DEĞEN ÇİFT YILDIZLARIN GEZEGENLERİ OLABİLİR Mİ?

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- Çift yıldızlarda keşfedilen gezegenler
- Disk oluşumu
- Bir simulasyon→ keşif zorluğu
- Işık eğrilerindeki etkiler
- O-C eğrileri

Çift Yıldızlarda Keşfedilen Gezegenler

1. Uzun dönemli ayrık çy'da bir bieşenin etrafında → 44 sistem (a>20 AB)
2. Kısa dönemli ayrık çy'da sistem etrafında → 10 sistem (0.08<a(AB)<0.23)
3. Değen çy'lar (ortak zarf içindeki sistemler) → ? Henüz keşfedilmedi
4. Ortak zarf sonrası sistemler (PCES) sistem etrafında→ 11 sistem
5. Nötron yıldızı çy sistemlerinde, sistem etrafında → 2 sistem ?

Uzun Dönemli çy'lar (a> 20 AB) : S –türü yörüngedeki gezegenler http://www.univie.ac.at/adg/schwarz/binary.htm

44 systems

SYSTEM	discovery	Spectral Type	Distance [parsec]	m_binary [m2/(m1+m2)]	a_binary [AU]	e_sec	number of planets	planets motion S-type, P-type	Exoplanet catalogue	comments	m1 [m_sun]	m2 [m_sun]
Kepler 132 Abc Bd	2014		500		450			S	Kepler 132			
HD38529 AbcB	2000-2002	G4VI / M3.0V	40.00	0.169	12042		2	S	HD 38529	Debris disk (>86 AU)	1.48	0.3
HD20782b / HD20781	2006	G2V / K0V	36.02	0.457	9080	0.24	1	S	HD 20782		1.00	0.84
HD125612 Ab-dB	2007-2009	G3V / M4	52.82	0.143	4759	0.00	3	S	HD 125612		1.1	0.184
HD222582 AB	1999	G5 / M3?	42.00	0.233	4746		1	S	HD 222582	secondary (red dwarf)	0.99	0.3
XO-2 b	2007	K0 V / K0 V	150.00	0.500	4600		1	S	XO-2		0.98	0.98
HD147513 AbB	2003	G3-G5V / DA2 VII	12.90	0.414	4451		1	S	HD 147513	HD147513 B w. dwarf	0.92	0.65
HD 213240 AbC	2001	G4 IV / M	40.75	0.107	3898		1	S	HD 213240	ref.(HD 213240 C)	1.22	0.146
Gl 777 AbcB	2003-2005	G6IV / M4.5V	15.89	0.161	2846		2	S	HD 190360	secondary (red dwarf)	1.04	0.2
HD89744 AbcB	2000/2013	F7V / L0V	40.00	0.054	2456		2	S	HD 89744	2nd. (heavy brown dwarf)	1.4	0.08
91 Aqr (HD 219449, GJ 893.2)	2003	K0III / ?	45.50	--	2248		1	S	91 Aqr		2.5	
HD101930 AaB	2005	K1V / M0-1	30.49	0.474	2200		1	S	HD 101930		0.74	0.666
ADS16402 BbA	2006	G0V / G0V	139.00	--	1550		1	S	HAT-P-1		1.12	1.16
HD80606b / HD80607	2003	G5V / G5V	58.40	0.500	1200	0.5	1	S	HD 80606	e_planet >>,because of second star	0.98	0.98
55 Cnc Ab-fB	1996-2007	G8V / M3.5-4V	13.02	0.120	1050		5	S	55 Cnc		0.95	0.13
HD11964 AbcB (GJ 81.1 A)	2005	G5 / K4	33.98	--	1010		2	S	HD 11964		1.125	
HD142022 AbB	2005	K0V / ?	35.87	--	794		1	S	HD 142022 A		0.99	
Ups And Ab-eB	1996-2010	F8V / M4.5V	13.47	--	702		4	S	ups And A		1.27	
HD188015 AbB	2004	G5IV / ?	52.60	--	684		1	S	HD 188015 b		1.09	
HD75289 AbB (HR3497)	1999	G0V / ?	28.94	0.118	620		2	S	HD 75289	HR3497 AB (r. dwarf)	1.05	0.14
83 Leonis ABbc	2005-2010	G6-K0IV / K2V	18.00	0.454	515		2	S	HD 99492		1	0.83

Kısa dönemli ayrık çy'da sistem etrafında : $7.4 < P < 40.1$ d , $P_p = 6\ P_{bin}$

Table 1: Circumbinary planets detected by *Kepler*. by transit observations.

Name	P_{bin} (days)	e_{bin}	P_p (days)	e_p	P_p/P_{crit}
Kepler-16	40.1	0.16	228.8	0.01	1.14
Kepler-34	28.0	0.52	288.8	0.18	1.21
Kepler-35	20.7	0.14	131.4	0.04	1.24
Kepler-38	18.8	0.10	106.0	0.07	1.42
Kepler-47b	7.4	0.02	49.5	0.04	1.77
Kepler-47d	7.4	0.02	187.3	-	-
Kepler-47c	7.4	0.02	303.1	< 0.41	10.8
Kepler-64	20.0	0.21	138.5	0.07	1.29
Kepler-413	10.1	0.04	66.3	0.12	1.60

Note: Kepler-47d awaits publication and has no e_p measurement.

Refs: Doyle et al. (2011); Welsh et al. (2012); Orosz et al. (2012a,b) Schwamb et al. (2013); Kostov et al. (2013, 2014).

Ortak zarf sonrası sistemler (PCES) sistem etrafında PCEB by ET or PT → 2. nesil gezegenler (www.exoplanets.eu) .

Showing 12 planetary systems / 15 planets / 2 multiple planet systems

All fields

exoplanet.eu

Show 100 entries

Planet Search

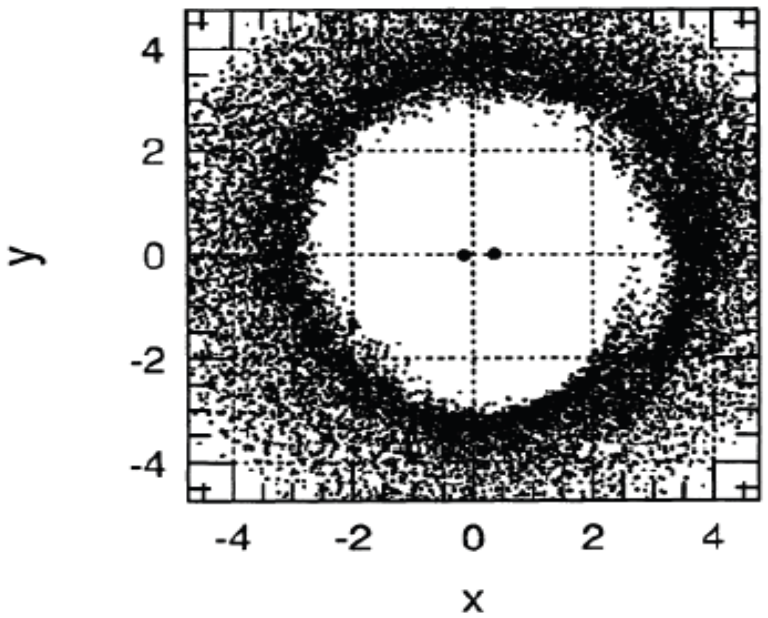
Planet	Mass (M_{Jup})	Radius (R_{Jup})	Period (day)	*a* (AU)	*e*	*i* (deg)	Ang. dist. (arcsec)	Status	Discovery	Update
V391 Peg b	3.2	—	1170	1.7	0	—	0.001214	R	2007	2014-08-22
OY Car b	8.48	—	—	6.18	—	—	—	R	2014	2014-07-09
PSR 1257 12 d	0.012	—	98.2114	0.46	0.0252	47	0.00092	R	1992	2014-02-25
PSR 1257 12 c	0.013	—	66.5419	0.36	0.0186	53	0.00072	R	1992	2014-02-25
PSR 1257 12 b	0.00007	—	25.262	0.19	0	—	0.00038	R	1992	2014-02-25
UZ For(ab) d	7.7	—	1900	2.8	0.05	—	—	R	2011	2014-01-28
NN Ser (ab) c	6.91	—	5660	5.38	0	—	0.01076	R	2010	2014-01-28
NN Ser (ab) d	2.28	—	2830	3.39	0.2	—	0.00678	R	2009	2014-01-28
PSR B1620-26 b	2.5	—	36525	23	—	—	0.006053	R	2003	2013-07-11
PSR 1719-14 b	1	0.4	0.090706293	0.0044	0.06	—	—	R	2011	2012-07-24
HW Vir (AB) b	14.3	—	4640	4.69	0.4	—	0.025912	R	2008	2012-06-15
HU Aqr(AB) c	5.9	—	5646	6.18	0.29	—	—	R	2011	2012-05-22
RR Cae b	4.2	—	4350	5.3	0	—	—	R	2012	2012-01-23
NY Vir b	2.3	—	2900	3.3	—	—	—	R	2011	2011-12-20
DP Leo b	6.05	—	10230	8.19	0.39	—	—	R	2009	2010-11-18

Showing 1 to 15 of 15 entries

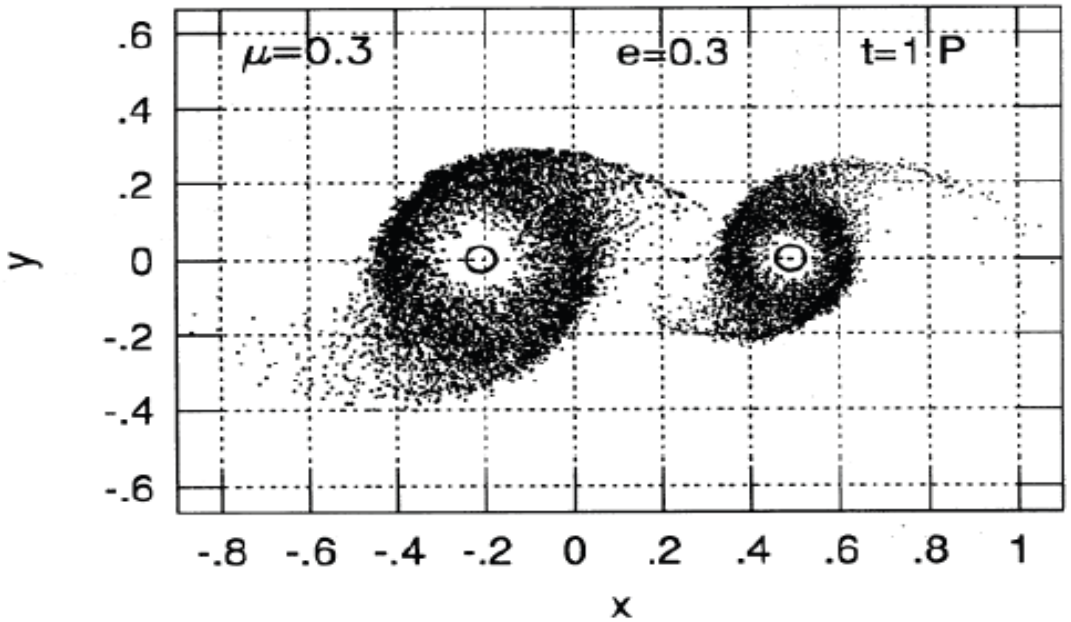
First Previous 1 Next Last

Dynamics of Binary-Disk Interaction
Artymowicz & Lubow, 1994

Circumbinary disk



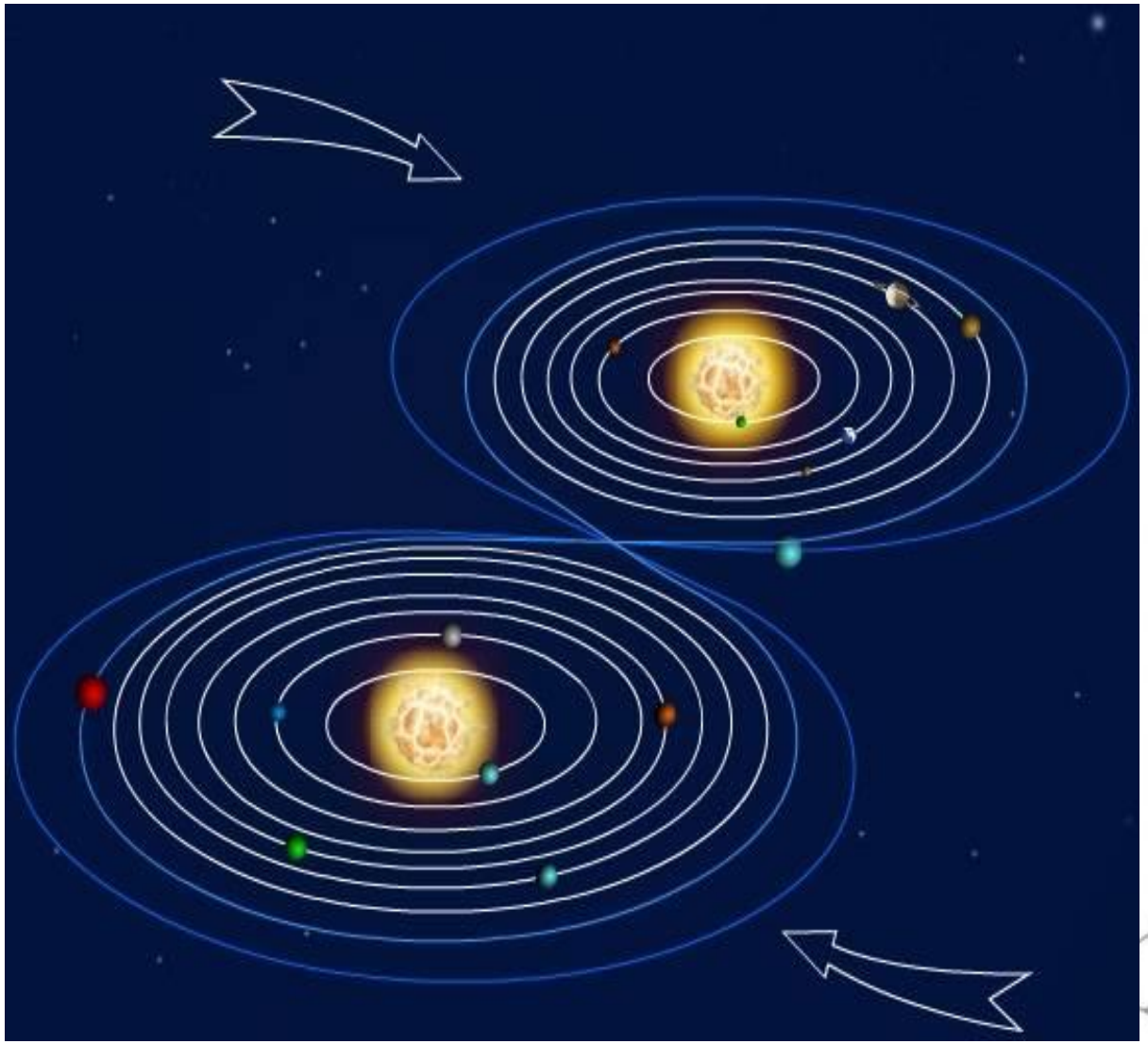
Circumprimary/secondary disk

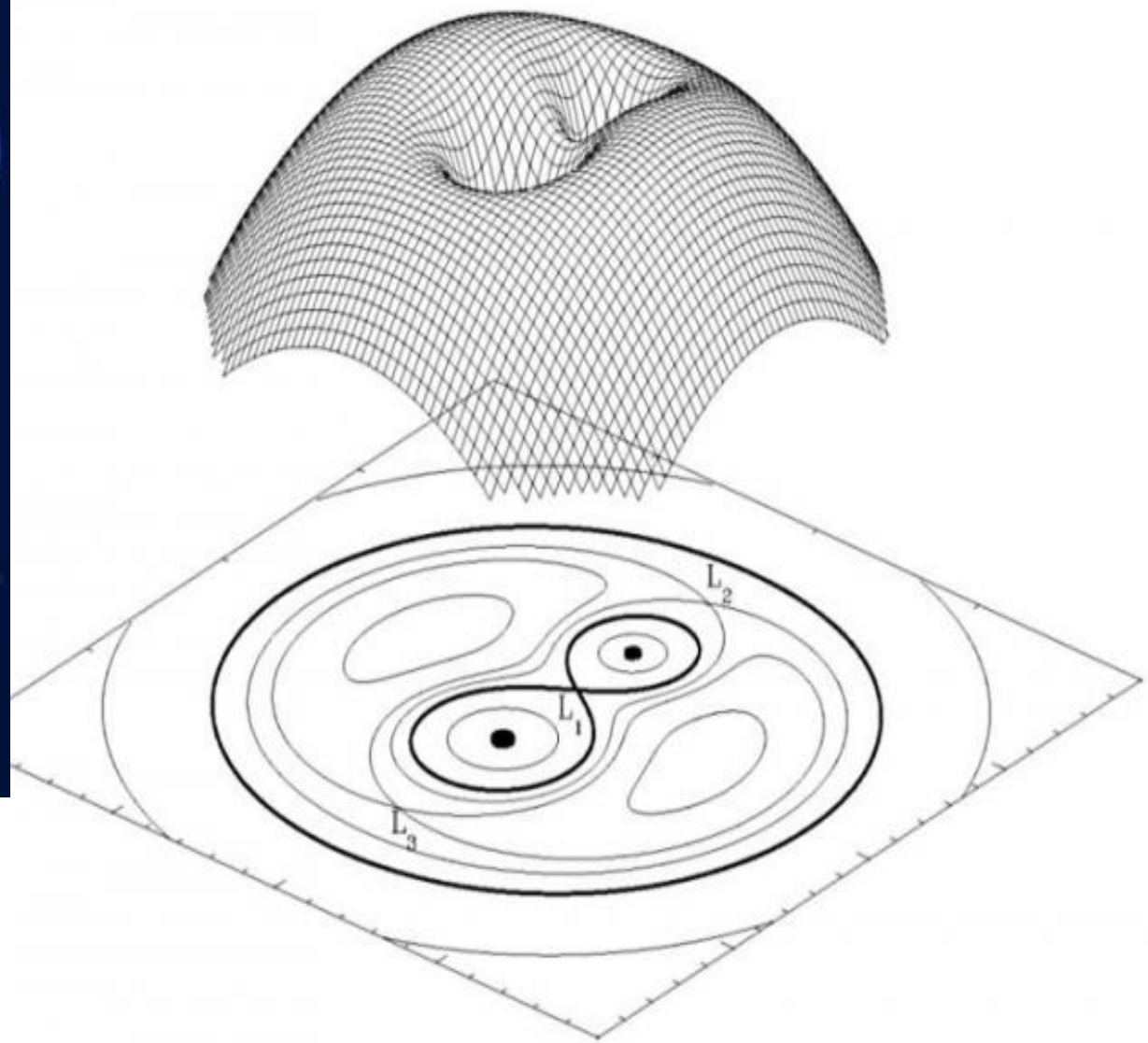


Inner edge: 1.8-2.6 a
(depending on eccentricity)

Çy'larda (bileşen veya sistem etrafında) ne zaman disk oluşabilir?

1. Sistem oluşurken
2. Büyük kütleli bileşen kütle transferine başlayınca
   (2. bileşen yeterince uzakta ise)
3. Evrimleşmiş sistemde kütle kaybı yeterince büyükse
4. Ortak zarf 2. Lagrange noktasından taşınca



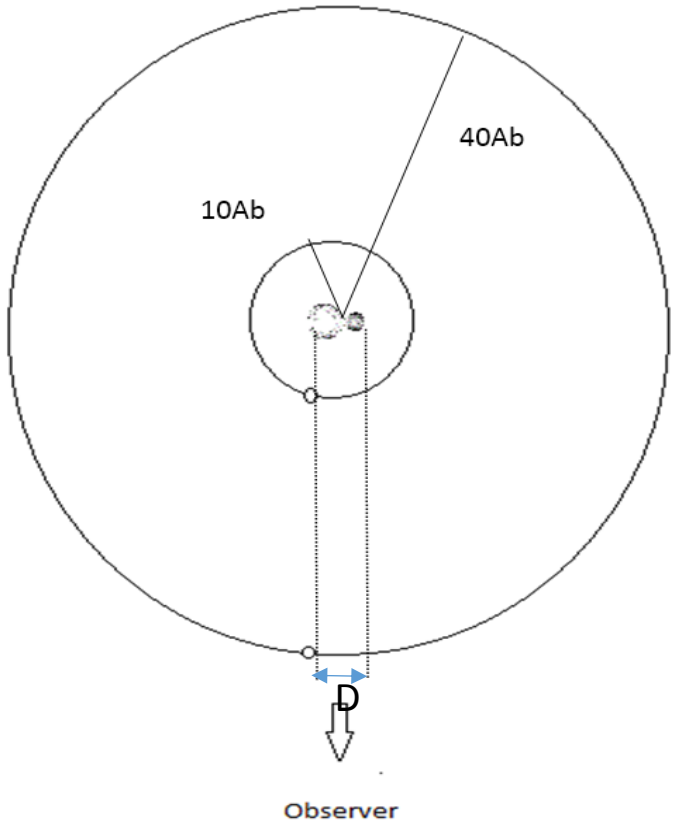

L_2
L_1
L_3

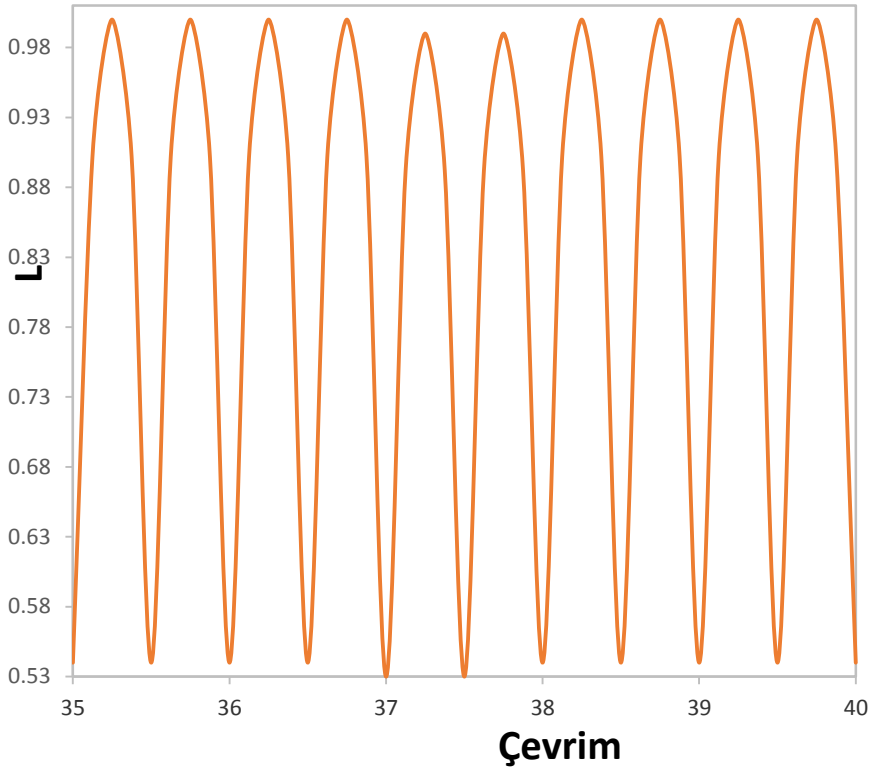
Değen çy’ların etrafında neden gezegen keşfedilemiyor ?

Bir Simulasyon

	W UMa		44i Boo	
R_1 ($R_\odot$)	1.375		0.87	
R_2 ($R_\odot$)	1.026		0.66	
M_1 ($M_\odot$)	1.12		0.98	
M_2 ($M_\odot$)	0.55		0.55	
A_b ($R_\odot$)	2.401		1.83	
P_b (days)	0.502		0.268	
	Linnell, 1991		Hill et al, 1989	
M_p (M_jupiter)	1		1	
A_p ($R_\odot$) $10A_b<A_p<40A_b$	24.01	96.04	18.31	73.25
P_p (days) $30P_b<P_p<300P_b$	15.06	150.60	8.04	80.4
D (days)	0.439	1.097	0.231	0.578
D (P_b)	0.874	2.186	0.862	2.155

b: Binary p: Planet





A_b : Çift yıldız yörüngesinin yarı büyük eksen uzunluğu

A_p: Gezegen yörüngesinin yarı büyük eksen uzunluğu

$10A_b < A_p < 40A_b$

Gezegenin kütlesi 1 M_jüpiter ve gezegen yörüngesinin eğimi 90 ise

Gezegen çiftin önünden geçerken çift yıldızın toplam ışığında yaklaşık % 1 lik bir azalma olmalı

P_b : Çift yıldızın dönemi

P_p: Gezegenin dönemi

$30\ P_b < P_p < 300P_b$

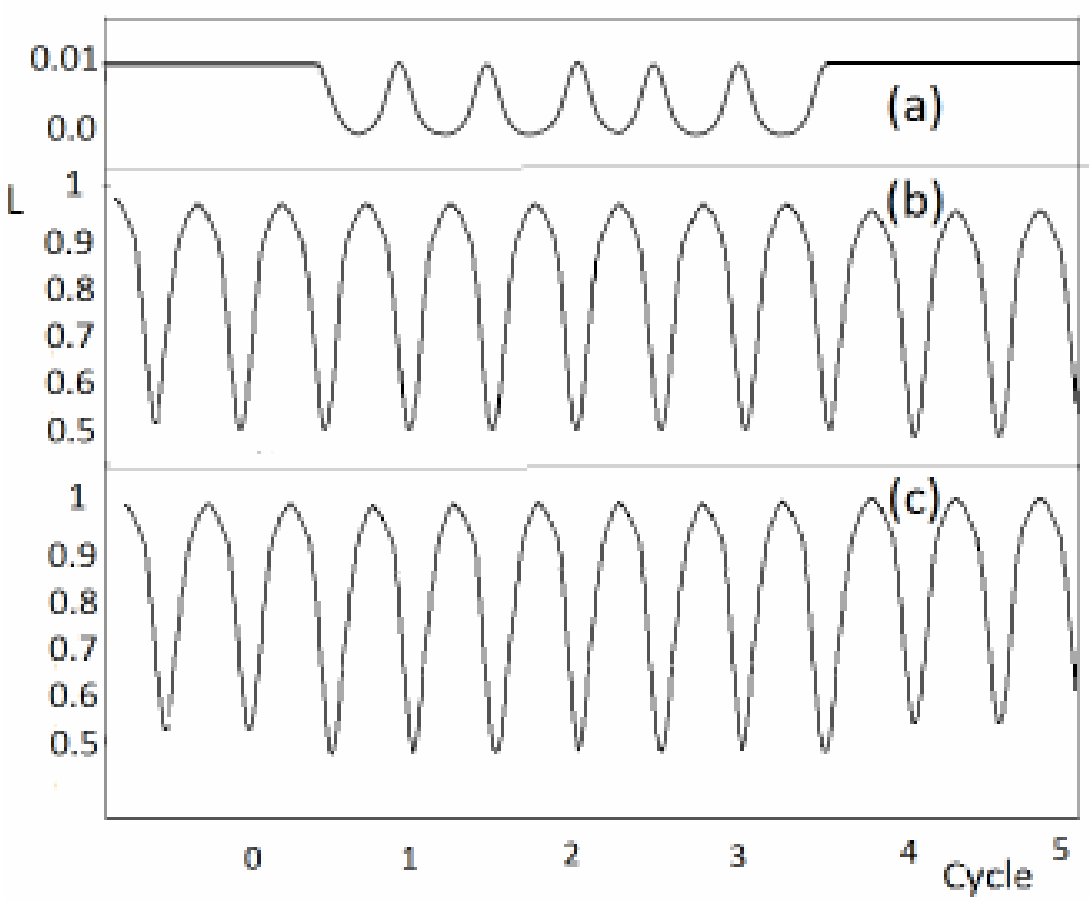
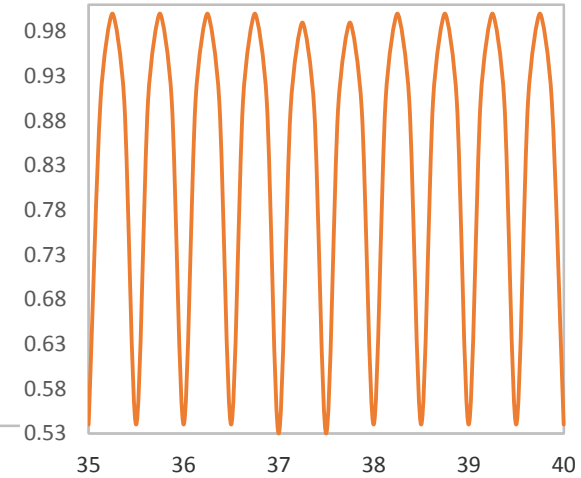


Figure 2. (a) A transit light curve of a circumbinary planet around W UMa system, (b) continuous light variation of W UMa for many cycles, and (c) the combined light variation of W UMa system with transiting circumbinary jovian planet.

W UMa



$A_p = 10A_b$

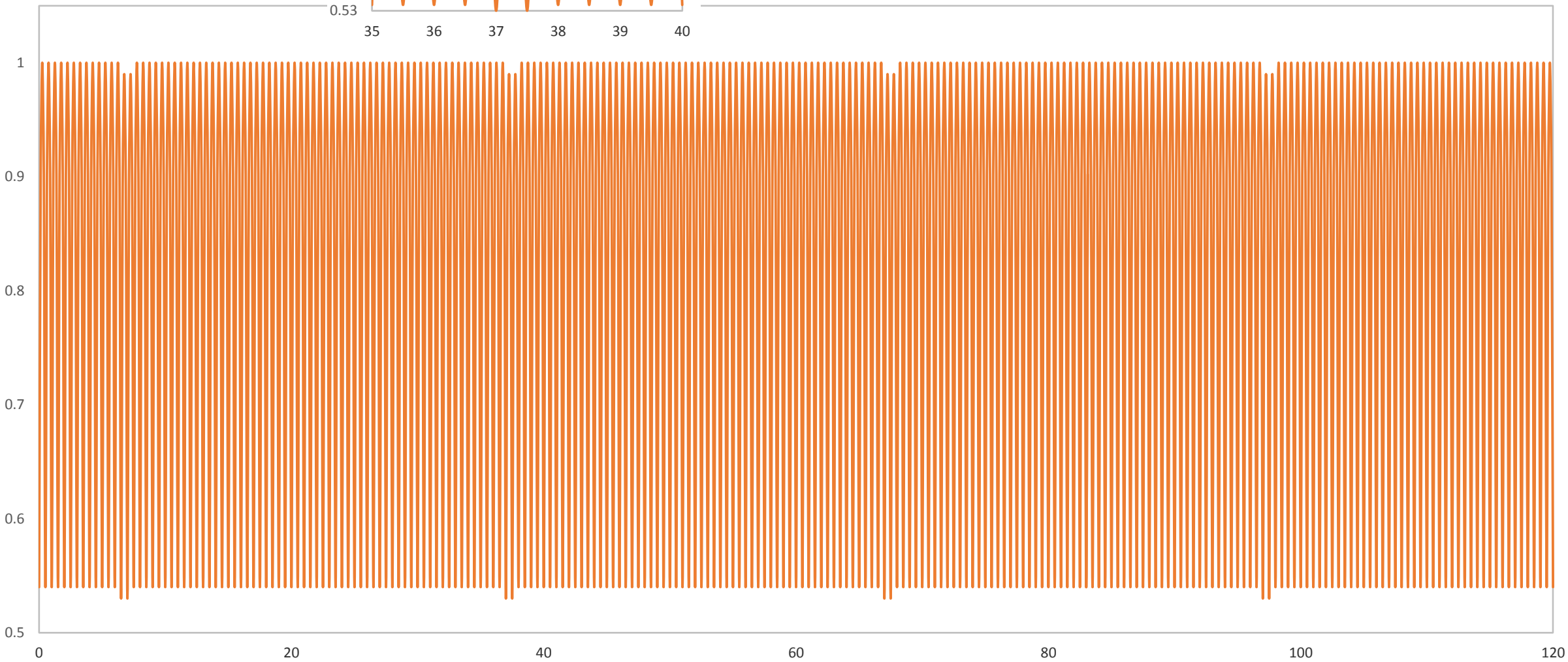
$P_p = 30\ P_b$

$P_p = 15$ gün

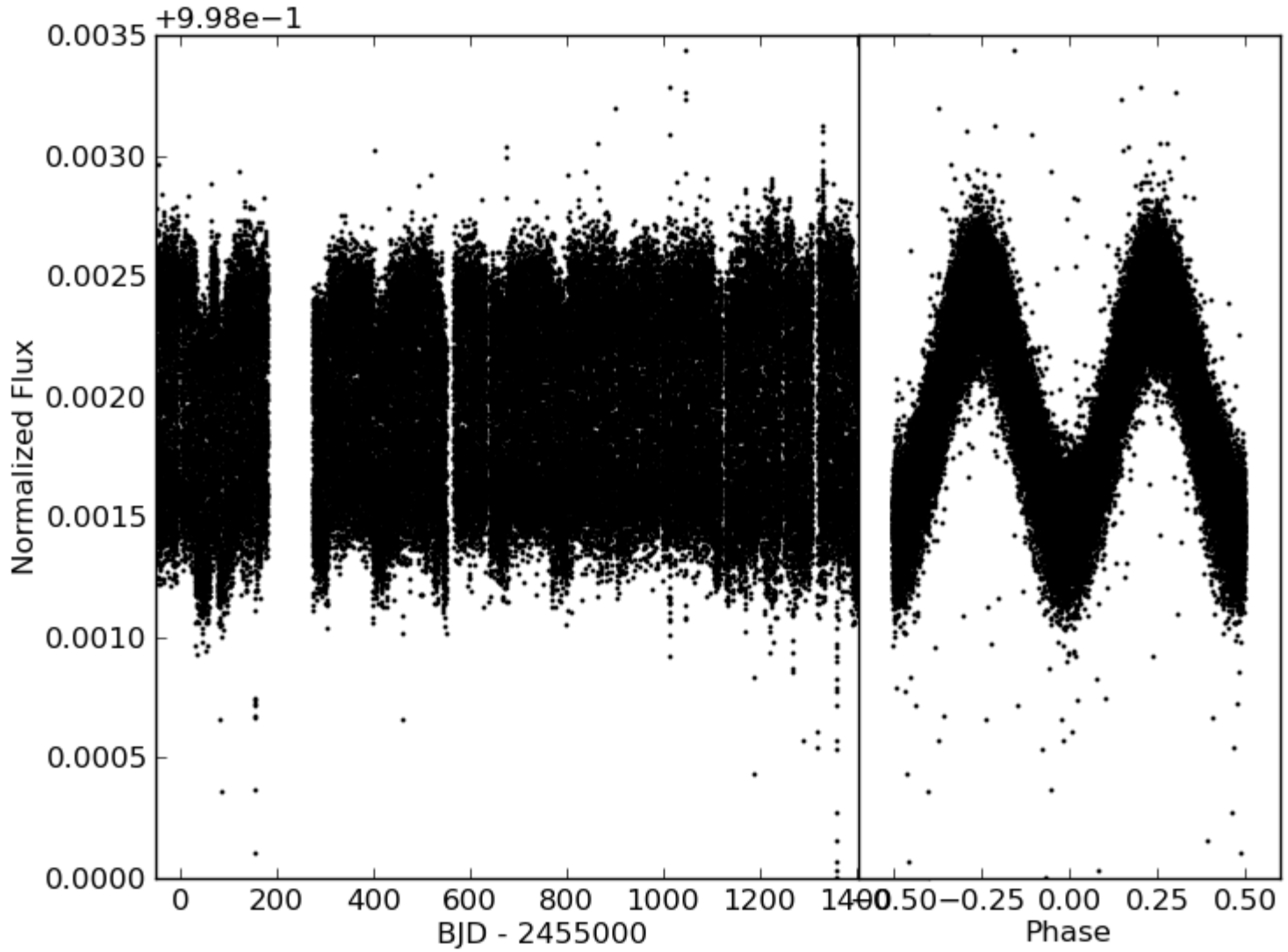
$P_b = 0.5$ d

$A_b = 2.4$ R

$D = 0.9\ P_b$



KIC 9612468


+9.98e−1
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Normalized Flux
0
200
400
600
800
1000
1200
1400
BJD - 2455000
−0.50
−0.25
0.00
0.25
0.50
Phase

Conroy, K.E. et al. 2013, ***Kepler*** **Eclipsing Binary Stars. IV. Precise Eclipse Times for Close Binaries and Identification of Candidate Three-Body Systems**

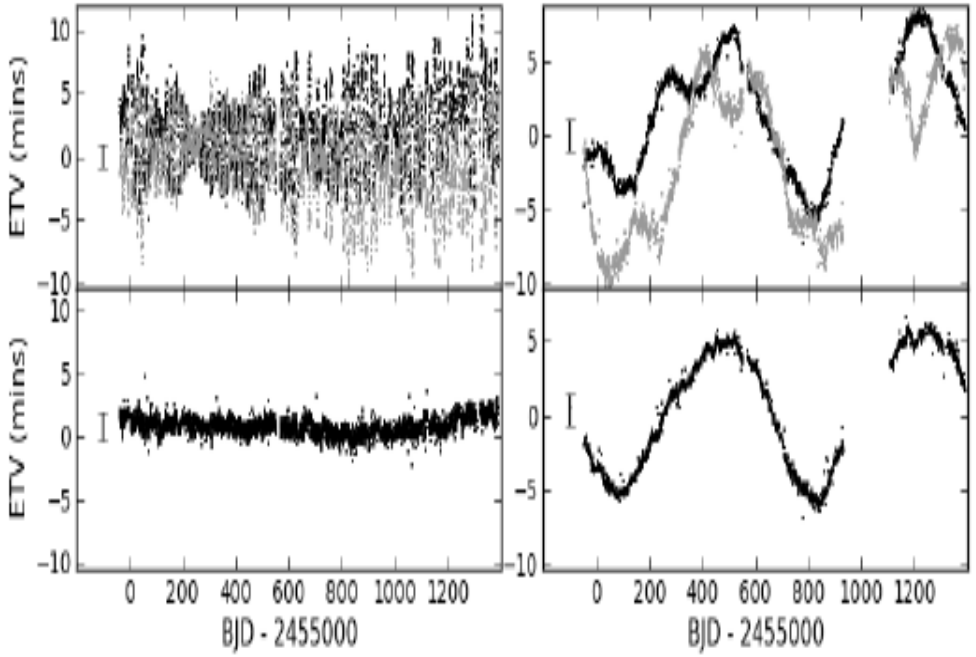


Fig. 5.— ETVs for KIC 6880727 (left) and 4451148 (right) determined for primary and secondary eclipses separately (top) and together (bottom). KIC 6880727 (left) shows an example with no underlying signal under the antiphase "noise", while KIC 4451148 (right) shows a possible underlying third-body signal. Typical errors for ETV measurements are shown to the left of the data.

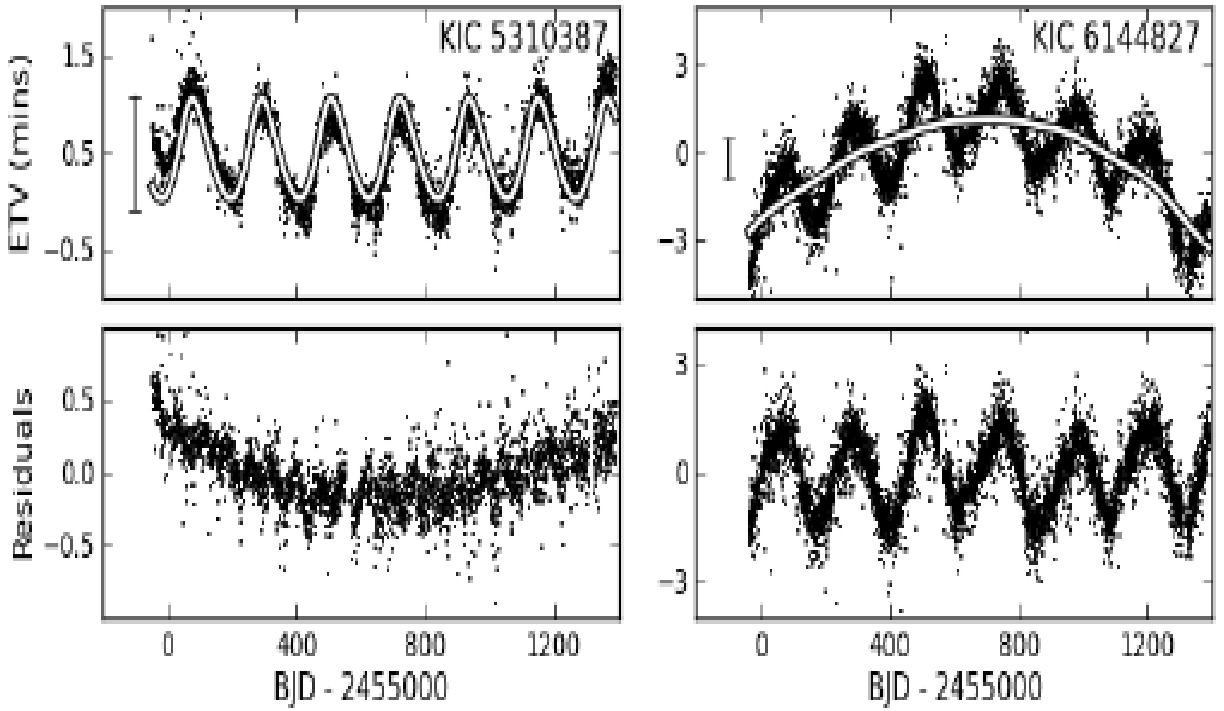


Fig. 12.— KIC 5310387 and 6144827 are among several ETV signals with residuals that suggest another parabolic or LTTE signal, possibly indicating the presence of a fourth body.

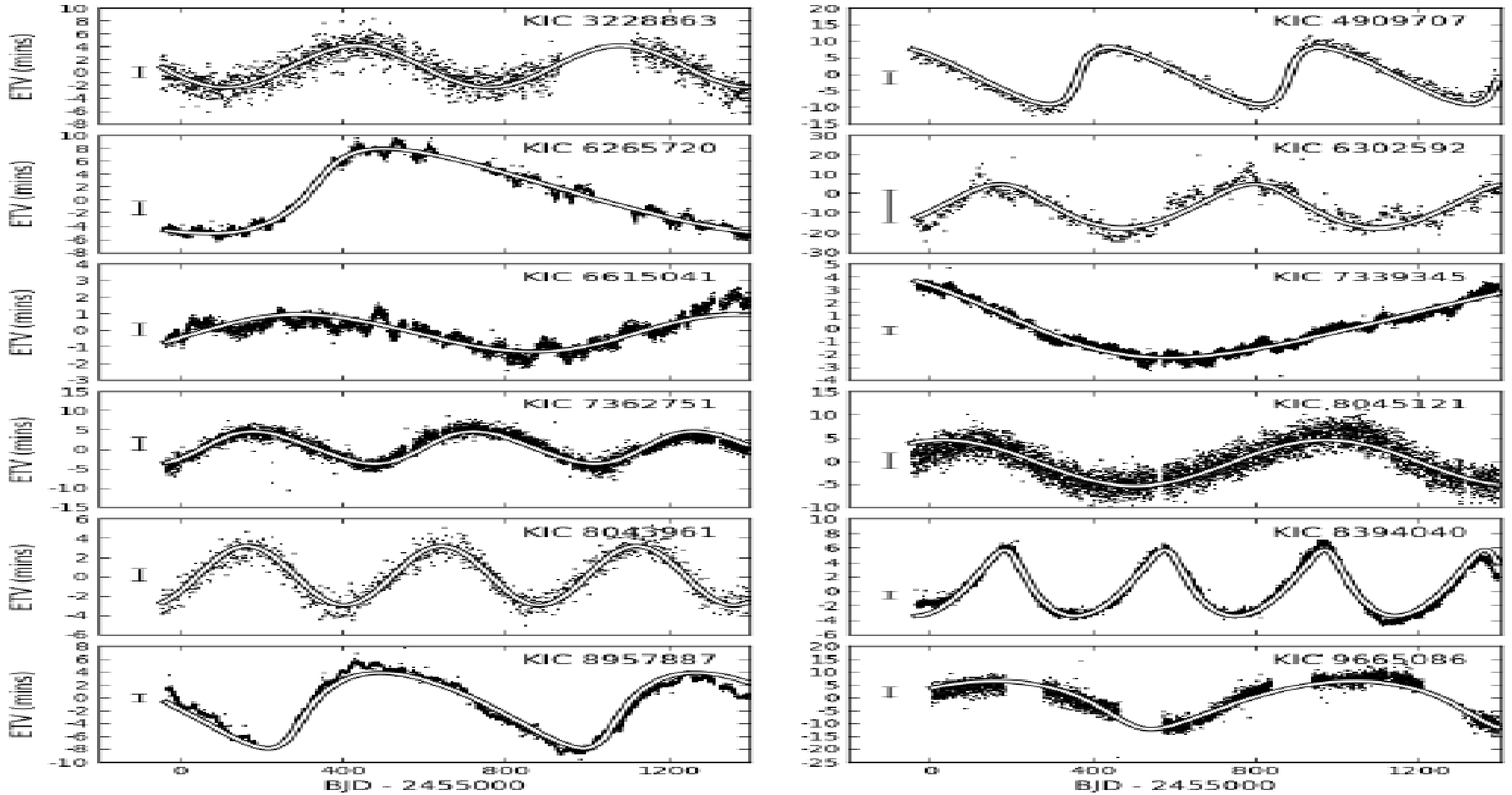
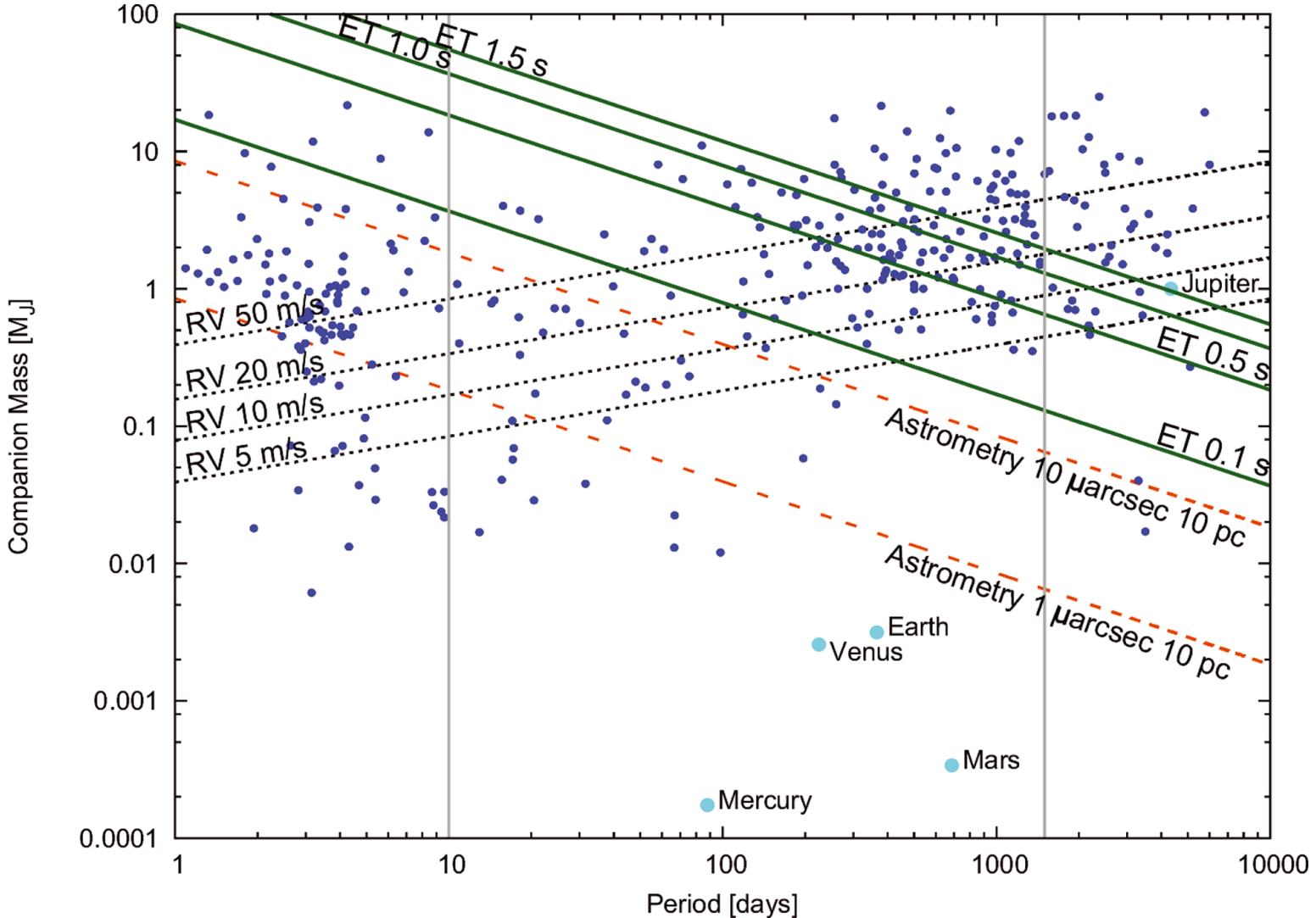


Fig. 7.— Gallery of select ETV signals found in close binaries with LTTE fits. These are KIC 3228863, 4909707, 6265720, 6302592, 6615041, 7339345, 7362751, 8045121, 8043961, 8394040, 8957887, and 9665086.

ET α $M_3 P_3^{2/3} \sin i / (M_1+M_2+M_3)^{2/3}$



ET method is capable

in detecting Jovian planets

-larger the orbits, the smaller the planets can be detected

-Around small mass systems

P. Sybilski,1_ M. Konacki1,2 and S. Kozłowski (2010)

SONUÇLAR

1. Değen çy'ların etrafında gezegen var ama henüz keşfedilmemiş olabilir. 1. nesil mi ? 2. nesil mi? Veya her ikisi de var olabilir mi ?
2. Değen çy'ların etrafında disk dinamiği nedeniyle hiç gezegen oluşmoyor olabilir mi?
3. Değen çy'lar ayrık çy'lardan yörünge küçülmesiyle oluştuğuna göre, sistem etrafındaki 1. nesil gezegenler sistem üzerine düşmüş olabilir mi? Neden olmasın?

- Daha keşfedilecek çok şey var: Daha çok simulasyon gerekli
- Gözlemsel olarak O-C eğrilerinden varsa Jüpiter büyüklüğünde gezegenler keşfedilebilir → Düşük genlikli uzun dönemli O-C eğrileri.

TEŞEKKÜRLER