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# Planets in Reflected Light

— Preparing yield of ELT and HWO —

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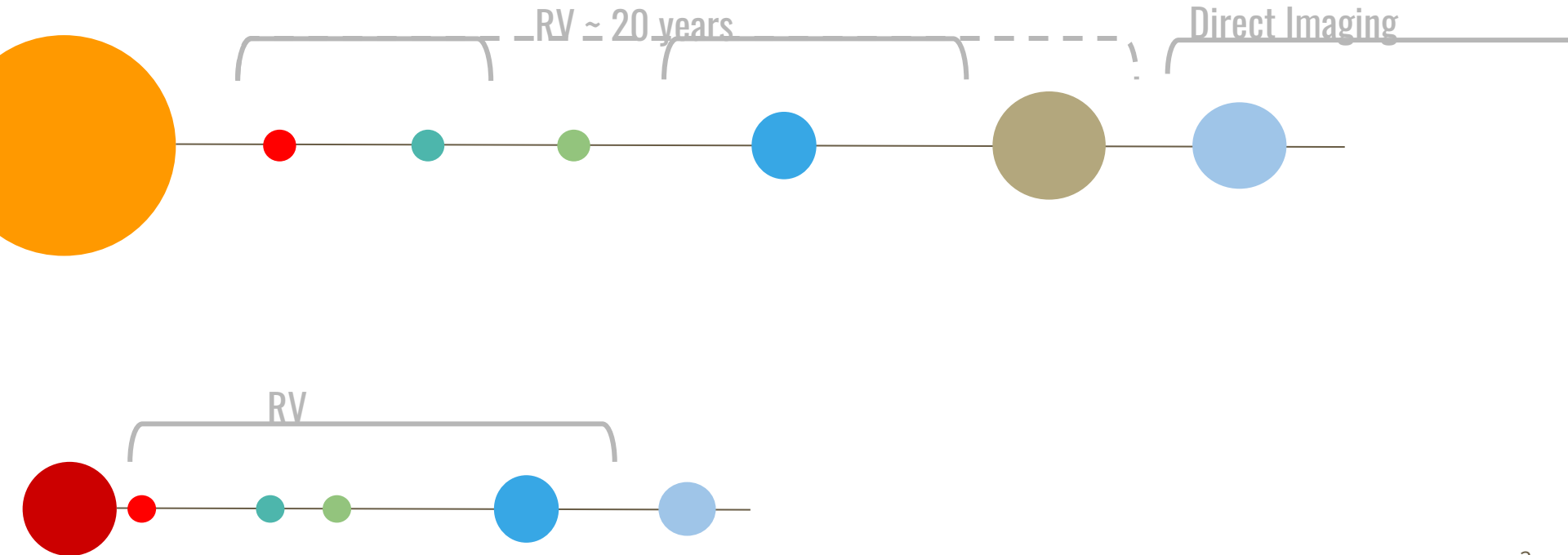


L. Mignon, G. Chaverot, L. Parc, L. Leboulleux, I. Boisse et al. in prep

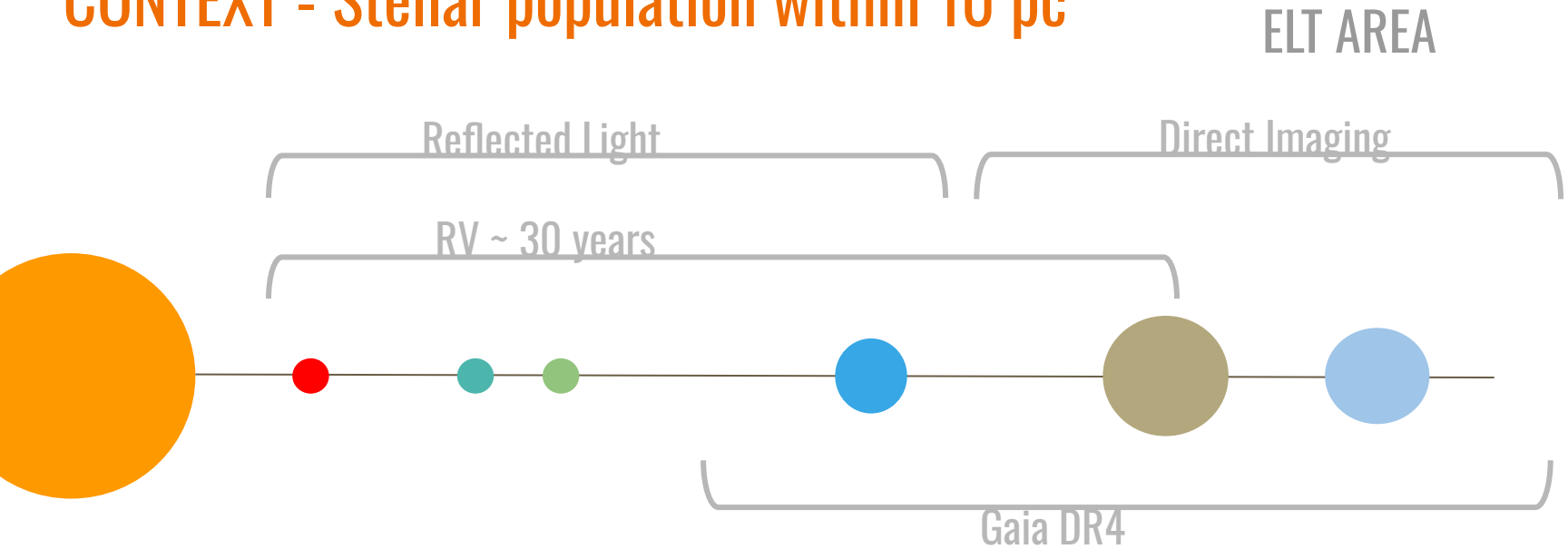


# CONTEXT - Stellar population within 10 pc

Today



# CONTEXT - Stellar population within 10 pc



**Not only the full view of the global architecture  
But the FULL understanding with at least 2 methods**

# REFLECTED LIGHT

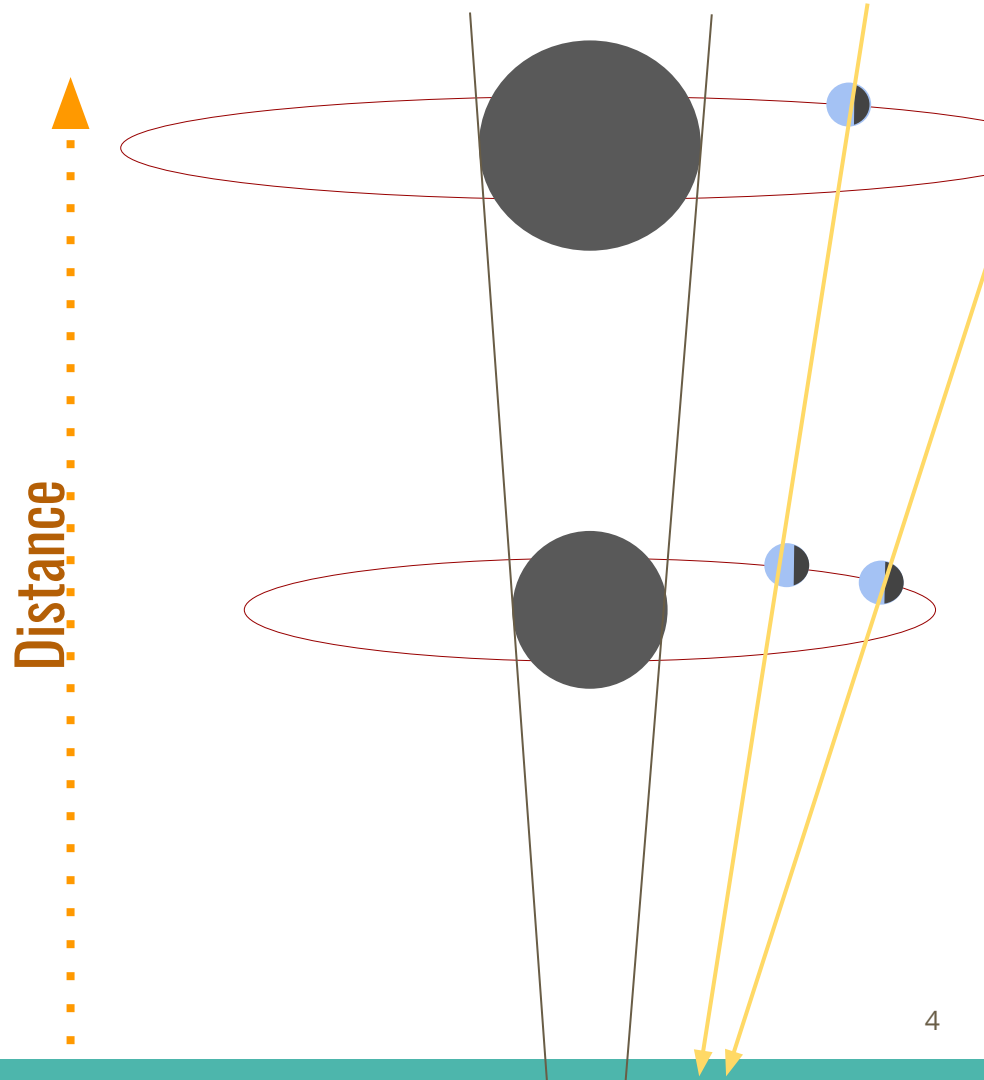
Planet = bad mirror (no thermal emission)

Planetary systems parameters:

1. Distance
2. Radius of planet
3. Flux from star
4. Albedo
5. Separation
6. Phase

Critical limitations:

1. Star-Planet contrast
2. Planet Magnitude



# ALBEDO OF EXOPLANETS

Planets from Solar system  
G. Chaverot, IPAG

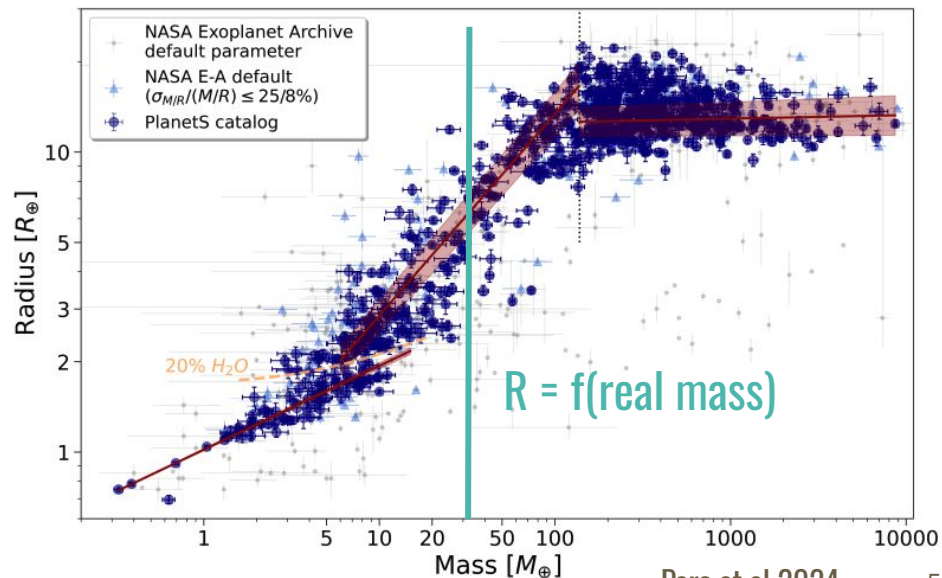
	V band [0.4,0.76] $\mu\text{m}$	H band [1.45, 1.8] $\mu\text{m}$	Ref
Mercury	0.14	0.28	1, 2
Venus	0.64	0.53 ([1.45,1.49] $\mu\text{m}$ )	3
Earth	0.23	0.09	4
Mars	0.17	0.24	5
Titan	0.21	0.06	6
Jupiter	0.56	0.10	7
Saturn	0.45	0.20	8
Neptune	0.38	0.01	9,10

**Notes.** References: 1. Klima et al. (2018) 2. McCord & Clark (1979) 3. Pérez-Hoyos et al. (2018) 4. Kofman et al. (2024) - As explain by Robinson (2025, submitted to PSJ), the Earth albedo is close to 0.24, which differs from the commonly admitted value of 0.35 from Cox (2000) that is inaccurate. 5. PSG, Payne+25 6. Lavvas et al. (2008) 7. L2018\_f3, Li et al. 2018 8. Coulter et al. (2022) 9. Karkoschka 1998 *trois ref possibles* 10. Irwin et al. (2022).

Mignon et al. in prep

# RADII OF EXOPLANETS

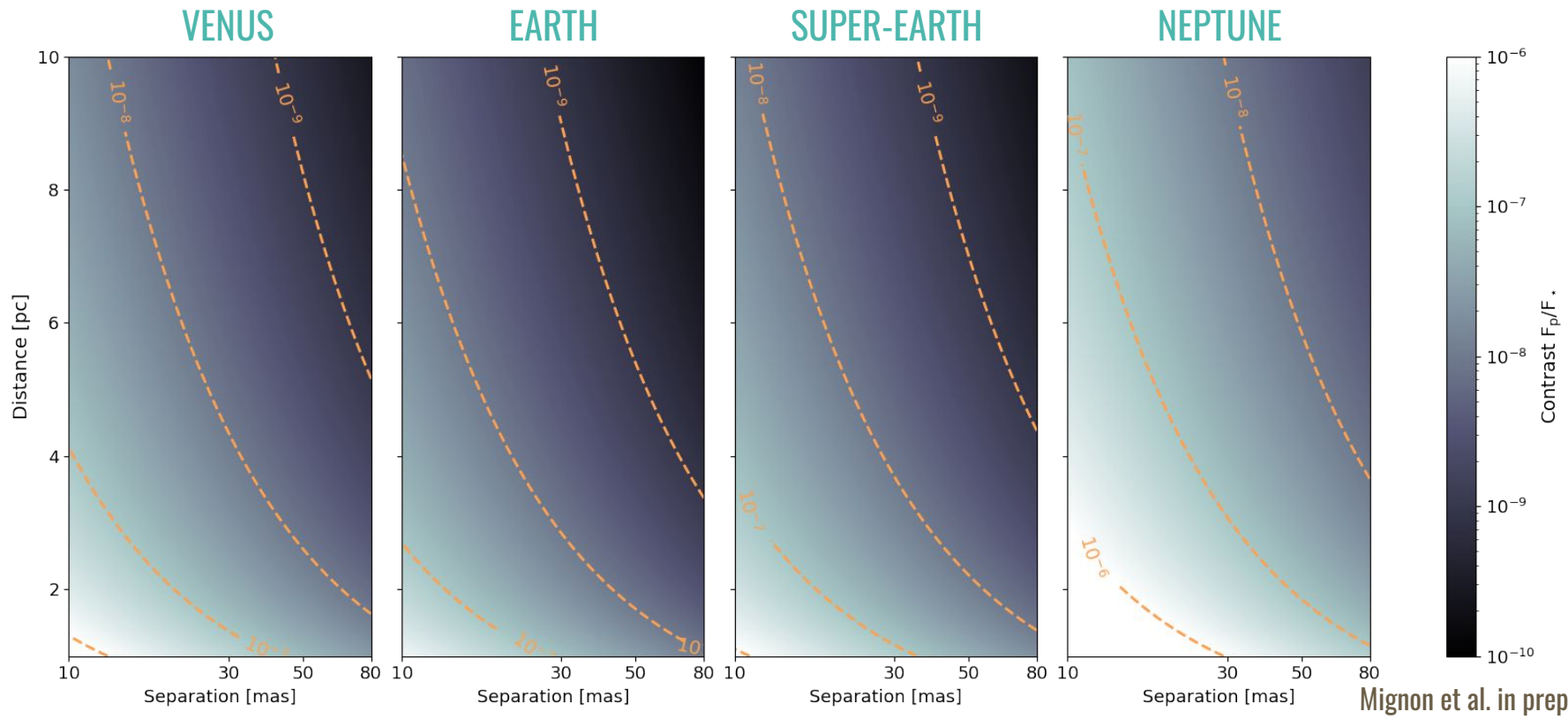
Mass-Radius relation from PlanetS catalog  
L. Parc, Geneva Observatory  
Converted to a density-map



Parc et al 2024

# STAR-PLANET CONTRAST

V band Albedo

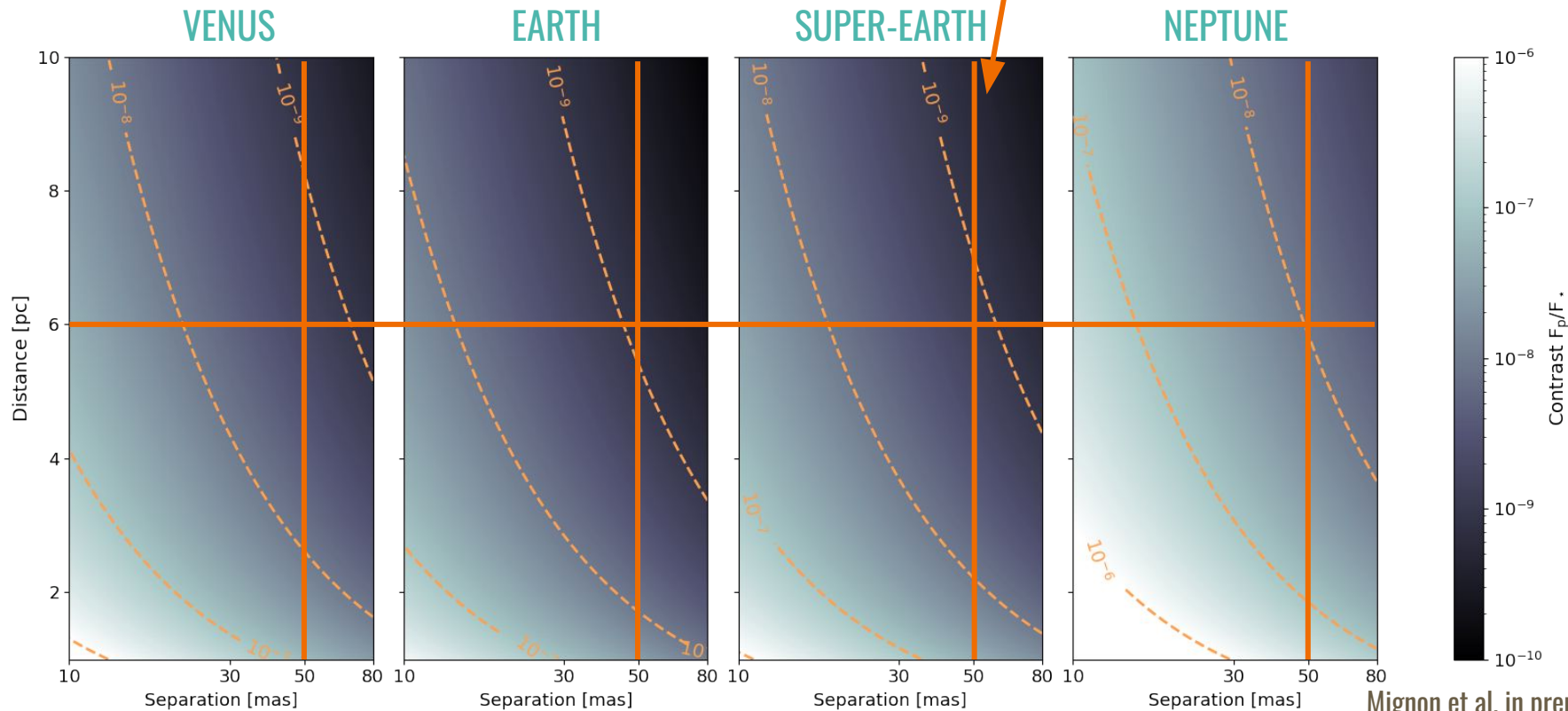


Mignon et al. in prep

# STAR-PLANET CONTRAST

Your favorite star-planet

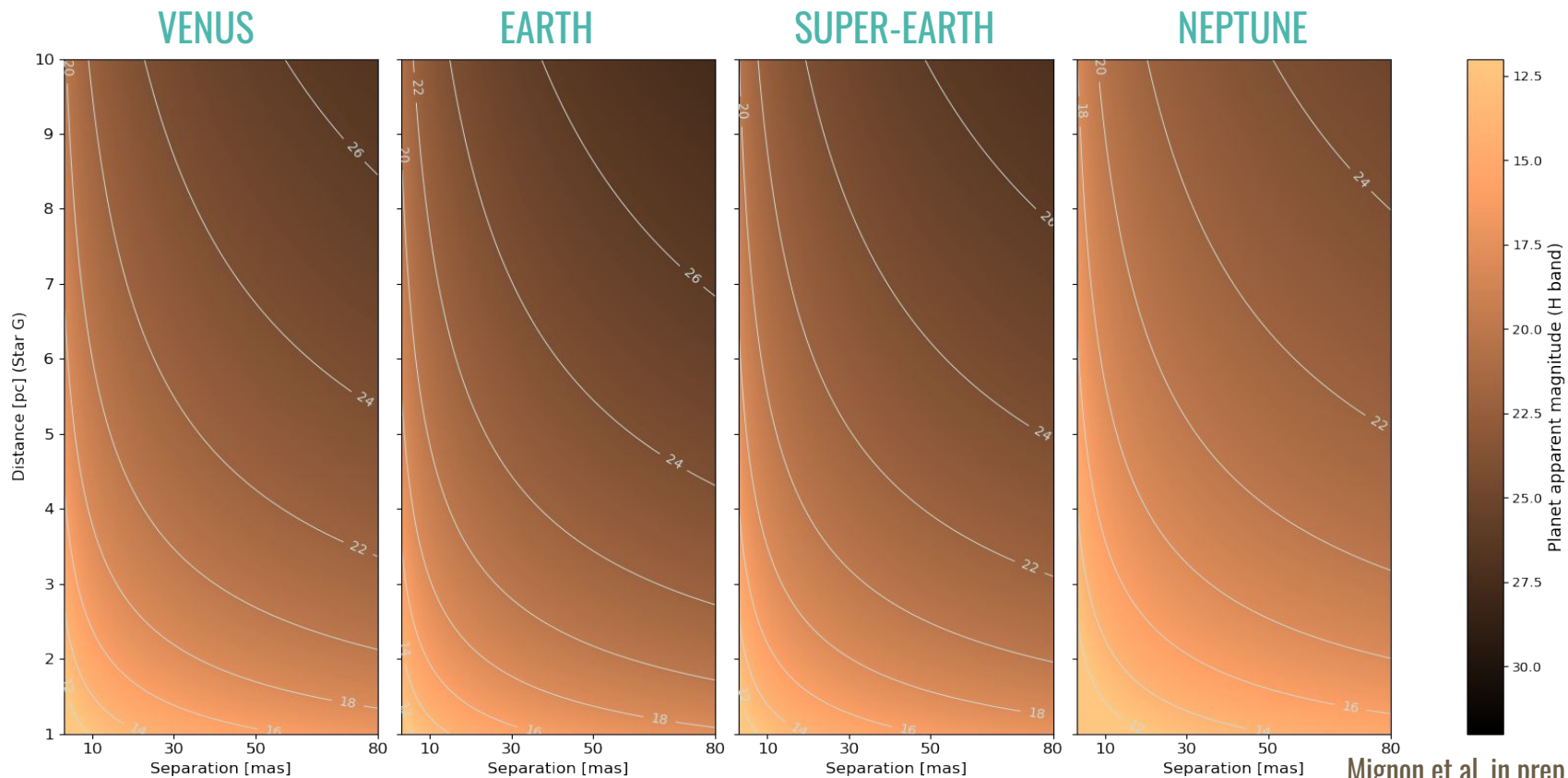
V band Albedo



Mignon et al. in prep

# PLANET APPARENT MAGNITUDE

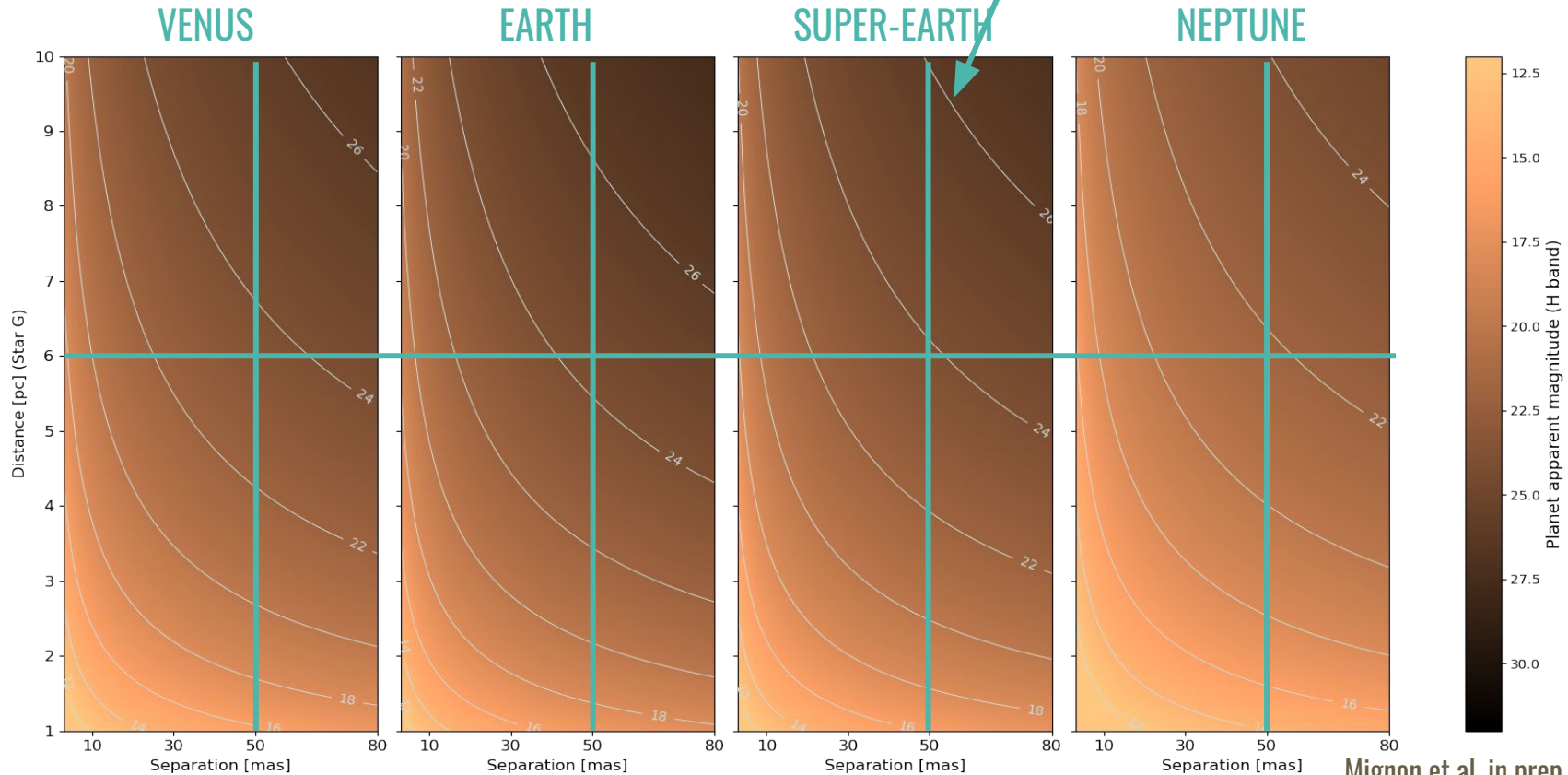
G Type Star  
V band Albedo



# PLANET APPARENT MAGNITUDE

Your favorite star-planet

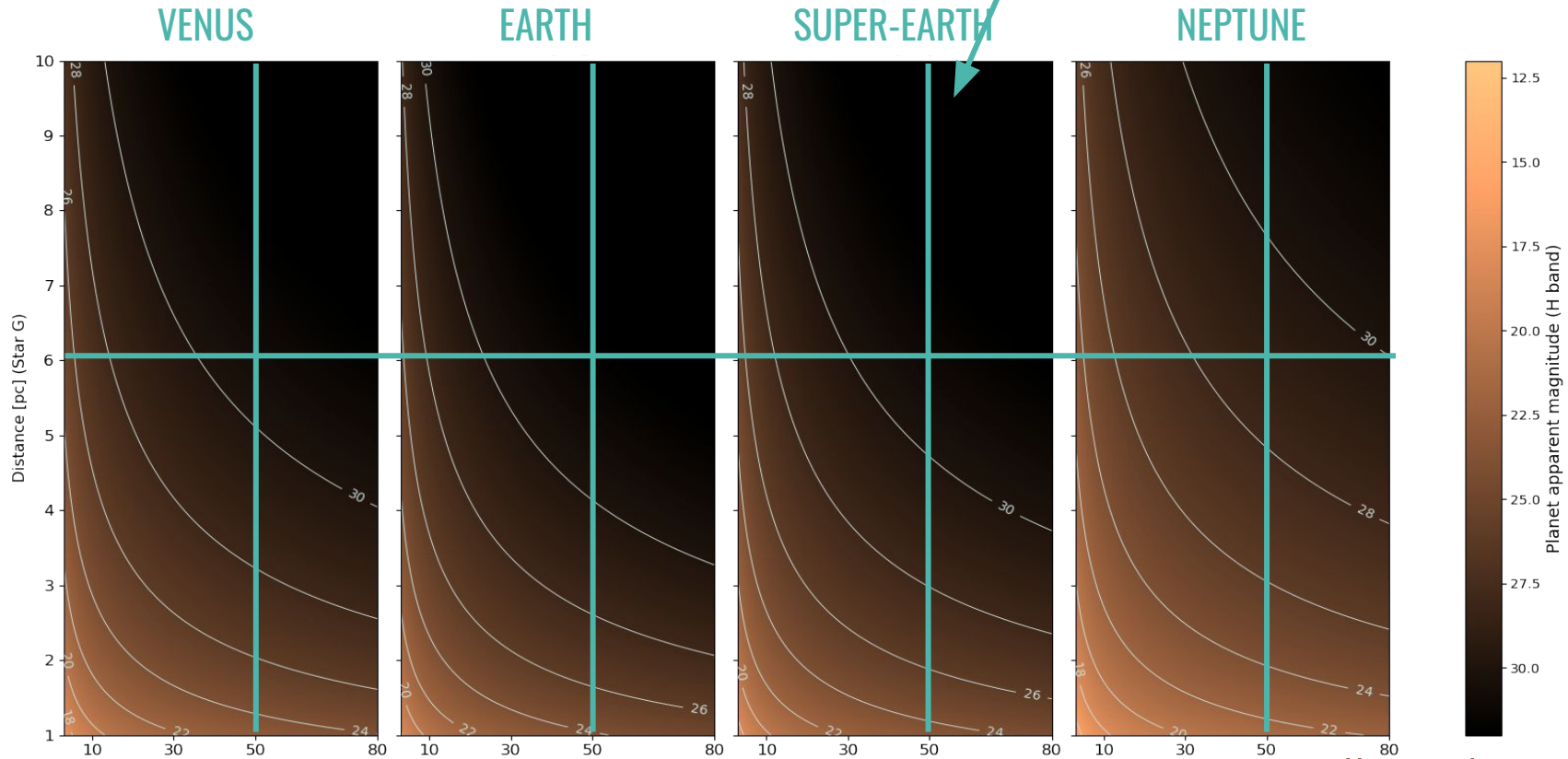
G Type Star  
V band Albedo



# PLANET APPARENT MAGNITUDE

Your favorite star-planet

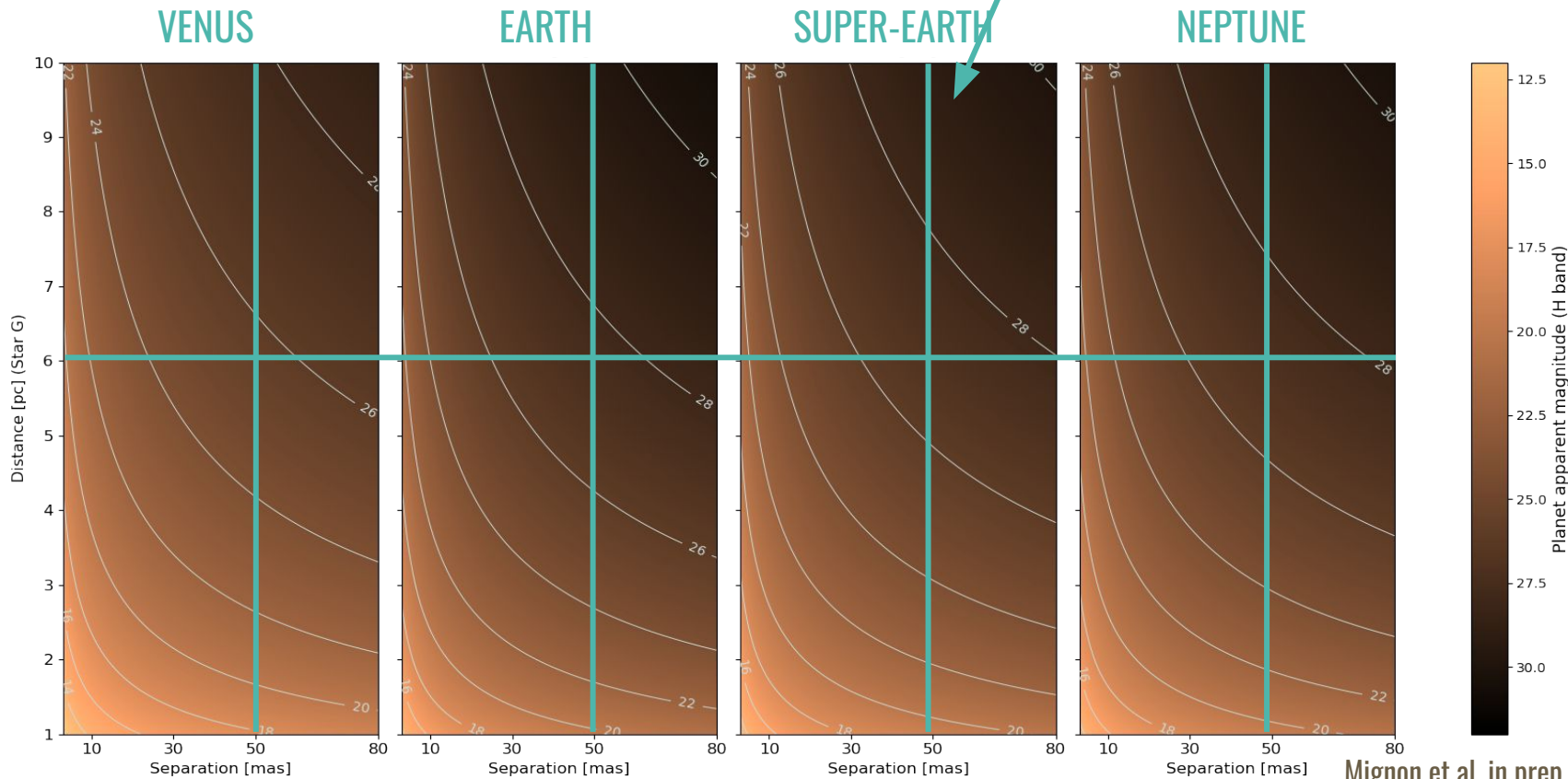
M3 Type Star  
V band Albedo



# PLANET APPARENT MAGNITUDE

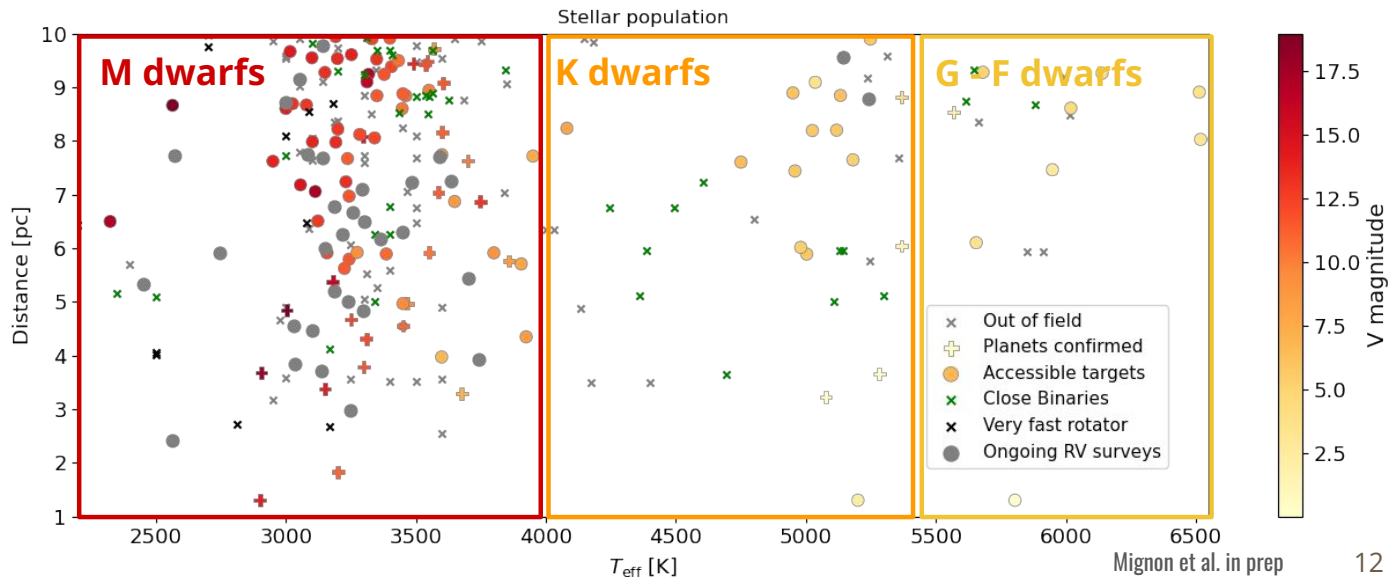
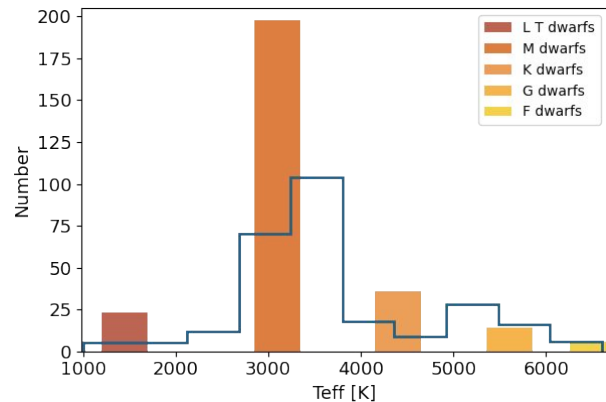
Your favorite star-planet

M3 Type Star  
H band Albedo



# Stellar population within 10 pc

198 M dwarfs, 36 K dwarfs, 14 G dwarfs, and only 6 F

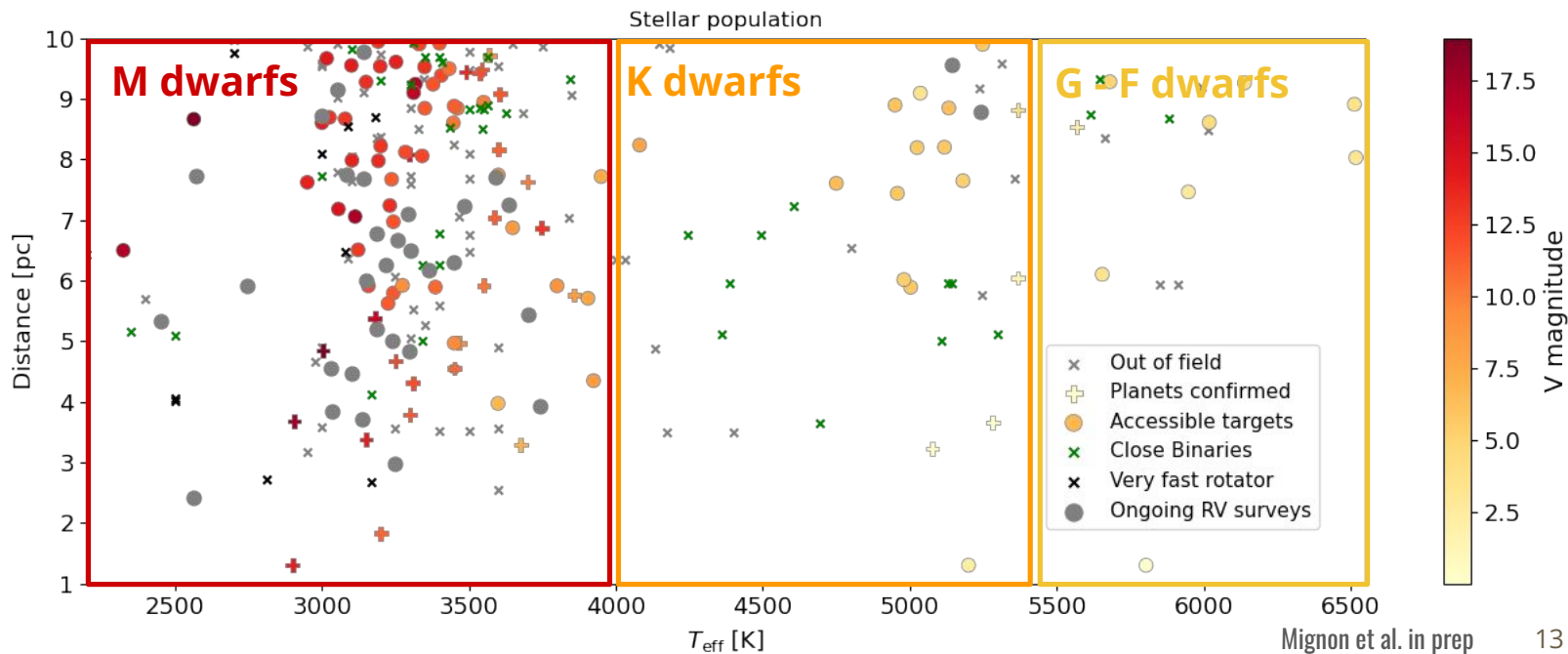


Gaia DR3  
Winters et al. 2021  
Gaidos et al. 2014  
RECONS catalogue

# Planet population within 10 pc

198 M dwarfs, 36 K dwarfs, 14 G dwarfs, and only 6 F  
79 Exoplanets detected and published - only 5 transit  
38 systems

→ No characterisation possible,  
even real masses....

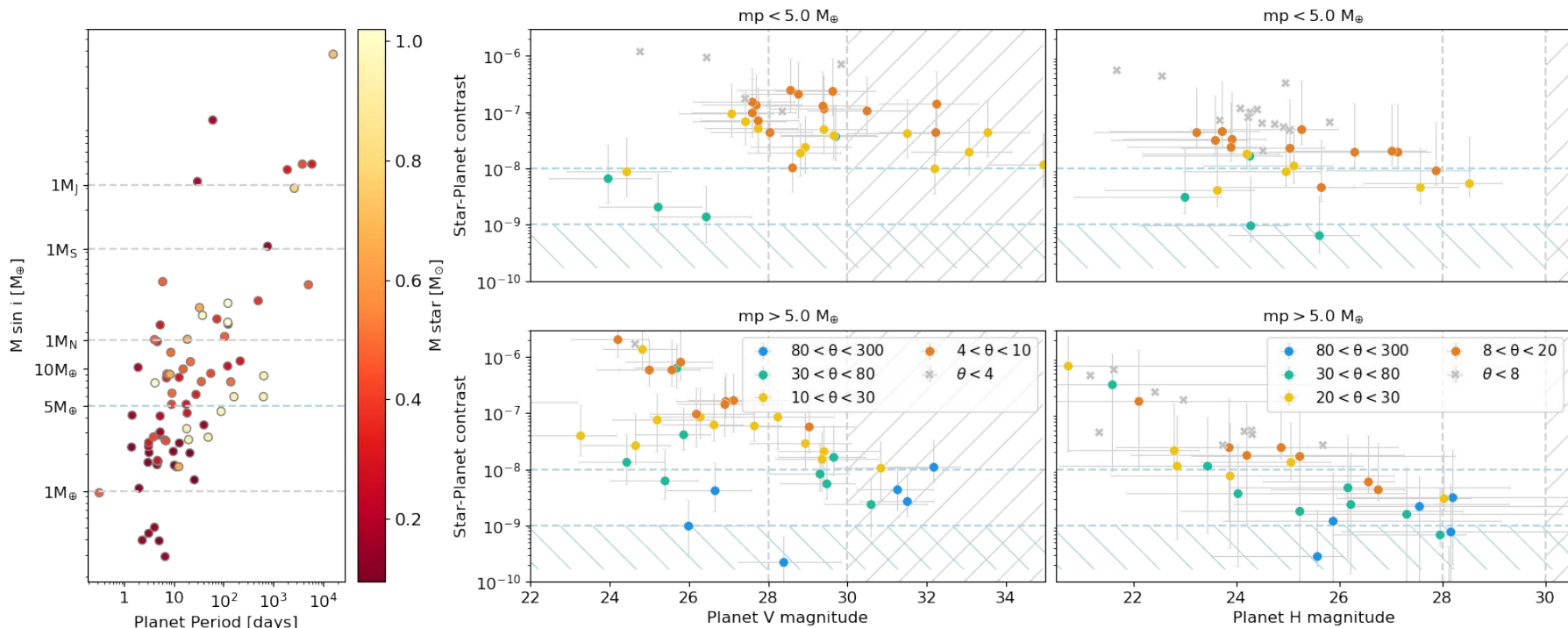


# Planet population within 10 pc

(Known) exoplanets:

- Msini to real Mass to Radii
- Radii to Albedo range

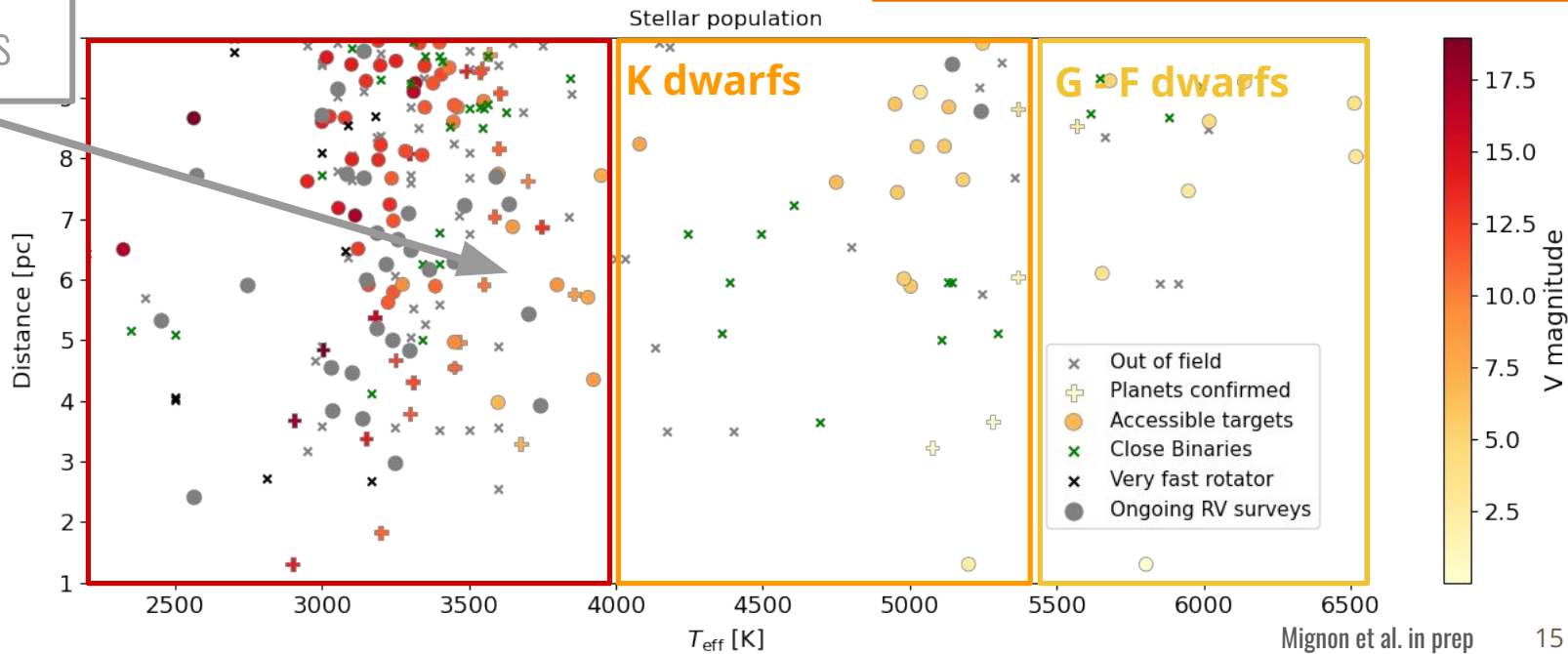
WP1 of PCS



# Planet population within 10 pc

198 M dwarfs, 36 K dwarfs, 14 G dwarfs, and only 6 F

Archival data  
from RV  
instruments



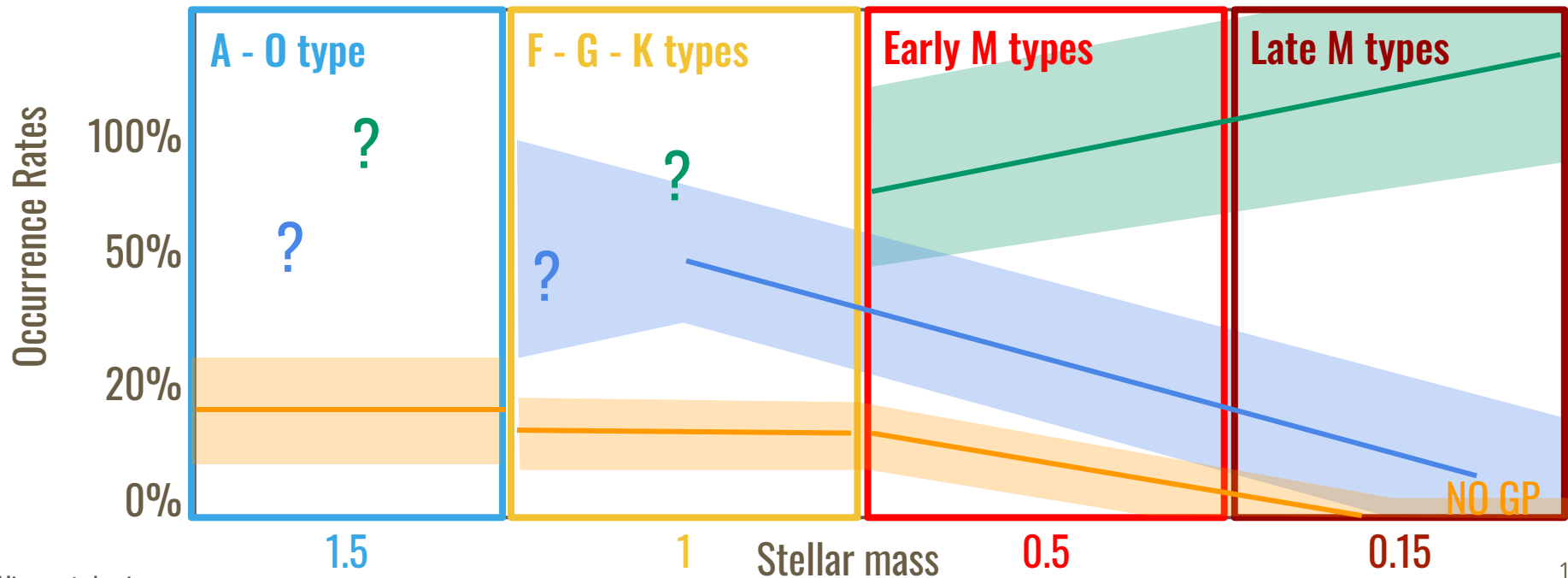
Monitoring with RV facilities to find the future best candidates



# Demographics of Exoplanets

Direct Imaging + RV + Transit

Jupiters  
Neptunes  
Earth and Super-earth



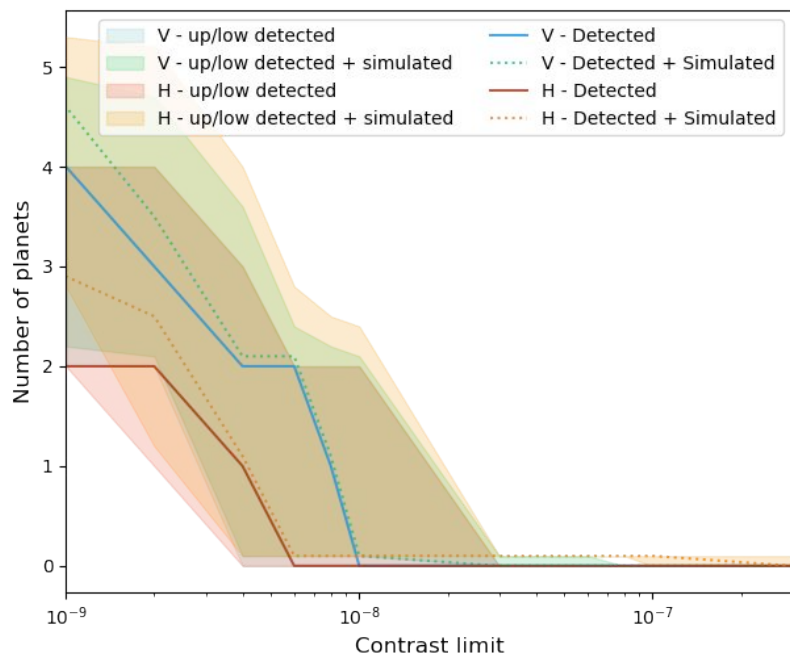
# Rocky Planet population simulation

Mignon et al 2025  
Kunimoto et al 2020  
Mayor et al 2011

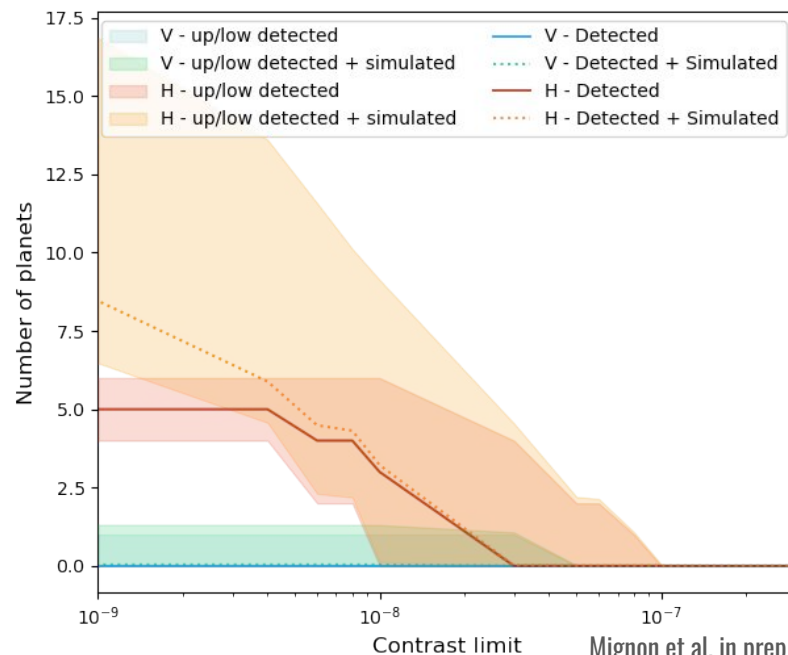
Rocky planets detected + simulated

Thresholds: max Mag = 28, ang. Sep = 20 to 80 mas,  $R < 1.5 R_e$

### F to K dwarfs



### M dwarfs



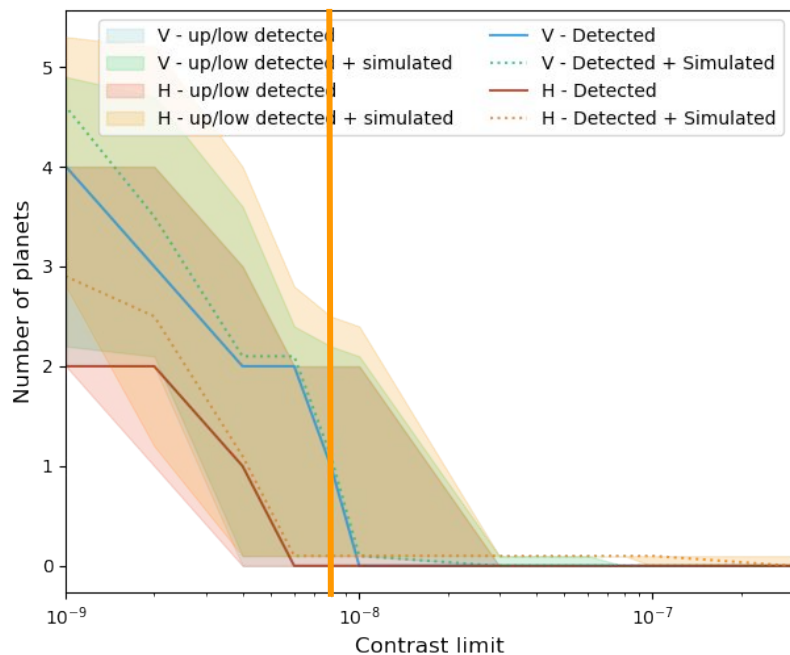
# Rocky Planet population simulation

Rocky planets detected + simulated

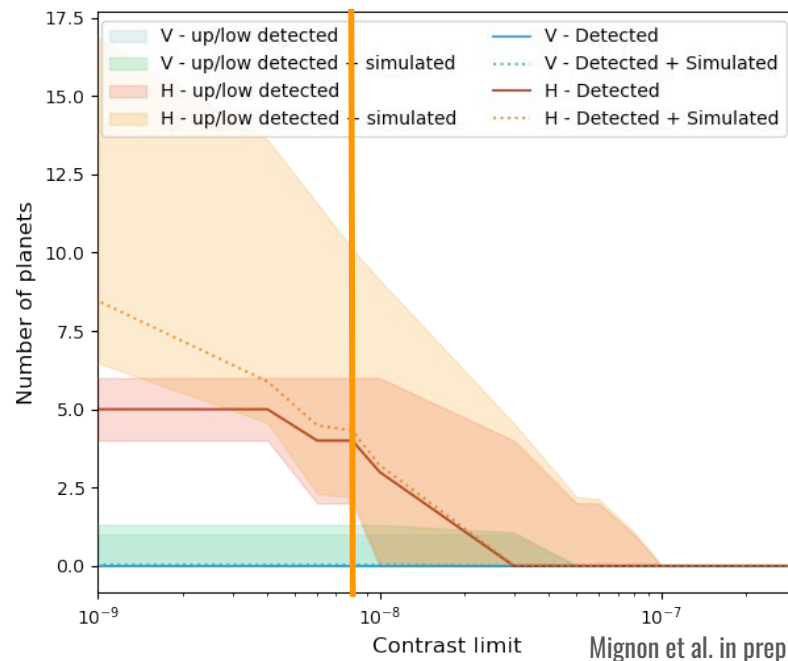
Thresholds: max Mag = 28, ang. Sep = 20 to 80 mas,  $R < 1.5 R_e$

Optimistic H band:  
- 10 around M and 2 around G-K  
Optimistic V band:  
- 1 around M and 2 around G-K

### F to K dwarfs



### M dwarfs



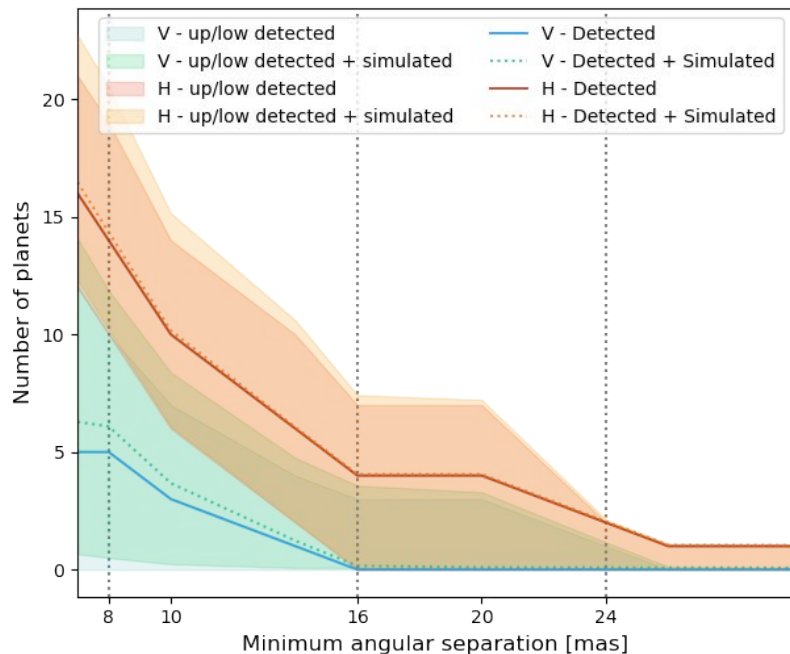
# Planet population simulation

Mignon et al 2025  
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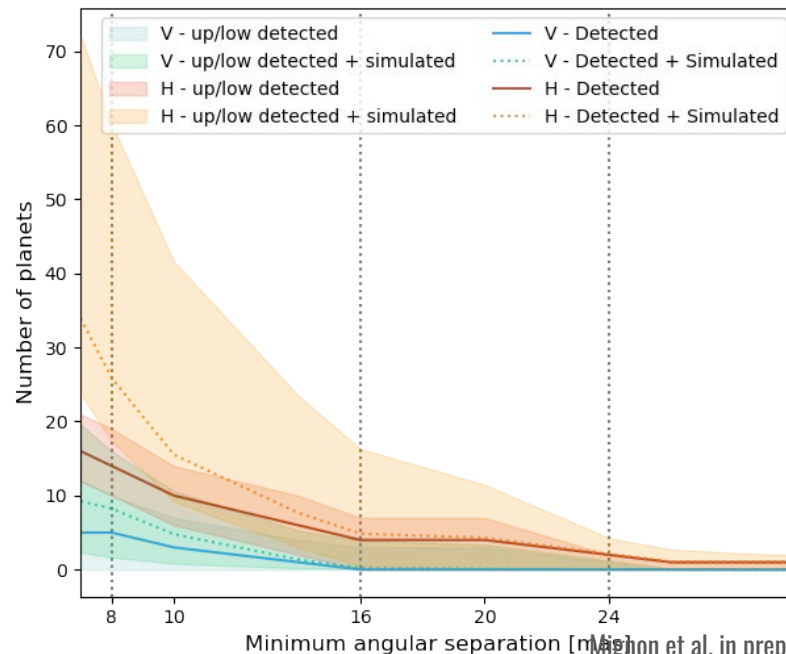
Rocky planets detected + simulated

Thresholds: max Mag = 28,  $R < 1.5 R_e$ , contrast = 10-8

## F to K dwarfs



## M dwarfs



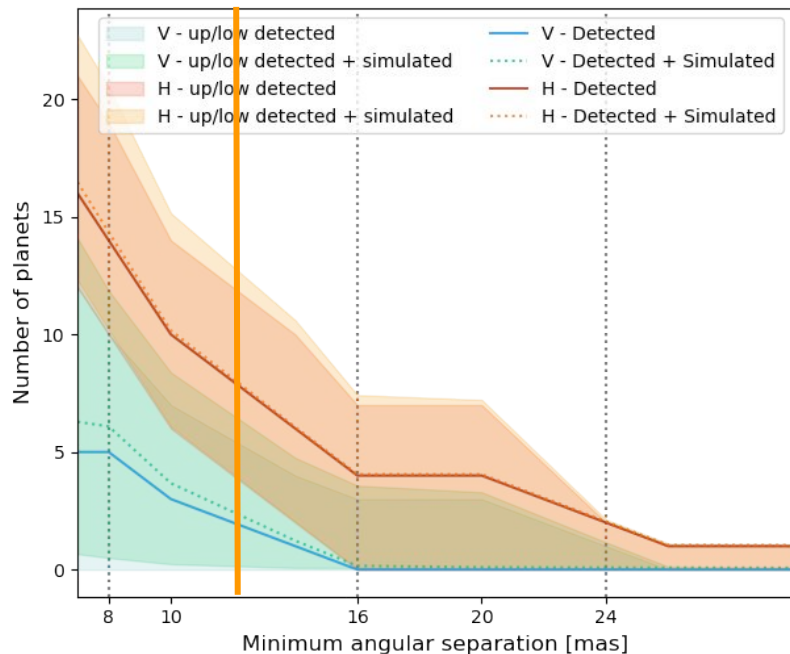
# Planet population simulation

Rocky planets detected + simulated

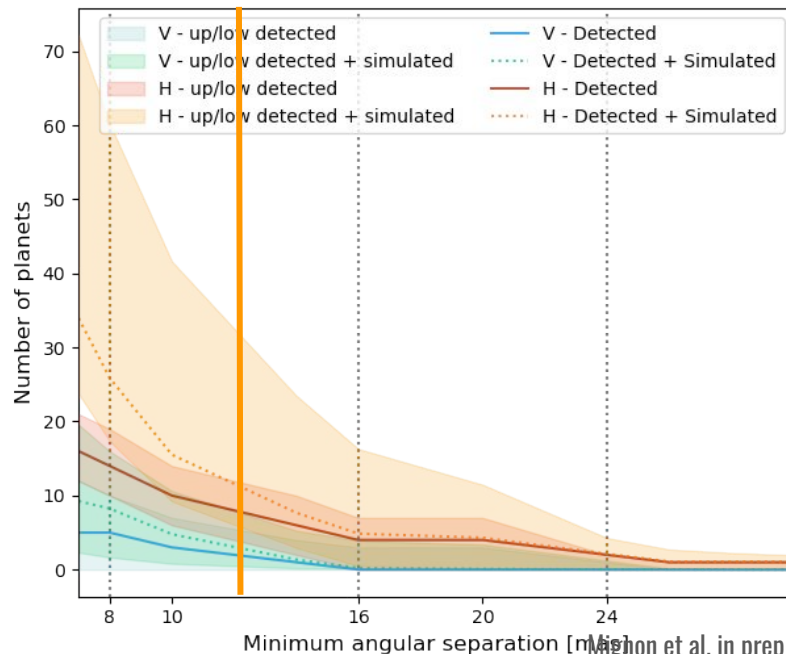
Thresholds: max Mag = 28,  $R < 1.5 R_e$ , contrast = 10-8

Around F to K dwarfs:  
- No such planets inner zone  
Around M dwarfs:  
- Lots of planets inner zone

## F to K dwarfs



## M dwarfs



# Planet population simulation

Neptunes detected + simulated

Thresholds: max Mag = 28, ang. Sep = 20 to 80 mas,  $R > 2 R_e$

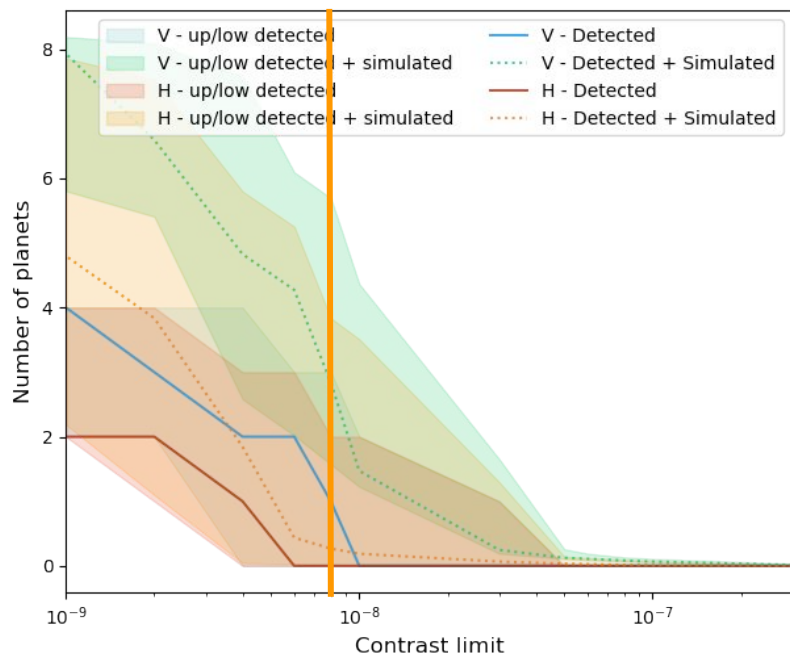
Optimistic H band:

- 17 around M and 4 around G-K

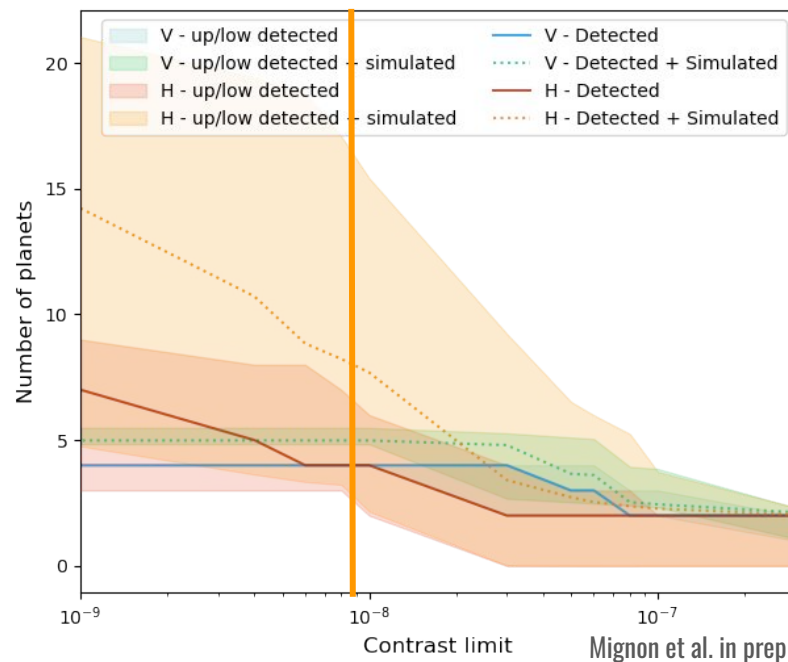
Optimistic V band:

- 5 around M and 6 around G-K

### F to K dwarfs



### M dwarfs

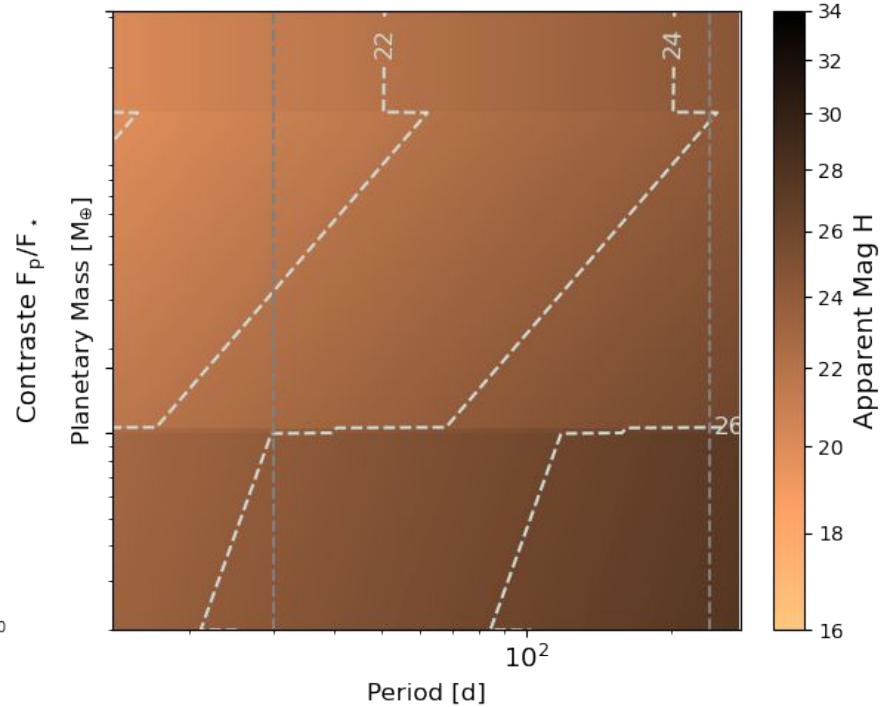
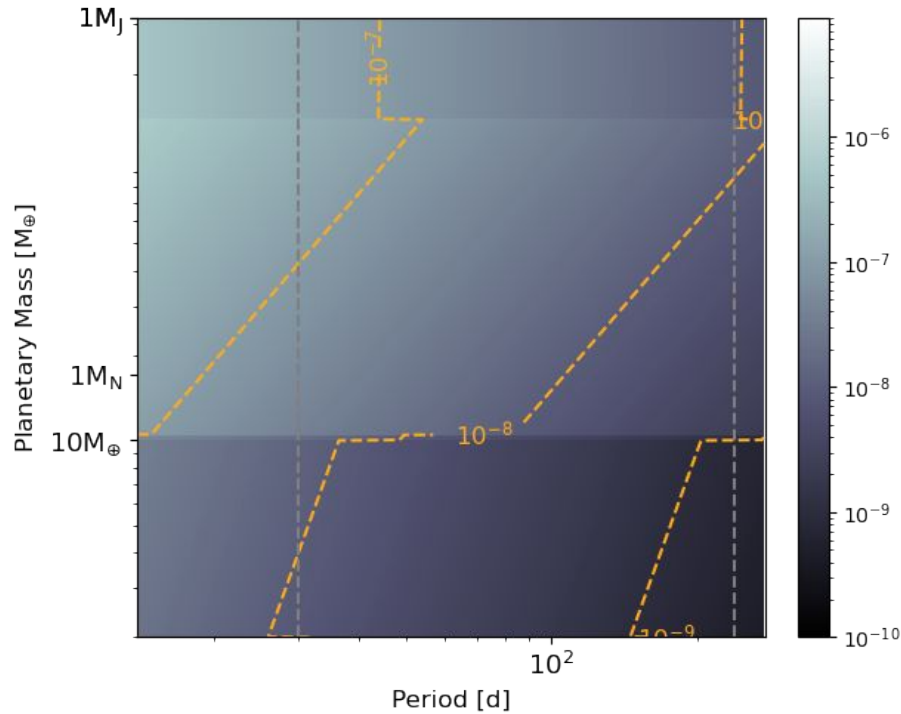


**Thank you for your attention**

L. Mignon, G. Chaverot, L. Parc, L.  
Leboulleux, I. Boisse, D. Mouillet, P.  
Delorme, et al. in prep

- On going RV surveys of the most promising **M and K dwarfs** with SPIRou (+ESP), NIRPS (+HARPS)
- $\frac{1}{3}$  of Solar 10 pc neighbourhood without RV follow up !
- **Simulations exhibit small number of planets**

# YOUR FAVORITE STAR



# SENSIBILITY

