HOMOGENEOUS STUDIES OF TRANSITING PLANETS

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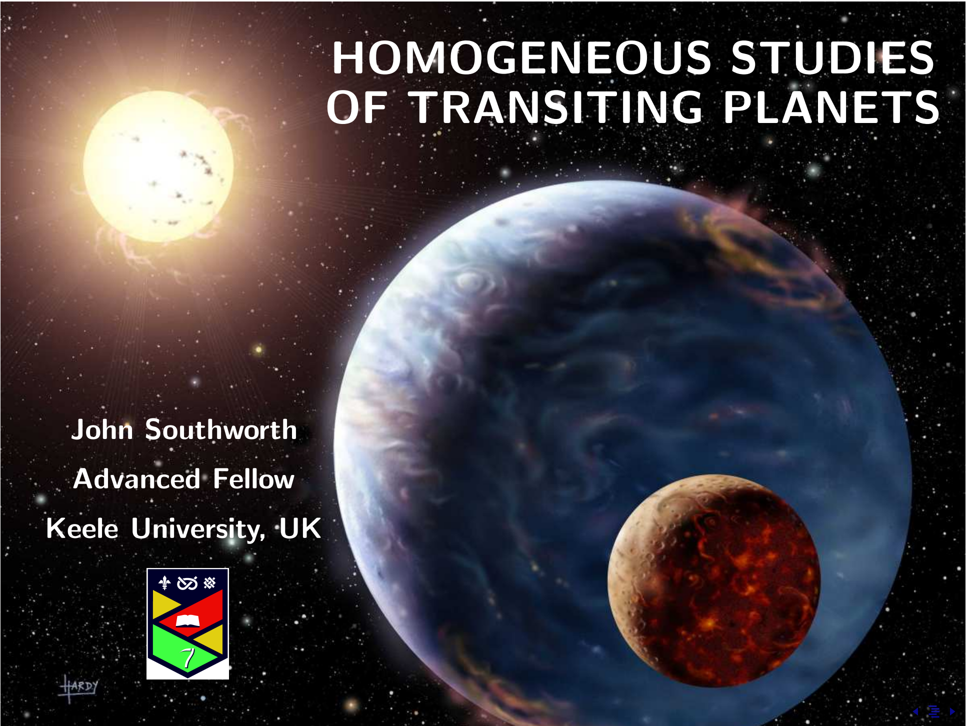
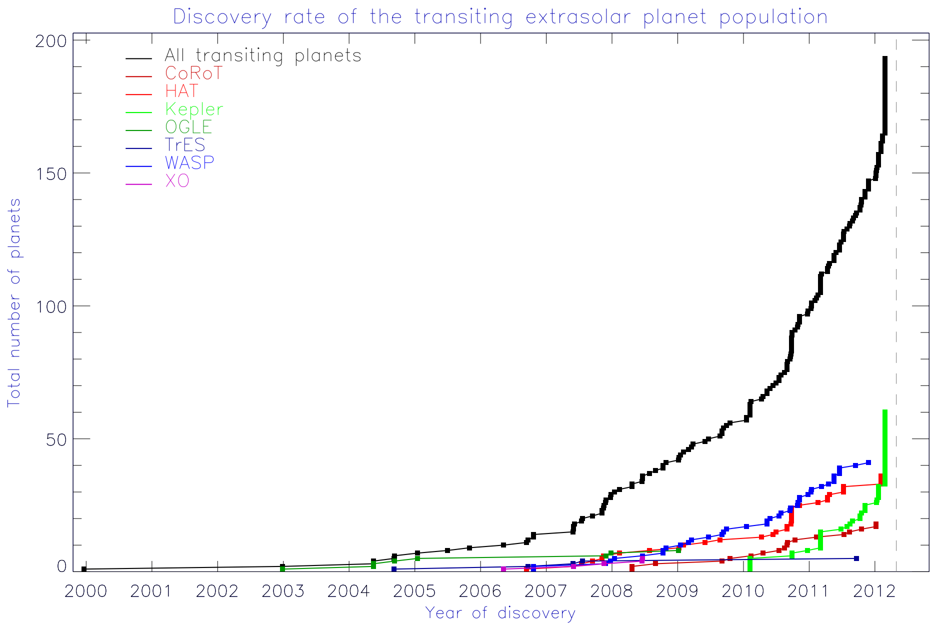
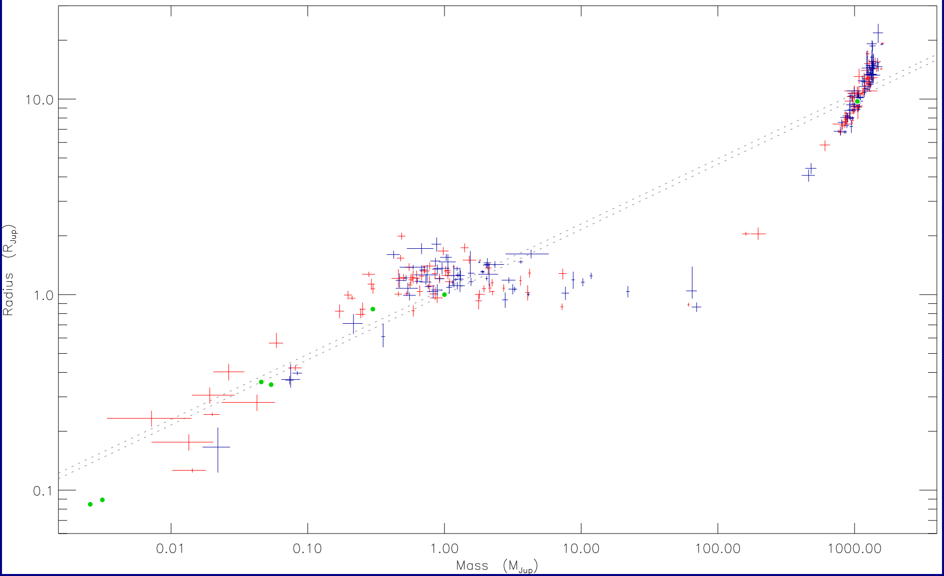




Discovery rate of the transiting extrasolar planet population
All transiting planets
CoRoT
HAT
Kepler
OGLE
TrES
WASP
XO
Total number of planets
Year of discovery
0
50
100
150
200
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

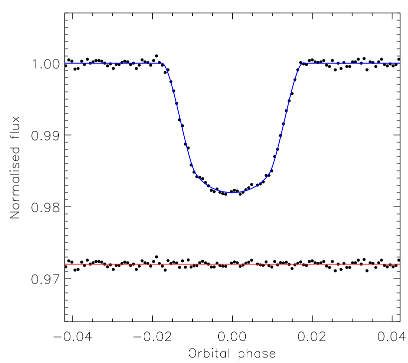


Mass versus radius: planets on the left, host stars on the right

Step 1: model the transit light curve

Fit a simple geometrical model to the data

I use the JKTEBOP code



Light curve of WASP-2
(Southworth et al. 2009)

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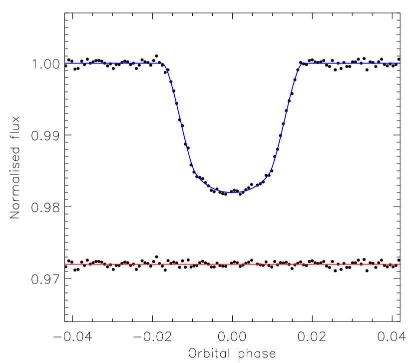
Derived parameters:

$P_{\rm orb}$	orbital period
$k = r_{\rm b}/r_{\rm A}$	ratio of planet to star radius
$r_{\rm A} = R_{\rm A}/a$	fractional radius of star
i	inclination of the orbit



Light curve of WASP-2
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Step 2: physical properties

- Light curve: $P_{\rm orb}$ $r_{\rm A}$ k i

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- Interpolate in stellar models:
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- Get planet mass and radius

  $\Rightarrow$ surface gravity $\Rightarrow$ atmosphere studies

  $\Rightarrow$ density $\Rightarrow$ composition and core size

  $\Rightarrow$ composition and core size $\Rightarrow$ formation scenario

Homogeneous studies of transiting planets

- Light curve fit: JKTEBOP
  - Limb darkening (five laws)
  - Contaminating light
  - Orbital eccentricity
  - Numerical integration (for long exposure times)
  - Statistical errors (Monte Carlo)
  - Correlated noise in the photometry (residual permutation)

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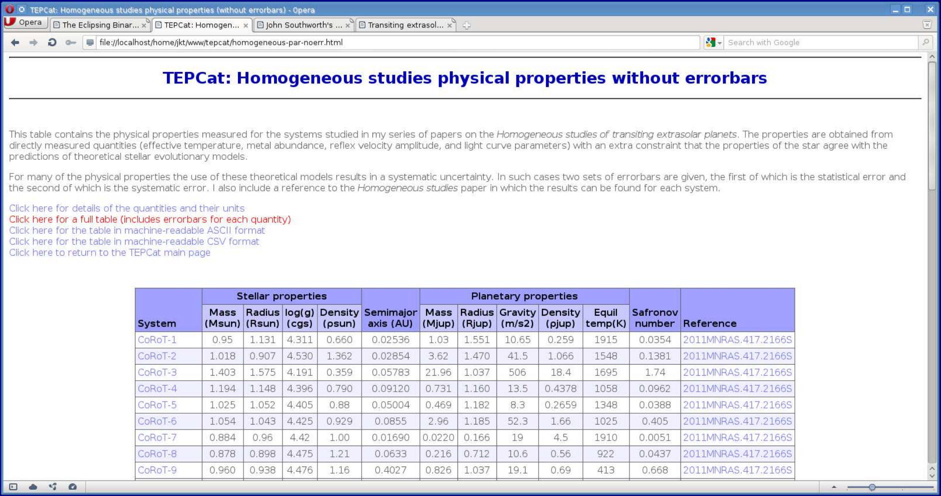
- Now done 60 transiting systems
- Southworth (2008, 2009, 2010, 2011)
- TEPCat: http://www.astro.keele.ac.uk/~jkt/tepcat/

TEPCat – homogeneous studies



TEPCat: Homogeneous studies physical properties (without errorbars) - Opera

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TEPCat: Homogeneous studies physical properties without errorbars

This table contains the physical properties measured for the systems studied in my series of papers on the *Homogeneous studies of transiting extrasolar planets*. The properties are obtained from directly measured quantities (effective temperature, metal abundance, reflex velocity amplitude, and light curve parameters) with an extra constraint that the properties of the star agree with the predictions of theoretical stellar evolutionary models.

For many of the physical properties the use of these theoretical models results in a systematic uncertainty. In such cases two sets of errorbars are given, the first of which is the statistical error and the second of which is the systematic error. I also include a reference to the *Homogeneous studies* paper in which the results can be found for each system.

Click here for details of the quantities and their units
Click here for a full table (includes errorbars for each quantity)
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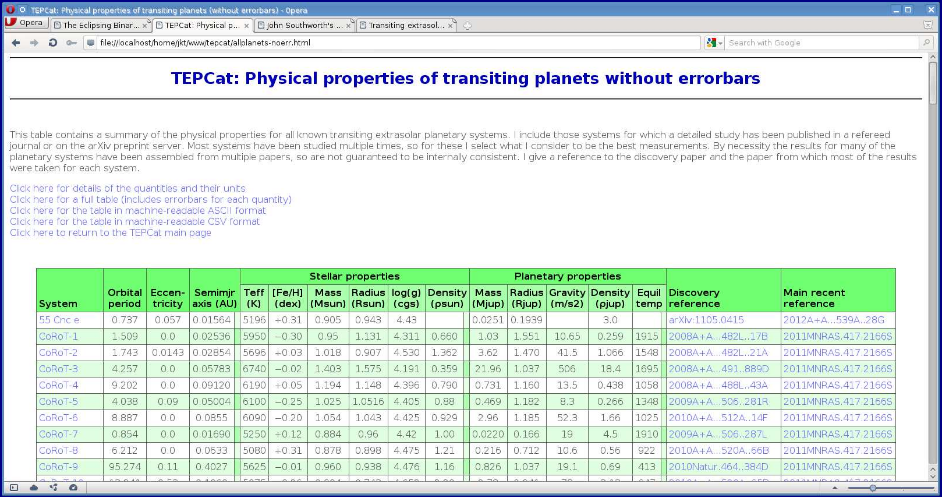
	Stellar properties					Planetary properties						
System	Mass (Msun)	Radius (Rsun)	log(g) (cgs)	Density (ρsun)	Semimajor axis (AU)	Mass (Mjup)	Radius (Rjup)	Gravity (m/s2)	Density (ρjup)	Equil temp(K)	Safronov number	Reference
CoRoT-1	0.95	1.131	4.311	0.660	0.02536	1.03	1.551	10.65	0.259	1915	0.0354	2011MNRAS.417.2166S
CoRoT-2	1.018	0.907	4.530	1.362	0.02854	3.62	1.470	41.5	1.066	1548	0.1381	2011MNRAS.417.2166S
CoRoT-3	1.403	1.575	4.191	0.359	0.05783	21.96	1.037	506	18.4	1695	1.74	2011MNRAS.417.2166S
CoRoT-4	1.194	1.148	4.396	0.790	0.09120	0.731	1.160	13.5	0.4378	1058	0.0962	2011MNRAS.417.2166S
CoRoT-5	1.025	1.052	4.405	0.88	0.05004	0.469	1.182	8.3	0.2659	1348	0.0388	2011MNRAS.417.2166S
CoRoT-6	1.054	1.043	4.425	0.929	0.0855	2.96	1.185	52.3	1.66	1025	0.405	2011MNRAS.417.2166S
CoRoT-7	0.884	0.96	4.42	1.00	0.01690	0.0220	0.166	19	4.5	1910	0.0051	2011MNRAS.417.2166S
CoRoT-8	0.878	0.898	4.475	1.21	0.0633	0.216	0.712	10.6	0.56	922	0.0437	2011MNRAS.417.2166S
CoRoT-9	0.960	0.938	4.476	1.16	0.4027	0.826	1.037	19.1	0.69	413	0.668	2011MNRAS.417.2166S

http://www.astro.keele.ac.uk/∼jkt/tepcat/

TEPCat – all transiting planets


TEPCat: Physical properties of transiting planets (without errorbars) - Opera

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TEPCat: Physical properties of transiting planets without errorbars

This table contains a summary of the physical properties for all known transiting extrasolar planetary systems. I include those systems for which a detailed study has been published in a refereed journal or on the arXiv preprint server. Most systems have been studied multiple times, so for these I select what I consider to be the best measurements. By necessity the results for many of the planetary systems have been assembled from multiple papers, so are not guaranteed to be internally consistent. I give a reference to the discovery paper and the paper from which most of the results were taken for each system.

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				Stellar properties						Planetary properties						
System	Orbital period	Eccen-tricity	Semimjr axis (AU)	Teff (K)	[Fe/H] (dex)	Mass (Msun)	Radius (Rsun)	log(g) (cgs)	Density (ρsun)	Mass (Mjup)	Radius (Rjup)	Gravity (m/s2)	Density (ρjup)	Equil temp	Discovery reference	Main recent reference
55 Cnc e	0.737	0.057	0.01564	5196	+0.31	0.905	0.943	4.43		0.0251	0.1939		3.0		arXiv:1105.0415	2012A+A...539A..28G
CoRoT-1	1.509	0.0	0.02536	5950	−0.30	0.95	1.131	4.311	0.660	1.03	1.551	10.65	0.259	1915	2008A+A...482L..17B	2011MNRAS.417.2166S
CoRoT-2	1.743	0.0143	0.02854	5696	+0.03	1.018	0.907	4.530	1.362	3.62	1.470	41.5	1.066	1548	2008A+A...482L..21A	2011MNRAS.417.2166S
CoRoT-3	4.257	0.0	0.05783	6740	−0.02	1.403	1.575	4.191	0.359	21.96	1.037	506	18.4	1695	2008A+A...491..889D	2011MNRAS.417.2166S
CoRoT-4	9.202	0.0	0.09120	6190	+0.05	1.194	1.148	4.396	0.790	0.731	1.160	13.5	0.438	1058	2008A+A...488L..43A	2011MNRAS.417.2166S
CoRoT-5	4.038	0.09	0.05004	6100	−0.25	1.025	1.0516	4.405	0.88	0.469	1.182	8.3	0.266	1348	2009A+A...506..281R	2011MNRAS.417.2166S
CoRoT-6	8.887	0.0	0.0855	6090	−0.20	1.054	1.043	4.425	0.929	2.96	1.185	52.3	1.66	1025	2010A+A...512A..14F	2011MNRAS.417.2166S
CoRoT-7	0.854	0.0	0.01690	5250	+0.12	0.884	0.96	4.42	1.00	0.0220	0.166	19	4.5	1910	2009A+A...506..287L	2011MNRAS.417.2166S
CoRoT-8	6.212	0.0	0.0633	5080	+0.31	0.878	0.898	4.475	1.21	0.216	0.712	10.6	0.56	922	2010A+A...520A..66B	2011MNRAS.417.2166S
CoRoT-9	95.274	0.11	0.4027	5625	−0.01	0.960	0.938	4.476	1.16	0.826	1.037	19.1	0.69	413	2010Natur.464..384D	2011MNRAS.417.2166S

http://www.astro.keele.ac.uk/∼jkt/tepcat/

TEPCat – observable quantities

TEPCat: Basic observable properties of transiting planets - Opera

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TEPCat: Basic observable properties of transiting planets

This table contains basic observable quantities all known (published) transiting extrasolar planets. The quantities comprise the sky position (J2000), V magnitude, latest orbital ephemerides, and the transit duration and depth. Transiting planets are denoted with a "TEP" and transiting brown dwarfs with a "BD". The transit depth is only approximate as it varies with wavelength.

The times of mid-transit are taken from published studies, which use a range of different time conventions (and do not always clearly state which). The most common is HJD(UTC), but BJD(UTC), HJD (TDB) and BJD(TDB) are also regularly used. The difference between HJD and BJD is only a few seconds, but the offset between UTC and TDB is currently 66.186s. A good explanation of this was given by Eastman et al (2010PASP..122..935E). If precise timings are needed then you should refer to the reference given in the final column of the table below.

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System	Type	Right ascension	Declination	V mag	Transit length (d)	Transit depth	Time of mid-transit	Orbital period (d)	Ephemeris reference
55 Cnc e	TEP	08 52 36.13	+28 19 53.0	5.95	0.0734	0.045 %	2455733.0087 ± 0.0012	0.7365449 ± 0.0000048	2012A+A...539A..28G
CoRoT-1	TEP	06 48 19.17	−03 06 07.8	13.6	0.10439	2.3 %	2454524.6231 ± 0.0002	1.5089686 ± 0.0000006	2009A+A...506..359G
CoRoT-2	TEP	19 27 06.50	+01 23 01.4	12.57	0.09446	3.2 %	2454237.53556 ± 0.00021	1.7429935 ± 0.0000010	2010A+A...511A...3G
CoRoT-3	BD	19 28 13.27	+00 07 18.6	13.29	0.153	0.25 %	2454283.13388 ± 0.00024	4.2567994 ± 0.0000035	2009A+A...506..377T
CoRoT-4	TEP	06 48 46.72	−00 40 22.0	14.0	0.184	1.3 %	2454141.36416 ± 0.00089	9.20205 ± 0.00037	2008A+A...488L..43A
CoRoT-5	TEP	06 45 06.54	+00 48 54.9	14.0	0.117	1.4 %	2454400.19885 ± 0.00002	4.0378962 ± 0.0000019	2009A+A...506..281R
CoRoT-6	TEP	18 44 17.40	+06 39 47.4	13.91	0.170	1.5 %	2454595.6144 ± 0.0002	8.886593 ± 0.00004	2010A+A...512A..14F
CoRoT-7	TEP	06 43 49.47	−01 03 46.9	11.72	0.0469	0.034 %	2454398.0769 ± 0.0015	0.853590 ± 0.000006	2012ApJ...745...81F
CoRoT-8	TEP	19 26 21.24	+01 25 35.2	14.76	0.114	0.7 %	2454239.03311 ± 0.00078	6.212381 ± 0.000057	2011MNRAS.417.2166S
CoRoT-9	TEP	18 43 08.81	+06 12 15.2	13.69	0.337	1.6 %	2454603.3447 ± 0.0001	95.2738 ± 0.0014	2010Natur.464..384D
CoRoT-10	TEP	19 24 15.29	+00 44 46.1	15.22	0.124	1.4 %	2454273.3436 ± 0.0012	13.2406 ± 0.0002	2010A+A...520A..65B

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TEPCat – Rossiter-McLaughlin

TEPCat: Rossiter-McLaughlin effect observations of transiting planets

This table catalogues the Rossiter-McLaughlin effects measured for known (published) transiting extrasolar planets. This effect is normally observed spectroscopically (usually via radial velocity measurements) but can be obtained photometrically, by analysis of starspot crossing events during transits.

All known Rossiter-McLaughlin measurements are included. Many systems have multiple measurements, often resulting from the same data. In these cases the most recent is normally the most reliable but it is worthwhile checking the literature to be sure.

The Rossiter-McLaughlin effect was originally predicted by Holt (1893) and observed (but not definitively) in the eclipsing binary star systems δ Librae (Schlesinger 1910) and λ Tauri (Schlesinger 1916). It was subsequently described and clearly demonstrated by Rossiter (1924) for β Lyrae and McLaughlin (1924) for β Persei. The designation "Rossiter-McLaughlin effect" arose from the latter two papers.

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System	λ (degrees)	Reference
CoRoT-1	77 ± 11	Pont et al. (2010)
CoRoT-2	7.2 ± 4.5 4.0 + 6.1 - 5.9	Bouchy et al. (2008) Gillon et al. (2010)
CoRoT-3	37.6 + 10.0 - 22.3	Triaud et al. (2009)
CoRoT-11	prograde	Gandolfi et al. (2010)
CoRoT-18	−10 ± 20	Hébrard et al. (2011)
CoRoT-19	−52 + 27 - 22	Guenther et al. (2011)
HAT-P-1	3.7 ± 2.1	Johnson et al. (2008)
HAT-P-2	1.2 ± 13.4 0.2 + 12.2 - 12.5	Winn et al. (2007) Loeillet et al. (2008)
HAT-P-4	−4.9 ± 11.9	Winn et al. (2011)

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