COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4064

Konkoly Observatory
Budapest
12 August 1994

HU ISSN 0374 - 0676

HIC 83921: A NEW PULSATING STAR IN HERCULES

During the photoelectric observations of the close binary system AK Herculis carried out in the summer 1993 at the stations of Capanne di Cosola (AL, Italy) and Castelnuovo Bormida (AL, Italy) the variability of the comparison star HIC 83921 (SAO 102617) was strongly suspected. After a close scrutiny of the available data, it was clear that HIC83921 was subjected to fast light variations.

The availability of the appropriate measurements of the check star HIC 83855 carried out during five nights (from 15 to 24 July 1993) as well as the sky background permitted to get a set of 772 differential photometric instrumental V data of the new suspected variable star. Additional photometry in June 1994 at Castelnuovo Bormida added a set of new 200 data points always in the instrumental V band.

The comparison star was HIC 83855 (SAO 102611) and the check one was HIC 83810 (SAO 102607) for the data set gained in 1994, while the ones obtained during the year 1993 were processed adopting HIC 83855 (SAO 102611) as comparison star.

The standard data for these stars are reported in Table 1. The whole photometry of HIC 83921 was carried out by a 200mm Schmidt-Cassegrain f15 telescope equipped with a photoelectric photometer Optec SSP5 (Spectral Sensitivity S5) operating in the Johnson-Morgan standard B and V bands. The adopted integration time was fixed to ten seconds.

Additionally a number of photoelectric observations of V463 Herculis, a variable star very near to HIC 83921, were also carried out in order to exclude at all a possible mistake in the identification of the new variable star.

Since this work is preliminary, here we limit us to search for the best phasing preliminary period. Eventual analysis in order to ascertain the existence of two (or more) pulsation periods will be postponed to a subsequent work. In order to get at least a preliminary value for the period we carried out spectrum analysis of the whole data set by Recursive Fourier Techniques making also appropriate analysis of the Spectral Window Function.

In order to get the clean spectrum we deconvolved the spectral window from the original power spectrum using the well known CLEAN technique (Roberts et al., 1987) obtaining a two peaked clean spectrum. Additionally a periodogram using the Generalized Phase Dispersion Minimization method (GPDM) (Gaspani, 1993b) was computed. This procedure does not assume any particular data fitting function so it is very efficient when the search signal is not sinusoidal. The generalized periodogram graphed in Figure 1 shows two peaks corresponding to frequencies f_1=7.77 and f_2=7.91 cycles/day. The frequency f_1=7.91 cycles/day dominates the first one, so we assumed it as preliminary true frequency. This implies a period P=0.1264 days.

Similar results were obtained with the CLEAN deconvolution technique.

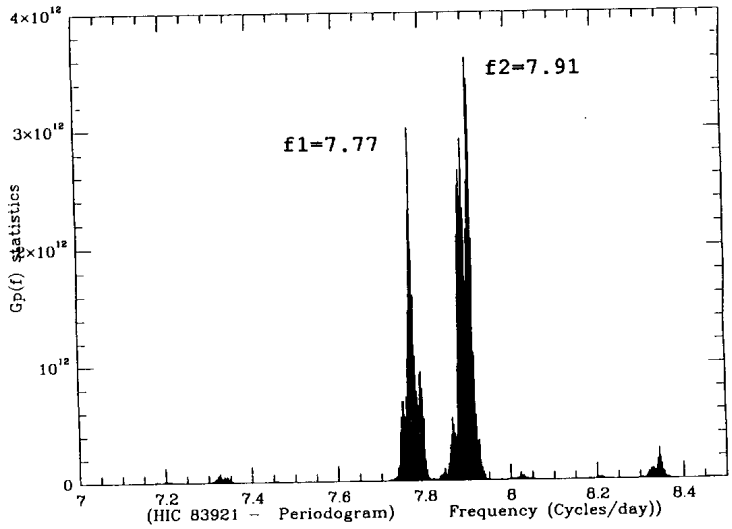

Figure 1. Periodogram of the whole data set showing two dominating frequencies: f_1=7.77 and f_2=7.91 cycles/day

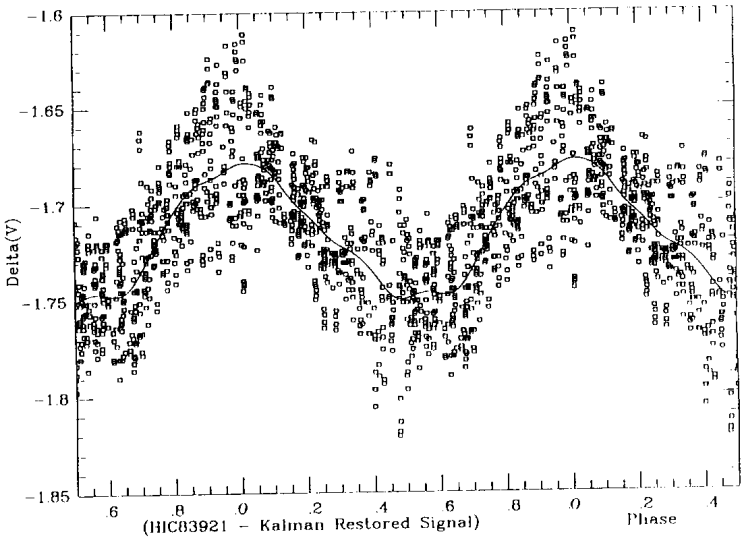

Figure 2. HIC 83921 – Photoelectric V data phased using the light elements listed in text (squares). The solid line is the restored light curve. The adopted restoration technique is based on the Scalar Kalman Filter.

Table 1. Data of the involved stars

HIC 83855 (SAO 102611=BD+16°3102=HD 154974)	
$\alpha(2000)=17^h08^m15^s.728$	$\delta(2000)=+16°15'37''.89$
V=7.300±0.030	B−V=0.590±0.020
Spectral type F8 IV	
HIC 83810 (SAO 102607=BD=+15°3116=HD 154892)	
$\alpha(2000)=17^h07^m41^s.319$	$\delta(2000)=+15°12'37''.57$
V=7.890±0.031	B−V=0.516±0.015
Spectral type: F8 V	
HIC 83921 (SAO 102617=BD+16°3105=HD 155118)	
$\alpha(2000)=17^h09^m04^s.91$	$\delta(2000)=+16°27'43''.80$
V=8.389±0.031	B−V=0.392±0.012
Spectral type: F0	

Table 2. HIC 83921 – Heliocentric times of maximum

JD 2449184.4572±0.0004
JD 2449191.421 ±0.002
JD 2449191.5408±0.0003
JD 2449510.5101±0.0007

Table 3

Epoch E	Observed time of maximum	Computed time of maximum	Residual (O−C)
0	184.4572	184.4619	−0.0047
55	191.4210	191.4153	+0.0057
56	191.5408	191.5417	−0.0009
2579	510.5101	510.5103	−0.0002

In order to refine the preliminary period found, four heliocentric times of maximum were computed using the available observations. The heliocentric times of maximum were computed using the available observations. The heliocentric times of maximum obtained by the Minimum Entropy SOP method (MEMSOP, Gaspani 1993a) are listed in Table II. On the basis of the four available times we obtained the following least squares fit:

$$\text{Maximum=J.D.(hel) } 2449184.462 + 0^d.126424 \times E$$
$$\pm 0.003 \pm 0.000002$$

that is the first ephemeris for the studied variable star. The comparison with the observations is shown in Table 3. Figure 2 shows the phased light curve composed by all the available data points and obtained using the ephemeris listed above.

In order to recover a convenient estimate of the true signal from the noisy data we processed the noisy phased data by a signal restoration technique based on the Kalman Filter Theory (Gaspani, 1993c). Figure 2 shows the restored light curve, graphed as a solid line, across the original data points. Evidently HIC 83921 is a short period pulsating star with a range about 0.08 magnitudes in the V band.

In order to draw some astrophysical considerations, we must take into account the pulsation period of HIC 83921 as well as its spectral type and its range. The period found during the present investigation is 0.126 days that coupled with the spectral type F0; the shape of the light curve enabled us to classify this star as a probable Delta Scuti. HIC 83921 seems to match well the typical parameters of this class of pulsating stars.

Further photoelectric observations are planned for the future.

Marco ALUIGI
GEOS - 3, Promenade Venezia,
F-78000 Versailles (France)

Gianni GALLI
GEOS - 3, Promenade Venezia,
F-78000 Versailles (France)

Adriano GASPANI
Osservatorio Astronomico di Brera
Via Brera 28, Milano (Italy) and
GEOS - 3, Promenade Venezia,
F-78000 Versailles (France)

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