Radial velocity detection of Exo-planets

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Detecting new earth

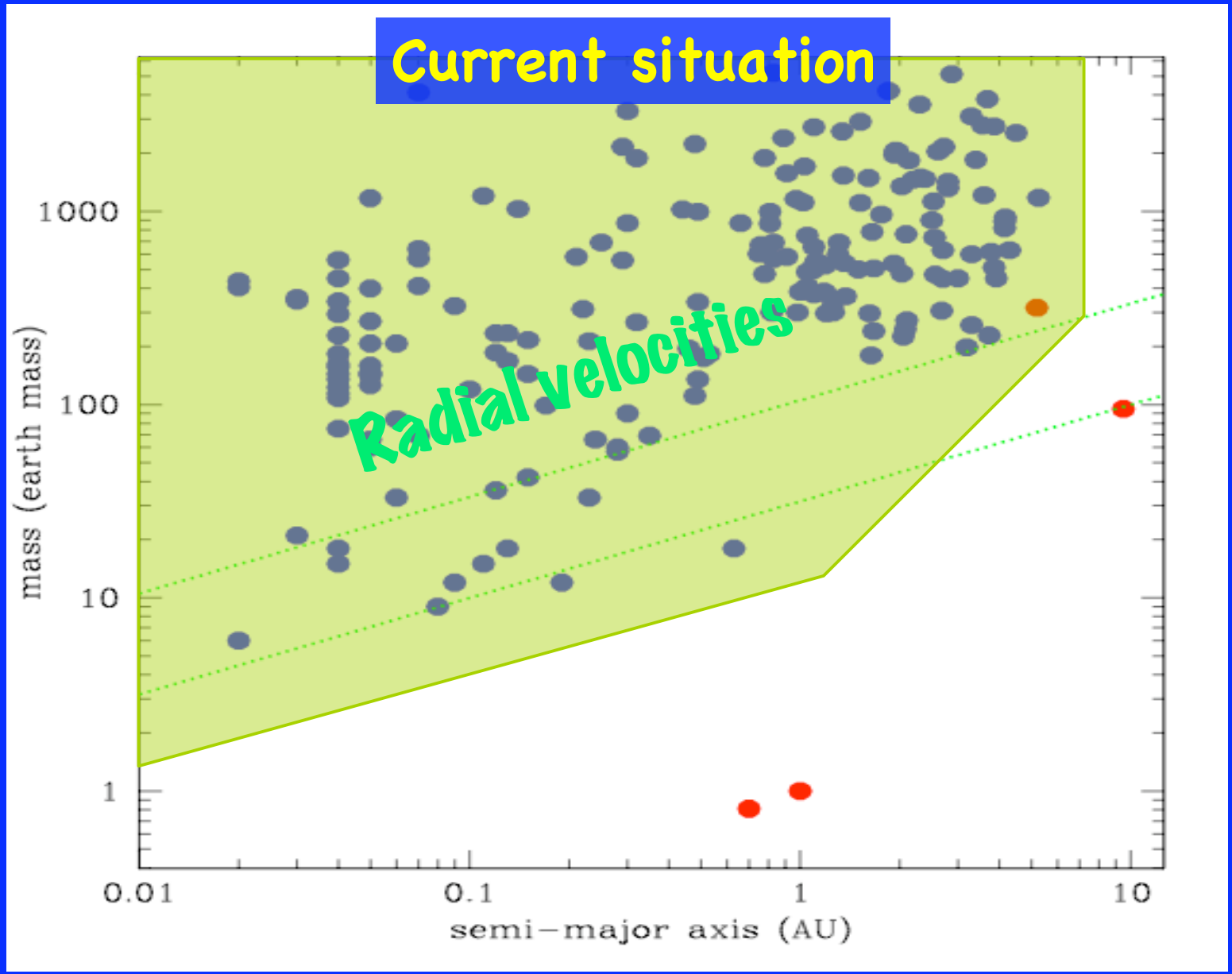
- Prime objective:

  search for earth mass planets with orbits shorter than 200 days on 50 old G and K stars.

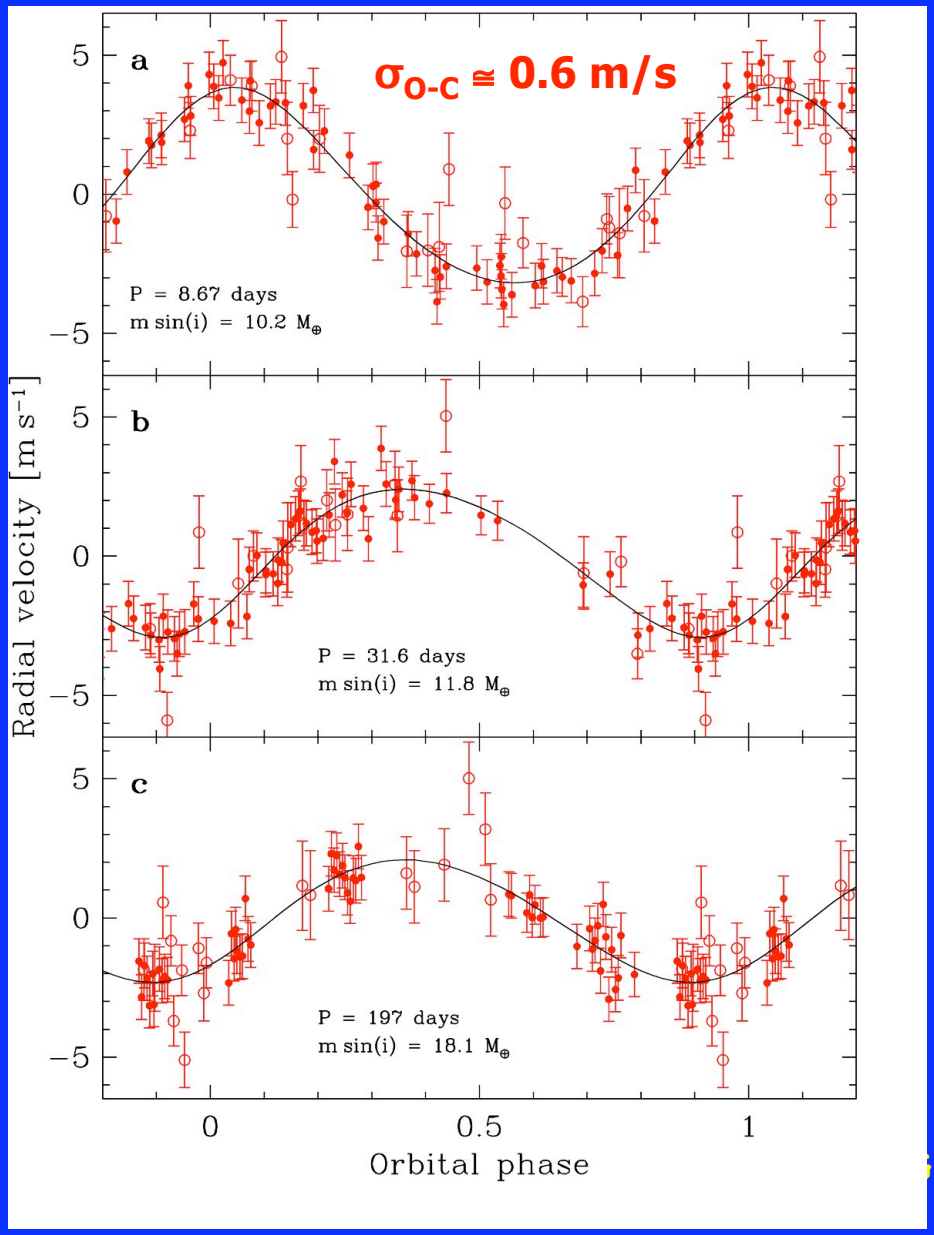
- telescope need:

  300 nights on 5 years

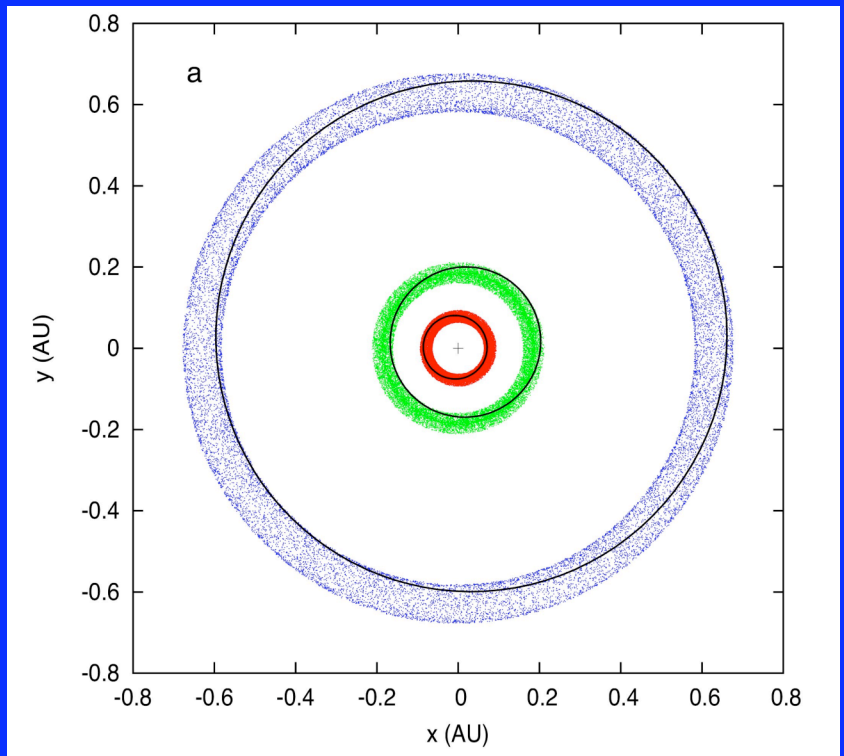
Current situation



HD 69830 – A test case …

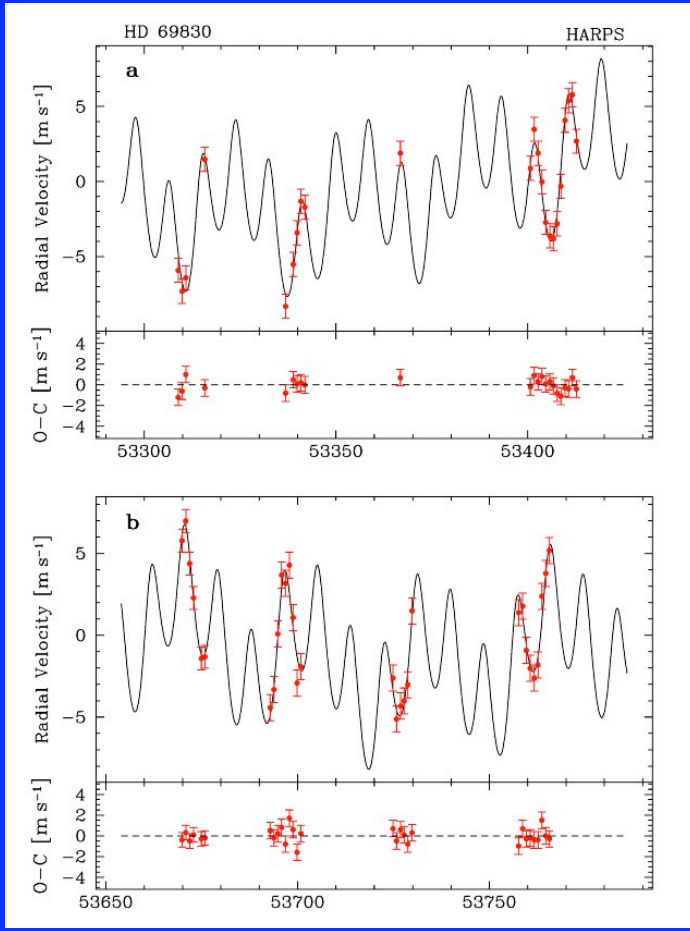


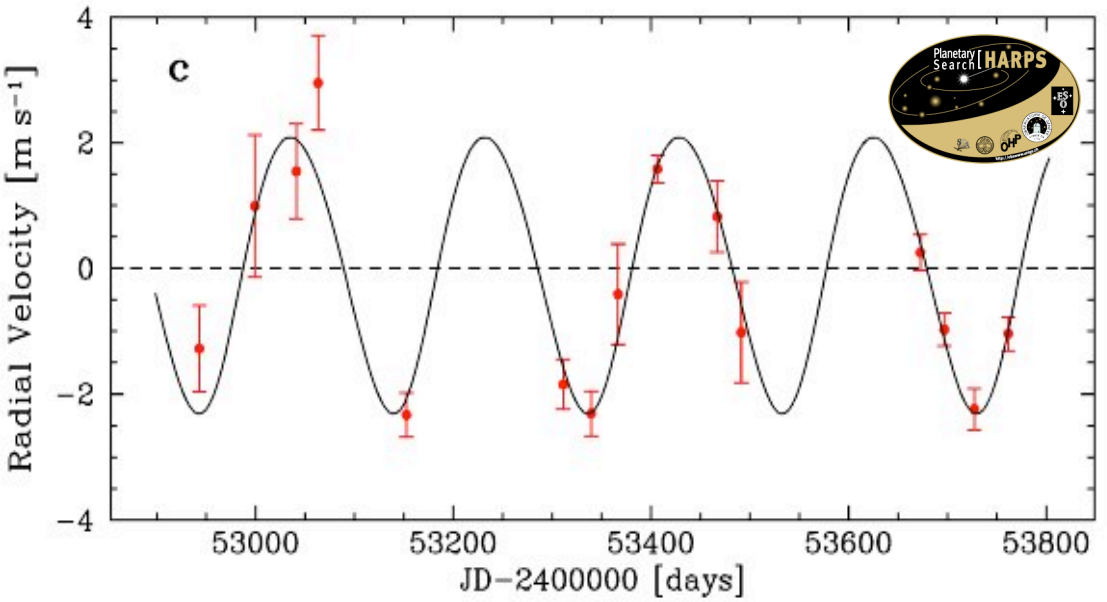
Lovis et al., Nature, 18 May 2006



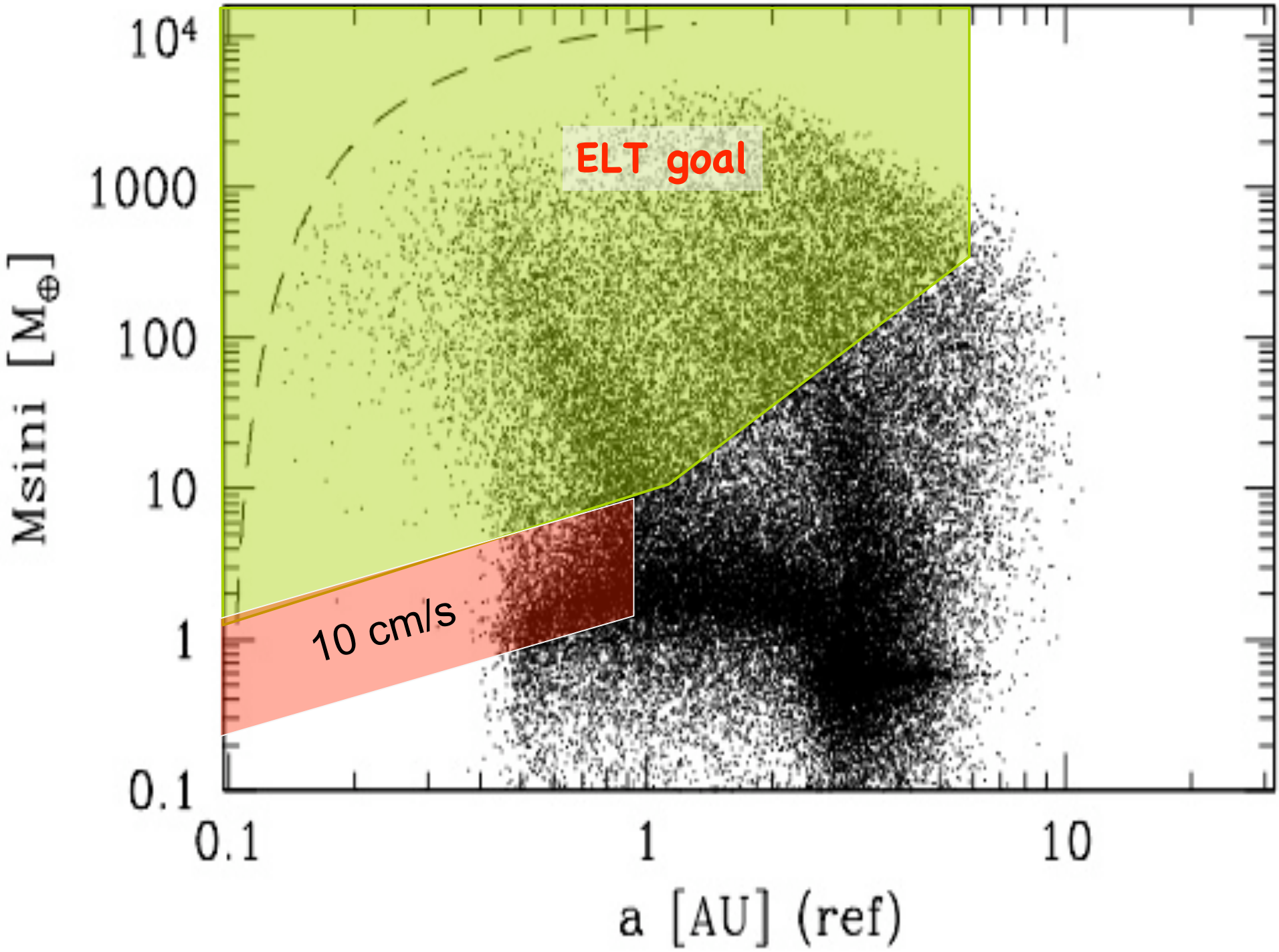
P1 = 8.67 days M sini = 10.2 M_{Earth}
P2 = 31.6 days M sini = 11.8 M_{Earth}
P3 = 197 days M sini = 18.1 M_{Earth}

HD 69830 – A test case …





20 cm/s *rms*


ELT goal
10 cm/s
Msini [M⊕]
10⁴
1000
100
10
1
0.1
0.1
1
10
a [AU] (ref)

Why ELT?

Photon Noise:
Extrapolating from HARPS results and taking into account that RV precision scales linearly
with the S/N ratio going from 1 m/s down to 3 cm/s will require 10^3 more photons!
We expect with ELT
5 cm/s precision in 30 min for a Vmag 9

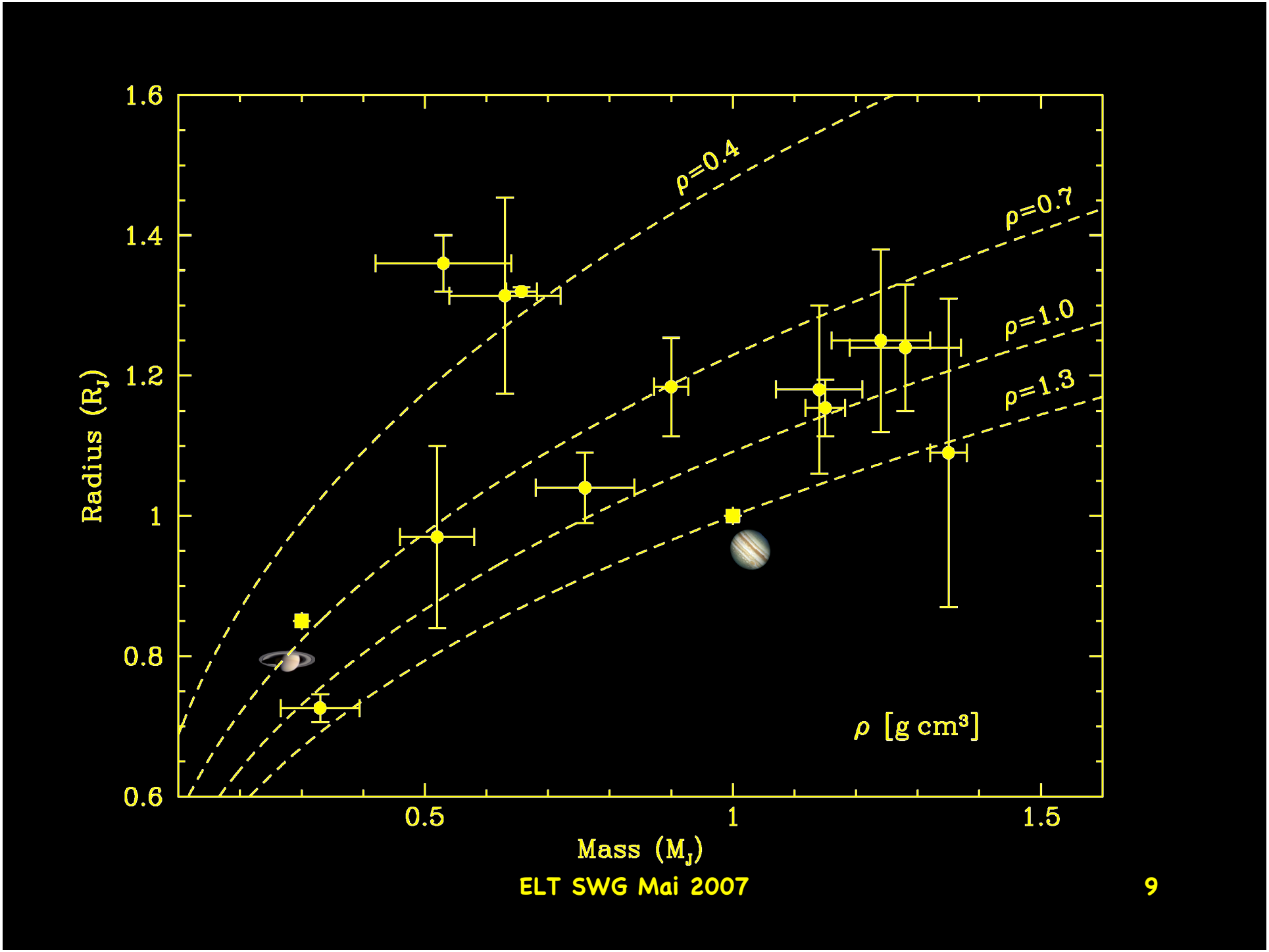
Astrophysical noise is the limit by level is yet unknown.
20 cm/s has been demonstrated. What about 5m/s?

Need of a precursor instrument on VLT !
-> ESPRESSO

Transiting planets

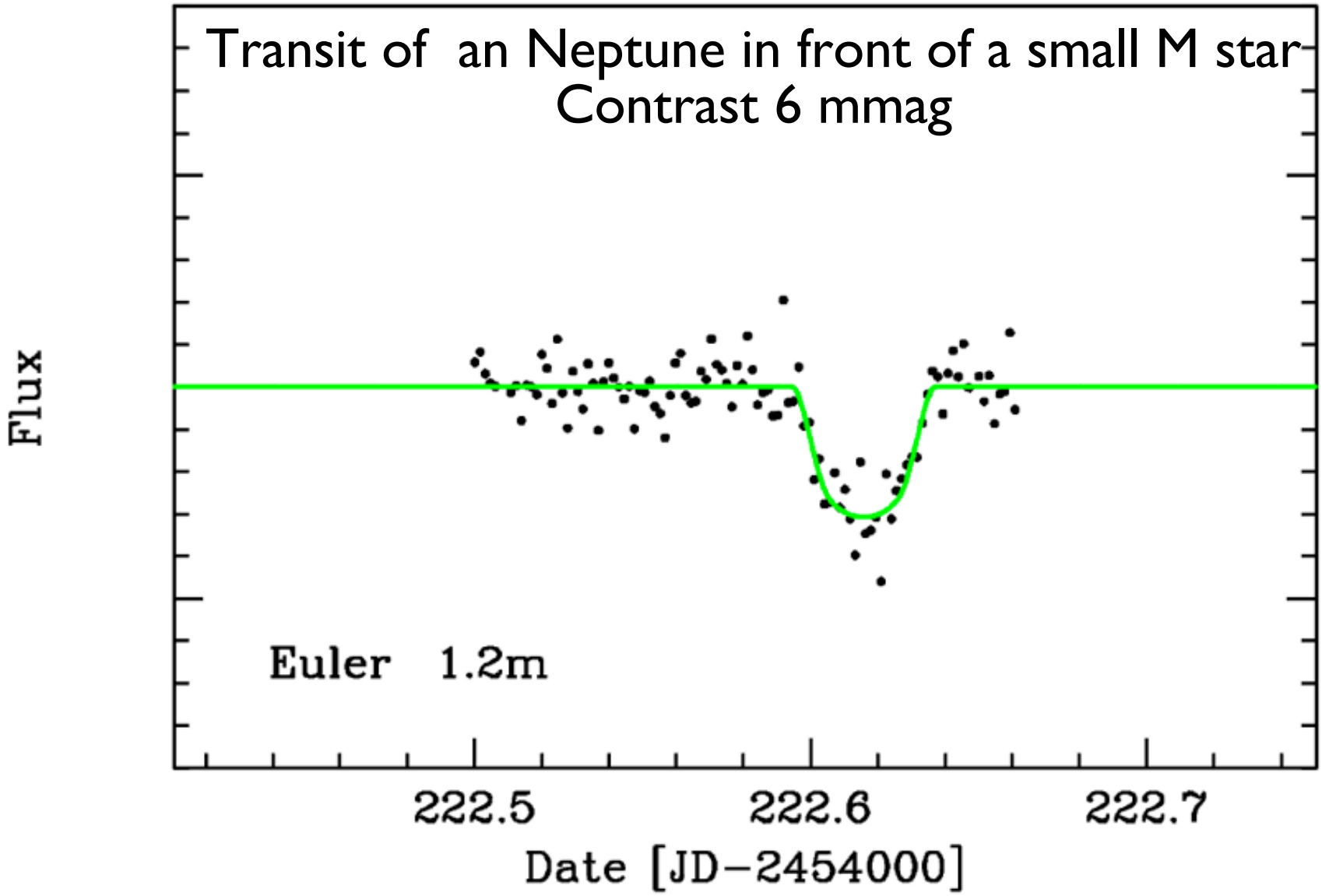
- Scientific goals:
  - measurements of mass and diameter of (small) transiting planets (detected from space)

- **Telescope need**
  shall depends on the number of objects...

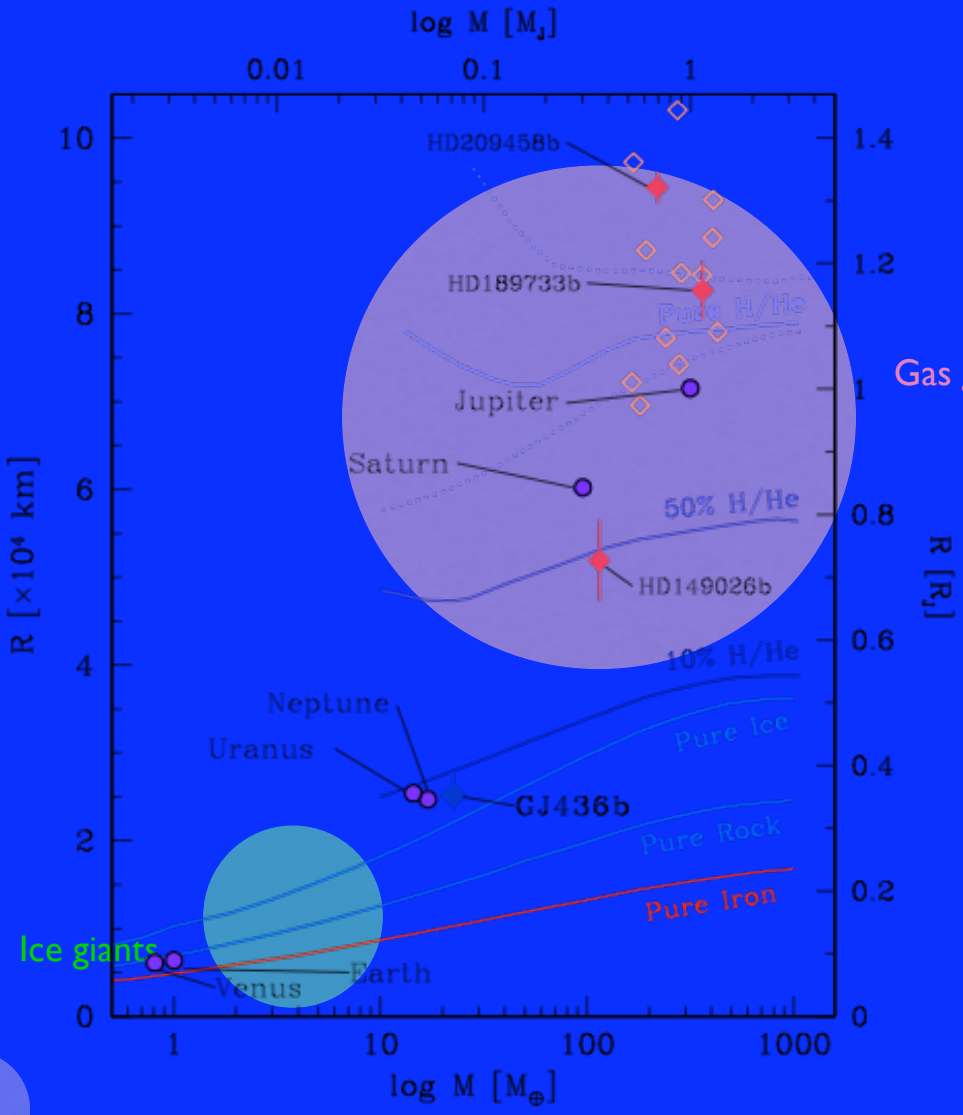

1.6
1.4
1.2
1
0.8
0.6
Radius (R_J)
0.5
1
1.5
Mass (M_J)
ρ=0.4
ρ=0.7
ρ=1.0
ρ=1.3
ρ [g cm³]

Transit curve of GJ 436 measured at La Silla (Chile)

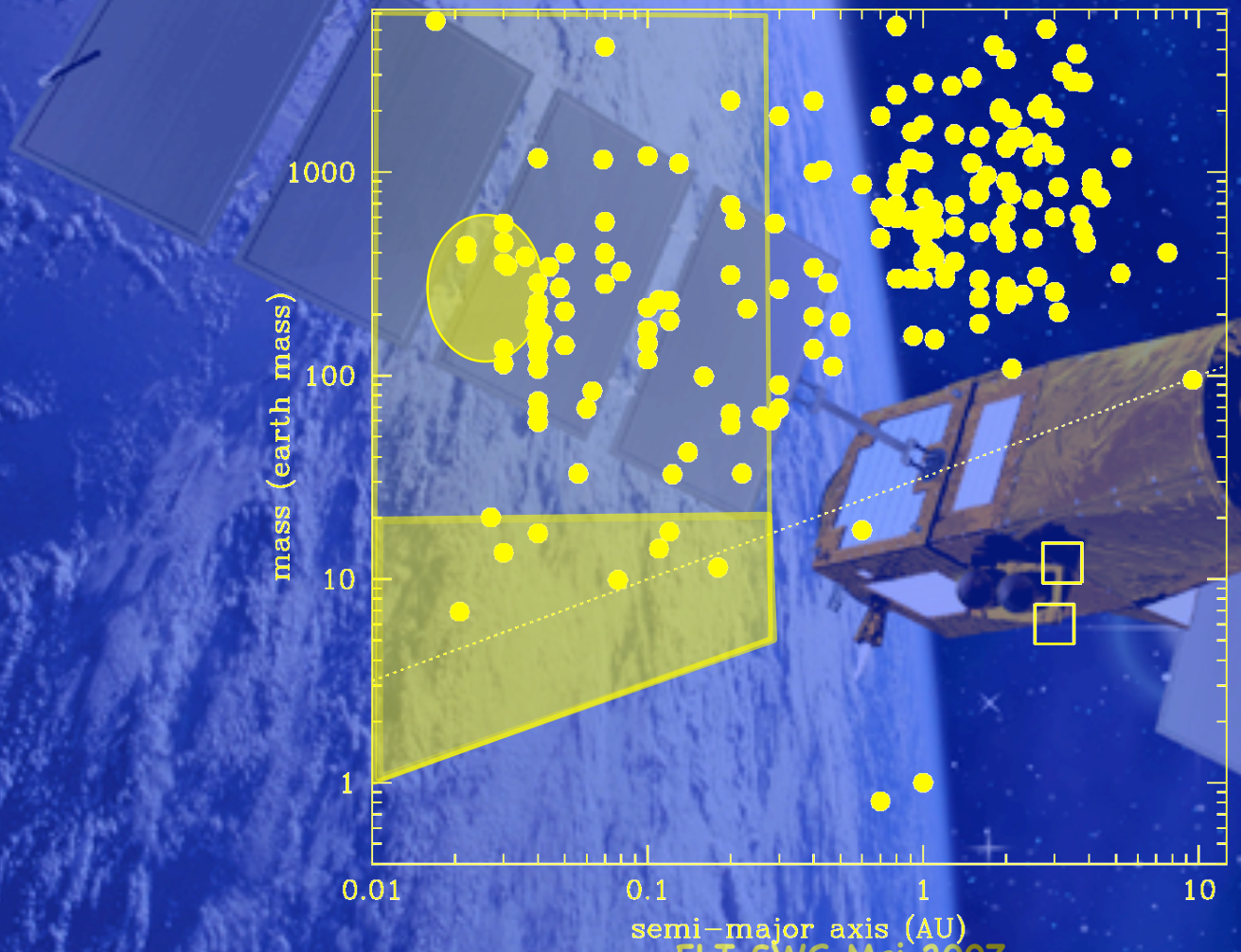
(Gillon et al. 2007 A&A in press)



The mass-radius diagram for planets



The COROT expectations



Neptune Mass object in in the Corot-Kepler era

Nbr of measurements scale with $2\sigma^2$!

	5 M_{earth}	10 M_{earth}	15 M_{earth}
F0 (1.60 Ms)	158	40	18
G0 (1.05 Ms)	104	26	14
K0 (0.79 Ms)	78	20	9
M0 (0.51 Ms)	50	13	6

Nb of Doppler measurements (1 m/s) need to constrain the mass (10% level) of transit detected planets at 0.1 AU