Studying the Characteristics of Exoplanets through Transit Observations

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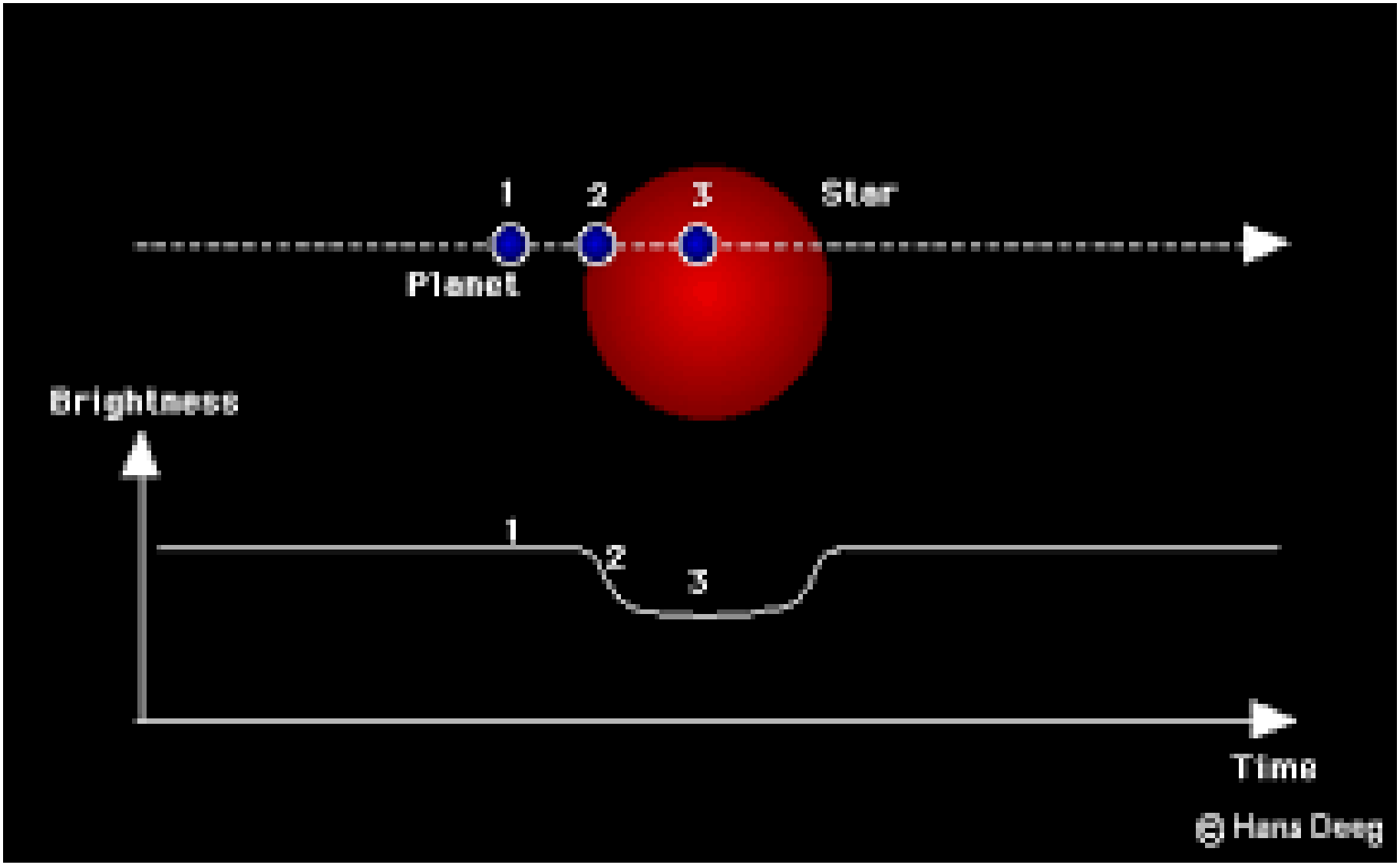
Outline

- A Network of Transit Survey
- Close-in Planet: WASP-43b
- Observations
- Results
- Conclusions

Transit Observation



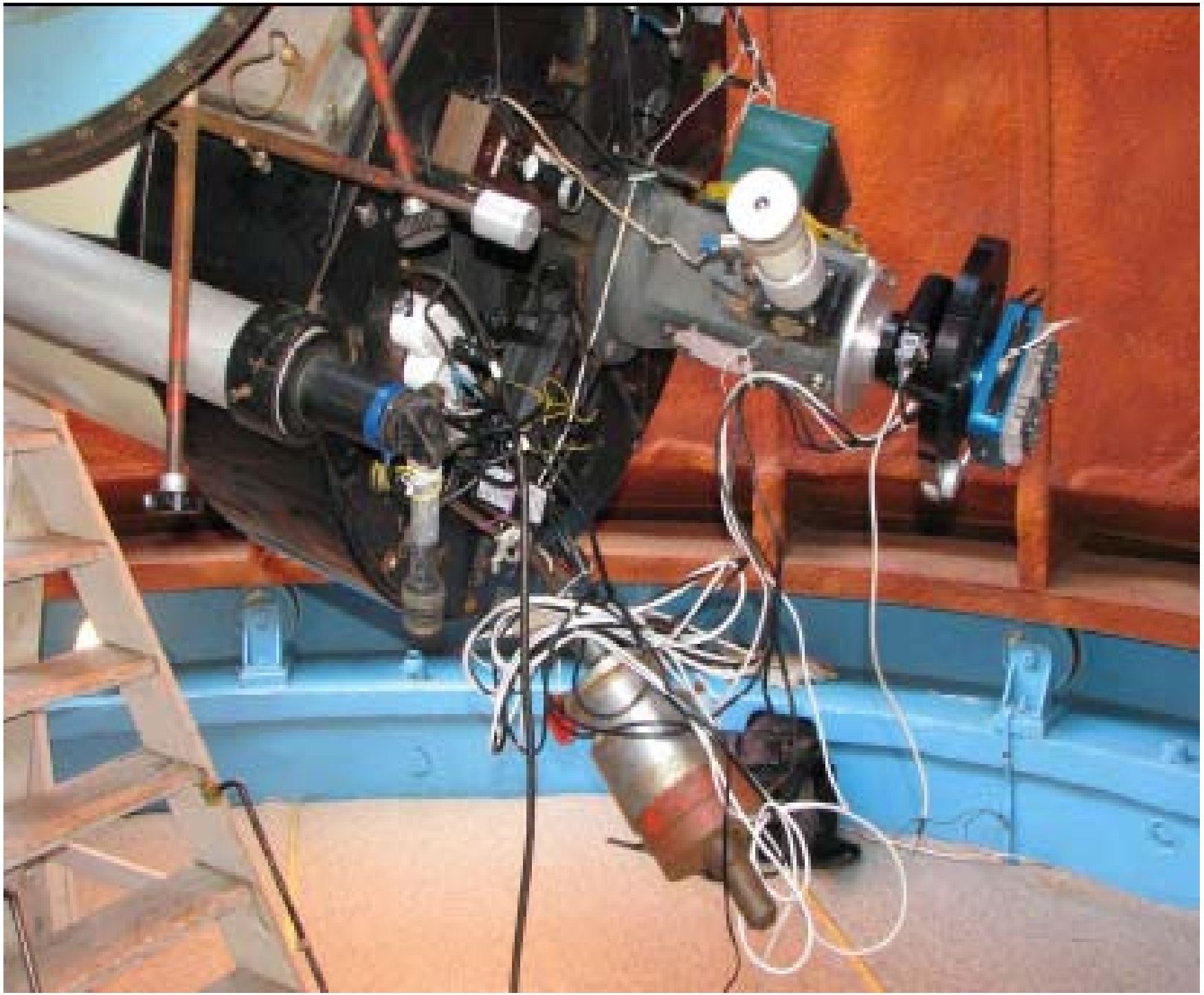
NETS Project

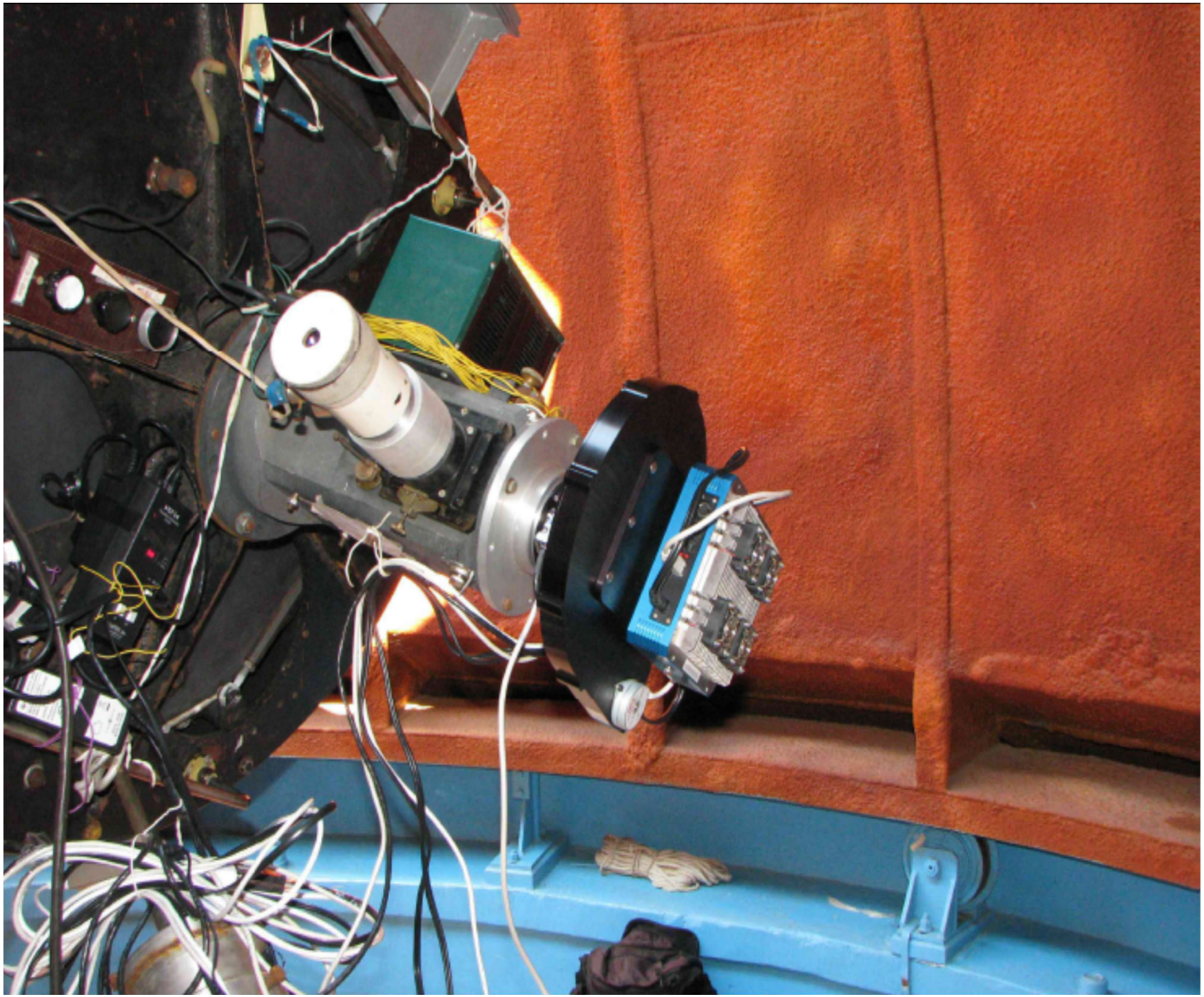
- A NEtwork of Transit Survey
  To monitor known planetary systems
- Multiple Sites:
  More light curves could be obtained
- Scientific Goal:
  To study orbital configurations and possible transit timing variations

Telescopes

- CrAO 0.8m, 1.25m, Crimea
- ARIES 130 cm, 104 cm, India
- HCT 2 meter, India
- WISE 46cm, Israel
- Purple Mountain Observatory 1.2 m, P.R.China
- P60, Palomar Observatory, U.S.A.
- Tenagra II 0.8m, Arizona, U.S.A.

0.8m Telescope: CrAO, Crimea



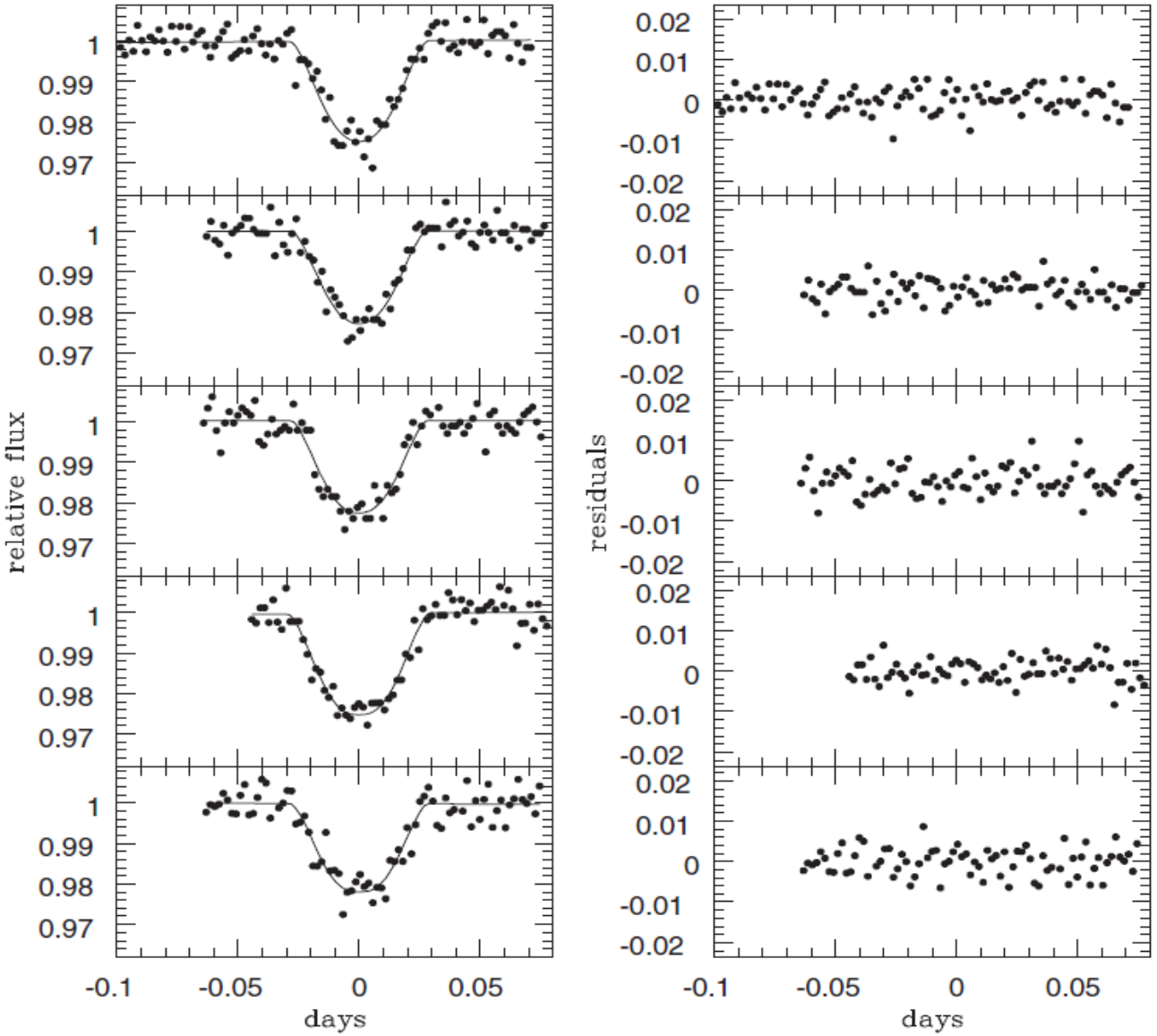


	ARIES		CrAO			Lulin	PMO	P60	Tenagra	WISE	Total
	104cm	130cm	AZT-11	MTM-500	RC-800						
CoRoT-1b									2		2
CoRoT-2b					2						2
GJ1214-b					1						1
HAT-P-5b										1	1
HAT-P-9b			1								1
HAT-P-12b							1	5	2	2	10
HAT-P-16b					1						1
HAT-P-18b									2		2
HAT-P-19b								1			1
HAT-P-21b									3		3
HAT-P-22b										1	1
HAT-P-23b			3	1	11			2	1		18
HAT-P-24b									1		1
HAT-P-32b								1			1
HAT-P-36b			4								4
HAT-P-37b								5			5
HAT-P-43b								2			2
KOI0135										1	1
Qatar-1b				6	1			11			18
Qatar-2b								1			1
TrES-2b										2	2
TrES-3b	1	1	2				2		12		18
TrES-5b				3				5			8
WASP-2b					2						2
WASP-3b			2				2				4
WASP-10b										1	1
WASP-11b/ HAT-P-10b					1						1
WASP-12b							1		5		6
WASP-14b										1	1
WASP-16b			1								1
WASP-24b			1								1
WASP-33b				6	1	1			2		10
WASP-36b								5			5
WASP-40b					1						1

Data Summary

- 170 light curves
- 30 targets

Our TrES-3 Light Curves



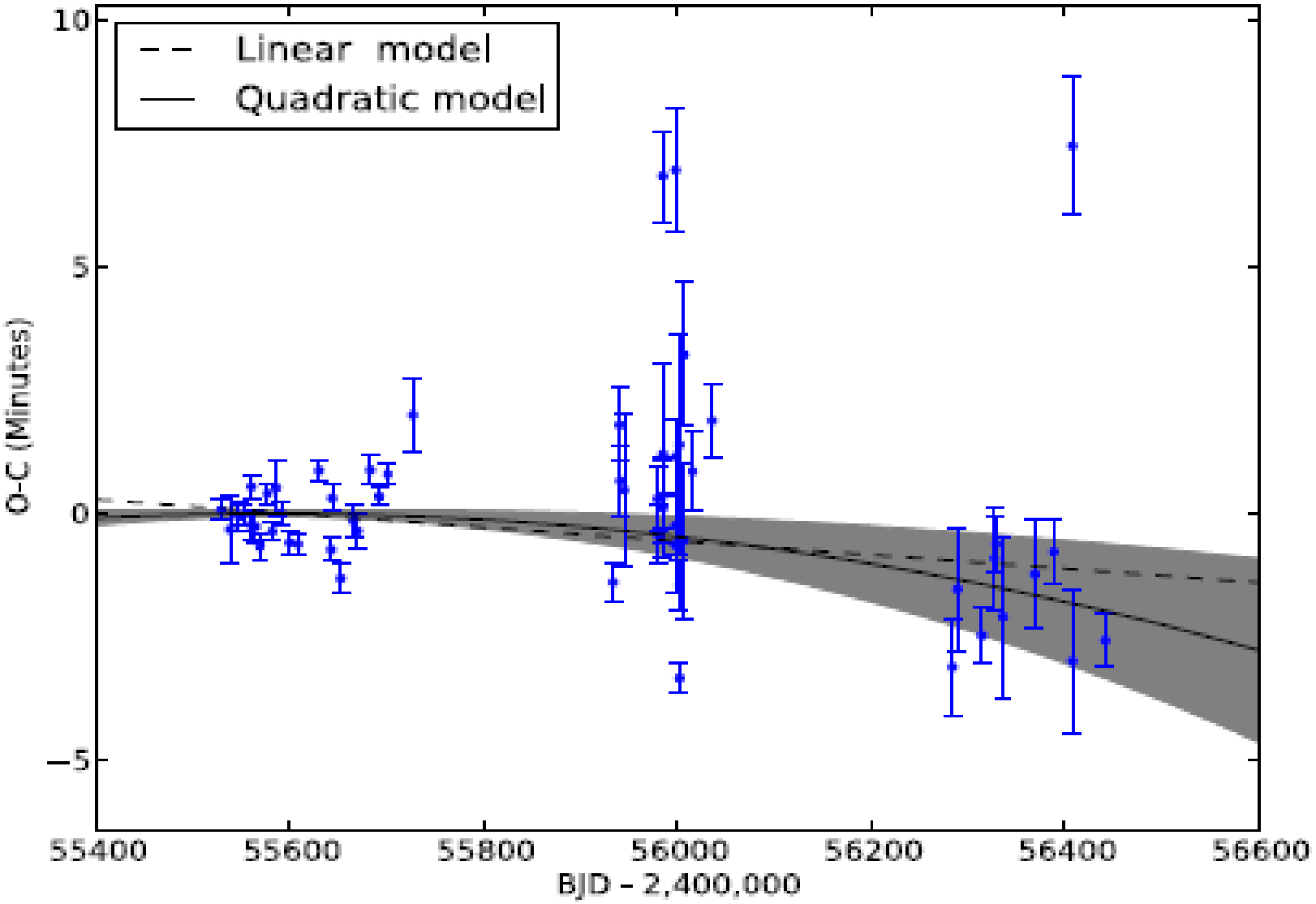
WASP-43b

- discovered by Hellier et al. (2011)
- with a mass of 1.8 Jupiter mass
- period is about 0.8 days
- semi-major axis a = 0.015 AU
- a hot Jupiter
- one of the most massive exoplanets on an extremely close orbit.

Previous Work

- Wang et al. (2013) confirmed the thermal emission from the planet
- Chen et al. (2014) detected the day-side thermal emission in the K band
- Kreidberg et al. (2014) determined the water abundance in the atmosphere
- Czesla et al. (2013) showed an X-ray detection from WASP-43 star, could be from tidal interactions with the planet

Blecic et al. (2014)



Possible Orbital Decay

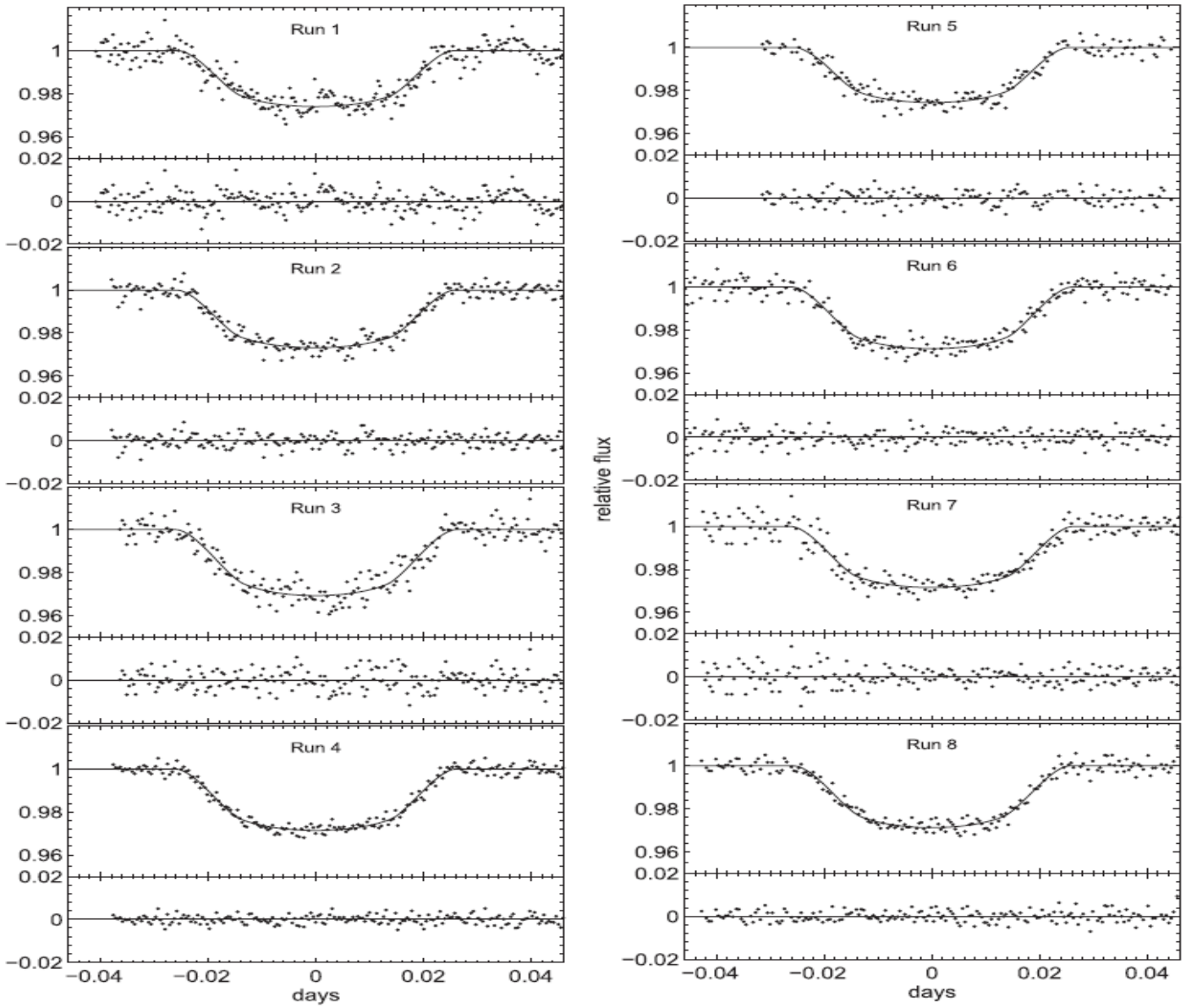
- Blecic et al. (2014) : orbital period is decreasing about 0.095 s per year
- Murgas et al. (2014): orbital period is decreasing about 0.15 s per year
- The above rates imply stellar tidal dissipation factor, Q, to be about 10^4
- This value contradicts with theoretical values (10^5 to 10^7, see Levrard et al. 2009)

The Log of Our Observations

Run	UT Date	Instrument	Filter	Interval (JD-2450000)	Exposure	No. of Images
1	2012 Mar 24	AZT-11	*R*	6011.212-6011.302	30	251
2	2014 Mar 12	P60	*R*	6728.698-6728.789	10	219
3	2014 Mar 16	P60	*R*	6732.767-6732.856	10	213
4	2014 Apr 07	P60	*R*	6754.731-6754.820	12	205
5	2014 Dec 24	P60	*R*	7015.864-7015.940	12	150
6	2015 Jan 06	P60	*R*	7028.864-7028.955	12	194
7	2015 Jan 15	P60	*R*	7037.815-7037.905	12	190
8	2015 Jan 19	P60	*R*	7041.882-7041.979	12	194

Note. For each run, the UT date, instrument, filter, observational interval (JD-2450000), exposure time (second), and the number of images are listed.

Our WASP-43 Light Curves

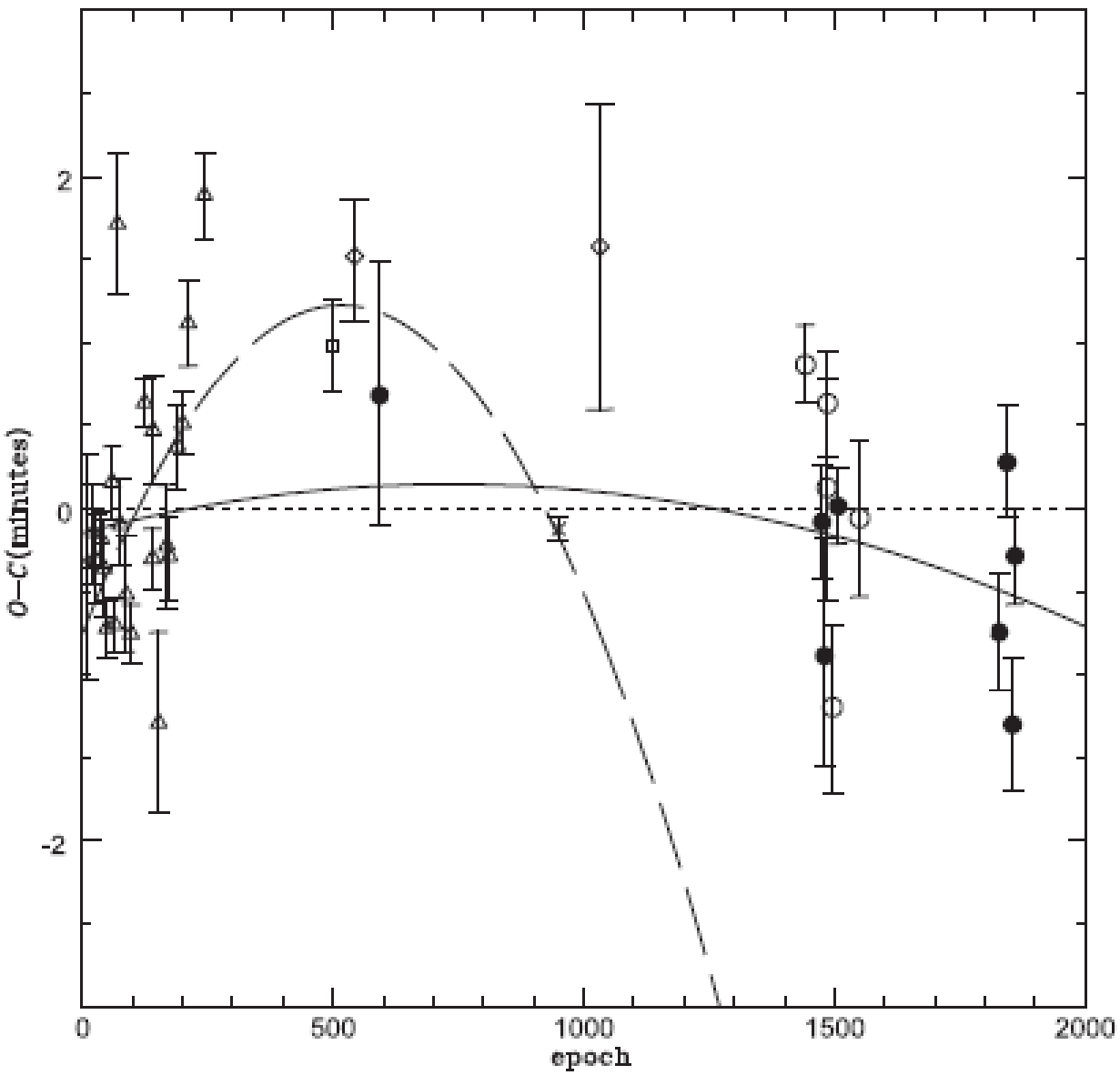


Timing

$$T_{\mathrm{m}}^{C}(E) = T_0 + PE,$$

$$T_S(E) = T_{q0} + P_q E + \delta P \frac{E(E-1)}{2}$$

O-C Diagram



A Smaller Decay Rate

- Orbital period is decreasing at a rate 0.028 s per year
- This gives a stellar tidal dissipation factor about 10^5
- It is within the theoretical range
- The contradiction is resolved !
- Later paper (Hoyer et al. 2016) reconfirms our result with a smaller rate

Chernov et al. (2017)

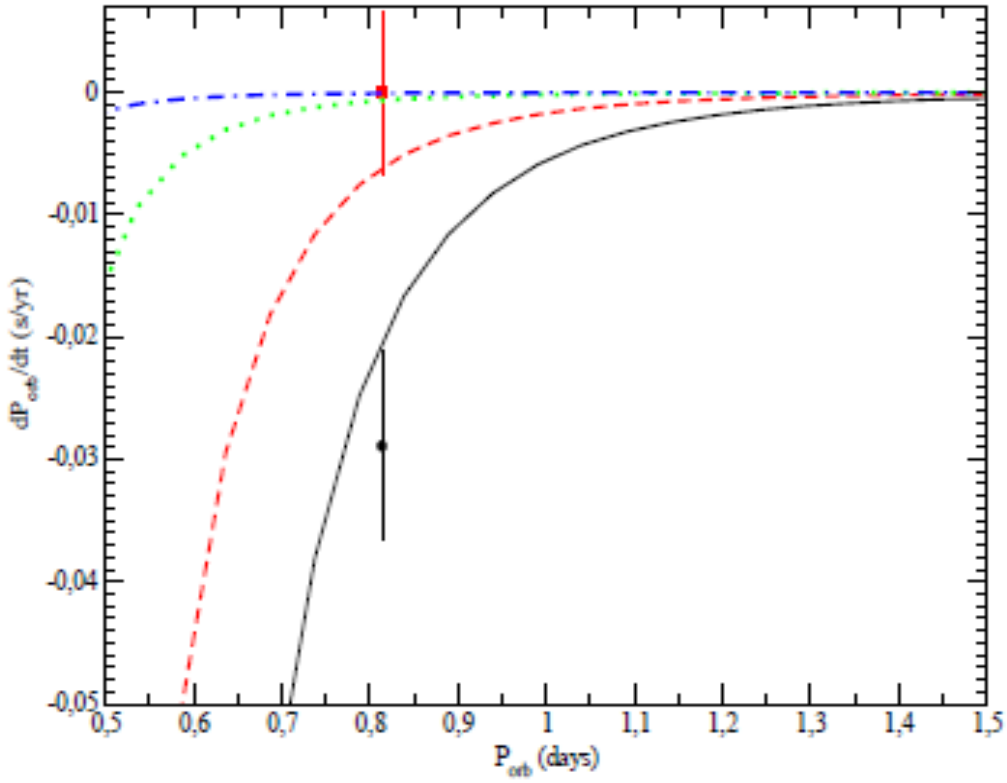
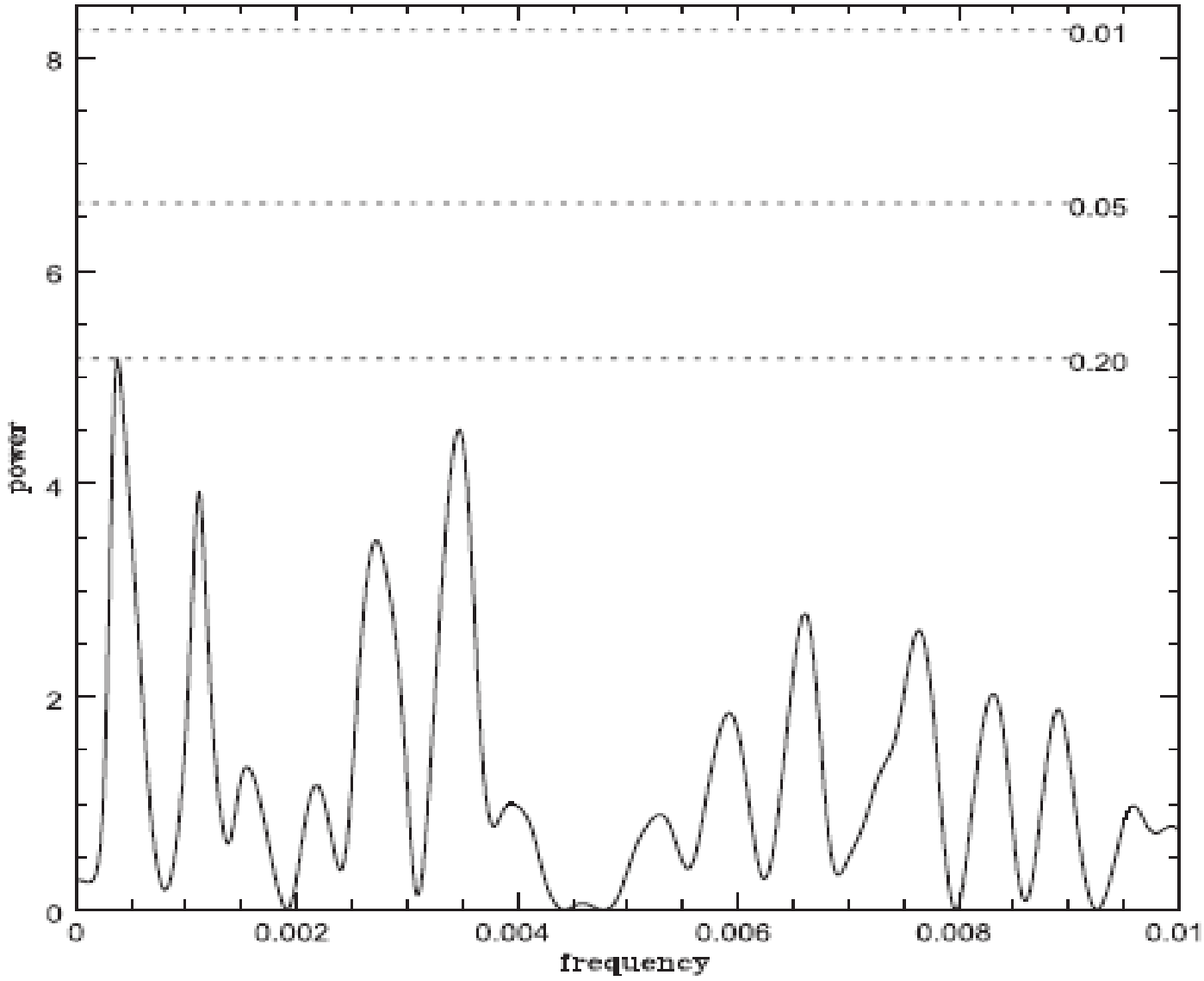


Figure 9. Results related to our model of WASP-43 are shown. Differen s/yr as functions of orbital period in days, for different values of the qua of particular curves. The black circle and red square show the positions of by Jiang et al. (2016) and Hoyer et al. (2016b), respectively.

Frequency Analysis



Conclusions

- Eight new transit light curves are presented
- Possible transit timing variation is studied
- A new orbital decay rate is obtained
- A more reasonable value of the stellar tidal dissipation factor Q = 10^5 is determined
- We seek for more survey collaborations
- We expect more interesting results to come