Astrophysical False Positives in Transit surveys:

From Kepler to PLATO 2.0

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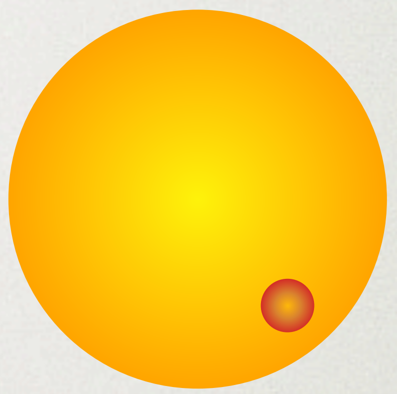
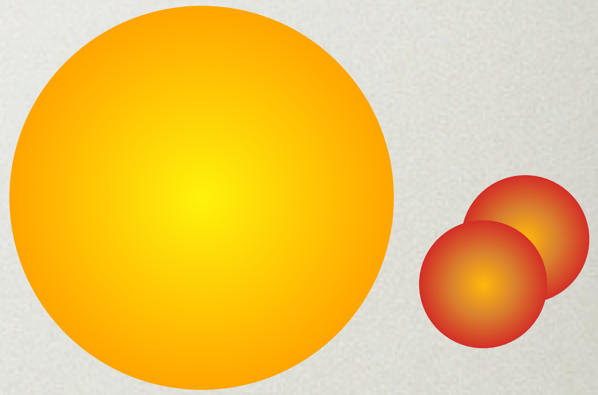
Outline

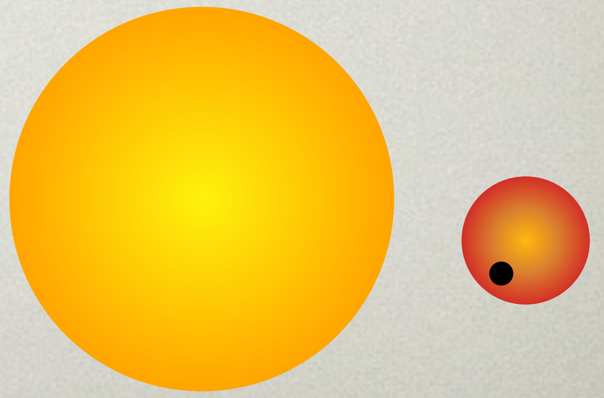
- Astrophysical false positives in transit surveys
- The *Kepler* false-positive rate
- False positives: from *Kepler* to *PLATO 2.0*
- Conclusion

Astrophysical false-positive scenarios

- Eclipsing binary (undiluted eclipse)
- Triple system (diluted eclipse)
- Companion transiting planet (diluted transit)
- Background eclipsing binary (diluted eclipse)
- Background transiting planet (diluted transit)
- *Eclipsing BD / WD*



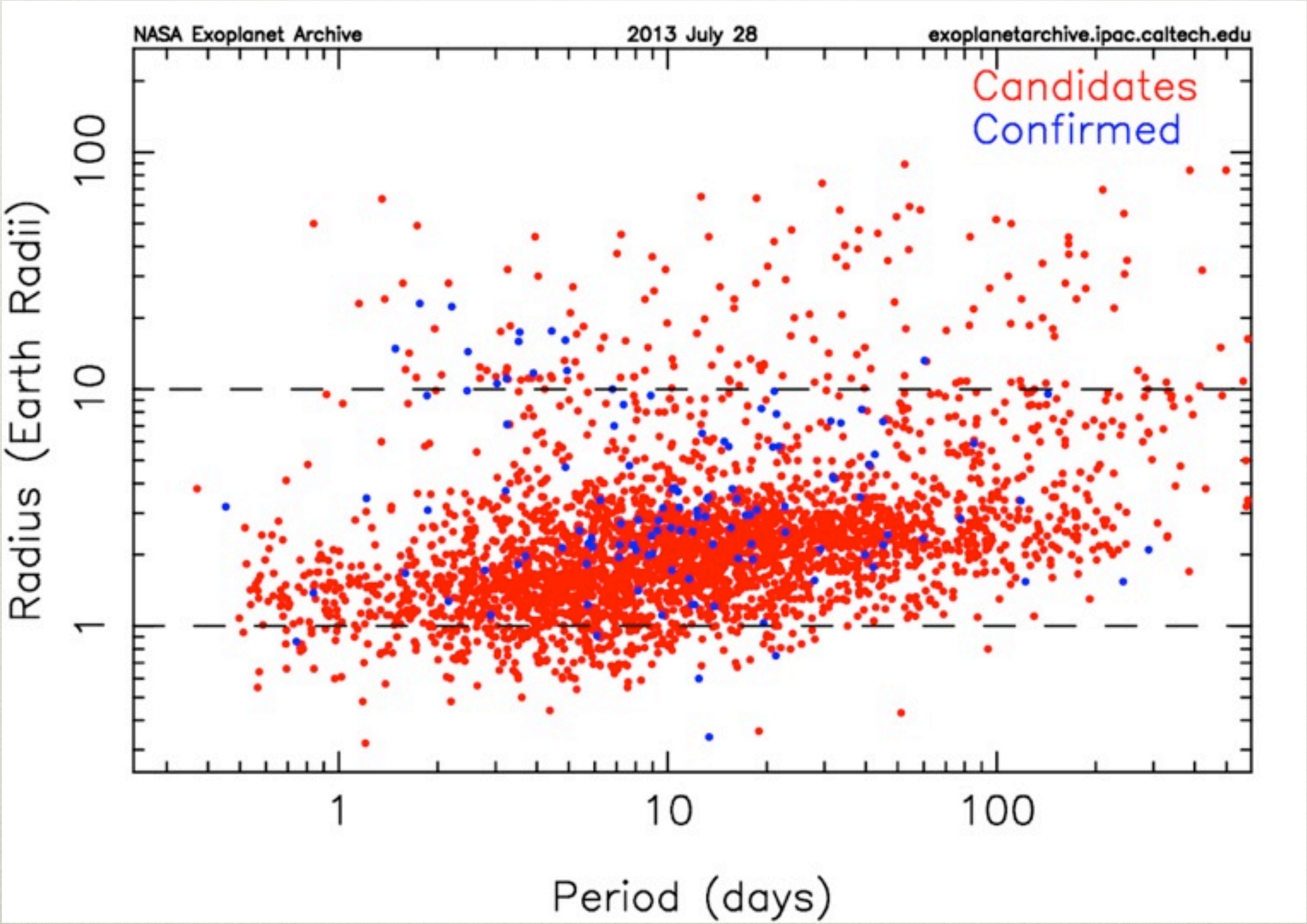




Theories of planetary formation, migration and evolution need observational guidance

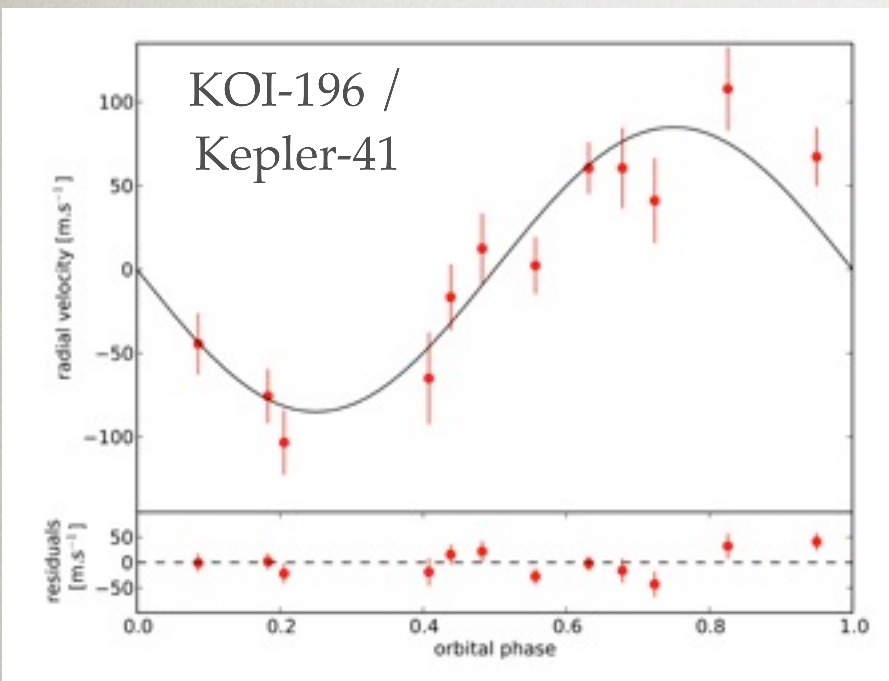
False positives can lead to wrong conclusions

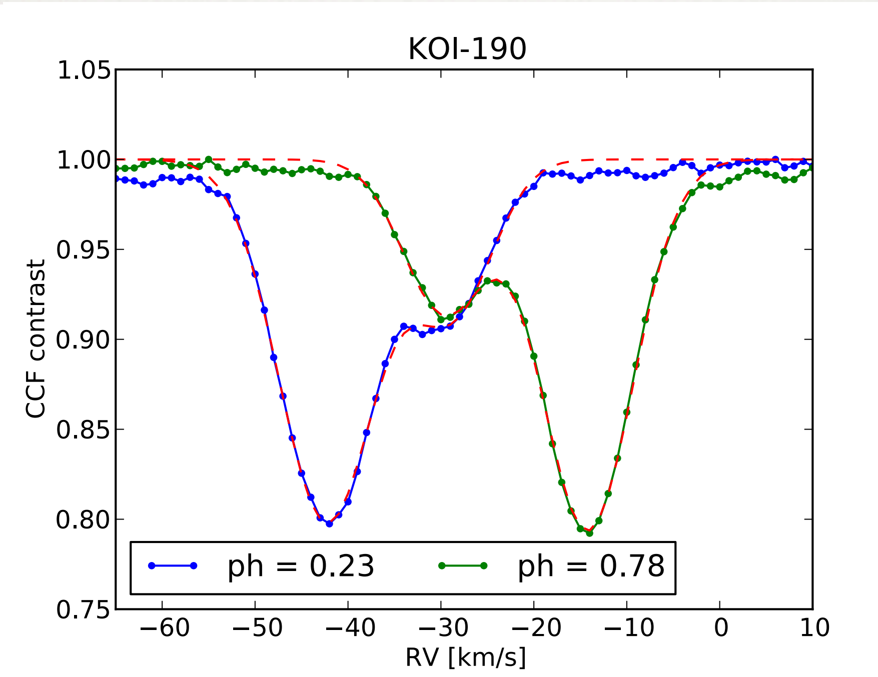
Where are the kepler planets ??

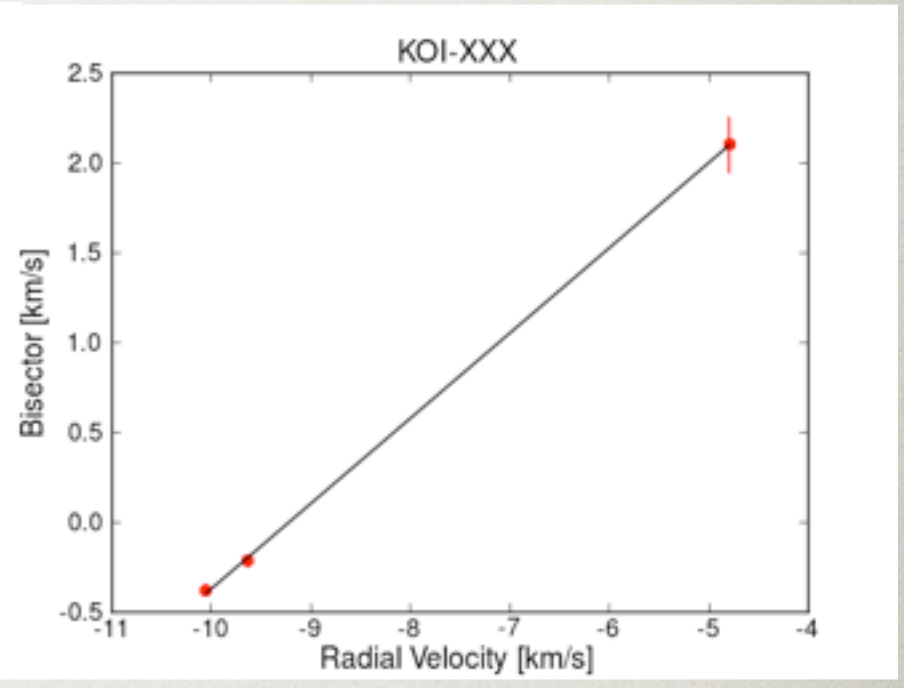


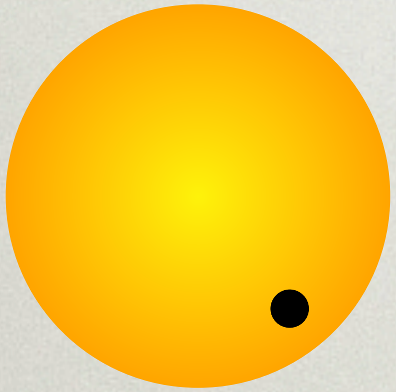
Radial velocity follow-up:
Unveiling the transiting candidates' nature

Kepler candidates followed up with the SOPHIE spectrograph:



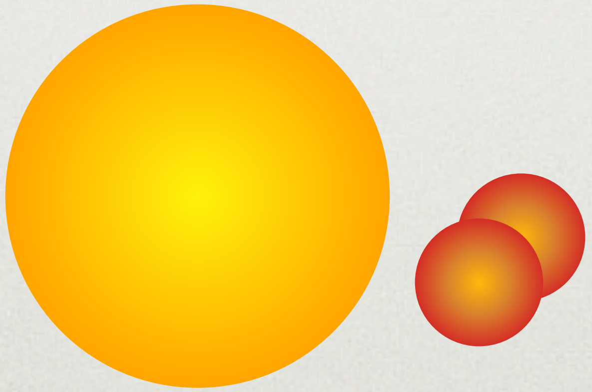






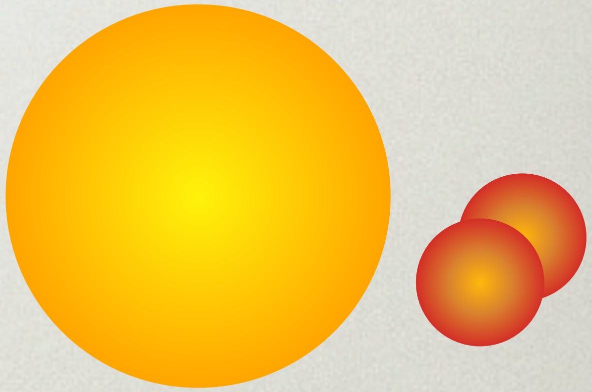
Planet

Santerne et al. (2011)



Triple system

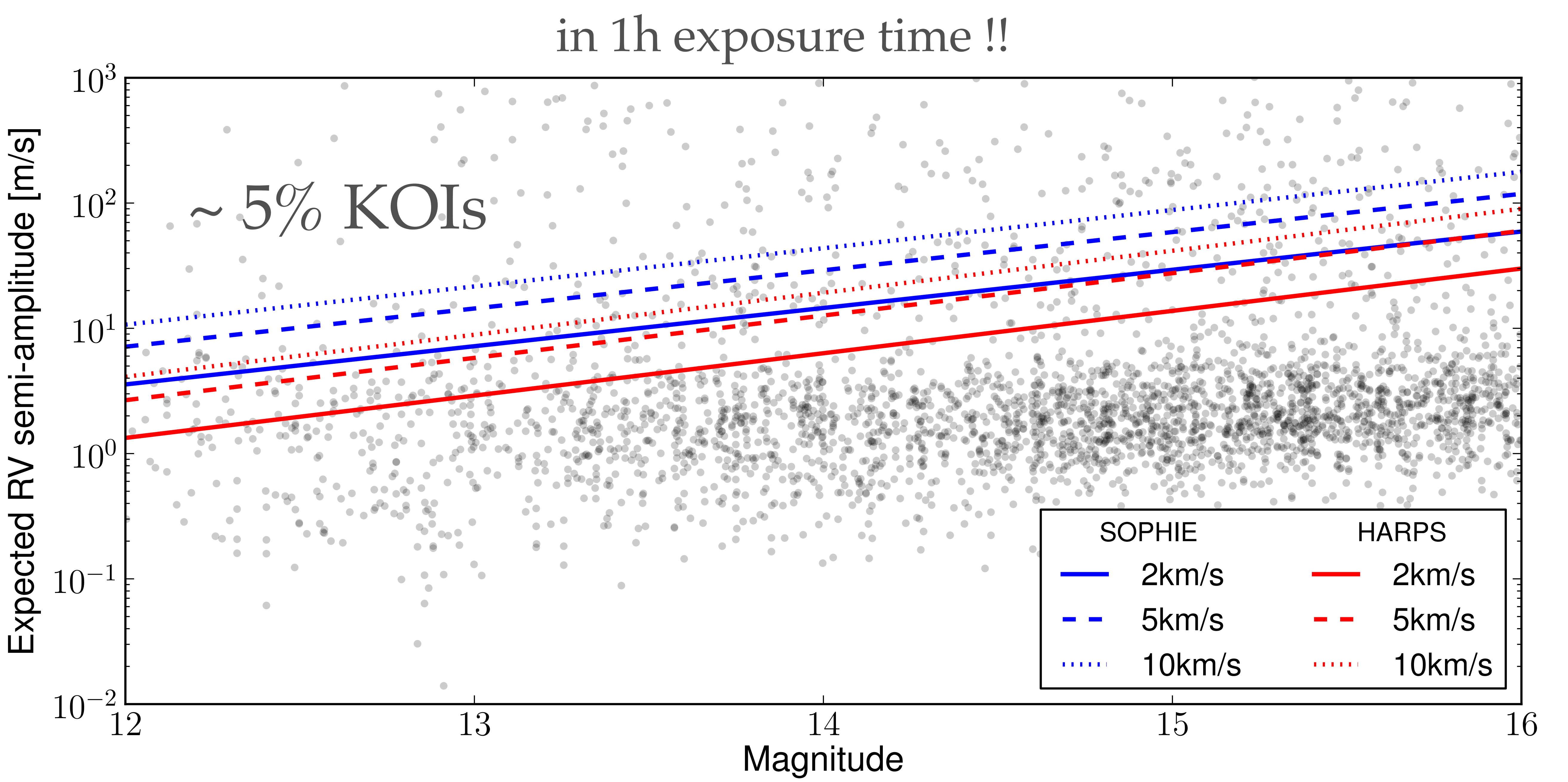
Santerne et al. (2012)



Triple system or BEB

Santerne et al. (in prep.)

Characterizing Kepler candidates



Planet-validation technique

PASTIS

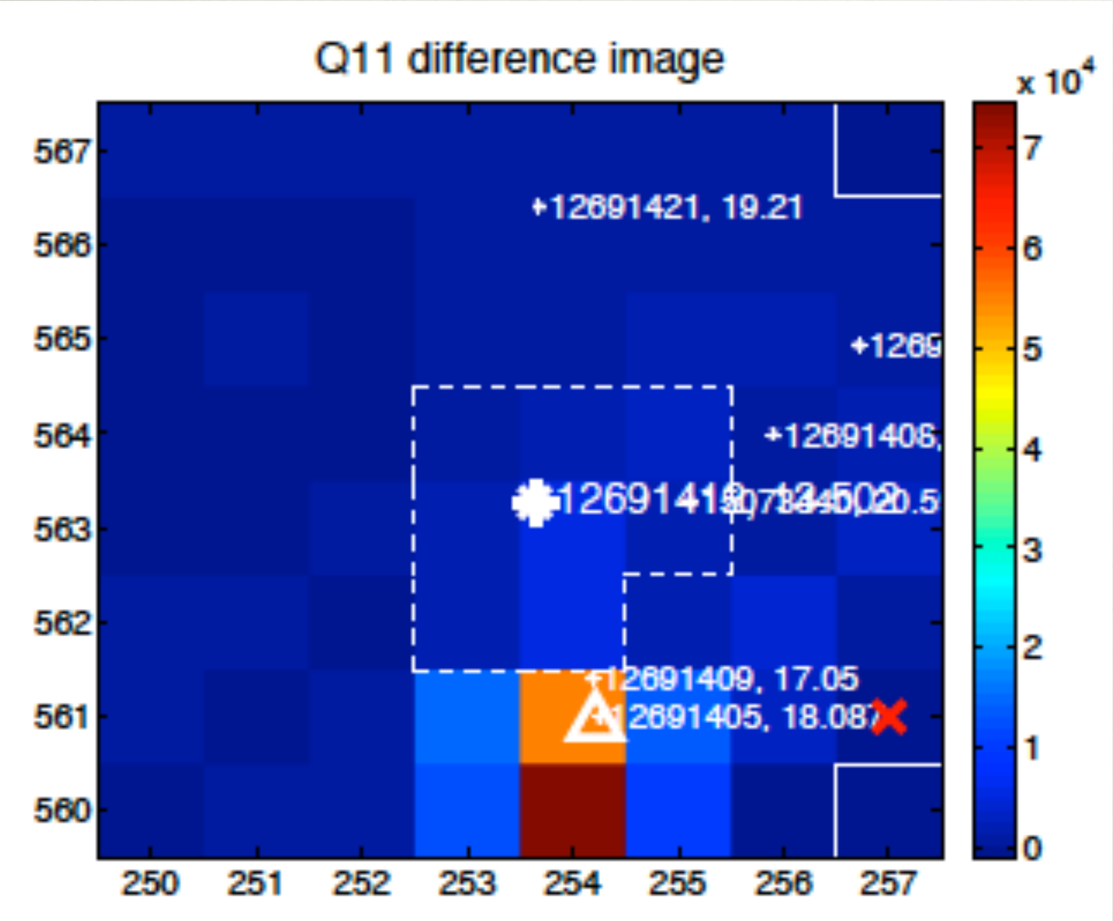
Planet Analysis & Small Transit Investigation Software

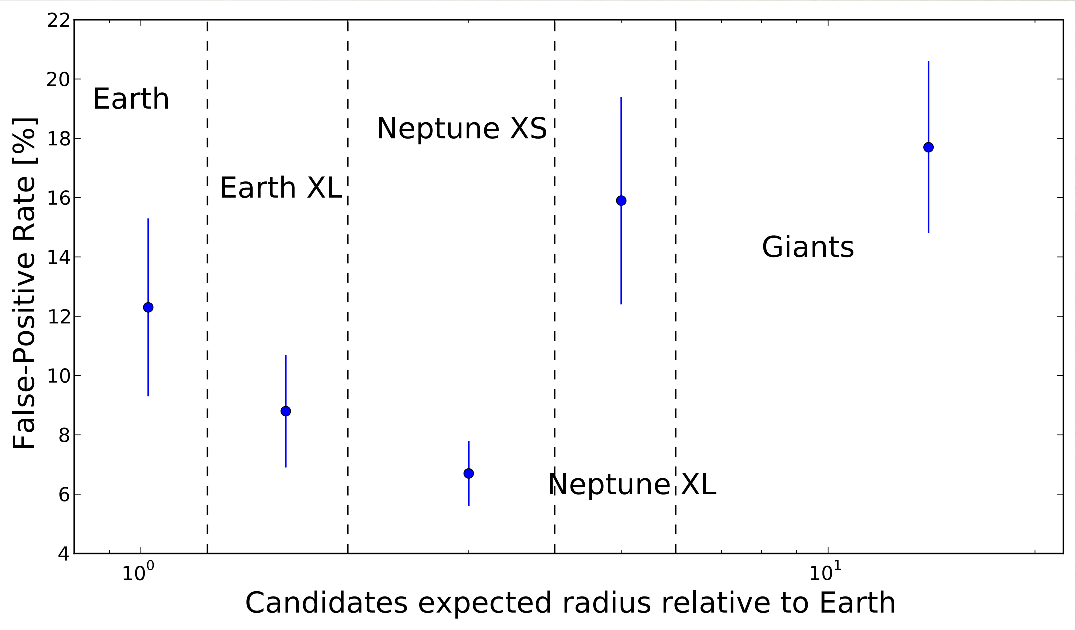
See Rodrigo Díaz's talk

tomorrow @ 9:30

The Kepler False-Positive rate

1. Morton & Johnson (2011): median FPP ~ 5% (modelisation)
2. Santerne et al. (2012a): 34.8±6.5% for giant close-in candidates (observations: SOPHIE data)
3. Fressin et al. (2013): global FPP 9.4±0.9% (modelisation)
4. Santerne et al. (2013): re-evaluation of Fressin's value to 11.3±1.1% (modelisation)

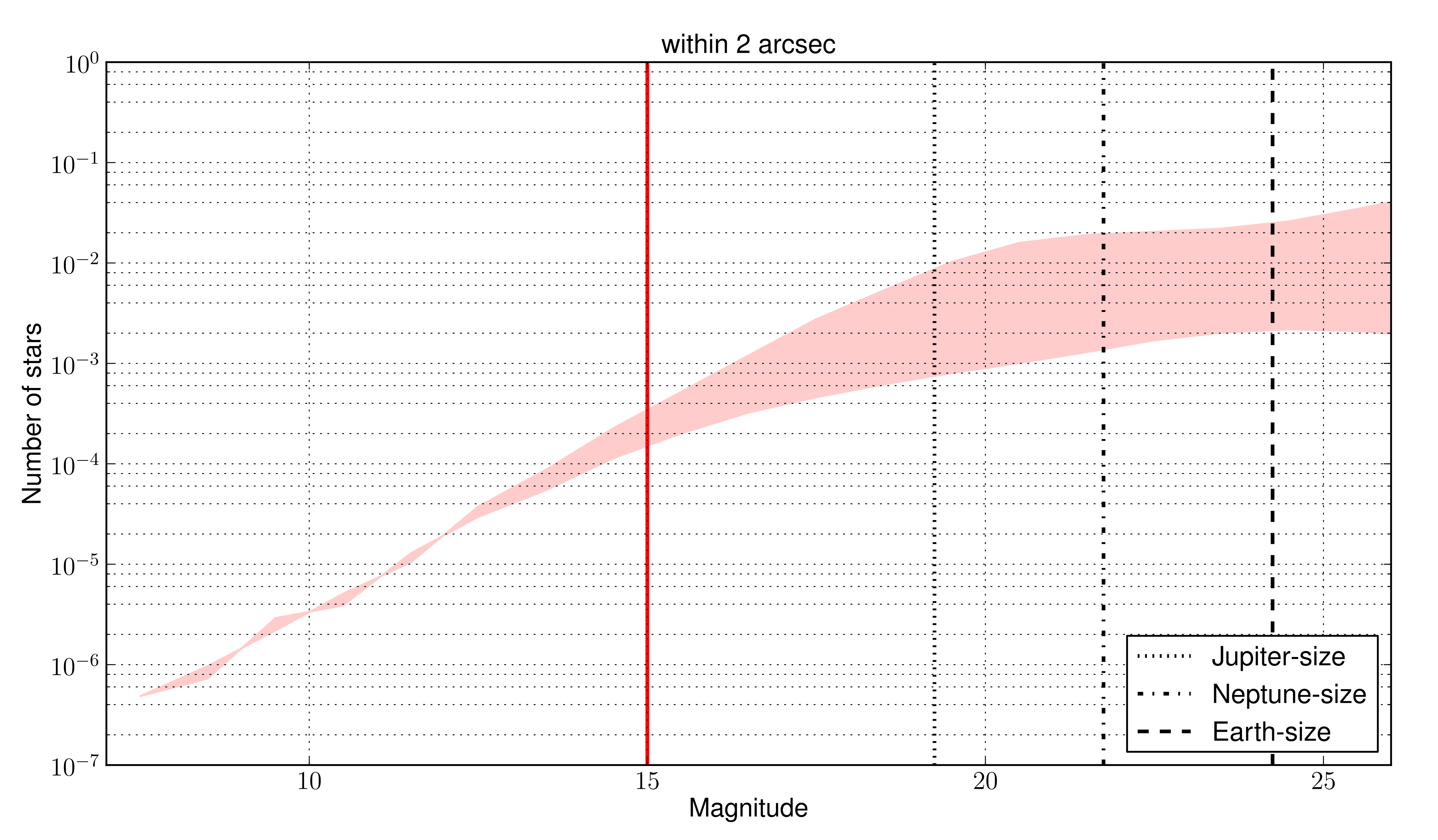




Main source of false-positives in *Kepler* field:

1. Companion transiting planets
2. Background transiting planets

Background stellar density

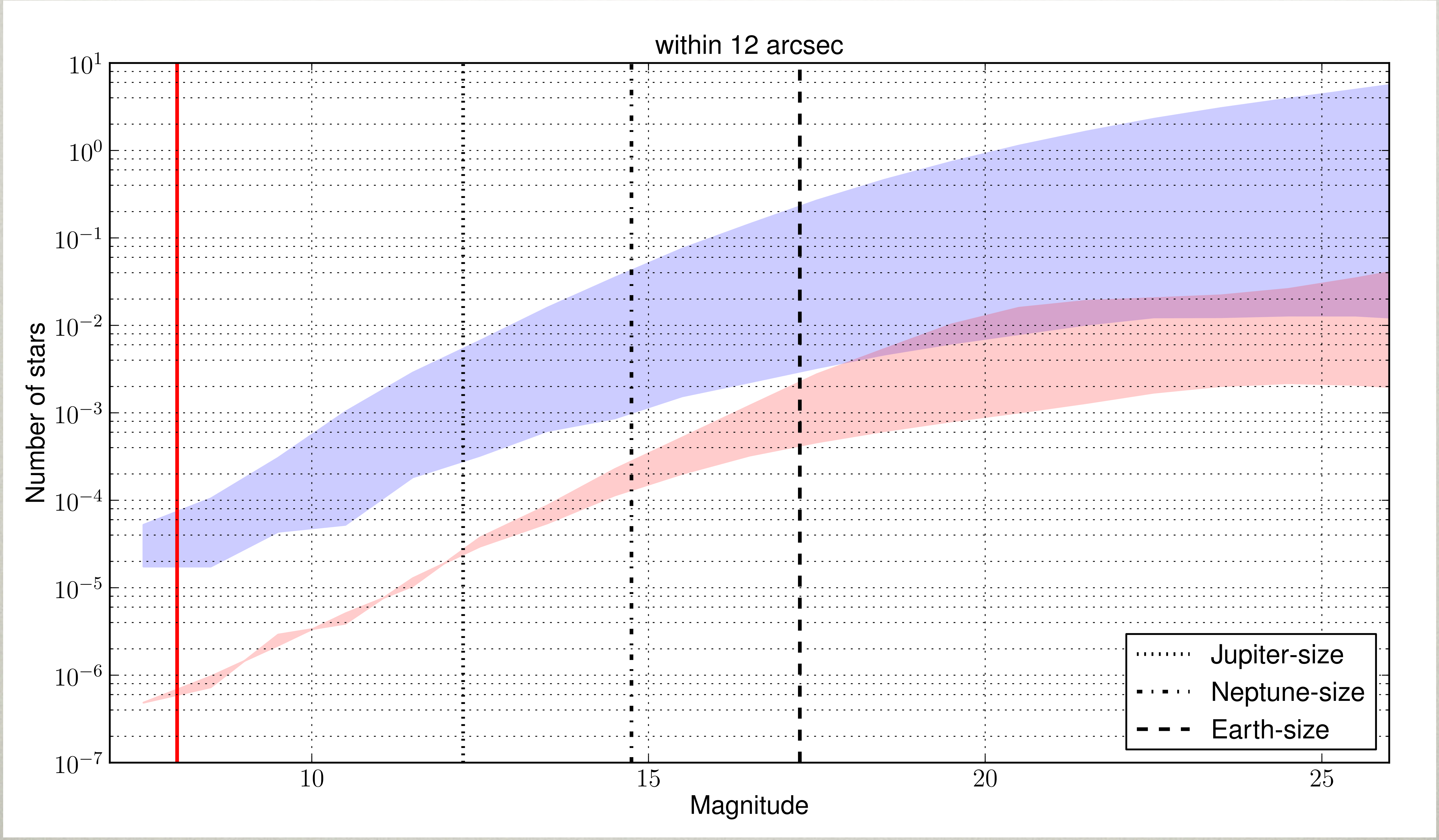


From Besançon Galactic Model

FROM KEPLER TO PLATO2.0

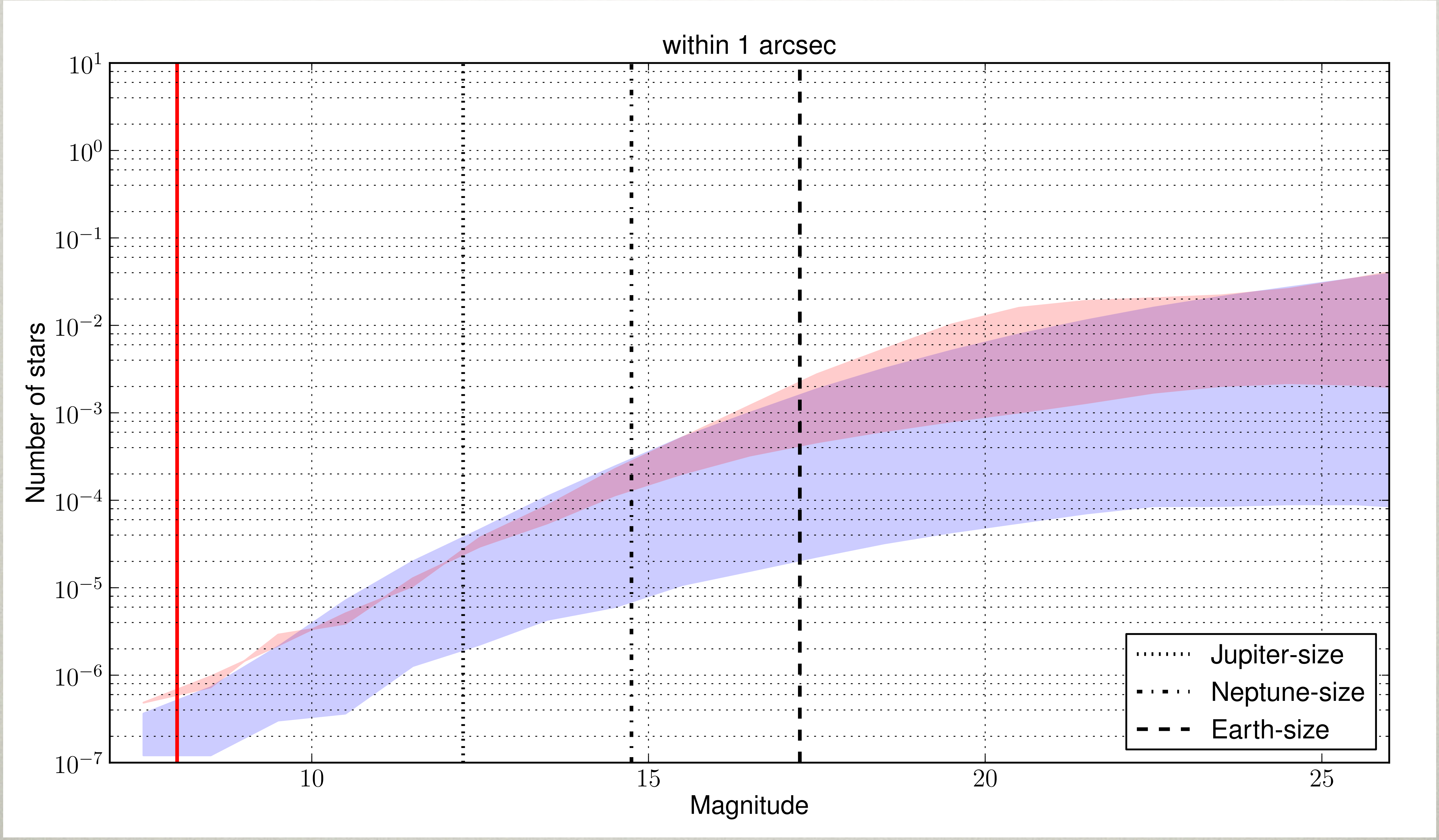
- Eclipsing binary ➙ same or less FP
- Triple system ➙ same or less FP
- Companion transiting planet
  ➙ same or more FP (?)
- Background eclipsing binary
  ➙ depends on background stellar density
- Background transiting planet
  ➙ depends on background stellar density

Background stellar density



 From Besançon Galactic Model

Background stellar density



From Besançon Galactic Model

Unveiling PLATO2.0 candidates' nature

- Eclipsing binary ➙ need RV
- Triple system ➙ need RV
- Transiting planet in binary ➙ need RV
- Background eclipsing binary ➙ need AO & RV
- Background transiting planet ➙ need AO & RV

CONCLUSION

- False positives are a classic nuisance in transit surveys & a limitation for statistics studies based on the candidates.
- Faint stars are difficult to follow-up with ground-based spectrographs
  ➙ need bright stars, need *PLATO* !
- Bright stars ➙ lower background stellar density **BUT** we need good centroid precision