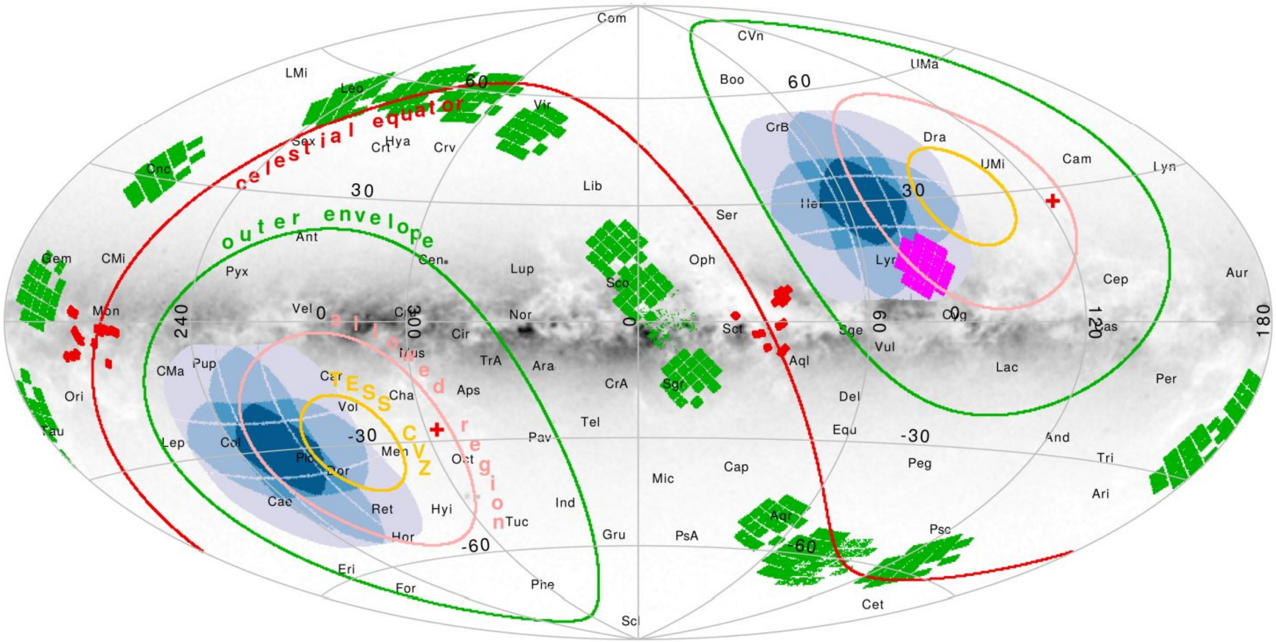
The PLATO Field(s) and the PLATO Prime Sample



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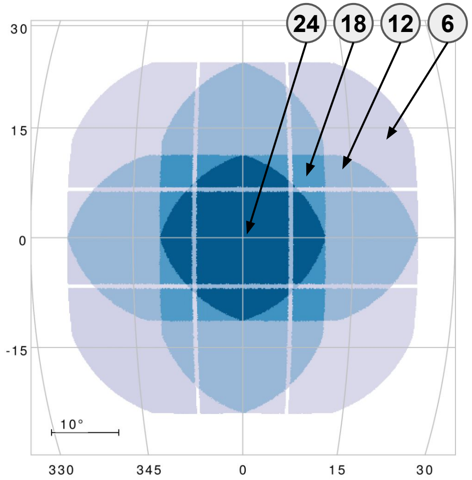
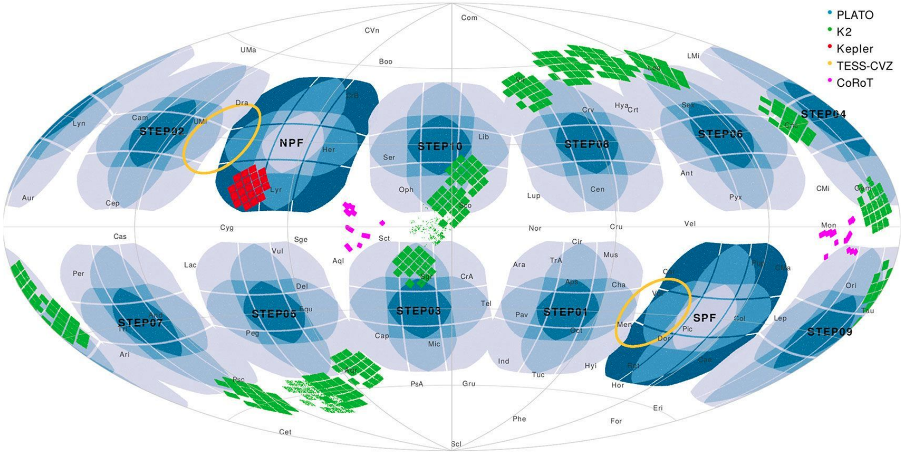
The PLATO Field(s): requirements

- PLATO will observe with **24 NCAMs** arranged in groups of six with an offset of 9.2°: flower-like pattern with different areas covered by 6, 12, 18, 24 NCAMs. Overall FOV: **~2150 deg² (~49°x49°), 5% of the whole sky**
- Also: **2 FCAMs** with color information (blue/red wide-band filter) and faster cadence (but smaller FOV)
- During its nominal 4-yr mission, PLATO will continuously monitor one or two pre-selected fields for at least two years each during the so-called Long-duration Observation Phase (**LOP**). The mission has been designed to have the capability to observe additional fields for shorter intervals, at least two months each (Step-and-stare Observation Phase; **SOP**)
- Several requirements for the LOP fields from SciRD: for instance, the center should be at β>63° (R-SCI-50), i.e. **close to the ecliptic poles**! But there are also requirements on the number of specific targets (next slide ↻)





Sky fields for ESA's planet-hunter satellite PLATO
(Marchiori, V., et al., 2019, A&A, 627, A71)

The PLATO Stellar Samples

The stellar samples are subsets of the tPIC (Montalto+ 2021; currently 218,820 stars in tPIC v2.1) defined in terms of spectral type, noise and magnitude (Table 1).

From the SciRD, PLATO shall observe during its LOP phase:

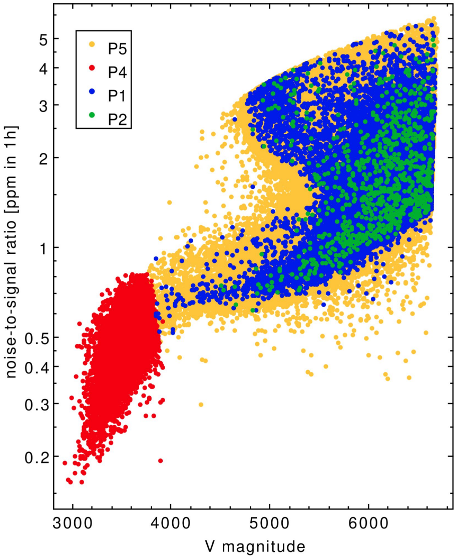
- ≥ 15,000 P1 (goal: 20,000)
- ≥ 1,000 P2
- ≥ 5,000 P4
- ≥ 245,000 P5

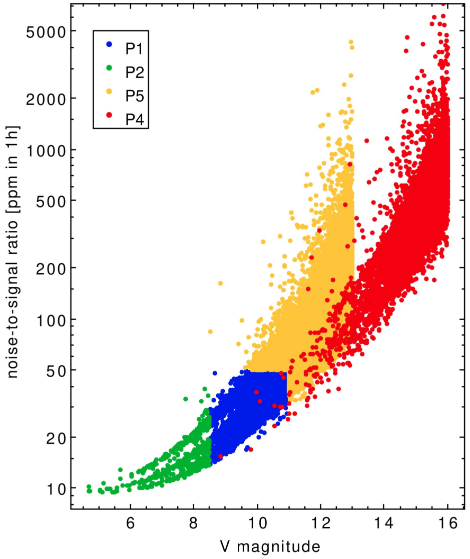
The **Prime Sample** (< 20,000) and the **Proprietary Sample** (< 2,000) are also subsets of the tPIC).

Moreover, 8% of the PLATO science data rate will be allocated to **Guest Observer (GO)** programs selected by ESA through open calls!

Table 1. Definitions of the main PLATO stellar samples.

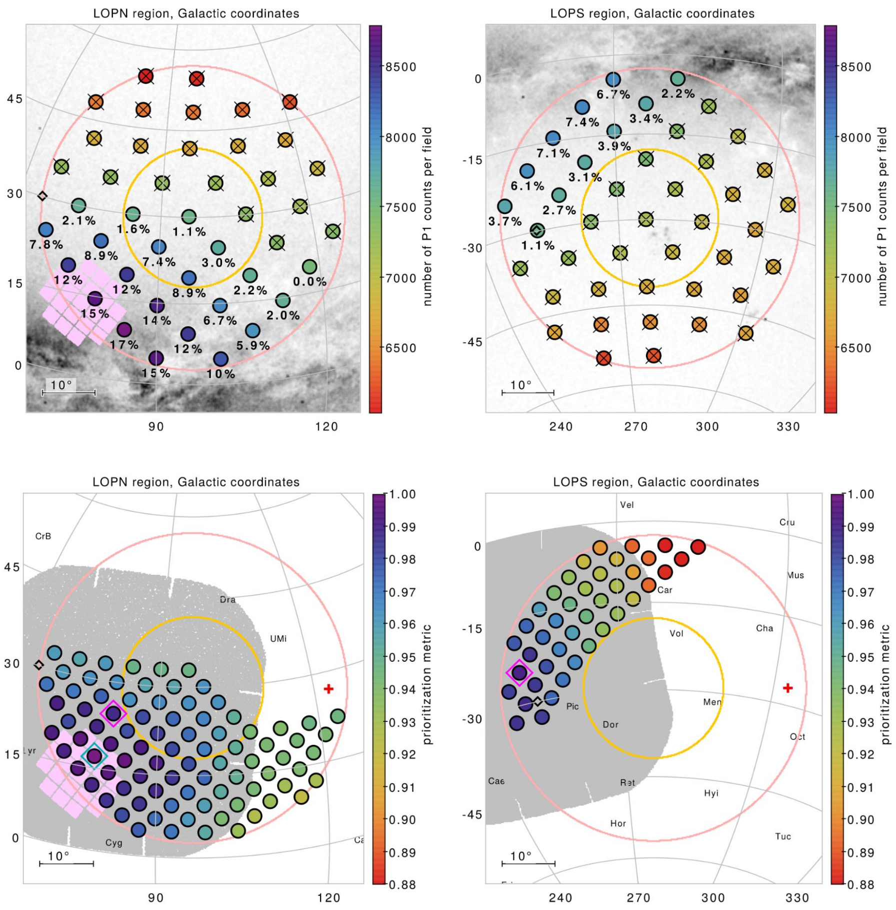
Sample	SpT	lum. class	mag. limit	Noise
P1	F5-K7	dwarfs and subgiants	$V < 11$	<50 ppm
P2	F5-K7	dwarfs and subgiants	$V < 8.5$	<50 ppm
P4	M	dwarfs	$V < 16$	–
P5	F5-K7	dwarfs and subgiants	$V < 13$	–





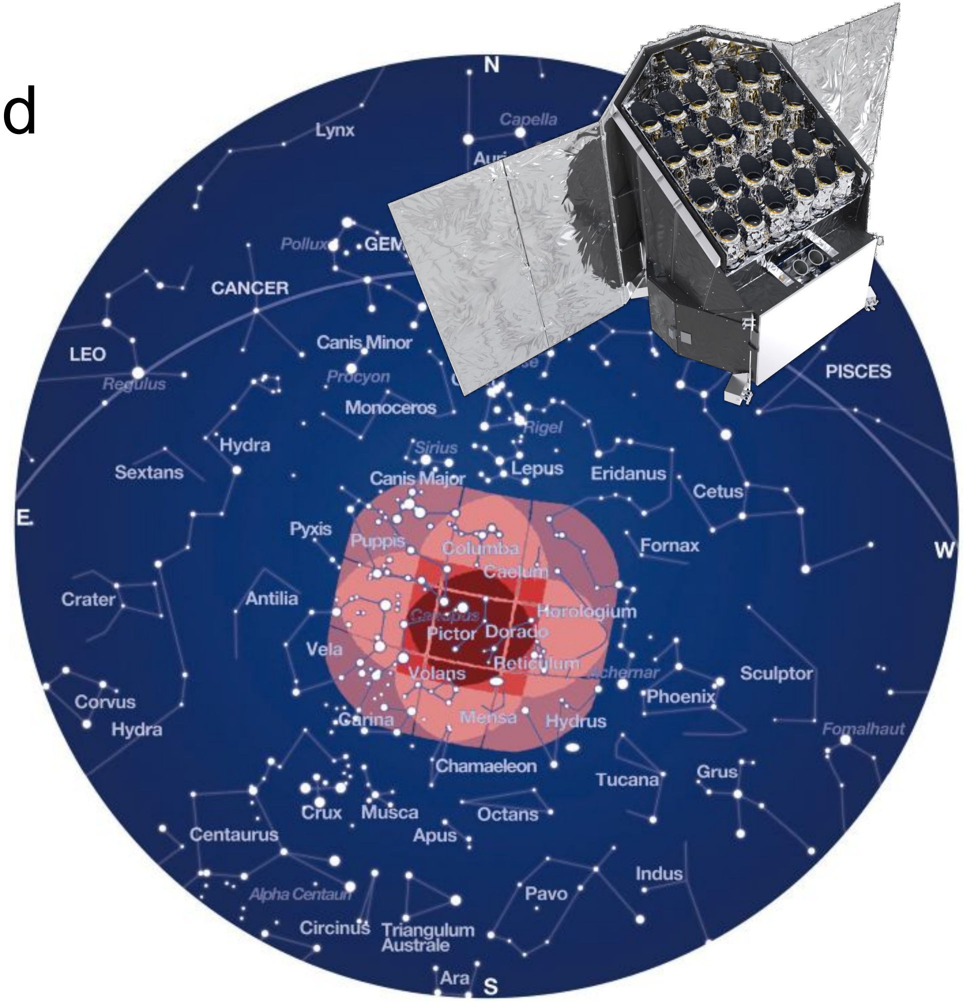
The optimization process

- Described in detail in Nascimbeni+ 2022, Nascimbeni+ 2025
- **Grid-based approach**: we first identified a number of grid points within the *allowed zone* (|β|>63° cap) to select the ones compliant with the requirements on the number of targets
- We then applied a *metric* which also takes into account R*, expected S/N and stellar contamination to identify the two most favorable fields: **LOPS1** and **LOPN1** (Nascimbeni+ 2022). The southern field has been later moved to **LOPS2**, to ensure that the selected field is independent of the initial spacecraft rotation angle after launch (Nascimbeni+ 2025).
- July 2023: after carefully considering the synergies with the ground-based facilities, the SWT selected as the first field…



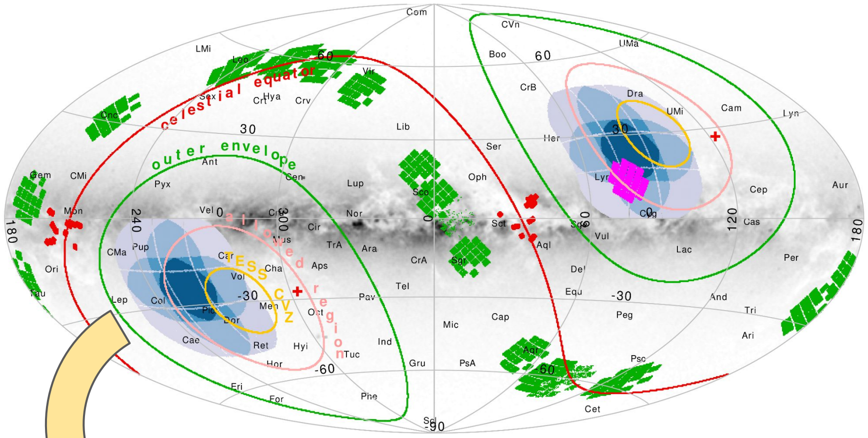
LOPS2: the first PLATO field

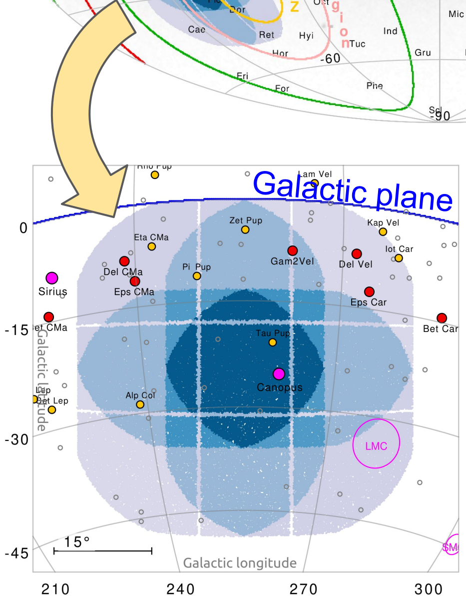
parameter	value	notes
α [deg]	95.31043	ICRS
α [hms]	06:21:14.5	ICRS
δ [deg]	−47.88693	ICRS
δ [dms]	−47:53:13	ICRS
l [deg]	255.9375	IAU 1958
b [deg]	−24.62432	IAU 1958
λ [deg]	101.05940	Ecliptic
β [deg]	−71.12242	Ecliptic
P1 targets	8 235	SciRD req. 7 500
P2 targets	699	SciRD req. 500
P4 targets	12 415	SciRD req. 2 500
P5 targets	167 149	SciRD req. 122 500



LOPS2: the first PLATO field

- PLATO will start its operation with a long-duration observing phase (LOP), i.e., with a field to be observed continuously for at least two years;
- *The first PLATO field will be “LOPS2”, centered at α~6h 21m, δ~−48° in the southern hemisphere* (Nascimbeni et al. 2025, A&A). Constellation-wise, it will cover Pic, Col, Dor, Cae, Ret, Pup entirely, plus smaller parts of CMa, Car, Vol, Men, Hor, Eri, Lep, Vel, Hyi for a total of ~2150 deg²;
- *LOPS2 spans −73.8°< δ <−20° in declination.* It will be fully visible only from southern facilities, but a non-negligible fraction of its 6 and 12 NCAM regions will also be accessible from low-latitude northern observatories;
- *LOPS2 spans −49°< b < 0° in Galactic latitude*, one of its sides being tangent to the disk. Wide range of stellar populations represented;
- Fully compliant with the PLATO Scientific Requirements in terms of P1-P2-P4-P5 counts





LOPS2 properties

parameter	value	notes
α [deg]	95.31043	ICRS
α [hms]	06:21:14.5	ICRS
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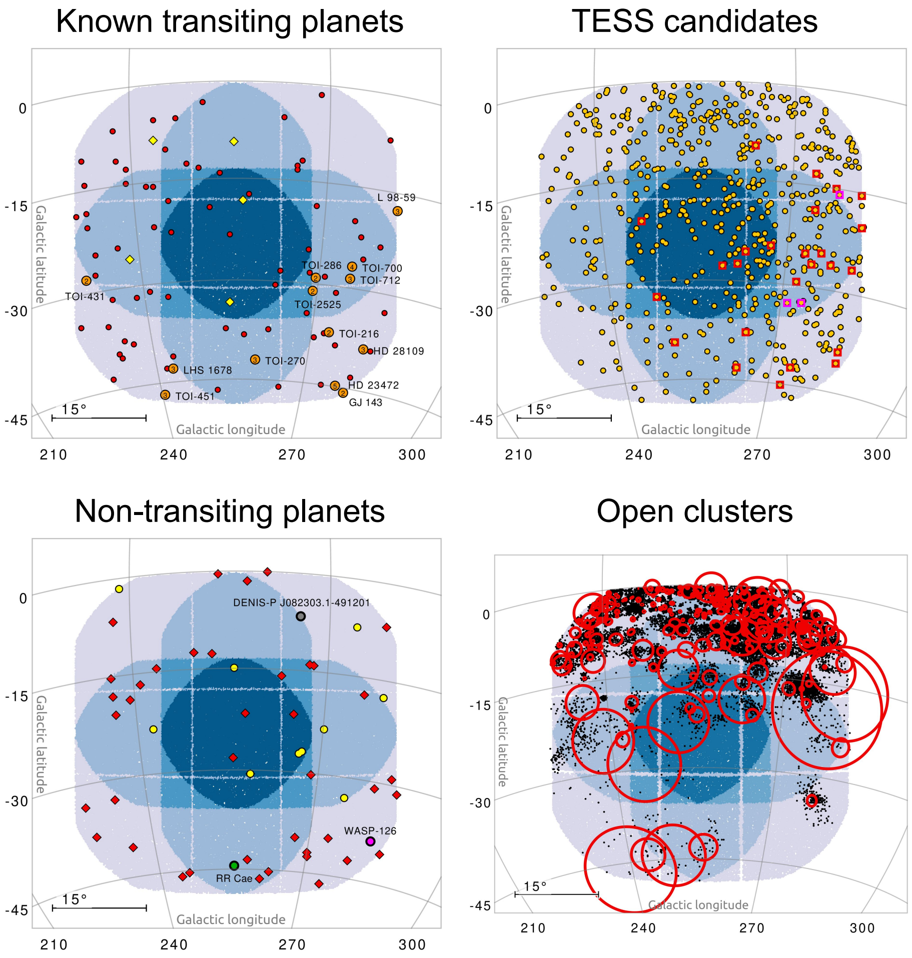
LOPS2: the first PLATO field

Synergies: most of the TESS continuous viewing zone (CVZ; β<−78°) and the JWST CVZ are fully within LOPS2, as are 544 TESS planetary candidates and 108 already confirmed transiting planets

The LOPS2 footprint also includes:

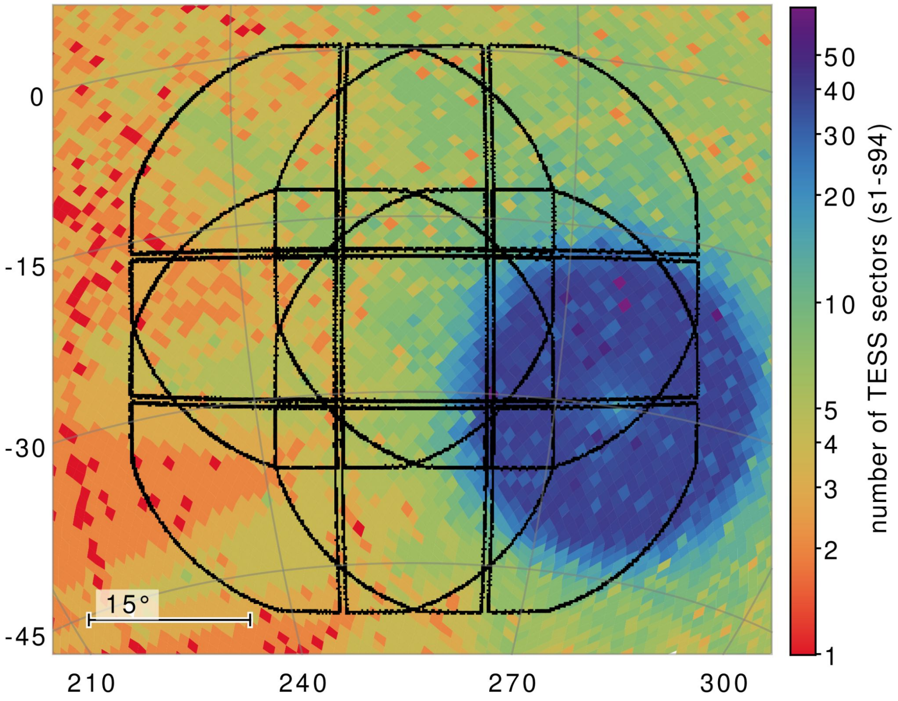
- the Large Magellanic Cloud (LMC);
- 367 open clusters, of which seven have a significant number of bright (*V*<15) solar-type stars;
- ~300k cataloged variable stars of almost all the known types, including EBs, LPV, γCas, CP, CV, δScu, γDor, Cepheids, RR Lyrae, SPB, βCep, etc.;
- 77 non-transiting exoplanets, mostly discovered with the radial velocity technique;
- some benchmark objects such as γ Dor, γ Vel, AB Dor and the Kapteyn's star;

…and much more. Huge community involvement!



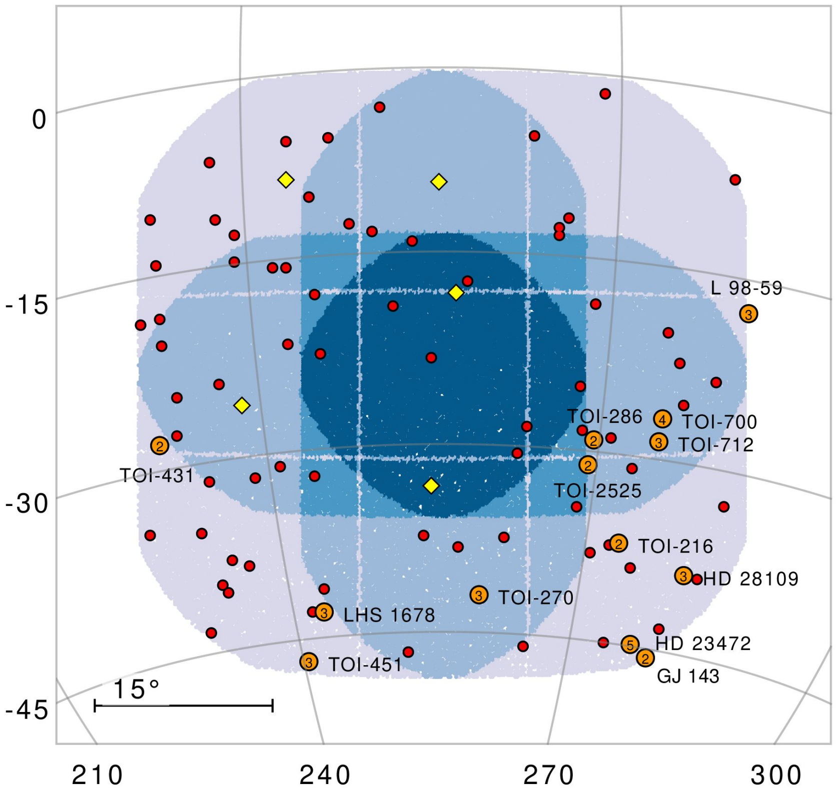
Synergy with TESS

- Among the 519 704 unique TESS targets observed at the regular 2-min cadence up to Sector 94 included, 37 910 lie within the approximate footprint of LOPS2
- Among these, 55% were observed for at least three TESS sectors (not always contiguous) and 15% for at least 13 sectors, or one year cumulated (mostly within the $\beta \lesssim -78°$ cap).
- In term of FFIs 25% of the LOPS2 sky area has been already surveyed through at least 12 TESS sectors, 55% through at least five sectors, and 88% by three.

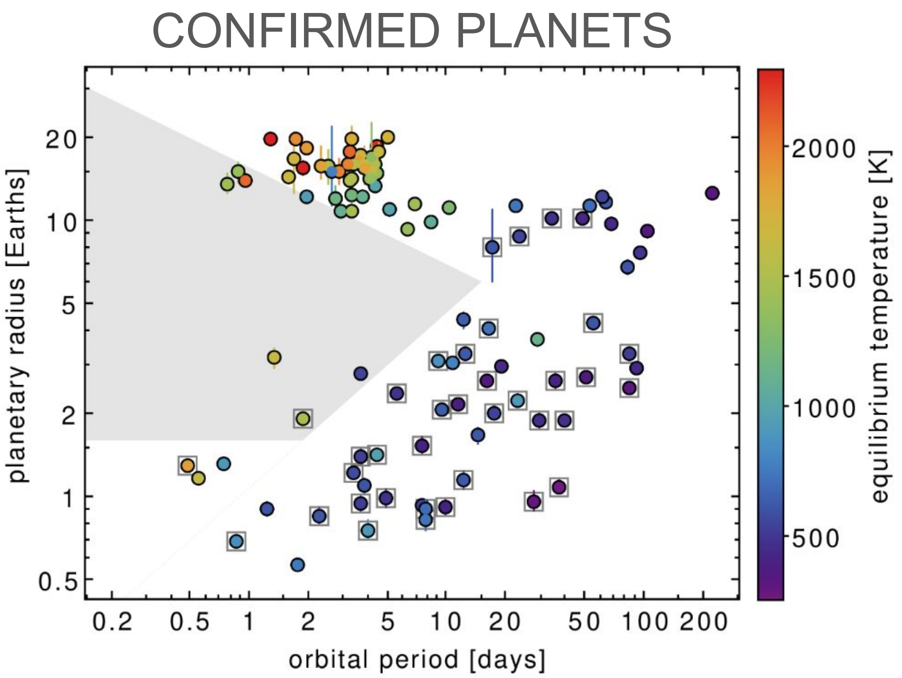


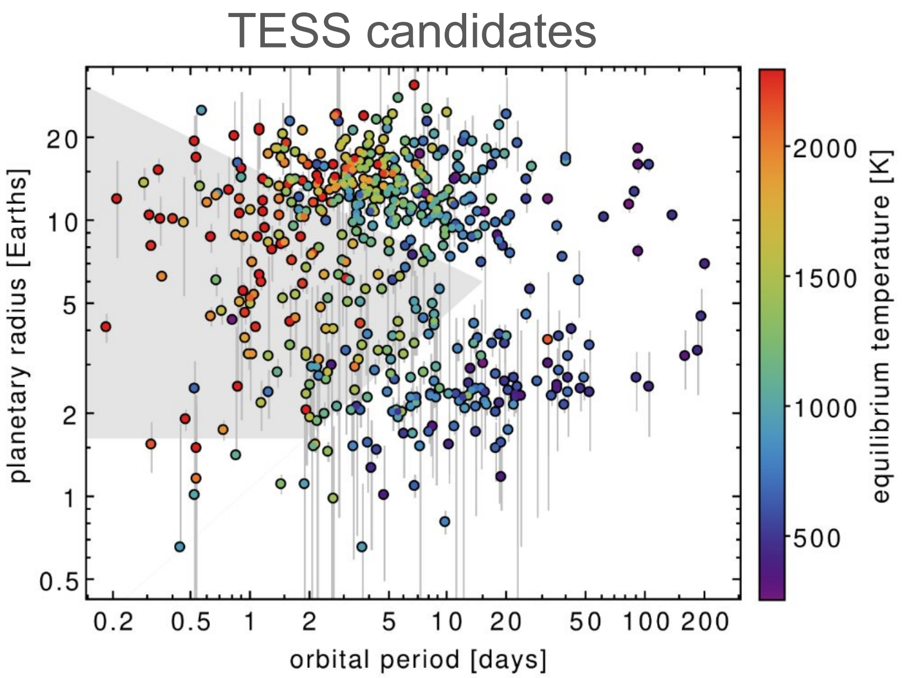
LOPS2: known exoplanets

- Overall, **108 confirmed transiting planets** are located in LOPS2 ; they belong to 84 distinct planetary systems. They cover a vast area of the parameter space: 47 HJ, 14 WJ/CJ, 24 (mini-)Neptunes, 23 rocky planets.
- 13 systems with **multiple transiting planets**: five doublets, six triplets and two high multiplicity systems (TOI-700, HD 23472)
- …but also 544 “active” **TOIs** (TESS candidates) and 53 **non-transiting planetary systems** mostly discovered by RVs and imaging: they will be ALL included in the PIC, regardless of their magnitude or S/N (within feasibility)
- In the case of non-transiting planets, PLATO could not only better characterize the host star, but also discover additional planets (e.g., inner companions to long-period planets discovered by RVs or astrometry)



LOPS2: known exoplanets





The PLATO Prime Sample

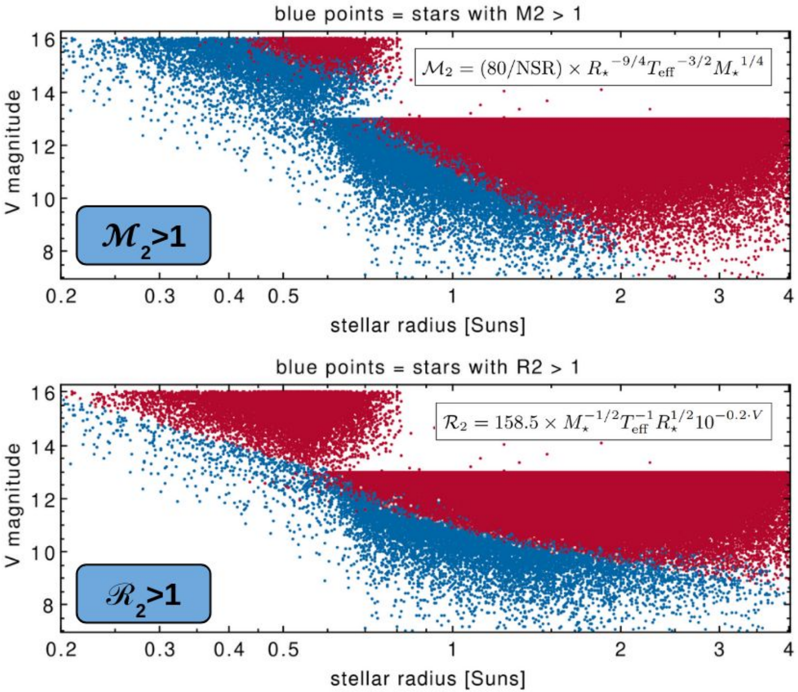
The ***Prime Sample*** (PS) is a subset of the tPIC on which the PLATO Consortium has committed to follow up the detected candidate planets (see the PLATO Science Management Plan). *As such, the PS focuses on exoplanetary science.*

Two ***metrics*** have been developed the guide the PS selection:

- **$\mathcal{M}_2$ is about the *photometric detection* by PLATO**; it is proportional to the SNR of an HZ planet. $\mathcal{M}_2$ is an *absolute* metric: $\mathcal{M}_2>1$ means that an habitable 1 $R_\oplus$ planet would be detectable* in the ≥2 years of a nominal LOP phase.

- **$\mathcal{R}_2$ is about the RV follow-up**; it is proportional to the SNR of an HZ planet. $\mathcal{R}_2$ is a *relative* metric: $\mathcal{R}_2$ >1 means that confirming an habitable, 1 $M_\oplus$ planet would be as easy* as it is for an Earth twin around a G2V star at V=11. It can be rescaled according to the amount of observing effort we can invest on the PS.

Both of them assign higher priority to bright, small, and nearby stars, as expected.



* both metrics of course assume white noise scaling ($N^{0.5}$) and no stellar activity, rotation, pulsations/granulations, binarity etc. since they cannot be captured as a simple function of the tPIC astrophysical parameters (T_{eff}, $M_\star$, $R_\star$).

The PLATO Prime Sample

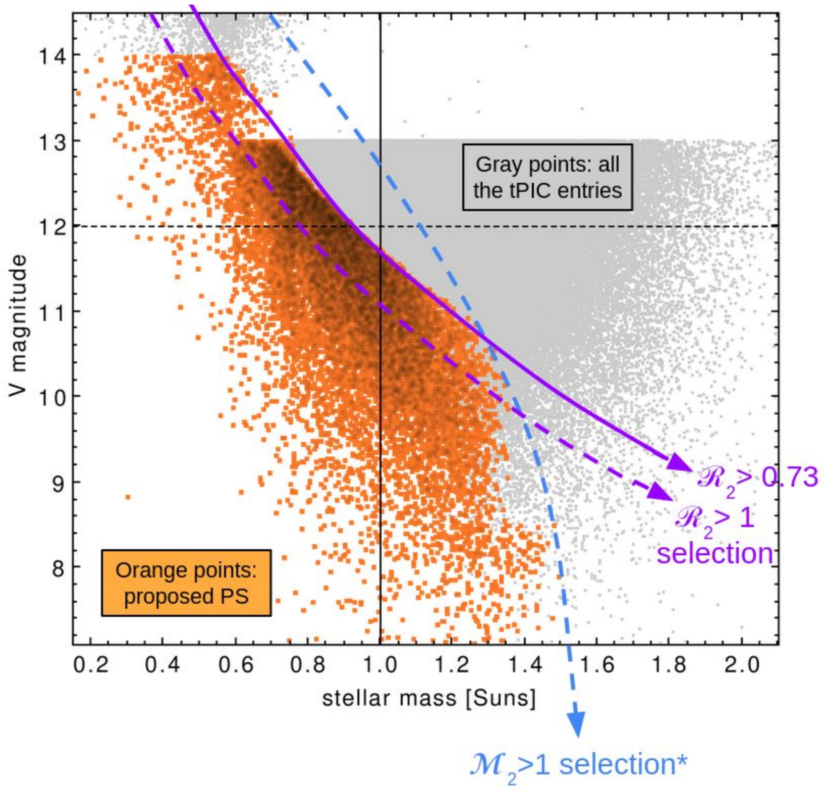
The SWT has agreed:

- to select a PS made of 15,000 stars
- to force the whole P2 sample into the PS;
- to exclude large (>1.5 $R_\odot$) and faint (V>14) stars;
- to adopt $\mathcal{M}_2$ as the base metric and to tune $\mathcal{R}_2$ so that 15k targets are reached.

The current PS selection is very effective in selecting the most suited stars for the follow-up. It includes:

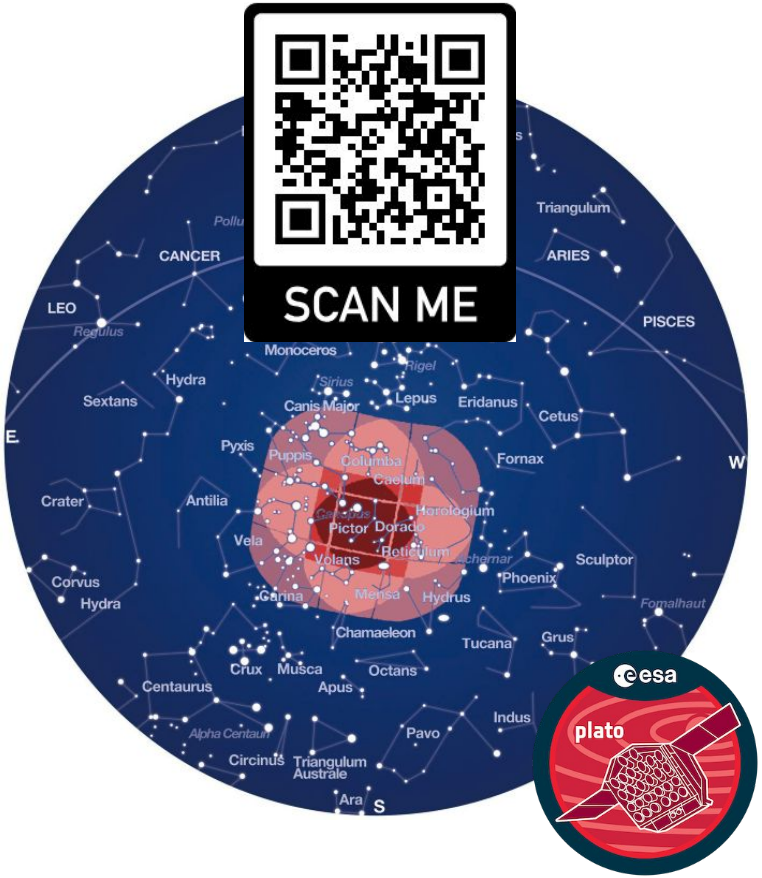
- ~1000 bright (V<11) K dwarfs (~6% of the PS), almost 100% of those available in the tPIC;
- ~2500 bright (V<11) G dwarfs (~17% of the PS), almost 100% of those available in the tPIC;
- ~750 M dwarfs (V<14) from the P4 sample

The astrophysical parameters (T_{eff}, $R_\star$, $M_\star$) of the PS are on average centered on the Solar values.

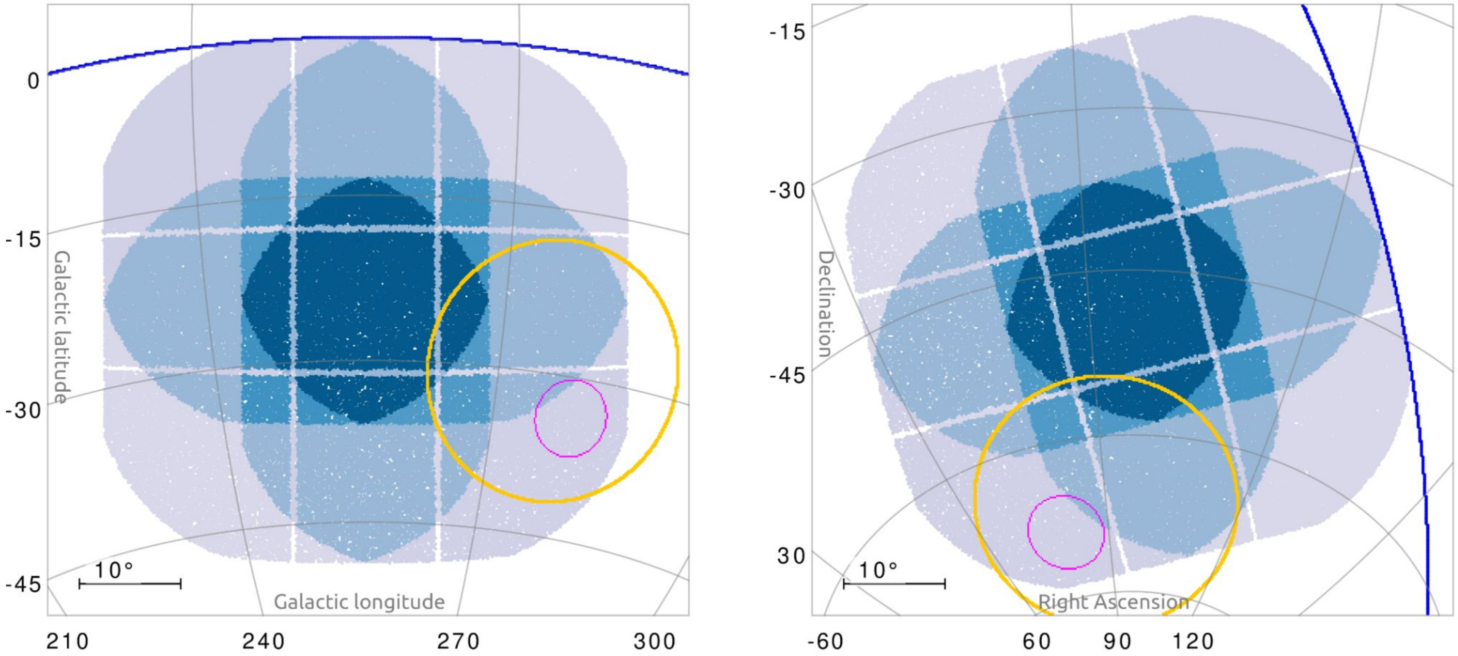


Conclusions

- LOPS2 will be the first PLATO field to be pointed, and it will be continuously monitored for *at least* 2 years
- Next field is still TBD, and it will be probably selected after examining real data from LOPS2
- The call for GO proposals will be released nine months before launch (i.e., in 2026): be prepared!
- The LOPS2 footprint can be downloaded from Zenodo https://zenodo.org/records/14720127 (⇨QR code)
- Many details on LOPS2 and the selection process in Nascimbeni+ 2025 (A&A 694, 313) and Nascimbeni+ 2022 (A&A 658, 31). A third (specifically on the P4 sample) and a fourth one (on the selection of the PS) are currently *in prep.*



BACKUP SLIDES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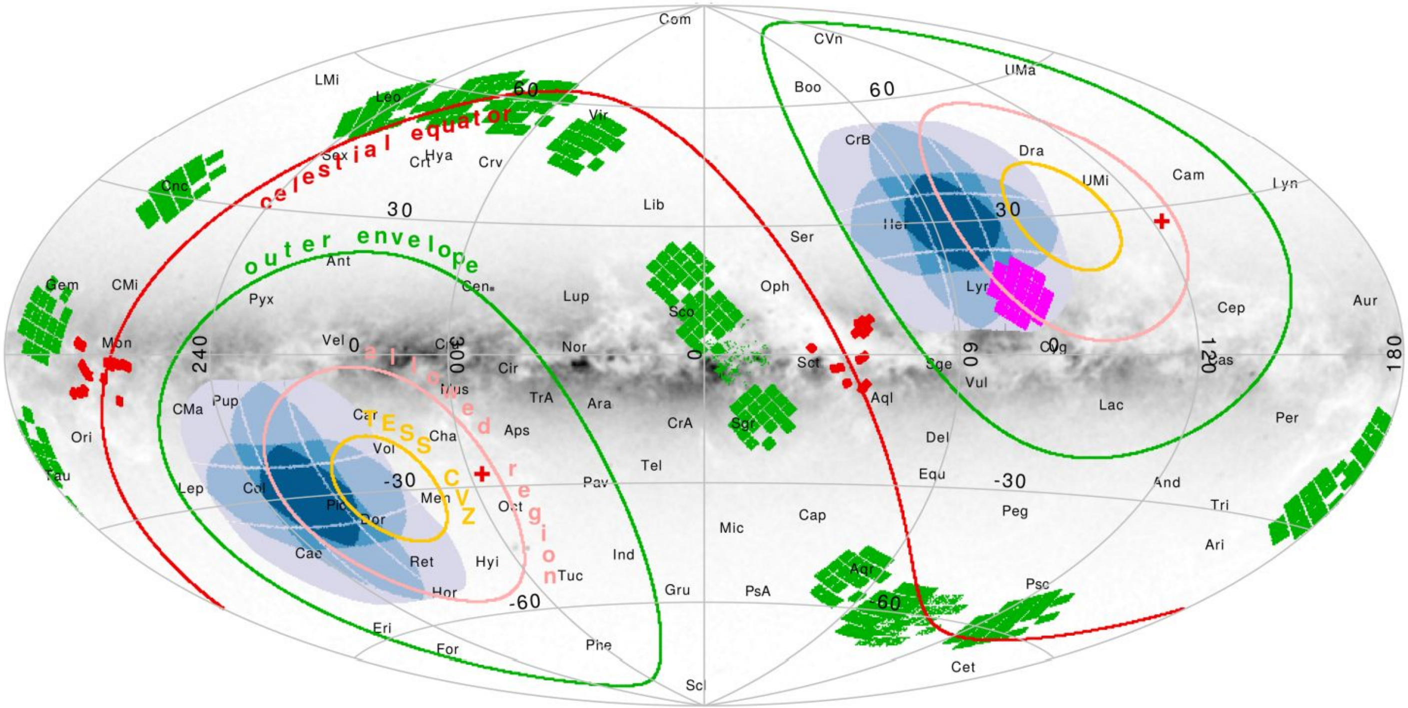
celestial equator
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LOPS2 visibility from the North

- Assuming φ=+28.5° (~La Palma) and LOPS2
- **No stars observable at airmass X<1.5** (i.e, δ>−31.5°; green parallel); this is true up to φ=−21.5°
- Only **10% of P1** and **19% of P5** are barely observable at airmass X<2 (δ>−19.7°; red parallel); most of them are imaged by six and twelve PLATO cameras
- Short answer: **the observability of LOPS2 from the northern facilities is marginal**. Moving to Mauna Kea (φ=+19.8°) would raise the fraction to 30% P1 and 39% P5 (mostly six and twelve cameras).
- In this regard, LOPS2 is one of the most favorable fields in the South; alternative pointings have zero overlap even with Mauna Kea