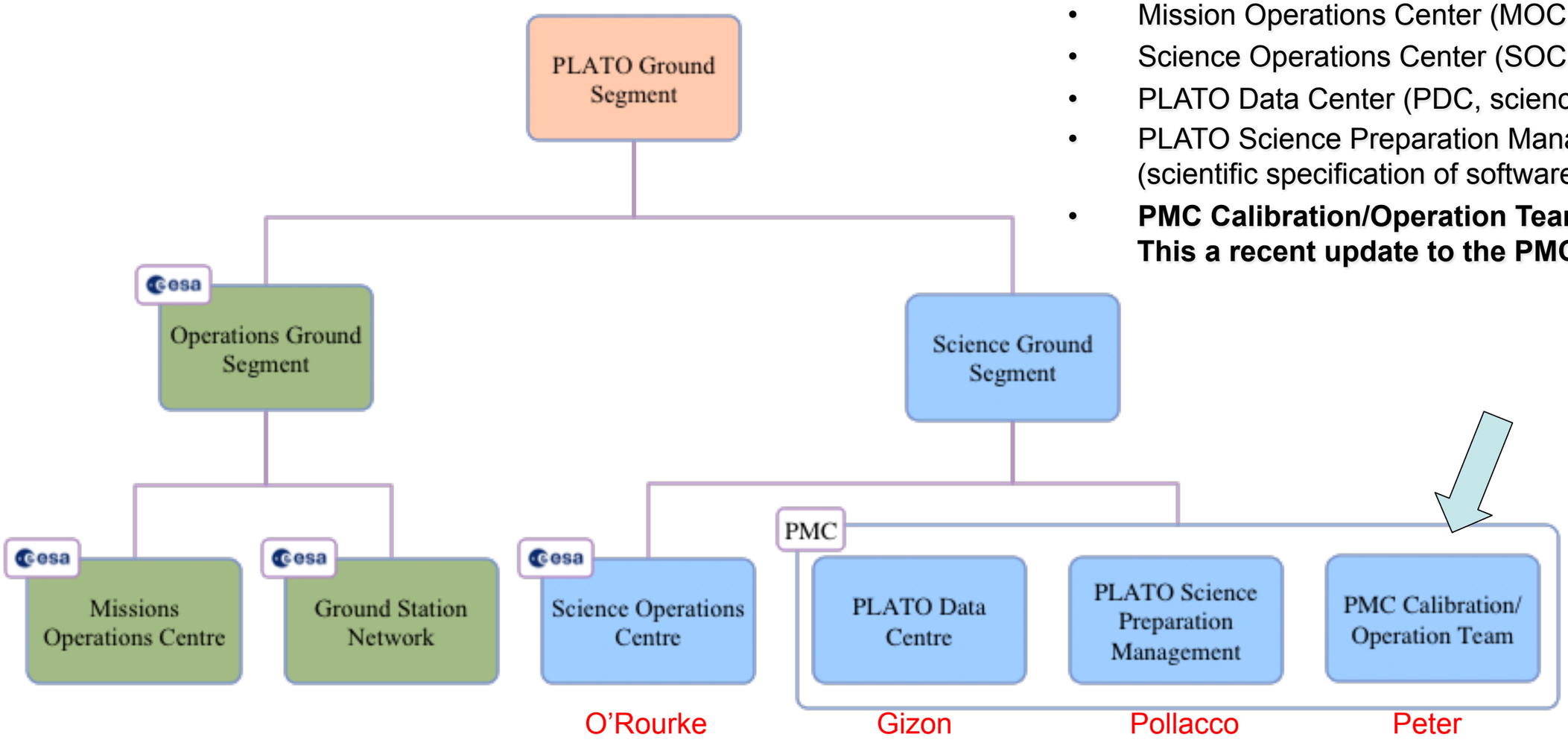
# PLATO DATA CENTRE

Laurent Gizon
and PDC Office

PLATO Stellar Science Meeting, 9-10 April 2015, Paris

New SIP release!
SGS PDCR status and feedback
PDC Office
Ongoing work

# PLATO Ground Segment (PGS)




- Mission Operations Center (MOC, flight-critical)
- Science Operations Center (SOC, mission-critical)
- PLATO Data Center (PDC, science-critical)
- PLATO Science Preparation Management (scientific specification of software)
- **PMC Calibration/Operation Team (calibration). This a recent update to the PMC SGS.**

The PDC is in charge of the calibration and processing of the PLATO observations. The PDC delivers the final PLATO science Data Products to the SOC.

PSPM provides the scientific specification of the algorithms that run at the PDC. PMC scientists scientifically validate L2 data (esp. DP6) using PDC tools

# New SIP Release of March 12

| | | |
|---|---|---|
| | PMC SGS SIP | Ref PLATO-MPSSR-PMC-SIP-001<br>Issue: 2 Revision: 3<br>Date: 11th March 2015<br>Page: 1/293 |

Max Planck Institute for Solar System Research
Goettingen

**PLATO MISSION CONSORTIUM**
**SCIENCE IMPLEMENTATION PLAN**

| | Name & Society | Date | Signature |
|---|---|---|---|
| Prepared by | Laurent Gizon<br>PLATO Data Processing Manager<br><br>Don Pollacco<br>PSPM Coordinator | 11th Mar 2015 | |
| Approved by | Heike Rauer<br>PLATO Mission Consortium Lead | 11th Mar 2015 | |
| Authorized by | Laurent Gizon<br>PLATO Data Processing Manager<br><br>Don Pollacco<br>PSPM Coordinator<br><br>Heike Rauer<br>PLATO Mission Consortium Lead | 11th Mar 2015 | |

| | | |
|---|---|---|
| ARCHIVING: | Limited Diffusion | Public x |
| DOCUMENT HANDLED IN CONFIGURATION: No | | |

## 11 REVIEW DOCUMENT LIST

| Document Name | Reference |
|---|---|
| Mission Requirements Document (MRD) | ESA-PLATO-ESAC-PRO-001 |
| | |
| Science Interface Requirements Document (SIRD) | ESA-PLATO-ESTEC-SCI-RS-003 |
| Science Operations Concept Document (SOCD) | ESA-PLATO-ESAC-OPS-001 |
| | |
| ESA SOC Science Implementation Plan (SOC SIP) | PLATO-SGS-PL-001 |
| PMC Science Implementation Plan (PMC SIP) | PLATO-PMC-SIP-MPSSR-001 |
| | |

Once again a huge effort. . .

PDC and PSPM inputs
SGS SIP consolidated by Ray Burston, Matthias Ammler, and PDC Office

# Data Levels

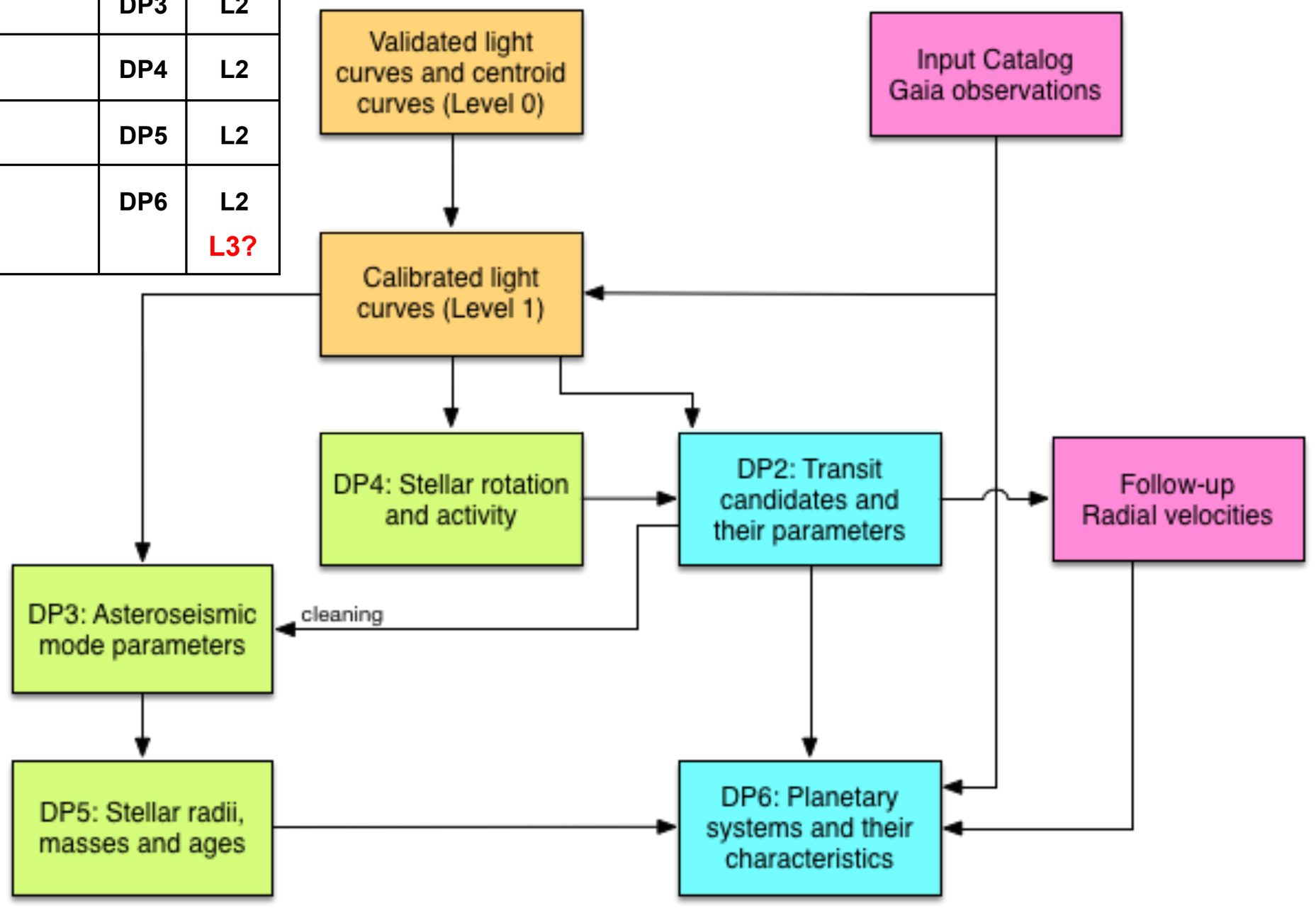
- **Telemetry baseline: Now 436 Gb/day using the K-Band**

  **An increase of about a factor of 4 in telemetry.**

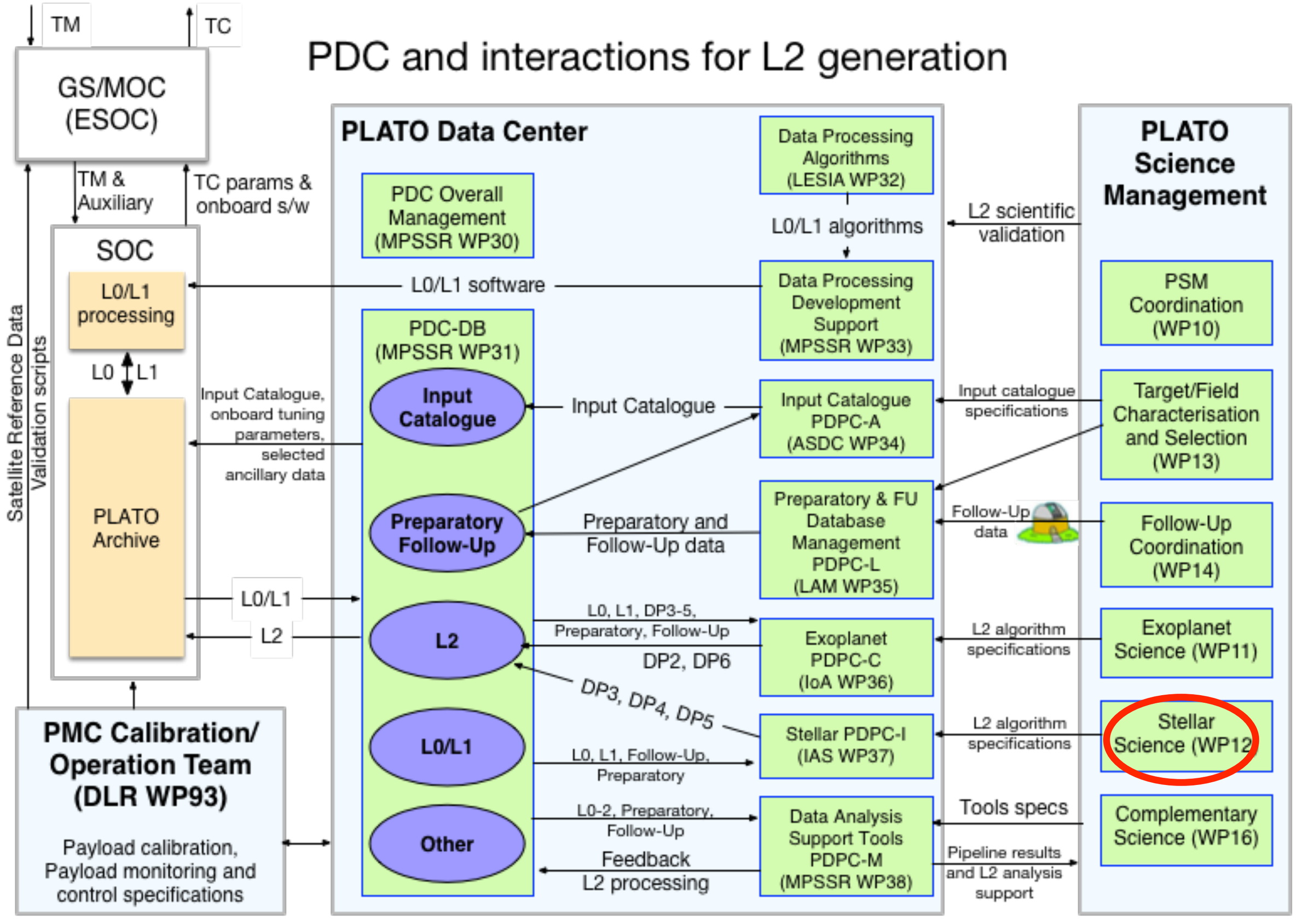
  **Many more imagettes can be downlinked (all P1 stars).**
- **Level 0**: Depacketized light curves and centroid curves plus selected (6x6) imagettes; for each telescope (32 NT@25s + 2 FT@2.5s).
- **Level 1**: Computation of average light curves and centroid curves for each star (science-ready). Analysis of imagettes to validate and optimize performance of on-board treatment. Implementation of on-ground instrumental corrections, such as CCD corrections and jitter corrections. FT are used for fine guidance and navigation and to identify possible blend scenarios.
- **Level 2**: PLATO science Data Products, processed by the PDC using algorithms specified by the PSPM.
- ***(TBC) Level 3:*** *Final list of confirmed + characterized planets (DP6)*

# PLATO Science Data Products

| | | |
|---|---|---|
| **Calibrated light curves and centroid curves** | **DP1** | **L1** |
| **Planetary candidate transits & their parameters** | **DP2** | **L2** |
| **Asteroseismic mode parameters** | **DP3** | **L2** |
| **Stellar rotation and activity** | **DP4** | **L2** |
| **Stellar radii, masses and ages** | **DP5** | **L2** |
| **Confirmed planetary systems and their characteristics** | **DP6** | **L2**<br>**L3?** |



# PDC and interactions for L2 generation



# PDC and interactions for L2 generation

TM
TC
GS/MOC (ESOC)
TM & Auxiliary
TC params & onboard s/w
SOC
L0/L1 processing
L0 L1
PLATO Archive
Satellite Reference Data
Validation scripts
Input Catalogue, onboard tuning parameters, selected ancillary data
L0/L1
L2
PMC Calibration/ Operation Team (DLR WP93)
Payload calibration, Payload monitoring and control specifications

**PLATO Data Center**

PDC Overall Management (MPSSR WP30)
PDC-DB (MPSSR WP31)
Input Catalogue
Preparatory Follow-Up
L2
L0/L1
Other

Data Processing Algorithms (LESIA WP32)
L0/L1 algorithms
L0/L1 software
Data Processing Development Support (MPSSR WP33)
Input Catalogue
Input Catalogue PDPC-A (ASDC WP34)
Preparatory and Follow-Up data
Preparatory & FU Database Management PDPC-L (LAM WP35)
L0, L1, DP3-5, Preparatory, Follow-Up
DP2, DP6
Exoplanet PDPC-C (IoA WP36)
DP3, DP4, DP5
Stellar PDPC-I (IAS WP37)
L0, L1, Follow-Up, Preparatory
L0-2, Preparatory, Follow-Up
Feedback L2 processing
Data Analysis Support Tools PDPC-M (MPSSR WP38)

L2 scientific validation
Input catalogue specifications
Follow-Up data
L2 algorithm specifications
L2 algorithm specifications
Tools specs
Pipeline results and L2 analysis support

**PLATO Science Management**

PSM Coordination (WP10)
Target/Field Characterisation and Selection (WP13)
Follow-Up Coordination (WP14)
Exoplanet Science (WP11)
Stellar Science (WP12)
Complementary Science (WP16)

# PDC and interactions for L2 generation

TM
TC
GS/MOC (ESOC)
TM & Auxiliary
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DP3, DP4, DP5
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L0-2, Preparatory, Follow-Up
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L2 scientific validation
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PLATO Science Management
PSM Coordination (WP10)
Target/Field Characterisation and Selection (WP13)
Follow-Up Coordination (WP14)
Exoplanet Science (WP11)
Stellar Science (WP12)
Complementary Science (WP16)

Splinter sessions cover most requirements to PDC
Not so directly WP32 and WP38 though

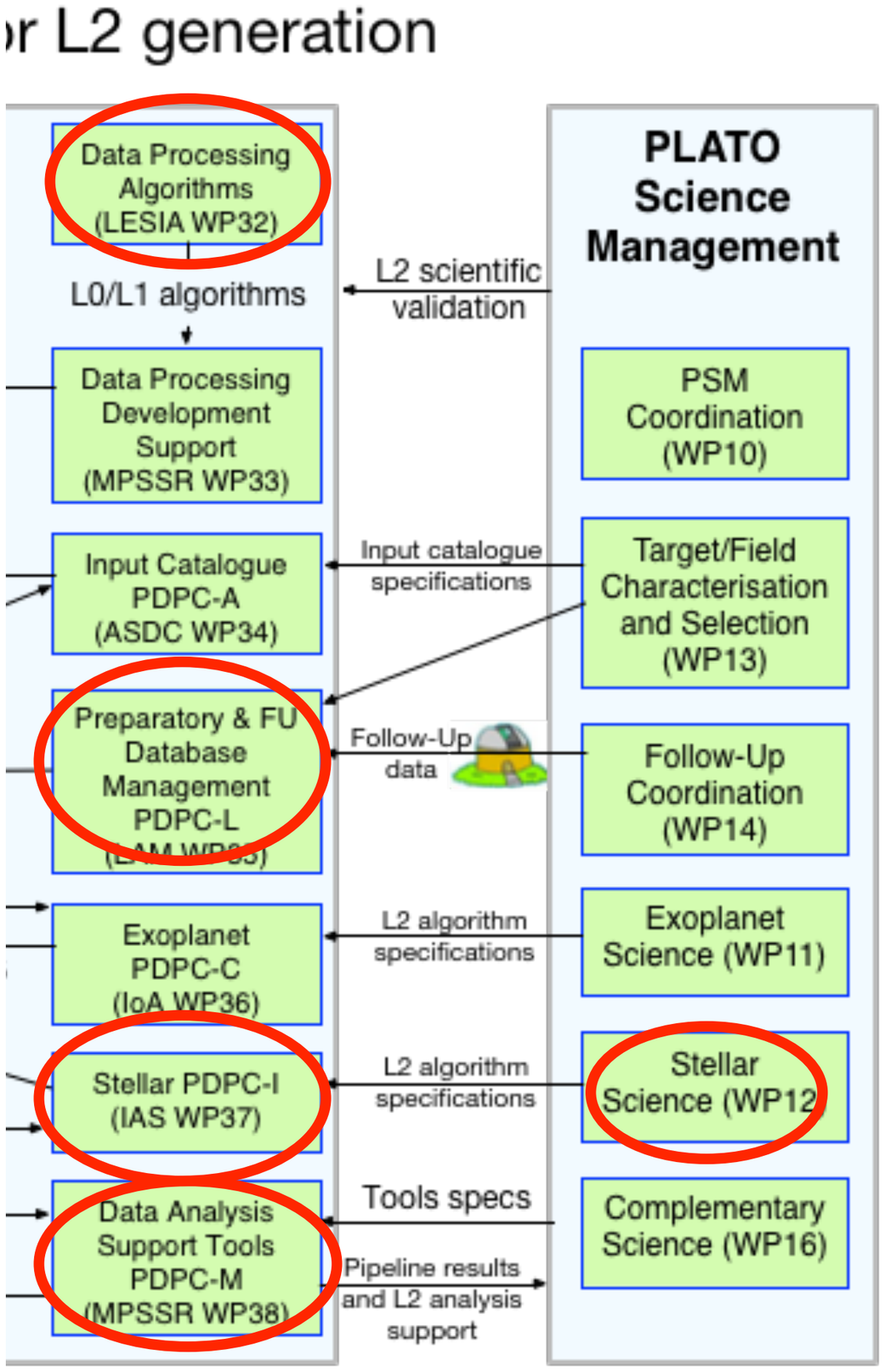
- DP5 ← WG1 (chair M.A. Dupret): Stellar models
  output: specifications for parameters driving a high quality of the stellar models to be built, specifications for the grids, ...

- Add. data and DP5 ← WG2 (chair T. Morel):
  Non-seismic diagnostics and model atmosphere
  output: stellar radius, gravity, effective temperature, chemical composition, ...

- DP4 ← WG3 (chair: A. F. Lanza):
  Stellar activity & rotation
  output: rotation periods, activity level, ...

- DP5 ← WG4 (chair M. Cunha):
  Seismic diagnostics and stellar parameters
  output: seismic stellar mass, radius, age ...

- DP3← WG5 (chair W.J. Chaplin):
  Seismic data analysis
  output: oscillation frequencies, amplitudes, widths ...



# PDC WBS

A lot of PDC leaders are here today: an opportunity to talk

DPS (payload)
Data Processing Algorithm WG

300 000
**PDC Management**
MPSSR | L. Gizon (PDPM) — DE

301 000
**PDC Project Office Manager**
MPSSR | R. Burston — DE

310 000 — DE
**System Architecture and Management**
MPSSR | R. Burston
310 001
**PDC-DB**

330 000 — DE
**Data Processing Development Support**
MPSSR | L.Gizon

350 000 — FR
**Preparatory & FU DB Management**
LAM | M. Deleuil
350 001
**PDPC-L**

370 000 — FR
**Stellar Analysis System**
IAS | T. Appourchaux
370 001
**PDPC-I**

320 000 — FR
**Data Processing Algorithms**
LESIA | R. Samadi

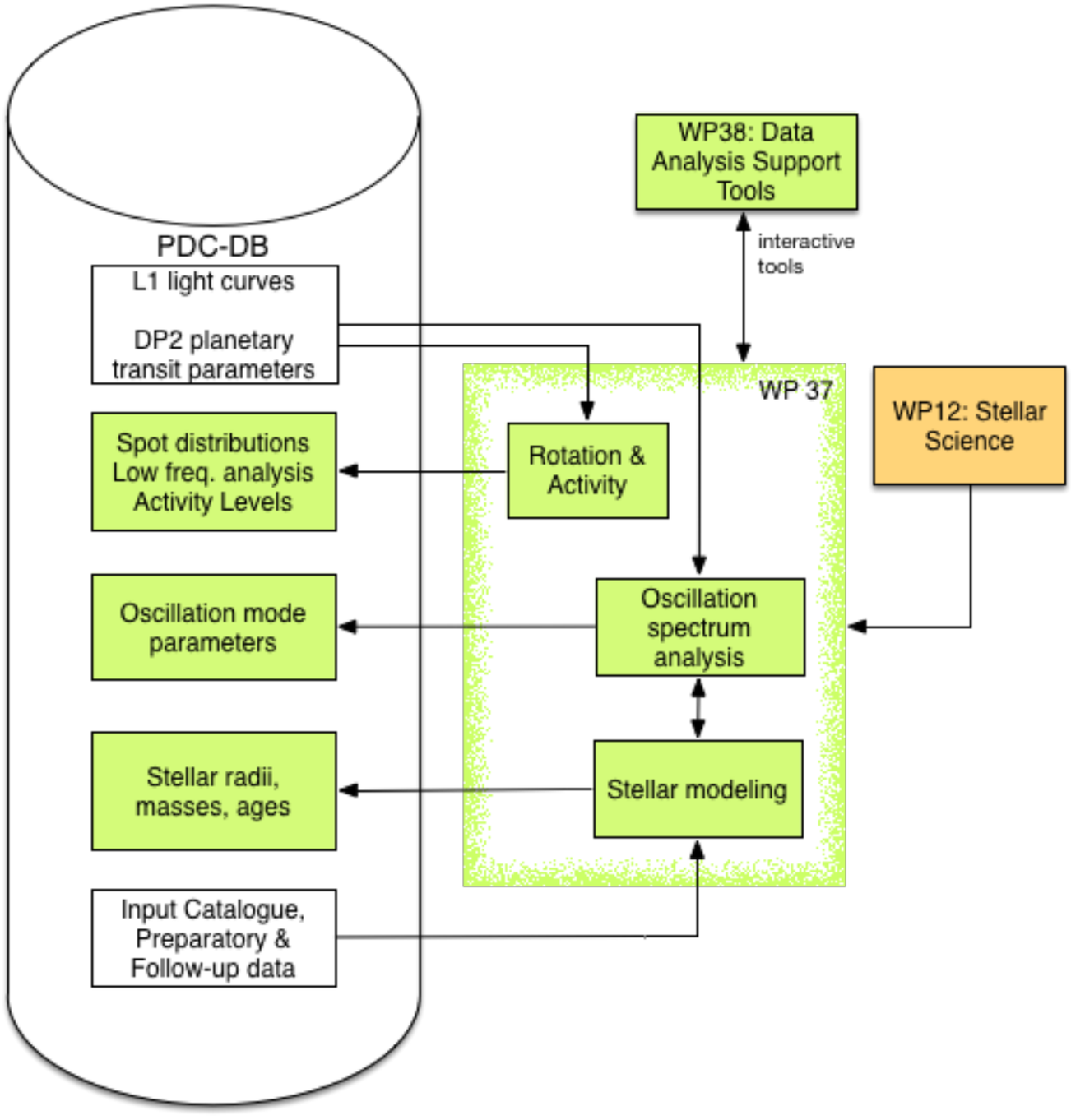
340 000 — IT
**Input Catalogue**
ASDC-ASI | P. Giommi
340 001
**PDPC-A**

360 000 — UK
**Exoplanet Analysis System**
IoA-Cam | N. Walton
360 001
**PDPC-C**

380 000 — DE
**Data Analysis Support Tools**
MPSSR | M. Ammler-von Eiff
380 001
**PDPC-M**

# PDC Stellar Analysis System: WP37

Thierry Appourchaux (IAS)




WP31: System Architecture (Raymond Burston)

A PDC Database (PDC-DB) will be a central hub that ensures relevant data is made available in a timely manner to other systems, such as the five PLATO Data Processing Centers (PDPCs) and the SOC, for the processing and exploitation of the PLATO observations

**Processing cycles**: The two-weekly cycle allows for triggering the downlink of the imagettes of candidate planets and for triggering the ground-based follow-up of objects of interest**. A full update of the science data products will be made available every three months.**

370 000
**Stellar Analysis System**
IAS | Appourchaux

370 001
**PDPC-I**
IAS | Appourchaux

→ Thierry's talk

371 000
**Planning & Management**
IAS | Ballans

371 100
**Operational Requirements**
IAS | Ballans

371 200
**Design of Workflows**
IAS | Ballans

371 300
**Development System**
IAS | Ballans

372 000
**Power Spectrum Analysis Tools**
IAS | Appourchaux

372 100
**Average Sesimic Parameter Measurement Tools**
Birmingham | Chaplin

372 200
**Mode Fitting Tools**
IAS | Appourchaux

372 210
**Solar-like Stars**
IAS | Appourchaux

372 220
**Solar-like Stars with Planets**
MPSSR | Gizon

372 230
**Multiple Stars**
IRAP | Ballot

372 240
**Ensemble Fit**
CEA | Garcia

372 250
**Red giants**
Birmingham | Davies

372 260
**Heat-Driven Pulsators**
Leuven | Aerts

372 300
**Data Products 3**
IAS | Appourchaux

372 400
**Simulations & Validations**
MPSSR | Schou

373 000
**Stellar Rotation & Microvariability Measurement Tools**
IAS | Baudin

373 100
**Stellar Background**
IAS | Boumier

373 200
**Rotation & Activity Analysis Tools**
CEA | Garcia

373 300
**Spot Distribution Measurement Tools**
Meudon | Mosser

373 400
**Data Products 4**
IAS | Baudin

373 500
**Simulations & Validations**
MPSSR | Schou

374 000
**Stellar Modelling Tools**
AAU | Aguirre

374 100
**Model Grid Acquisition**
CAUP | Bazot

374 200
**Seismic Diagnostics & Tools**
Birmingham | Miglio

374 210
**Forward Tools**
Birmingham | Miglio

374 220
**Inversion Tools**
LESIA | Goupil

374 300
**Data Products 5**
AAU | Kjeldsen

374 310
**End-Product Guarantee**
Granada | Suarez

374 400
**Simulations & Validations**
MPSSR | Schou

375 000
**L1 Correction from known Transits**
IAC | Alonso

# Data Analysis Support Tools: WP38

Coordinator is Matthias Ammler-von Eiff (MPSSR)

- Interactive tools to assist PMC scientists to inspect and scientifically validate PLATO Data Products (including stellar DPs) on a case-by-case basis and update ranking of planetary systems. Tools to replay the pipelines step by steps and inspect intermediate data products.
- Tools for search, statistical analysis and data mining of large samples
- Tools to provide feedback to mission planning, e.g. trigger download of imagettes to the ground.
- Tools to provide feedback to L2 processing pipelines (exoplanet and stellar)

# SGS PDCR Timeline

**March-May 2015: PLATO SGS Preliminary Design Consolidation Review (SGS PDCR)**

- 12th March 2015: Distribution of SGS PDCR documentation package to SGS PDCR Expert Panel
- 12th March 2015: Kickoff presentations to SGS PDCR Expert Panel
- 31st March 2015: Deadline for Feedback from SGS PDCR Expert Panel
- 15th April 2015: Deadline for SGS Responses to Feedback raised by the SGS PDCR Expert Panel
- 20-24th April 2015: Meeting of SGS PDCR Expert Panel to review Feedback and SGS Responses
- mid-May 2015: Final SGS PDCR Report sent by SGS PDCR Expert Panel

# 10 EXPERT PANEL COMPOSITION

The composition of the Review Panel is as follows:

| Review Panel | | |
|---|---|---|
| KRETSCHMAR, Peter | SRE-OOG | Panel Chairperson |
| JENKINS, Jon | NASA/Ames Research Centre | Panel member |
| SIDDIQUI, Hassan | SRE-OOO | Panel member |
| JORDA, Laurent | CNRS, LAM | Panel member (TBC) |
| BEDDING, Tim | Univ. Sydney | Panel member |
| BUENADICHA, Guillermo | SRE-ODE | Panel member |
| BAKKER, Jorgo | SRE-OOH | Panel member |
| SYMONDS, Kate | HSO-OSA | Panel member |
| AGNOLON, David | SRE-FMP | Panel member |
| PILBRATT, Göran | SRE-S | Panel member |
| SALGADO, Jesus | SRE-OE | Panel Member |
| GONDOIN, Philippe | SRE-FP | Observer |
| HERAS, Ana | SRE-S | Observer |
| O' ROURKE, Laurence | SRE-OOR | Observer |
| RAUER, Heike | PMC | Observer |
| GIZON, Laurent | PMC | Observer |
| POLACCO, Don | PMC | Observer |
| TEXIER, Damien | SRE-ODL | Observer |

# 11 REVIEW DOCUMENT LIST

| Document Name | Reference |
|---|---|
| Mission Requirements Document (MRD) | ESA-PLATO-ESAC-PRO-001 |
| | |
| Science Interface Requirements Document (SIRD) | ESA-PLATO-ESTEC-SCI-RS-003 |
| Science Operations Concept Document (SOCD) | ESA-PLATO-ESAC-OPS-001 |
| | |
| ESA SOC Science Implementation Plan (SOC SIP) | PLATO-SGS-PL-001 |
| PMC Science Implementation Plan (PMC SIP) | PLATO-PMC-SIP-MPSSR-001 |
| | |

# SGS PDCR Expert Panel Feedback (SAS related examples)

- ESA-PLATO-ESTEC-SCI-RS-003: SIRD: Sect 6.3: PSIRD-Devpt-SciVal-002: 'scientifically validate' - this is an open-ended concept. Can there be additional text either in the requirement box, or in a section in the SIRD, that provides more detail as to what is meant by this? Examples would help.

- ESA-PLATO-ESAC-OPS-001: SOCD: Sect 3.1: PLATO relies on the PDC for L2 processing. Is there even a remote chance a (larger) SOC could step in, in case the PDC cannot fulfill its obligations? Are there plans for a standardized L2 architecture?

- ESA-PLATO-ESTEC-SCI-RS-003: Level 1 data products should probably also include the power spectrum of the light curves

- ESA-PLATO-ESTEC-SCI-RS-003: Level 2 data products should also include the global asteroseismic quantities, such as Dnu and numax, and also the masses and radii inferred from these

- ESA-PLATO-ESAC-PL-001: 7.4.4.1 Reqs on level 1 data into archive w/in 3 years of end of ops seem rather long compared to the req that level 0 data be produced within one day of receipt of data. The level 1 data should be in the archive much sooner, say within 1 year of the end of the ops for first version. Final reprocessed data should be in archive within 3 years of end of mission.

- ESA-PLATO-ESAC-PL-001: PSIRD-Devpt-DP-008/012. Are there re-processing requirements for PLATO as algorithms and software are improved over the course of the mission? Is there a plan to host multiple versions of the archival data products from different pipelines, or will there only be one version available to the public at any given time?

# PDC Project Office

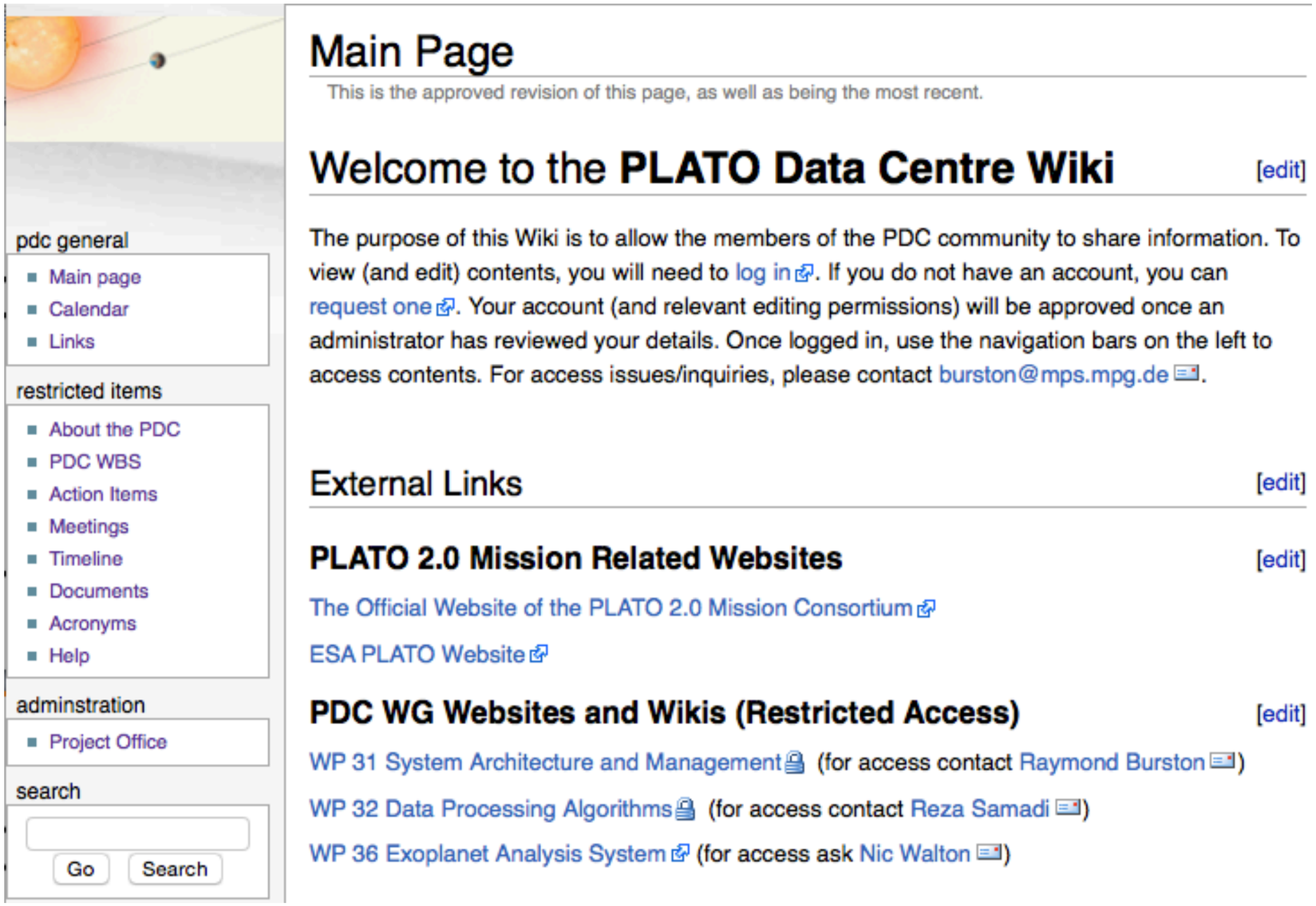
- PDCoffice@mps.mpg.de at MPS Gottingen ~4 FTEs
- PDC office coordinates documentation and answers questions:
  - PDPM: ***Laurent Gizon***
  - PDC Project Office Manager: ***Raymond Burston***
  - PDC Project Office Deputy Manager: ***Valerian Chifu***
  - PDC Risk Management: ***Matthias Ammler-von Eiff***
  - PDC Scheduling: ***Joerg Knoche (new)***
  - PDC Cost Monitoring: ***Michal Svanda (Prague)***

- PDC Wiki http://www2.mps.mpg.de/services/plato/wiki/index.php

# PDC Wiki

http://www2.mps.mpg.de/services/plato/wiki/index.php

- PDC Calendar
- PDC WBS
- Action Items
- Meetings
- Timeline
- Documents (including PMC SIP and PDC WPDs)
- Acronyms
- Request account now
- Bookmark the page



# PDC Wiki: Documents (including PMC SIP)



## Documents

This is the approved revision of this page, as well as being the most recent.

**Contents** [hide]



## M3 Documents for the PLATO SGS PDCR, 12th March-May 2015 [edit]

Here we provide the ESA and PMC documents that feed into the PLATO Science Ground Segment Preliminary Design Consolidation Review, March-May 2015

### PMC Documents for the SGS PDCR, 12th March-May 2015 [edit]

The PMC documents that feed into the SGS PDCR are the PMC SIP and the PDC/PSPM WPDs.

- PLATO Mission Consortium Science Implementation Plan (PMC SIP), Issue: 2, Revision: 3 (pdf)
- PDC WPDs Development, Issue: 2, Revision: 3 (pdf)
- PDC WPDs Operations, Issue: 2, Revision: 3 (pdf)
- PDC WPDs Post-Operations, Issue: 2, Revision: 3 (pdf)
- PSPM WPDs Development, Issue: 2, Revision: 1 (pdf)
- PSPM WPDs Operations, Issue: 2, Revision: 1 (pdf)
- PSPM WPDs Post-Operations, Issue: 2, Revision: 1 (pdf)

### ESA Documents for the SGS PDCR, 12th March-May 2015 [edit]

The four ESA documents that feed into the SGS PDCR are the SIRD, SOCD, MRD, and the ESA SOC SIP. In addition we also provide here the latest versions of the SciRD and the PLATO 2.0 Instrument Project Management Plan, which are both not under review, for your reference. The Science Management Plan is also provided for your reference, but note that this document is currently being significantly updated.

- Science Implementation Requirements Document (SIRD), Issue: 1, Revision: 6 (pdf)
- Science Operations Concept Document (SOCD), Issue: 1, Revision: draft 6 (pdf)
- Mission Requirements Document (MRD), Issue: 4, Revision: 1 (pdf)
- ESA Science Operations Center Science Implementation Plan (ESA SOC SIP), Issue: 0, Revision: 3 (pdf)
- Science Requirements Document (SciRD), Issue: 5, Revision: 0 (pdf)
- PLATO 2.0 Instrument Project Management Plan, Issue 1, Revision 0 (pdf)
- PLATO Science Management Plan, Issue 2, Revision 2 (pdf)

# On-going work: PDC

- PDC contribution to PDCR review
- Under PSAT responsibility: Refined definitions of Data Products wrt specific samples of stars. Data policy.
- Implications of K-band upgrade
- Interfaces PDC/PSPM, e.g. re. processing of FU data products
- Interfaces PDC/SOC: developing software in common
- Overall system architecture
- Simulation concept. Text exists.
- Coherent development plan for PDC and PSPM

- Updates to ESA's SOCD, SIRD, SciRD, SMP (incl. data policy)
- Regular update of PMC's WBS, WPDs, SIP, costs (← done)
- PDC will keep open a wiki to deal with day to day affairs

# Simulations

(At least) 3 kinds of simulators are needed:

One simulating image level data, i.e. raw samples, including detailed instrumental effects and user-defined astrophysical inputs (cf. PLATOSim)

→ useful to investigate specific issues and validate algorithms on a small scale (i.e. with limited-in-size but quite realistic data)

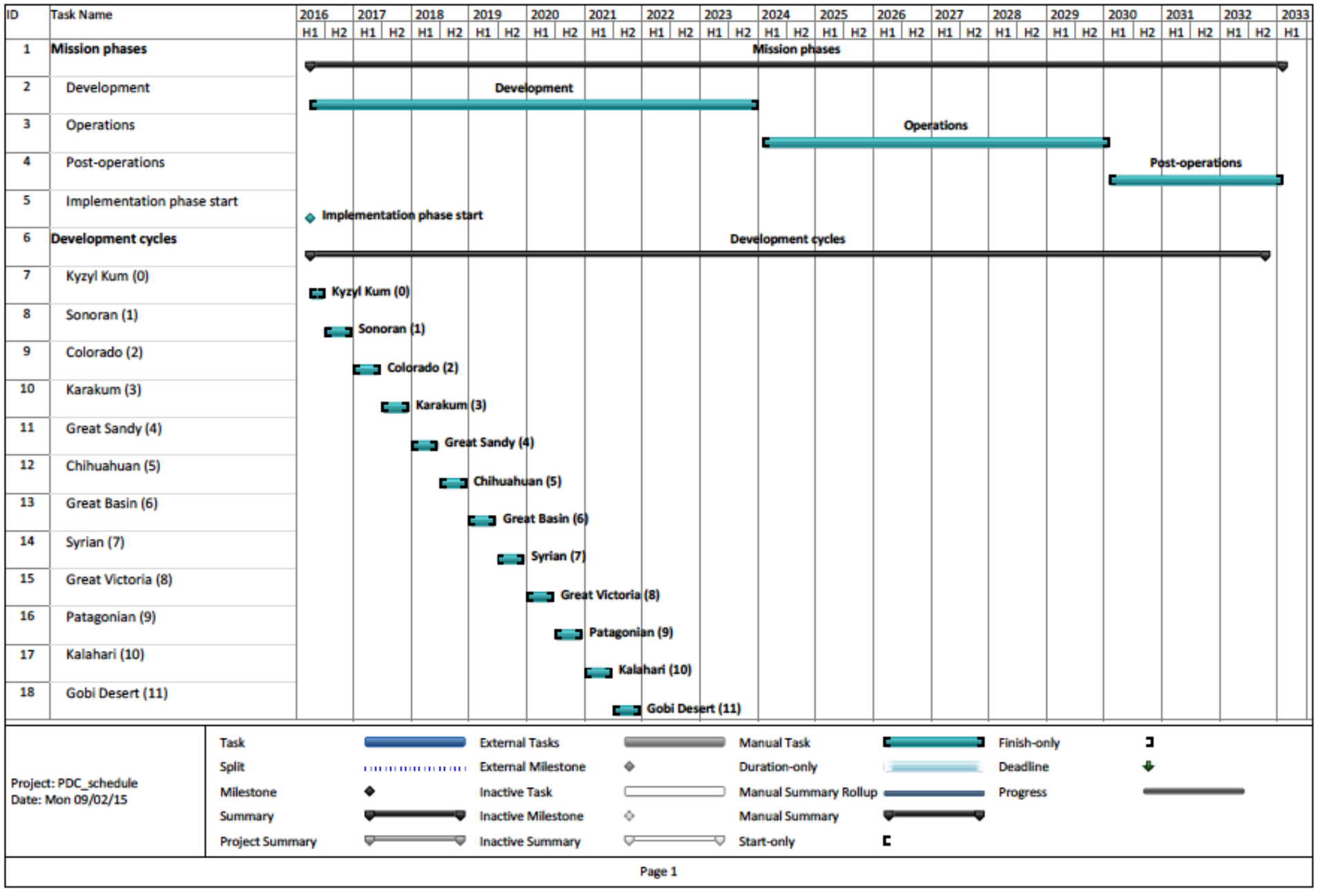
One simulating telemetry as downloaded from the satellite, with simplified instrumental effects and astrophysical inputs

→ useful to generate large-volume datasets to be used in end-to-end tests, involving all systems

one simulating intermediate data products as produced by different systems (e.g. PDPCs) or different steps in the data processing.

→ Useful for downstream systems, which may end up not participating to the end-to-end tests (due to the simulated data being to simplistic to trigger them or to delays in the testing schedule).

# Scheduling


ID
Task Name
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033
H1 H2
1 Mission phases
2 Development
3 Operations
4 Post-operations
5 Implementation phase start
6 Development cycles
7 Kyzyl Kum (0)
8 Sonoran (1)
9 Colorado (2)
10 Karakum (3)
11 Great Sandy (4)
12 Chihuahuan (5)
13 Great Basin (6)
14 Syrian (7)
15 Great Victoria (8)
16 Patagonian (9)
17 Kalahari (10)
18 Gobi Desert (11)
Mission phases
Development
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Post-operations
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Development cycles
Kyzyl Kum (0)
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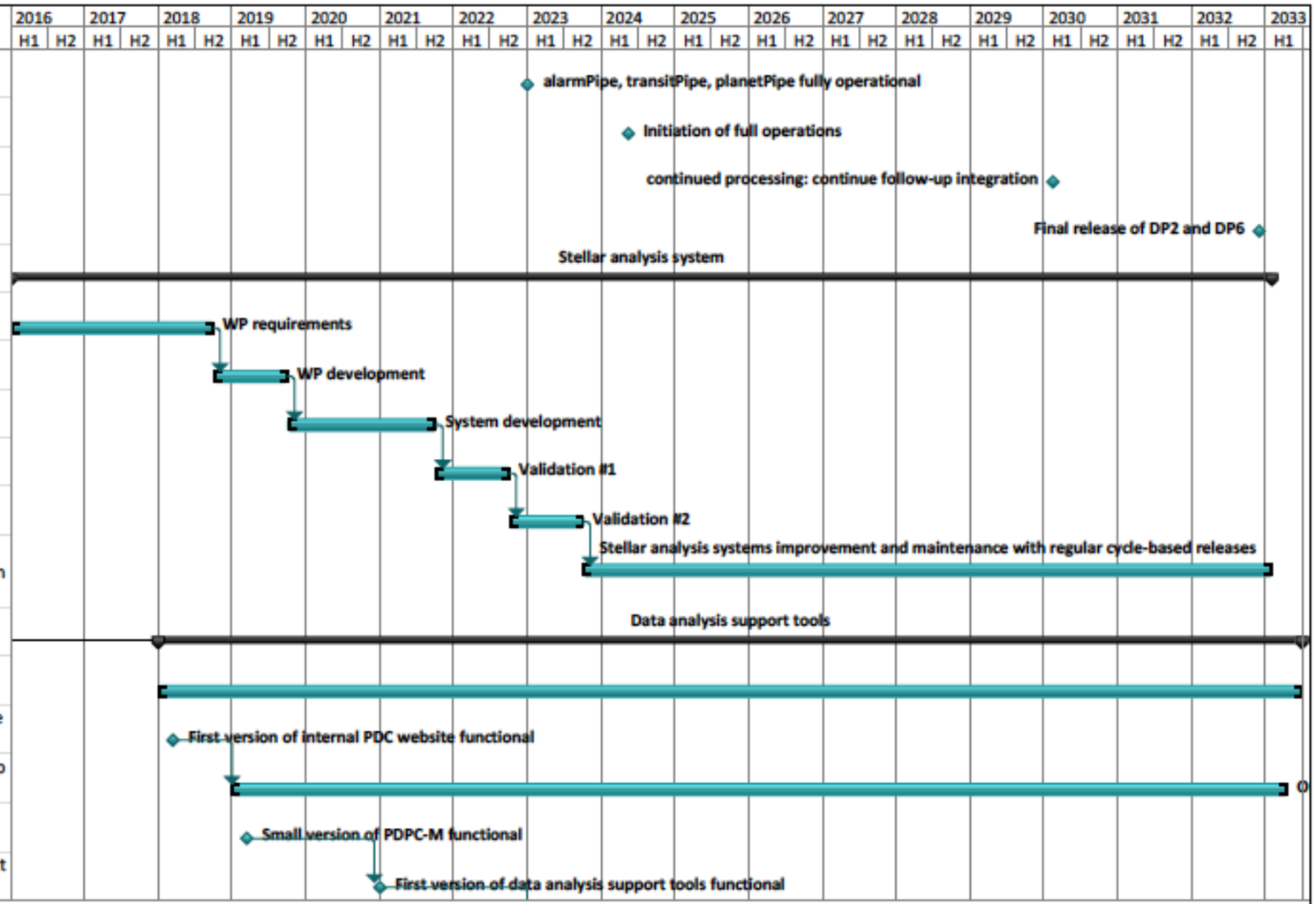
Great Sandy (4)
Chihuahuan (5)
Great Basin (6)
Syrian (7)
Great Victoria (8)
Patagonian (9)
Kalahari (10)
Gobi Desert (11)
Project: PDC_schedule
Date: Mon 09/02/15
Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress

# PDC Scheduling

| ID | Task Name |
|---|---|
| 102 | alarmPipe, transitPipe, planetPipe fully operational |
| 103 | Initiation of full operations |
| 104 | continued processing: continue follow-up integration |
| 105 | Final release of DP2 and DP6 |
| 106 | **Stellar analysis system** |
| 107 | WP requirements |
| 108 | WP development |
| 109 | System development |
| 110 | Validation #1 |
| 111 | Validation #2 |
| 112 | Stellar analysis systems improvement and maintenance with regular cycle-based releases |
| 113 | **Data analysis support tools** |
| 114 | Documentation system operations and maintenance |
| 115 | First version of internal PDC website functional |
| 116 | Operations and maintenance of web interface to tools |
| 117 | Small version of PDPC-M functional |
| 118 | First version of data analysis support tools functional |




Project: PDC_schedule
Date: Mon 09/02/15

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Task | External Tasks | Manual Task | Finish-only |
| Split | External Milestone | Duration-only | Deadline |
| Milestone | Inactive Task | Manual Summary Rollup | Progress |
| Summary | Inactive Milestone | Manual Summary | |
| Project Summary | Inactive Summary | Start-only | |

# Towards the Operational System

Activities ought to address:

- Algorithmic complexity, evolution from current knowledge taking into account the expertise in PSPM from CoRoT and Kepler results.
- Computational complexity – number of targets, data richness
- Data challenges – managing the data flows, considerations of volume (K-band)
- People challenges – automation and final manual review and ranking of planetary systems
- End-to-end testing and validation
- And funding issues. . .

8-9 years to create an effective discovery pipeline!

Thank You

# Data Processing Algorithms: WP32

Coordinator is Réza Samadi (LESIA)

## Definition of on-board & on-ground data treatment algorithms (up to L1)

- Telemetry: 436 Gb per day (3.5 hr window per day for downlink)
  - Light curves and centroid curves for all 32 NT and 2 FT
  - Imagettes: typically 6x6 pixels for NT and 9x9 pixels for FT
  - House keeping (e.g. temperatures and voltages)

- Basic on-ground processing from L0 to L1
  - PSF modeling across the field (using imagettes)
  - Differential aberration (relativistic effect on star line of sight)
  - Satellite jitter correction
  - Outliers (glitches, proton impacts)
  - Flux calibration: gain of the electronic chains, quantum efficiency of the CDDs
  - Long-term effects (CCD ageing effects, long term temperature variations)
  - Feedback to TC → optimization of parameters (e.g. masks)