


gaia

# Gaia, long-period planets, and follow-up

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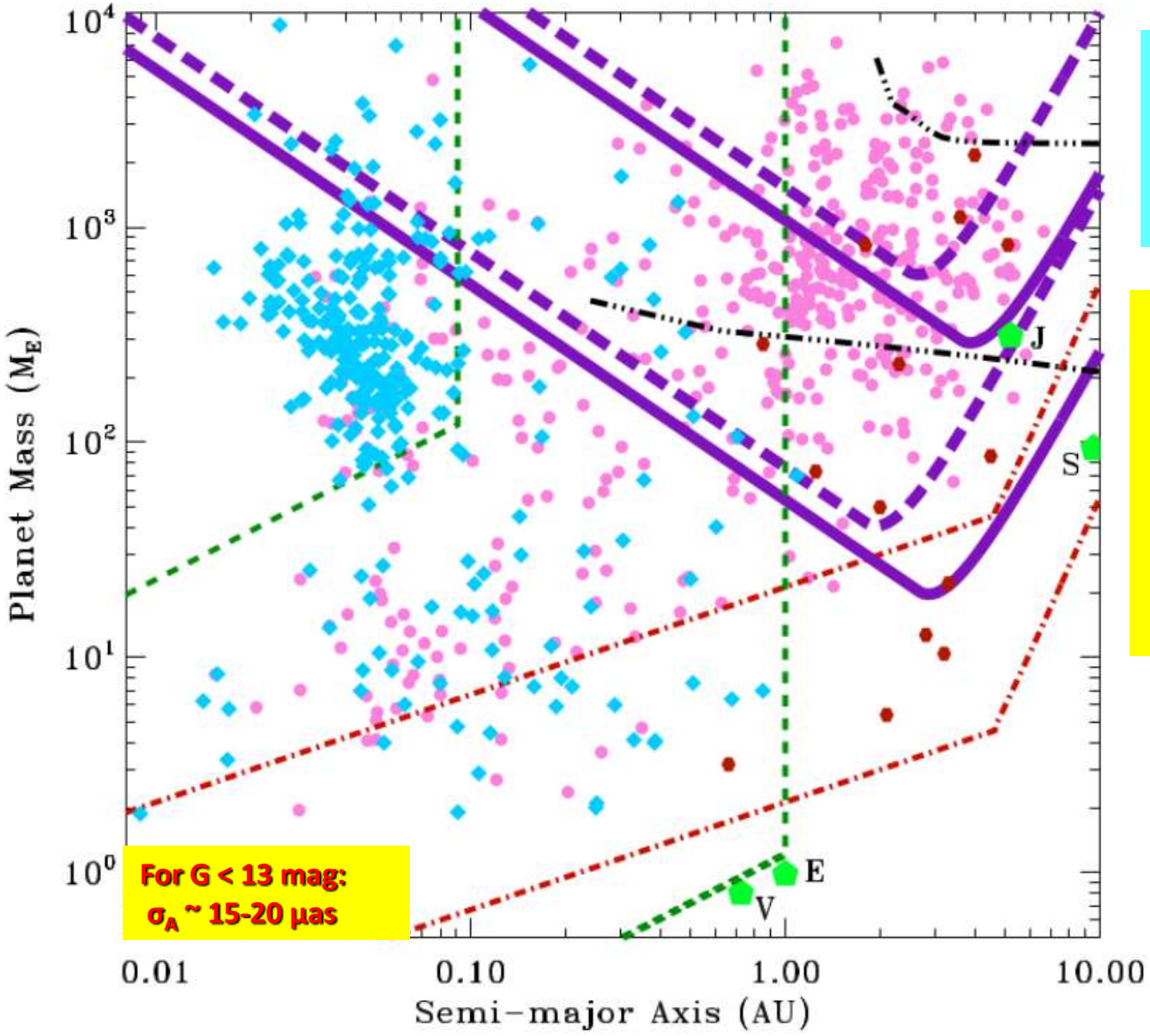
# Gaia Discovery Space



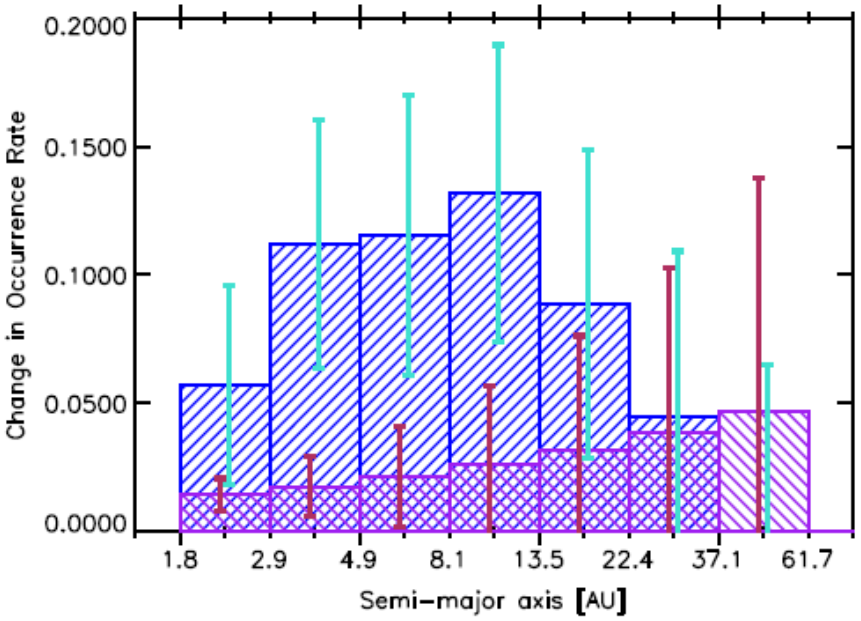

**Unbiased, magnitude-limited planet census of maybe $10^6$-$10^7$ stars**

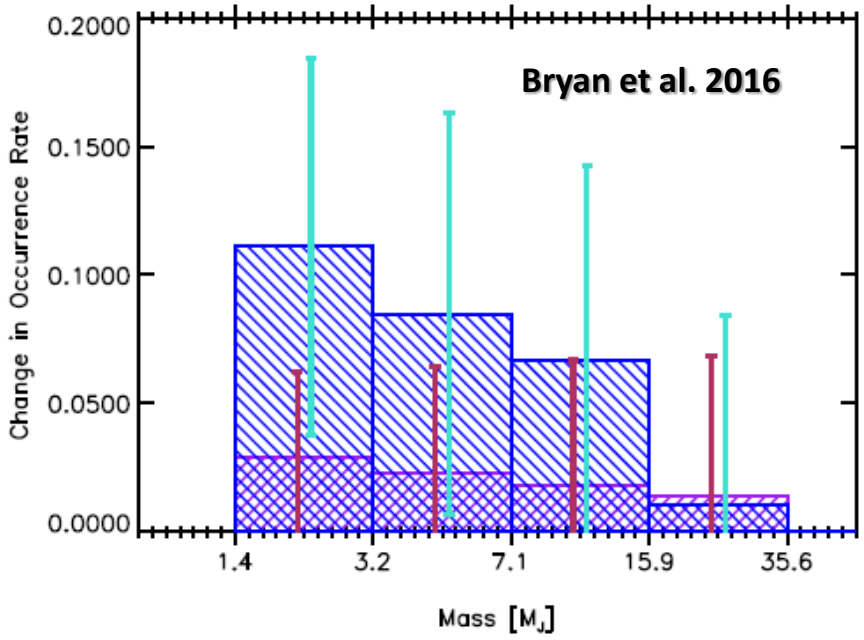
**On the order of >$10^4$ NEW gas giants (< 15 $M_{JUP}$) around A through M dwarfs Numbers might as much as triple for a 10-yr mission**

Lattanzi et al. 2000,
Sozzetti et al.2001
Casertano et al. 2008
Perryman et al. 2014
Sozzetti et al. 2014
Sahlmann et al. 2014

# Gaia & Multiple Systems

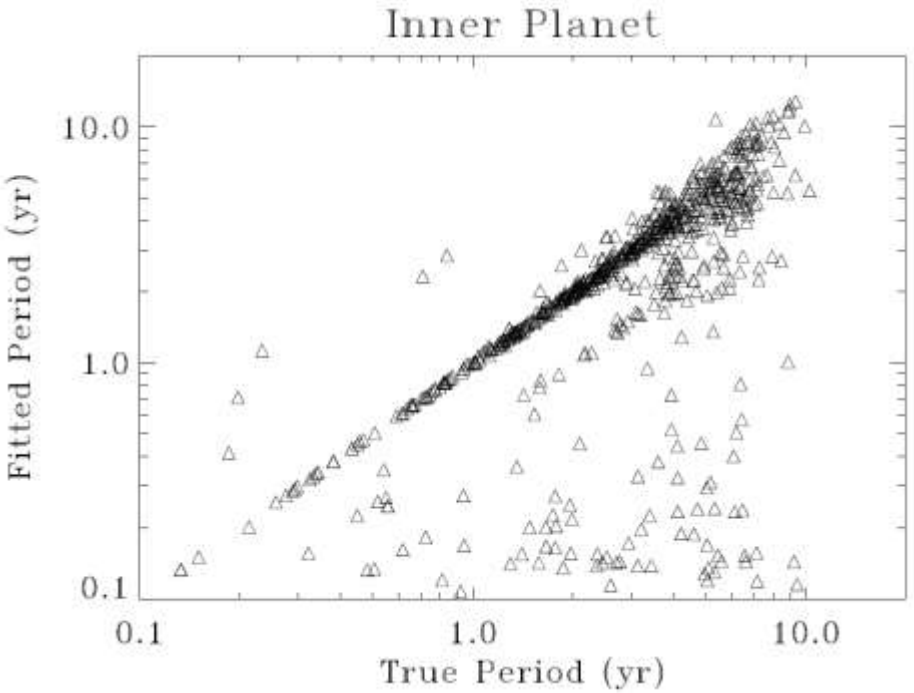
**>50% of 1-GP systems has additional massive companions**

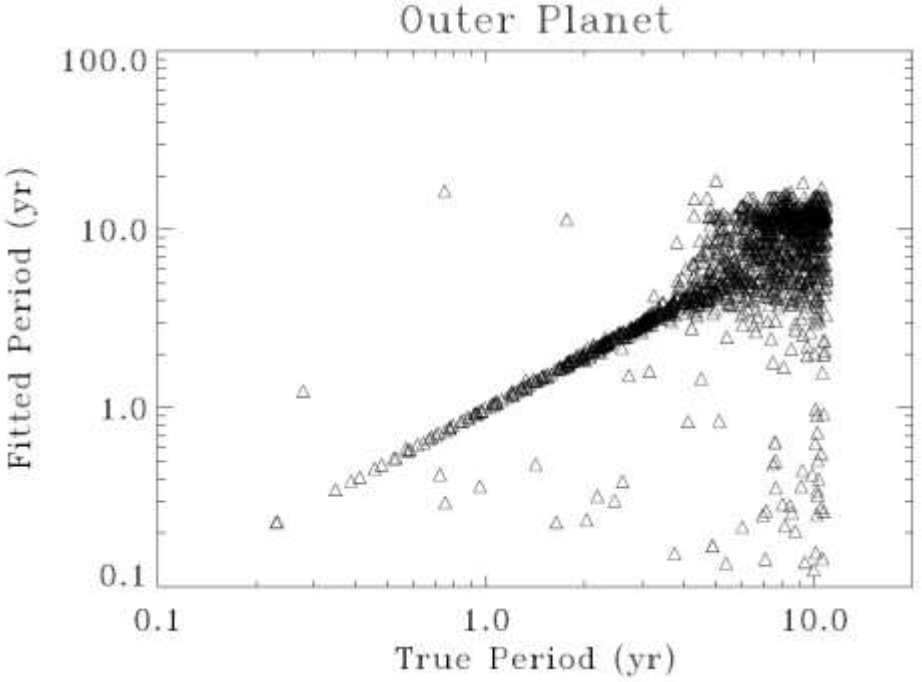



- Combine Perryman et al. (2014) and Casertano et al. (2008) results:
- $T_{mission}$= 5 yr:
  >2500 two-planet systems with σ(M)<15%-20%, some 250 $I_{rel}$ measurements
- $T_{mission}$= 10 yr:
  >6000 two-planet systems with σ(M)<15%-20%, some 600 $I_{rel}$ measurements

# Large GOG-based simulation



# SO:

- Gaia has the potential to screen ALL (P1,P2,P4,P5) PLATO targets for intermediate-separation (single and multiple) giant planets.

- Much improved understanding of architectures, formation, evolution

- And this will come for free… GREAT!

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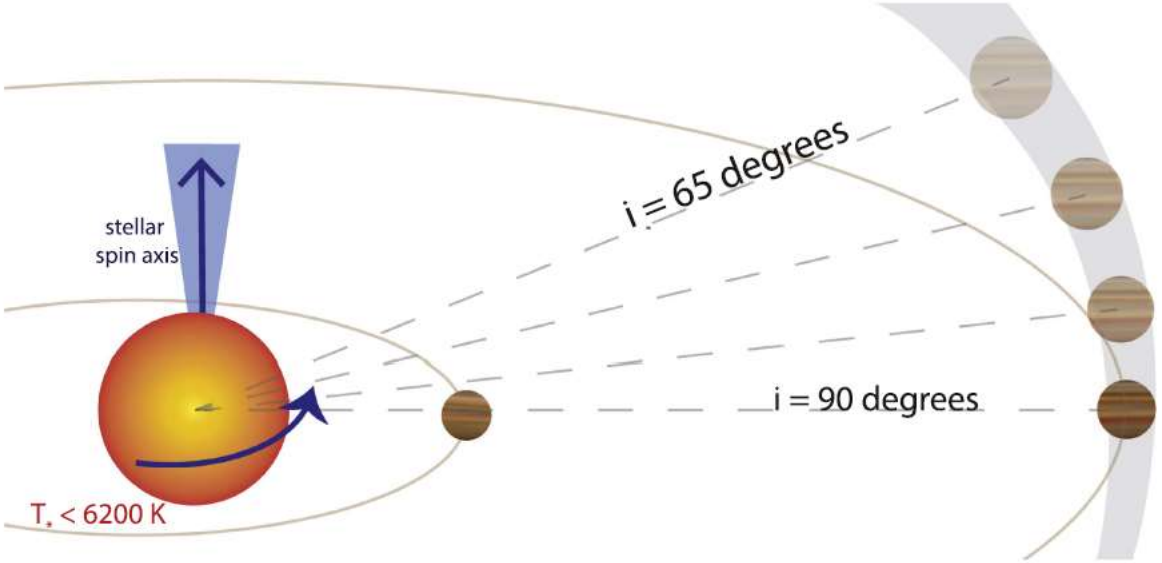
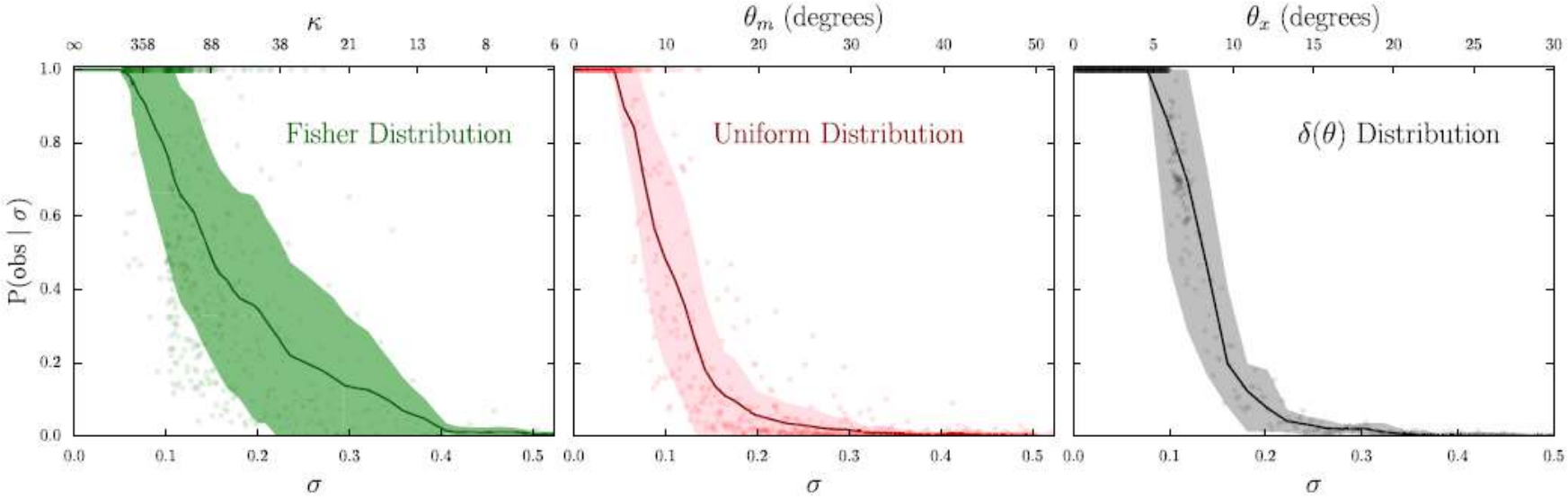
# BUT LET US ASK THE QUESTIONS:

1) Can Gaia find astrometrically long-period transiting planets?
2) Can Gaia help in the characterization of long-period transit candidates?

# Multiple (Transiting?) Systems




**Becker et al. 2017**




**Outer companions of hot Jupiters should be nearly coplanar**

# Gaia Astrometry And Transiting Giant Planets

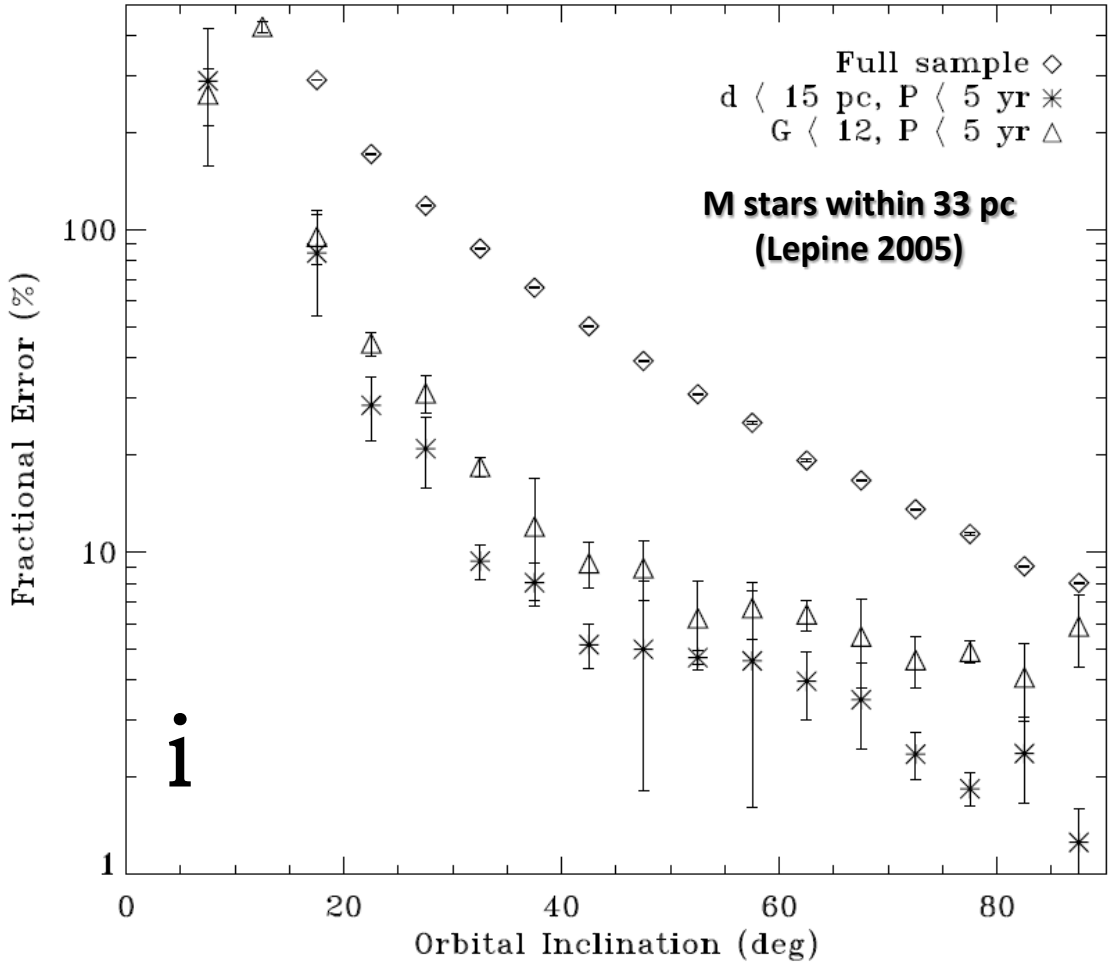
Sozzetti et al. 2014

**For well-measured, quasi-edge-on orbits, i is measured to 2-3%**

**Gaia may find hundreds of candidate transiting giant planets around F-G-K-M dwarfs of all ages and [Fe/H].**

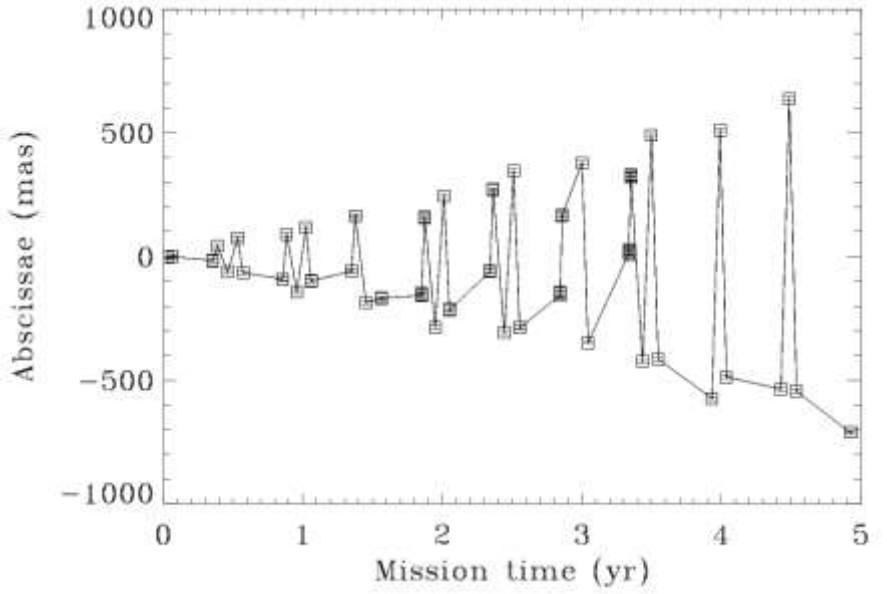
**Some may be really transiting!**

**Follow-up efforts, both ways!**



# Gaia + RV Follow-up (1)

**Giacobbe et al. in prep.**

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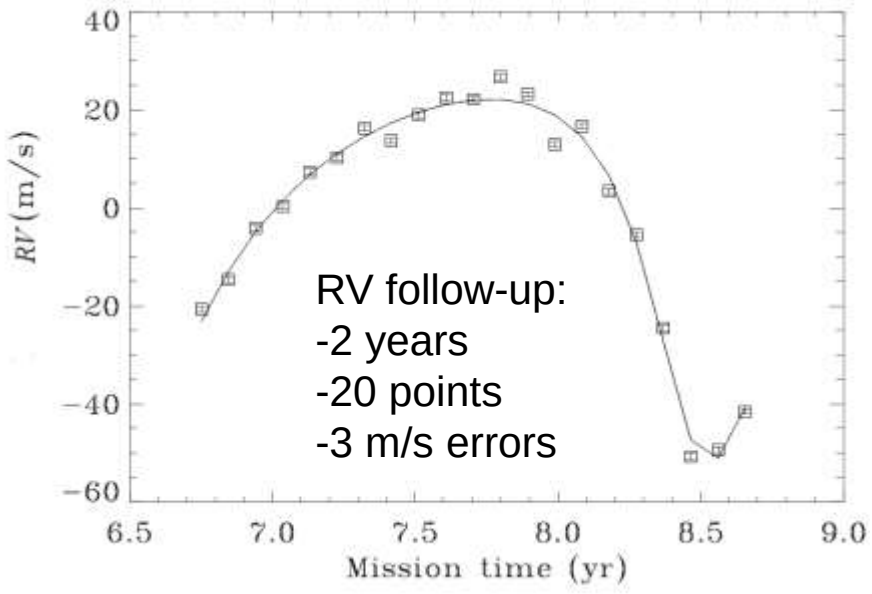
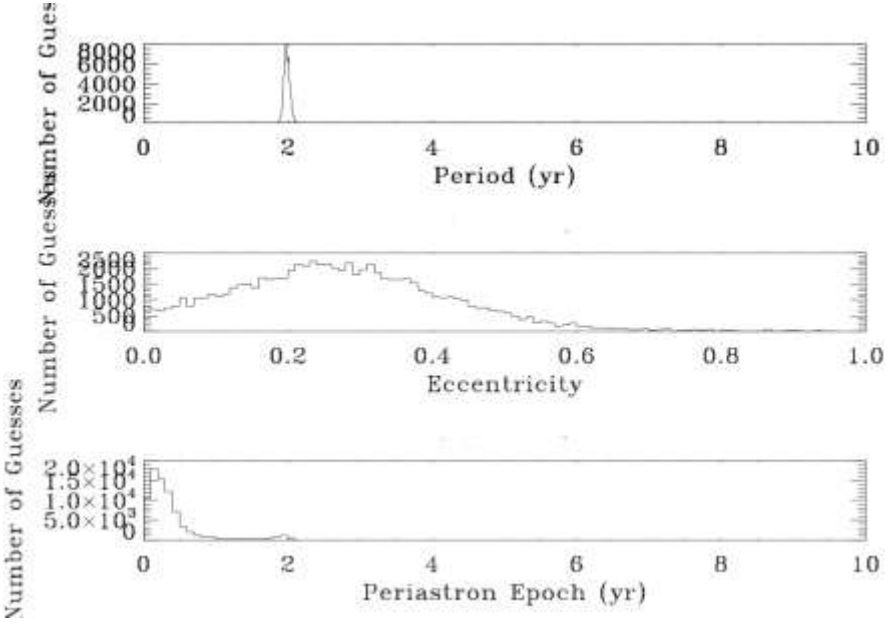
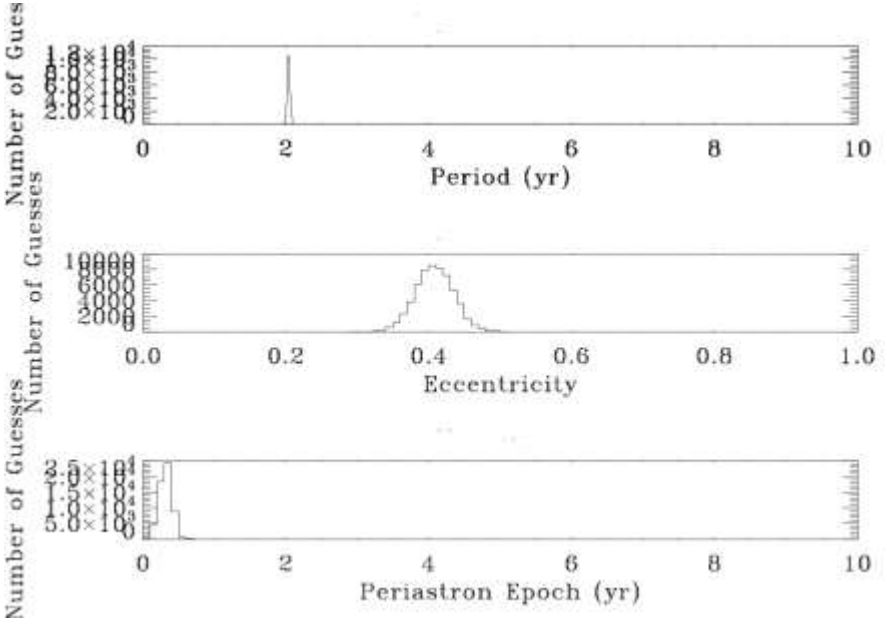
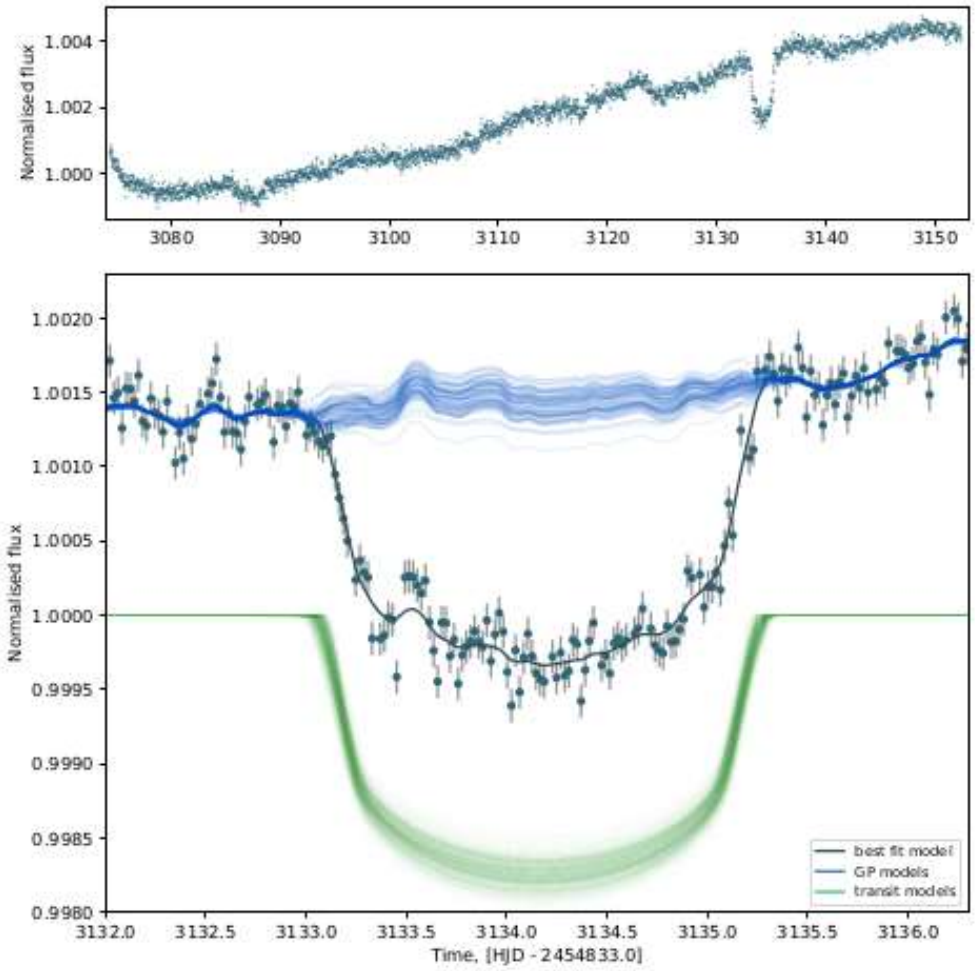



RV follow-up:
-2 years
-20 points
-3 m/s errors



# EPIC248847494
# The longest period transiting planet candidate from K2
# Giles et al. 2018




**P ~ 10 yrs**

**Radius = 1.1 $R_{jupiter}$**

**Mass ~ 1 $M_{jupiter}$ from 1 yr RV campaign with CORALIE @ ESO**

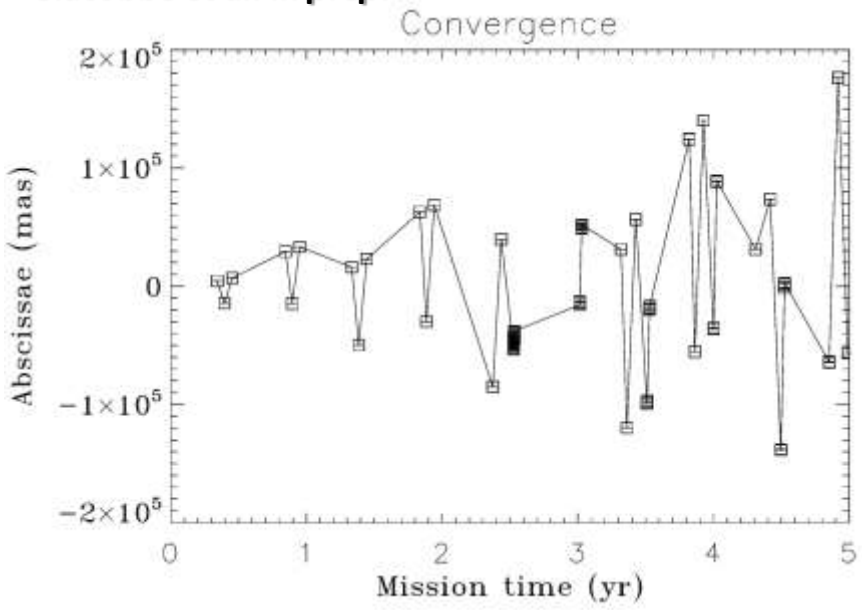
**I = 90°**

**eccentricity ???**

**Host star:**
**V = 12.4 mag**
**M = 0.9 $M_{sol}$**
**R = 2.7 $R_{sol}$**
**D = 560 pc**

# Gaia + RV Follow-up (2)

**Giacobbe et al. in prep.**

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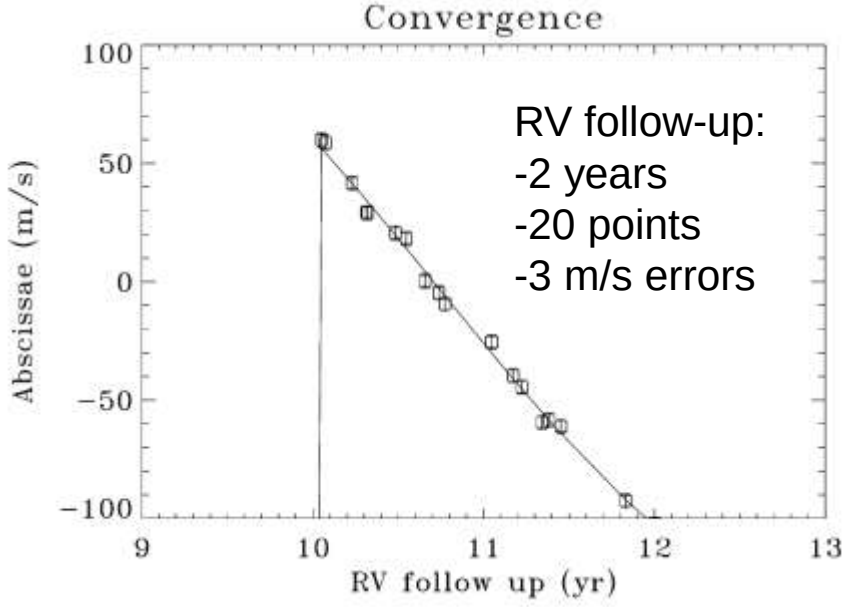
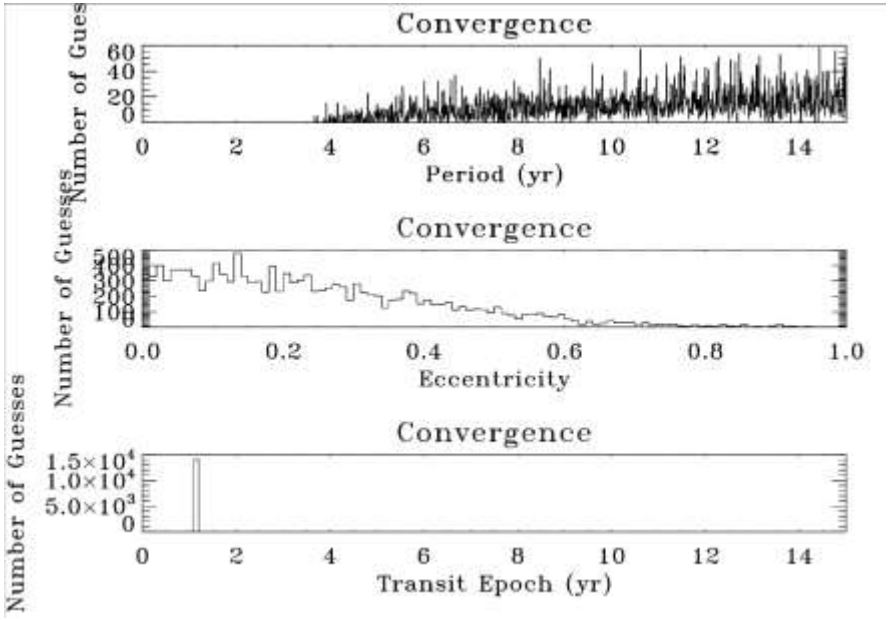
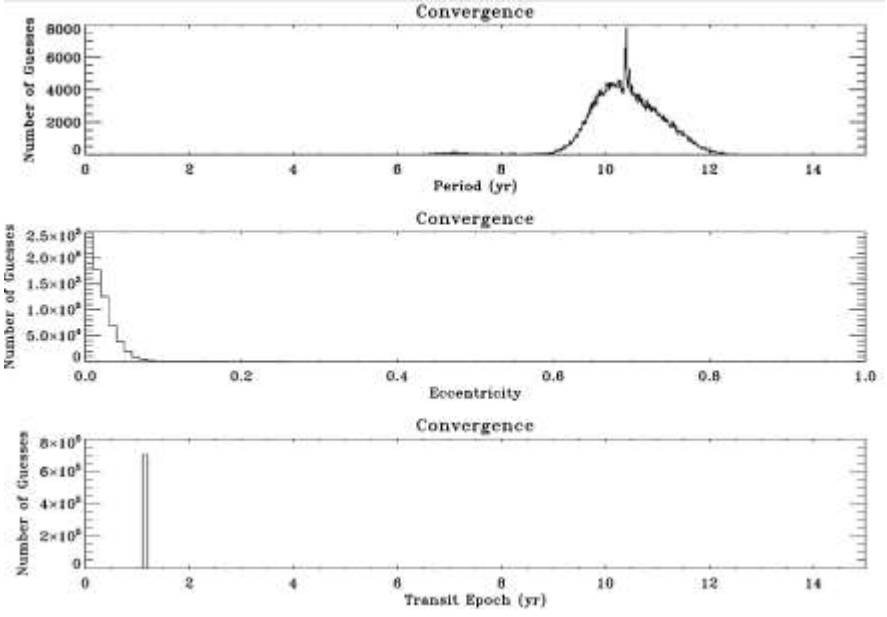


# Considerations

- Starting from DR4, and with any other DRs pending extension, Gaia data on exoplanets might allow selecting a sample of potentially transiting systems at intermediate separations

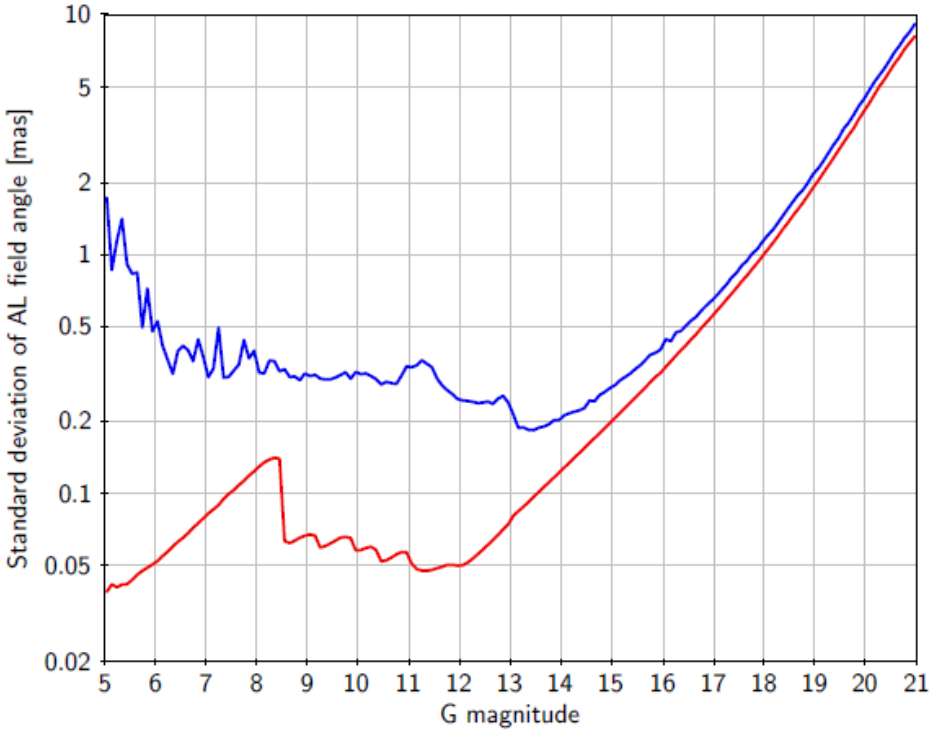
- RV follow-up might allow constraining transit ephemeris sufficiently to make them attractive targets for follow-up with PLATO (if they are not observed already!)

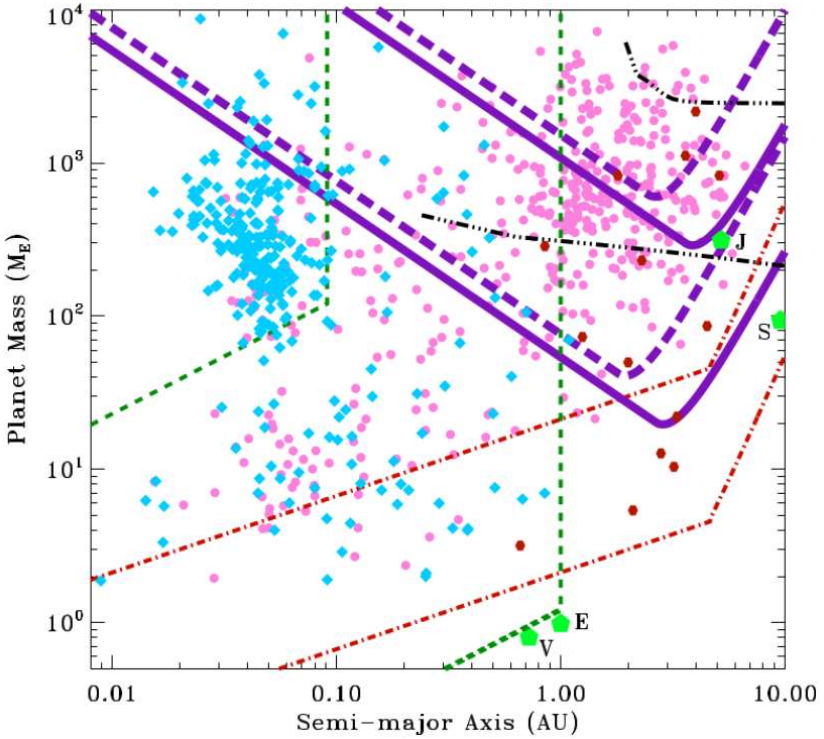
- If long-period companions are found in already known transiting systems, those might be seen as particularly high-interest configurations for PLATO

- If long-period planets with single-transit events are seen by Gaia, such companions might be further characterized early on (better with RVs too!)

# A Word of Caution

**Lindegren et al. 2018**




*** G < 13 mag: typical $\sigma_A$ ~ 50-60 µas**
*** BUT: systematic errors ~ 0.2-0.5 mas**
*** Calibration of bright stars limited**

**For Gaia, G < 13 mag:**
**$\sigma_A$ ~ 15-20 µas (over 9 CCDs)**

**Critical to improve significantly the bright-star performance:**

- At G < 13 mag exoplanet detections maximize the Gaia impact and synergy potential
- At G > 13 mag exoplanet detections will primarily have only a statistical value