ETAP: an Exoplanetary Transit Analyzer Program

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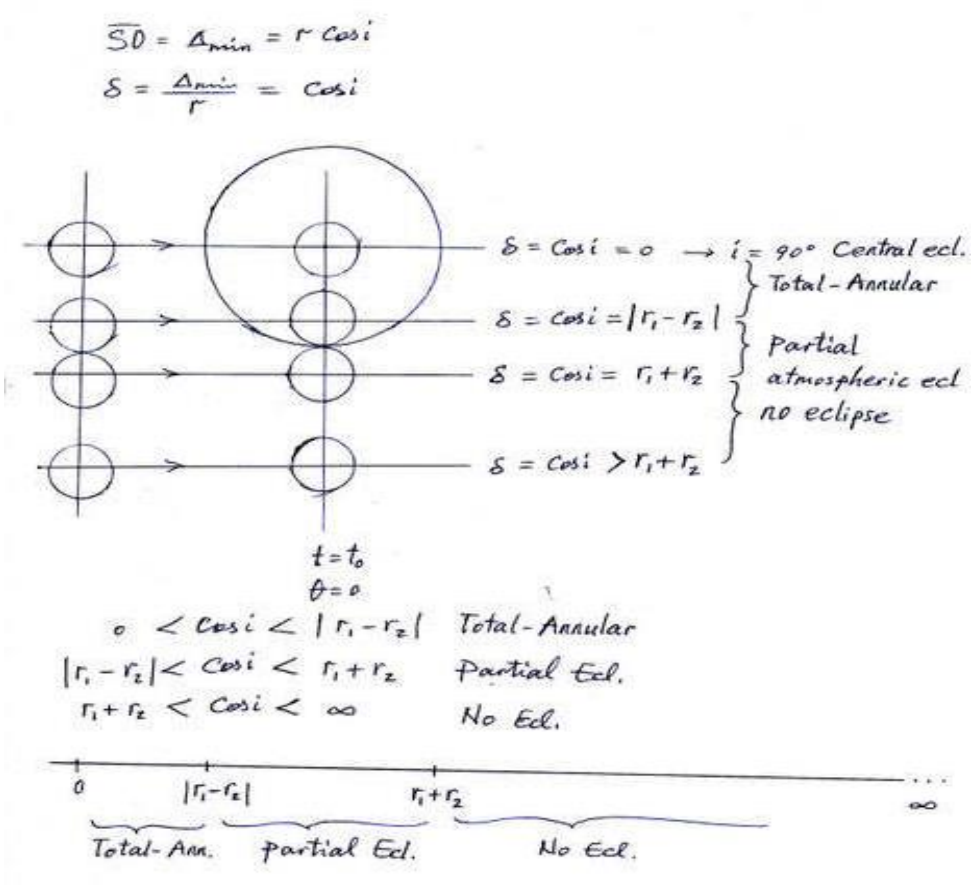
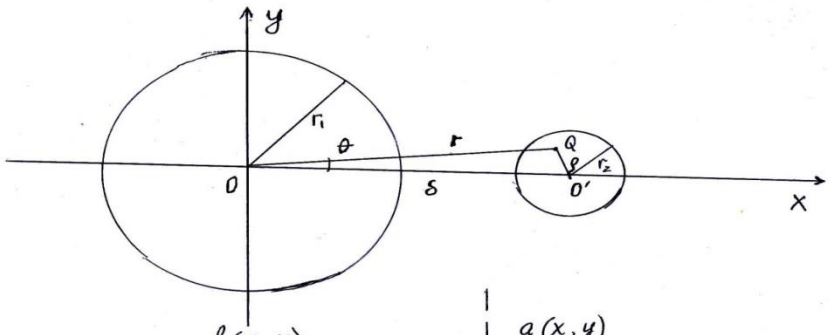
TAP (Gazak et al. 2012),
JKTEBOP (Southworth 2008, -based on EBOP Popper & Etzel 1981; Etzel 1981; Nelson & Davis 1972) ,
FITSH (Pál 2012),
PHEOBE (Prša & Zwitter 2005),
VARTOOLS (Hartman et al. 2008),
Nightfall5, PhoS-T (Mislis et al. 2012),
Systemic (Meschiari et al. 2009), and
EXOFAST (Eastmann et al. 2013).
WINFITTER (Rhodes and Budding 2014).
ETAP : Exo-Transit Analyser (Demircan and Volkan 2014).

Model:

- Herhangi bir tutulmaya göre ışık kaybı barınak yıldız ve ötegezegenin kırınım deseni ile ilişkili (Kopal, 1977; Kopal ve Demircan, 1978).
- Yıldız ve gezegen şekilleri küresel,
- Barınak yıldızın parlaklık dağılımı simetrik,
- Her hangi bir derecede kenar kararma yasası,
- Rastgele yörünge eğimi ve basıklığı





$f(x,y)$ | $g(x,y)$

$$F(u,v) = \int_{-\infty}^{\infty}\int f(x,y)\, e^{-2\pi i(xu+yv)}\,dx\,dy\,; \qquad G(u,v) = \int_{-\infty}^{\infty}\int g(\xi,\eta)\, e^{-2\pi i((\delta+\xi)u+\eta v)}\,d\xi\,d\eta$$

$$= L_1 \sum_{l=0}^{\infty} C^l z^\nu \Gamma(\nu)\frac{J_\nu(2\pi q r_1)}{(2\pi q r_1)^\nu} \qquad = 2\pi r_2^2\, e^{-2\pi i \delta u}\frac{J_1(2\pi q r_2)}{2\pi q r_2}$$

$$L_1\alpha(r_1,r_2,\delta) = \int_{-\infty}^{\infty}\int F(u,v)\,G(u,v)\,du\,dv\,, \qquad \alpha = \sum_{l=0}^{\infty} C^l \alpha_l^\circ$$

$$\alpha_l^\circ(r_1,r_2,\delta) = (2\pi r_2)^2 z^\nu \Gamma(\nu)\int_0^{\infty}\frac{J_\nu(2\pi q r_1)}{(2\pi q r_1)^\nu}\,\frac{J_1(2\pi q r_2)}{2\pi q r_2}\,J_0(2\pi q\delta)\,q\,dq$$

$$a = \frac{r_1}{r_1+r_2}\,, \quad b = \frac{r_2}{r_1+r_2} = 1-a\,, \quad c = \frac{\delta}{r_1+r_2}\,, \quad \nu = \frac{l+2}{2}$$

$$\alpha_l^\circ(a,c) = z^\nu \Gamma(\nu)\, b\int_0^{\infty}(ay)^{-\nu} J_\nu(ay)\,J_1(by)\,J_0(cy)\,dy$$

$$\alpha_n^0 = 2^\nu T(\nu) b\int_0^{\infty}(ay)^{-\nu}J_\nu(ay)J_1(by)J_0(cy)\,dy$$

$$= b^2(1-c^2)^{(\nu+1)}T(\nu)\sum_{n=0}^{\infty}\frac{n!(\nu+2n+2)}{(n+1)\Gamma(\nu+n+1)}\left[R_n^{(1,\nu)}(a)\right]^2 R_n^{(\nu+1,0)}(c^2)$$

Tutulum fonksiyonu (bkz. Kopal 1979)

$$\alpha = \sum_{n=0}^{N} C_n \alpha_n,$$

Cn katsayıları kenar kararma katsayıları cinsinden

$$C_0 = \frac{1-\sum_{n=1}^{N} u_n}{1-\sum_{n=1}^{N}\frac{n u_n}{n+2}},$$

n= 0 için, ve

$$C_n = \frac{u_n}{1-\sum_{n=1}^{N}\frac{n u_n}{n+2}},$$

n > 0 için. Bu yolla geometrik elemanlar ışınım parametrelerinden ayrılabiliyor ve ışık eğrisinin analizine olanak sağlıyor.

Exoplanet Transit Analyzer

File Edit Analysis Graphics Help

Star ID= KIC 6922244

Light Curve Loaded: Yes

P=	3.52254	0.0000013	C:\PLEASE\user_files\KEPLER8berr.lc
T0=	131.6841	0.0001	Update LC File

Host star

Mag.=	13.76	0.3	Filter=	Kepler	
T (K)=	5595	120	Limb Drk=	Quadratic	
R (R)=	0.992	0.058	u_a=	0.435	
M (M)=	1.018	0.044	u_b=	0.248	
log g=	4.23	0.2			
BC=	-0.2	0.1			
d(pc)=	560	20	No. of planets	1	
r*=	0.145	0.002			
RV(km/s)=	10.1	0.1			

exoPlanet 1

rp=	0.014	0.001	
i=	84.16	0.18	
M_b=	0.66	0.01	Mjup
R_b=	0.96	0.06	Rjup
e=	0	0.001	
w=	0	1	deg

LC ☑ RV ☑ Other: ☐

Active Planet File: C:\PLEASE\user_files\KEPLER8b.pls

LC Manipulation Window

Light Curve Manipulation Window

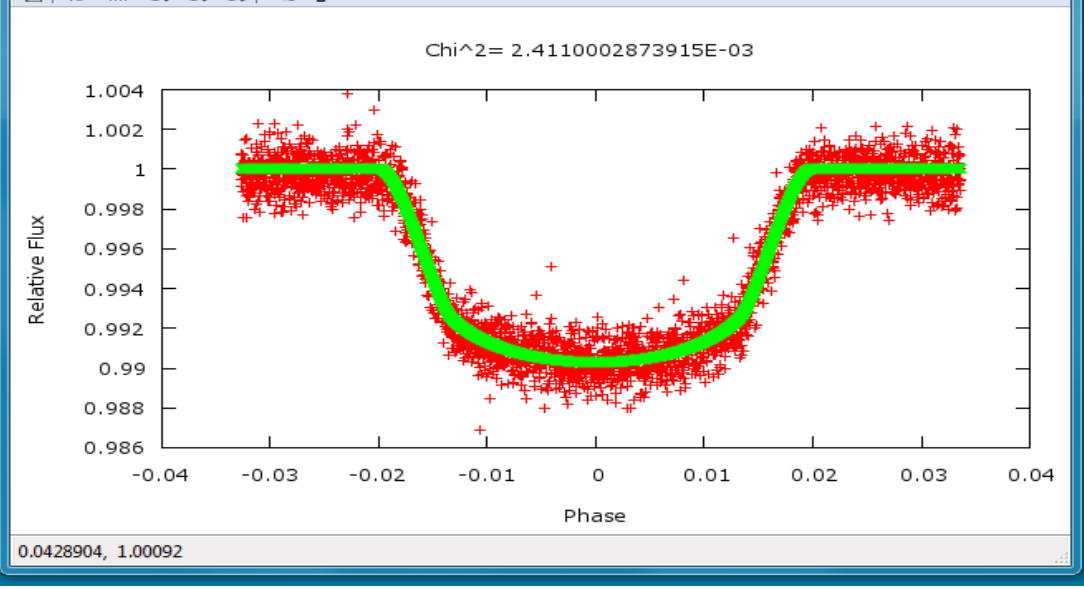
x-range: -0.02 0.02

y-range: 0.986 1.002

☐ Plot Residuals

refresh eps file exit

Gnuplot (window id : 0)



0.0428904, 1.00092

Light Curve Fitting Window

Light Curve Fitting

	Value	Step	Error
☐ p=	3.52254	0.000001	
☑ T0=	131.684100	0.0001	
☑ r*=	0.14550000	0.0001	
☑ rp=	0.014000000	0.0001	
☑ i=	84.1690	0.001	
☐ e=	0	0.001	
☐ w=	0	0.2	
Limb Darkening:	Quadratic		
☐ u_a=	0.435	0.001	
☐ u_b=	0.248	0.001	

χ^2 2.411000287E-3

Iterate

Estimate Errors

Update All

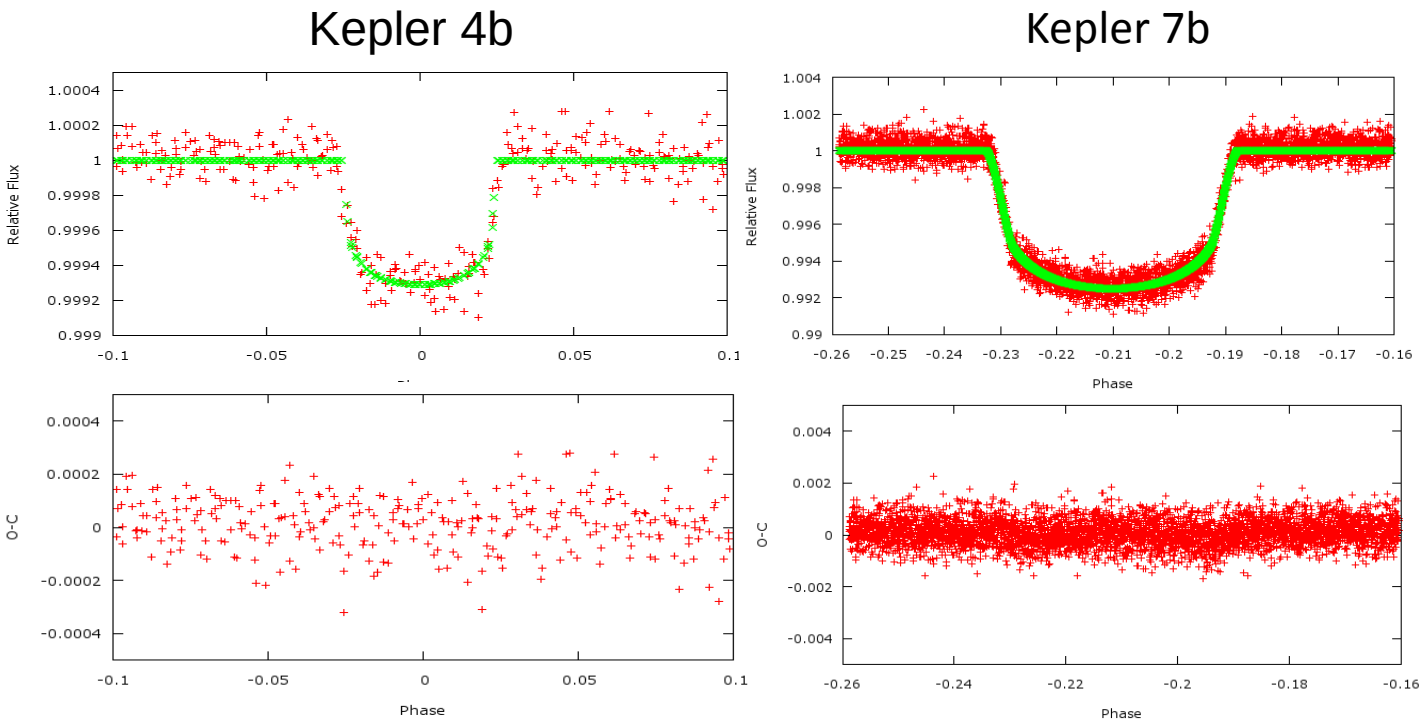
Cancel

Fitting Progress

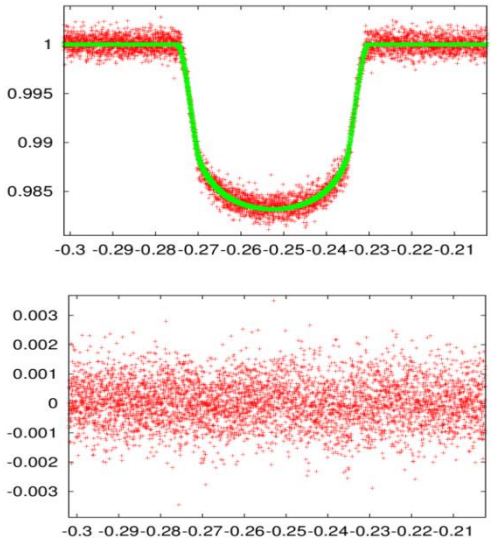
20%

Error Estimation Progress

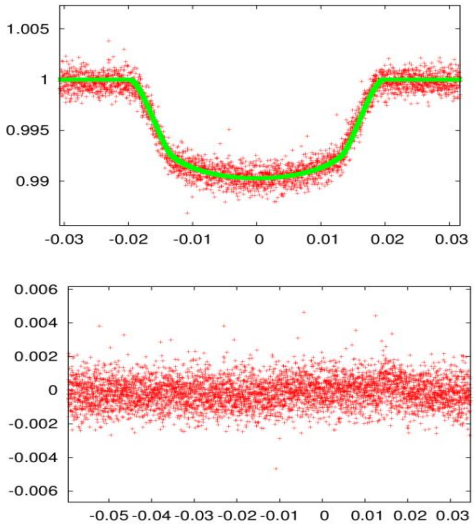
- Fit algoritması: $\chi 2$ minimizasyonu,
- Parametre hatası: Jackknife yöntemi



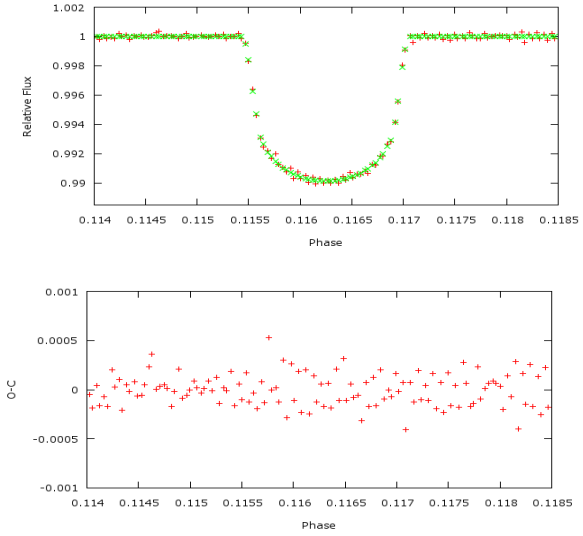
Kepler 12b



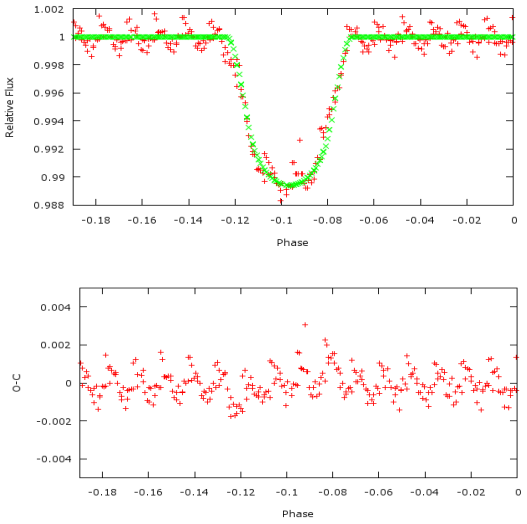
Kepler 8b



Kepler 86b



Kepler 412b



Star Name / Parameter	[1]Kepler4b	[2]Kepler7b	[3]Kepler8b	[4]Kepler12b	[6]Kepler86b	[7]Kepler412b	[8]OGLE-TR-113b
P (days)*	3.21346	4.885525	3.52254	4.4379637	282.5255	1.720861232	1.4324752
T_0 (HJD)*	2454132.2354	2454967.27571	2454132.2223	2454133.3333	2454292.5983	2454132.0935	2452324.3660
*e**	0	0.1	0	0.01	0.41	0.0038	0
w (deg)*	-	357.1	-	182	3.4	125	-
r_s	0.1519(3)	0.15012(5)	0.14527(2)	0.12525(1)	0.0056(1)	0.2090(6)	0.1570(4)
r_s (liter.)	0.1516043	0.1503539	0.1430333	0.1240029	0.00565(1)	0.202	0.155
r_p	0.003689(4)	0.01220(2)	0.01398(1)	0.01480(1)	0.000512	0.0214(1)	0.0212(5)
r_p (liter.)	0.003657	0.012076	0.013729	0.014246	0.000547	0.0214	0.022
i (deg)	89.65(3)	85.312(5)	84.154(3)	88.782(2)	89.842(1)	80.903(2)	89.4(6)
i (deg) (liter.)	89.76	85.18	84.07	88.76	89.83	80.89	86.7
u_1, u_2**	0.4086, 0.2633	0.3948, 0.2711	0.3585, 0.2917	0.367, 0.274	0.435, 0.248	0.60, 0.36	0.60, 0.36
N	310	2314	3189	4335	56	303	180
χ^2	3.33E-6	2.29E-4	2.41E-3	2.67E-3	6.04E-6	1.69E-4	4.28E-3

**: fixed parameters*