The radial velocity TATOOINE search for circumbinary planets

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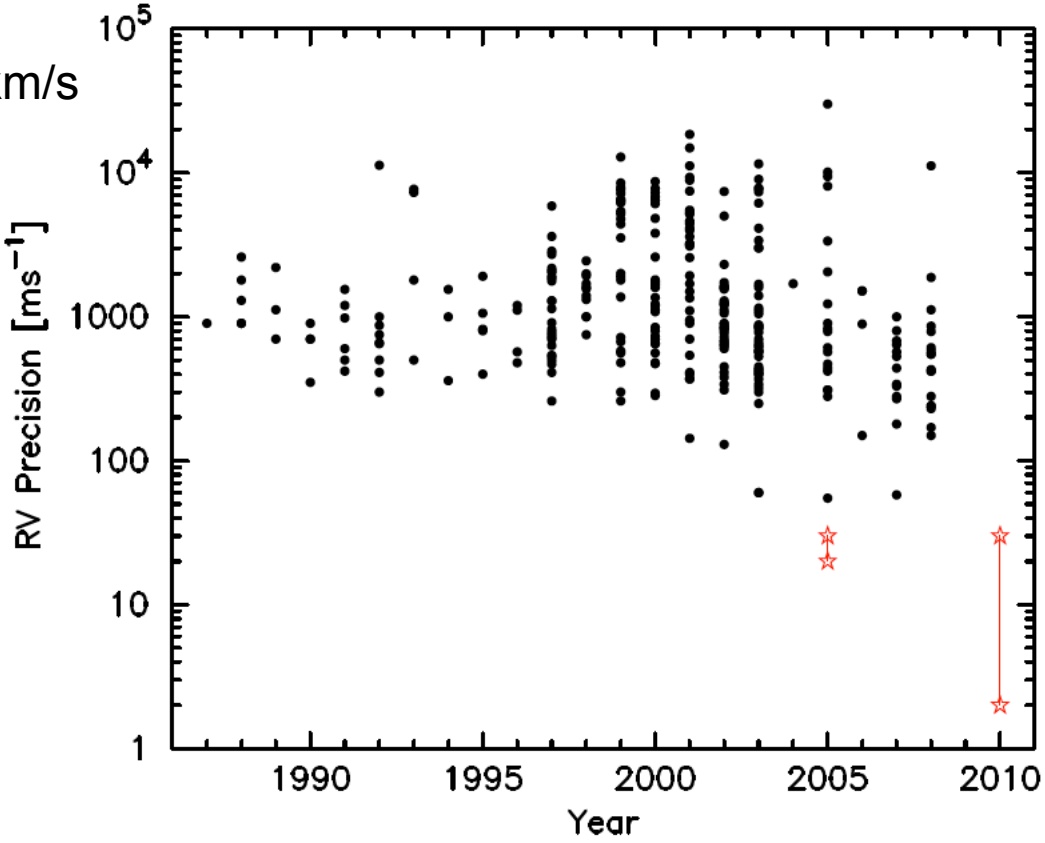
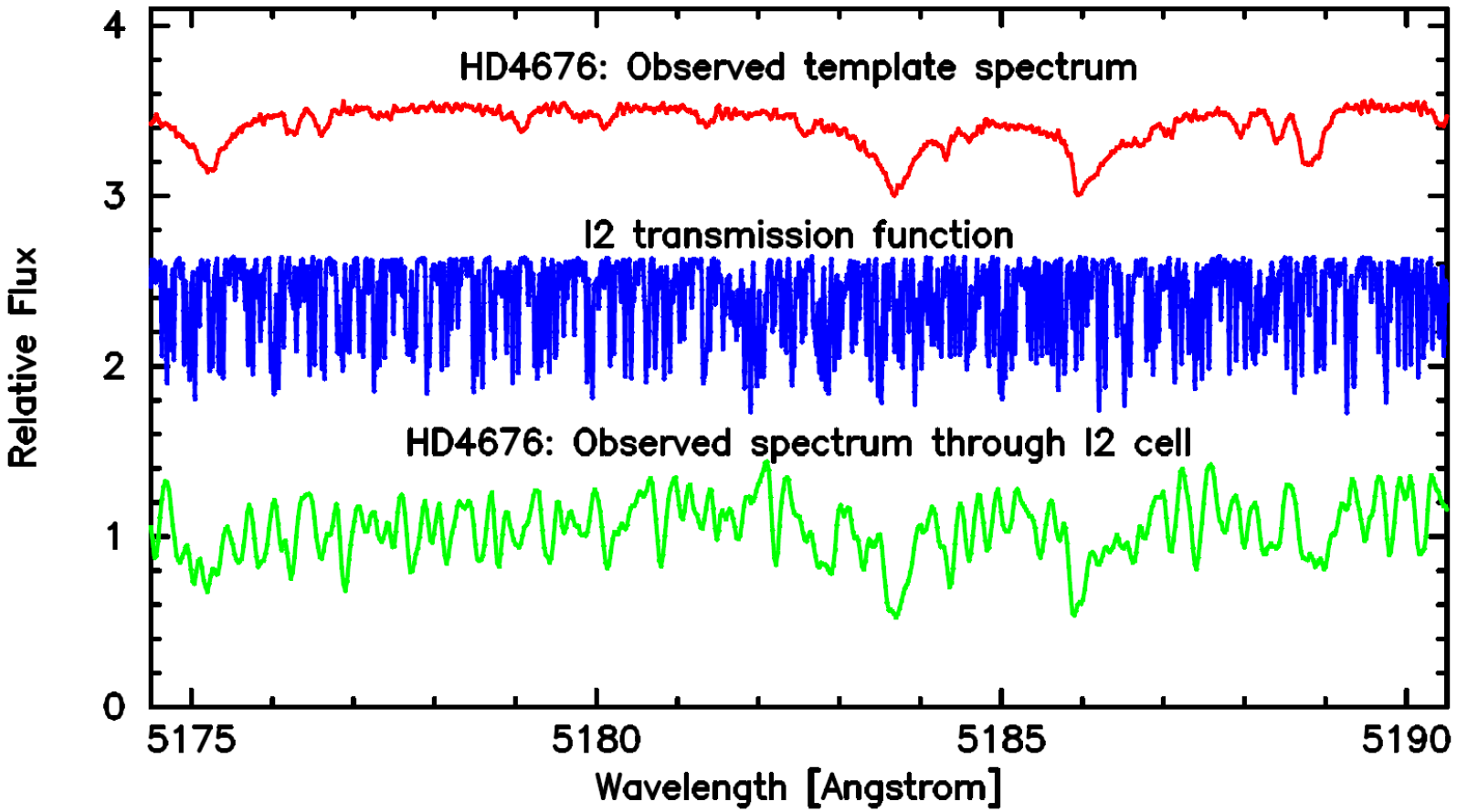
RVs of *double-lined* spectroscopic binaries

Pickering, 13 Nov 1889, SB2, Mizar
Vogel, 28 Nov 1889, SB1, Algol

Plummer et al, 1908,
HD83808, SB2,
RV precision of several km/s



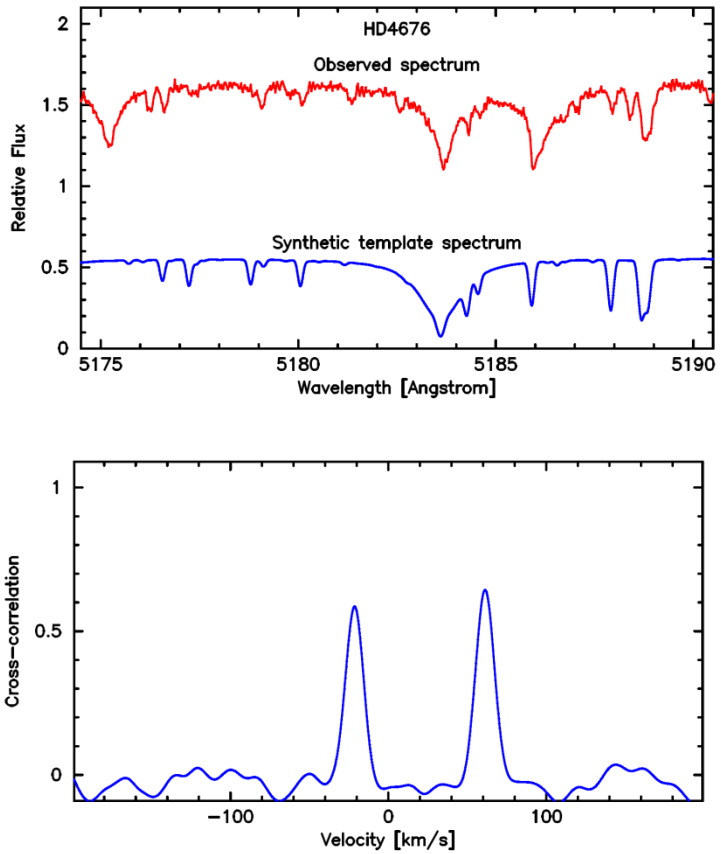
Iodine cell technique

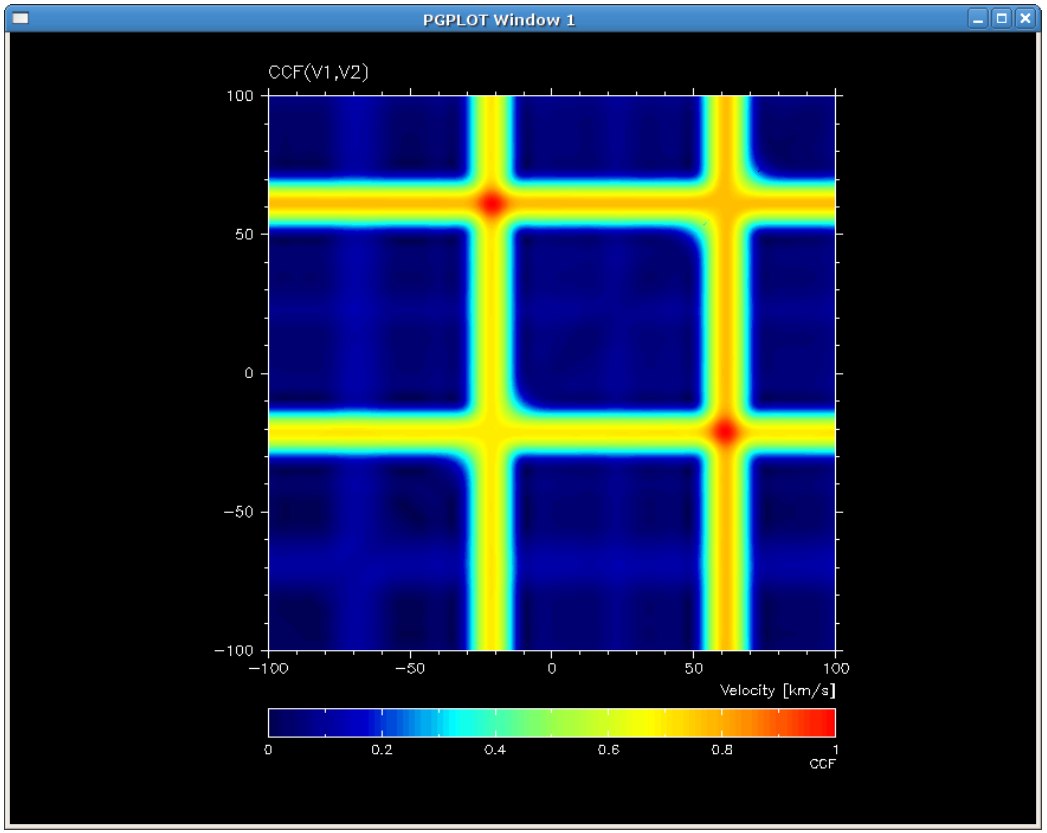


Binary star iodine cell technique (Konacki, 2005, ApJ)

Two-dimensional cross-correlation: TODCOR

Zucker & Mazeh 1994

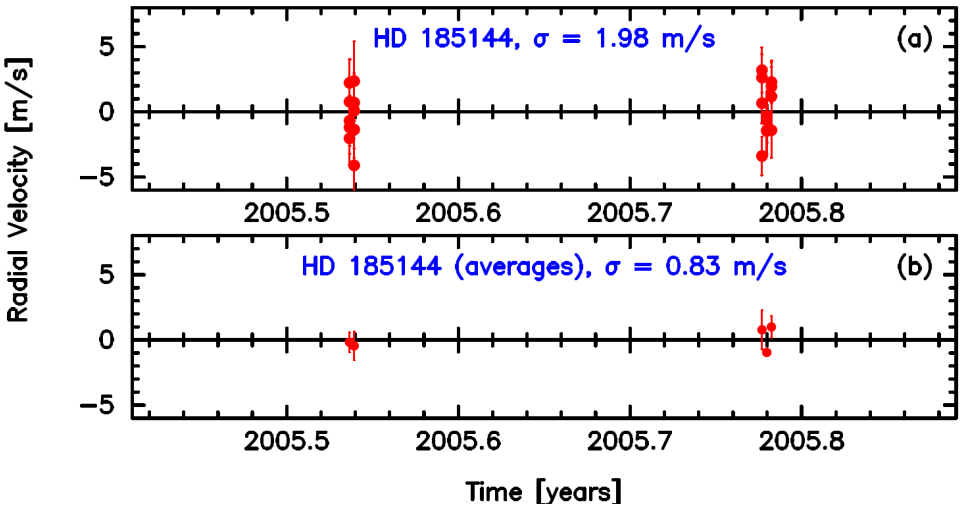




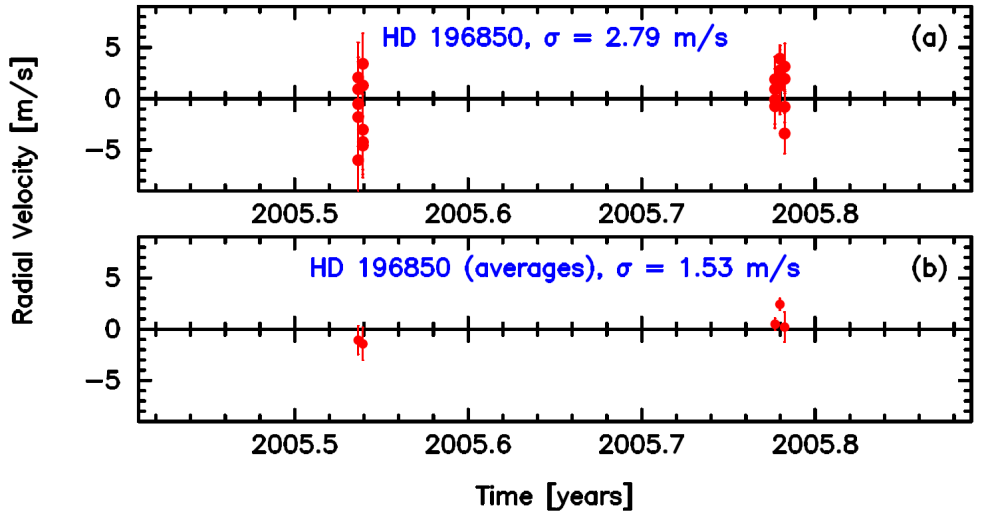
Typical binary star RV precision: 20-30 m/s (Konacki, 2005, ApJ)

Completely new RV data pipeline

HD185144, V=4.7, K0V
SNR ~600 per pixel
Time span: 3 months

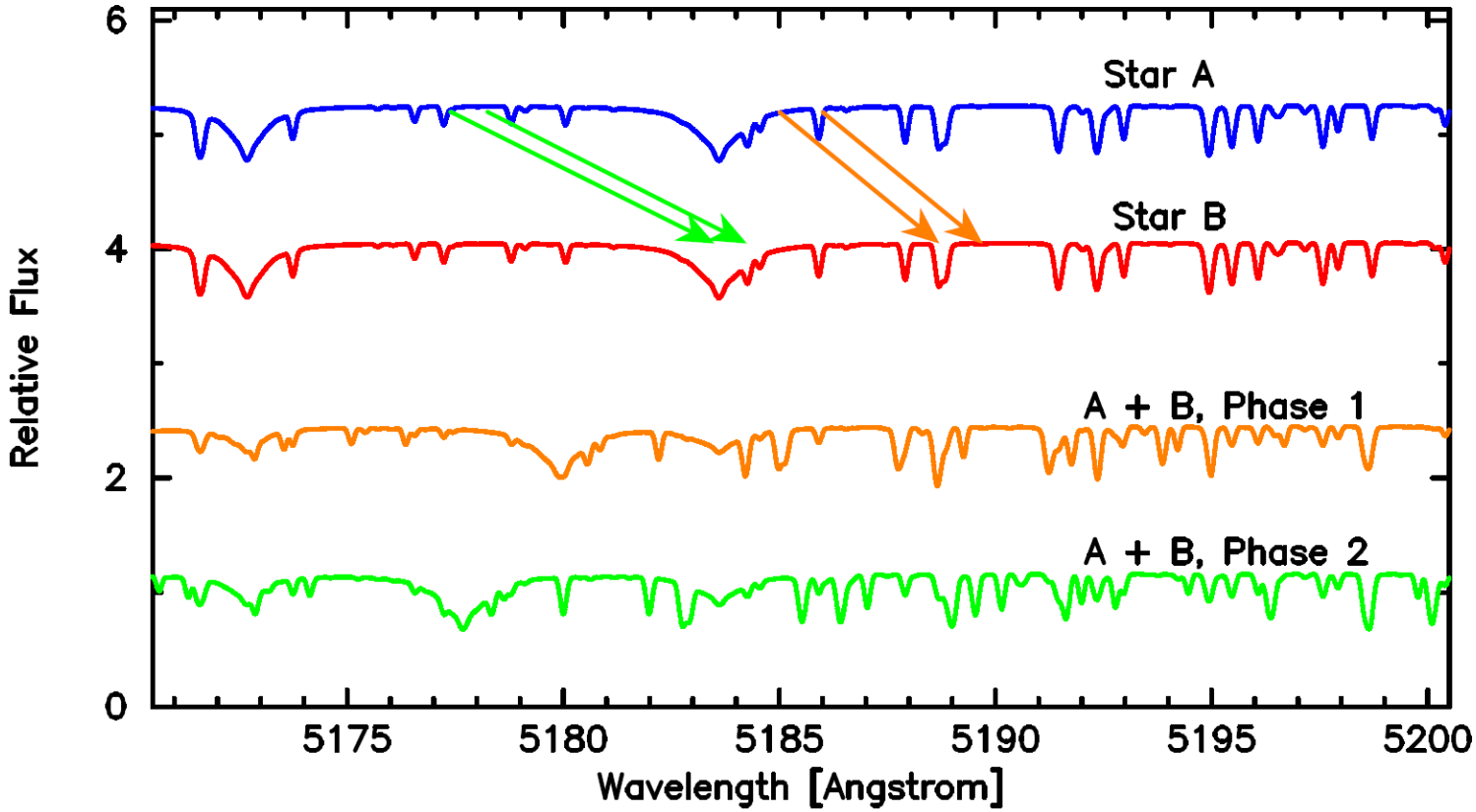


HD196850, V=6.8, G0V
SNR ~600 per pixel
Time span: 3 months



RV precision of ~1 m/s for single stars

Tomographic disentangling of spectra



Idea: Bagnuolo & Gies 1991

Numerical realization: Konacki et al 2010, ApJ, submitted, astroph/0910.4482

The method will also work on spectra from non-iodine spectrographs such as HARPS

The TATOOINE search for circumbinary planets

The Attempt To Observe Outer-planets In Non-single-stellar Environments

M. Konacki, M. Muterspaugh, A. Howard, S. Brown, K. Helminiak

Northern Hemisphere:

2003-2007 Keck/HIRES
2006-2007 TNG/SARG (Canary Islands)
2006- 3-m/0.9-m/Hamspec (Lick Observatory)
in collaboration with Matt Muterspaugh (TSU)

Total sample: ~50 SB2s (mostly non eclipsing, for now) and increasing

Time span varies ~1-6 years

Southern Hemisphere:

SALT/HRS (South Africa, Polish share 10%) ~2011?

HD78418

G5IV-V
V = 5.9 mag

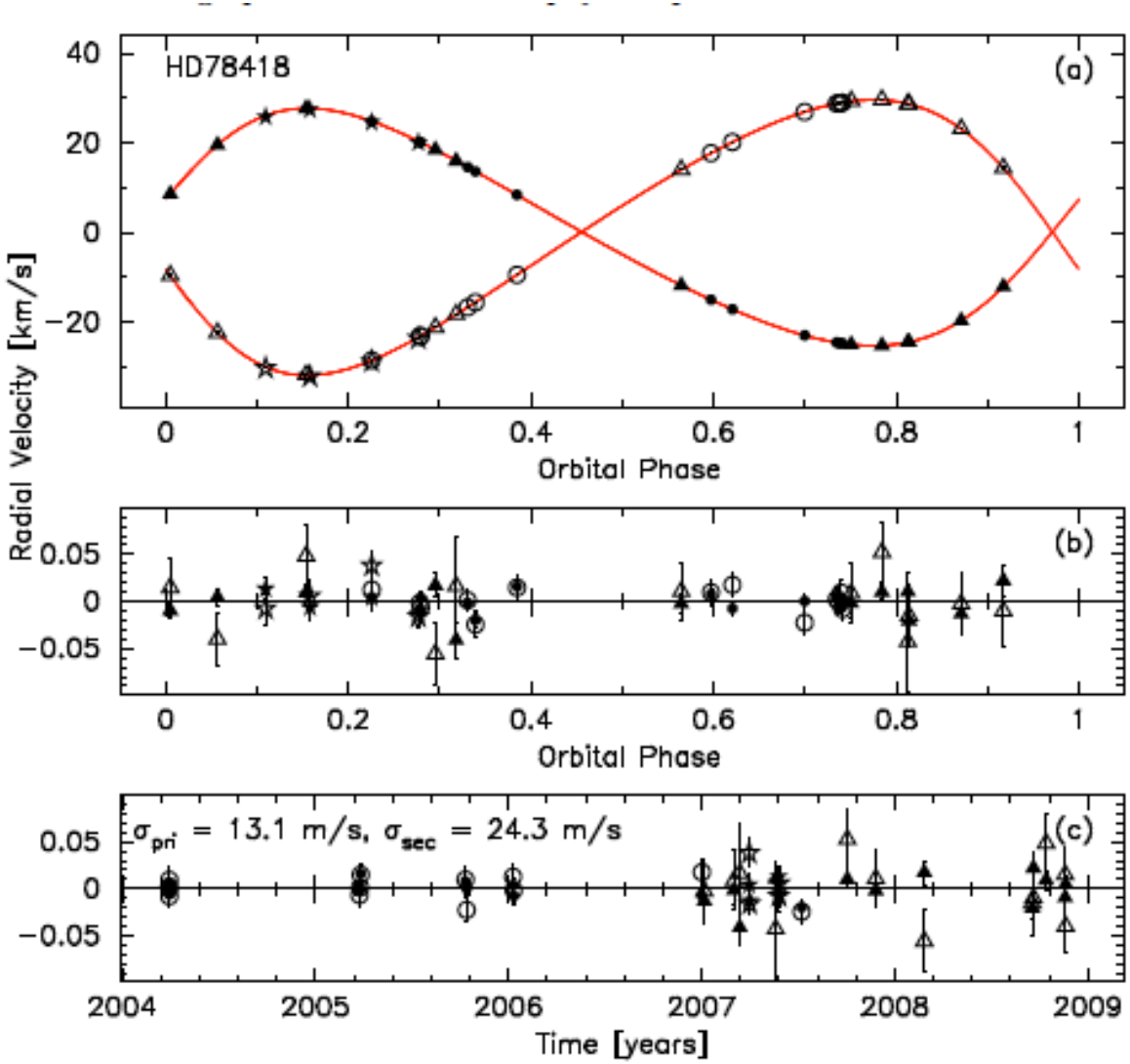
P = 19.4 days
e = 0.20
K_1 = 26.8 km/s
K_2 = 30.7 km/s

Keck I/HIRES:
SNR ~250 per pixel
r = 2.3

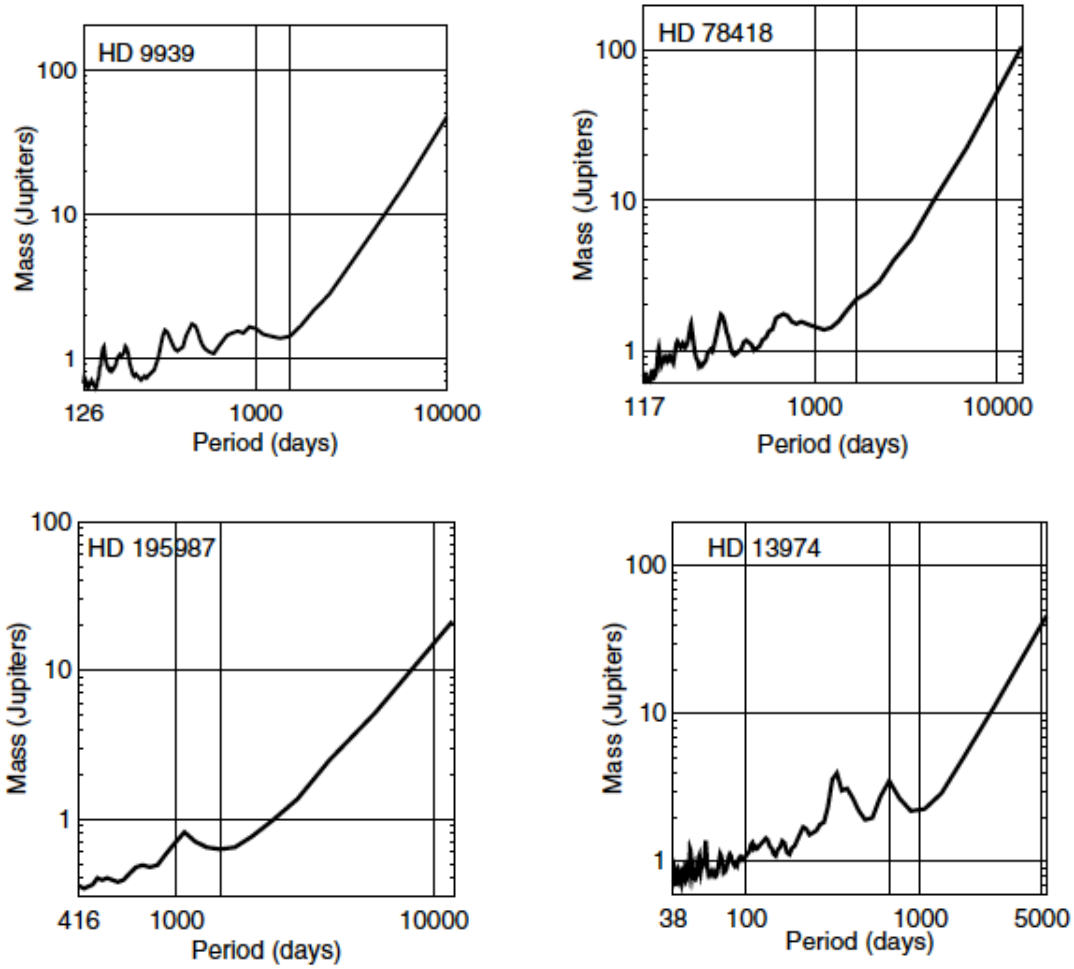
SNR primary ~175
SNR secondary ~75

RMS primary 6.9 m/s
RMS secondary 14.3 m/s

Total:
58 measurements
Time span: 5 years



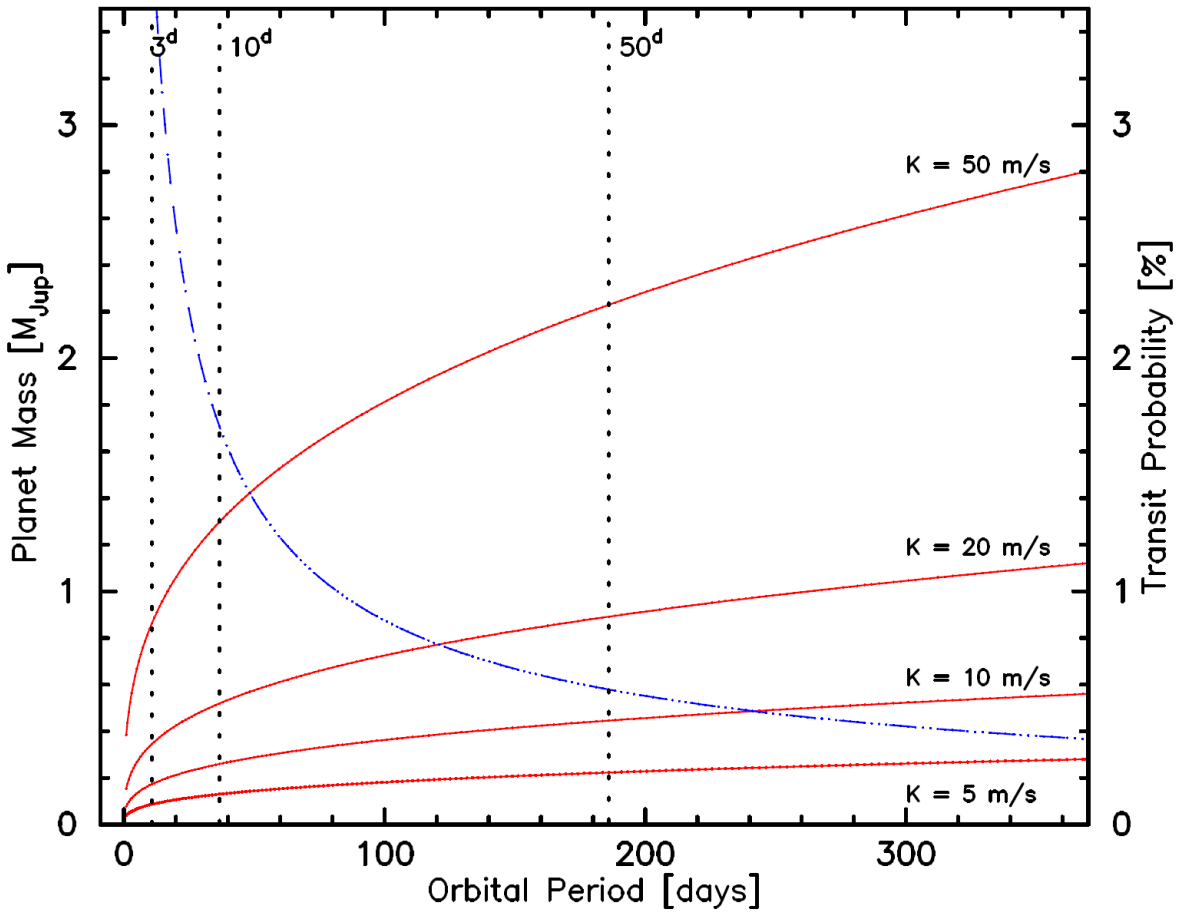
Limits to circumbinary planets



Konacki, Muterspaugh, Kulkarni, Helminiak, 2009, ApJ

Prospects for spectroscopic follow-up of transiting circum(eclipsing)binary planetary candidates

1 M_{Sun} + 1 M_{Sun}

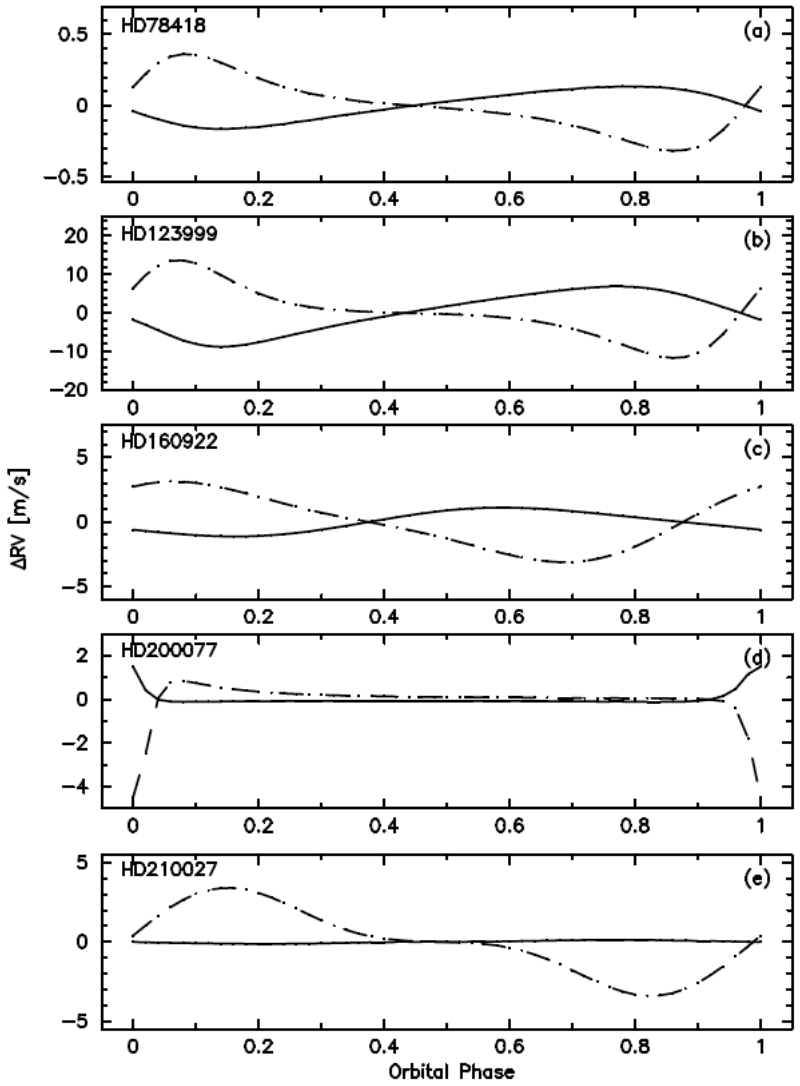


Konacki, IAU 253, 2009

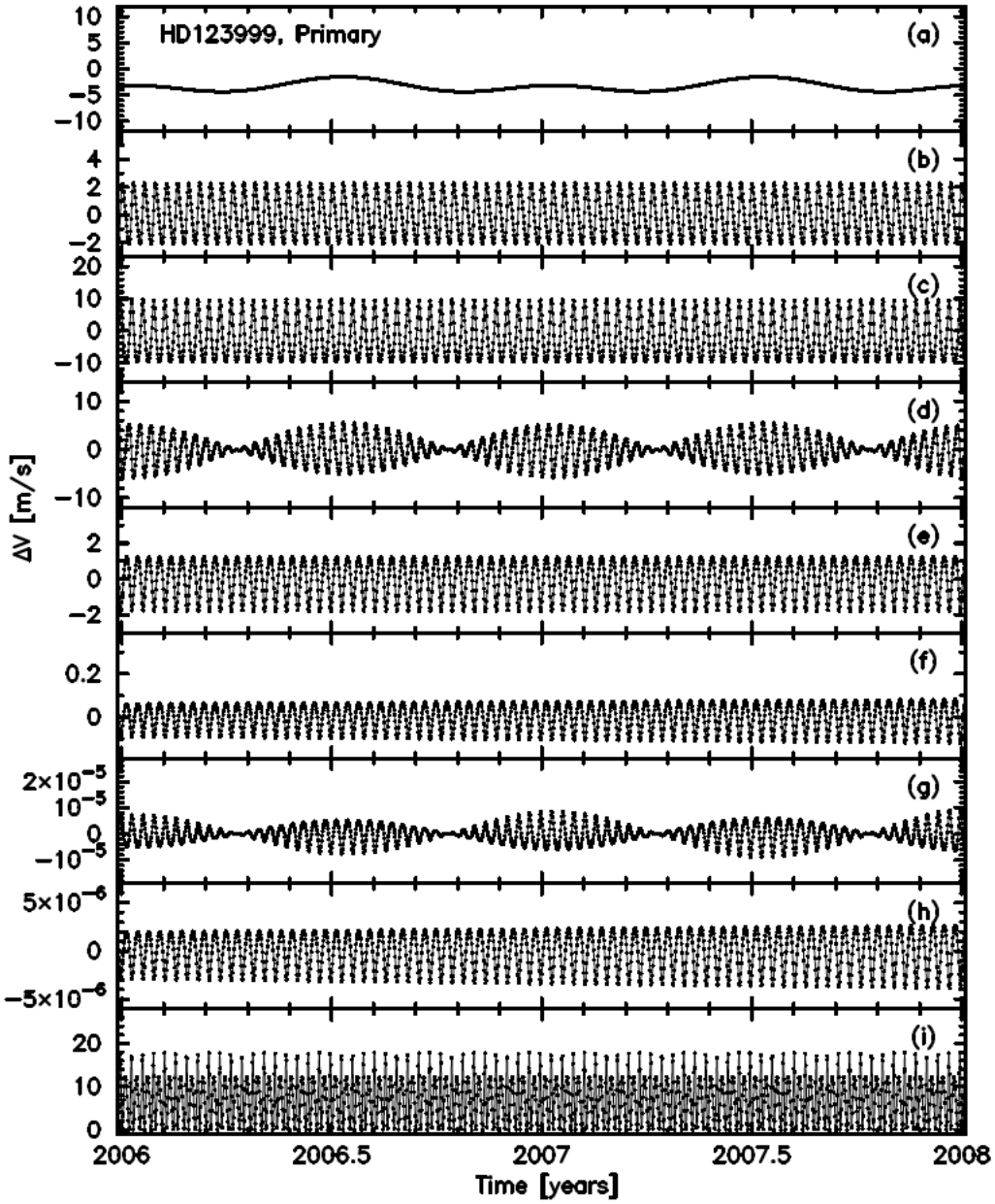
Palomar Testbed Interferometer (PTI)

NS 110 m
NW 86 m
SW 87 m
K (2.2 μm), H (1.6 μm)

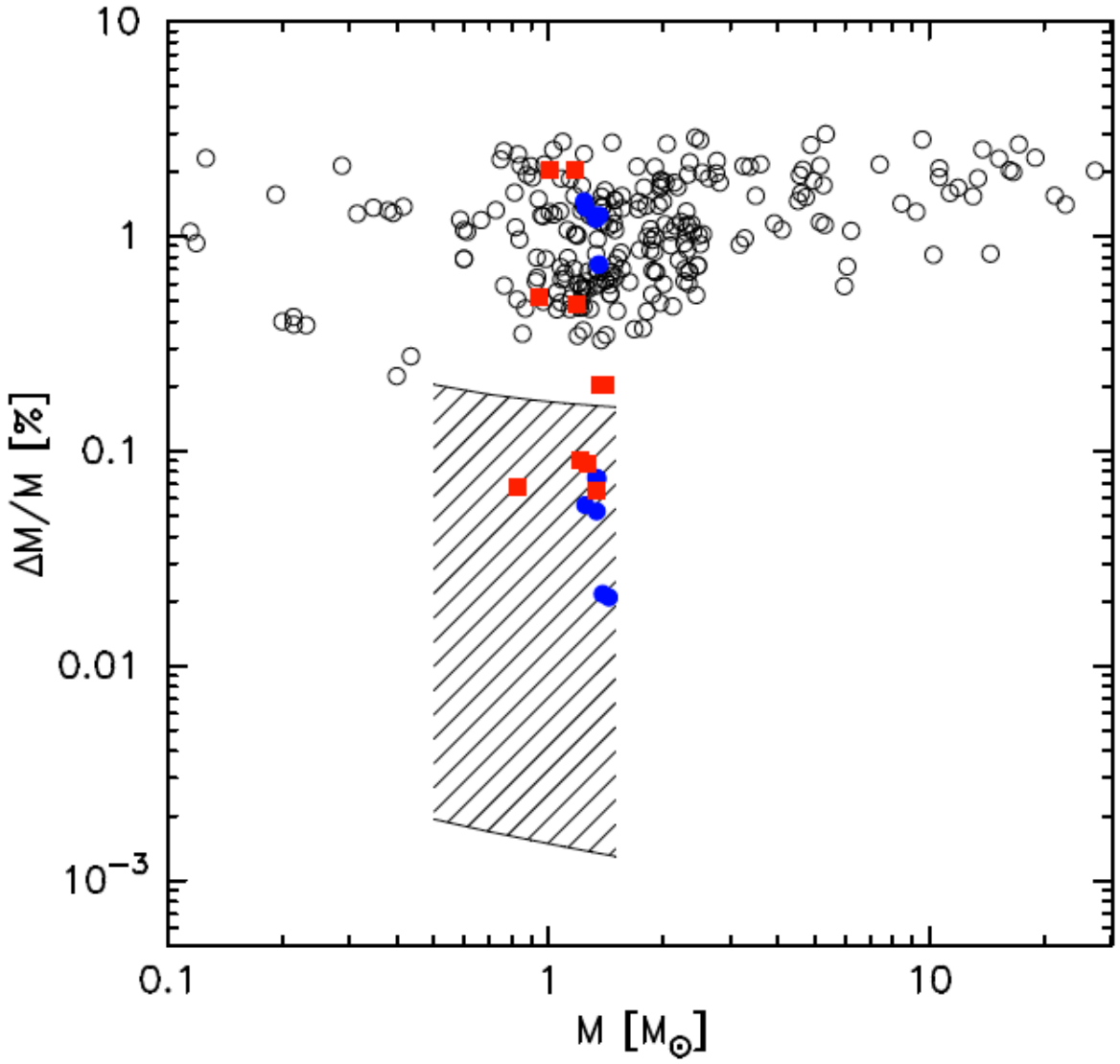
Tidal distortion effects



Relativistic effects

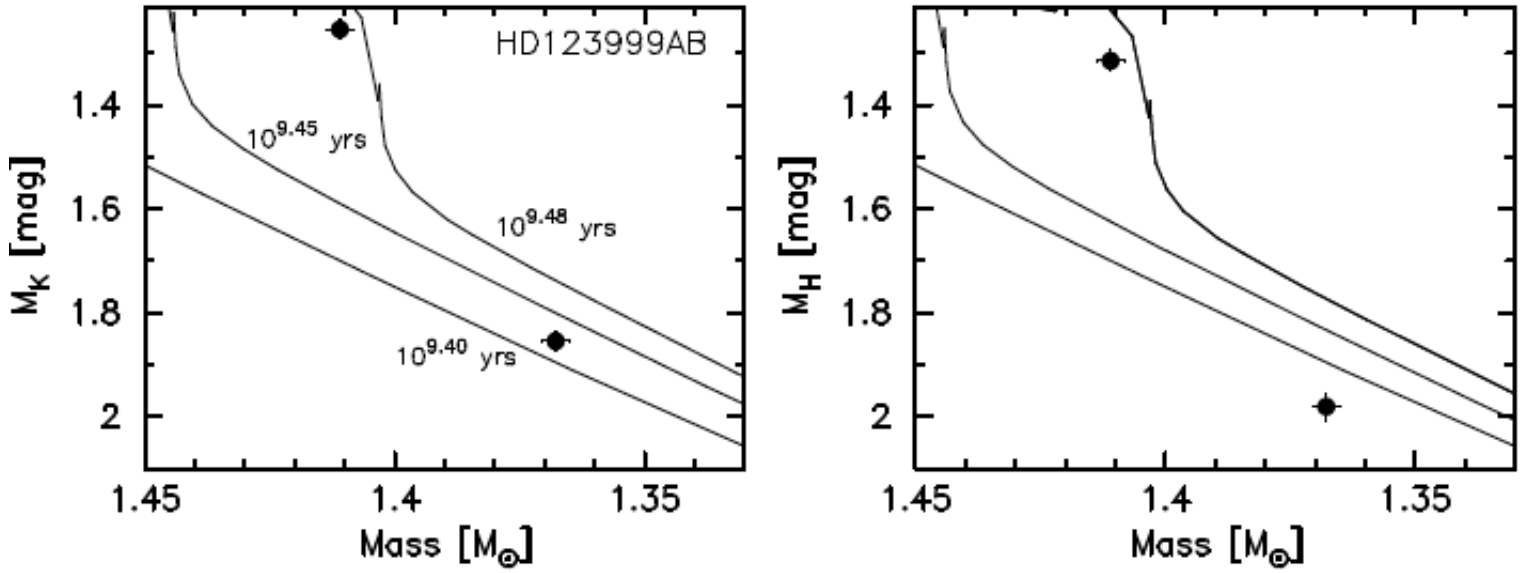


High precision stellar astronomy



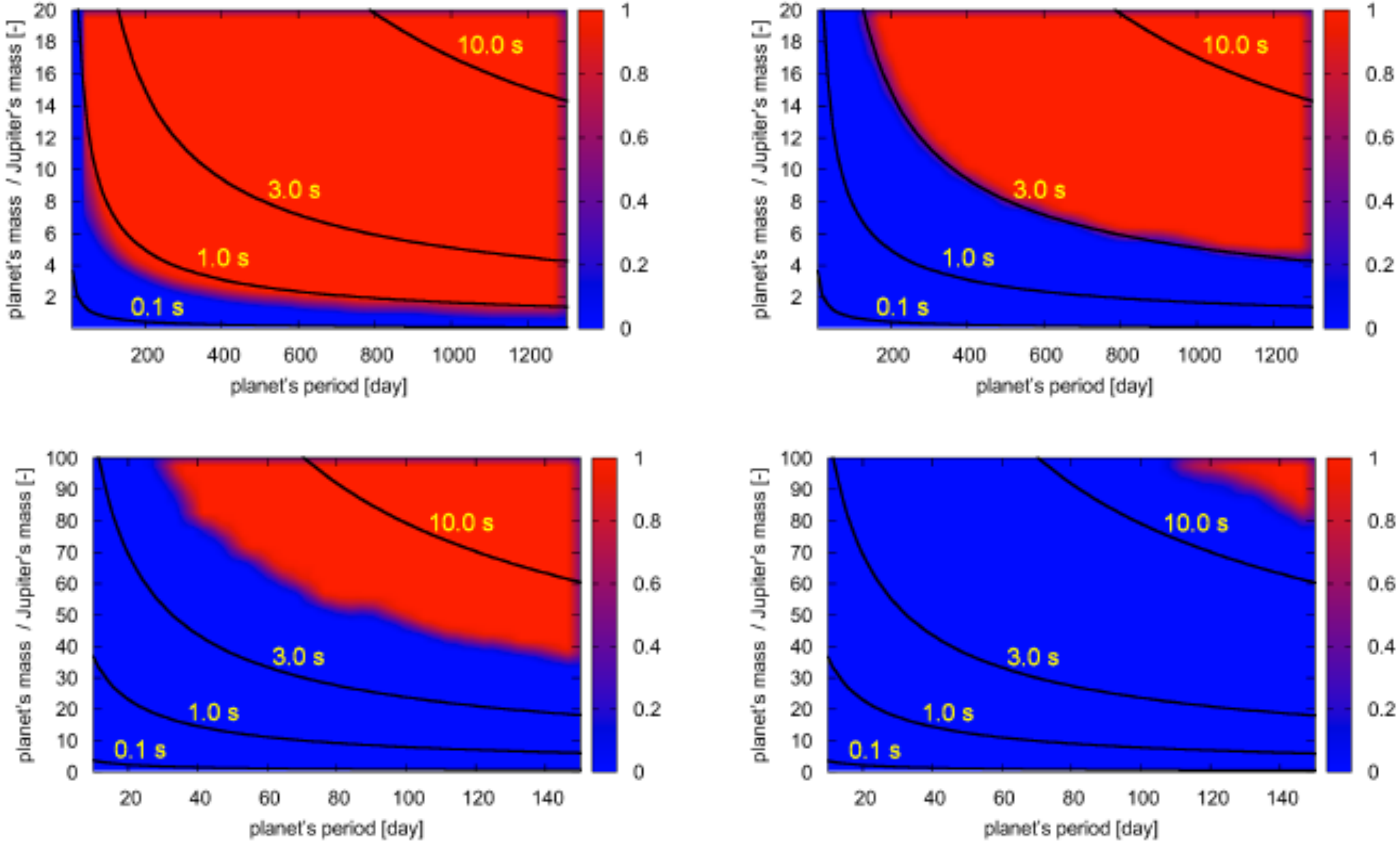
Konacki, Muterspaugh et al 2010, ApJ, submitted, astroph/0910.4482

High precision stellar astronomy



Circumbinary planets via eclipse timing – Kepler and CoRoT

Kepler, V = 9, 14 mag

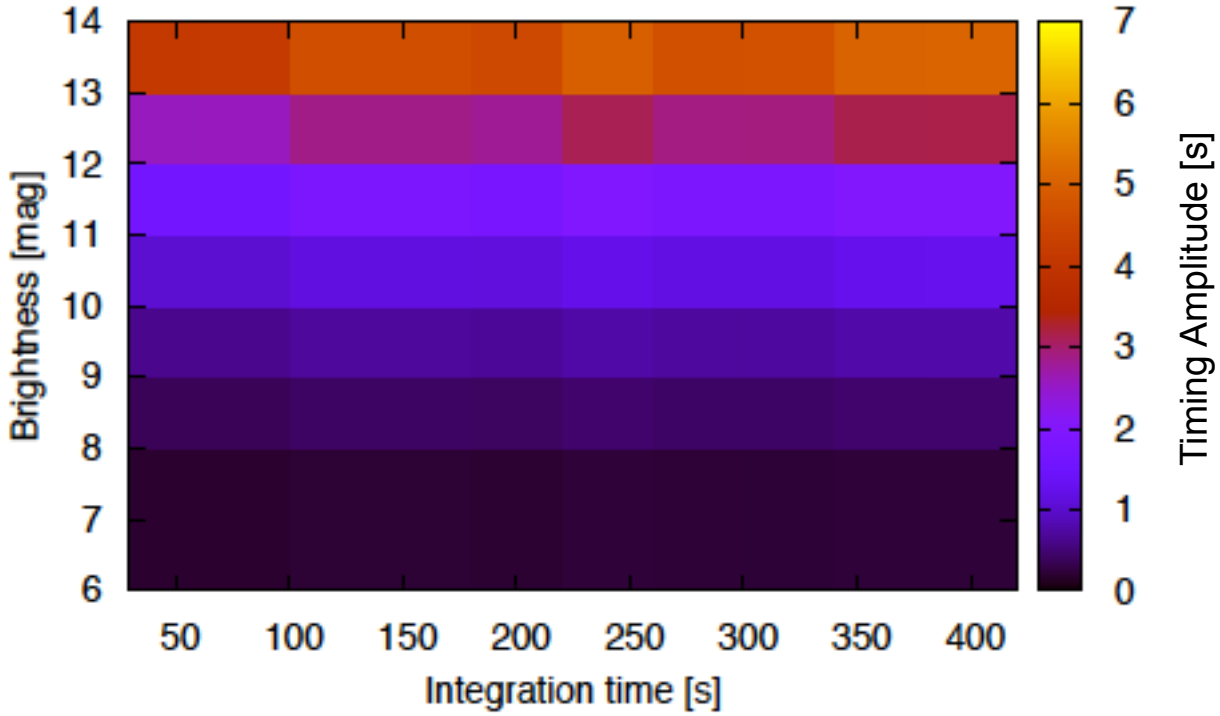


CoRoT, V = 13, 15 mag

P. Sybilski, M. Konacki, S. Kozlowski, 2010, MNRAS, on astroph mid Feb

Circumbinary planets via eclipse timing - ground based case, 0.5-m automated telescope

M. Konacki, K. Helminiak, S. Kozlowski, M. Ratajczak, P. Sybilski



A = 1 sec, ~2 Jupiter masses @ P = 3 years, $M_* = 2\ M_{Sun}$