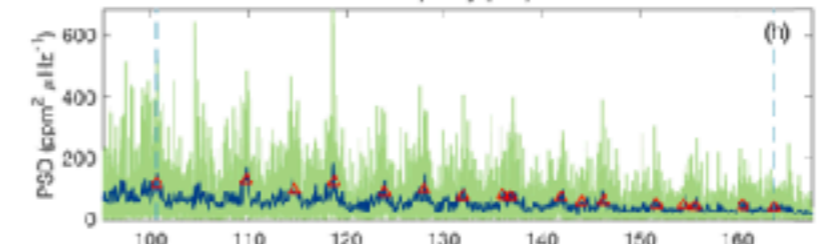
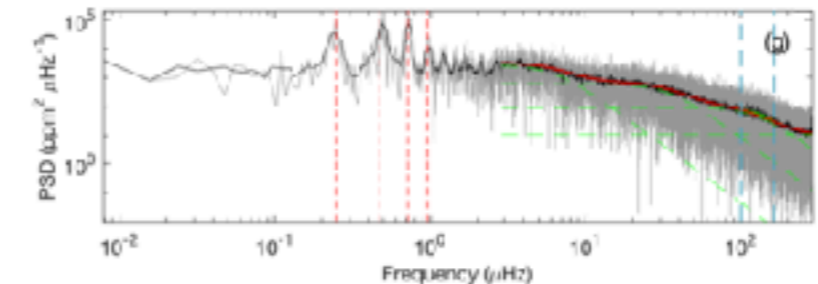
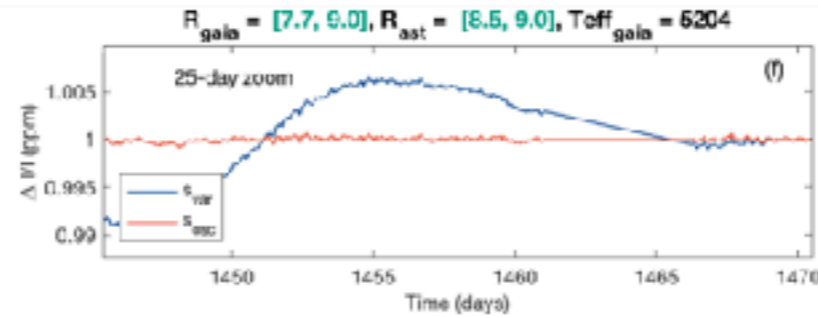
Search for rotation peak in periodogram



Search for rotation peak in autocorrelation of time series



Time series folded on detected rotation period



Zoom to inspect variability (here 20-day window)

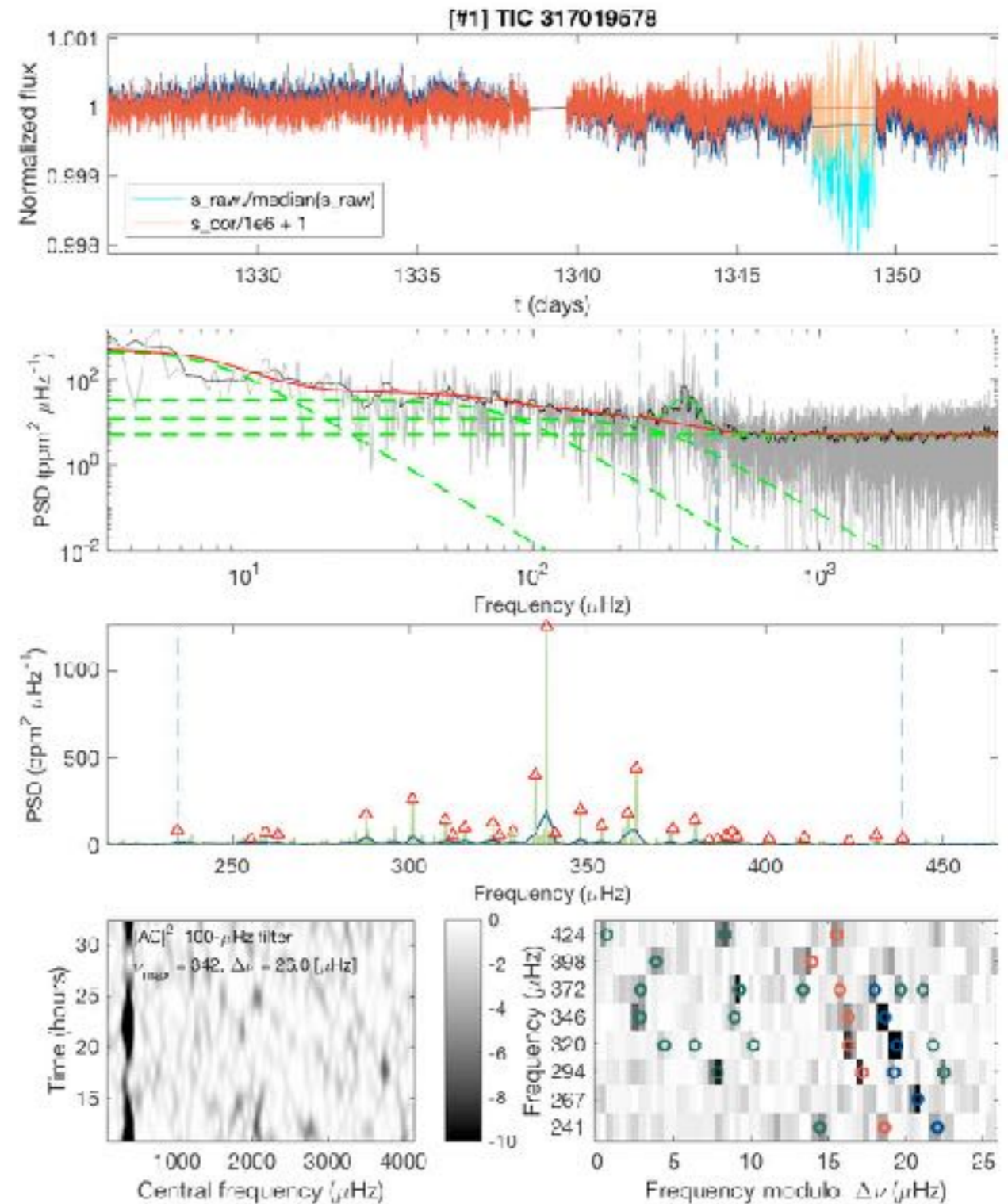
Power spectrum (log-log scale)
Background fitting

Detected stellar oscillations

Left: envelope of autocorrelation
Right: échelle diagram

Example of quick look tool

- Vetting sheet: interested in oscillations (DP3) and background activity



Client-User Interface

- Testing possible technology to be used for the Support Tools.
- Study and tests developed by Pascal Guterman at LAM (Marseille)
- Simple functionalities

Target Tscope Filter Spotmod Transit Imagette Astero

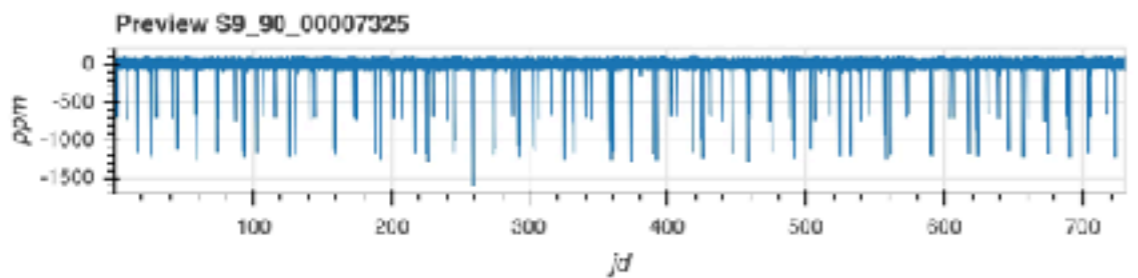


Target selection

#	rankin	confid	id	m	type	rE	period	durath	T0	Teff	logT	logg	rms	nscop	f
0	207		S9_90	5.24		NaN	NaN	NaN	8.8050	5490	NaN	4.5	12.492	18	1.4113
1	176	*	S9_90	6.86	planet	NaN	NaN	NaN	29.290	4966	NaN	4.66	6.3690	6	2.0820
2	202		S9_90	7.31		NaN	NaN	NaN	157.10	4335	NaN	4.72	6.2580	12	1.3556
3	62	***	S9_90	8.87	gp	NaN	NaN	NaN	0.1660	3676	NaN	4.68	6.4554	24	2.0617
4	13	****	S9_90	7.1	tr	NaN	NaN	NaN	3.8220	4056	NaN	4.75	6.3790	12	0.6140
5	259		S9_90	2.03		15.570	2064.0	3.6660	0.3250	7244	3.8560	3.92	17.400	6	1.1407
6	271	***	S9_90	2.42	gp	NaN	NaN	NaN	14.610	4677	NaN	3.18	6.4551	18	0.6100
7	246	*	S9_90	8.90	planet	NaN	NaN	NaN	0.0780	3867	NaN	4.78	10.674	18	2.0050
8	280	***	S9_90	2.46	gp	NaN	NaN	NaN	9.1470	5000	NaN	3.04	7.6440	12	0.9034
9	196		S9_90	0.55		9.0050	5057.0	10.140	33.080	9333	3.9700	3.83	5.3250	24	1.9711
10	91	*	S9_90	8.59	planet	NaN	NaN	NaN	2.0320	4083	NaN	4.87	6.7651	6	2.3290
11	165		S9_90	0.02		NaN	NaN	NaN	4.3250	4027	NaN	4.67	6.3877	6	1.0460
12	98		S9_90	4.26		NaN	NaN	NaN	287.50	6109	NaN	4.28	7.2151	12	1.4400
13	96	*	S9_90	4.18	planet	NaN	NaN	NaN	0.3130	6166	NaN	4.4	7.3804	12	0.6020
14	73	*	S9_90	8.32	planet	NaN	NaN	NaN	0.0710	4075	NaN	4.8	20.510	12	0.5720

Source:

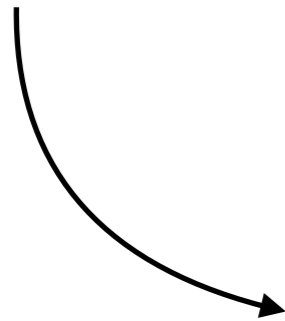
Show:



Client-User Interface demo

- Goal: runs on a PDPC-M server and send visualization to user
- Ex: choose target in the database

List of stars
(target catalog)



Light curve



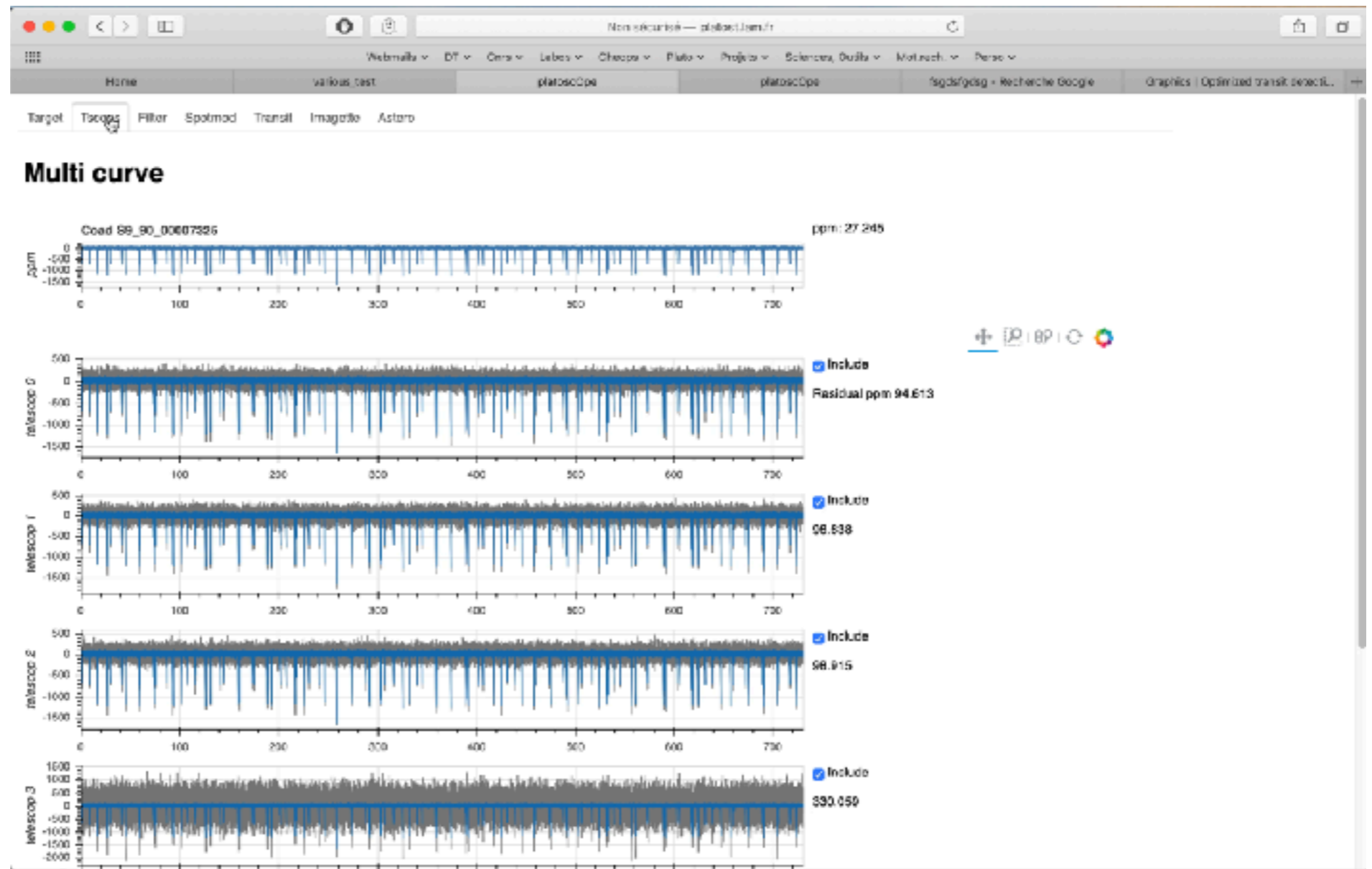
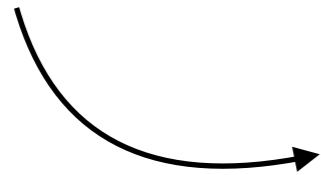
The screenshot shows a web browser window with the URL 'Non sécurisé - platost.lam.fr'. The page has a navigation menu with items like 'Home', 'various_list', 'planetsCps', 'planetsOpn', 'log&logdeg - Recherche Google', and 'Graphix | Optimized transit search...'. Below the navigation is a 'Target selection' section with a logo for 'PlatOSc' and a table of stars. The table has columns: #, rank, contid, id, m, type, IL, period, dursh, ID, lat, lng, log, rms, nscop, and i. The table contains 14 rows of star data. To the right of the table is a 'Source' dropdown menu set to 'GSP', a 'Show' dropdown menu set to 'Telescopes', a green 'Show' button, and a 'Submit' button. Below the table is a 'Preview 89_90_00007325' light curve plot showing 'Opave' vs 'jd'.

#	rank	contid	id	m	type	IL	period	dursh	ID	lat	lng	log	rms	nscop	i
0	207		89_90_5.24			NaN	NaN	NaN	6.800	5490	NaN	4.5	12.496	18	1.4118
1	176	*	89_90_6.86	planet	NaN	NaN	NaN	25.250	4055	NaN	4.65	8.269	8	2.6500	
2	262		89_90_7.31			NaN	NaN	NaN	87.14	4335	NaN	4.72	6.268	12	1.2657
3	82	**	89_90_8.87	gb	NaN	NaN	NaN	0.168	3878	NaN	4.68	5.894	24	2.0612	
4	15	****	89_90_7.1	tv	NaN	NaN	NaN	3.820	4056	NaN	4.75	8.578	12	0.6140	
5	250		89_90_2.65			15.571	2054.0	3.558	0.325	7244	3.850	3.92	17.406	6	1.1405
6	271	**	89_90_2.42	gb	NaN	NaN	NaN	14.811	4677	NaN	3.18	8.455	18	0.6100	
7	246	*	89_90_8.92	planet	NaN	NaN	NaN	0.076	5887	NaN	4.79	10.674	18	2.0050	
8	280	**	89_90_2.46	gb	NaN	NaN	NaN	9.147	5000	NaN	3.04	7.644	12	0.5034	
9	168		89_90_6.65			0.0054	5067.0	10.14	33.06	0838	3.070	3.63	5.325	24	1.6718
10	84	*	89_90_8.89	planet	NaN	NaN	NaN	2.052	4063	NaN	4.67	8.765	8	2.2290	
11	160		89_90_8.62			NaN	NaN	NaN	4.320	4027	NaN	4.67	6.387	8	1.6190
12	98		89_90_4.38			NaN	NaN	NaN	287.5	5109	NaN	4.29	7.215	12	1.4400
13	90	*	89_90_4.16	planet	NaN	NaN	NaN	0.310	5106	NaN	4.4	7.500	12	0.6020	
14	73	*	89_90_8.22	planet	NaN	NaN	NaN	0.071	4075	NaN	4.6	20.512	12	0.5725	

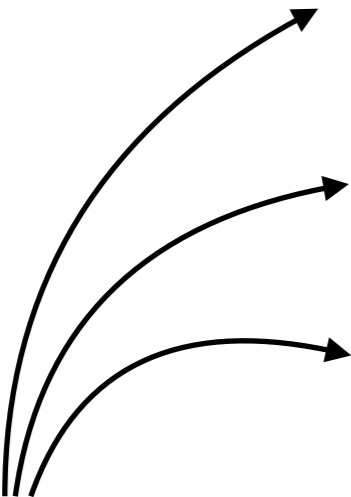
Client-User Interface demo

- Goal: runs on a PDPC-M server and send visualization to user
- Ex: visualize light curves from individual telescopes

Mean PLATO
light curve



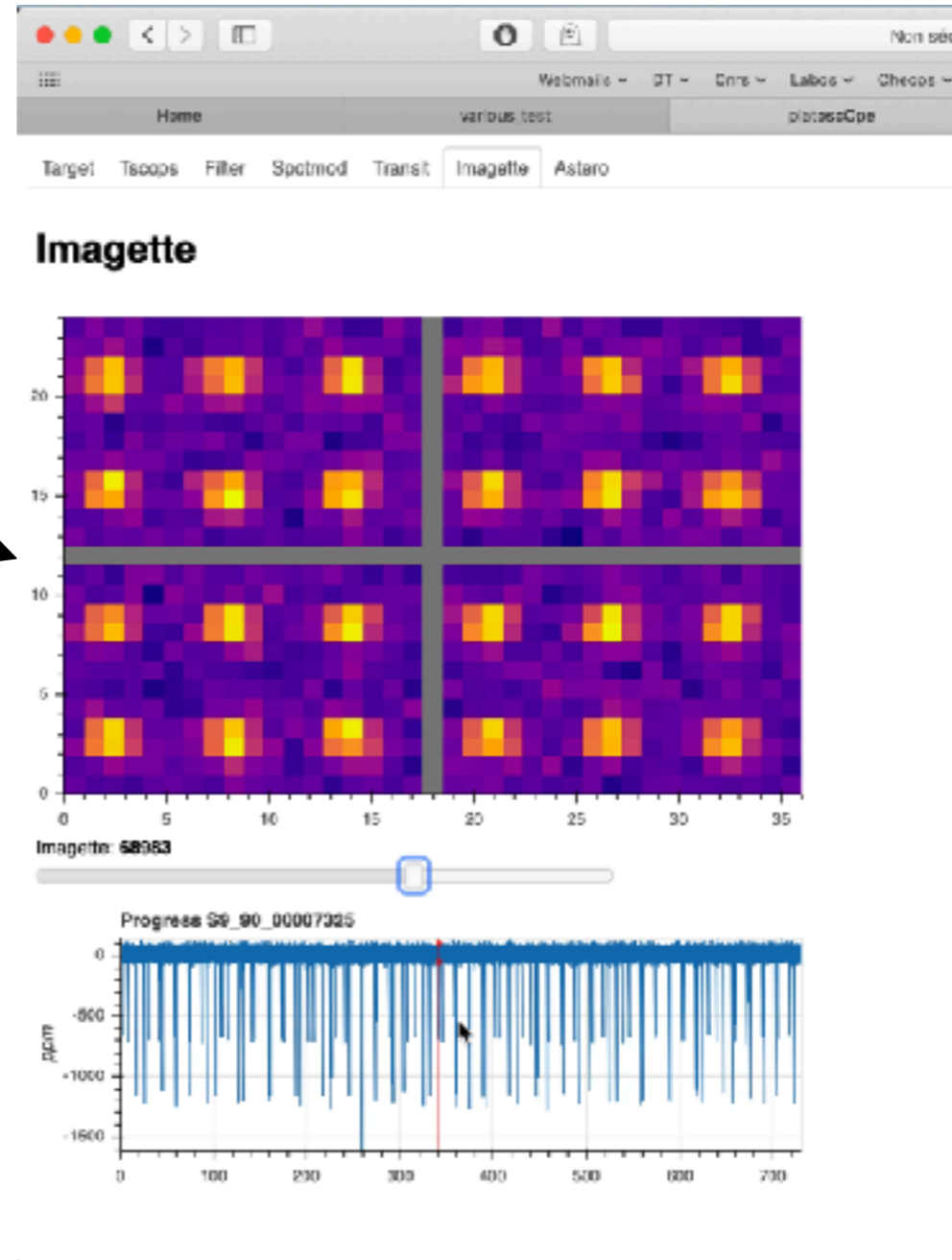
Individual light curves
per telescope



Client-User Interface demo

- Goal: runs on a PDPC-M server and send visualization to user
- Ex: visualize imagettes from all the telescope as a function of time

All imagettes for
the chosen star at
a given time



Mean PLATO light curve

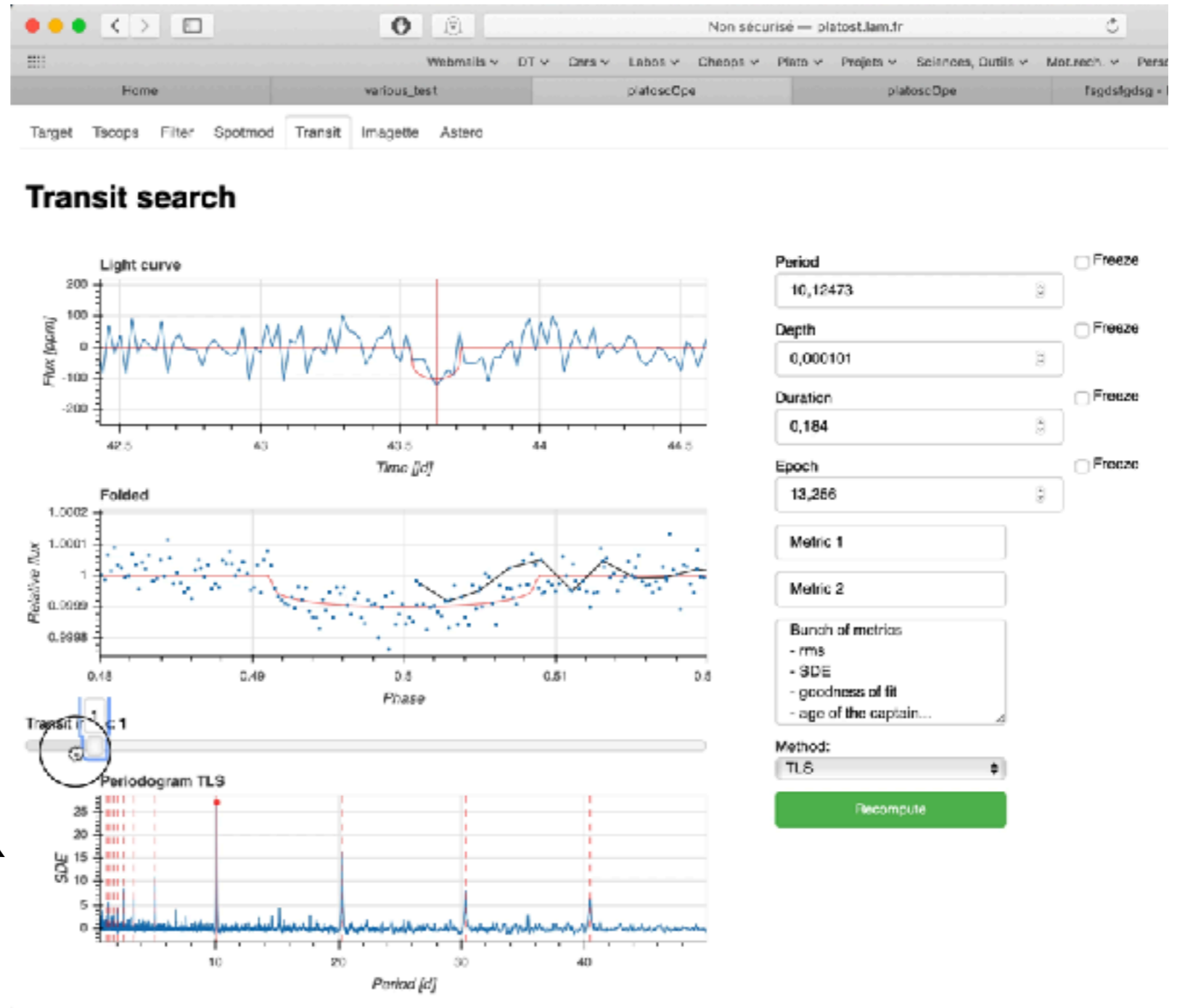
Client-User Interface demo

- Goal: runs on a PDPC-M server and send visualization to user
- Ex: visualize individual transits vs folded transits and periodogram

Light curve zoomed on one single transit

Folded light curve

Fourier spectrum (periodogram)



Client-User Interface demo

- Goal: runs on a PDPC-M server and send visualization to user
- Ex: visualize stellar rotation

Light curve: data (blue)
And filtered signal (orange)

Power spectrum as a
function of frequency
(log-log scale)
Filter selection (orange)

Whitened power spectrum
(not loglog scale)



Conclusions

- Kick off interaction with PSM
- We have a large list of possible tools
 - Sort mandatory from nice to have functionalities
- Technical specifications: put numbers on requirements

Additional Slides

WP38

Data Analysis Support Tools (DAST)

**Dedicated PDC processing
center at MPS: PDPC-M**

WP38: SIRD requests

- [\[PSIRD-Devpt- DAST-001\]](#) Based on PSM specifications, the PDC shall design, develop, integrate, test, and technically validate the data analysis support tools.
 - Assist the PMC and PSWT to inspect and to **scientifically validate the PLATO data products** within the PDC. Assist ranking of planetary candidates, to confirm planetary systems, and thus provide feedback to the Level 2 processing pipelines.
 - The PSWT will recommend which subset of these tools shall be made available to the community. [\[also PSIRD-Ops-DAS-002\]](#)
- [\[PSIRD-Devpt-CS-007\]](#) **Call for proposals:** The PDC shall provide, to the SOC, a PDC Calls for Proposals Tool Set to enable users to calculate the observation signal/noise ratio depending on the target position in the PLATO field, the target visibility, and the location of the target on the detectors. The associated documentation to enable use of the Calls for Proposals Tool Set will be provided alongside the Tool Set.
 - **Will it interact with PDC-DB (PIC, POC)? Runs at SOC or at PDPC-M?**
- [\[PSIRD-Devpt-DP-002\]](#) The PDC shall provide algorithms to the SOC to support their development of: - Level 0 pipelines; - a **Quick Look Analysis system**; - a Real Time Analysis system; - statistical tools, with the purpose of allowing the SOC to perform a quick look assessment and the validation of the Level 0 data.
 - [\[PSIRD-Ops-QLA-003\]](#) The PDC shall provide support for maintaining the modules implemented at the SOC for the quick-look assessment and the validation of **Level 0 data**
- [\[PSIRD-Devpt- VO-002\]](#) PDC shall develop and maintain **VO tools and services** for use within the PMC
- [\[PSIRD-Devpt-Web-001 & PSIRD-Ops-Web-002\]](#) The PDC shall develop and maintain an **internal PDC web site**, in order to give PMC scientists access to the data analysis support tools, and to provide information for ground-based follow-up observers.
- [\[PSIRD-PostOps-L2Final- 004\]](#) The PSM shall **scientifically validate the final list of planets** and their characteristics, in particular using the data analysis support tools available at PDC.

WP38: according to the SIP

Ref PLATO-MPSSR-PMC-SIP-0001 Issue: 2 Revision: 5 (draft r3404) Date: 15 May 2019

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- The main objective of this WP is to implement various tools for the analysis of the PLATO data to assist the consortium scientists in the scientific validation of the PLATO data products on a case-by-case basis.
 - **Provide users with a web interface to the PDC-DB and other relevant databases >> ACCESS TO DATA? Not in SIRD**
 - Enable PMC scientists to **inspect the PLATO data products** (and intermediate data products),
 - Enable PMC scientists to **assess the quality** of the PLATO data products and **give feedback** to the exoplanet and stellar data processing systems
 - Enable PMC scientists to **update the ranking** of planetary systems on a target-by-target basis and confirm planetary systems and their characterization >> **Based on light curves only, or by including GB support?**
 - Enable PMC scientists to access and **display information** on stars and exoplanets
 - Enable PMC scientists to **replay processing pipeline** steps for individual targets >> **is replaying possible?**
 - Enable PMC scientists to perform statistical analyses (e.g. multidimensional correlation analyses) of large samples of stars and/or planets
 - Provide **feedback** to the PSM to support the coordination and future planning of ground-based follow-up observations
 - Provide PMC scientists with **documentation** about PDC algorithms and data products.
 - Provide web services to export data in **VO-compatible** format
 - Provide (possibly through the ESA archive) downloadable VO-compatible software tools for data handling
- **PDC web site** (WP 386 200) [...] interfaces to access databases (PDC-DB and external, WP 386 100) and a dedicated interface for follow-up observers (including WP14 and GOP team [TBC]) which will allow them to obtain relevant follow-up information and to provide feedback over the status and quality of ground-based follow-up observations (WP 386 400).

Breakdown structure

- Revision of structure in progress
- Pascal Guterman (LAM)
 - Technology for client-user interface
- Federico Spada DP5
- Jie Yu DP4?

