Analysis of Hyades Double Star Occultation: 70 Tau (R659) on 2016 Jan 19 using Limovie

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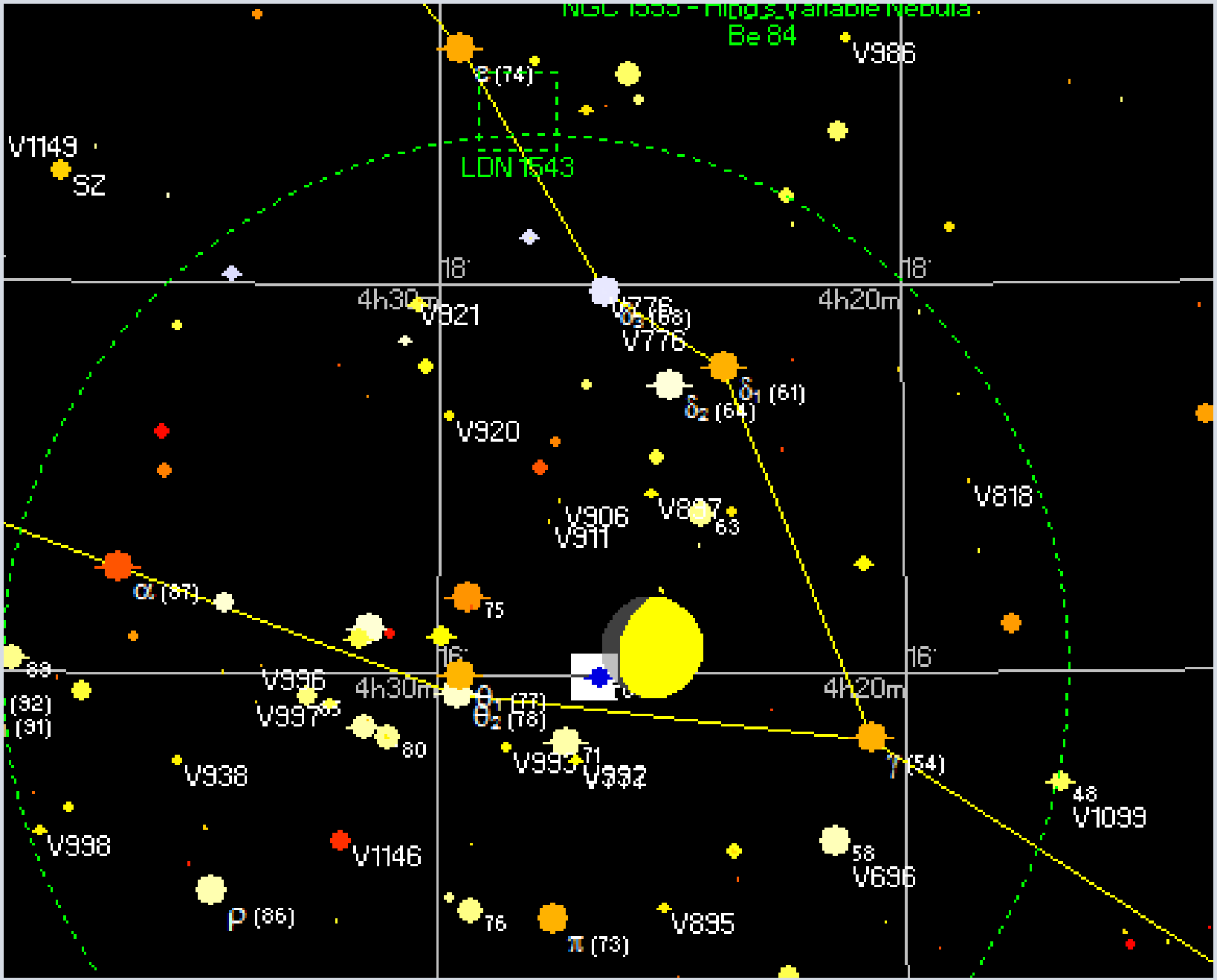
BAA Lunar Section Occultation coordinator [10-15min]

Introduction

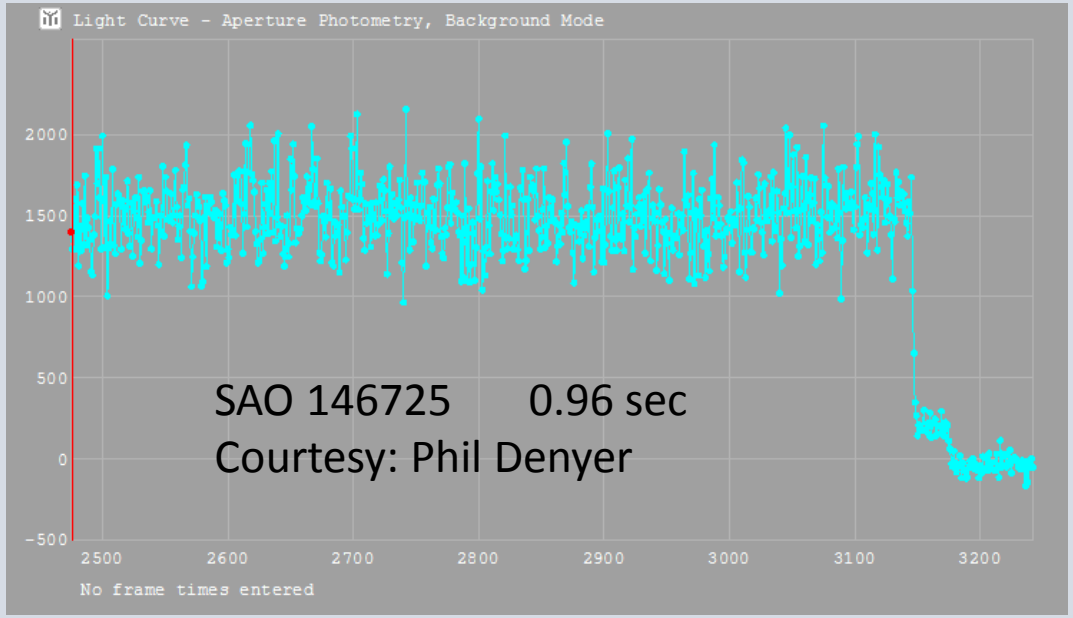
- The BAA Lunar Section Occultation Sub-section, have reported non-instantaneous events since the 1970's through the pages of the Lunar Section Circular. (listed in Appendix-1)
- Project "Fade" was introduced around that time - prompted by IOTA.
- There are about 17 BAA reports found in the LSC (visual and video)
- Video observations of "occultation doubles" are co-ordinated "Globally" by *Brian Loader* in New Zealand

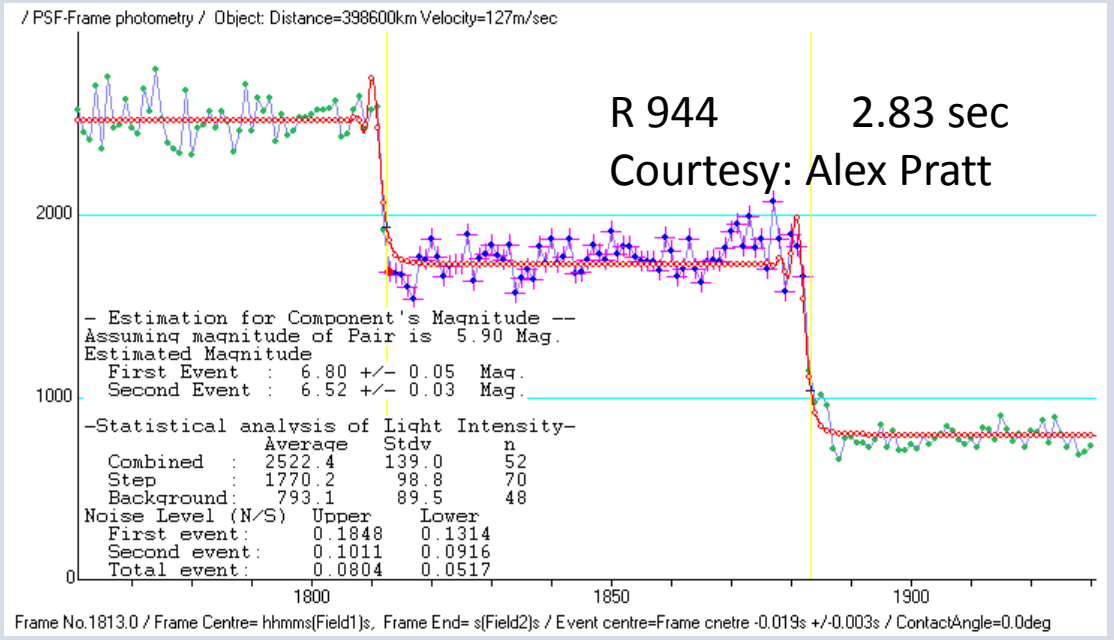
- Phil Denyer recorded a step event for SAO 146725 on 2014 Feb 2
- Alex Pratt recorded a step-event for R944 on 2014 Mar 09 [2.8s]
- I report my first clear step event: 70 Tau on 2016 Jan 19 [0.4s]

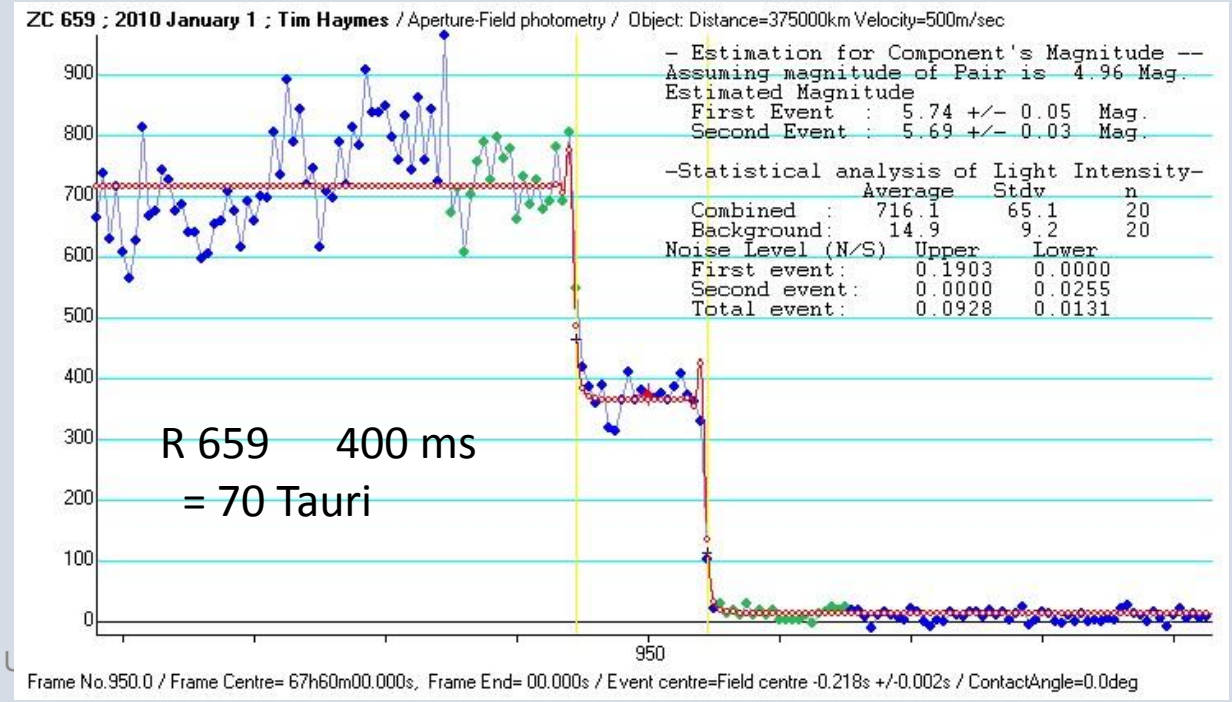
These are known double stars, and useful for data analysis.


NGC 1555 - Hind's Variable Nebula
Be 84
V986
ε (74)
V1149
SZ
LDN 1543
18'
4h30m
4h20m
V821
V776
δ2 (68)
δ1 (61)
δ2 (64)
V920
V818
V906
V911
63
α (87)
75
16'
89
(92)
(91)
V996
V997
4h30m
θ1 (77)
θ2 (78)
80
71
V938
V998
V1146
ρ (86)
76
π (73)
V895
58
V696
48
V1099
γ (54)

Events Compared





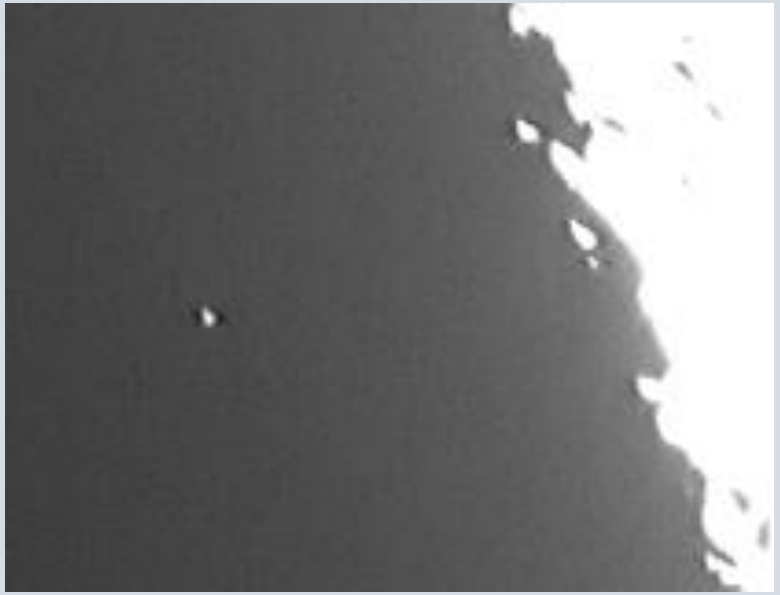


The Observation of 70 Tau

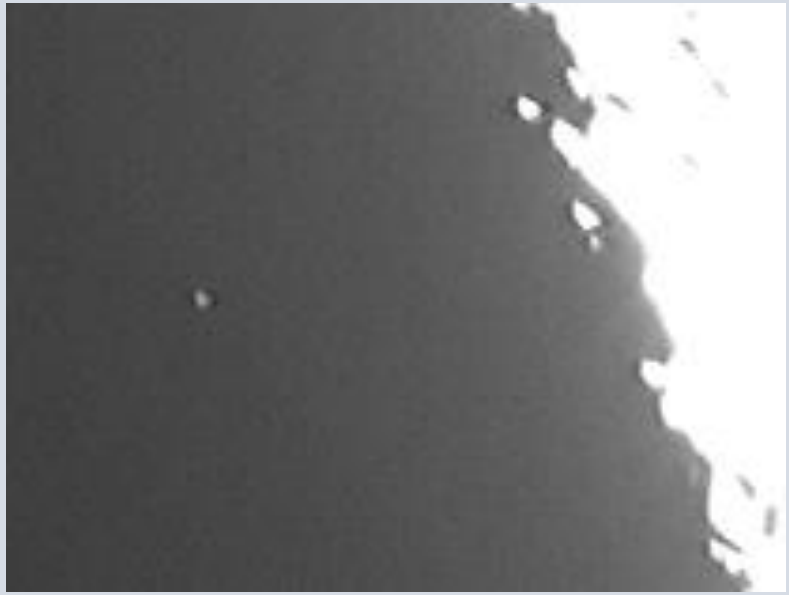
The recording was made at field level (50 fps) using WAT-910HX and a 30cm F/4 Newtonian, EQ6, recording to Digital Tape with a Sony TRV 22E camcorder. Conversion to AVI was by FireWire Express Card, and Windows Movie maker. The OS was W7

= WAT 910HX setting 1/50th
= WAT 120N+ setting HIGH-1

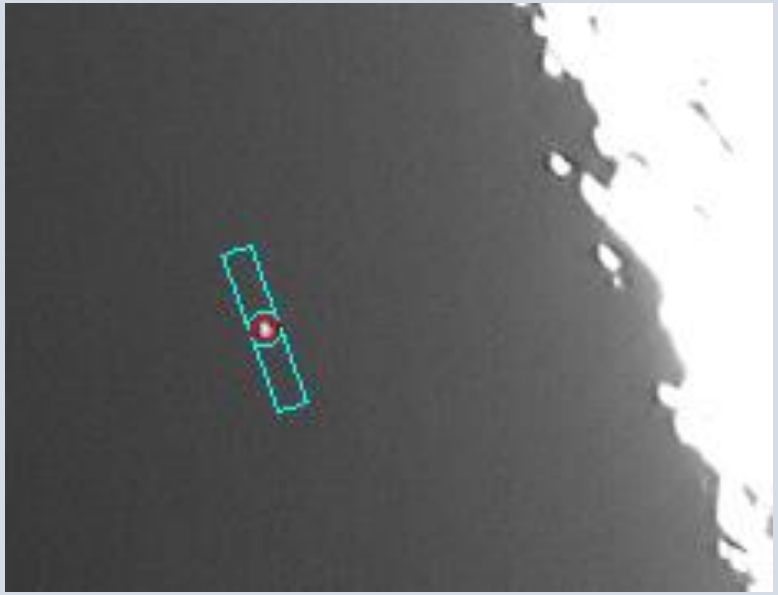
Before occultation



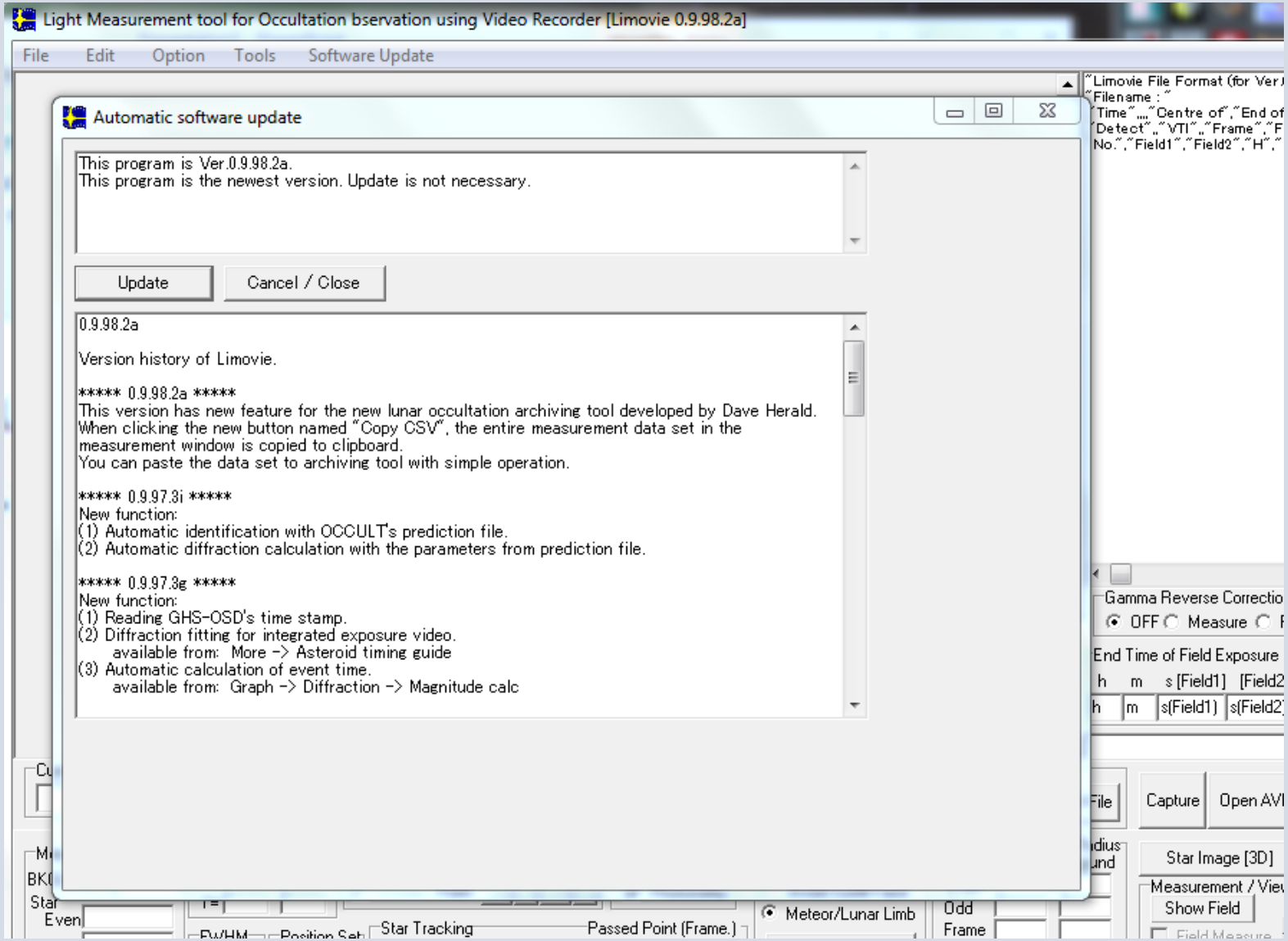
Step down in brightness



Limovie mask



LiMovie Current Version is 0.9.98.2a



How is Limovie Installed?

- No installation required ! (but *avisynth* might be needed for big files)
- File Source: I obtained my copy from Brian Loader and Jan Manek
- Just copy the exe file to a directory like: C:\limovie09982a\limovie.exe
- Create short-cut for the desktop (XP, w7)
- Documentation – very little !!! Alex Pratt, Jan Manek and Brian Loader were all most helpful.

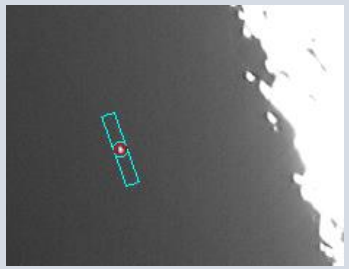
Limovie Settings

1) PSF Photometty OFF
(untick the box)

2) Field Measure ON

3) Use the scroll bar to advance the time nearer the event

4) Click on the star to add the mask

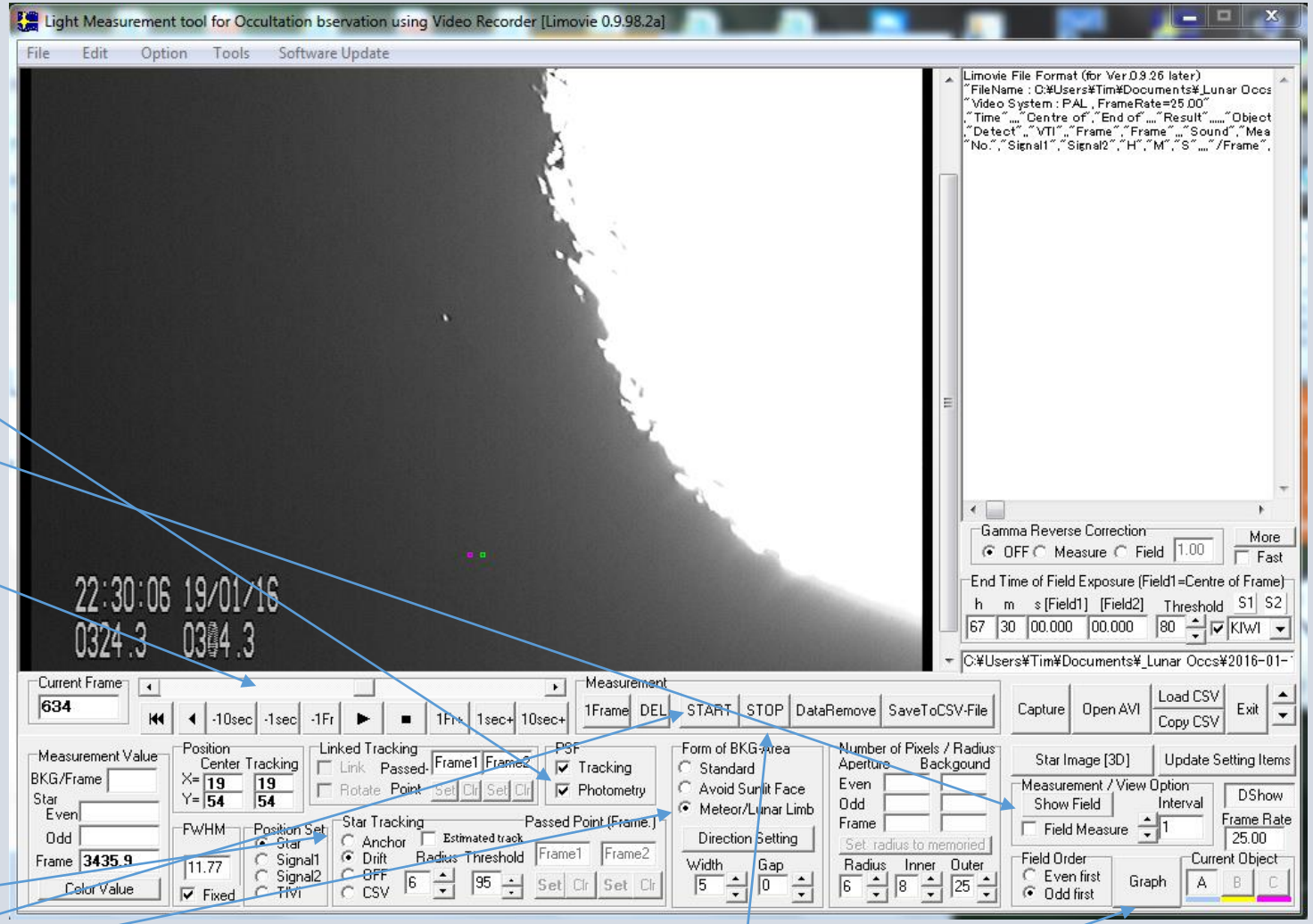


5) Star Track set to Anchor

6)Form of mask = meteor/lunar Limb

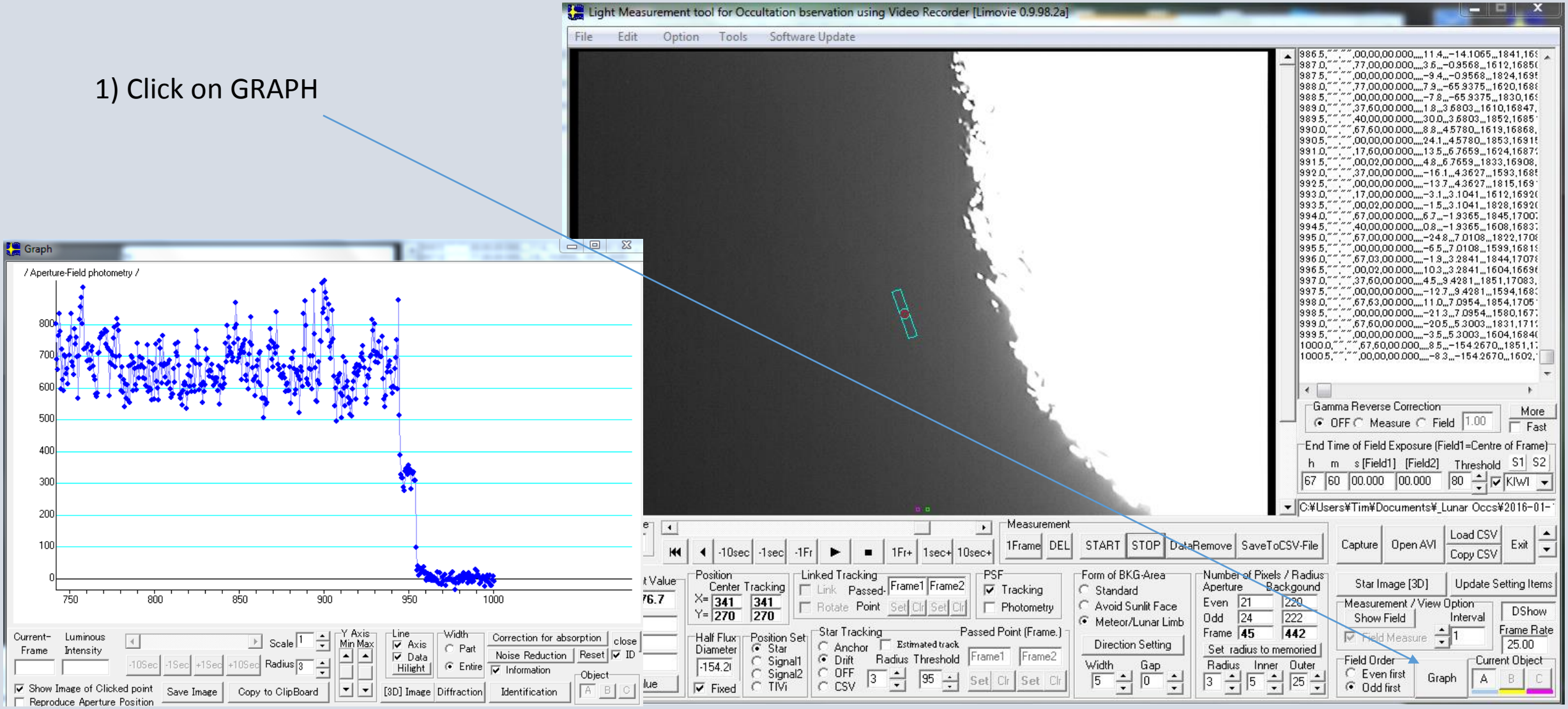
7) START

8)STOP / DISPLAY GRAPH



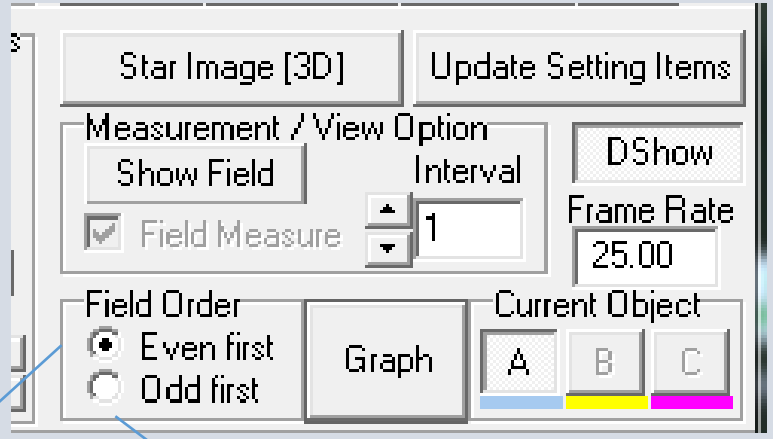
Limovie data FIELDS are collected

1) Click on GRAPH

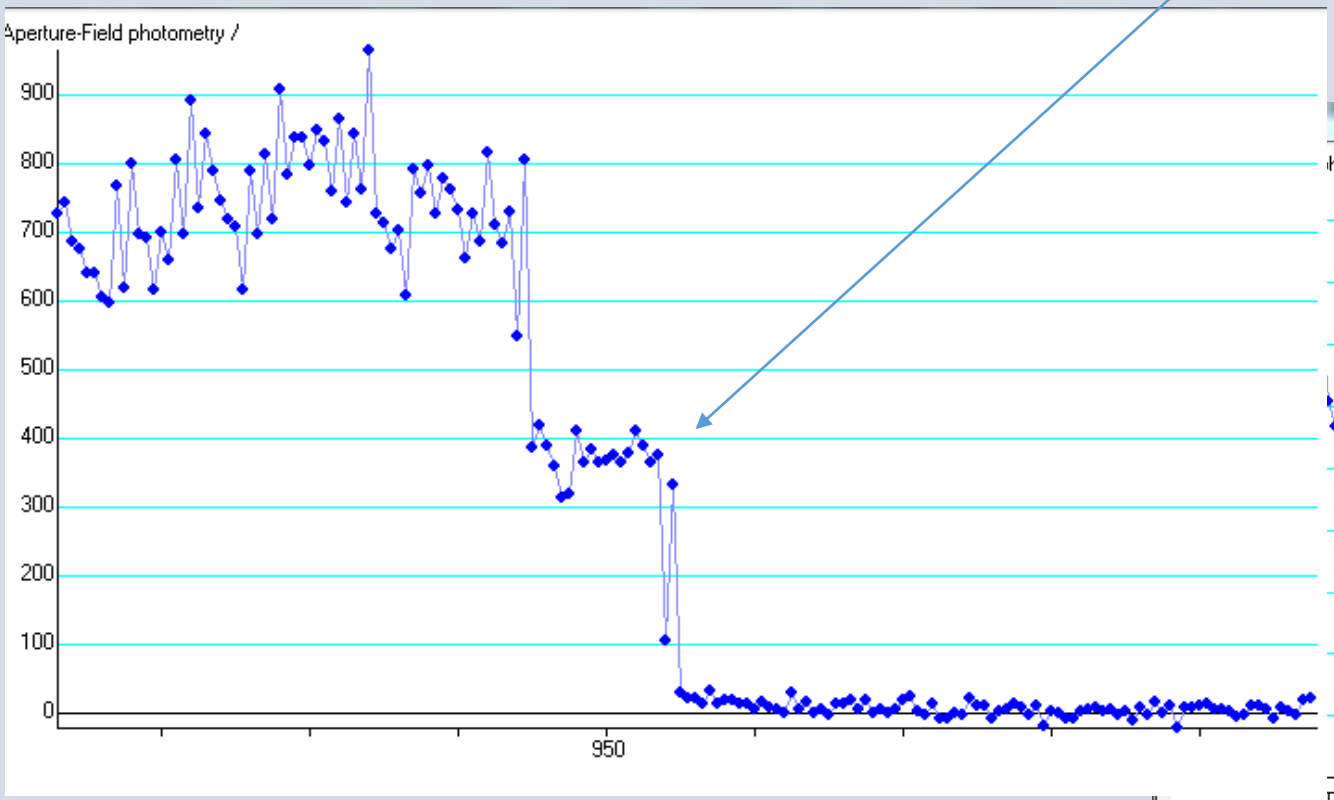


Look closely at the graph Odd or Even Frames?

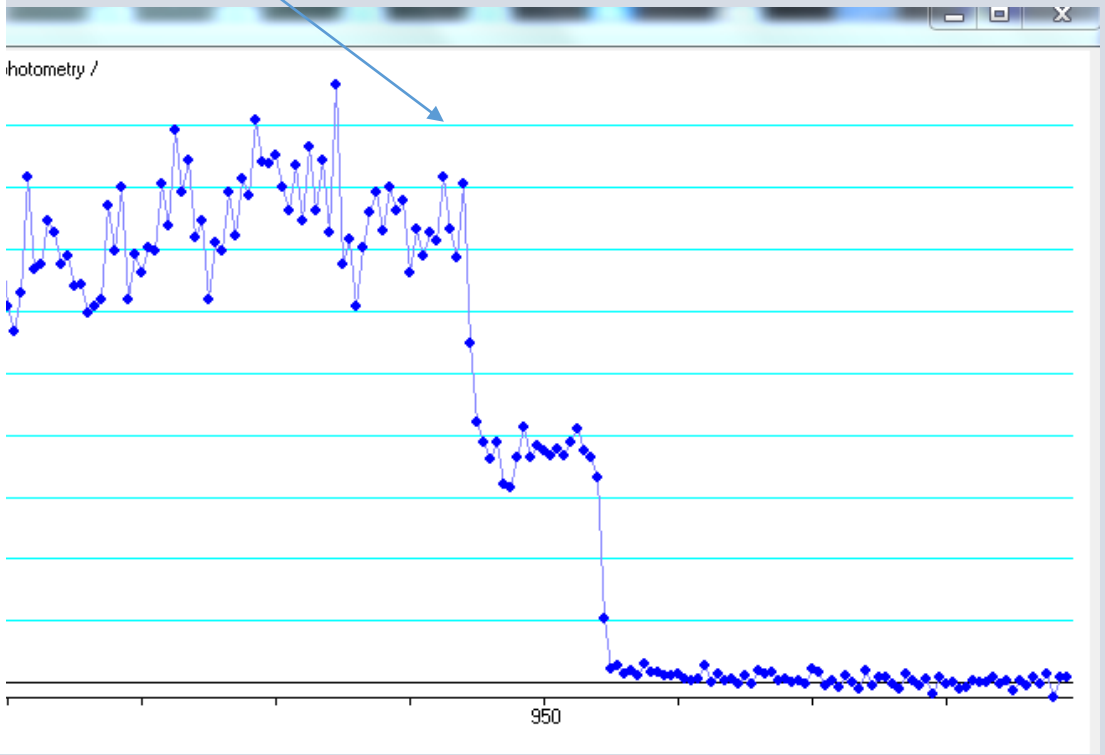
… is camera dependant



Even First

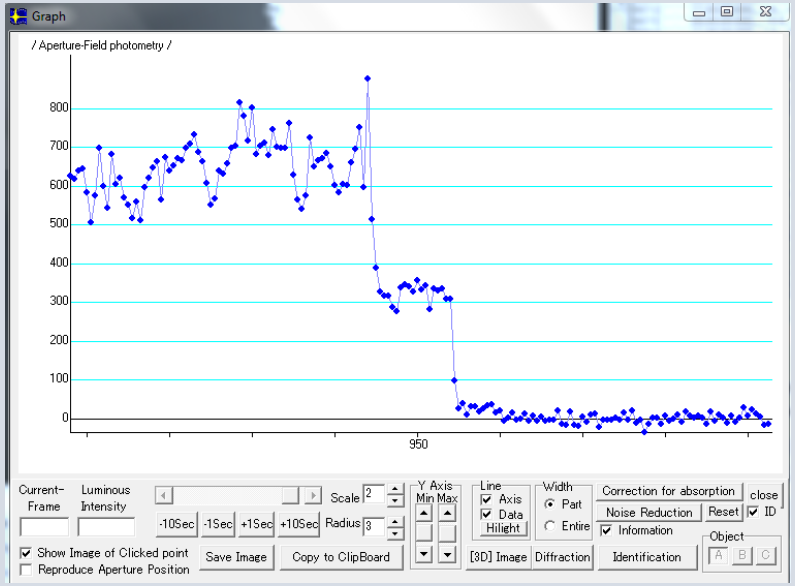


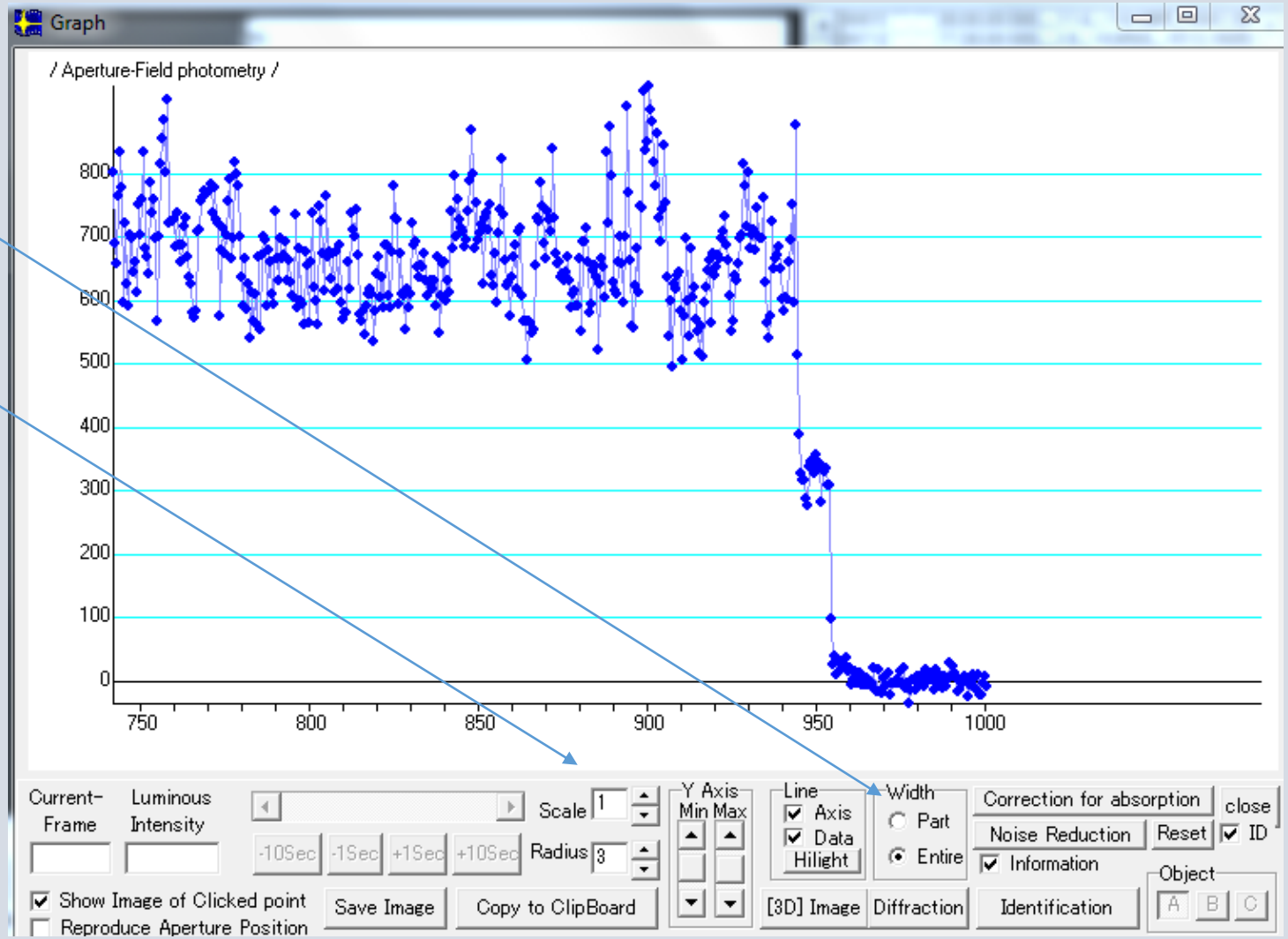
Odd First for WAT910HX



Viewing the graph

1) Click PART
2) Then expand the detail





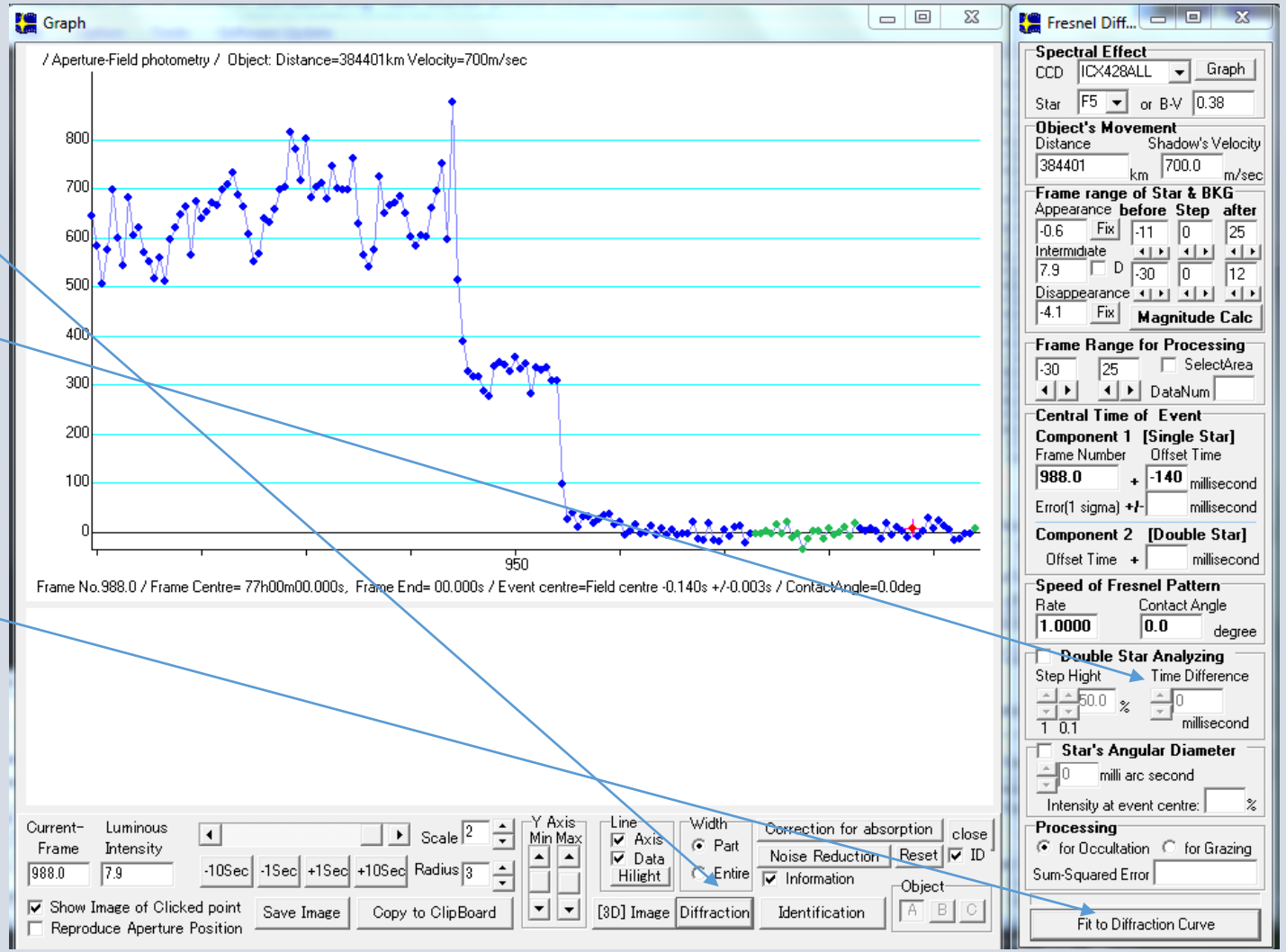
Now the analysis

1) Click on Diffraction to get the box on the right hand side

2) Enter 400ms in the Double Star analysing

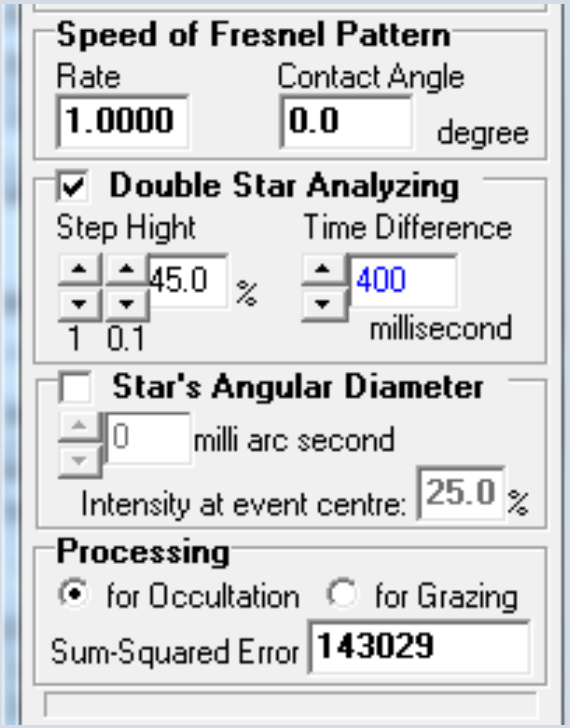
3) Click on a point at frame 900 on the step event.

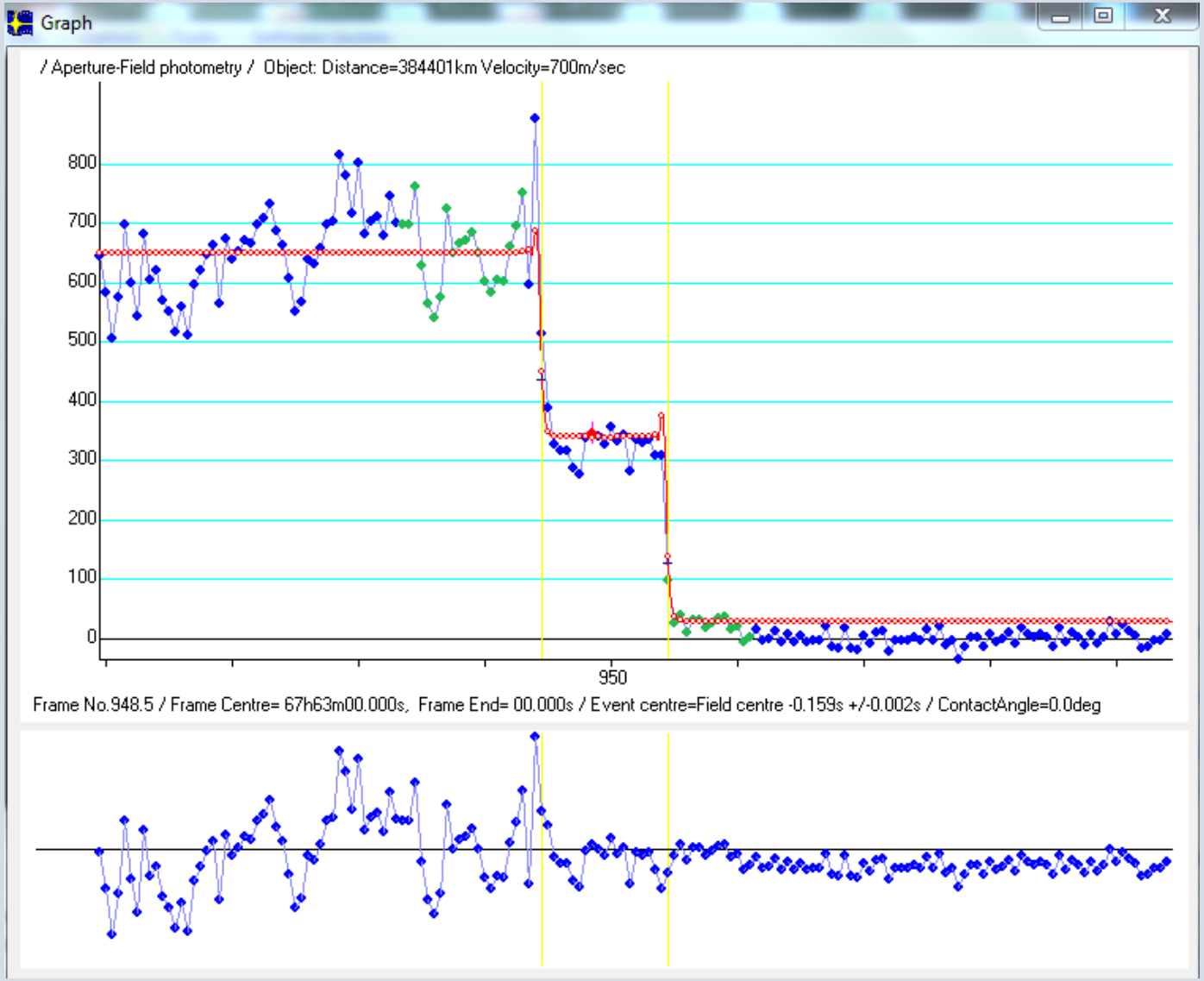
4) HIT Fit Diffraction Curve



Refinements

1) Change the Step Height
2) Change the Time Difference (step)
3) Try to minimise the Sum-Squared Error





Some additional factors

Cct deg

SV m/s

```
16 Jan 19 22 30 19.2 D     659SF7  6.6     s  81+ 128     48 224  34S 132 105 142 +3.1 +6.9 +1.3-2.9 .285  -49.7      4 25 37.3  15 56 28 370.5 790.0
   R659 = 70 Tauri
       659 is triple: Aa,Ab 7.74 7.00 0.09" 145.9, dT = +0.32sec : AB 6.4 13.4 129" 339.5, dT = -403sec
       659 is a close double. Observations are highly desired
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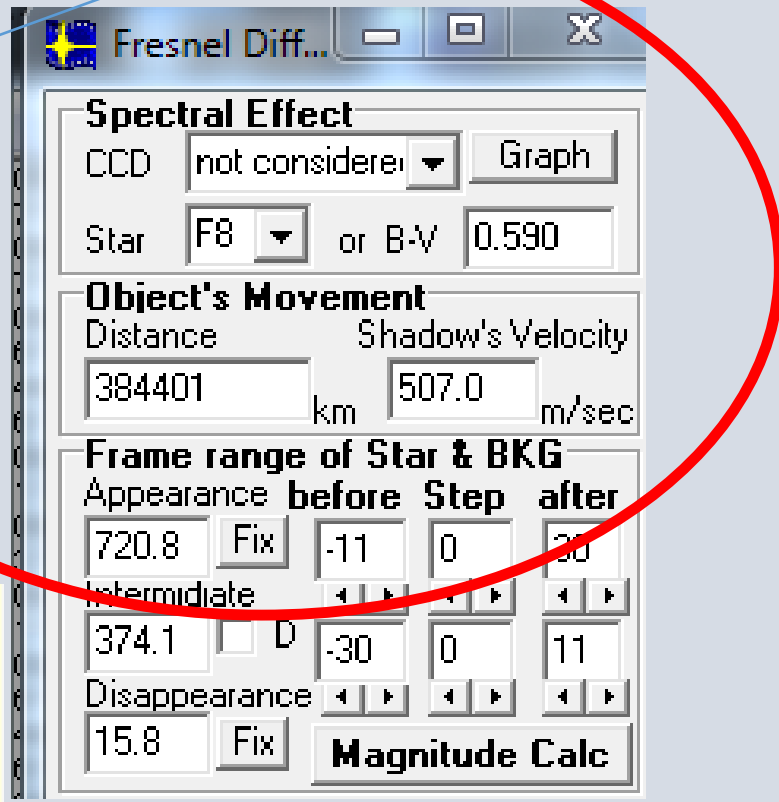
1) CCD spectral characteristics
2) Star Spectral type
3) Magnitude difference
4) Object Movement: DISTANCE and VELOCITY Ref (a)



Shadow velocity = SV x Cos(Cct)

= 507 m/s Ref (d)

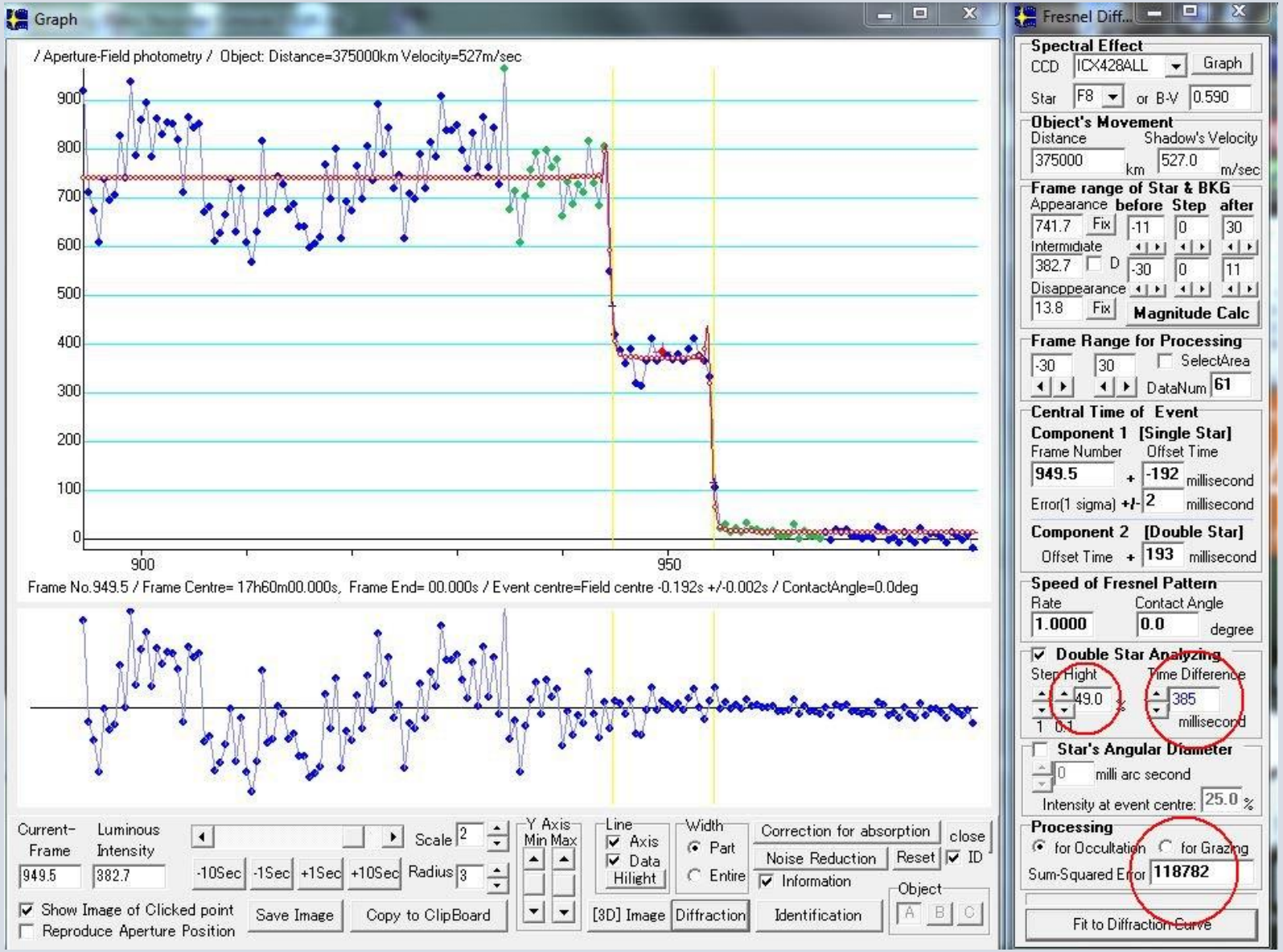
Object Distance is taken from Sky Map Pro

Cct	Contact Angle - the difference between the normal to the lunar limb and the direction of lunar motion. values range between -180 and +180. Disappearance have values in the range +90 to -90; reappearances are in the range 90 to 180, or -90 to -180. The sign of Cct indicates whether the star is to the north (+'ve) or south (-'ve) of the direction of motion.

References:

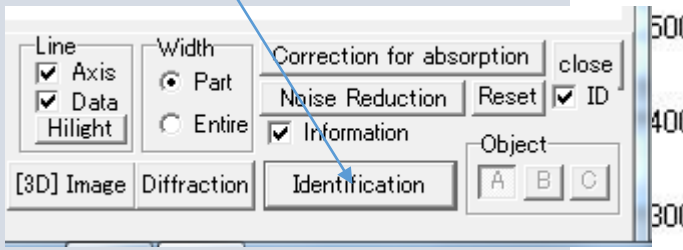
a) A Guide to Video Recording Lunar Occultations - Alex Pratt
b) BAAJ V122, No3 [June 2012] Lunar Occultation of double stars – A Pratt
c) JOA V1 No2 – Light Curve of the 1978 Aldebaran Graze Cine Film – T Haymes
d) Jan Manek – private communication

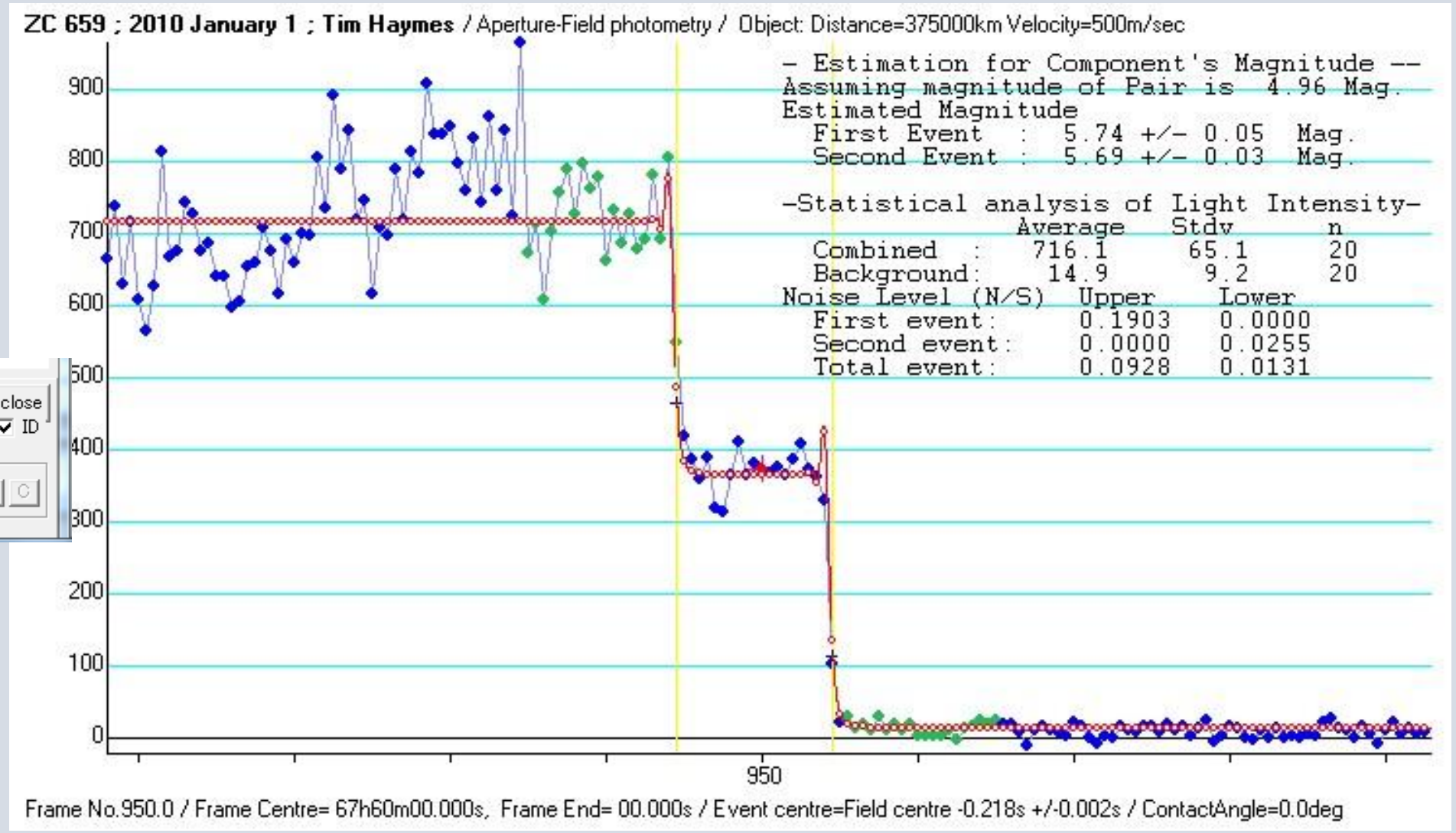
And finally


Graph
/ Aperture-Field photometry / Object: Distance=375000km Velocity=527m/sec
900
800
700
600
500
400
300
200
100
0
900
950
Frame No.949.5 / Frame Centre= 17h60m00.000s, Frame End= 00.000s / Event centre=Field centre -0.192s +/-0.002s / ContactAngle=0.0deg
Current-Frame
949.5
Luminous Intensity
382.7
Scale
2
-10Sec
-1Sec
+1Sec
+10Sec
Radius
3
Y Axis Min Max
Line
Axis
Data
Hilight
Width
Part
Entire
Correction for absorption
close
Noise Reduction
Reset
ID
Information
Object
A
B
C
Show Image of Clicked point
Reproduce Aperture Position
Save Image
Copy to ClipBoard
[3D] Image
Diffraction
Identification
Fresnel Diff...
Spectral Effect
CCD
ICX428ALL
Graph
Star
F8
or B-V
0.590
Object's Movement
Distance
Shadow's Velocity
375000
km
527.0
m/sec
Frame range of Star & BKG
Appearance
before
Step
after
741.7
Fix
-11
0
30
Intermidiate
382.7
D
-30
0
11
Disappearance
13.8
Fix
Magnitude Calc
Frame Range for Processing
-30
30
SelectArea
DataNum
61
Central Time of Event
Component 1 [Single Star]
Frame Number
Offset Time
949.5
+
-192
millisecond
Error(1 sigma) +/-
2
millisecond
Component 2 [Double Star]
Offset Time +
193
millisecond
Speed of Fresnel Pattern
Rate
Contact Angle
1.0000
0.0
degree
Double Star Analyzing
Step Hight
Time Difference
49.0
%
385
millisecond
1
0.1
Star's Angular Diameter
0
milli arc second
Intensity at event centre:
25.0
%
Processing
for Occultation
for Grazing
Sum-Squared Error
118782
Fit to Diffraction Curve

Data added

1) Use the Identification dialogue





Appendix -1, some reported “fade” events (UK)

Year	month [1]	Observer, Location	Star	Date [2]	Description / notes
1977	05	T Haymes (Salford)	SAO 095791	1977-Mar-27	D, then R for 3.5s and brightening +D
1978	12	T Haymes / D Gavine (Scotland)	Aldebaran	1978-Aug-26	Fade 1 sec GRAZE on Cine Film
1979	04	M Taylor (Wakefield)	ZC 0672	1979-Feb-05	“ fade at immersion with flash”
1979	06	M Ratcliffe (Newbury)	ZC 0934		Fade of 2-3 sec at GRAZE
1981	04	D Hall (Leicester)	ZC 0015	1979-Nov-29	Fade Confirmed Double [3]
1983	09	T.Haymes (Maidenhead)	BD +14 2243		Fade spurious ?
1983	09	S.C.Pattinson (S Croydon)	BD +23 1779	1983-Apr-19	Faded
1988	07	T Haymes (Maidenhead)	X 14011	1988-Apr-24	Faded over 0.5 sec VISUAL
1989	07	T Haymes (Maidenhead)	X 16618	1989-Jun-10	Step event, 0.5 mag drop, 3 sec [5]
1990	09	A Wells (Birmingham)	ZC0844	1990-Mar-04	Query of event at 22-21UT [4]
2007	11	A Elliott (Lytham St Annes)	Regulus	2007-Oct-07	Gradual GRAZE: 7 D/R Pairs VIDE
2012	03	G North (Bexhill-on-Sea)	HIP87568	1996-Oct-17	Step 0.25s VISUAL 216 mm x 93
2012	04	AR Pratt (Leeds)	ZC3524	2011-Nov-06	Step 0.4s VIDEO confirmed

SAO 146725	2014 Feb 2	VID	P. Denyer	STEP 0.96s	2014-02
SAO95456(R944)	2014 Mar 9.9	VID	A. Pratt	STEP 2.8s	-
SAO97340	2014 Mar 11.9	VID	Haymes+Pratt	WIDE 18s	2014-04
Omega Leonis	2014 Mar 13.9	EYE	Ray Pearce	1 to 1.5s	-

Thankyou for your attention.

Any Questions please… ?