

SEVEN HIGHLIGHTS OF THE CYGNUS PROJECT

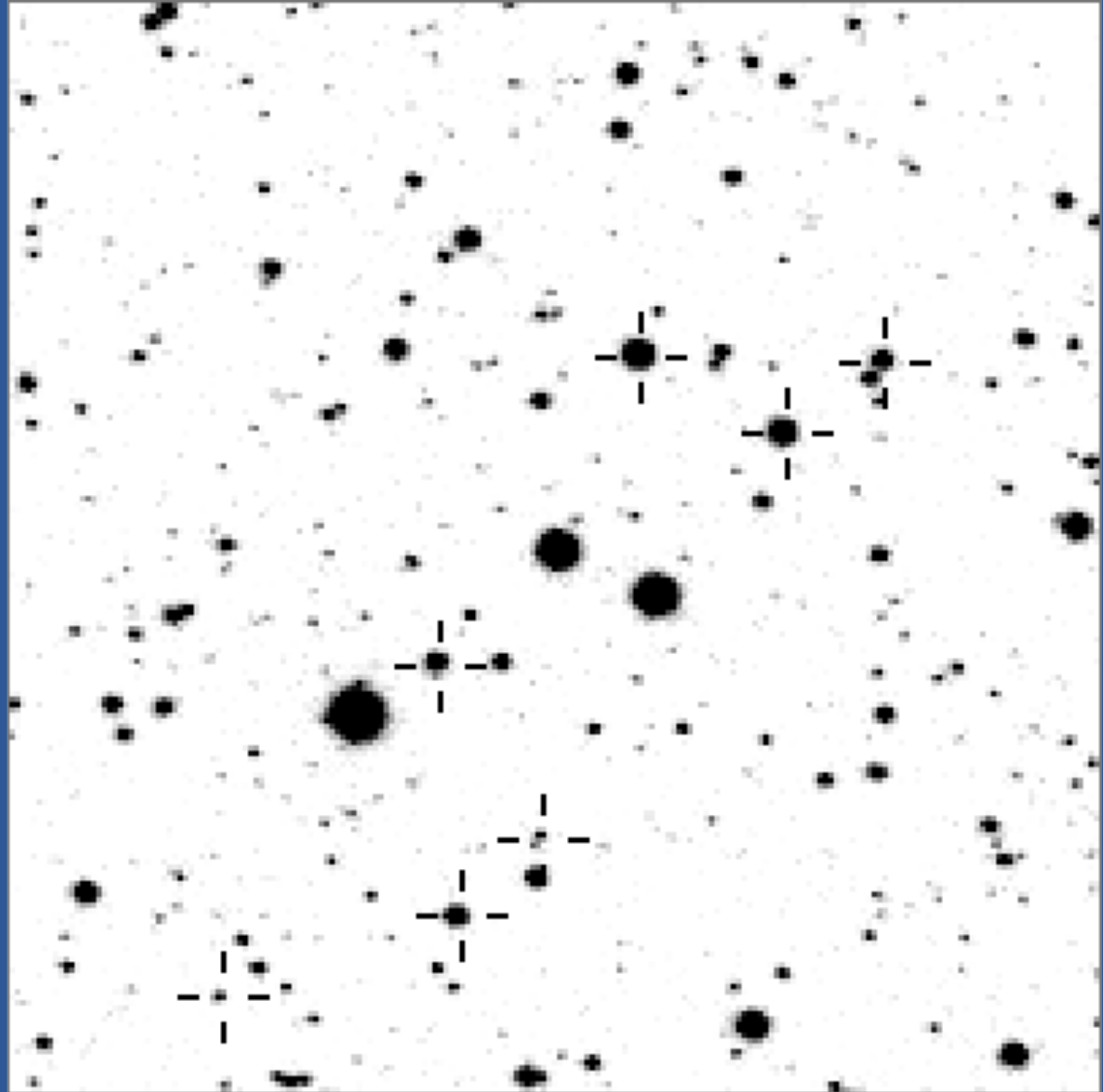
Stan Waterman- VSS York 2014

7 of 77!

- ▣ Finding and Identifying Stars!
- ▣ Picture Coefficients
- ▣ Discovering that stars vary in Brightness!
- ▣ Periodograms and Phase Plots
- ▣ Dip Hunting
- ▣ Hot Worlds- finding two transient events
- ▣ A few favourite light curves

Finding and Identifying Stars

This is about 0.25% of an image and contains about a 1000 identifiable objects



Picture Coefficients

Having identified 15 stars an equation can be solved:

$$\begin{aligned}ra = & (a_1) + (a_2 x) + (a_3 y) + (a_4 x^2) \\ & + (a_5 xy) + (a_6 y^2) + (a_7 x^3) + (a_8 x^2y) \\ & + (a_9 xy^2) + (a_{10} y^3) + (a_{11} x^4) + (a_{12} x^3y) \\ & + (a_{13} x^2y^2) + (a_{14} xy^3) + (a_{15} y^4)\end{aligned}$$

Picture Coefficients

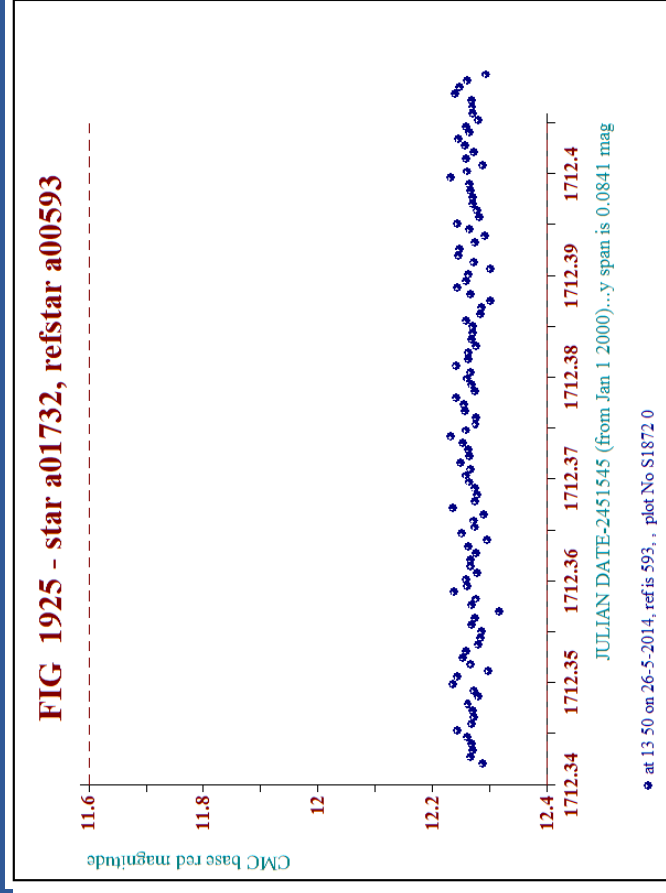
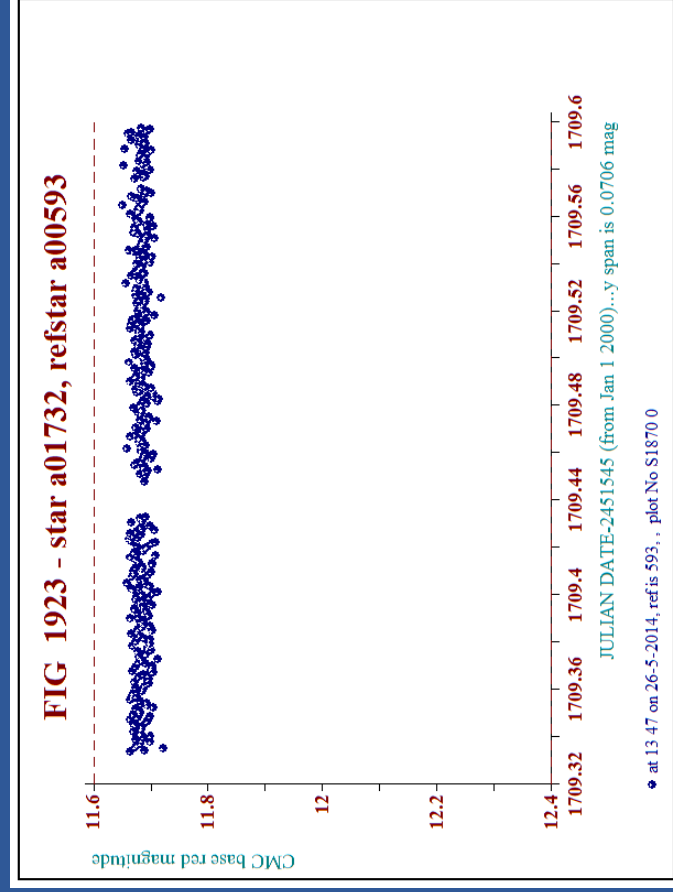
For ra and dec in x and y and for x and y in ra and dec

$$\begin{aligned}x = & (b_1) + (b_2 \text{.ra}) + (b_3 \text{.dec}) + (b_4 \text{.ra}^2) \\ & + (b_5 \text{.ra.dec}) + (b_6 \text{dec}^2) + (b_7 \text{ra}^3) \\ & + (b_8 \text{ra}^2 \text{.dec}) + (b_9 \text{ra.dec}^2) \\ & + (b_{10} \text{dec}^3) + (b_{11} \text{ra}^4) + (b_{12} \text{ra}^3 \text{.dec}) \\ & + (b_{13} \text{ra}^2 \text{.dec}^2) + (b_{14} \text{ra.dec}^3) + (b_{15} \text{dec}^4)\end{aligned}$$

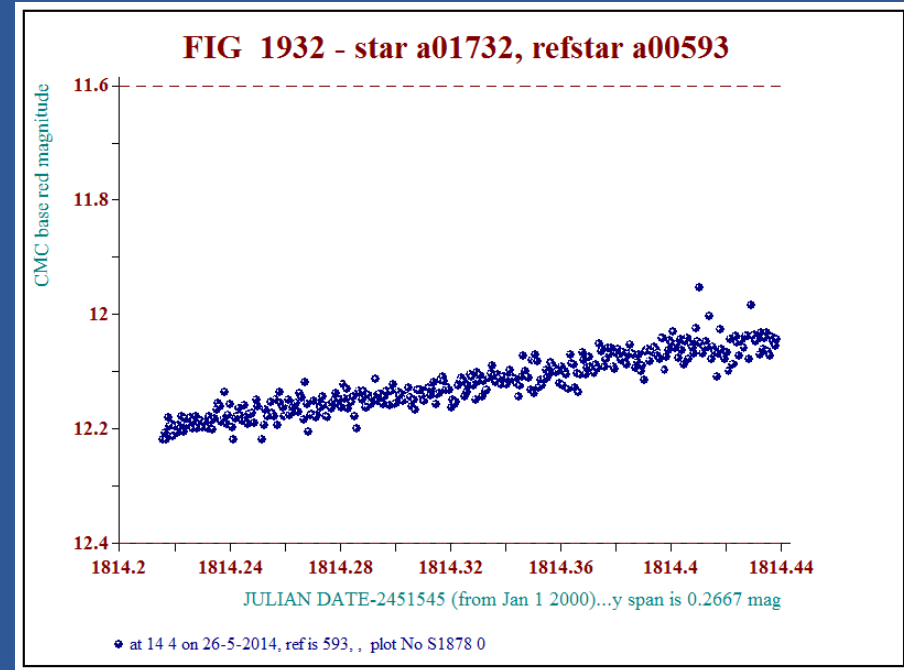
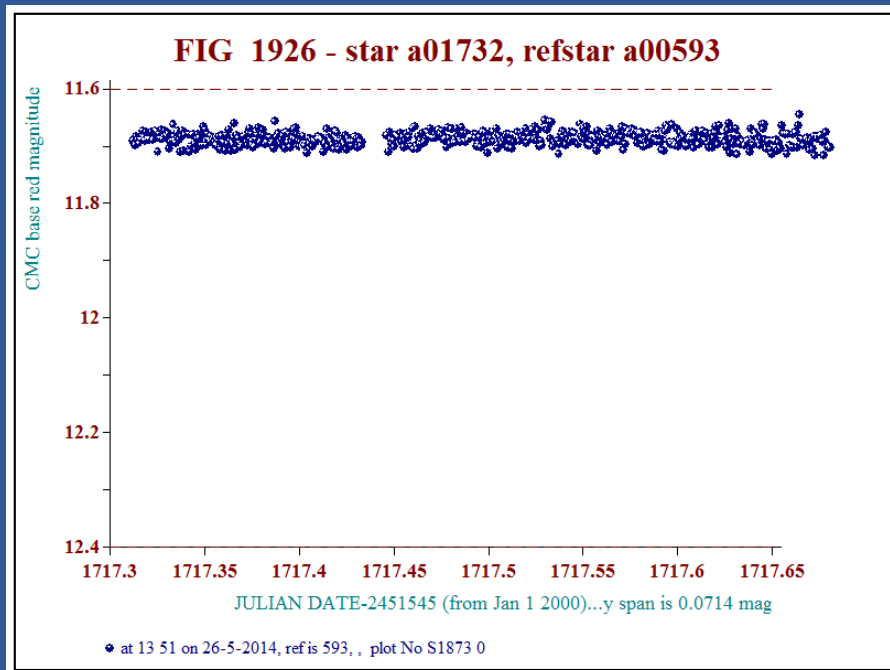
SKY → chip xy → SKY

- ▣ So any point in every image has a known ra and dec and any ra and dec can be given an x and y in any image- so objects, even if not visible in a single image can be located
- ▣ This was a real highlight- I found looking in Vizier this year that my image contained 4 quasars, 5 pulsars and 4 Xray stars.
- ▣ I found all the quasars, none of the pulsars and two of the Xray Stars I had as variables

Stars vary in Brightness!



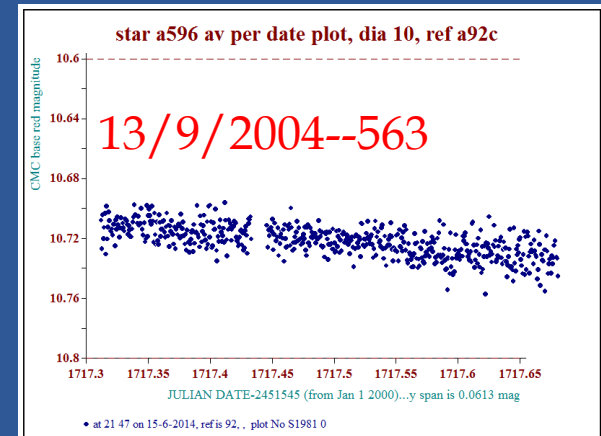
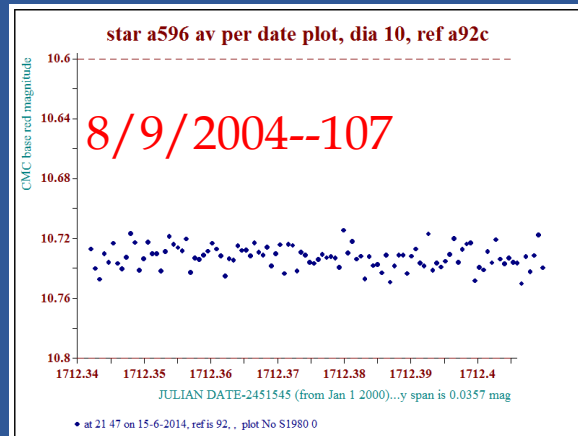
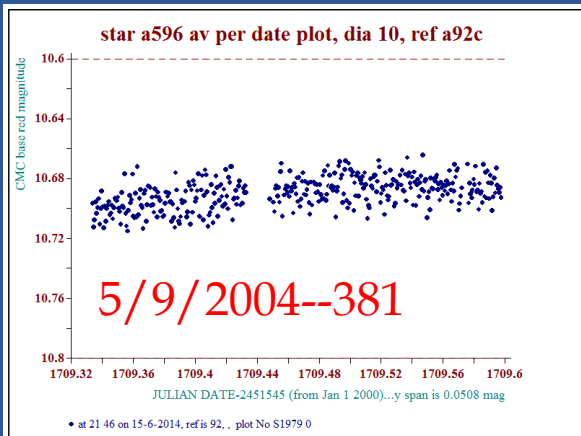
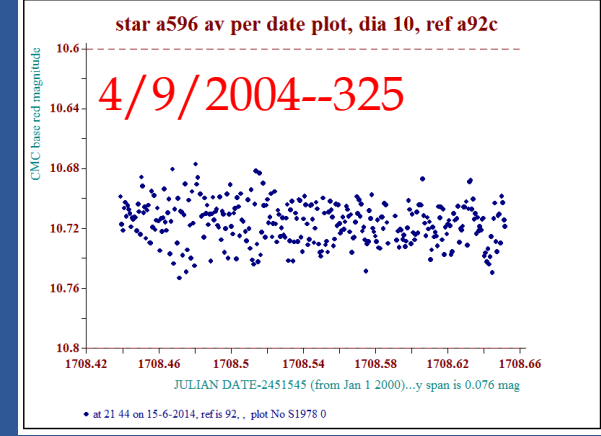
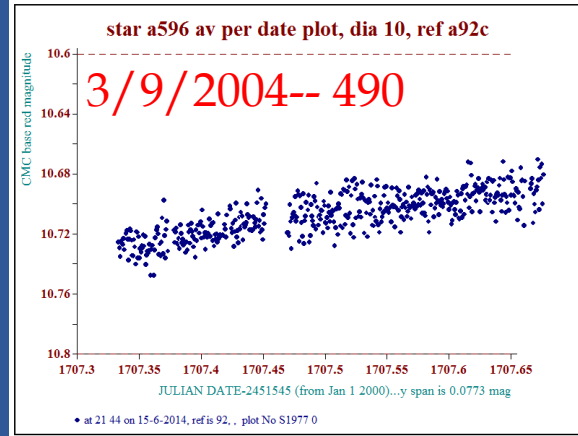
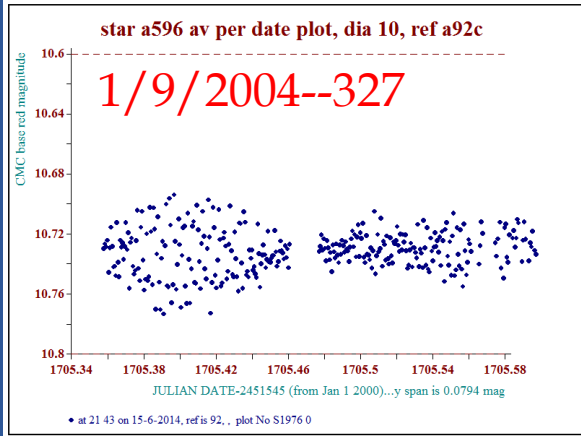
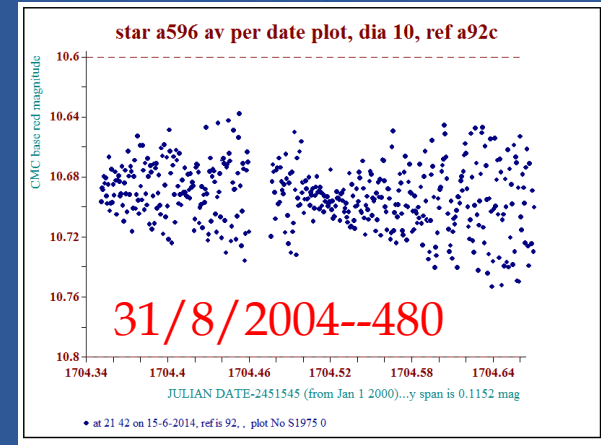
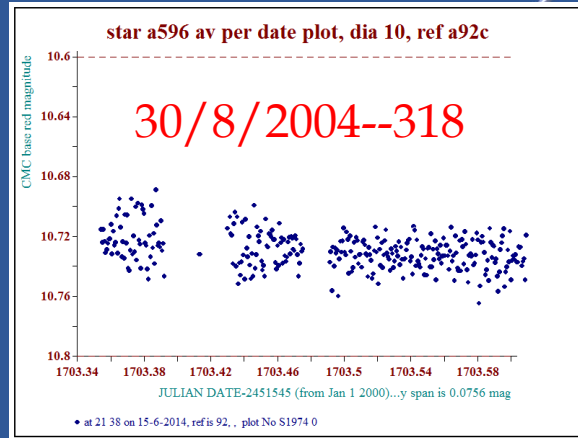
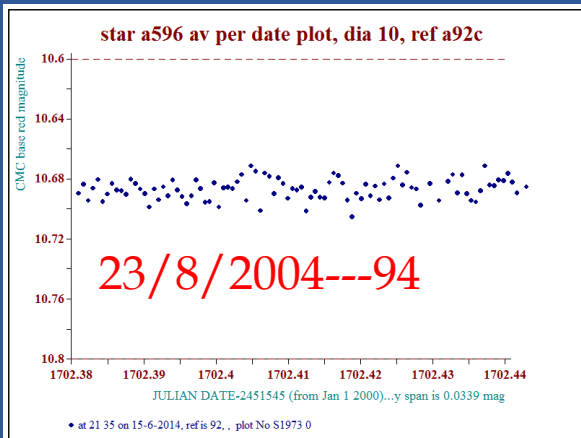
Stars Vary in Brightness!



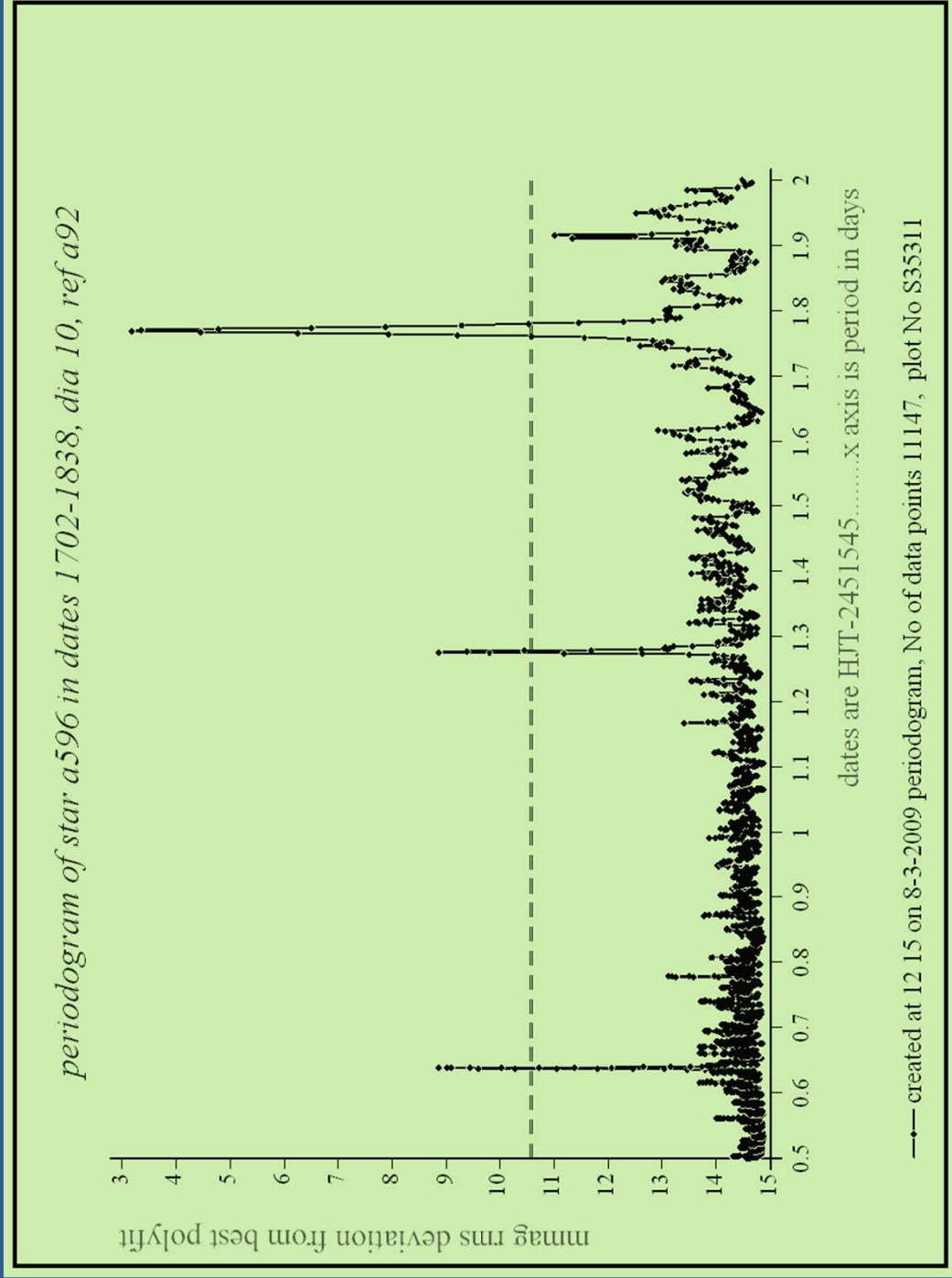
V530cyg

Periodograms and Phase Plots

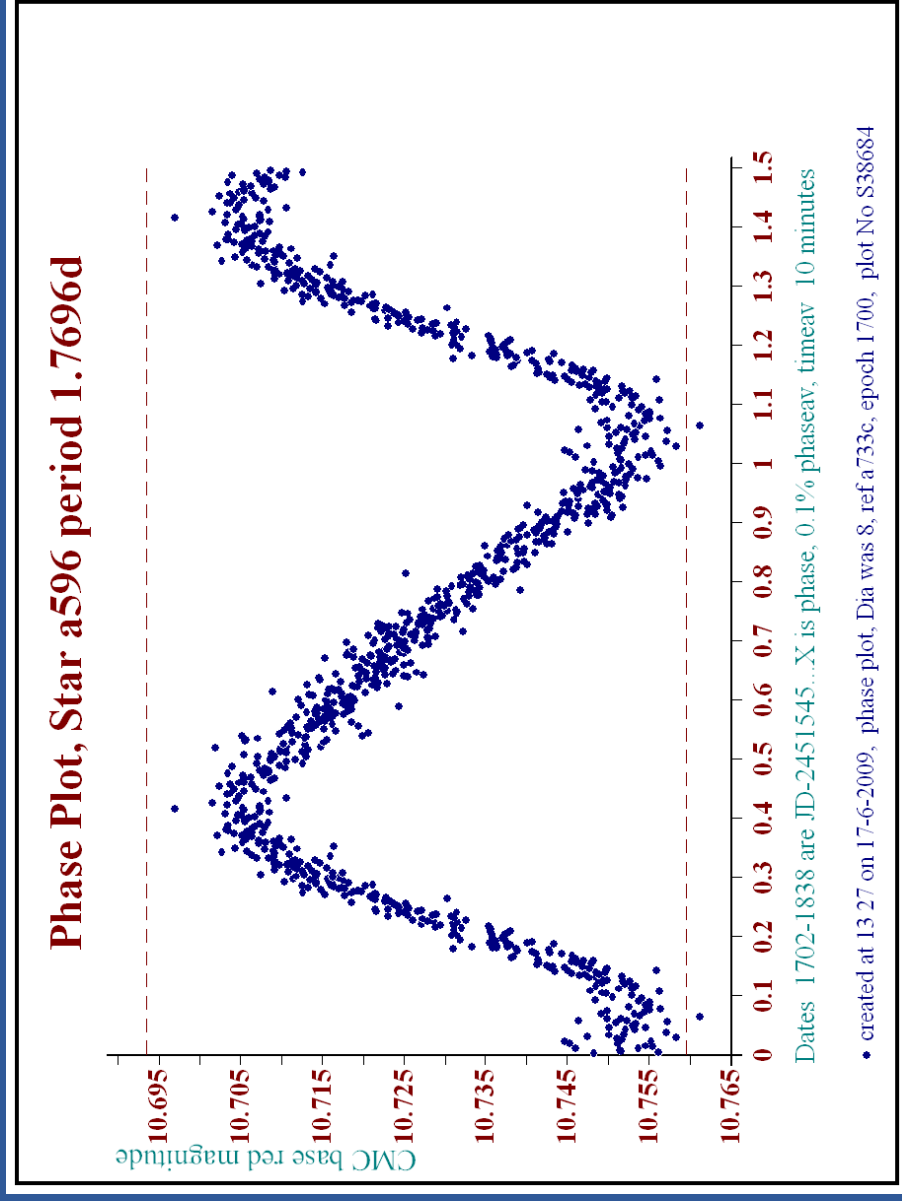
Star 00596--1st 9 days in 2004



The Periodogram

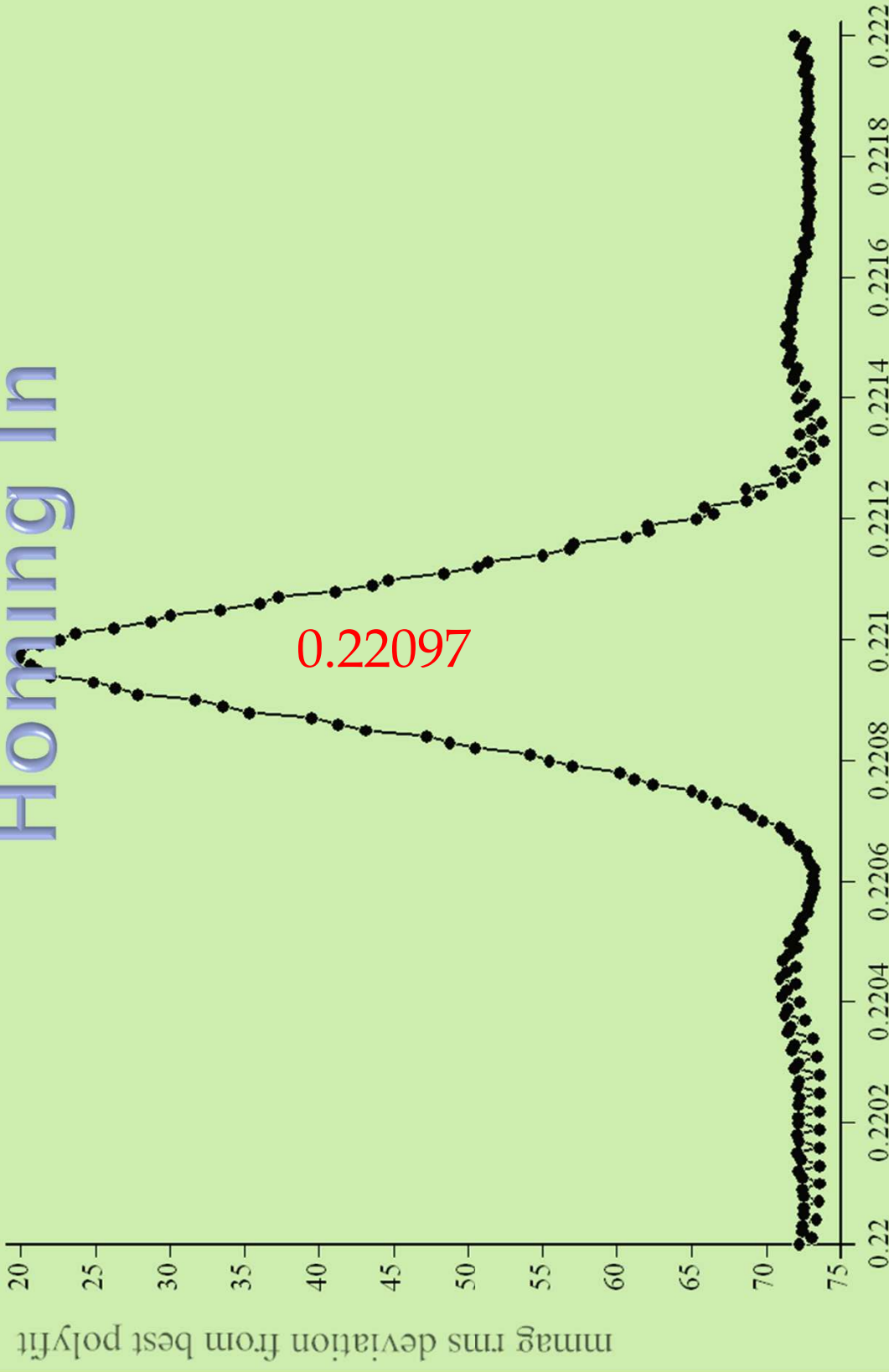


The 2004/5 Phase-Plot



periodogram of star a9582 in dates 2772-2903, dia 8, ref a779

Homing In



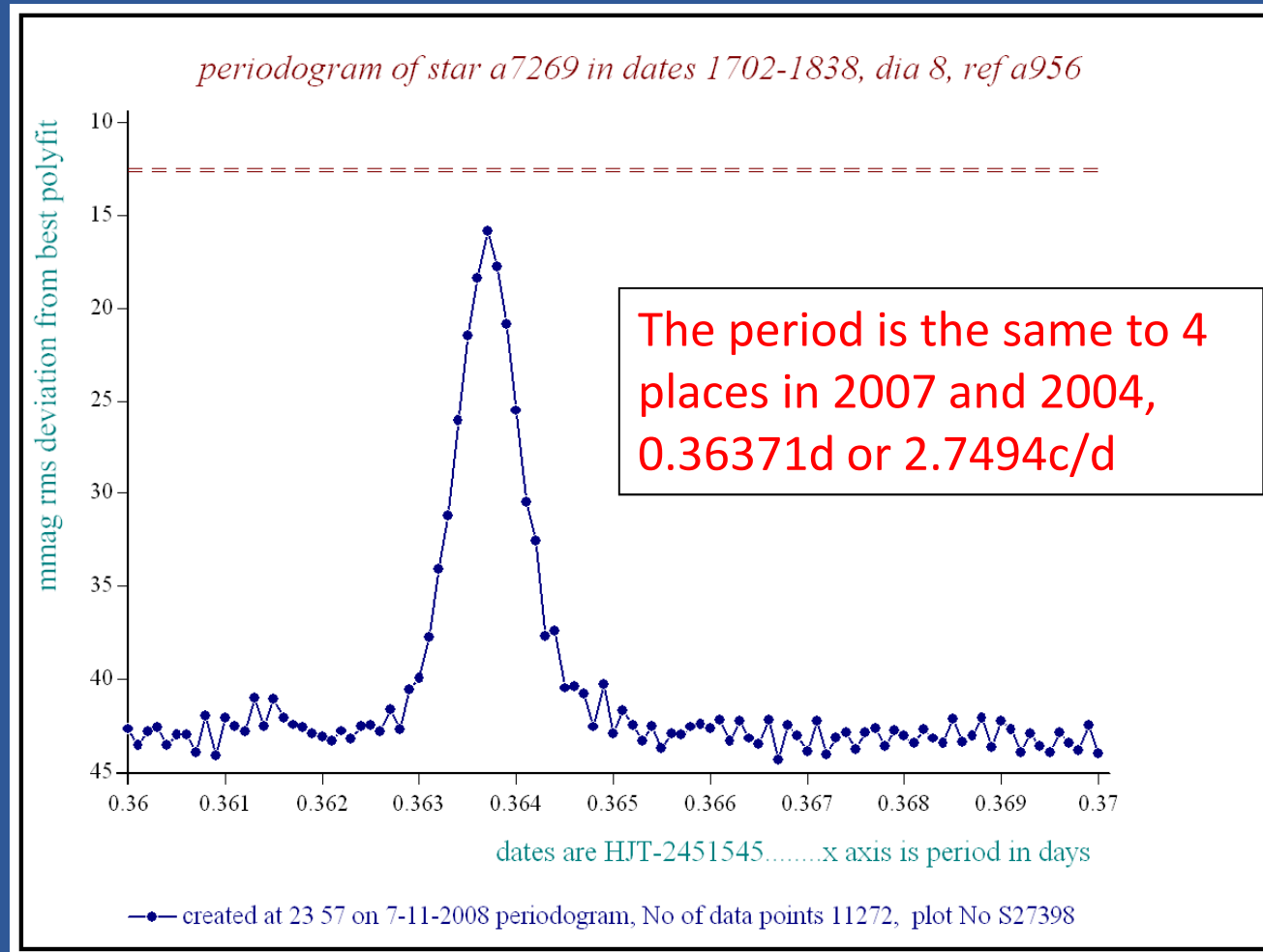
dates are HJT-2451545.....x axis is period in days

—●— created at 14 26 on 30-10-2008 periodogram, No of data points 10612, plot No S25767

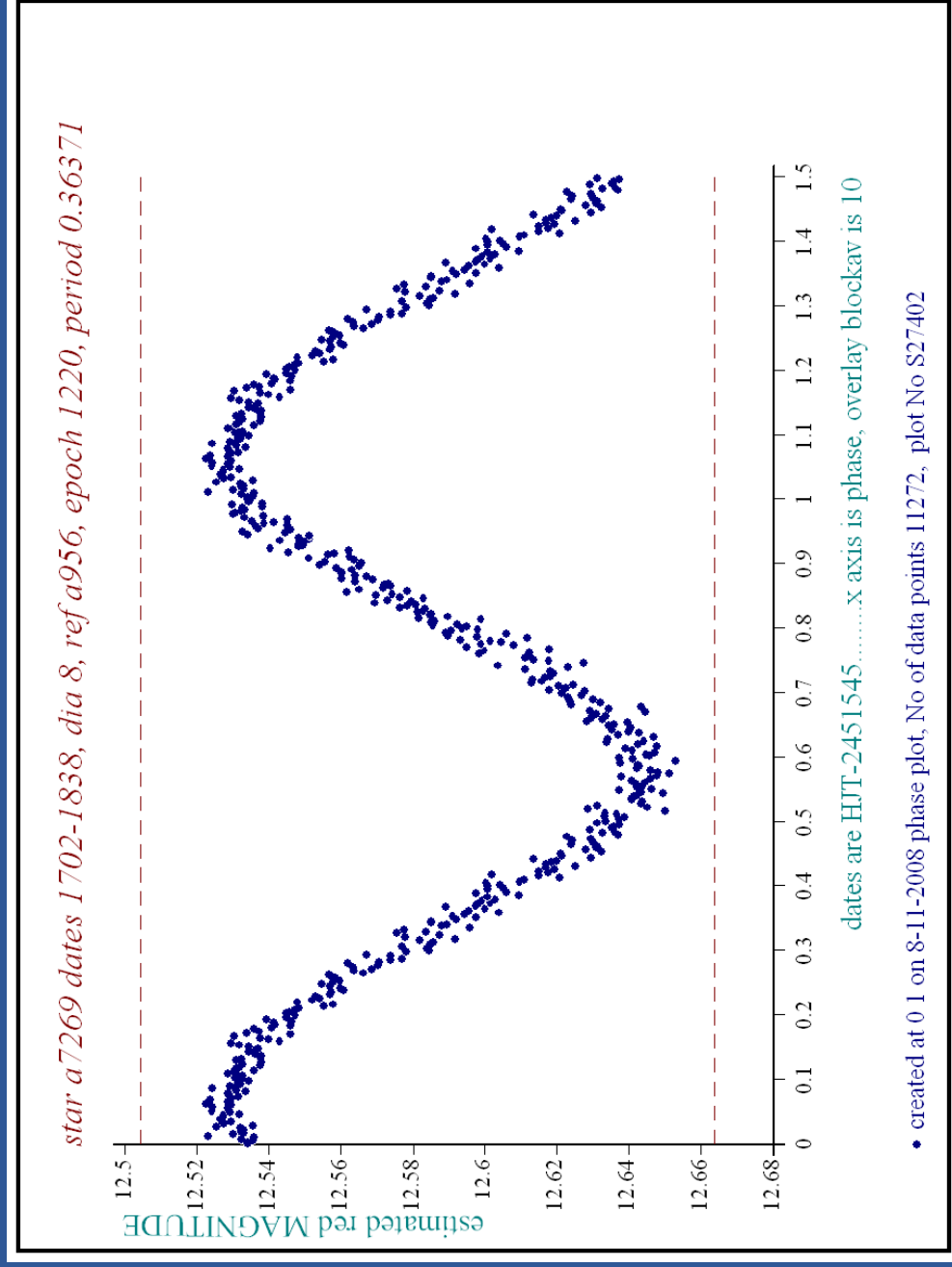
Dip Hunting

- ▣ Simple but CPU intensive
- ▣ Simply chop the data into equal intervals of time
- ▣ Overlay all the choppings, add, look for pattern
- ▣ Do this for 30,000 time intervals
- ▣ Repeat for every star
- ▣ About two weeks CPU on 2009 desktop
- ▣ About 350 new variables were found
- ▣ The result for one star may be:

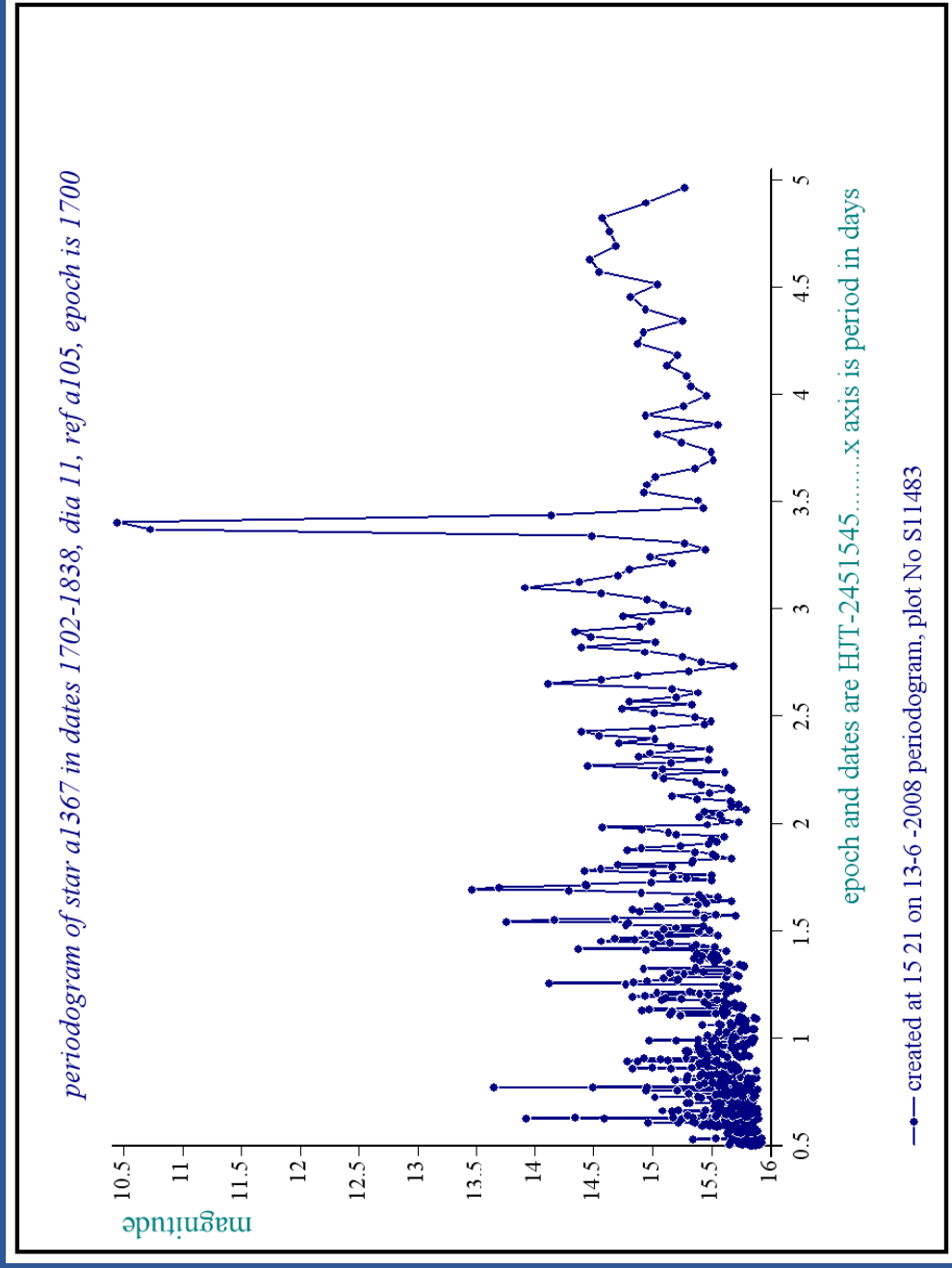
Periodogram of star 7269, 2004 data



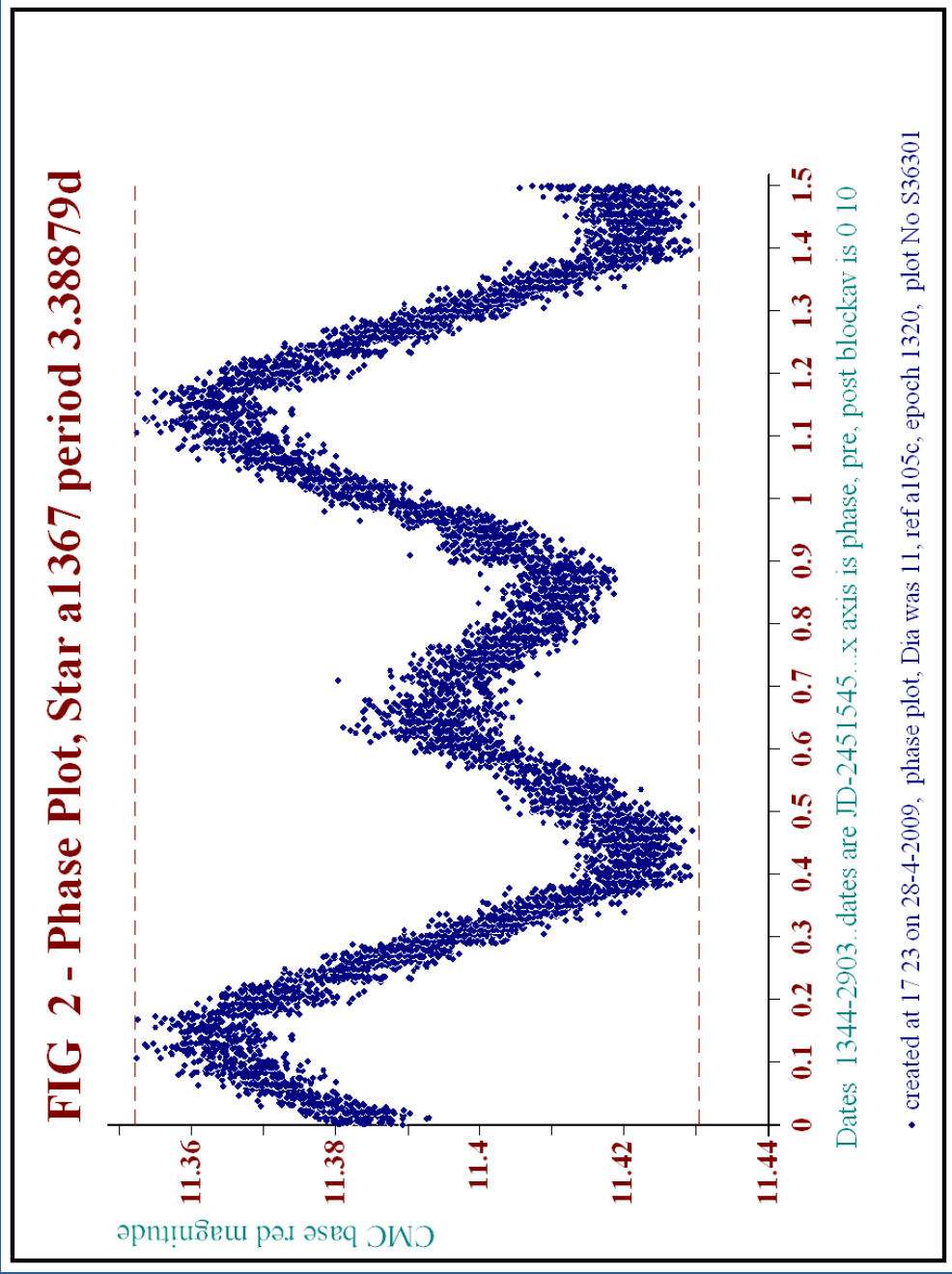
Star 7629



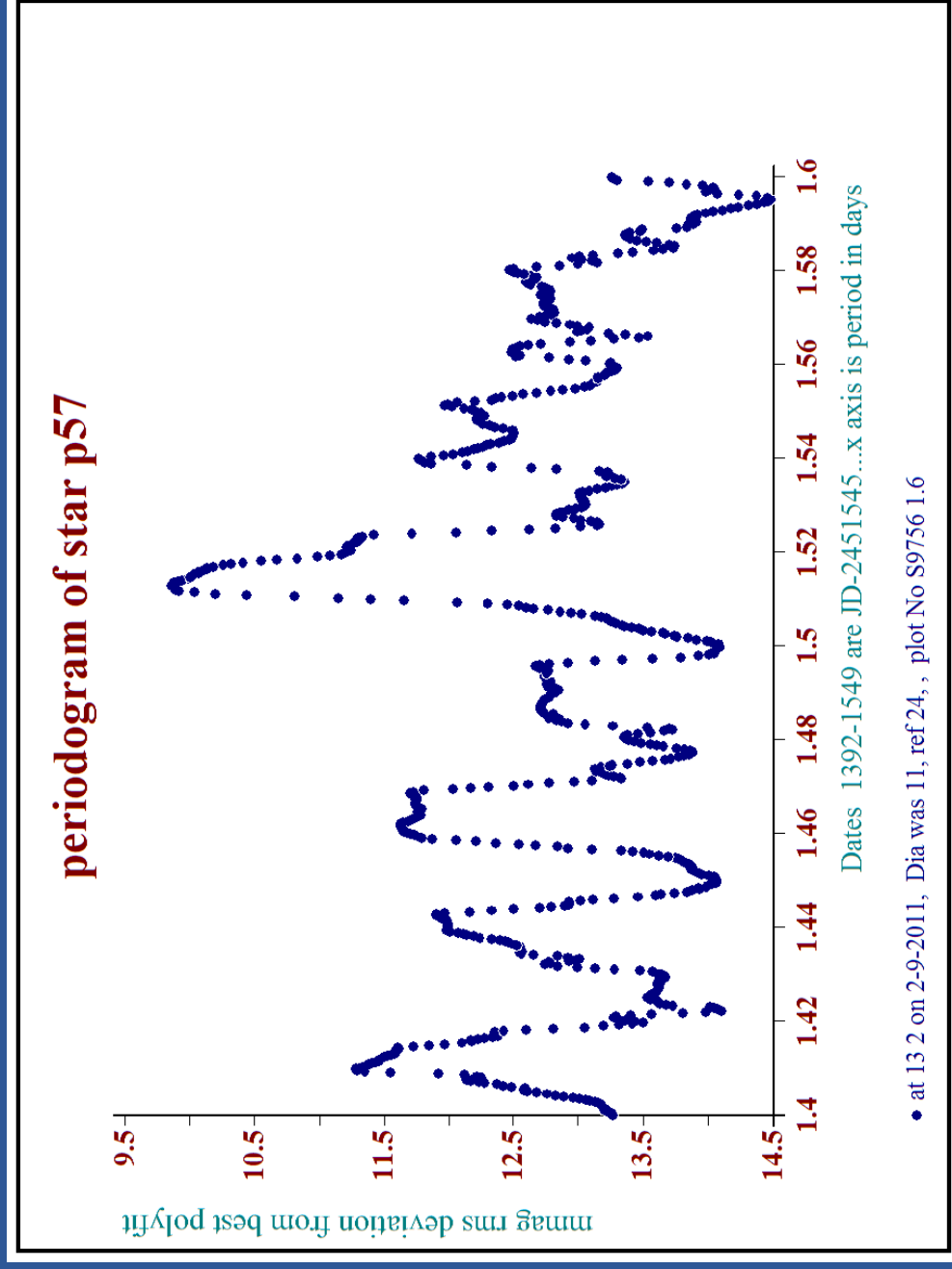
And another: a01367



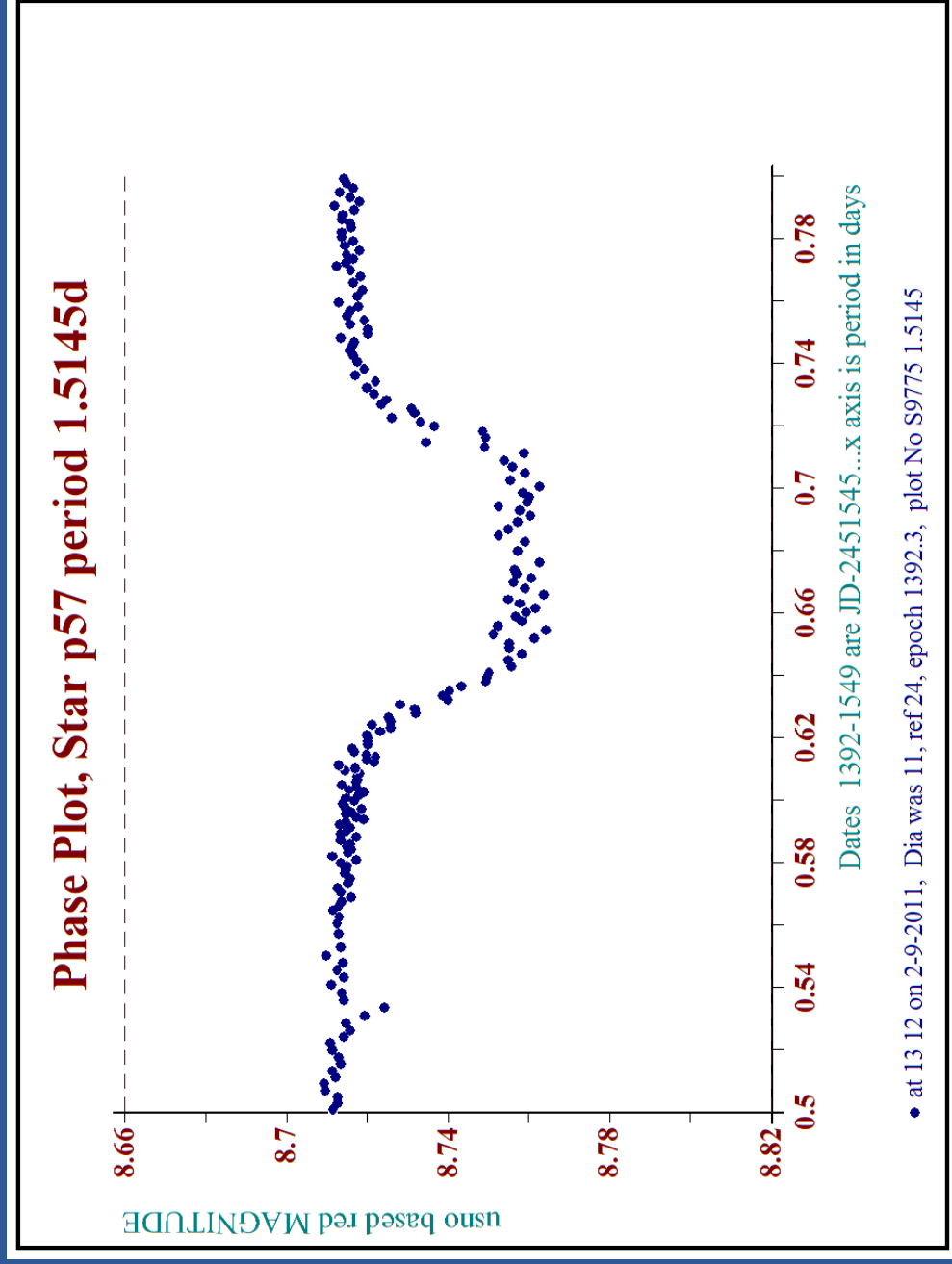
With this phase plot:



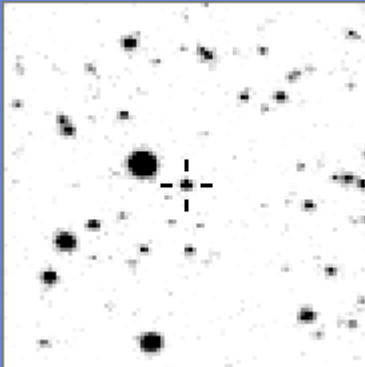
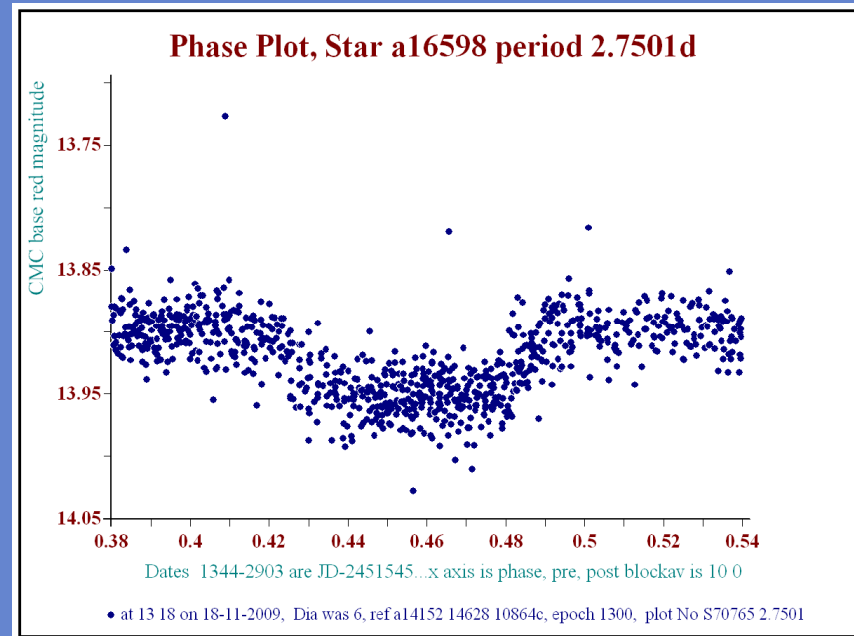
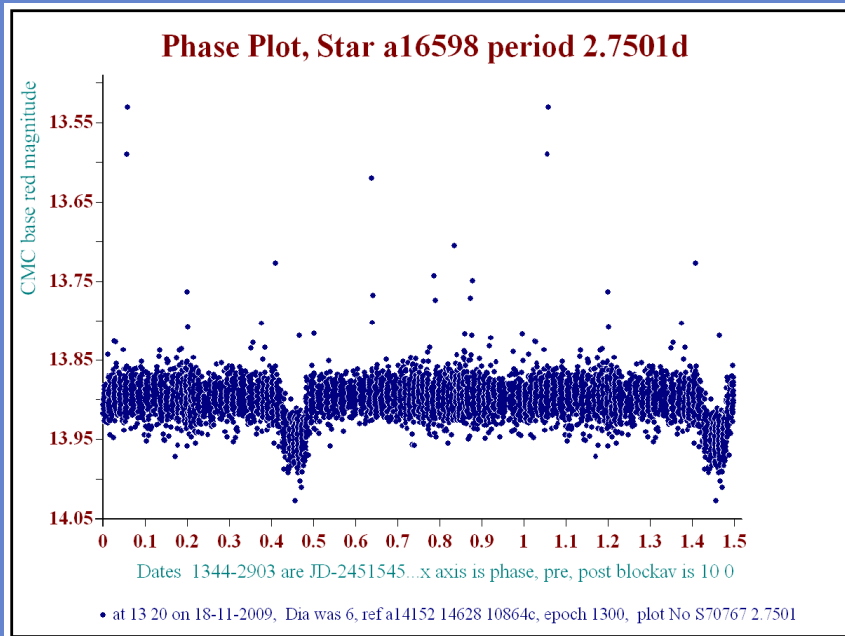
A poor Periodogram



But A Significant Star



Star 16598 P=2.7501 R2=2.3Rj



Dip width=0.081 Depth =0.057 P=2.7501

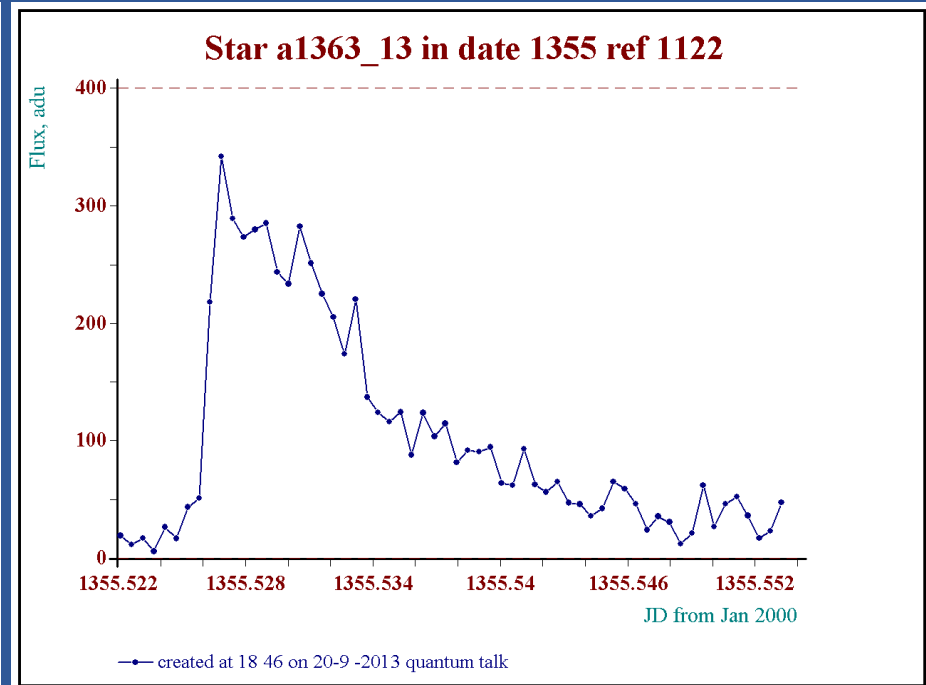
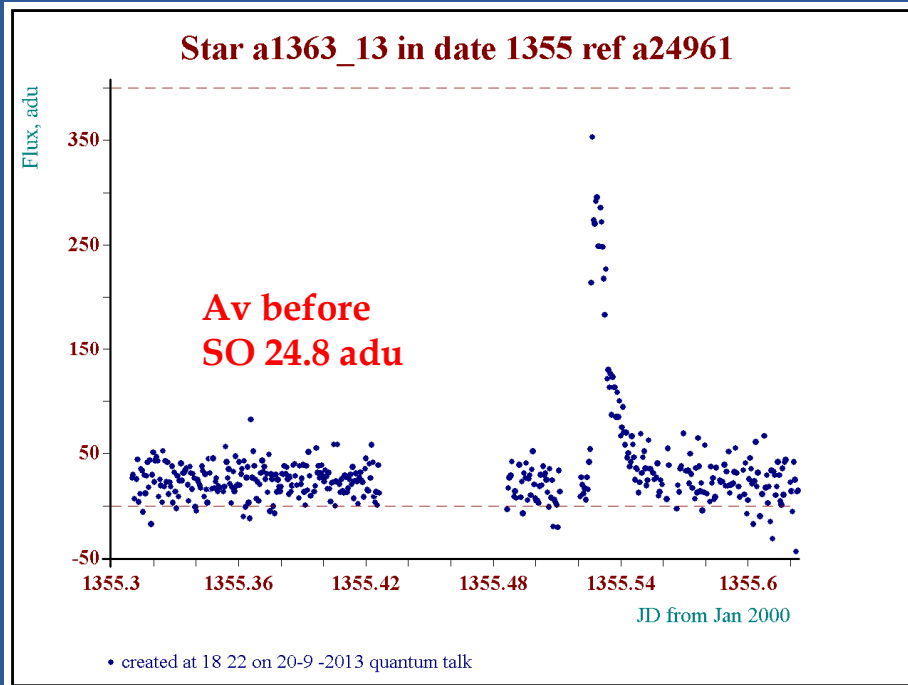
IF: Tc= 6030, G0 m1= 1.1 M_☉ r 1= 1.05 R_☉

Then: r1+r2=2.24 **r2=2.3Rj** Rorb=8.9 ☉ **m2 ≈0.16 M_☉** M3/4

So, probably a red dwarf companion but may just be a well inflated hot Jupiter

Hot Worlds: Two Flares

Star 1363-13



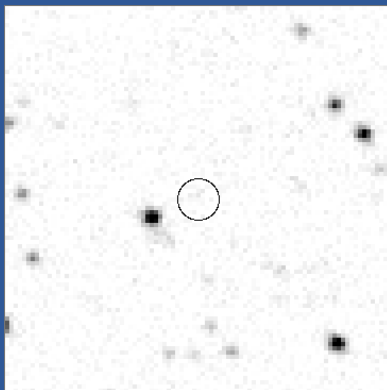
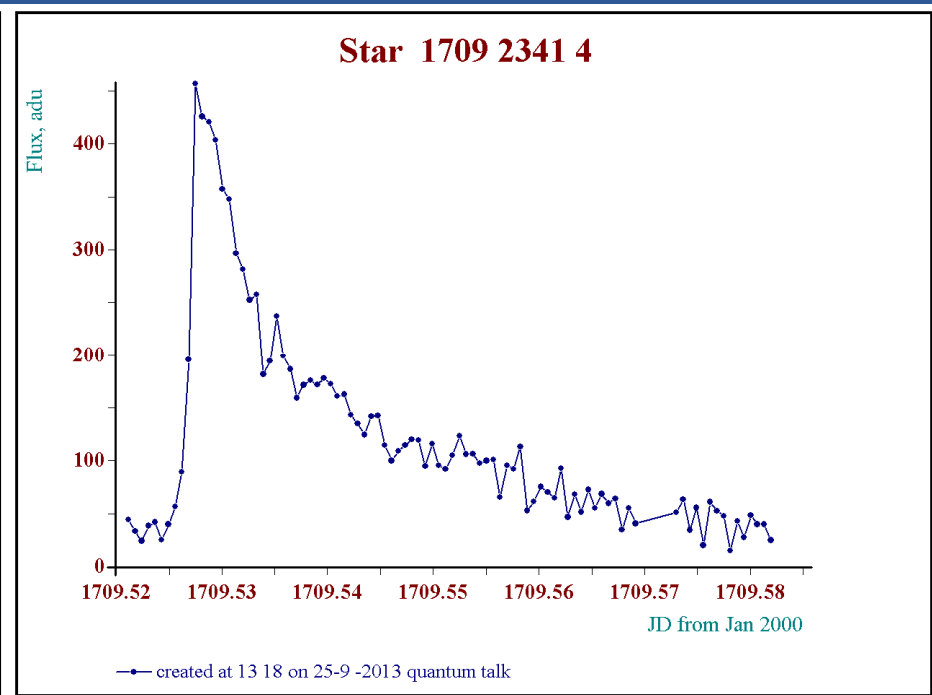
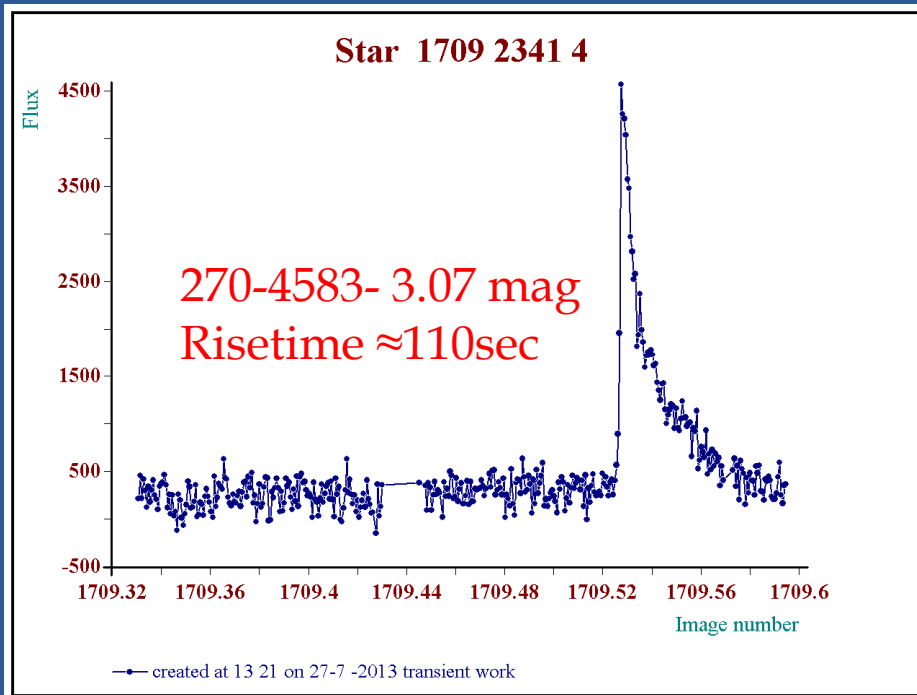
This flare happened on 18th September 2003 at 38 minutes past midnight. My 7th night of collecting data so I hope I may have caught another flareup in one of the remaining 200 nights.

If we take this curve at face value then the peak is at .5268 so $1/e$ is at .5356, .0088d or **12.7 mins**.

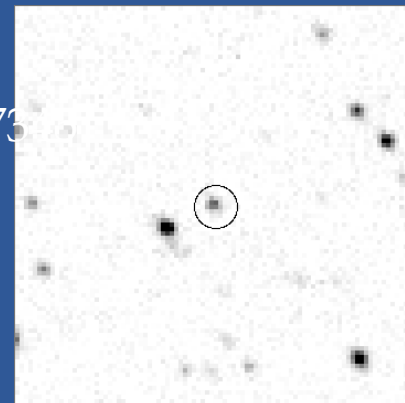
Unless the peak was really at .5266 and 400 then the time constant is **11.5 mins**

It brightens by 2.6 magnitudes in a little under 90 seconds

Star 2341-4



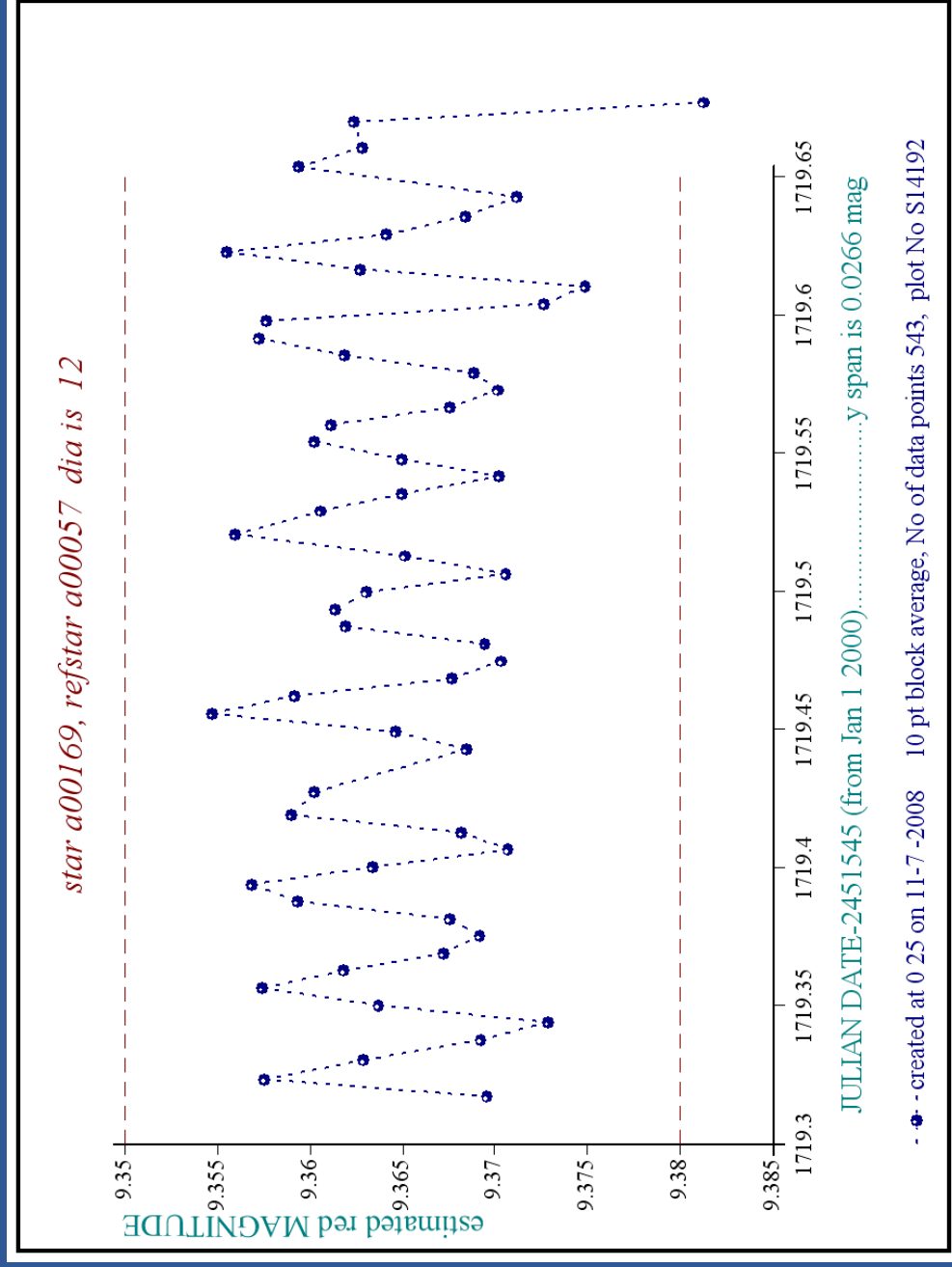
USNO 1350 136475
B,R= 18.8 16.4



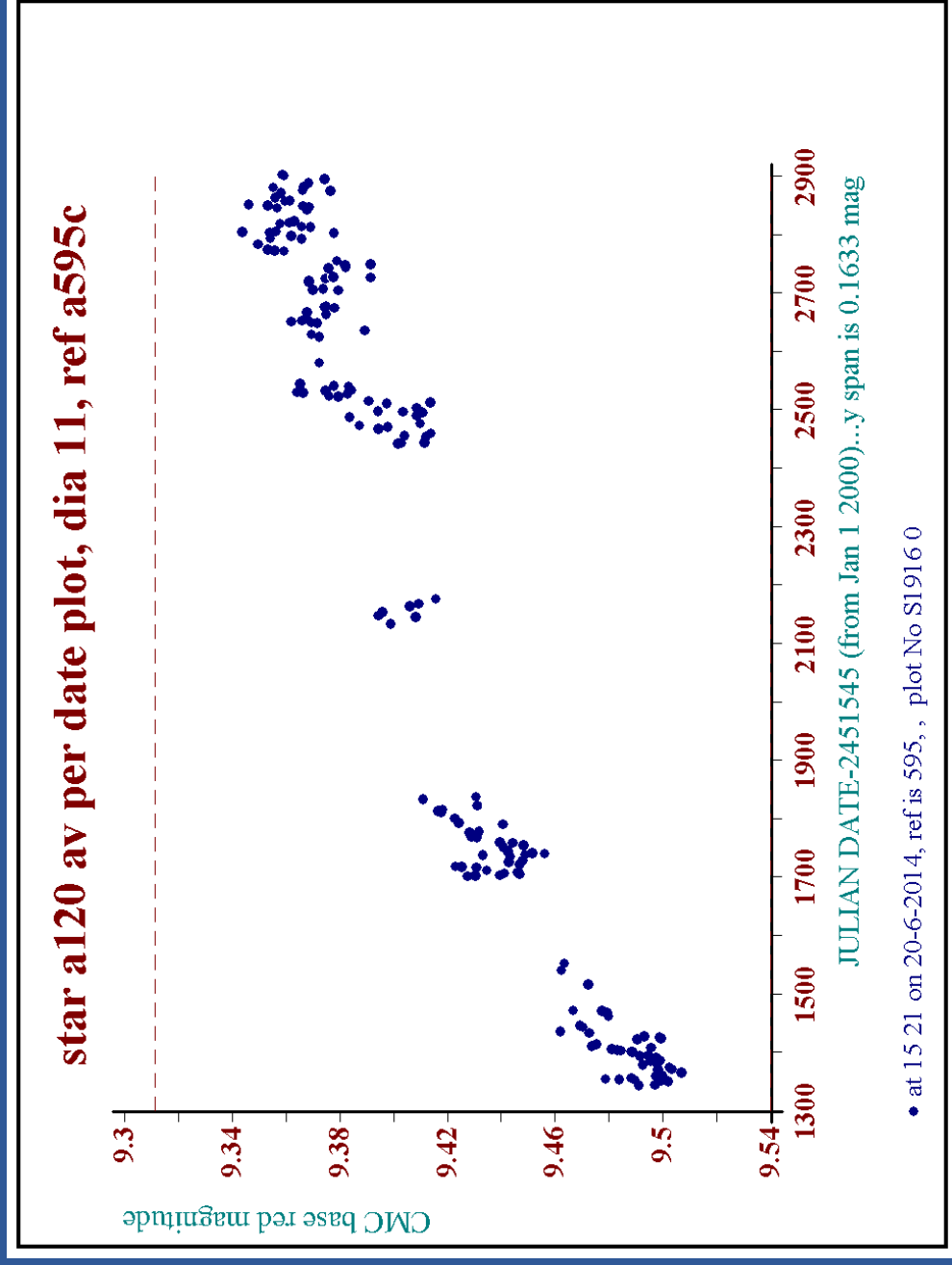
A Few Favourite Light Curves

- ▣ Fastest
- ▣ Slowest
- ▣ Prettiest
- ▣ Biggest
- ▣ Most Sinusoidal
- ▣ A small group
- ▣ Very interesting!

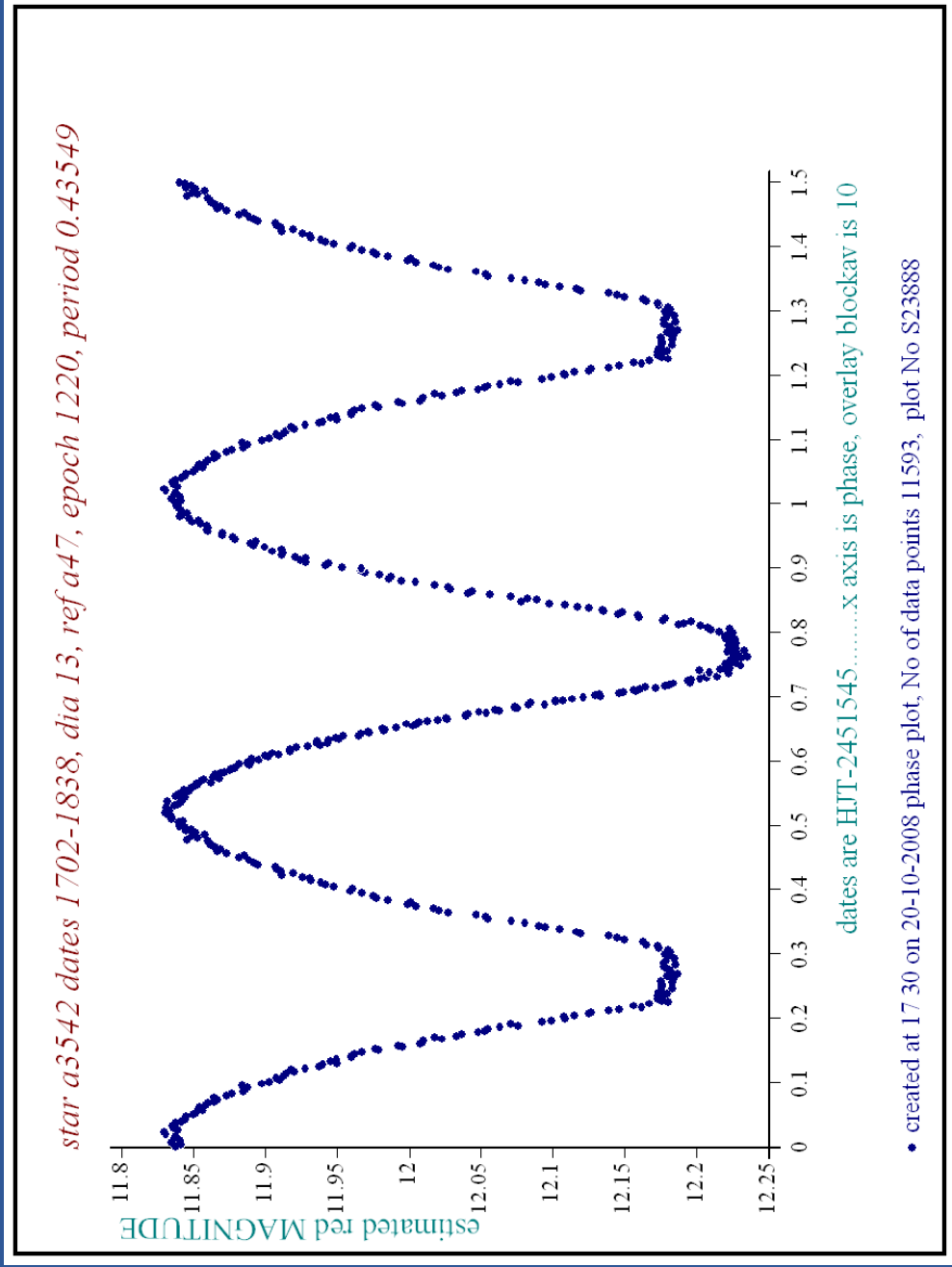
Fastest- 30.003 cs per day



Slowest- 0.14 mag in 1600days

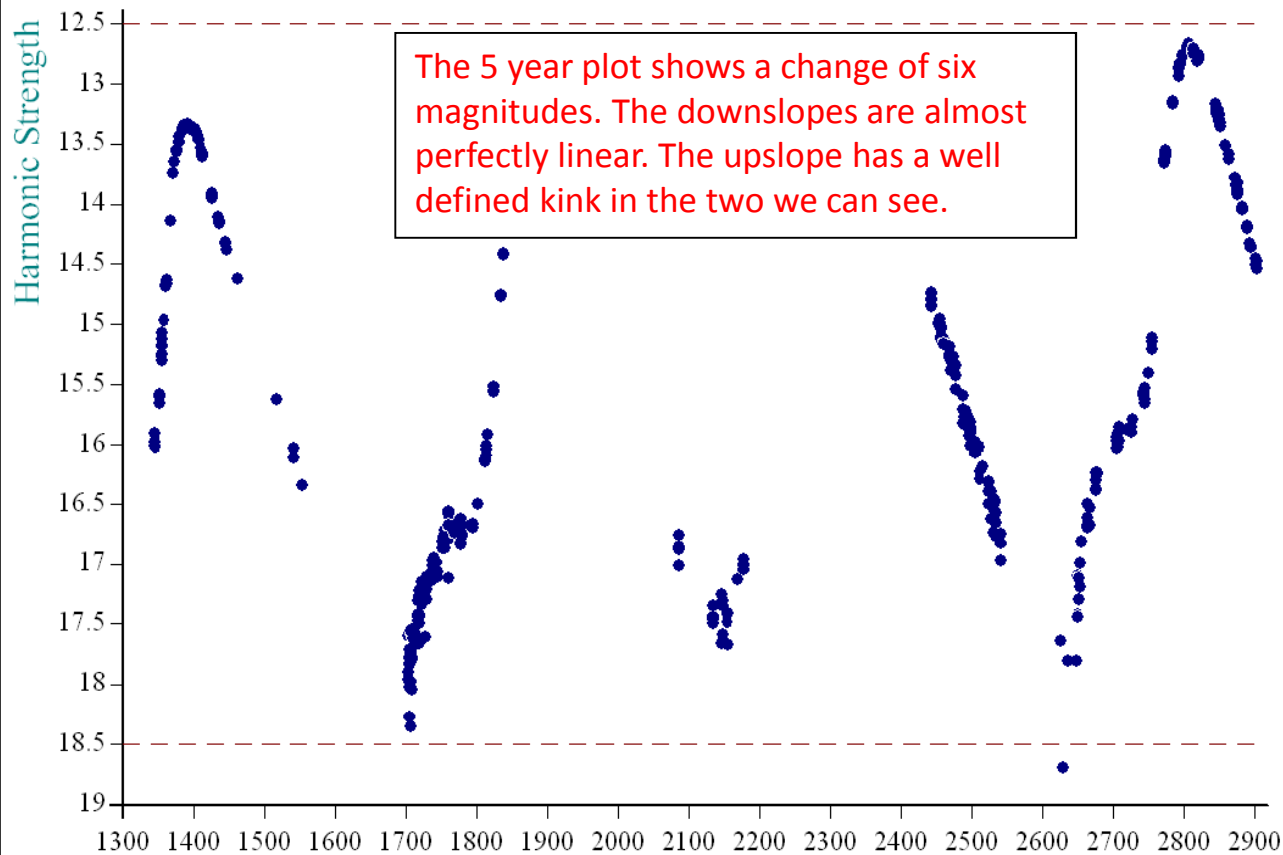


Prettiest



Biggest Range

Deep Average Plot, star 11459 from Autumn 2003 to Autumn 2007 ref844

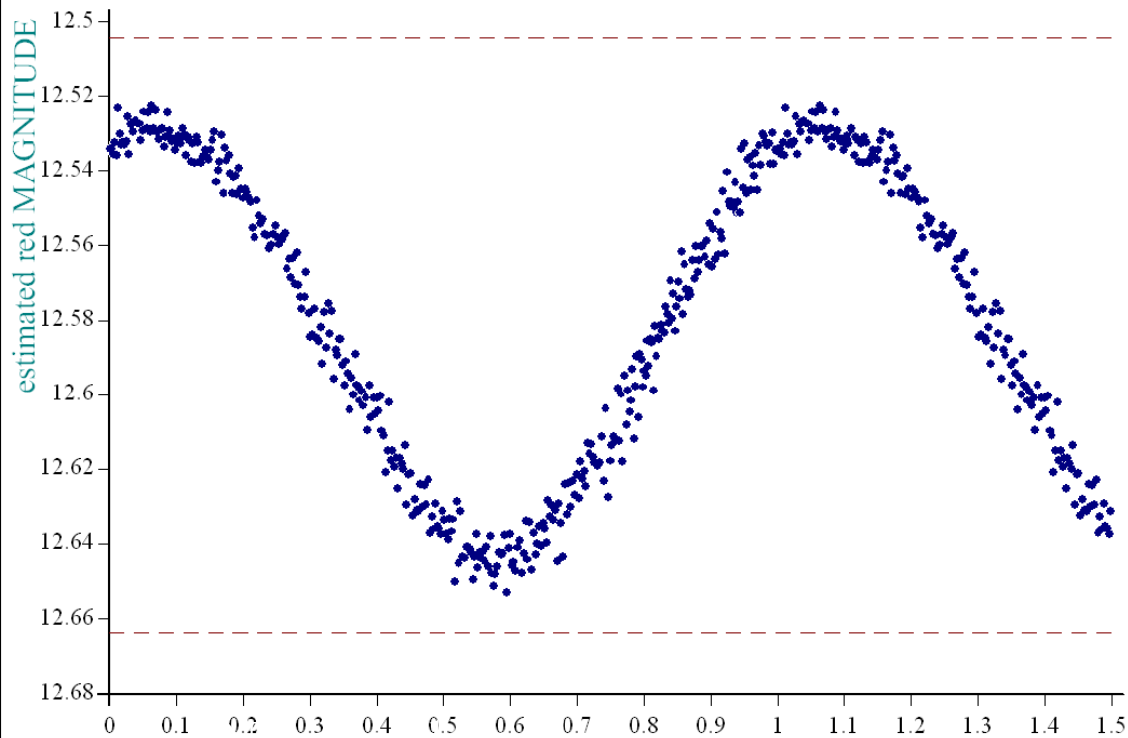


JULIAN DATE-2451545 (from Jan 1 2000).....y span is 6.033 mag

• created at 23 51 on 7-11-2008 °100 images per point° plot No S27395

Most Sinusoidal Star

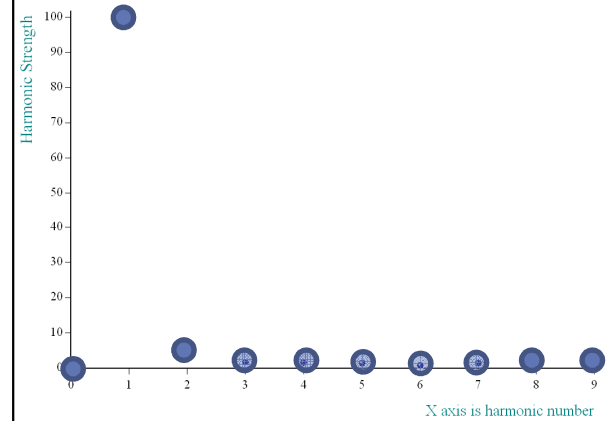
star a7269 dates 1702-1838, dia 8, ref a956, epoch 1220, period 0.36371



dates are HJT-2451545.....x axis is phase, overlay blockav is 10

• created at 0 1 on 8-11-2008 phase plot, No of data points 11272, plot No S27402

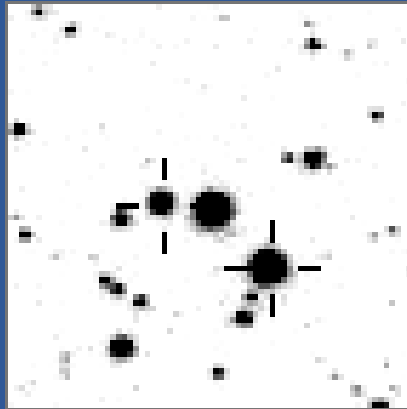
Fourier Plot star a7269 in dates 1702-1838 ref a956, period 0.36371



• created at 0 1 on 8-11-2008 Fourier Plot plot No S27403

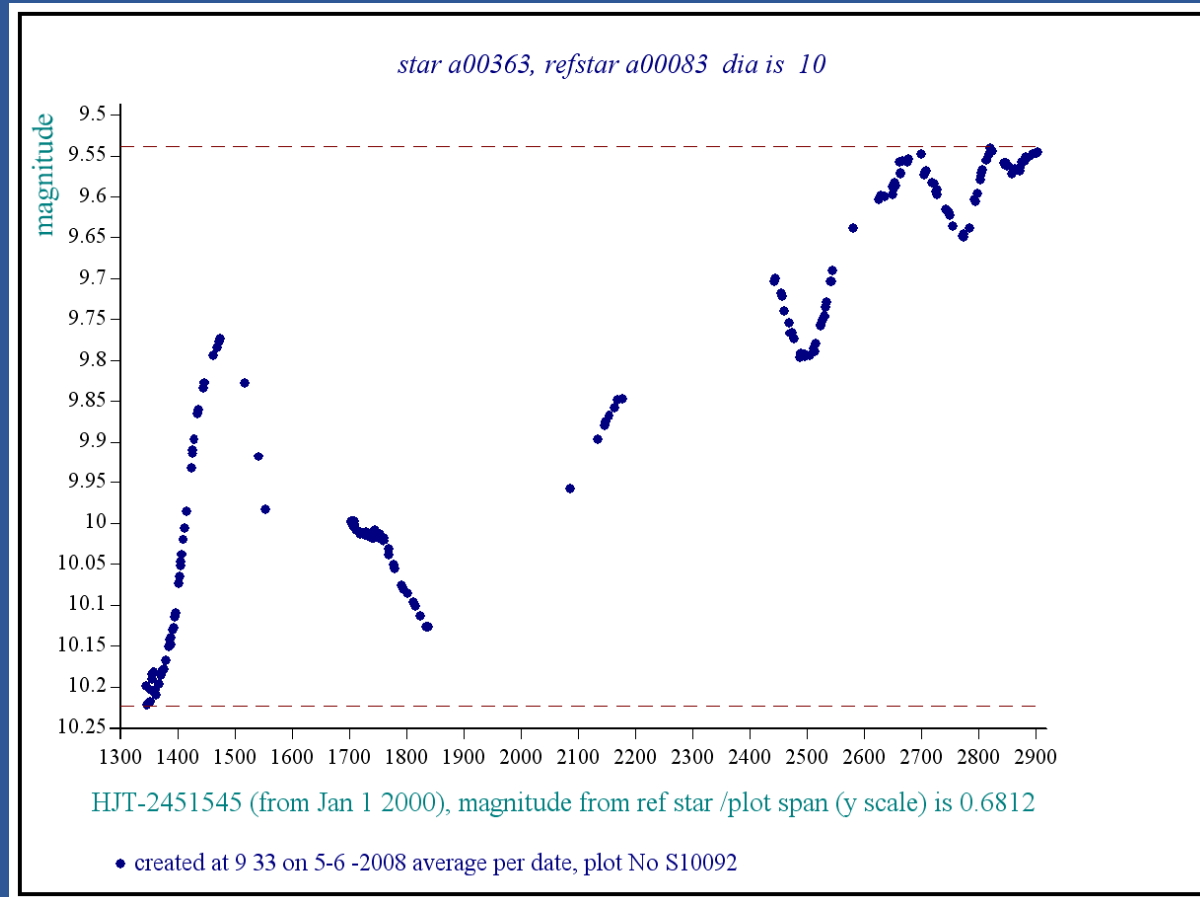
1	100
2	3.8
3	1.5
4	1.5
5	1.4
6	0.6
7	1.3
8	0.4
9	1.2

To finish, a little group Centre is V 577 Cyg

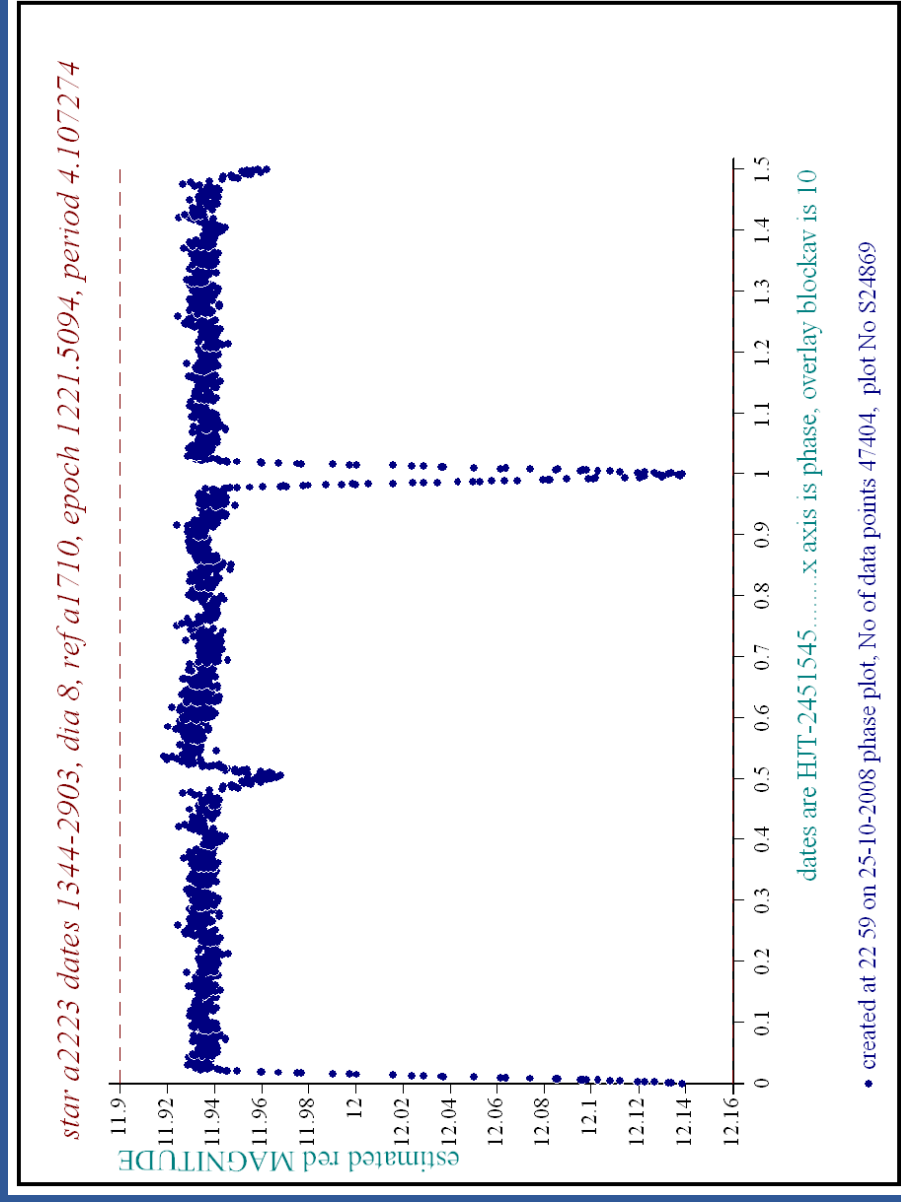


variables & brighter stars

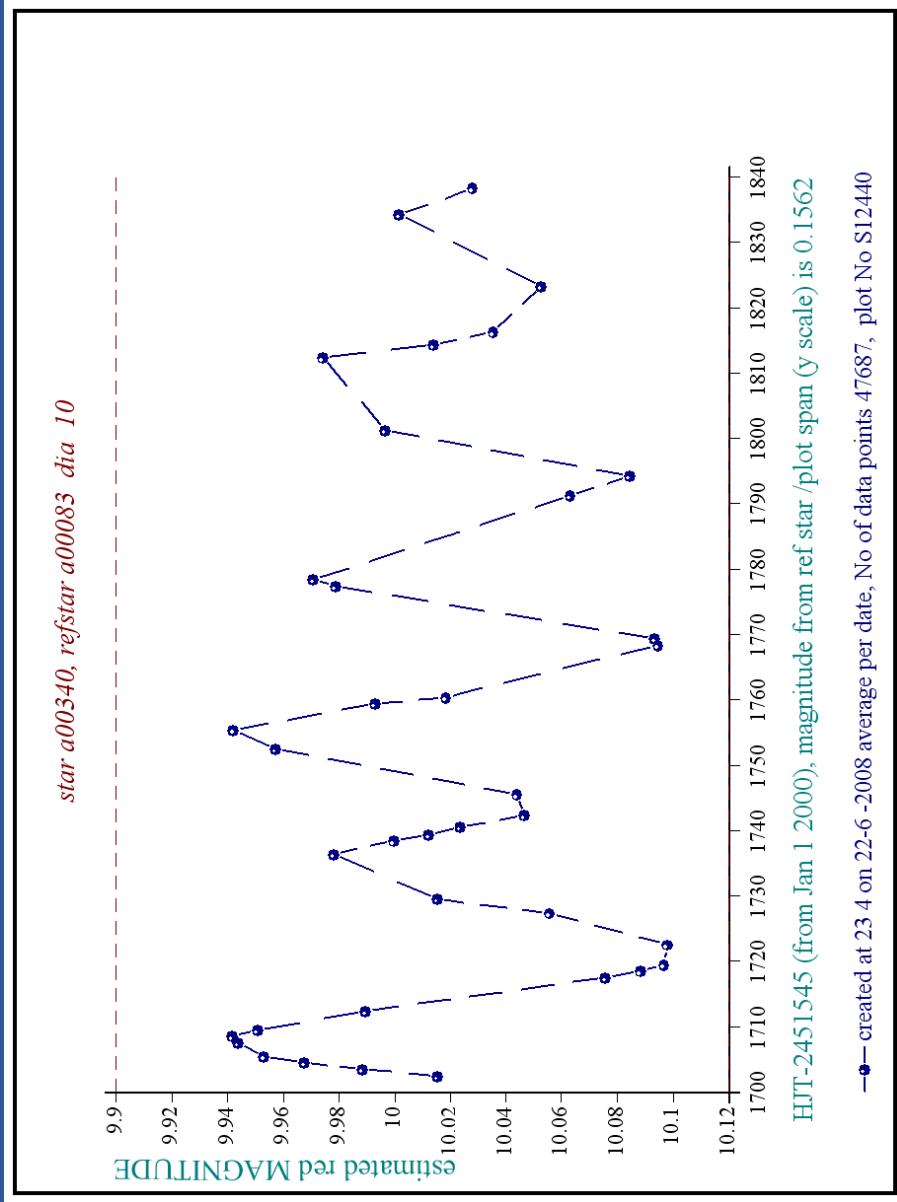
- 363v O
- 340v a
- 2223v b
- **b** · **O** ·
- e ·
-
- **a** · o ·
- c ·



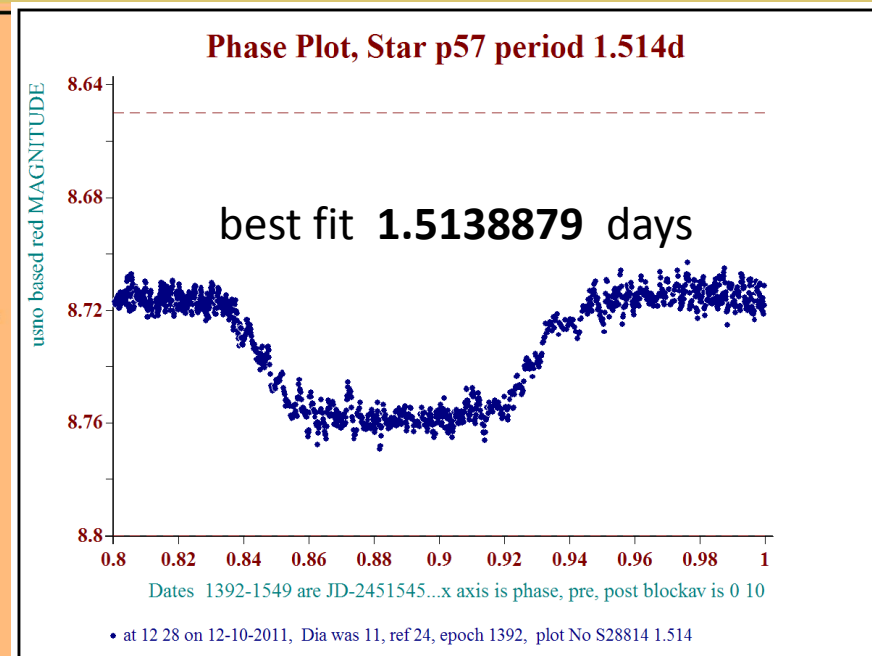
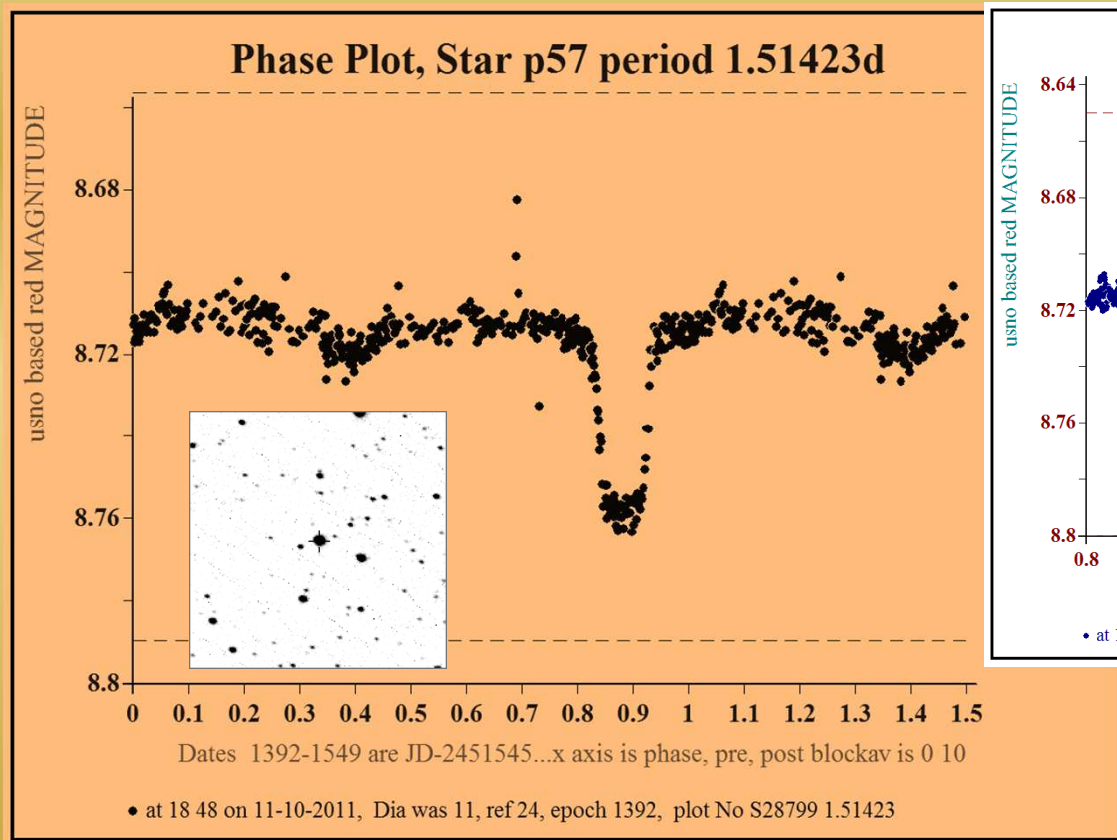
Left is EB Star a02223



Right is Star a00340



Star p00057- 45mmag



This system is triple, the larger of this pair is one of a visual double 0.2"-0.3" sep
Star SWp057 - HD33543 -WDS 05129+4136A ---period guess 400-1000 yrs

The Cygnus Project

Stan Waterman

