GAPS

GLOBAL ARCHITECTURE OF PLANETARY SYSTEMS

R. Claudi - INAF - Astronomical Observatory of Padova

GAPS and HARPS-N

Extrasolar Planets

The HARPS - N Tale

Once upon a time ...

Before GAPS

May/June 2010

3. L'accordo per essere accettabile deve avere un alto profilo scientifico, e rappresentare per INAF una concreta opportunita' di diventare uno dei protagonisti mondiali nello studio dei pianeti extrasolari.

November 2011

7. La ricerca, caratterizzazione e studio dei pianeti extrasolari son destinati a diventare una parte sempre piu` rilevante dell'astronomia futura, e quindi l'importanza strategica di un accordo su HARPS-N va misurata in una prospettiva di lungo termine, che vada ben al di la' del numero pur ragguardevole (una cinquantina) di ricercatori INAF attualmente impegnati a far partire anche in Italia questo settore di ricerca.

March 2012

Parere del CS sull'ipotesi HARPS-North

Il CS ha discusso i documenti trasmessigli, e si e` anche avvalso del memo presentato al Presidente dal Prof. Piotto, ma che gli uffici non avevano trasmesso.

In estrema sintesi, il CS e` in linea di massima favorevole all'operazione, purche' siano fatte salve alcune condizioni irrinunciabili. Qui di seguito si elencano alcuni punti emersi dalla discussione, che rappresentano alcune linee guida su come condurre la trattativa con la controparte privilegiando gli aspetti scientifici. Il CS [illegible]

attraente, in quanto piu' importante del possesso dello strumento e` il suo uso scientifico e il contesto in cui questo avviene.

3. L'accordo per essere accettabile deve avere un alto profilo scientifico, e rappresentare per INAF una concreta opportunita' di diventare uno dei

INAF incaricata a direttamente nel

quantificare la

accedere a dati RPS-N si potra'

'ora le modalita' on quelli Plato,

qualora questa missione fosse approvata dall'ESA.

7. La ricerca, caratterizzazione e studio dei pianeti extrasolari son destinati a diventare una parte sempre piu` rilevante dell'astronomia futura, e quindi l'importanza strategica di un accordo su HARPS-N va misurata in una prospettiva di lungo termine, che vada ben al di la' del numero pur ragguardevole (una cinquantina) di ricercatori INAF attualmente impegnati a far partire anche in Italia questo settore di ricerca.
8. Piuttosto che la cessione in proprieta' dello strumento, che ha scarsissimo interesse pratico, andrebbe negoziata (oltre agli aspetti scientifici) una partecipazione alle spese di gestione, proporzionale al numero di notti dedicate a HARPS-N.
9. L'eventuale accordo deve essere tra INAF e controparte, non tra TNG e controparte. Quindi e` INAF (non TNG) che eventualmente entra nel Consorzio HARPS-N.
10. Il CS considera opportuno che venga sentito anche il parere del TAC del TNG.

17 Giugno 2010

May/June 2010

July 2010

November 2011

February 2012

March 2012

HARPS-N at TNG: A Science Opportunity for the Italian Astronomical Community

Edited by Raffaele Gratton

INAF

Date 7/26/2010

M.G. Lattanzi, R. Silvotti, A. Sozzetti, *INAF-Osservatorio Astronomico di Pino Torinese*
E. Antonello, L. Mantegazza, E. Poretti, M. Rainer, P. Spanò, *INAF-Osservatorio Astronomico di Brera*
M. Barbieri, S. Benatti R. Claudi, S. Desidera, L. Girardi, R. Gratton, *INAF-Osservatorio Astronomico di Padova*
S. Bernabei, *INAF-OA Bologna*
F. Palla, *INAF-OA Arcetri*
F. D'Antona, C. Maceroni, P. Ventura, M. Di Criscienzo, *INAF-OA Monte Porzio*
D. Cardini, M.P. Di Mauro, *INAF-IASF Roma*
D. Turrini, *INAF–IFSI Roma*
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G. Micela, *INAF-Osservatorio Astronomico di Palermo*
A.Martinez Fiorenzano, R. Cosentino, *INAF-TNG*
F. Marzari, V. Nascimbeni, G. Piotto, *Univ. Padova*
L.R. Bedin, *Space Telescope Science Center*
L. Pasquini, *ESO*

May/June 2010

July 2010

November 2011

February 2012

March 2012

Padova

EXOPLANETARY SCIENCE CON HARPS-N 28/11/2011

Agenda & Presentazioni

LUNEDI' 28 NOVEMBRE

Inizio meeting ore 14:00

14:00 Introduzione (R. Gratton)
14:15 HARPS-N (presentazione dello strumento, schedula) (E. Molinari)
14:35 HARPS-N GTO program (G. Micela)
14:55 Statistiche sull'uso di HARPS-S e risultati S. Desidera)

15:10 Ricerca di pianeti di piccola massa attorno a nane M (A. Sozzetti)
15:20 Ricerca di pianeti attorno a stelle mid-M (G. Micela)
15:40 Attivita' stellare e velocita' radiali di alta precisione (N....

Read more...

And
Roma Meeting

RIUNIONE NATIONALE SU HARPS-N 02/02/2012

Agenda
h. 11:00 - Introduzione ad Harps-N e al GTO
G. Vettolani; "Welcome" (10m)
F. Pepe; "Harps-N, user manual, GTO, pipeline" (30m)
E. Molinari; "Agreement INAF-Harps-N " (10m)

h. 12:00 - Proposte per la scienza con Harps-N - I parte
A. Sozzetti; "Global Architecture of Planetary Systems (GAPS): from Jupiters to super-Earths" (15m)
• Surveying the cool Neighbors for Super Earths - G. Micela (10m)
• Architecture evolution I: The Role of Tides - N. Lanza (8m)

May/June 2010

July 2010

November 2011

February 2012

March 2012

Catania Kick Off Meeting

70 people are involved in the GAPS mob …

53 Italians
17 the rest of the world

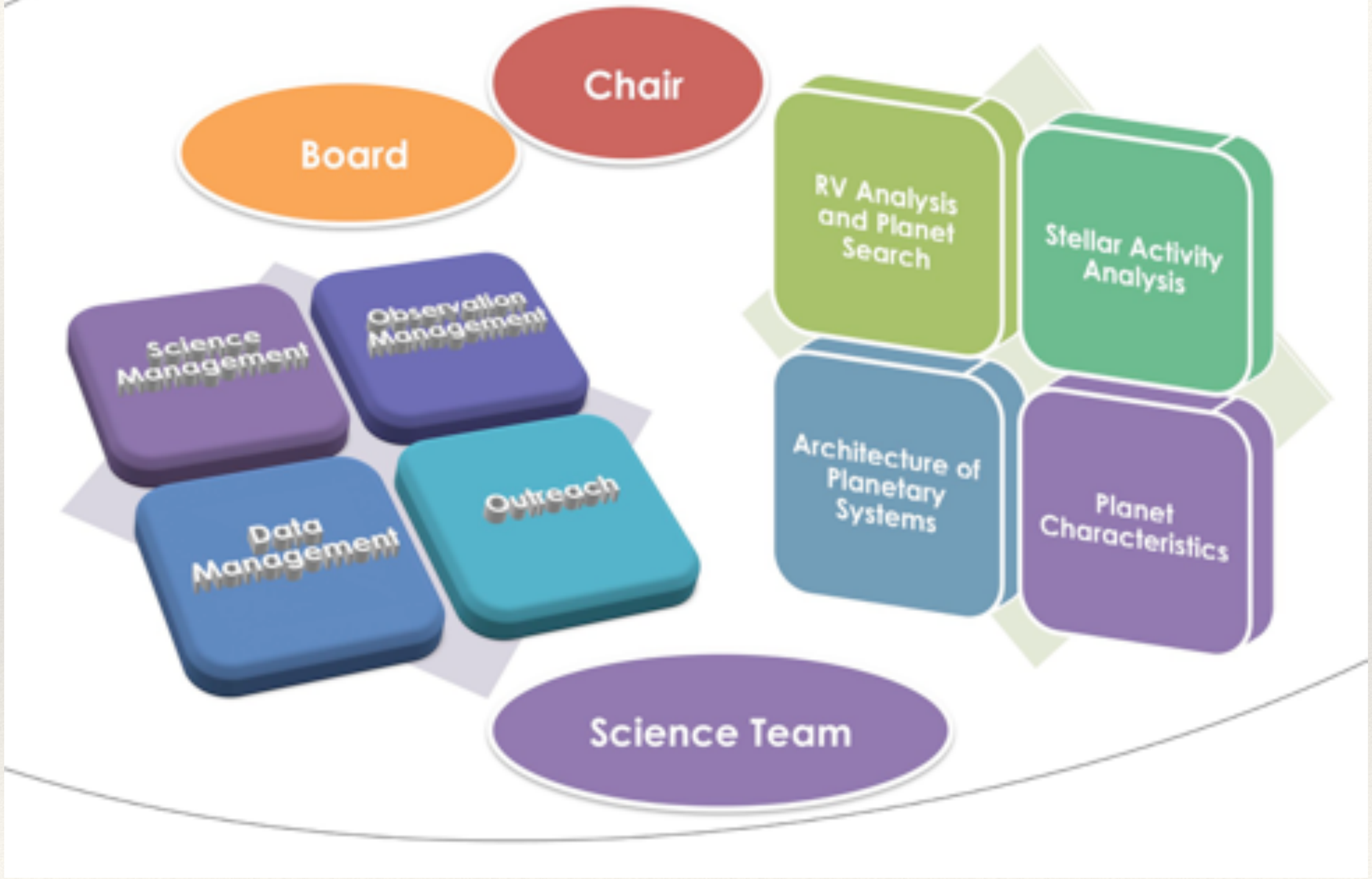
- Many small - size program, no optimal scheduling

- Wide collaboration, many expertise, many ideas, Efficiency in operation, Tools sharing

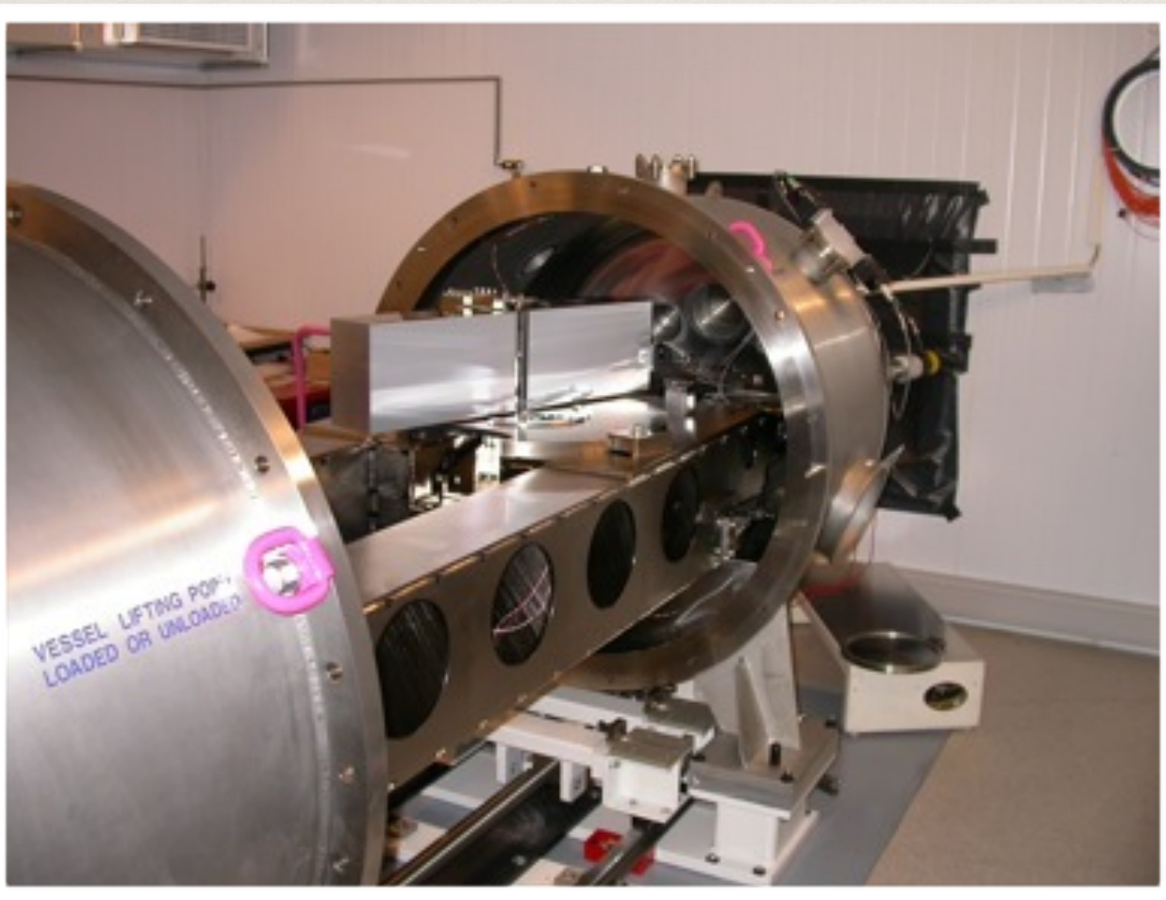
- Quality in Results

- To be competitive, Coordination is needed

Team Organization



GAPS is a structured multi layered, largely synergetic italian project designed to maximize the scientific return in exoplanetary astrophysics



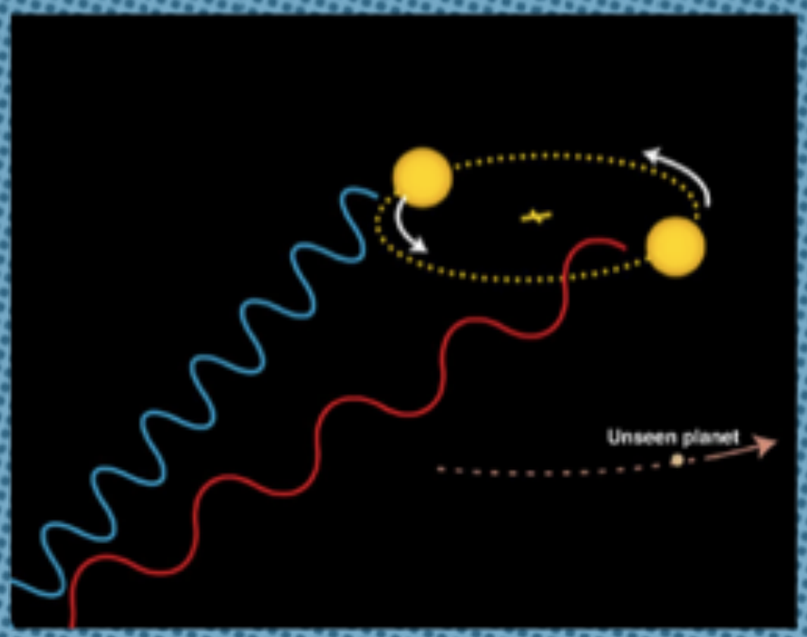
Taking advantage of the unique capabilities of HARPS-N @ TNG

Radial Velocity Technique

Technique:

The radial velocity of a star orbiting the barycenter of the planet – star system changes as function of time with a semiamplitude K given by:

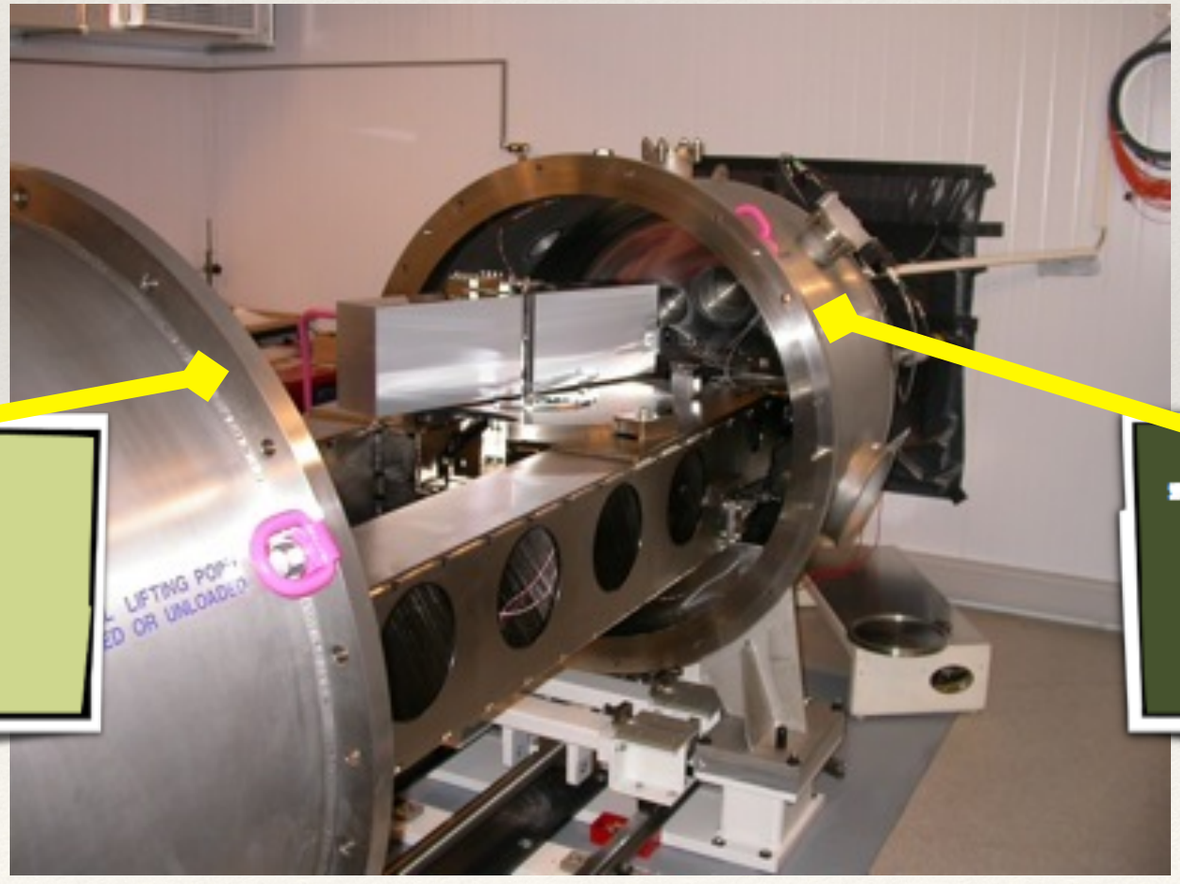
$$k_1 = \frac{28.4\ \mathrm{m\,s^{-1}}}{\sqrt{1-e^2}} \frac{m_2 \sin i}{M_{\mathrm{Jup}}} \left(\frac{m_1 + m_2}{M_{\mathrm{Sun}}} \right)^{-2/3} \left(\frac{P}{1\ \mathrm{yr}} \right)^{-1/3}$$



Jupiter	@ 1 AU	: 28.4 m s^{-1}
Jupiter	@ 5 AU	: 12.7 m s^{-1}
Neptune	@ 0.1 AU	: 4.8 m s^{-1}
Neptune	@ 1 AU	: 1.5 m s^{-1}
Super-Earth (5 $M_\oplus$)	@ 0.1 AU	: 1.4 m s^{-1}
Super-Earth (5 $M_\oplus$)	@ 1 AU	: 0.45 m s^{-1}
Earth	@ 1 AU	: 9 cm s^{-1}

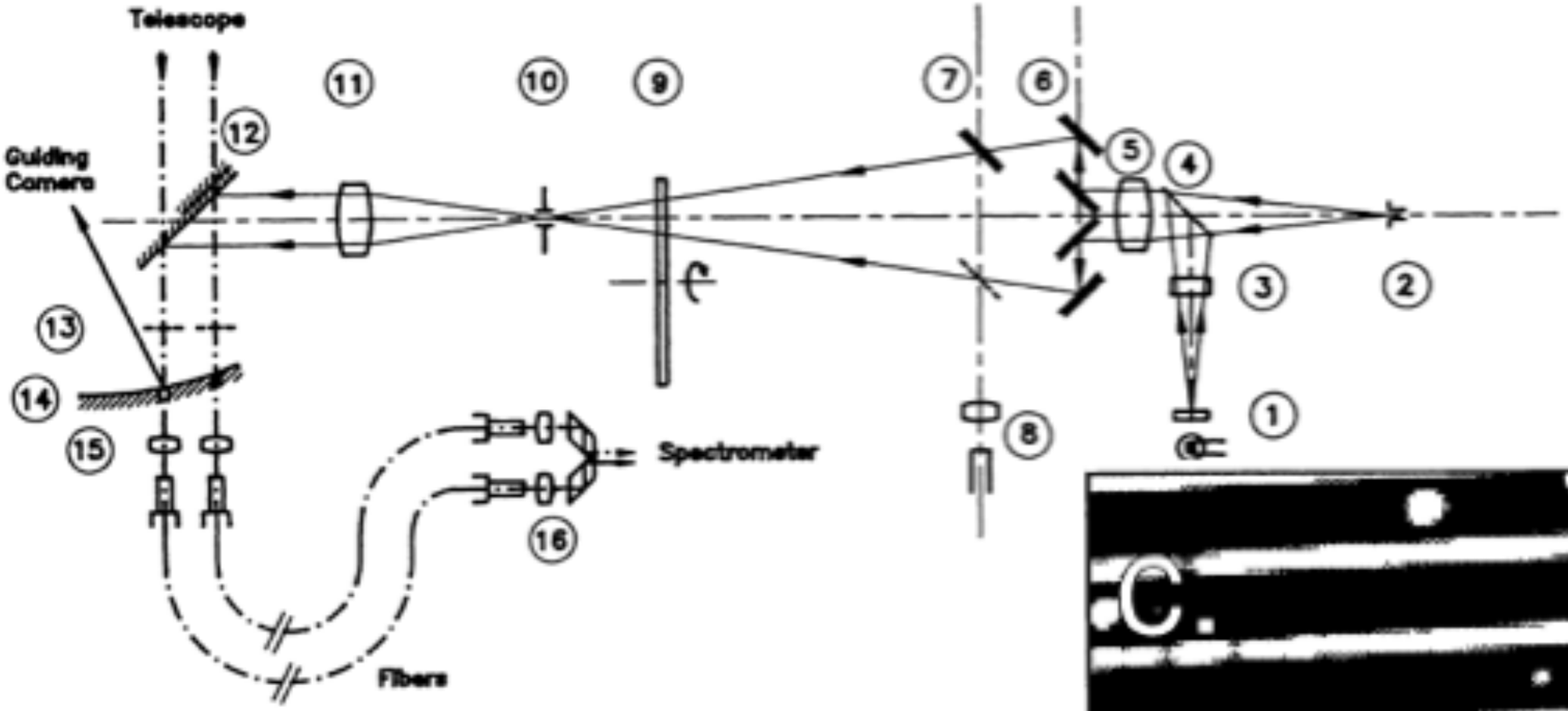
HARPS-N

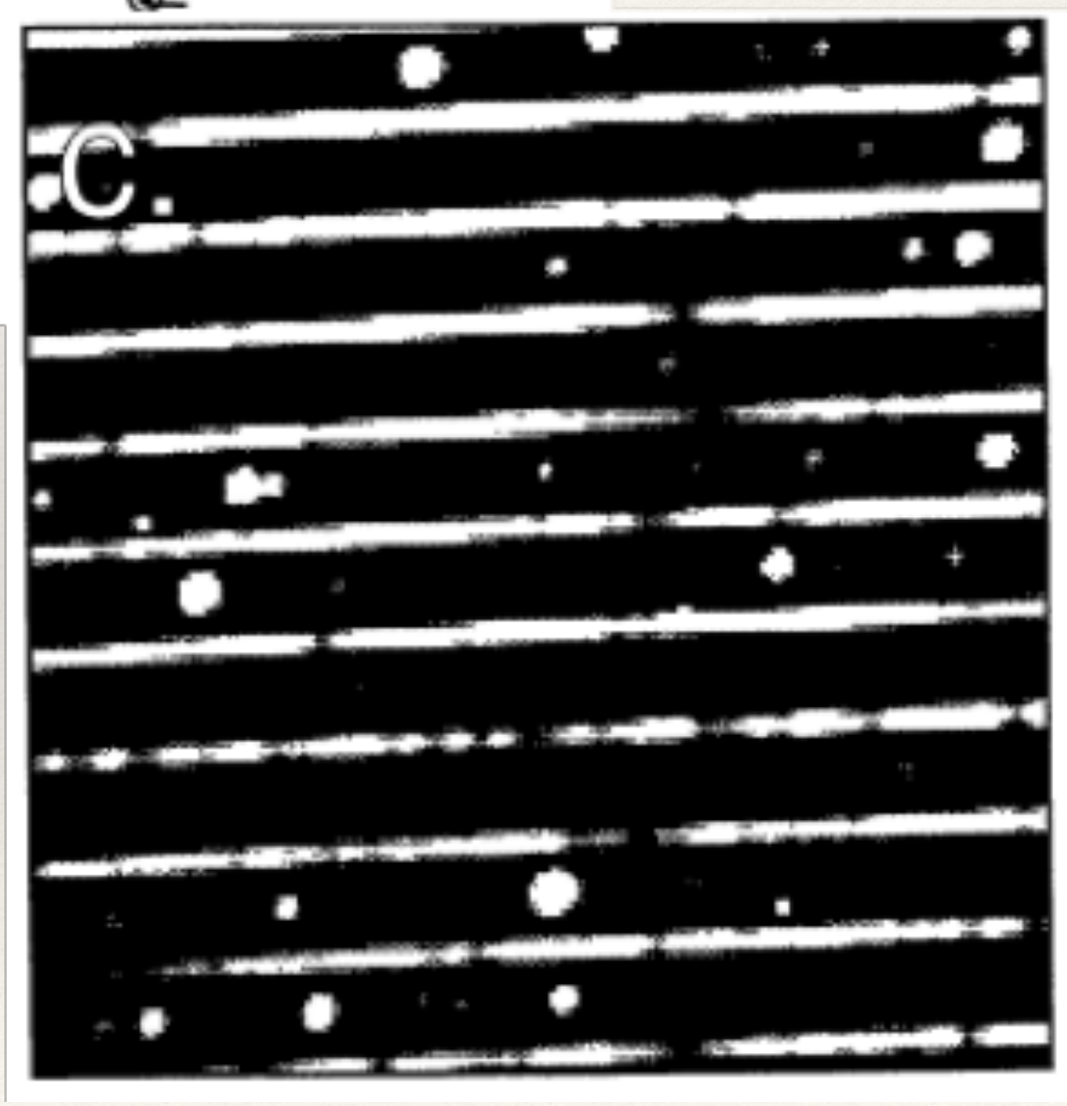
Wavelength Range: 383 nm - 690 nm
Spectral resolution: 115000
1ms^{-1}@SNR=60

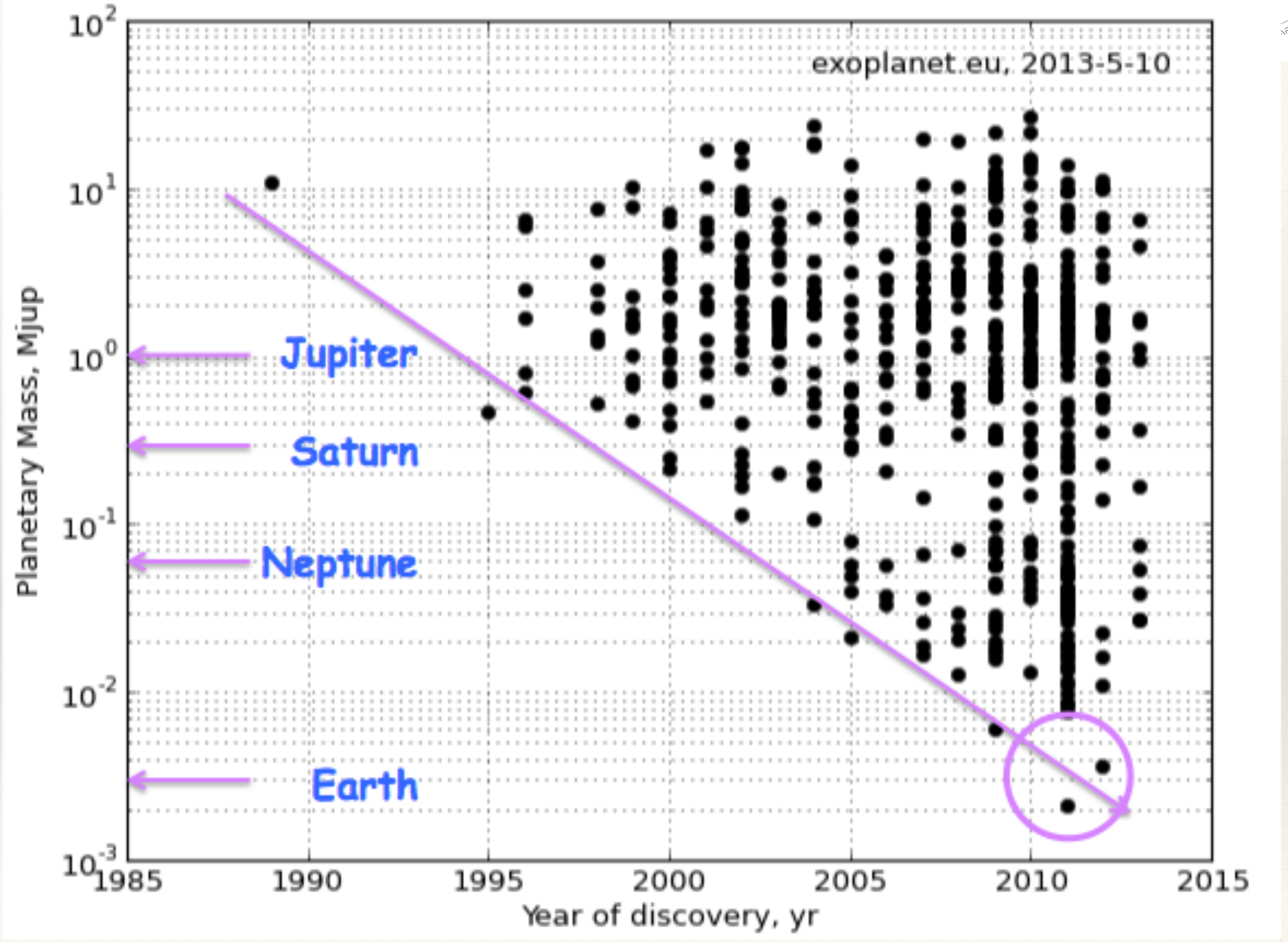


Vacuum Operation

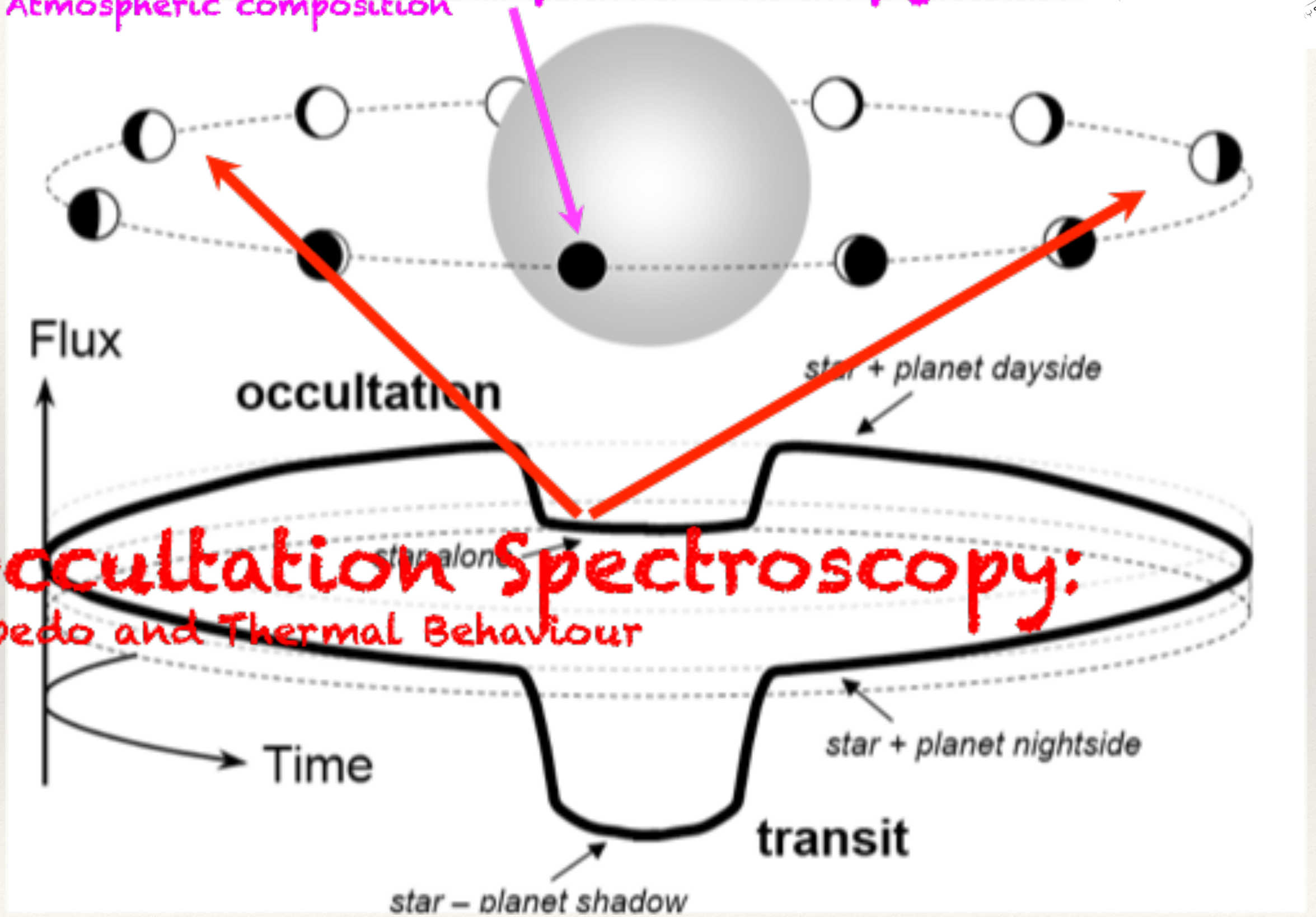
Temperature Control


Telescope
Guiding Camera
Spectrometer
Fibers
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

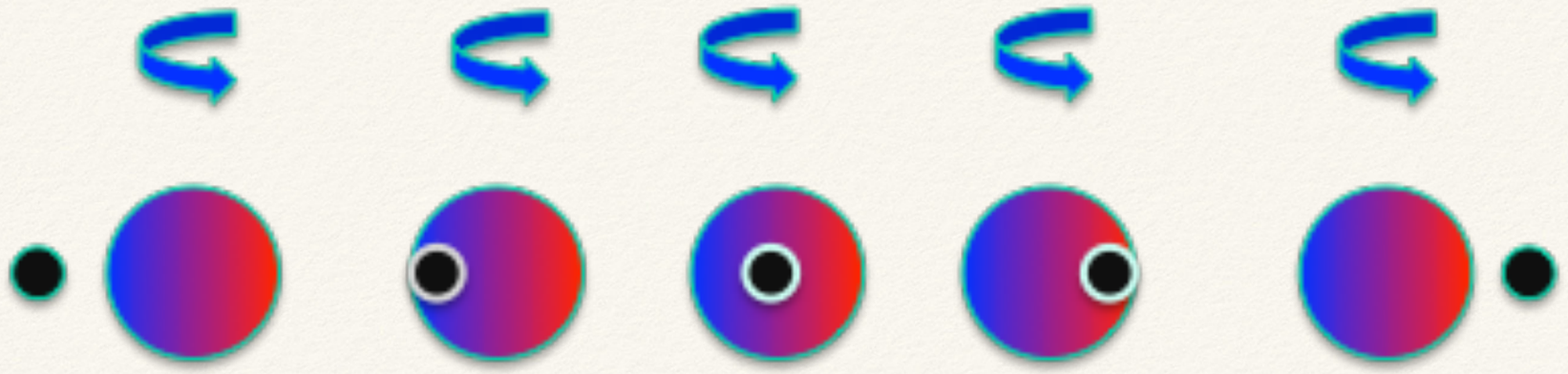

C

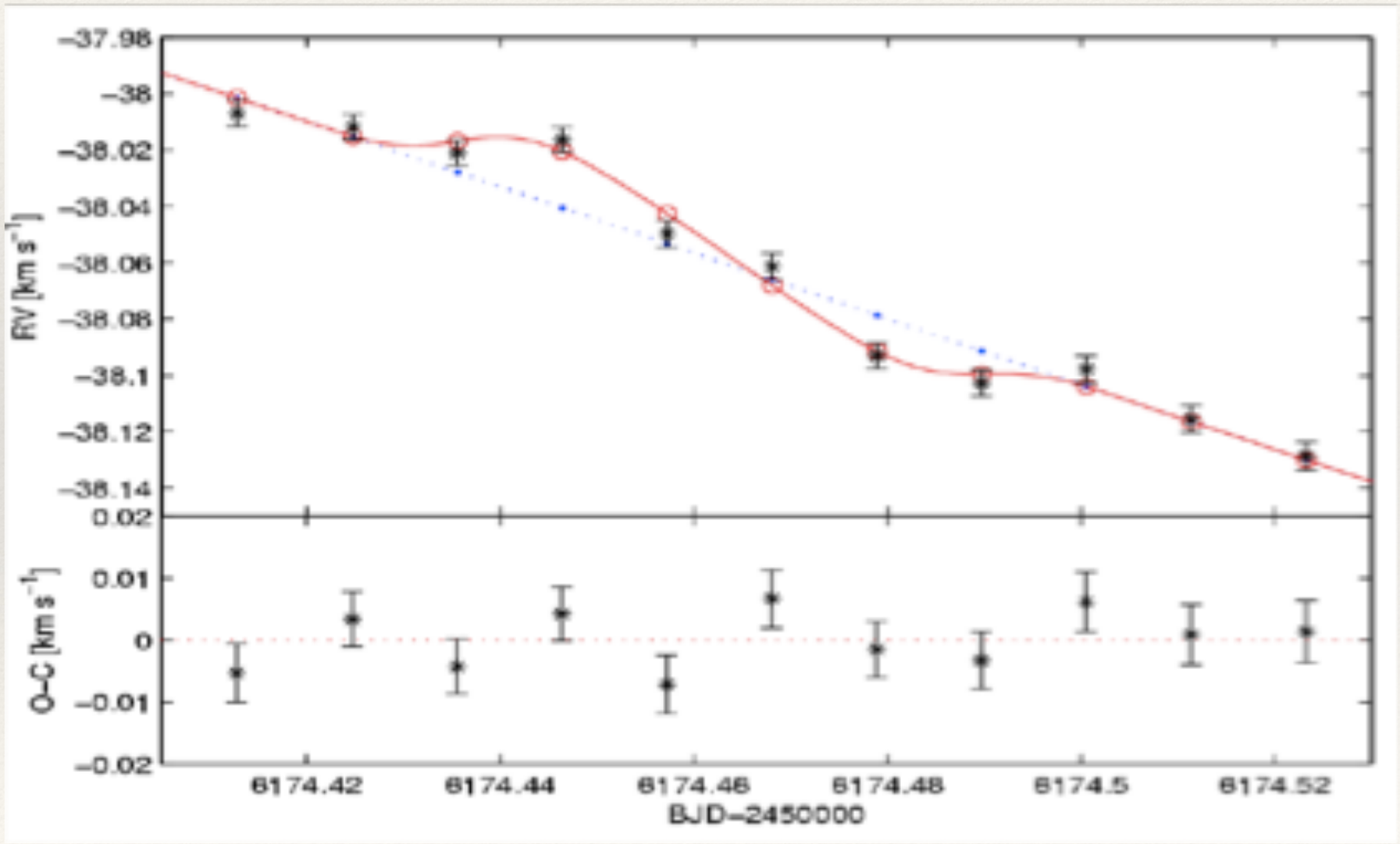

exoplanet.eu, 2013-5-10
Jupiter
Saturn
Neptune
Earth
Planetary Mass, Mjup
Year of discovery, yr
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
1985
1990
1995
2000
2005
2010
2015

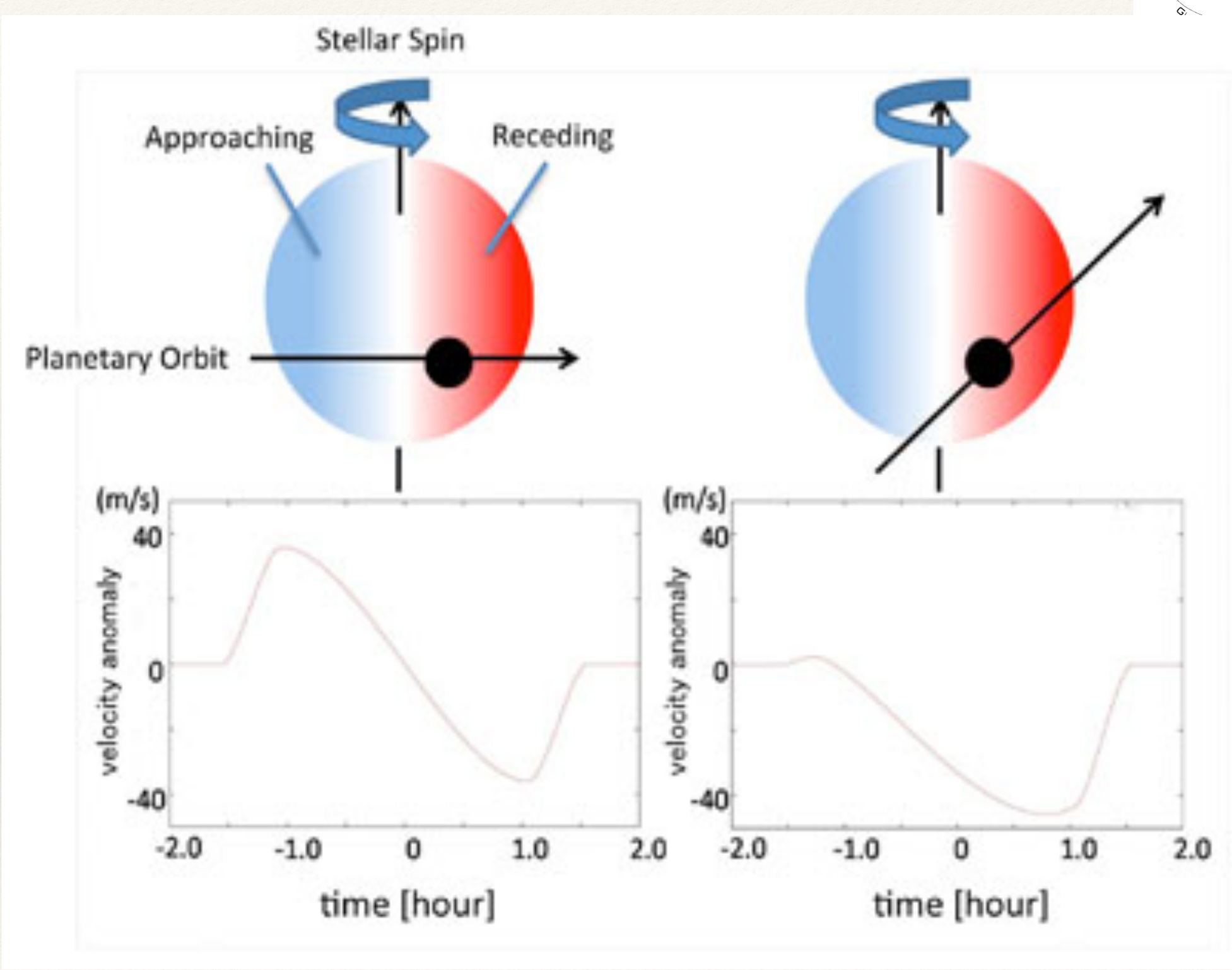
Transmission Spectroscopy:
Atmospheric composition

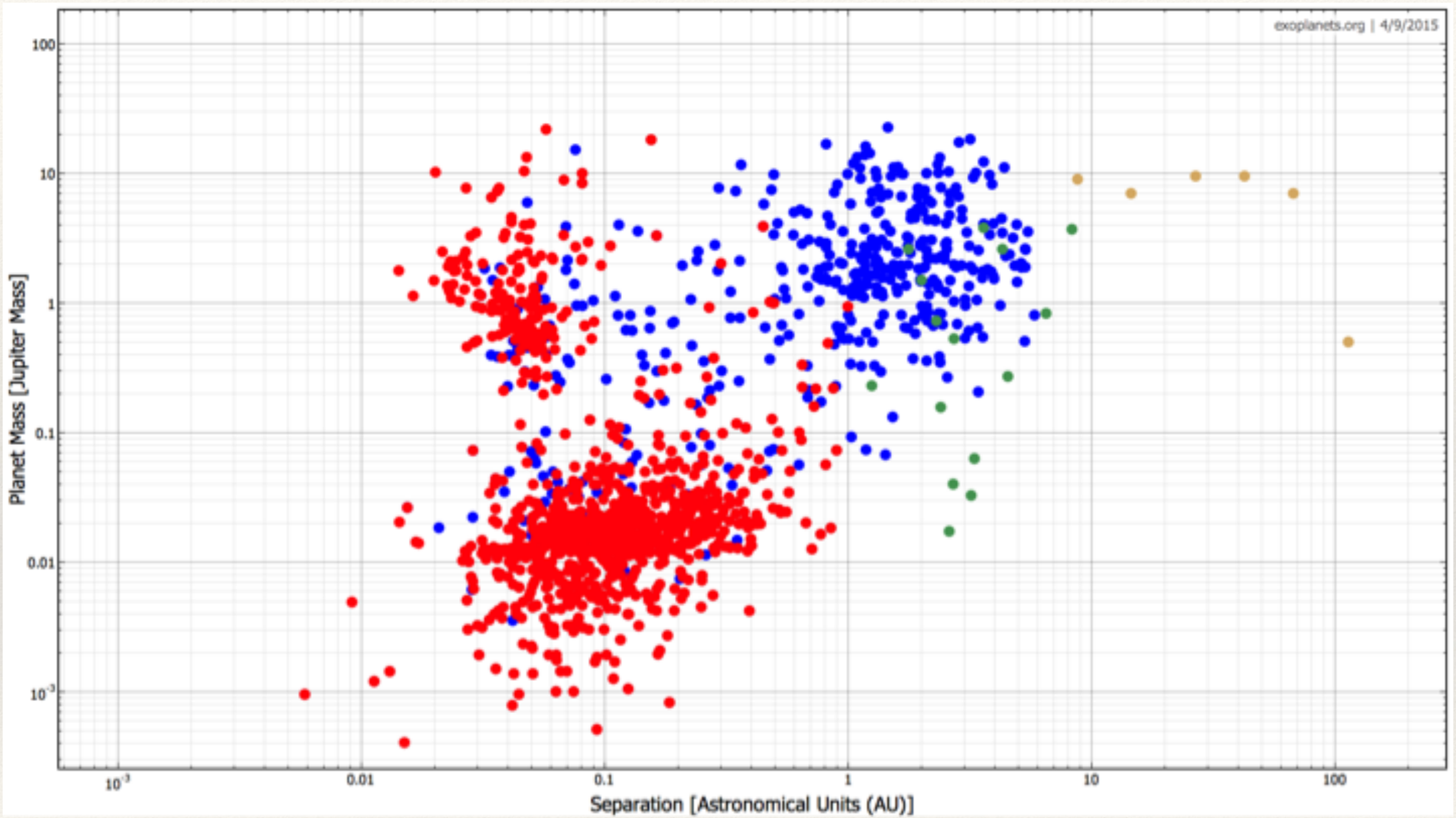


Occultation Spectroscopy:
Albedo and Thermal Behaviour



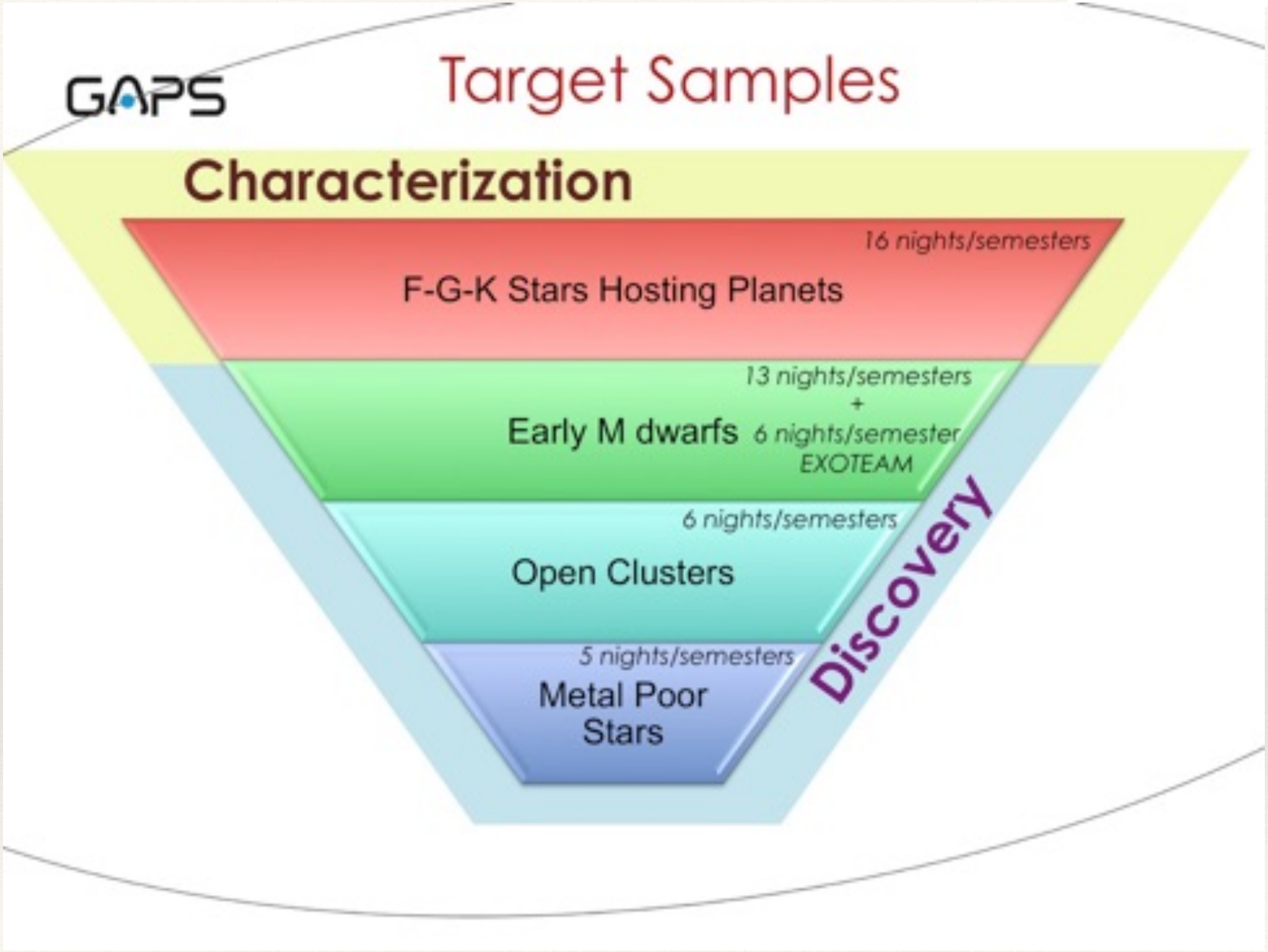

−37.98
−38
−38.02
−38.04
−38.06
−38.08
−38.1
−38.12
−38.14
RV [km s−1]
0.02
0.01
0
−0.01
−0.02
O−C [km s−1]
6174.42
6174.44
6174.46
6174.48
6174.5
6174.52
BJD−2450000


Stellar Spin
Approaching
Receding
Planetary Orbit
(m/s)
40
0
-40
velocity anomaly
-2.0
-1.0
0
1.0
2.0
time [hour]
(m/s)
40
0
-40
velocity anomaly
-2.0
-1.0
0
1.0
2.0
time [hour]


exoplanets.org | 4/9/2015
100
10
1
0.1
0.01
10^{-3}
Planet Mass [Jupiter Mass]
10^{-3}
0.01
0.1
1
10
100
Separation [Astronomical Units (AU)]

- TO STUDY THE FREQUENCY OF LOW MASS PLANETS AS FUNCTION OF M* [Fe/H] , DENSITY OF ENVIRONMENT
- TO CHARACTERIZE ALREADY KNOWN PLANETARY SYSTEMS
- TO ANALYZE THE ACTIVITY OF HOST STARS AND ITS EFFECT ON THE DERIVATION OF PLANET PARAMETERS
- TO DERIVE ACCURATE MEASUREMENTS OF PLANETARY MASS BY MEANS OF ASTEROSEISMOLOGIC STUDY OF HOST STARS

Target Samples



Frequency of Habitable LMP to low-mass stars

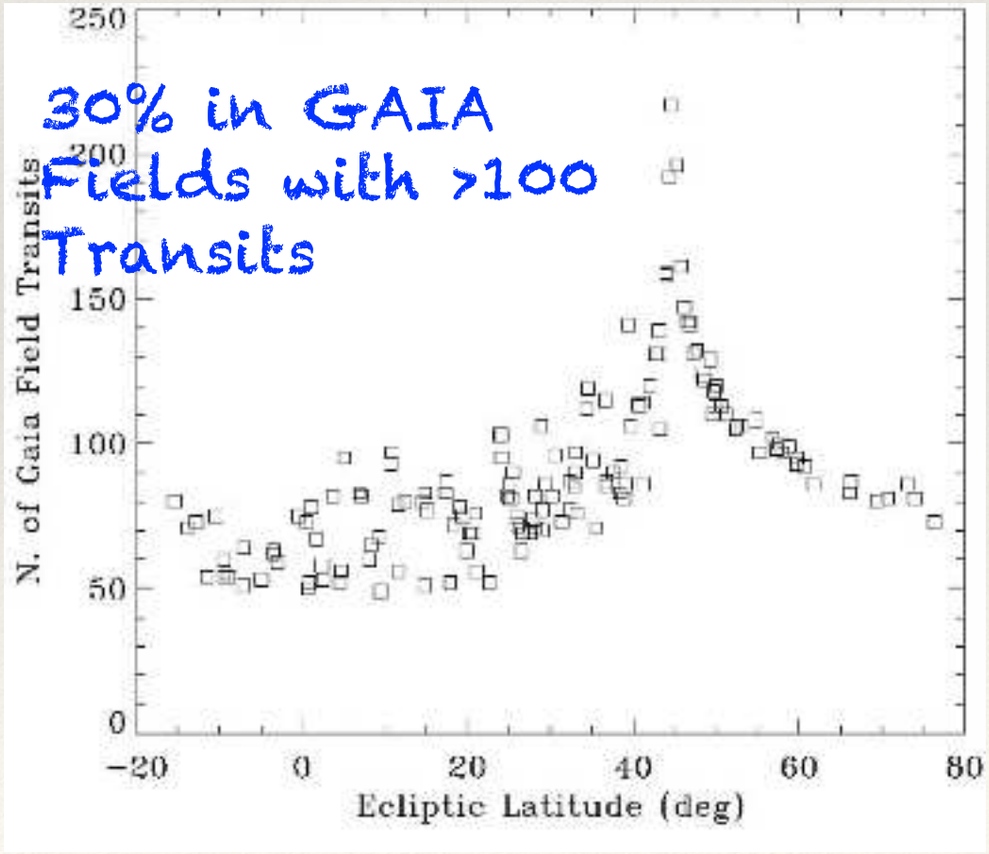
GAPS
GLOBAL ARCHITECTURE OF PLANETARY SYSTEMS

AIMS:

- Frequency of Super Earths in HZ of Mdwarfs
- Dependence of PS architecture on stellar mass
- to provide benchmark systems for atmospheric characterization

SAMPLE:

120 M Stars M0≤M≤M2.5
evenly distributed
V<12 mag



Test of Migration and P formation searching for new low mass companion in known planetary systems

GAPS

GLOBAL ARCHITECTURE OF PLANETARY SYSTEMS

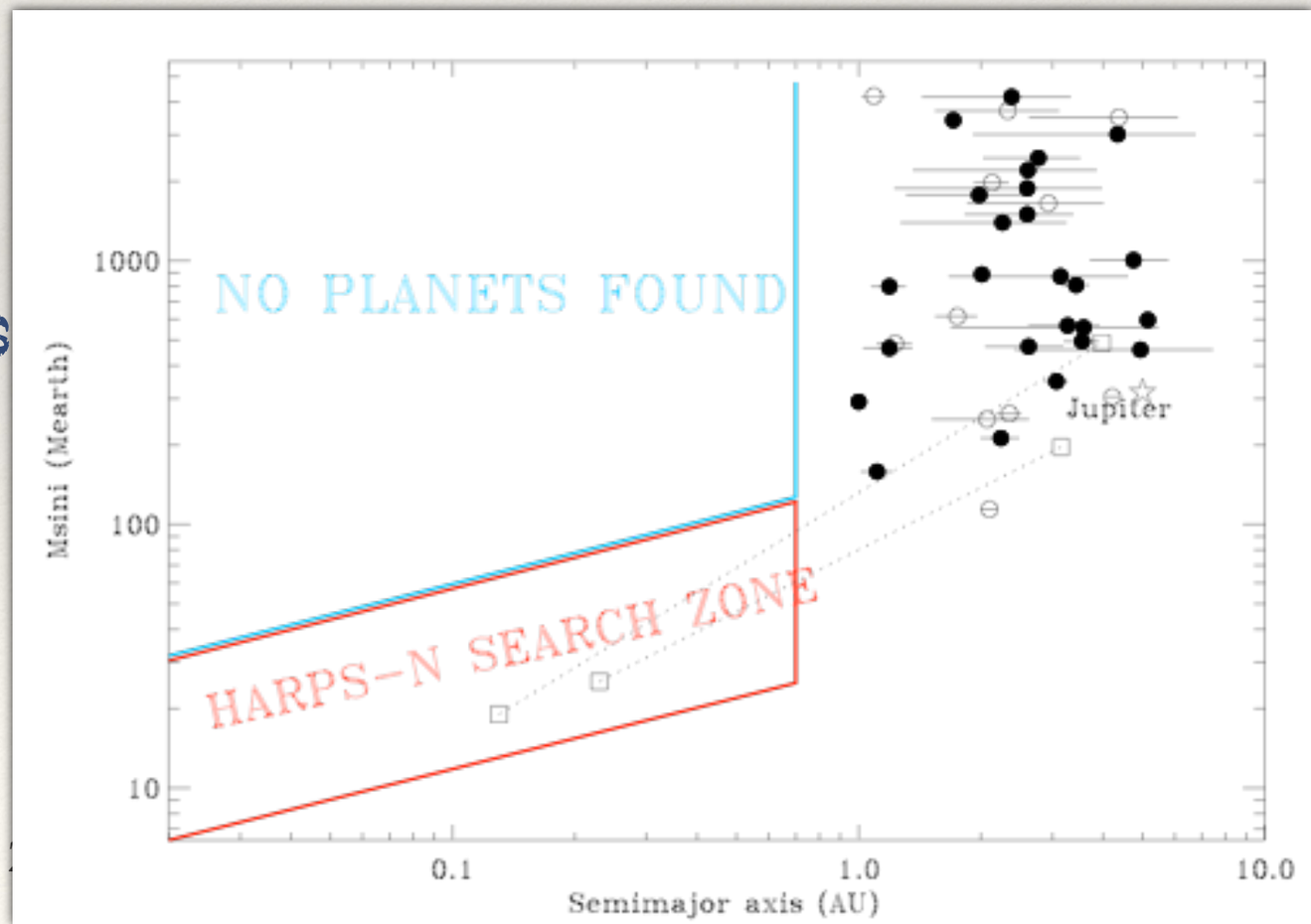
AIMS:

- Rate of long Period companions in transiting systems
- Fraction of LMP ($\leq 1 M_{Neptune}$) in close orbits
- Role of additional companion in alignment between orbits and stellar rotation

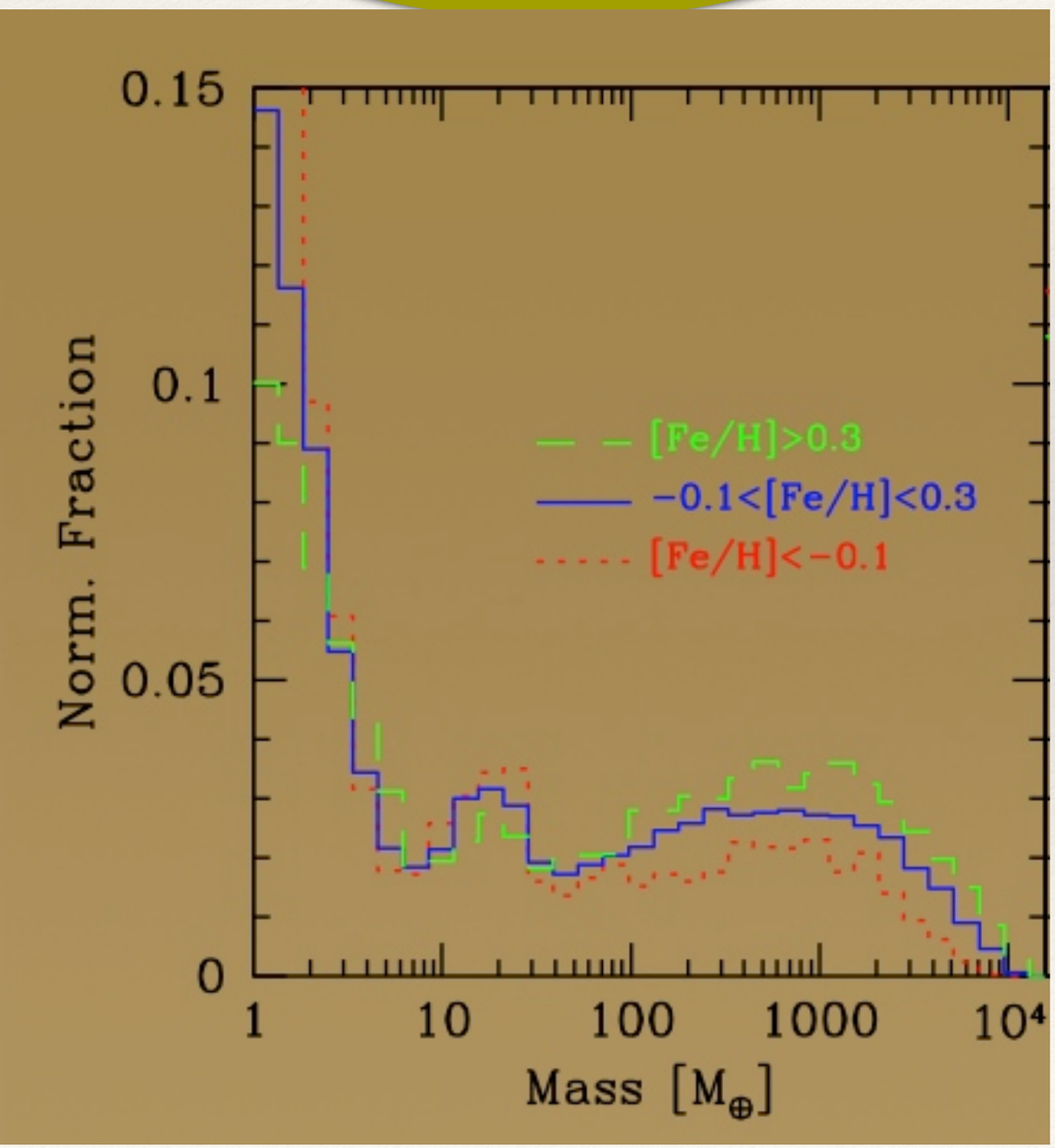
SAMPLE

80 Known Planetary systems with different architecture and alignment status

V≤12 mag



Frequency of Neptune-Mass companion around Low [Fe/H] srtars



GAPS
GLOBAL ARCHITECTURE OF PLANETARY SYSTEMS

AIMS:

- Frequency of Neptunes and Super Earths
- To compare results with data for Solar Metallicity stars

SAMPLE

Sub sample of 60 out of 200 stars with $-2.0 \leq [Fe/H] \leq -0.5$ observed at KECK/HIRES. HARPS-N Sample has $-1.0 \leq [Fe/H] \leq -0.5$. All Chromospherically quiet and V<11.0

Mordasini et al., 2012

Rate of GP in dense environment

GAPS

GLOBAL ARCHITECTURE OF PLANETARY SYSTEMS

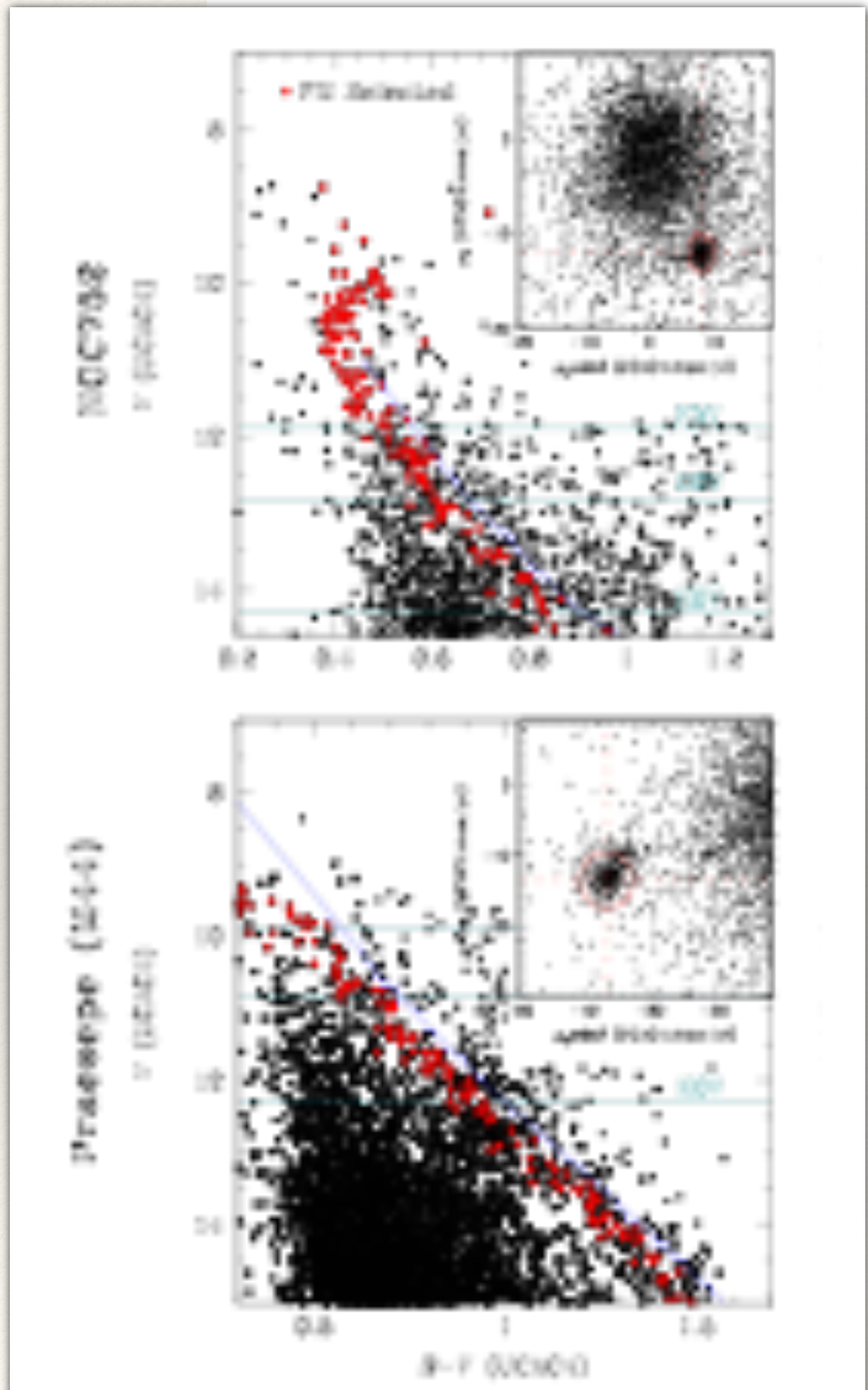
AIMS:

✦To find Hot Jupiters in nearby open clusters (NGC752 andM44)

SAMPLE

64 MS stars (>F5)

	NGC752	M44
m-M	8.4	6.3
[Fe/H]	0.08	0.16
Age	2Gyr	0.8Gyr



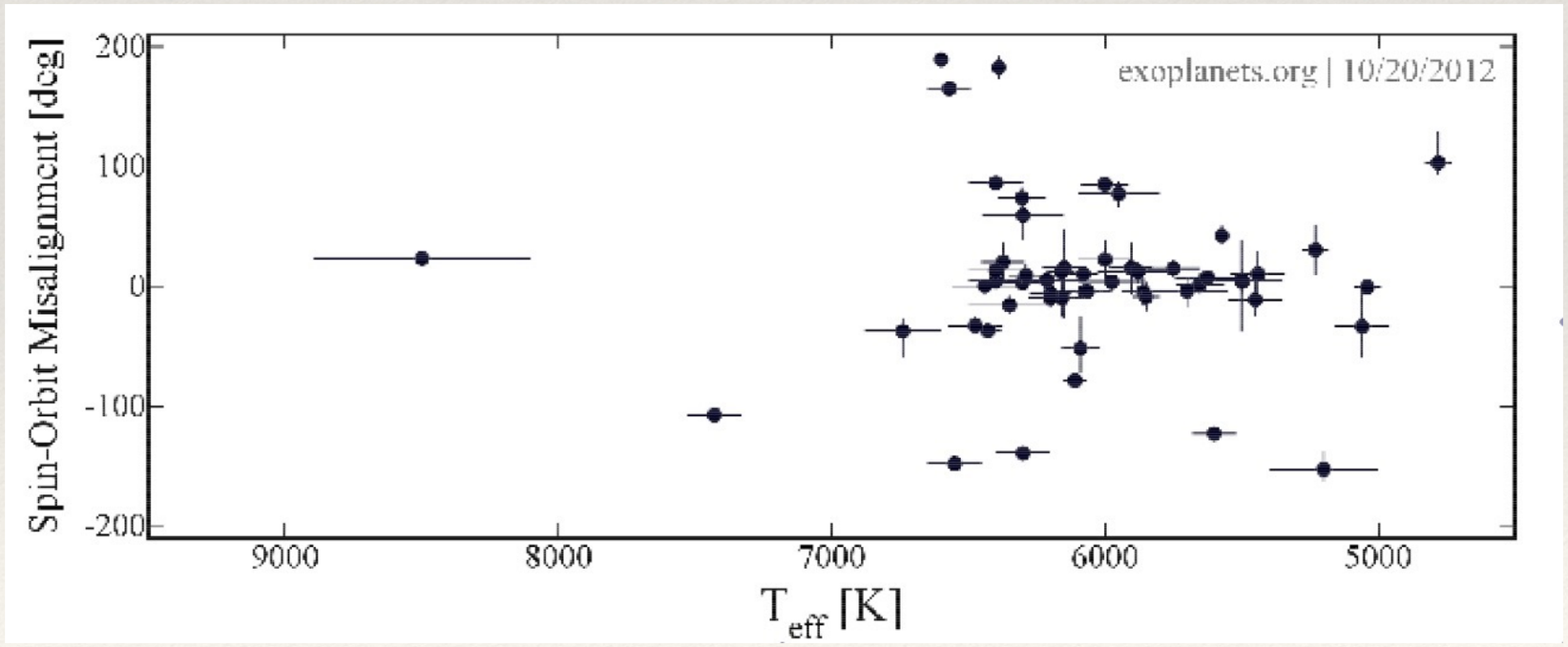
Planet-Disk Planet-Planet Interaction through RML effect

AIMS:

- To Characterize the degree of spin/orbit alignment
- To measure spin/orbit angle
- to gather evidence pro/con proposed mechanisms for orbital evolution in close-in planets

SAMPLE

Targets between several Known transiting systems



Asteroseismology and SPI

AIMS:

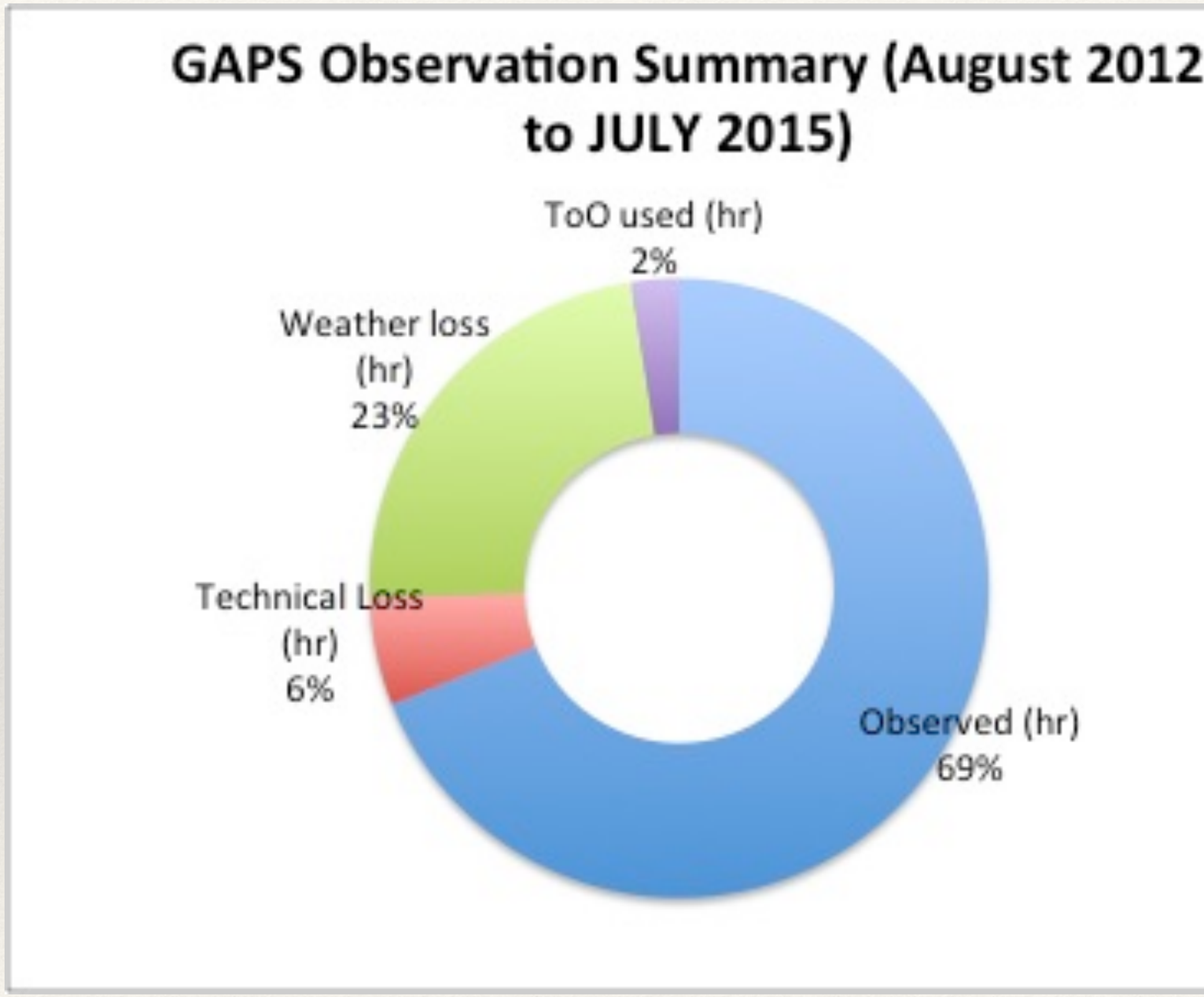
- Characterization of the tidal interaction between planets and host stars
- To study the impact of SPI on Stellar Activity
- Improvement of physical parameters of host stars

SAMPLE:

Stars whose monitoring is useful also for other purpose (nu And; tau Boo; k CrB)

236 nights (6 semesters) from August 2012 to September 2015

5448 spectra of 273 objects



Communitarian Results and Outreach...

- Consolidation of National Community
- Education and Training (7 PhD; 3 Lauree Magistrali; 1 Laurea Triennale)
- Several Exoplanetary Courses in Palermo, Roma (the 3 Universities) and Padova

Uno, nessuno centomila…
Sistemi Solari

Web: http://altrimondi.inaf.it/ Facebook: https://www.facebook.com/GAPSaltrimondi?fref=ts
Twitter: https://twitter.com/exoplanetsit Slide Share: http://www.slideshare.net/Altrimondi

Scientific Results...

GAPS
GLOBAL ARCHITECTURE OF PLANETARY SYSTEMS

The GAPS Programme with HARPS-N@TNG X. The multi-planet system KELT-6: detection of the planet KELT-6 c and measurement of the Rossiter-McLaughlin effect for KELT-6 b ⋆

M. Damasso[1], M. Esposito[2,3], V. Nascimbeni[4,5], S. Desidera[4], A.S. Bonomo[1], A. Bieryla[6], L. Malavolta[4,5], K. Biazzo[7], A. Sozzetti[1], E. Covino[8], D. W. Latham[6], D. Gandolfi[9,10], M. Rainer[11], C. Petrovich[12], K. A. Collins[13,14], R.U. Claudi[4], R. Cosentino[7,15], R. Gratton[4], A.F. Lanza[7], G. Micela[16], I. Pagano[7], G. Piotto[4,5], L. Di Fabrizio[15], P. Giacobbe[1], M. Gomez-Jimenez[2,3], S. Murabito[2,3], C. Boccato[4], M. Molinaro[17], L. Affer[16], M. Barbieri[18], L. R. Bedin[4], S. Benatti[4], F. Borsa[9], J. Maldonado[16], E. Poretti[11], G. Scandariato[7], J. Southworth[19], R. Zanmar Sanchez[7]

The GAPS Programme with HARPS-N@TNG VI: The Curious Case of TrES-4b ⋆

...zzetti[1], A.S. Bonomo[1], K. Biazzo[2], L. Mancini[3], M. Damasso[1], S. Desidera[4], R. Gratton[4], A.F. Lanza[2], E. ...Rainer[5], L. Malavolta[4], L. Affer[6], M. Barbieri[4], L.R. Bedin[4], C. Boccato[4], M. Bonavita[4], F. Borsa[5], S. ...atham[9], G. Lodato[10], A. ...inari[12,13], C. Mordasini[3], V. ...riato[2], E. Shkolnik[17], and J.

LETTER TO THE EDITOR
XIV-21
...25332
Astronomy & Astrophysics

The GAPS Programme IV: A Planetary Syst

S. Desidera[1], A.S. Bonomo[2], R.U. Claudi[1], M. Damass...
...Benatti[1], D. Gandolfi[4,6], R. Gratton[1], A.F. Lanza[4], V. Nasc...
L.R. Bedin[1], A. Bignamini[10], M. Bonavita[1], F. Borsa[11], P. C...
Covino[13], M. Esposito[14], P. Giacobbe[2], A. Harutyunyan...
Lodato[16], C. Lovis[17], A. Maggio[9], L. Malavolta[7,17], L. Mancini...
Molinari[18,19], C. Mordasini[18], U. Munari[1], I. Pagano[4], M. Pedan...
Rainer[11], I. Ribas[20], N.C. Santos[21,22], G. Scandariato[4], R. Silvot...

[1] INAF – Osservatorio Astronomico di Padova, Vicolo dell'Osservatorio 5, ...
[2] INAF – Osservatorio Astrofisico di Torino, Via Osservatorio 20, I-10025, ...
[3] Osservatorio Astronomico della Regione Autonoma Valle d'Aosta, Fraz. Lie...
[4] INAF – Osservatorio Astrofisico di Catania, Via S.Sofia 78, I-95123, Catan...
[5] Dipartimento di Fisica e Astronomia Galileo Galilei – Università di Pad...
[6] Landessternwarte Königstuhl, ZAH, Universität Heidelberg, Königs...

The GAPS programme with HARPS-N at TNG

...prehensive analysis of the XO-2 stellar and planetary systems⋆,⋆⋆

...nasso[1,2], K. Biazzo[3], A. S. Bonomo[1], S. Desidera[4], A. F. Lanza[3], V. Nascimbeni[4,5], M. Esposito[6,7], ...A. Sozzetti[1], R. Cosentino[3,8], R. Gratton[4], L. Malavolta[5,9], M. Rainer[10], D. Gandolfi[3,11], E. Poretti[10], ...Ribas[12], N. Santos[13,14,15], L. Affer[16], G. Andreuzzi[8], M. Barbieri[4], L. R. Bedin[4], S. Benatti[4], ...M. Bonavita[4], F. Borsa[10], L. Borsato[5], W. Boschin[8], P. Calcidese[2], A. Carbognani[2], ...Claudi[4], E. Covino[18], A. Cunial[5], P. Giacobbe[1], V. Granata[5], A. Harutyunyan[8], ...Lodato[19], V. Lorenzi[8], L. Mancini[20], A. F. Martinez Fiorenzano[8], ...[8,21], M. Molinaro[22], U. Munari[4], S. Murabito[6,7], I. Pagano[3], ...[7], R. Silvotti[1], and J. Southworth[23]

...ences)

A COORDINATED XMM-NEWTON AND HARPS-N VIEW OF HD 17156: A GIANT EXOPLANET AS AN X-RAY LIGHT MATCH⋆

A. Maggio[1], I. Pillitteri[1,2], G. Scandariato[3], A.F. Lanza[3], S. Sciortino[1], F. Borsa[4], A. Bonomo[5], R. Claudi[6], ...Desidera[6], R. Gratton[6], G. Micela[1], I. Pagano[3], G. Piotto[6,7], A. Sozzetti[5], R. Cosentino[8], J. Maldon...

Draft version June 11, 2015

The GAPS Programme with HARPS-N at TNG VIII: Observations of the Rossiter-McLaughlin effect and characterisation of the transiting planetary systems HAT-P-36 and WASP-11/HAT-P-10

T. Mancini[1] et al

Stellar parameters of early M dwarfs from ratios of spectral features at optical wavelengths ⋆,⋆⋆

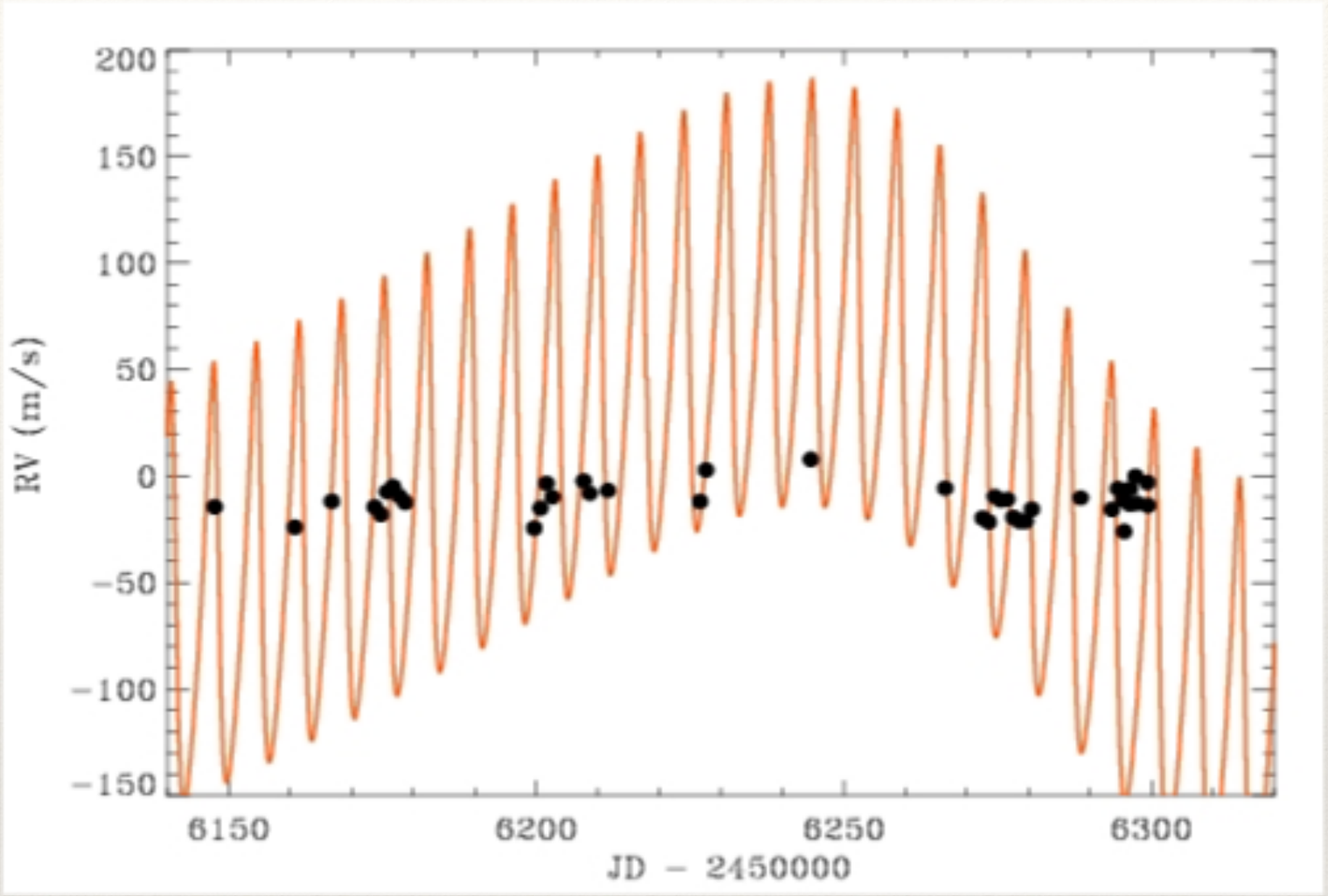
...Maldonado[1], L. Affer[1], G. Micela[1], G. Scandariato[2], M. Damasso[3], B. Stelzer[1], M. Barbieri[4], L. R. Bedin[4], K. ...o[2], A. Bignamini[5], F. Borsa[6], R.U. Claudi[4], E. Covino[7], S. Desidera[4], M. Esposito[8,9], R. Gratton[4], J. I. González ...ernández[8,9], A.F. Lanza[2], A. Maggio[1], E. Molinari[10,11], I. Pagano[2], M. Perger[12], I. Pillitteri[1], G. Piotto[13,4], E. ...oretti[6], L. Prisinzano[1], R. Rebolo[8,9], I. Ribas[12], E. Shkolnik[14], J. Southworth[15], A. Sozzetti[3], and A. Suárez Mascareño[8,9]

The GAPS Programme with HARPS-N at TNG

VII. Putting exoplanets in the stellar context: magnetic activity and asteroseismology of τ Bootis A⋆

F. Borsa[1], G. Scandariato[2], M. Rainer[1], A. Bignamini[3], A. Maggio[4], E. Poretti[1], A. F. Lanza[2], M. P. Di Mauro[5], S. Benatti[6], K. Biazzo[2], A. S. Bonomo[7], M. Damasso[7], M. Esposito[8,9], R. Gratton[6], L. Affer[4], M. Barbieri[6], C. Boccato[6], R. U. Claudi[6], R. Cosentino[2,10], E. Covino[11], S. Desidera[6], A. F. M. Fiorenzano[10], D. Gandolfi[2,12], ...Harutyunyan[10], J. Maldonado[4], G. Micela[4], P. Molaro[3], E. Molinari[10,13], I. Pagano[2], I. Pillitteri[4,14], G. Piotto[6,15], E. Shkolnik[16], R. Silvotti[7], R. Smareglia[3], J. Southworth[17], A. Sozzetti[7], B. Stelzer[4]

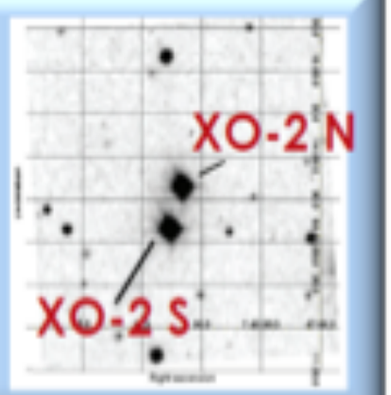
Killing Planet (KP) program
Early results: HIP 11952



No giant planets around the very metal poor star HIP 11952.
Desidera et al. 2013, A&A, 554, A29

A Planetary System For XO-2S

The binary system:
$\Delta R \approx 0.04$ mag
sep ≈ 30 arcsec
Super-metal-rich

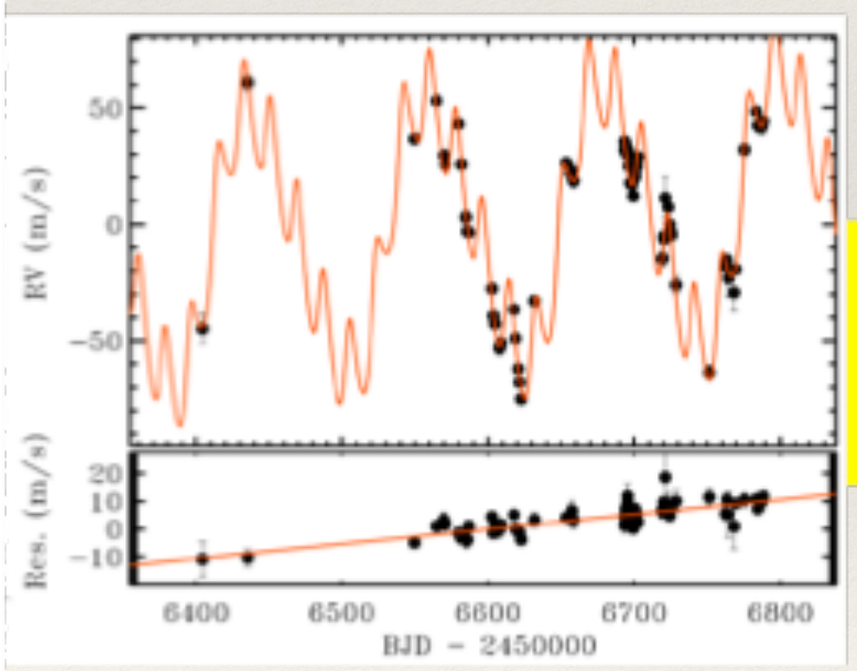


Burke et al 2007 :
Transiting planet around XO-2 N

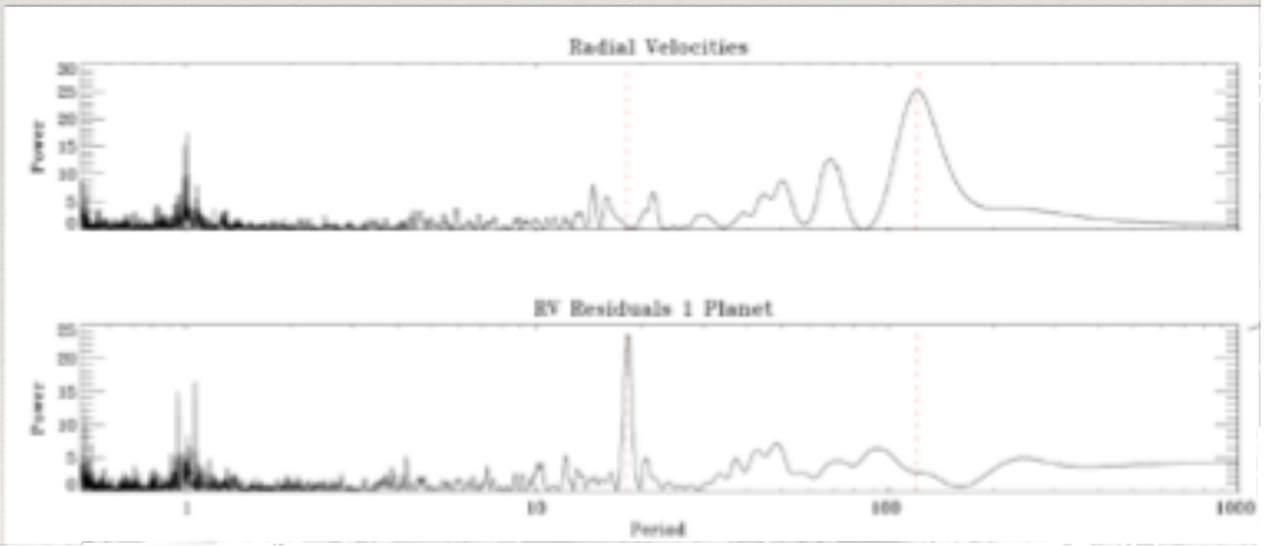
Period [d]	≈ 2.6
Mass [M_J]	≈ 0.57
e	≈ 0

Desidera, Bonomo, Claudi et al. 2014, A&A, 567, L6:

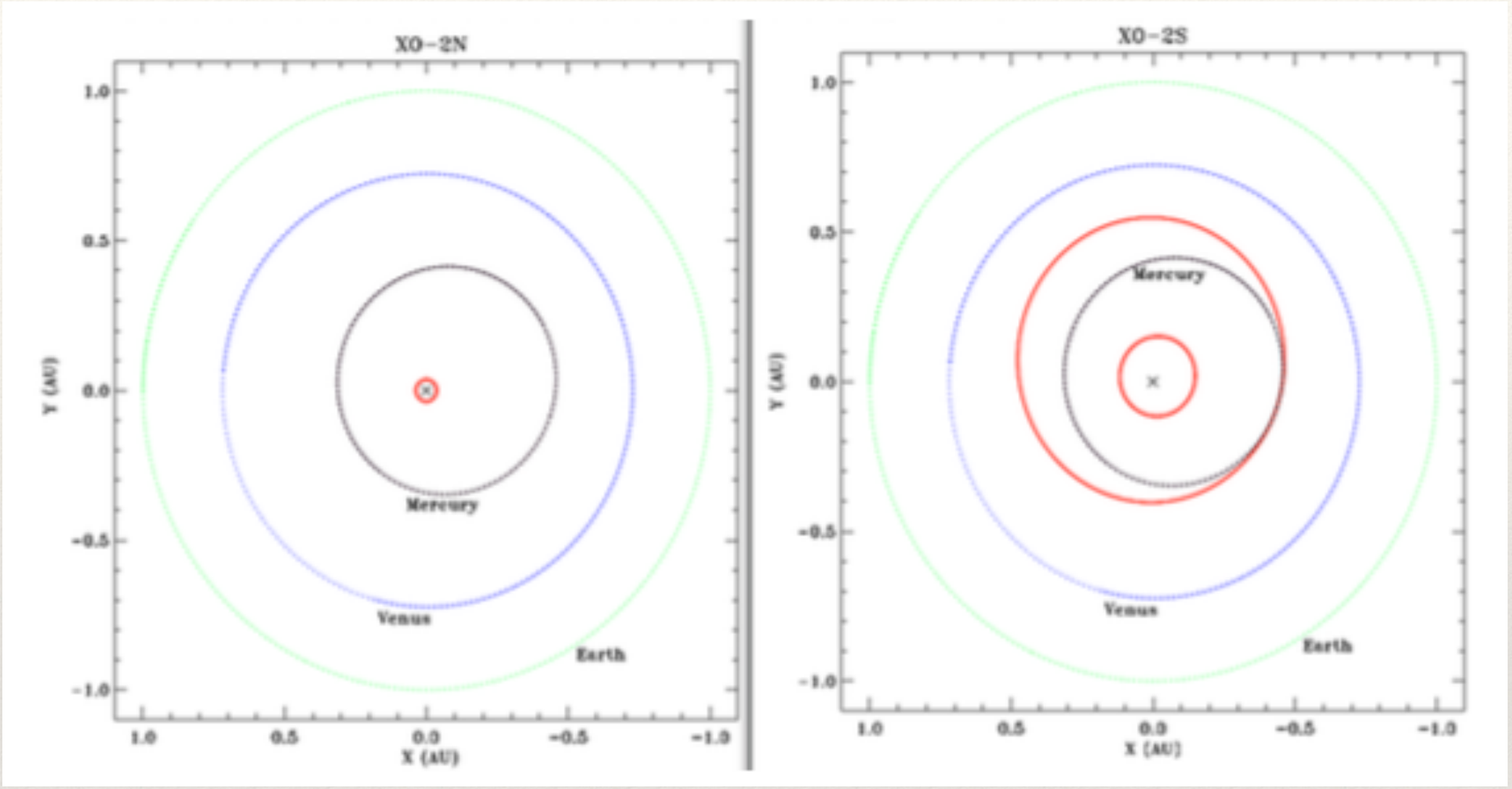
Two giant planets around the southern component!



K_1=58 m/s
P_1=18 d
K_2=20 m/s
P_2=120 d
rms=3 m/s



A Planetary System For XO-2S

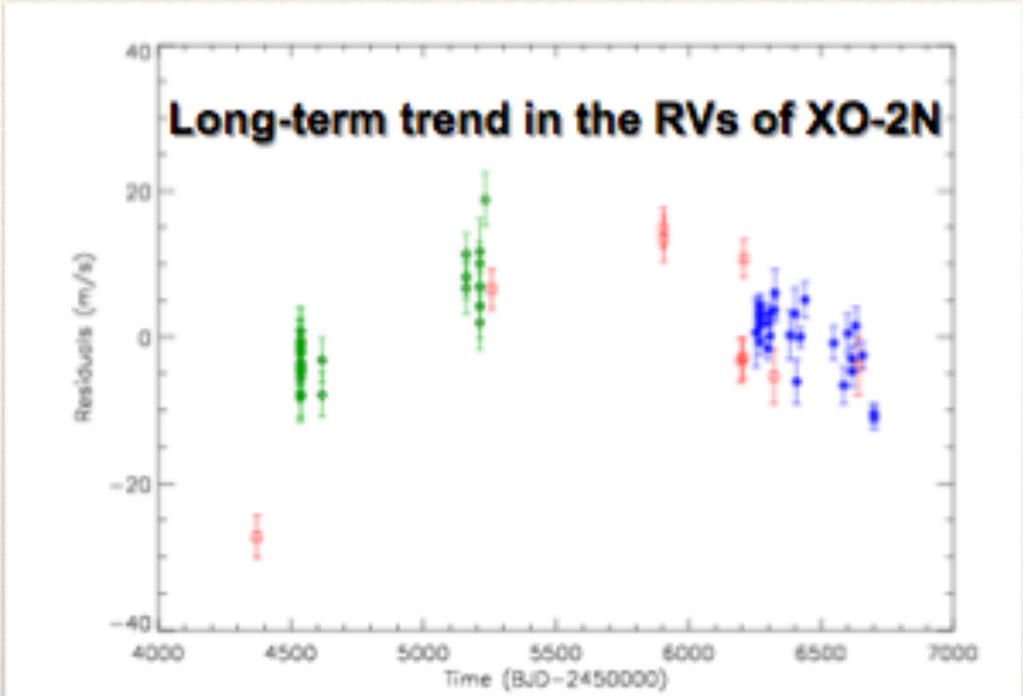


XO-2 Nb
M=0.597 MJ
P=2.616 d
a=0.037 AU

XO-2 S b	XO-2S c
Msini=0.259 MJ	Msini=1.370 MJ
P=18.157 d	P=120.80
a=0.134 AU	a=0.476

XO-2 Global System Analysis

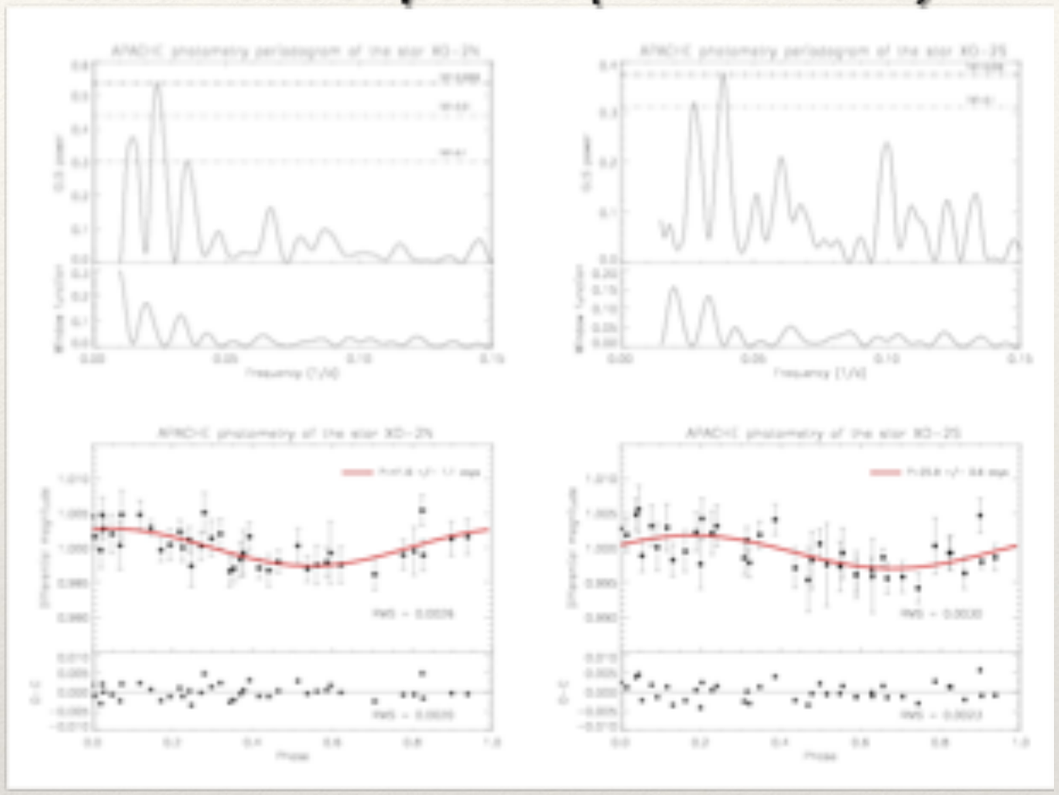
(Damasso et al. 2015, A&A 575, A111)



Differential Abundance Analysis

Parameter	XO-2N	XO-2S	Note
T_{eff} (K)	5332±57	5395±54	
logg (cgs)	4.44±0.08	4.43±0.08	
[Fe/H] (dex)	0.43±0.05	0.39±0.05	
Microturb. ξ (km s^{-1})	0.88±0.11	0.90±0.10	
$V \sin I_*$ (km s^{-1})	1.07±0.09	1.5±0.3	
Mass ($M_\odot$)	0.97±0.05	0.98±0.05	(1)
	0.96±0.05	-	(2)
Radius ($R_\odot$)	$1.01^{+0.1}_{-0.07}$	$1.02^{+0.09}_{-0.06}$	(1)
	$0.998^{+0.013}_{-0.012}$	-	(2)
Age (Gyr)	$7.9^{+2.3}_{-3.0}$	$7.1^{+2.5}_{-2.9}$	(1)
	$7.8^{+1.2}_{-1.3}$	-	(2)
Luminosity ($L_\odot$)	0.70±0.04	0.79±0.14	for XO-2N: (2) for XO-2S: (1)

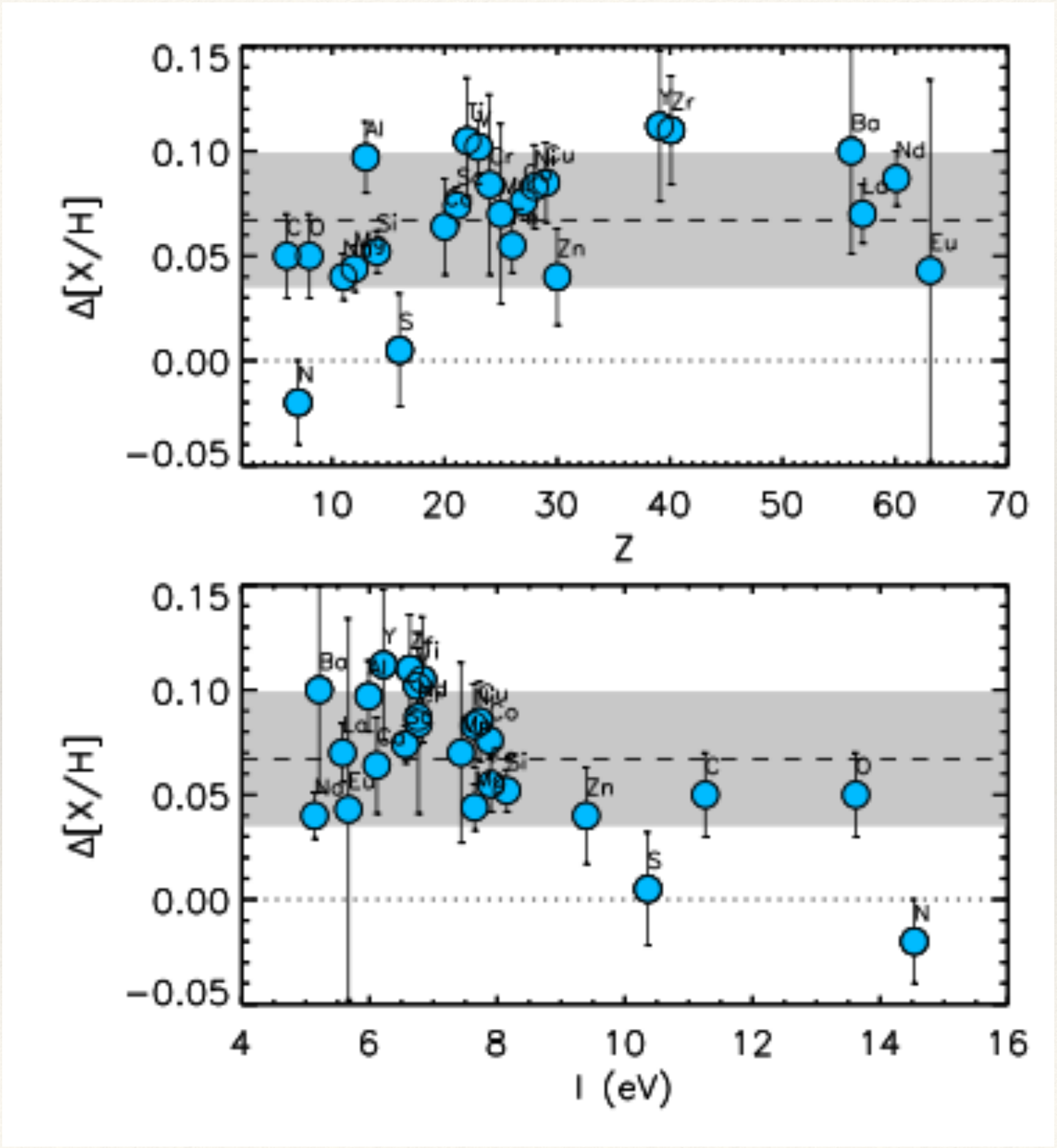
Stellar rotation periods (from APACHE)



Determination of activity levels

Activity indicator	XO-2N (36 spectra)	XO-2S (56 spectra)
$\log R'_{HK}$	-4.91±0.09	-5.03±0.07
S-index	0.0054±0.0009	0.0038±0.0009
Expected stellar rot. period [days]	39.4±3.9 [N84]	41.2±2.9 [N84]
	41.3±5.3 [M08]	44.7±4.0 [M08]
Measured stellar rot. period [days]	41.6±1.1	26.1±0.6

XO2 System Differential Analysis

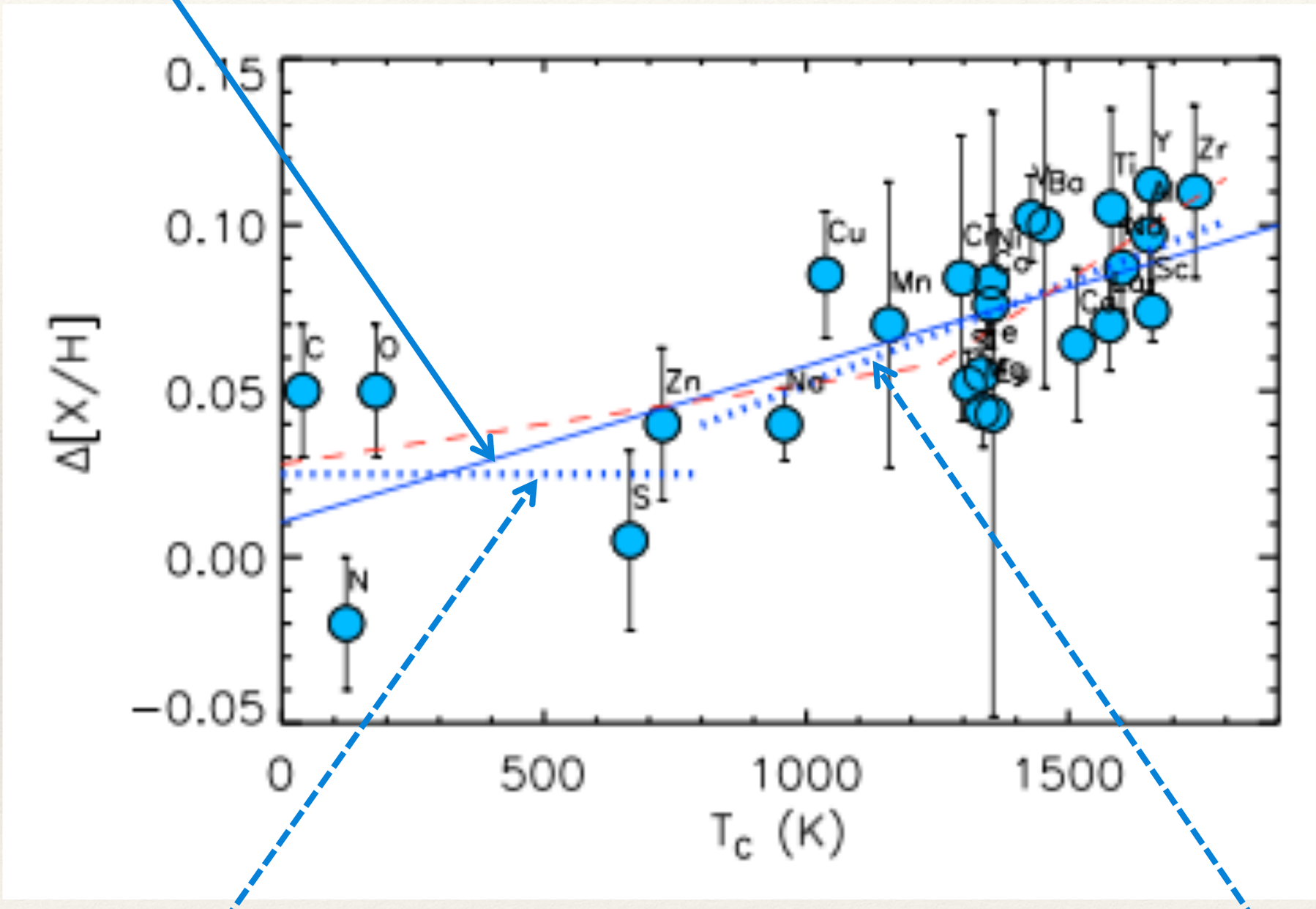


Biazzo et al. 2015

XO2 System Differential Analysis

Linear Fit

Biazzo et al. 2015

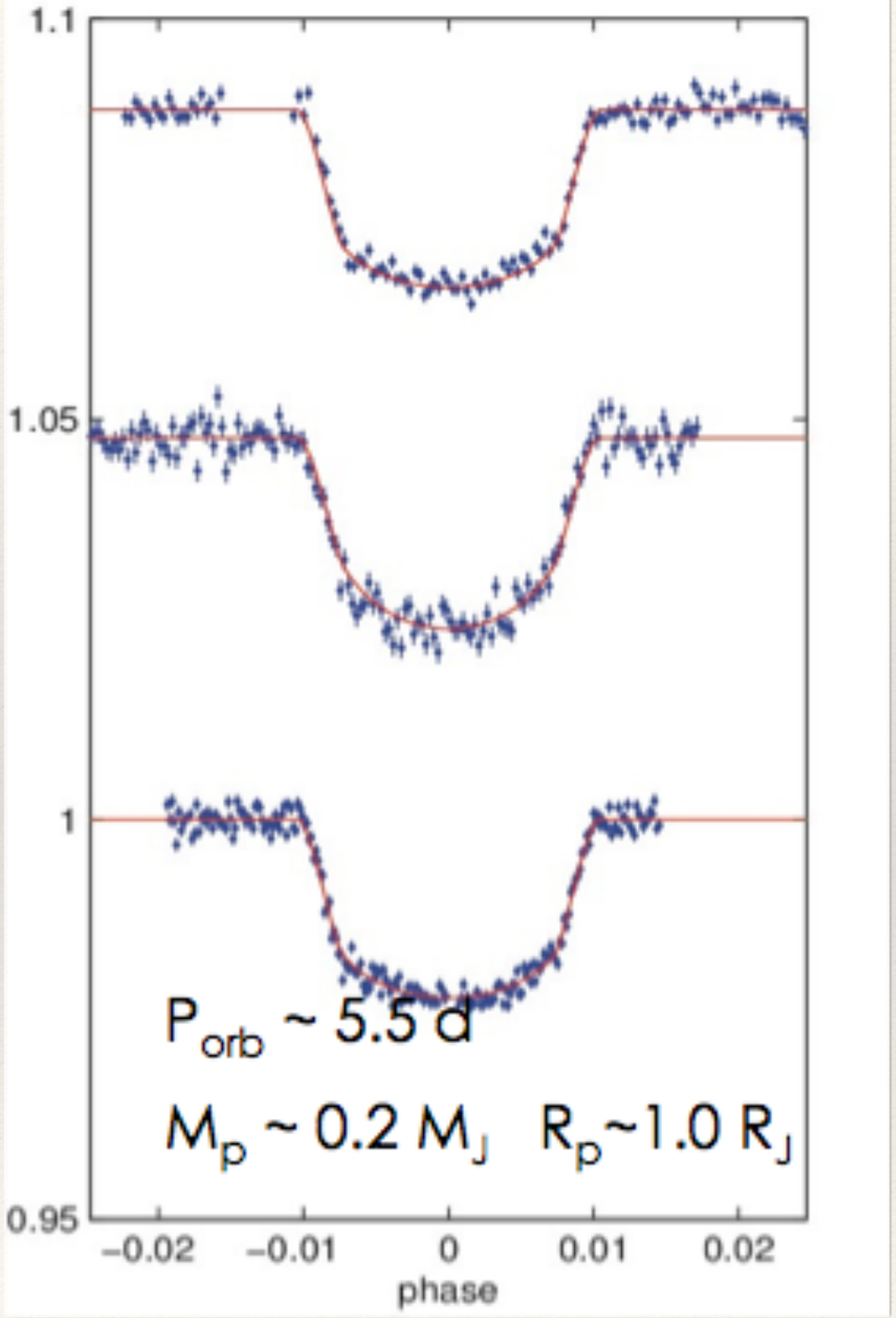


Average of Volatiles

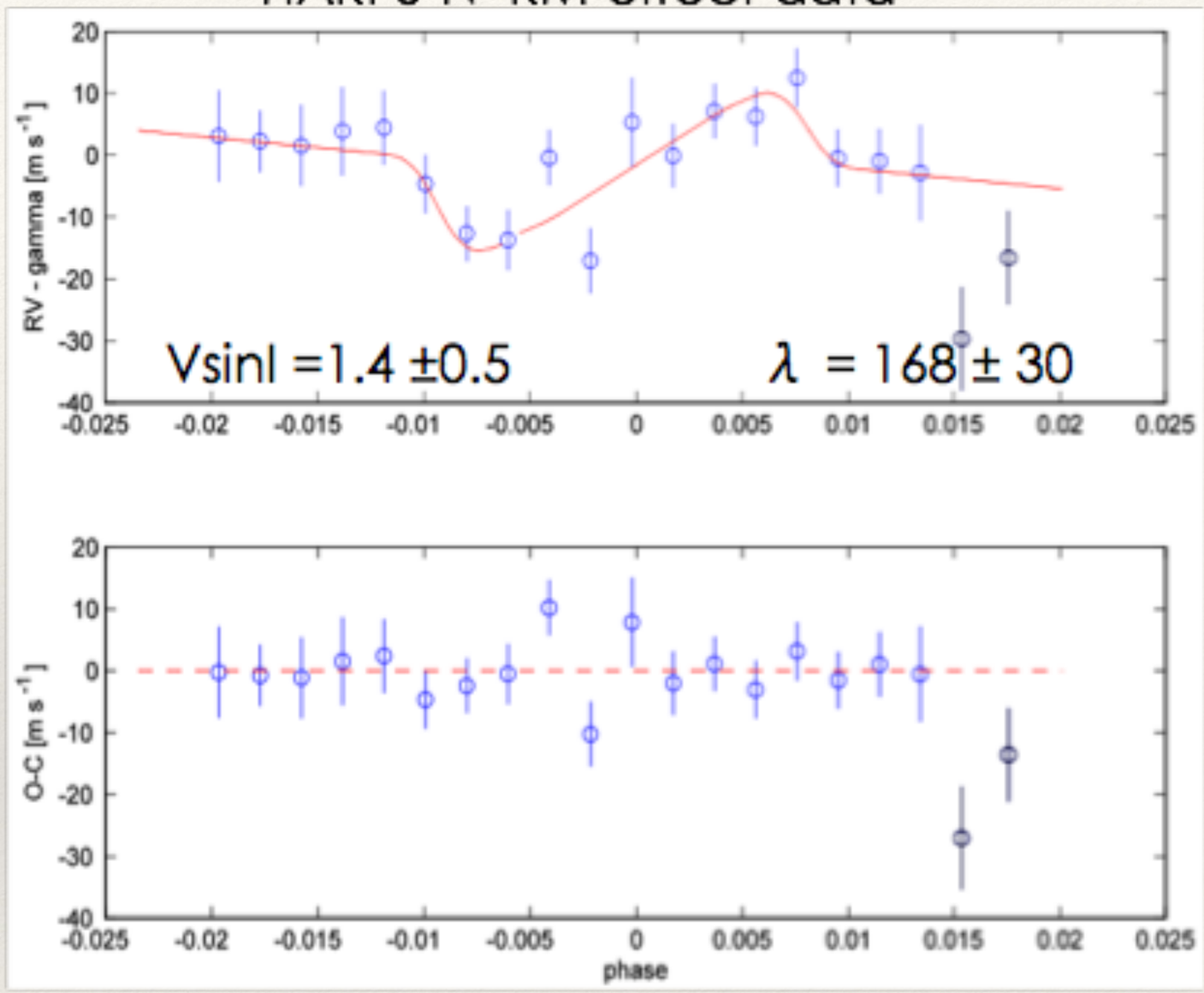
Refractory Trends

GAPS III. HAT-P-18b retrograde orbit

Phot. from 1.5m@Loiano



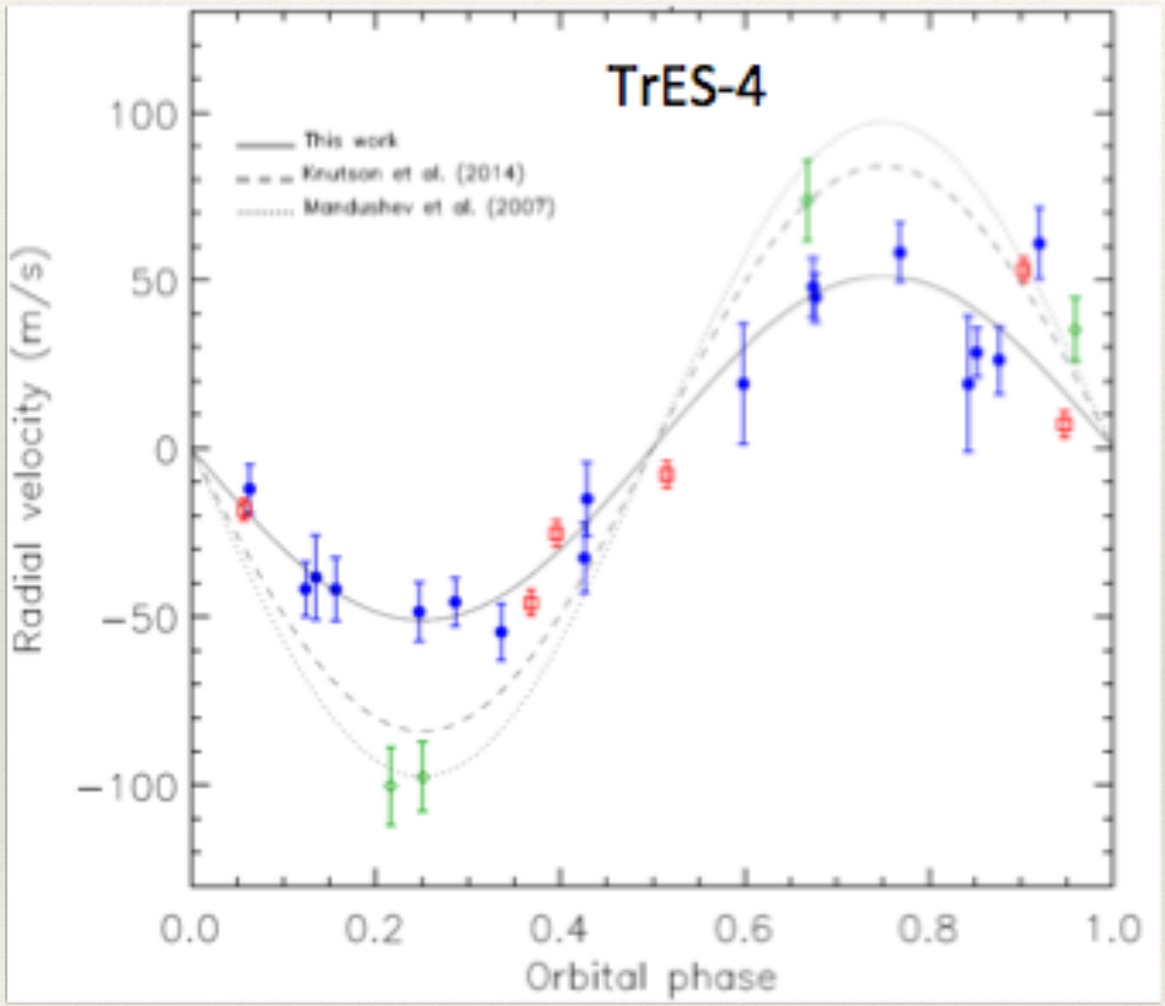
HARPS-N RM-effect data



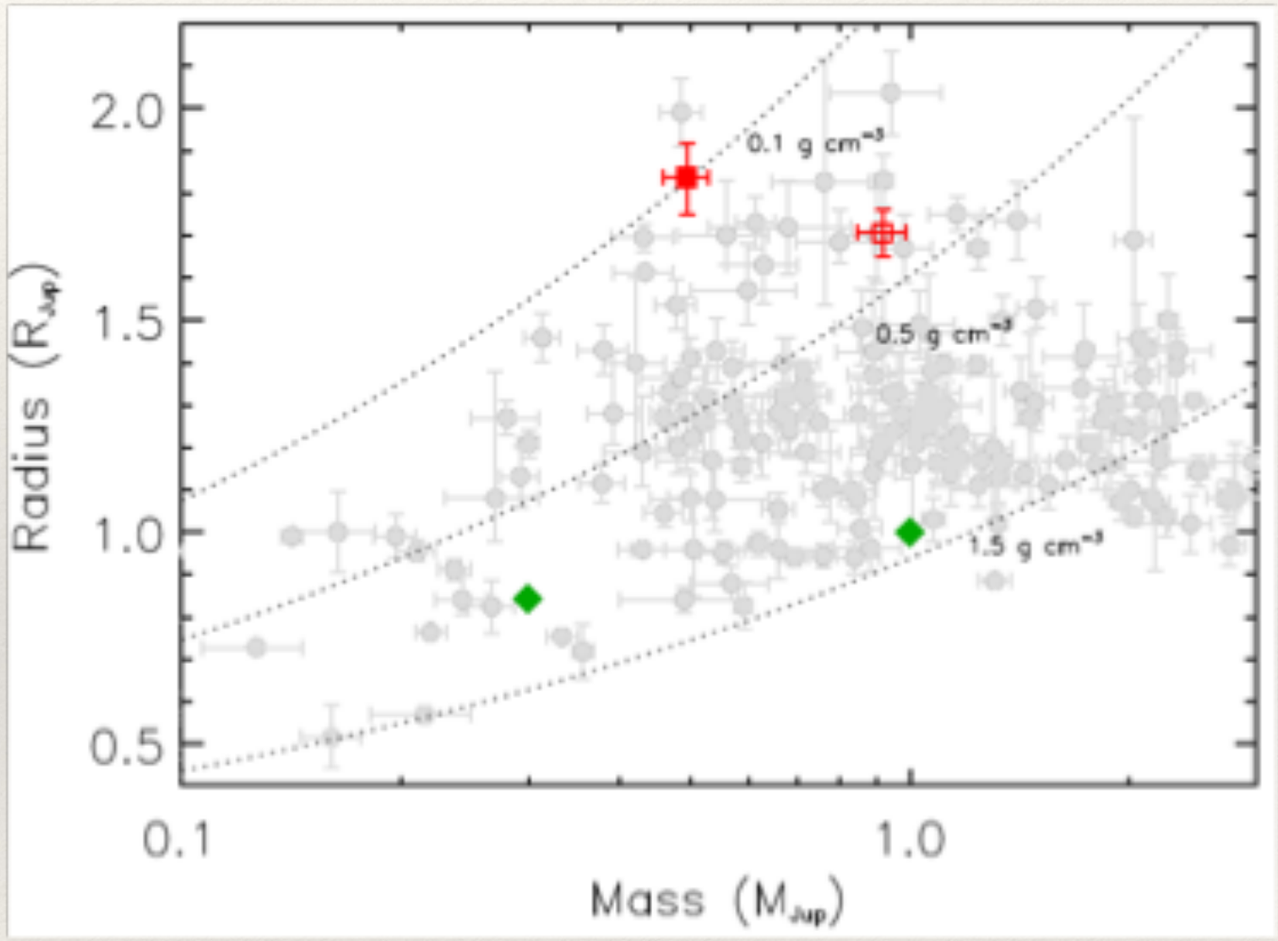
Host: V~12.8 K7V T_{eff}=4860±70K
log*g* =4.5±0.1 [Fe/H]= 0.11 ±0.09

Esposito et al. 2014 A&A 564 L13

The Curious Case of...



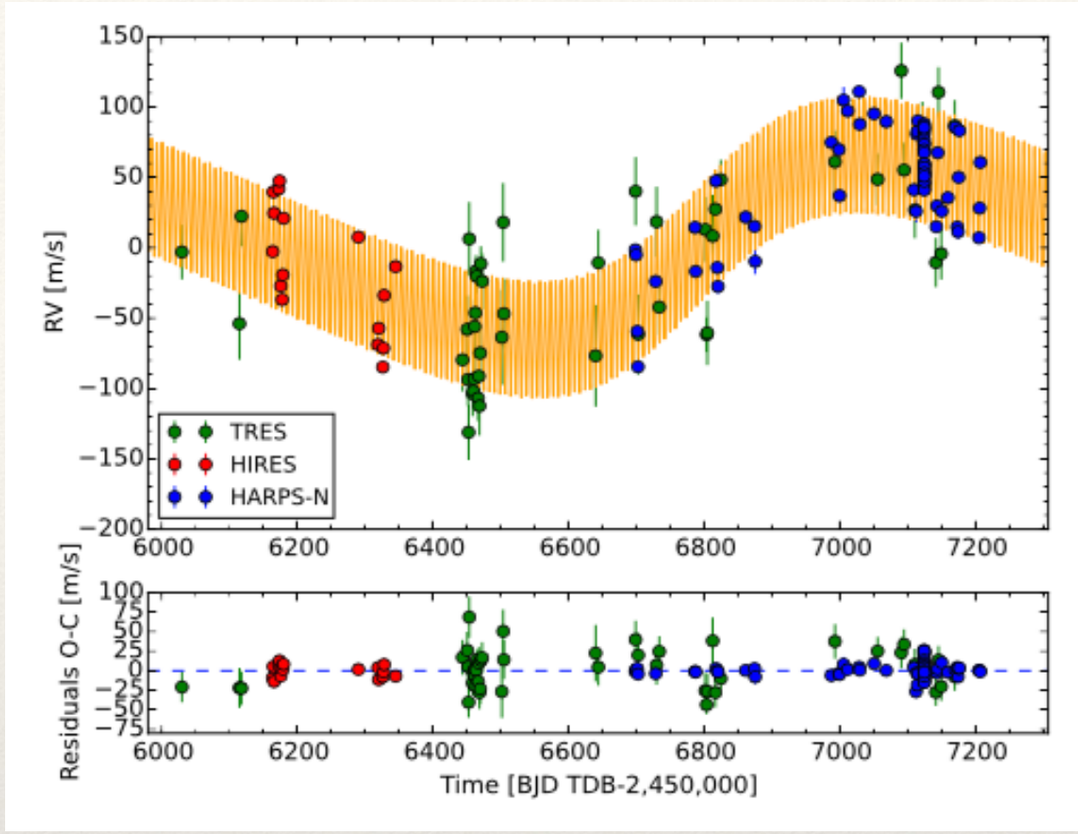
Sozzetti, Bonomo, Biazzo et al. A&A 575, L15

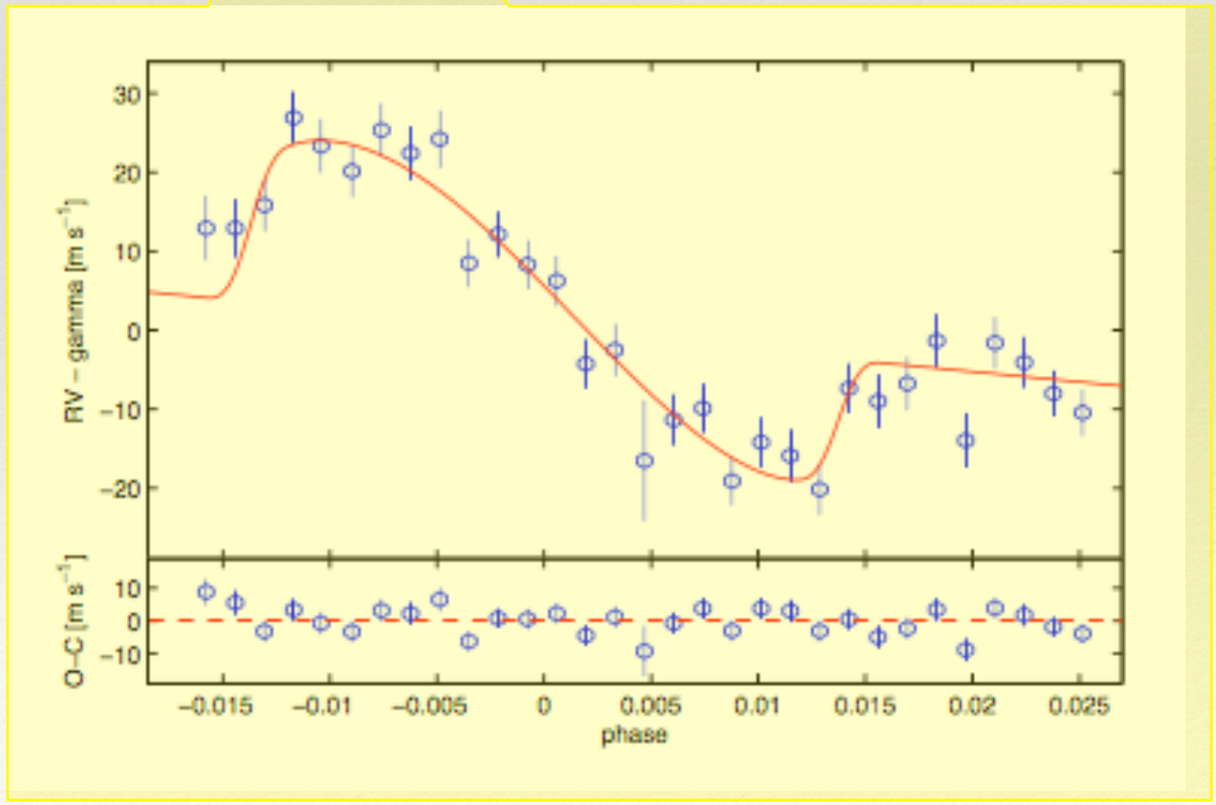


Now the second lowest-density transiting Hot Jupiter known!

One more Planet in KELT 6 System ....

Kelt 6 b	Kelt 6 c
M=0.442	Msini=3.71
P=7.845 d	P=1276d
a=0.080 AU	a=2.39 AU

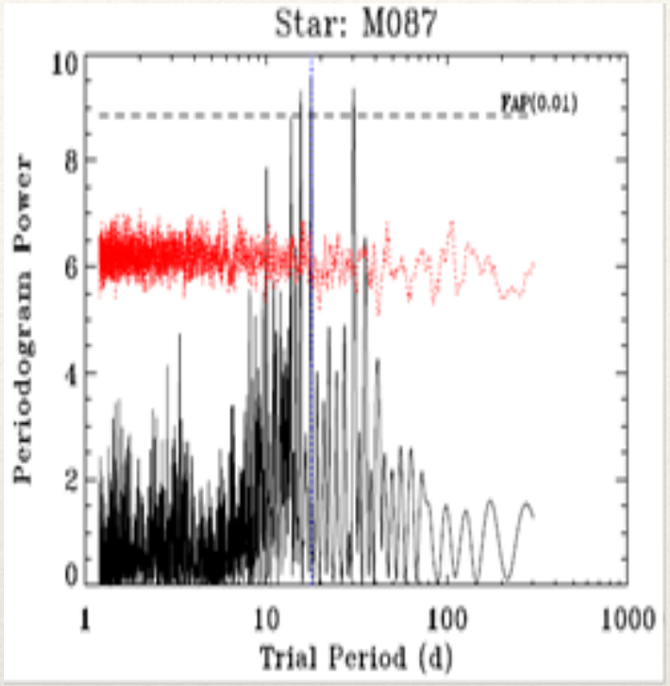




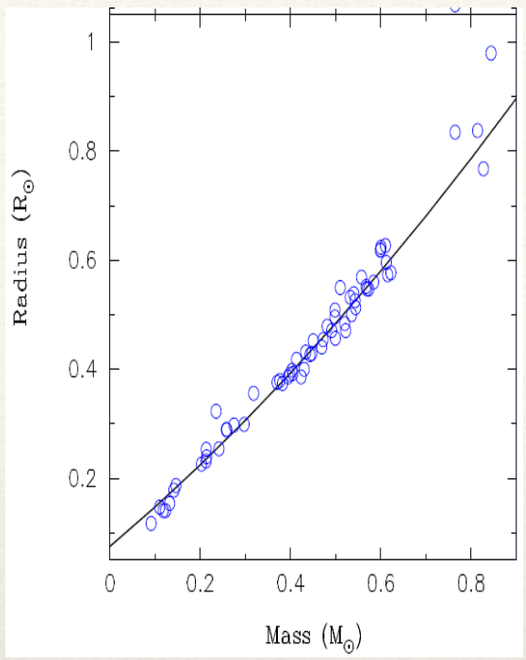
KELT-6 b moves in a pro- grade orbit and is slightly misaligned with respect to the stellar spin axis, with a projected spin-orbit angle $\lambda = -36^\circ \pm 11^\circ$.

Damasso et al 2015 A&A

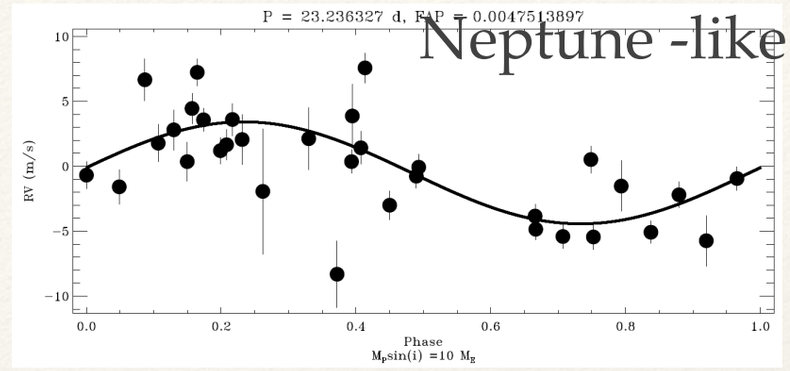
Furthermore ....



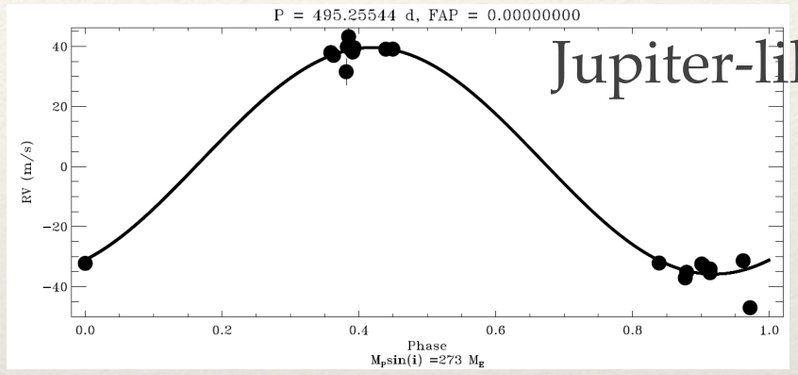
Affer et al. in preparation



Maldonado et al. 2015, A&A, 57 7, 132



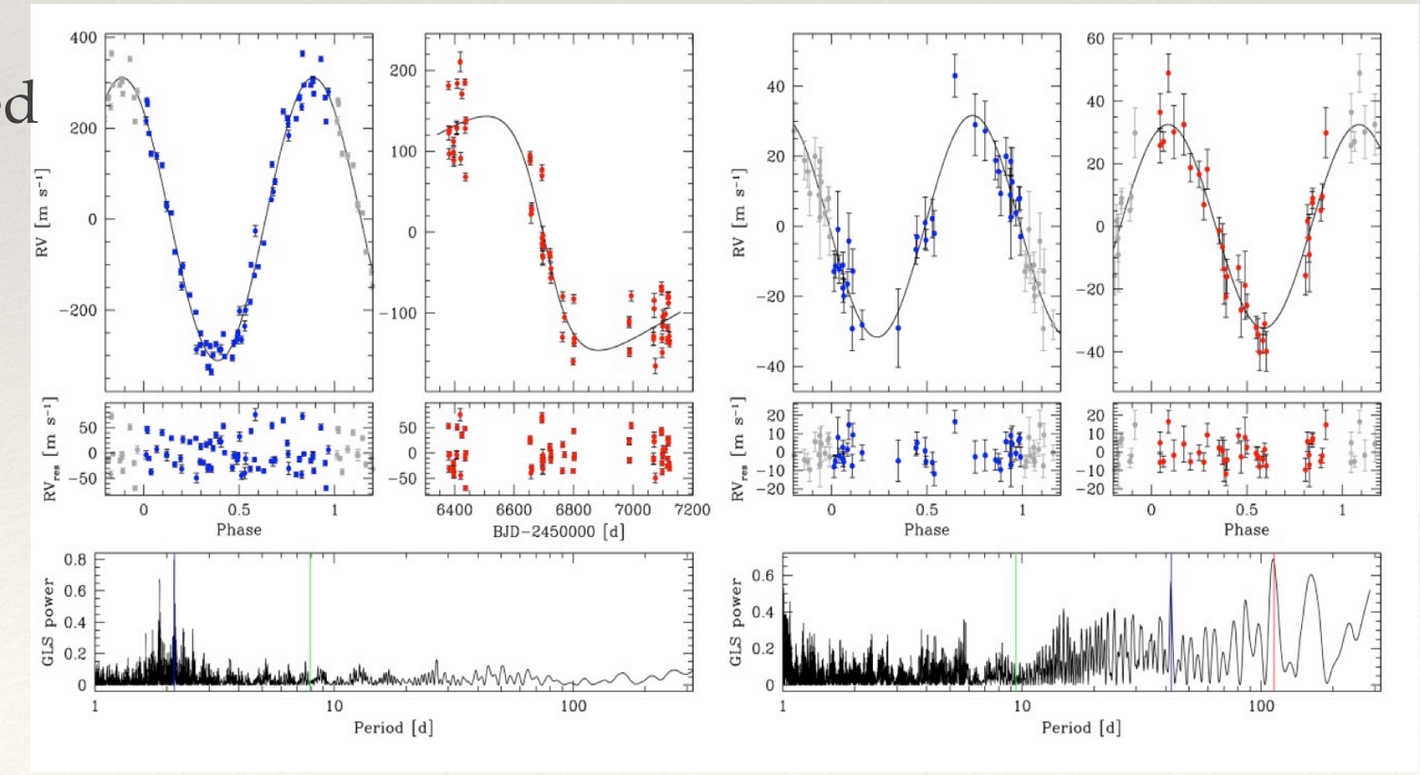
Neptune -like



Jupiter-like

Two Candidates in Metal Poor sample

Candidates in crowded enivironment



New GAPS Candidate orbiting the same star

Already Known Hot Jupiter

Just Published...

-- A HARPS-N investigation of the τ Boo system to jointly study asteroseismology, the planetary orbit, and star-planet magnetic interactions.

-- Empirical relationships to derive accurate stellar parameters for early M dwarfs

-- RML measurements and spectroscopic characterization of the transiting planetary systems HAT-P-36 and WASP-11/HAT-P-10

-- Differential abundances of the XO-2 binary system

… And Many More To Come:

-- Statistics of eccentricities in transiting systems
-- Correlation between Activity of the host stars and planetary characteristics
-- RML measurements for 10 more systems
-- Survey sensitivity limits and ensemble chemical abundance determinations

And naturally, new planet discoveries!

Towards GAPS 2 ...

Short Term
<2yr up to 2017

Intensive monitoring (det. small planets)

Lot of visits (>100) reduction of n. target

Medium Term
2-4 yr up to 2017-2019

Preparation an Follow up CHEOPS and TESS

Long Term
>4yr later than 2019

Preparation PLATO and ARIEL (?) follow up GAIA