

Soğuk Yıldızlardan Sıcak Yıldızlara Kromosferik Aktivite Davranışı

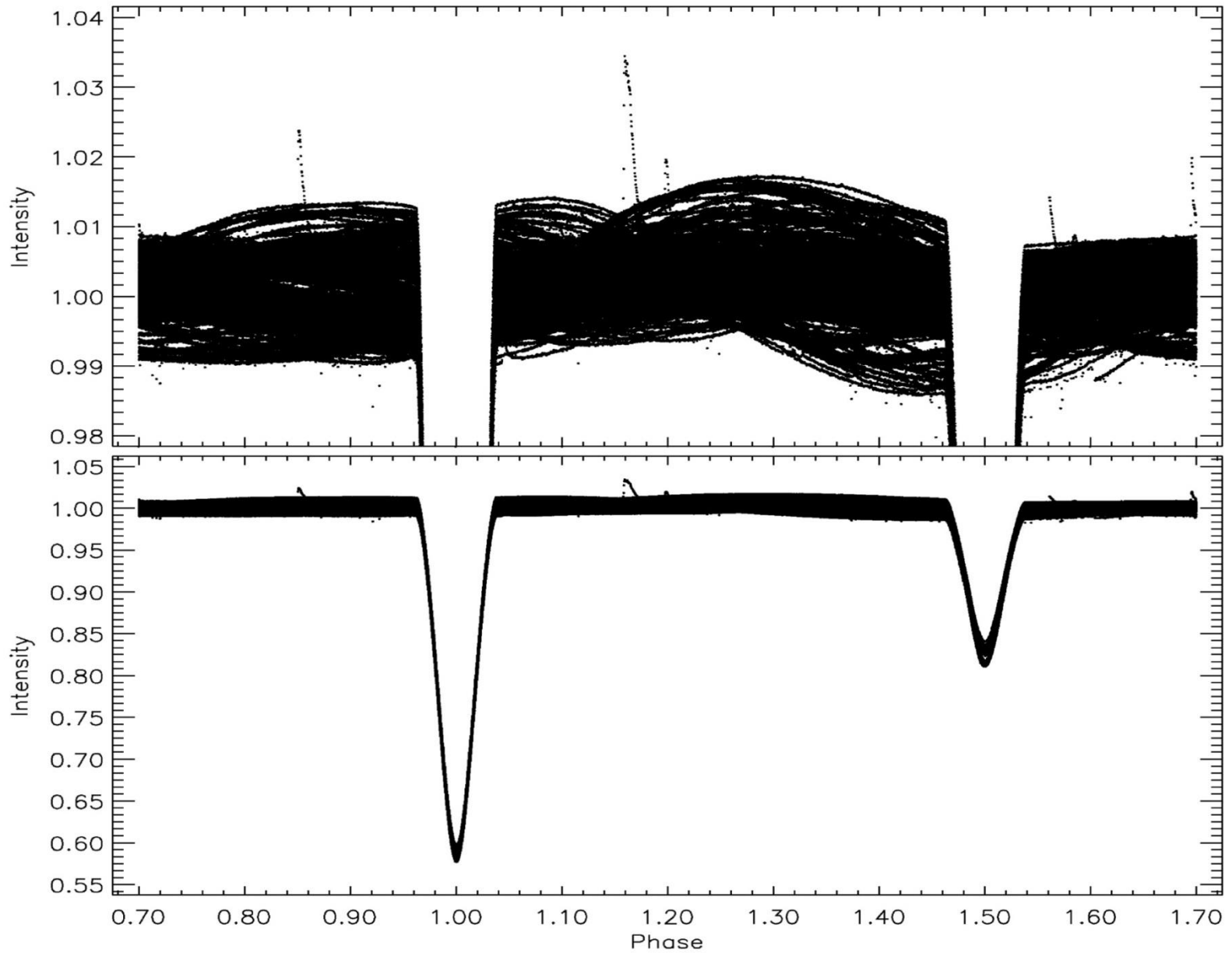
Ezgi YOLDAŞ

EGE ÜNİVERSİTESİ

91150001031

Danışman: Doç. Dr. Hasan Ali DAL

KIC 9641031



KIC 9641031 – FL Lyr

P_{orb}	(gün)	2.18 ⁽¹⁾	
a	(AB)	4.27 ⁽³⁾	
i	(°)	86.3 ⁽³⁾	
(B-V)	(^m)	0.74 ⁽⁴⁾	
Age	(Gyr)	3.055 – 15.25 ⁽⁵⁾	
R_1	(R_{\odot})	1.283 ⁽⁶⁾	
R_2	(R_{\odot})	0.963 ⁽⁷⁾	6150
T_1	(K)	5724 ⁽⁸⁾ - 6412 ⁽⁹⁾	
T_2	(K)	5080 ⁽¹⁰⁾ – 5506 ⁽¹¹⁾	5300
M_1	(M_{\odot})	1.218 ⁽¹²⁾	
M_2	(M_{\odot})	0.958 ⁽¹³⁾	
d	(pc)	128.77 ⁽¹⁴⁾	
J,H,K	(^m)	8.243 - 7.985 - 7.899 ⁽¹⁵⁾	
B	(^m)	9.75 ⁽¹⁶⁾	
Spectral type	-	F8 V + G8 V ⁽¹⁷⁾	

(1) Slawson et al.(2011)

(2), (3),(7),(12),(13),(17) Eker et al. (2014)

(4) Tokunaga (2000)

(5) Brown (2010)

(6),(10) Guillout et al. (2009)

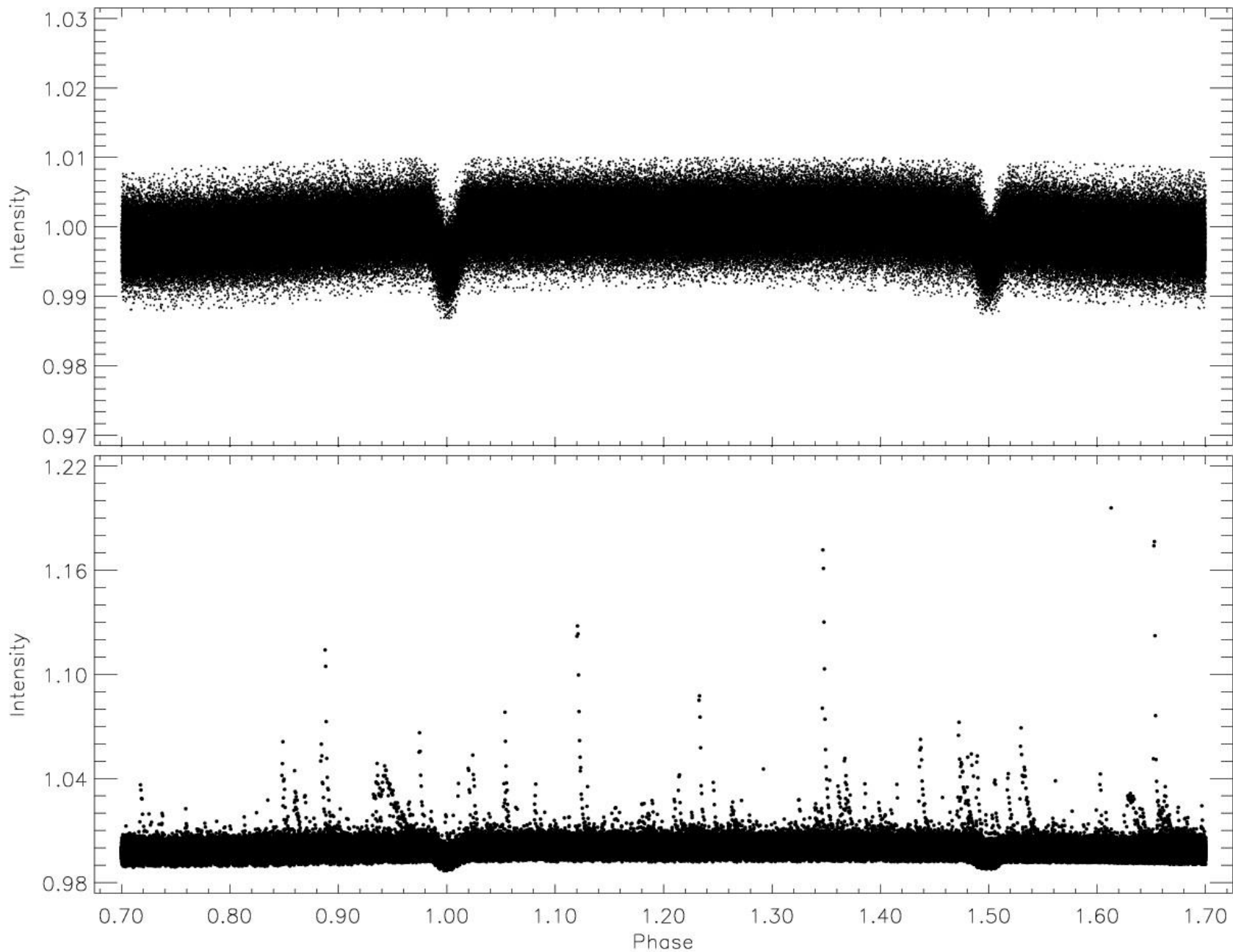
(11) Popper et al. (1986)

(14) Anderson et al. (2012)

(15) 2MASS All-Sky Survey Catalogue, Cutri et al. 2003

(16) The FON Astrophraphic Catalogue (FONAC), Kislyuk et al. (1990)

KIC 9761199



KIC 9761199

P_{orb}	(gün)	0.692031 ⁽¹⁾ - 1.3839980 ⁽²⁾	
a	(AB)	0.013 ⁽³⁾	
i	(°)	74.47 ⁽⁴⁾	
(B-V)	(^m)	0.068 ⁽⁵⁾ - 1.36 ⁽⁶⁾	
Age	(Gyr)	0.77 ⁽⁷⁾	
L	(L_{\odot})	0.082 ⁽⁸⁾	
R	(R_{\odot})	0.48 ⁽⁹⁾ - 0.84 ⁽¹⁰⁾	4060
T	(K)	3742 ⁽¹¹⁾ - 4060 ⁽¹²⁾	3891
M	(M_{\odot})	0.51 ⁽¹³⁾ - 0.65 ⁽¹⁴⁾	
d	(pc)	198 ⁽¹⁵⁾	
J,H,K	(^m)	13.574 - 12.926 - 12.782 ⁽¹⁶⁾	
B	(^m)	17.2 ⁽¹⁷⁾	
sini	(°)	0.99451 ⁽¹⁸⁾	
Spectral type	-	M1 V ⁽¹⁹⁾	

(1) Watson (2006)

(2),(4) Couhlin et al. (2011)

(3) Borucki et al. (2011)

(5),(18) Slawson et al. (2011)

(6), (7) Walkowicz & Basri (2013)

(8) Mann et al. (2013)

(9), (11), (13) Muirhead et al. (2014)

(10), (12),(14) Coughlin & Lopez-Morales (2012)

(15), (19) Muirhead et al. (2012)

(16) 2MASS All-Sky Survey Catalogue, Kharchenko 2001; Cutri et al. 2003

(17) USNO ACT Catalogue, Urban et al. 1997

Analizlerde İzlenen Yol

KIC 9641031



SML (Starspot Modeling Light Curve)



Minimum Zamanları



Flare Enerjisi Hesaplaması

KIC 9761199



Işık Eğrisi Analizi

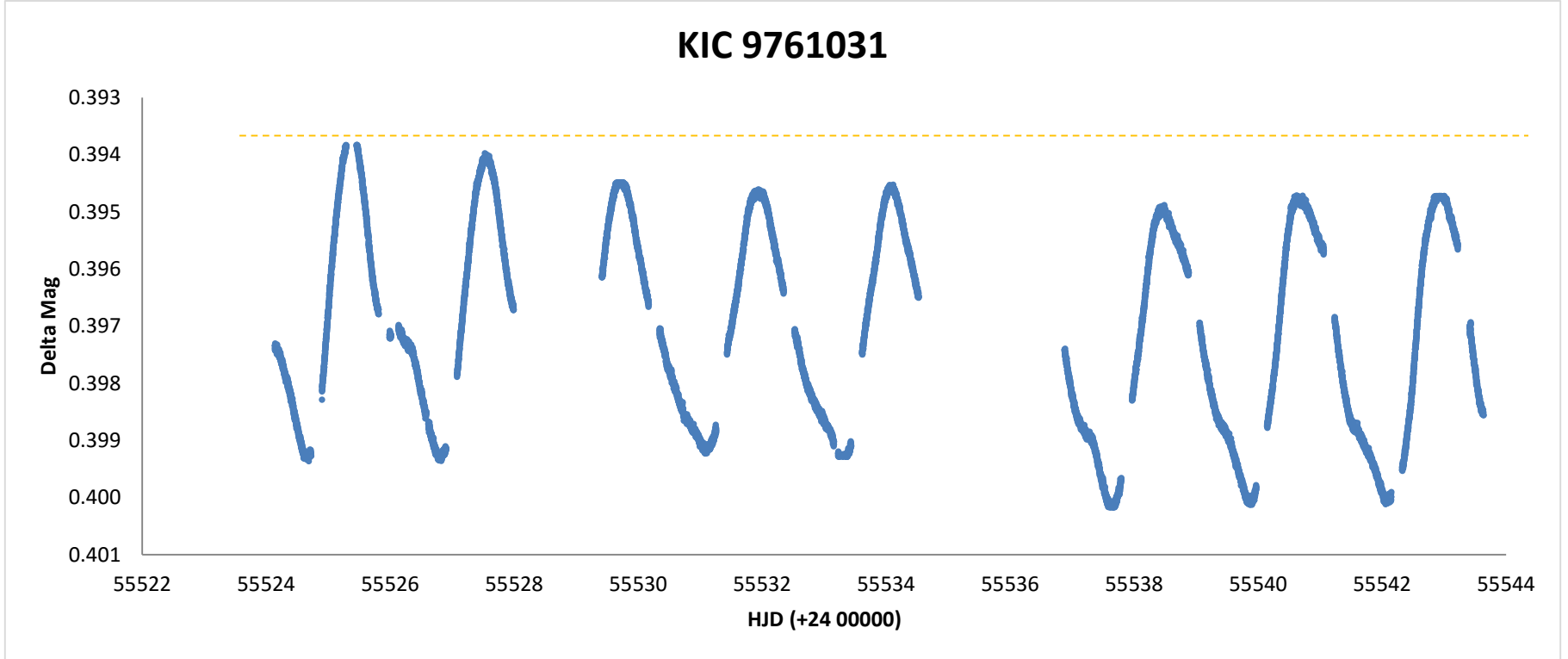


Lekelerin Modellenmesi



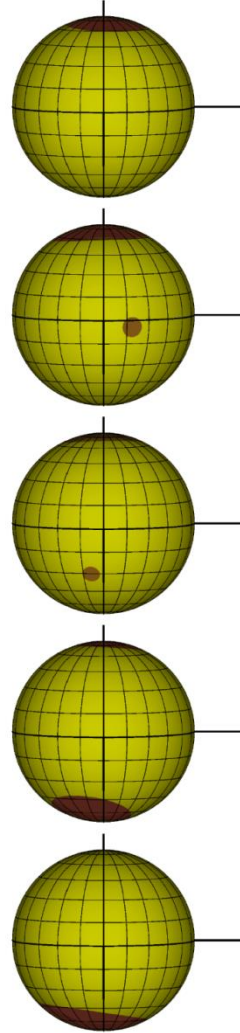
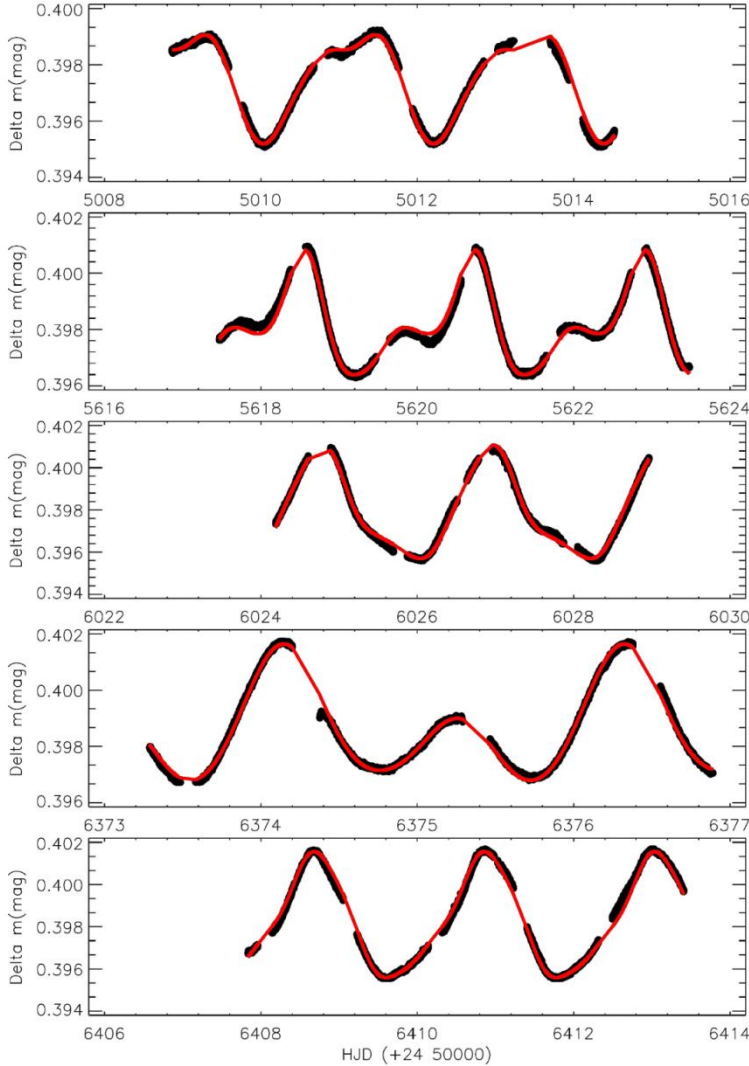
Flare Enerjisi Hesaplaması

Bu alıřmada, Kepler Uydusu ile elde edilen **KIC 9641031** (*FL Lyr*) ve **KIC 9761199** sistemlerinin fotometrik verileri, Kepler Veri Tabanı'ndan " **Short Cadence** " formunda alınmıř ve veri üzerinde analizler iin uygun formatlarda setler oluřturulacak řekilde dzenlemeler yapılmıřtır.



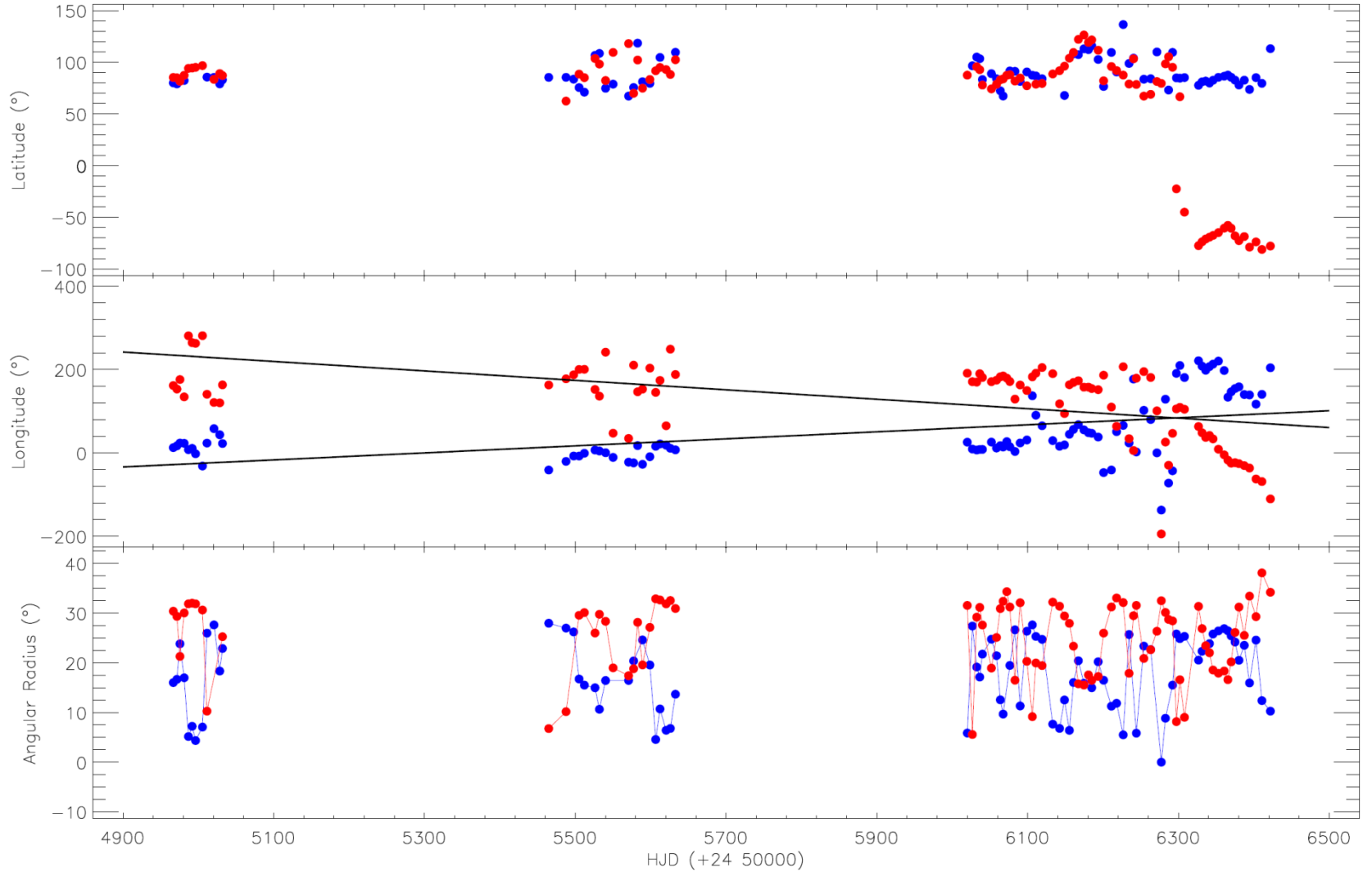
Not : Minimumlar atıldı. Sistem Rotational Modulation gsterdiđi iin flare bařlangı ve bitiř noktaları, flare enerjisi gibi parametrelerin hesaplanabilmesi iin flare parlamaları dıřında kalan ıřık eđrisi temel alınarak sistemin ıřık deđiřimi Fourier Serisi ile modellenmiřtir. Oluřturulan sentetik eđri flareler iin temel dzey olarak kabul edilmiřtir.

SML Modeli – KIC 9641031



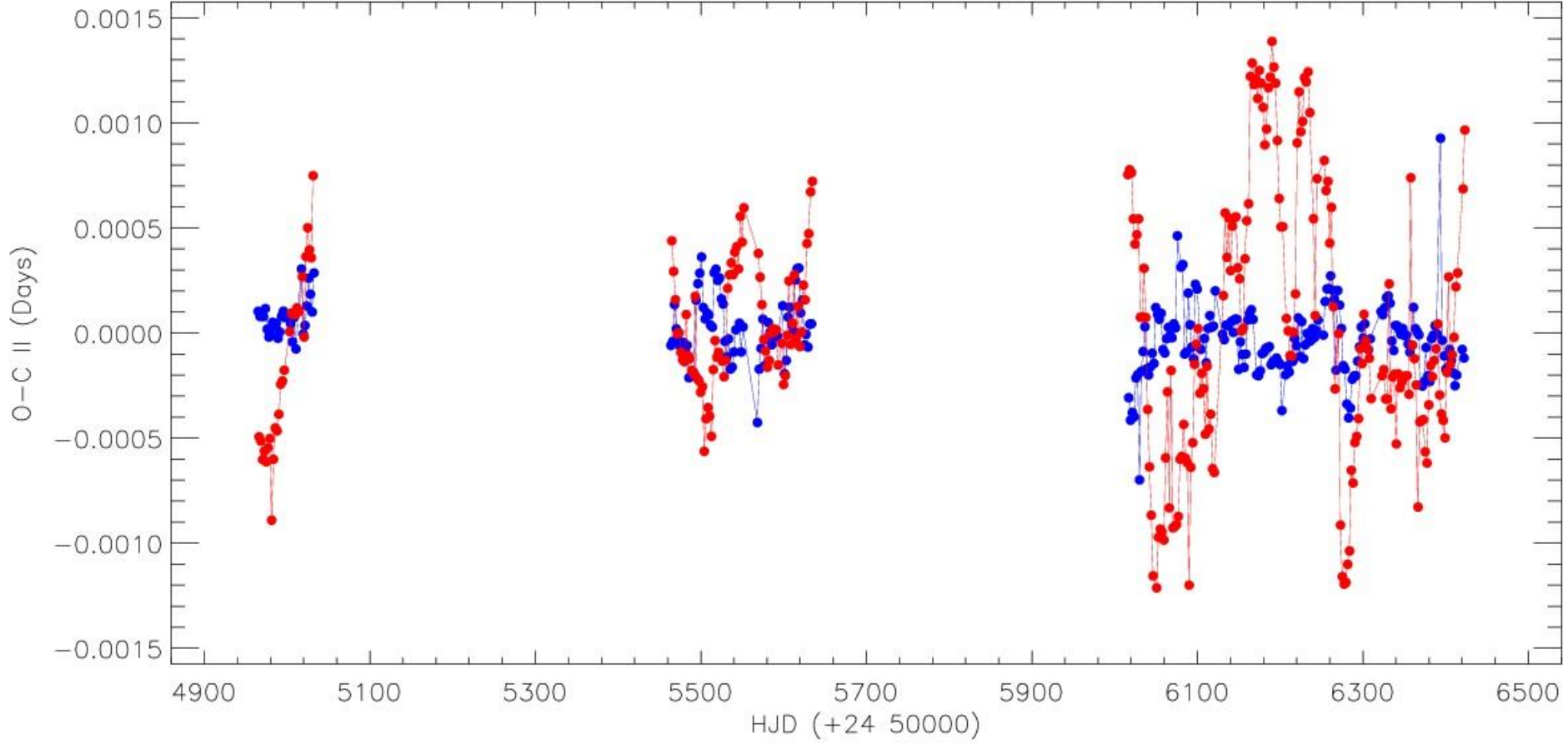
Aktif bileşen üzerinde $+50^\circ$ ile $+100^\circ$ enlemleri arasında 180° boylam farkına sahip iki soğuk leke olduğu görülmüştür.

Tüm setler için, leke sıcaklık faktörünün birinci leke için $kw = 0.75$, ikinci leke için $kw = 0.85$ olduğu kabul edilmiş ve her bir set için bu değerler kullanılmıştır.



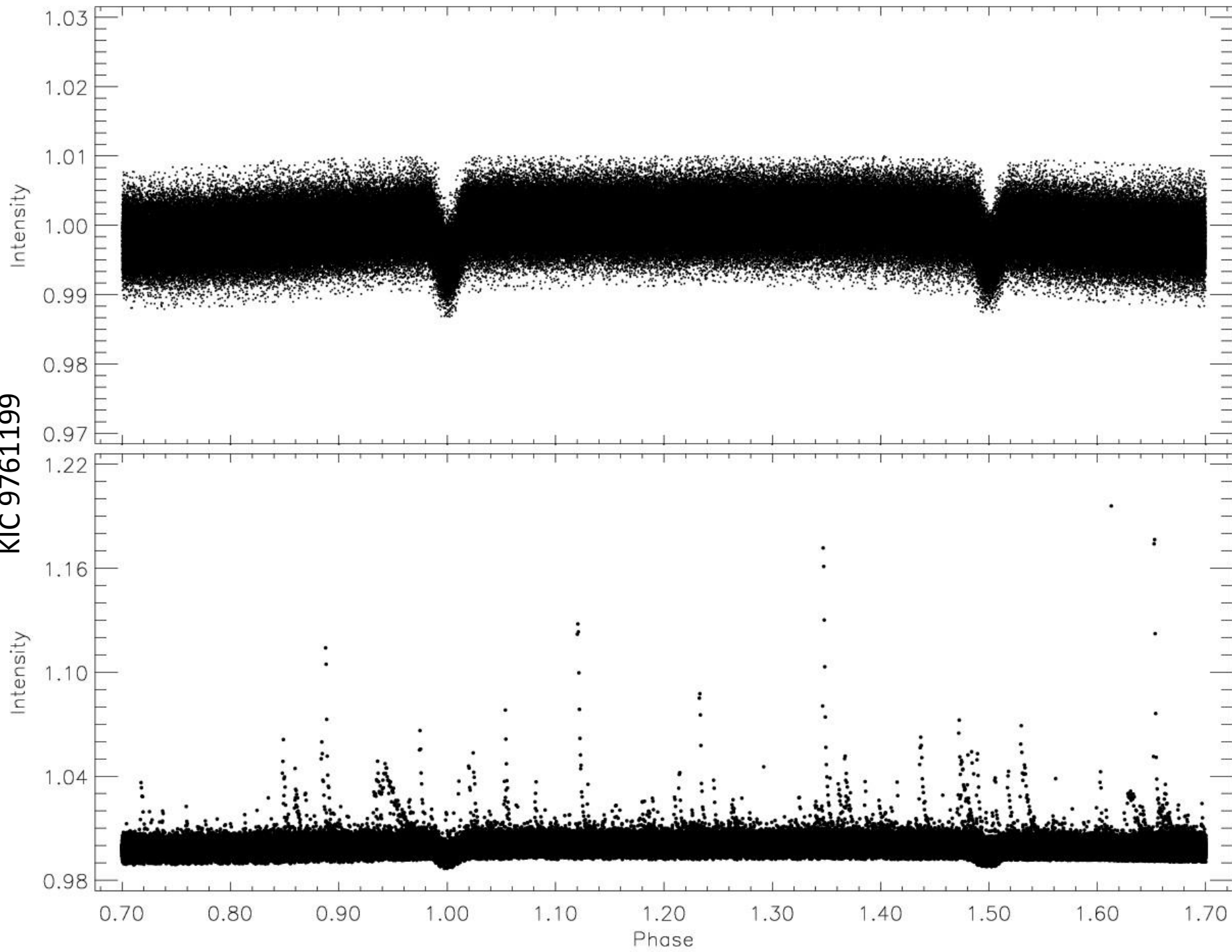
SPOTMODEL Programı (Ribarik et al. 2003) ile elde edilen leke parametrelerinin zamana göre değişimi. Şekilde mavi noktalar birinci lekenin ($kw = 0.75$), kırmızı noktalar ise ikinci lekenin ($kw = 0.85$) parametrelerini göstermektedir. Orta paneldeki düz çizgiler ise, iki lekenin boylam değişiminin doğrusal temsilleridir.

Minimum Zamanları



O-C II artıklarının zamana göre değişimi. Mavi renkli noktalar baş minimum, kırmızı renkli noktalar yan minimumdan okunan zaman artıklarını göstermektedir. Yan minimum zamanlarındaki değişim, Tran et al. (2013, 2015) tarafından yapılan çalışmalarda leke konfigürasyonu kaynaklı olduğunu ortaya çıkmıştır.

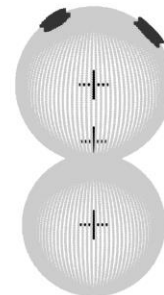
KIC 9761199



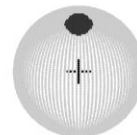
Parameter	Value
q	0.689 ± 0.001
$i(^{\circ})$	77.44 ± 0.01
$T_1(K)$	4060 (fixed)
$T_2(K)$	3891 ± 1
Ω_1	8.959 ± 0.003
Ω_2	7.468 ± 0.003
L_1/L_T	0.605 ± 0.002
g_1, g_2	0.32 (fixed)
A_1, A_2	0.50 (fixed)
$x_{1,bol}, x_{2,bol}$	0.696, 0.686 (fixed)
x_1, x_2	0.709, 0.700 (fixed)
$\langle r_1 \rangle$	0.1211 ± 0.0001
$\langle r_2 \rangle$	0.1093 ± 0.0001
$Co - Lat_{SpotI}$ (rad)	0.820 ± 0.003
$Long_{SpotI}$ (rad)	1.710 ± 0.003
R_{SpotI} (rad)	0.180 ± 0.001
T_{fSpotI}	0.940 ± 0.001
$Co - Lat_{SpotII}$ (rad)	0.524 ± 0.003
$Long_{SpotII}$ (rad)	4.712 ± 0.003
R_{SpotII} (rad)	0.157 ± 0.001
$T_{fSpotII}$	0.950 ± 0.001

Phase

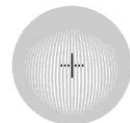
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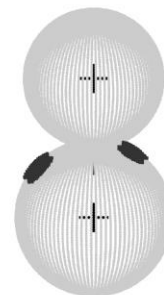
0.25



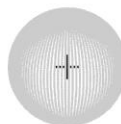
+



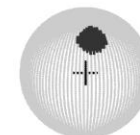
0.50



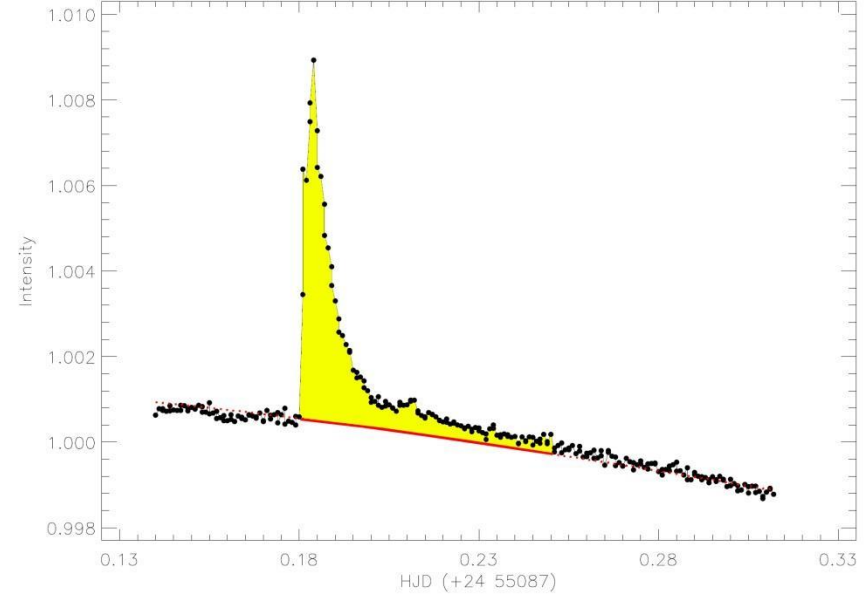
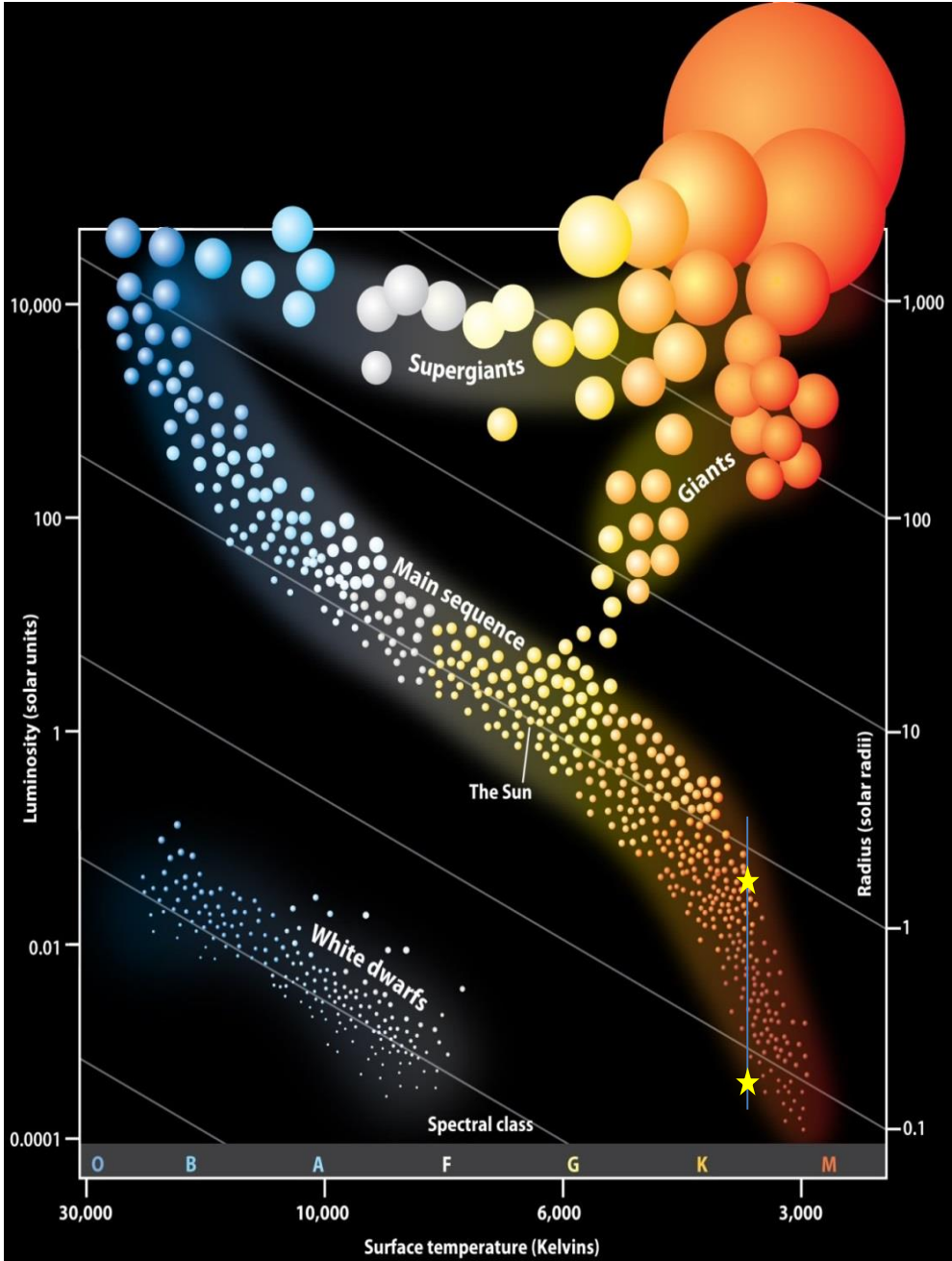
0.75



+



nasıl hesaplanır ?



$$P = \int \left(\frac{I_f - I_0}{I_0} \right) dt \quad E = P \times L$$

P : Eşdeğer süre

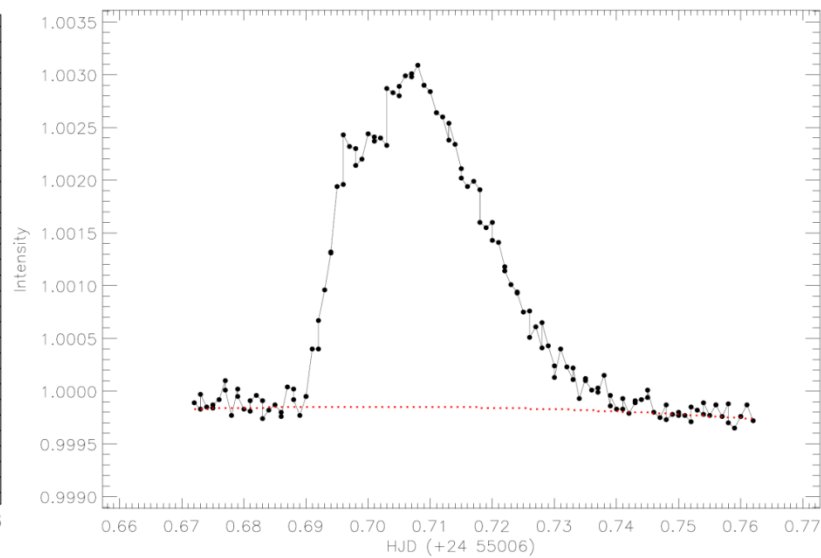
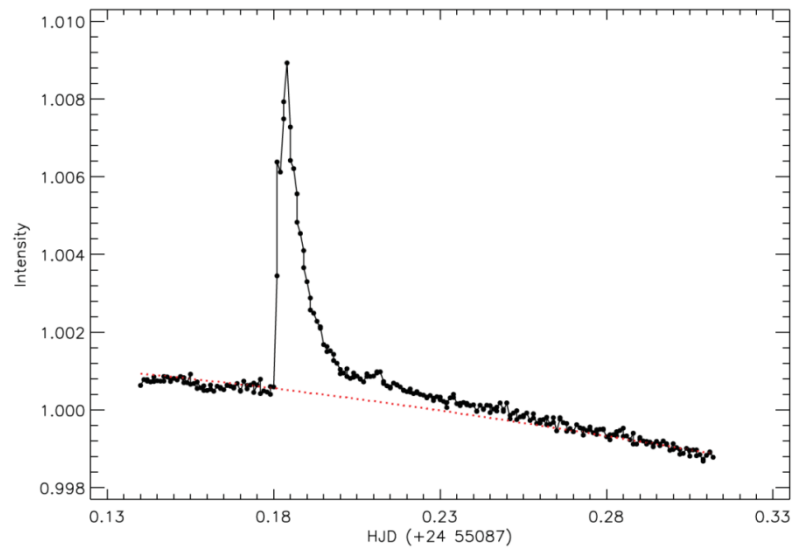
I_f : Flare anındaki akı

I_0 : Temel düzey akısı

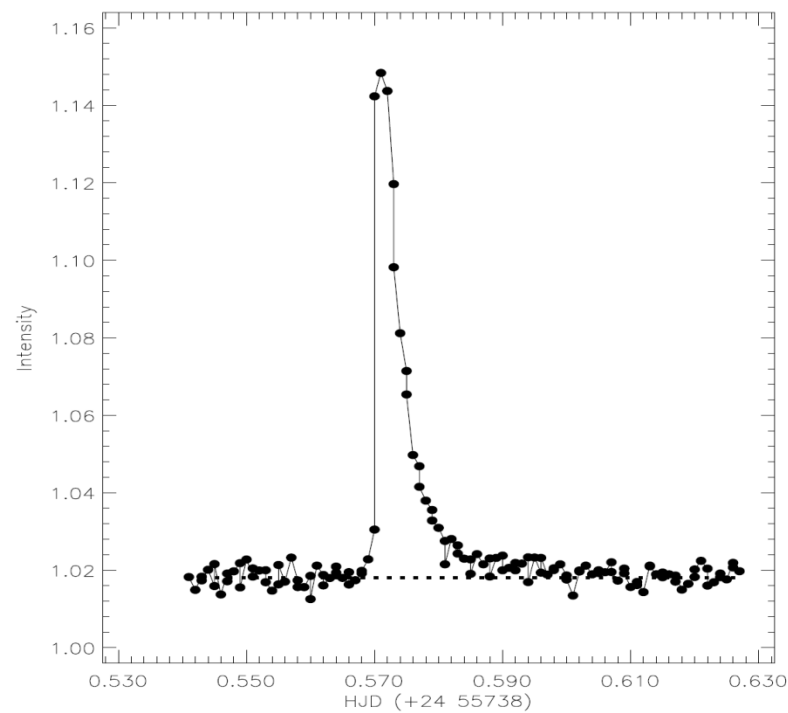
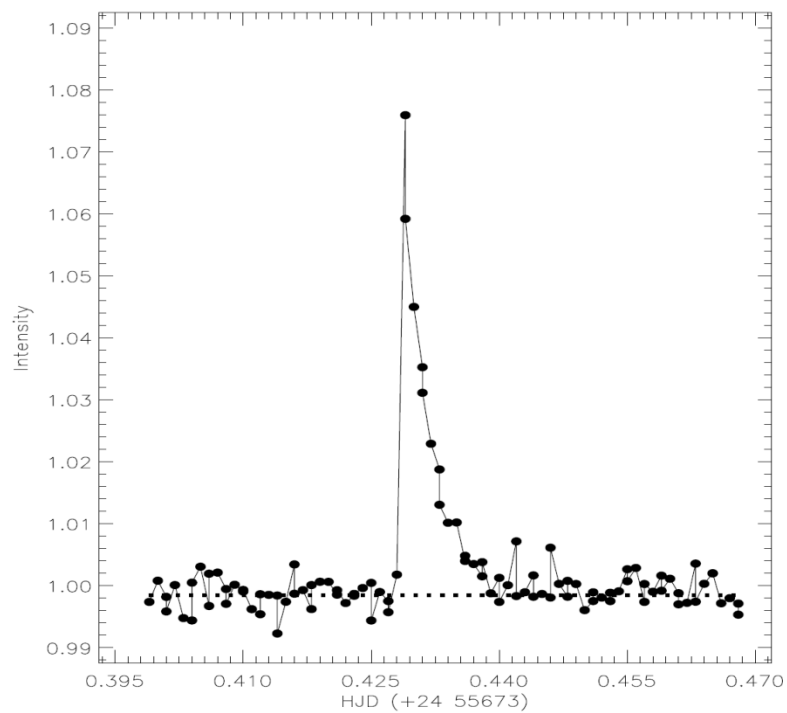
E : Flare enerjisi

L : Yıldızın ışıması

KIC 9641031



KIC 9761199



Hesaplanan flare parametrelerinin birbirleriyle ilişkileri incelendiğinde, flare eşdeğer süresinin flare toplam süresine göre belirli bir kural çerçevesinde değiştiği görülür. SPSS V17.0 (Green et al. 1999) ve Grahpad Prism V5.02 (Dawson & Trapp 2004) programları ile yapılan regression hesaplamaları, flare eşdeğer sürelerinin dağılımı için en iyi fonksiyonun the One Phase Exponential Association (OPEA) olduğunu göstermiştir.

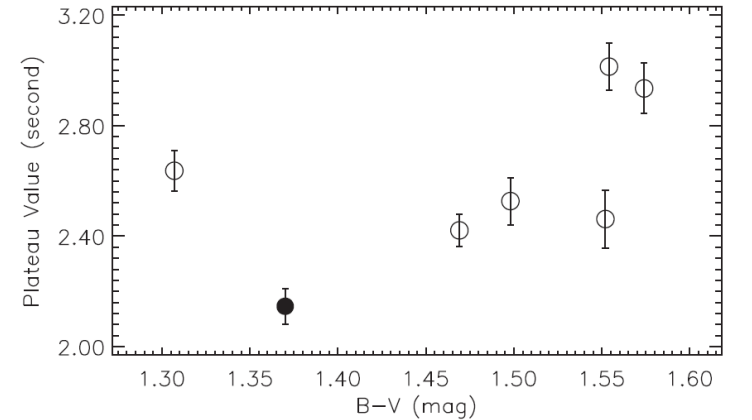
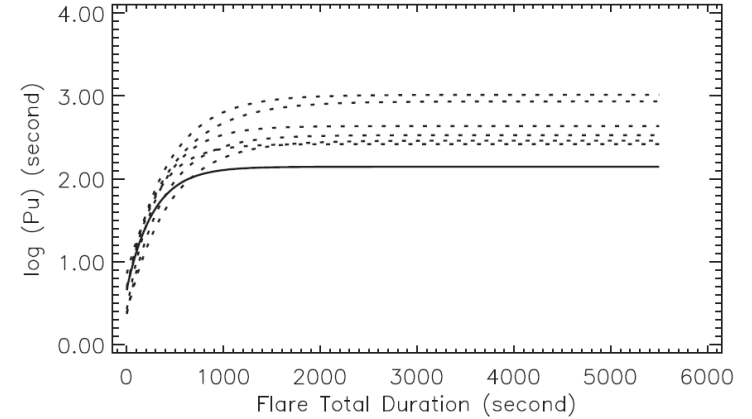
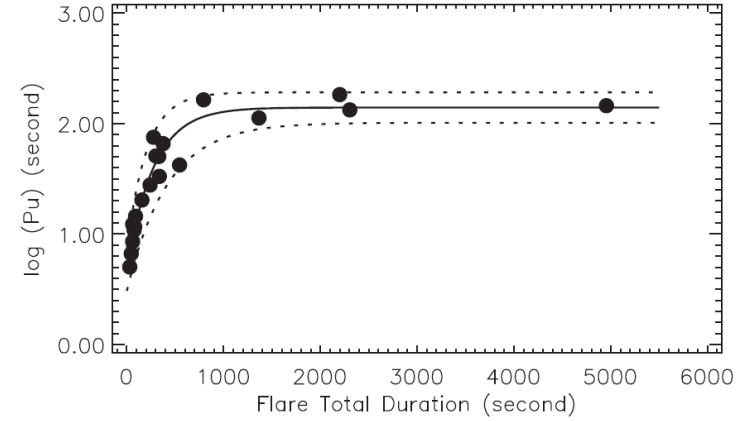
The OPEA fonksiyonu (Motulsky 2007; Spanier & Oldham 1987) **Plateau** terimine sahip olan özel bir fonksiyondur. Eşdeğer sürelerinin dağılımını tanımlayan bu fonksiyon:

$$y = y_0 + (Plateau - y_0) \times (1 - e^{-k \times x})$$

Y : logaritmik ölçekte eşdeğer süredir

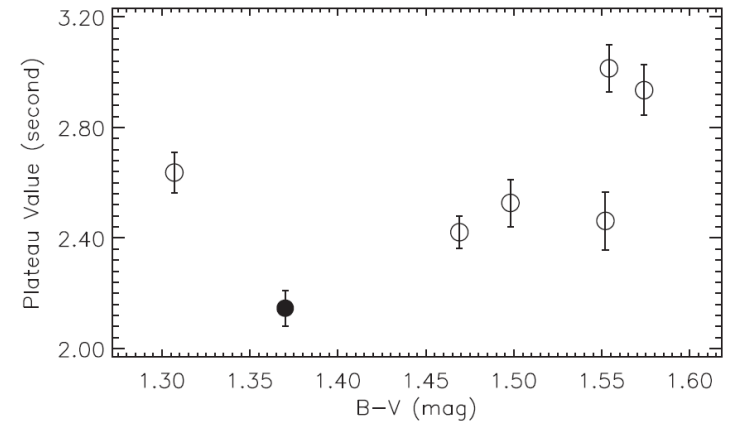
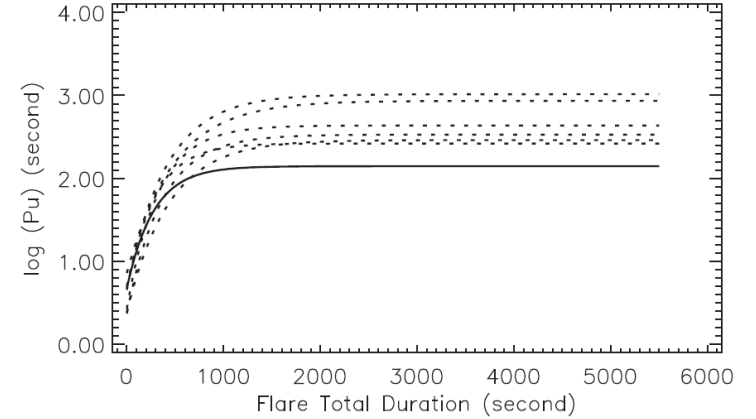
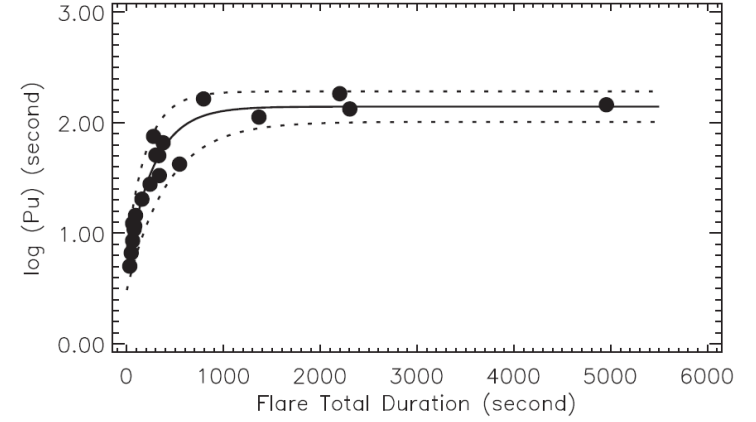
X : flare toplam süresi

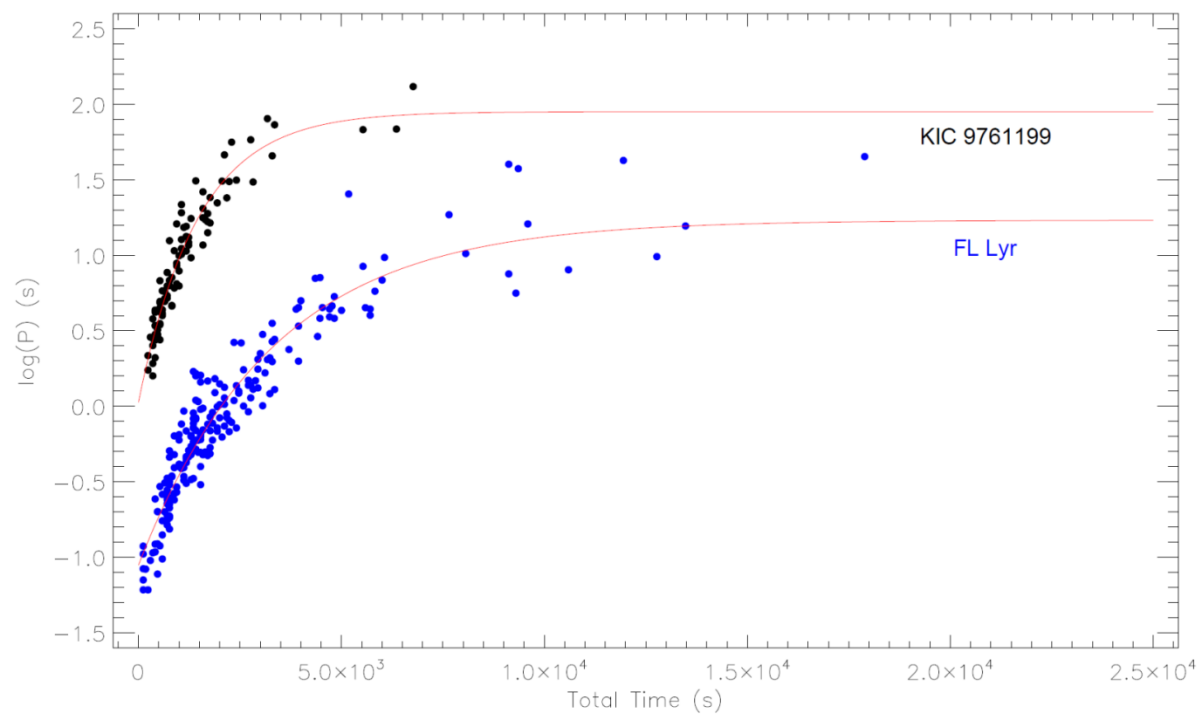
Y_0 : her hangi bir yıldızda gözlenen bir flare için minimum eşdeğer süre



Plateau değeri ise belirli bir yıldızda gözlenen bir flare için, eşdeğer sürenin üst limitini tanımlar.

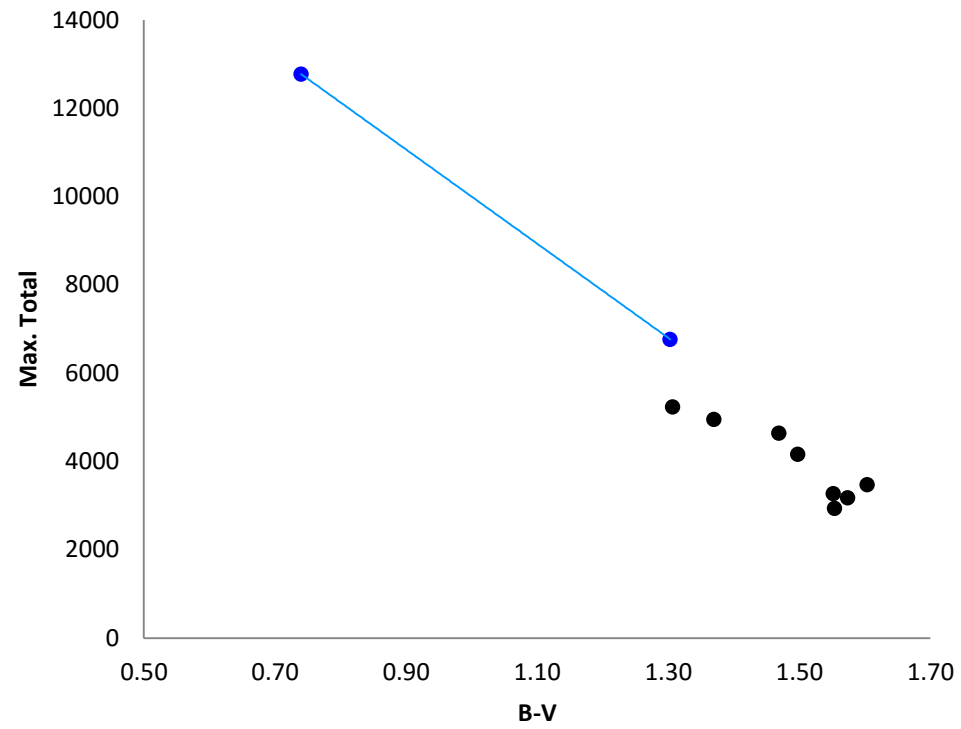
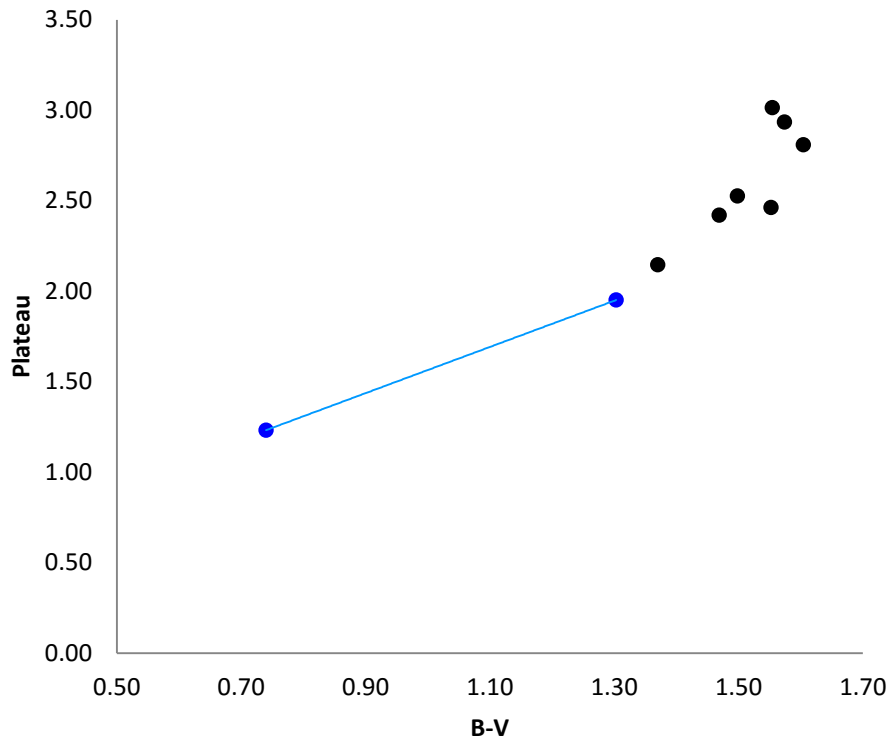
Bu parametre, gözlem yapılan dalgaboyu aralığında flare aktivitesi için doyma seviyesi (saturation level) olarak tanımlanmıştır (Dal and Evren 2011).





$$N_1 = \Sigma n_f / \Sigma T_t$$

Parametre	KIC 9641031	KIC 9761199
B-V (m)	0.740	1.303
Toplam Gözlem Süresi (Gün)	576.475	289.829
Flare Sayısı	240	94
Plateau (s)	1.232 ± 0.069	1.951 ± 0.069
Half Time (s)	2291.7	1014
Toplam Eşdeğer Süre (s)	556.81321	628.11671
N_1 (h ⁻¹)	0.41632	0.01351



Flare Parlama Süresi: $\tau_r = \frac{l}{B}$

Flare Sönümlenme Süresi: $\tau_d = \frac{E_{th}}{R}$

Toplam Isısal Enerji: $E_{th} = \frac{B^2}{8\pi}$

$\tau_t = \tau_r + \tau_d$ $\tau_t \propto B, n_e$

I: Manyetik Lup Yüksekliği

B: Manyetik Alan Şiddeti

E_{th}: Toplam Isısal Enerji

R: Plazmanın Salma Katsayısı ($R \propto n_e$)

KAYNAK:

1 Van Den Oord and Barstow (1988)

2 Van Den Oord et al. (1988)

3 Temmer et al. (2001)

4 Reeves and Warren (2002)

5 Imannishi et al. (2003)

6 Pandey and Singh (2008)

7 Yokoyama and Shibata (1998)

8 Shibata and Yokoyama (1999, 2002)

9 Yamamoto et al. (2002)

Bu çalışmada tüm modeller τ_t üzerinden yapılmıştır. Sonuç olarak τ_t ile B ve n_e arasında bir model kurulabilirse, bir yıldızda flare süreci ile ortaya çıkan kütle kaybı belirlenebilecek ve dolayısıyla da yıldız evriminde manyetik aktivite sonucu açıl momentum kaybı sorununa bir cevap verilebilecektir.

Detailed Chromospheric Activity Nature of KIC 9641031

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Abstract

This study depends on KIC 9641031 eclipsing binary with a chromospherically active component. There are three type variations, such as geometrical variations due to eclipses, sinusoidal variations due to the rotational modulations, and also flares, in the light curves. Taking into account results obtained from observations in the Kepler Mission Database, we discuss the details of chromospheric activity. The sinusoidal light variations due to rotational modulation and the flare events were modelled. 92 different data subsets separated using the analytic models were modelled separately to obtain the cool spot configuration. According to the model, there are two active regions separated by about 180° longitudinally between the latitudes of $+50^\circ$ and $+100^\circ$. 240 flares, whose parameters were computed, were detected. Using these parameters, the OPEA model was derived, in which the Plateau value was found to be 1.232 ± 0.069 s, and *half-life* parameter was found as 2291.7 s. The flare frequency N1 was found as 0.41632 h^{-1} , while the flare frequency N2 was found as 0.00027. Considering these parameters together with the orbital period variations demonstrates that the period variations depend on chromospheric activity. Comparing the system with its analogue, the activity level of KIC 9641031 is remarkably lower than the others.

Keywords: binaries: eclipsing – methods: data analysis – methods: statistical – stars: flare – stars: individual: (KIC 9641031) – techniques: photometric

CHROMOSPHERICALLY ACTIVE LOW-MASS CLOSE BINARY: KIC 9761199

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Draft version: May 8, 2016

RESUMEN

Favor de proporcionar un resumen en español. If you are unable to translate your abstract into Spanish, the editors will do it for you.

ABSTRACT

In this study, we present the results obtained from KIC 9761199's the photometrical data acquired by the Kepler Mission. The light curve of the system, the sinusoidal variation out-of-eclipses and instant-short term flare events in the entire light curves were analyzed. The temperature of the secondary component was found to be 3891 ± 1 K, while the mass ratio of the components (q) was found to be 0.689 ± 0.001 , and the orbital inclination (i) was computed as $77^\circ.44 \pm 0^\circ.01$. The sinusoidal variation is caused by the stellar spots of two active regions separated by about 180° longitudinally located around the latitudes of $+47^\circ$ and $+30^\circ$. In addition, 94 flares were detected and their parameters were computed. The OPEA model was derived for these flares and its parameters were computed. The *Plateau* value as saturation level for the active component was found to be 1.951 ± 0.069 s, while the *half - life* value was found to be 1014 s. The flare frequency N_1 was found to be $0.01351 h^{-1}$, while the flare frequency N_2 was found to be 0.00006. Maximum flare rise time (T_r) was found to be 1118.098 s, while maximum flare total time (T_t) was found to be 6767.72 s. Comparing its analogue it is seen that the chromospheric activity level of KIC 9761199, which is a low-mass close binary system according to the light curve analyses, is an expected level according to the $(B - V)$ color index of $1^m.303$ for the active component.

Key Words: techniques: photometric — methods: data analysis — stars: binaries: eclipsing — stars: low-mass — stars: flare — stars: individual: KIC 9761199

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