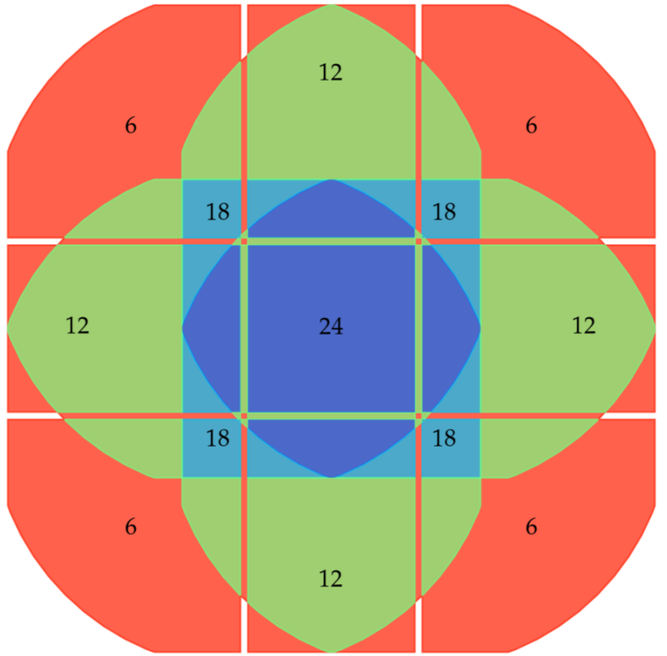
Observing fields & data products

Outline

- PLATO fields
- PLATO input catalogue
- PLATO data products

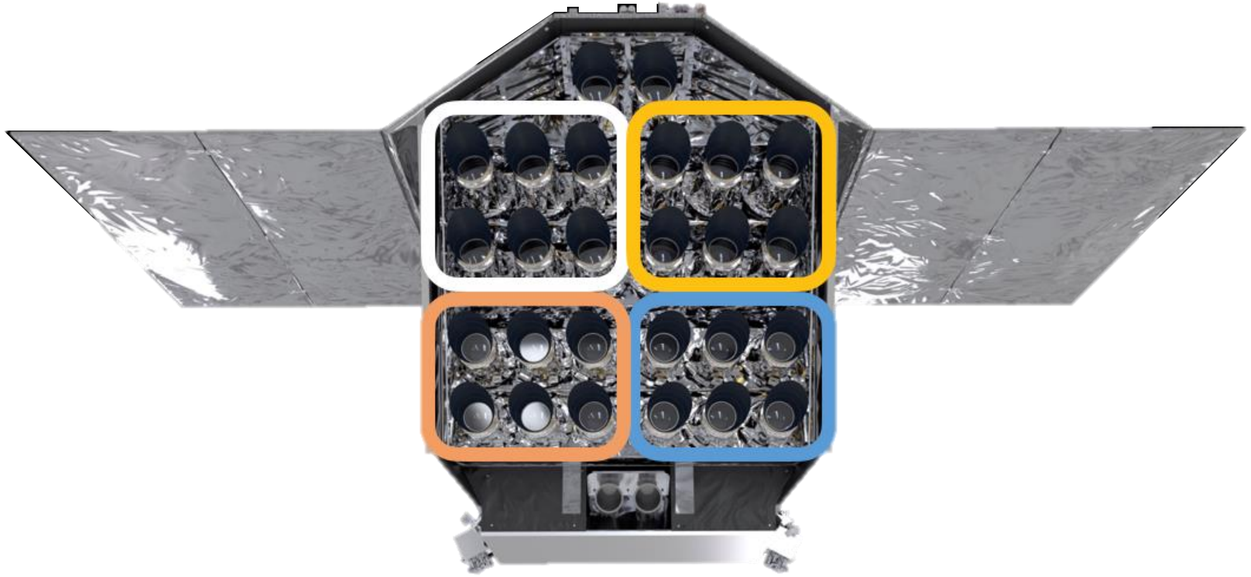
PLATO field of view

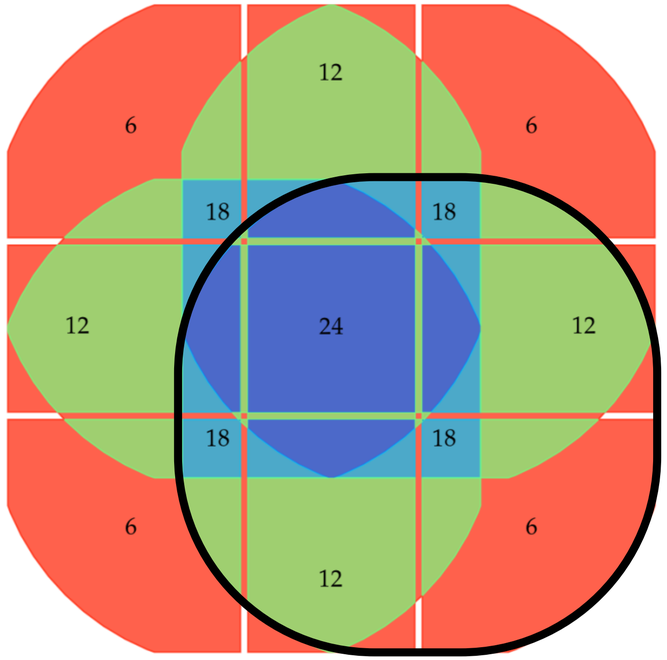


- 4 groups of six cameras
  - Cameras in the same group have fully overlapping fields of view
  - Fields of view of each group are offset

- Total field of view ~2232 deg^2

PLATO field of view





- 4 groups of six cameras
  - Cameras in the same group have fully overlapping fields of view
  - Fields of view of each group are offset

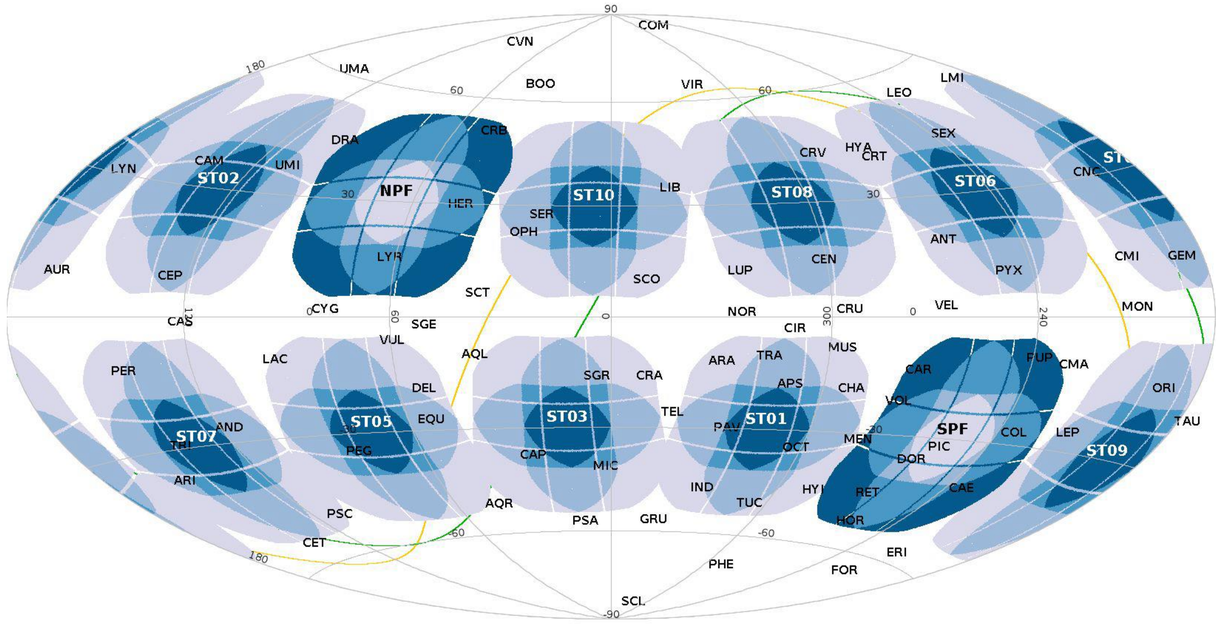
- Total field of view ~2232 deg^2

PLATO fields

- Two main fields:
  - LOPN in the North
  - LOPS in the South

- Baseline observing strategy is 2 years on LOPS, followed by 2 years on LOPN.

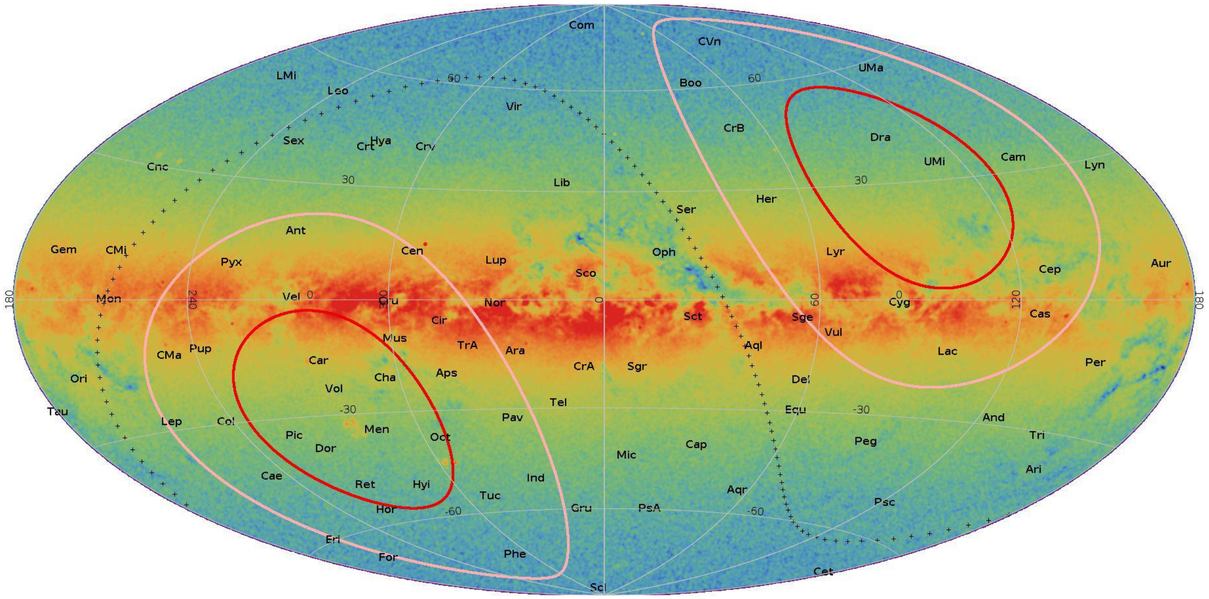
- Final choice of fields driven by two types of criteria:
  1. **Formal requirements** on things like position of the field centres, number of stars, etc.
  2. **Optional criteria maximizing scientific return**

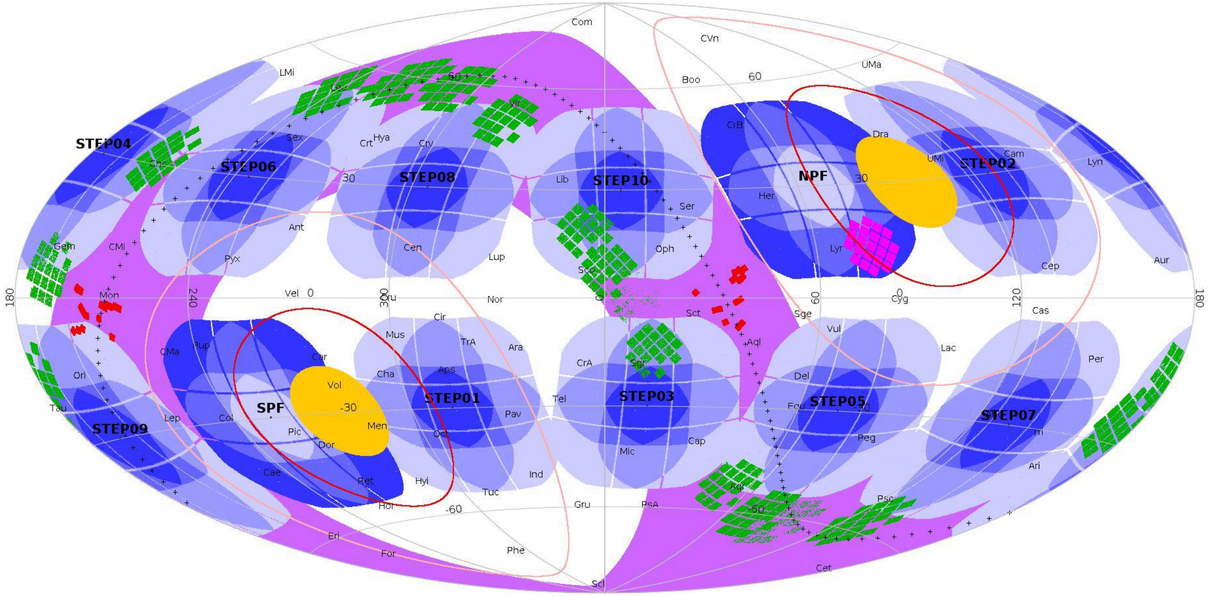


LOP and SOP test fields from Nascimbeni+ 2016

Criteria for field selection

- Photometric contamination from crowding
  (impacts photometric noise, planetary/stellar parameters, follow-up)
- Astrophysical contamination from blended EBs
  (impacts false positive rate and follow-up)
- Interstellar reddening
  (impacts stellar classification of distant PLATO targets but also shields background contaminant)
- Synergies with other surveys
  (Kepler/K2, TESS, Gaia, CHEOPS, etc.)
- Known high-priority planetary systems
- Known stellar clusters and associations
- Ease of follow-up (depending on seasonality/declination)
- ...others?



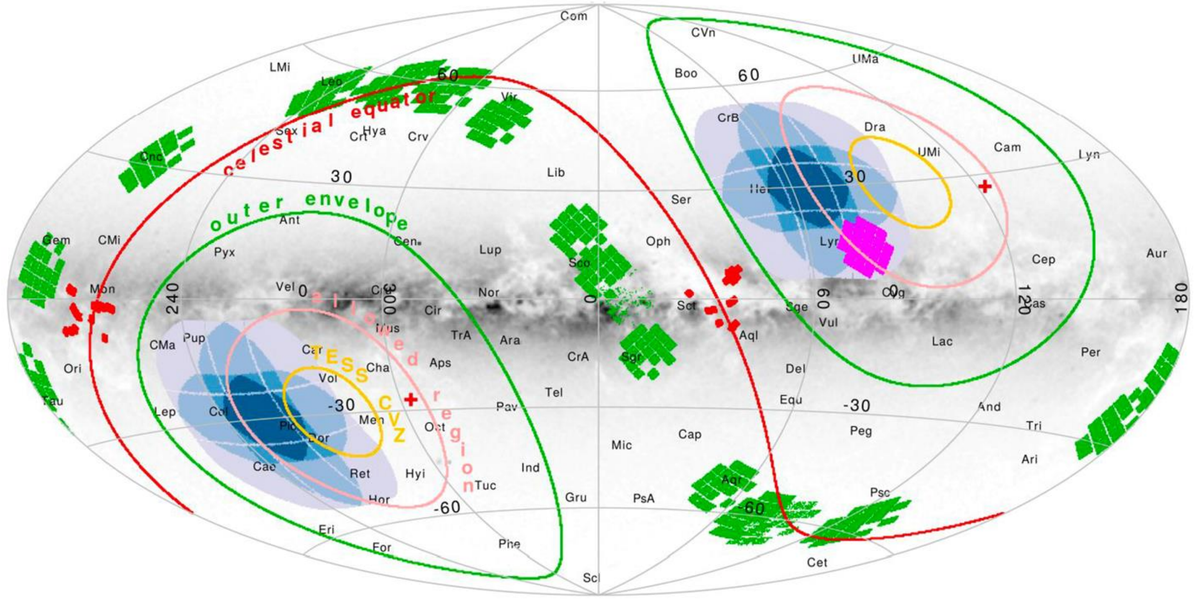


Field selection

- The PIC team used a grid-based approach to identify the optimal choice of fields.
  - Prioritisation metric to evaluate possible positions
  - Accounting for optional criteria

- Details of the selection process are described in Nascimbeni et al. (2022), A&A 658, 31

- Fields LOPS1 and LOPN1 presented as the most favourable long-field pointings.



The PLATO field selection process

I. Identification and content of the long-pointing fields

V. Nascimbeni[1,2], G. Piotto[2,1], A. Börner[3], M. Montalto[2,1], P. M. Marrese[4,5], J. Cabrera[6], S. Marinoni[4,5], C. Aerts[7,8,9], G. Altavilla[4,5], S. Benatti[10], R. Claudi[1], M. Deleuil[11], S. Desidera[1], M. Fabrizio[4,5], L. Gizon[12,13,14], M. J. Goupil[15], V. Granata[2,1], A. M. Heras[16], D. Magrin[1], L. Malavolta[2,1], J. M. Mas-Hesse[17], S. Ortolani[2,1], I. Pagano[18], D. Pollacco[19,20], L. Prisinzano[11], R. Ragazzoni[2,1], G. Ramsay[21], H. Rauer[6,22,23], and S. Udry[24]

(Affiliations can be found after the references)

Received 19 September 2021 / Accepted 26 October 2021

ABSTRACT

PLAnetary Transits and Oscillations of stars is an ESA M-class satellite planned for launch by the end of 2026 and dedicated to the wide-field search of transiting planets around bright and nearby stars, with a strong focus on discovering habitable rocky planets hosted by solar-like stars. The choice of the fields to be pointed at is a crucial task since it has a direct impact on the scientific return of the mission. In this paper, we describe and discuss the formal requirements and the key scientific prioritization criteria that have to be taken into account in the Long-duration Observation Phase (LOP) field selection, and apply a quantitative metric to guide us in this complex optimization process. We identify two provisional LOP fields, one for each hemisphere (LOPS1 and LOPN1), and we discuss their properties and stellar content. While additional fine-tuning shall be applied to LOP selection before the definitive choice, which is set to be made two years before launch, we expect that their position will not move by more than a few degrees with respect to what is proposed in this paper.

Key words. catalogs – astronomical databases: miscellaneous – techniques: photometric – planetary systems – planets and satellites: detection – stars: fundamental parameters

Final choice of fields

- In the South, further study showed that a slight adjustment in Galactic longitude would give very similar results, as well as:
  - Increased flexibility in choice of field rotation angle
  - Moving Sirius outside the field of view
  - Increasing overlap with the TESS continuous viewing zone.

- Investigation of possible field rotation angles showed that there was no significant advantage to be gained over Θ=0°

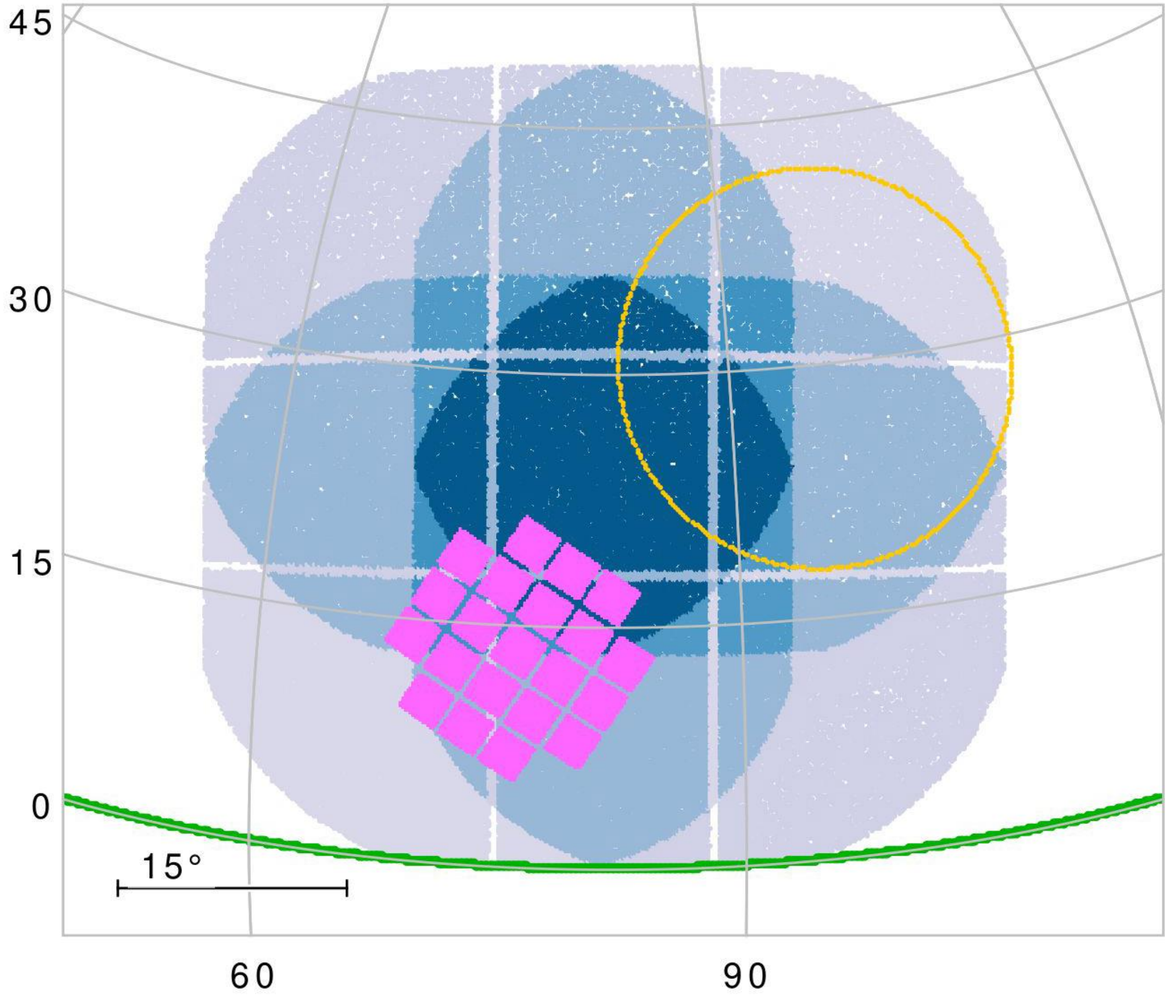
- LOPN1 settled on as a final proposal. **LOPS2 has been announced as the choice of southern field.**

field	LOPS2	LOPN1	notes
HEALPix index	#2189	#0878	level $k = 4$, RING scheme
α [deg]	95.31043	277.18023	ICRS
α [hms]	06:21:14.5	18:28:43.2	ICRS
δ [deg]	−47.88693	52.85952	ICRS
δ [hms]	−47:53:13	52:51:34	ICRS
l [deg]	255.9375	81.56250	IAU 1958
b [deg]	−24.62432	24.62432	IAU 1958
λ [deg]	101.05940	287.98162	Ecliptic
β [deg]	−71.12242	75.85041	Ecliptic

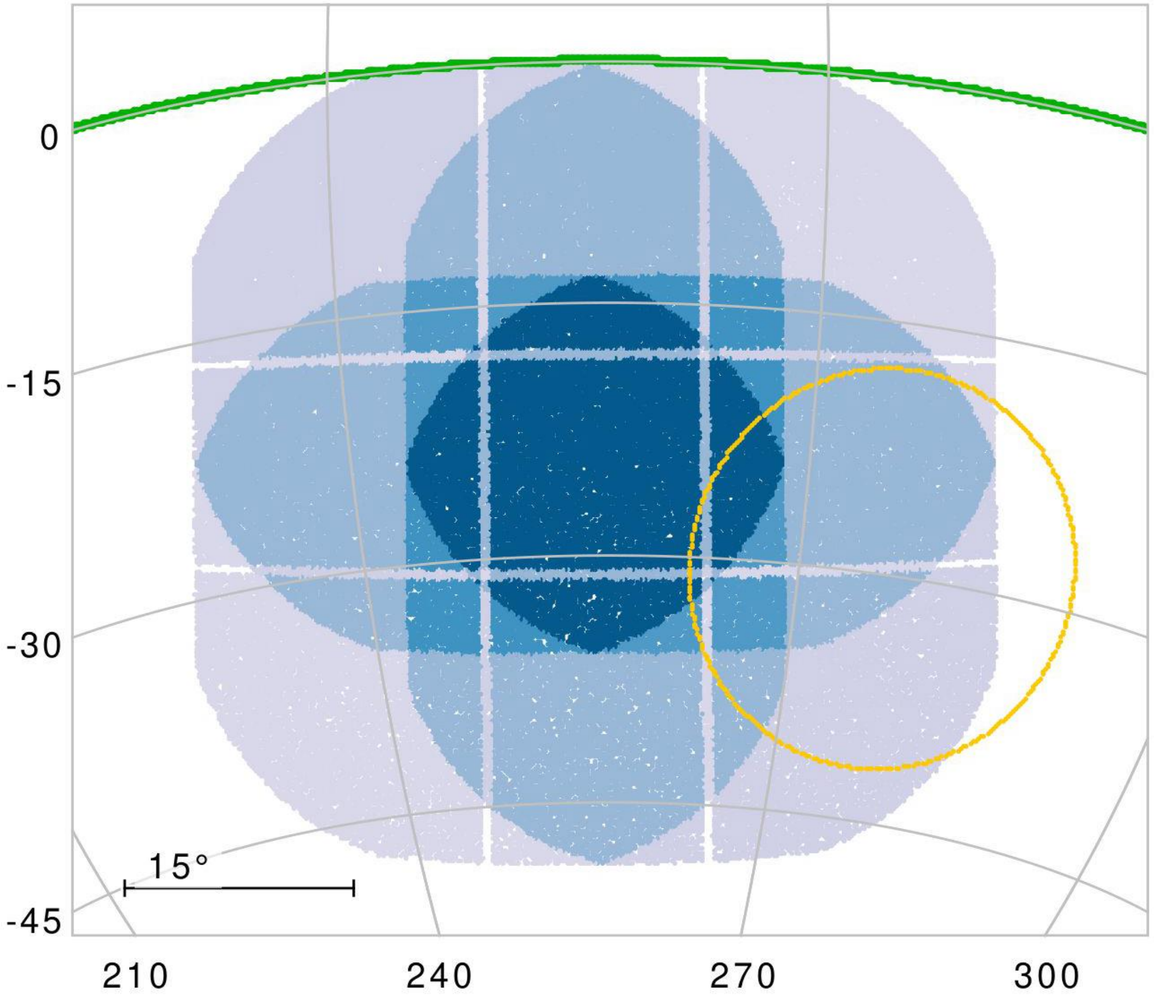
Details of LOPS2 & LOPN1
LOPS2 details available on the PLATO mission websites

Chosen fields

LOPN1
α≃277°.1, δ≃52°.9
l≃81°.6, b≃24°.6

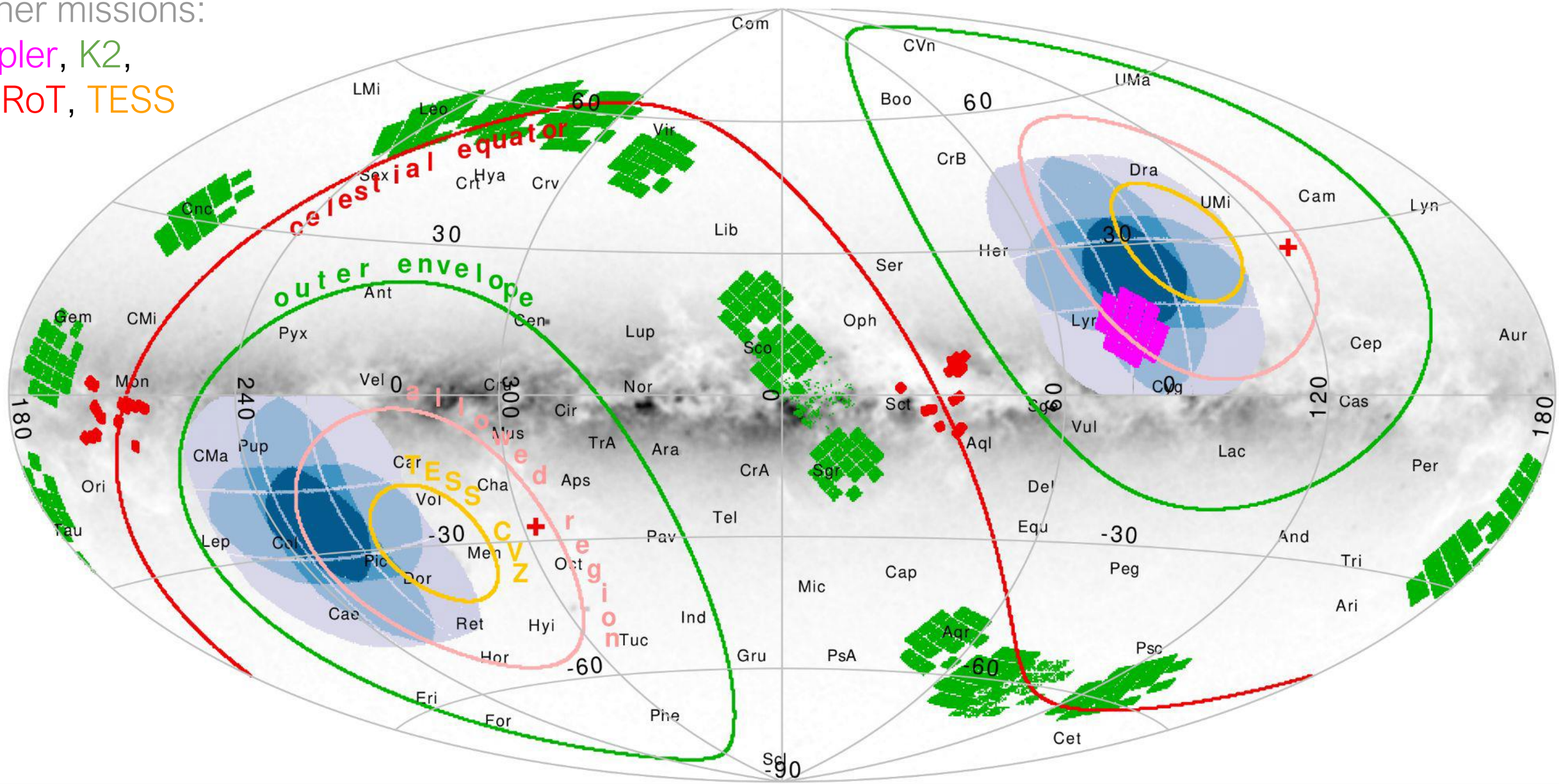


LOPS2
α≃95°.3, δ≃−47°.9
l≃255°.9, b≃−24°.6



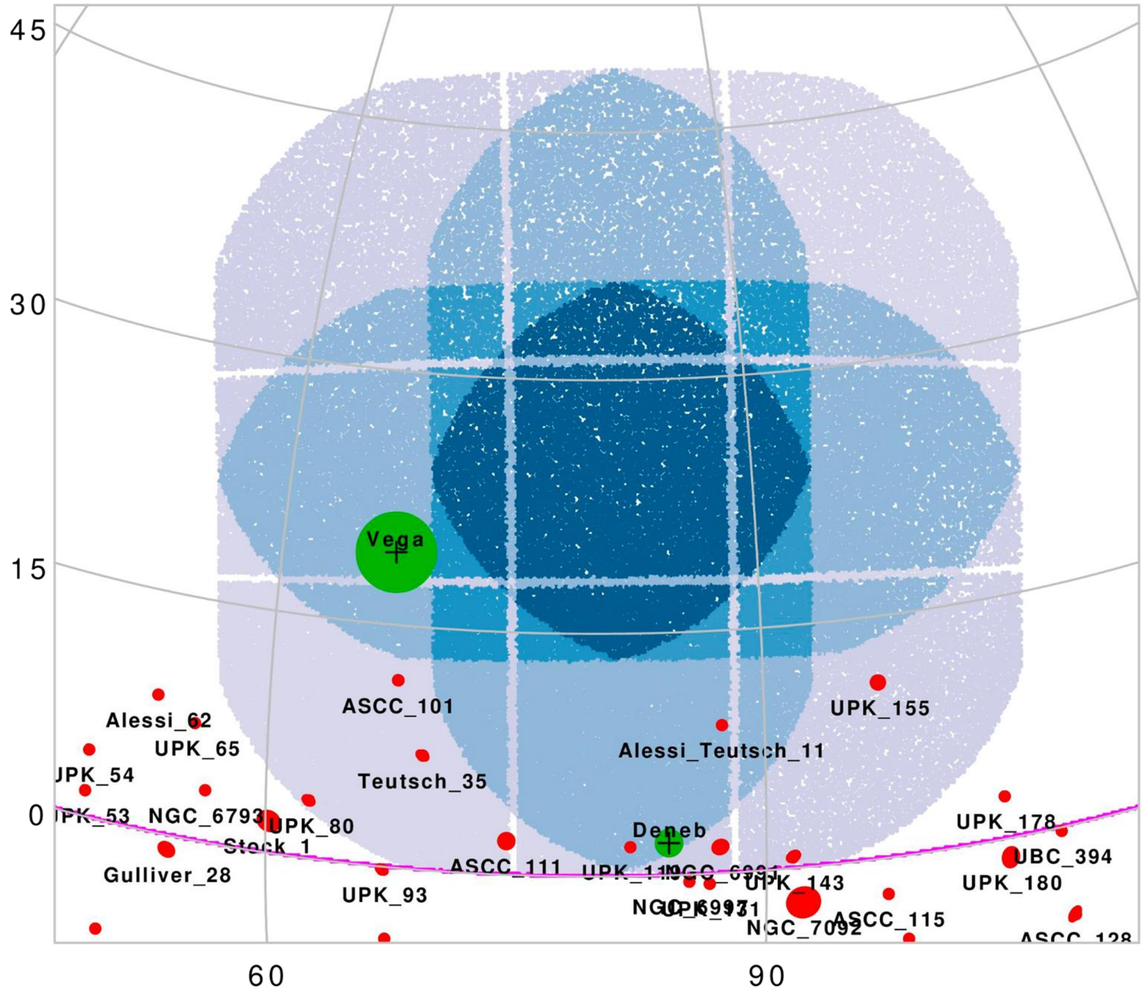
Full sky projection

Other missions:
Kepler, K2,
CoRoT, TESS

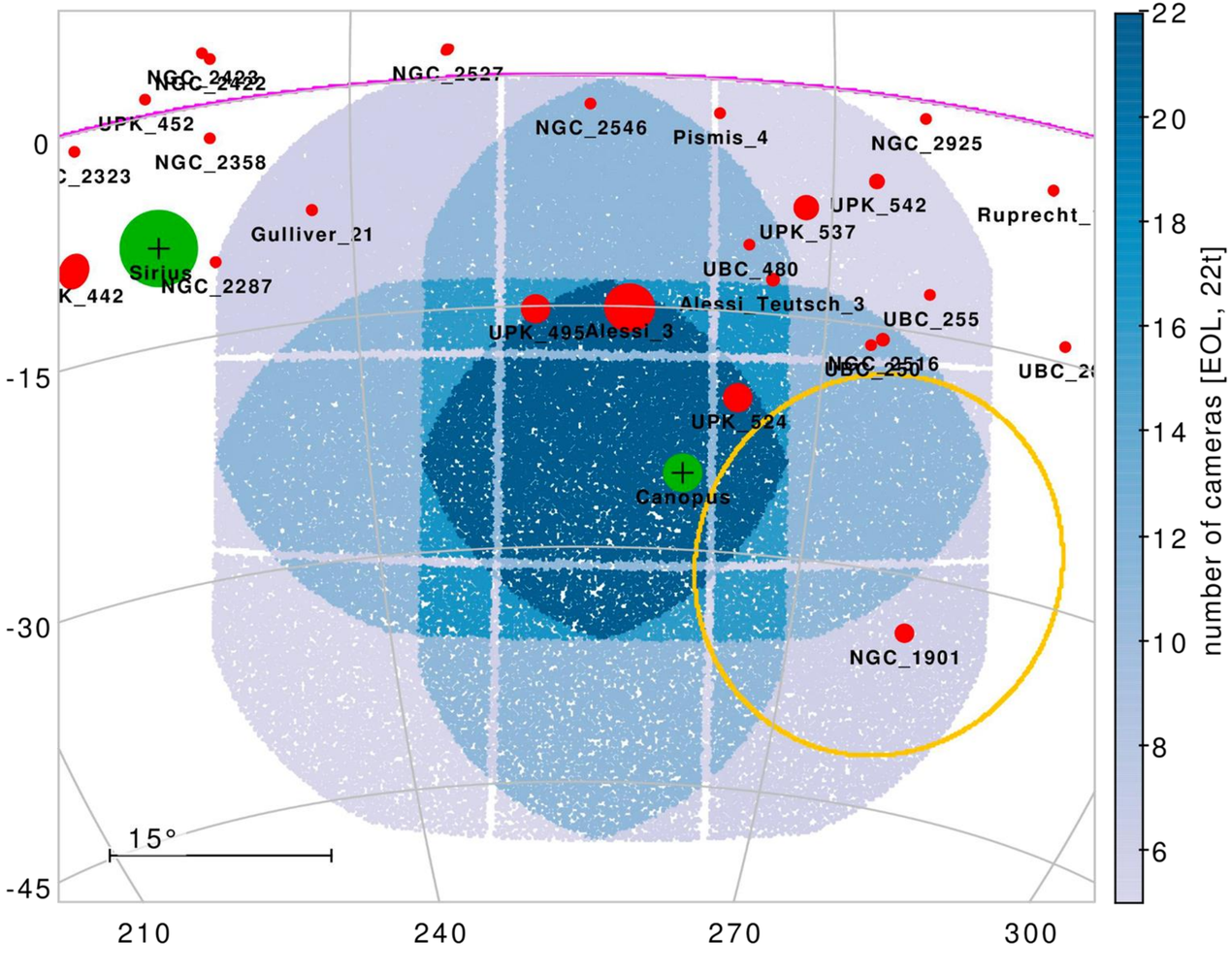


Contamination

LOPN1
α≃277°.1, δ≃52°.9
l≃81°.6, b≃24°.6



LOPS2
α≃95°.3, δ≃−47°.9
l≃255°.9, b≃−24°.6



PLATO input catalogue

- The overall PIC is a combination of four components

$$\text{PIC} = \mathbf{t}\text{PIC} + \mathbf{fg}\text{PIC} + \mathbf{c}\text{PIC} + \mathbf{scv}\text{PIC}$$

- **t**PIC = target PIC; the main catalogue of science targets
- **fg**PIC = fine guidance performance
- **c**PIC = instrument calibration
- **scv**PIC = science calibration and validation
  - Science Calibration Stars allow for discovery of new input physics in stellar models
  - Validation Stars assist with optimising free parameters for chosen input physics

- **target** PIC = target PIC; the main catalogue of science targets
  - Covers the PLATO samples defined in our requirements:

	P1	P2	P4	P5
No. stars	≥15,000	≥1,000	≥5,000	≥245,000
Type	Dwarf & sub-giant F5 - K7	Dwarf & sub-giant F5 - K7	M-dwarf	Dwarf & sub-giant F5 - K7
V magnitude	≤11	≤8.5	≤16	≤13
Random noise (ppm in 1hr)	≤50	≤50	-	-
Star count in tPIC 2.0.0	16,896	1,398	24,707	313,558

  - “Prime Sample” of up to 20,000 targets selected from these as highest priority targets.

- New version (2.0.0) of the catalogue is now available, based on Gaia DR3.
  - Available to consortium members via the PSM office

PLATO data levels

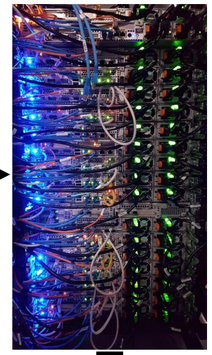
telemetry

ESA SOC

Level 0 products

Level 1 products

PDC



Level 2 products

Level 3 products

PSM GOP

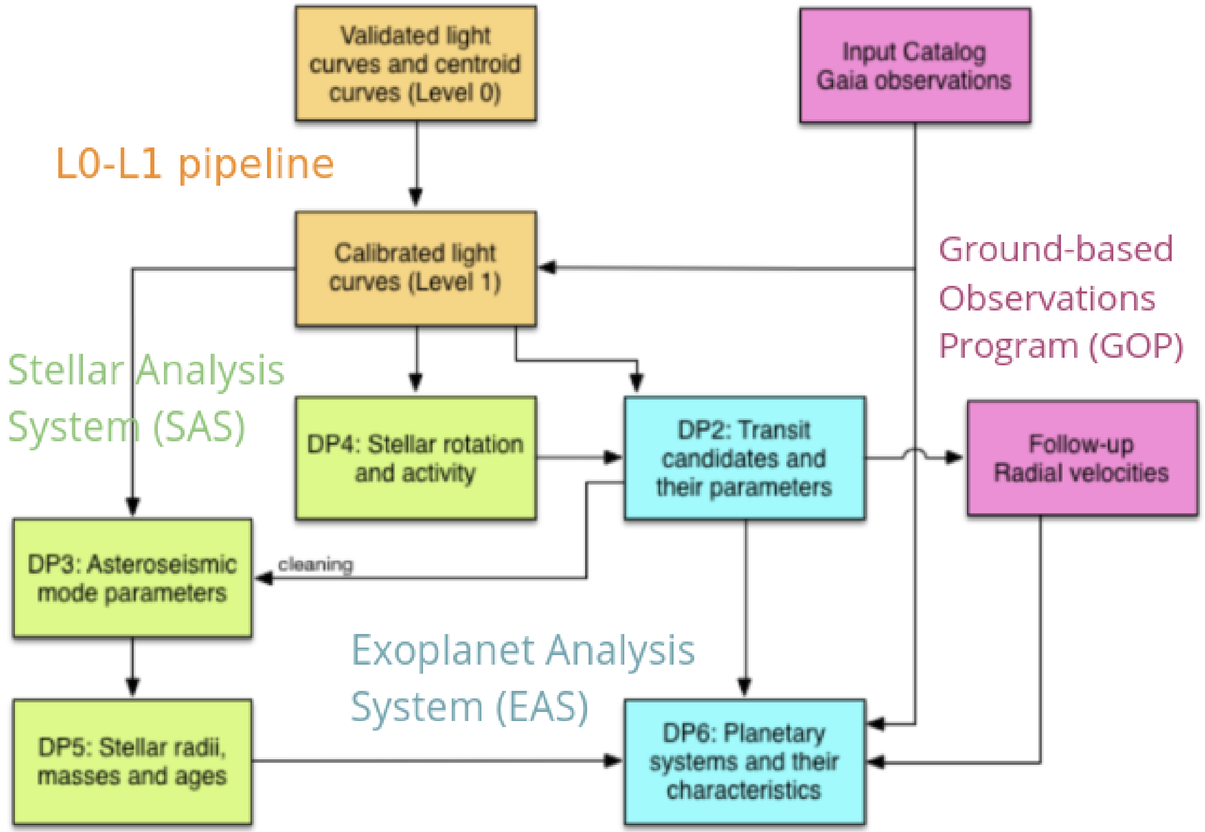
Level g products

From the spacecraft

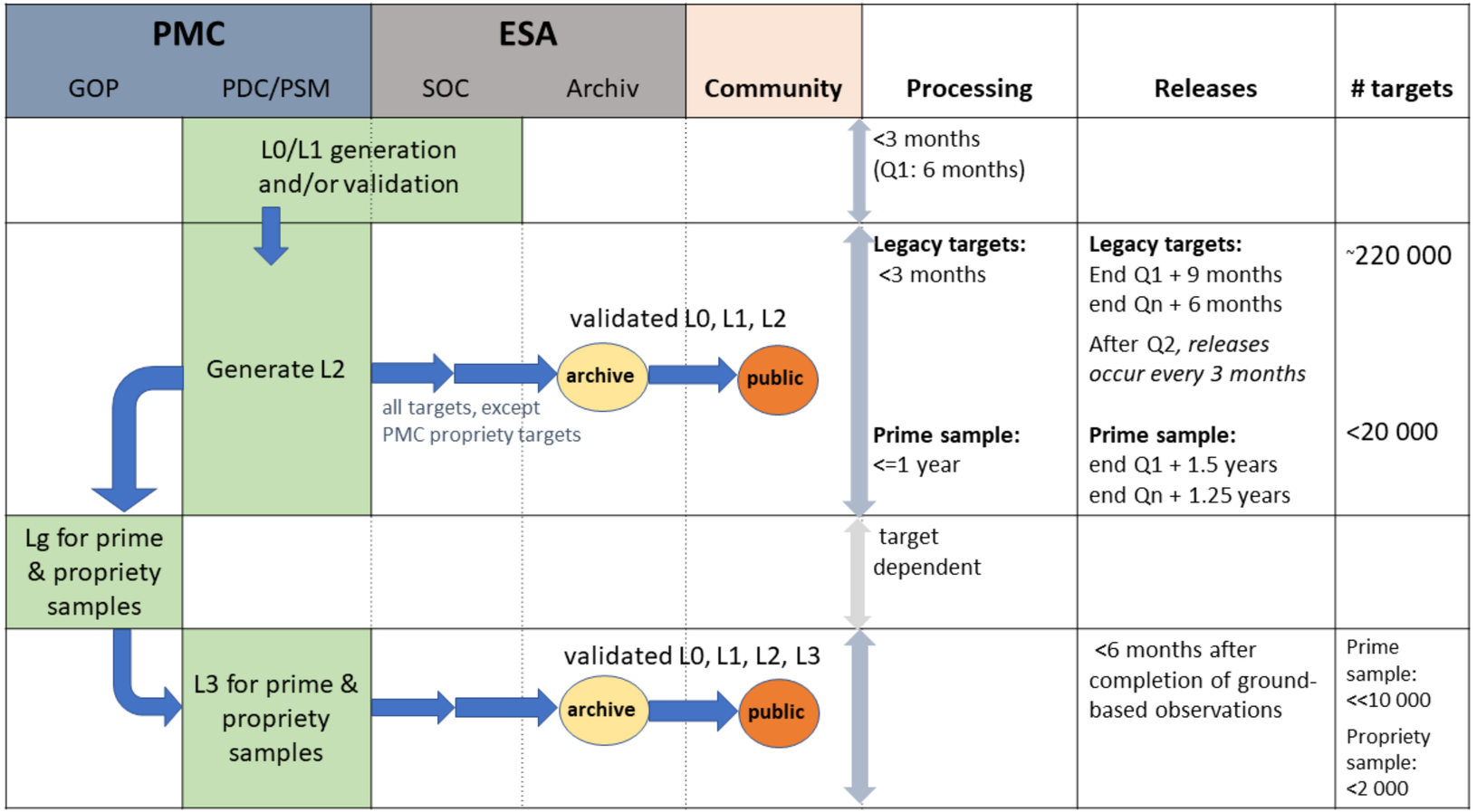
	P1	**P2**	**P4**	**P5**
No. stars	≥15,000	≥1,000	≥5,000	≥245,000
Type	Dwarf & sub-giant F5 - K7	Dwarf & sub-giant F5 - K7	M-dwarf	Dwarf & sub-giant F5 - K7
V magnitude	≤11	≤8.5	≤16	≤13
Random noise (ppm in 1hr)	≤50	≤50	-	-
Sampling times (s)				
Lightcurve	-	-	-	600 50 (for 10% of targets)
Centroid curve	-	-	-	50 (for 5% of targets)
Imagettes (6x6 postage stamps)	25	25	25	25 (for >9000 targets)

Data products

- Level 1 products:
  - Calibrated light curves, imagettes, and centroid curves
  - Information on photometric contaminants
- Level 2 products:
  - Planetary candidates with transit parameters
  - Asteroseismic mode parameters
  - Stellar rotation periods & activity metrics
  - Stellar radii, masses, and ages
  - Living catalogue of planetary systems confirmed from PLATO data only, with parameters
- Level 3 products:
  - Living catalogue of planetary systems confirmed from PLATO data & follow-up data, with parameters



Data releases



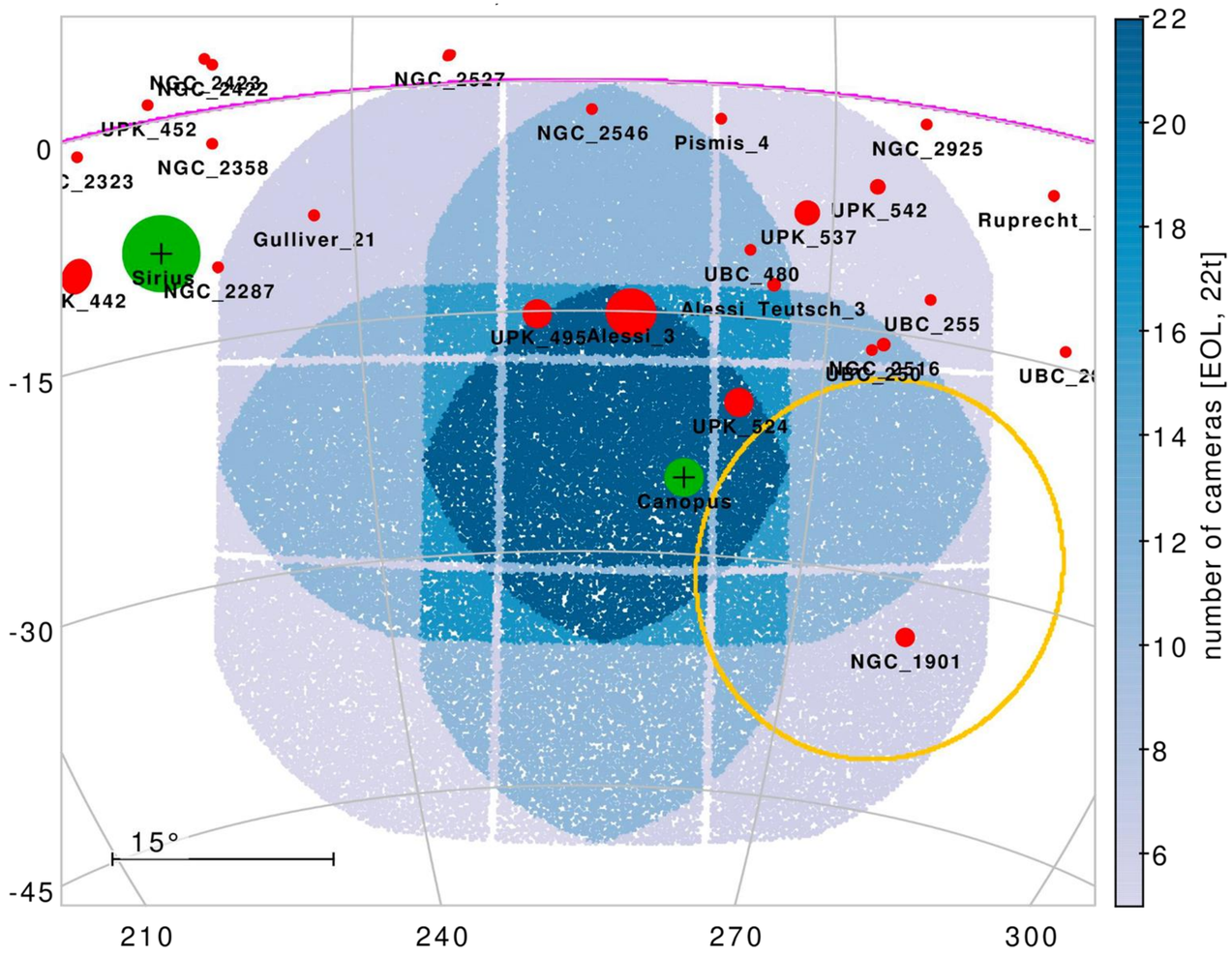
Summary of the data release timescales
Rauer et al. (in prep)

- Proprietary period finishes at the latest at the end of the post-operations phase.
- Guest Observer targets will be proprietary for 1 year after delivery of the last Level 1 products.
- All products will be made available to the community through the ESA PLATO Archive (PAX).

Summary

- First PLATO field has been announced – LOPS2
- PLATO input catalogue v2.0.0 is available for consortium members
- PLATO will produce an extensive set of data products, available to the community via the ESA PLATO Archive (PAX)

LOPS2
α≃95°.3, δ≃−47°.9
l≃255°.9, b≃−24°.6



Thanks!

psmoffice@warwick.ac.uk