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BV OBSERVATIONS OF THE OCT. 1990 ECLIPSE OF 22 Vul

INTRODUCTION

Zeta Aurigae eclipsing binaries consist of a K or M giant and a B main sequence star. Around the times of the eclipse contacts, the B star shines through the outer atmosphere and inner stellar wind of the giant, producing absorption features. Because the B star is small, these binaries offer a unique opportunity to spatially resolve the density, velocity structure, composition, and ionization state of the near environment of the giant star.

Unfortunately, the typically large orbits mean that orbital inclinations must lie quite close to 90^{o} for there to be eclipses, and the frequency of the eclipses will be low. There are presently only 9 such systems known; Zeta Aurigae itself, Epsilon Aurigae, VV Cep, 31 and 32 Cyg, and four recent discoveries; Tau Persei (Ake, et al. 1986), HR 6902 (Griffin and Griffin, 1986), HR 2554 (Ake and Parsons, 1987), and 22 Vul (Parsons and Ake, 1983). The number is expected to grow with the ongoing systematic search conducted by the Griffins (Griffin, et al. 1990).

22 Vul was discovered to be a Zeta Aurigae system in 1983 (Parsons and Ake 1983) and is especially interesting, having the latest hot component (B9) and the earliest cool component (G3 Ib-II) of the class, as well as the shortest period (249 days). Ake, Parsons, and Kondo (1985) performed a preliminary analysis of the star, and found some uncertainties which could be clarified by more photometry. For example, combined ground-based and IUE fluxes are difficult to fit with a standard color and the standard reddening law. Also, the hot component is quite faint and only an upper limit on its luminosity class is known. While mass transfer effects appear not to be important, the UV spectrum is similar to some interacting binaries, and P Cygni-type line profiles show the entire region surrounding the stars is filled with a cool gas. It may be that 22 Vul is in the brief phase before or after the supercritical mass flow stage presently observed in Beta Lyrae (Ake, Parsons, and Kondo 1985).

In order to make further progress, the relative sizes, shapes, brightnesses, and positioning of the stars must be measured more accurately. This requires good photometry, especially around the time of the eclipse contacts. Towards this end, Cabrillo Observatory undertook BVR observations of 22 Vul during its October 1990 primary eclipse.

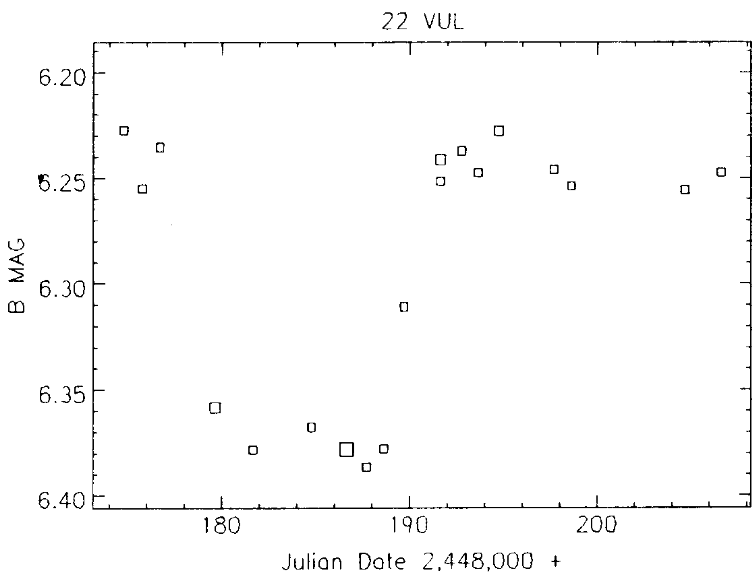

Figure 1. Differential B magnitude relative to 24 Vul

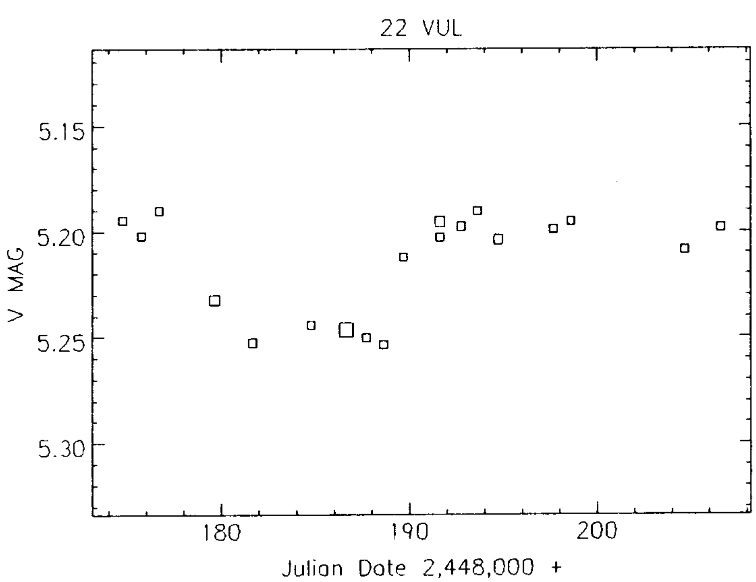

Figure 2. Differential V magnitude relative to 24 Vul

Table 1. V and B-V magnitudes for each observation

Hel. JD	JD(V)	V	JD(B-V)	B-V
2448174+	0.72053	5.195	0.72010	1.040
2448174+	0.72233	5.197	0.72206	1.018
2448174+	0.72485	5.192	0.72453	1.040
2448175+	0.71624	5.194	0.71596	1.061
2448175+	0.71834	5.204	0.71799	1.057
2448175+	0.72042	5.208	0.72013	1.041
2448176+	0.67280	5.194	0.67231	1.037
2448176+	0.67525	5.191	0.67485	1.042
2448176+	0.67763	5.185	0.67727	1.057
2448179+	0.63339	5.217	0.63306	1.149
2448179+	0.63514	5.232	0.63486	1.109
2448179+	0.63720	5.248	0.63691	1.120
2448179+	0.63339	5.217	0.63306	1.149
2448179+	0.63514	5.232	0.63486	1.109
2448179+	0.63720	5.248	0.63691	1.120
2448181+	0.63889	5.247	0.63853	1.138
2448181+	0.64069	5.252	0.64043	1.110
2448181+	0.64287	5.251	0.64249	1.132
2448181+	0.65001	5.249	0.64975	1.127
2448181+	0.65194	5.264	0.65162	1.121
2448184+	0.76111	5.249	0.76081	1.125
2448184+	0.76355	5.239	0.76313	1.134
2448184+	0.76551	5.245	0.76521	1.111
2448186+	0.64076	5.251	0.64049	1.131
2448186+	0.64285	5.248	0.64256	1.133
2448186+	0.64472	5.251	0.64439	1.124
2448186+	0.65139	5.249	0.65110	1.128
2448186+	0.65341	5.253	0.65304	1.119
2448186+	0.65524	5.228	0.65494	1.153
2448186+	0.64076	5.251	0.64049	1.131
2448186+	0.64285	5.248	0.64256	1.133
2448186+	0.64472	5.251	0.64439	1.124
2448186+	0.65139	5.249	0.65110	1.128
2448186+	0.65341	5.253	0.65304	1.119
2448186+	0.65524	5.228	0.65494	1.153
2448187+	0.69576	5.245	0.69530	1.150
2448187+	0.69715	5.244	0.69681	1.139
2448187+	0.69866	5.255	0.69826	1.137
2448187+	0.70005	5.258	0.69970	1.119
2448187+	0.70144	5.250	0.70111	1.135
2448188+	0.62083	5.245	0.62057	1.138
2448188+	0.62208	5.255	0.62181	1.122
2448188+	0.62492	5.252	0.62464	1.124
2448188+	0.62617	5.253	0.62590	1.125
2448188+	0.62743	5.263	0.62715	1.112
2448189+	0.68757	5.225	0.68715	1.111
2448189+	0.68925	5.210	0.68883	1.099
2448189+	0.69071	5.207	0.69035	1.104
2448189+	0.69212	5.212	0.69174	1.088
2448189+	0.69362	5.207	0.69319	1.091
2448191+	0.62045	5.208	0.62016	1.030
2448191+	0.62484	5.190	0.62456	1.060
2448191+	0.62604	5.186	0.62573	1.044
2448191+	0.63108	5.188	0.63079	1.044
2448191+	0.63404	5.201	0.63376	1.045
2448191+	0.63970	5.200	0.63942	1.052
2448191+	0.64091	5.198	0.64063	1.052
2448191+	0.64645	5.199	0.64611	1.061
2448191+	0.64770	5.212	0.64740	1.033
2448192+	0.76366	5.188	0.76339	1.052
2448192+	0.76498	5.197	0.76472	1.055
2448192+	0.77013	5.199	0.76986	1.039
2448192+	0.77141	5.207	0.77115	1.012
2448193+	0.63126	5.195	0.63100	1.035
2448193+	0.63249	5.187	0.63222	1.045
2448193+	0.63561	5.196	0.63536	1.076
2448193+	0.63794	5.184	0.63767	1.072
2448194+	0.73278	5.205	0.73204	0.992
2448194+	0.73398	5.195	0.73372	1.040
2448194+	0.73530	5.201	0.73501	1.043
2448194+	0.74000	5.199	0.73973	1.034
2448194+	0.74131	5.201	0.74102	1.041
2448194+	0.74259	5.223	0.74230	0.996
2448194+	0.74411	5.203	0.74383	1.021
2448197+	0.66649	5.197	0.66583	1.078
2448197+	0.66815	5.204	0.66767	1.043
2448197+	0.67016	5.204	0.66949	1.037
2448197+	0.67292	5.198	0.67234	1.041
2448197+	0.67525	5.193	0.67464	1.035
2448198+	0.60889	5.197	0.60844	1.047
2448198+	0.61036	5.196	0.61005	1.064
2448198+	0.61191	5.201	0.61161	1.043
2448198+	0.61321	5.193	0.61291	1.068
2448198+	0.61450	5.190	0.61424	1.070
2448204+	0.67745	5.207	0.67705	1.060
2448204+	0.67920	5.202	0.67874	1.064
2448204+	0.68117	5.212	0.68078	1.042
2448204+	0.68257	5.218	0.68228	1.022
2448204+	0.68477	5.204	0.68404	1.048
2448206+	0.60213	5.200	0.60184	1.049
2448206+	0.60350	5.199	0.60314	1.049
2448206+	0.60487	5.196	0.60455	1.050

OBSERVATIONS

Cabrillo College Observatory has a .25m Schmidt-Cassegrain with a PC controlling an Optec SSP-3A photometer equipped with Johnson-Cousins BVRI filters. We use the RPHOT data acquisition and reduction software package (Nolthenius 1990). Each clear night in October and early November 1990, the star was observed with the following sequence; sky - comparison - variable - variable - variable - comparison - sky. Each night, from three to 12 observations were made of the variable star. Each observation consisted of 4 to 8 consecutive 10-second integrations in each of the filters B, V, and R. The comparison star was 24 Vul = HR 7753. Figure 1 shows the light curve in B, with each night's data averaged to a single point. Unfortunately, most of the critical periods of ingress and egress were spoiled by clouds. Figure 2 shows the V light curve. All magnitudes are differential with respect to 24 Vul, whose B=5.32 and B-V=0.95. Table 1 shows the V and B-V for each observation.

RESULTS

The eclipse depth is 0.150 ± 0.007 in B, and 0.051 ± 0.007 in V; in good agreement with the Parsons, Ake, and Hopkins (1985) values of 0.136 and 0.052, respectively. From the single ingress and egress observations, the time of mid-eclipse is found to be JD 2448184.94 ±.1. Combining this with the well-observed eclipse of August 1984 (Parsons, Ake, and Hopkins 1985) gives a photometric period of 249.1828 ±.01 days. The duration of totality is not well determined, but is at least 8.8 days, and less than 10.0 days, with no significant difference between the durations in B and V.

With this further refinement in the photometric period, it should be possible to better target the brief and critical partial phases during subsequent eclipses.

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