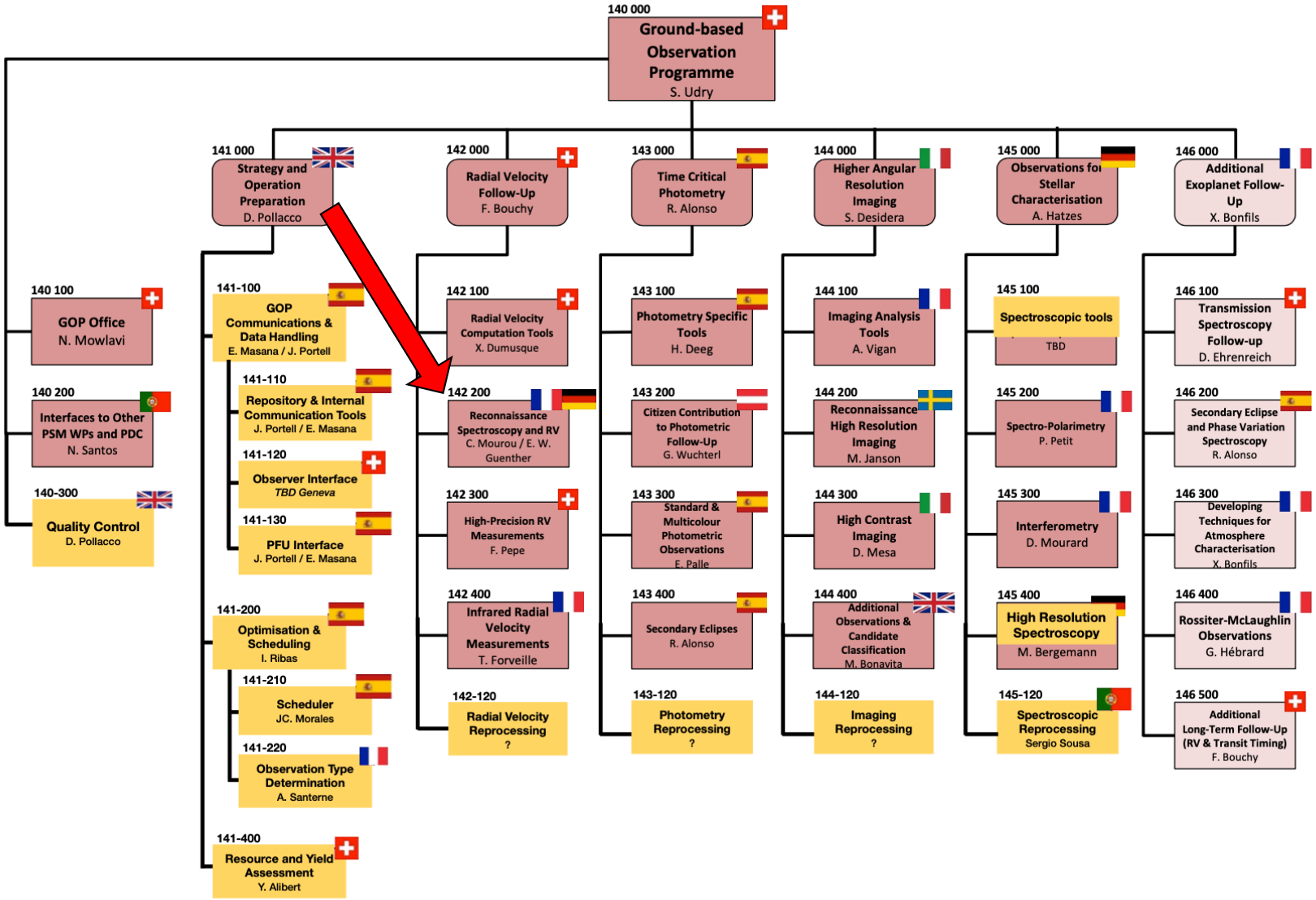
WP 142 200

Medium accuracy RV- measurements and reconnaissance spectroscopy and

The work package structure



WP 142 200 - Recon spectroscopy and medium precision RV-measurements (> 3m/s)

1.) Define screening strategy for medium precision RV.

2.) Define criteria :

→ continue medium-precision RV-measurements.

→ move to high-precision RV follow-up.

→ stop observations.

3.) Develop tools to estimate expected number RV-measurements needed for different instruments.

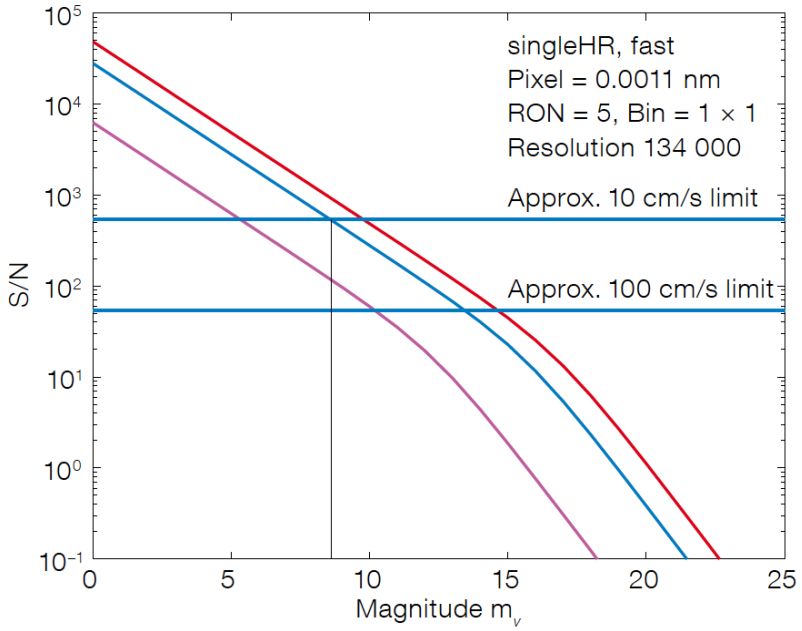
4.) Strategy to distinguish giant planets from brown dwarfs, and binaries with the minimum number of RV measurements.

5.) Assess the status, performance and availability of telescopes and instruments for the above-mentioned objectives.

https://docs.google.com/spreadsheets/d/1MY3GmuZhfyTFuCUCYwgCIVQQ_bQD2IHKDZkFncHGZ24/edit?usp=sharing

	Instrument name	Web page	Status (Existing / Project / In Dev)	Instrument PI	Starting Date of operation	Location (Observatory + Coordinates)	Telescope/Observatory Director	Telescope Diameter (m)	Median seeing (arcsec)	Expected Nb of nights/year for PLATO FU	Time Allocation (TAC / GTO)	Local contact person (support astronomer)	Demonstrated RV systematic limitation (m/s)	Photon-noise uncertainties on a V=11 G2 star for 1h exposure (m/s)	Spectral resolution	Spectral Domain (nm)	Fiber/Slit acceptance (arcsec)	References for instrument description	References for RV FU	Reduction pipeline and Data products
2	HARPS		Existing																	
3	HARPS-North		Existing																	
4	HIRES		Existing																	
5	APF		Existing																	
6	SALT/HRS		Existing																	
7	FIES		Existing																	
8	SOPHIE	obs-hp.fr	Existing	I. Boisse	2006	OHP/+45°	A. Le Van Suu	2	2		TAC	I. Boisse			75000/40000	387-694	3			
9	TLS-Echelle (TCI	tls-tautenburg.de	Existing	E.W.Guenther	1996	TLS/+51°	A.P. Hatzes/M. R	2	2	40	GTO	E.W.Guenther	46 m/s, 9.3 mag,	60 m/s	65000	462-734 (VIS)	1.2		Kabath+ 2021	Viper
10	CAFE		Existing																	
11	CARMENES		Existing																	
12	ESPRESSO		Existing																	
13	CORALIE		Existing																	
14	FEROS																			
15	SPIROU	spirou.irap.omp.e	Existing	JF Donati	2018	MK/+20°	JG Cuby	3.6	0.65		TAC	L. Arnold			70000	980-2450	1.3	Donati+ 2020 MNRAS		APERO
16	NIRPS																			
17	Neo-Narval		in dev	T. Boehm	2020	TBL/+45°	A. Lopez	2			TAC	Ph. Mathias								
18	SPIP		in dev	JF Donati	2023	TBL/+45°	A. Lopez	2			TAC	P. Fouqué			70000	980-2450				
19	CRIRES+		Existing																	
20	ANDES		Project																	
21	THE (HARPS-3)																			
22	PFS2																			
23	CHIRON																			
24	Veloce		Existing																	
25	iSHELL		Existing																	
26	PARVI																			
27	HPF		Existing																	
28	IRD		Existing																	
29	EXPRES		Existing																	
30	MAROON-X		Existing																	
31	NIED		Existing																	
32	KPF		Existing																	
33	iLocater																			
34	GCLEF																			
35	MINERVA																			
36	PARAS-2																			
37	TOU																			
38	MINERVA-R																			
39	GIARPS		Existing																	
40	PLATOspec	https://stelweb.as	in dev	P. Kabaith	2023	LS/-29		1.5	0.9	200	GTO	P. Kabath			68000	360-680				
41	OES		existing	Kabath				2	2	40	GTO	Kabath	70		40000	380-900				
42	MaHPS/FOCES	https://www.usm.	Existing	H. Kellermann		Wd/+48		2	0.9		GTO		3.5		70000	380-870				
43																				

Why do we want to take medium accuracy RV-measurements?



How much observing time would we needed if all stars with low mass-planets were to be observed with ESPRESSO?

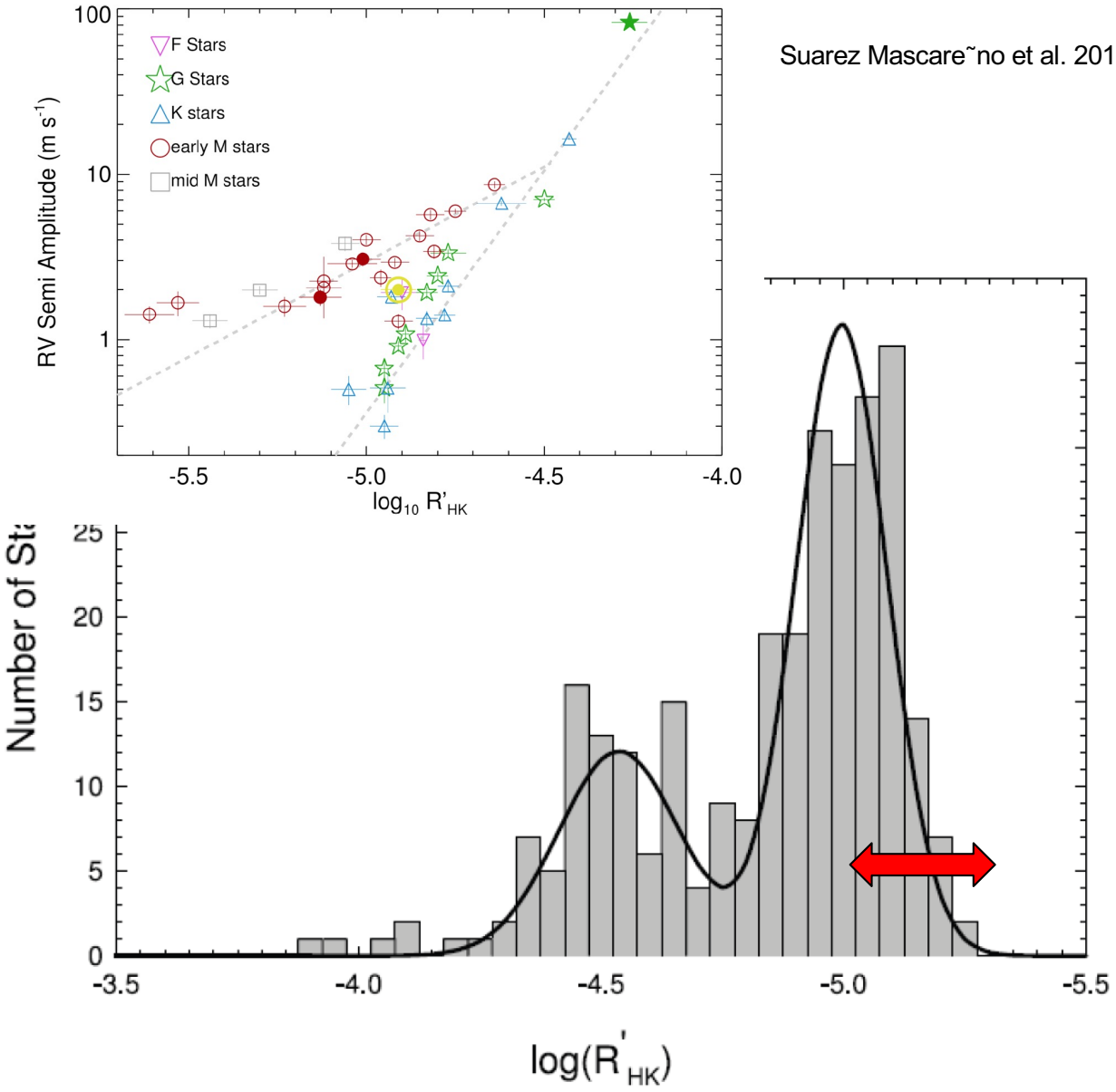
Red, blue and magenta curves indicate exposure times of 3600 s, 1200 s and 60 s, respectively.

PLATO: 1200 planets of all types orbiting star brighter than 11 mag.

We would need 1200s +120s (overheads) per target. 1200 targets x 6 spectra → 110 nights.

→ Impossible

You need to know the activity level of a star before you take 100 RV-measurements, with HARPS/ESPRESSO!



Suarez Mascare˜no et al. 2017

100 RV-measurements allow to detect a 4 (2) M_{Earth} planet in HZ of G-star, or 2 (1) M_{Earth} of K-star if the star has R'_{HK}<-5.0 (5,1).

32 (8)% of the G-stars have R'_{HK}<-5.0 (5,1).

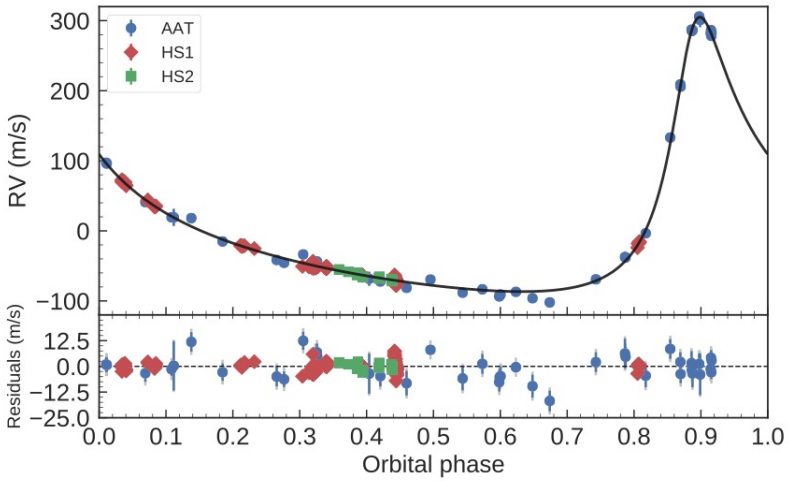
Why reconnaissance spectroscopy and medium accuracy RV-measurements?

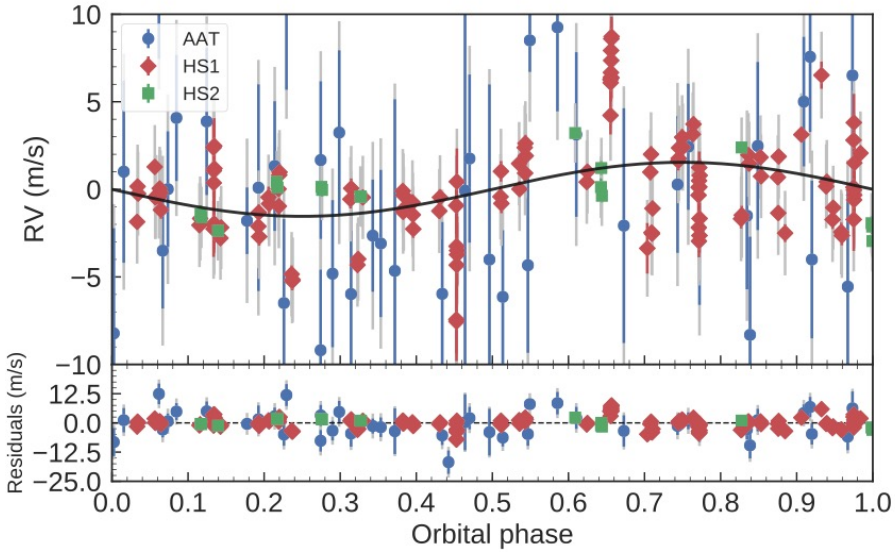
→ No “contamination” by giants thanks to Gaia.
→ Gaia data also allows to exclude most BEBs (Panahi et al. 2022).
→ MOS-spectroscopy to determine the stellar parameters.
→ Very active stars identified in the LC-analysis.

Aim 1.) Find out if there are additional objects in the system like gas-giants (12% of the systems with a terrestrial planet, Jeanne Davoult, Lankwitz Sep 2022), brown dwarfs, or companion stars (SB-fraction 15.6%±1.5%; Latham ea.2002) .
Aim 2.) Determine activity level using CaIIHK lines.
Aim 3.) Obtain high-resolution (high S/N) spectra to refine Teff, log(g), [Fe/H], and vsini.

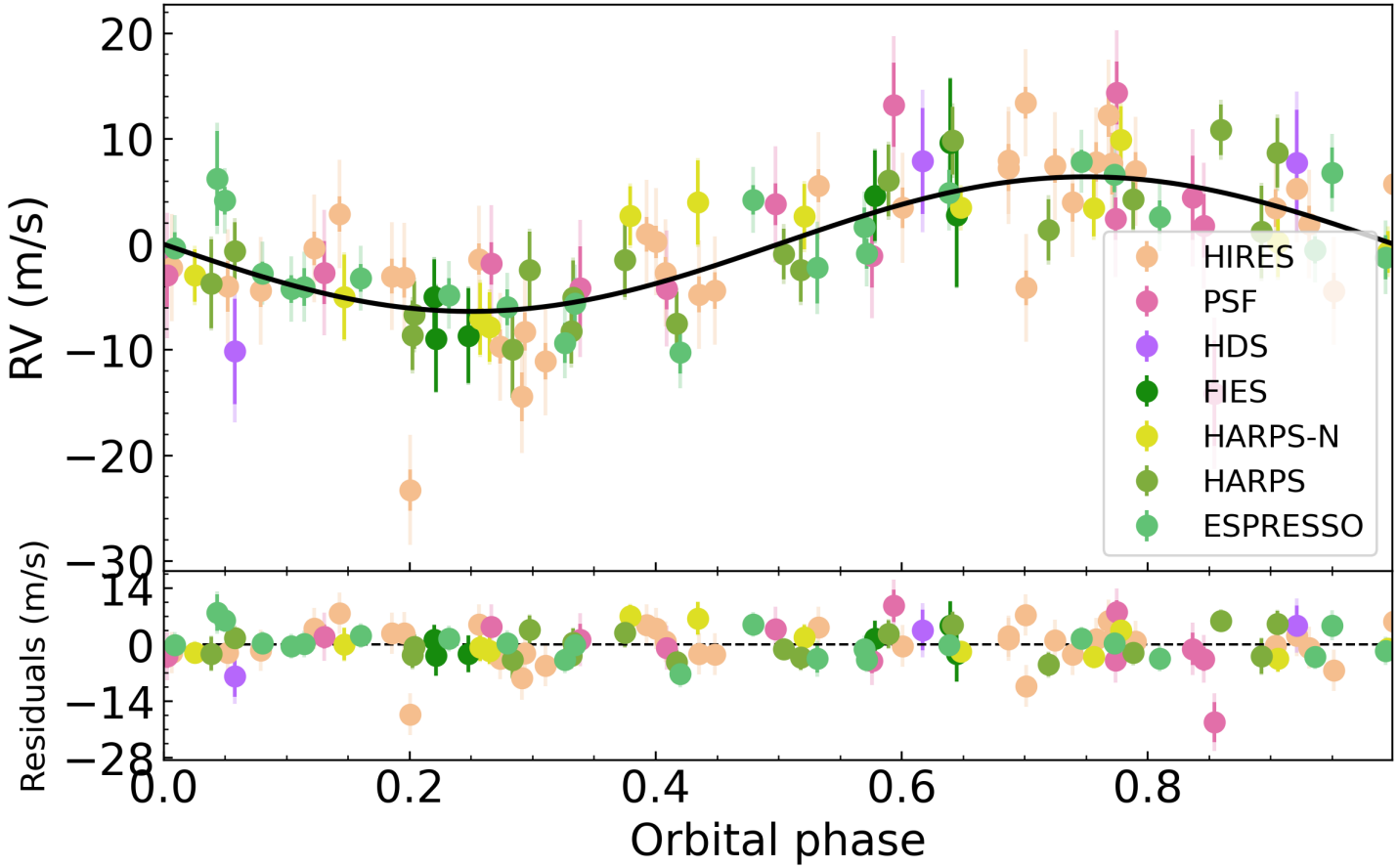
→ How many RV-measurements are needed with which instrument?
→ J.D: about 60% of the terrane planets are in systems containing several low-mass planets, only 5% of the terrane planets are single.

Example for system with a planet of Mp=9.66 M_{Jup}, and P=2091d, and a planet with Mp=4.5 M_{Earth}, and P=6.2d. (pi Men)





Example: Combining the RV-measurements of several instruments:
First observations with FIES → HARPS → ESPRESSO



A first estimate what is required:

- → Let us assume that we have 1200 targets.
- → Let us assume that the targets have typically 11 mag.
- → Let us assume that we take at least three spectra and the combined spectrum should have a S/N>100. For 10% of the stars we need > 30 RVs.
- → 2m-class telescopes (e.g. Café):1200x3x2500s + 120x30x2500s

  total if only 2m-class telescopes are used: 600+ nights!
- → 4m class telescopes (e.g. HARPS): 1200x3x900s + 120x30x2500s.
- total if only 4m-class telescopes are used: 200 nights!

- Please fill in:
- https://docs.google.com/spreadsheets/d/1MY3GmuZhfyTFuCUCYwgCIVQQ_bQD2IHKDZkFncHGZ24/edit?usp=sharing

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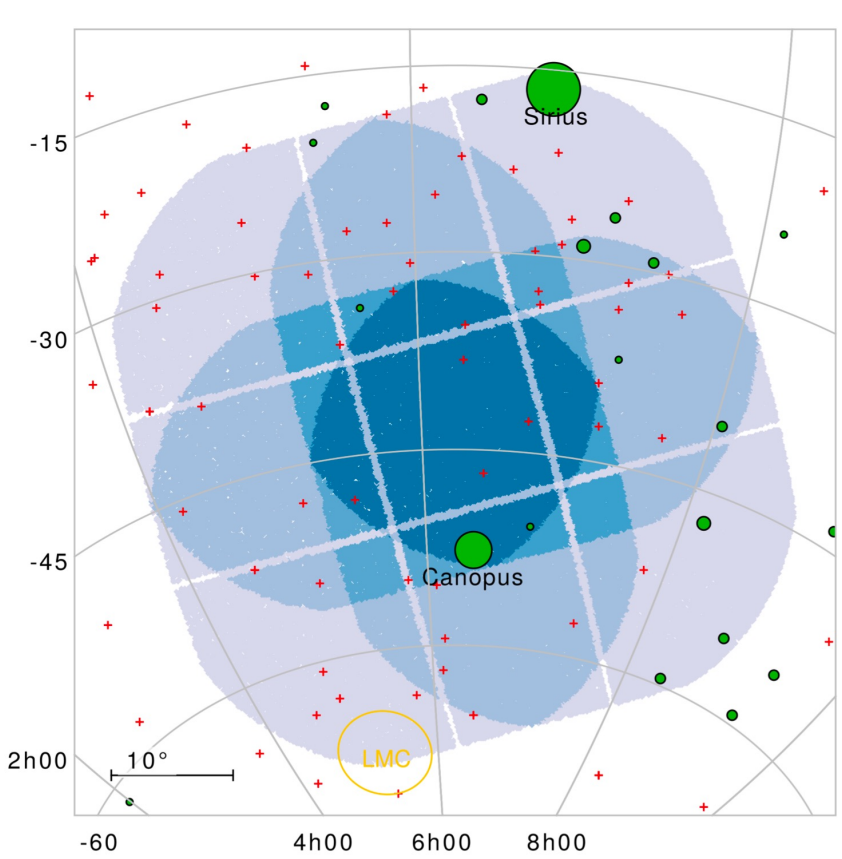
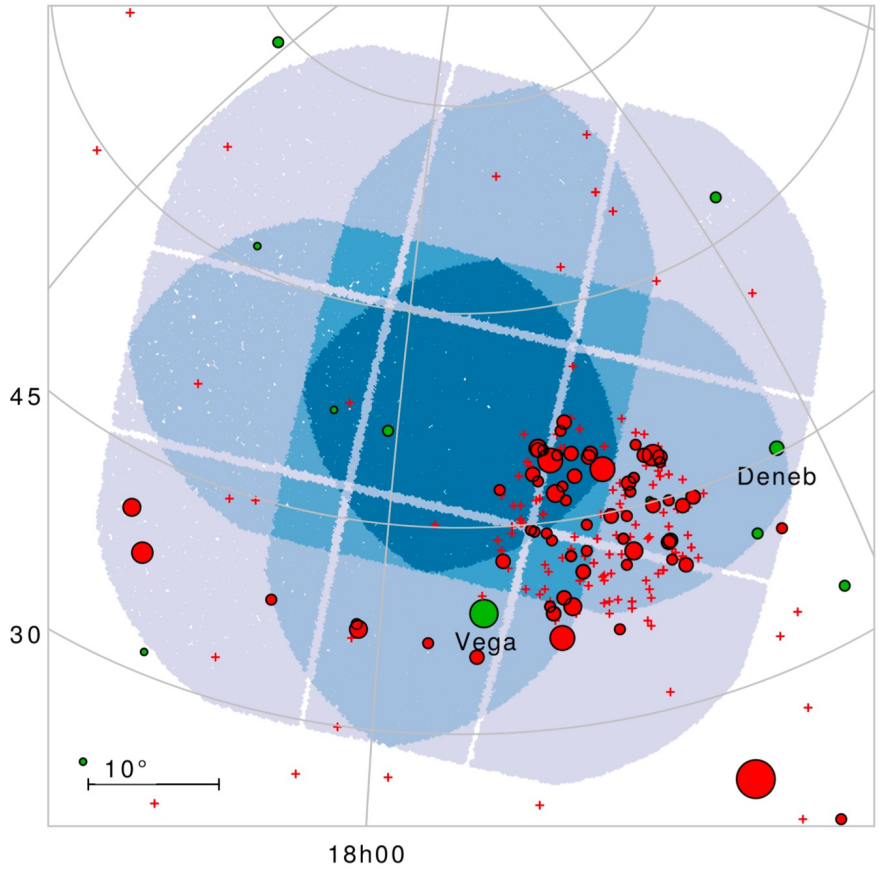
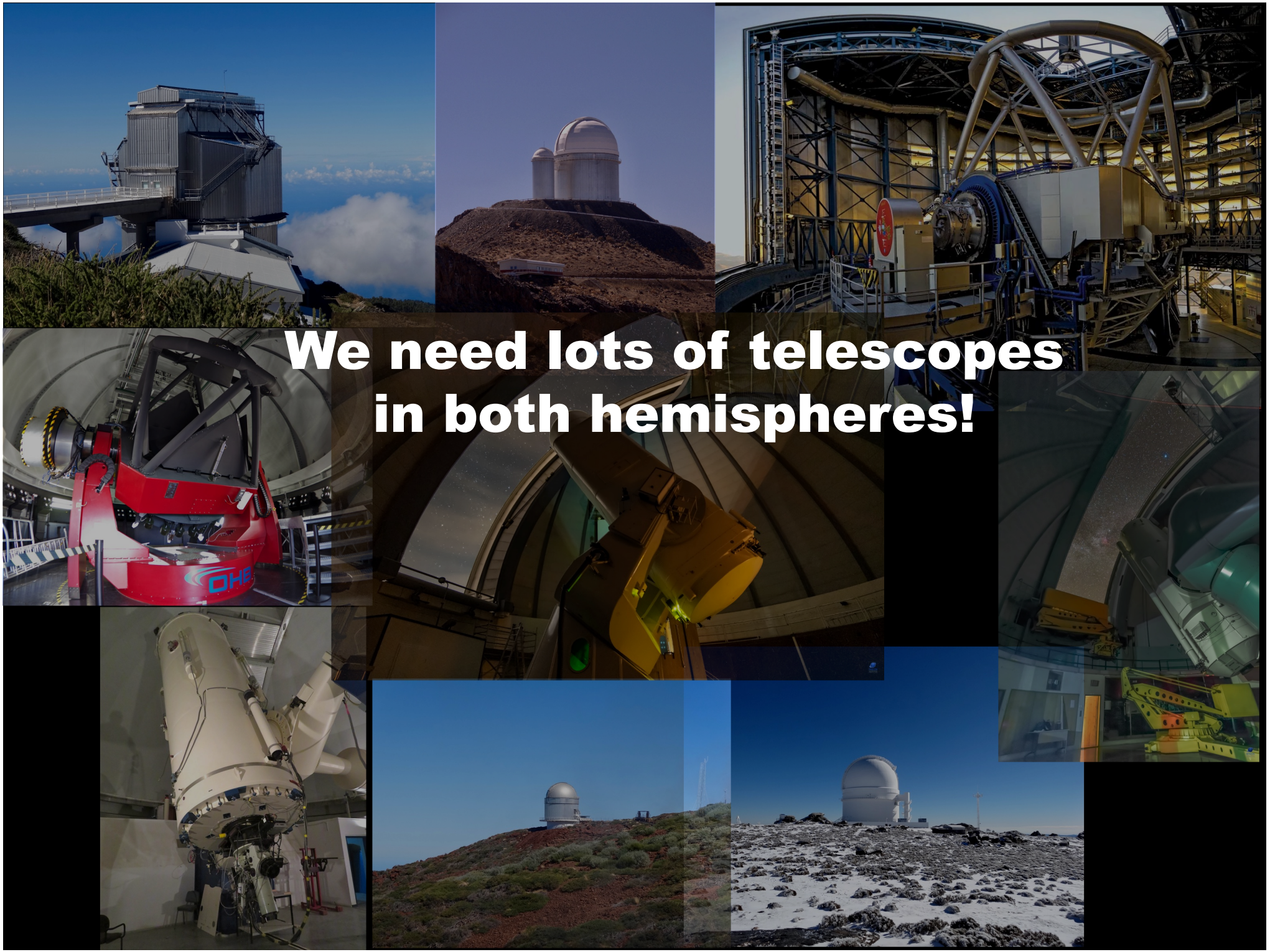
The PLATO fields





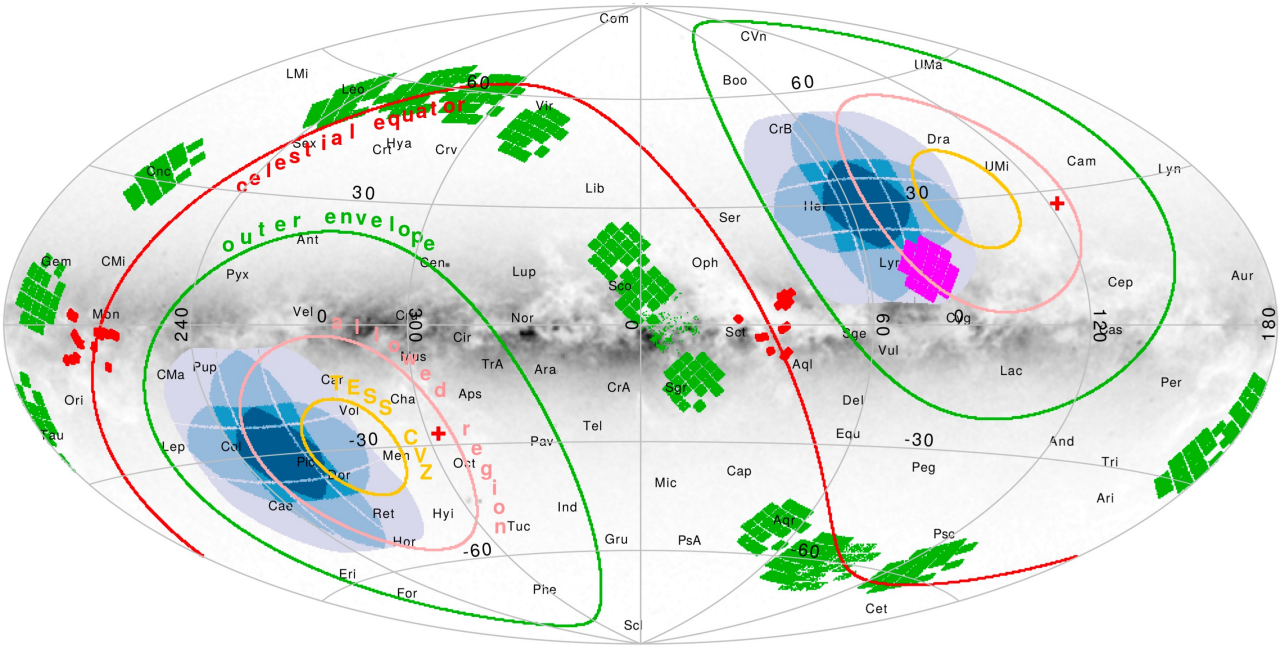

We need lots of telescopes
in both hemispheres!

Comparison with previous surveys

- CoRoT: 33 planets with mass from RVs and radius.
- Kepler: 297 planets with mass from RVs and radius (incl. upper limits).
- K2: 102 planets with mass from RVs and radius.
- TESS: 212 planets with mass from RV and radius.

→ Total 664 transiting planets where the mass has been determined by RV-measurements (12.10.2022) so far!

Thank you


celestial equator
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