Jet Propulsion Laboratory
California Institute of Technology

An Analysis and Implications of Kepler's Photometric Uncertainties

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8 October 2013

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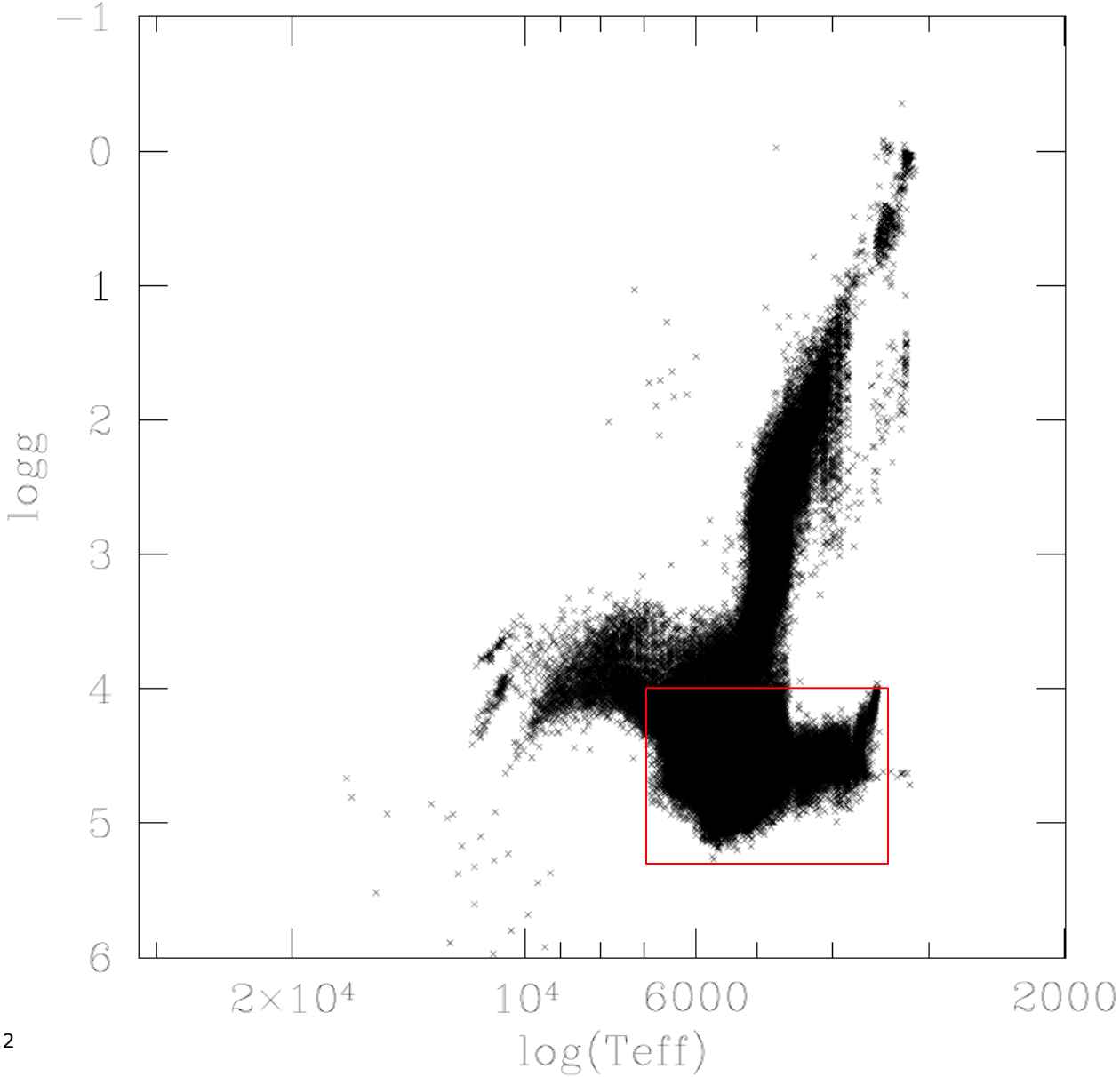
Goal: Understand the limits of Kepler observations

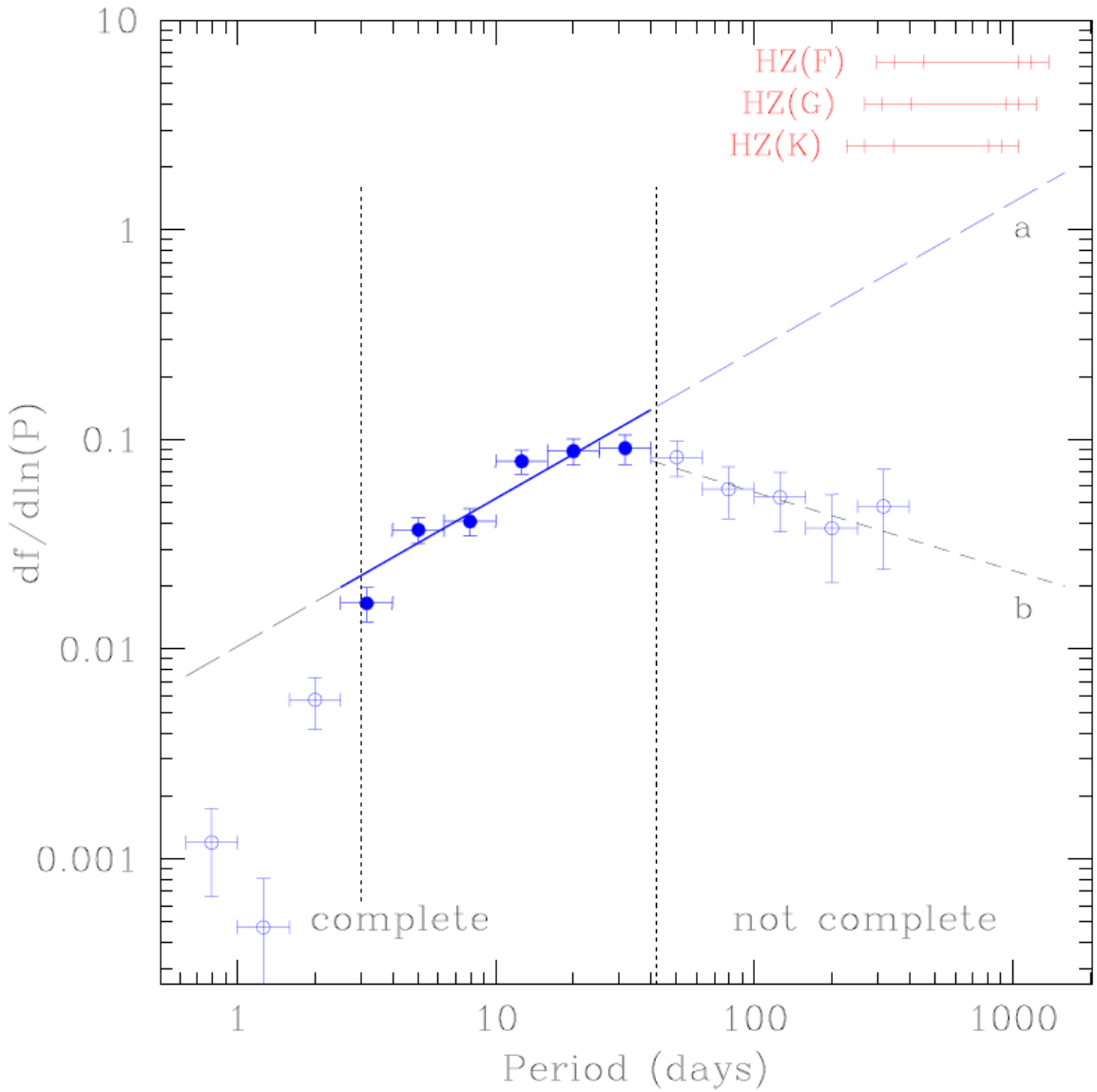
- Photometric uncertainty prevents Kepler from being able to detect **small** planets, with **long** periods, as they transit **faint** stars
- This paper aims to quantify this effect
- With the “missing” data quantified, we have a better chance of modeling the distributions of planets, with radius and period, and thereby extrapolating to estimate eta-sub-Earth

Select 3200-7000K, log g > 4.0

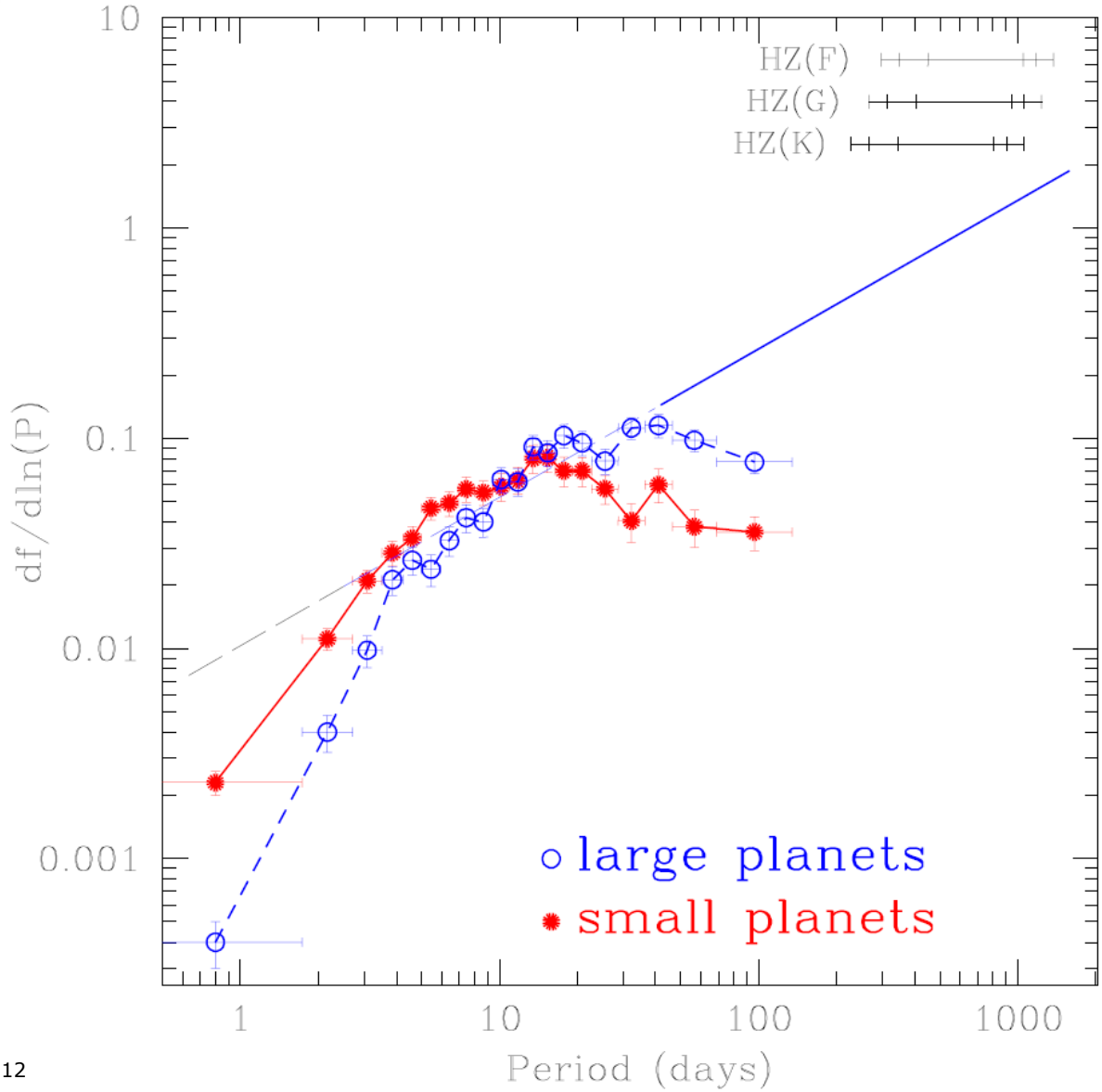


tgr_0_291 4/15/2012

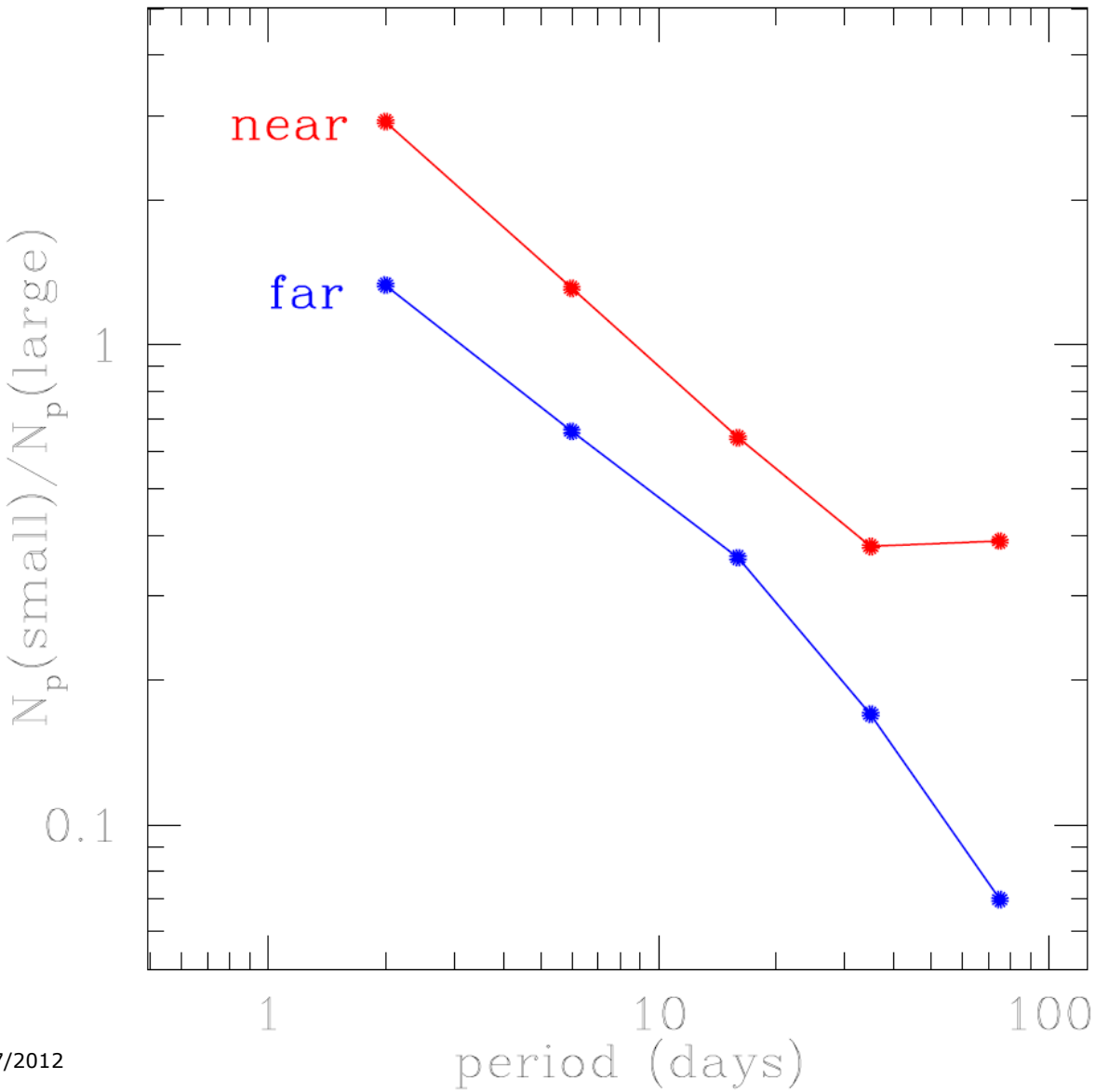
Basis of Previous $\eta_{\oplus}$ Estimate



Strong bias for P > 30 days

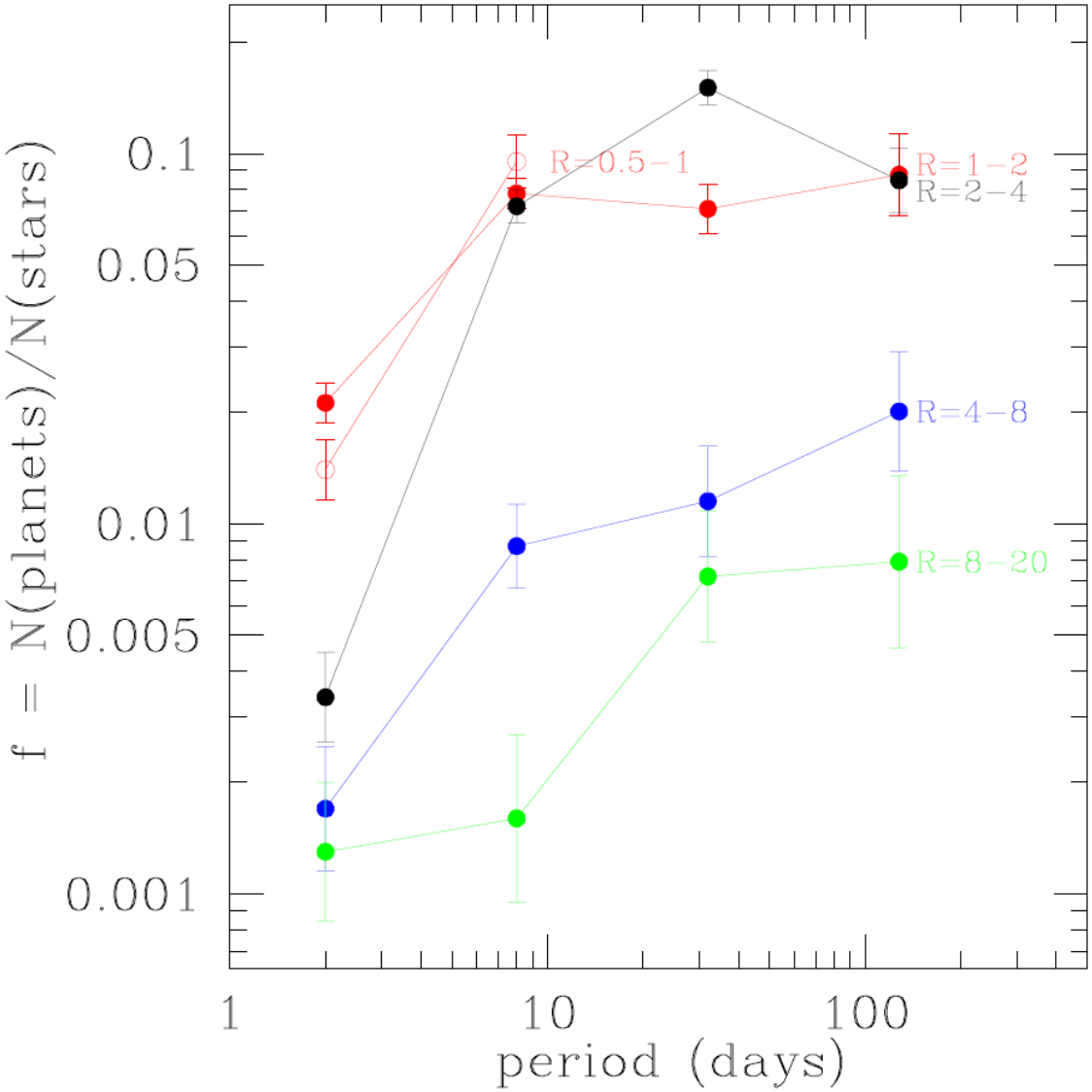


Indication of a detection bias with distance



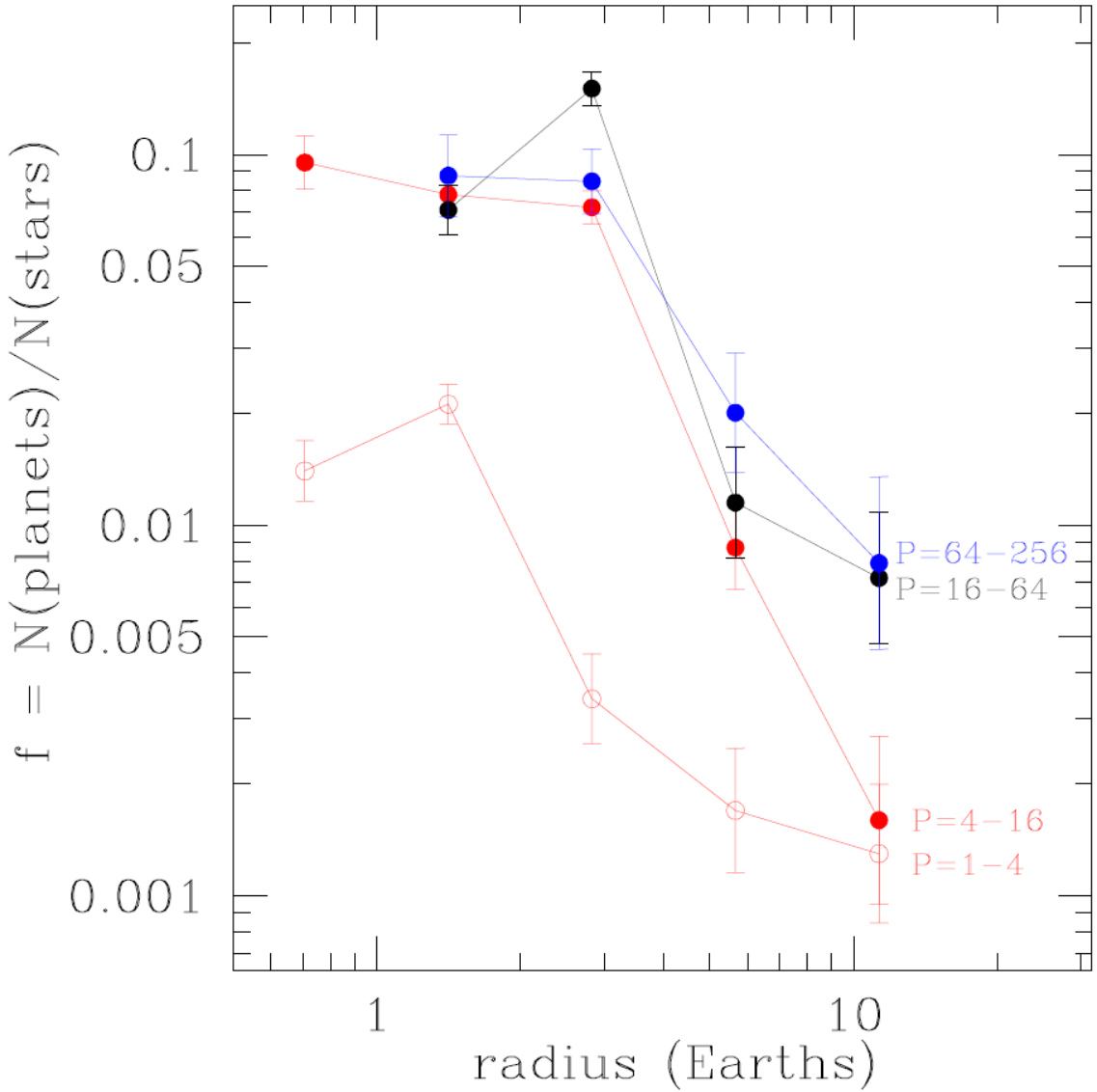
xtg_per_v2 11/17/2012

Indication of missing small planets at long periods



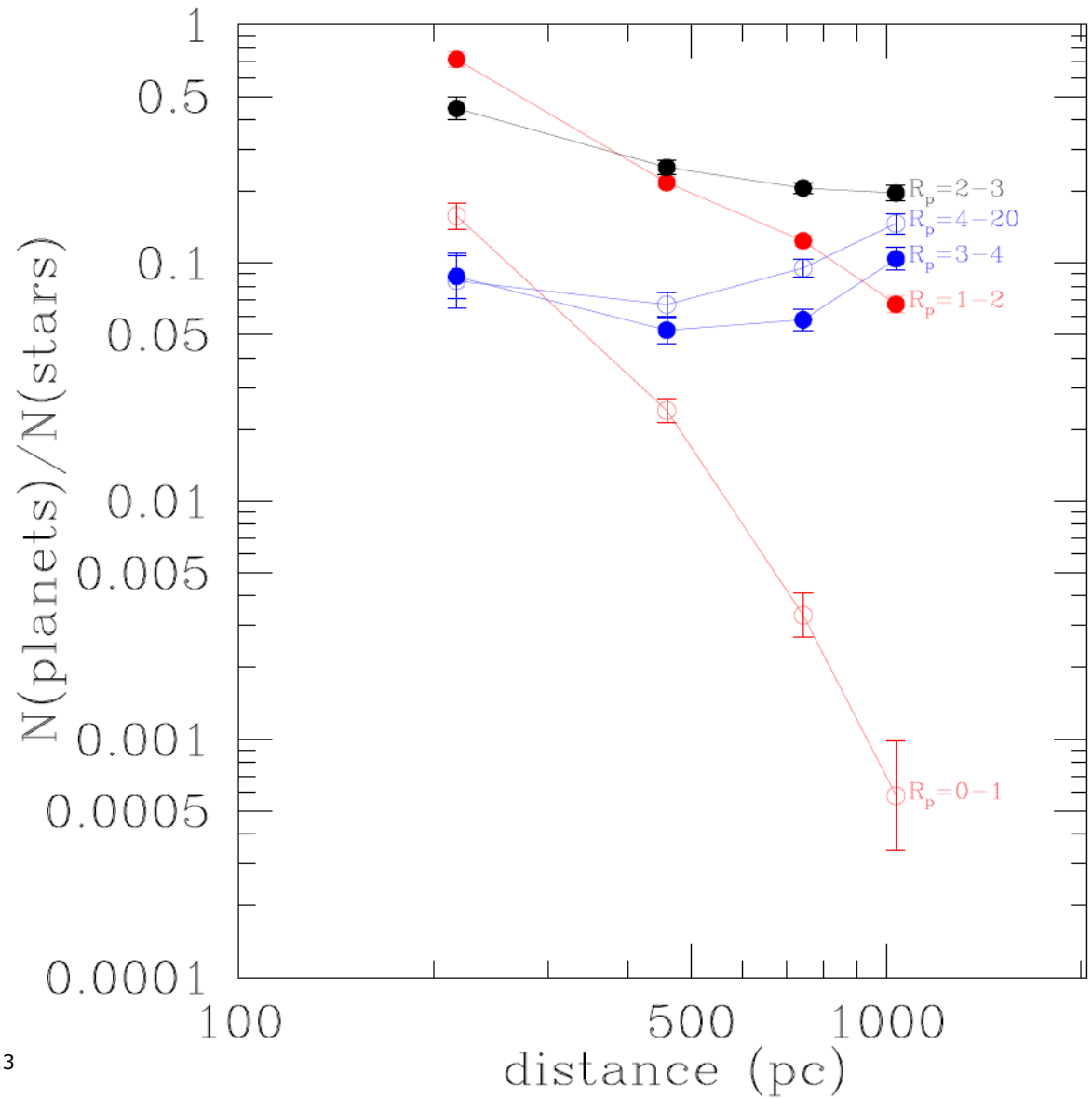
dps3bx 3/25/2013

Indication of missing small planets at long periods

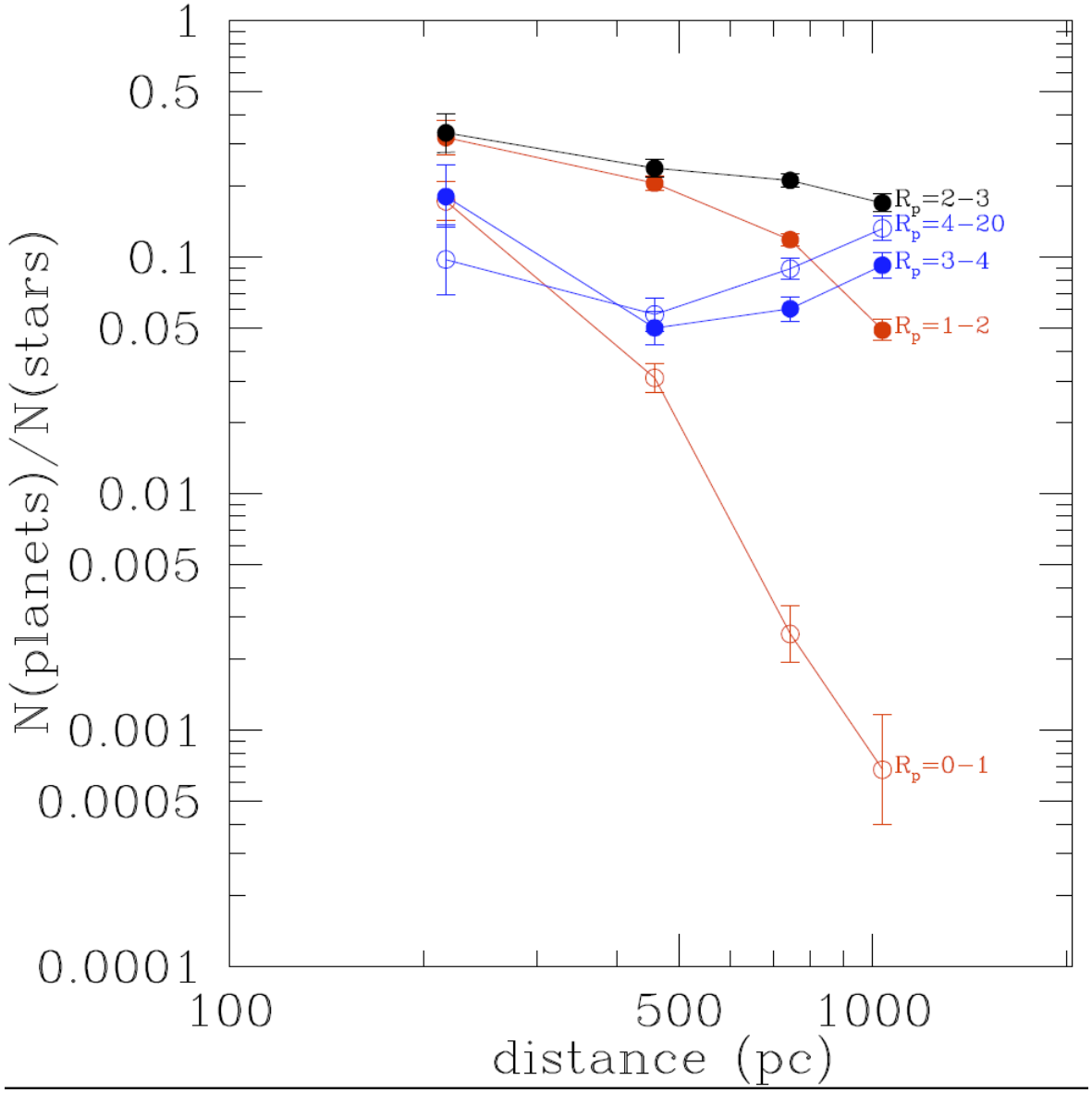


dps3ax 3/25/2013

Indication of missing small planets at large distance

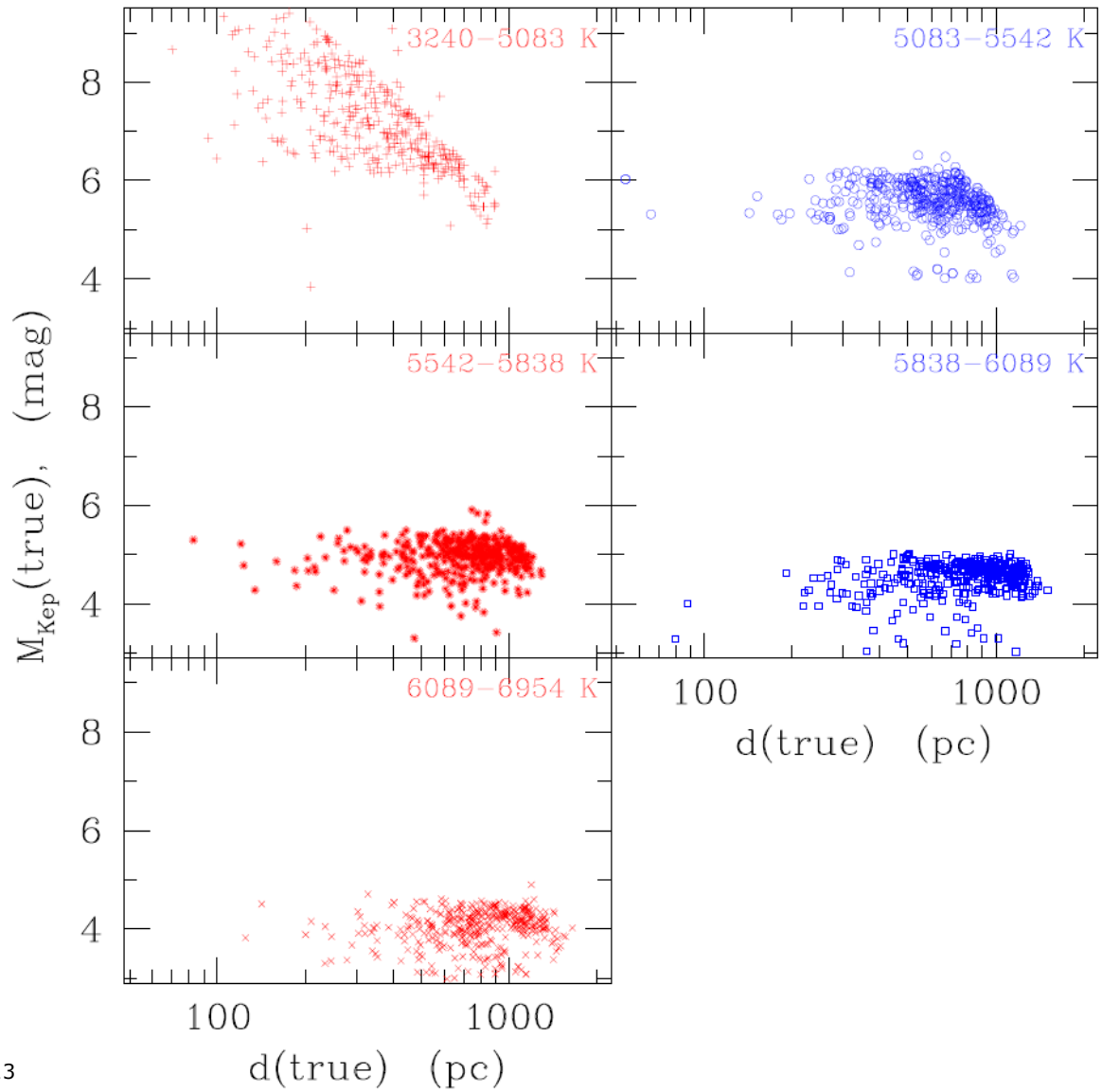


Indication of missing small planets at large distance



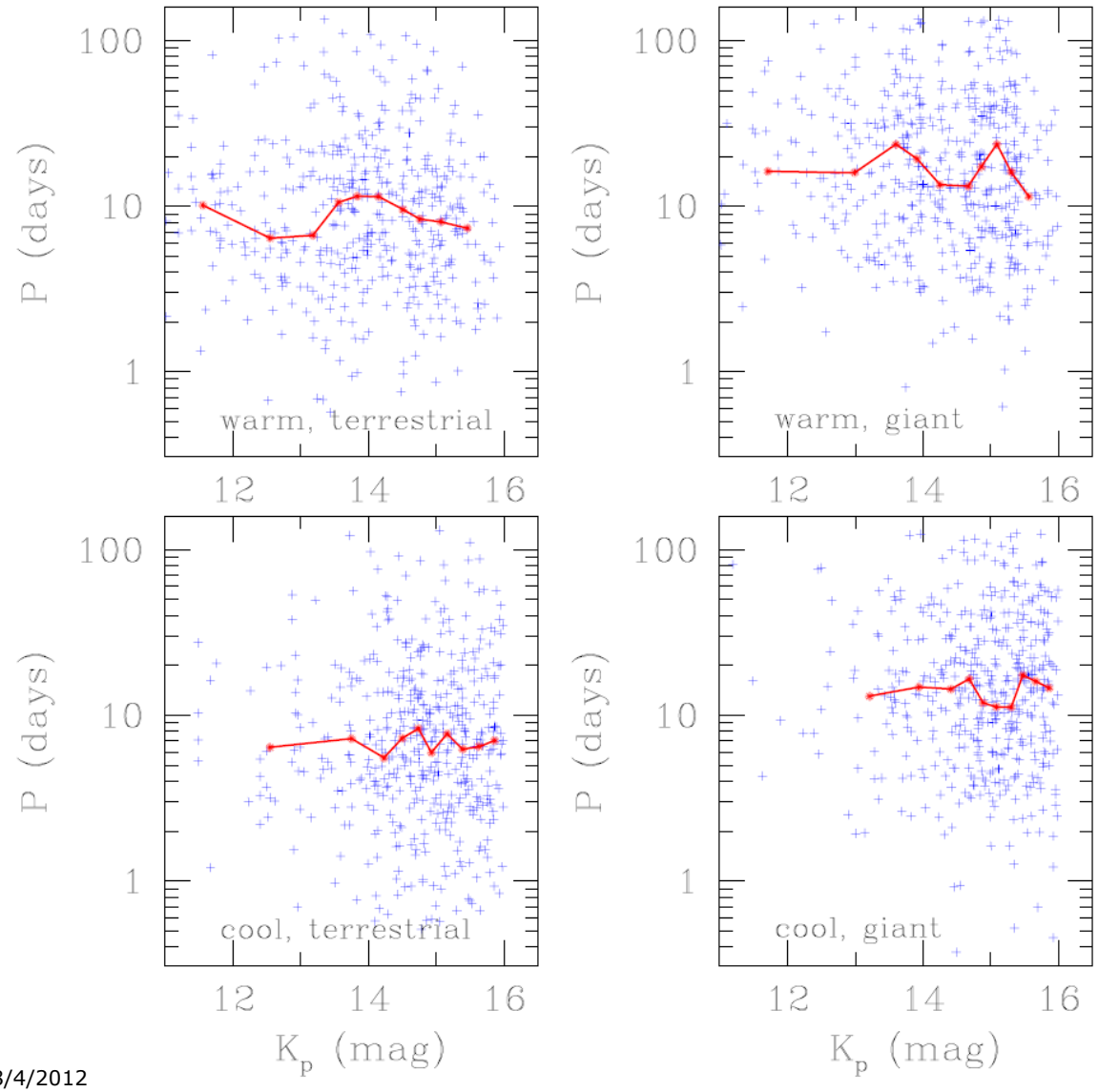
dps2d 3/16/2013

Reasonable clustering in absolute magnitude vs distance



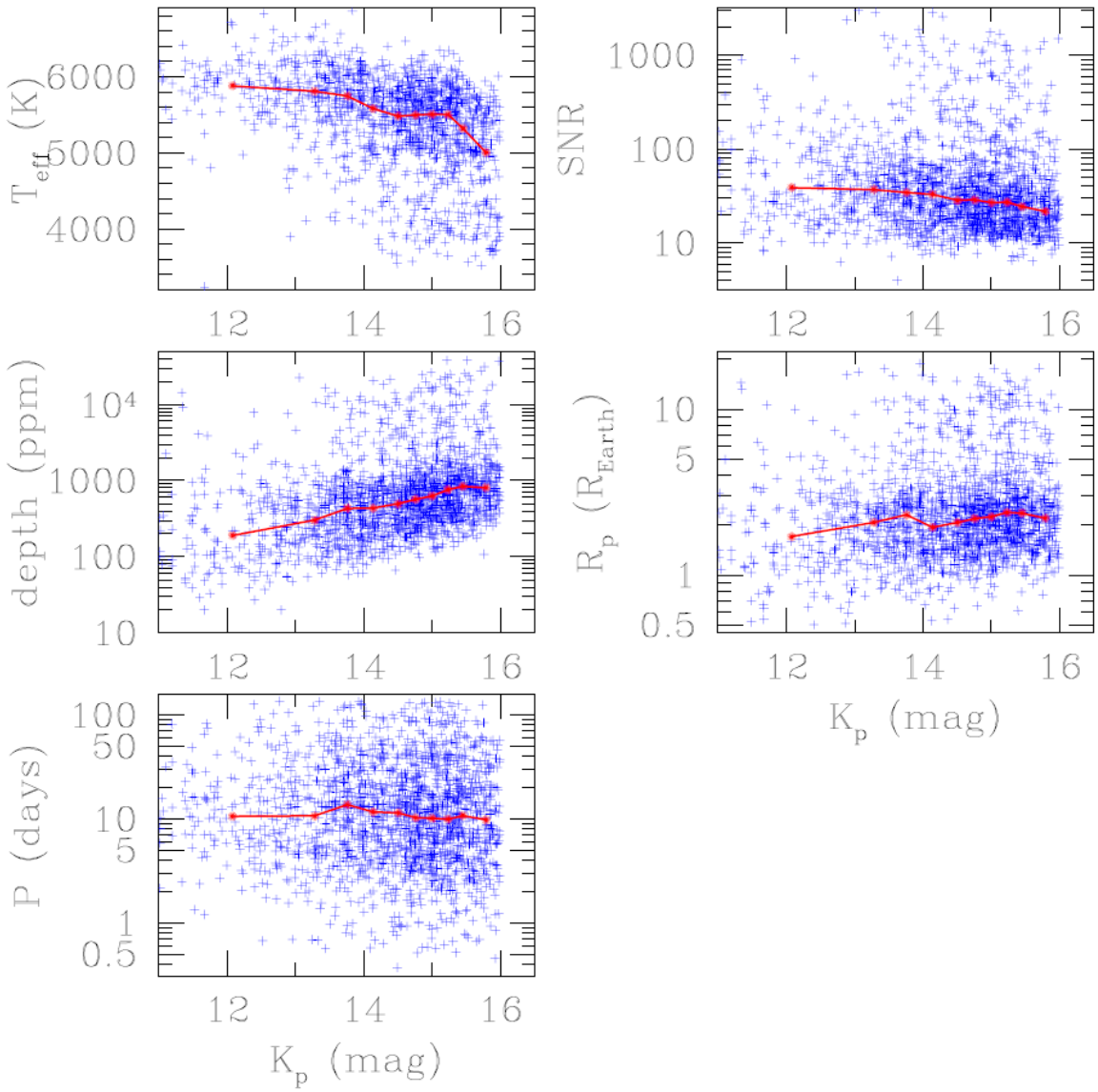
dmkepawin_033 2/21/2013

Reasonable scatter in period vs magnitude



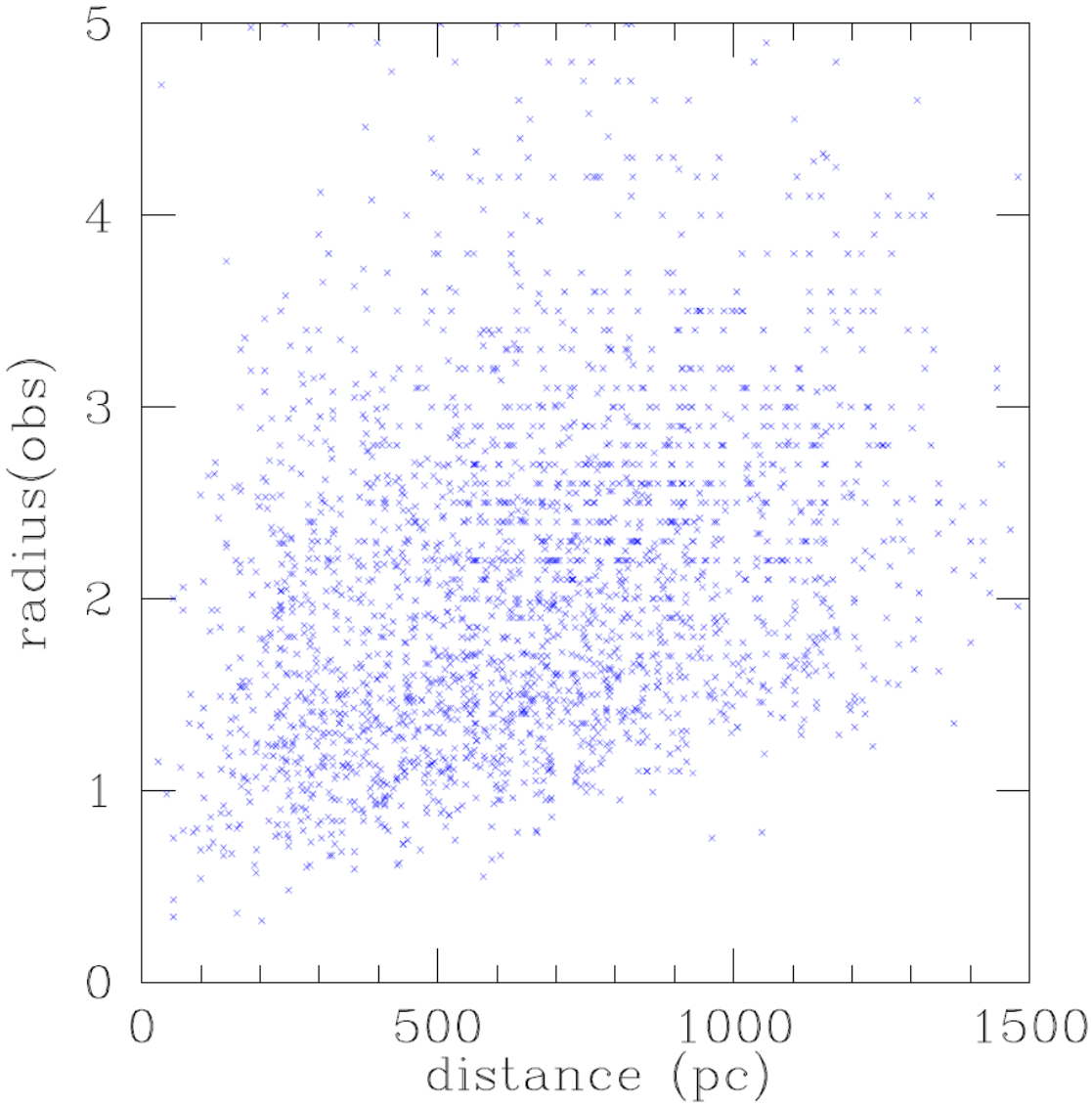
kpscatter_wctg 8/4/2012

Reasonable scatter with magnitude

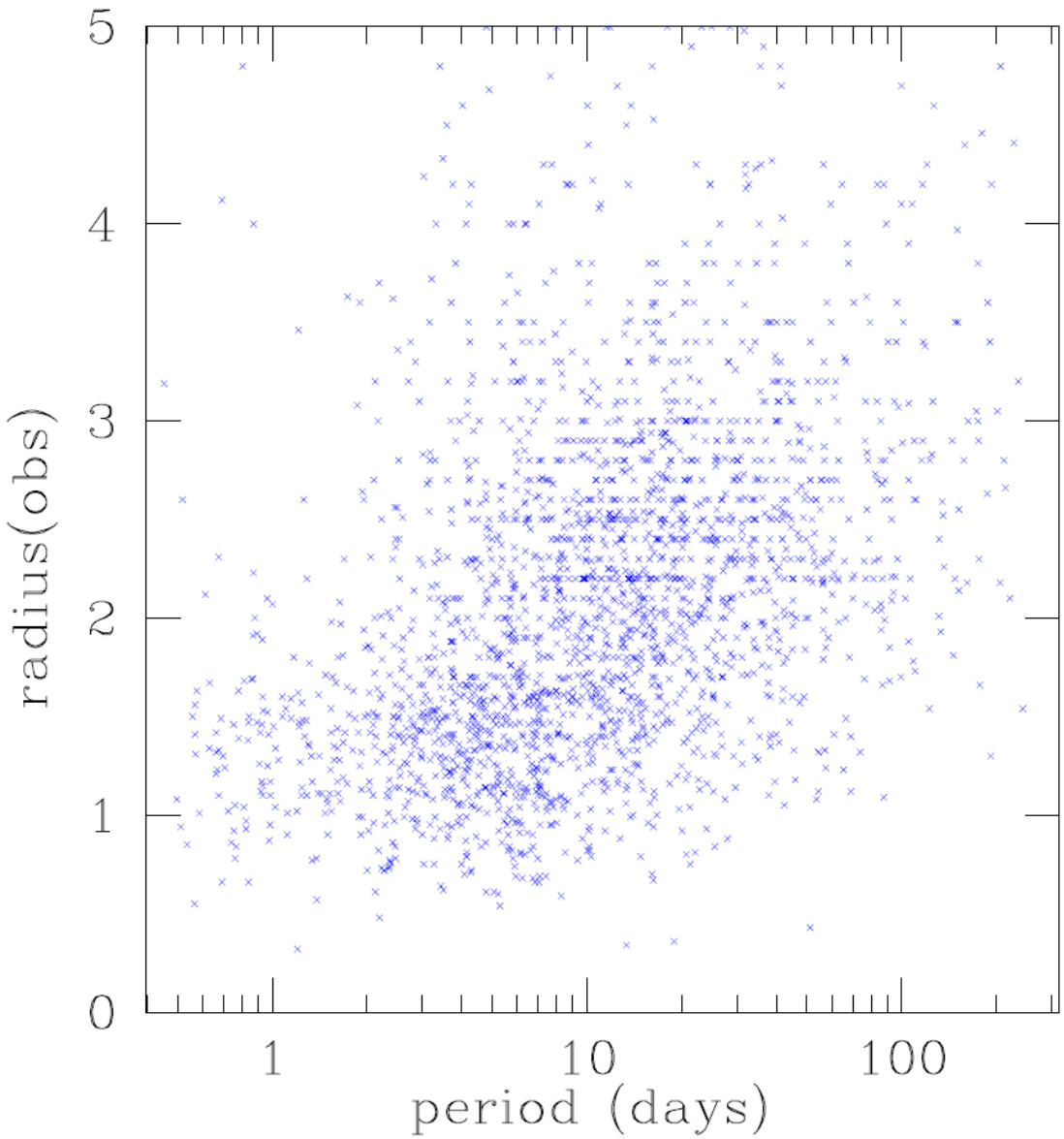


Kpscatter2 8/4/2012

Missing small planets at large distance

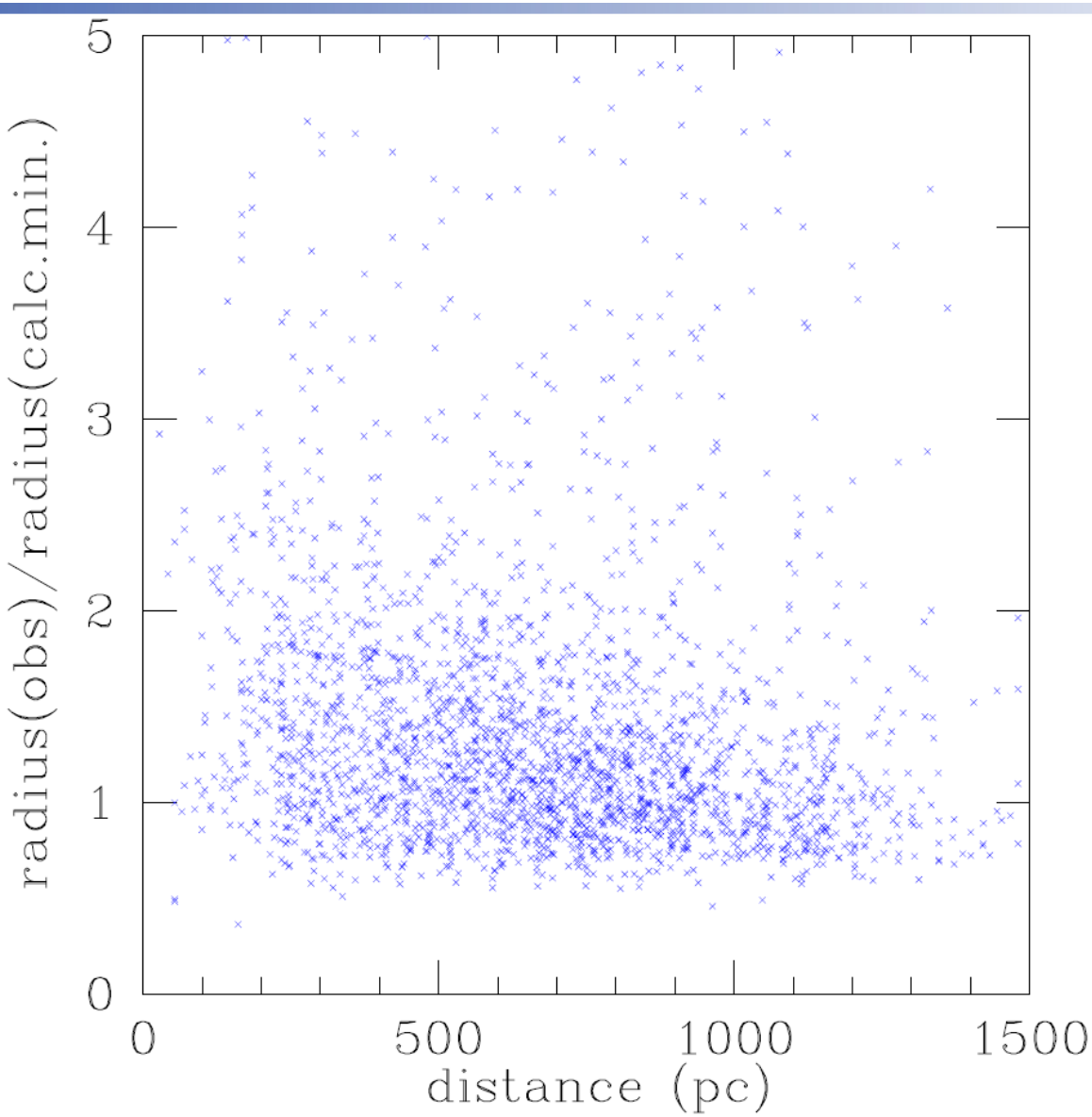


Missing small planets at long periods



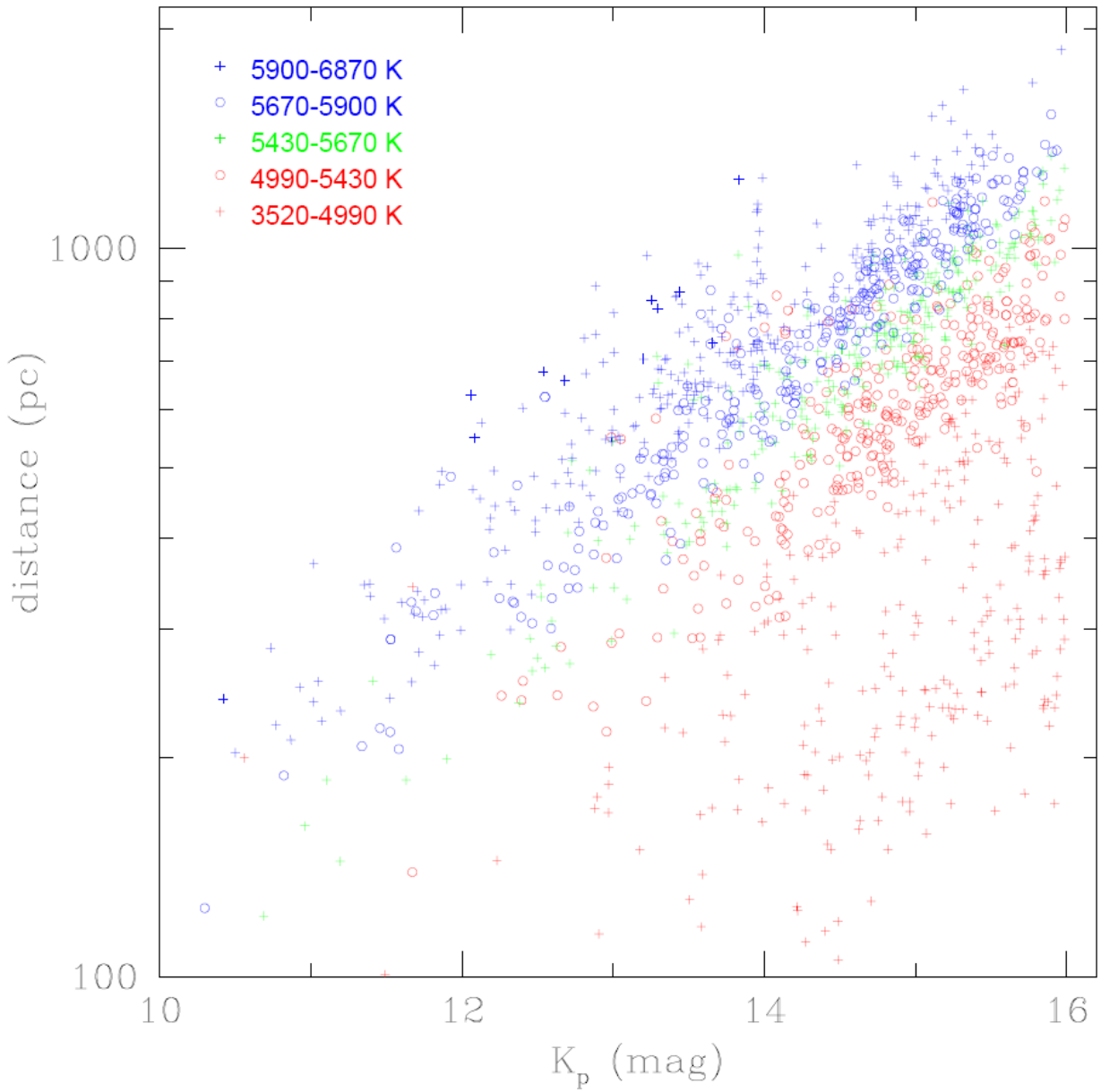
roc6 7/3/2013

No distance bias when minimum observable radius considered



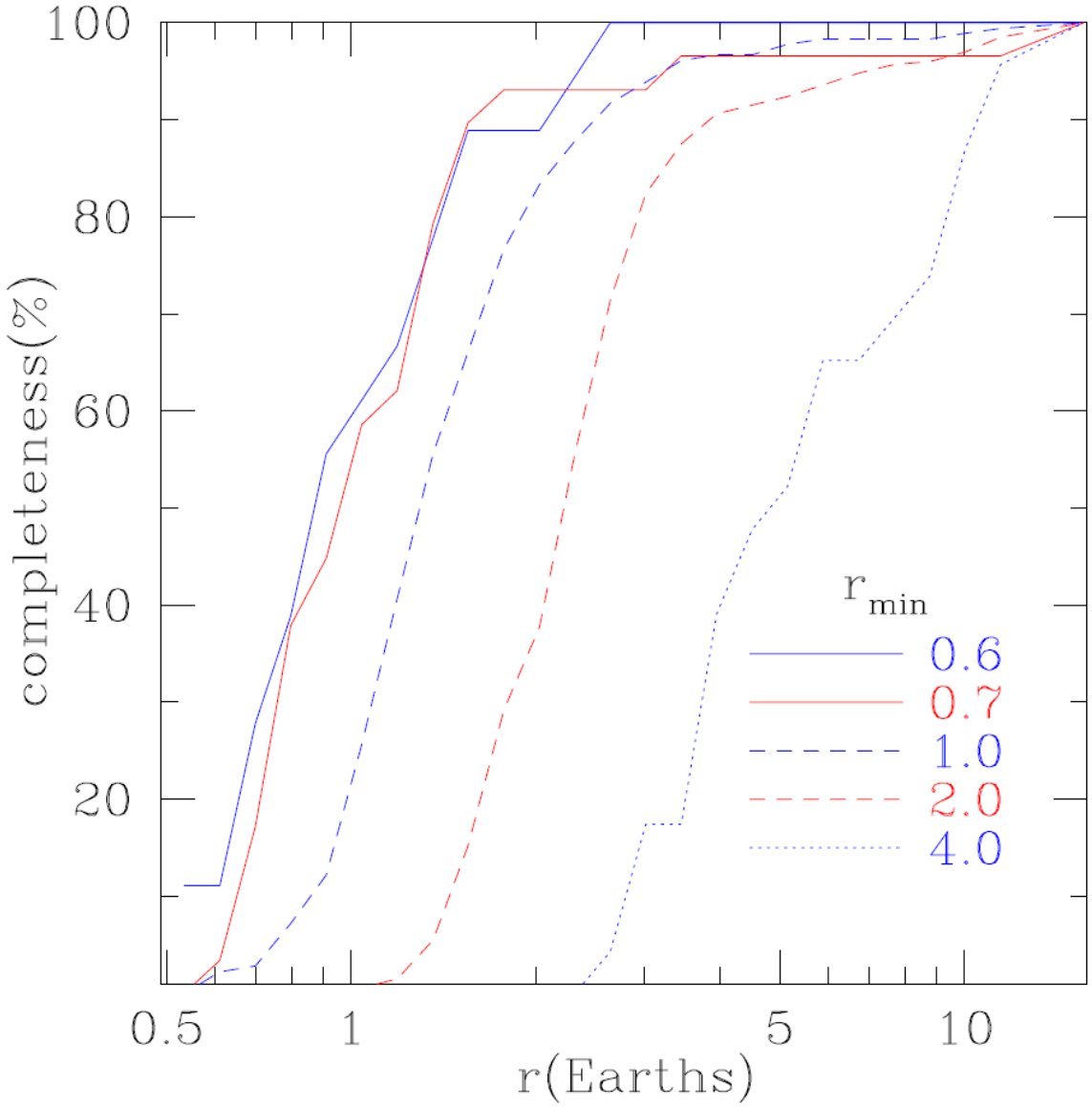
roc5a 4/28/2013

Distance vs magnitude



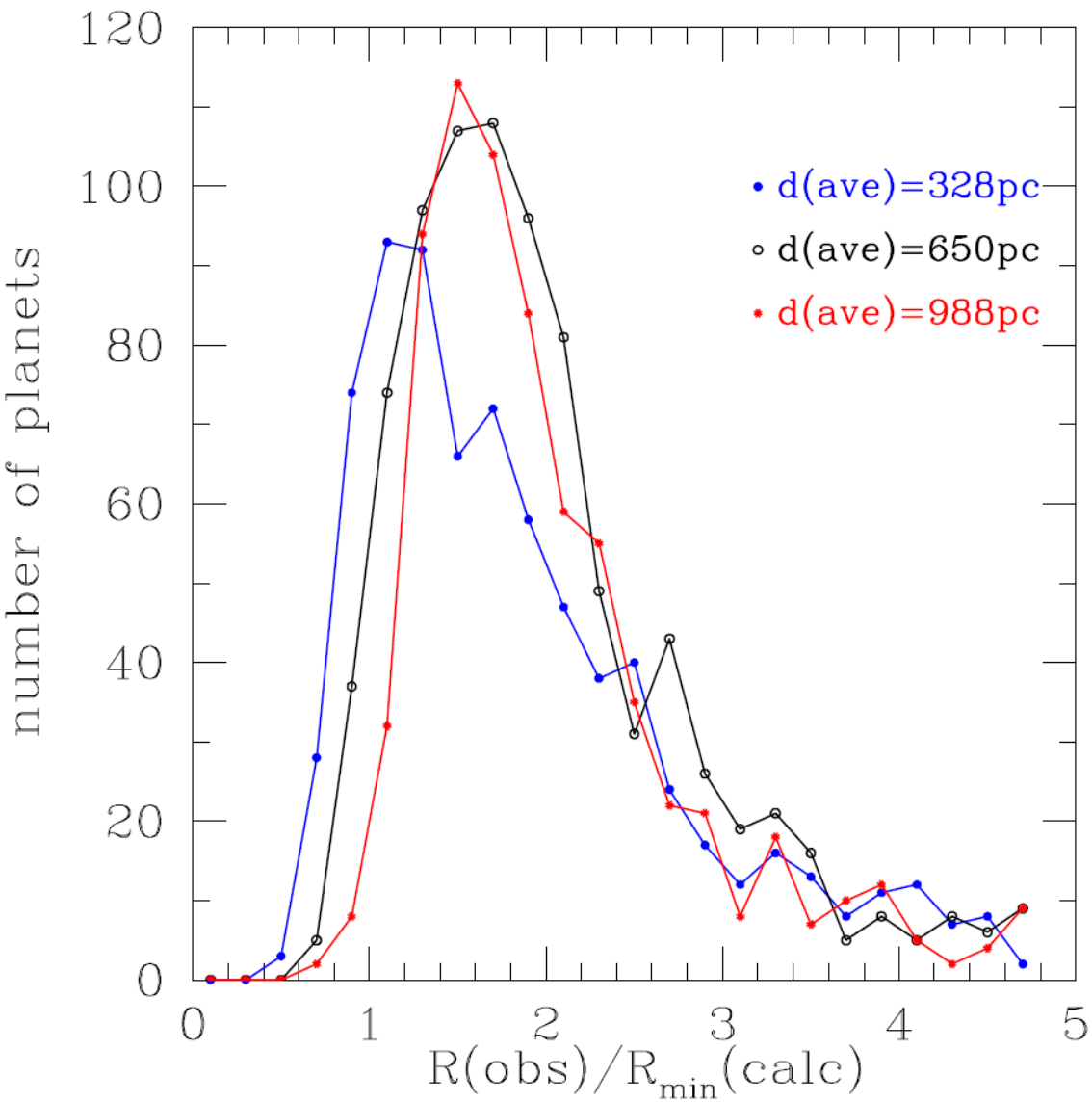
mag_dist_3 10/7/2012

Cumulative planets vs minimum radius



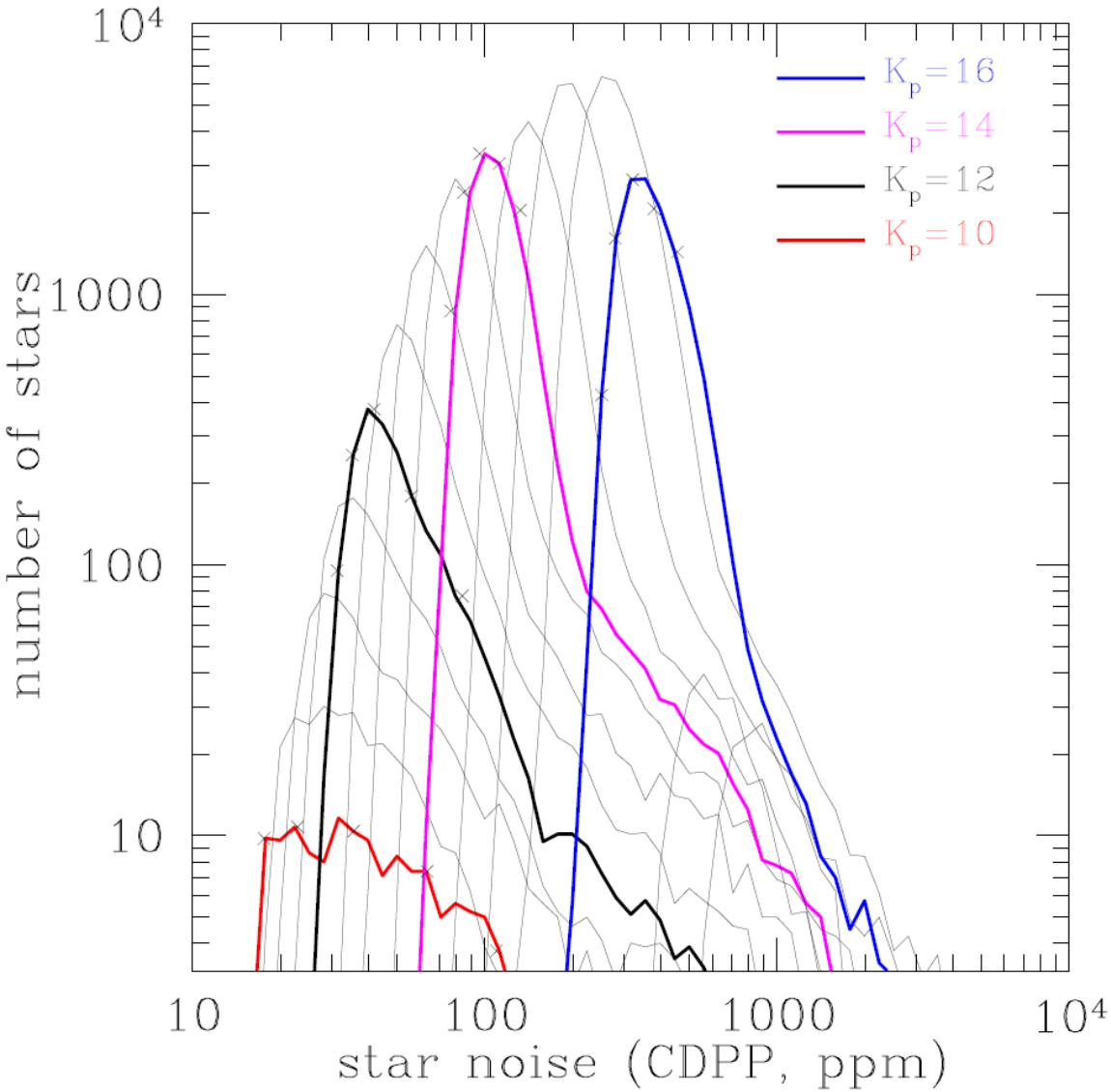
nprmin6 6/1/2013

Small bias against distant planets even after r(min) scaling

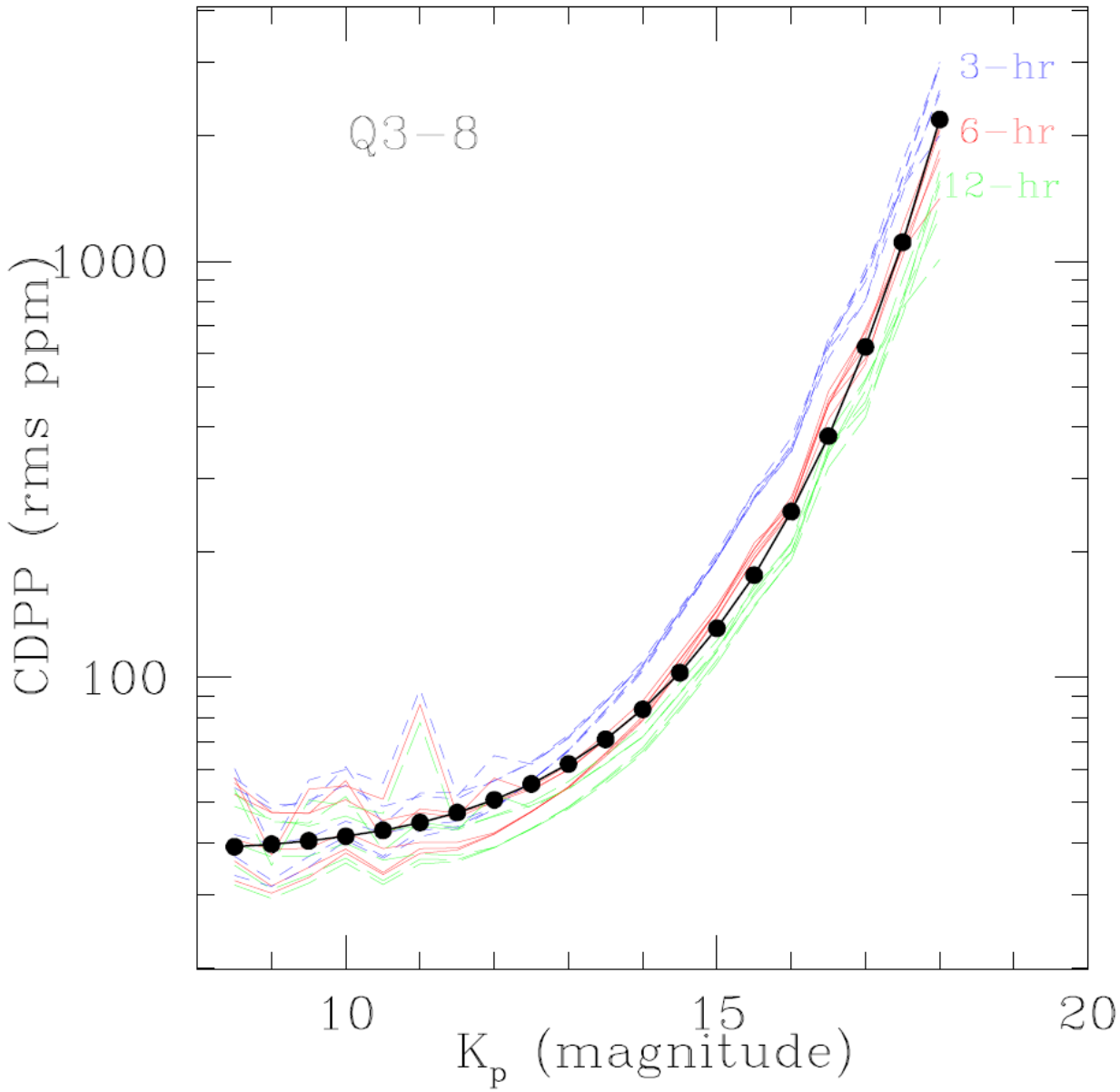


numroc4 3/22/2013

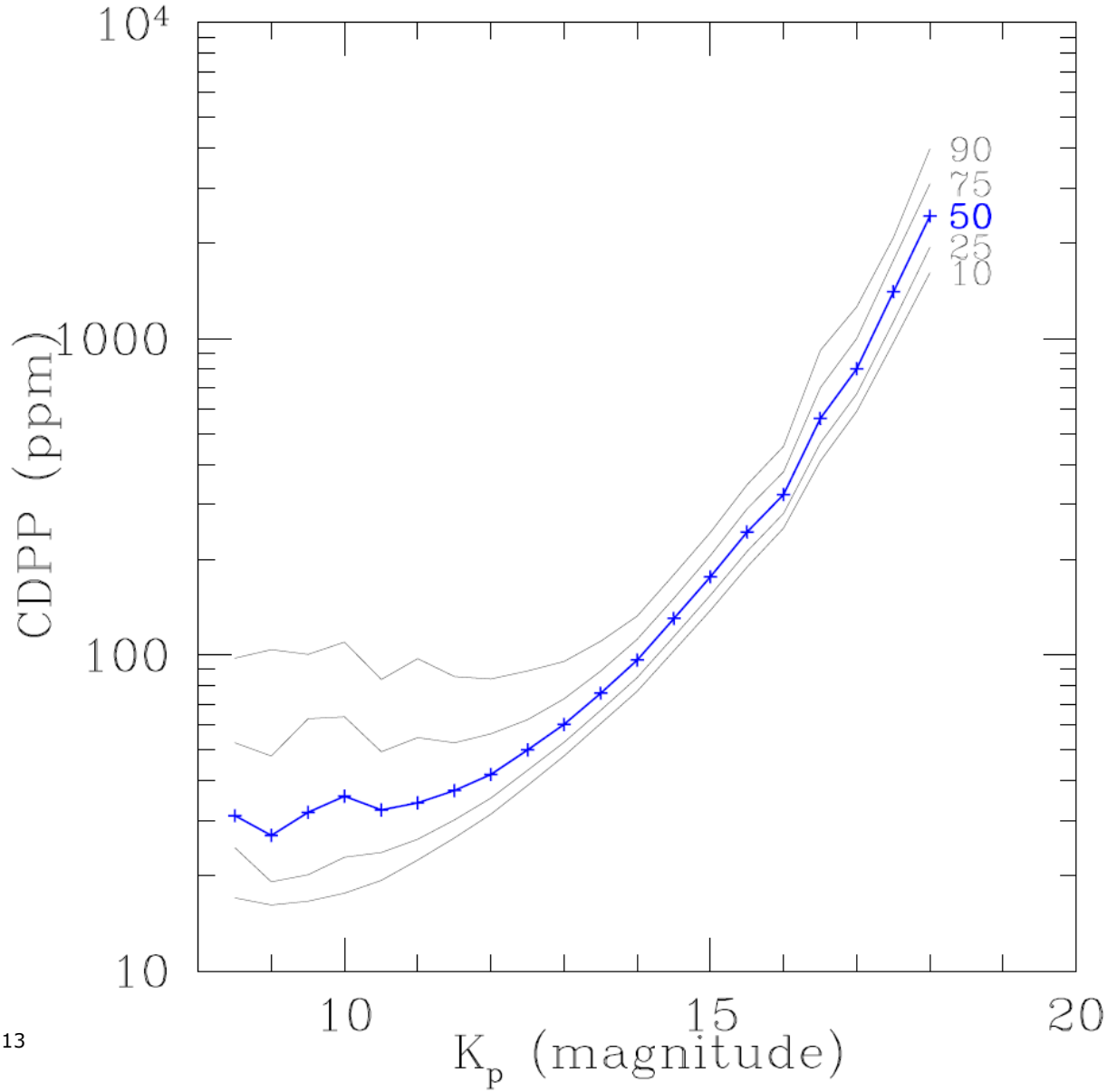
Faint stars have more noise



Median noise (CDPP) vs magnitude

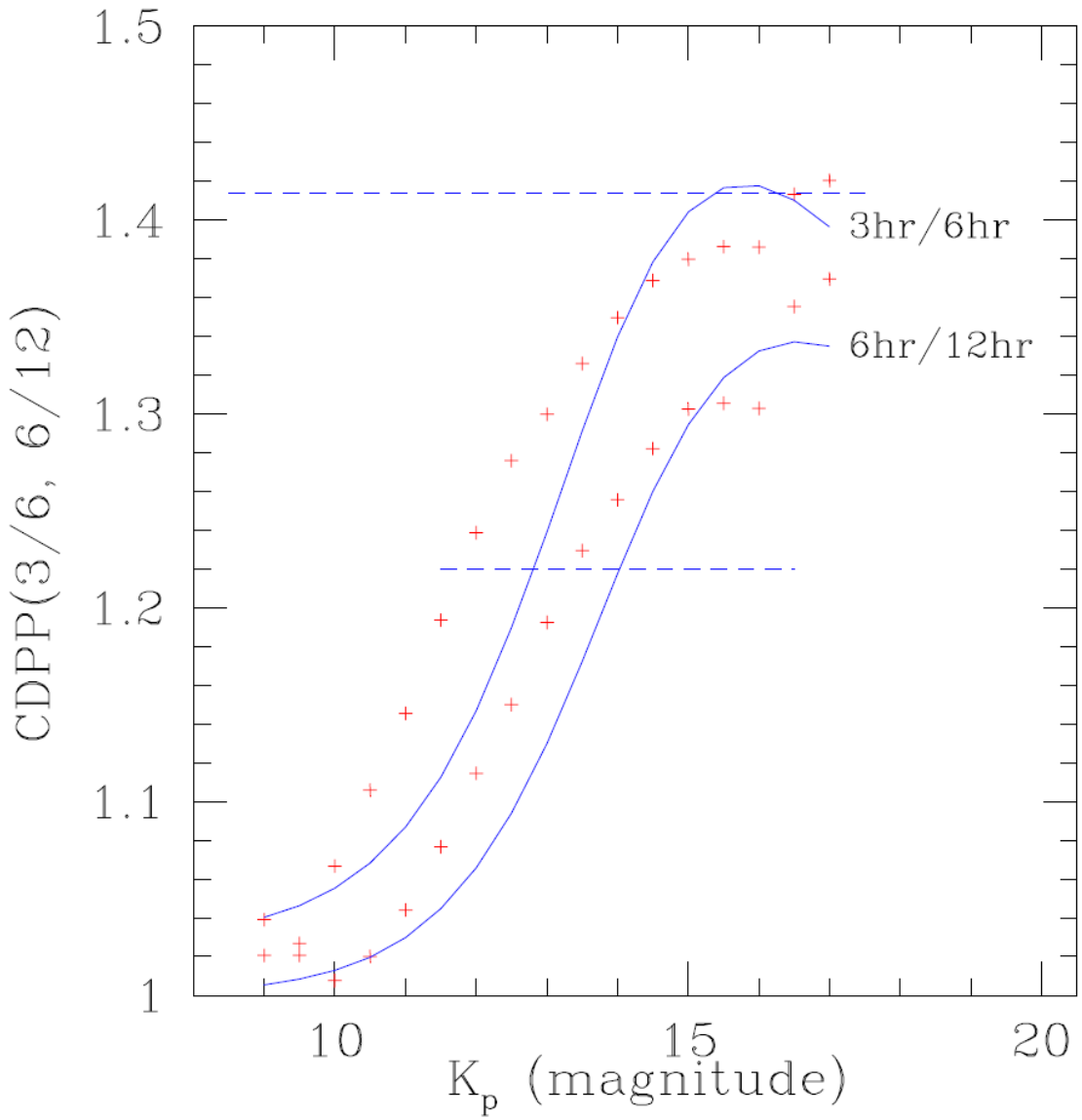


Median (& 10-90%) noise vs magnitude



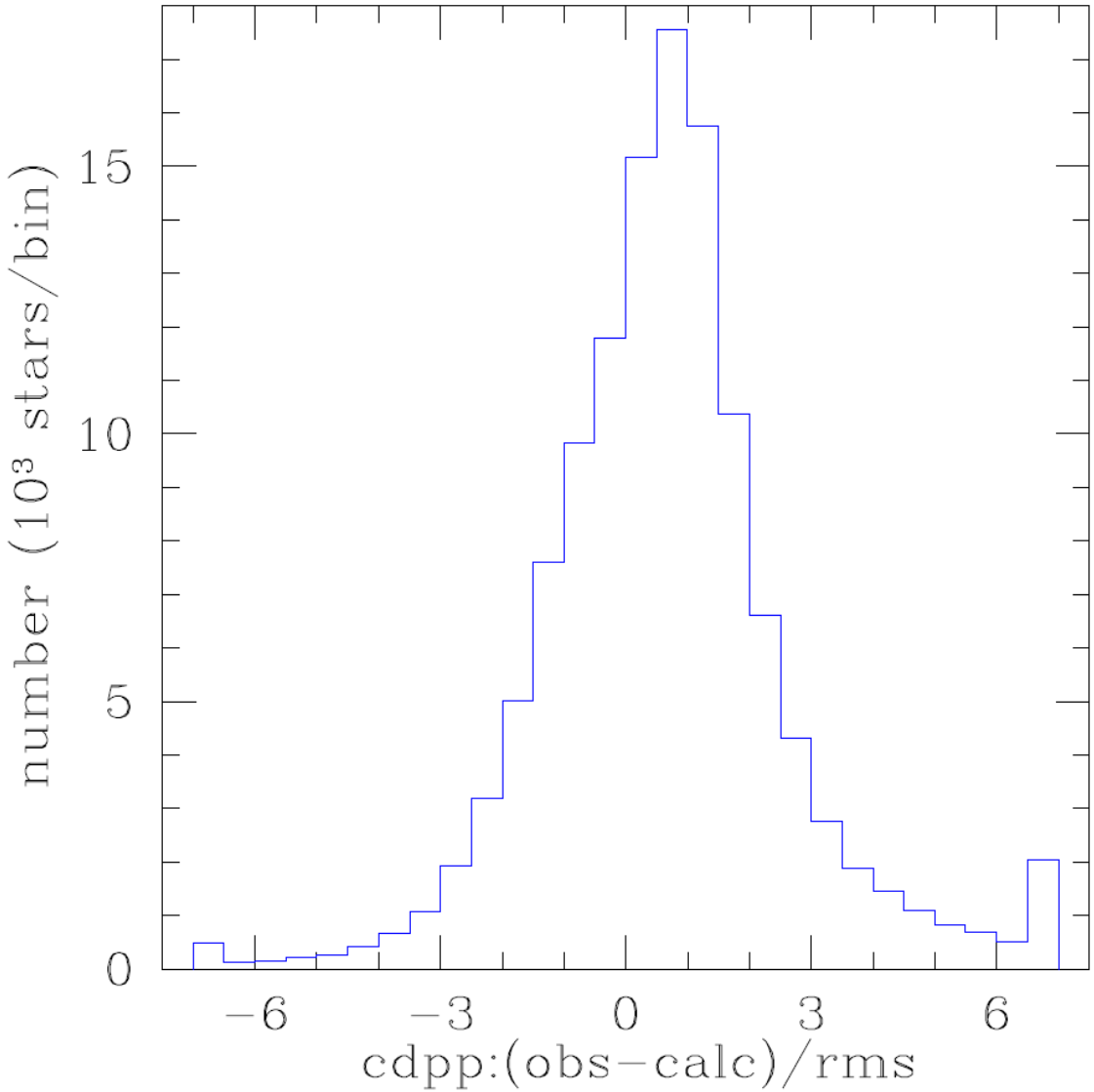
cdppper 4/21/2013

Ratio of 3/6 hr and 6/12 hr noise vs magnitude

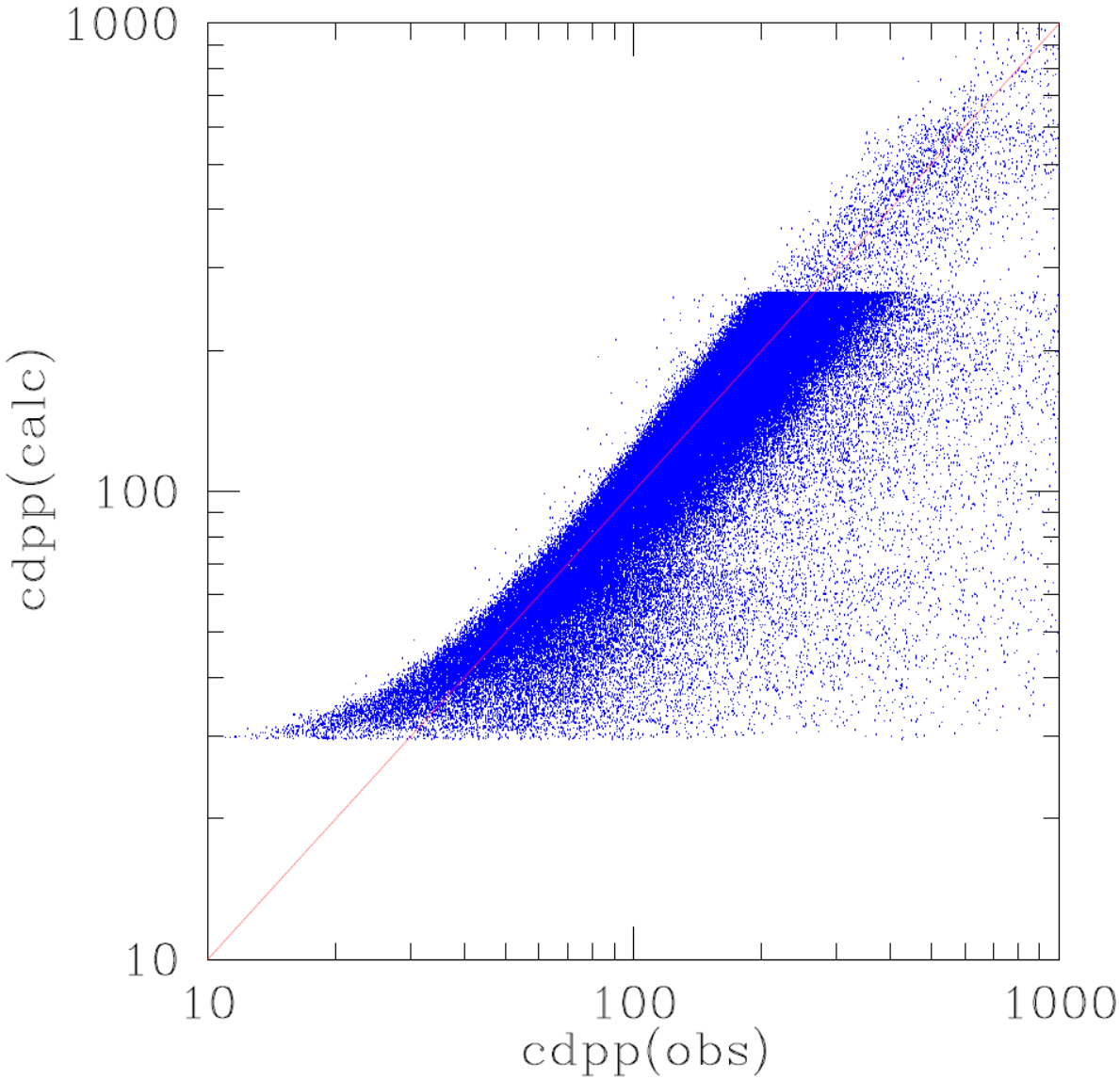


cdpptimeorig 7/6/2013

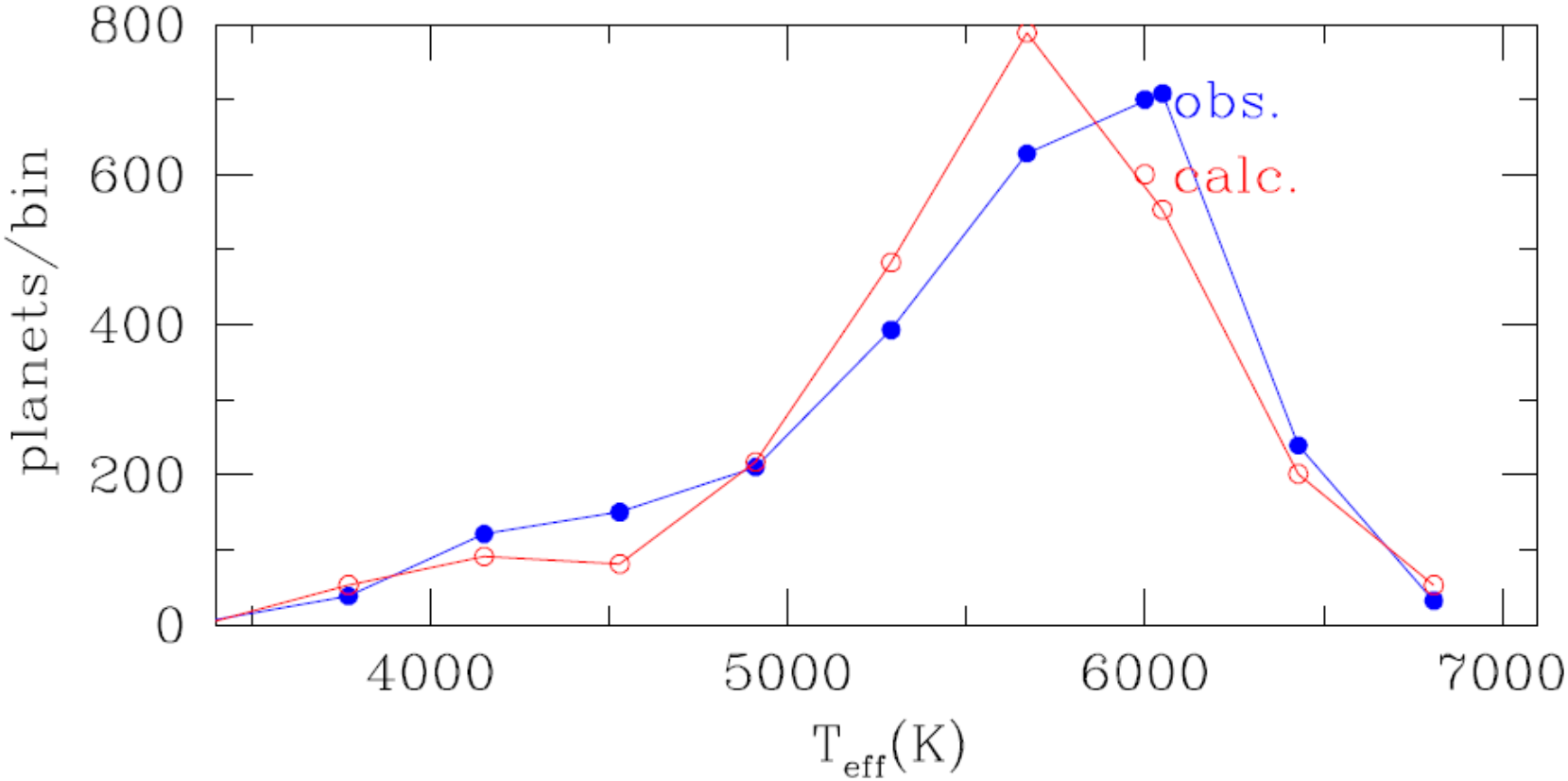
Relative scatter of observed – calculated noise



Calculated vs observed noise (CDPP)



Comp67_3 6/28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600
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200
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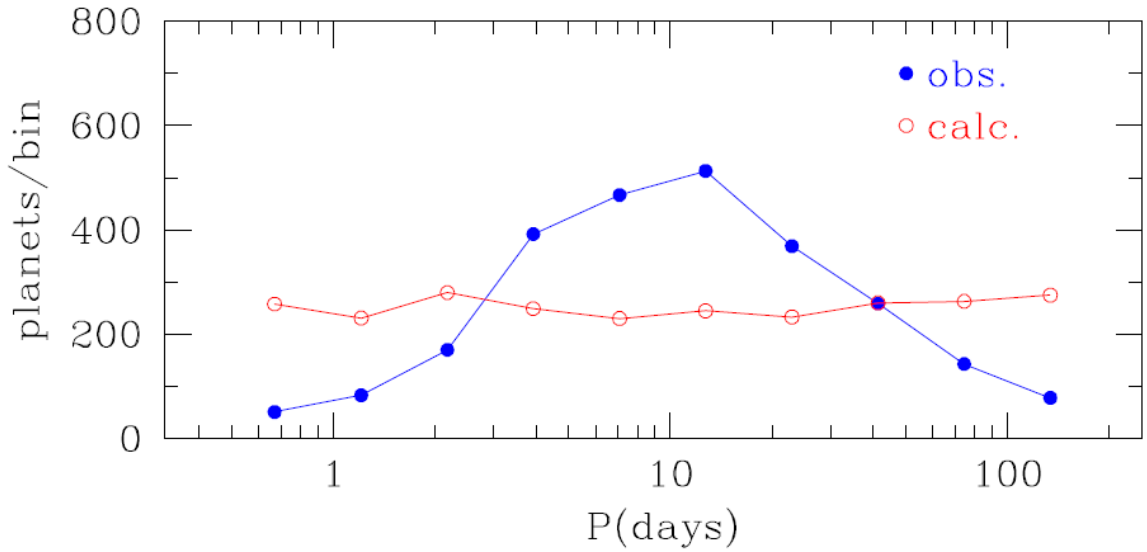
planets/bin
4000
5000
6000
7000
T_{eff}(K)
obs.
calc.

Comp67_1 6/28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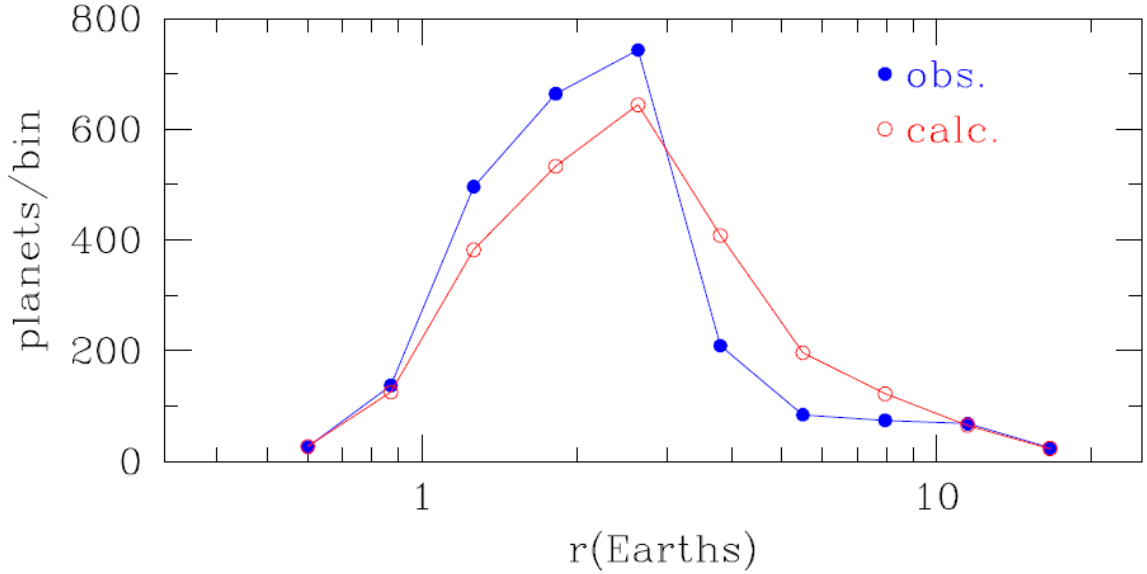
P(days)
obs.
calc.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planets/bin
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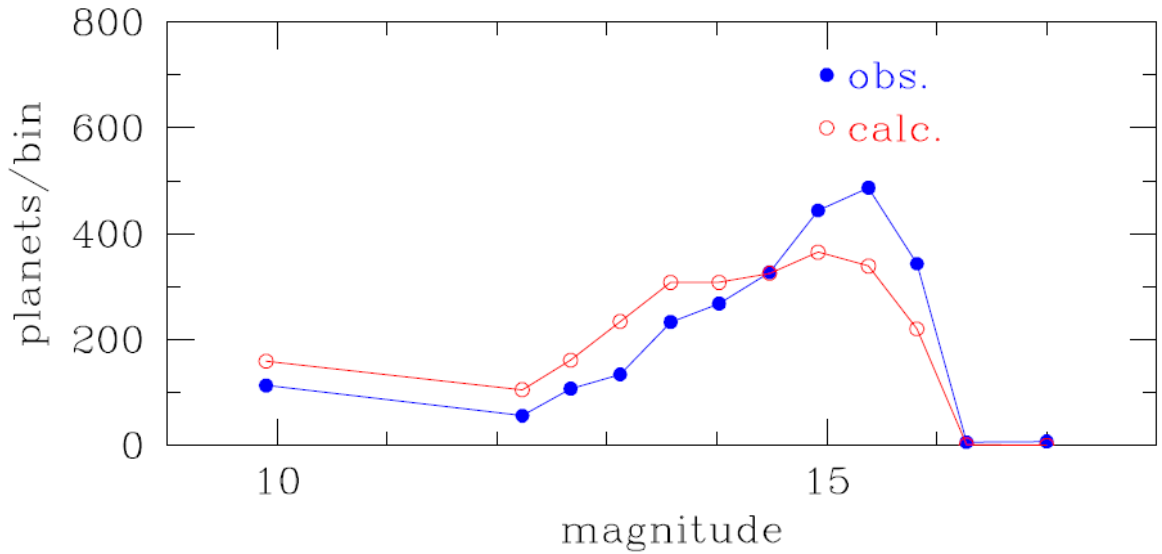
10
r(Earths)
obs.
calc.

Comp67_2 6/28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planets/bin
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magnitude
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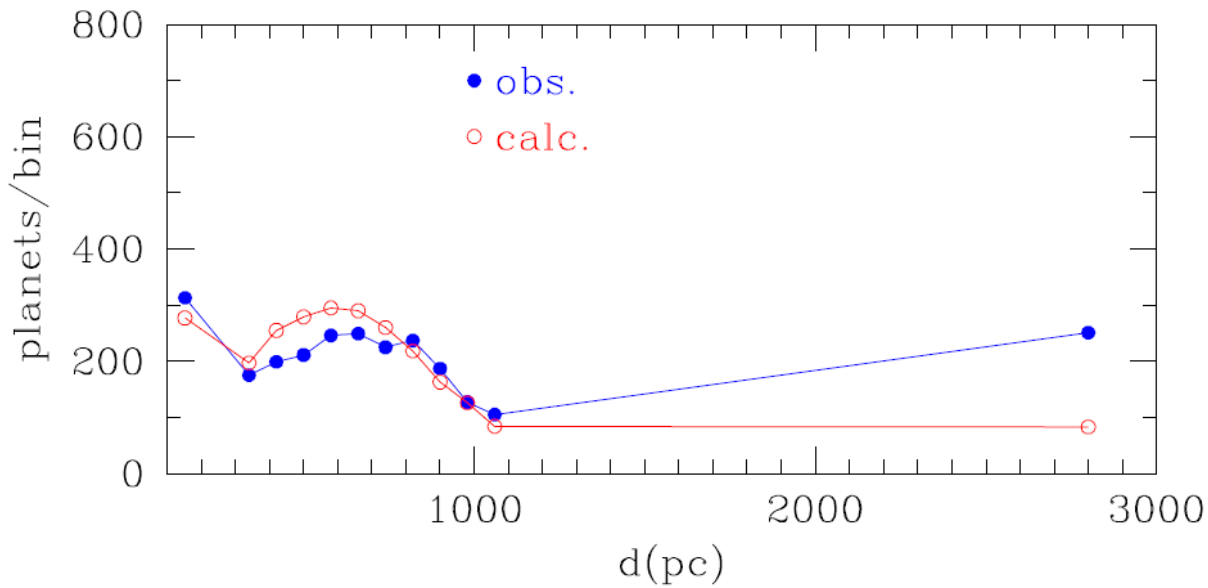
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2000
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d(pc)
obs.
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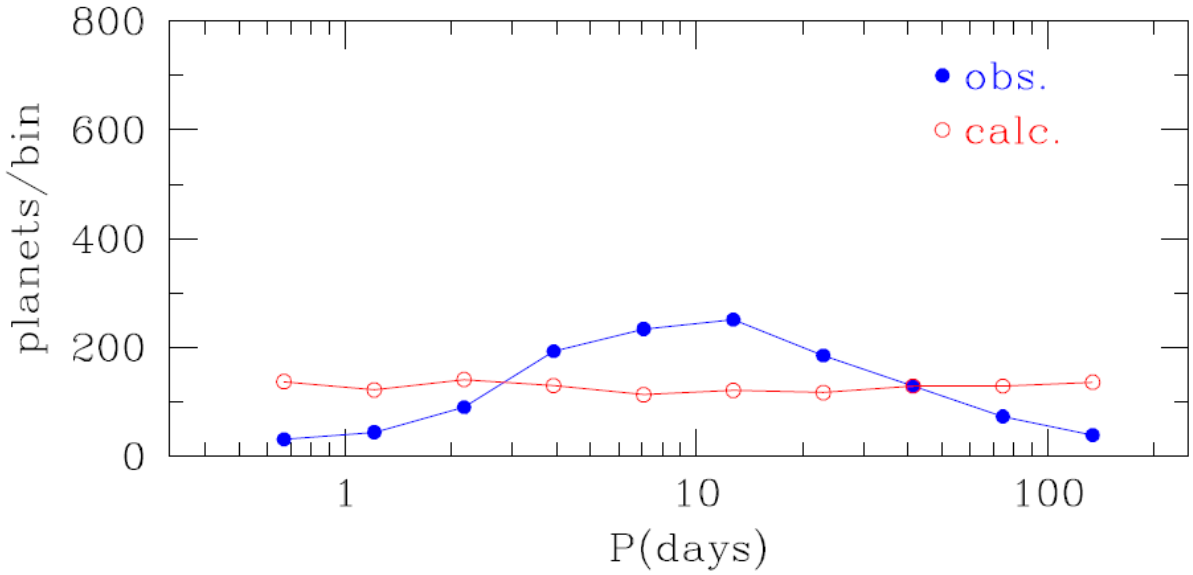
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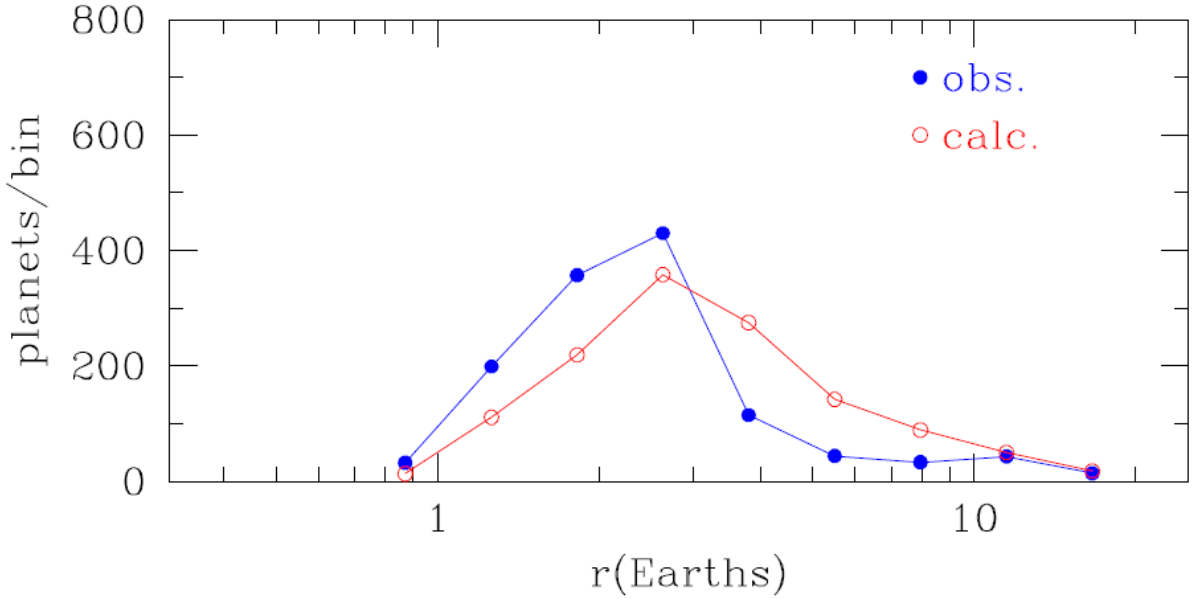
400
200
0
planets/bin
obs.
calc.
1
10
100
P(days)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planets/bin
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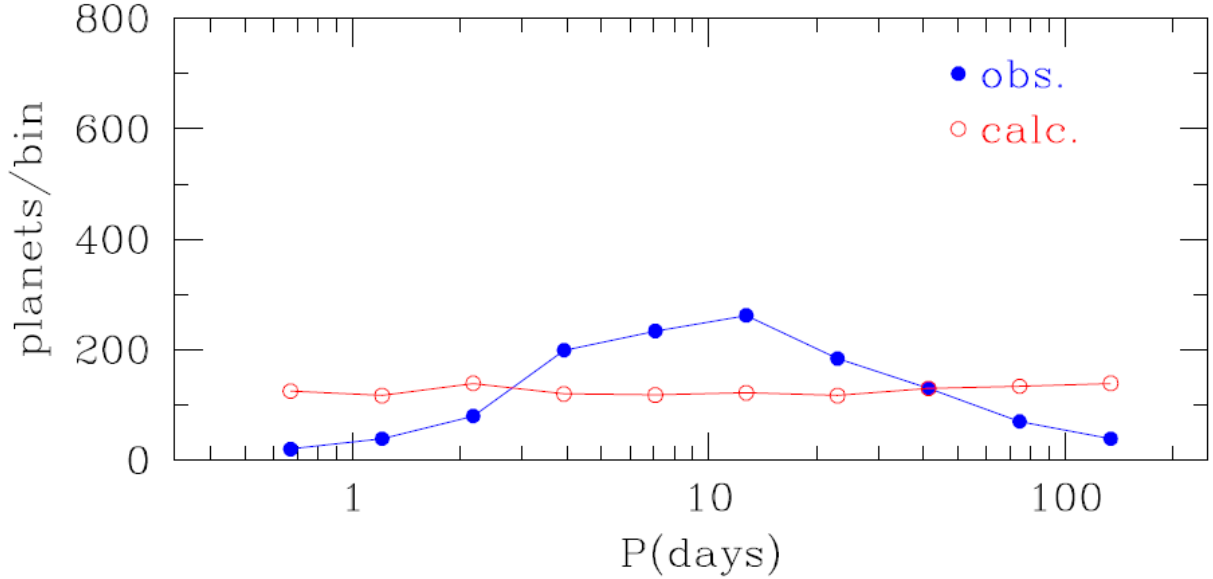
r(Earths)

Comp66 6/23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P(days)
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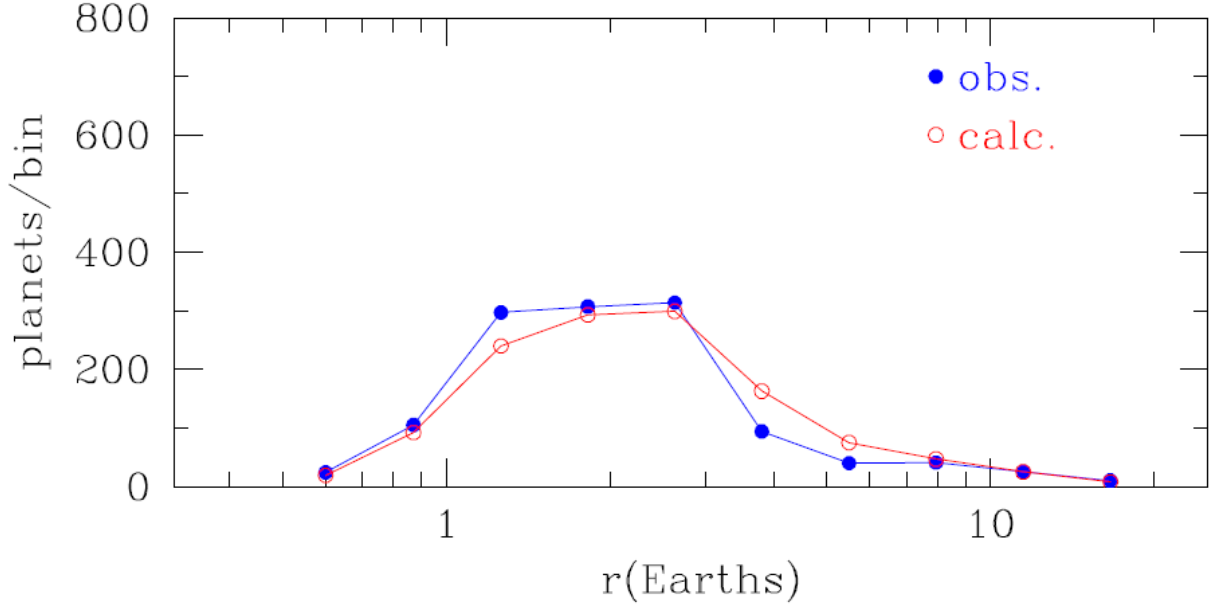
calc.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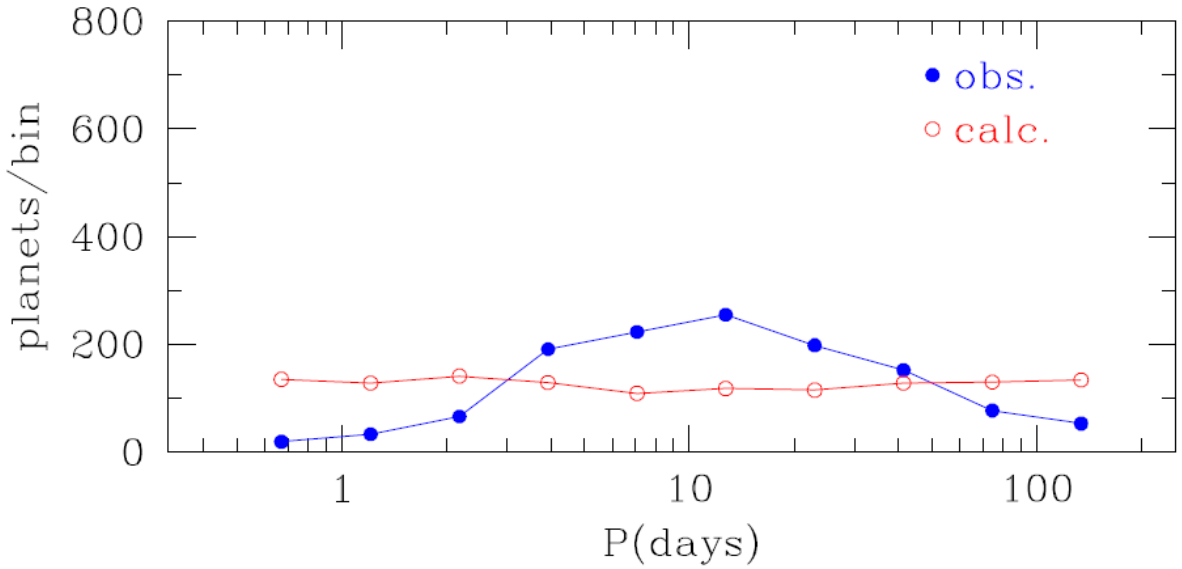
10
r(Earths)
obs.
calc.

Comp62 6/22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10
100
P(days)
obs.
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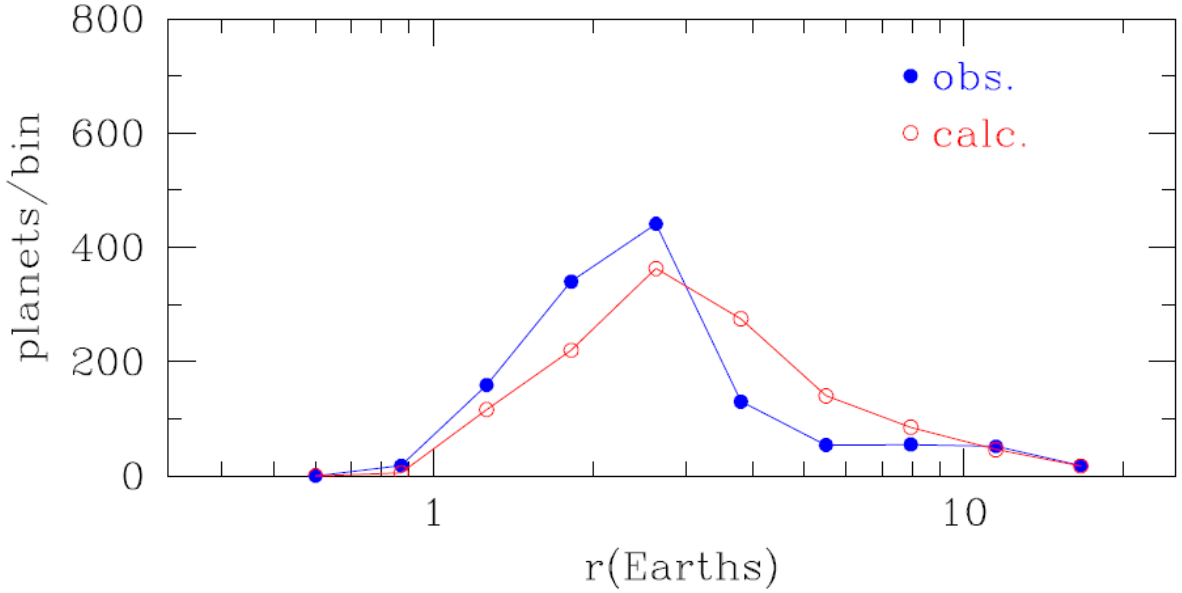
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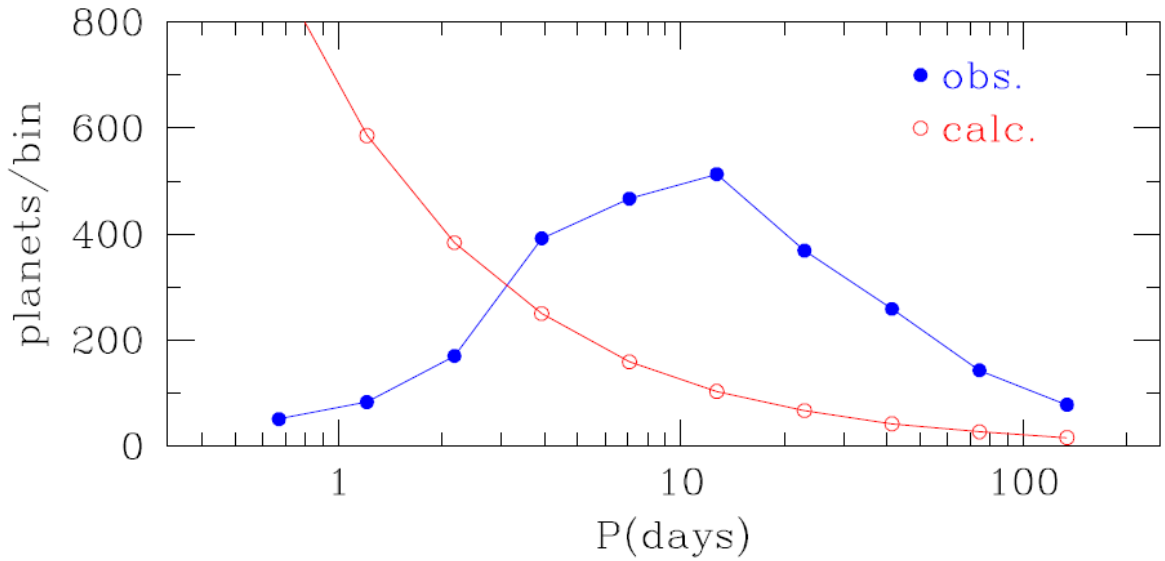
Comp57 6/22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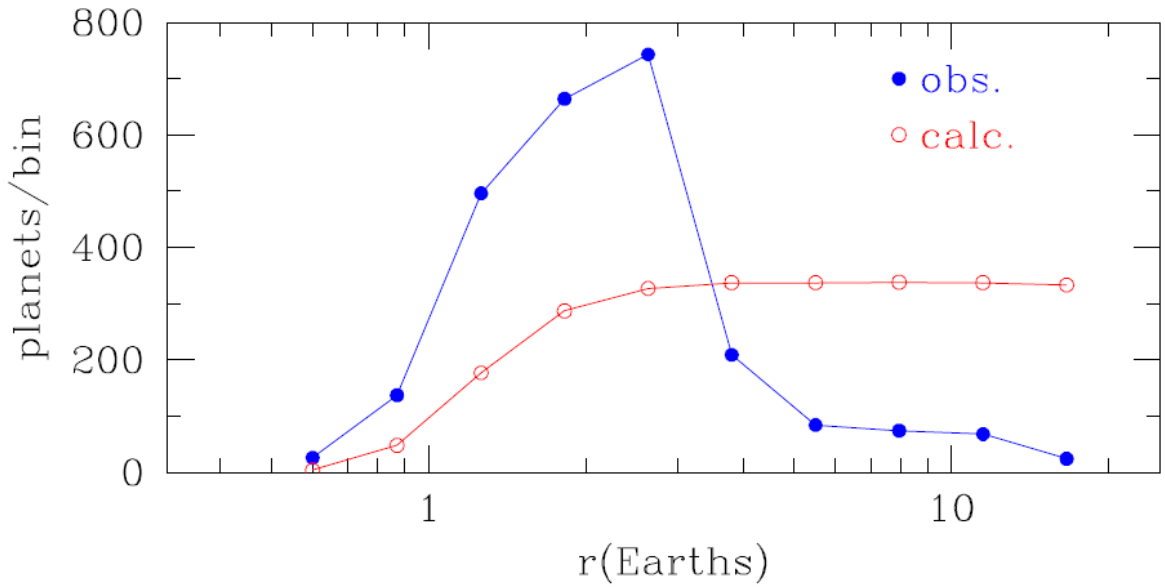
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planets/bin
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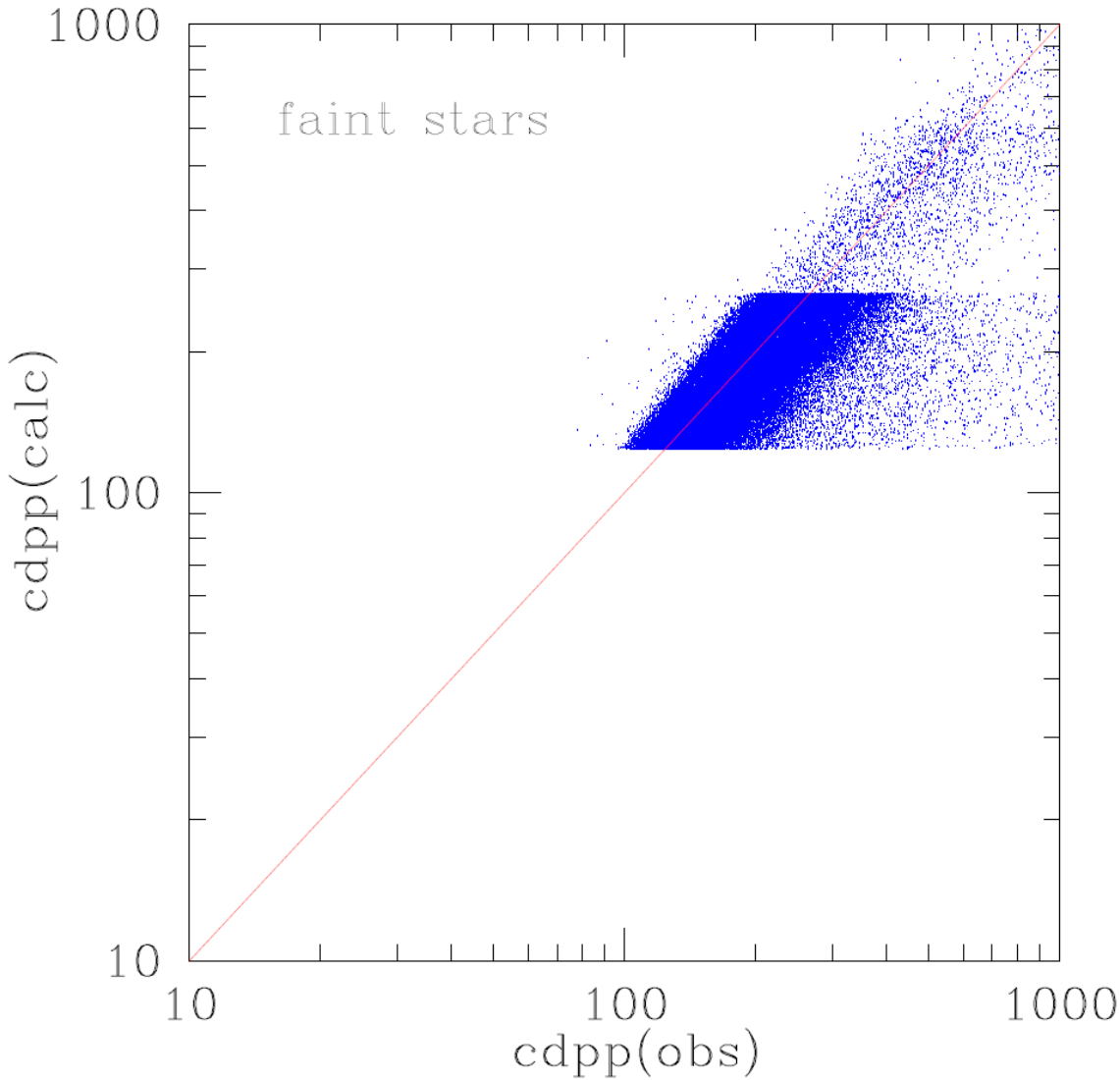
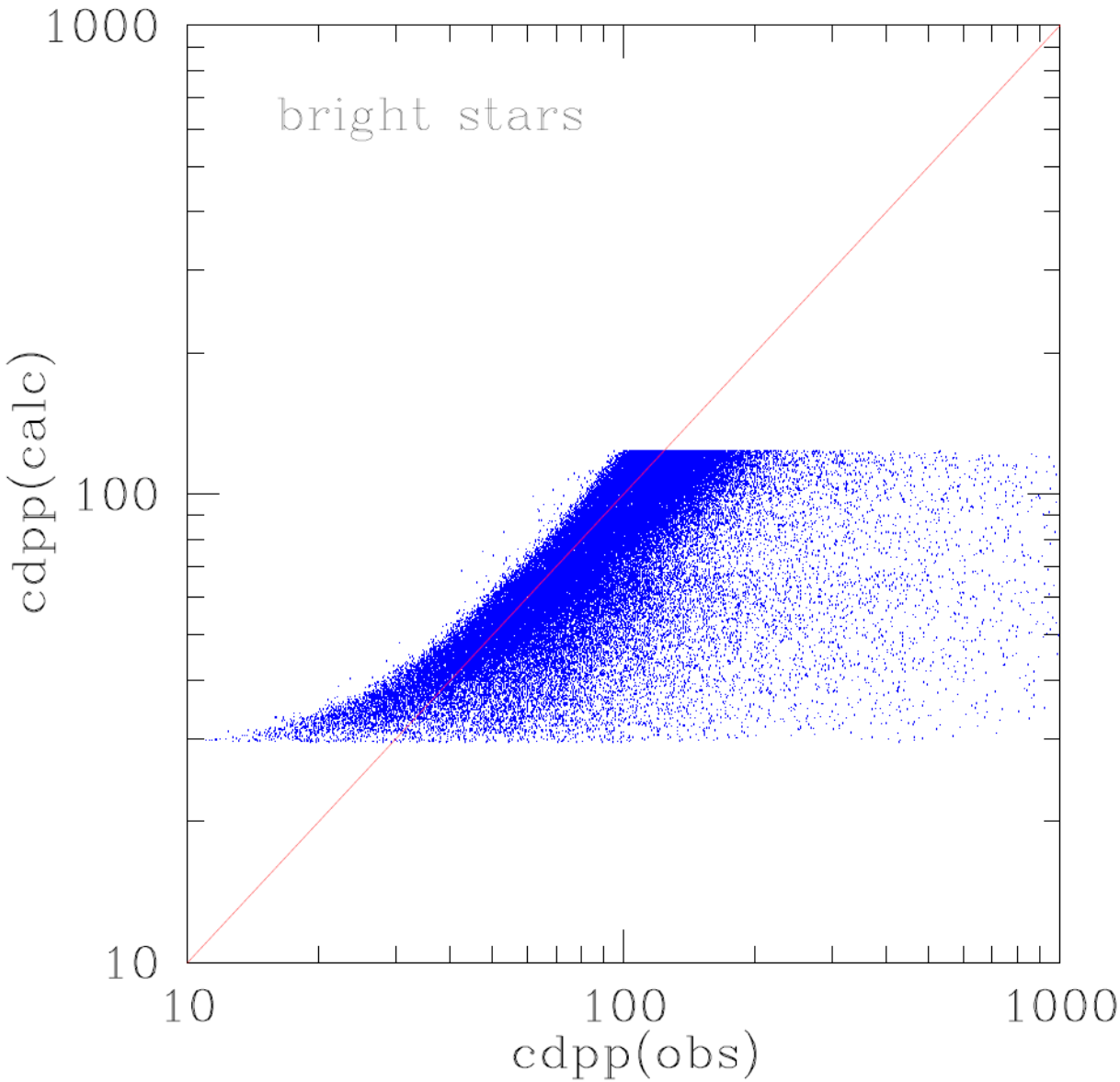
r(Earths)
obs.
calc.

Backup charts

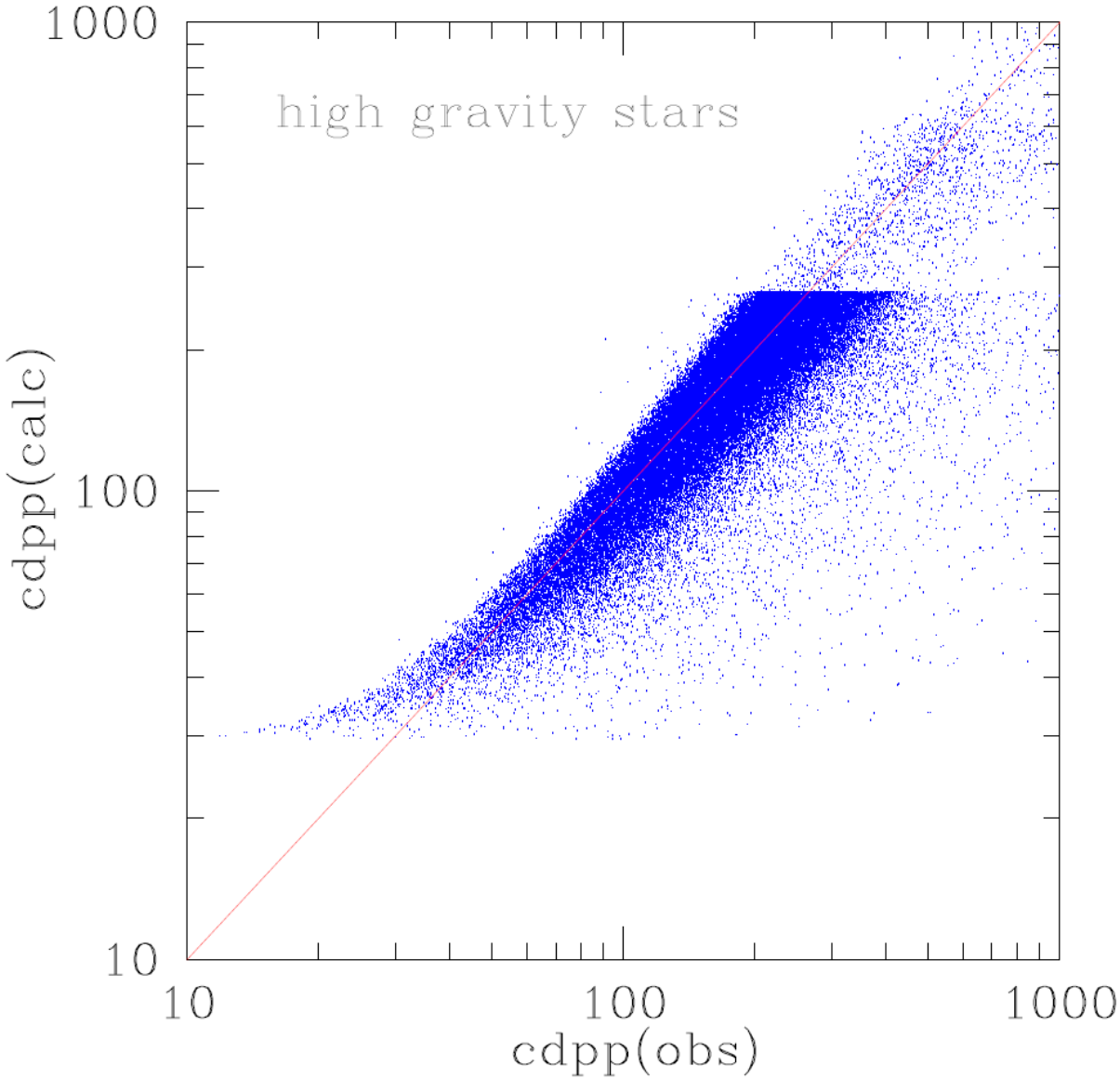
Crmsfaint 7/15



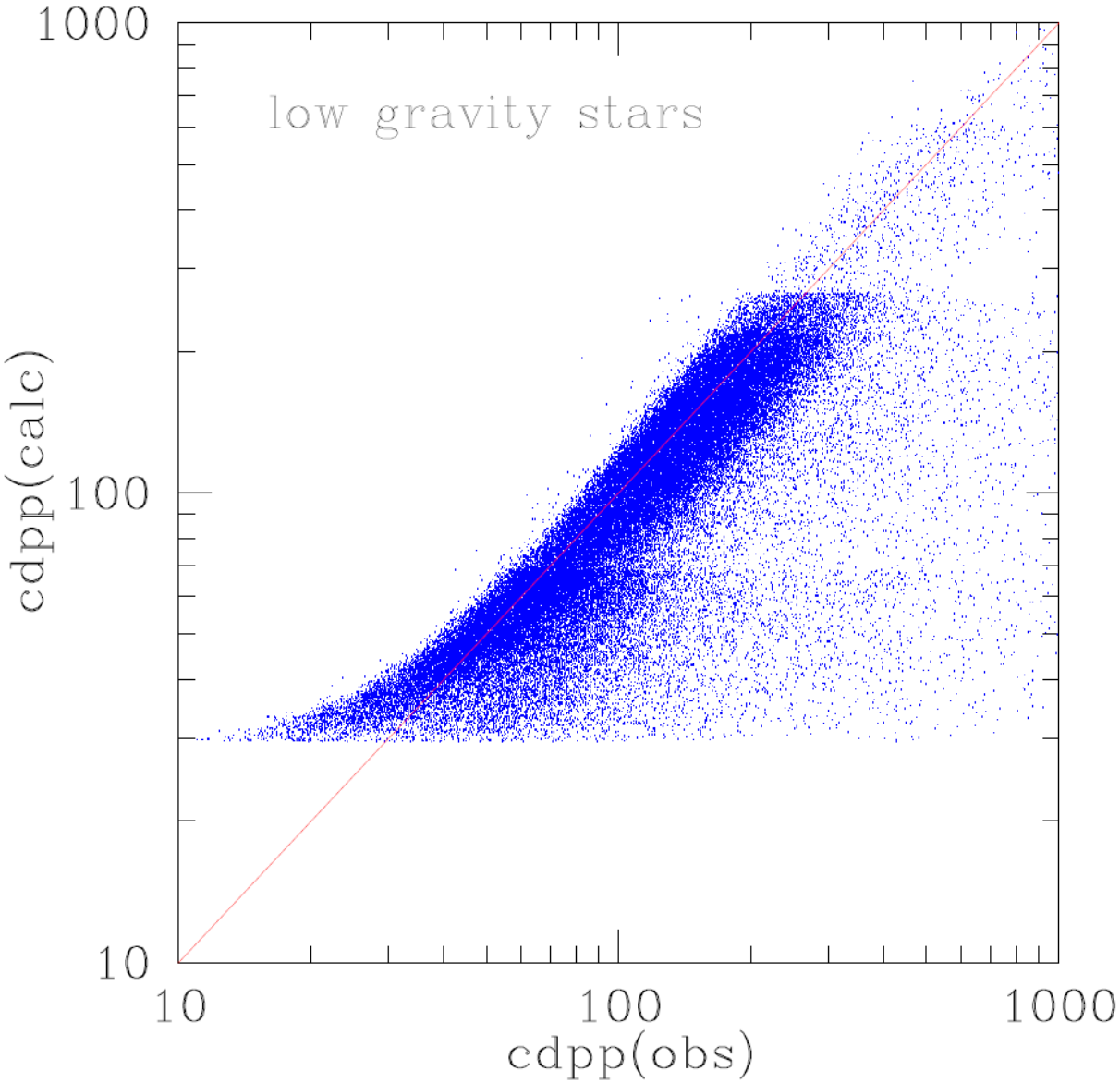
Crmsbright 7/15



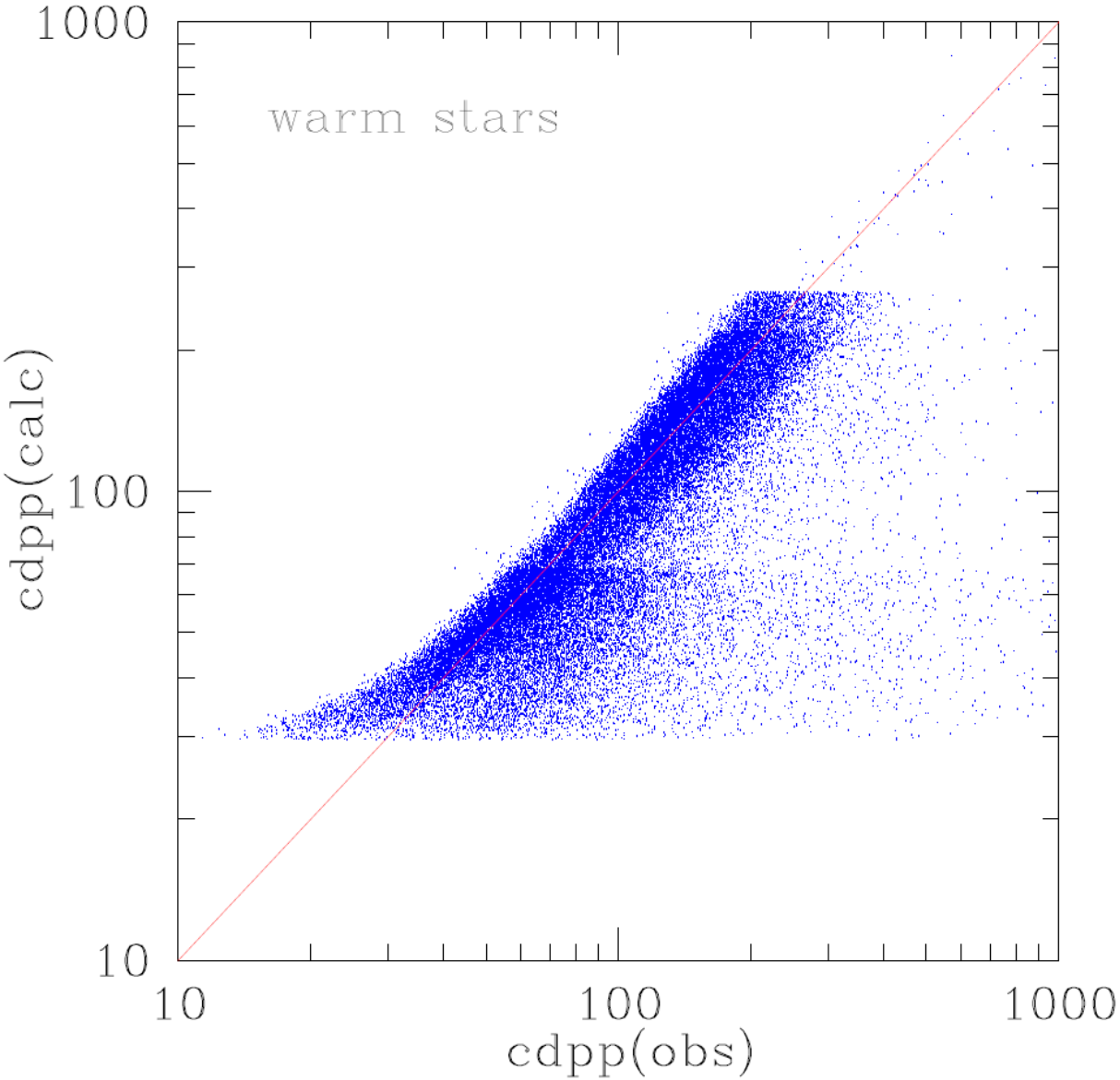
Crmshighg 7/15



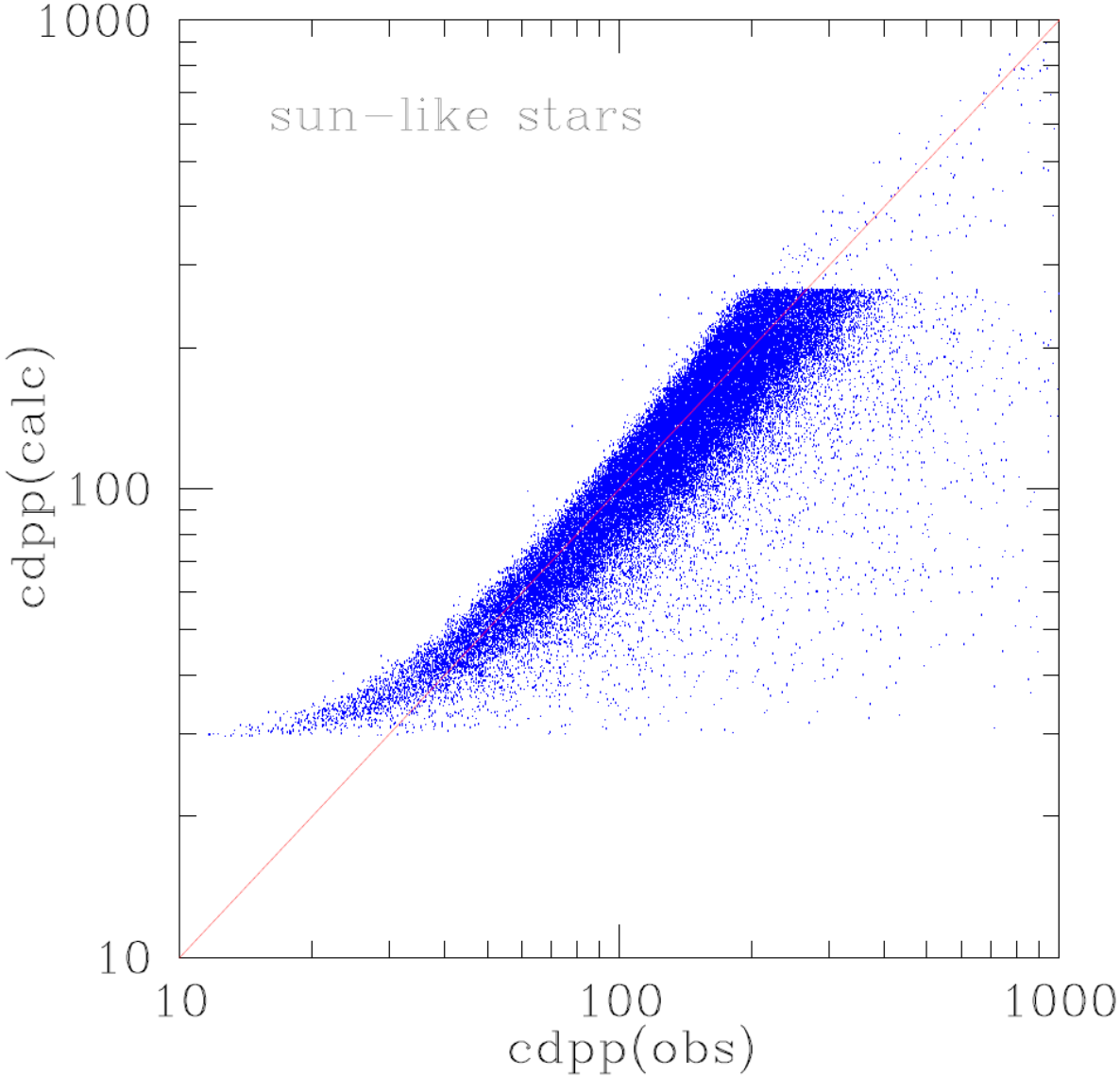
Crmslowg 7/15



Crmswarm 7/15



Crmssun 7/15



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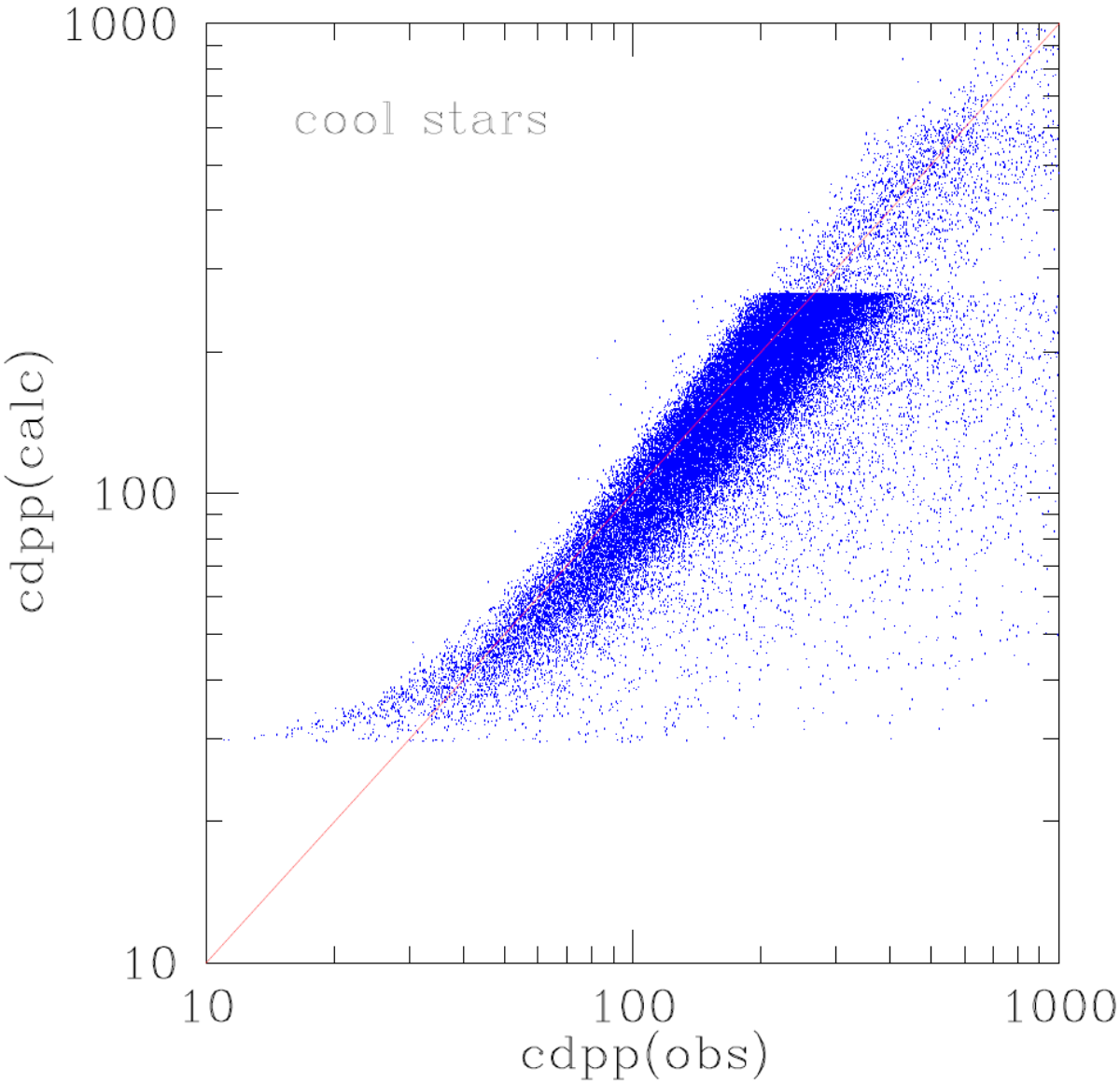
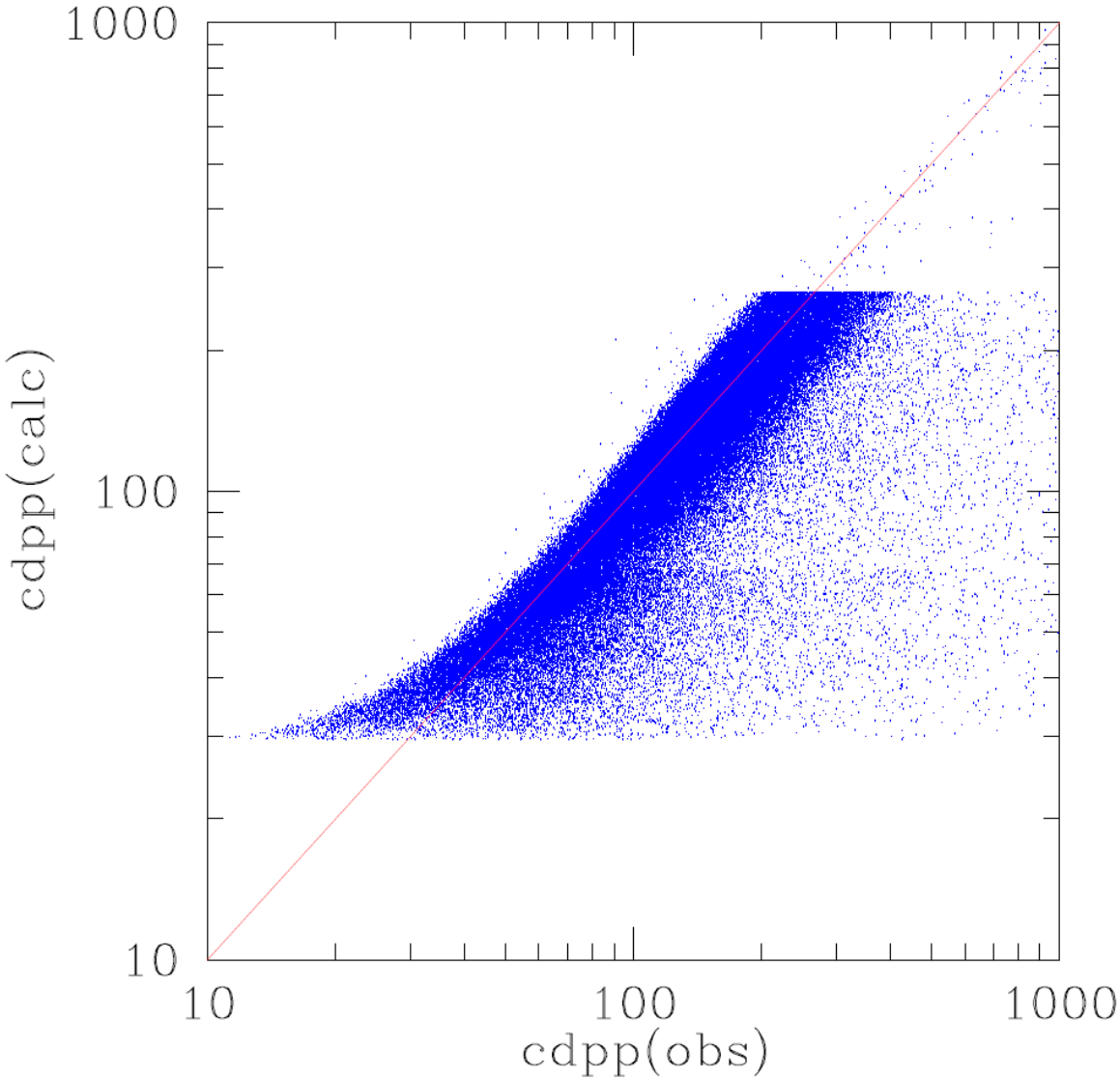
Crms2 7/15