SuperWASP automatic transit candidate investigation strategy

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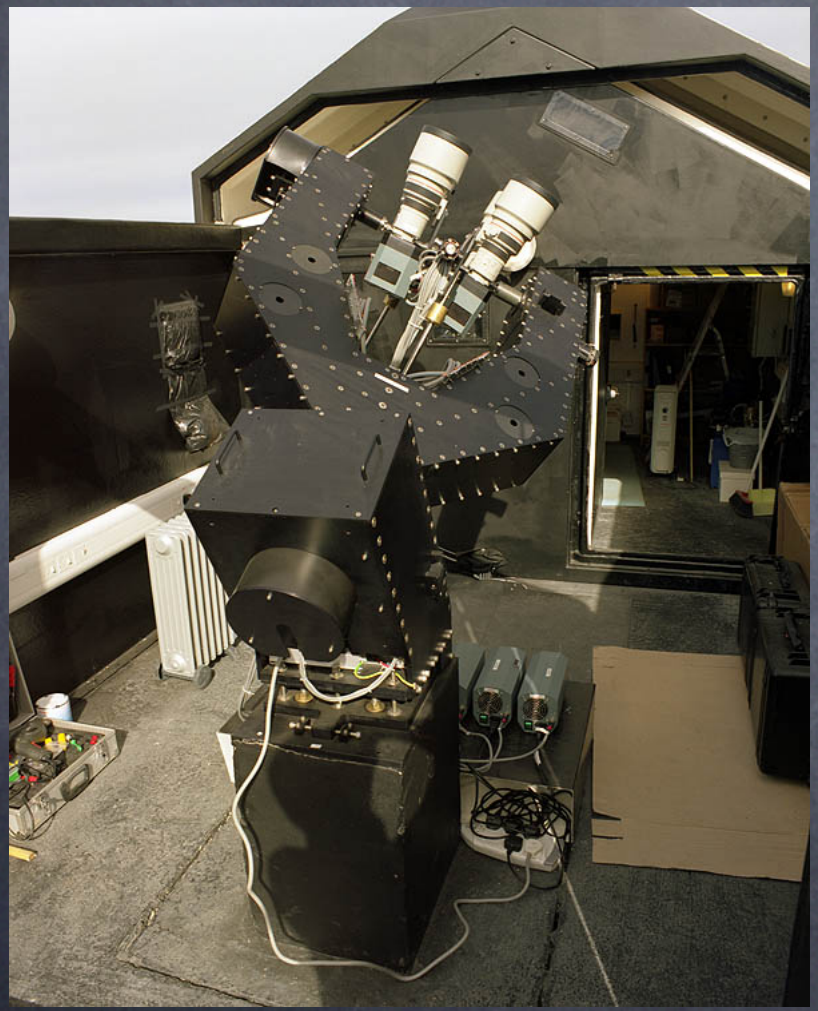
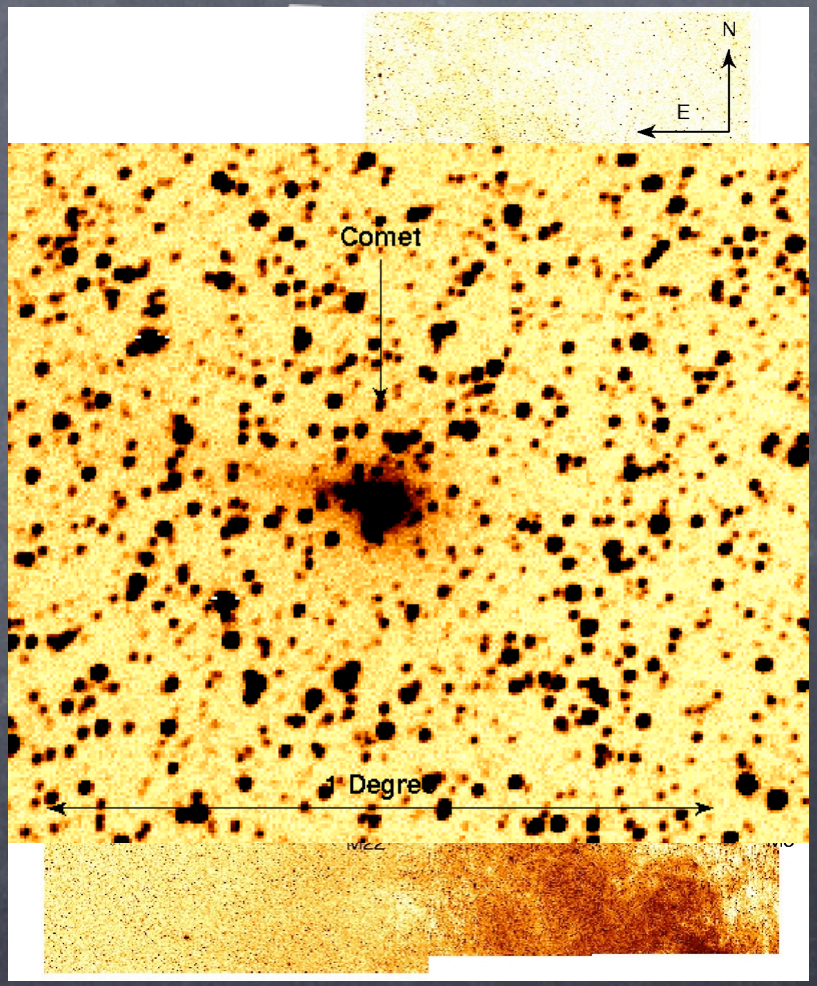
the SuperWASP collaboration

SuperWASP

www.superwasp.org





mosaic by Damian Christian

superwasp

www.superwasp.org

- currently 5 cameras, each with
  - 11 cm aperture 200mm f1/8 telephoto lens
  - 7.8x7.8 deg FOV
- plate scale 13.7"/pixel
- dozen fields monitored for several months for >=6 h / night with sampling time <= 8 min

motivation

- 100's of candidates expected per season
- cannot possibly follow all spectroscopically
- lots of information already available in public archives as target stars are bright (V=8-13)
- need a means of automatically rating candidates for follow-up

the archive

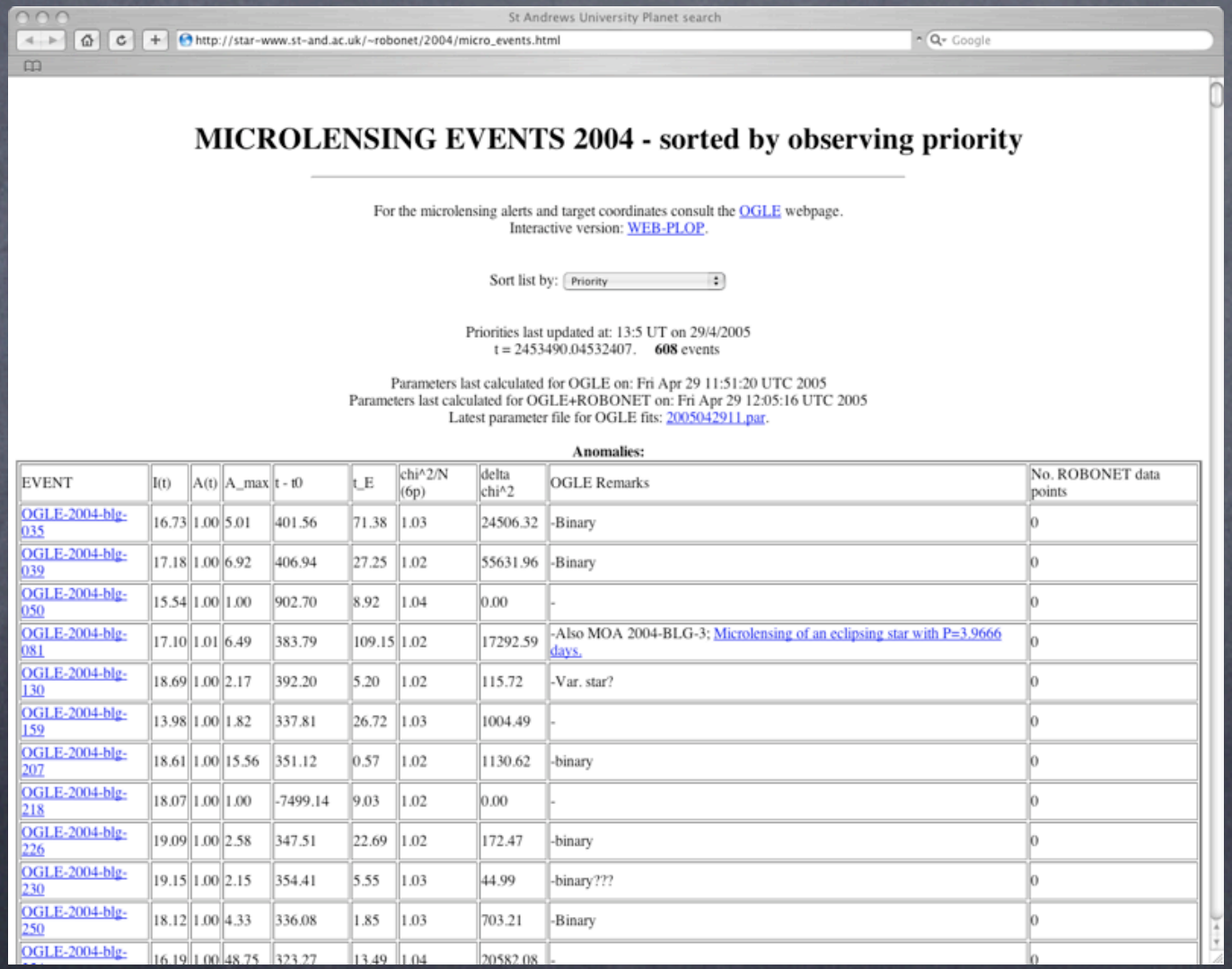
- enormous data volumes (20TB/yr from 2006)
- 3 components: images, photometry, catalogue
- photometry stored so as to allow
  - frequent increments (new data)
  - rapid extraction of individual LCs
  - sky tiles (10000 stars), 1 file / tile / night
- allows upload of high level information (tables of particular types of objects)

basic strategy

- The SuperWASP archive contains images, light curves & tables
- Each time a transit search is performed the resulting candidate list is uploaded to the archive
- "Metascript" acting on archive extracts candidate list
  - calls subscripts to perform individual diagnostics, returning "metrics" + graphic output
  - creates individual candidate webpages with plots / result of the various diagnostics
  - combines indvidual metric and produces summary page with priority ranked table & links to individual candidate pages
  - webpages stored in archive
- Need user feedback mecanism & tracking of follow-up obs

what the master table may look like:

example from the ROBONET project (Dan Bramich)



MICROLENSING EVENTS 2004 - sorted by observing priority

For the microlensing alerts and target coordinates consult the OGLE webpage.
Interactive version: WEB-PLOP.

Sort list by: Priority

Priorities last updated at: 13:5 UT on 29/4/2005
t = 2453490.04532407. **608** events

Parameters last calculated for OGLE on: Fri Apr 29 11:51:20 UTC 2005
Parameters last calculated for OGLE+ROBONET on: Fri Apr 29 12:05:16 UTC 2005
Latest parameter file for OGLE fits: 2005042911.par.

Anomalies:

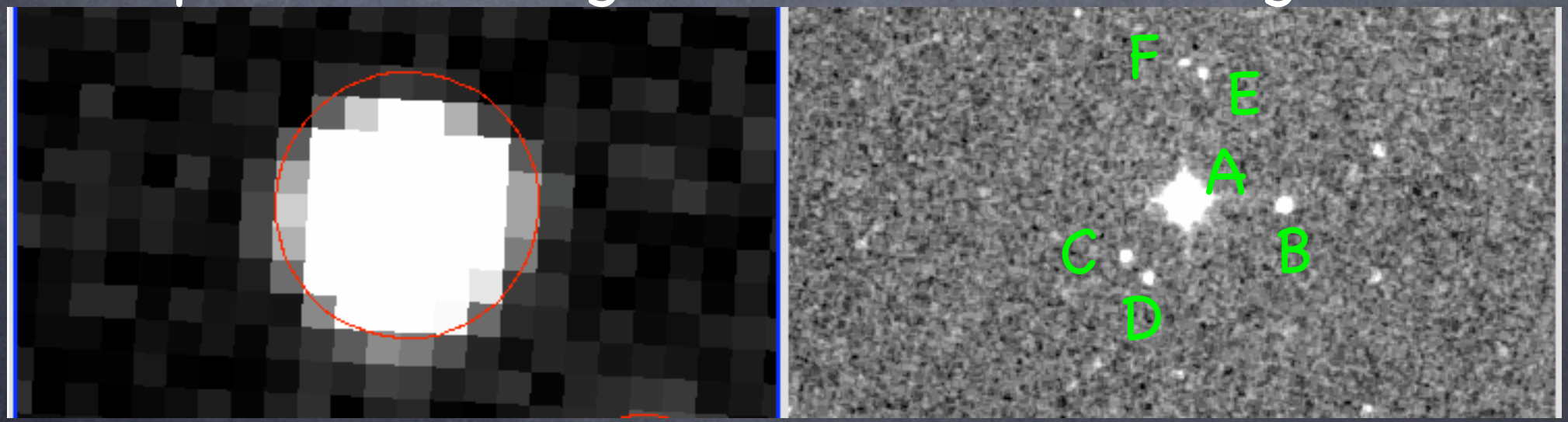
EVENT	I(t)	A(t)	A_max	t - t0	t_E	chi^2/N (6p)	delta chi^2	OGLE Remarks	No. ROBONET data points
OGLE-2004-blg-035	16.73	1.00	5.01	401.56	71.38	1.03	24506.32	-Binary	0
OGLE-2004-blg-039	17.18	1.00	6.92	406.94	27.25	1.02	55631.96	-Binary	0
OGLE-2004-blg-050	15.54	1.00	1.00	902.70	8.92	1.04	0.00	-	0
OGLE-2004-blg-081	17.10	1.01	6.49	383.79	109.15	1.02	17292.59	-Also MOA 2004-BLG-3; Microlensing of an eclipsing star with P=3.9666 days.	0
OGLE-2004-blg-130	18.69	1.00	2.17	392.20	5.20	1.02	115.72	-Var. star?	0
OGLE-2004-blg-159	13.98	1.00	1.82	337.81	26.72	1.03	1004.49	-	0
OGLE-2004-blg-207	18.61	1.00	15.56	351.12	0.57	1.02	1130.62	-binary	0
OGLE-2004-blg-218	18.07	1.00	1.00	-7499.14	9.03	1.02	0.00	-	0
OGLE-2004-blg-226	19.09	1.00	2.58	347.51	22.69	1.02	172.47	-binary	0
OGLE-2004-blg-230	19.15	1.00	2.15	354.41	5.55	1.03	44.99	-binary???	0
OGLE-2004-blg-250	18.12	1.00	4.33	336.08	1.85	1.03	703.21	-Binary	0
OGLE-2004-blg-	16.19	1.00	48.75	323.27	13.49	1.04	20582.08	-	0

subscripts - stars

- assess degree of contamination in aperture

SuperWASP image

DSS image

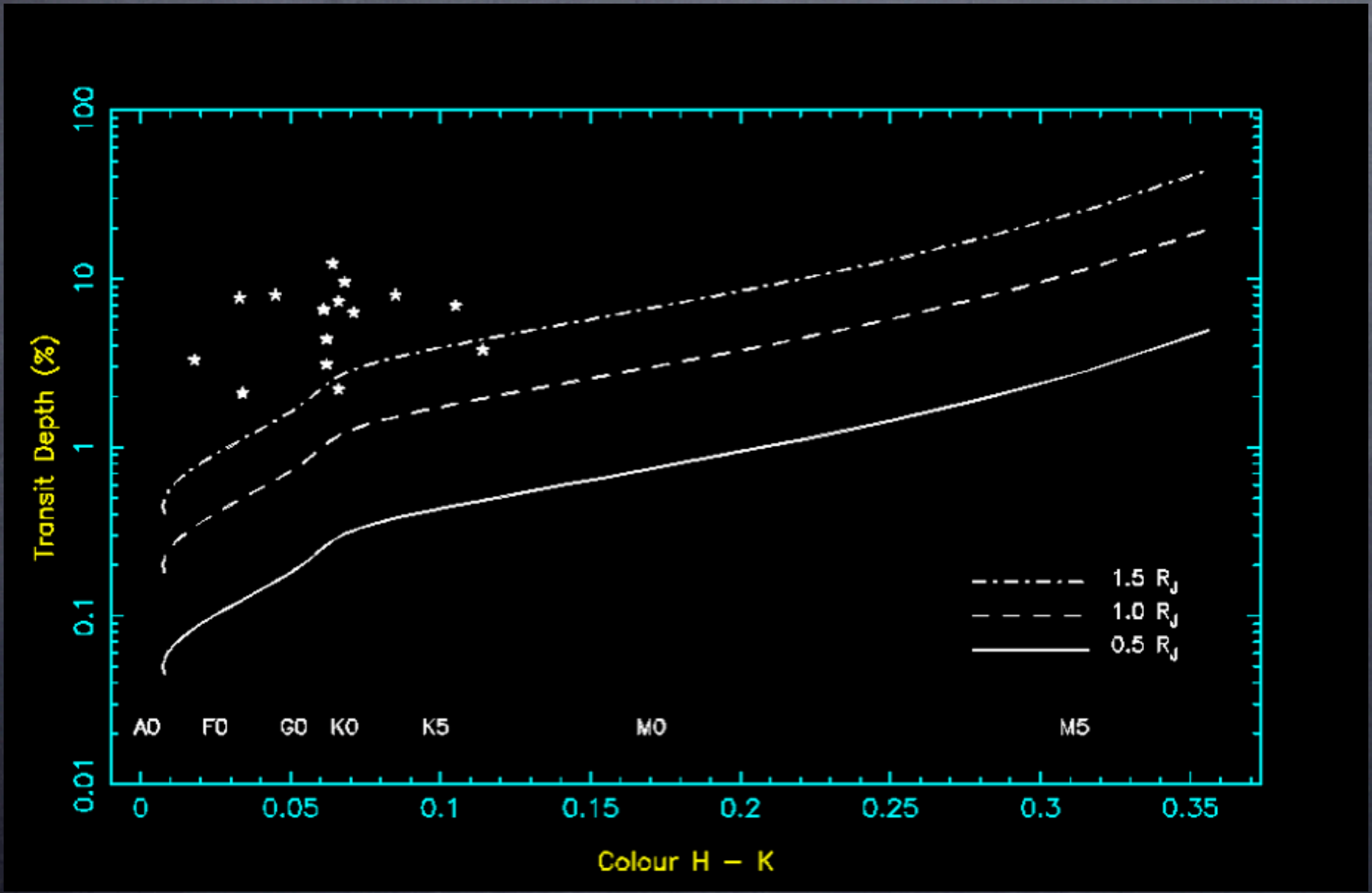


→ produce list of potential primary stars (using Tycho2, USNO2.0, 2MASS) taking into account flux ratios

subscripts - stars

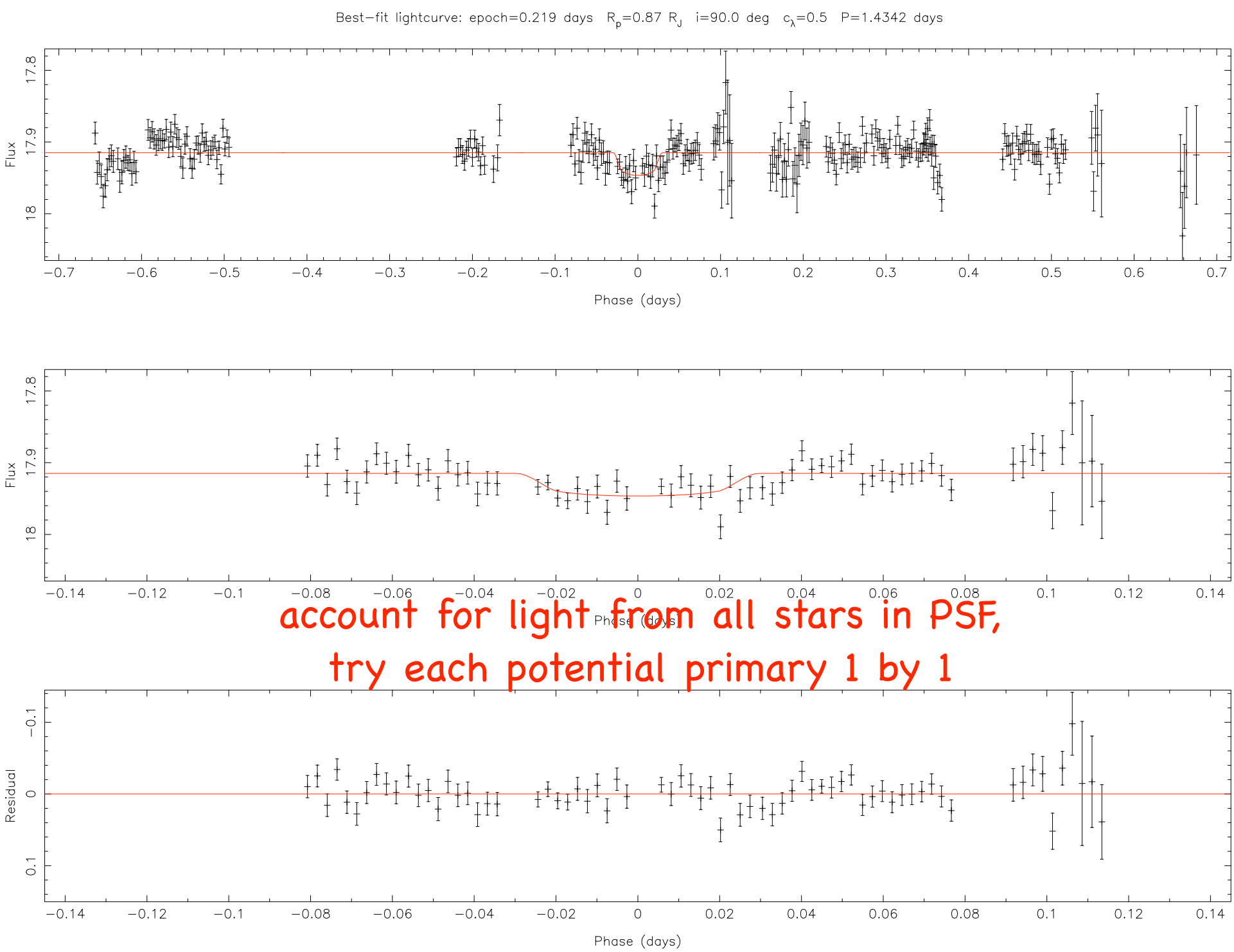
- assess degree of contamination in aperture
- extract info on targets from public archives
  - colours
  - proper motions (high proper motion -> more likely dwarf)
- compute likely radius of primary star(s) from colours

subscripts - stars



subscripts - lightcurves

- refined light curve analysis
  - flag: transits last whole nights, single events...
  - refined transit fit using stellar parameters


Best−fit lightcurve: epoch=0.219 days R_p=0.87 R_J i=90.0 deg c_λ=0.5 P=1.4342 days
Flux
Phase (days)
Residual
account for light from all stars in PSF,
try each potential primary 1 by 1

subscripts - lightcurves

- refined light curve analysis
  - flag: transits last whole nights, single events...
  - refined transit fit using stellar parameters
  - also do stellar eclipse fit

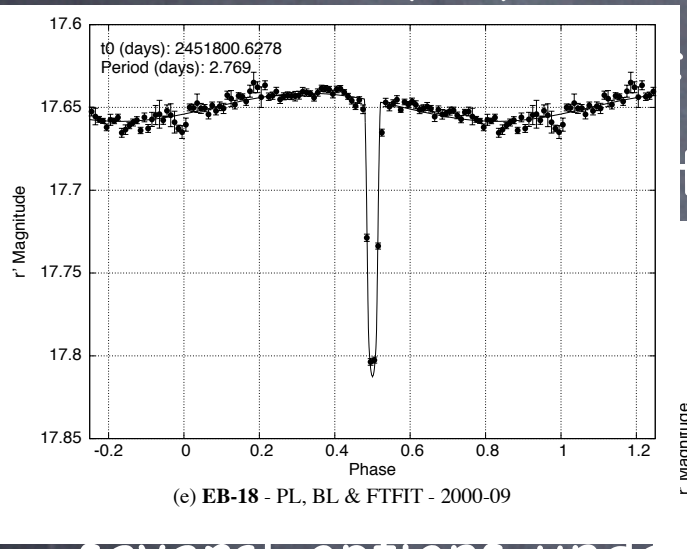
several options under study:

- match against library of simulated EB light curves

- simple model with double sine + triangular / rectangular eclipses

subscripts - lightcurves

St Andrews open cluster planet search
Bramich et al. (2005)



(e) **EB-18** - PL, BL & FTFIT - 2000-09

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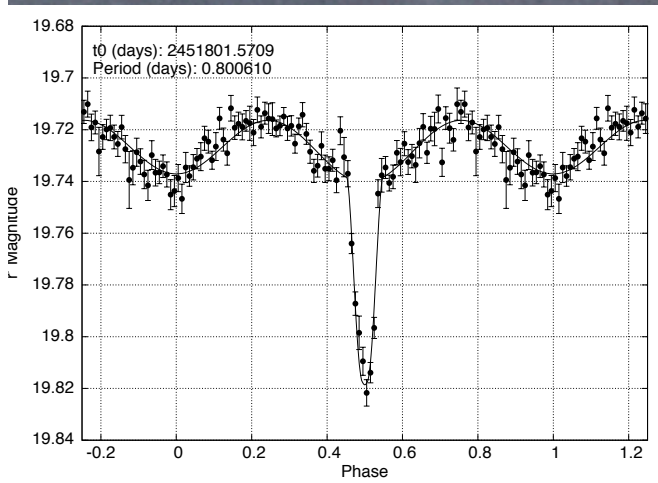
ts last whole nights, single events...

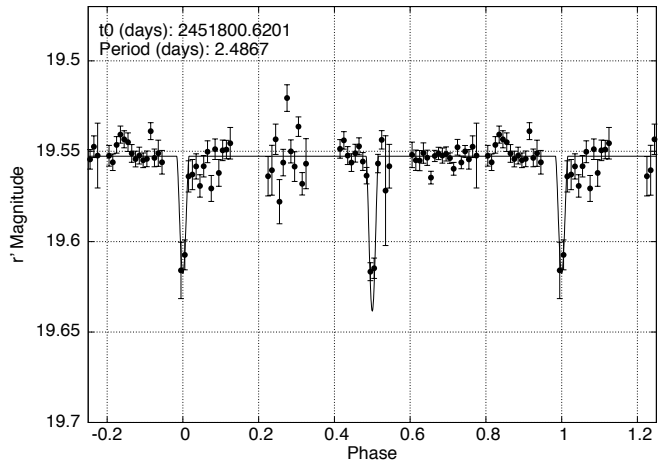
arameters

several options unde

- simple m



(b) **EB-13** - PL, BL & FTFIT - 1999-06, 1999-07 & 2000-09



(d) **TR-3** - PL, BL & Eclipsing Binary Fit - 2000-09

subscripts - lightcurves

- refined light curve analysis
  - flag: transits last whole nights, single events...
  - refined transit fit using stellar parameters
  - also do stellar eclipse fit

several options under study:

- match against library of simulated EB light curves
- simple model with double sine + triangular / rectangular eclipses
- neural networks trained on observed or simulated light EB curves

subscripts - lightcurves

- refined light curve analysis
  - flag: transits last whole nights, single events...
  - refined transit fit using stellar parameters
  - also do stellar eclipse fit
    - which fits best, transit or eclipse?

conclusion

- scripts take input from the archive and output (ranked list of candiates) is stored in archive
- regular updates (each time new candidates added)
- status:
  - strategy agreed
  - jobs being distributed
  - aim for working system by end of summer