When Homer Nods

Reconciling our period analysis of V883 Sco with history

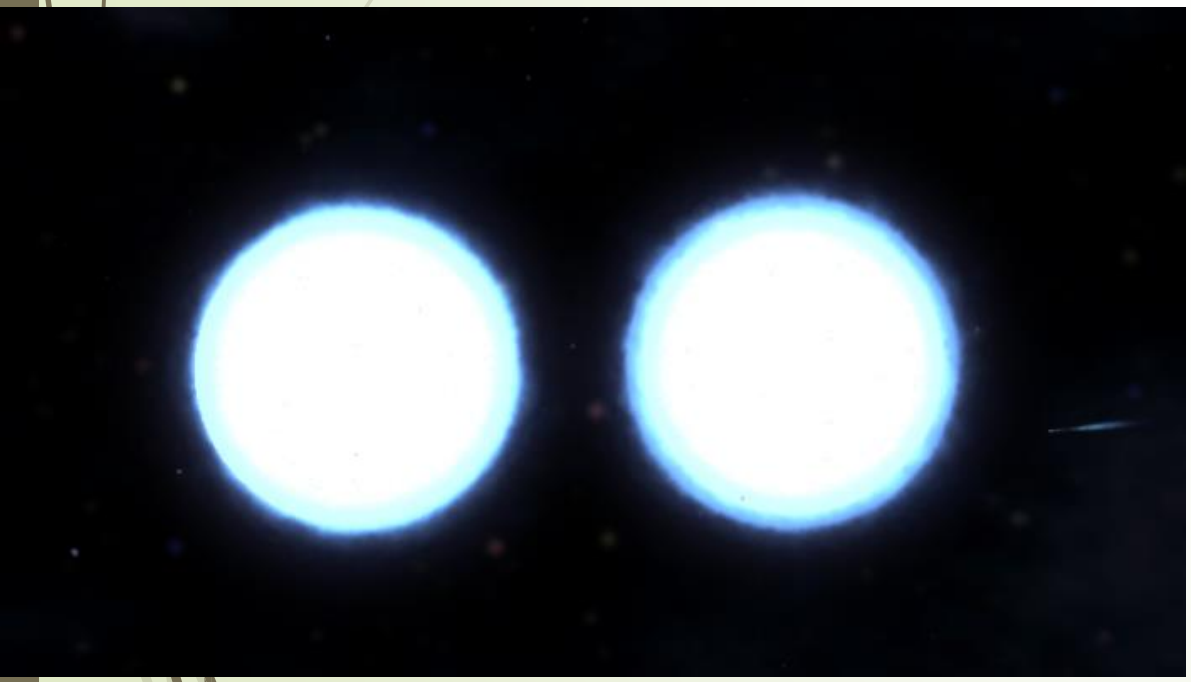
A joint research effort by (in chronological order)

Neil Butterworth (patient DSLR observer),
Mark Blackford (period finder),
Tom Richards (analyst & paper writer)

Eight centuries after Homer wrote *The Iliad*, the Roman poet Horace noticed the reappearance of a character whom the author killed off previously in the epic, and noted in Latin, "Quandoque bonus dormitat Homerus," translated as "Even good old Homer nods."

GCVS Catalogue data about V883 Sco

- Mag: 7.34-7.66
- Spectrum: B2.5 V
- Type: EB/KE (close but not contacting eclipsing binary) – or so they say
- Period: 1.29484 d – or so they say



Like this

Original data

- **JD 243 8828.315 + 1.294 745 x E**
- 26 plates from Sonneberg (Thuringia, E. Germany) & Mt John 1963-1972 measured photometrically. Densitometer?
- Only 0.35 mag amplitude.
- Strohmeier, W. & Knigge, R. 1973. *Bamberg Veroeffentlichungen der Remeis-Sternwarte*, 10,106. 1973. BamVe..10..106S.

BV 1390 Sco = CoD $-37^{\circ}11118(7^{m}.5)$ = HD 152901 (B5)

Min = JD 243 8228.315 + $1^{d}.294\ 745$. E

	Minima	E	B - R
243	8228.315	0	0.000
	8230.314	1.5	+0.057
	8252.223	18.5	-0.045
	8499.579	209.5	+0.015
	8501.571	211	+0.065
	8549.419	248	+0.007
	8562.378	258	+0.001
	8582.335	273.5	-0.093
	8584.336	275	-0.034
	8608.253	293.5	-0.070
	8610.254	295	-0.011
	8621.248	303.5	-0.022
	8634.218	313.5	0.000
	8877.538	501.5	-0.092
	8916.438	531.5	-0.032
	9287.397	818	-0.019
	9671.958(NZ)	1115	+0.002
	9710.844(NZ)	1145	+0.046
	9954.203(NZ)	1333	-0.007
244	0027.999(NZ)	1390	-0.011
	0336.128(NZ)	1628	-0.032
	0338.126(NZ)	1629.5	+0.024
	0409.958(NZ)	1685	-0.002
	0720.111(NZ)	1924.5	+0.059
	1065.142(NZ)	2191	+0.041
	1447.073(NZ)	2486	+0.022

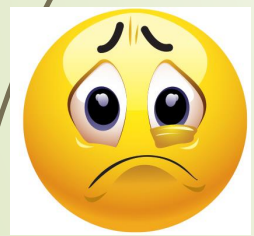
Ampl. $0^{m}.35$; EB-Lichtkurve mit tiefem Nebenminimum.
In Sonneberg keine weiteren Minima gefunden.

(NZ) = Minima auf Platten aus Neuseeland (M. CLARK)

Sonneberg Observatory Plate Archive: 270 000 plates 1928 - 2002, largest European plate collection

Observations since then – just one!

- Roger Diethelm, visual observation(!) 1976. *BBSAG* 29, 1
- JD 2442977.449 (1976-07-17)
- On the S&K Light elements, O-C = 0.0093 d.
- Good result, confirms S&K's light elements – or so it seems



- *Lack of a long series of minima measurements is a serious problem for the analysis of close binaries*

Then along comes our data

- 19 observation sets by Neil Butterworth
- They yielded 6 minima measurements
- But O-C's (from S&K light elements) are all over the place and too big
- Someone's results are just plain wrong!

HJD	HJD err	O-C [d]	O-C err
2457283.916	0.007	0.191	0.007
2457579.108	0.006	0.182	0.006
2457909.047	0.006	-0.039	0.006
2457922.068	0.007	0.034	0.007
2457268.933	0.007	0.098	0.007
2457564.133	0.007	0.096	0.007

So, derive Light Elements from a different source

- Mark Blackford derived a Light Element fit from ASAS3:
- **HJD 2457579.114(3) + 4.34119(4) x E**
- Fits Neil's primary minima well

- S&K period: 1.295 d
- Our period: 4.341 d
  - 3.35 times as big!

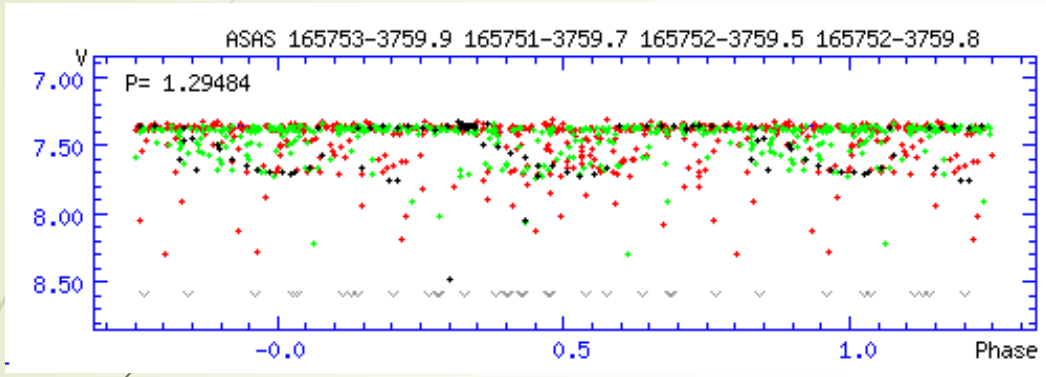
HJD of min	HJD error	O-C (d)	O-C error
2457283.916	0.007	0.0061	0.009285
2457579.108	0.006	-0.0035	0.008627
2457909.047	0.006	0.0043	0.008556
2457922.068	0.007	0.0017	0.009285

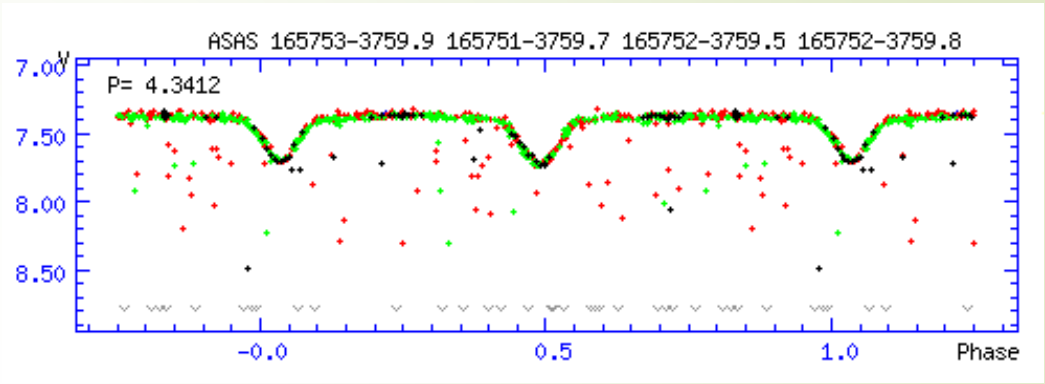
Confirmation of our period

S&K Period

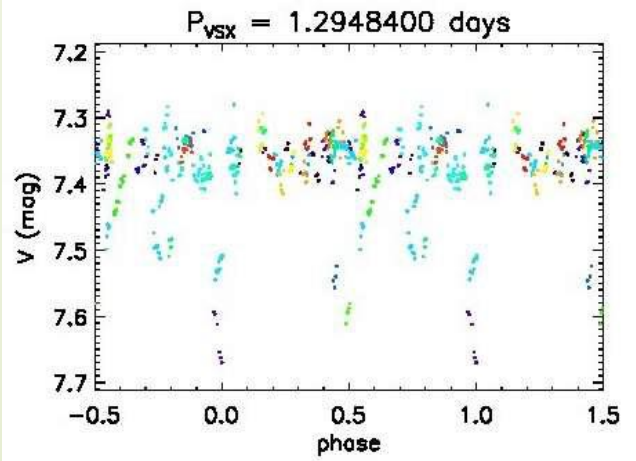
Our Period

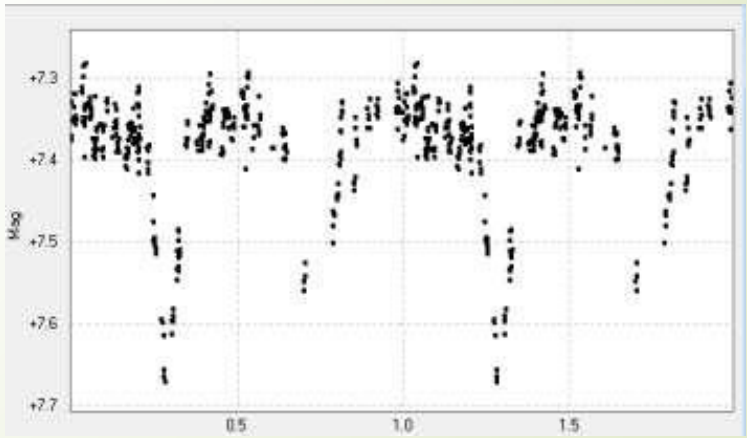
ASAS3





INTEGRAL-OMC





Sent to the OEJV – our period not accepted

- Major problems:
  - Are we really right?
    - Aliasing mistake?
    - Period (sub)multiple?
  - If we're right, how come S&K are so wrong?
    - Subtext - S&K are more reputable than us!

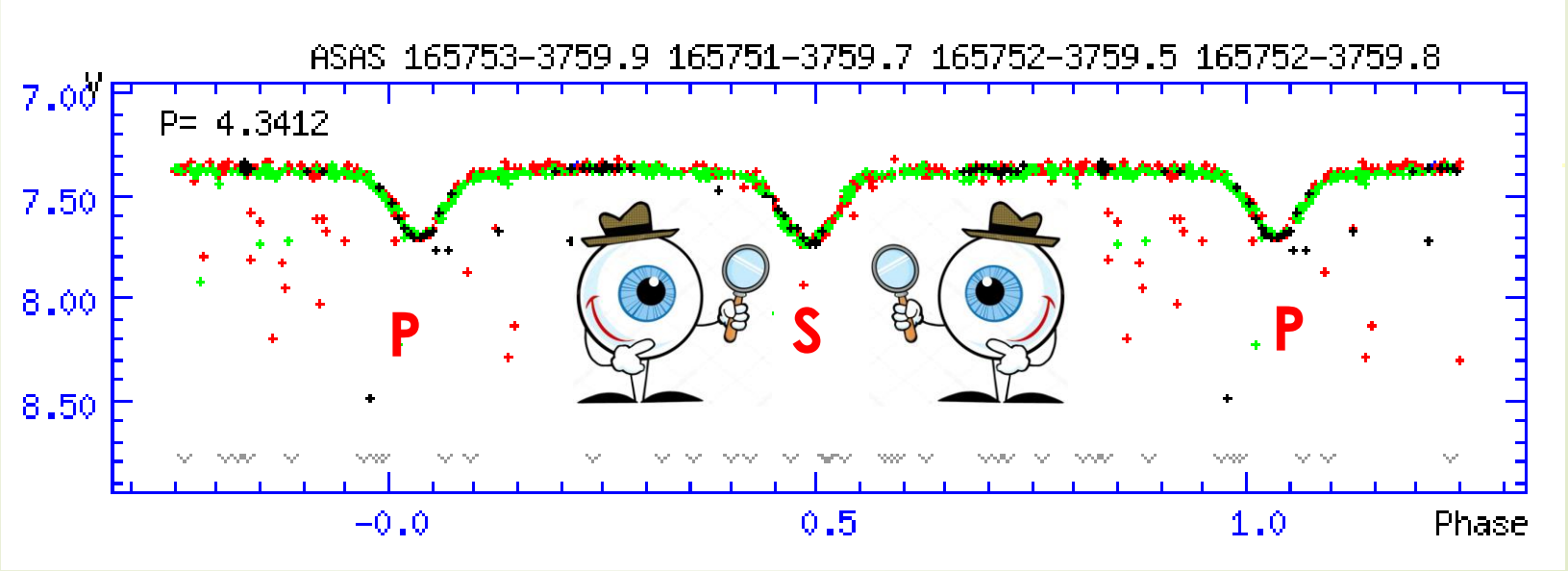
On our light elements, S&K's minima have O-C's ranging from -0.18d to +0.32 d.

Not believable!!

Two Clues

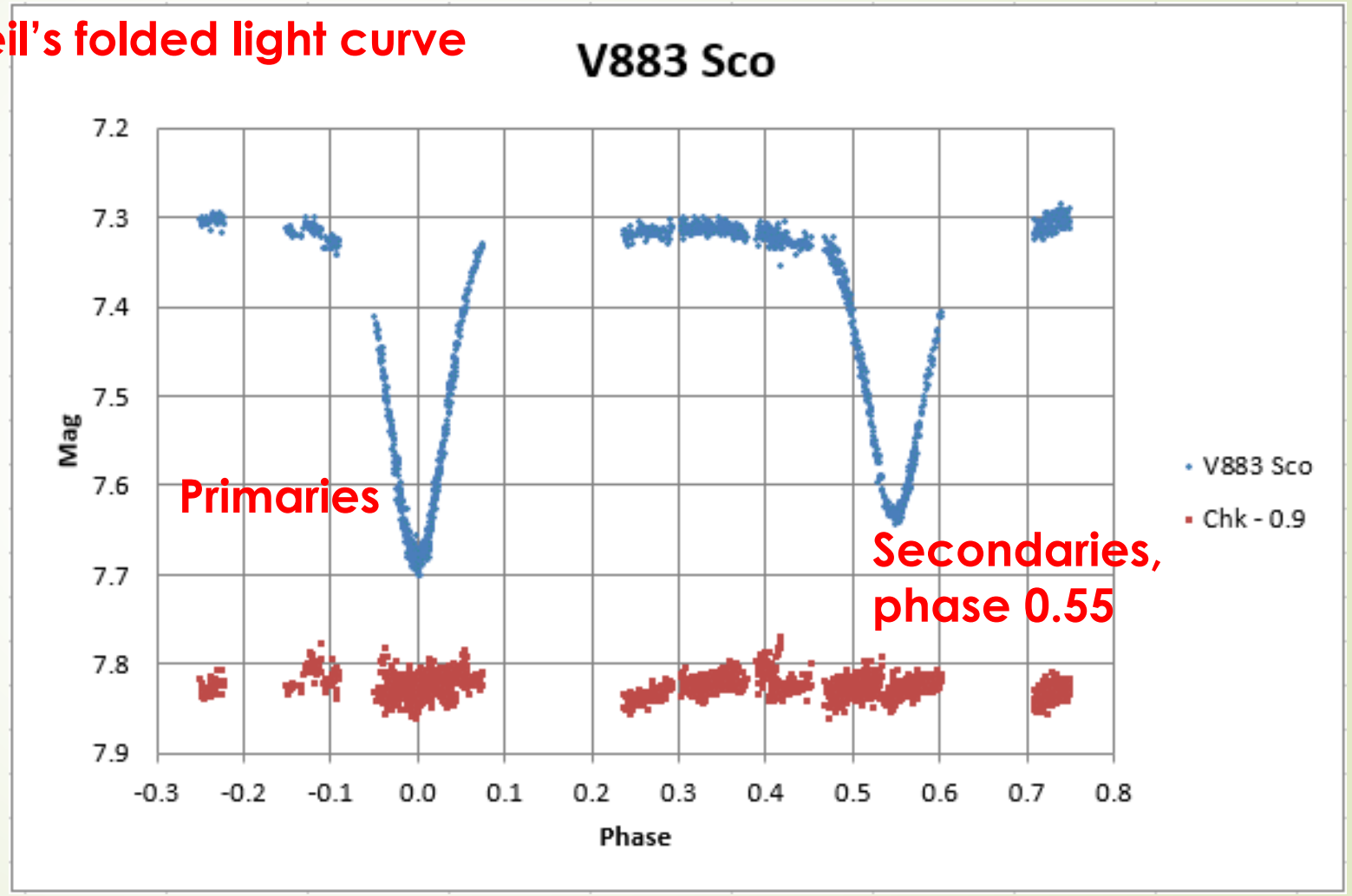
- On the short S&K period (1.2 d) it was classified as a contact binary (EB)
- EBs are usually tidally locked, ***assume circular orbits***
- On our period (3.4 d), it's an EA (semi)-detached, ***possibly elliptical orbit.***

1. **The ASAS3 light curve confirms ellipticity.**
2. **Secondary minimum about as deep as Primary – easily confused by S&K**



So which minima are primary, which secondary?

- We can distinguish!
- S&K couldn't
- (About 0.04 mag difference)



Can now separate P & S minima times in ASAS3, OMC and Neil.

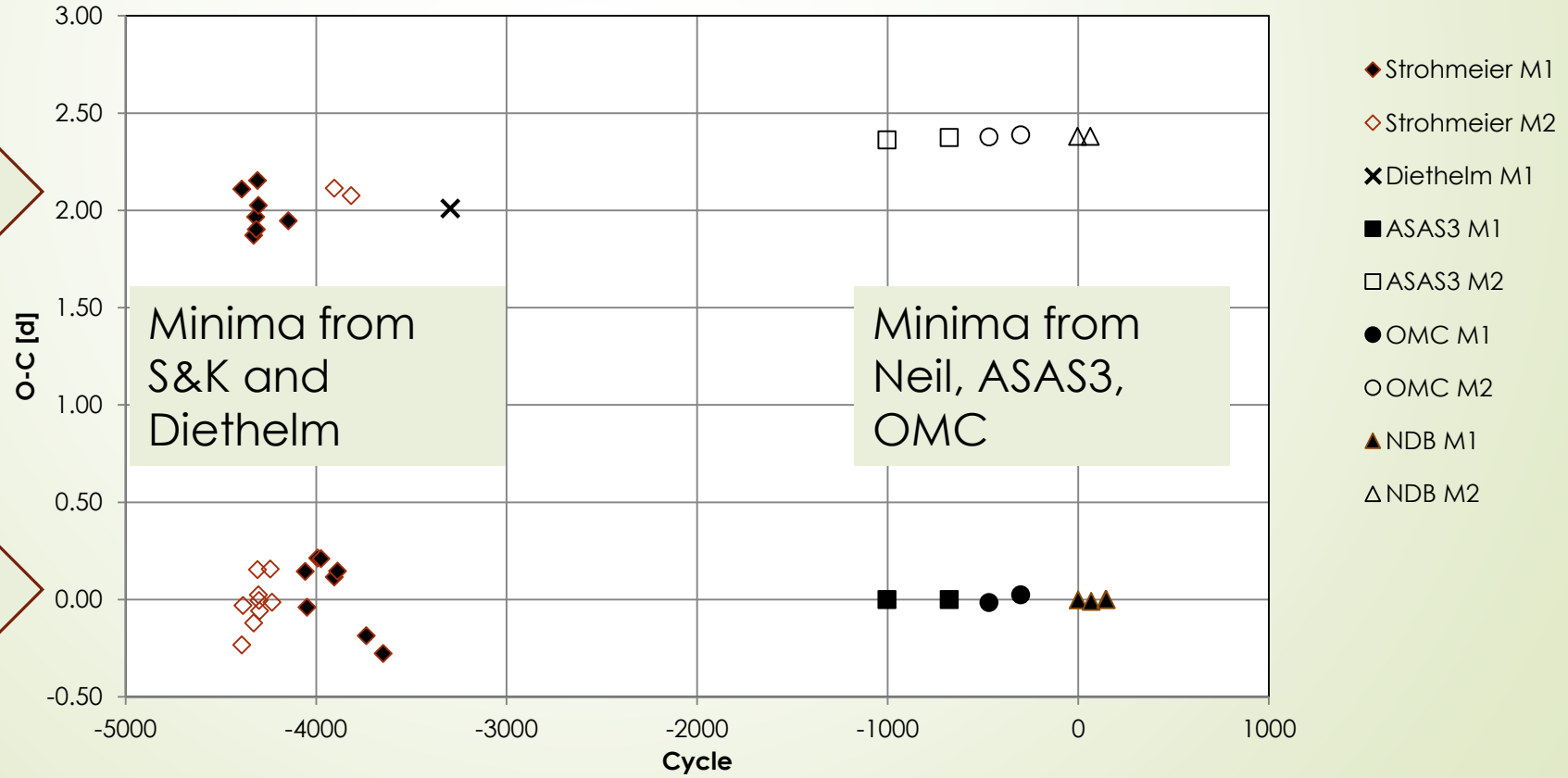
- **Combine all three & re-calculate Light Elements:**
- MinI = HJD 2457283.917(5) + 4.3411**64**(11) x E
- MinII = HJD 2457268.936(3) + 4.3411**82**(6) x E
- So phase of epoch of secondary minimum = 0.549
- Those 1-sigma period errors don't quite overlap, so there might be apsidal motion (elliptical orbit precessing)

O-C analysis finally explains the S&K data

- Make O-C plot using our primary-minima light elements
- O-C gives definitive identification of all primary & secondary eclipses
- Confirms slightly different secondary period. Apsidal motion?

Secondary minima

Primary minima

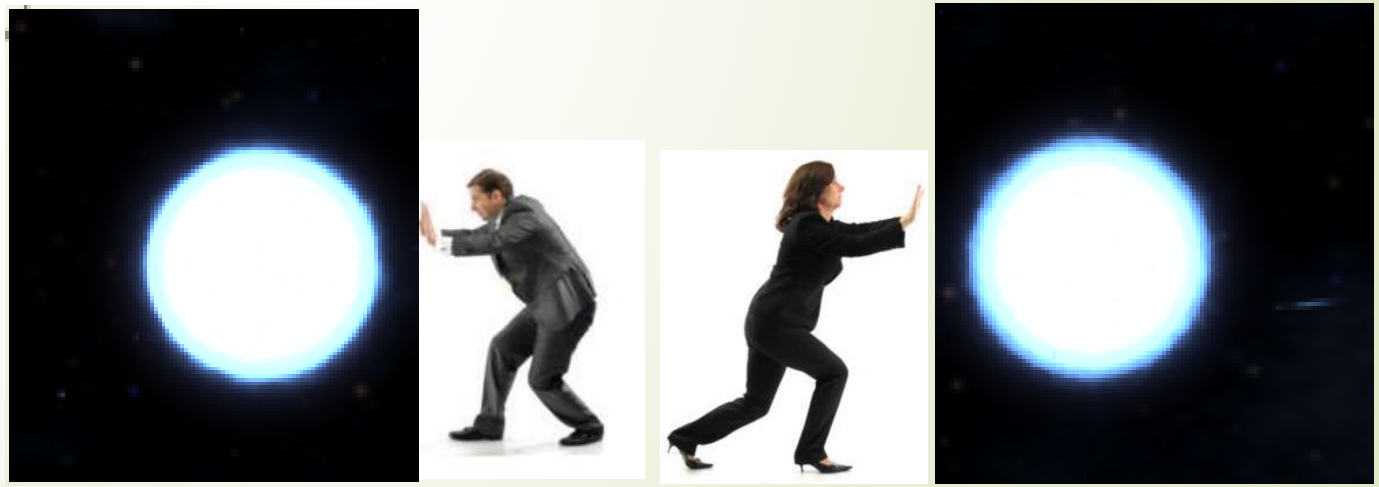


Revised paper accepted

Richards, T; Butterworth, N; Blackford, MG, 2017.
Note on the period of V883 Sco.
Open European Journal of Variable Stars, 186

- We explained definitively how S&K went wrong
- We were able to correct the S&K analysis
- And now we have a "new" very bright EA binary awaiting further research

Not like this



Like this

And the morals of this tale are…

1. Obtaining a continuing series of eclipse timings is vital for robust period analysis
2. Confusing primary and secondary minima of similar depth is easy
3. Photographic photometry is coarse & unreliable with small amplitudes (visual is worse)
4. Photographic & visual cadence is too great to measure sharp mag changes around a minimum
5. Outstanding researchers make mistakes if data are too coarse
6. Outstanding researchers always get the benefit of the doubt
7. **Prove your case rigorously!**