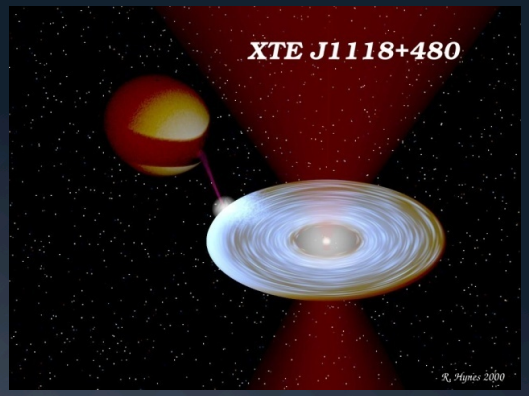
HIGH SPEED OPTICAL PHOTOMETRY OF LMXBS

Paul A. Mason

University of Texas at El Paso

& E. L. Robinson

University of Texas at Austin



V1727 Cyg (NS)

J1118+480 (BH)

J1753-027 (BHC)

MS 1603+260 (NS)*

V1055 Ori (UCB)*

J1957+115 (NS?)**

See posters:
(10) *Froning et al.
(23) **Robinson et al.

And the UTEP Astrophysics Undergraduate Team:

Sebastian Gomez

Emmanuel Gonzalez

Ryan Lee

Isaac Lopez

Lorena C. Monroy

Alex Price

Aurelio Paez

Collaborators on parts of this project:

Amanda Bayless (SWRI) Cynthia Froning (U Colorado)

Rob Hynes (LSU) Pasi Hakala (Turku, Finland)

OBSERVATIONS

Telescopes: 2.1-m and 2.7-m telescopes of McDonald Observatory.

CCD Photometry using a broad-band (BVR) filter and usually 1-10s integrations.

Typically, 20-25 nights of data (~4 hours each night) are obtained.

V1727 Cyg (NS)

J1118+480 (BH)

J1753-027 (BHC)

MS 1603+260 (NS)*

V1055 Ori (UCB)*

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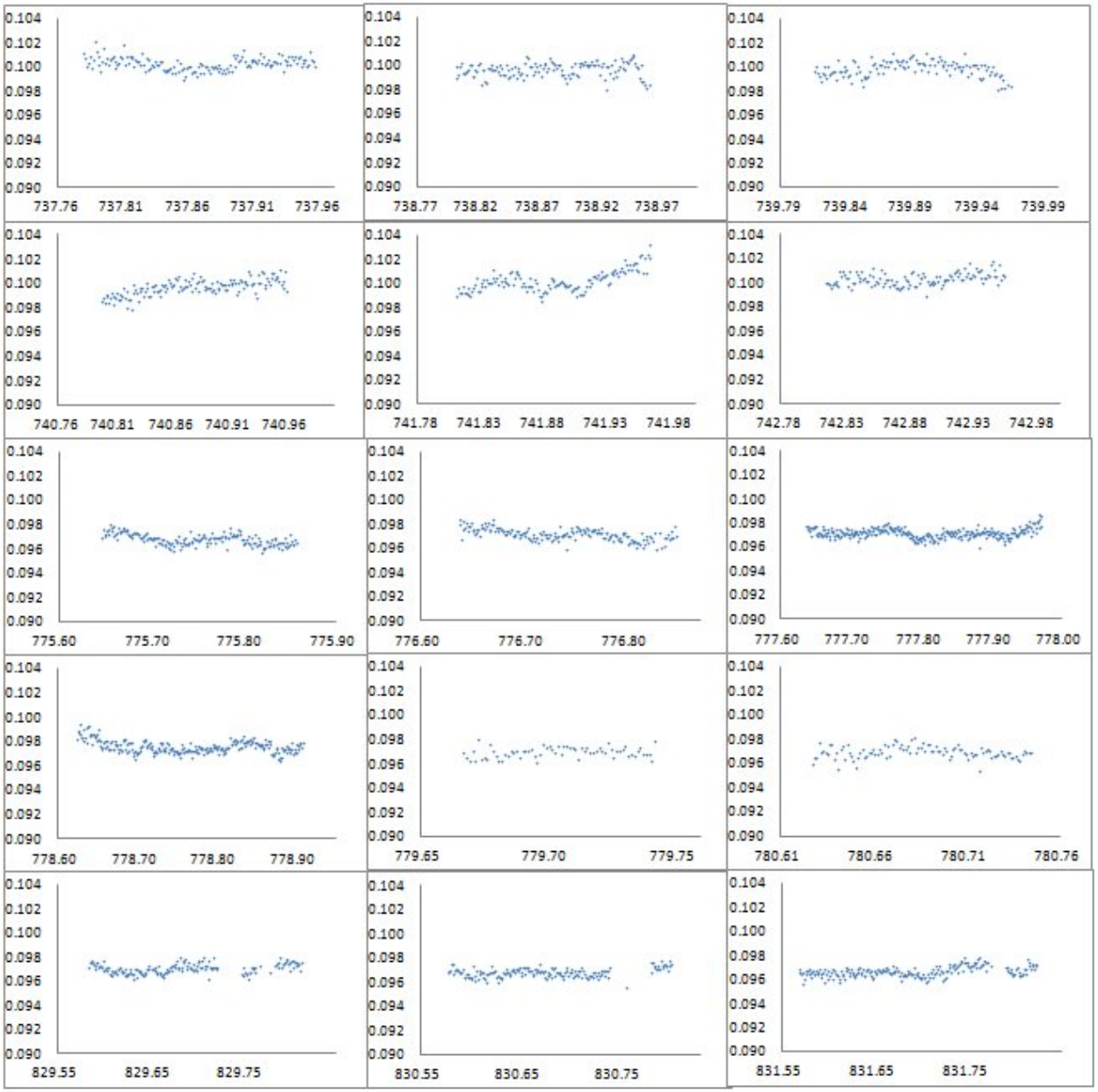
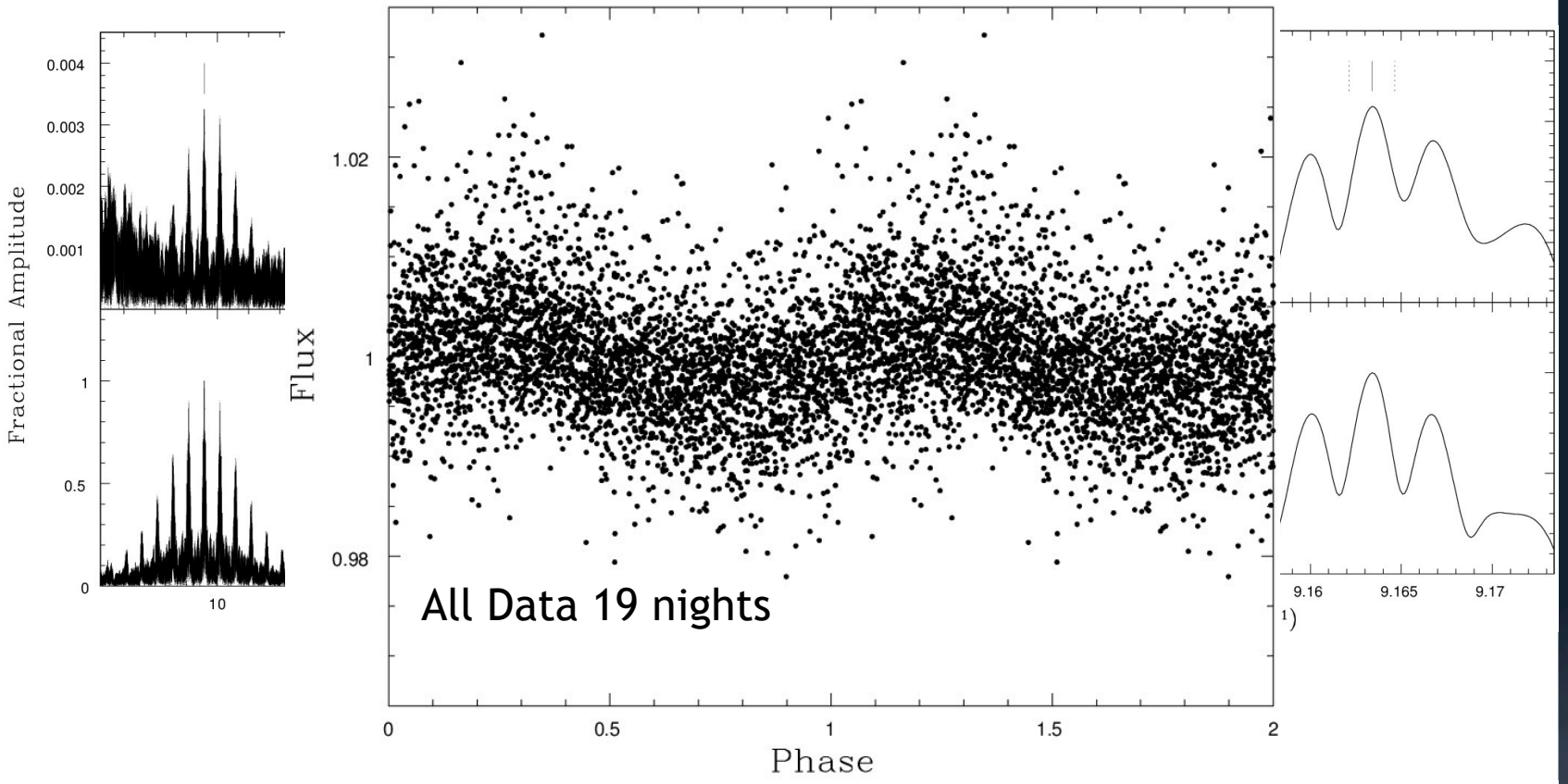
V1727 CYGNI - LIGHT CURVES



V1727 CYG - PERIOD ANALYSIS



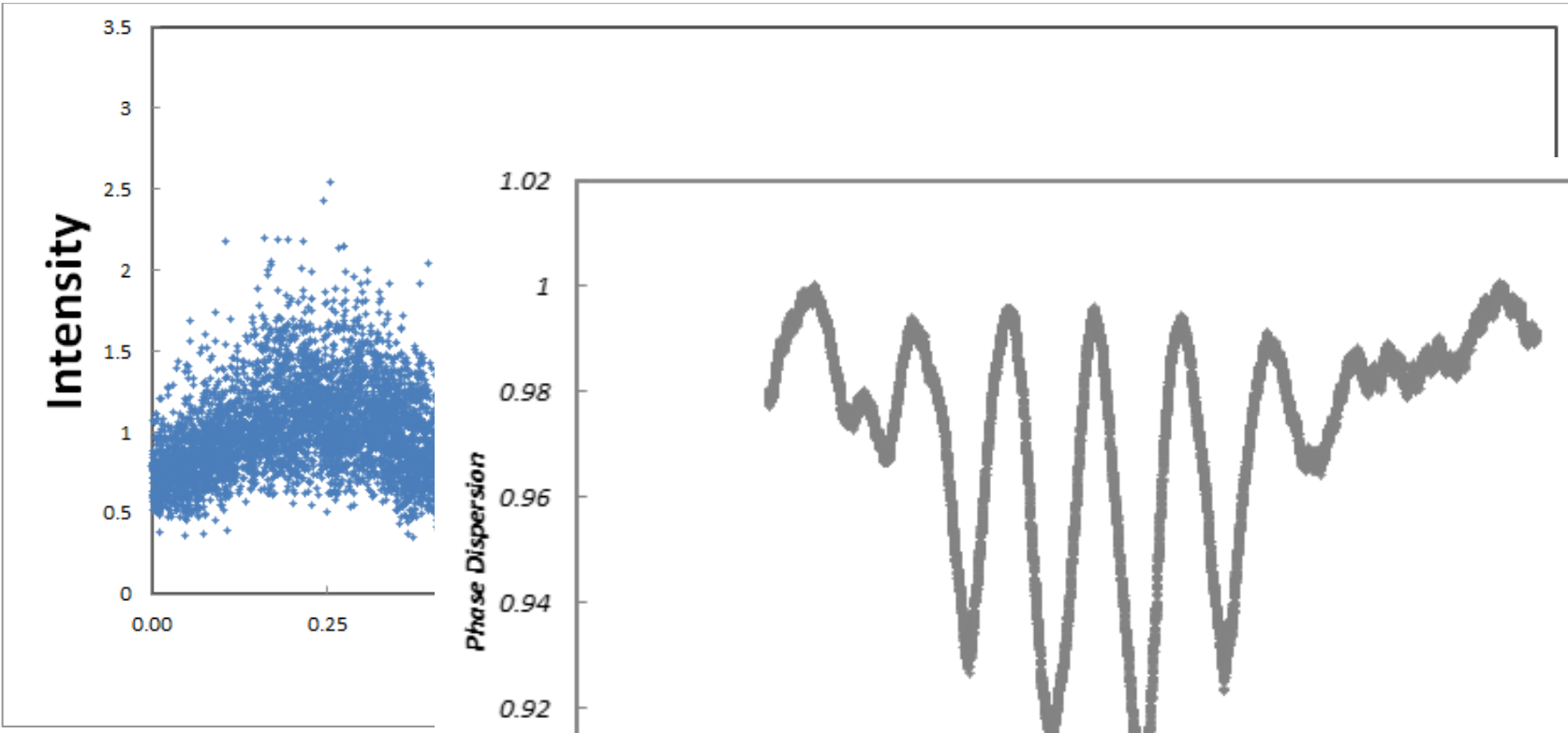
Optical light curve is interpreted as ellipsoidal variations, with likely some x-ray heating of the face of the secondary. Minima are nearly identical.

SUMMARY OF RESULTS

V1727 Cygni is an LMXB containing a neutron star, currently in quiesence. Thorstensen (1979) obtained an optical light curve during outburst and obtained a period of 5.24 hours, interpreted as the orbital period of the binary. V1727 Cygni is a hierarchical triple system with an F class star in wide orbit about the close LMXB pair. Bothwell (2008).

We present the first detection of ellipsoidal variations of the secondary found at 0.10912971 +/- 0.00000063 days giving an orbital period of 0.21825942 +/- 0.00000126 days. A tiny amplitude of 0.00321 +/- 0.00014 in relative intensity is measured with t_0 at 2455443.67500 +/- 0.00160 HJD (Price et al. 2012).

J1118+480
ALL DATA PHASE FOLDED



J1118+480
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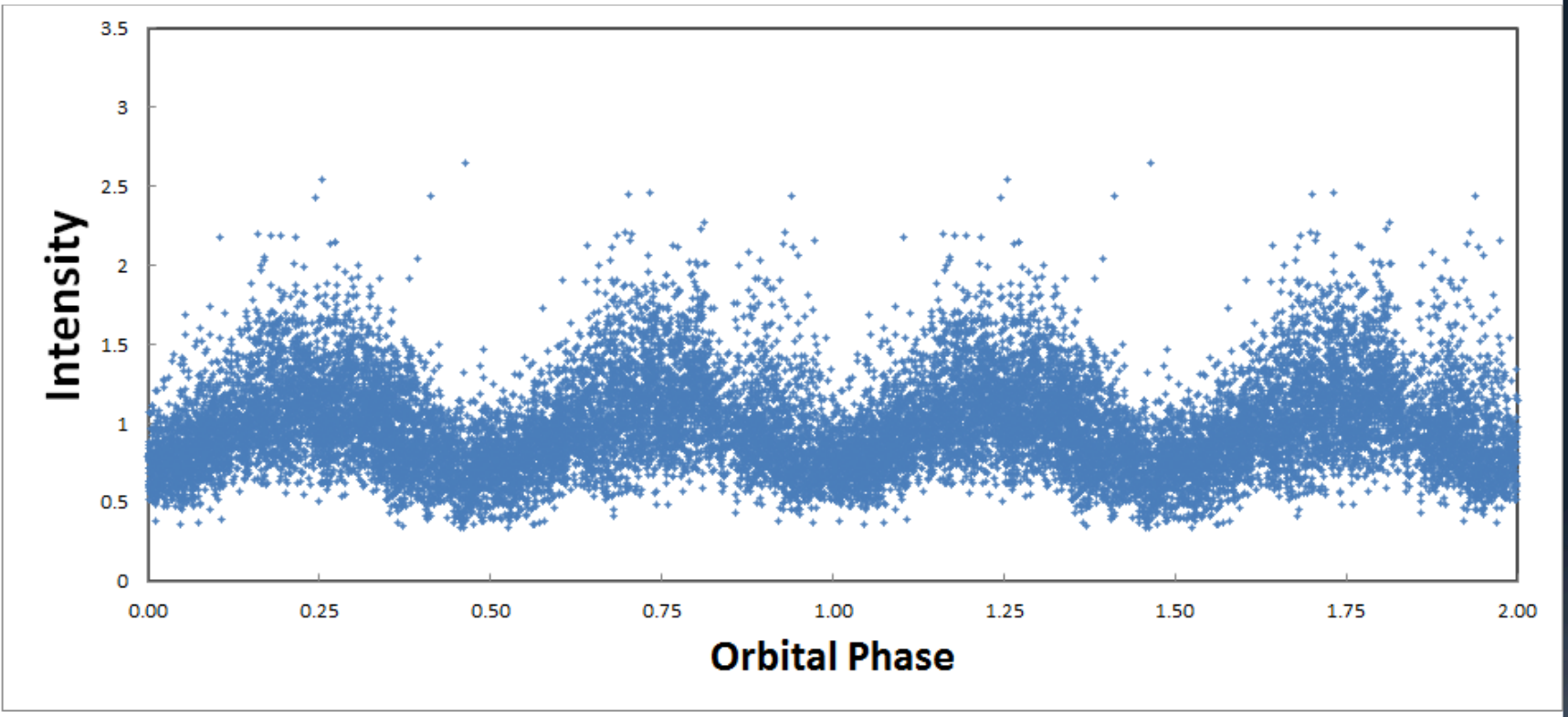
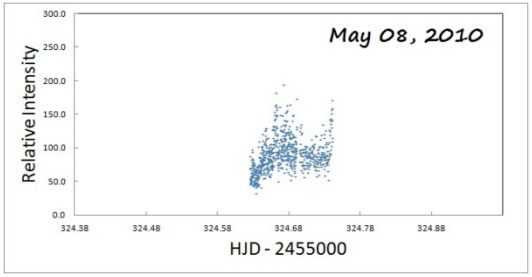
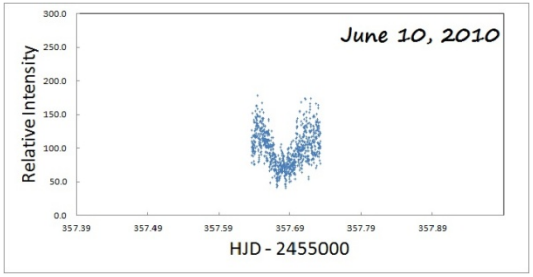
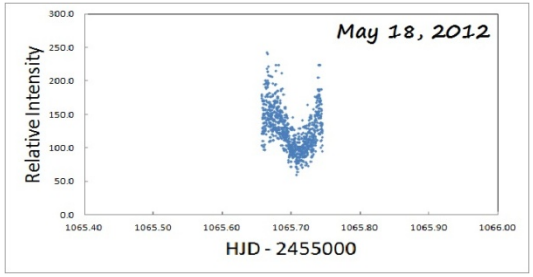
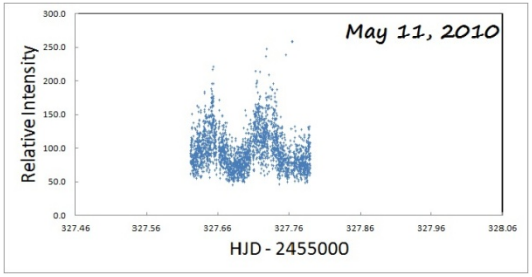


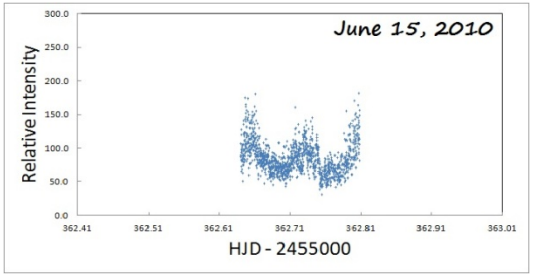
J1118+480 - LIGHT CURVES

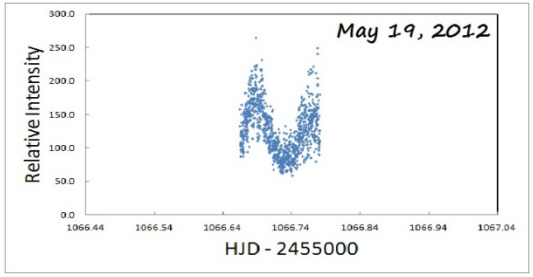


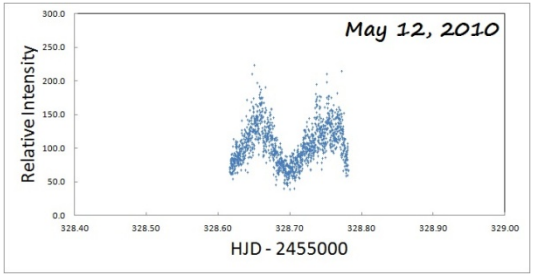


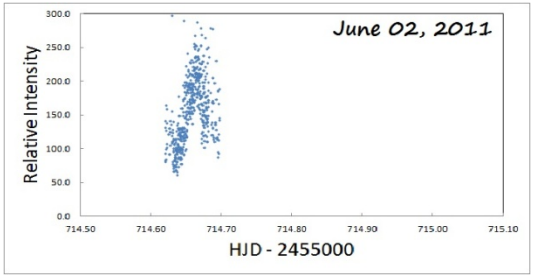


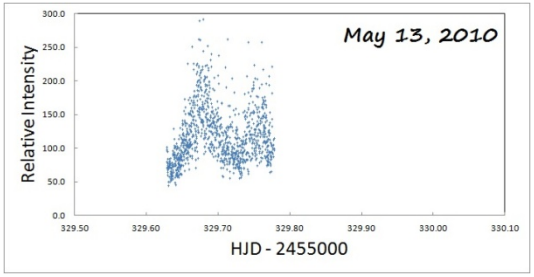


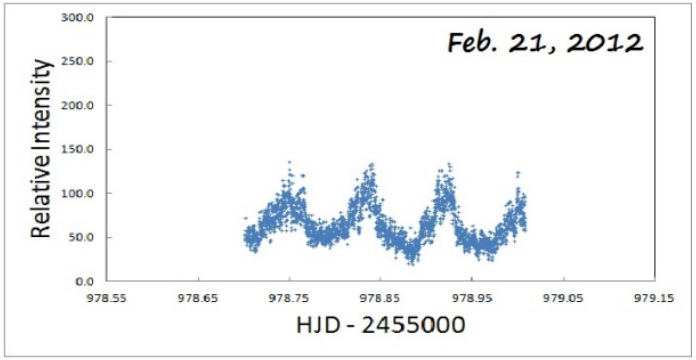








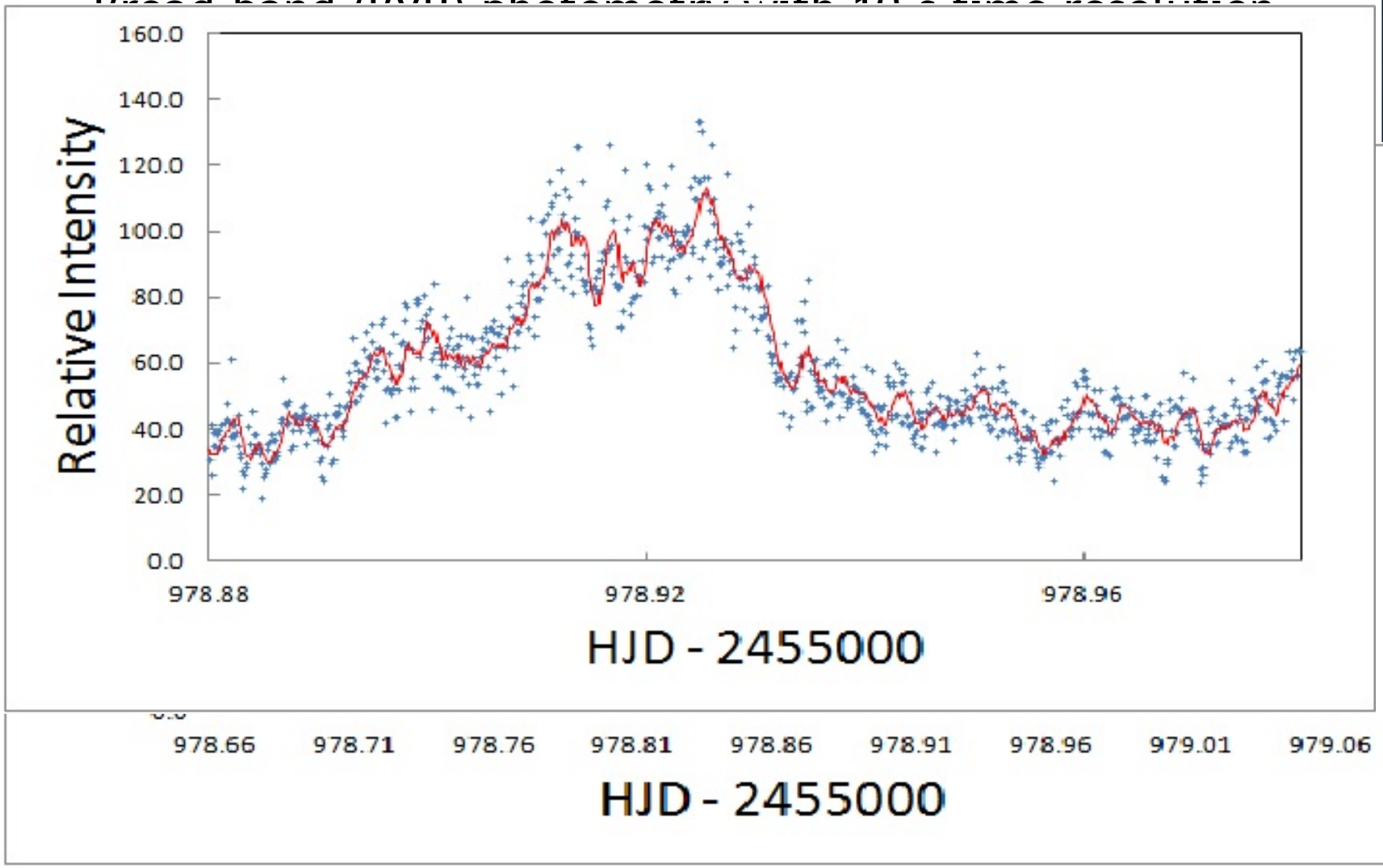




J1118+480

McDonald Observatory 82 in (2.1-m) telescope

Broad band (BVR) photometry with 10 s time resolution



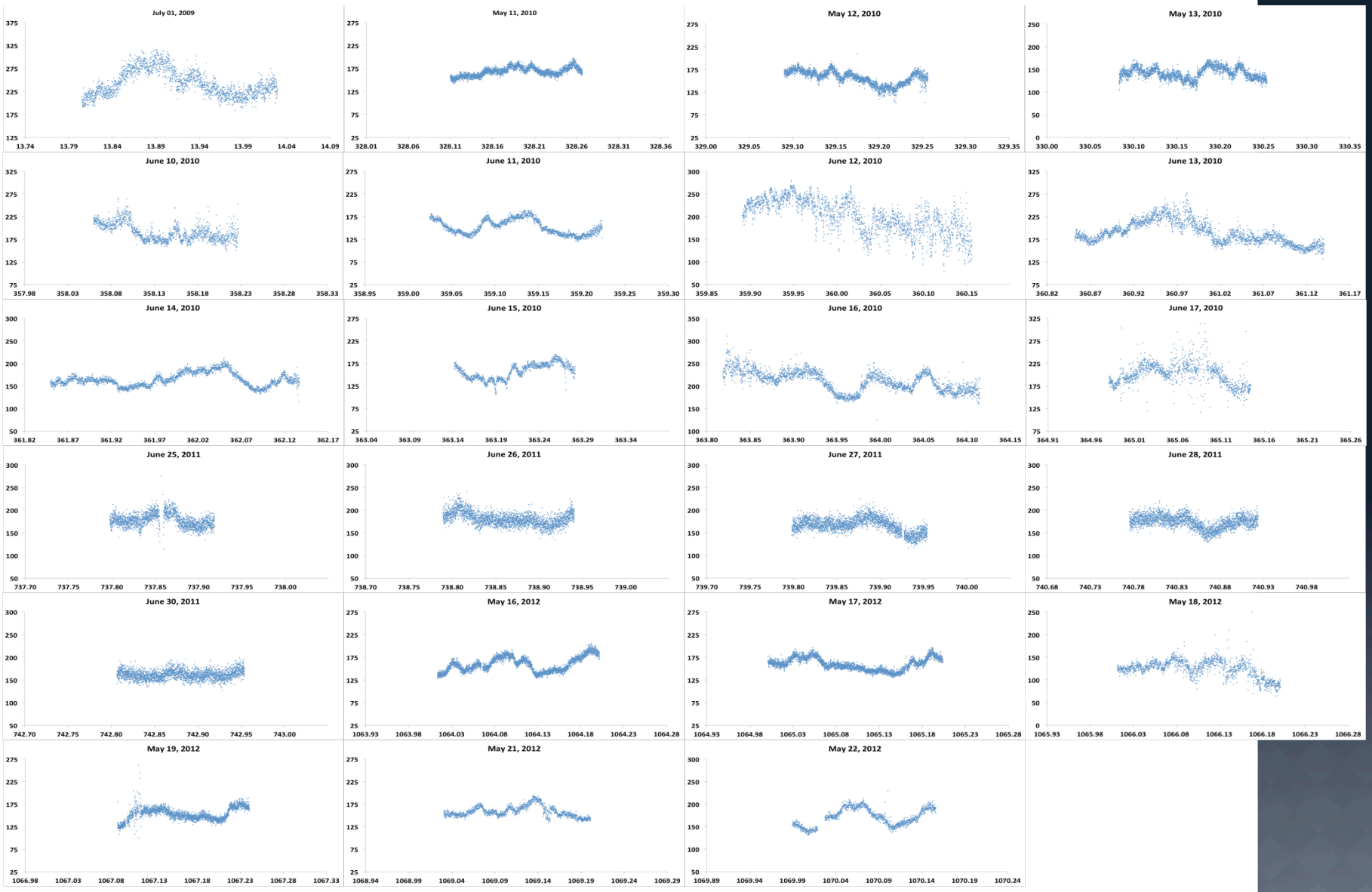
SUMMARY OF RESULTS

J1118+480 is an LMXB containing a black hole, currently in quiescence. The light curves have a large-amplitude, nearly sinusoidal, modulation at 1/2 the orbital period that we attribute to ellipsoidal variations of the secondary star, first seen by Gelino et al. 2006).

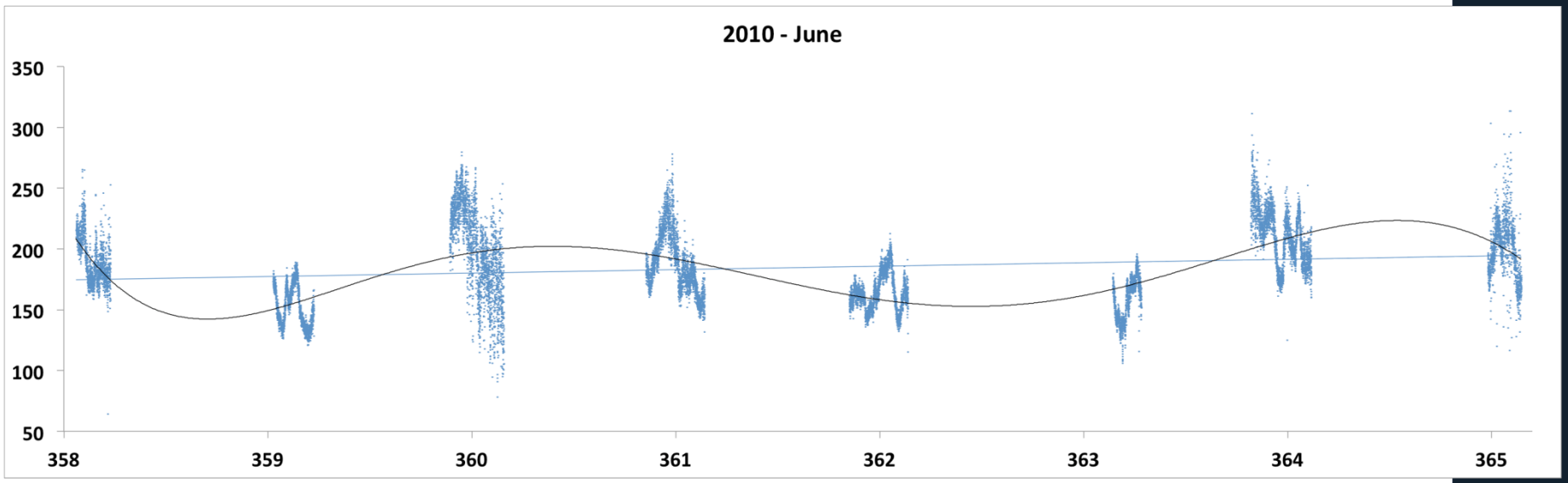
One of the minima in the ellipsoidal variation is deeper than the other. The maxima are similar in brightness. Flickering amplitude is highest during the bright phases of the ellipsoidal variations.

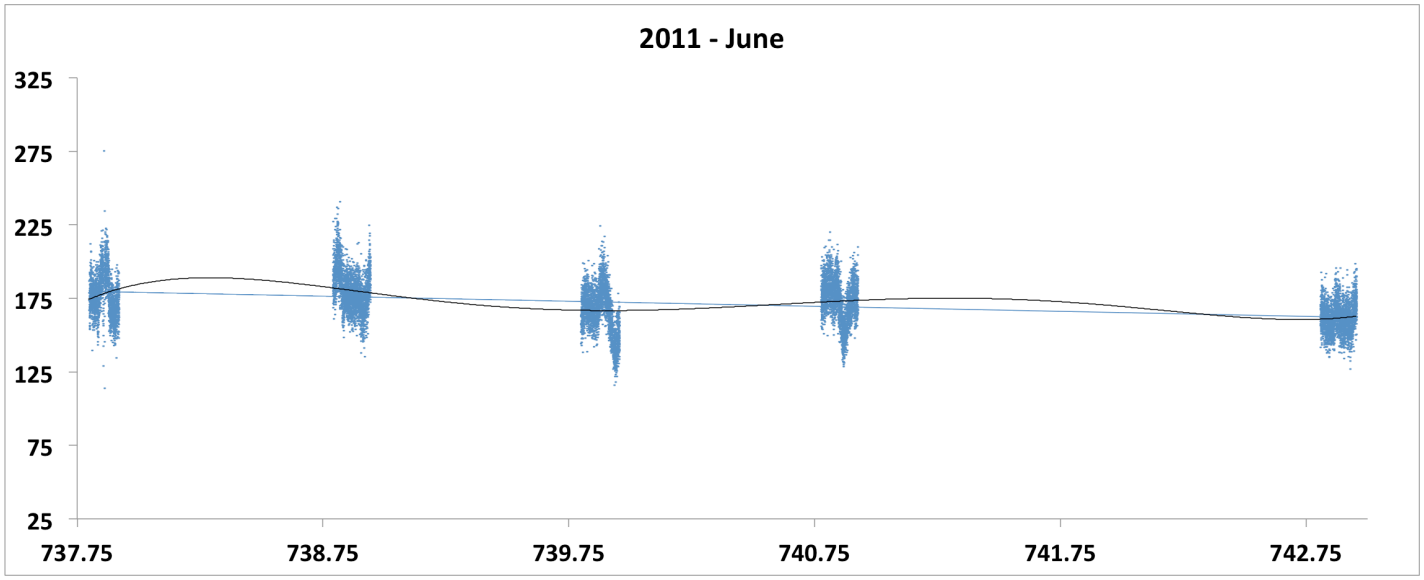
The orbital period is P= 0.16993344 +/- 0.00000048 days and the time of zero crossing (negative to positive) is HJD 2455324.60280 +/- 0.00025 (Monroy et al. 2012). The ephemeris will be further improved with data in hand.

J1753-027 LIGHT CURVES

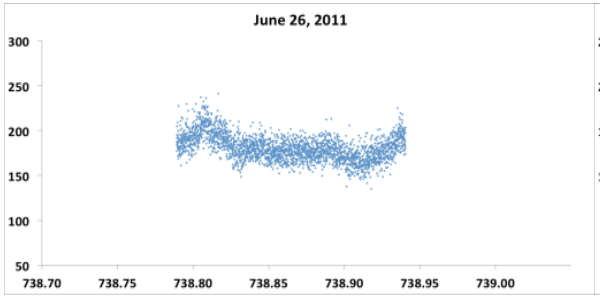


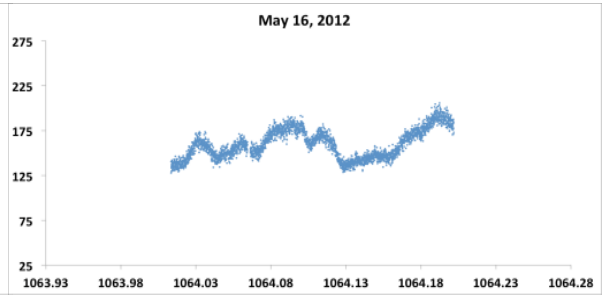
J1753-027- LIGHT CURVES

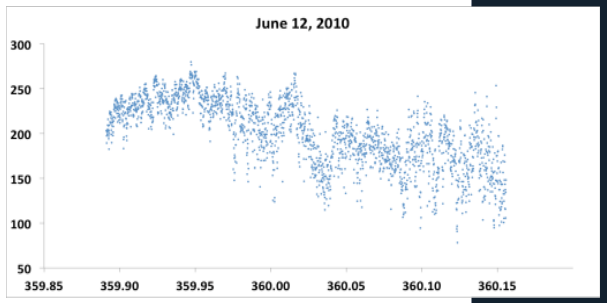


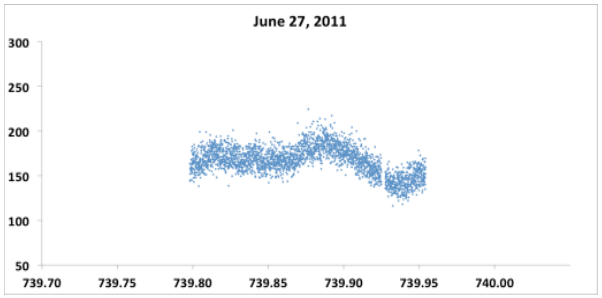


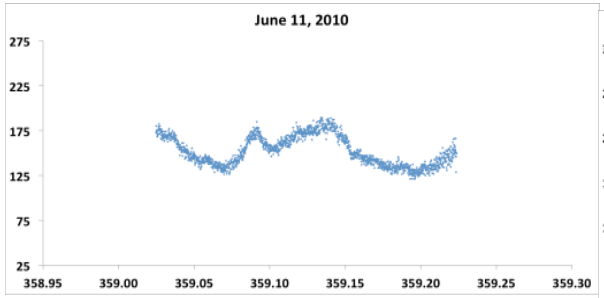
J1753-027 LIGHT CURVES

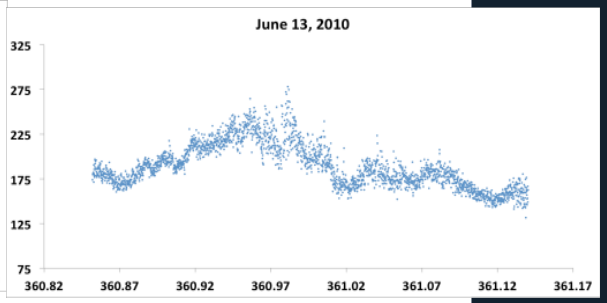


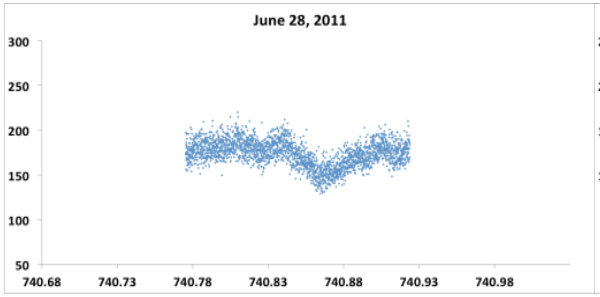


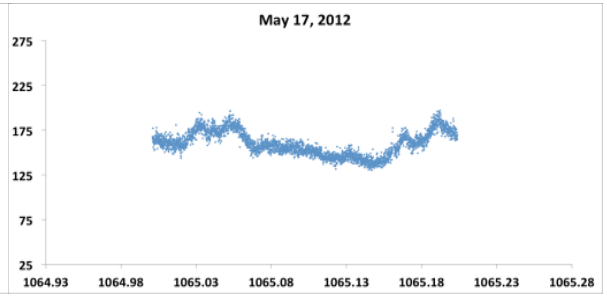


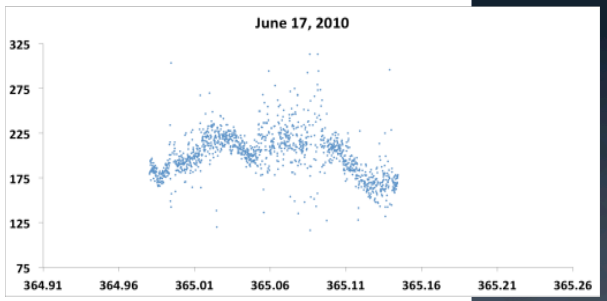


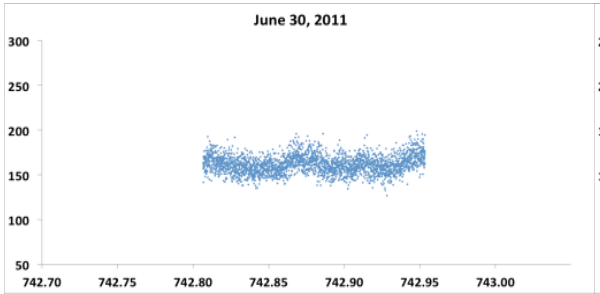


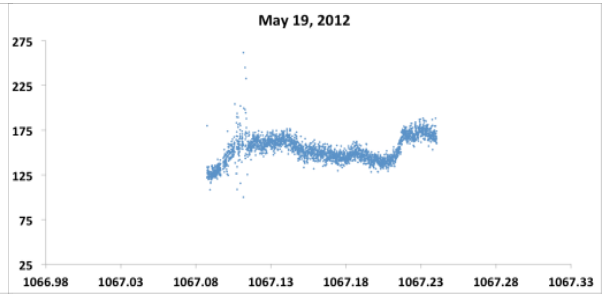


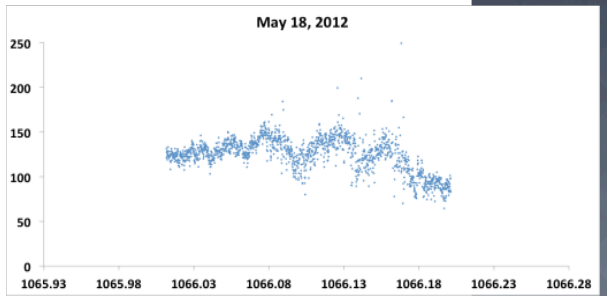




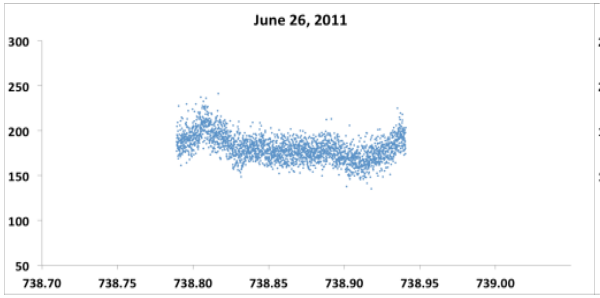


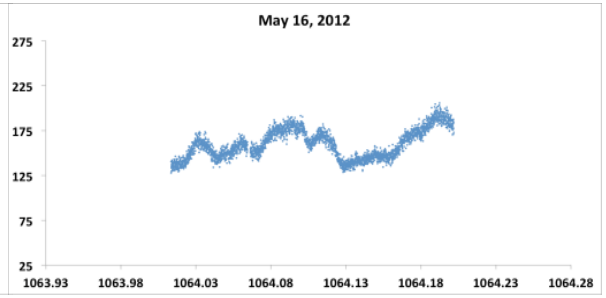


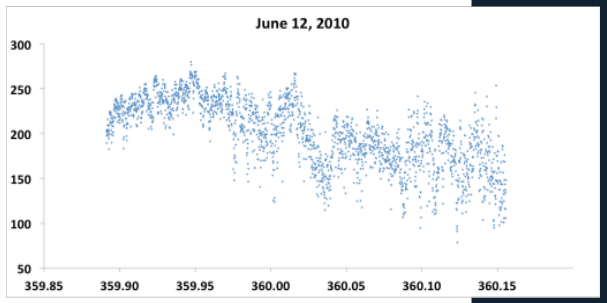


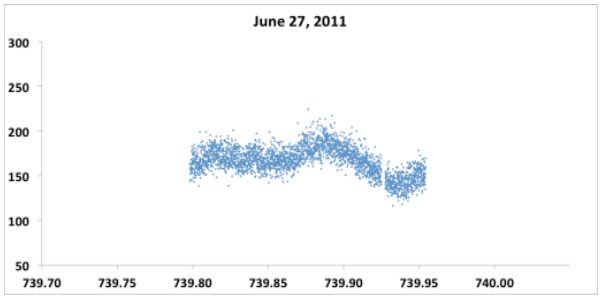


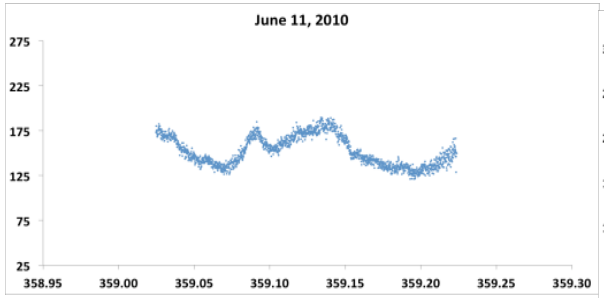
J1753-027 LIGHT CURVES

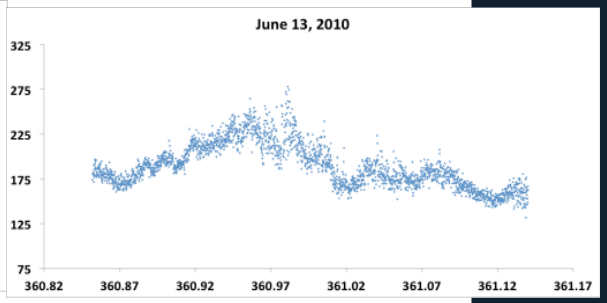


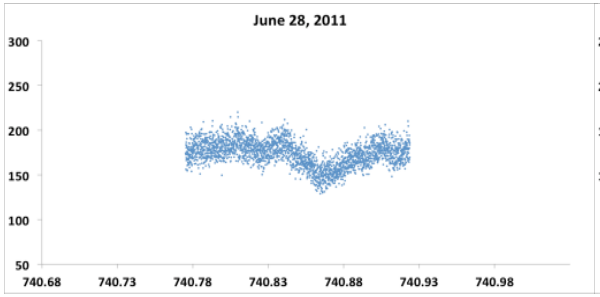


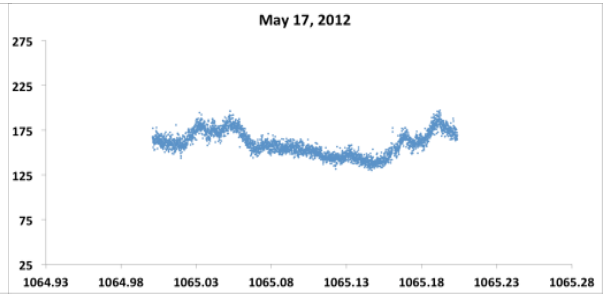


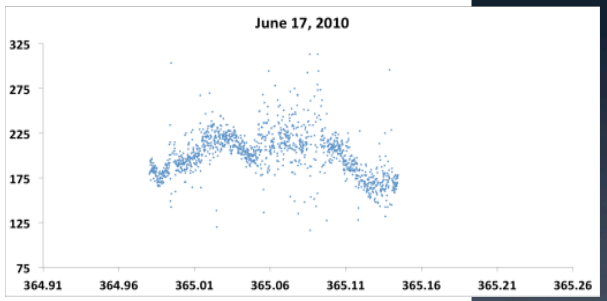


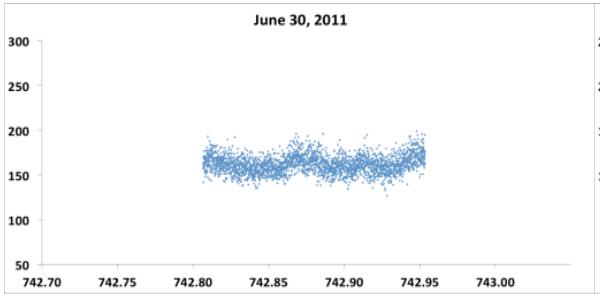


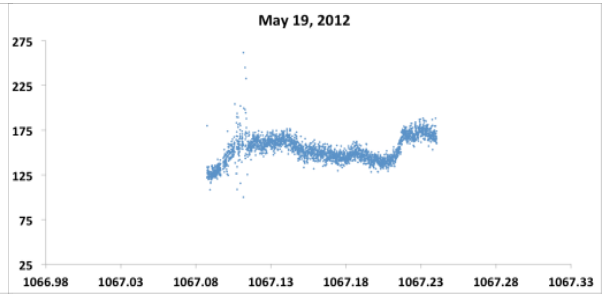


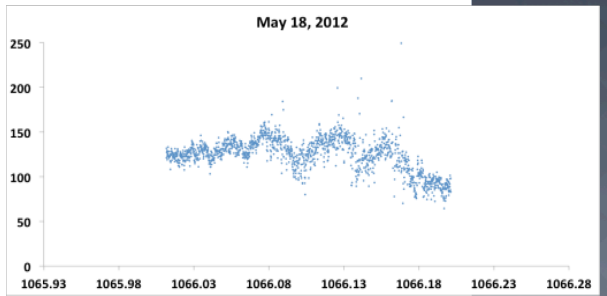








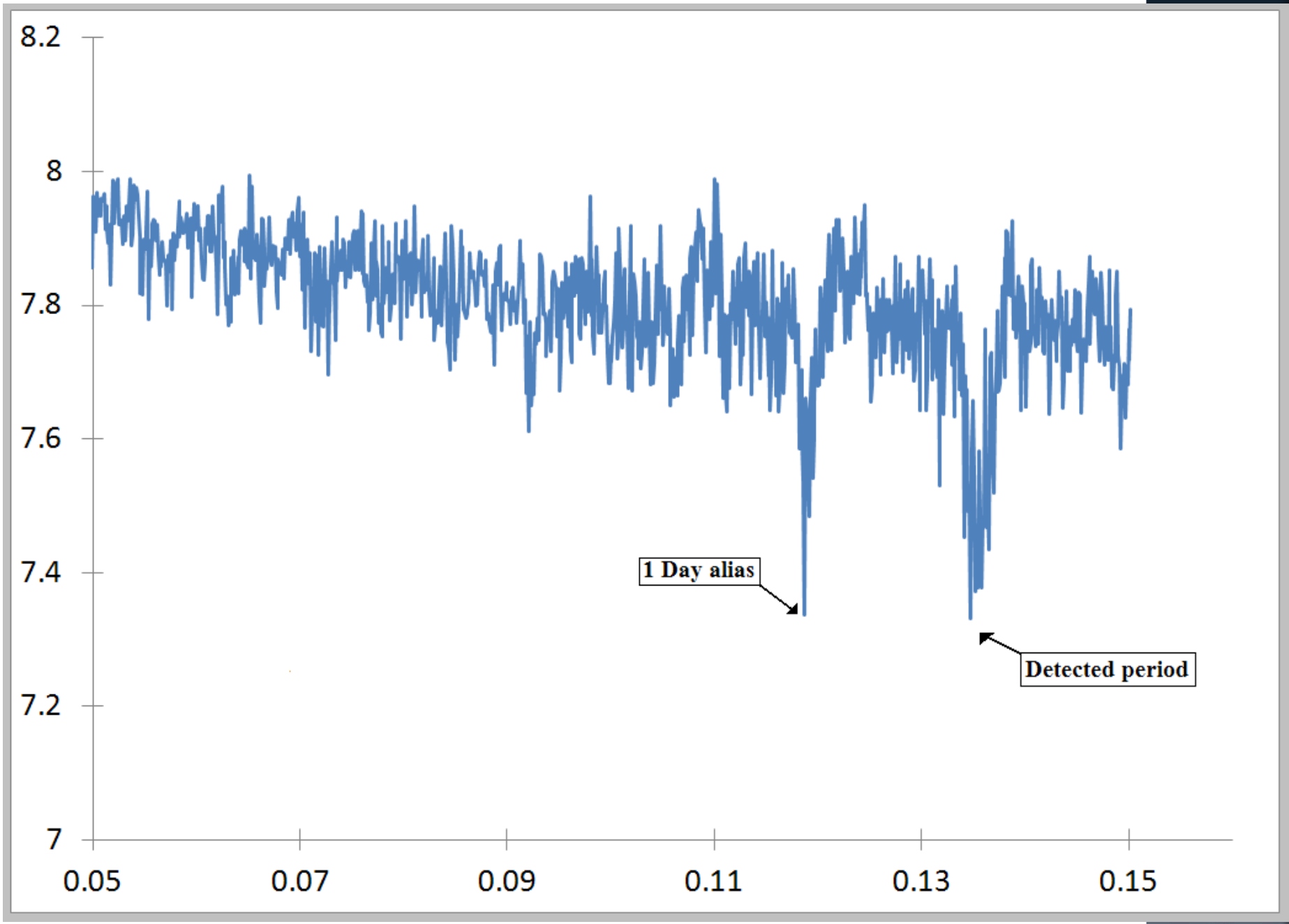




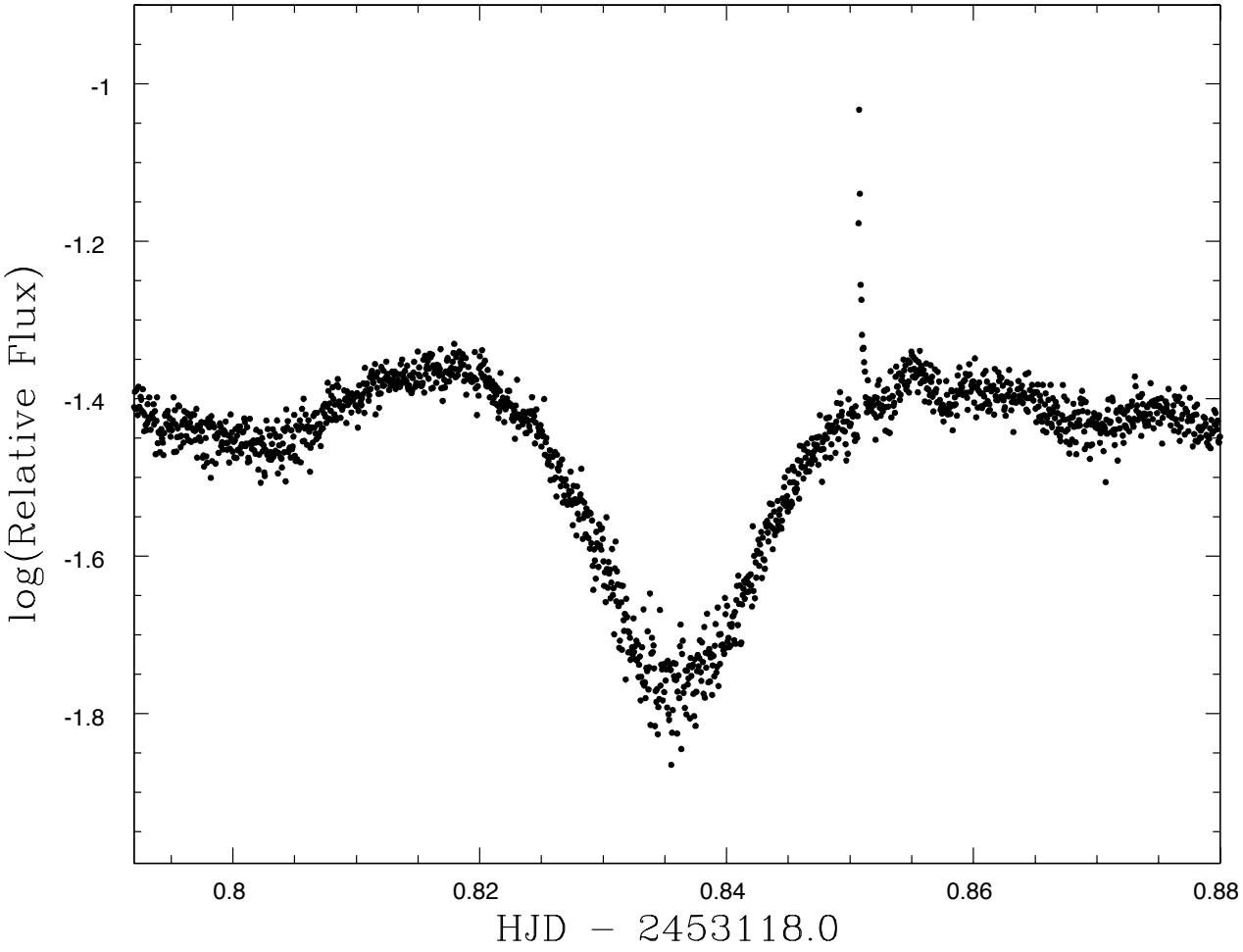
SUMMARY OF RESULTS

Swift J1753-027 was discovered with Swift/BAT after an X-ray outburst (Palmer et al., 2005). From its its spectrum and X-ray timing, the compact star is regarded as a good black hole candidate (e.g., Miller et al. 2006). One mystery concerning this binary is a reported negative time-lag between optical and X-ray photometric data (Zhang et al., 2010). Zurita et al. (2008) obtained light curves of Swift J1753.4-0126 that, while highly variable, allowed for the determination of an optical period that was attributed to the superhump phenomenon. In this model, the accretion disk is asymmetric and precesses in the orbital frame of the binary with a period that appears as a beat period between the orbital period and the superhump period.

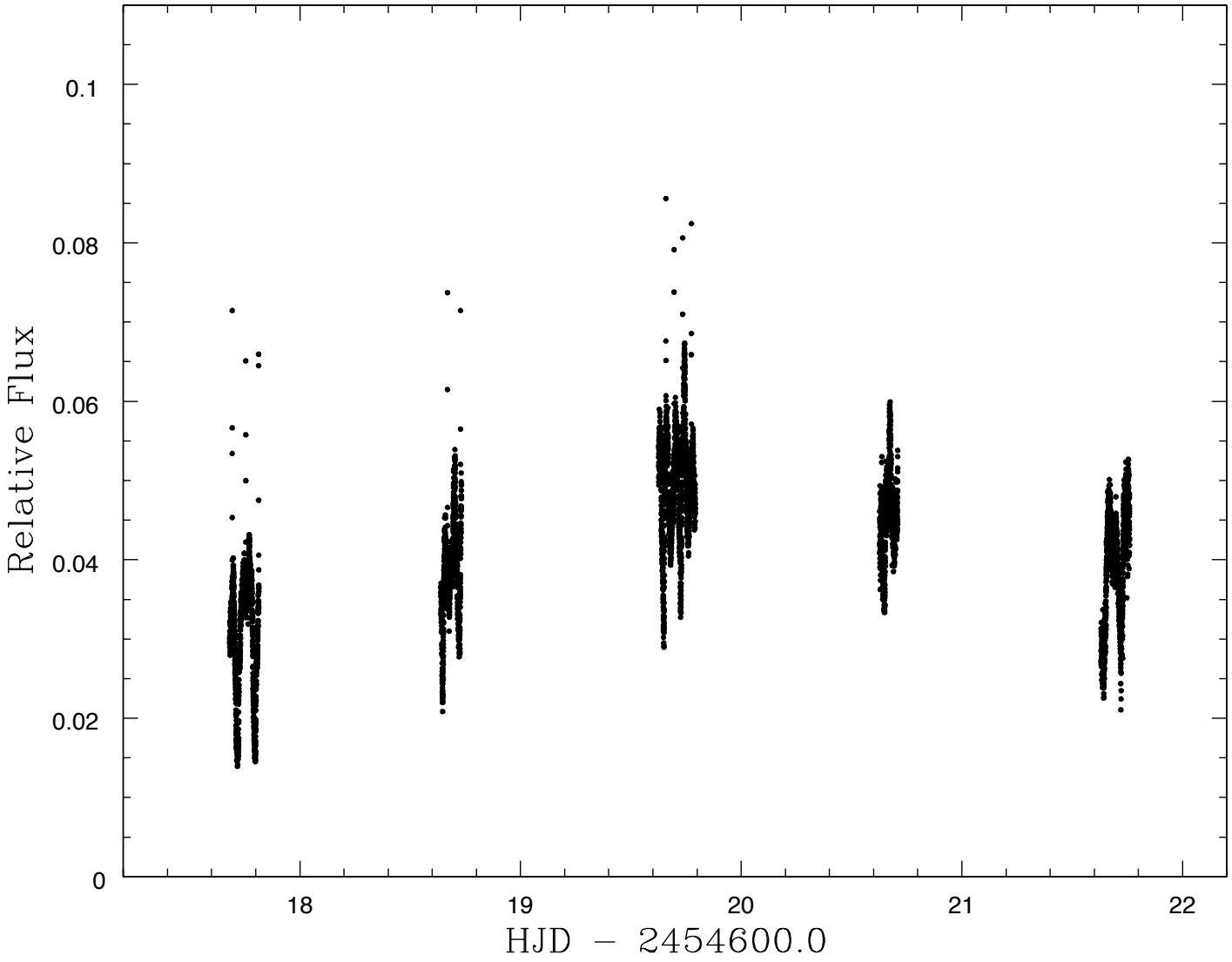
The light curves vary significantly from night-to-night; yet some distinctive features frequently recur, for example a remarkably linear drop to a minimum. We detect a sharp PDM feature highly consistent with the sharp feature at 3.245 hr of Zurita et al. (2008), this may be the orbital period of the binary. We suggest that the superhump period is detected as the broad feature in the PDM, see Figure 3. With that interpretation, the superhump period has an estimated coherence time of ~18 days.


8.2
8
7.8
7.6
7.4
7.2
7
0.05
0.07
0.09
0.11
0.13
0.15
1 Day alias
Detected period

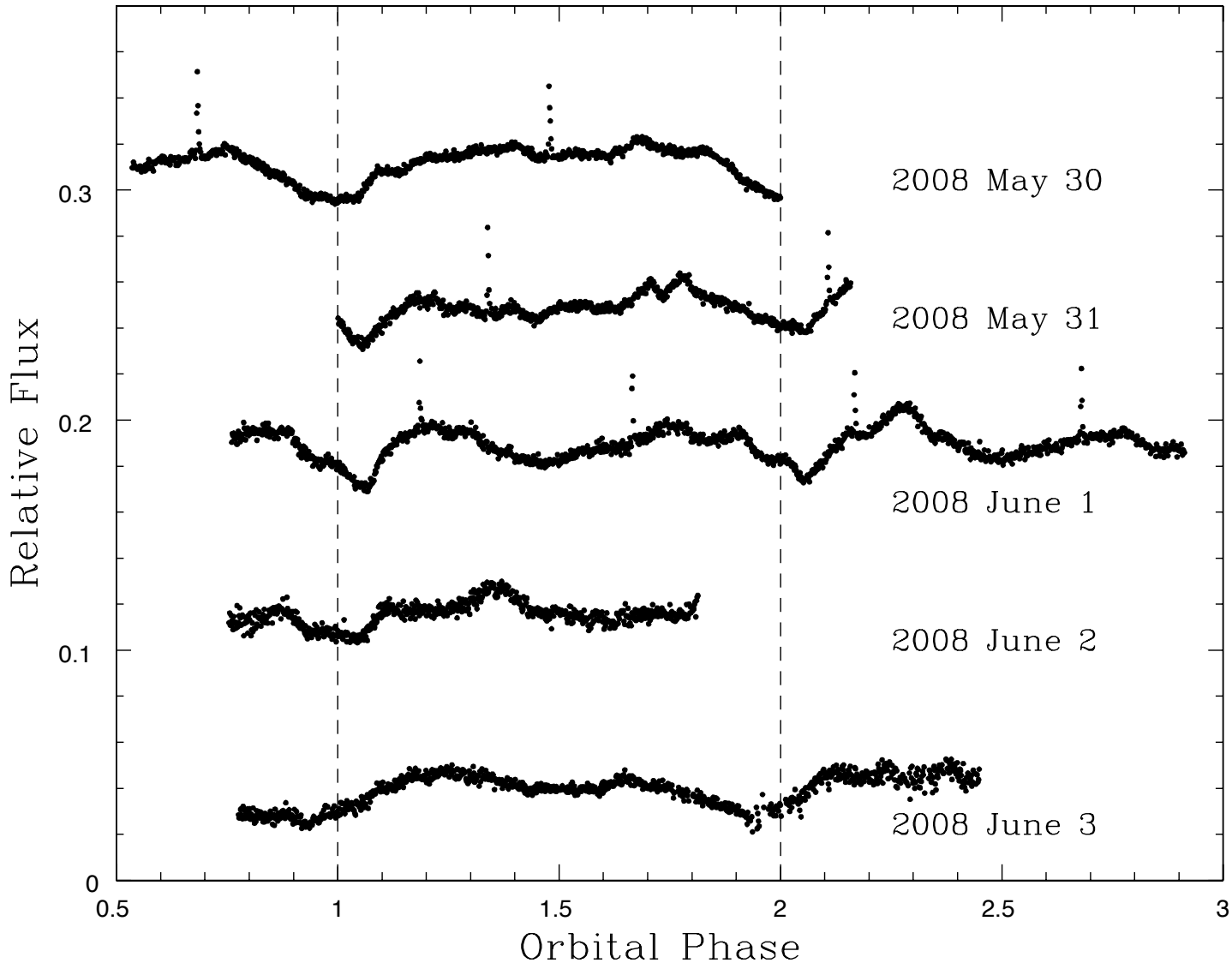
MS 1603+260



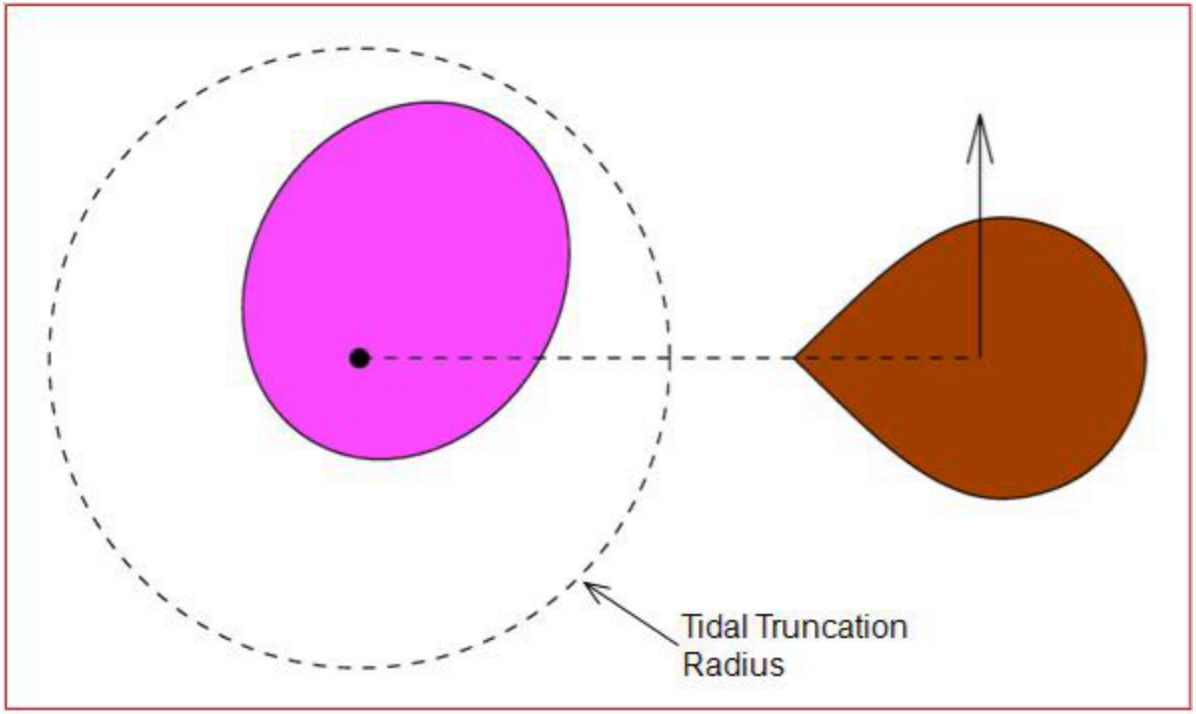
MS 1603+260



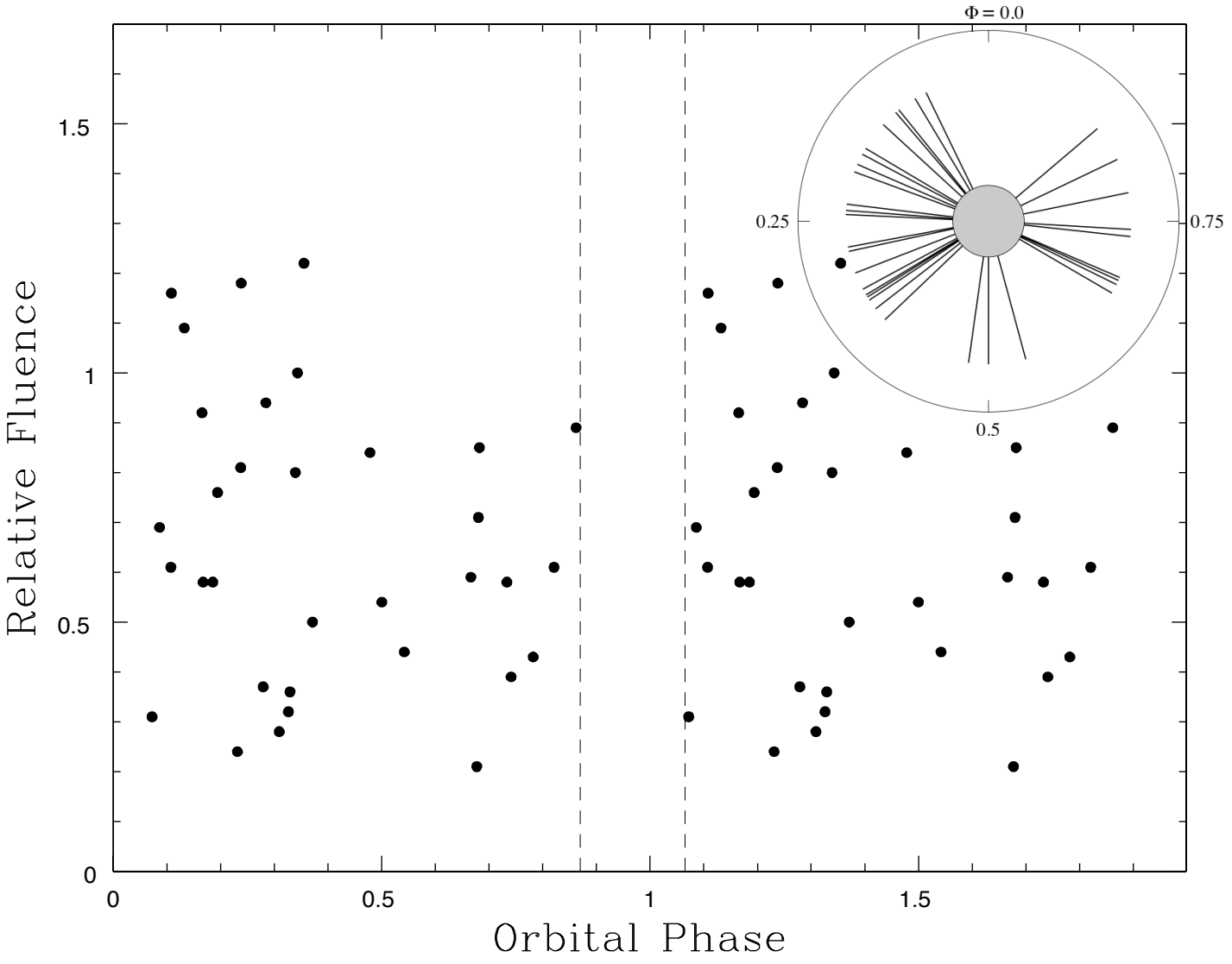
MS 1603+260


Relative Flux
Orbital Phase
0
0.1
0.2
0.3
0.5
1
1.5
2
2.5
3
2008 May 30
2008 May 31
2008 June 1
2008 June 2
2008 June 3

MS 1603+260



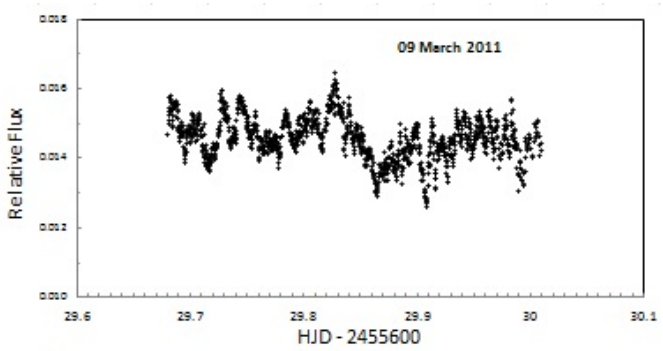
MS 1603+260

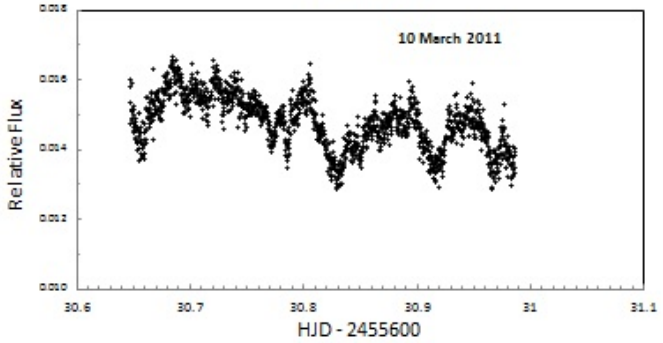

Φ = 0.0
0.25
0.75
0.5
Relative Fluence
Orbital Phase
0
0.5
1
1.5
0
0.5
1
1.5

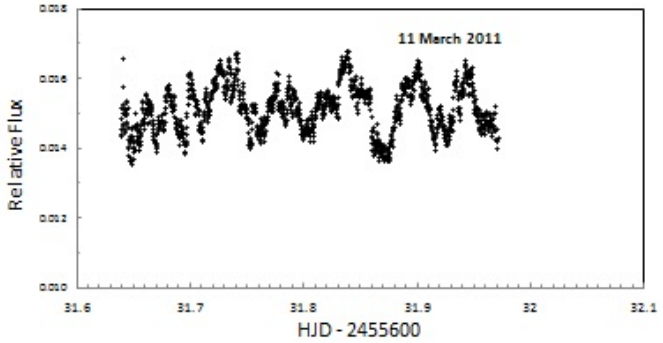
SUMMARY OF RESULTS

MS 1603+260 has partial eclipse of the accretion disk that are well modeled with an elliptical disk and measure an upper limit to the rate of change of its orbital period, $|\dot{P}| < 4.2 \times 10{-}11$ (unitless). The light curve of UW CrB shows optical counterparts of type I X-ray bursts. We tabulate the times, orbital phases, and fluences of 33 bursts and show that the optical flux in the bursts comes primarily from the accretion disk, not from the secondary star. The new observations are consistent with a model in which the accretion disk in UW CrB is asymmetric and precesses in the prograde direction with a period of ~ 5.5 days. (Mason et al. 2012 submitted)

4U 0614+091


09 March 2011
Relative Flux
0.018
0.016
0.014
0.012
0.010
29.6
29.7
29.8
29.9
30
30.1
HJD - 2455600


10 March 2011
Relative Flux
0.018
0.016
0.014
0.012
0.010
30.6
30.7
30.8
30.9
31
31.1
HJD - 2455600


11 March 2011
Relative Flux
0.018
0.016
0.014
0.012
0.010
31.6
31.7
31.8
31.9
32
32.1
HJD - 2455600