PLATO week 9, Marseille, 9-11 October 2019

9-11 Oct 2019 Marseille (France)

LAST WEEK TO REGISTER !

REGISTRATION (SHARP) DEADLINE: SEPTEMBER 30

https://platoweek9.sciencesconf.org/

JOB ANNOUNCEMENT @ LAM / MARSEILLE

Aim: work on high-precision photometric data catalogs
for the PLATO Input Catalog

Contacts: Magali Deleuil & Alexandre Santerne

PLATO Input Catalog Workshop - Padova - 25 September 2019

FALSE POSITIVES:

WHAT CAN BE DONE FOR THE PIC ?

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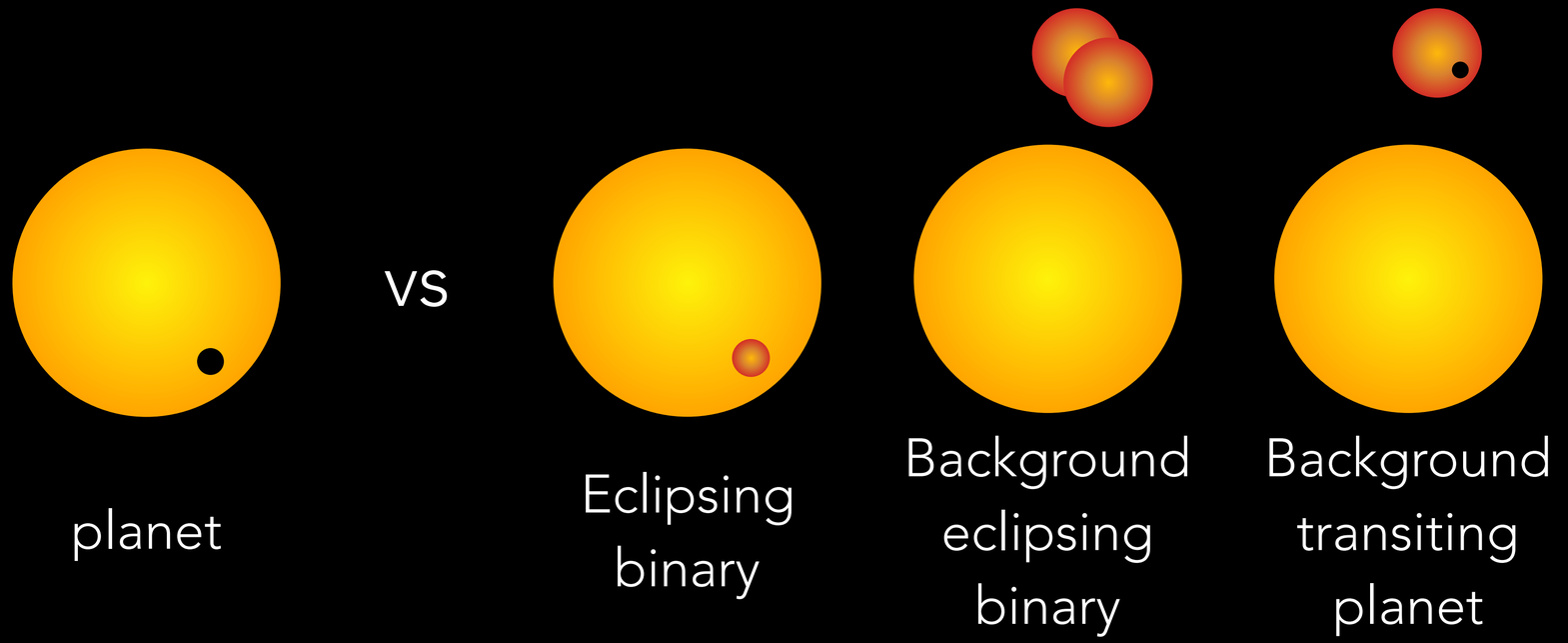
AIX-MARSEILLE UNIVERSITY
ALEXANDRE.SANTERNE@LAM.FR

THE PLANET-VALIDATION TECHNIQUE

$$\frac{\textit{Probability of being a planet}}{\textit{Probability of being a false positive}} << 1$$



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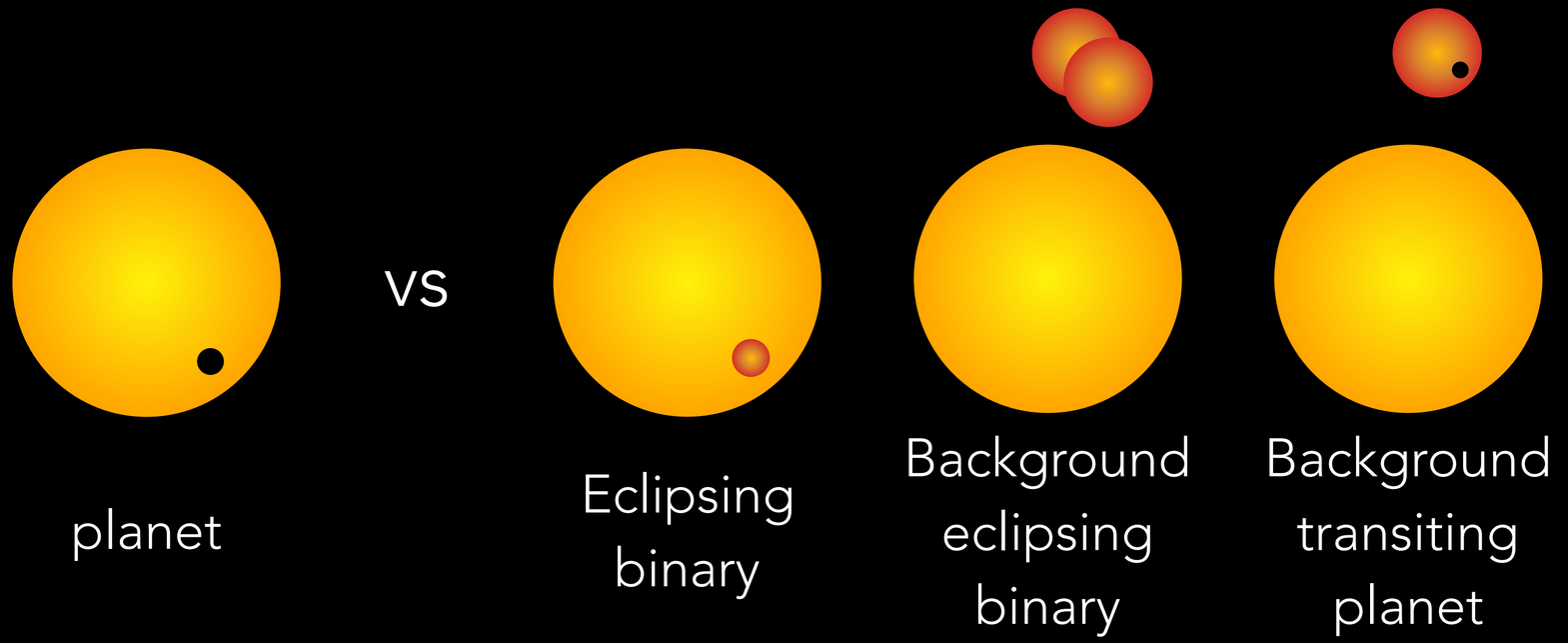

<u>Needed for:</u>

- P1: exoplanet ranking to avoid wasting FUp - RV ressources
- P5: scientifically exploit the sample and derive unbiased occurrence rates

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$$\frac{p\left(S_{planet}|D,I\right)}{p\left(S_{FP_1}|D,I\right)+p\left(S_{FP_2}|D,I\right)+\cdots+p\left(S_{FP_n}|D,I\right)} \ll 1$$

S: SCENARIO
D: DATA
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$$\frac{p\left(S_{FP_1}|D,I\right)}{p\left(S_{planet}|D,I\right)}=\frac{p\left(S_{FP_1}|I\right)}{p\left(S_{planet}|I\right)}\times\frac{p\left(D|S_{FP_1},I\right)}{p\left(D|S_{planet},I\right)}$$

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NO PLATO DATA !
➠ PIC

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THE *A-PRIORI* FALSE-POSITIVE PROBABILITY (I)

$$FPP^{-1}_{(a\ priori)} = \sum_i \frac{p\left(\mathcal{S}_{FP_i}|\mathcal{I}\right)}{p\left(\mathcal{S}_{planet}|\mathcal{I}\right)}$$

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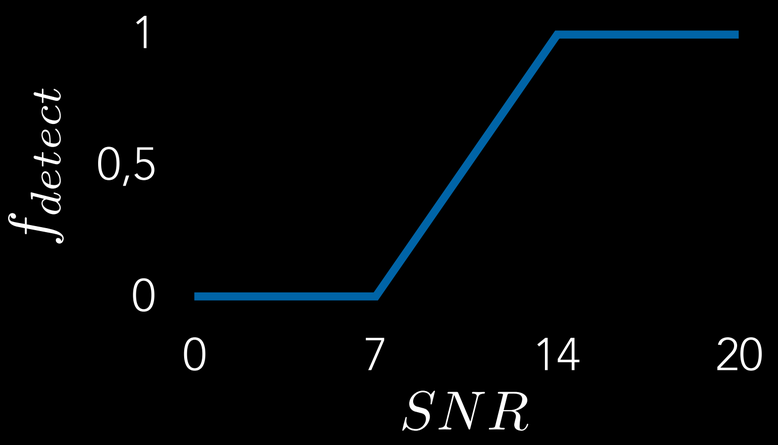

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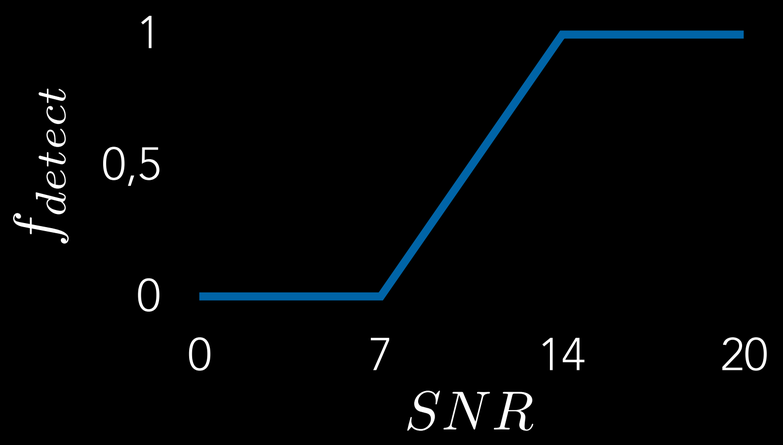

$$SNR = \frac{\delta\left(R_\star, r_p\right)}{\sigma} \times \frac{f^{\Pi}_\star(P)}{f^{\Pi}_{tot}(P)} \times \sqrt{N_t\left(a, e, R_\star, r_p\right)}$$

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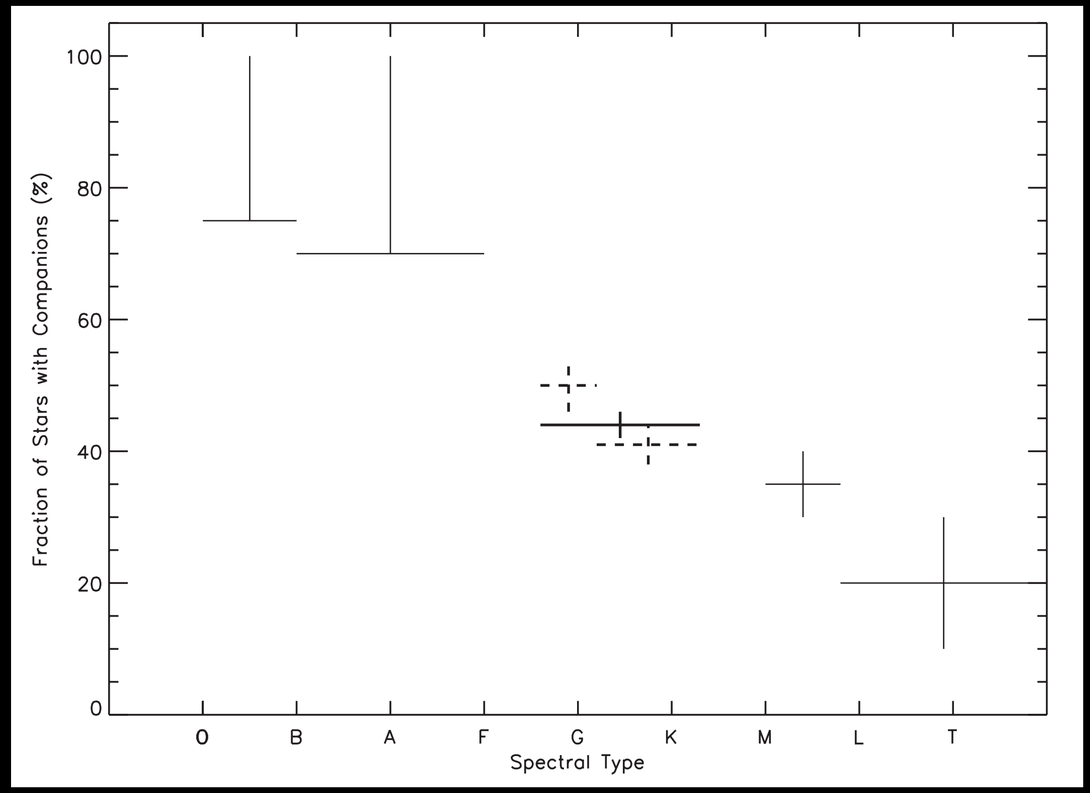

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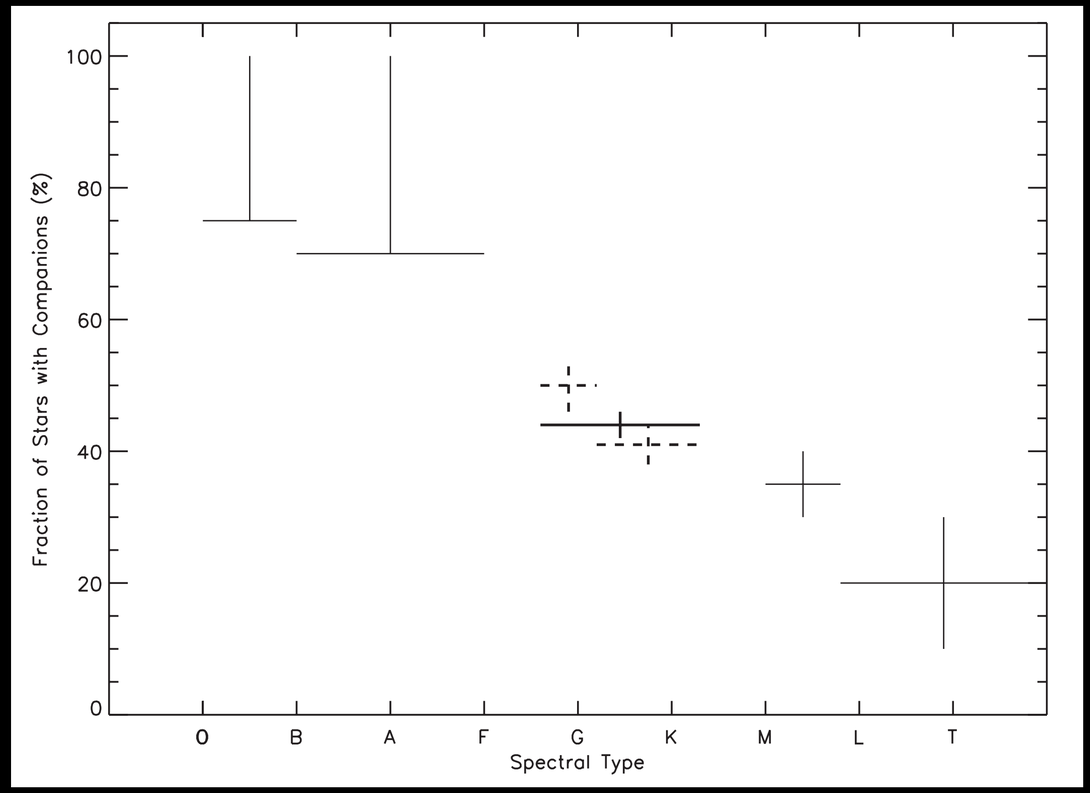

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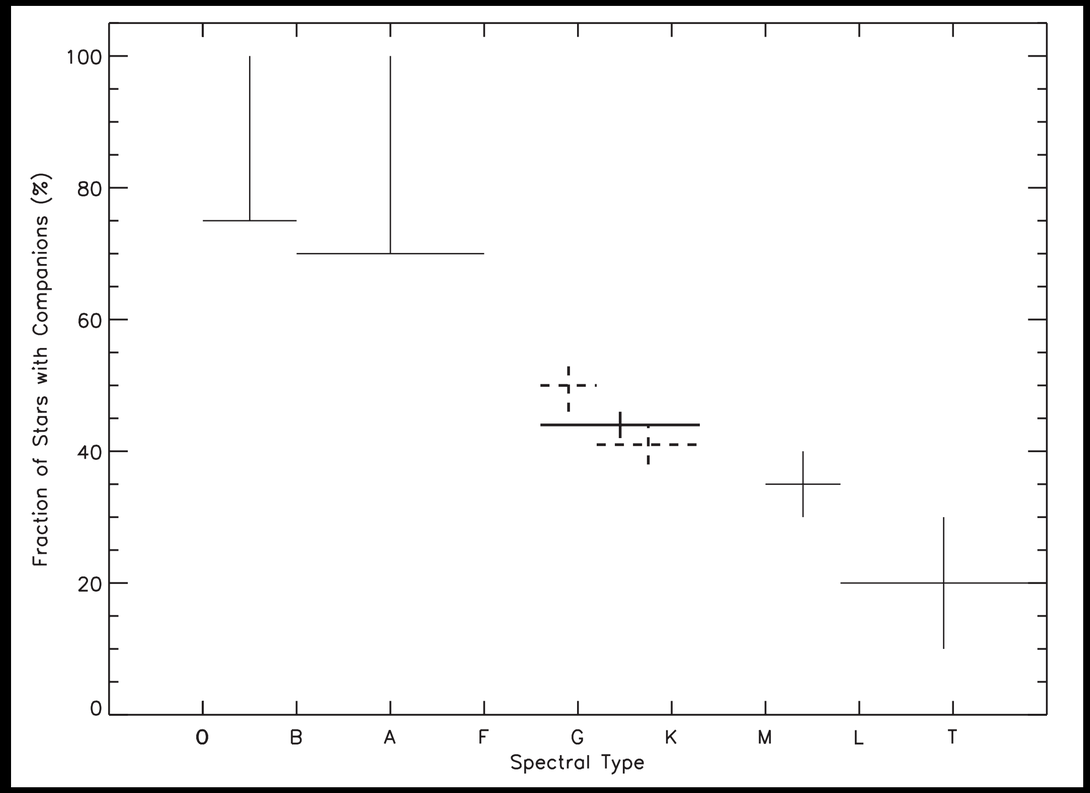
$\mathcal{O}_{EB} = 33 \pm 2\%$ (Raghavan et al., 2010)



BACKGROUND PROBABILITY

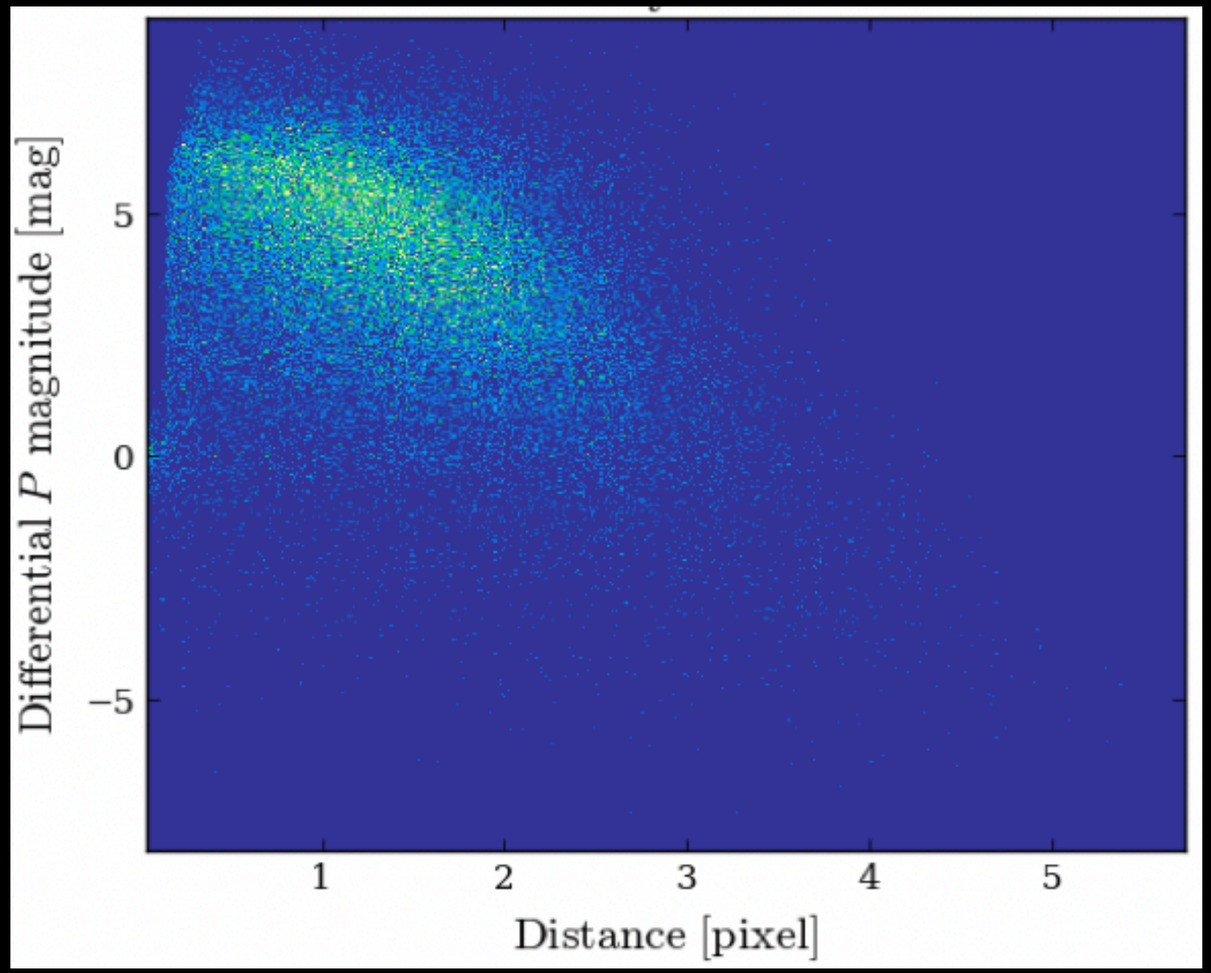
50k targets = 3M contaminants

(Marchiori PhD's thesis, based on Gaia DR2)

For most targets:

$$p_{BG} \approx 1$$

Contaminants that can mimic a 1Re planet



Marchiori et al. (2019)

THE *A-PRIORI* FALSE-POSITIVE PROBABILITY (II BIS)

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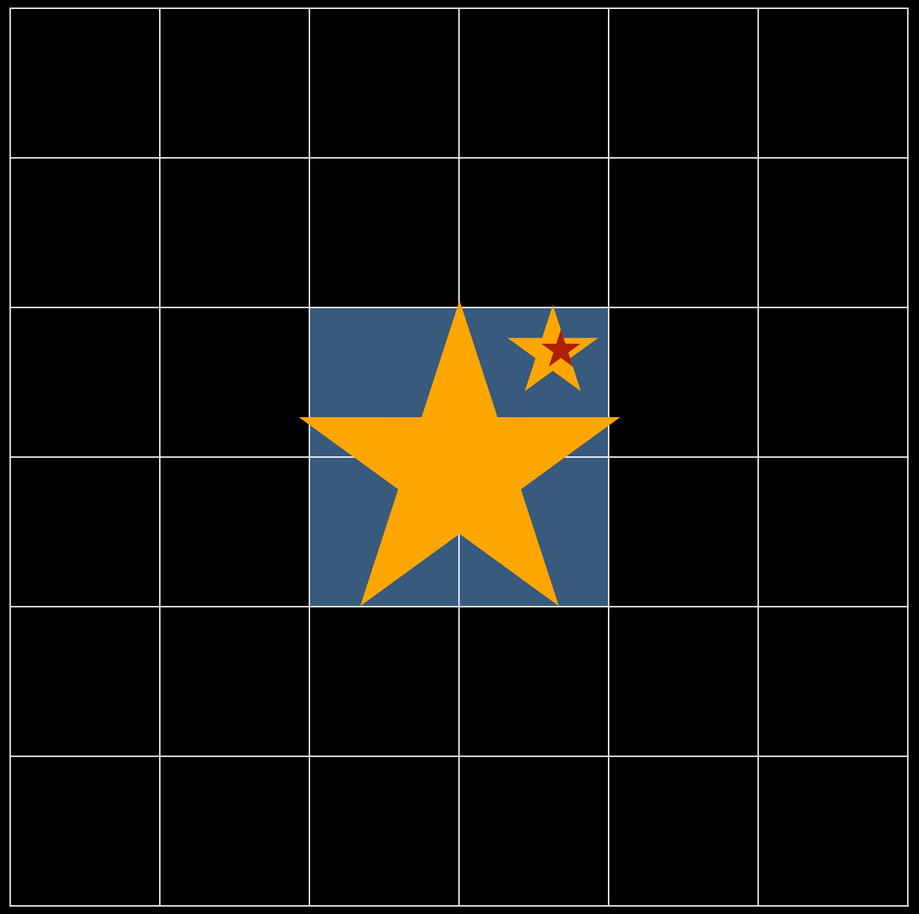
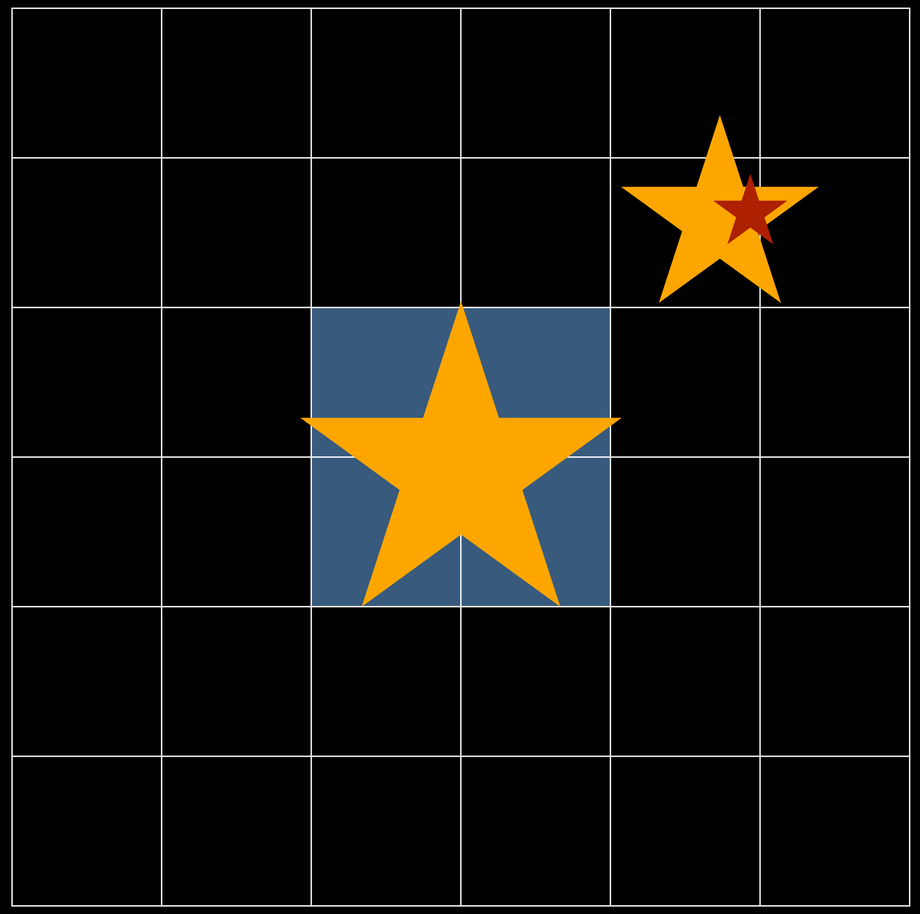
$$SNR = \frac{\delta\left(R_1, R_2\right)}{\sigma} \times \frac{f^{\Pi}_{BEB}(P)}{f^{\Pi}_{tot}(P)} \times \sqrt{N_t\left(a, e, R_1, R_2\right)}$$

SENSITIVITY TO REJECT FALSE POSITIVES (P5)

Faint CoB signal



Large CoB signal



Same contamination but different FPP

THE *A PRIORI* FALSE-POSITIVE PROBABILITY (III)

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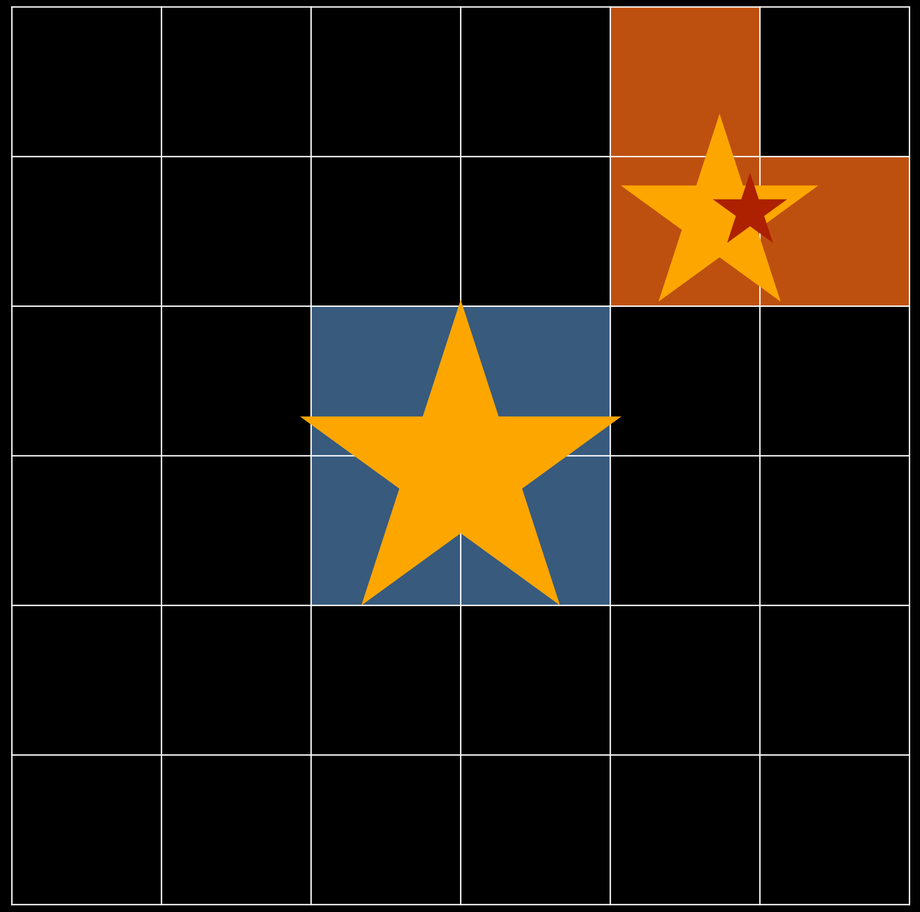
THE *A PRIORI* FALSE-POSITIVE PROBABILITY (III)

$$p(\mathcal{S}_{BEB}|I) = \mathcal{O}_{EB} \times p_{BG} \times p_{eclipse} \times p_{detect} \times (1 - p_{reject})$$

p_{reject} depends on the method used:

- Center of Brightness (CoB = centroids)
- Double Aperture Photometry

Need to be investigated…



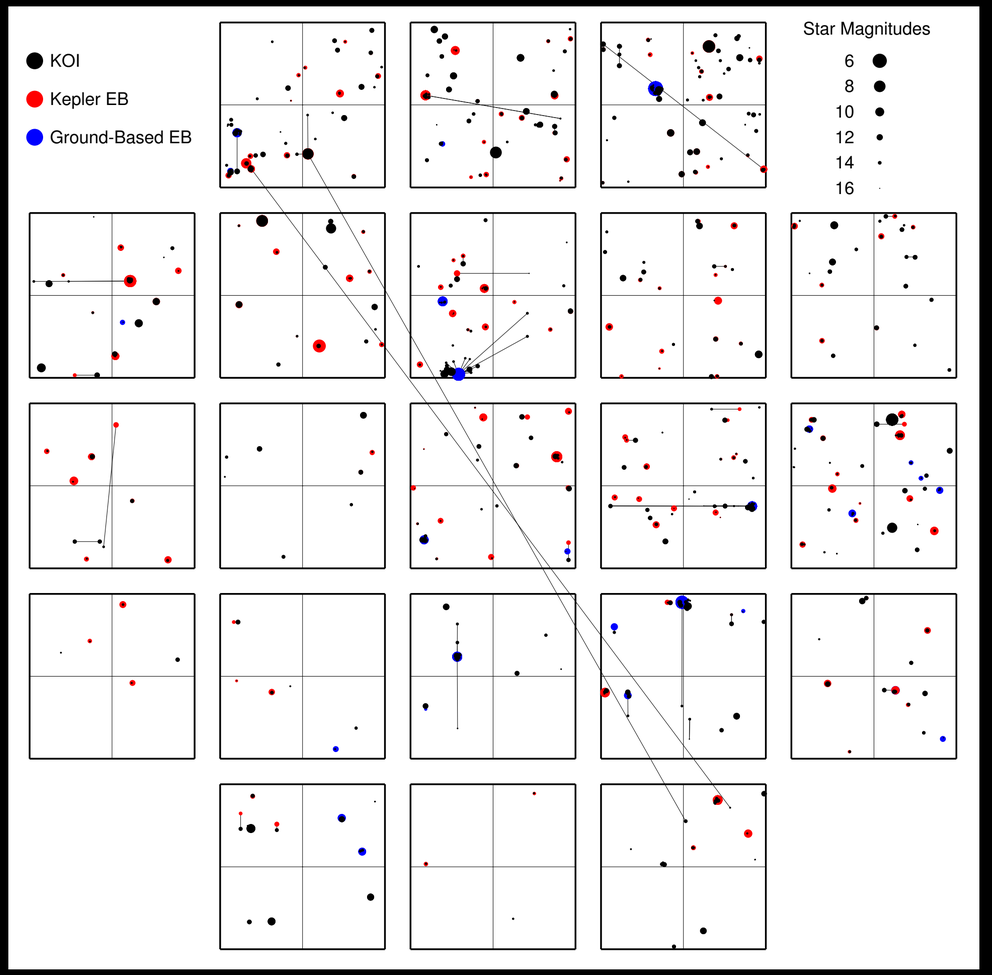
CONCLUSIONS / TAKE-HOME MESSAGES

- For every PLATO potential target, we can compute its *a-priori* FPP
- *a-priori* FPP is more informative than contamination to select targets, which is specially important for the P5 sample
- Need to work on at the target-by-target level
- Gaia has all what we need (even if distance >1”), forget galactic models
- PIC should include all known objects within (and close) to the PLATO fields
- *a-priori FPP* will then be used by the WP366 for planet validation / ranking to feed FUp (cf Stephane’s talks tomorrow) + the occurrence rate analysis of the P5 sample

A FEW KEPLER EXAMPLES ...

- During Q0 + Q1, an unknown EB was used as guide star
  ➠ all stars have systematics during the transit events !

- Ground-based (bright) EB mimicking KOIs
  (cf Coughlin et al. 2014)



Coughlin et al. 2014