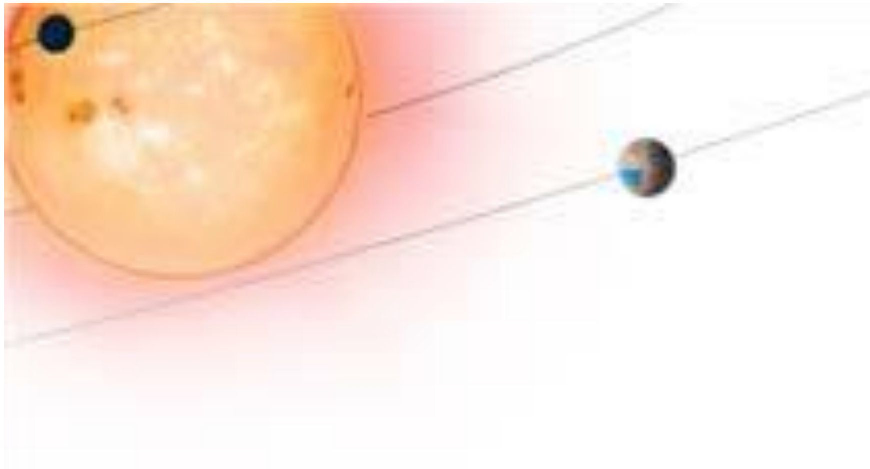

The Plato Input Catalog (PIC)

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Universita' di Padova

- Because of the huge size of PLATO field (~2124 sq deg) and the consequent number of pixels ($24x4x4510^2$+ 2x4x4510x2255 $pixel^2$, ~$0.7m^2$), it is not possible to download raw data.

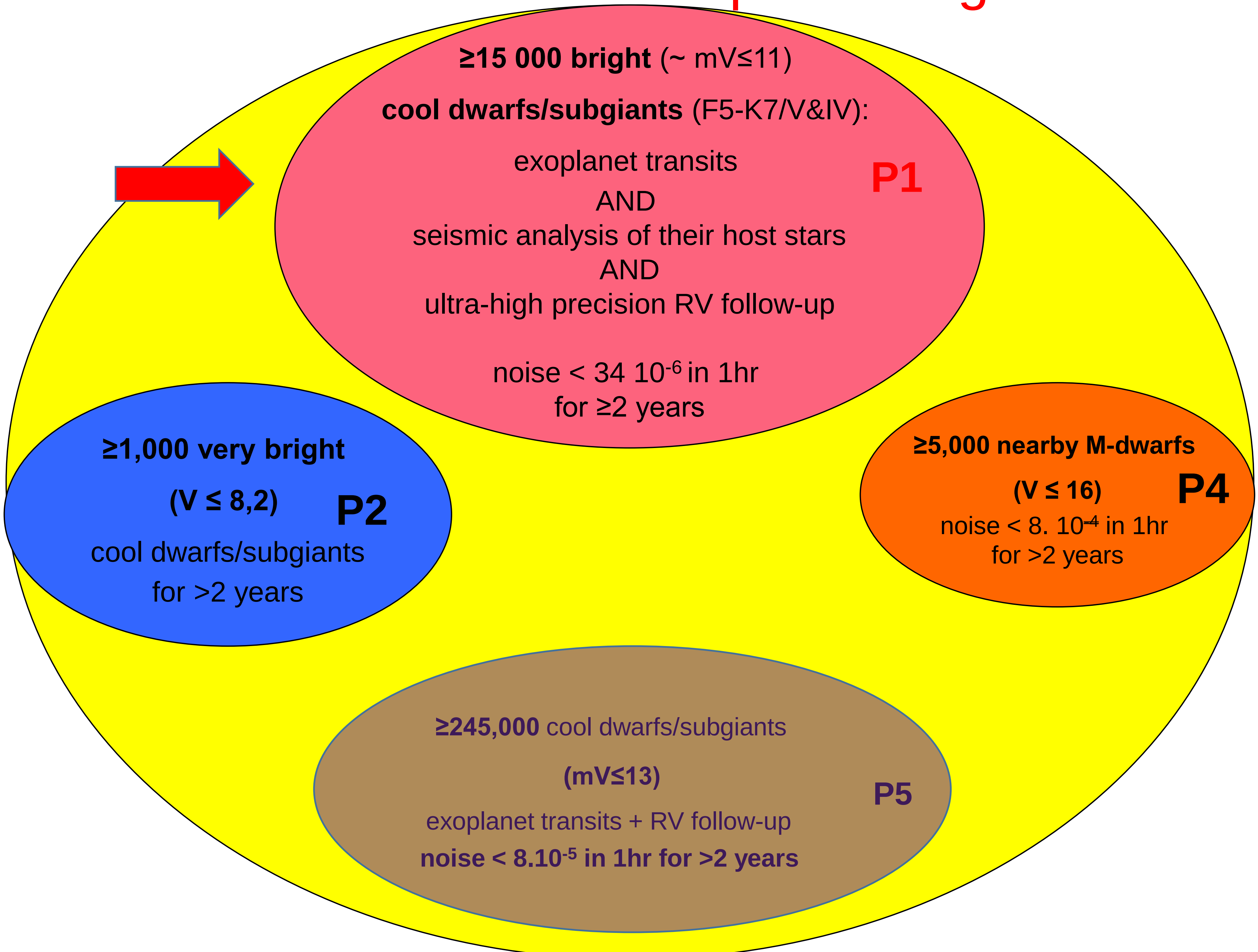
- Light curves will be produced on board for all targets. Imagettes for a small (~$2x10^4$) subsample of targets (all P1 targets+), will be downloaded: **We need to pre-select our targets.**

- The minimum content of the **Plato Input Catalog** (PIC) includes the positions of the targets (dwarfs and sub-giants with spectral type later than F5) around which planet transits shall be searched for, and followed-up.

- For each target, we need **a table of contaminants**, to optimize photometric mask and candidate exoplanet validation (minimize follow-up costs).

- For each target, the PIC shall contain a number of parameters intended to make the validation, confirmation and follow up of the candidates easier, faster and cheaper.

PLATO stellar samples
for the final 24+2 telescopes configuration



Ongoing PLATO Input Catalog activities for:

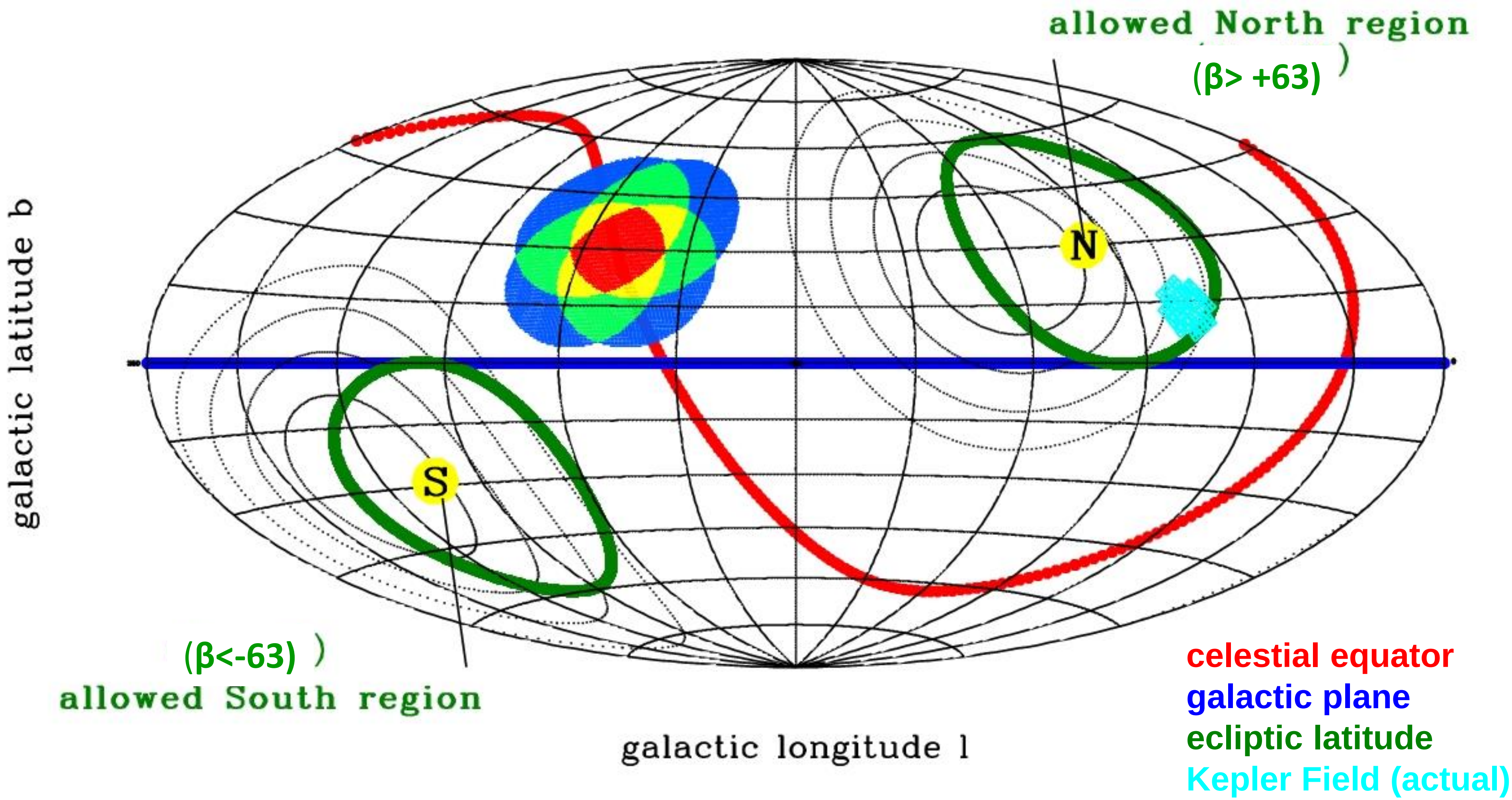
1. PLATO performance evaluation

2. PDC tools preparation

3. PLATO field location

4. For PLATOsim

Observable regions



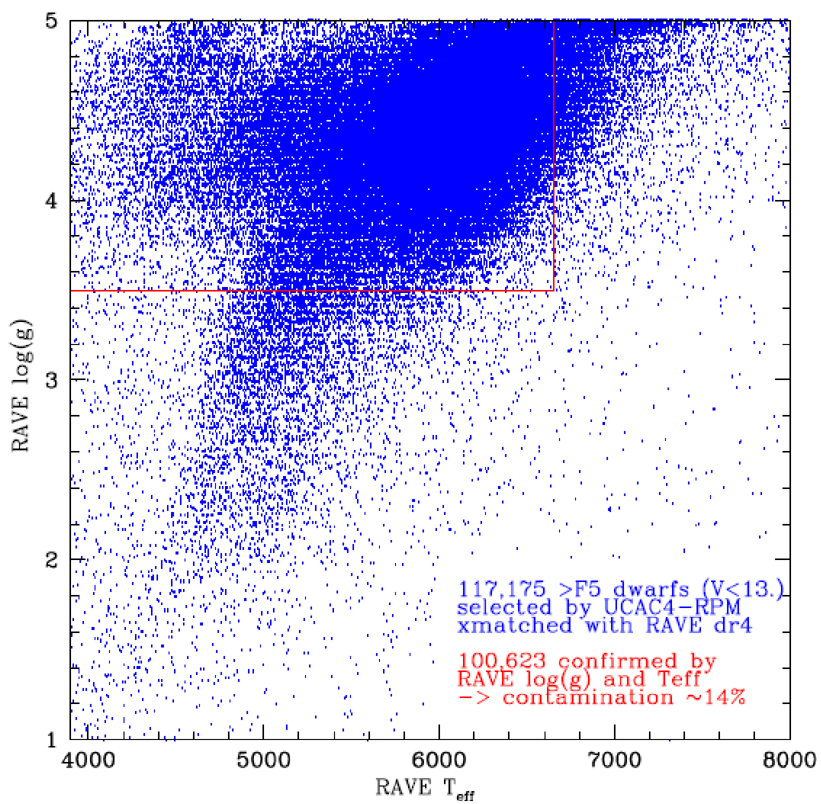
The center of the two long-duration (LD) fields must be located within 27 deg from the ecliptic poles (|β|>63). Thus the **allowed center regions** are two 2750 deg2 caps at |δ|>40. Each **Plato FOV** will cover ~2232 deg^2

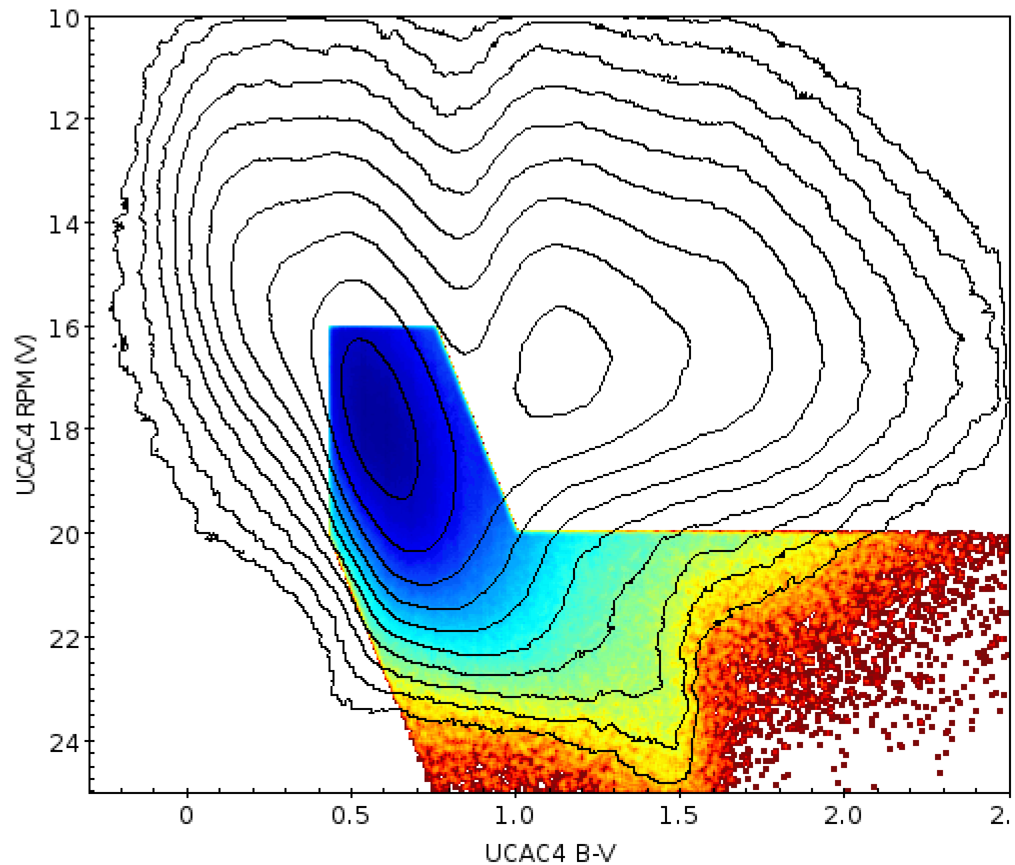
During the 4-yr mission (plus possible extension), potentially almost **50%** of the sky (LD+S&S phases) will be covered by Plato! We need an unprecedented **all-sky stellar classification (*V*<13 plus M dwarfs down to V~16)** to select the fields and the targets.

The first PIC (PICV0.1) from UCAC4-RPM catalog

As both the completeness and the classification accuracy of the available databases fade rapidly in the range 10<V<11, we constructed a brand new all-sky database of FGKM dwarfs (UCAC4-RPM) by applying the **reduced proper-motion** technique to the UCAC4 catalog.

We used the RAVE DR4 classification as a calibrator.



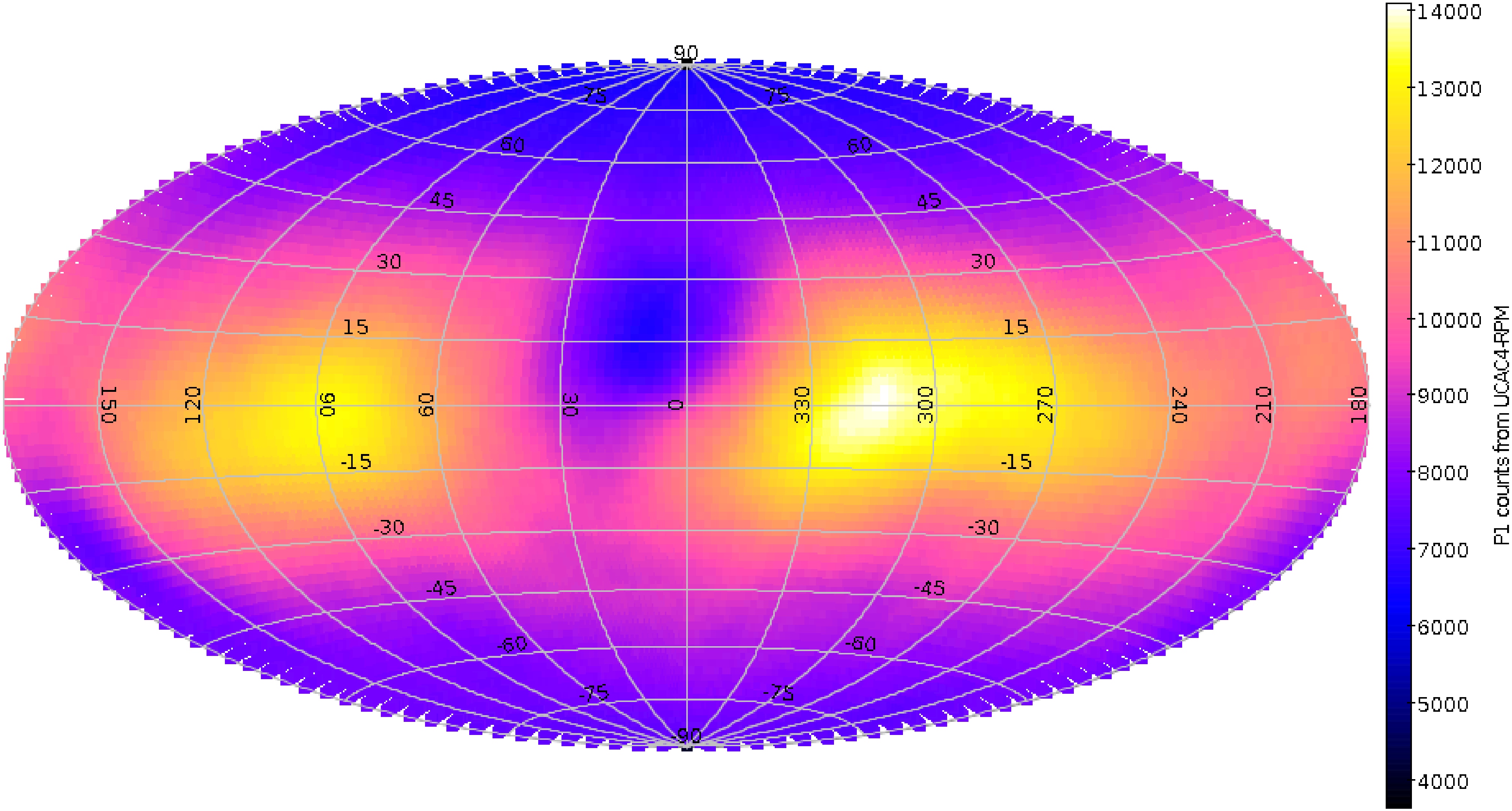


The resulting subset is a reasonably complete census of all the 2,500,000 main-sequence dwarfs brighter than V~13.

The fraction of false positives (mostly field red giants) is about 20%.

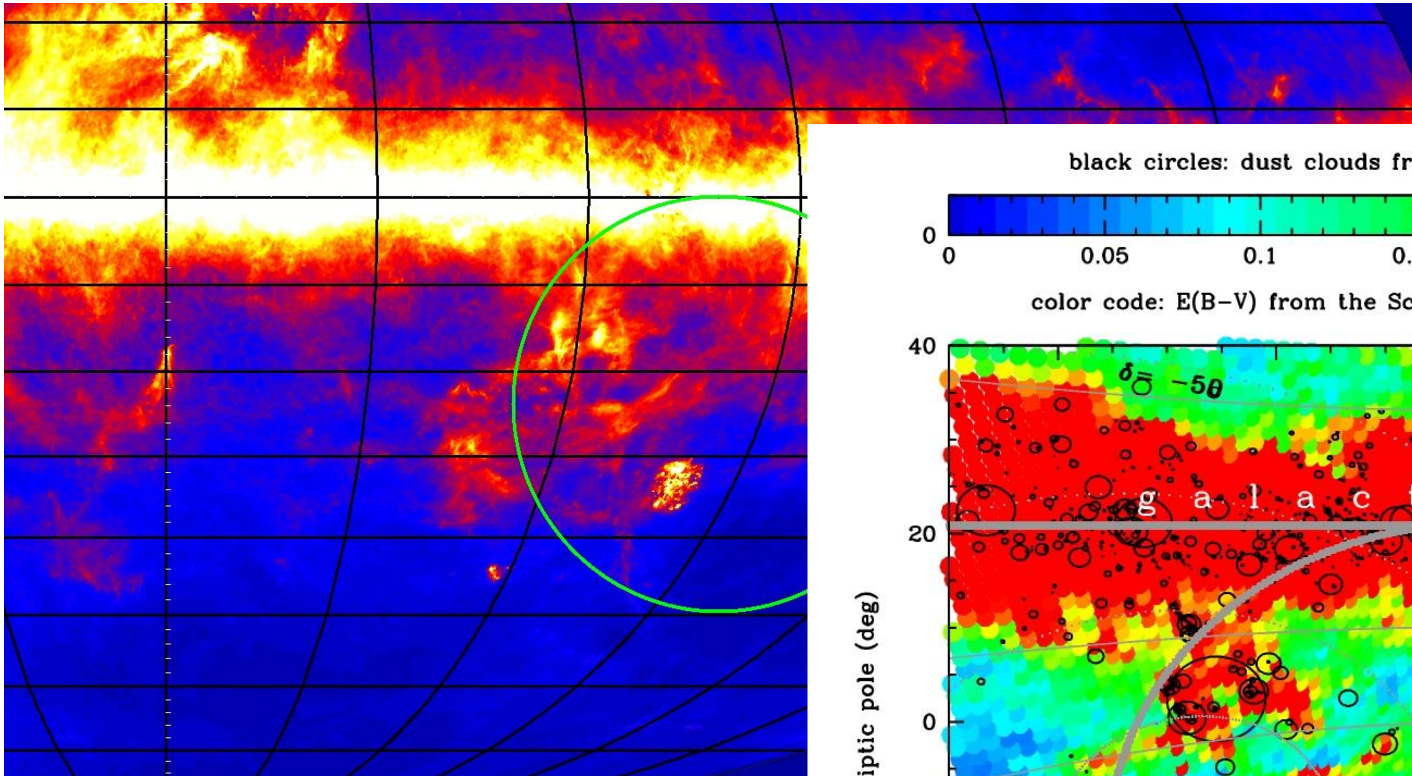
(Nascimbeni et al. 2016, MNRAS, 463, 4210)

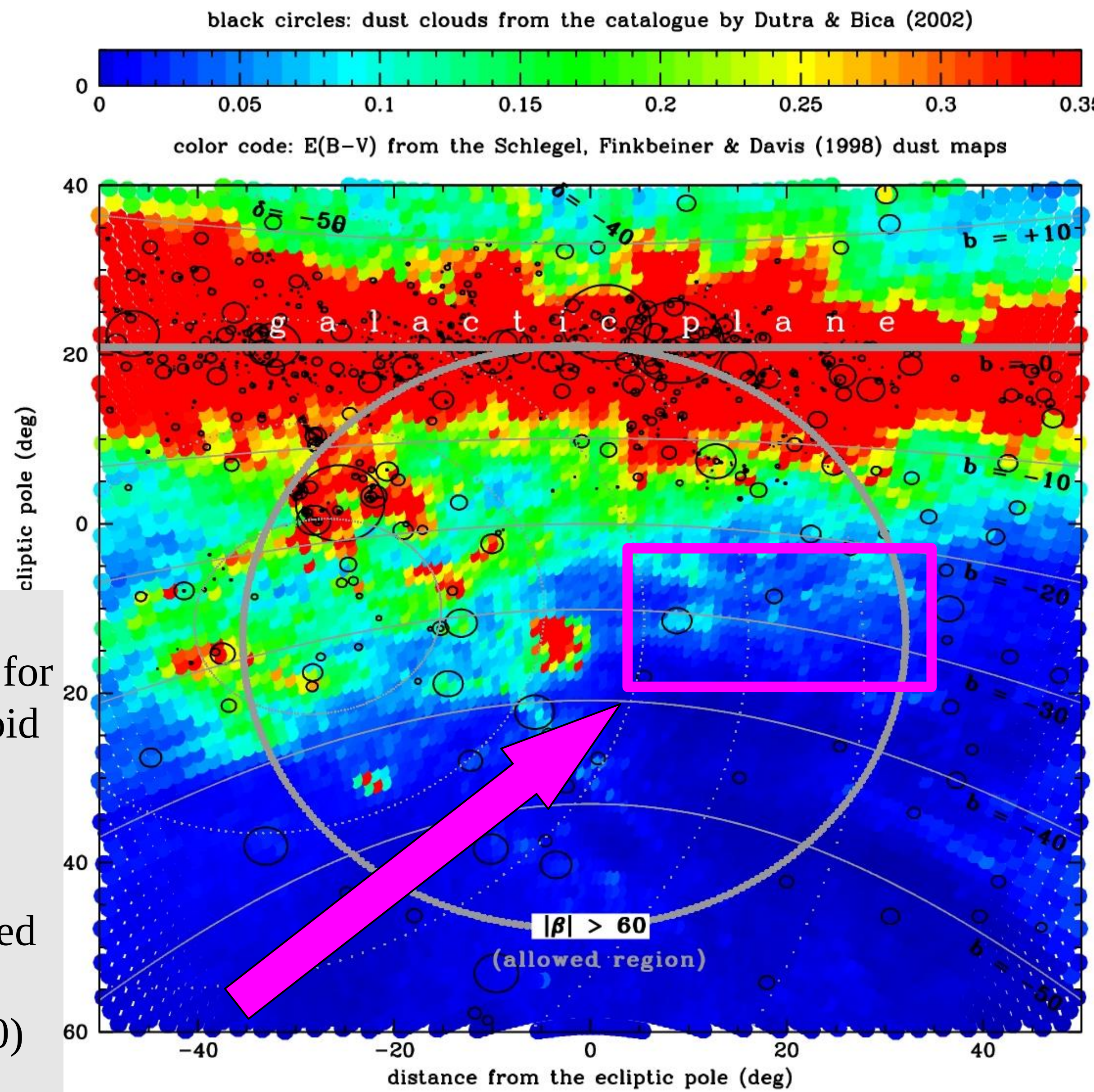
The UCAC4-RPM catalog: density maps



This first PIC has been used for performance estimate and for the identification of preliminary long duration fields

Reddening from dust maps

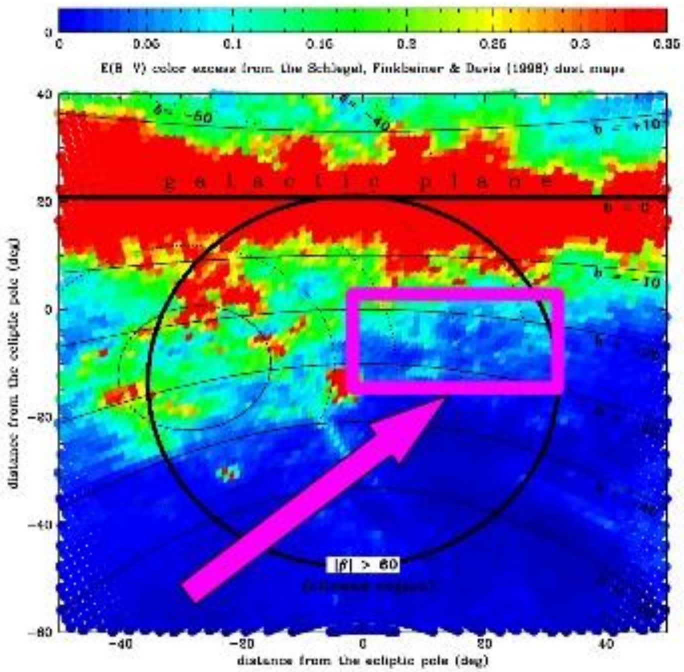


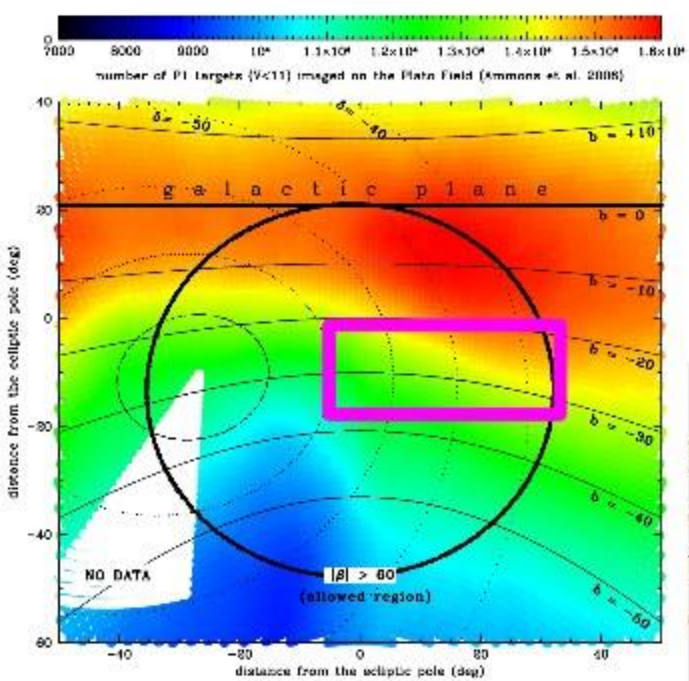


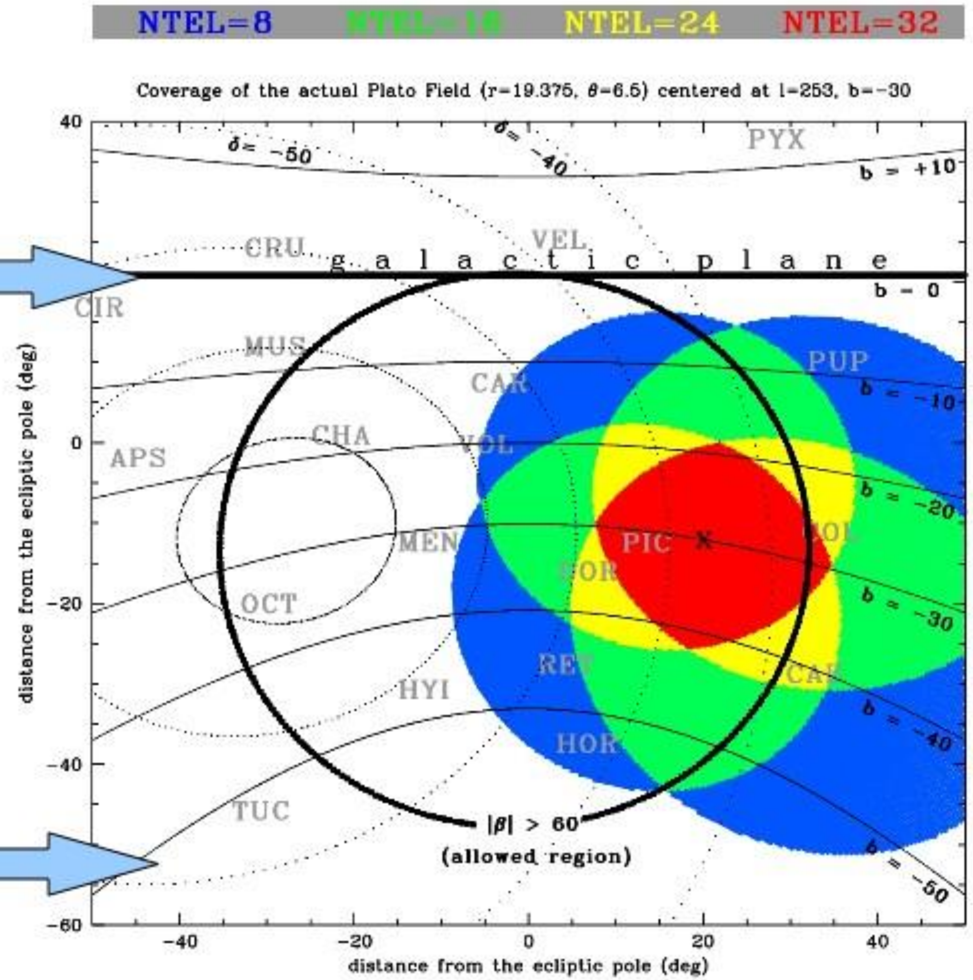
Since **reddening** is a strong source of errors for our classification techniques, we want to avoid as much as possible the "dusty" regions.

Following the dust maps by Schlegel et al (1998) and Dutra & Bica (2005), we identified a region with b~**-30** where the interstellar extinction is unusually low (l<270, delta>-60)

The proposed 1st Plato Field







Following the need to satisfy the P1-P5 requirements (b>-30, l<270), to avoid as much as possible the galactic plane (crowding+contamination), to minimize the reddening: **we propose l=253, b=-30 (in Pictor) as center of the first Plato long-duration FOV**.

(Nascimbeni et al. 2016, MNRAS, 463, 4210)

The proposed (preliminary) Southern PLATO long duration field

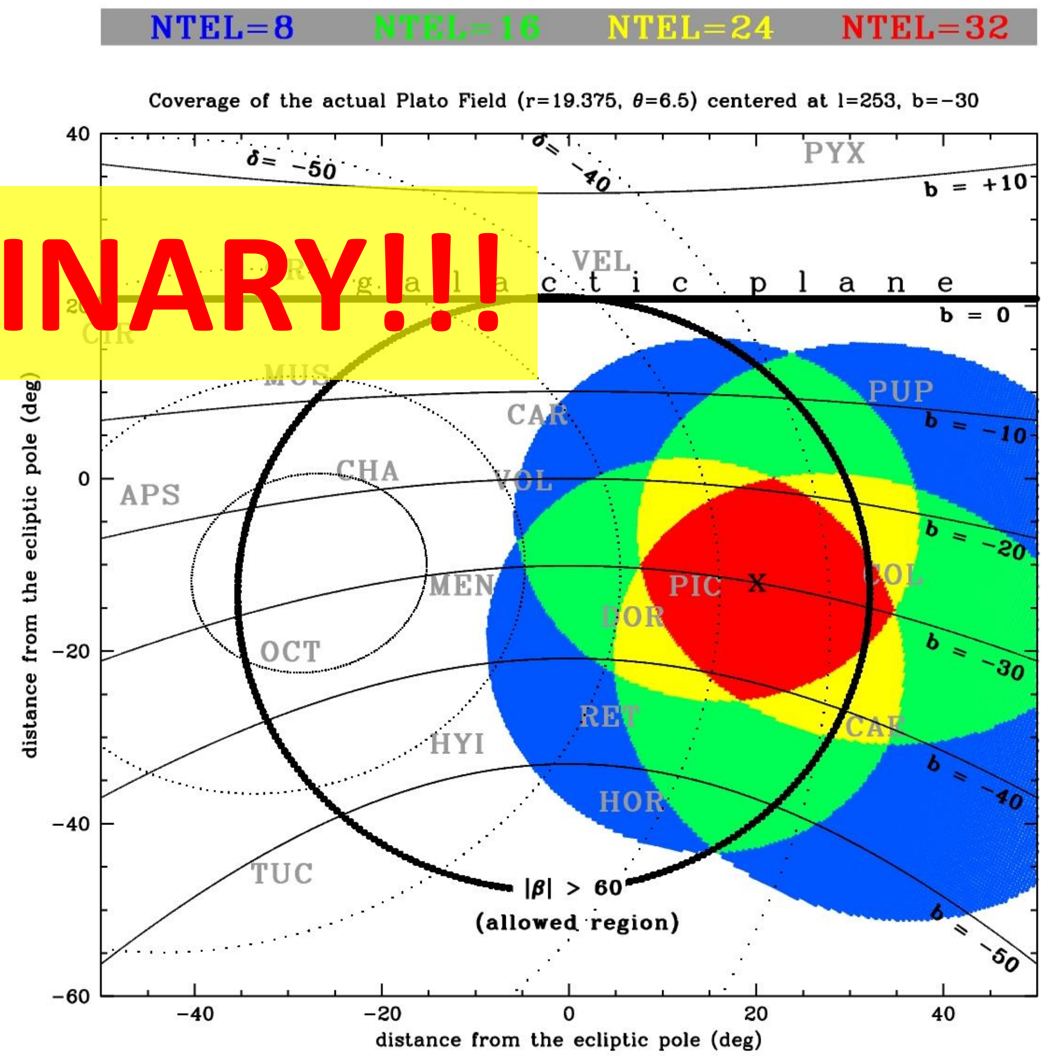
l = 253, b = -30,
α = 5h 47m, δ = -46 26
(in Pictor)

1) tangent to the galactic plane, most of the field **avoids regions with extreme stellar crowding**, the area covered by >8 telescopes is mostly in low-extinction regions

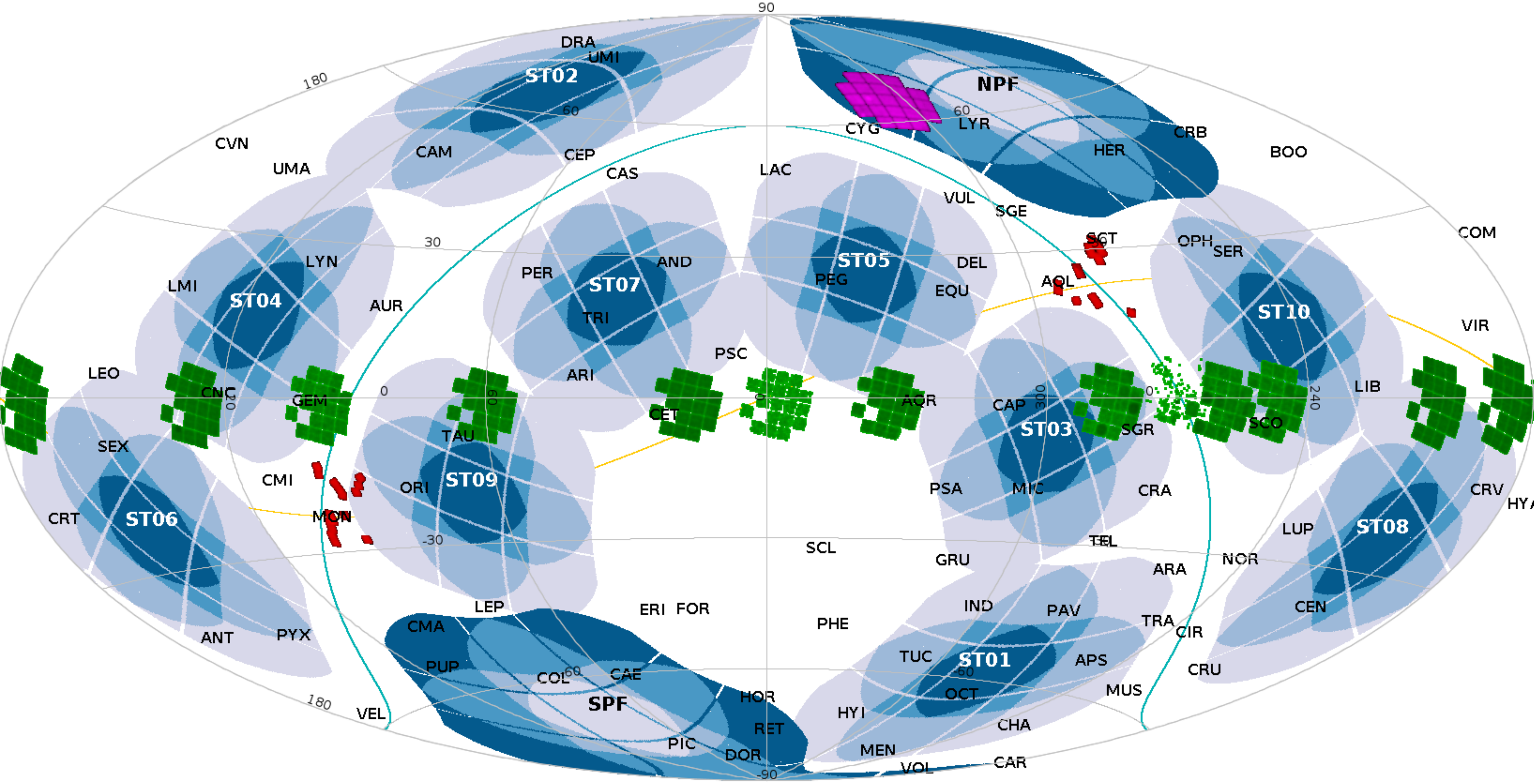
2) **the requirement for P1 targets is met** according to both photometric classifications & galactic models

3) the field is in the southern emisphere, mostly at δ > -60 → **easy to be observed with the southern facilities**

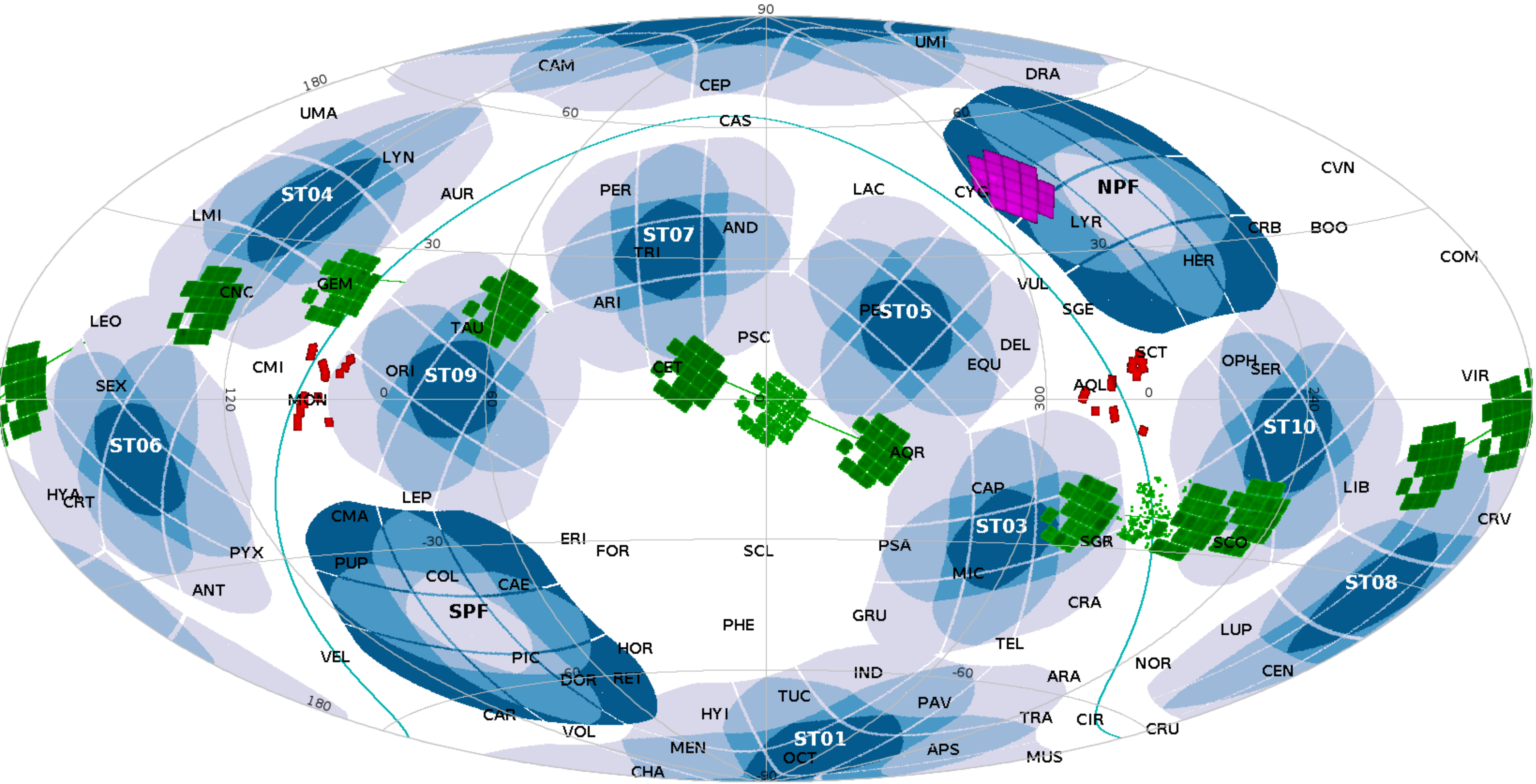
PRELIMINARY!!!



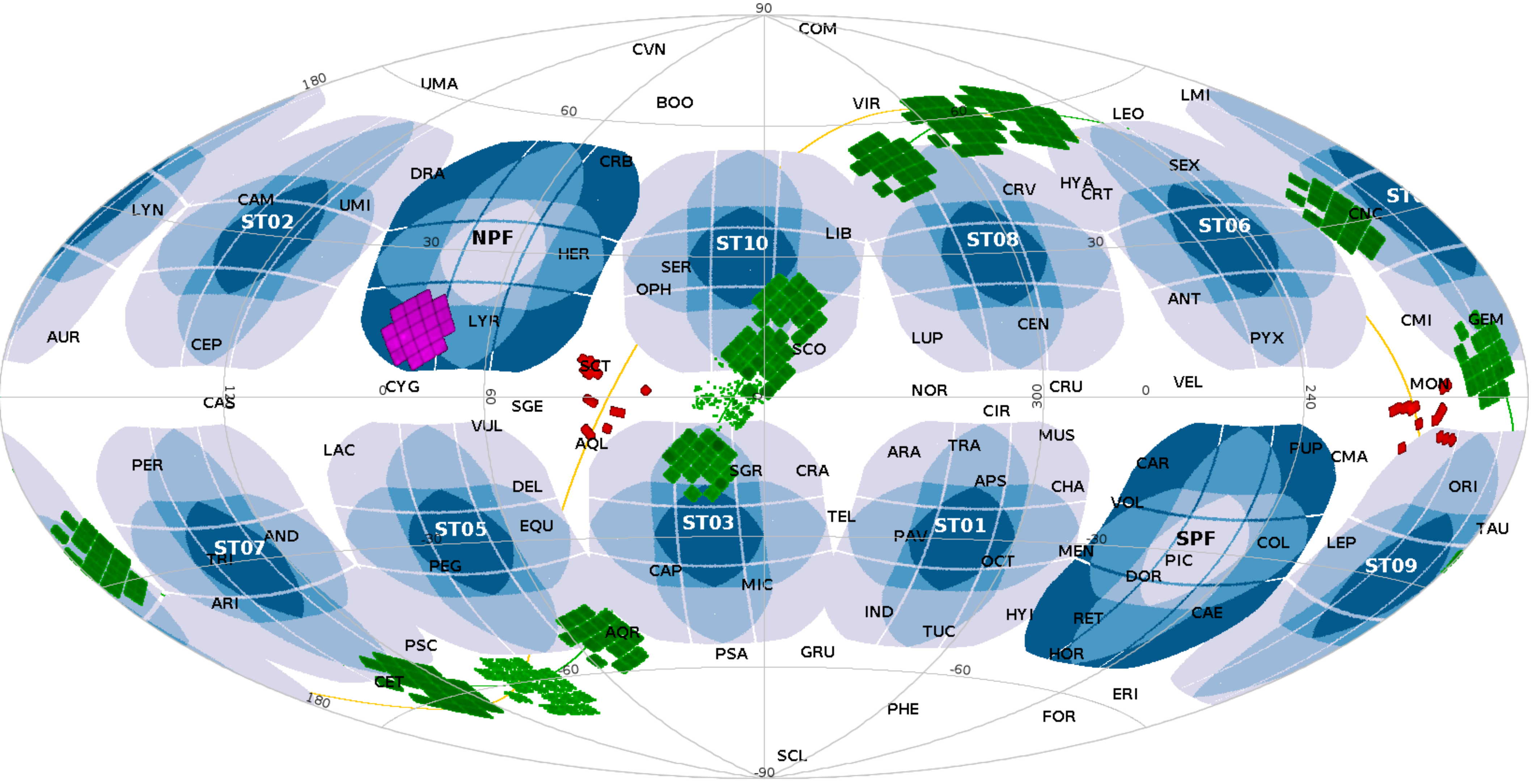
Preliminary PLATO fields in ecliptic coordinates



Preliminary PLATO fields in equatorial coordinates



Preliminary PLATO fields in galactic coordinates



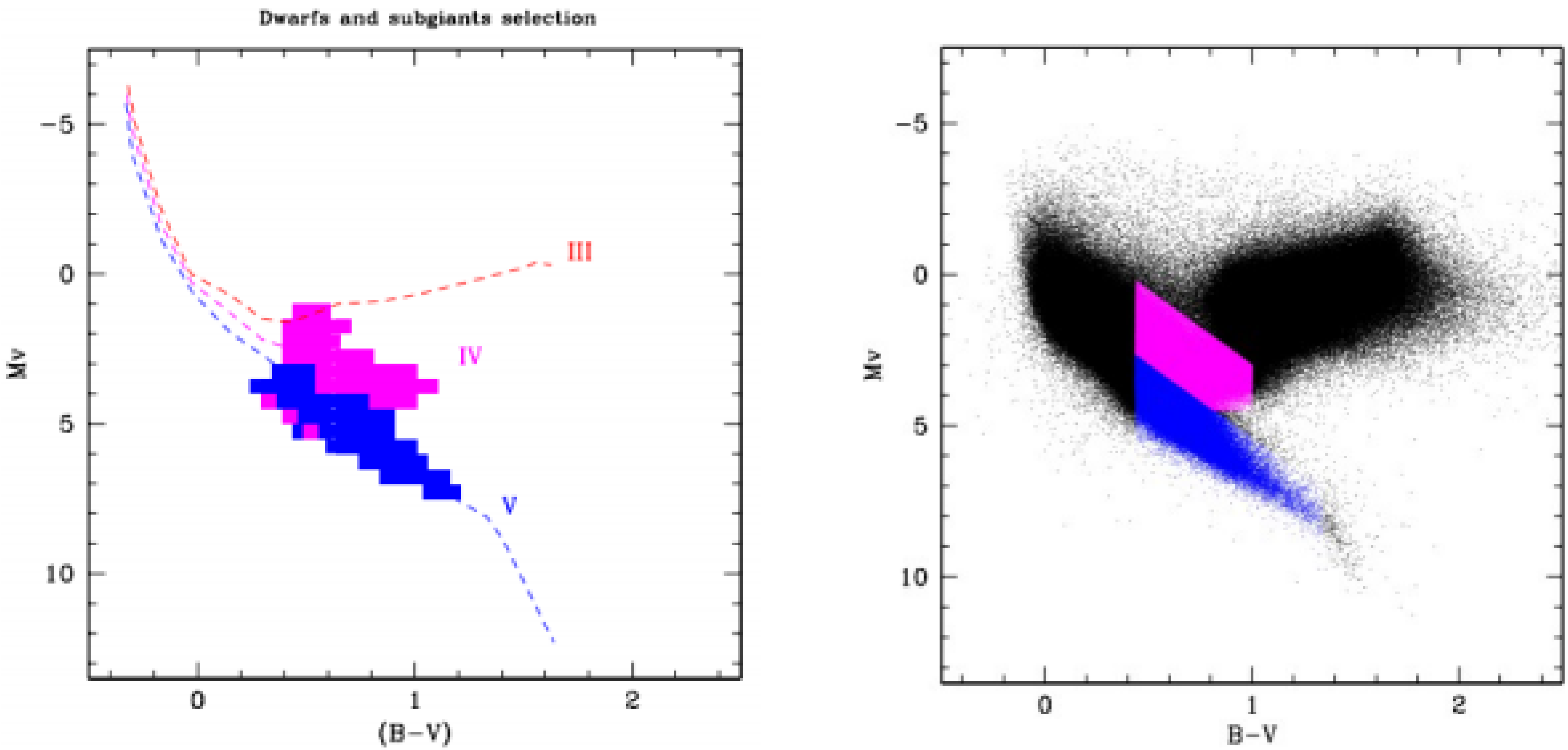
Populating the PIC: target selection

PLATO will observe dwarfs and subgiants with 4<*V*<16, SpT >F5 ➔ **all possible PLATO targets will also be observed by *Gaia*.**

Simulations from DPAC's CU2 team showed that **simple cut in *Gaia* G-mag and d** is able to provide a "clean" sample of main-sequence dwarfs later than F5, with only ~1% "pollution" from cool giants. Pollution lowered to ~ 0.1%, using Teff/log(g)/[Fe/H] from ***Gaia* spectro-photometry and *Gaia* and ground-based spectroscopy**

NOTE: Major improvements expected after DR2 release, though, upon request of the performance team, we are working to prepare a catalog based (mainly, but not only) on GAIA DR1 (PIC V0.2).

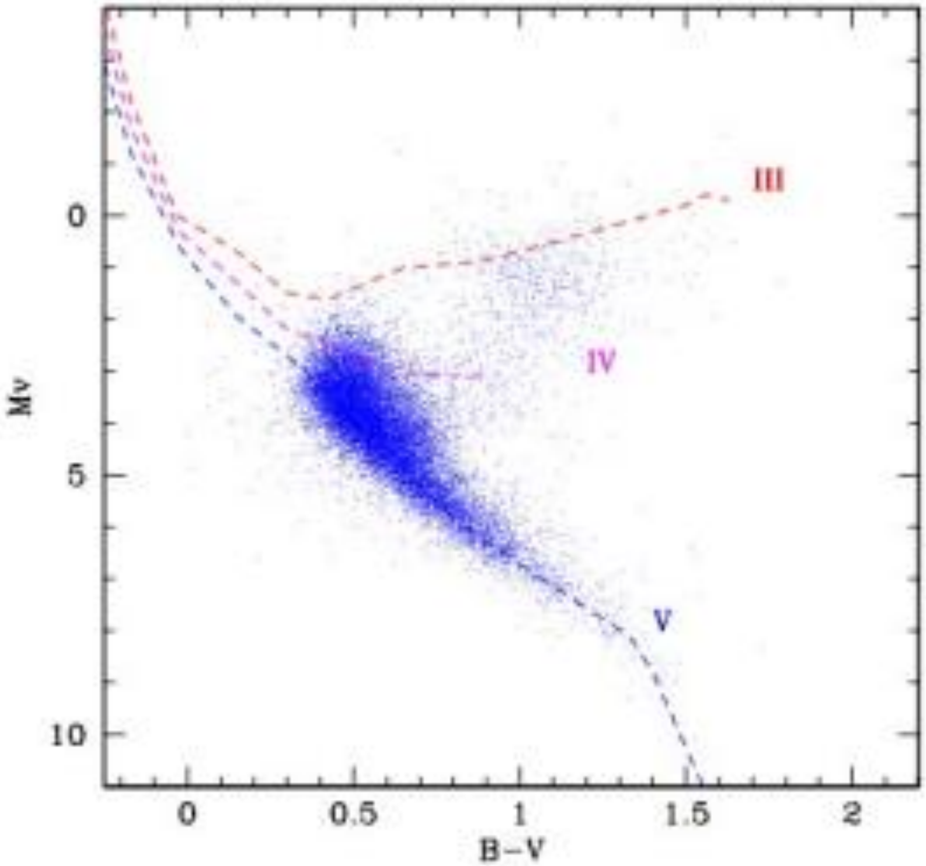
Parallax (GAIA-DR1) based selection



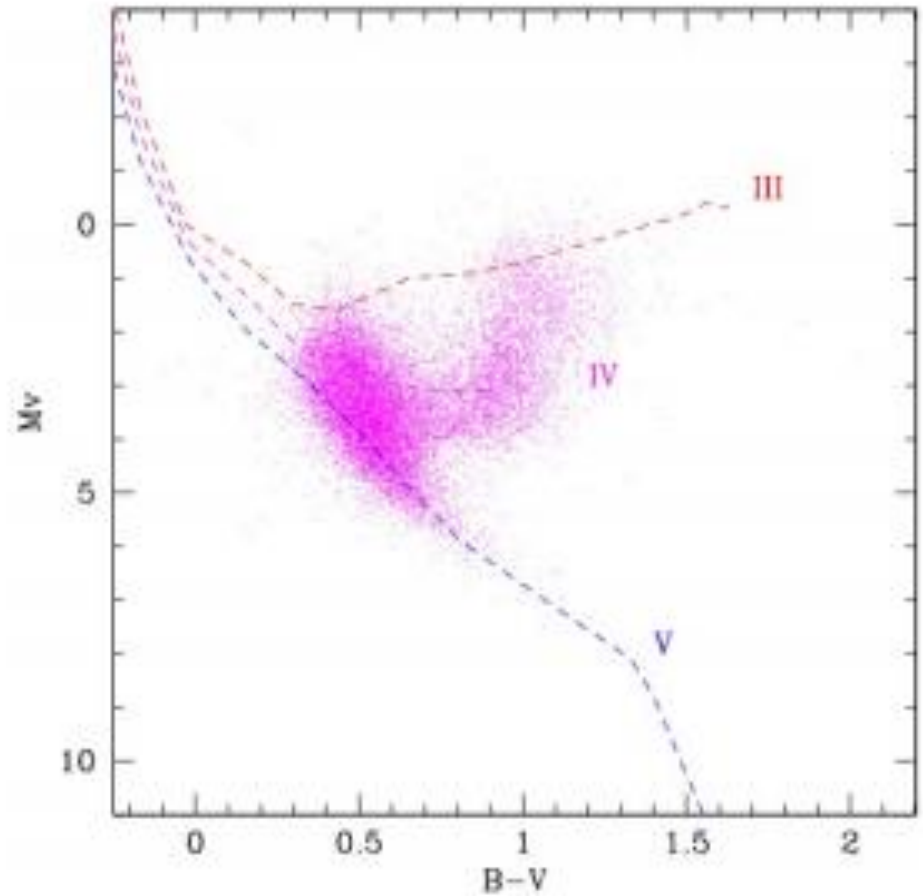
DWARFS (blue): log g > 4, 4050 K < T_{eff} < 6510 K
SUB-GIANTS (magenta): 3.5 < log g <4.0, 4050 K < Teff < 6510 K
(from Pecaut & Mamajek (2013), ApJS, 208, 9)

RAVE DR5 used as proxy to define the region in the CMD occupied by >F5

DWARFS

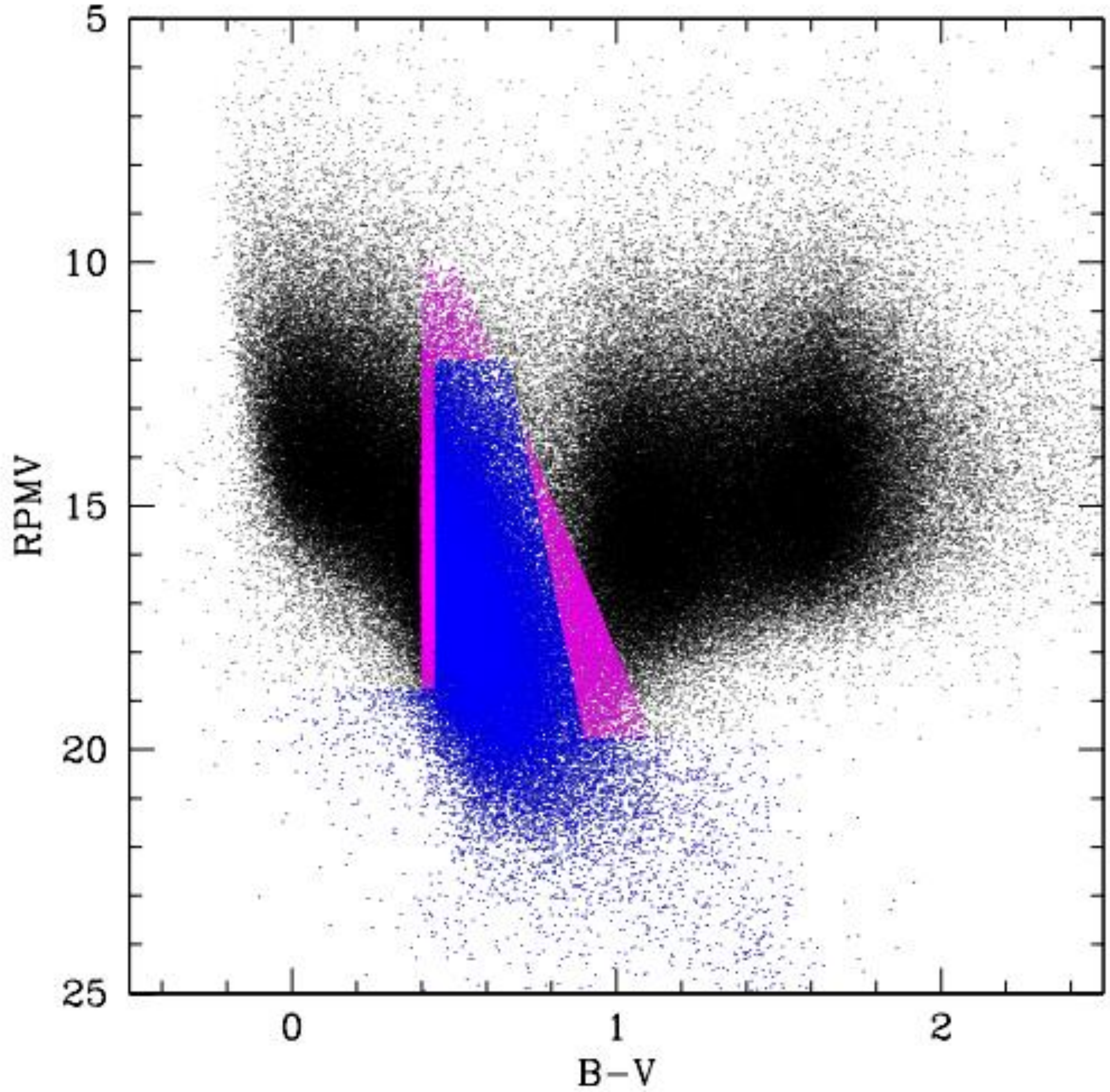


SUB-GIANTS



Stars classified by RAVE (DR5) as dwarfs and sub-giants using GAIA (DR1) parallaxes. In the region of hot dwarfs and sub-giants a significant overlap exists. **To be significantly improved with GAIA-DR2.**

RPMV-based selection



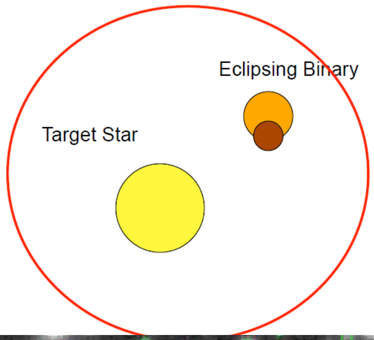
For the (~30% for V<=11 sample) of the stars with no GAIA DR1 parallaxes, we adopted a similar approach as in Nascimbeni et al. (2016) to define the selection regions in the CMD using reduced proper motions from UCAC5

The PIC will be composed by two primary tables

PIC main → It is the main catalog, containing information on the target stars, organized into a single table for all PLATO samples.

Contaminants → It is a table containing, for each target, a list of contaminant stars, that is stars that fall within a given angular distance from the target and up to a certain limiting magnitude.

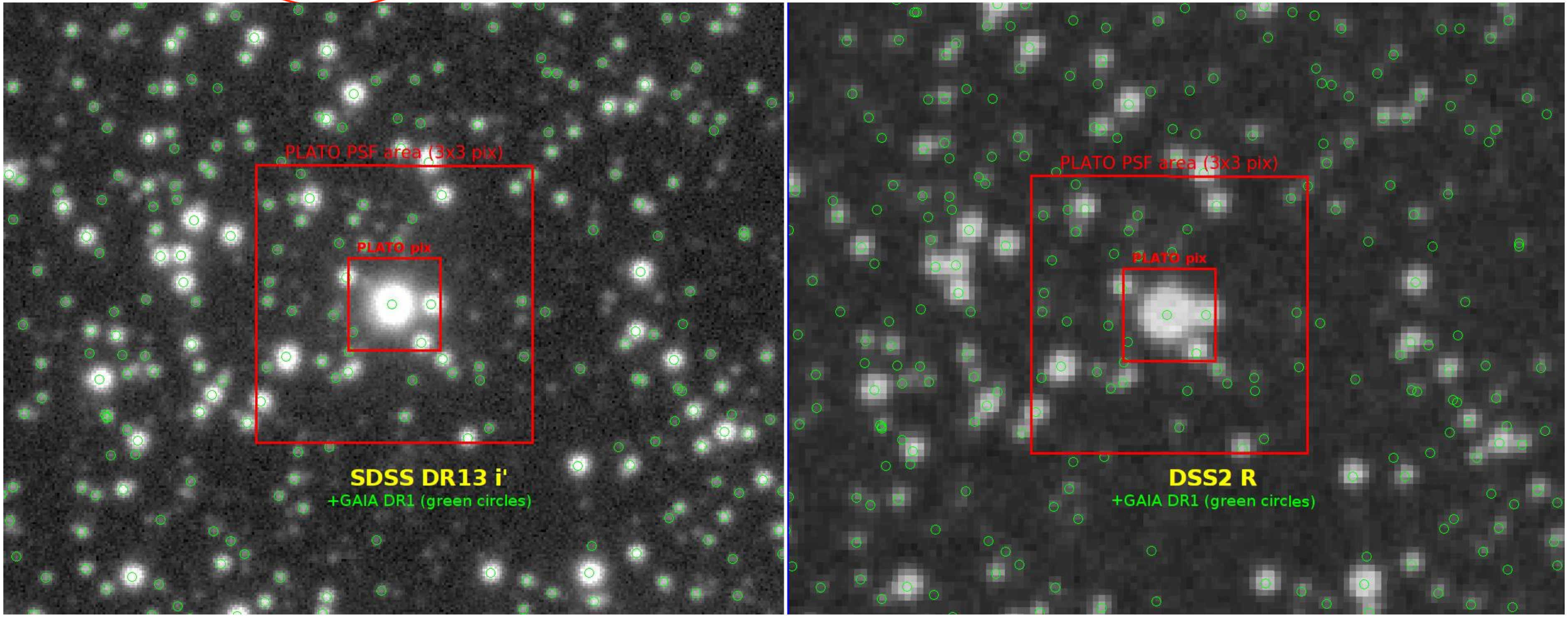
Contaminants problem



Typical false positive source: an eclipsing binary, fainter than the target, within the PSF radius of the target.

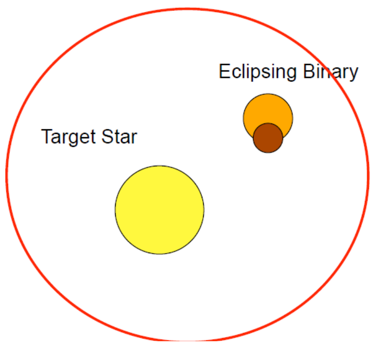
The problem becomes serious in «crowded fields», e.g. towards the Galactic plane for PLATO

Region to include and Δmag of contaminants to be defined



PLATO pix size 15 arcsec; 90% of PSF light in 2.5x2.5 pix (center)→3.0x3.0 (border)

Contaminants identification



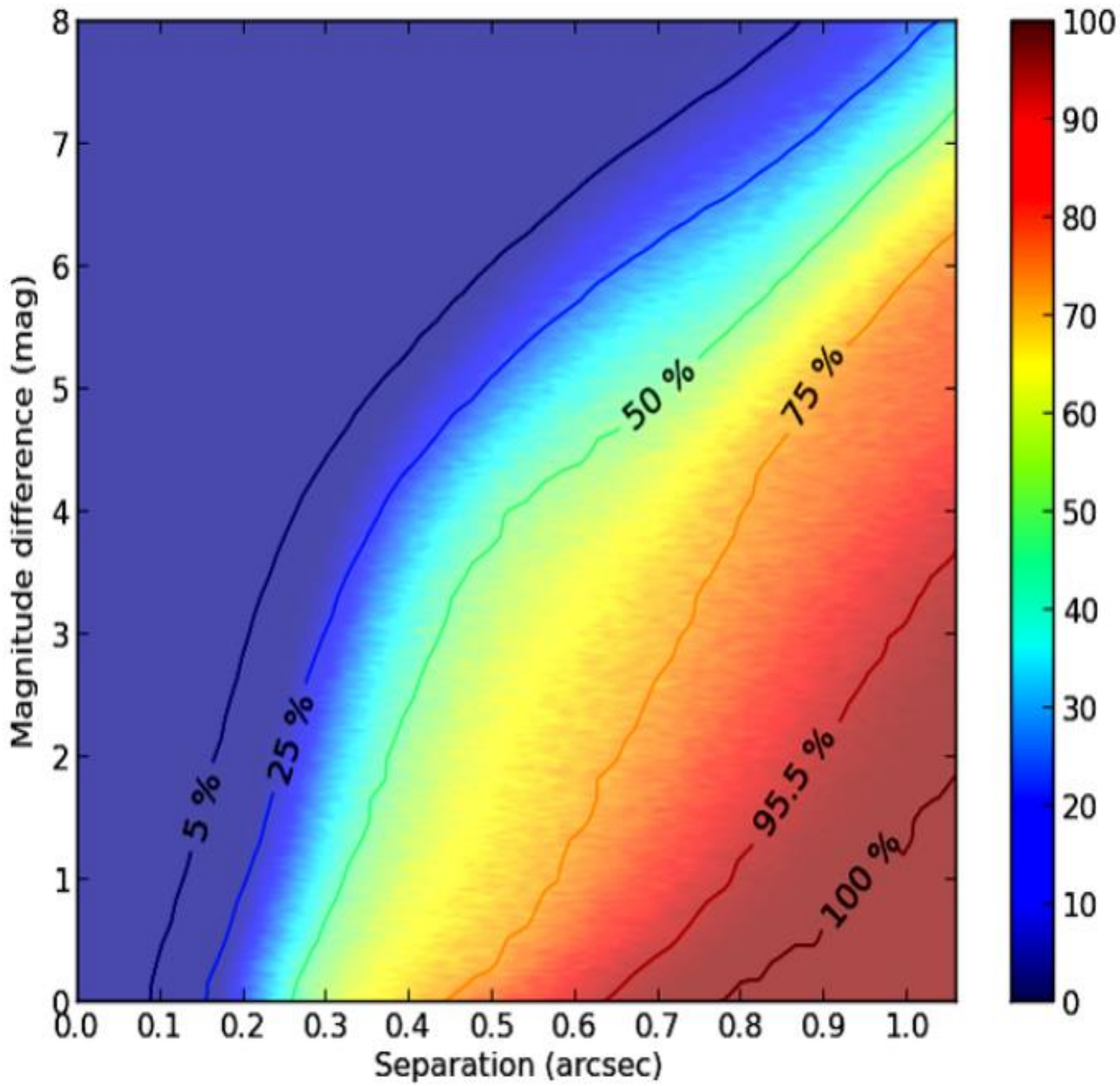
The key quantity is Δm, the magnitude difference between the target and the eclipsing binary in the background. If δ is the measured transit depth, it could be due either to a transit in front of the target, or to an eclipse of depth δ_c of a star Δm fainter, following

$$\delta_c = -2.5 \log_{10}(10^{-04\Delta m} - \delta) - \Delta m$$

Example for an (extreme) case of an eclipsing binary with depth δ_c=1 mag simulating a transit of δ depth in a target Δm magnitude brighter

case	δ	Δm	m_{lim} (V=8)	m_{lim} (V=11)	m_{lim} (V=13)
gas giant	0.01	4.45	12.45	15.45	17.45
Neptunian	0.001	6.95	14.95	17.95	19.95
Earth	80 ppm	9.69	17.69	20.69	22.69

Gaia detection completeness



Blends at $\Delta m \leq 4$ can be resolved at 50% completeness (or better beyond 0.5”) from the central source, while the minimum separation increases up to 1” at $\Delta m = 8$.

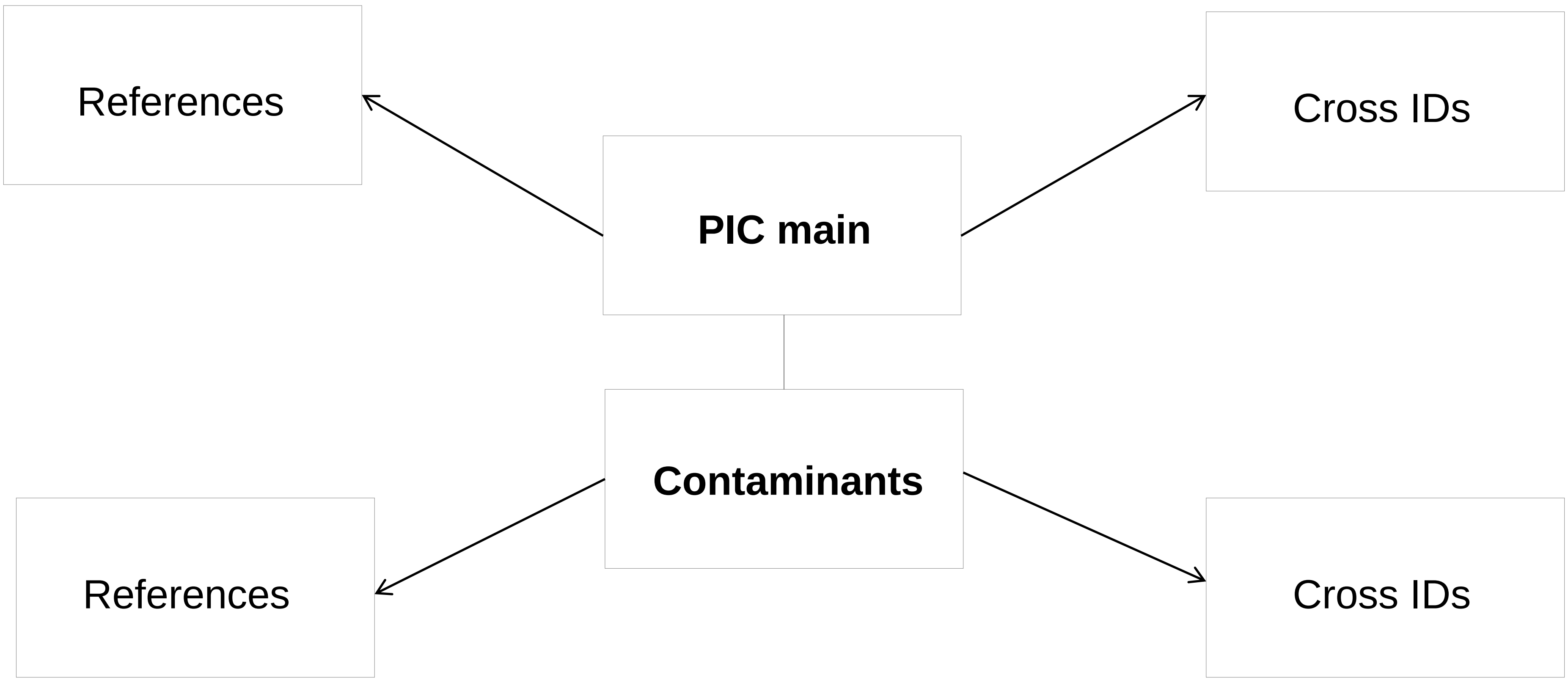
Gaia will be able to solve harder blends also closer 0.5” but only for smaller Δm. Data may be available only from DR4, but still on time for the PIC

Gaia can provide variability indication, helping to identify contaminating eclipsing binaries.

There will be four ancillary tables:

References	→	For each field in the target/contaminant table report the reference source from which The information was taken.
Cross IDs	→	For each field in the target/contaminants table report the ID of the star in the catalog That was adopted as reference source.

PIC catalog: global structure



PIC main: content

Parameters will be organized in five different groups:
1. ASTROMETRIC PARAMETERS
2. PHOTOMETRIC PARAMETERS
3. SPECTROSCOPIC PARAMETERS
4. PLANETARY PARAMETERS
5. ADDITIONAL PARAMETERS

There is a group presently working on the parameter selection

Thank you