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Physical properties and radius variations in the HAT-P-5 planetary system from simultaneous four-colour photometry

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ABSTRACT
The radii of giant planets, as measured from transit observations, may vary with wavelength due to Rayleigh scattering or variations in opacity. Such an effect is predicted to be large enough to detect using ground-based observations at multiple wavelengths. We present defocussed photometry of a transit in the HAT-P-5 system, obtained simultaneously through Strömgren u, Gunn g and r, and Johnson I filters. Two more transit events were observed through a Gunn r filter. We detect a substantially larger planetary radius in u, but the effect is greater than predicted using theoretical model atmospheres of gaseous planets. This phenomenon is most likely to be due to systematic errors present in the u-band photometry, stemming from variations in the transparency of Earth's atmosphere at these short wavelengths. We use our data to calculate an improved orbital ephemeris and to refine the measured physical properties of the system. The planet HAT-P-5 b has a mass of $1.06 \pm 0.11 \pm 0.01\,\mathrm{M_{Jup}}$ and a radius of $1.252 \pm 0.042 \pm 0.008\,\mathrm{R_{Jup}}$ (statistical and systematic errors respectively), making it slightly larger than expected according to standard models of coreless gas-giant planets. Its equilibrium temperature of 1517 ± 29 K is within 60 K of that of the extensively-studied planet HD 209458 b.

Key words: stars: planetary systems — stars: fundamental parameters — stars: individual: HAT-P-5

APPENDIX A: FULL RESULTS FOR THE LIGHT CURVES ANALYSED IN THIS WORK

The tables in this Appendix contain the detailed results of the analysis for HAT-P-5 studied in this work.

Note that whilst all the results are best fits to the relevant data, some parameters are unphysical (for example the limb darkening coefficients imply that the limb of the star produces a negative amount of light). In these cases the unphysical results have *not* been used but are retained in the tables for completeness.

REFERENCES

Bakos, G. Á., et al., 2007, ApJ, 671, L173

This paper has been typeset from a TEX/ LATEX file prepared by the author.

Table A1. Parameters of the JKTEBOP best fits of the CAHA g-band light curve, using different approaches to LD. For each part of the table the upper quantities are fitted parameters and the lower quantities are derived parameters. T_0 is given as BJD(TDB) $-$ 2455000.0. The light curve contains 204 datapoints.

	Linear LD law	Quadratic LD law	Square-root LD law	Logarithmic LD law	Cubic LD law
All LD coefficients fixed					
$r_{\rm A} + r_{\rm b}$	0.1360 ± 0.0060	0.1371 ± 0.0048	0.1381 ± 0.0057	0.1376 ± 0.0055	0.1473 ± 0.0068
k	0.1094 ± 0.0020	0.1108 ± 0.0014	0.1112 ± 0.0016	0.1109 ± 0.0016	0.1158 ± 0.0015
i (deg.)	89.97 ± 1.45	88.87 ± 1.30	88.54 ± 1.44	88.73 ± 1.42	86.73 ± 0.84
$u_{\rm A}$	0.74 fixed	0.56 fixed	0.45 fixed	0.80 fixed	0.50 fixed
$v_{\rm A}$		0.21 fixed	0.37 fixed	0.19 fixed	0.10 fixed
T_0	432.45434 ± 0.00027	432.45435 ± 0.00025	432.45435 ± 0.00026	432.45435 ± 0.00025	432.45435 ± 0.00026
$r_{\rm A}$	0.1225 ± 0.0052	0.1235 ± 0.0042	0.1243 ± 0.0050	0.1238 ± 0.0048	0.1320 ± 0.0059
$r_{\rm b}$	0.01341 ± 0.00083	0.01368 ± 0.00062	0.01382 ± 0.00075	0.01373 ± 0.00073	0.01529 ± 0.00087
σ ($m$mag)	1.2151	1.1970	1.1974	1.1971	1.1981
$\chi^2_{\rm red}$	1.0273	0.9968	0.9975	0.9970	0.9991
Fitting for the linear LD coefficient and perturbing the nonlinear LD coefficient					
$r_{\rm A} + r_{\rm b}$	0.1449 ± 0.0072	0.1392 ± 0.0064	0.1425 ± 0.0072	0.1396 ± 0.0064	0.1422 ± 0.0071
k	0.1149 ± 0.0021	0.1123 ± 0.0022	0.1137 ± 0.0022	0.1126 ± 0.0022	0.1136 ± 0.0022
i (deg.)	87.1 ± 1.1	88.2 ± 1.6	87.5 ± 1.4	88.0 ± 1.6	87.6 ± 1.6
$u_{\rm A}$	0.581 ± 0.053	0.506 ± 0.068	0.377 ± 0.067	0.738 ± 0.078	0.571 ± 0.056
$v_{\rm A}$		0.21 perturbed	0.37 perturbed	0.19 perturbed	0.10 perturbed
T_0	432.45435 ± 0.00025	432.45436 ± 0.00024	432.45436 ± 0.00026	432.45436 ± 0.00026	432.45436 ± 0.00026
$r_{\rm A}$	0.1300 ± 0.0062	0.1252 ± 0.0055	0.1280 ± 0.0062	0.1255 ± 0.0056	0.1277 ± 0.0062
$r_{\rm b}$	0.01494 ± 0.00095	0.01406 ± 0.00086	0.01455 ± 0.00099	0.01413 ± 0.00087	0.01450 ± 0.00099
σ ($m$mag)	1.1939	1.1949	1.1941	1.1940	1.1941
$\chi^2_{\rm red}$	0.9968	0.9984	0.9971	0.9969	0.9971
Fitting for both LD coefficients					
$r_{\rm A} + r_{\rm b}$	0.1449 ± 0.0070	0.1496 ± 0.0061	0.1503 ± 0.0056	0.1501 ± 0.0055	0.1504 ± 0.0055
k	0.1149 ± 0.0021	0.1187 ± 0.0027	0.1199 ± 0.0025	0.1194 ± 0.0025	0.1195 ± 0.0025
i (deg.)	87.07 ± 1.02	86.25 ± 0.73	86.07 ± 0.62	86.14 ± 0.63	86.09 ± 0.62
$u_{\rm A}$	0.58 ± 0.06	0.96 ± 0.28	2.33 ± 0.87	-0.01 ± 0.28	0.79 ± 0.16
$v_{\rm A}$		-0.67 ± 0.45	-2.92 ± 1.39	-0.91 ± 0.49	-0.72 ± 0.38
T_0	432.45435 ± 0.00025	432.45433 ± 0.00026	432.45434 ± 0.00026	432.45434 ± 0.00025	432.45434 ± 0.00025
$r_{\rm A}$	0.1300 ± 0.0060	0.1337 ± 0.0052	0.1342 ± 0.0048	0.1341 ± 0.0047	0.1344 ± 0.0048
$r_{\rm b}$	0.01494 ± 0.00096	0.01587 ± 0.00093	0.01609 ± 0.00084	0.01601 ± 0.00086	0.01606 ± 0.00083
σ ($m$mag)	1.1939	1.1891	1.1877	1.1884	1.1881
$\chi^2_{\rm red}$	0.9968	0.9942	0.9920	0.9930	0.9926

Table A2. Parameters of the JKTEBOP best fits of the CAHA r-band light curve, using different approaches to LD. For each part of the table the upper quantities are fitted parameters and the lower quantities are derived parameters. T_0 is given as BJD(TDB) − 2455000.0. The light curve contains 204 datapoints.

	Linear LD law	Quadratic LD law	Square-root LD law	Logarithmic LD law	Cubic LD law
All LD coefficients fixed					
$r_{\rm A}+r_{\rm b}$	0.1409 ± 0.0049	0.1414 ± 0.0051	0.1417 ± 0.0054	0.1422 ± 0.0054	0.1479 ± 0.0050
k	0.11262 ± 0.00133	0.11359 ± 0.00099	0.11399 ± 0.00114	0.11405 ± 0.00111	0.11646 ± 0.00098
i (deg.)	88.21 ± 1.34	88.03 ± 1.24	87.90 ± 1.18	87.82 ± 1.06	86.82 ± 0.63
$u_{\rm A}$	0.63 fixed	0.37 fixed	0.22 fixed	0.71 fixed	0.40 fixed
$v_{\rm A}$		0.31 fixed	0.53 fixed	0.28 fixed	0.15 fixed
T_0	432.45461 ± 0.00020	432.45460 ± 0.00019	432.45461 ± 0.00019	432.45460 ± 0.00018	432.45457 ± 0.00019
$r_{\rm A}$	0.1266 ± 0.0043	0.1269 ± 0.0044	0.1272 ± 0.0047	0.1276 ± 0.0047	0.1325 ± 0.0044
$r_{\rm b}$	0.01426 ± 0.00064	0.01442 ± 0.00062	0.01450 ± 0.00069	0.01455 ± 0.00066	0.01543 ± 0.00062
σ ($m$mag)	0.9489	0.9322	0.9326	0.9325	0.9422
$\chi^2_{\rm red}$	1.0334	0.9959	0.9969	0.9967	1.0176
Fitting for the linear LD coefficient and perturbing the nonlinear LD coefficient					
$r_{\rm A}+r_{\rm b}$	0.1430 ± 0.0053	0.1392 ± 0.0046	0.1414 ± 0.0051	0.1404 ± 0.0049	0.1412 ± 0.0054
k	0.1149 ± 0.0015	0.1127 ± 0.0016	0.1139 ± 0.0014	0.1132 ± 0.0016	0.1138 ± 0.0016
i (deg.)	87.6 ± 0.9	88.6 ± 1.3	88.0 ± 1.3	88.2 ± 1.4	88.0 ± 1.4
$u_{\rm A}$	0.526 ± 0.040	0.399 ± 0.054	0.225 ± 0.053	0.737 ± 0.069	0.499 ± 0.046
$v_{\rm A}$		0.31 perturbed	0.53 perturbed	0.28 perturbed	0.15 perturbed
T_0	432.45461 ± 0.00018	432.45460 ± 0.00019	432.45461 ± 0.00019	432.45460 ± 0.00019	432.45461 ± 0.00019
$r_{\rm A}$	0.1283 ± 0.0046	0.1251 ± 0.0040	0.1270 ± 0.0044	0.1261 ± 0.0042	0.1268 ± 0.0047
$r_{\rm b}$	0.01474 ± 0.00069	0.01410 ± 0.00061	0.01446 ± 0.00067	0.01428 ± 0.00064	0.01443 ± 0.00070
σ ($m$mag)	0.9344	0.9317	0.9326	0.9319	0.9325
$\chi^2_{\rm red}$	1.0058	1.0000	1.0020	1.0005	1.0018
Fitting for both LD coefficients					
$r_{\rm A}+r_{\rm b}$	0.1430 ± 0.0054	0.1391 ± 0.0055	0.1390 ± 0.0074	0.1384 ± 0.0092	0.1388 ± 0.0094
k	0.1149 ± 0.0015	0.1123 ± 0.0023	0.1106 ± 0.0039	0.1110 ± 0.0041	0.1102 ± 0.0043
i (deg.)	87.6 ± 0.9	88.7 ± 1.4	89.3 ± 1.5	89.4 ± 1.7	90.0 ± 1.6
$u_{\rm A}$	0.526 ± 0.041	0.375 ± 0.143	-0.656 ± 1.253	1.028 ± 0.771	0.455 ± 0.082
$v_{\rm A}$		0.37 ± 0.33	2.14 ± 2.30	0.63 ± 0.92	0.63 ± 0.69
T_0	432.45461 ± 0.00019	432.45460 ± 0.00019	432.45459 ± 0.00019	432.45459 ± 0.00020	432.45459 ± 0.00019
$r_{\rm A}$	0.1283 ± 0.0047	0.1250 ± 0.0049	0.1252 ± 0.0068	0.1245 ± 0.0084	0.1250 ± 0.0086
$r_{\rm b}$	0.01474 ± 0.00071	0.01404 ± 0.00068	0.01384 ± 0.00077	0.01383 ± 0.00091	0.01377 ± 0.00096
σ ($m$mag)	0.9344	0.9316	0.9308	0.9310	0.9304
$\chi^2_{\rm red}$	1.0058	1.0048	1.0031	1.0035	1.0023

Table A3. Parameters of the JKTEBOP best fits of the CAHA I-band light curve, using different approaches to LD. For each part of the table the upper quantities are fitted parameters and the lower quantities are derived parameters. T_0 is given as BJD(TDB) $-$ 2455000.0. The light curve contains 199 datapoints.

	Linear LD law	Quadratic LD law	Square-root LD law	Logarithmic LD law	Cubic LD law
All LD coefficients fixed					
$r_{\rm A} + r_{\rm b}$	0.1488 ± 0.0062	0.1450 ± 0.0065	0.1456 ± 0.0063	0.1457 ± 0.0067	0.1559 ± 0.0059
k	0.11841 ± 0.00125	0.11673 ± 0.00113	0.11754 ± 0.00117	0.11742 ± 0.00118	0.12009 ± 0.00100
i (deg.)	86.91 ± 0.82	87.59 ± 1.25	87.40 ± 0.99	87.40 ± 1.07	86.00 ± 0.60
$u_{\rm A}$	0.42 fixed	0.26 fixed	0.07 fixed	0.58 fixed	0.25 fixed
$v_{\rm A}$		0.32 fixed	0.56 fixed	0.27 fixed	0.15 fixed
T_0	432.45433 ± 0.00026	432.45436 ± 0.00026	432.45436 ± 0.00024	432.45436 ± 0.00026	432.45424 ± 0.00024
$r_{\rm A}$	0.1330 ± 0.0054	0.1298 ± 0.0057	0.1303 ± 0.0056	0.1304 ± 0.0059	0.1391 ± 0.0052
$r_{\rm b}$	0.01575 ± 0.00077	0.01516 ± 0.00078	0.01531 ± 0.00076	0.01531 ± 0.00081	0.01671 ± 0.00072
σ ($m$mag)	1.2776	1.2710	1.2764	1.2754	1.2944
$\chi^2_{\rm red}$	1.0067	0.9961	1.0045	1.0031	1.0332
Fitting for the linear LD coefficient and perturbing the nonlinear LD coefficient					
$r_{\rm A} + r_{\rm b}$	0.1442 ± 0.0064	0.1436 ± 0.0064	0.1445 ± 0.0066	0.1441 ± 0.0064	0.1446 ± 0.0066
k	0.1171 ± 0.0016	0.1161 ± 0.0018	0.1166 ± 0.0017	0.1164 ± 0.0018	0.1167 ± 0.0018
i (deg.)	87.6 ± 1.3	87.9 ± 1.6	87.7 ± 1.5	87.8 ± 1.5	87.6 ± 1.5
$u_{\rm A}$	0.453 ± 0.055	0.293 ± 0.070	0.123 ± 0.067	0.639 ± 0.080	0.414 ± 0.061
$v_{\rm A}$		0.32 perturbed	0.56 perturbed	0.27 perturbed	0.15 perturbed
T_0	432.45438 ± 0.00025	432.45437 ± 0.00024	432.45437 ± 0.00024	432.45437 ± 0.00026	432.45437 ± 0.00026
$r_{\rm A}$	0.1291 ± 0.0056	0.1287 ± 0.0056	0.1294 ± 0.0057	0.1291 ± 0.0056	0.1295 ± 0.0057
$r_{\rm b}$	0.01512 ± 0.00084	0.01494 ± 0.00083	0.01510 ± 0.00085	0.01502 ± 0.00086	0.01511 ± 0.00085
σ ($m$mag)	1.2761	1.2699	1.2731	1.2717	1.2729
$\chi^2_{\rm red}$	1.0097	0.9997	1.0048	1.0027	1.0045
Fitting for both LD coefficients					
$r_{\rm A} + r_{\rm b}$	0.1442 ± 0.0064	0.1447 ± 0.0074	0.1448 ± 0.0089	0.1450 ± 0.0083	0.1413 ± 0.0119
k	0.1171 ± 0.0016	0.1157 ± 0.0029	0.1137 ± 0.0040	0.1151 ± 0.0042	0.1119 ± 0.0054
i (deg.)	87.6 ± 1.2	87.8 ± 1.8	88.1 ± 1.8	87.8 ± 1.8	89.7 ± 1.9
$u_{\rm A}$	0.45 ± 0.05	0.19 ± 0.22	-1.16 $\pm$ 1.47	0.95 ± 0.71	0.33 ± 0.14
$v_{\rm A}$		0.52 ± 0.48	2.82 ± 2.64	0.70 ± 0.90	0.90 ± 0.93
T_0	432.45438 ± 0.00025	432.45435 ± 0.00027	432.45435 ± 0.00026	432.45435 ± 0.00026	432.45436 ± 0.00026
$r_{\rm A}$	0.1291 ± 0.0055	0.1297 ± 0.0065	0.1300 ± 0.0079	0.1300 ± 0.0071	0.1271 ± 0.0104
$r_{\rm b}$	0.0151 ± 0.0008	0.0150 ± 0.0010	0.0148 ± 0.0011	0.0150 ± 0.0011	0.0142 ± 0.0013
σ ($m$mag)	1.2761	1.2691	1.2701	1.2698	1.2715
$\chi^2_{\rm red}$	1.0097	1.0036	1.0052	1.0048	1.0074

Table A4. Parameters of the JKTEBOP best fits of the Loiano r-band light curve, using different approaches to LD. For each part of the table the upper quantities are fitted parameters and the lower quantities are derived parameters. T_0 is given as BJD(TDB) $-$ 2455000.0. The light curve contains 311 datapoints.

	Linear LD law	Quadratic LD law	Square-root LD law	Logarithmic LD law	Cubic LD law
All LD coefficients fixed					
$r_{\rm A} + r_{\rm b}$	0.1539 ± 0.0057	0.1549 ± 0.0052	0.1571 ± 0.0050	0.1569 ± 0.0048	0.1651 ± 0.0044
k	0.11493 ± 0.00139	0.11530 ± 0.00099	0.11628 ± 0.00098	0.11606 ± 0.00098	0.11857 ± 0.00083
i (deg.)	86.46 ± 0.67	86.31 ± 0.58	86.02 ± 0.53	86.05 ± 0.50	85.13 ± 0.39
$u_{\rm A}$	0.63 fixed	0.37 fixed	0.22 fixed	0.71 fixed	0.40 fixed
$v_{\rm A}$		0.31 fixed	0.53 fixed	0.28 fixed	0.15 fixed
T_0	708.51479 ± 0.00020	708.51481 ± 0.00020	708.51481 ± 0.00020	708.51481 ± 0.00019	708.51481 ± 0.00019
$r_{\rm A}$	0.1380 ± 0.0049	0.1388 ± 0.0046	0.1407 ± 0.0043	0.1406 ± 0.0042	0.1476 ± 0.0038
$r_{\rm b}$	0.01586 ± 0.00075	0.01601 ± 0.00067	0.01636 ± 0.00064	0.01632 ± 0.00061	0.01750 ± 0.00055
σ ($m$mag)	1.2832	1.2714	1.2746	1.2735	1.2786
$\chi^2_{\rm red}$	1.0351	1.0022	1.0098	1.0064	1.0163
Fitting for the linear LD coefficient and perturbing the nonlinear LD coefficient					
$r_{\rm A} + r_{\rm b}$	0.1614 ± 0.0045	0.1544 ± 0.0060	0.1573 ± 0.0052	0.1558 ± 0.0057	0.1569 ± 0.0054
k	0.1180 ± 0.0011	0.1151 ± 0.0017	0.1164 ± 0.0014	0.1157 ± 0.0015	0.1163 ± 0.0014
i (deg.)	85.49 ± 0.44	86.37 ± 0.71	85.99 ± 0.57	86.20 ± 0.65	86.04 ± 0.59
$u_{\rm A}$	0.512 ± 0.041	0.377 ± 0.056	0.217 ± 0.057	0.726 ± 0.061	0.492 ± 0.049
$v_{\rm A}$		0.31 perturbed	0.53 perturbed	0.28 perturbed	0.15 perturbed
T_0	708.51481 ± 0.00020	708.51481 ± 0.00020	708.51481 ± 0.00019	708.51481 ± 0.00019	708.51481 ± 0.00019
$r_{\rm A}$	0.1443 ± 0.0039	0.1385 ± 0.0052	0.1409 ± 0.0046	0.1396 ± 0.0049	0.1406 ± 0.0047
$r_{\rm b}$	0.01704 ± 0.00059	0.01594 ± 0.00080	0.01640 ± 0.00070	0.01615 ± 0.00076	0.01634 ± 0.00071
σ ($m$mag)	1.2768	1.2712	1.2747	1.2730	1.2744
$\chi^2_{\rm red}$	1.0184	1.0054	1.0131	1.0094	1.0123
Fitting for both LD coefficients					
$r_{\rm A} + r_{\rm b}$		0.1626 ± 0.0086	0.1667 ± 0.0078	0.1649 ± 0.0087	0.1662 ± 0.0084
k		0.1061 ± 0.0024	0.1084 ± 0.0019	0.1075 ± 0.0021	0.1078 ± 0.0021
i (deg.)		86.63 ± 0.94	86.00 ± 0.74	86.25 ± 0.84	86.11 ± 0.79
$u_{\rm A}$		-0.14 $\pm$ 0.29	-2.61 $\pm$ 0.69	2.12 $\pm$ 0.35	0.35 $\pm$ 0.12
$v_{\rm A}$		1.82 $\pm$ 0.49	5.64 $\pm$ 1.14	2.02 $\pm$ 0.49	1.52 $\pm$ 0.37
T_0		708.51479 ± 0.00019	708.51480 ± 0.00020	708.51480 ± 0.00019	708.51480 ± 0.00020
$r_{\rm A}$		0.1470 ± 0.0078	0.1504 ± 0.0072	0.1489 ± 0.0079	0.1500 ± 0.0077
$r_{\rm b}$		0.01560 ± 0.00093	0.01630 ± 0.00082	0.01601 ± 0.00089	0.01618 ± 0.00088
σ ($m$mag)		1.2618	1.2632	1.2621	1.2633
$\chi^2_{\rm red}$		0.9894	0.9953	0.9919	0.9942

Table A5. Parameters of the JKTEBOP best fits of the z-band light curve from Bakos et al. (2007), using different approaches to LD. For each part of the table the upper quantities are fitted parameters and the lower quantities are derived parameters. T_0 is given as HJD $-$ 2454000.0. The light curve contains 1026 datapoints.

	Linear LD law	Quadratic LD law	Square-root LD law	Logarithmic LD law	Cubic LD law
All LD coefficients fixed					
$r_{\rm A} + r_{\rm b}$	0.1517 ± 0.0041	0.1550 ± 0.0037	0.1548 ± 0.0038	0.1548 ± 0.0036	0.1686 ± 0.0032
k	0.11156 ± 0.00081	0.11189 ± 0.00063	0.11231 ± 0.00060	0.11212 ± 0.00062	0.11477 ± 0.00047
i (deg.)	86.38 ± 0.47	86.01 ± 0.38	86.00 ± 0.40	86.02 ± 0.37	84.56 ± 0.26
$u_{\rm A}$	0.48 fixed	0.21 fixed	0.05 fixed	0.56 fixed	0.20 fixed
$v_{\rm A}$		0.32 fixed	0.56 fixed	0.27 fixed	0.10 fixed
T_0	241.77659 ± 0.00016	241.77658 ± 0.00015	241.77658 ± 0.00016	241.77658 ± 0.00016	241.77653 ± 0.00016
$r_{\rm A}$	0.1365 ± 0.0036	0.1394 ± 0.0033	0.1391 ± 0.0034	0.1392 ± 0.0032	0.1512 ± 0.0028
$r_{\rm b}$	0.01523 ± 0.00049	0.01560 ± 0.00044	0.01563 ± 0.00044	0.01561 ± 0.00042	0.01735 ± 0.00037
σ ($m$mag)	1.9928	1.9958	1.9961	1.9961	2.0131
$\chi^2_{\rm red}$	1.7136	1.7215	1.7236	1.7232	1.7599
Fitting for the linear LD coefficient and perturbing the nonlinear LD coefficient					
$r_{\rm A} + r_{\rm b}$	0.1496 ± 0.0041	0.1458 ± 0.0053	0.1465 ± 0.0049	0.1464 ± 0.0048	0.1467 ± 0.0046
k	0.1109 ± 0.0010	0.1089 ± 0.0014	0.1095 ± 0.0012	0.1093 ± 0.0013	0.1098 ± 0.0013
i (deg.)	86.67 ± 0.52	87.34 ± 0.90	87.17 ± 0.72	87.22 ± 0.76	87.11 ± 0.69
$u_{\rm A}$	0.507 ± 0.035	0.357 ± 0.050	0.188 ± 0.049	0.704 ± 0.059	0.491 ± 0.039
$v_{\rm A}$		0.32 perturbed	0.56 perturbed	0.27 perturbed	0.10 perturbed
T_0	241.77659 ± 0.00017	241.77656 ± 0.00016	241.77658 ± 0.00015	241.77657 ± 0.00015	241.77658 ± 0.00016
$r_{\rm A}$	0.1347 ± 0.0035	0.1315 ± 0.0047	0.1321 ± 0.0043	0.1320 ± 0.0042	0.1322 ± 0.0041
$r_{\rm b}$	0.01494 ± 0.00052	0.01432 ± 0.00068	0.01446 ± 0.00061	0.01442 ± 0.00060	0.01452 ± 0.00061
σ ($m$mag)	1.9928	1.9926	1.9925	1.9925	1.9926
$\chi^2_{\rm red}$	1.7144	1.7118	1.7127	1.7123	1.7130
Fitting for both LD coefficients					
$r_{\rm A} + r_{\rm b}$	0.1496 ± 0.0043	0.1385 ± 0.0089	0.1404 ± 0.0075	0.1396 ± 0.0098	0.1505 ± 0.0066
k	0.1109 ± 0.0011	0.1056 ± 0.0037	0.1042 ± 0.0035	0.1046 ± 0.0035	0.1009 ± 0.0017
i (deg.)	86.7 ± 0.5	89.9 ± 1.5	89.6 ± 1.7	89.9 ± 1.7	88.0 ± 1.3
$u_{\rm A}$	0.507 ± 0.033	0.302 ± 0.191	-1.028 ± 1.161	1.235 ± 0.635	0.416 ± 0.069
$v_{\rm A}$		0.59 ± 0.65	2.83 ± 2.14	0.89 ± 0.74	1.40 ± 0.26
T_0	241.77659 ± 0.00016	241.77653 ± 0.00016	241.77653 ± 0.00016	241.77653 ± 0.00016	241.77654 ± 0.00015
$r_{\rm A}$	0.1347 ± 0.0038	0.1253 ± 0.0083	0.1272 ± 0.0067	0.1264 ± 0.0089	0.1367 ± 0.0060
$r_{\rm b}$	0.01494 ± 0.00054	0.01322 ± 0.00069	0.01325 ± 0.00090	0.01323 ± 0.00091	0.01379 ± 0.00067
σ ($m$mag)	1.9928	1.9932	1.9929	1.9930	1.9915
$\chi^2_{\rm red}$	1.7144	1.7121	1.7121	1.7119	1.7080

Table A6. Parameters of the JKTEBOP best fits of the R-band light curve from Bakos et al. (2007), using different approaches to LD. For to LD. For each part of the table the upper quantities are fitted parameters and the lower quantities are derived parameters. T_0 is given as HJD/BJD $-$ 2454000.0. The light curve contains 855 datapoints.

	Linear LD law	Quadratic LD law	Square-root LD law	Logarithmic LD law	Cubic LD law
All LD coefficients fixed					
$r_{\rm A} + r_{\rm b}$	0.1429 ± 0.0043	0.1415 ± 0.0039	0.1422 ± 0.0040	0.1417 ± 0.0037	0.1468 ± 0.0033
k	0.10987 ± 0.00102	0.11004 ± 0.00073	0.11020 ± 0.00084	0.11021 ± 0.00076	0.11310 ± 0.00057
i (deg.)	87.35 ± 0.64	87.53 ± 0.60	87.42 ± 0.62	87.48 ± 0.57	86.56 ± 0.39
$u_{\rm A}$	0.58 fixed	0.33 fixed	0.19 fixed	0.67 fixed	0.30 fixed
$v_{\rm A}$		0.30 fixed	0.54 fixed	0.27 fixed	0.10 fixed
T_0	272.45016 ± 0.00014	272.45015 ± 0.00015	272.45015 ± 0.00015	272.45014 ± 0.00014	272.45020 ± 0.00013
$r_{\rm A}$	0.1288 ± 0.0037	0.1275 ± 0.0034	0.1281 ± 0.0035	0.1277 ± 0.0032	0.1319 ± 0.0029
$r_{\rm b}$	0.01415 ± 0.00053	0.01403 ± 0.00046	0.01411 ± 0.00049	0.01407 ± 0.00044	0.01492 ± 0.00039
σ ($m$mag)	2.3957	2.3912	2.3899	2.3899	2.3964
$\chi^2_{\rm red}$	2.2997	2.2682	2.2729	2.2681	2.2751
Fitting for the linear LD coefficient and perturbing the nonlinear LD coefficient					
$r_{\rm A} + r_{\rm b}$	0.1409 ± 0.0040	0.1418 ± 0.0041	0.1412 ± 0.0038	0.1415 ± 0.0042	0.1410 ± 0.0039
k	0.11150 ± 0.00086	0.11090 ± 0.00103	0.11109 ± 0.00091	0.11098 ± 0.00097	0.11123 ± 0.00096
i (deg.)	87.42 ± 0.61	87.39 ± 0.69	87.43 ± 0.58	87.41 ± 0.66	87.43 ± 0.62
$u_{\rm A}$	0.429 ± 0.030	0.264 ± 0.045	0.107 ± 0.047	0.606 ± 0.057	0.401 ± 0.034
$v_{\rm A}$		0.30 perturbed	0.54 perturbed	0.27 perturbed	0.10 perturbed
T_0	272.45014 ± 0.00013	272.45015 ± 0.00014	272.45014 ± 0.00013	272.45015 ± 0.00013	272.45014 ± 0.00014
$r_{\rm A}$	0.1267 ± 0.0035	0.1276 ± 0.0036	0.1271 ± 0.0034	0.1274 ± 0.0037	0.1269 ± 0.0034
$r_{\rm b}$	0.01413 ± 0.00048	0.01415 ± 0.00052	0.01412 ± 0.00048	0.01413 ± 0.00052	0.01412 ± 0.00049
σ ($m$mag)	2.3878	2.3911	2.3890	2.3899	2.3886
$\chi^2_{\rm red}$	2.2661	2.2650	2.2651	2.2649	2.2651
Fitting for both LD coefficients					
$r_{\rm A} + r_{\rm b}$	0.1409 ± 0.0038	0.1413 ± 0.0047	0.1415 ± 0.0044	0.1442 ± 0.0050	0.1447 ± 0.0048
k	0.1115 ± 0.0009	0.1111 ± 0.0015	0.1110 ± 0.0018	0.1015 ± 0.0015	0.1016 ± 0.0014
i (deg.)	87.42 ± 0.57	87.43 ± 0.80	87.41 ± 0.78	88.73 ± 1.26	88.59 ± 1.25
$u_{\rm A}$	0.429 ± 0.030	0.312 ± 0.122	0.043 ± 0.668	2.149 ± 0.227	0.292 ± 0.064
$v_{\rm A}$		0.21 ± 0.25	0.65 ± 1.16	2.07 ± 0.31	1.65 ± 0.20
T_0	272.45014 ± 0.00013	272.45015 ± 0.00014	272.45015 ± 0.00013	272.45008 ± 0.00013	272.45007 ± 0.00014
$r_{\rm A}$	0.1267 ± 0.0033	0.1271 ± 0.0040	0.1273 ± 0.0038	0.1309 ± 0.0046	0.1314 ± 0.0043
$r_{\rm b}$	0.01413 ± 0.00047	0.01412 ± 0.00062	0.01414 ± 0.00061	0.01329 ± 0.00050	0.01334 ± 0.00051
σ ($m$mag)	2.3878	2.3900	2.3892	2.3983	2.3947
$\chi^2_{\rm red}$	2.2661	2.2673	2.2677	2.2705	2.2667