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VISUAL ESTIMATES and TAROT MEASUREMENTS of FG Boo

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ABSTRACT : The variations of FG Boo = HD 135120 were discovered by Hipparcos. GEOS's members have been observing this star visually since July 2003. From May 2007 to January 2009, the automatic telescope Tarot of the Calern observatory obtained more than 2500 measurements. All these observations show two kinds of oscillations : a semi-regular variation with a small amplitude (0.4 mag.) and a short period (from 10 to 40 days) and long period cycles (about 400 days) with an amplitude larger than one magnitude. Thus, FG Boo seems to be a SRB variable star.

RESUME : Les variations de FG Boo = HD 135120 ont été découvertes par le satellite Hipparcos. L'étoile a été observée visuellement au GEOS à partir de juillet 2003, puis par l'un des télescopes Tarot de mai 2007 à janvier 2009. Les mesures obtenues montrent deux sortes d'oscillations : une variation semi-régulière d'amplitude 0.4 mag et de période s'étalant sur plusieurs dizaines de jours et une variation plus lente , environ 400 jours , de plus d'une magnitude d'amplitude . Ces observations permettent de conclure que FG Boo est une variable du type SRB.

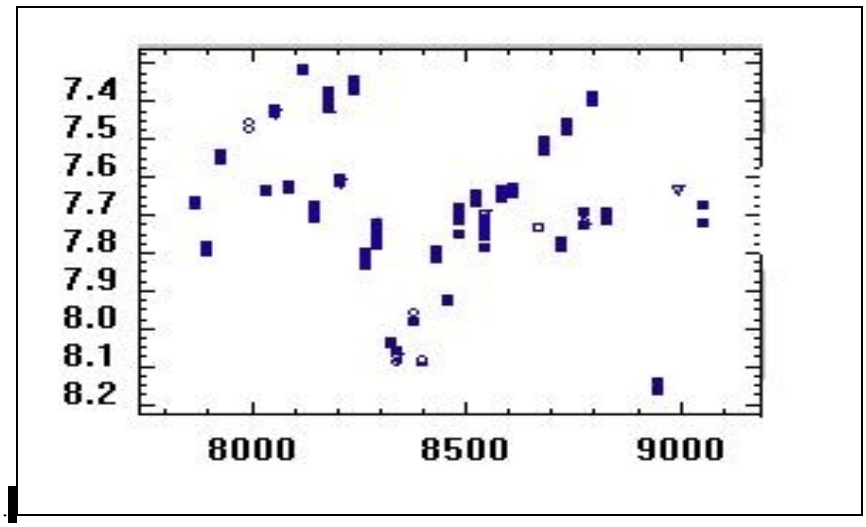
RESUMEN : Las variaciones de FG Boo = HD 135120 han sido descubiertas por el satélite Hipparcos. La estrella fue observada visualmente por el GEOS a partir de julio de 2003 y con un telescopio Tarot desde mayo de 2007 hasta enero de 2009. Las medidas obtenidas muestran dos clases de oscilaciones: una variación semi-regular de amplitud 0,4 mag con un periodo de algunas decenas de días y una variación más lenta, más o menos 400 días, de amplitud superior a una magnitud. Estas observaciones permiten clasificar FG Boo como variable de tipo SRB.

RIASSUNTO : La variabilita' di FG Boo = HD 135120 e'stata scoperta dal satellite Hipparcos e poi osservata visualmente dal GEOS a partire dal luglio 2003. Piu' di 2500 misure sono state inoltre ottenute fra il 2007 e il 2009 col telescopio automatico TAROT all'osservatorio di Calern. L'analisi di tutte queste misure mostra due tipi di oscillazione : una variazione semi-regolare con un'ampiezza di 0.4 mag e un periodo di alcune decine di giorni ed un'altra con periodicita' di circa 400 giorni ed un'ampiezza maggiore di 1 magnitudine. Sulla base di questi risultati possiamo concludere che FG Boo e'una variabile di tipo SRB.

1. INTRODUCTION

FG Boo = HD 135120 = SAO 29436 = HIP 74337
α = 15h 11m 35s δ = 49° 54' 11'' (2000) Spectral type : M2 III

The variations of FG Boo were discovered by Hipparcos (fig. 1). The Hipparcos magnitude is based on 119 observations : Hpmag at maximum is 7.35 and Hpmag at minimum 8.06 ; scatter on Hpmag is 0.203. FG Boo appears as an unsolved variable [1].



Fig; 1: the light curve obtained by Hipparcos .

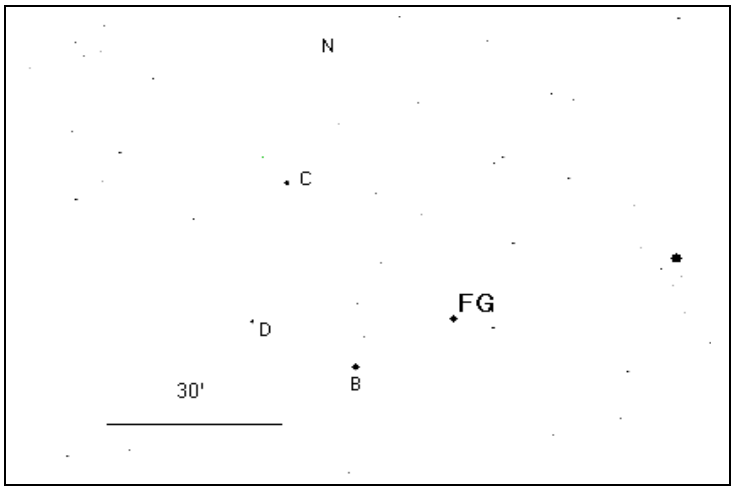
2. VISUAL OBSERVATIONS

The observation of FG Boo is easy : the star is circumpolar in Europe and the background density is very low. The figure 2 gives a chart of the field of FG Boo [2].
The comparison stars were :

B : HD 135401 V = 7.25 sp. K0
C : HD 135597 V = 8.09 sp. K5
D : HD 135696 V = 8.63 sp. F8

Few observations used also the star A
which is 1.5° south of FG Boo :

A : HD 135364 V = 7.15 sp. K0



Fig; 2 : Field of FG Boo with the comparison stars.

We began to observe FG Boo in GEOS in July 2003 and received 988 estimates from 6 observers, who used the Argelander's method and binoculars from 50 to 100mm. The table 1 summarizes these observations :

Observers		Estimates	Extreme dates
Michel DUMONT	DMT	568	2000 apr – 2008 dec
Carlo PAMPALONI	PMP	143	2003 july – 2008 sept
Franck GOBET	GBF	108	2005 sept – 2007 mar
Jean EYRAUD	EYR	84	2005 aug – 2008 oct
Monique BISSON	BIM	51	2003 july – 2006 july
Mario CHECHUCCI	CHC	34	2003 july – 2003 dec

Table 1 : The received estimates

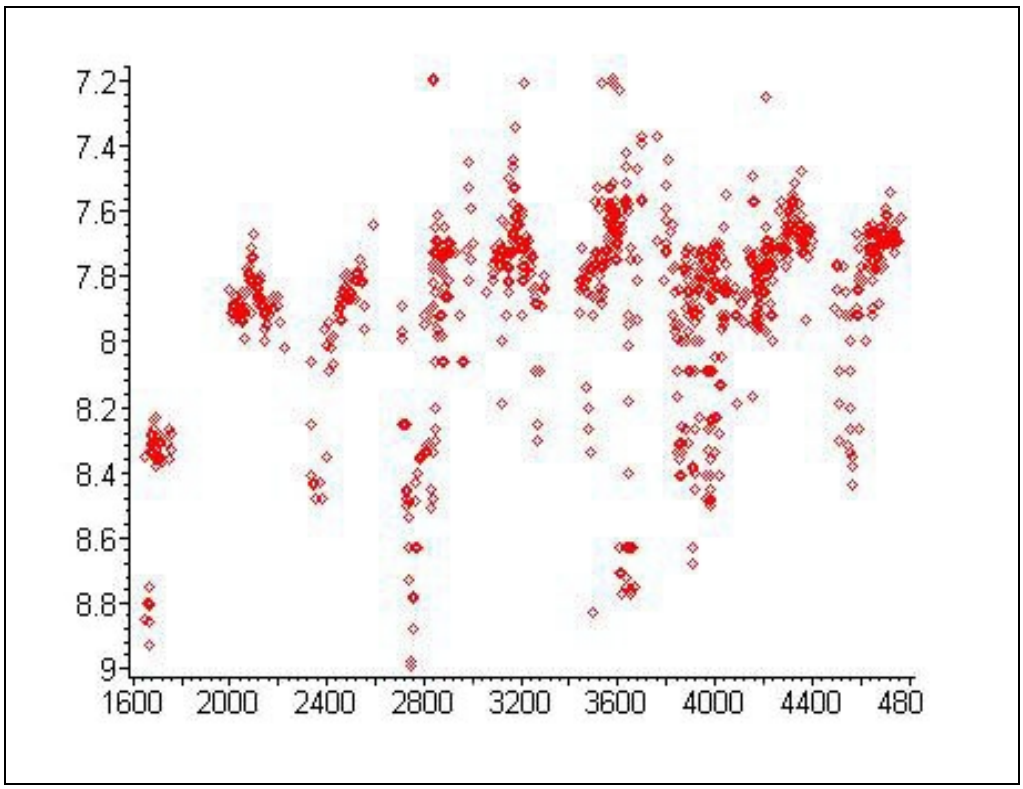


Fig. 3 : The visual light curve of FG Boo from 2000
In abscissa, the time (JD 245…), in ordinate, the visual magnitude.

The star varies from 7.3 to 8.7.
The curve looks rather scattered, but a semiregular variation appears clearly.
We find maxima at 2080, 2530, 3160, 3750, 4280 and 4680,
and minima at 1660, 2350, 2740, 3610, 3970 and 4560.
Some extrema were missed, because nearly all observations were from March to September.
A first pseudo-period of 400 days appears.

3. TAROT MEASUREMENTS.

In May 2007, we asked for photometric measurements with the 250 mm automatic telescope of the Tarot Calern Observatory. This telescope was devised to observe quickly the Gamma Ray Bursts. It can be pointed to any direction of the sky in less than 5 seconds. If there is no Gamma Ray Burst to observe, the telescope observes other targets, sometimes variable stars.
Between 2007 May and 2009 January, it obtains 1489 measurements in V and 1216 in B .

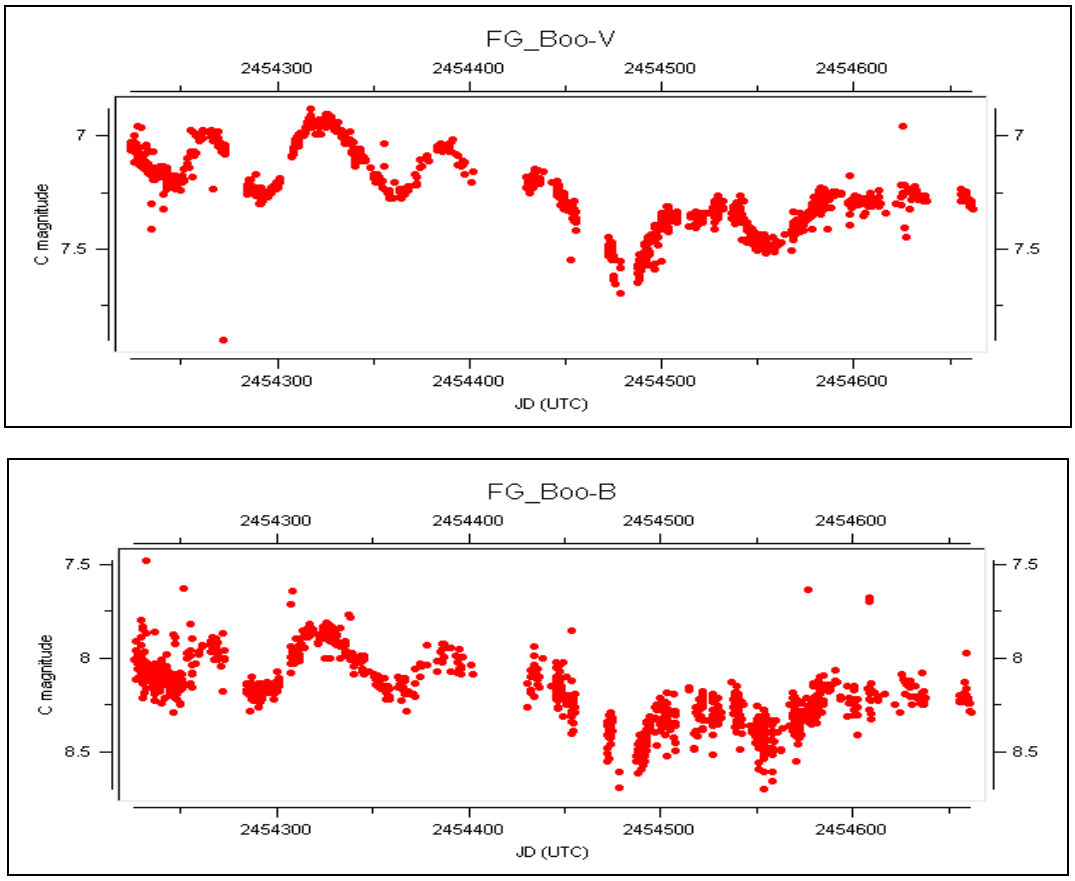


Fig. 4: the two light curves obtained by Tarot in V and B.

Two modulations appear :

- A rapid semiregular variation with a small amplitude (0.4 mag).
  Maxima fall at 4263, 4320, 4388, 4436, 4575, 4717 and 4837.
  Minima fall at 4248,4294, 4363, 4470,4558 and 4810.
  Once more, some extrema were missed (minimum around 4420) and, sometimes, the variation is slow and irregular (4600 to 4700).
  These cycles vary from 40 to 140 days.
- A slow variation with an amplitude of one magnitude, this kind of cycle lasts perhaps 500 days and contains 6 or 8 small cycles of the rapid variation. But Tarot observations extend on 700 days and cannot confirm this second pseudo-periodicity of variation .

The semiregular variation detected by visual estimates is precisely this second kind of cycle. The minimum observed visually at 4560 coincides with the minimum of Tarot observations at 4558.

4. CONCLUSIONS

These described observations let us conclude that FG Boo is a semiregular SR variable star. Its spectral type (M2 III) places it among SRA or SRB variables. But the alternation of periodic variations and small irregular changes and the simultaneous presence of two (or more) periods permit to say that FG Boo is a SRB star.

REFERENCES :

[1] The Hipparcos and Tycho Catalogues. Celestia 2000.
[2] Guide. Version 8.0 Project Pluto.