UBV PHOTOMETRY OF RT PERSEI

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Abstract. Photoelectric and absolute elements of the system RT Per have been determined in *U*, *B*, and *V* filters. It is suggested that the primary star may be surrounded by a gaseous disk.

1. Introduction

The Algol-type eclipsing binary RT Per, discovered by Ceraski (1940), has frequently been observed by visual, photographic and photoelectric methods. Based on these observations, a number of epochs of primary minima have been derived. Dugan (1915) derived the orbital elements using his visual observations. Struve (1947) was the first to study the system spectroscopically. He found this variable to be a single line spectroscopic binary and derived its spectroscopic elements.

The present study was undertaken to investigate the photoelectric orbital elements and to obtain full light curves in the *U*, *B* and *V* filters.

2. Observations and Reduction

RT Per was observed during the period 1976 to 1978 on the 104 cm Sampurnanand reflector of Uttar Pradesh State Observatory using EMI 6094S photomultiplier (thermoelectrically cooled to −20°C) and the standard *U*, *B*, and *V* filters. An aperture 15 arc seconds in diameter was used to exclude a nearby star. The comparison star used was the same as that chosen by Mancuso and Milano (1976). The typical error of a single night's observations ranged between $0\overset{m}{.}002$ to $0\overset{m}{.}008$. A total of 553 observations (173 in *U*, 180 in *B*, and 180 in *V*) were obtained. All the observations were transformed to the standard *UBV* system with aid of the coefficients derived from the observations of eight standard stars.

The differential magnitudes in *U*, *B*, and *V*, in the sense $\mathrm{Var}_{\odot}$–$\mathrm{Comp}_{\odot}$ are listed respectively in Tables I(a), I(b) and I(c), wherein the first column is the heliocentric Julian date. The second column is phase calculated with the ephemeris

$$\mathrm{JD}\ 2443\,516.195 + 0\overset{d}{.}84939889E,$$

where the epoch is the time of minimum derived by us and the period is that

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TABLE I(a)

Differential magnitudes of RT Per in *U* filter

JD (Hel)	Phase in days	Δm	JD (Hel)	Phase in days	Δm
2443 471.1845	0.010	−0.773	2443 478.2973	0.384	+0.598
.1930	0.020	−0.592	.3271	0.419	+0.575
.1982	0.026	−0.392	.3337	0.427	+0.585
0.2055	0.035	−0.181	.3420	0.437	+0.553
.2062	0.036	−0.143	.3434	0.438	+0.539
.2125	0.043	+0.014	.3799	0.481	+0.517
.2174	0.049	+0.146	.3917	0.495	+0.457
.2241	0.057	+0.338	.3925	0.496	+0.450
.2251	0.058	+0.342	.4020	0.507	+0.467
.2466	0.083	+0.541	.4088	0.515	+0.477
.2477	0.084	+0.579	.4116	0.519	+0.482
.2600	0.099	+0.560	.4219	0.531	+0.487
.2671	0.107	+0.551	.4286	0.539	+0.488
.2778	0.120	+0.548	492.1118	0.648	+0.590
.2792	0.122	+0.563	.1128	0.649	+0.586
.2894	0.134	+0.597	.1201	0.658	+0.625
.2959	0.141	+0.625	.1260	0.665	+0.617
.3051	0.152	+0.602	.1333	0.673	+0.621
.3062	0.153	+0.634	.1397	0.675	+0.624
.3333	0.185	+0.650	.1420	0.683	+0.614
.3398	0.193	+0.661	.1469	0.689	+0.606
478.1252	0.181	+0.600	.1806	0.729	+0.600
.1322	0.190	+0.606	.1903	0.740	+0.595
.1412	0.200	+0.599	.1955	0.746	+0.595
.1452	0.205	+0.610	.2042	0.757	+0.599
.1532	0.214	+0.591	.2051	0.758	+0.599
.1542	0.216	+0.636	.2153	0.770	+0.603
.1612	0.224	+0.605	.2233	0.779	+0.605
.1672	0.231	+0.601	.2317	0.789	+0.600
.1768	0.242	+0.595	.2330	0.791	+0.614
.1778	0.243	+0.598	.2403	0.799	+0.603
.1848	0.252	+0.622	.2470	0.807	+0.612
.1916	0.260	+0.603	.2536	0.815	+0.603
.1986	0.268	+0.608	.2549	0.816	+0.605
.1997	0.269	+0.609	.2628	0.826	+0.586
.2079	0.279	+0.610	.2679	0.832	+0.592
.2136	0.285	+0.625	.2749	0.840	+0.582
.2212	0.294	+0.615	.2757	0.841	+0.585
.2223	0.296	+0.613	.2874	0.855	+0.598
.2309	0.306	+0.612	.2937	0.862	+0.590
.2372	0.313	+0.624	.3020	0.872	+0.619
.2438	0.321	+0.631	.3030	0.873	+0.610
.2532	0.332	+0.611	.3110	0.882	+0.576
.2591	0.339	+0.641	.3166	0.889	+0.555
.2694	0.351	+0.600	.3469	0.925	+0.515
.2705	0.352	+0.613	.3529	0.932	+0.481
.2795	0.363	+0.611	.3614	0.942	+0.433
.2858	0.370	+0.608	.3624	0.943	+0.416
.2952	0.382	+0.606	.3690	0.951	+0.293

Table I(a) (continued)

JD (Hel)	Phase in days	Δm	JD (Hel)	Phase in days	Δm
2443 492.3749	0.958	+0.196	2443 840.2228	0.478	+0.535
.3822	0.966	+0.048	.2297	0.487	+0.534
.3831	0.967	+0.035	.2325	0.491	+0.540
.3904	0.976	−0.206	.2329	0.491	+0.540
516.1177	0.910	+0.627	.2391	0.498	+0.533
.1191	0.912	+0.627	.2430	0.502	+0.515
.1278	0.922	+0.610	.2437	0.503	+0.515
.1337	0.929	+0.602	.2495	0.510	+0.492
.1413	0.938	+0.596	.2322	0.513	+0.500
.1422	0.939	+0.467	.2330	0.513	+0.500
.1477	0.945	+0.399	.2596	0.522	+0.501
.1557	0.955	+0.342	.2644	0.528	+0.507
.1565	0.956	+0.281	.2654	0.529	+0.488
.1701	0.972	−0.218	.2710	0.535	+0.504
.1711	0.973	−0.305	.2748	0.540	+0.551
.1763	0.979	−0.370	.2755	0.541	+0.545
.1902	0.995	−0.796	.2811	0.547	+0.541
.1930	0.999	−1.000	.2848	0.552	+0.563
.1987	0.005	−1.002	.2858	0.553	+0.563
.1996	0.007	−0.950	.2962	0.565	+0.544
.2055	0.013	−0.871	.2972	0.566	+0.543
.2107	0.020	−0.582	.3018	0.571	+0.548
.2118	0.021	−0.379	.3100	0.582	+0.570
.2176	0.028	−0.277	.3108	0.583	+0.571
.2251	0.037	−0.044	.3158	0.588	+0.583
.2265	0.038	−0.003	.3213	0.594	+0.597
.2475	0.063	+0.466	.3223	0.595	+0.606
.2483	0.064	+0.485	.3304	0.605	+0.558
.2565	0.073	+0.563	.3368	0.613	+0.600
.2628	0.081	+0.611	.3423	0.618	+0.624
.2641	0.082	+0.616	.3433	0.619	+0.638
.2739	0.094	+0.647	.3498	0.628	+0.584
.2794	0.100	+0.677	.3535	0.632	+0.590
840.2022	0.454	+0.525	.3586	0.638	+0.583
.2068	0.460	+0.536	.3598	0.640	+0.567
.2141	0.468	+0.534	.3650	0.646	+0.560
.2144	0.468	+0.534	.3696	0.651	+0.602
.2198	0.475	+0.529			

TABLE I(b)

Differential magnitudes of RT Per in *B* filter

JD (Hel)	Phase in days	Δm	JD (Hel)	Phase in days	Δm
2443 471.1765	0.001	−0.873	2443 471.2041	0.033	−0.286
.1859	0.072	−0.769	.2070	0.037	−0.193
.1941	0.021	−0.550	.2130	0.044	−0.022
.1968	0.023	−0.495	.2162	0.047	+0.053

Table I(b) (continued)

JD (Hel)	Phase in days	Δm	JD (Hel)	Phase in days	Δm
2443 471.2232	0.056	+0.150	2443 478.3785	0.480	+0.384
.2264	0.059	+0.212	.3896	0.493	+0.356
.2456	0.082	+0.406	.3938	0.498	+0.335
.2491	0.086	+0.414	.4035	0.509	+0.318
.2614	0.101	+0.457	.4125	0.520	+0.392
.2659	0.106	+0.452	.4230	0.532	+0.441
.2766	0.119	+0.447	.4271	0.537	+0.464
.2806	0.123	+0.452	.4368	0.545	+0.480
.2910	0.135	+0.459	.4503	0.560	+0.479
.2945	0.140	+0.467	492.1104	0.646	+0.479
.3037	0.150	+0.479	.1139	0.650	+0.475
.3076	0.155	+0.496	.1212	0.659	+0.484
.3397	0.187	+0.495	.1250	0.663	+0.479
.3382	0.191	+0.499	.1319	0.672	+0.480
.3490	0.204	+0.509	.1368	0.677	+0.476
.3534	0.209	+0.500	.1434	0.685	+0.485
.3632	0.220	+0.490	.1462	0.688	+0.477
478.1262	0.183	+0.457	.1823	0.731	+0.490
.1312	0.189	+0.484	.1917	0.742	+0.490
.1402	0.199	+0.475	.1945	0.745	+0.489
.1442	0.204	+0.480	.2028	0.755	+0.479
.1522	0.213	+0.479	.2463	0.759	+0.978
.1552	0.217	+0.485	.2167	0.771	+0.491
.1622	0.225	+0.483	.2205	0.776	+0.467
.1662	0.230	+0.483	.2306	0.788	+0.467
.1757	0.241	+0.478	.2340	0.792	+0.471
.1785	0.244	+0.491	.2431	0.802	+0.470
.1861	0.253	+0.495	.2450	0.805	+0.471
.1903	0.258	+0.488	.2524	0.813	+0.469
.1978	0.267	+0.489	.2556	0.817	+0.471
.2000	0.269	+0.487	.2642	0.827	+0.475
.2093	0.280	+0.485	.2669	0.830	+0.469
.2122	0.284	+0.489	.2739	0.839	+0.474
.2202	0.293	+0.475	.2771	0.842	+0.470
.2232	0.297	+0.490	.2885	0.856	+0.477
.2319	0.295	+0.466	.2922	0.860	+0.479
.2358	0.312	+0.471	.3010	0.872	+0.472
.2452	0.323	+0.488	.3044	0.875	+0.476
.2549	0.334	+0.482	.3124	0.884	+0.462
.2577	0.337	+0.473	.3152	0.887	+0.465
.2674	0.349	+0.478	.3478	0.926	+0.441
.2723	0.355	+0.475	.3517	0.903	+0.387
.2809	0.365	+0.494	.3600	0.940	+0.346
.2842	0.369	+0.479	.3640	0.943	+0.305
.2931	0.379	+0.515	.3671	0.954	+0.198
.2980	0.385	+0.491	.3735	0.958	+0.173
.3285	0.421	+0.472	.3812	0.965	+0.018
.3313	0.424	+0.473	.3843	0.969	−0.066
.3410	0.435	+0.459	.3911	0.977	−0.207
.3445	0.440	+0.442	516.1170	0.909	+0.453

Table I(b) (continued)

JD (Hel)	Phase in days	Δm	JD (Hel)	Phase in days	Δm
2443 516.1198	0.913	+0.453	2443 840.2235	0.479	+0.401
.1188	0.923	+0.454	.2304	0.488	+0.381
.1326	0.928	+0.445	.2318	0.490	+0.393
.1403	0.937	+0.346	.2339	0.492	+0.393
.1433	0.940	+0.299	.2398	0.499	+0.284
.1468	0.944	+0.265	.2420	0.501	+0.271
.1541	0.953	+0.141	.2444	0.504	+0.283
.1579	0.957	+0.056	.2500	0.511	+0.335
.1607	0.961	+0.023	.2522	0.513	+0.336
.1690	0.970	−0.101	.2540	0.515	+0.335
.1720	0.974	−0.258	.2604	0.523	+0.366
.1752	0.978	−0.367	.2628	0.526	+0.366
.1880	0.993	−0.786	.2664	0.530	+0.397
.1939	0.000	−0.900	.2720	0.536	+0.378
.1973	0.004	−0.886	.2741	0.539	+0.380
.2003	0.007	−0.882	.2763	0.542	+0.393
.2032	0.001	−0.802	.2819	0.548	+0.406
.2060	0.014	−0.800	.2841	0.551	+0.401
.2093	0.018	−0.633	.2868	0.554	+0.426
.2128	0.022	−0.557	.2890	0.556	+0.416
.2155	0.025	−0.429	.2954	0.564	+0.408
.2239	0.035	−0.176	.2982	0.568	+0.413
.2273	0.039	−0.082	.3008	0.570	+0.418
.2465	0.062	+0.289	.3090	0.580	+0.435
.2492	0.065	+0.329	.3118	0.585	+0.422
.2579	0.075	+0.423	.3148	0.587	+0.434
.2614	0.079	+0.447	.3203	0.593	+0.455
.2648	0.083	+0.479	.3233	0.596	+0.467
.2751	0.095	+0.548	.3312	0.606	+0.473
.2777	0.098	+0.530	.3360	0.611	+0.469
840.2033	0.455	+0.403	.3415	0.618	+0.467
.2061	0.459	+0.403	.3441	0.621	+0.472
.2130	0.467	+0.390	.3506	0.629	+0.476
.2151	0.469	+0.366	.3527	0.631	+0.479
.2207	0.475	+0.389	.3586	0.638	+0.478
.2221	0.477	+0.385	.3608	0.641	+0.479

TABLE I(c)

Differential magnitudes of RT Per in *V* filter

JD (Hel)	Phase in days	Δm	JD (Hel)	Phase in days	Δm
2443 471.1751	0.999	−0.805	2443 471.2079	0.038	−0.245
.1872	0.013	−0.704	.2148	0.046	+0.010
.1949	0.023	−0.434	.2155	0.047	+0.012
.1959	0.024	−0.445	.2222	0.055	+0.038
.2030	0.032	−0.406	.2273	0.061	+0.175

Table I(c) (continued)

JD (Hel)	Phase in days	Δm	JD (Hel)	Phase in days	Δm
2443 471.2445	0.081	+0.377	2443 478.3764	0.477	+0.372
.2506	0.088	+0.429	.3875	0.490	+0.331
.2632	0.103	+0.423	.3952	0.499	+0.298
.2645	0.104	+0.425	.4045	0.510	+0.334
.2753	0.117	+0.429	.4059	0.512	+0.335
.2820	0.125	+0.447	.4139	0.521	+0.341
.2921	0.137	+0.441	.4243	0.536	+0.354
.2933	0.138	+0.442	.4283	0.353	+0.382
.3028	0.149	+0.438	492.1097	0.645	+0.478
.3087	0.156	+0.476	.1149	0.652	+0.463
.3357	0.188	+0.467	.1229	0.661	+0.468
.3376	0.190	+0.466	.1240	0.663	+0.475
.3474	0.202	+0.476	.1308	0.670	+0.479
.3551	0.211	+0.506	.1368	0.677	+0.476
.3640	0.222	+0.503	.1441	0.686	+0.471
.3689	0.224	+0.504	.1451	0.687	+0.472
.3761	0.236	+0.510	.1840	0.733	+0.474
.3836	0.254	+0.500	.1931	0.744	+0.473
478.1272	0.184	+0.508	.2018	0.754	+0.479
.1302	0.187	+0.493	.2073	0.760	+0.479
.1392	0.198	+0.498	.2181	0.773	+0.479
.1422	0.202	+0.508	.2191	0.774	+0.475
.1502	0.211	+0.499	.2299	0.787	+0.480
.1552	0.217	+0.491	.2351	0.793	+0.475
.1642	0.227	+0.490	.2428	0.802	+0.480
.1652	0.229	+0.490	.2435	0.803	+0.471
.1750	0.240	+0.487	.2510	0.812	+0.486
.1799	0.246	+0.491	.2570	0.819	+0.473
.1882	0.256	+0.497	.2649	0.828	+0.465
.1896	0.257	+0.497	.2659	0.829	+0.468
.1963	0.265	+0.498	.2729	0.838	+0.462
.2014	0.271	+0.490	.2785	0.844	+0.464
.2105	0.282	+0.489	.2902	0.858	+0.453
.2115	0.284	+0.495	.2912	0.859	+0.458
.2171	0.289	+0.492	.2999	0.869	+0.437
.2244	0.298	+0.490	.3062	0.877	+0.438
.2330	0.308	+0.487	.3135	0.885	+0.430
.2341	0.310	+0.486	.3142	0.886	+0.428
.2562	0.336	+0.496	.3488	0.927	+0.393
.2570	0.337	+0.489	.3499	0.928	+0.344
.2657	0.347	+0.470	.3579	0.938	+0.335
.2736	0.357	+0.468	.3649	0.946	+0.242
.2823	0.366	+0.476	.3714	0.953	+0.142
.2834	0.368	+0.467	.3725	0.954	+0.132
.2924	0.378	+0.461	.3800	0.964	+0.019
.2990	0.386	+0.466	.3853	0.970	−0.123
.3298	0.422	+0.479	.3918	0.978	−0.246
.3306	0.423	+0.472	516.1156	0.908	+0.460
.3406	0.135	+0.471	.1212	0.914	+0.450
.3459	0.441	+0.463	.1302	0.925	+0.448

Table I(c) (continued)

JD (Hel)	Phase in days	Δm	JD (Hel)	Phase in days	Δm
2443 516.1316	0.926	+0.450	2443 840.2311	0.489	+0.317
.1392	0.935	+0.400	.2349	0.493	+0.338
.1442	0.941	+0.336	.2408	0.499	+0.324
.1460	0.943	+0.334	.2412	0.500	+0.316
.1530	0.952	+0.184	.2453	0.505	+0.332
.1588	0.955	+0.069	.2514	0.512	+0.312
.1600	0.960	+0.047	.2518	0.512	+0.286
.1676	0.969	−0.134	.2548	0.516	+0.286
.1732	0.975	−0.268	.2612	0.524	+0.337
.1740	0.978	−0.285	.2620	0.525	+0.339
.1878	0.993	−0.666	.2674	0.531	+0.352
.1947	0.001	−0.797	.2732	0.537	+0.400
.1961	0.002	−0.789	.2735	0.538	+0.402
.2019	0.009	−0.751	.2771	0.543	+0.336
.2026	0.010	−0.723	.2827	0.549	+0.350
.2072	0.015	−0.647	.2834	0.550	+0.358
.2082	0.017	−0.633	.2882	0.555	+0.401
.2140	0.023	−0.388	.2946	0.563	+0.393
.2148	0.024	−0.378	.2990	0.569	+0.422
.2229	0.034	−0.178	.2998	0.570	+0.423
.2284	0.040	−0.008	.3082	0.579	+0.431
.2454	0.060	+0.241	.3128	0.586	+0.433
.2506	0.067	+0.320	.3138	0.588	+0.435
.2593	0.077	+0.411	.3193	0.592	+0.531
.2607	0.078	+0.419	.3240	0.597	+0.470
.2760	0.096	+0.471	.3327	0.608	+0.474
.2772	0.098	+0.466	.3351	0.610	+0.474
840.2043	0.456	+0.492	.3405	0.617	+0.478
.2054	0.458	+0.492	.3452	0.623	+0.480
.2120	0.466	+0.442	.3514	0.630	+0.484
.2158	0.470	+0.376	.3524	0.631	+0.485
.2210	0.476	+0.354	.3578	0.637	+0.486
.2214	0.477	+0.354	.3616	0.642	+0.381
.2242	0.480	+0.353	.3672	0.648	+0.372
.2308	0.488	+0.325	.3680	0.649	+0.375

found by Mancuso and Milano (1976). Time of primary minimum light was determined from the data of a single night, on which both branches of the primary eclipse had been observed. The method of bisecting the chords was used to compute the time of minimum. The times of minimum found separately for each filter were not significantly different. Differential magnitudes are given in the last column. The differential magnitudes and colours against the phases have been plotted, respectively, in Figures 1 and 2.

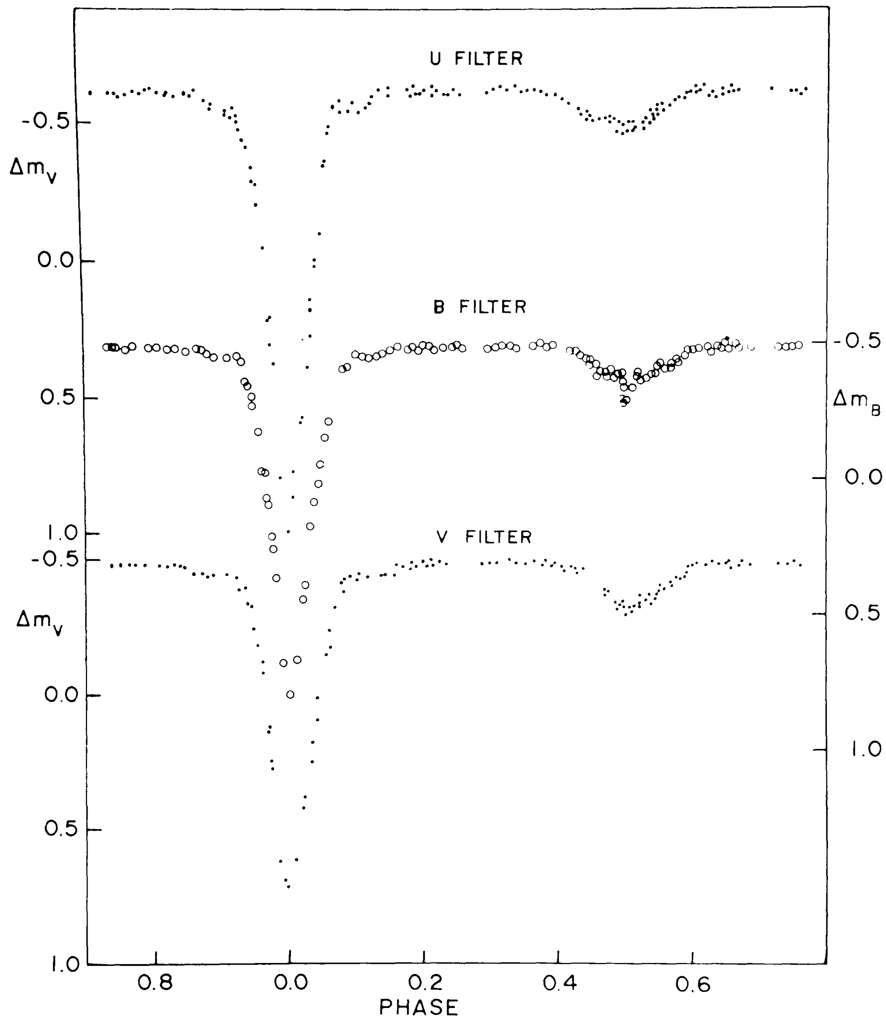

Fig. 1. The light curves in *U*, *B*, and *V* filters.

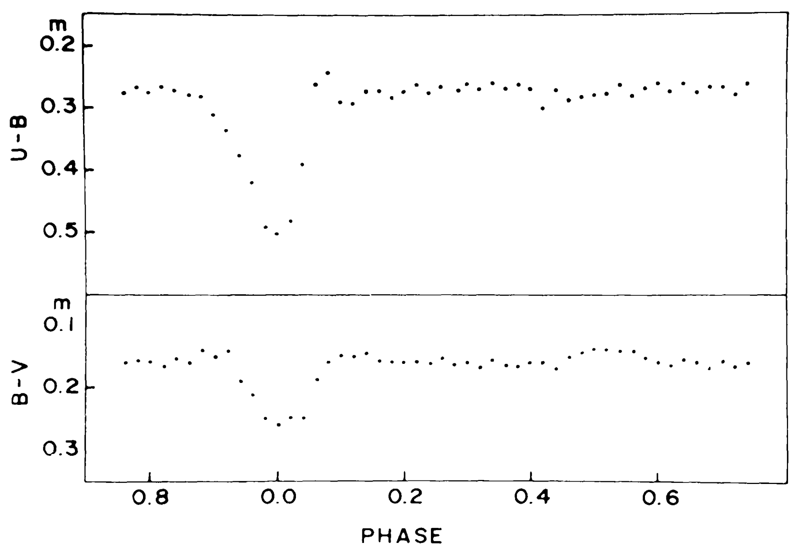

Fig. 2. Observed colours and phase of RT Per.

3. Evidence for Disk Around the Primary Component

It can be seen from Figure 1 that the shoulders of the primary minimum are depressed, as also found in the light curves of several eclipsing binary systems such as RW Tau and U Cep (Batten, 1973), RX Gem (Hall and Walker, 1975), β Per (Guinan *et al.*, 1976) and RW Per (Hall and Stuhlinger, 1978). The duration and depth of the depression are given in Table II.

This depression in the light curve near the shoulders of the primary minimum could be explained by assuming that the hotter component is surrounded by a disk of circumstellar material which is luminous by the scattered light, and lies in the plane of the orbit. The reduction of the light before and after the first and fourth contact is due to the eclipse of disk by the subgiant before and after the hotter component is eclipsed.

TABLE II

Depth and duration of depression

Filter	Depth	Duration
U	$0\overset{m}{.}058$	$0\overset{P}{.}136$
B	$0\overset{m}{.}040$	$0\overset{P}{.}150$
V	$0\overset{m}{.}023$	$0\overset{P}{.}164$

4. Orbital Elements

On the assumption that the light outside the eclipse (cf. Russell and Merrill, 1952) is of the form

$$I = A_0 + A_1 \cos\theta + A_2 \cos 2\theta + \cdots,$$

the coefficients have been determined by a least-squares fit. In order to use only the light outside the eclipse for this calculation, we excluded the observations from phases $0\overset{P}{.}80$ to $0\overset{P}{.}20$ and from $0\overset{P}{.}30$ to $0\overset{P}{.}70$ (Figure 1). The coefficients for each filter are given in Table III.

After eliminating the extra light produced by the proposed gaseous disk

TABLE III

Fourier coefficients

	Filter		
Coefficient	U	B	V
A_0	0.9789	0.9978	0.9924
A_1	−0.0068	−0.0030	−0.0063
A_2	0.0000	−0.0013	−0.0014

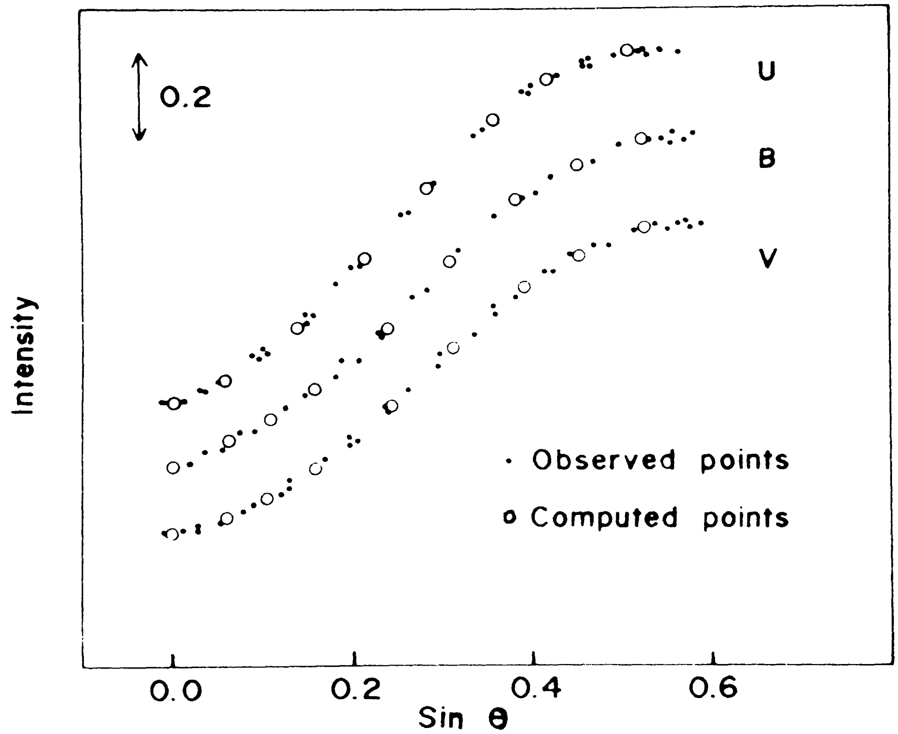

Fig. 3. Primary eclipses of RT Per.

around the primary component, the light curve was analysed. The normalized rectified intensity of primary eclipse was reflected about 0° and plotted on a large scale to obtain a solution using the R/M method of Russell and Merrill (1950, 1952). The limb-darkening coefficients were chosen from Grygar *et al.* (1972). They are $X_h = 0.8$, 0.8, 0.6, respectively, for U, B, and V. The best fit to the observations was obtained for $k = 0.78$, treating the primary eclipse as a partial occultation (Figure 3). The orbital elements are given in Table IV.

TABLE IV

Photometric solutions for RT Per

Element	Filter		
	U	B	V
X_h (assumed)	0.8	0.8	0.6
α_0^{oc}	0.891	0.875	0.873
k	0.78	0.78	0.78
p_0	−0.72	−0.72	−0.69
i	85°0	85°2	84°6
r_h	0.224	0.225	0.227
r_c	0.288	0.289	0.291
l_0^{oc}	0.229	0.289	0.311
L_h	0.845	0.802	0.790
L_c	0.155	0.198	0.210
θ_e	29°9	30°0	30°2

Using the spectroscopic elements given by Struve (1947) and the mean values of r_h, r_c, and i, determined by us, the following absolute elements have been determined.

Semi-major axis of the orbit:	$A = 6.4\ R_\odot$,	
Masses:	$M_h = 1.15\ M_\odot$,	$M_c = 0.33\ M_\odot$,
Radii:	$R_h = 1.45\ R_\odot$,	$R_c = 1.85\ R_\odot$.

5. Discussions

It can be seen from the light curves that the secondary minima show a considerable asymmetry in all the three filters, the slope of the descending branch being greater than that of the ascending branch. This asymmetry in the light curve may be due to the gas stream emerging radially from the subgiant component to the primary component through the inner Lagrangian point L_1. We

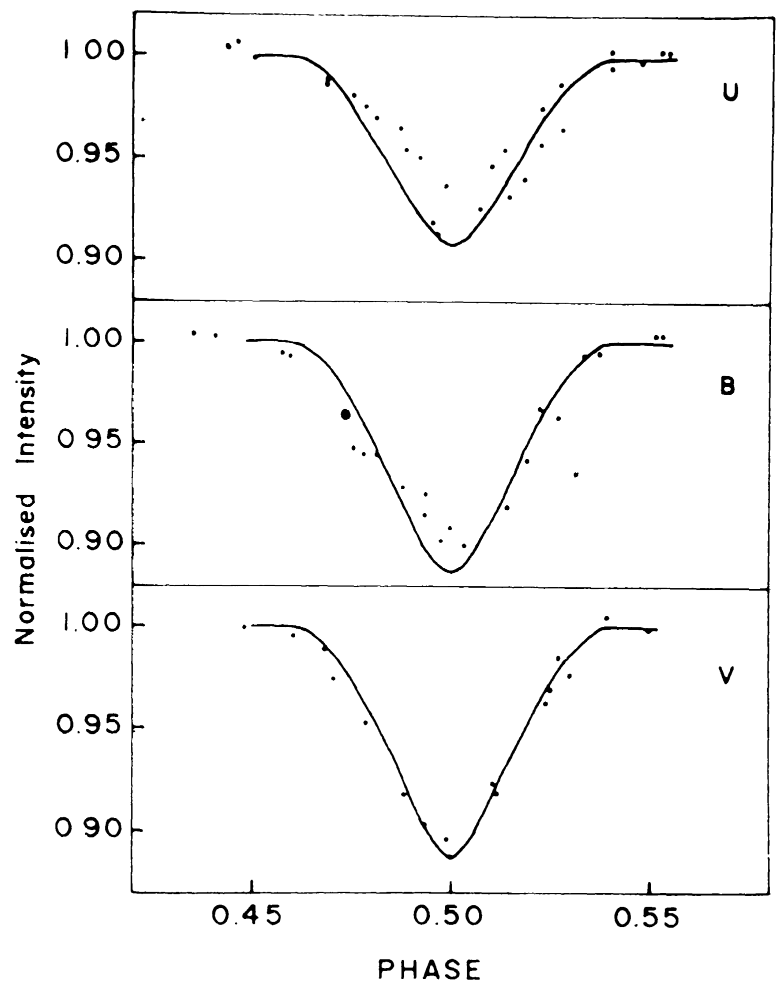

Fig. 4. Comparison of the observed and calculated curves around secondary eclipses in U, B, and V filters.

find that in the U and B observations the light curves show a large scatter in the descending branch of the secondary minimum. The observed points and the computed curves for the secondary eclipse are shown in Figure 4, where the latter have been determined from the elements listed in Table IV. The computed curves for the secondary eclipse are sharp and deep in all the three filters.

From Table IV we see that there is agreement among the values of r_h, r_c, and i in all the filters. The following uncertainties in the model might have caused the determination of the orbital elements to be less reliable.

(1) Gas streams are expected to cause a hot spot at the point of impact on the hot star. We made no correction for such a hot spot.

(2) The scatter in the observations outside of the minima could have been caused by some third light (Figure 1) in the system. No correction for this, except for redefining the light level, has been incorporated in getting the solution.

In addition to the above uncertainties, it has been assumed that the primary component obeys the mass–luminosity relation. In a close binary, in which mass exchange is assumed to occur through L_1, this is certainly a poor assumption (Chia, 1977). Thus the elements determined by us are not very accurate, but we feel that this solution is suitable as a starting point for any attempt to find the true solution, which should involve a more realistic model and in which some corrections should be made for the complicating effects of circumstellar material.

Further, on the basis of our light curves (Figures 1 and 2) and period study (Mancuso and Milano, 1975) for this binary system, we feel that the secondary star is in a rapid mass-transfer phase similar to TV Cas (Chaubey, 1979).

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