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PHOTOELECTRIC OBSERVATIONS AND ANALYSIS OF VARIABILITY OF THE β CEPHEI-TYPE STAR KP PERSEI

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RESUMEN

Se presentan observaciones fotoeléctricas de la estrella variable tipo β Cephei, KP Persei, hechas en 1977 y 1978 en los observatorios astronómicos de Zacatecas y de San Pedro Mártir. La fotometría se efectuó en el sistema *B* (algunas noches en *UB* o *UBV*).

Se ha hecho un análisis de frecuencia. Los resultados indican la existencia de tres componentes con los períodos $P_1 = 0^{d}.201779$, $P_2 = 0^{d}.198085$, y $P_3 = 0^{d}.227099$.

ABSTRACT

Photoelectric observations of the β Cephei-type variable, KP Persei, made in 1977 and 1978 in Zacatecas and San Pedro Mártir are presented. The photometry was performed mainly in the *B* system and some nights also in the *UB* or *UBV*.

A frequency analysis of the blue photometry was carried out. Three sine-wave components with periods $P_1 = 0^{d}.201779$, $P_2 = 0^{d}.198085$, and $P_3 = 0^{d}.227099$ were found.

Key words: PHOTOMETRY – STARS-PULSATION – STARS-VARIABLES.

I. INTRODUCTION

KP Persei = HR 1072 = HD 21803 ($V = 6^{m}.40$, B2 IV) belongs to the group of β Cephei-type variables. Its variations in luminosity were discovered two decades ago by Lynds (1959), who found a period of $0^{d}.20 = 4^{h}\ 48^{m}$. Spectroscopic observations by Struve and Zebergs (1959) revealed velocity variations with the same period.

Photometric measurements of KP Persei were subsequently made by Magalashvili and Kumsishvili (1962) and by Rossati (1963, 1967). The latter author considers the star to be a W UMa variable and describes its light variability as having a period of $0^{d}.4038$. However, since the radial velocity period amounts to about half this value, Rossati's interpretation is open to doubt.

Further observational data on the light variations of KP Persei were provided by Klock (1965) and by Joshi (1966). In 1964 and 1965 the star was investigated by Jerzykiewicz (1971).

In the present paper new photometric measurements

TABLE 1

JOURNAL OF OBSERVATIONS

	JD$_\odot$	$-\Delta m$
	2443494+	
B	^{d}.5868	0^{m}.962
	.5952	0.968
	.6038	0.966
	.6112	0.965
	.6208	0.968
	.6292	0.982
	.6390	0.997
	.6465	1.016
	.6549	1.023
	.6618	1.022
	.6698	1.043
	.6764	1.046
	.6850	1.054
	.6958	1.061
	.7067	1.057
	.7125	1.059
	.7215	1.042
	.7282	1.026
	.7368	1.010
	.7475	0.982
	.7580	0.987
	.7657	0.976
	.7740	0.968
	.7803	0.952
	.7890	0.944
	.7965	0.951
	.8052	0.936
	.8128	0.963
	.8200	0.973
	.8285	0.970
	.8368	1.003
	.8438	1.007
	.8514	1.014
	2443495+	
B	^{d}.5701	0^{m}.960
	.5771	0.955
	.5875	0.943
	.5990	0.955
	.6083	0.951
	.6170	0.953
	.6253	0.956
	.6326	0.957
	.6475	0.975
	.6545	0.983
	.6695	1.015
	.6778	1.023
	.6895	1.030
	.7007	1.036
	.7100	1.017
	.7215	1.020
	.7372	1.008
	.7455	0.975
	.7524	0.998
	.7625	0.985
	.7730	0.954
	.7819	0.956
	.7896	0.950
	.7967	0.954
	.8045	0.956
	.8125	0.960
	.8215	0.946
	.8278	0.942
	2443496+	
U	^{d}.5593	1^{m}.061
	.5768	1.043
	.5931	1.042
	.6100	1.047
	.6260	1.063
	.6427	1.075
	.6576	1.102
	.6810	1.141
	.6961	1.159
	.7108	1.172
	.7282	1.140
	.7600	1.080
	.7740	1.056
	.7907	1.038
	.8025	1.045
B	^{d}.5650	0^{m}.956
	.5820	0.959
	.5980	0.962
	.6146	0.969
	.6317	0.995
	.6468	0.996
	.6628	1.021
	.6858	1.032
	.7003	1.054
	.7150	1.059
	.7322	1.029
	.7503	0.997
	.7646	0.964
	.7795	0.950
	.7941	0.947
	.8060	0.949
V	^{d}.5718	0^{m}.718
	.5865	0.703
	.6025	0.704
	.6185	0.713
	.6368	0.733
	.6514	0.745
	.6700	0.757
	.6906	0.786
	.7052	0.793
	.7219	0.789
	^{d}.7545	0^{m}.724
	.7691	0.727
	.7843	0.693
	.7982	0.693
	.8097	0.687
	2443498+	
B	^{d}.5753	0^{m}.992
	.5892	0.971
	.6100	0.964
	.6247	0.973
	.6385	0.984
	.6593	0.999
	2443504+	
U	^{d}.5486	1^{m}.086
	.5593	1.125
	.5683	1.141
	.5768	1.128
	.5802	1.170
	.5933	1.184
	.5975	1.191
	.6180	1.166
	.6218	1.154
	.6475	1.091
	.6545	1.080
	.6670	1.052
	.6733	1.045
	.6920	1.020
	.6955	1.030
	.7114	1.035
	.7150	1.058
	.7448	1.085
	.7483	1.102
	.7608	1.122
	.7642	1.134
	.7768	1.156
	.7802	1.152
	.7955	1.184
	.7990	1.175
	.8132	1.169
	.8168	1.159
B	^{d}.5545	0^{m}.998
	.5640	1.035
	.5712	1.038
	.5844	1.048
	.5885	1.060
	.6080	1.051
	.6122	1.065
	.6393	1.006
	.6426	1.000
	.6580	1.005
	.6622	0.956
	.6822	0.946
	.6857	0.958
	.7010	0.951
	.7045	0.965
	.7201	0.977
	.7236	0.972
	.7325	0.995
	.7558	1.010
	.7688	1.030
	.7725	1.042
	.7858	1.047
	.7892	1.065
	.8038	1.074
	.8087	1.069
	.8230	1.028
	.8268	1.015
	2443505+	
U	^{d}.5470	1^{m}.109
	.5622	1.126
	.5747	1.145
	.5864	1.167
	.5969	1.164
	.6080	1.161
	.6212	1.128
	.6337	1.113
	.6462	1.079
	.6614	1.058
	.6760	1.030
	.6879	1.046
	.6983	1.036
	.7128	1.050
	.7240	1.066
	.7358	1.086
	.7490	1.110
	.7629	1.130
	.7771	1.166
	.7928	1.169
	.8045	1.177
B	^{d}.5539	1^{m}.052
	.5657	1.038
	.5788	1.046
	.5905	1.042
	.6003	1.078
	.6115	1.061
	.6247	1.035
	.6378	0.990
	.6496	0.991
	.6650	0.978
	.6795	0.956
	.6913	0.950
	.7018	0.948
	.7163	0.975
	.7275	0.981
	^{d}.7392	0^{m}.997
	.7531	1.010
	.7670	1.025
	.7810	1.044
	.7962	1.056
V	^{d}.5580	0^{m}.775
	.5698	0.792
	.5822	0.786
	.5935	0.796
	.6039	0.787
	.6170	0.782
	.6295	0.752
	.6407	0.740
	.6531	0.724
	.6711	0.701
	.6830	0.694
	.6941	0.715
	.7060	0.710
	.7200	0.721
	.7316	0.731
	.7435	0.740
	.7580	0.769
	.7718	0.790
	.7885	0.812
	.8004	0.801
	.8128	0.793
	2443507+	
U	^{d}.5486	1^{m}.117
	.5542	1.116
	.5702	1.146
	.6192	1.163
	.6350	1.127
	.6386	1.134
	.6518	1.088
	.6550	1.094
	.6704	1.055
	.6740	1.058
	.6913	1.067
	.7065	1.052
	.7197	1.060
	.7227	1.065
	.7375	1.084
	.7407	1.089
	.7572	1.131
	.7608	1.134
	.7736	1.140
	.7857	1.176
	.7982	1.170
	.8017	1.164
B	^{d}.5590	1^{m}.025
	.5646	1.041
	.6247	1.044
	.6300	1.046
	.6433	1.012
	.6468	1.014
	.6615	1.006
	.6657	0.977
	.6808	0.946
	.6854	0.952
	.7115	0.961
	.7149	0.974
	.7268	0.999
	.7312	0.986
	.7462	1.012
	.7500	1.003
	.7657	1.034
	.7690	1.021
	.7906	1.038
	.7948	1.044
	.8072	1.049
	2443511+	
B	^{d}.5800	0^{m}.955
	.5915	0.978
	.6032	0.991
	.6145	1.000
	.6252	1.019
	.6387	1.034
	.6495	1.028
	.6600	1.036
	.6700	1.040
	.6805	1.031
	.6904	1.045
	.7040	1.053
	.7170	1.019
	.7280	1.020
	.7395	1.013
	.7515	1.008
	.7630	0.985
	.7708	0.990
	2443512+	
B	^{d}.5656	0^{m}.964
	.5793	0.970
	.5920	0.968
	.6075	0.971
	.6195	0.990
	.6310	1.000
	.6435	1.006
	.6570	1.004
	.6680	1.032
	.6790	1.036
	.6900	1.008
	.7040	1.018
	.7336	1.010
	.7420	0.988
	2443514+	
U	^{d}.5556	1^{m}.053
	.5604	1.041
	.5750	1.039
	.5778	1.045
	.5910	1.043
	.5951	1.045
	.6153	1.076
	.6194	1.063
	.6326	1.086
	.6354	1.101
	.6549	1.147
	.6576	1.142
	.6757	1.172
	.6792	1.183
	.6910	1.187
	.6944	1.178
	.7174	1.158
	.7208	1.147
	.7361	1.086
	.7389	1.072
B	^{d}.5660	0^{m}.970
	.5694	0.952
	.5826	0.944
	.5861	0.952
	.6000	0.945
	.6042	0.943
	.6243	0.970
	.6278	0.996
	.6410	1.000
	.6451	0.997
	.6667	1.036
	.6701	1.050
	.6826	1.062
	.6861	1.059
	.7042	1.042
	.7076	1.038
	.7257	1.008
	.7299	0.981
	.7479	0.992
	.7515	0.982
	2443517+	
U	^{d}.5507	1^{m}.103
	.5535	1.113
	.5674	1.077
	.5694	1.070
	.5875	1.049
	.5903	1.051
	.6042	1.041
	.6069	1.043
	.6239	1.057
	.6264	1.073
	.6403	1.099
	.6438	1.106
	.6597	1.126
	.6625	1.130
	.6792	1.163
	.6819	1.166
	.6986	1.177
	.7014	1.174
	.7139	1.147
	.7167	1.142
	.7319	1.121
	.7347	1.118
	.7514	1.096
	.7542	1.076
	.7688	1.072
	.7715	1.067
B	^{d}.5583	0^{m}.985
	.5611	0.991
	.5757	0.977
	.5792	0.954
	.5951	0.953
	.5979	0.955
	.6111	0.953
	.6146	0.964
	.6313	0.972
	.6347	0.983
	.6493	0.997
	.6521	1.003
	.6667	1.043
	.6694	1.042
	.6882	1.063
	.6917	1.062
	.7056	1.049
	.7083	1.043
	.7222	1.018
	.7257	1.031
	.7417	0.999
	.7451	1.000
	.7604	0.982
	.7632	0.980
	.7757	0.992
	.7785	0.990
	2443527+	
U	^{d}.5688	1^{m}.177
	.5722	1.182
	.5840	1.202
	.5875	1.197
	.5979	1.194
	.6007	1.202
	.6111	1.154
	.6139	1.165
	.6250	1.122
	.6278	1.142
	^{d}.6438	1^{m}.077
	.6465	1.082
	.6563	1.045
	.6590	1.052
	.6715	1.029
	.6743	1.036
	.6861	1.019
	.6896	1.021
	.7063	1.050
	.7097	1.066
	.7243	1.090
	.7285	1.102
B	^{d}.5799	1^{m}.070
	.5910	1.055
	.5944	1.058
	.6042	1.058
	.6069	1.040
	.6188	1.028
	.6215	1.030
	.6319	0.994
	.6347	1.013
	.6500	0.958
	.6528	0.945
	.6632	0.961
	.6660	0.947
	.6778	0.955
	.6813	0.945
	.6944	0.945
	.6986	0.948
	.7160	0.999
	.7194	0.976
	.7347	1.010
	.7375	1.040
	2443528+	
U	^{d}.5815	1^{m}.155
	.5850	1.169
	.5958	1.143
	.6009	1.162
	.6155	1.149
	.6190	1.138
	.6315	1.112
	.6357	1.115
	.6503	1.077
	.6551	1.069
	.6697	1.086
	.6732	1.073
	.6871	1.058
	.6926	1.064
	.7079	1.064
	.7128	1.061
B	^{d}.5878	1^{m}.044
	.5919	1.041
	.6051	1.014
	.6100	1.049
	.6290	1.035
	.6447	1.002
	.6614	1.012
	.6648	0.997
	.6800	0.959
	.6968	0.979
	.7023	0.960
	.7176	0.961
	.7225	0.997
	2443530+	
U	^{d}.5944	1^{m}.121
	.6097	1.118
	.6326	1.118
	.6493	1.107
	.6646	1.096
	.6812	1.079
	.7028	1.084
	.7201	1.090
	.7375	1.103
	.7549	1.113
	.7722	1.119
	.7868	1.125
B	^{d}.6028	0^{m}.997
	.6201	0.987
	.6417	0.978
	.6576	0.967
	.6736	0.973
	.6896	0.961
	.7118	0.961
	.7292	0.968
	.7458	0.983
	.7653	0.990
	.7805	0.999
	.7958	0.994
	2443531+	
U	^{d}.5646	1^{m}.108
	.5674	1.133
	.5819	1.111
	.5972	1.112
	.6063	1.144
	.6160	1.115
	.6188	1.118
	.6319	1.132
	.6347	1.109
	.6465	1.133
	.6493	1.128
	.6611	1.144
	.6639	1.142
	.6780	1.107
	^{d}.6938	1^{m}.107
	.6965	1.120
	.7090	1.104
	.7125	1.122
	.7250	1.075
	.7285	1.079
	.7382	1.092
	.7424	1.094
B	^{d}.5917	1^{m}.011
	.6104	1.042
	.6368	1.046
	.6410	1.037
	.6514	1.028
	.6542	1.006
	.6660	1.016
	.6694	1.039
	.6833	1.031
	.6868	0.988
	.7000	0.986
	.7153	0.990
	.7194	1.020
	.7460	1.002
	.7525	1.004
	2443532+	
B	^{d}.5882	0^{m}.966
	.5986	0.975
	.6055	0.971
	.6125	0.983
	.6180	0.983
	.6257	0.986
	.6458	0.993
	.6528	0.998
	.6597	1.003
	.6687	0.993
	.6743	0.997
	.6819	0.992
	.6868	0.991
	.6930	0.988
	.7021	0.978
	.7160	0.973
	.7222	0.972
	.7292	0.966
	.7347	0.963
	.7424	0.965
	.7480	0.970
	.7555	0.971
	.7687	0.969
	.7785	0.971
	.7840	0.974
	.7917	0.985
	.7980	0.977
	.8042	0.977
	2443533+	
B	^{d}.6076	0^{m}.947
	.6132	0.971
	.6180	0.970
	.6319	0.983
	.6361	1.000
	.6424	1.007
	.6458	1.001
	.6521	1.006
	.6555	1.012
	.6764	1.017
	.6805	1.019
	.6861	1.013
	.6910	1.012
	.7028	1.007
	.7062	1.013
	.7111	0.995
	.7167	0.996
	.7222	0.987
	.7312	0.969
	.7361	0.961
	.7410	0.962
	.7458	0.953
	.7535	0.946
	.7576	0.944
	.7674	0.941
	.7715	0.941
	.7771	0.940
	.7847	0.941
	.7917	0.942
	2443538+	
U	^{d}.5625	1^{m}.011
	.5660	1.015
	.5785	1.045
	.5813	1.038
	.5938	1.043
	.6056	1.068
	.6076	1.076
	.6188	1.098
	.6215	1.108
	.6333	1.147
	.6354	1.140
	.6493	1.157
	.6528	1.166
	.6674	1.170
	.6708	1.178
	.6826	1.188
	.6924	1.183
	.7021	1.164
	.7174	1.132
	.7215	1.124
B	^{d}.5701	0^{m}.950
	.5736	0.941
	.5854	0.954
	.5889	0.967
	.5993	0.974
	.6021	0.980
	.6118	0.980
	.6146	0.968
	.6250	0.997
	.6285	0.990
	.6396	1.014
	.6438	1.020
	.6583	1.052
	.6625	1.042
	.6750	1.054
	.6785	1.053
	.6927	1.060
	.7083	1.041
	.7118	1.018
	.7271	0.985
	2443540+	
B	^{d}.5951	0^{m}.942
	.6035	0.944
	.6070	0.945
	.6140	0.954
	.6180	0.953
	.6278	0.963
	.6326	0.966
	.6382	0.967
	.6455	0.977
	.6514	0.982
	.6570	0.987
	.6632	0.989
	.6680	0.993
	.6715	1.000
	.6770	1.001
	.6861	1.003
	.6910	1.006
	.6944	1.008
	.7000	1.005
	.7097	1.003
	.7167	1.001
	.7208	0.995
	.7257	0.990
	.7292	0.987
	.7347	0.981
	.7390	0.978
	.7460	0.975
	.7528	0.966
	.7570	0.958
	.7640	0.960
	.7674	0.952
	.7743	0.945
	.7777	0.943
	2443548+	
B	^{d}.5625	1^{m}.054
	.5690	1.052
	.5733	1.065
	.5780	1.070
	.5830	1.066
	.5885	1.055
	.5925	1.059
	.5980	[illegible]
	.6025	[illegible]
	.6075	1.026
	.6125	1.024
	.6180	1.033
	.6255	1.005
	.6320	0.987
	.6405	0.981
	.6455	0.985
	.6505	0.974
	.6566	0.976
	.6650	0.968
	.6705	0.964
	.6765	0.949
	.6830	0.971
	.6878	0.978
	.6945	0.978
	2443549+	
B	^{d}.5590	1^{m}.040
	.5632	1.047
	.5685	1.056
	.5736	1.066
	.5785	1.059
	.5826	1.073
	.5875	1.048
	.5930	1.070
	.5986	1.050
	.6045	1.034
	.6098	1.020
	.6145	1.021
	.6198	1.007
	.6253	0.985
	.6313	0.987
	.6370	0.975
	.6430	0.972
	.6517	0.962
	.6590	0.948
	.6660	0.942
	.6736	0.939
	.6800	0.941
	.6870	0.940
	.6910	0.936
	.6955	0.947
	2443550+	
B	^{d}.5653	1^{m}.036
	.5708	1.033
	.5758	1.037
	.5805	1.032
	.5860	1.024
	.5920	1.026
	.5980	1.038
	.6066	1.022
	.6120	1.016
	.6167	1.009
	.6222	0.988
	.6276	0.992
	.6326	0.976
	.6440	0.975
	.6494	0.977
	.6552	0.963
	.6604	0.954
	.6667	0.953
	.6736	0.948
	.6790	0.950
	.6850	0.964
	.6900	0.970
	.6931	0.985
	2443552+	
B	^{d}.5605	1^{m}.019
	.5667	1.020
	.5737	1.027
	.5785	1.026
	.5840	1.031
	.5885	1.033
	.5986	1.025
	.6020	1.029
	.6100	1.028
	.6150	1.016
	.6220	1.004
	.6270	0.995
	.6326	0.999
	.6375	0.988
	.6426	0.983
	.6470	0.978
	.6518	0.977
	.6585	0.978
	.6640	0.983
	.6700	0.978
	.6757	0.969
	.6830	0.978
	.6868	0.982
	2443553+	
B	^{d}.5620	0^{m}.997
	.5686	1.003
	.5764	0.986
	.5870	1.001
	.5940	1.002
	.5993	0.998
	.6050	1.008
	.6104	1.003
	.6177	1.016
	.6250	1.012
	.6315	1.006
	.6403	1.014
	.6462	1.017
	.6530	1.013
	.6621	1.017
	.6690	1.016
	.6756	1.009
	.6812	0.997
	.6870	1.003
	.6926	1.004
	2443862+	
U	^{d}.6618	1^{m}.026
	.6674	1.039
	.6861	1.117
	.6896	1.098
	.7014	1.130
	.7042	1.156
	.7146	1.174
	.7194	1.178
	.7306	1.179
	.7333	1.186
	.7458	1.191
	.7486	1.201
	.7632	1.172
	.7653	1.178
	.7792	1.134
	.7840	1.113
	.7986	1.059
	.8021	1.072
B	^{d}.6729	1^{m}.006
	.6806	0.988
	.6931	1.028
	.6958	1.046
	.7083	1.063
	.7229	1.077
	.7375	1.058
	.7417	1.043
	.7542	1.069
	.7569	1.073
	.7694	1.041
	.7750	1.014
	.7920	0.993
	.8076	1.001
	.8111	0.961

are provided and an analysis of the light variability is carried out.

II. OBSERVATIONS

The star was investigated on 25 nights (24 nights between 1977 December 17 and 1978 February 14, and on one night in December 1978). Most of the observations (21 nights) were secured in the astronomical observatory at Cerro de la Virgen in Zacatecas (Universidad Nacional Autónoma de México and Universidad Autónoma de Zacatecas). On four nights the observations were made in the Observatorio Astronómico Nacional in San Pedro Mártir, Baja California Norte (UNAM).

The Zacatecas equipment consisted of a 50-cm telescope, at the Cassegrain focus of which a "Pacific" digital photometer was attached. An unrefrigerated IP21 photomultiplier tube was used as the light receiving unit. At the Observatorio Astronómico Nacional the observations were made with a 84-cm telescope, equipped with a conventional photometer containing a IP21 tube, refrigerated with dry ice.

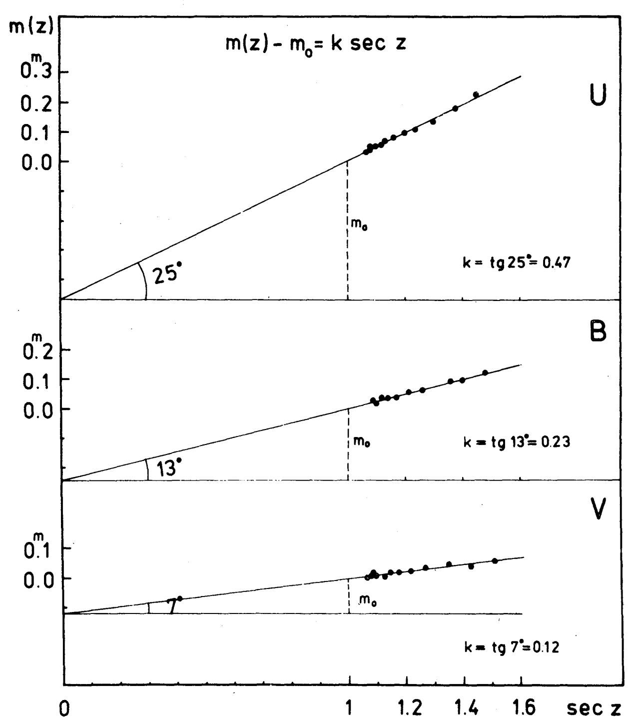

Fig. 1. The determination of the atmospheric extinction coefficient, k, in *U, B* and *V* for Zacatecas on 1977 December 28. The Bouguer method was applied. It consists in observing a star at different zenith distances. The current observations of the comparison star were used. The values m(z), plotted as a function of sec z, are magnitudes of the star expressed in relation to their extreme values at culmination (the scale is shifted in order to have m(0) = 0). The vertical segments, shown in dashed lines, represent (in this system) the magnitudes outside the atmosphere, m_0.

The observations were made with standard *UBV* filters. On thirteen nights the measurements were performed with the *B* filter only, on ten nights with *U* and *B*, and on two nights with all three filters.

The atmospheric extinction coefficient was determined on several nights. The values of this coefficient –similar for Zacatecas and San Pedro Mártir– were of the order of 0.5, 0.25, and 0.1 magnitude per air mass in *U*, *B*, and *V*, respectively. An example of the determination of extinction is shown in Figure 1.

Two comparison stars were observed: HD 21448 ($V = 7^m\!.15$, B3), and HD 21455=HR 1047 ($V = 6^m\!.24$, B5 V). On six nights, viz. on JD 2443000 + 496, + 498, + 504, + 505, + 507, and +862, only the first one was observed. On the remaining 19 nights the observations were made with both comparison stars. There was very good agreement between results obtained on any given night with either one of the comparison stars. Therefore, we concluded that these two objects are constant in light, and that the observational material collected on the six nights when only one comparison star was utilized is of the same quality as the material secured on the remaining nights, when the two comparison stars were used.

We obtained about 1800 magnitude differences "variable *minus* comparison". All observations were next reduced to the first comparison star, and mean values of two or four successive magnitude differences were taken. Consequently, each of the 807 data points, listed in Table 1 as Δm, represents a mean magnitude difference in the sense "KP Per *minus* HD 21448". These data are plotted as a function of heliocentric Julian Day in Figure 2.

III. THE LIGHT VARIATIONS

From the inspection of the light-curves one can see that in the ultraviolet the amplitudes are markedly larger than in the blue. There is, however, no distinct difference between the amplitudes in the blue and the visible. On an average, the *U* light ranges are nearly 30% larger than the *B* ranges. The *B*/*V* amplitude ratio amounts to about 1.05.

The *U*, *B*, and *V* times of light maxima (minima) coincide. On some nights, however, there is evidence for the *U* extremes to occur before the corresponding *B* extremes. Similar slight differences (of the order of

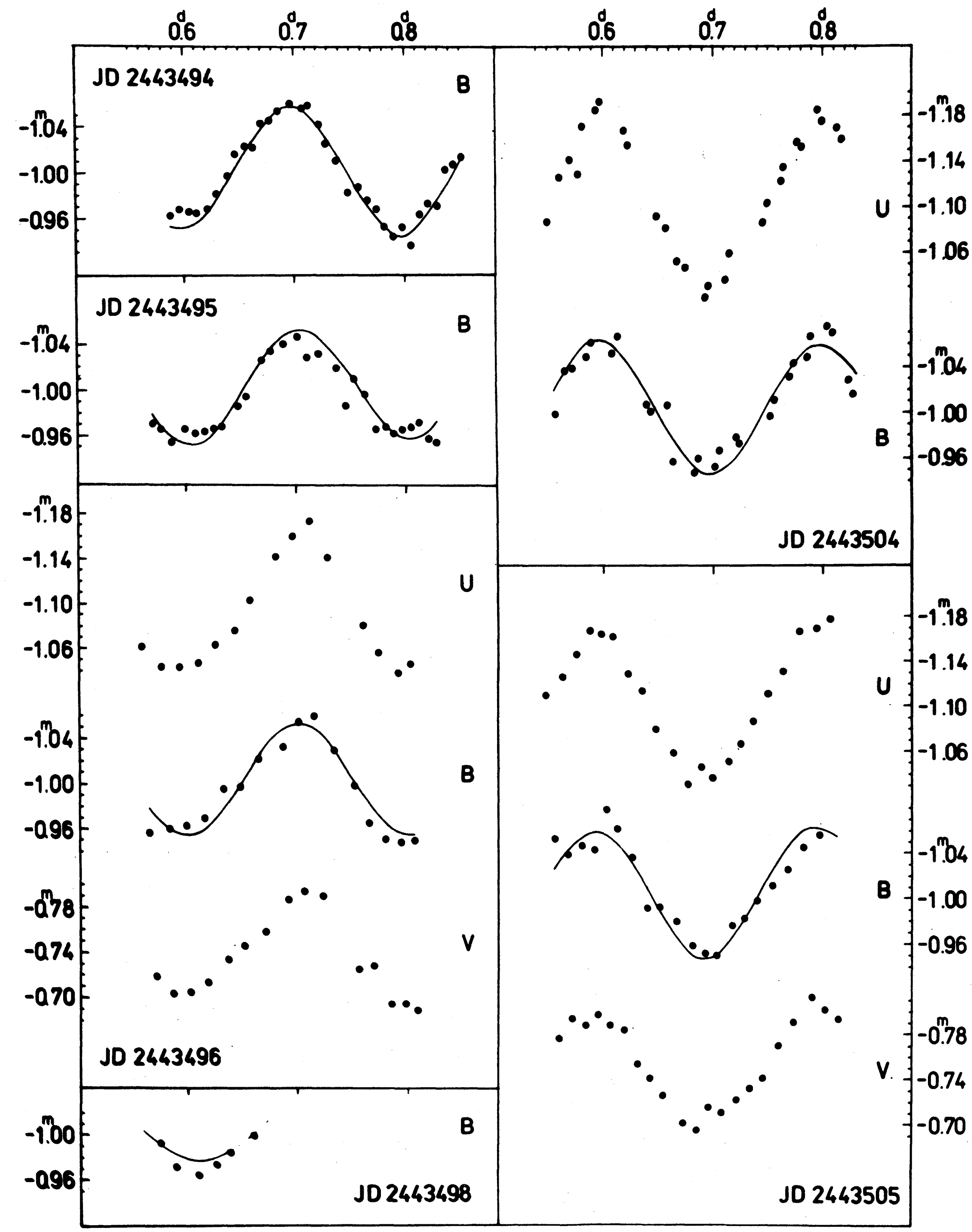

Fig. 2*a*. The *UVB, UB,* and *B* light-curves of KP Persei. Solid lines are segments of the three-component synthetic light-curve, the parameters of which are listed in Table 2. For JD 2443862 the synthetic light-curve was derived as described in the text.

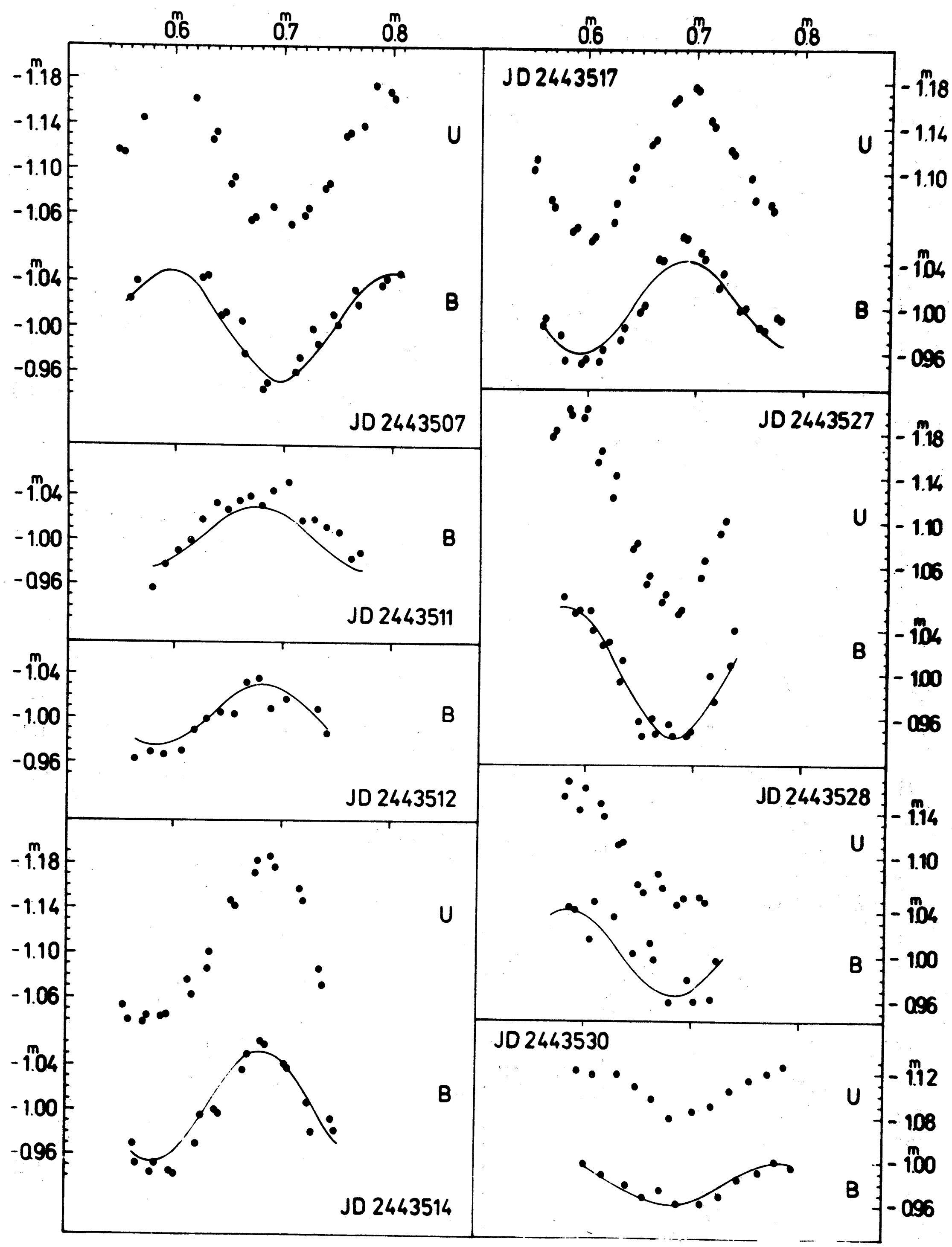

Fig. 2*b*. Same as Figure 2*a*.

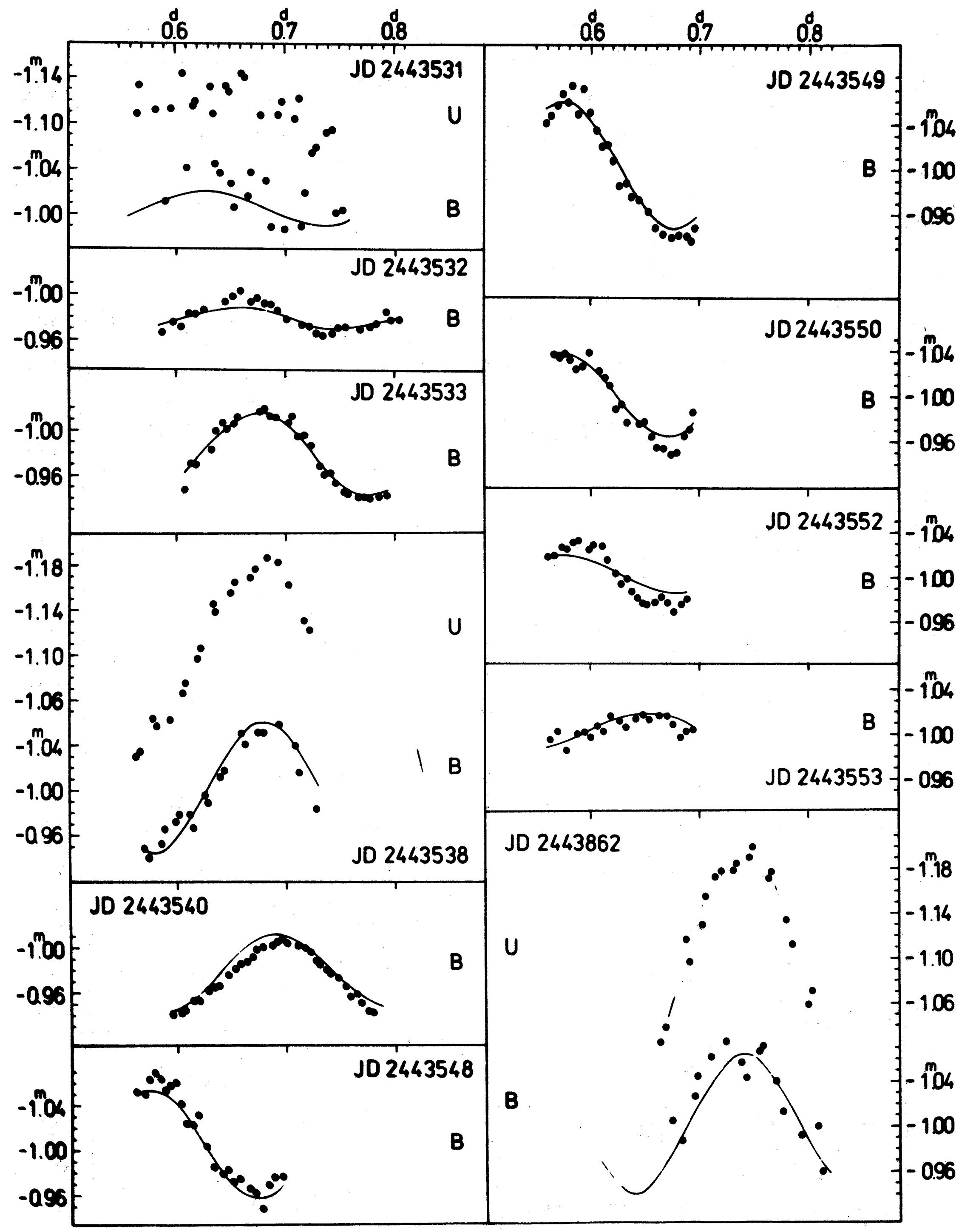

Fig. 2c. Same as Figure 2a.

two minutes) between the *U* and *B* maxima have been reported earlier by Jerzykiewicz (1971).

There are considerable changes in the amplitudes of the light variation (notice, e.g., the progressive decrease of the amplitude from JD 2443549 to 2443553). The extreme *B* light ranges amount to 0.12 and 0.03. In Fig. 3 the light ranges are plotted against the Julian Day. The plot suggests a cyclic variation with a period of 10.83 days. This value agrees with the $10^{d}.85$ beat-period found by Jerzykiewicz (1971), and with the 11-day cycle suggested by Klock (1965). Our observations, however, cannot be represented by the 17-day beat-period reported by Joshi (1966).

The primary period in the light variation of KP Persei can be estimated from the observed epochs of maximum light. There is a distinct maximum on JD 2443862.734, and ten well marked maxima, occurring about one year earlier on JD 2443000 + 494.696, + 495.700, + 496.706, + 504.598, + 514.686, + 517.690, + 538.679, + 548.580, + 549.582, and + 552.590. From these data we derive the primary period $P_1 = 0^{d}.201775 \pm 0^{d}.000005$. This value agrees to within one standard deviation with that of $0^{d}.20175 \pm 0^{d}.00003$, as obtained by Jerzykiewicz (1971).

The secondary period cannot be derived unambiguously from P_1 and the above-mentioned beat-period of $10^{d}.83$. We get either $P_2 = 0^{d}.198084$ or $P_2 = 0^{d}.205606$. The question of which of these two possibilities is the case will be answered in the next section.

An inspection of the data reveals that a satisfactory representation of the light variability of KP Persei requires more than two sine-wave components. This can be seen from Figure 3.

If the light variation of the star were due to a simple beat-phenomenon, the light ranges would show strict periodicity, and the scatter in the figure would have to be much less than actually observed. Multiperiodicity is also evident from the sequence of the light-curves in Figure 2 between JD 2443549 and 2443553. On the first three nights the light maxima fall about $n \times 0^{d}.2$ apart (where n is a whole number), as would be expected from the value of P_1 and the fact that the beat-period is rather long. However, on JD 2443553 the epoch of the light maximum deviates by about $0^{d}.07$ from this description.

IV. FREQUENCY ANALYSIS

It has been recently found by Jerzykiewicz and Mysior (1980) that at least three sine-wave components are present in the light variation of KP Persei. From a frequency analysis of Jerzykiewicz's 1964 and 1965 blue-colour observations they determined the following values of the primary, secondary, and tertiary periods: $P_1 = 0^{d}.20177$, $P_2 = 0^{d}.19808$, and $P_3 = 0^{d}.22711$. Similar values of the periods were also obtained by these authors from a combination of 1963 and 1964 observations of Klock (1965) and Rossati (1967).

The analysis of the present observational material was based on the *B* magnitude photometry listed in Table 1. It has been restricted to the observational season of 1977/78, spanning an interval of 59 days. The separate night of JD 2443862 was omitted; we also rejected the observations of JD 2443498, 2443528, and 2443531 because of the low quality of the data. Thus the material of 21 nights, comprising 481 data-points, was left for analysis.

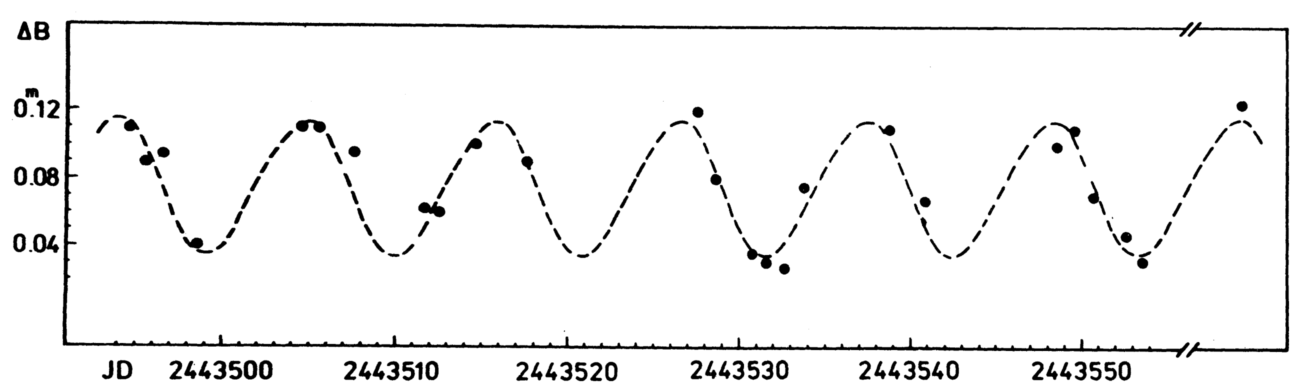

Fig. 3. The *B* light ranges of KP Persei, plotted as a function of date. The dashed curve corresponds to a period of 10.83 days. The last point represents the observation at JD 2443862, reduced with this period.

TABLE 2

THE PARAMETERS OF THE SYNTHETIC LIGHT-CURVE OF KP PERSEI IN THE BLUE LIGHT

i	f_i (c/d)	P_i	A_i	ϕ_i (rad)
1	4.9559	$0^d.20178$	$0^m.0323$	0.115
			± .0007	±.023
2	5.0492	0.19805	0.0235	−0.102
			± .0007	±.031
3	4.4043	0.22705	0.0072	4.34
			± .0007	±.10

A_o (Zacatecas) $= -1^m.0029 \pm 0^m.0005$
A_o (San Pedro Mártir) $= -0^m.9788 \pm 0^m.0005$
$T = 2443000^d.0$
Standard deviation $= 0^m.0011$

Our analysis confirmed the above-mentioned results of Jerzykiewicz and Mysior. We obtained the following values for the periods: $P_1 = 0^d.20178$, $P_2 = 0^d.19805$, $P_3 = 0^d.22705$. They agree to within the expected uncertainties with the values we derived in the preceding section by using the epochs of maxima. The secondary period is thus the shorter one of the two values determined from P_1 and the $10^d.83$ beat-period.

The values of P_1, P_2, and P_3 were used to fit our *B* observations by the method of least-squares to the following synthetic light-curve:

$$\Delta m = A_o + \sum_{i=1}^{3} A_i \cos\left[2\pi f_i(t - T) + \varphi_i\right],$$

where $f_i = 1/P_i$ are the frequencies, A_i are the amplitudes, and φ_i are the initial phases. The results are listed in Table 2 and compared with observations in Figure 2.

The listed periods were obtained from a two-month season of observations. Therefore they are not accurate enough to try to represent the single night of JD 2443862. However, by combining the observations of Rossati (1967), Klock (1965), Jerzykiewicz (1971), and our data we found that the best values of the periods are $P_1 = 0^d.2017786$, $P_2 = 0^d.1980855$, $P_3 = 0^d.2270986$. Using these numbers and the amplitudes and initial phases from Table 2 we computed a synthetic light-curve for the above-mentioned night. It is compared with observations in the last panel of Figure 2. The agreement is satisfactory.

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