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THE FIRST GROUND-BASED PHOTOMETRIC OBSERVATIONS OF GM DRACONIS

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Name of the object:	
$GM Dra = BD + 58^{\circ}1721 = HIP 84837 = HD 238677$	

Equatorial coordination	ates:	Equinox:
$\mathbf{R.A.} = 17^{h}20^{m}21.89$	$DEC. = +57^{\circ}58'26''.92$	2000

## Observatory and telescope:

TÜBİTAK (Scientific and Technical Research Council of Turkey) National Observatory, 40-cm Cassegrain telescope

Detector:	Hamamatsu, R 4457 (PMT)				
Filter(s):	Johnson $B, V$ and $R$				
Comparison star(s):	$BD + 58^{\circ}1716$				
Check star(s):	$BD + 58^{\circ}1730$				
Transformed to a standard system: No					
Availability of the data:					
Upon request					
Type of variability:	EW				



Figure 1. The light and color curves of GM Dra

Table 1: Photometric minima times of GM Dra

JD Hel.	Min	O - C	Reference
2400000 +	rybe		
48500.1791	Ι	-0.0001	HIPPARCOS ESA $(1998)$
51743.4579(3)	II	0.0011	This work
51750.3999(7)	Ι	-0.0011	This work

Table 2: The light levels and their differences in the light curves of GM Dra

	В	V	R
Max. light at 0.75	-0.665	-0.708	-0.735
Max. light at $0.25$	-0.685	-0.715	-0.743
Min. light at $0.00$	-0.404	-0.462	-0.507
Min. light at $0.50$	-0.413	-0.470	-0.510
$\Delta \max. (m_{0.75} - m_{0.25})$	0.020	0.007	0.008
$\Delta \min. (m_{0.00} - m_{0.50})$	0.009	0.008	0.003
Depth of Min. I	0.271	0.250	0.232
Depth of Min. II	0.262	0.242	0.229

## **Remarks:**

The variability of GM Dra was first discovered by HIPPARCOS (ESA, 1998). The photometric observations of the system by HIPPARCOS show a  $\beta$  Lyrae type light curve with an amplitude of 0<sup>m</sup> 27 ranging from 8<sup>m</sup> 77 to 9<sup>m</sup> 04. The mean orbital period derived by HIPPARCOS from the best light curve fit is 0<sup>d</sup> 338736 and the epoch is given as HJD 2448500.1791 (ESA, 1998). The spectral type of the system is given as F8.

The first ground-based photometric observations of GM Dra were made on 3 nights during 2000 observing season. The instrumental differential B, V and R light and B - V and V - R color curves are shown in Figure 1. During the observations, we obtained one primary and one secondary times of minimum light. These times of minima and their errors, which were determined by using the method of Kwee & van Woerden (1956), are presented in Table 1. The times of the minima given in Table 1 are averaged values of the eclipse times obtained in B, V and R colors during the same observing night. We have combined the epoch derived by HIPPARCOS with our values in order to derive the new epoch and period of the system and calculated the following improved light elements by using the least squares method:

 $\text{HJD}_{\min I} = 2451750.4010(11) + 0.3387412(2) \times E.$ 

The O-C values in column 3 in Table 1 were calculated using the ephemeris given in this formula.

The photometric phases in Figure 1 were calculated with this formula. The shape of the light curves of GM Dra in Figure 1 is a typical of EW type, although it was noted to be EB type in HIPPARCOS (ESA, 1998). An asymmetry between the light level of maximum I (0.25 phase) and that of maximum II (0.75 phase), is clearly seen in the *B* light curve, but not seen in the *V* and *R* light curves (see Table 2). There are irregular variations in the B - V and V - R color curves in the Figure 1. Especially, there is a significant blueing at about 1.3 phase in the B - V color curve and a significant reddening at about 1.38 phase in the V - R color curve.

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References:

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