Minima of long period eclipsing stars

Paschke Anton 1)
Klotz Alain 2)
Boër Michel 3)
1) GEOS (Groupe Européen d'Observation Stellaire)
2) Centre d'Etude Spatiale des Rayonnements, Observatoire Midi-Pyrénées, Toulouse, France
3) Observatoire de Haute-Provence, France
Anton@Paschke.com

Abstract: This is the first of a planned seria of minima lists. It contains only five stars,
UU Cas, EK Cas, RS Cep, EX Cep, KL Cep.

Introduction
Long period eclipsing stars are in general very neglected as long as observers have to seek them manually by star-hoping. An automated telescope is much more efficient. The well known Rotse sky survey is often the only available source of information, but it was active only a few months and ceased the activity some years ago.

We are using the 25-cm automatic telescopes TAROT http://tarot.obs-hp.fr
(Boer et al., 2001, Bringer et al., 1999). One of the telescopes is located in the northern hemisphere in Calern Observatory (Observatoire de la Cote d'Azur, Nice University, France). A second identical telescope in the southern hemisphere, located in ESO La Silla Observatory, Chile, is in operation since 2006 September. Images are obtained by 2048x2048 Marconi 42-40 thin back illuminated CCD. Field of view of both telescopes is 1.86/deg x 1.86/deg. Data reduction, from bias subtraction and flatfielding to photometry using SExtractor (Bertin & Arnouts, 1996), is performed automatically.

The main purpose of TAROT is obvious from the name – to observe gamma ray burst afterglows. But that takes only a very small fraction of the telescope time. The lions share of the time is used for RR Lyrae stars and a small fraction is also used for eclipsing stars. The idea is to take one or two pictures with both I and V filters on every clear night. About 20 stars are on the observing schedule.

The first year of operation is now completed and for some stars we collected enough data to determine a mean minimum time. The observation of some of the reported stars was discontinued, other stars have been scheduled on their place.

Results:			elements used	error(ph)	error(days)
UU	Cas 53883.616	V	28751.72 + 8.51929	0.030	0.245
UU	Cas 53883.624	I			
EK	Cas 53895.594	I	38388.12 + 8.677942	0.050	0.434
EK	Cas 53895.603	V			
RS	Cep 53928.435	I	40862.607 + 12.42000	0.010	0.124
RS	Cep 53928.447	V			
EX	Cep 53921.300	V	52873.341 + 13.43444	0.005	0.067
EX	Cep 53921.320	I			
KL	Cep 54211.600	IV	34724.700 +256.1	0.005	1.2

As minima are determined from folded data, by fitting a curve (sum of harmonics) to the measurements close to the expected minimum. The minimum time and the error are first estimated in units of phase and then calculated in days.

Discussion:
UU Cas
Primary   minimum 0.45 mag amplitude
Secondary minimum 0.30 mag amplitude
UU Cas was frequently observed in the past. There exist many photographic minima, the last from K. Häussler. The only photoelectric observation known to us is Hipparcos. UU Cas is classified as an EB star in the GCVS and it clearly shows an EB lightcurve.

EK Cas
Primary   minimum 0.45 mag amplitude
Secondary minimum 0.10 mag amplitude
EK Cas was frequently observed in the past, the last observation was from Beyer, it was visual. Rotse data allow to determine one minimum too.
EK Cas is classified as an EB star in the GCVS and it clearly shows an EB lightcurve.

RS Cep
Primary   minimum 1.6 mag amplitude, $D = 0.10$ = 1.2 days
Secondary minimum 0.1 mag amplitude, $D = 0.25$ = 3.1 days
The star was also observed frequently in the past. The minima times derived from Hipparcos and Rotse data differ a bit more then may be expected. The star is classified as EA in GCVS but is not realy constant at normal light.

EX Cep:
Primary   minimum 0.6   mag amplitude, $D = 0.043 = 0.58$ days
Secondary minimum 0.07 mag amplitude, $D = 0.1$ = 1.3 days
Only photographic observations by Strohmeier and one ccd minimum by Jungbluth are known. The minimum is very sharp, the star shows constant light in the remaining time.

KL Cep.
Primary   minimum 0.3   mag amplitude, $D = 0.024 = 6.14$ days
Secondary minimum: only two points observed so far.
Only the GCVS base-minimum, from Miller and Wachmann is known. KL Cep shows continuous variability that is obviously not caused by eclipses. The period is 115.57 days, the amplitude about 0.15 mag.

The individual measurements on all reported stars are attached to this paper.

References:

Samus N. N. et al, 2006, General Catalouge of Variable Stars, 4th edition
electronic version http://www.sai.msu.su/groups/cluster/gcvs/

Wozniak, P.R., Vestrand, W.T., Akerlof, C.W. et al., 2004, Astron. J., 127, 2436
Rotse   http://skydot.lanl.gov/

O-C gate http://var.astro.cz/ocgate/

K.Häussler, Mitteilungen der Bruno H.Bürgel Sternwarte Hartha 3.1

M.Beyer, Aastronomische Nachrichten 288.89, H 2/3, 1964

H.Jungbluth, Neue Elemente fuer EX Cephei, BAV Rundbrief 2004 / 3

W.J.Miller & A.A.Wachmann, RIC Astr 8, N12, 1971

Bertin, E., Arnouts, S., 1996, *A&AS*, **117**, 393

Bringer, M., Boër, M., Peignot, C., Fontan, G., Merce, C., 1999, *A&AS*, **138**, 581

Boër, M., Atteia, J. L., Bringer, M., Gendre, B., Klotz, A., Malina, R., de Freitas Pacheco, J. A., Pedersen, H., 2001, *A&A*, **378**, 76