False positives in the Corot transiting planet search

Goal: estimate the amount of ground-based observations necessary for the Corot ground-based follow-up to pick up transiting planets

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False positives in photometric transit surveys:

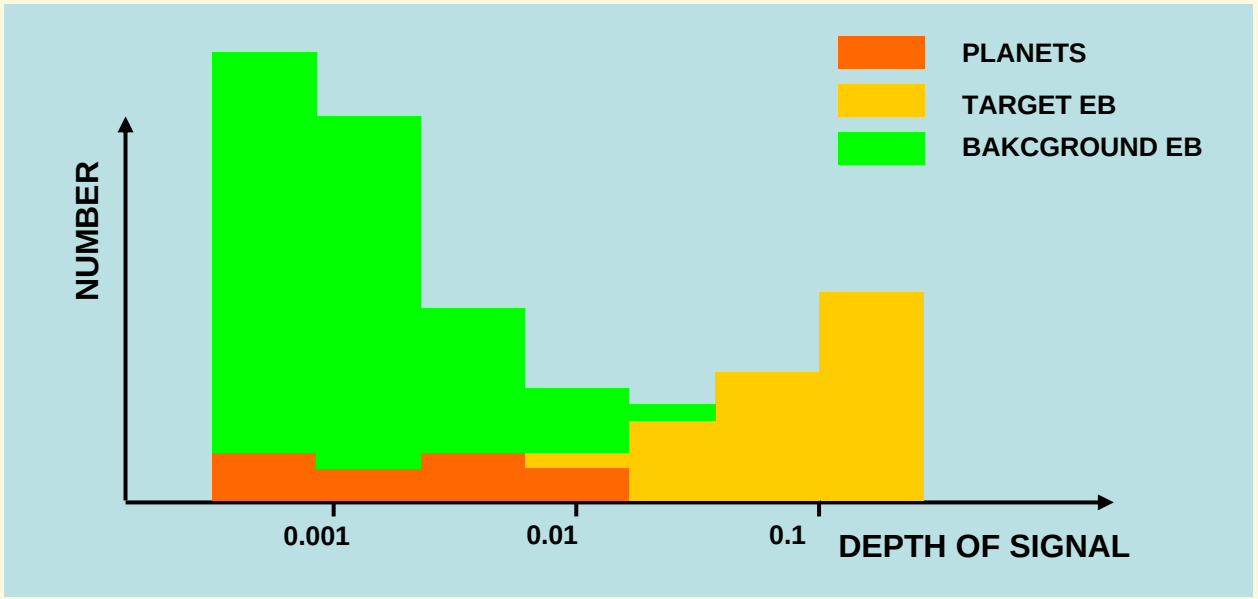
contaminants much more frequent than planets
transiting stellar companion / background eclipsing binary / triple systems / variability

OGLE survey : 5 planets for 137 transit candidates (~half of them convincing)

all other surveys : 2 planets for 50++ candidates

$\Rightarrow$ large follow-up effort

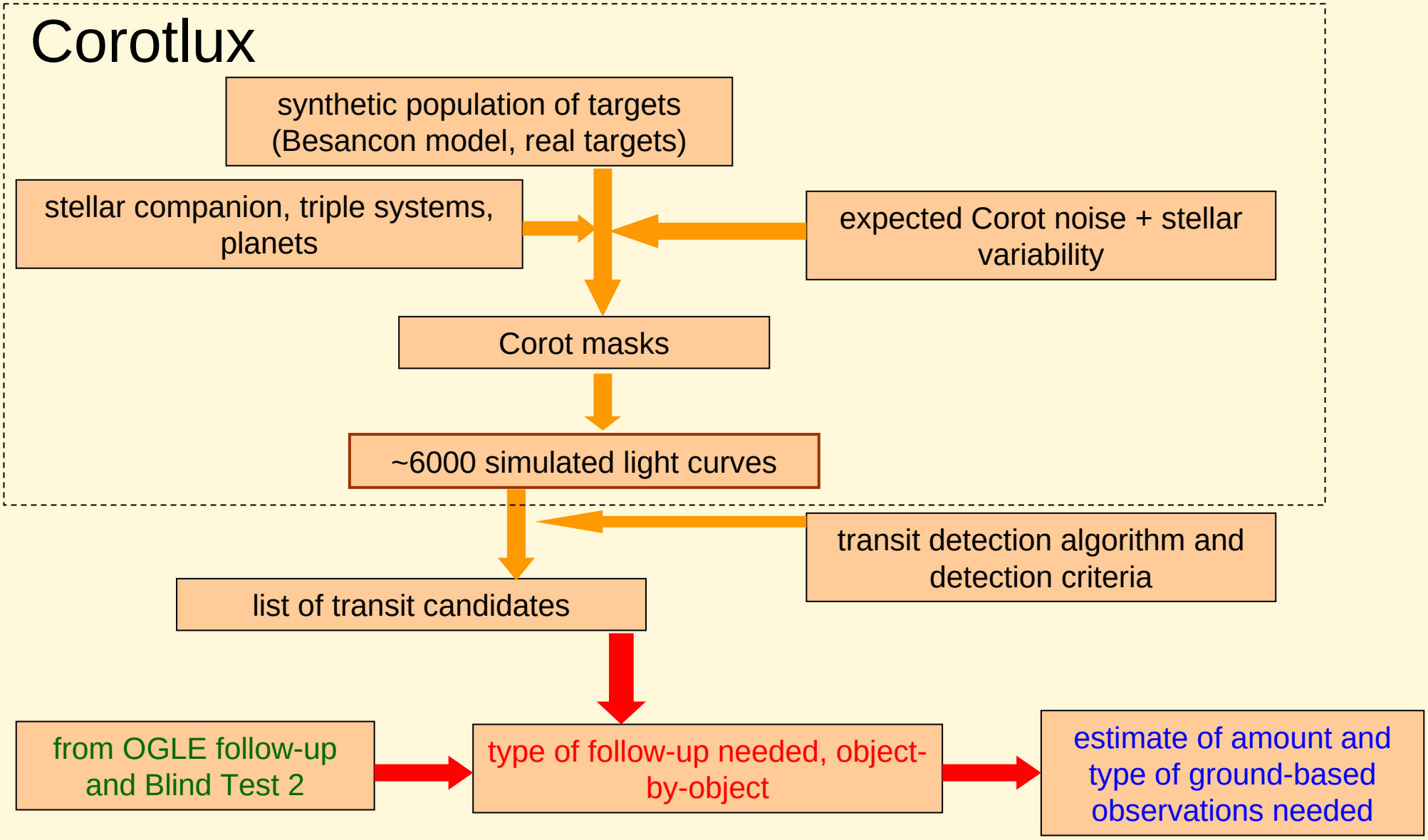
Astrophysical false positives in COROT



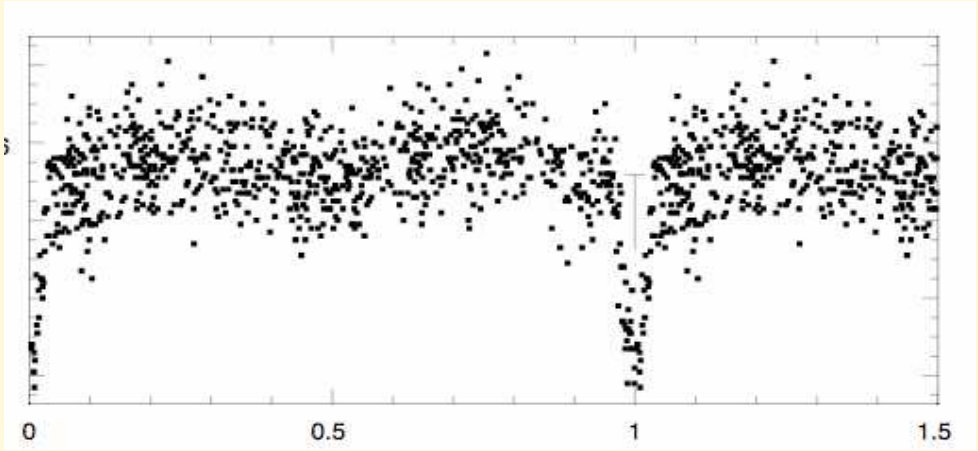
Initial « COROTLUX » simulations ⇒ **80 - 120 transit/eclipse detections per 6-month campains**

end-to-end simulator for the Corot planetary transit search

T. Guillot, F. Pont, F. Fressin, M. Marmier


Corotlux
synthetic population of targets (Besancon model, real targets)
stellar companion, triple systems, planets
expected Corot noise + stellar variability
Corot masks
~6000 simulated light curves
transit detection algorithm and detection criteria
list of transit candidates
from OGLE follow-up and Blind Test 2
type of follow-up needed, object-by-object
estimate of amount and type of ground-based observations needed

False positive identification from the COROT lightcurves



from experience with OGLE follow-up

from Corot Blind Test 2 analysis by the IAC team (Hans Deeg et al.)

Results

[*anticenter field, for 150-day campaign, high detection threshold*]

Draw	Planets	Identifiable binaries	Background impostor	Target impostor
1	6	62	14	8
2	7	67	11	2
3	6	60	10	6

Identifiable binaries: *can be told apart from lightcurve + exodat only*

Background impostor: *eclipsing companion not on the Corot target*

Target impostor: *eclipsing companion on the Corot target*

Results

[*anticenter field, for 150-day campaign, high detection threshold*]

70 - 90 detected *candidates* (incl. very deep eclipsing binaries)

the majority (**~4/5**) can be dismissed by a close examination of the light curve

(mainly secondary eclipses, also transit shape and duration, sinusoidal modulations)

16-32 « planetary » candidates for the follow-up

6 - 20 background impostors ← cleared by follow-up photometry

1 - 10 target impostors ← cleared by follow-up spectroscopy

5 - 15 planets and unsolved systems

Comments

-number of objects manageable with the observation means of the follow-up team (at least in the anticenter field)

- more cases clearable by photometric follow-up (~half) than by two-VR spectroscopy

- relatively high number of follow-up targets (up to half) that cannot be cleared by first screening (in-out transit photometry + 2 VR points) and require many VR measurements -!-

Going nearer to the threshold?

Supposing we accept candidates until the point were we get as many false positives are bona fide transits/eclipse

(aiming for more planets and smaller planets)

Separation between « secure » and « low » threshold modeled on OGLE and Pont&Zucker (2006) detection model.

Draw	Planets	Identifiable binaries	Background impostor	Target impostor	**False positives**
1	0	0	4	1	**5**
2	2	1	5	1	**7**
3	2	0	4	0	**4**

False positives: *detection due to activity or measurement noise. No real transit or eclipse signal.*

Going nearer to the threshold?

10 -20 additional candidates

[80 - 100]

very few can be dismissed from the light curve only (too low SNR)

1/3 number of planets compared to high-SNR part (*mass bias not so strong*)

10 - 20 « planetary » transit candidates

[30 - 50]

4 - 10 background impostors

[15 - 25]

follow-up photometry

0 - 1 target impostors

[1 - 10]

follow-up spectroscopy

8 - 16 planets and unsolved systems

[15 - 30]

Comments (2)

- working in the « gray zone » is difficult and potentially very expensive in ground-based follow-up time

- first screening (in-out transit photometry + 2 VR points) not very useful

- must think carefully before embarking on follow-up of low-SNR candidates. Low return-to-investment compared to high-SNR candidates