

COMMISSION 27 OF THE I. A. U.  
INFORMATION BULLETIN ON VARIABLE STARS  
Number 3099

Konkoly Observatory  
Budapest  
15 October 1987  
HU ISSN 0374-0676

H-ALPHA VARIABLES IN THE FIELD OF NGC7000, IC5068  
AND IC5070

In the course of a program to detect H-alpha emission stars in different Milky Way fields a 36 sq. deg. field was observed in Cygnus containing the NGC7000, IC5068 and IC5070 HII regions. The observations were carried out on several nights in 1979 with the 40" Schmidt telescope of the Byurakan Astrophysical Observatory. (For more details of these observations see Melikyan et al. 1987). It was known that in this region there were about 300 H-alpha emission stars found by Merrill and Burwell (1949, 1950), Herbig (1958), Welin (1973), Tsvetkov (1975), Tsvetkov and Tsvetkova (1978). Melikyan et al. have found 33 new H-alpha emission objects in their survey and 7 of them appeared to show variations in the H-alpha intensity. They have identified altogether 42 H-alpha variables in this region. They classified the intensity of the emission in five categories: 0=no emission, 1= weak, 2= medium, 3= strong and 4= very strong. These results are summarized in Table 1. where the 1st column gives the name of the objects (LkH $\alpha$ , BH $\alpha$ , UH $\alpha$  mean objects found in the Lick survey, in Byurakan and by Welin, respectively; asterisks designate stars discovered by Melikyan et al.). Columns 2-5 (designated with H1 to H4) give the classified intensities published in the cited literature, observed by Melikyan et al. on the nights of 25.07.79, 26.07.79 and 11.09.79, respectively.

Table 1.

Name	H1	H2	H3	H4	Remarks	Name	H1	H2	H3	H4	Remarks
LkHa145	2	4	3	1	IR	BHa16	3	2	1	1	IR
LkHa146	2	0	0	2		3*	0	0	1	3	
LkHa147	2	3	2	1		8*	0	3	3	1	
LkHa150	1	0	2	1		11*	0	1	1	3	IR
LkHa151	2	0	1	1		15*	0	0	3	2	
LkHa154	2	3	1	3		16*	0	1	1	3	
LkHa155	3	2	2	2	IR	19*	0	2	2	3	
LkHa156	2	0	0	2		20*	0	1	0	3	
LkHa159	2	0	0	2		UHα9	2	2	2	3	
LkHa160	2	0	2	2		UHα14	2	0	0	3	IR
LkHa161	2	0	1	2		UHα17	1	3	3	3	
LkHa164	2	1	1	1		UHα26	3	0	2	3	
LkHa166	1	2	2	1		UHα29	1	2	3	3	
LkHa171	3	0	2	3		UHα39	1	2	3	3	
LkHa174	2	2	0	0		UHα44	2	4	4	4	
LkHa176	3	1	1	2		UHα62	2	0	0	3	
LkHa177	2	0	1	3		UHα79	1	0	0	2	
LkHa178	1	2	2	2		UHα101	1	0	0	3	
LkHa179	1	2	2	1		UHα104	2	0	0	3	
LkHa188	2	2	3	1							
LkHa182	2	3	2	3							
LkHa187	1	0	0	1							
LkHa192	2	0	0	3							

( IR designate objects identified with IRAS point sources )

Table 2.

Correlations:	H1	H2	H3	H4
H1	1.0000	-.0289	-.0999	-.0954
H2	-.0289	1.0000	.6462**	-.0919
H3	-.0999	.6462**	1.0000	.0171
H4	-.0954	-.0919	.0171	1.0000
N of cases:	42	1-tailed Signif: ** - .001		

Table 3.a-c

Crosstabulation: H1  
By H2

H2->	Count	0	1	2	3	4	Row Total
H1	0	2	3	1	1		7
	1	4		5	1		10
	2	11	1	3	3	2	20
	3	2	1	2			5
	Column Total	19	5	11	5	2	42
		45.2	11.9	26.2	11.9	4.8	100.0

Crosstabulation: H2  
By H3

H3->	Count	0	1	2	3	4	Row Total
H2	0	10	4	4	1		19
	1	1	4				5
	2	1	1	6	3		11
	3		1	2	2		5
	4				1	1	2
	Column Total	12	10	12	7	1	42
		28.6	23.8	28.6	16.7	2.4	100.0

Crosstabulation: H3  
By H4

H4->	Count	0	1	2	3	4	Row Total
H3	0	1	1	4	6		12
	1		3	2	5		10
	2		4	3	5		12
	3		3	1	3		7
	4					1	1
	Column Total	1	11	10	19	1	42
		2.4	26.2	23.8	45.2	2.4	100.0

In order to study the stochastic behaviour of the H-alpha variability we compared columns 2-5 pairwise by computing the linear correlations between them. These correlations are summarized in Table 2. As one can infer from this table, columns H2 and H3 show a correlation at a high level of significance. To present the dependence between the different columns in more detail we present cross-tabulations of H1 to H2 in Tables 3a-c. Again, one can see that H2 and H3 reveal very strong tie but no dependence can be found between the other columns. We can explain this fact on the following way: H2 and H3 designate data on consecutive nights whereas the time differences between observations corresponding to the other columns are much greater. Therefore, it is natural to suppose that there is an average covariance length of a few days in the stochastic process representing the H-alpha variability of the sources. To set up this hypothesis on a more sound basis we need further observations, possibly on consecutive nights. As a byproduct of this work we might even get the functional form of the dependence of covariances on the time difference between the observations.

L.G. BALAZS  
Konkoly Observatory,  
Hungary

N.D. MELIKYAN  
Byurakan Astrophysical Observatory,  
USSR

S.Yu. MELNIKOV and V.S. SHEVCHENKO  
Tashkent Astronomical Institute, USSR

#### References:

- Herbig, G.H.: 1958, *Astrophys. J.*, 128, 259  
 Melikyan, N.D., Shevchenko, V.S., Melnikov, S.Yu.: 1987,  
 IBVS No. 3073  
 Merrill, P.W. and Burwell, C.G.: 1949, *Astrophys. J.*, 110, 387  
 Merrill, P.W. and Burwell, C.G.: 1950, *Astrophys. J.*, 112, 72  
 Tsvetkov, M.K.: 1975, *Astrofizika*, 11, 579  
 Tsvetkov, M.K., Tsvetkova, K.P.: 1978, IBVS No. 1447  
 Welin, G.: 1973, *Astron. and Astrophys.*, Suppl. Ser., 9, 183