

VV UMa (093156) GCVS elements: JD 2437348.9309 + 0.68736464E
 Revised elements: JD 2441080.690 + 0.6873664E

Establishing revised elements for this star is straightforward. Although the O-C is large (about one and one-half hours) the deviation from the GCVS period is very small. No change of period during the past six years is indicated. Projected backward, the revised elements do not converge with the GCVS initial epoch. During an earlier era a period appreciably longer than the current period may have been in effect.

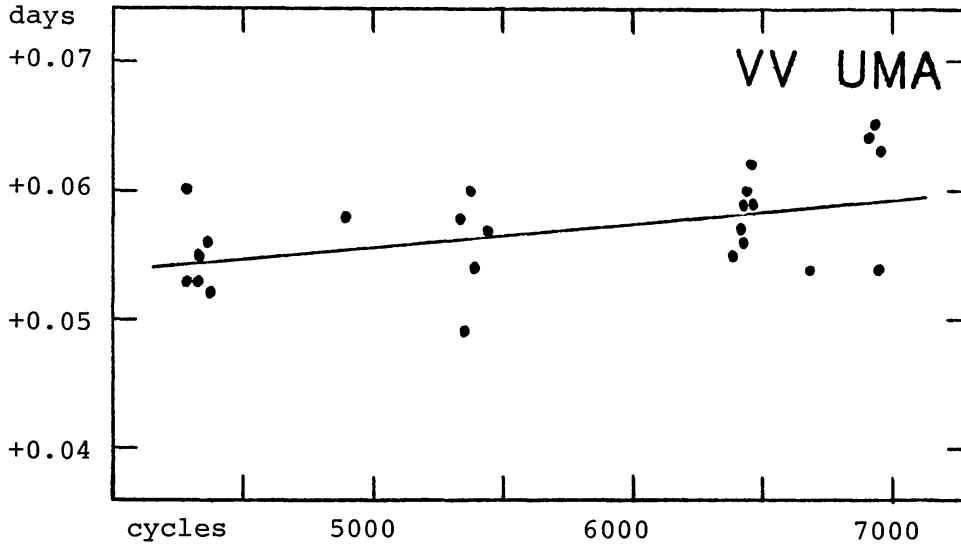


Figure 7. VV UMa, O-C Residuals.

REFERENCES

- Baldwin, M. 1973a, I.A.U. Information Bulletin on Variable Stars, No. 795.
 Baldwin, M. 1973b, JAAVSO, 2, 7.
 Diethelm, R., Germann, R., Locher, K., and Peter, H. 1972-1974, BBSAG Bulletin No. 1-14.
 Diethelm, R., and Locher, K. 1968-1972, Orion No. 104, 109, 112, 115, 116, 117, 118, 120, 121, 122, 123, 126, 127, and 128.
 Kukarkin, B. V., et al. 1969, General Catalog of Variable Stars, Moscow.
 _____, 1971, General Catalog of Variable Stars, First Supplement, Moscow.
 Robinson, L. 1965-1968, I.A.U. Information Bulletin on Variable Stars No. 111, 114, 119, 129, 154, 180, 221, and 247.
Sky and Telescope 1965, 29, 255.

The data collected were analyzed to determine the following relationships:

- 1) Frequency of observed group type (Table I, Fig. 2).
- 2) Frequency of solar flare activity associated with the various group types (Table II, Fig. 3).
- 3) Frequency of flares of importance 1, 2, and 3 associated with the various group types (Fig. 4).

My results (Fig. 3) show that no flares were recorded on "O" Sunspot days, when "A" or "G" groups were the only groups present, or during other times of "quiet" sun. I also found that more "B" groups occurred than "A", whereas Kopecký and Křivský found more "A" groups than "B" during their observational period (1956-1963, a period including spot maximum of cycle 19). It also appears from my observations that during times close to sunspot minimum few groups grow to become the giant "E" and "F" groups. Therefore too few of these were present to give a significant sample in regard to flare occurrence.

According to my observations "B" groups had the greatest probability of occurrence .286 (Table II), but only five flares occurred near these groups. Results also show that flares do occur near both active growing and active static groups, generally near the most complex spot groupings. (75% or 39 flares out of 52 were associated with active growing groups, while 25%, or 13 out of 52 flares were placed near static, but active groups).

Apparently, from the "D" group stage on, the probability of a flare occurring is considerably larger than in earlier stages of group development. It was found that active "H" groups were the greatest flare producers (prob. .385), at least during the period close to sunspot minimum under study. However, only 26 of these groups out of a total of 503 groups occurred during my observational period. One reason for the great number of "H" and "J" groups probably lies in the Waldmeier grouping system, as complex groups that are not bipolar are classified as "H" and "J" groups as are the large inactive groups that remain from decay processes in "D", "E", and "F" groups. This results in classifying both the most active and inactive groups the same. This in turn influences the joint probabilities computed in Table II.

Figure 4 shows that importance 1 (-1,1,+1), and 2 (-2,2,+2) flares were usually associated with active "H" or "D" groups while both importance 3 (-3) flares were associated with active "J" groups. This last association is probably misleading because the sample is small, and as mentioned previously few "E" and "F" groups were present during this time span.

After determining the simple probabilities of group occurrence and occurrence of flares within that group, one would have to conclude that the probabilities are so low (the joint probability of a "D" group plus flare is .037, Table II), that group type alone would not be sufficient data on which to base a flare prediction. This conclusion was also reached with even lower probabilities by Kopecký and Křivský for proton flares.

Since the project was done for only a short period of time and towards the minimum part of the solar activity cycle, all of the results are probably not the same as they would be if the data were taken for the full solar cycle, or over a 6-8 year period centered on spot maximum. The results of Kopecký and Křivský were taken from this latter type of time period. Also, the number of cloudy days (43 out of a total of 213

observational days) could alter the results by a small amount. However, this could not have altered the results significantly because the probabilities are already so low that only major changes could alter them by a significant amount. In cases where only one cloudy day elapsed, groups were extrapolated from adjacent days. In actuality, very few consecutive cloudy days were present during my observational period.

Since my observations were made visually, some errors have undoubtedly been introduced in determination of group type. However, I do not believe this should alter the general results in a meaningful way, for the same reasons stated above.

REFERENCES

- Kopecký, M. and Křivský, L. 1966, Bulletin of the Astronomical Institutes of Czechoslovakia, 17, 360
 Křivský, L. 1972, Solar Activity Observations and Predictions, Ed: MacIntosh, P. and Dryer, M., The Massachusetts Institute of Technology: Alpine Press Inc., 389.
Solar Bulletin. American Association of Variable Star Observers - Solar Division.
Waldmeier Sunspot Grouping, partial reprint of paper by M. Waldmeier, through correspondence with Casper Hossfield, Chairman of the Solar Division of the AAVSO.

Table I

Frequency of Observed Solar Groups
 1 June 1973 - 31 December 1973

class	frequency	percent of total	cumulative frequency
A	73	14.51	73
B	144	28.63	217
C	52	10.34	269
D	64	12.72	333
E	12	2.39	345
F	3	.59	348
G	2	.40	350
H	26	5.17	376
J	127	25.25	503
	503	100.00	

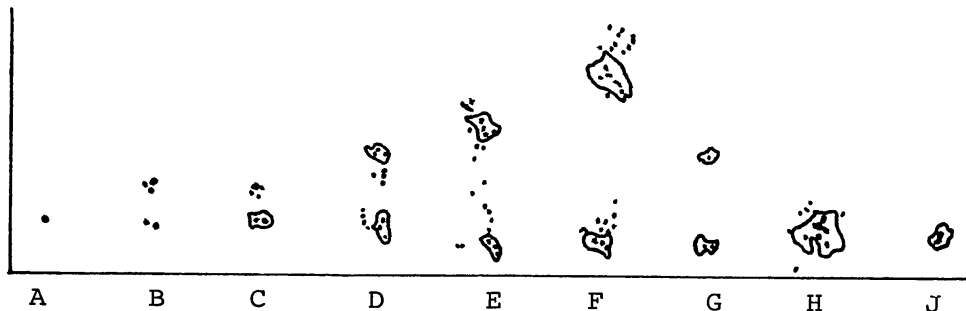


Figure 1. The Waldmeier (Zurich) Grouping System

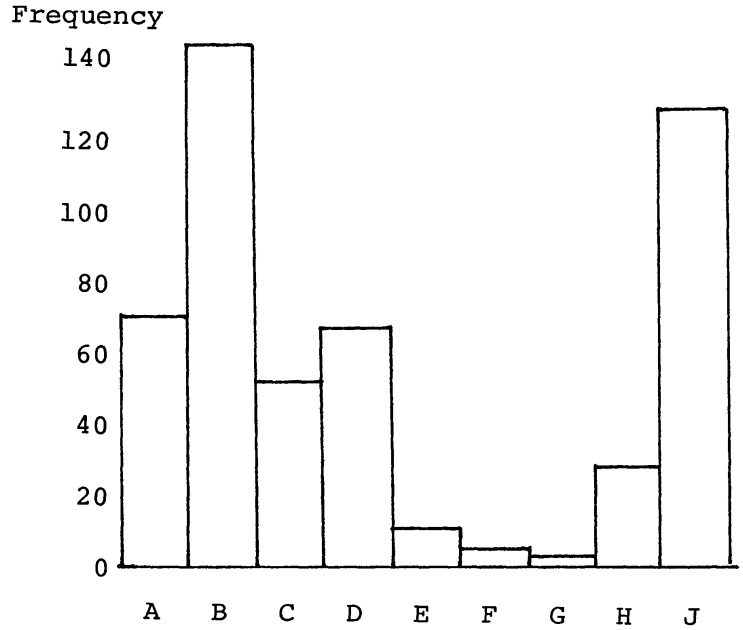


Figure 2. Histogram frequency of various Waldmeier group types.

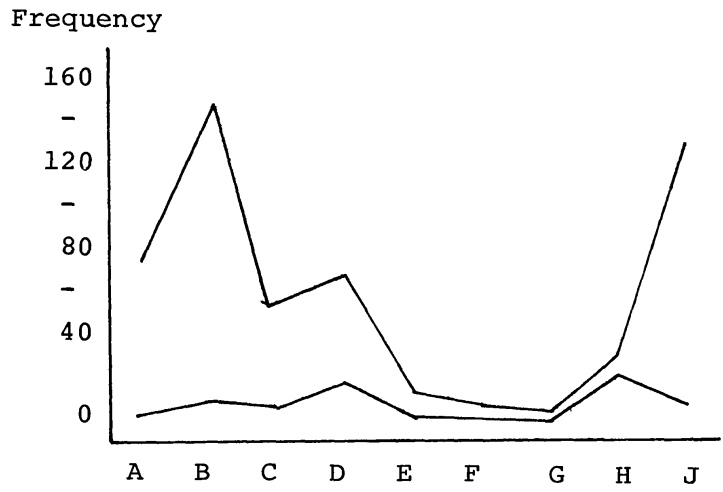


Figure 3. Solar flare activity by group type.

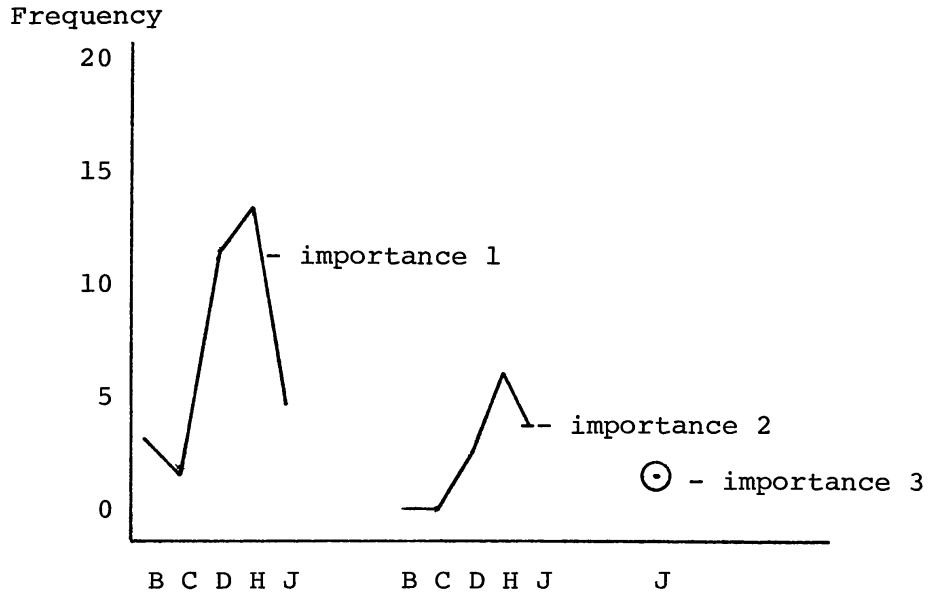


Figure 4. Flare importance versus group type.

Table II, Probabilities
Individual and Joint Occurrence
Solar Events (1 June - 31 December)

observed group occurrence type	observed flare occurrence	probability of joint occurrence
A- 73/503 (.145) x	0/52 (0) =	0
B-144/503 (.286) x	5/52 (.096) =	.027
C- 52/503 (.103) x	4/52 (.077) =	.008
D- 64/503 (.127) x	15/52 (.288) =	.037
E- 12/503 (.024) x	0/52 (0) =	0
F- 3/503 (.006) x	0/52 (0) =	0
G- 2/503 (.004) x	0/52 (0) =	0
H- 26/503 (.052) x	20/52 (.385) =	.020
J-127/503 (.252) x	8/52 (.154) =	.039
Total groups: 503		
Total flares: 52		
Total days: 210		