KIC 8462852 Intrinsic variability

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Abstract

The light curve of KIC 8462852 in dips around day 1519 and 1568 shows features matching clearly the rotational period of the star. Changes in brightness (unevenly distributed around its surface in these two cases) are shown modulated by the rotational period. Therefore the probable explication of this mysterious variability must be some phenomenon of the star itself instead of occultations by external objects.

Subject headings: stars: individual (KIC8462852) stars: variables: general

Introduction

KIC 8462852 is an F3 star in the Kepler field. It was discovered to undergo irregular dimming events, lasting for one or a few days with reductions in flux as large as 20 % ([1]Boyajian et al. 2016).

Additionally has been observed a progresive decrease of about 3 % over the four years of Kepler data ([2]Montet et al. 2016) and other decrease in photometry along the last century ([3]Schaefer 2016) Although the latter is disputed as an artifact by other authors ([4]Lund et al. 2016).

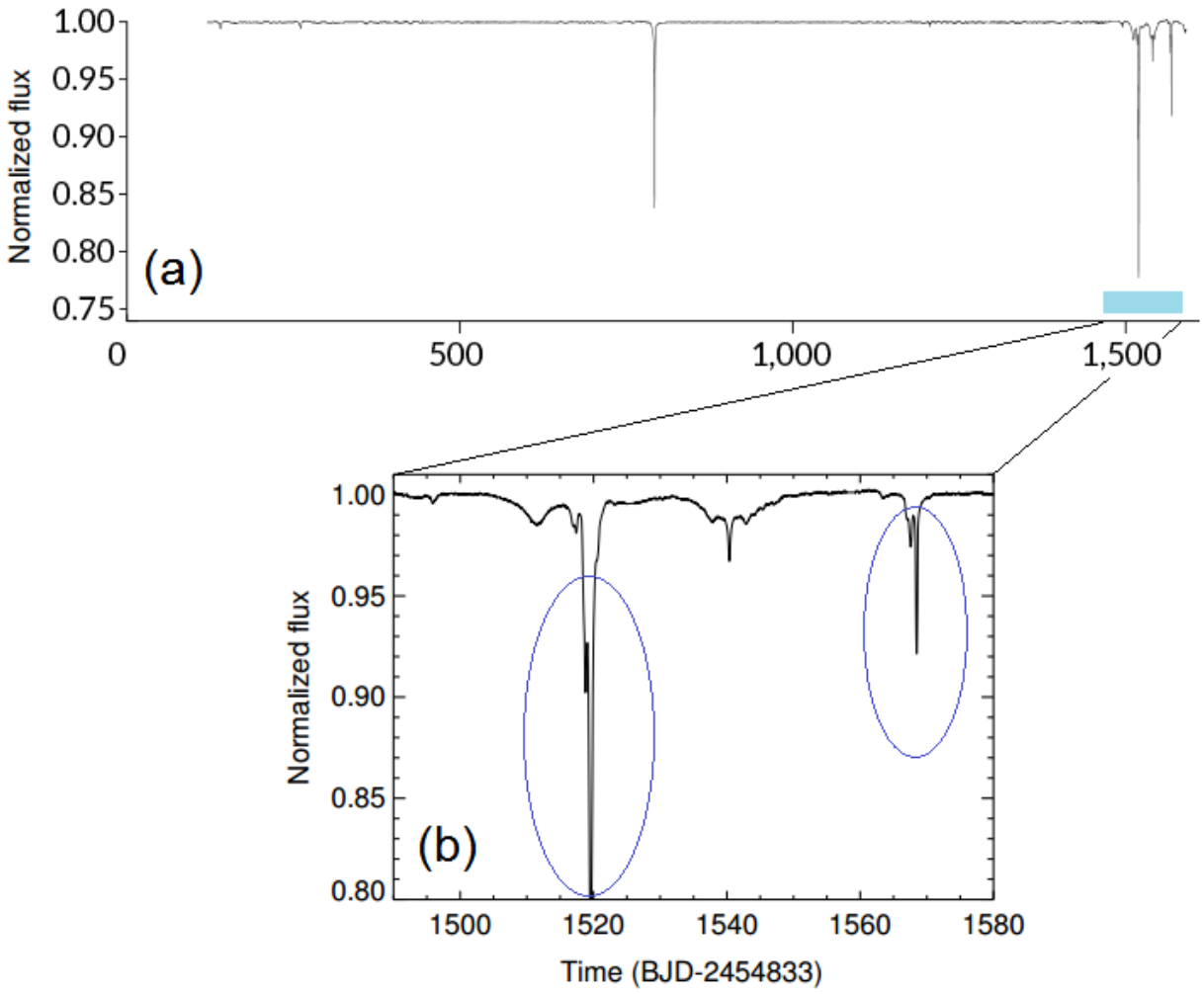

Figure 1: (a) Kepler light curve for KIC 8462852 showing the entire 4 years of data collected. (b) The two dips with "double spike".

Rotational period matching the light curve

The rotation period is 0.88 days, obtained from the Fourier transform of the Kepler photometry. ([1]Boyajian et al. 2016) It is precisely a time span observed in some of these "dips", as shown in Figure 2 and 3. It would be an unlikely coincidence for external objects. This is a very clear signal/hint that variability is intrinsic to the star, not due to occultations by external objects.

It would be an unlikely coincidence that the movement of external and distant objects were synchronized with the rotation of the star. However, if the brightness variability occurs

Table 1: Major dips

Strength #	Kepler Day	Drop approx.		Lightcurve shape
1	1519	20 %	*	Double bump matches rotation period.
2	793	15 %		Clean curve.
3	1568	8 %	*	Double bump matches rotation period.
4	1540	3 %		Weakest and complex.

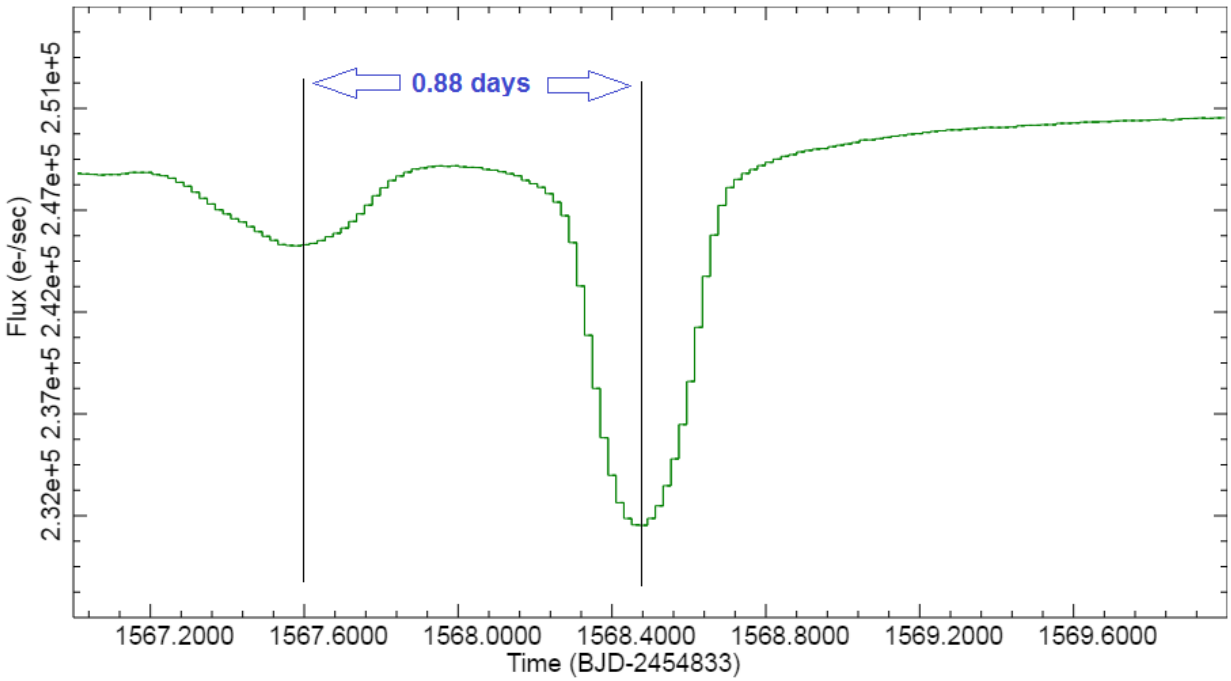

Figure 2: The coincidence in day 1568 is the cleanest and spectacular. Distance between peaks: 1568.46 - 1567.58 = 0.88 days

on the surface of the star itself (and is distributed unevenly in these two cases), then one would expect this modulation by rotational period in the light curve.

These graphics in fig.2 and 3 with high temporal resolution come from Kepler data which can be found in archive.stsci.edu/kepler[5] The two dips studied are found in the files of 2013.

Dip 1519: file KPLR008462852-2013098041711

Dip 1568: file KPLR008462852-2013131215648

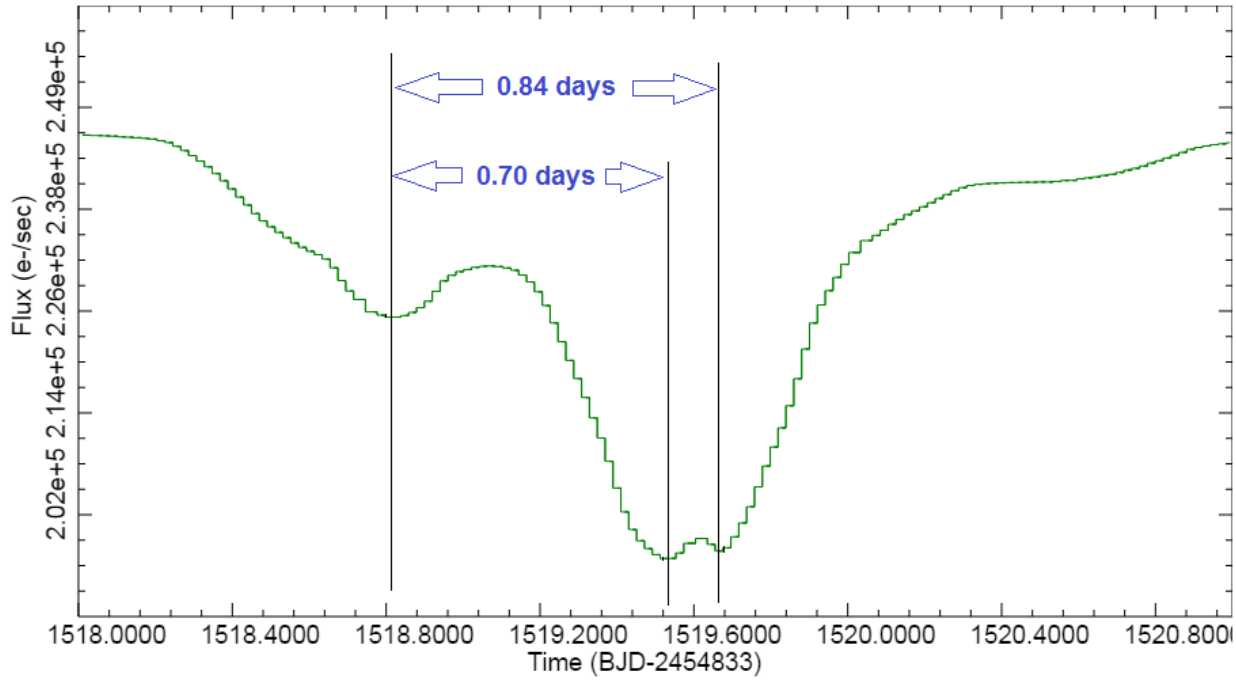

Figure 3: The stronger dip in day 1519. Distance between peaks: 1519.66 - 1518.82 = 0.84 days 1519.52 - 1518.82 = 0.70 days

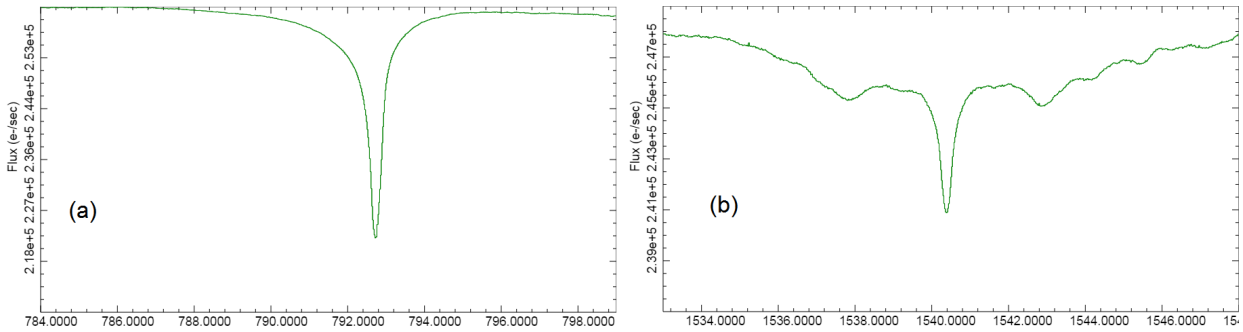

Figure 4: (a) Dip around day 790. Clean decrease (uniform acceleration approx.) for a few days. peak, and fast recovery. The phenomenon in this case could be more regularly distributed over the surface of the star, or maybe it appeared in a polar area permanently visible. (b) Other dip with lower intensity and more complex structure around day 1540. (Different vertical scales.)

Discussion

Most proposals hypotheses are based on occultations by external objects. From large groups of comets to alien structures. (In a search in arxiv 3 results appear talking about SETI, between 9 total) The nature of these decreases brightness are presently unknown. But the

Table 2: Time Spans

Time main peak	Time small peak	Time Span	Rotation Period %
1568.461	1567.582	0.879	*** Exact !
1519.522	1518.822	0.700	79.5 %
1519.665	1518.822	0.843	*** 95.7 %

coincidence with the period of rotation in some of the main dips suggests that it is an intrinsic variability of the star, something on its surface. and sometimes occurs irregularly, with greater intensity in one hemisphere.

References

(1) T. S. Boyajian et al, Planet Hunters X. KIC 8462852 Where's the Flux?, *MNRAS* arxiv.org/abs/1509.03622

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(3) Bradley E.Schaefer, KIC8462852 Faded at an Average Rate of 0.164 Magnitudes Per Century From 1890 To 1989, *Astroph. Journal Letters.* arxiv.org/abs/1601.03256

(4) Michael B. Lund et al., The Stability of F-star Brightness on Century Timescales, *arXiv preprint.* arxiv.org/abs/1605.02760

(5) Kepler Data. archive.stsci.edu/kepler