Measuring the orbital decay of CD-3011223 from gravitational wave emission

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Outline

- Advantages of eclipsing binaries
- Existing studies on CD -3011223
- Motivation for study
- Preliminary work
- Outlook

Why are they interesting?

- Constraints on component parameters
- Age of the Galaxy
- Possible SN Ia progenitors
- Sources for Gravitational Wave (GW) radiation

(NGO/eLISA)

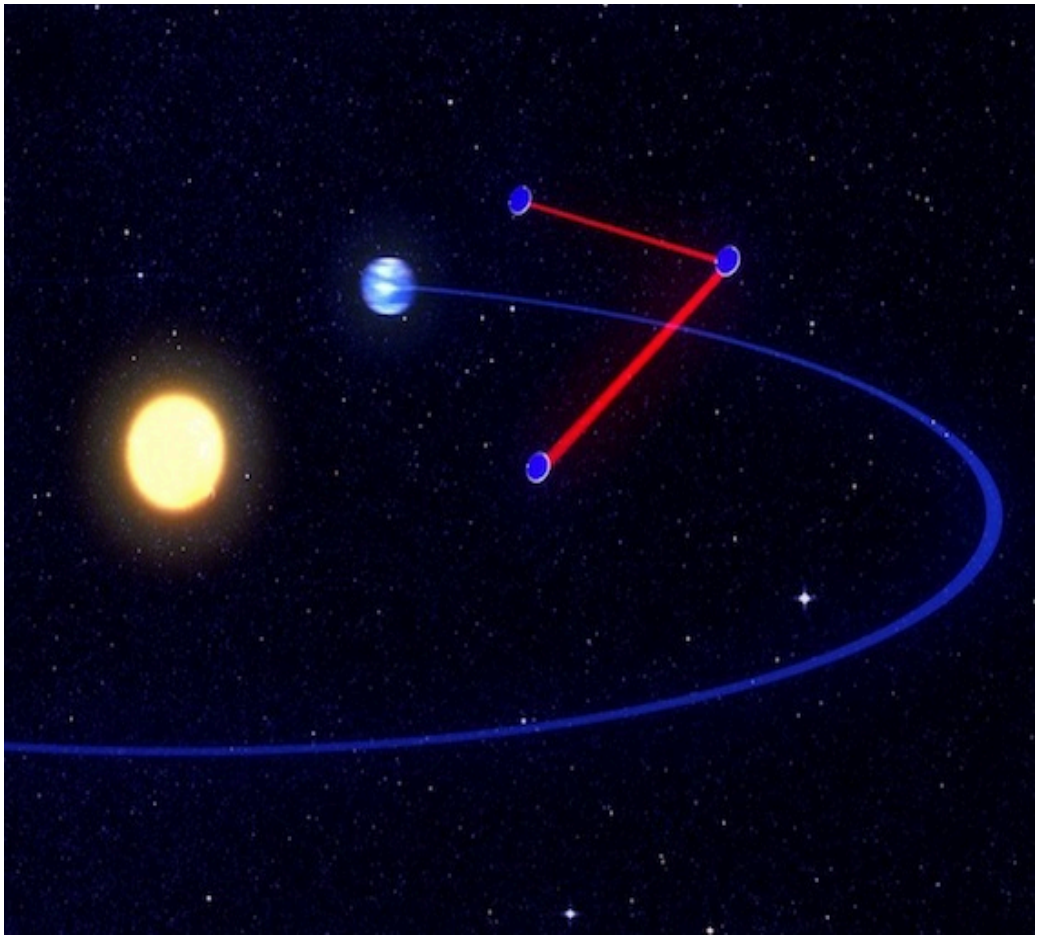


Figure: eLISA mission detectors

CD -3011223

- White Dwarf – subdwarf binary
- Masses : 0.79 , 0.54 solar mass
- Possible SN Ia progenitor
- Very bright: 11.9 mag

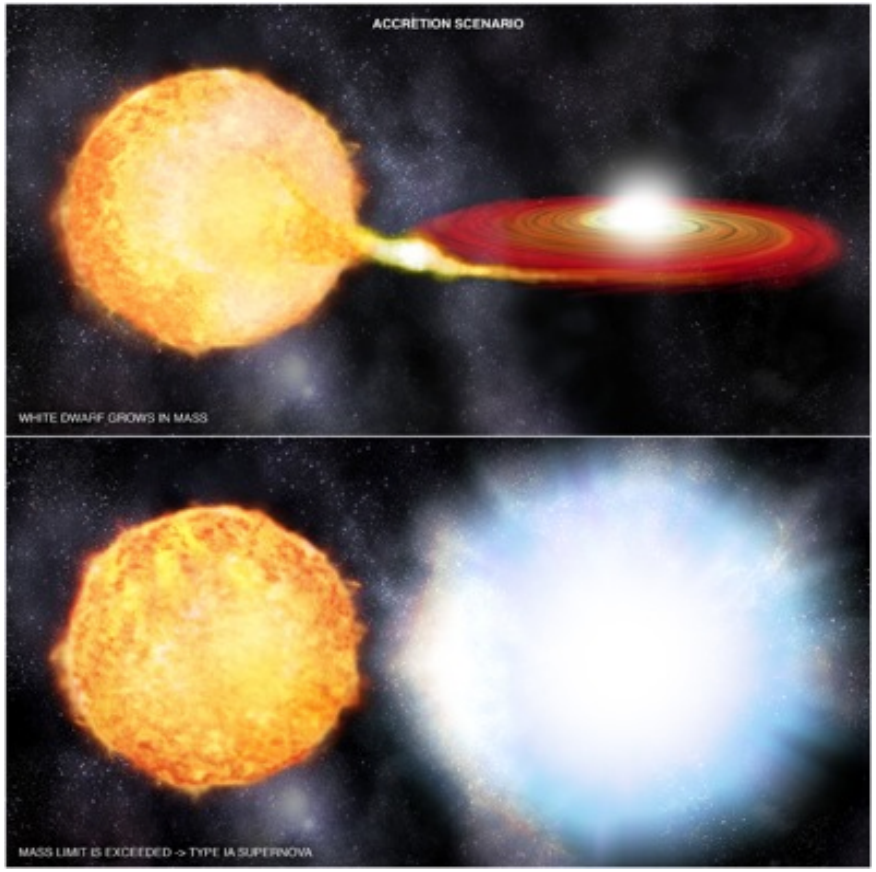
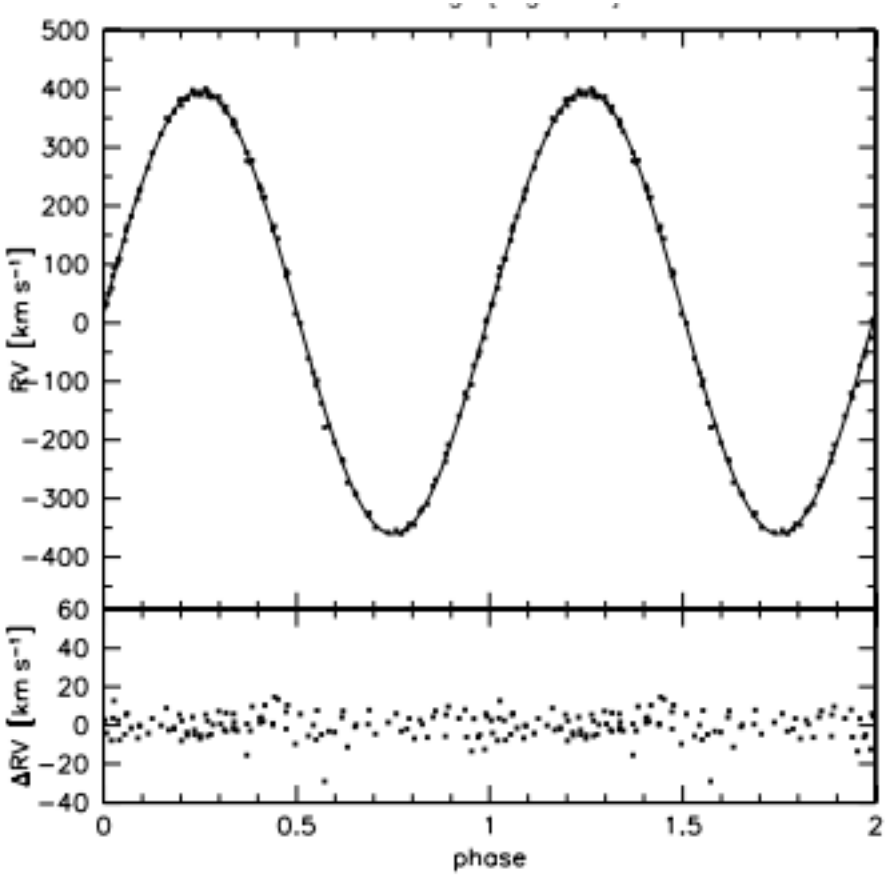


Figure: An artistic's impression of SN Ia progenitor systems (Top: Single degenerate, Bottom: Double-degenerate)

Spectroscopy of CD -3011223



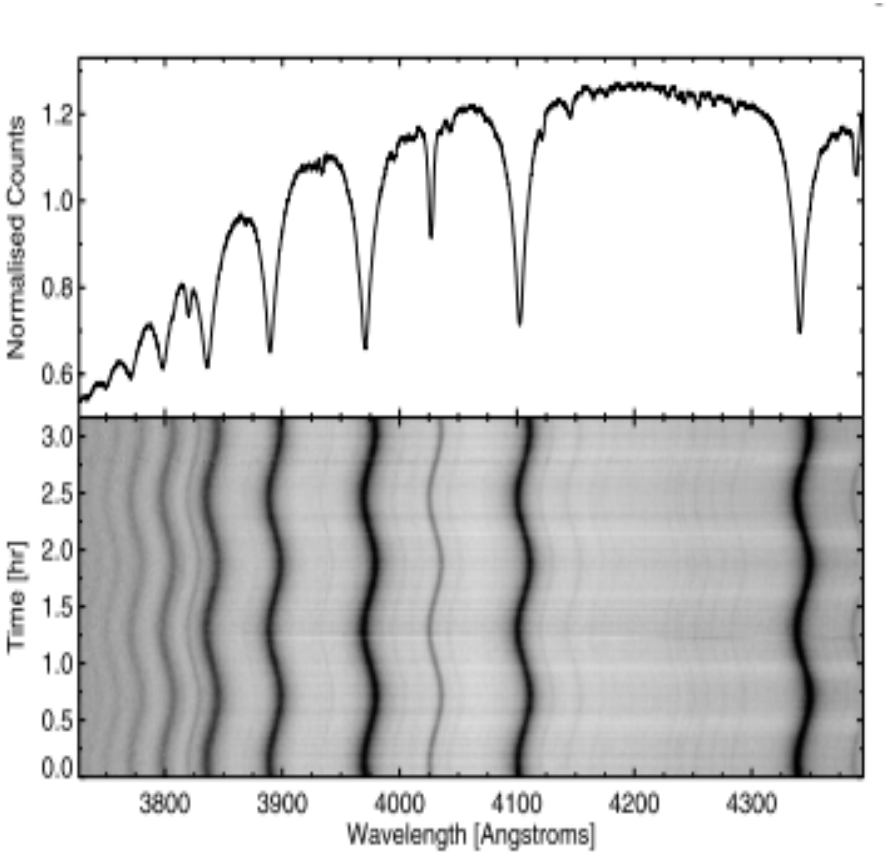


Figure: (Left) Radial velocity curve (Right): Co-added SOAR/Goodman spectra. Balmer lines are visible.

SOAR light curve of CD -3011223

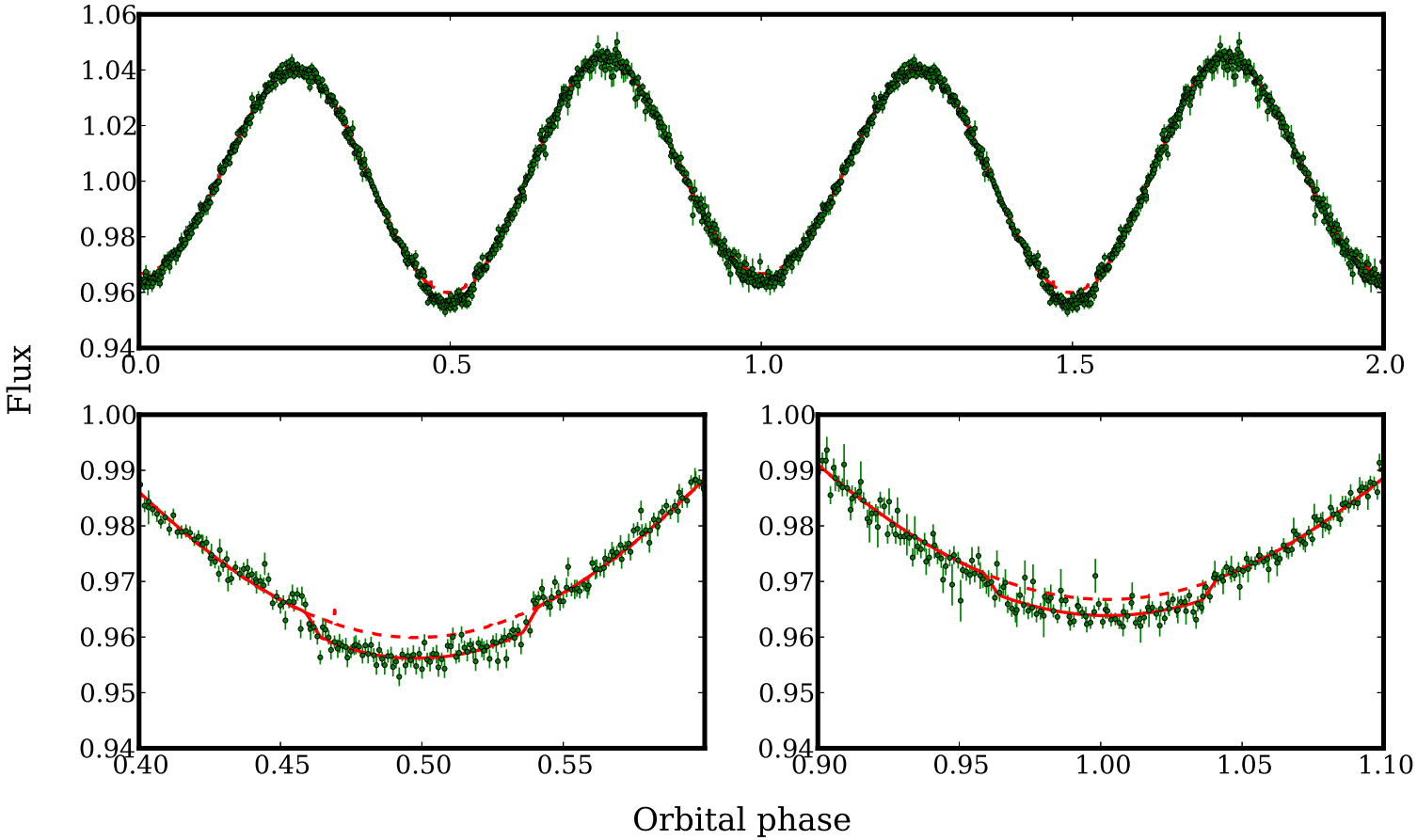


Figure: Light curve of CD-30

Current Constraints

- Component parameter measurements
- Orbital decay measurement (Geier + 2013)
- Log *h* -21.5 +/- 0.3 (Roelofs et al. 2007)

($\dot{P} = 1.01 \times 10^{-12} \pm 3.38 \times 10^{-12}$ ss^{-1})

consistent with expected

P ~ 6×10^{-13} ss^{-1}

Discrepancy in Parameters

Derived parameters			
Solution 1			
sdB mass	$M_{\rm sdB}$	$[M_\odot]$	0.47 ± 0.03
sdB radius	$R_{\rm sdB}$	$[R_\odot]$	0.169 ± 0.005
WD mass	$M_{\rm WD}$	$[M_\odot]$	0.74 ± 0.02
WD radius	$R_{\rm WD}$	$[R_\odot]$	0.0100 ± 0.0004
Orbital inclination	i	[°]	83.8 ± 0.6
Separation	a	$[R_\odot]$	0.599 ± 0.009
Mass ratio	q		0.63 ± 0.02
Solution 2			
sdB mass	$M_{\rm sdB}$	$[M_\odot]$	0.54 ± 0.02
sdB radius	$R_{\rm sdB}$	$[R_\odot]$	0.179 ± 0.003
WD mass	$M_{\rm WD}$	$[M_\odot]$	0.79 ± 0.01
WD radius	$R_{\rm WD}$	$[R_\odot]$	0.0106 ± 0.0002
Orbital inclination	i	[°]	82.9 ± 0.4
Separation	a	$[R_\odot]$	0.619 ± 0.005
Mass ratio	q		0.68 ± 0.01

Figure: Parameters for components. Table 1 Geier et al. 2013

Previous Studies

- Very few orbital decay measurements
- Hulse-Taylor binary (Nobel Prize 1993)
- J0651 (Hermes et al. 2012, Brown et al. 2011), faster, but fainter

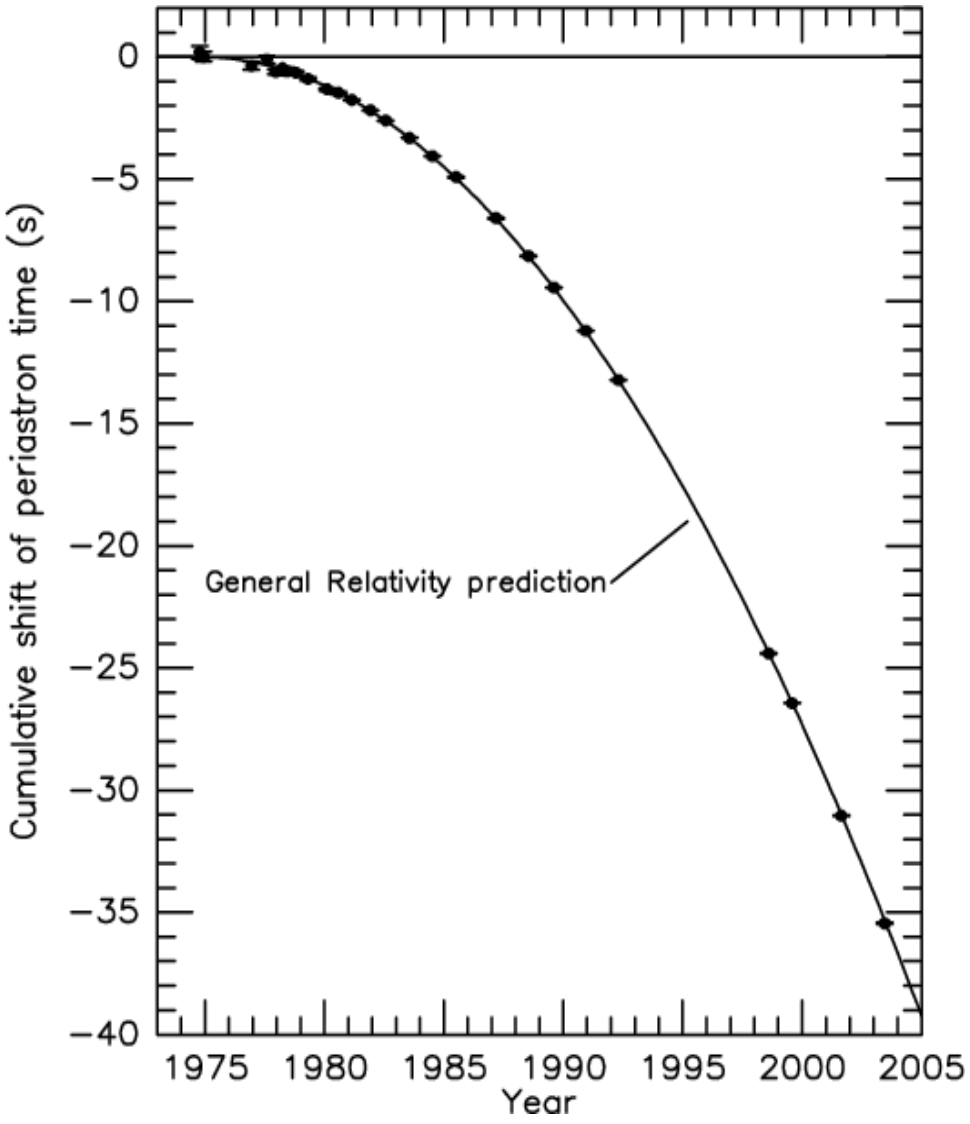


Figure: Periastron shift of Hulse-Taylor binary system

Motivation

- Constrain binary parameters precisely
- Timespan from Common Envelope to SNIa
- Measure period shift
- High SNR, time-sampled photometry
- Predicted shift : 19s (current) 22s (following year)

Analysis

- FORS2 reflex reduction
- Stable Comparison Star
- Folded with t_0 and P

(Geier et al. 2013)

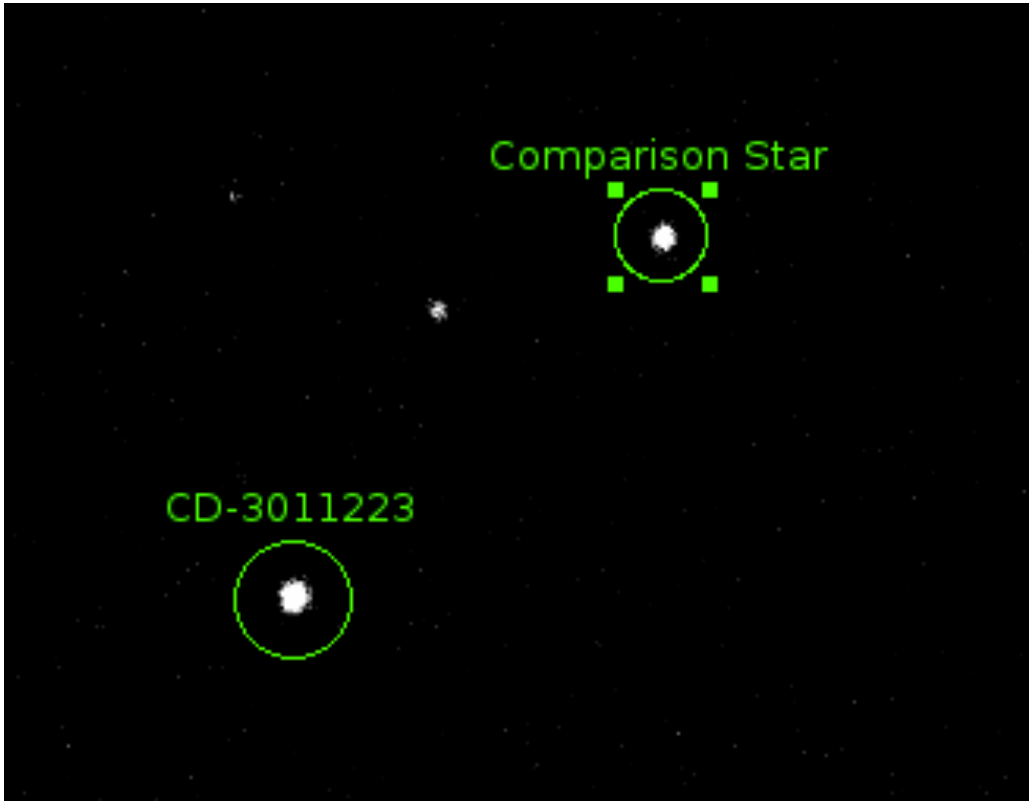


Figure: Image of CD-3011223 and the comparison star

CD-3011223 Light Curve

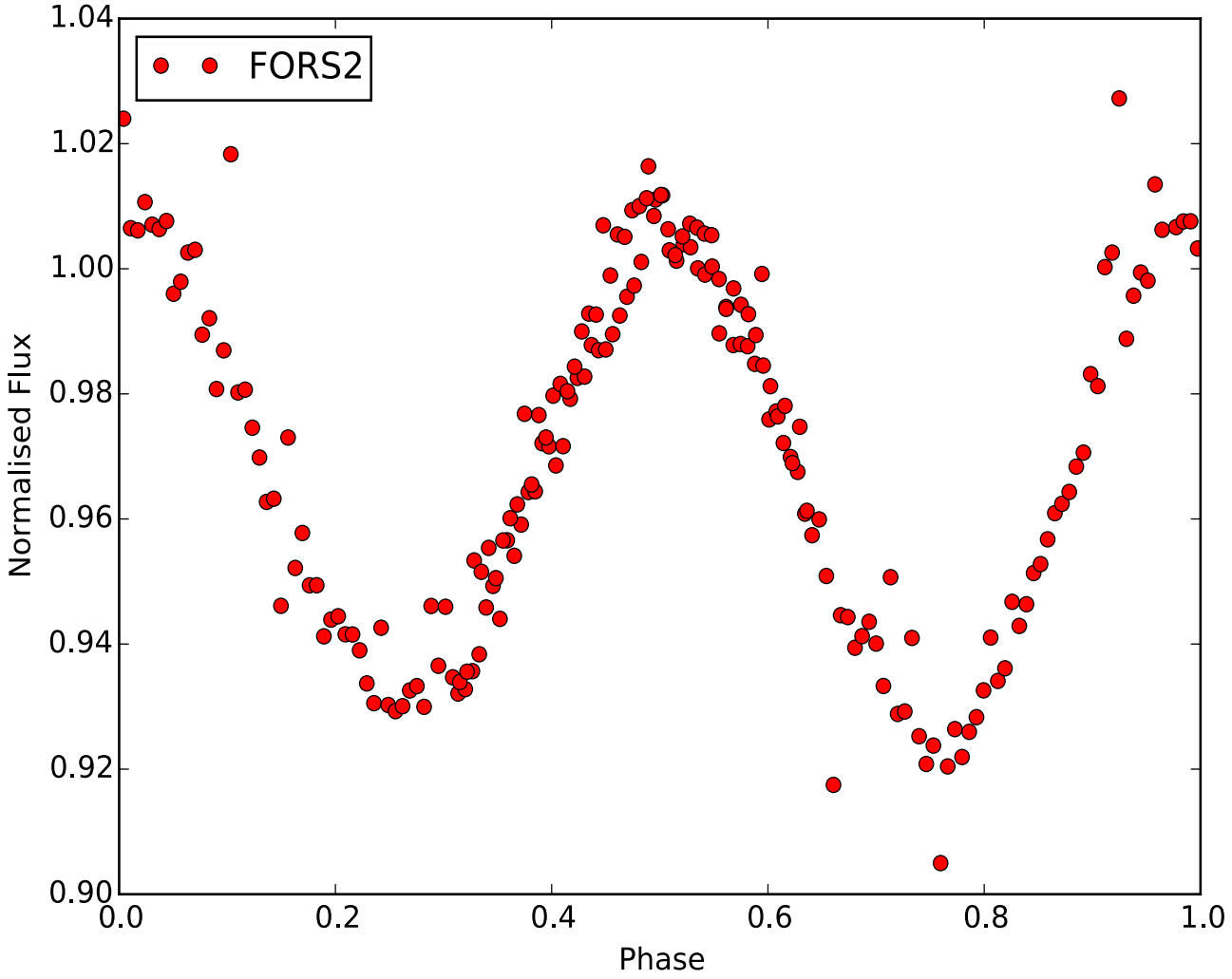


Figure: FORS2 light curve of CD-30

Comparison with existing data

- Data from 2000 (ASAS)
- Light curve from SWASP
- Higher SNR
- Resolved eclipse

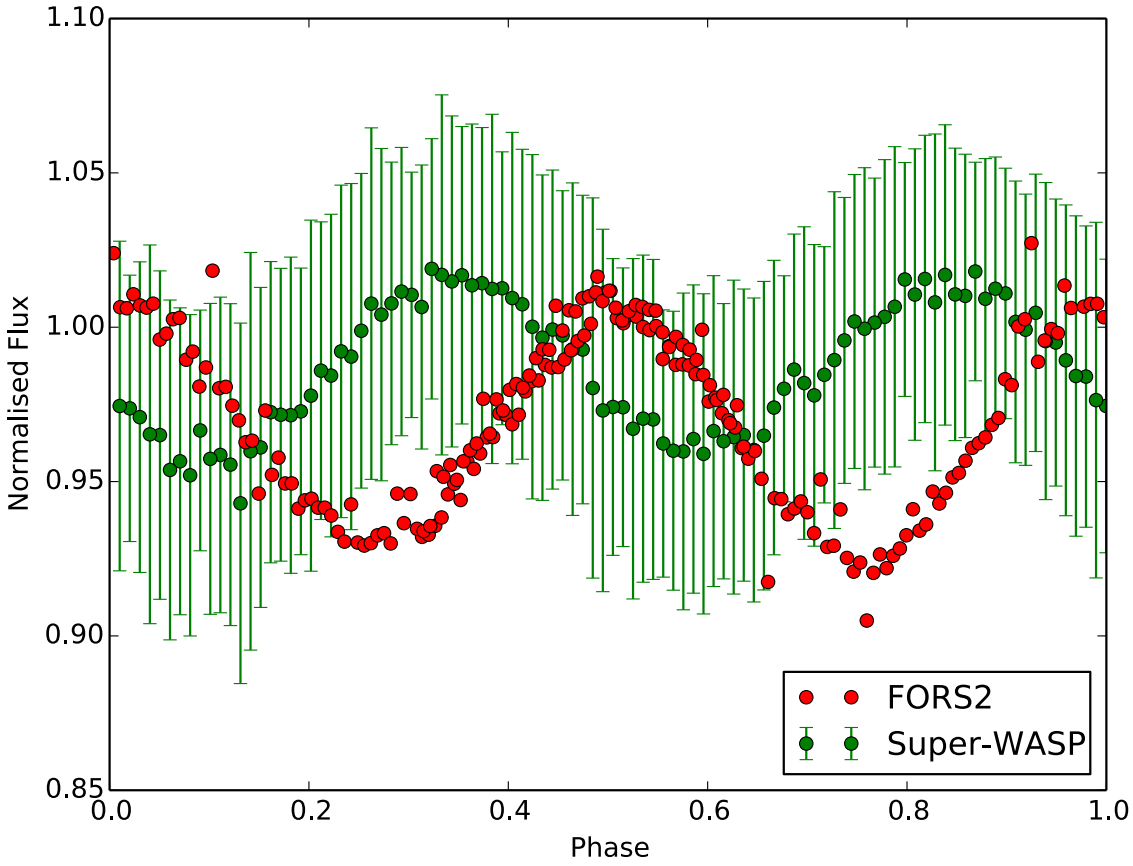


Figure:VLT light curve (red) compared with the phase binned SWASP light curve

Outlook

- Shift to the same time-step
- Create O-C diagram
- P96 : Program Scheduled
- Continuous monitoring of CD-30