Planets and evolved stars

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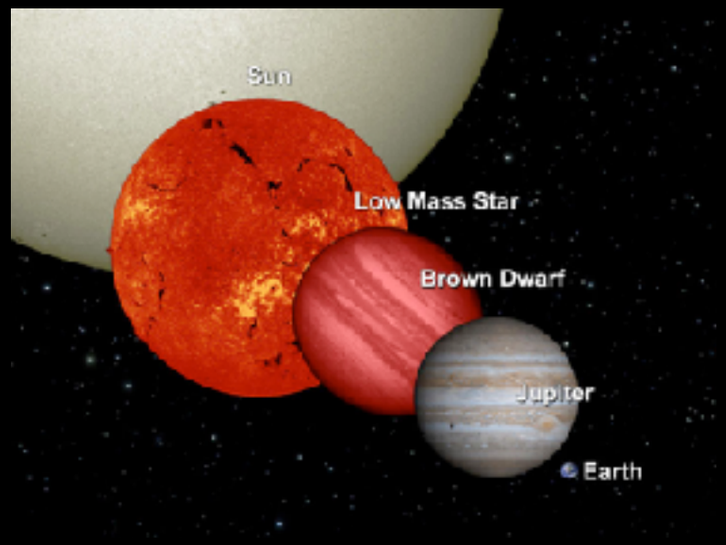
4/10/2022 ESA´s Madrid-Area Exoplanets Science Meeting



Star brightness vs. temperature

O and B stars

Lines of constant radius

Main sequence stars

White dwarfs

M stars

Giants and supergiants

O B A F G K M

Absolute magnitude (brightness)

Luminosity (Suns)

Spectral class

Surface temperature (Kelvin)

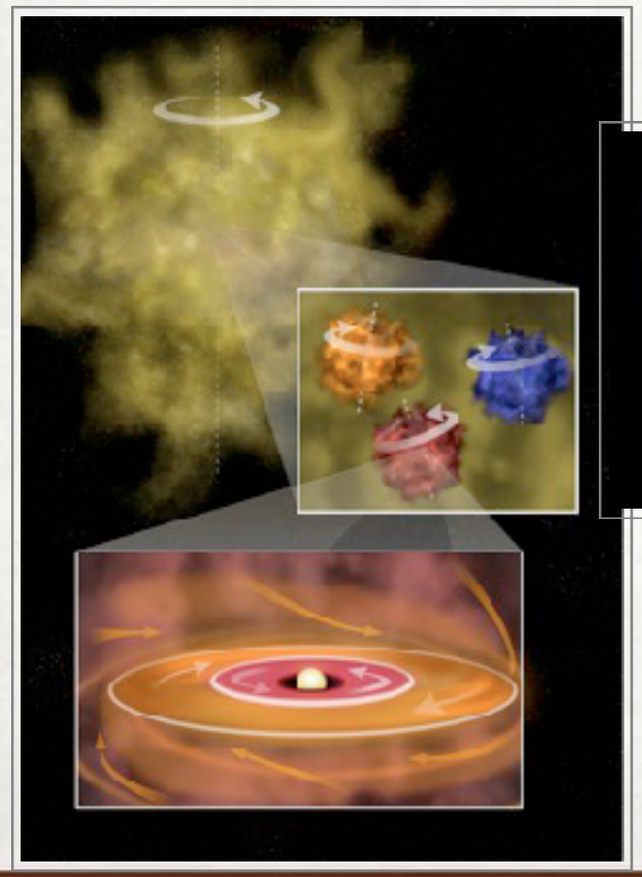
30,000 20,000 10,000 7,000 6,000 5,000 4,000 3,500 2,500

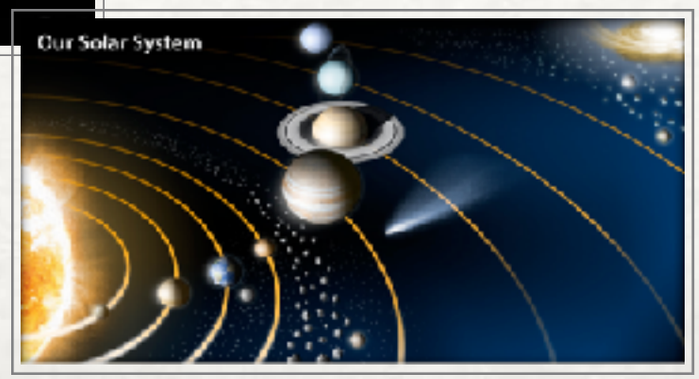
O5 B0 B5 A0 A5 F0 F5 G0 G5 K0 K5 M0 M5

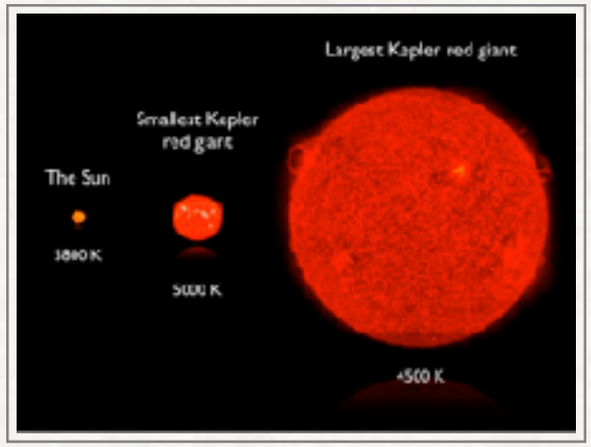
Astronomy

MOTIVATION OF OUR WORK

- Determine how the planet formation process depends on the mass of the star (BY TARGETING EVOLVED SYSTEMS $M>1M_{SUN}$.)
- Explore the chemistry of planet formation (WE GO TO LOW Z).
- Test the physics of star-planet interaction processes: i.e tidal forces, stellar mass-loss, planetary irradiation(WE HAVE THE THEORY TOOLS).
- Explore the diversity of planetary systems.



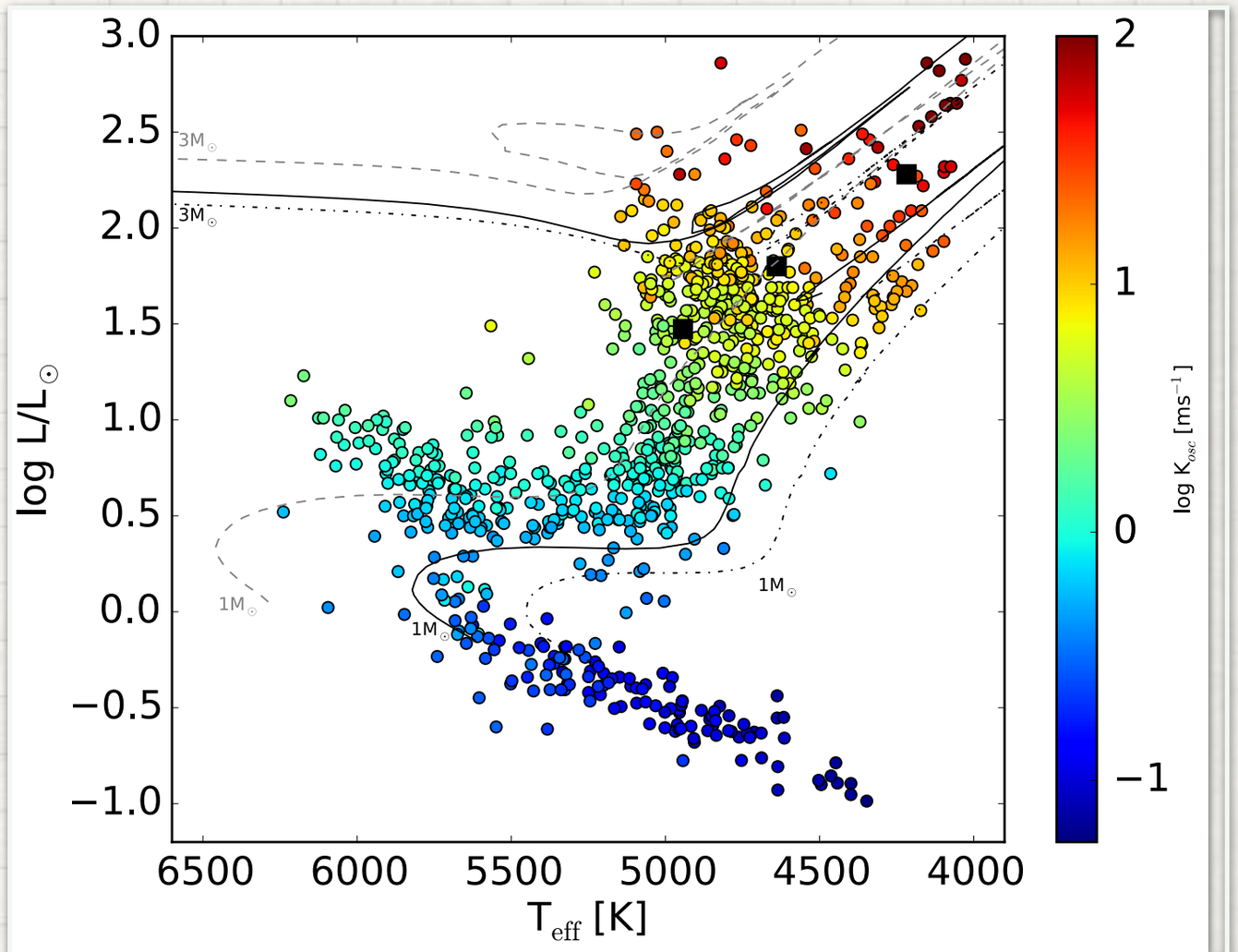




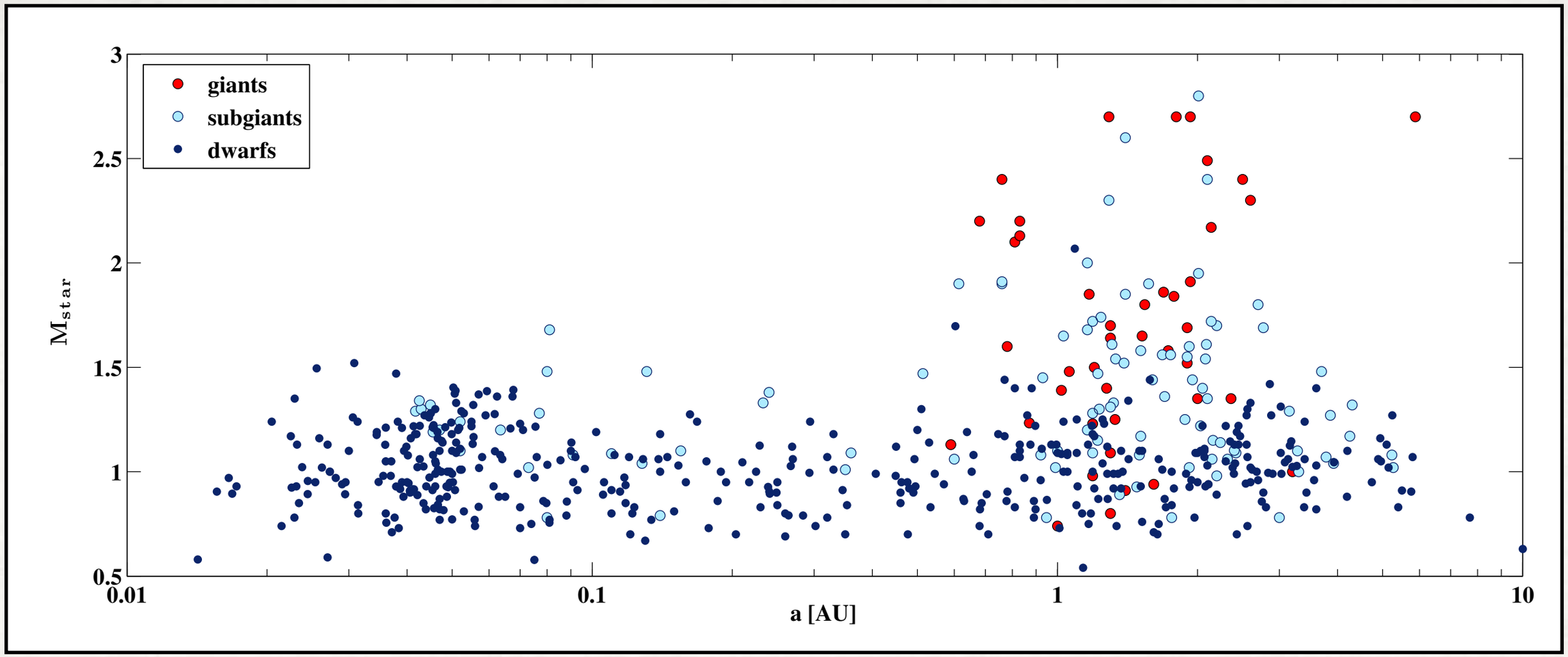
WD

RV VARIABLES AND LOW ACTIVITY

1000 STARS FOLLOWED AT THE HOBBY-EBERLY TELESCOPE SINCE 2004

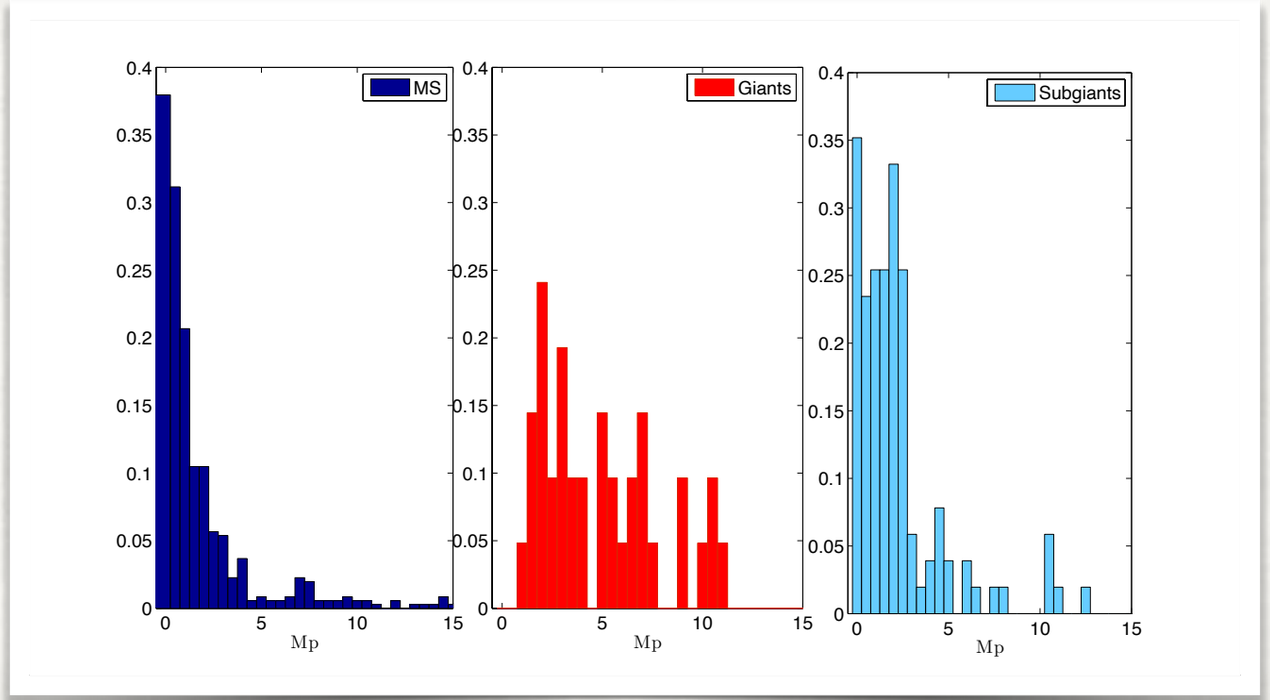


BEST 200 TARGETS FOR OVER 3 YEARS WITH HARPS-N

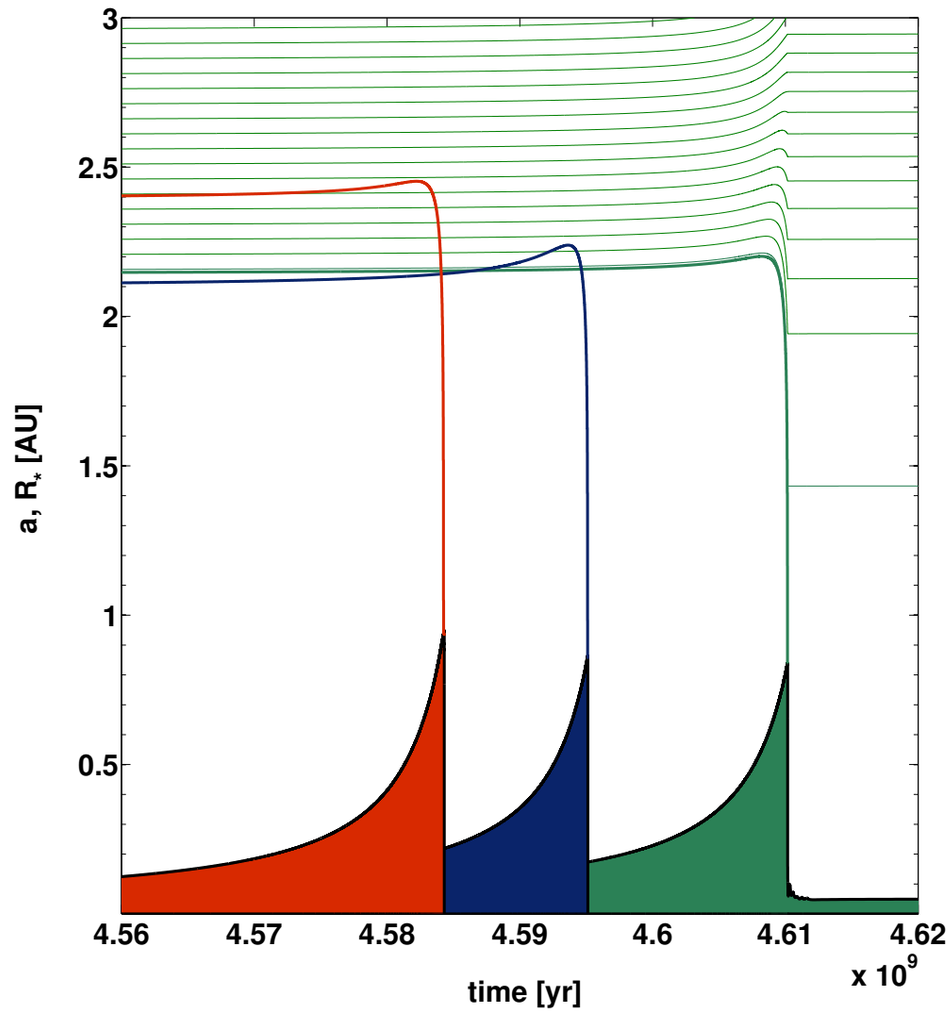


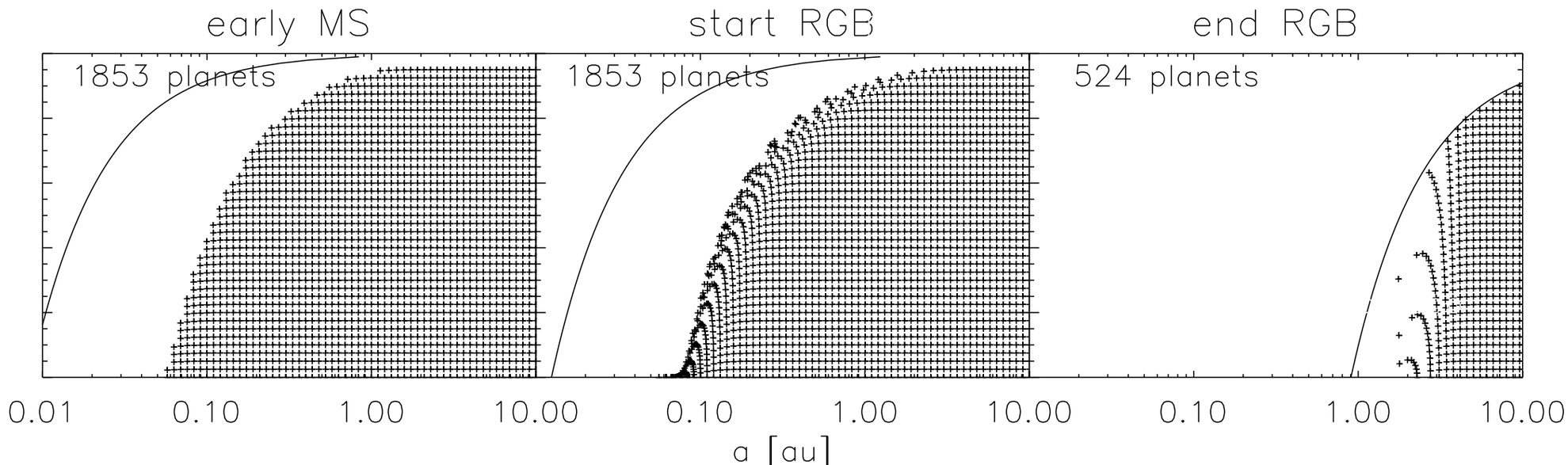
Niedzielski, Villaver et al. (2015, 2016, 2021), Villaver et al. (2014,2017); Adamów et al. (2014,15, 18)

Selection effects: more jitter
Primordial differences in planet formation?



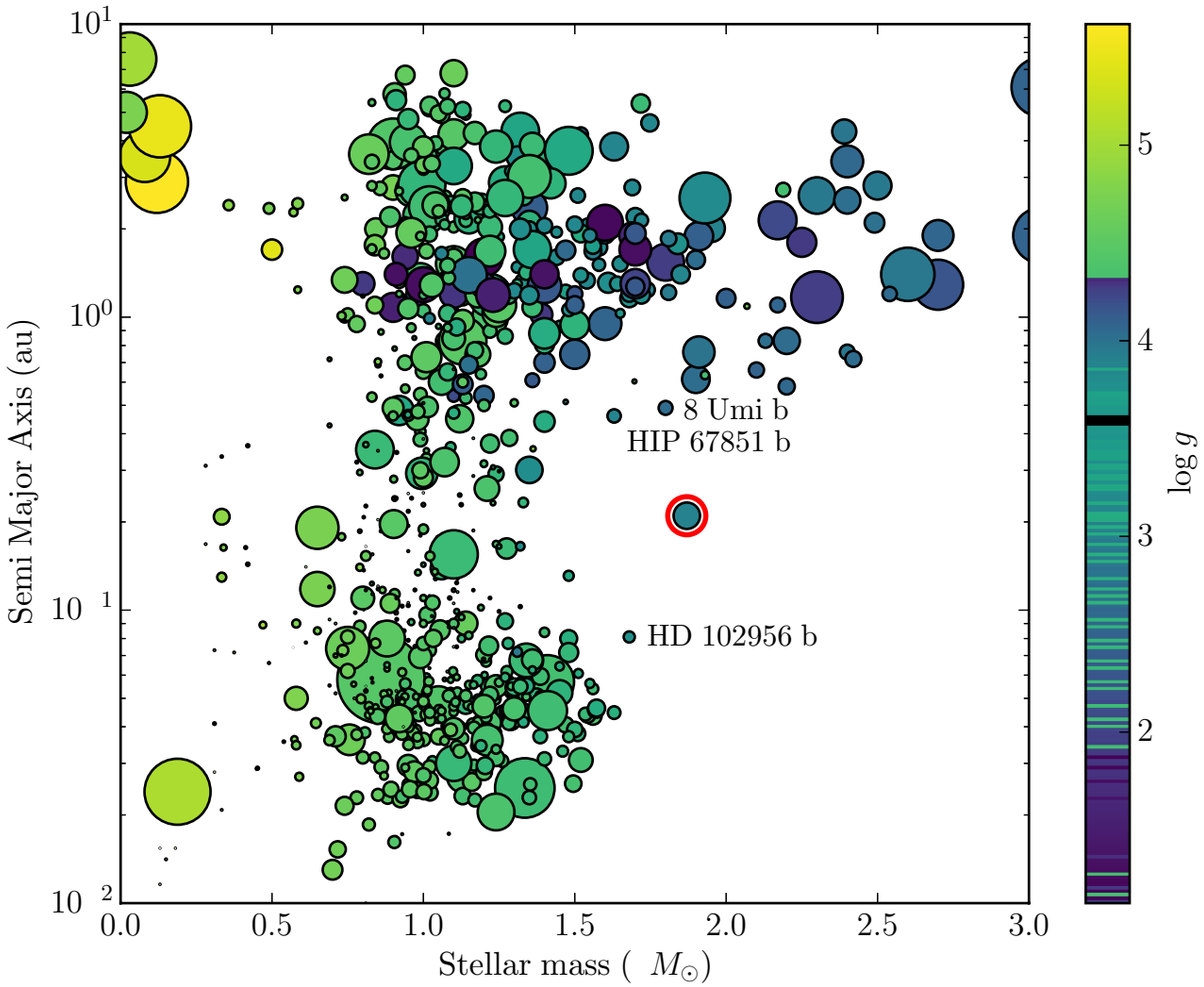
ECCENTRICITY EVOLUTION AND MASS-LOSS

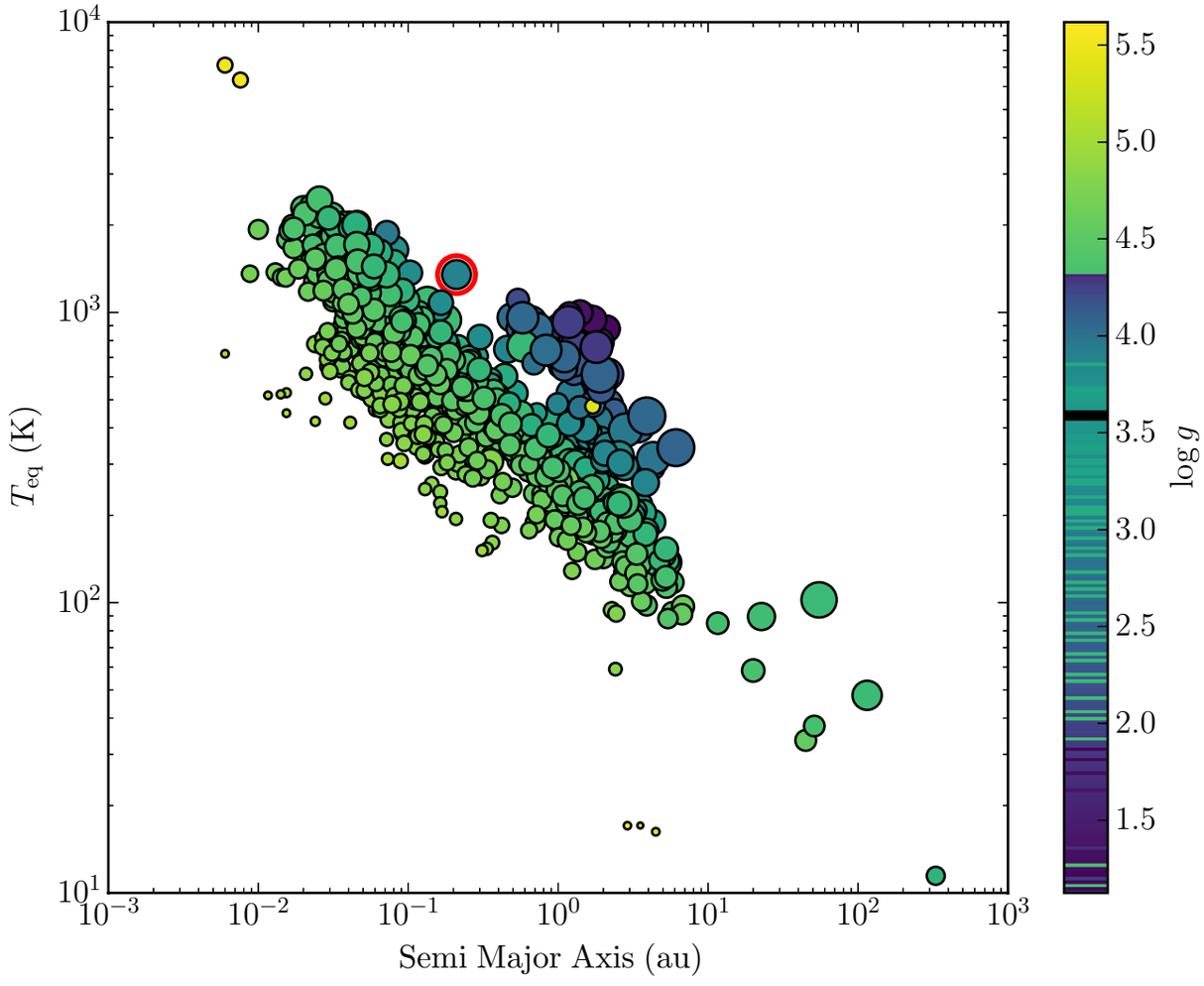




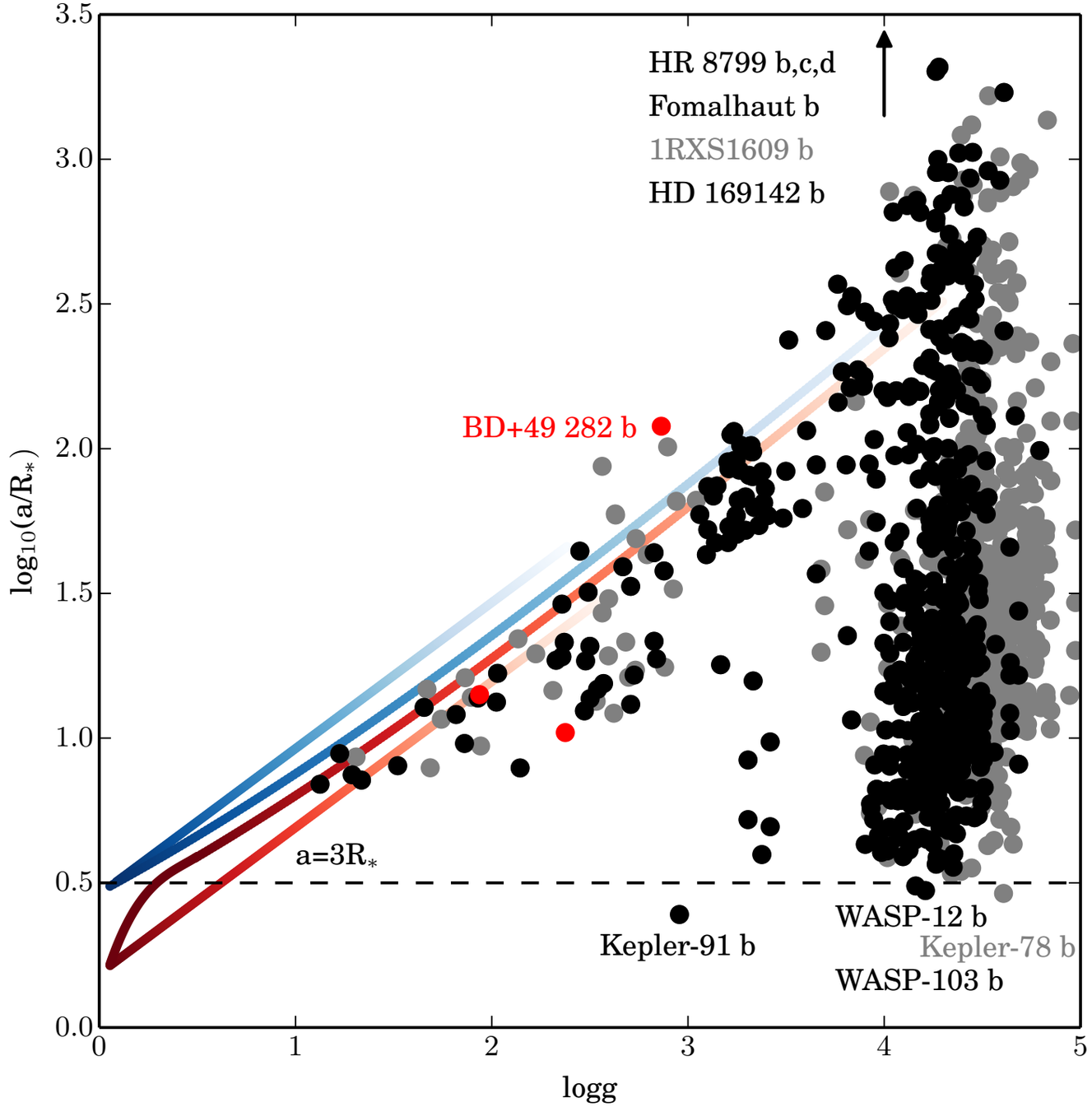
Villaver et al. (2014)

TAPAS IV: WARM (HOT) JUPITER TYC 3667-1280-1



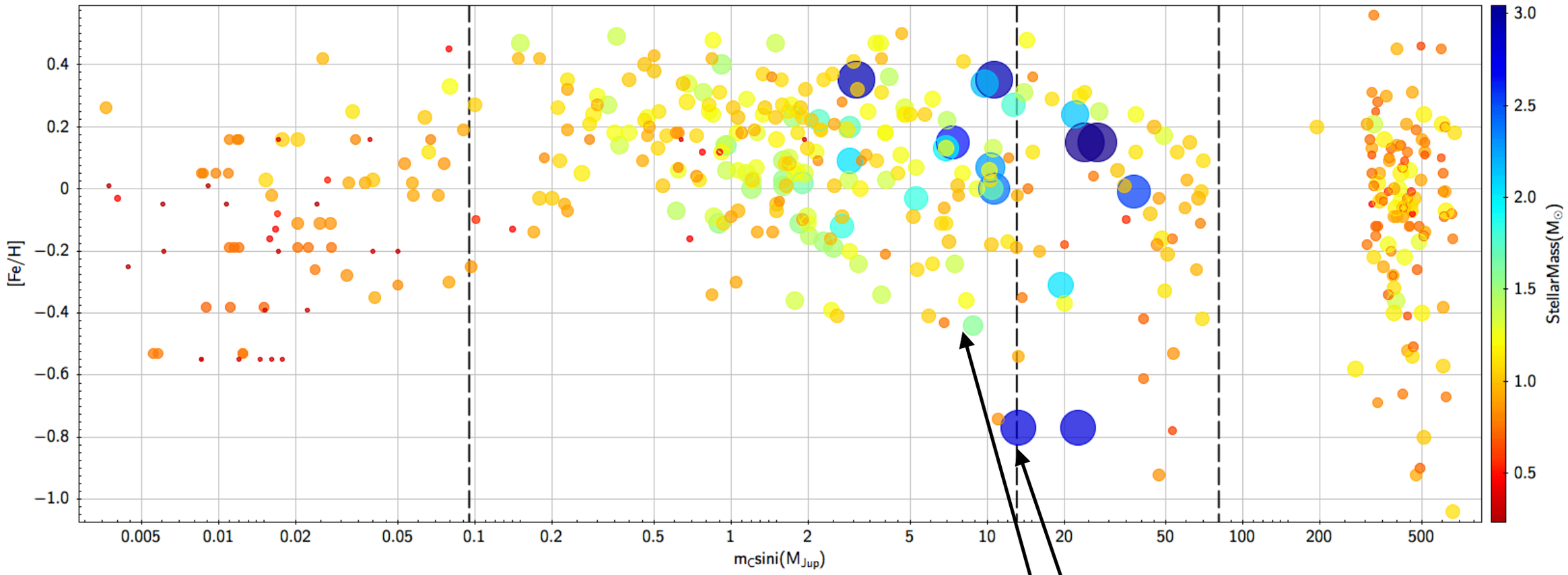


Niedzielski, Villaver, et al. (2016)



Niedzielski et al. (2015); tracks from Villaver et al.

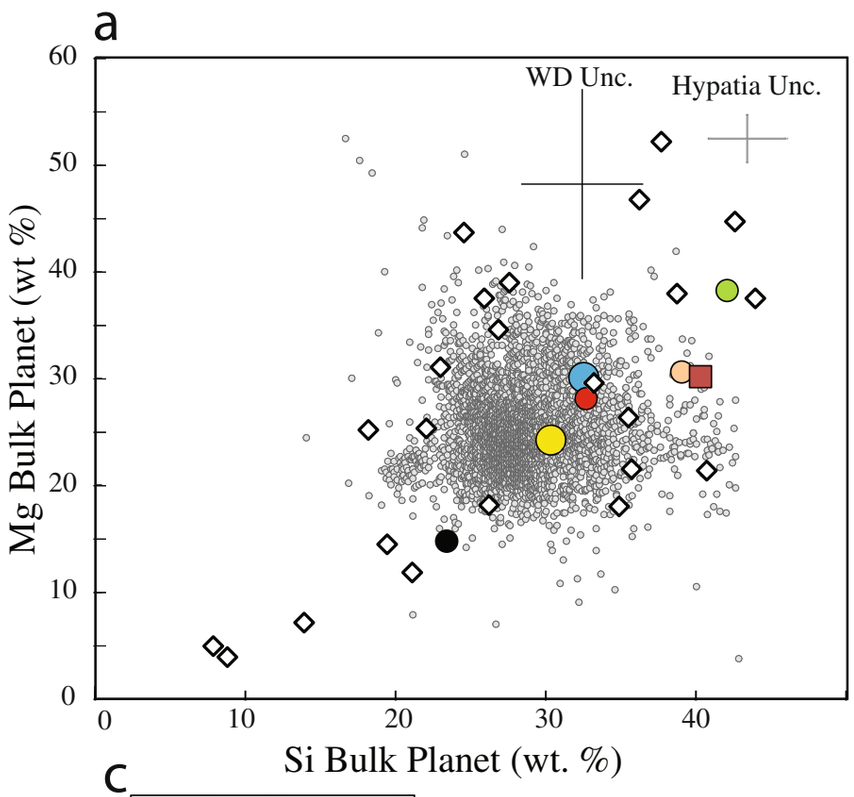
Mass-Metallicity relation: the star

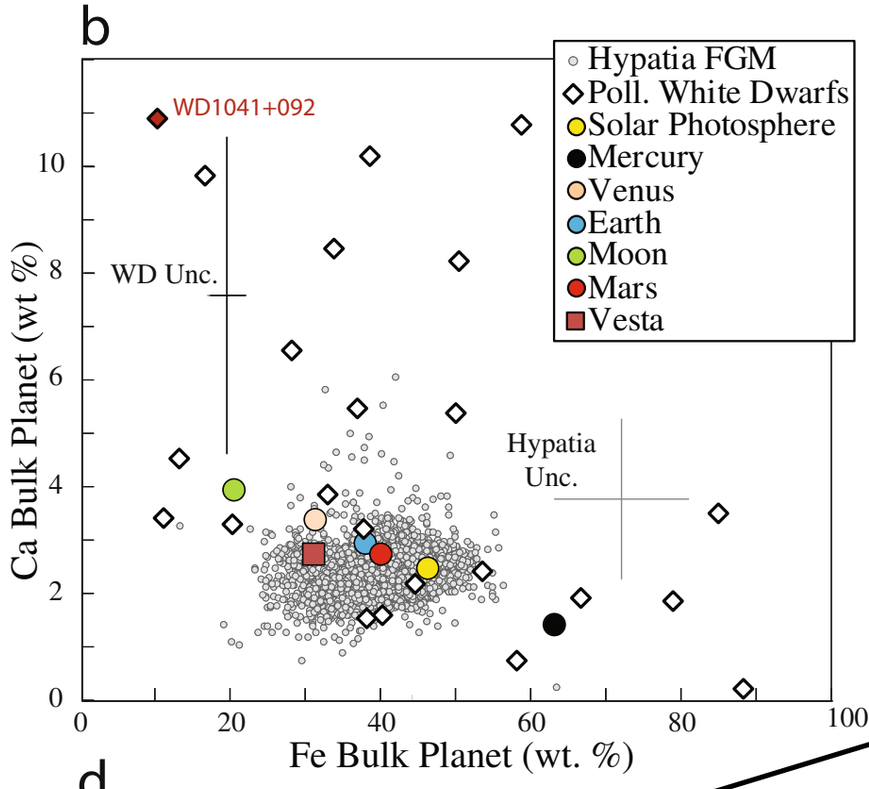


Maldonado, J.; Villaver et al. (2019)

TAPAS, red giant stars Villaver et al. (2017)

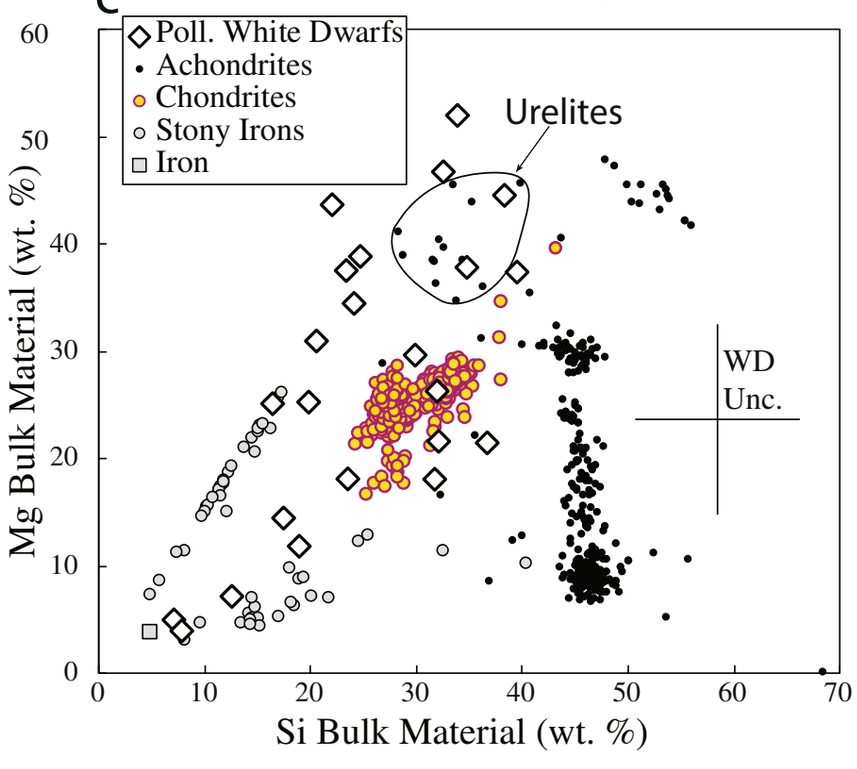
Exoplanet composition from Polluted WDs

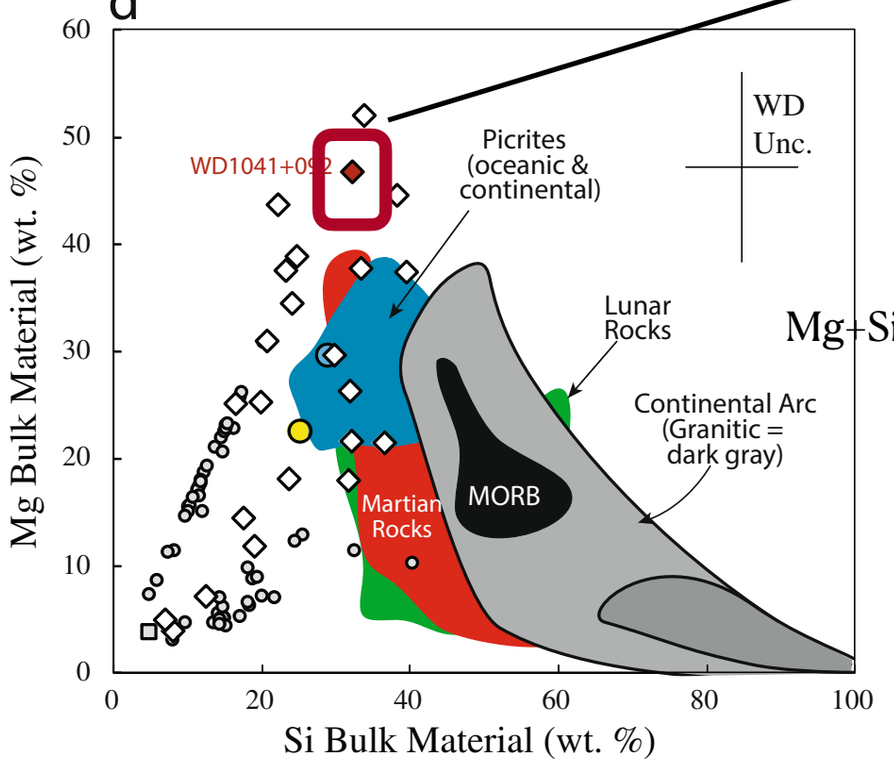




Highest Ca
Argued to have crust composition

Plate tectonics!!!!

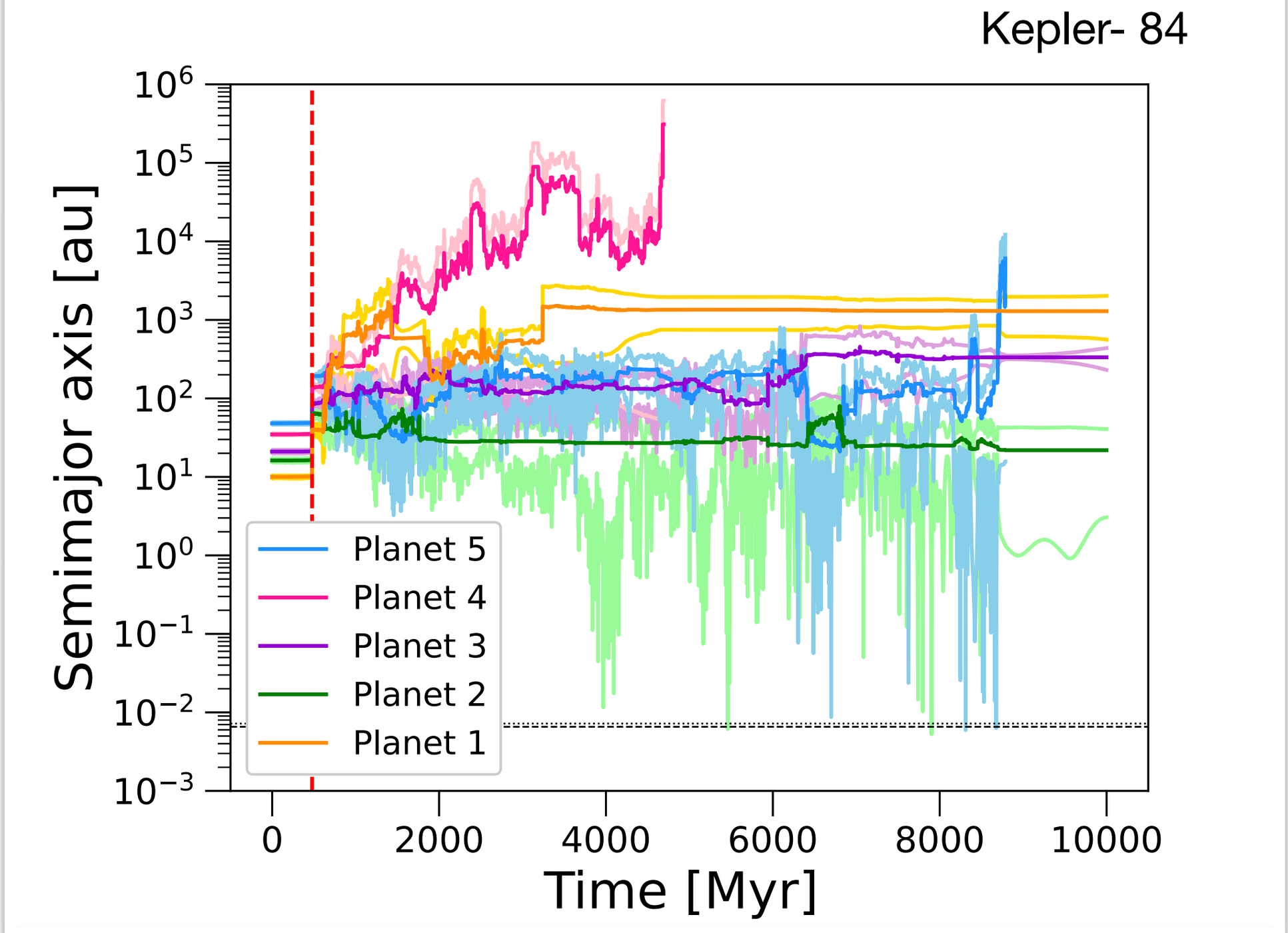




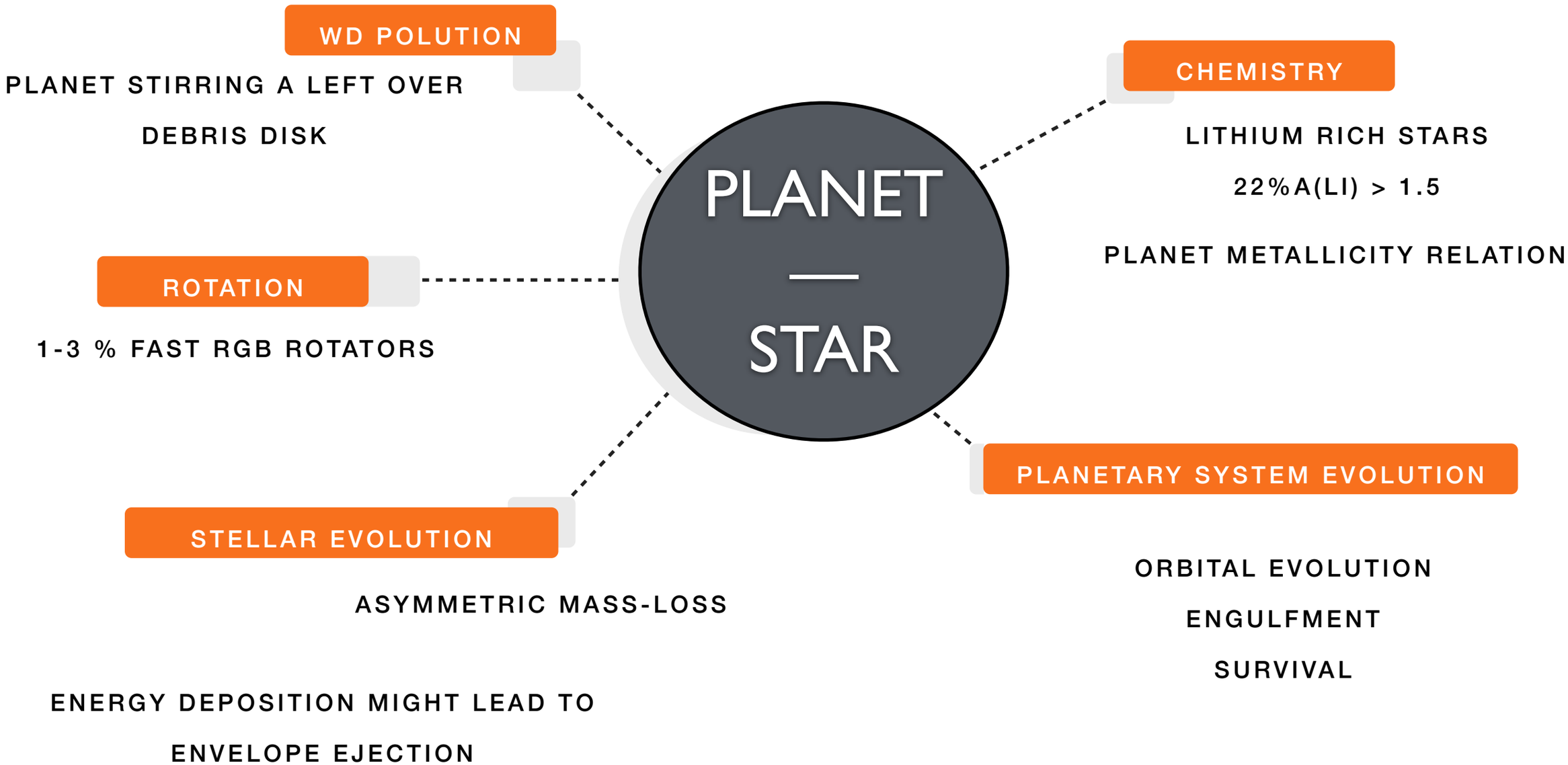
Mg+Si+Ca+Fe normalized to 100%

Putirka & Xu (2021)

Multiple planetary systems



Maldonado, R., Villaver et al. (2021ab, 2022)


WD POLUTION
PLANET STIRRING A LEFT OVER
DEBRIS DISK
CHEMISTRY
LITHIUM RICH STARS
22%A(LI) > 1.5
PLANET METALLICITY RELATION
PLANET
—
STAR
ROTATION
1-3 % FAST RGB ROTATORS
PLANETARY SYSTEM EVOLUTION
ORBITAL EVOLUTION
ENGULFMENT
SURVIVAL
STELLAR EVOLUTION
ASYMMETRIC MASS-LOSS
ENERGY DEPOSITION MIGHT LEAD TO
ENVELOPE EJECTION