Occultation observation method with USB CMOS camera

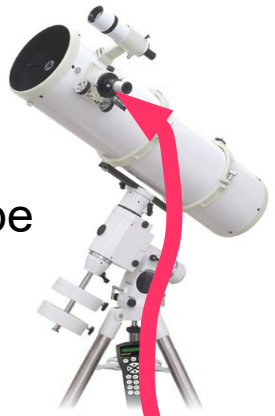
2021. Feb. 14

JOIN(Japan Occultation Information Network)
Hiroyuki Watanabe

Introduction

- In July 2019, as part of the Destiny+ plan by JAXA and Chiba Institute of Technology, there was a campaign to observe stellar eclipse by 3200 Phaethon, and JOIN also called for cooperation.
- The expected size of Phaethon was about 5 km, the maximum extinction time was 0.5 seconds, and the target star was so faint as 11.2 mag, so the condition seemed to be much worse than the conventional asteroid occultation observation target.
- Until then, when observing the 11th magnitude star class, the exposure time was 0.12 to 0.24 seconds with an analog CCD camera, so if the dimming time is 0.5 seconds, only 2 to 4 frames can be taken, and it is necessary to specify the time. Was expected to be tough.
- In order to increase the temporal resolution, it was necessary to use a high-sensitivity camera for short-time exposure and shooting at a high frame rate, so we decided to consider using a CMOS camera for planetary shooting.
- The CMOS camera for planetary photography is supposed to be captured using a PC, and the time stamp is a method of recording the system time of the PC in a frame by software.
- Since the system time of the PC is not accurate, it is necessary to correct the time using GPS outdoors.
- Recently, a cheap GPS module that can be connected via USB and free software that uses it to correct the time on the PC have appeared, and by combining these, the time on the PC can be adjusted within +/- 0.3 seconds relative to UTC.
- However, not only the time correction of the PC, but the time to receive the data from the CMOS camera and give the time changes depending on the capture size and the number of bits, so it is not possible to record the exact time.
- Before the analog time inserter was introduced, in order to correctly record and correct the shooting time, the GPS PPS signal was emitted by the LED or the PPS beep sound was emitted, and it was shot and recorded before and after shooting.
- The method of simultaneously recording the beep sound is recorded on a different audio track from the photometric image, so it can be recorded and corrected even during photometry, but it is necessary to have software that confirms the image and audio track at the same time. But, It is difficult to accurately obtain the rise time.
- On the other hand, since LED firing can be handled with the same software as photometry, it can be corrected accurately, but it was not possible to optically record the LED firing at the same time as the target star during observation.
- A method using OAG (Off-Axis Guider) was proposed in the material presented by Aart Olsen at the 2017 IOTA Annual Meeting, but no concrete one was found.
- This time, using this as a hint, we investigate the projection of PPS-LED firing onto a CMOS chip using OAG, and report practical results.
- In addition, I will introduce the new version that Limovie author Kazuhisa Miyashita added the function to correct the dimming time by using the PPS-LED firing to accurately record the time stamp that was recorded in UTC.

Occultation observation system with USB CMOS camera



Telescope

USB CMOS camera
+PPS projection unit

GPS sattelite

LED cable

GPS module for PPS
LED firing

USB3.0 cable

Moblie PC with
SharpCap

USB GPS module for
PC time correction

USB GPS module for PC time correction

For identification of observation location and PC time correction within UTC +/- 0.3 seconds by USB GPS

amazon Deliver to Japan | All | VK172

All Today's Deals Customer Service Gift Cards Sell Registry

‹ Back to results

HiLetgo VK172 G-Mouse USB GPS/GLONASS USB GPS Receiver for Windows 10/8/7 /VISTA/XP

Visit the HiLetgo Store

4.4 out of 5 stars 205 ratings | 22 answered questions

Amazon's Choice for "vk172"

Price: $12.99 + No Import Fees Deposit & $7.31 Shipping to Japan Details

Brand	HiLetgo
Color	White
Are Batteries Included	No

About this item

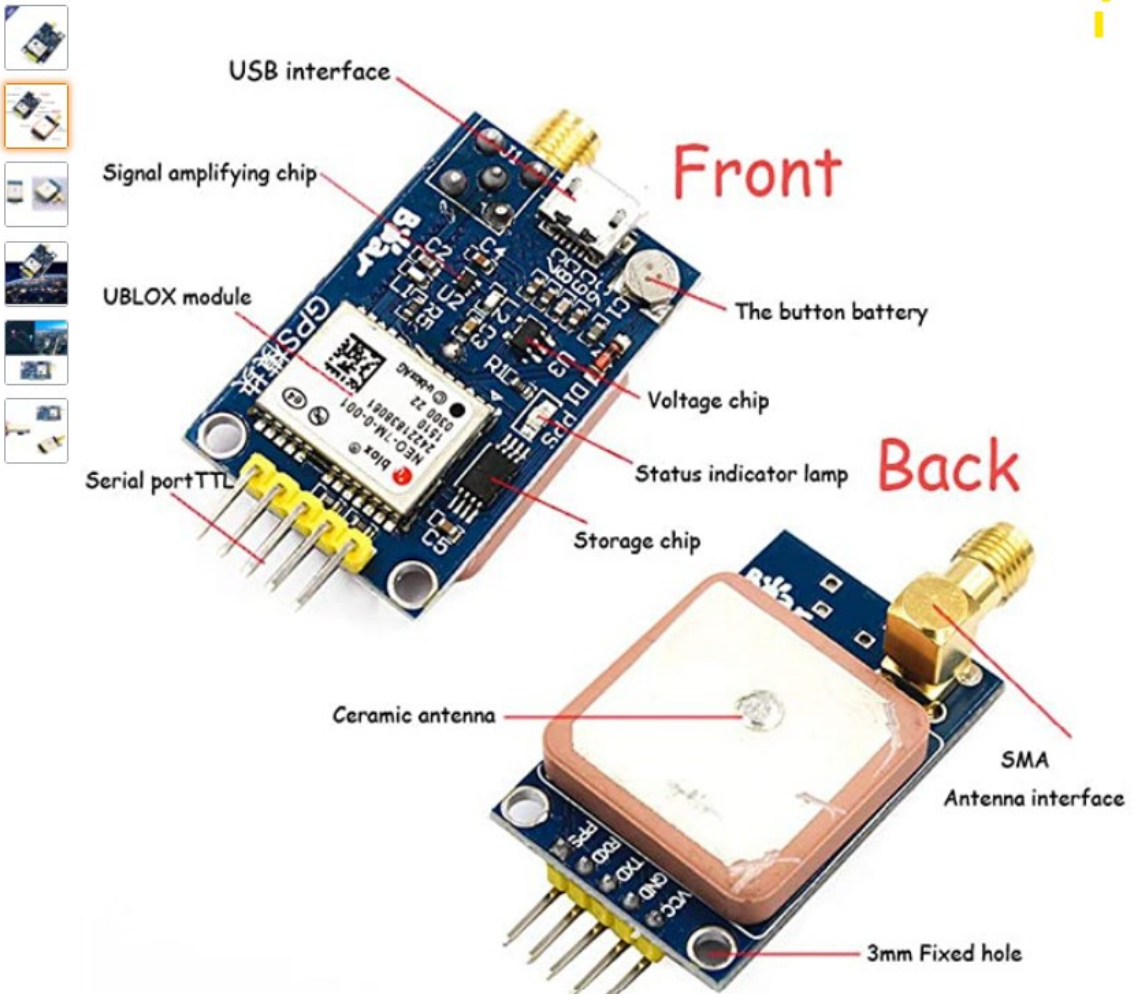
- VK172 G-MOUSE USB GPS Receiver for Windows 10/8/7/VISTA/XP
- VK172 G-MOUSE USB GPS/GLONASS USB GPS Receiver
- Supported operating systems: Windows 10/8/7/Vista/XP/CE
- Reference coordinate system: WGS-84
- Tracking sensitivity:-162dBm

GPS module for PPS LED firing

https://www.amazon.com/Ximimark-Satellite-Positioning-Antenna-Interface/dp/B07HQR85PG/ref=sr_1_6?crid=2GF41M 90%

amazon Deliver to Japan All gps module neo-6m

Cheap GPS modules use only PPS output because the sentence output timing is unstable.
Powered by USB mobile battery



Ximimark NEO-7M UBLOX GPS Satellite Positioning Module with SMA Antenna Interface for Arduino STM32 C51 Replace NEO-6M 3.3V/5V Power Supply 1Pcs

Brand: Ximimark

★★★☆☆ 10 ratings

Price: $12.39 + No Import Fees Deposit & $7.13 Shipping to Japan
Details

- Get 51 Arduino STM32 microcontroller routine.
- with a USB interface, you can watch the computer positioning effect directly phone line.
- with the passive ceramic antenna and passive antenna amplifier, make better use of the individual effects.
- with SMA interface can be directly connected to an active antenna SMA.
- TTL level, compatible with 3.3V/5V systems.

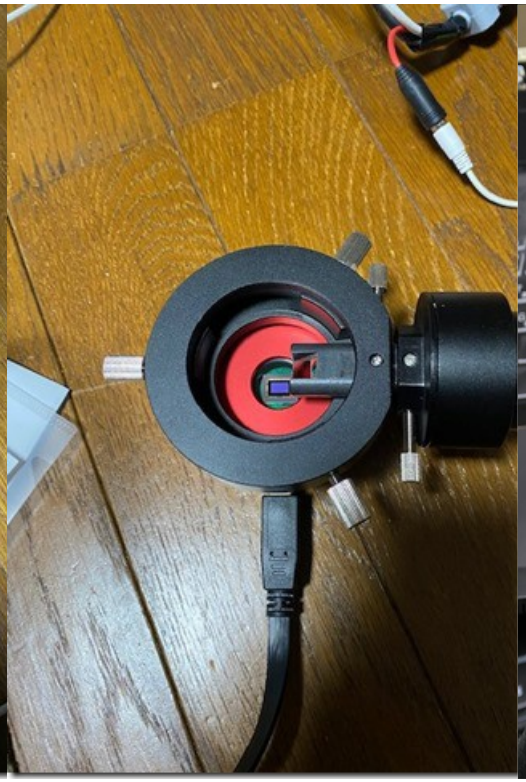
› See more product details

New (2) from $12.39

GPS PPS LED firing unit

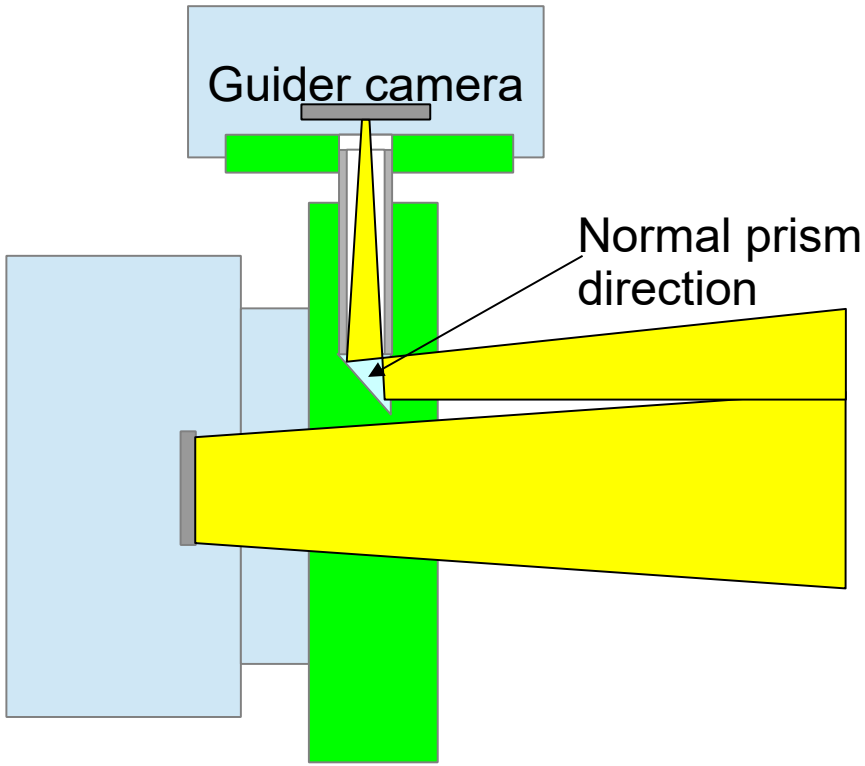
PPS projection unit

A method in which the prism of the ZWO OAG is inverted and the light of the PPS-emitting LED is projected onto the camera.
=>No expensive parts other than OAG are required. Only plastic plate to fix LED is required.
The point is to place the LED at a position about 4mm off the center of the hole.
=>At this position, good band-like light is obtained at the edge of the image.

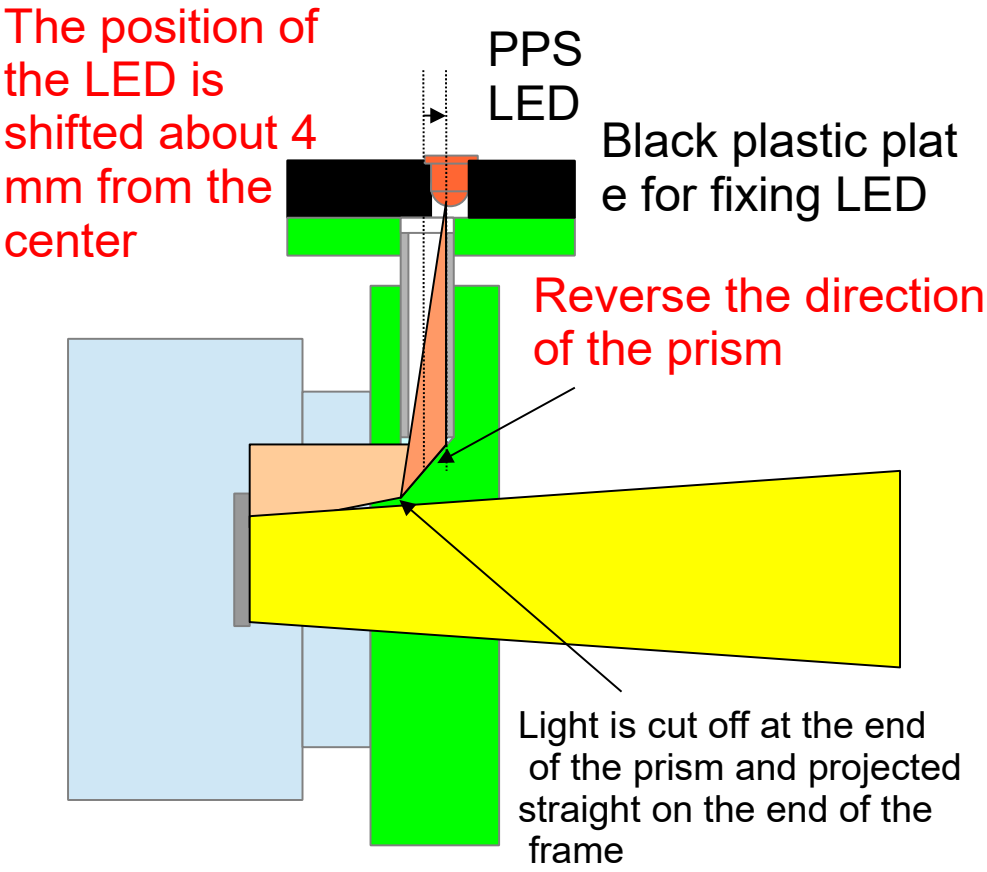
PPS projection unit

Structure of PPS projection unit



Off-axis guider

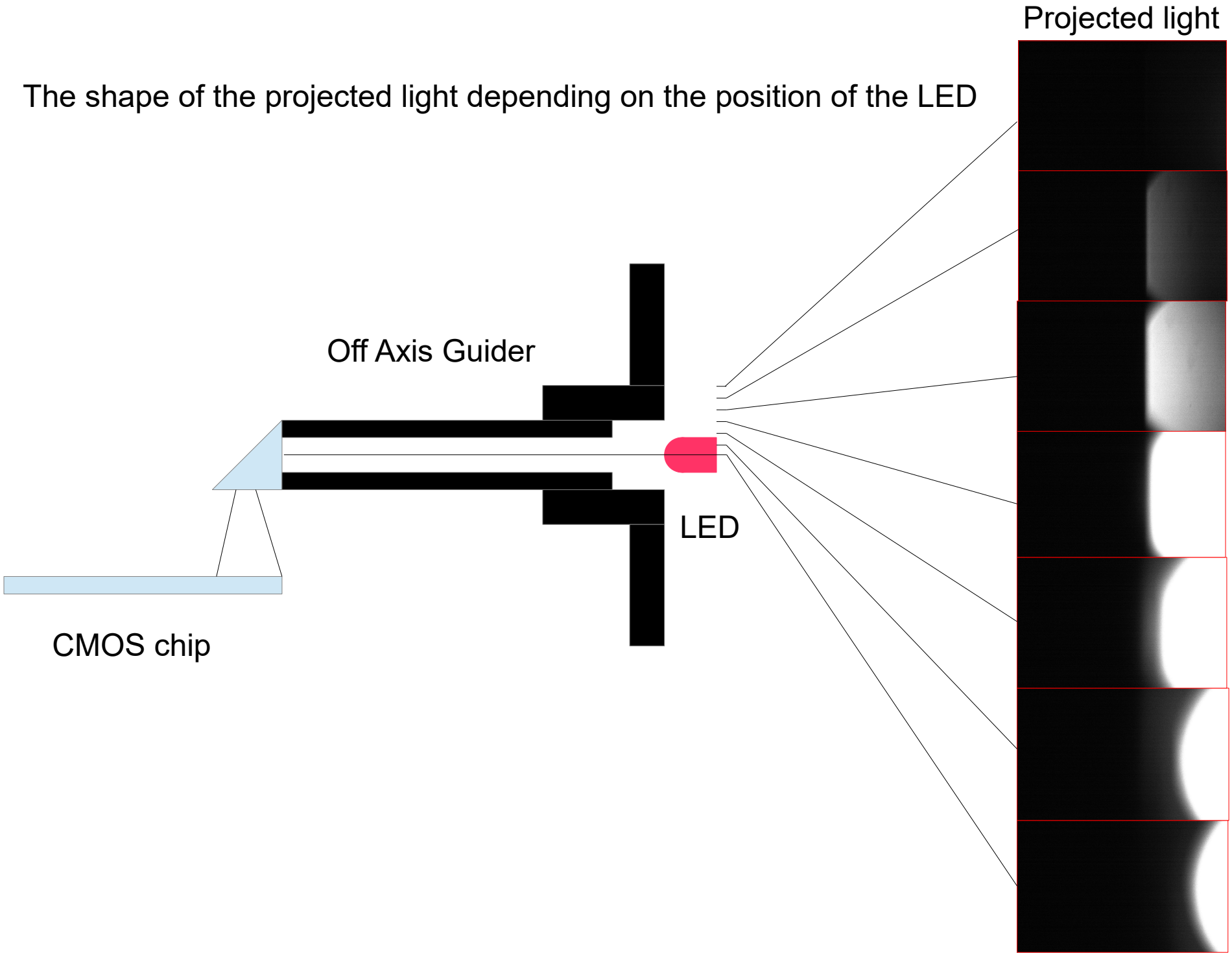
When using a normal off-axis guider



Off-axis guider

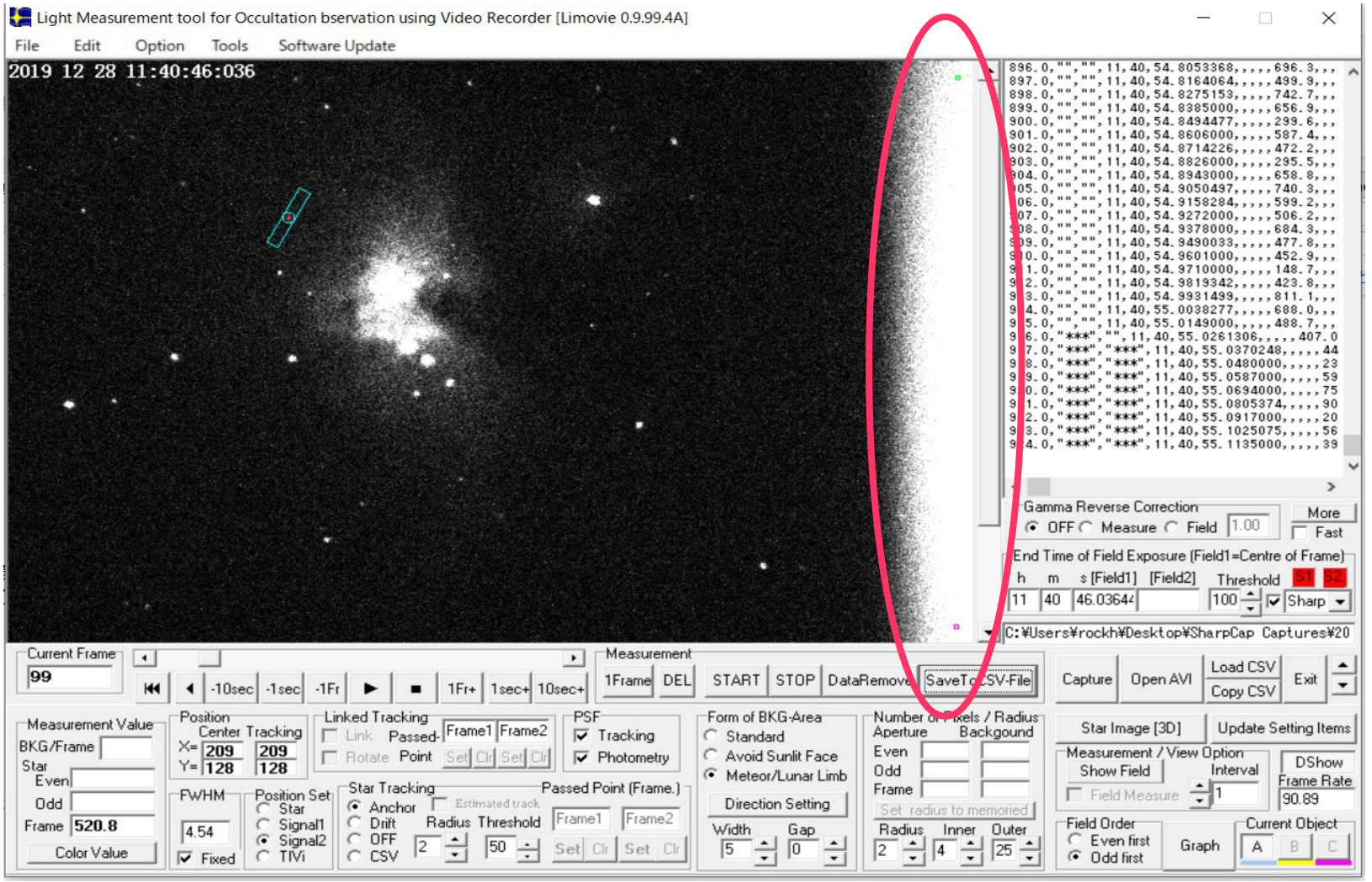
When used as a PPS projection unit

The shape of the projected light depending on the position of the LED



PPS projection unit

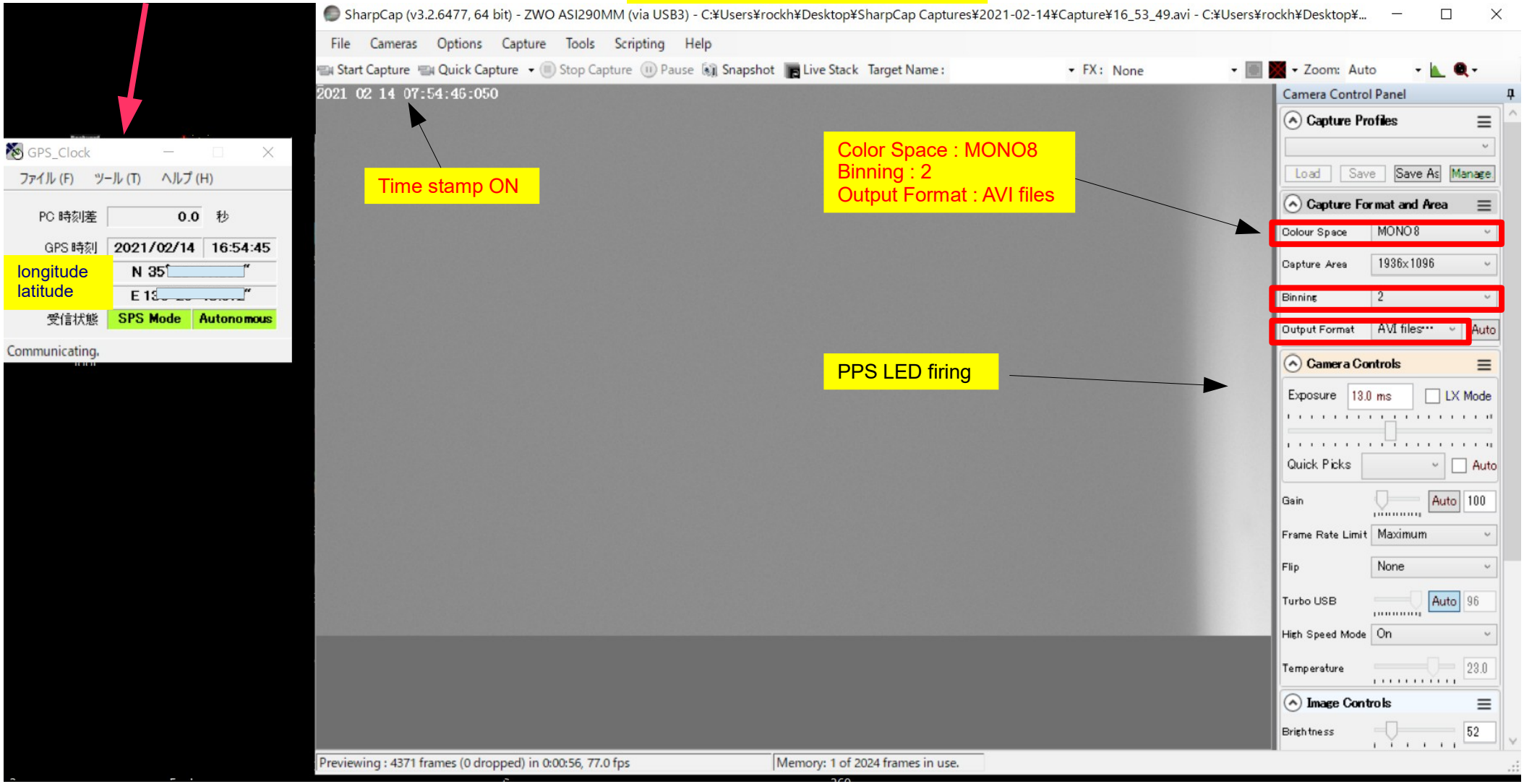
-PPS emission is projected on the right end in a band shape without affecting the observation
=> Time correction during observation is possible.



GPS-PC time correction software example and SharpCap settings

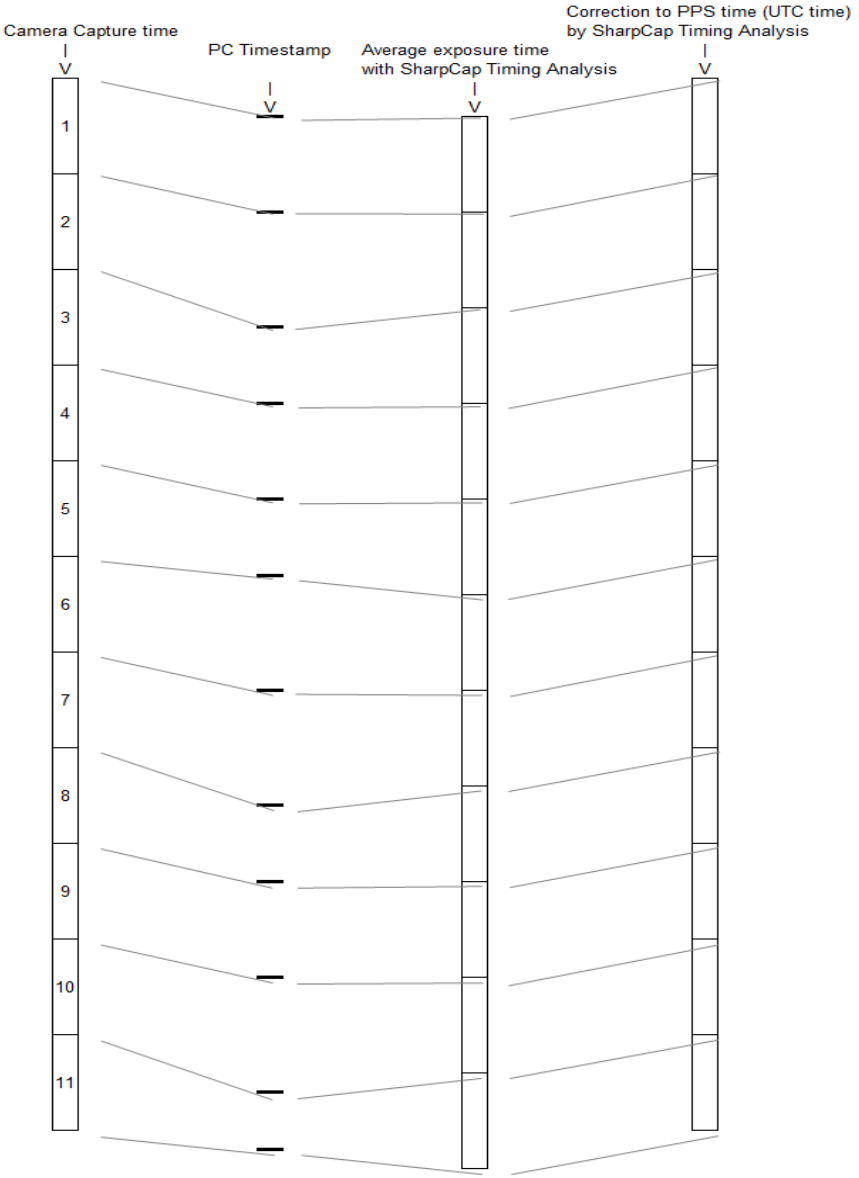
GPS-PC time correction software

SharpCap setting



SharpCap time stamp and time correction image by Limovie

Time	Camera Capture time	PC Timestamp with duration	Average exposure time with SharpCap Timing Analysis	Correction to PPS time (UTC time) by SharpCap Timing Analysis
0.000	0.000			0.000
0.005				
0.010		0.010	0.010	
0.015				
0.020				
0.025	0.025			0.025
0.030				
0.035		0.035	0.035	
0.040				
0.045				
0.050	0.050			0.050
0.055				
0.060			0.060	
0.065		0.065		
0.070				
0.075	0.075			0.075
0.080				
0.085		0.085	0.085	
0.090				
0.095				
0.100	0.100			0.100
0.105				
0.110		0.110	0.110	
0.115				
0.120				
0.125	0.125			0.125
0.130		0.130		
0.135			0.135	
0.140				
0.145				
0.150	0.150			0.150
0.155				
0.160		0.160	0.160	
0.165				
0.170				
0.175	0.175			0.175
0.180				
0.185			0.185	
0.190		0.190		
0.195				
0.200	0.200			0.200
0.205				
0.210		0.210	0.210	
0.215				
0.220				
0.225	0.225			0.225
0.230				
0.235		0.235	0.235	
0.240				
0.245				
0.250	0.250			0.250
0.255				
0.260			0.260	
0.265		0.265		
0.270				
0.275	0.275			0.275
0.280		0.280		
0.285			0.285	



There is a difference between the PC time and UTC, and there are delays and fluctuations in PC processing.
Time that eliminates fluctuation and includes only delay time

Limovie0.9.99.5A5b
Asteroid occultation analysis procedure
(Including PPS flash correction)

Feb 14, 2021
Rev. 02

http://astro-limovie.info/limovie/program/limovie09995A5b.zip

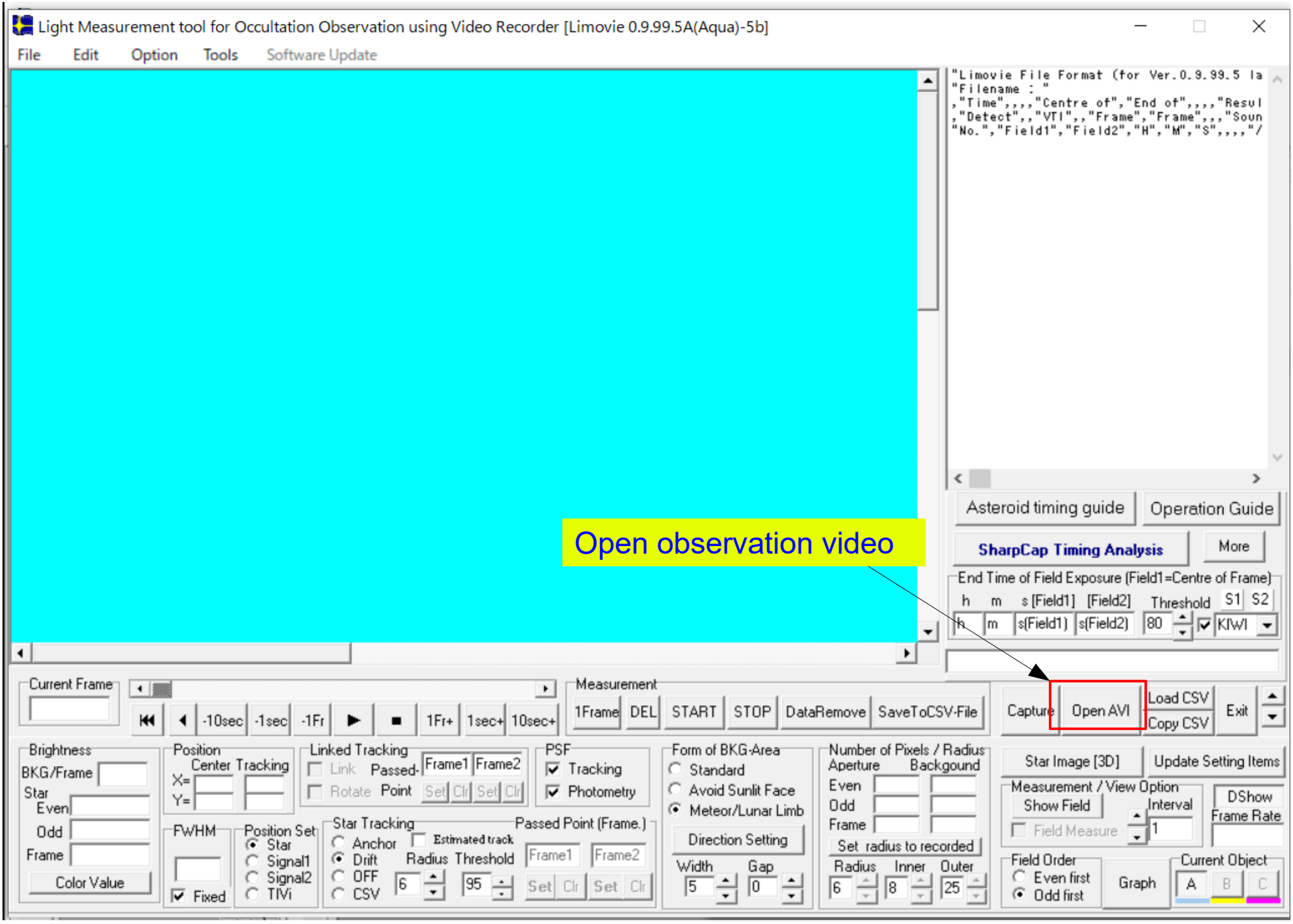
Points to consider when shooting

1. For PPS flash, shoot before and after shooting in the same file with the same exposure time as shooting.However, Gain can be changed.
2. Select the exposure time from the table below and use it to correct the PPS LED flash.

Table: Relationship between shooting exposure time (msec) and slope of Sharp Cap Timing Analysis (P.19) graph

http://astro-limovie.info/limovie/program/CaSEDLEP101.zip

Exp Exposure Time (msec)	FR Frame Rate (int)	Shift on Frame / UTC (msec)	P Shift /Exp (%)	L 1PPS LED Cap Time (sec)	Aplox straight line's incline
5.1	196	0	8	25	\
6.1	164	0	7	31	/
6.9	145	1	7	28	/
13.0	77	1	8	26	/
13.5	74	-1	7	27	\
14.1	71	1	8	26	/
14.3	70	1	7	29	/
15.4	65	1	6	31	/
20.8	48	-2	8	26	\
34.4	29	-2	7	29	\
35.8	28	2	7	30	/
39.9	25	-3	6	32	\
41.8	24	3	8	26	/
43.6	23	3	6	31	/
45.3	22	-3	8	27	\
45.6	22	3	7	28	/
47.8	21	4	8	25	/
50.2	20	4	8	25	/
55.8	18	4	8	25	/
58.6	17	-4	6	31	\
59.1	17	5	8	25	/
62.2	16	-5	8	26	\
62.8	16	5	8	26	/
67.0	15	5	7	27	/
71.1	14	-5	6	31	\
71.8	14	5	7	28	/
76.5	13	-6	7	28	\
77.3	13	5	6	32	/
82.8	12	-6	8	26	\
83.8	12	6	7	30	/
90.3	11	-7	7	27	\
91.5	11	7	7	28	/
99.3	10	-7	7	28	\
112.0	9	8	7	27	/
124.0	8	-8	6	28	\
126.0	8	8	6	28	/
144.0	7	8	6	31	/
165.0	6	-10	6	27	\
197.0	5	-15	8	20	\
202.0	5	10	5	30	/
246.0	4	-16	7	22	\
253.0	4	12	5	29	/
327.0	3	-19	6	22	\
338.0	3	14	4	31	/
490.0	2	-20	4	30	\


Light Measurement tool for Occultation Observation using Video Recorder [Limovie 0.9.99.5A(Aqua)-5b]
File
Edit
Option
Tools
Software Update
Open observation video
Asteroid timing guide
Operation Guide
SharpCap Timing Analysis
More
End Time of Field Exposure (Field1=Centre of Frame)
Threshold
S1
S2
KIWI
Current Frame
-10sec
-1sec
-1Fr
1Fr+
1sec+
10sec+
Measurement
1Frame
DEL
START
STOP
DataRemove
SaveToCSV-File
Capture
Open AVI
Load CSV
Copy CSV
Exit
Brightness
BKG/Frame
Star
Even
Odd
Frame
Color Value
Position
Center Tracking
Linked Tracking
Link
Rotate
Passed-Point
Frame1
Frame2
PSF
Tracking
Photometry
Form of BKG-Area
Standard
Avoid Sunlit Face
Meteor/Lunar Limb
Direction Setting
Number of Pixels / Radius
Aperture
Backgound
Set radius to recorded
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
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Frame Rate
FWHM
Fixed
Position Set
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Signal1
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Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
Passed Point (Frame.)
Width
Gap
Inner
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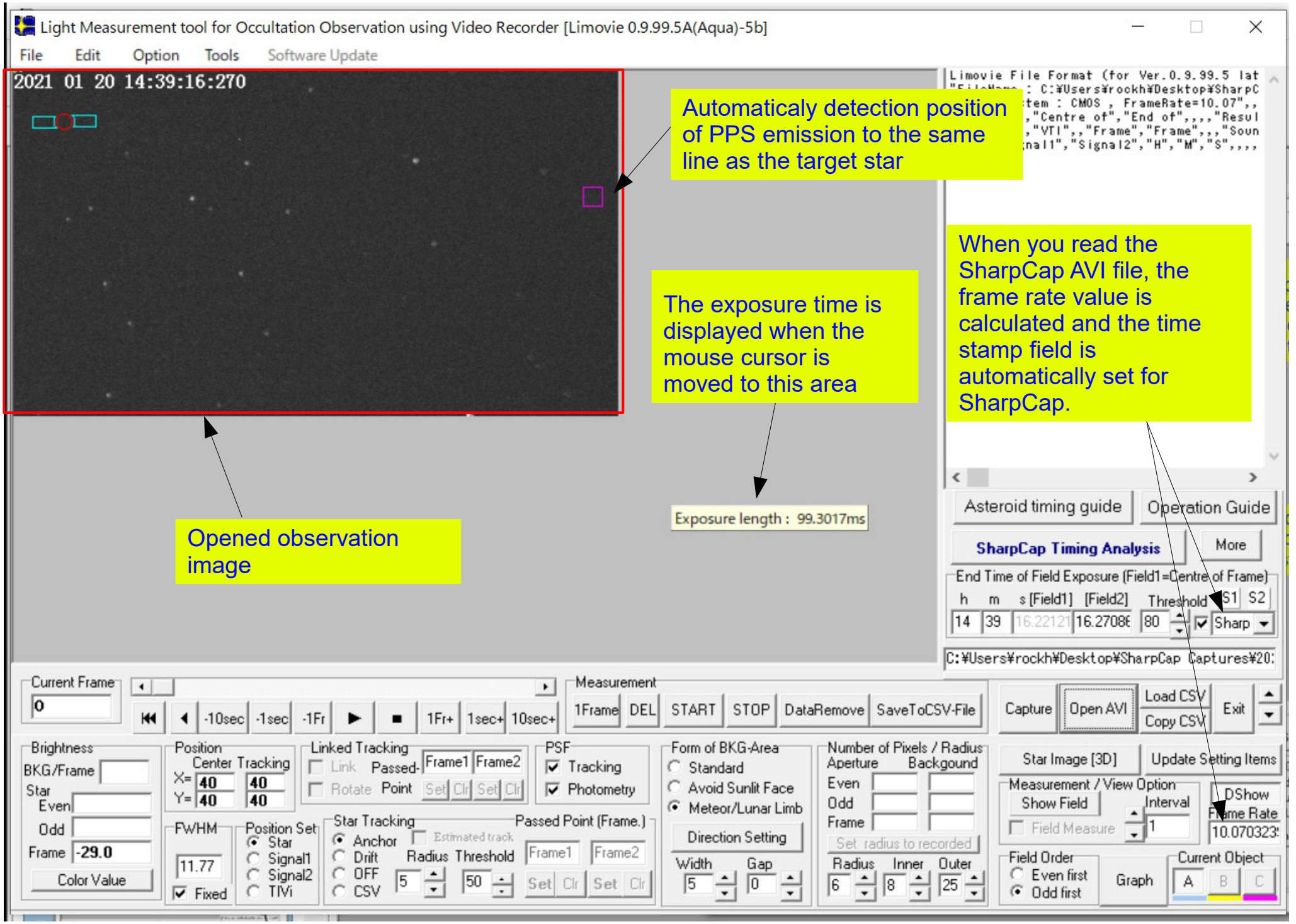
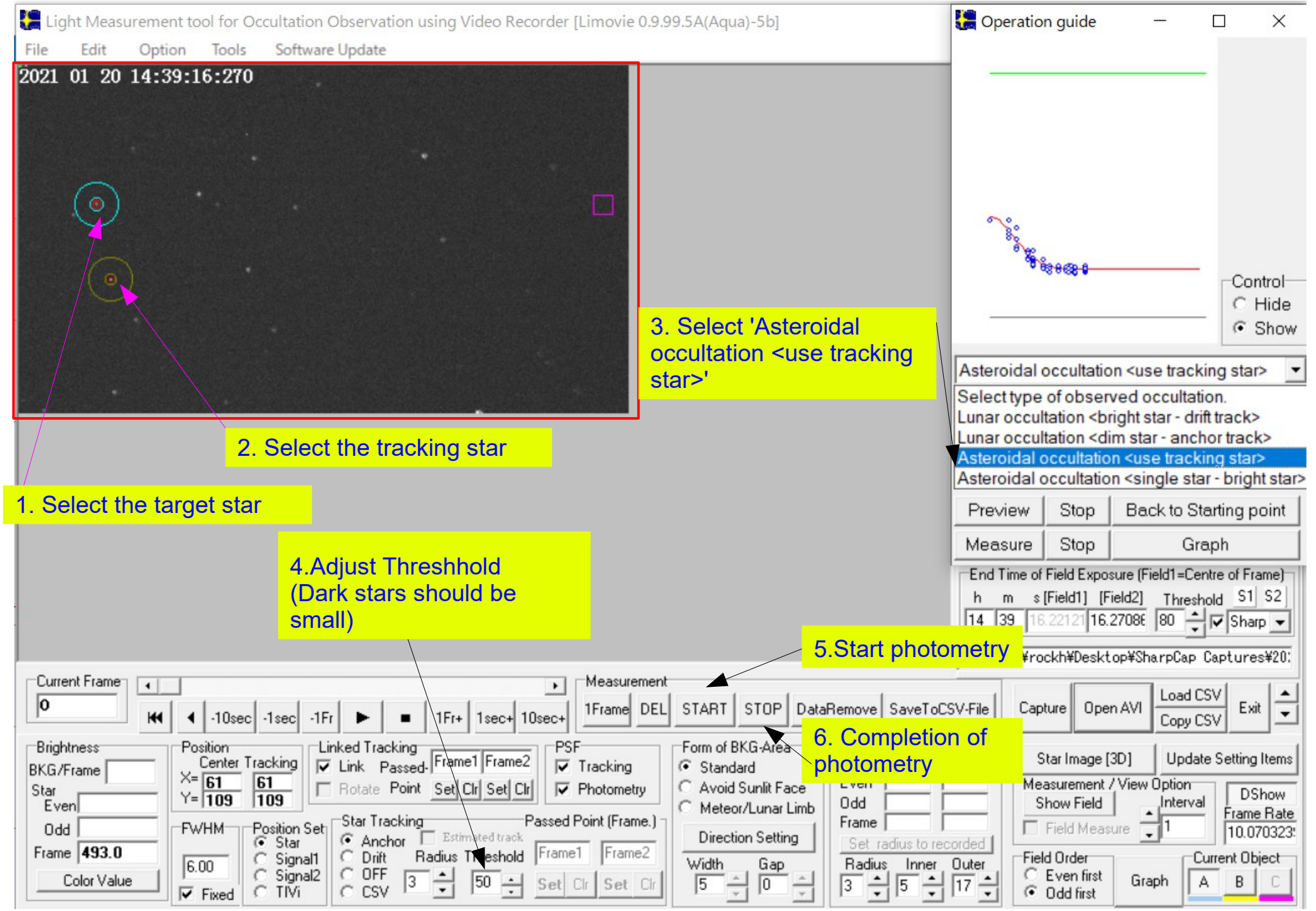
Field Order
Even first
Odd first
Graph
Current Object
A
B
C


Light Measurement tool for Occultation Observation using Video Recorder [Limovie 0.9.99.5A(Aqua)-5b]
File
Edit
Option
Tools
Software Update
2021 01 20 14:39:16:270
Automaticaly detection position of PPS emission to the same line as the target star
The exposure time is displayed when the mouse cursor is moved to this area
When you read the SharpCap AVI file, the frame rate value is calculated and the time stamp field is automatically set for SharpCap.
Opened observation image
Exposure length : 99.3017ms
Asteroid timing guide
Operation Guide
SharpCap Timing Analysis
More
End Time of Field Exposure (Field1=Centre of Frame)
Current Frame
Measurement
1Frame
DEL
START
STOP
DataRemove
SaveToCSV-File
Capture
Open AVI
Load CSV
Copy CSV
Exit
Brightness
Position
Linked Tracking
PSF
Form of BKG-Area
Number of Pixels / Radius
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Field Order
Even first
Odd first
Graph
Current Object
Star Tracking
Passed Point (Frame.)
Direction Setting
Set radius to recorded


Light Measurement tool for Occultation Observation using Video Recorder [Limovie 0.9.99.5A(Aqua)-5b]
File Edit Option Tools Software Update
2021 01 20 14:39:16:270
1. Select the target star
2. Select the tracking star
3. Select 'Asteroidal occultation <use tracking star>'
4.Adjust Threshhold (Dark stars should be small)
5.Start photometry
6. Completion of photometry
Operation guide
Control
Hide
Show
Asteroidal occultation <use tracking star>
Select type of observed occultation.
Lunar occultation <bright star - drift track>
Lunar occultation <dim star - anchor track>
Asteroidal occultation <use tracking star>
Asteroidal occultation <single star - bright star>
Preview
Stop
Back to Starting point
Measure
Stop
Graph
End Time of Field Exposure (Field1=Centre of Frame)
h m s [Field1] [Field2] Threshold S1 S2
Sharp
Current Frame
-10sec -1sec -1Fr 1Fr+ 1sec+ 10sec+
Measurement
1Frame DEL START STOP DataRemove SaveToCSV-File
Capture
Open AVI
Load CSV
Copy CSV
Exit
Brightness
BKG/Frame
Star
Even
Odd
Frame 493.0
Color Value
Position
Center Tracking
X= 61 61
Y= 109 109
Linked Tracking
Link Passed-Point Frame1 Frame2
Rotate
PSF
Tracking
Photometry
Form of BKG-Area
Standard
Avoid Sunlit Face
Meteor/Lunar Limb
Direction Setting
Width Gap
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
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Frame Rate
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FWHM
6.00
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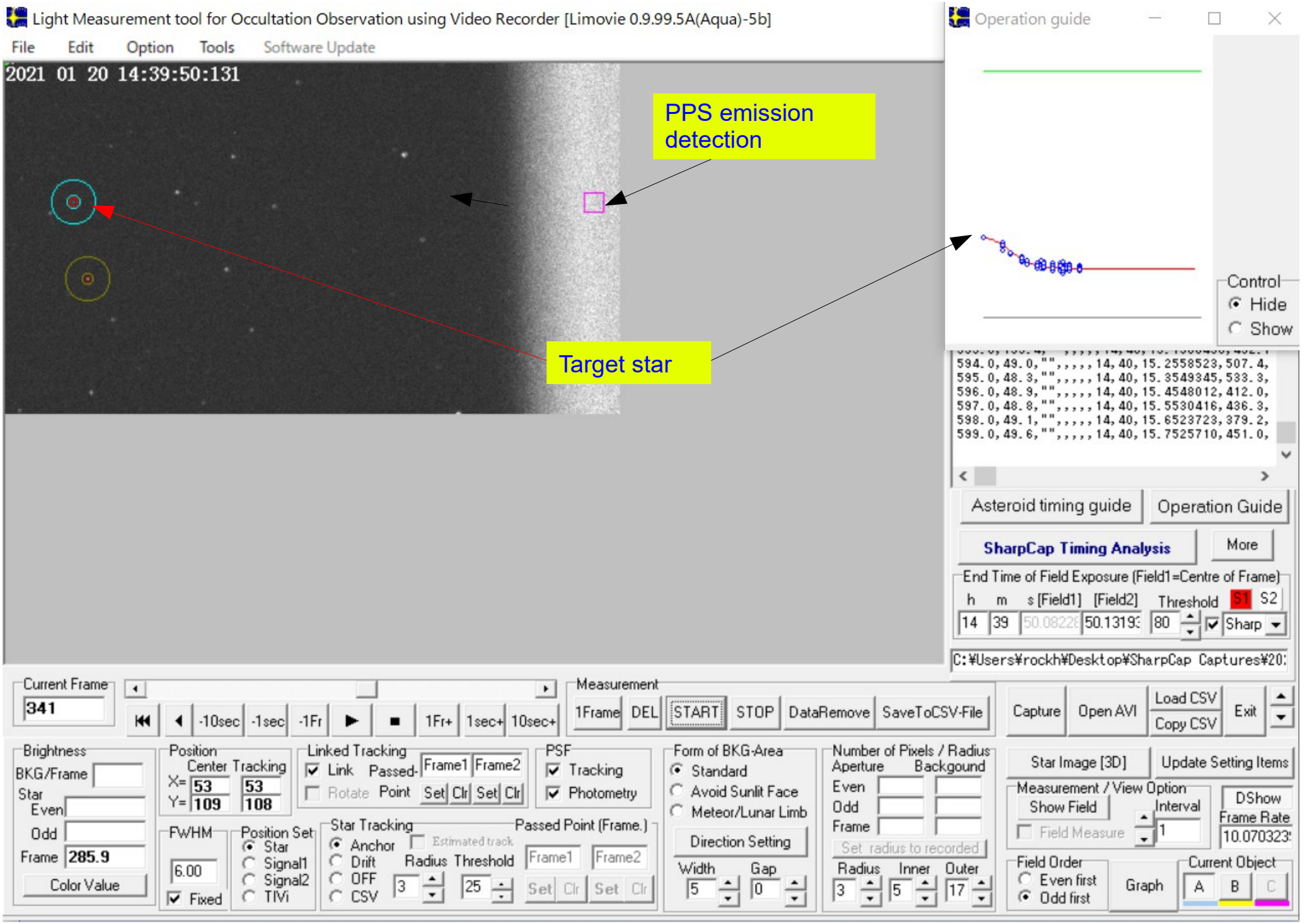
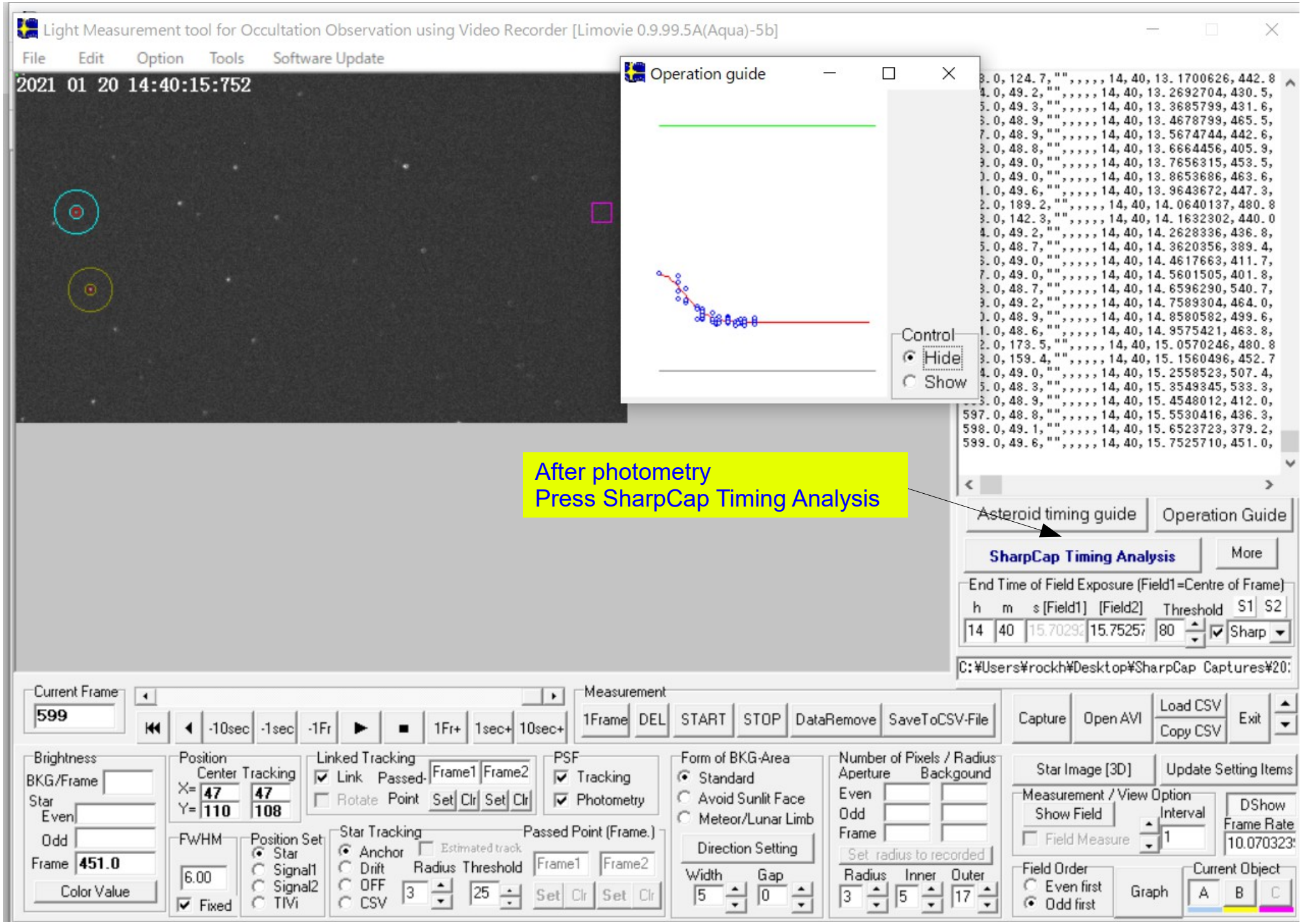
Position Set
Star
Signal1
Signal2
TIVi
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius Threshold
Passed Point (Frame.)
Frame1 Frame2
Set Clr Set Clr
Odd
Frame
Set radius to recorded
Radius Inner Outer
Field Order
Even first
Odd first
Graph
Current Object
A B C

State of photometry




Light Measurement tool for Occultation Observation using Video Recorder [Limovie 0.9.99.5A(Aqua)-5b]
File
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Tools
Software Update
2021 01 20 14:40:15:752
Operation guide
Control
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After photometry
Press SharpCap Timing Analysis
Asteroid timing guide
Operation Guide
SharpCap Timing Analysis
More
End Time of Field Exposure (Field1=Centre of Frame)
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[Field2]
Threshold
S1
S2
Sharp
Current Frame
599
-10sec
-1sec
-1Fr
1Fr+
1sec+
10sec+
Measurement
1Frame
DEL
START
STOP
DataRemove
SaveToCSV-File
Capture
Open AVI
Load CSV
Copy CSV
Exit
Brightness
BKG/Frame
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Even
Odd
Frame
451.0
Color Value
Position
Center
Tracking
X=
Y=
Linked Tracking
Link
Rotate
Passed-Point
Frame1
Frame2
Set
Clr
PSF
Tracking
Photometry
FWHM
6.00
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Star Tracking
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CSV
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Radius
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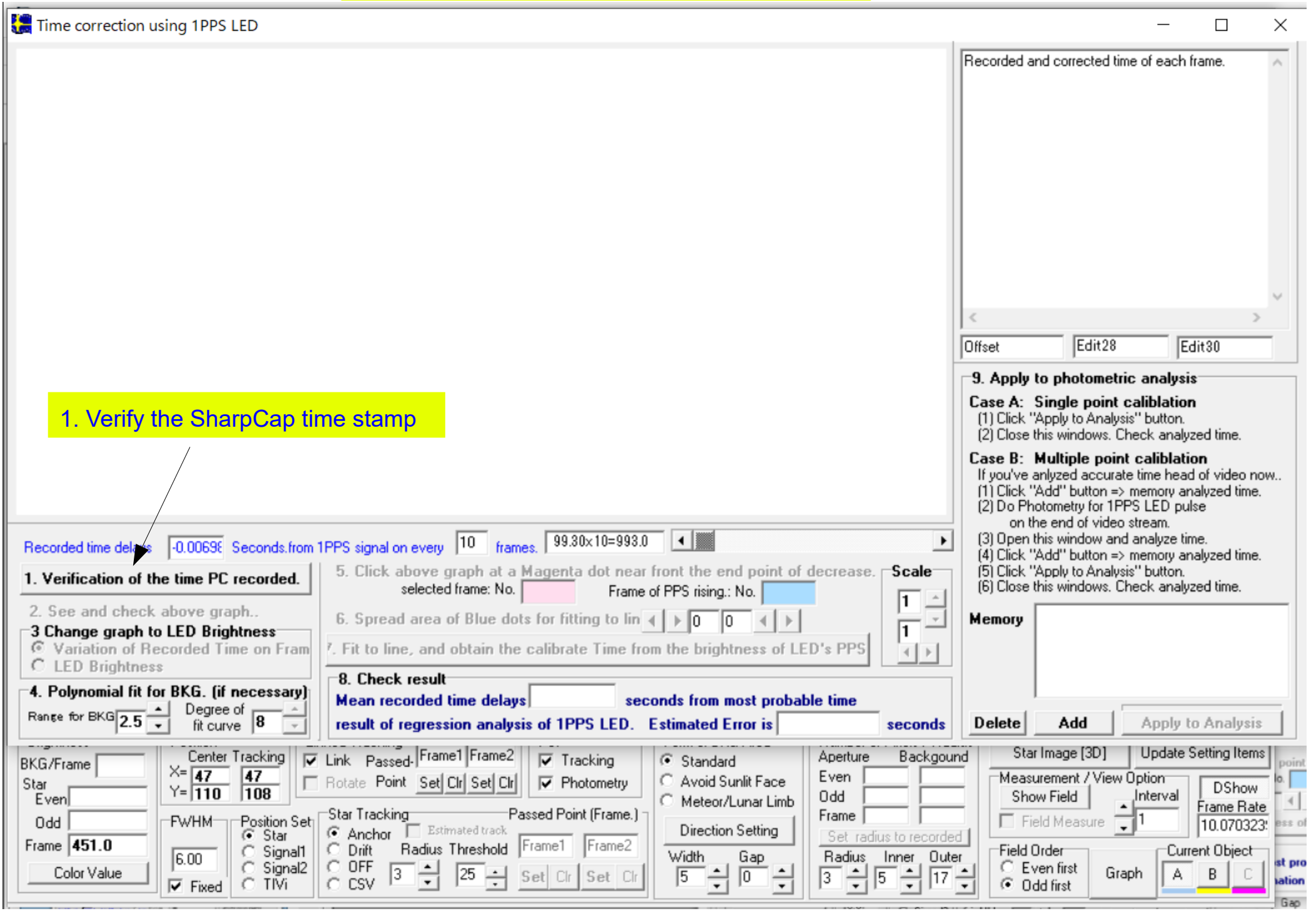
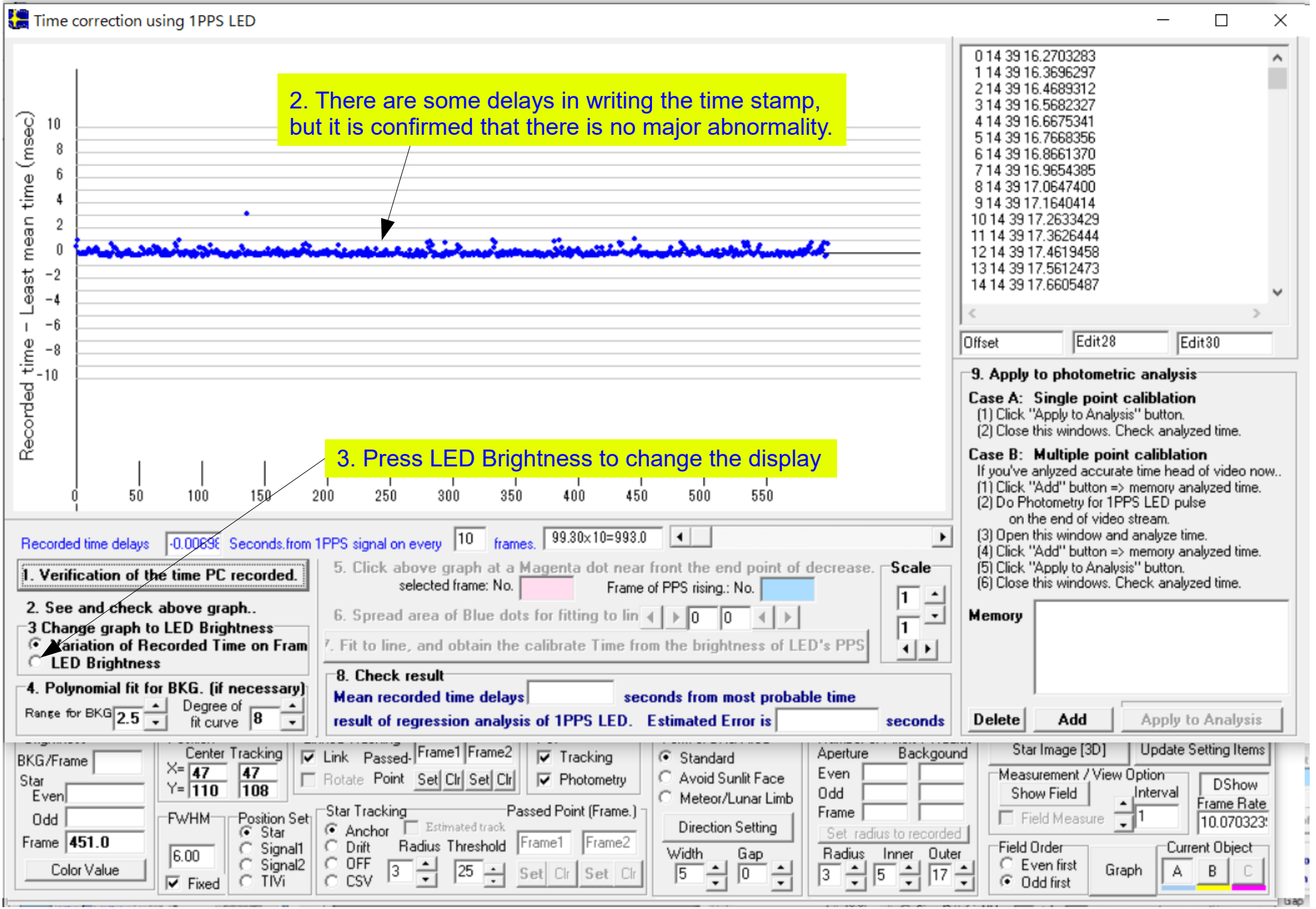
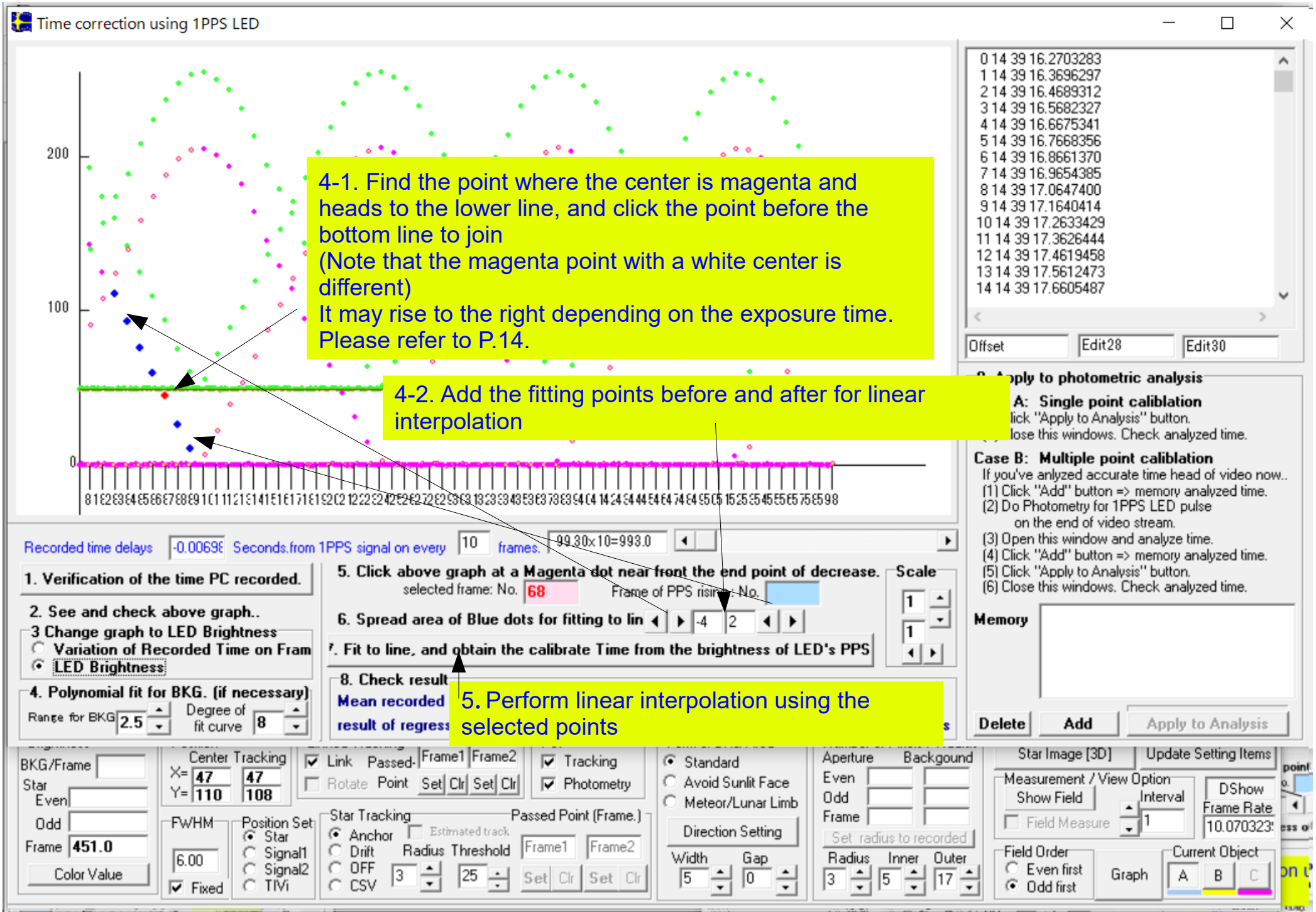
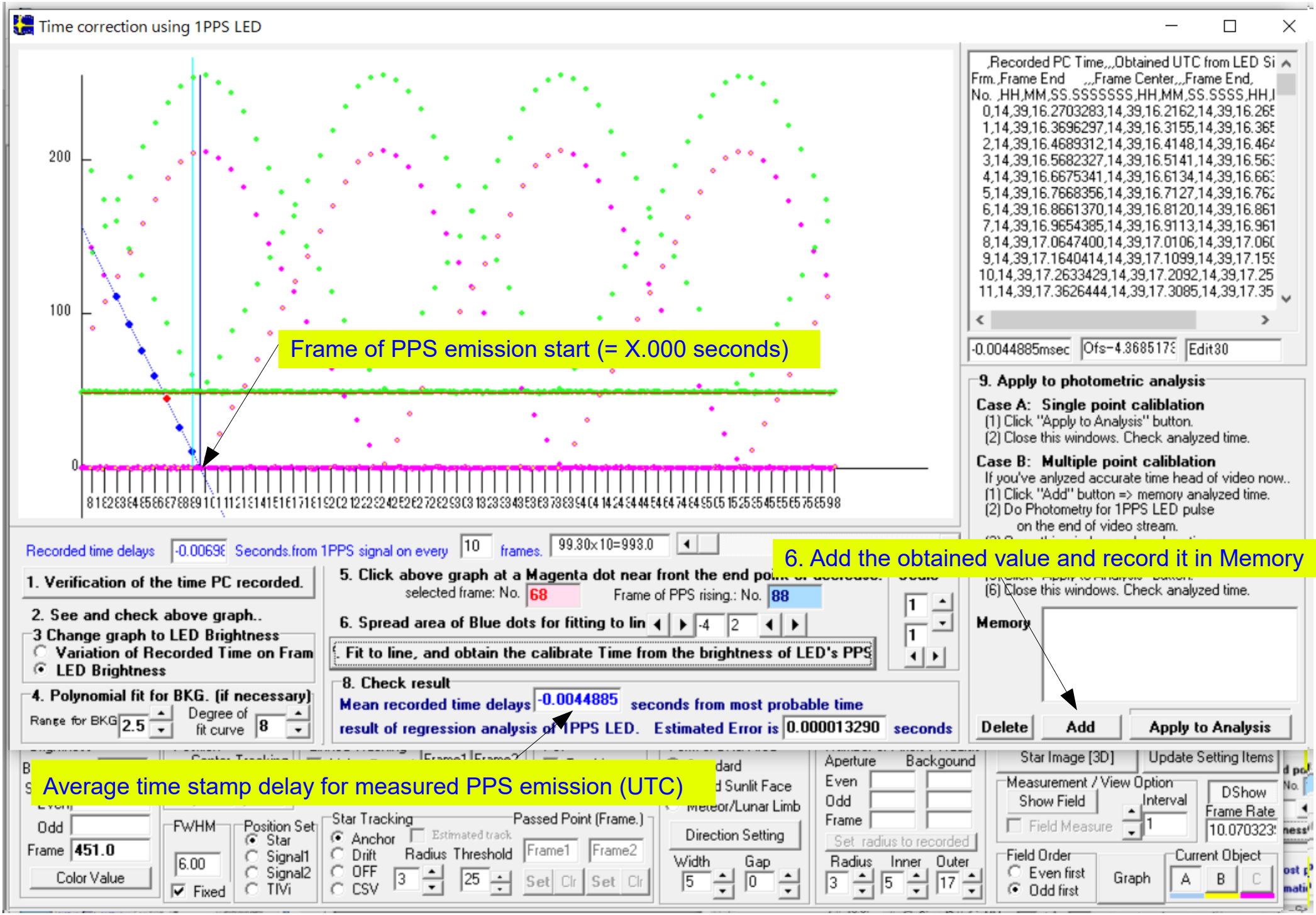
Direction Setting
Width
Gap
Number of Pixels / Radius
Aperture
Background
Even
Odd
Frame
Set radius to recorded
Radius
Inner
Outer
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
DShow
Frame Rate
Field Order
Even first
Odd first
Graph
Current Object
A
B
C

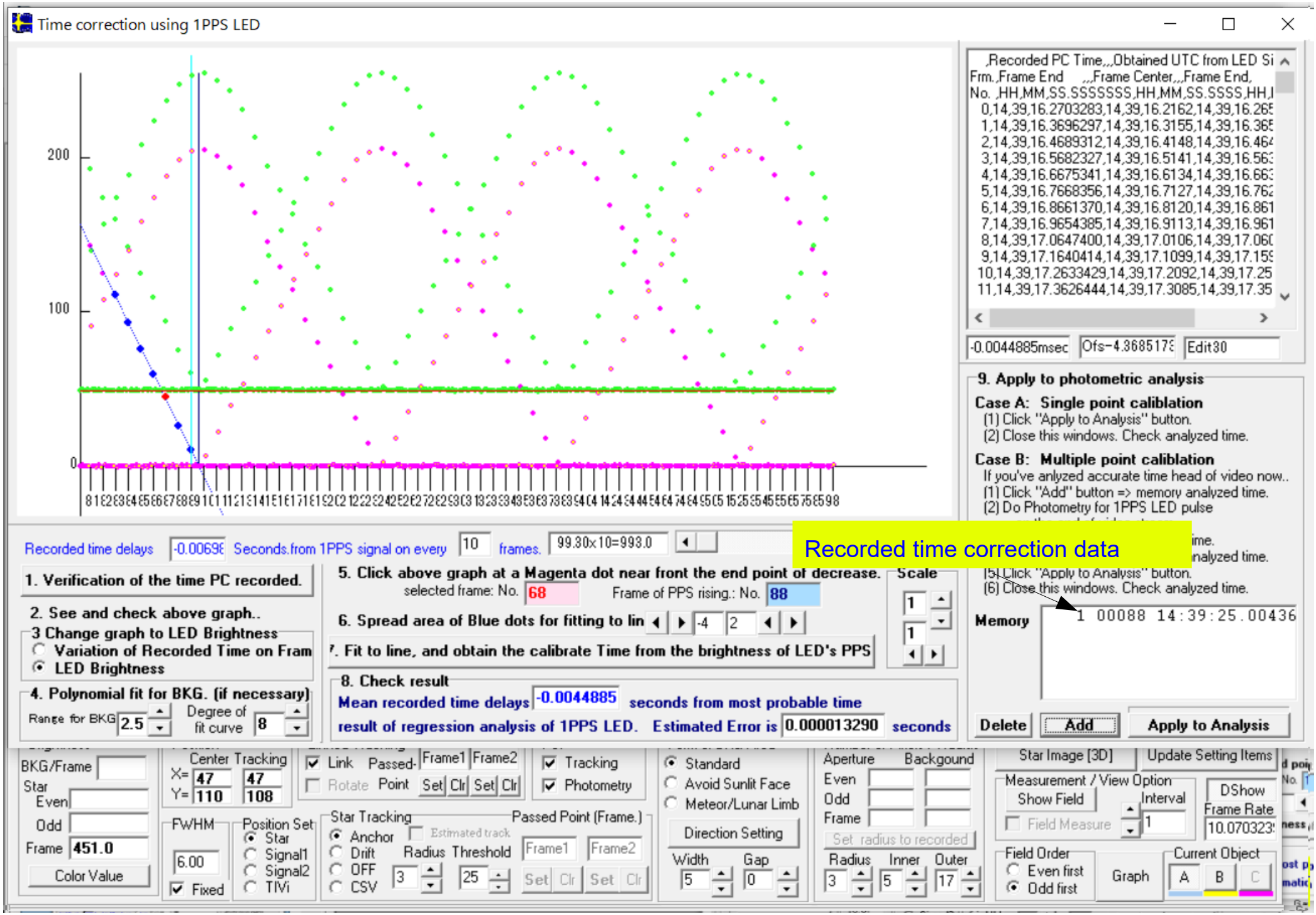
SharpCap Timing Analysis initial screen

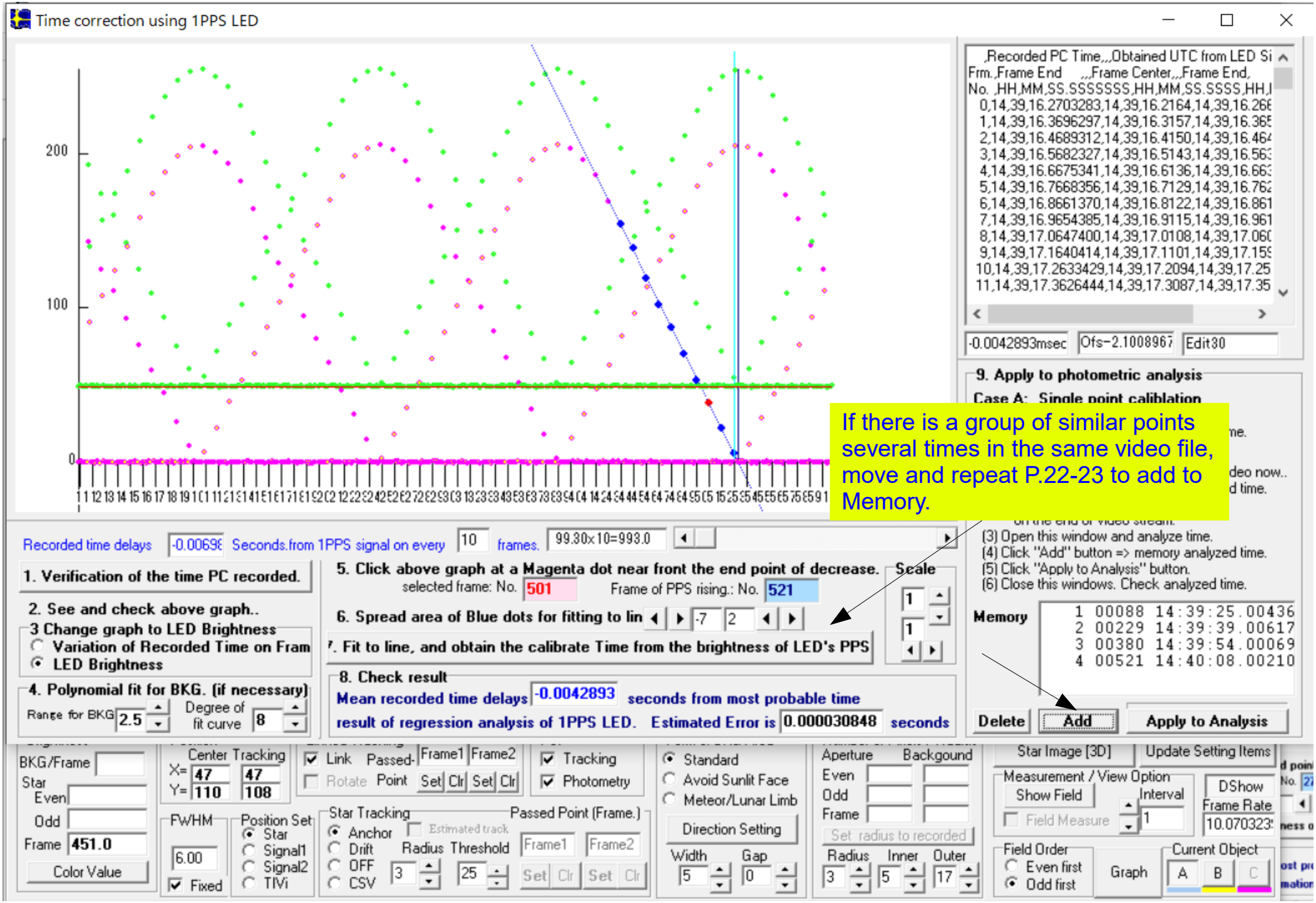


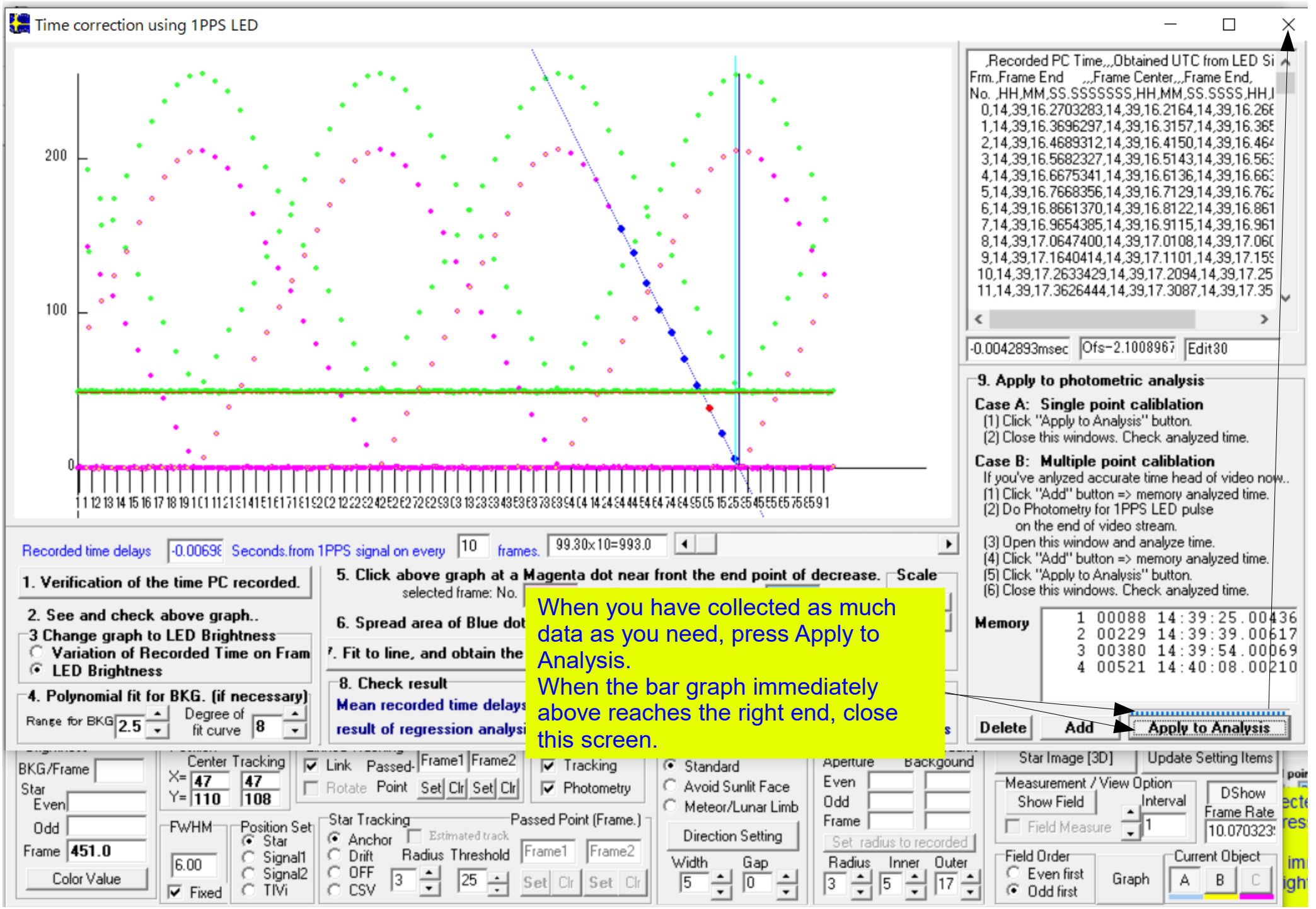

Time correction using 1PPS LED
2. There are some delays in writing the time stamp, but it is confirmed that there is no major abnormality.
3. Press LED Brightness to change the display
Recorded time – Least mean time (msec)
0 14 39 16.2703283
1 14 39 16.3696297
2 14 39 16.4689312
3 14 39 16.5682327
4 14 39 16.6675341
5 14 39 16.7668356
6 14 39 16.8661370
7 14 39 16.9654385
8 14 39 17.0647400
9 14 39 17.1640414
10 14 39 17.2633429
11 14 39 17.3626444
12 14 39 17.4619458
13 14 39 17.5612473
14 14 39 17.6605487
Offset
Edit28
Edit30
9. Apply to photometric analysis
Case A: Single point caliblation
(1) Click "Apply to Analysis" button.
(2) Close this windows. Check analyzed time.
Case B: Multiple point caliblation
If you've anlyzed accurate time head of video now..
(1) Click "Add" button => memory analyzed time.
(2) Do Photometry for 1PPS LED pulse on the end of video stream.
(3) Open this window and analyze time.
(4) Click "Add" button => memory analyzed time.
(5) Click "Apply to Analysis" button.
(6) Close this windows. Check analyzed time.
Memory
Delete
Add
Apply to Analysis
Recorded time delays
Seconds.from 1PPS signal on every
frames.
99.30x10=993.0
1. Verification of the time PC recorded.
2. See and check above graph..
3 Change graph to LED Brightness
Variation of Recorded Time on Fram
LED Brightness
4. Polynomial fit for BKG. (if necessary)
Range for BKG
Degree of fit curve
5. Click above graph at a Magenta dot near front the end point of decrease.
selected frame: No.
Frame of PPS rising.: No.
6. Spread area of Blue dots for fitting to lin
Fit to line, and obtain the calibrate Time from the brightness of LED's PPS
8. Check result
Mean recorded time delays
seconds from most probable time
result of regression analysis of 1PPS LED.
Estimated Error is
seconds
Scale
BKG/Frame
Star
Even
Odd
Frame
451.0
Color Value
Center Tracking
X=
Y=
47
110
47
108
FWHM
6.00
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Link
Rotate
Passed-Point
Frame1
Frame2
Set
Clr
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
3
25
Passed Point (Frame.)
Tracking
Photometry
Standard
Avoid Sunlit Face
Meteor/Lunar Limb
Direction Setting
Width
Gap
5
0
Aperture
Backgound
Even
Odd
Frame
Set radius to recorded
Radius
Inner
Outer
3
5
17
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
DShow
Frame Rate
10.070323
Field Order
Even first
Odd first
Graph
Current Object
A
B
C

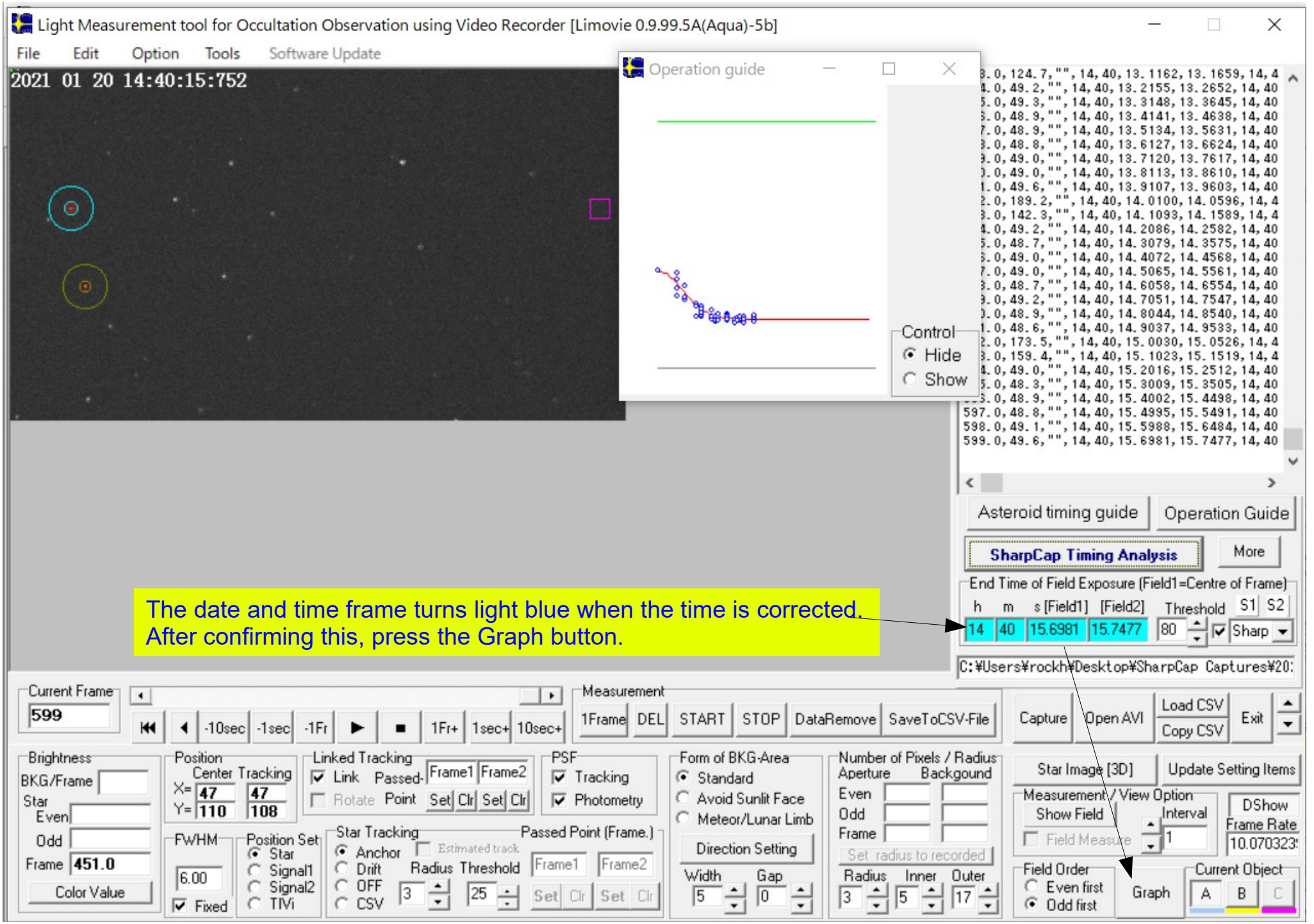

Time correction using 1PPS LED
4-1. Find the point where the center is magenta and heads to the lower line, and click the point before the bottom line to join
(Note that the magenta point with a white center is different)
It may rise to the right depending on the exposure time.
Please refer to P.14.
4-2. Add the fitting points before and after for linear interpolation
5. Perform linear interpolation using the selected points
Recorded time delays
Seconds.from 1PPS signal on every
frames.
1. Verification of the time PC recorded.
2. See and check above graph..
3 Change graph to LED Brightness
Variation of Recorded Time on Fram
LED Brightness
4. Polynomial fit for BKG. (if necessary)
Range for BKG
Degree of fit curve
5. Click above graph at a Magenta dot near front the end point of decrease.
selected frame: No.
Frame of PPS rising: No.
6. Spread area of Blue dots for fitting to lin
7. Fit to line, and obtain the calibrate Time from the brightness of LED's PPS
8. Check result
Mean recorded
result of regress
Scale
Memory
Delete
Add
Apply to Analysis
Case A: Single point caliblation
Case B: Multiple point caliblation
If you've anlyzed accurate time head of video now..
(1) Click "Add" button => memory analyzed time.
(2) Do Photometry for 1PPS LED pulse on the end of video stream.
(3) Open this window and analyze time.
(4) Click "Add" button => memory analyzed time.
(5) Click "Apply to Analysis" button.
(6) Close this windows. Check analyzed time.
Offset
Edit28
Edit30
Center Tracking
Link
Passed-Point
Frame1
Frame2
Tracking
Photometry
Standard
Avoid Sunlit Face
Meteor/Lunar Limb
Direction Setting
Aperture
Background
Even
Odd
Frame
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
DShow
Frame Rate
Field Order
Even first
Odd first
Graph
Current Object
BKG/Frame
Star
Color Value
FWHM
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
Passed Point (Frame.)
Set
Clr
Width
Gap
Radius
Inner
Outer

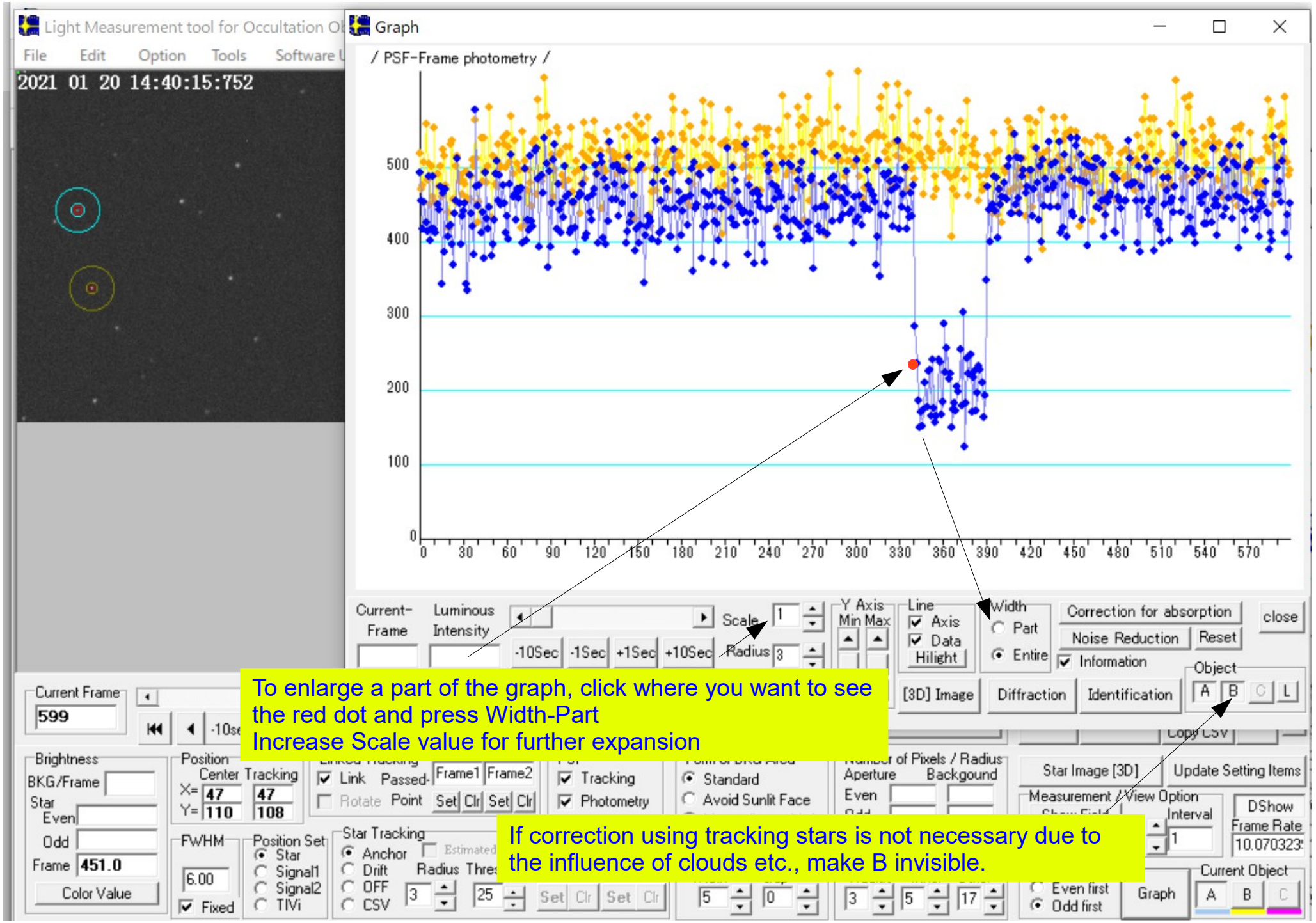

Time correction using 1PPS LED
Frame of PPS emission start (= X.000 seconds)
Recorded time delays
Seconds.from 1PPS signal on every
frames.
1. Verification of the time PC recorded.
2. See and check above graph..
3 Change graph to LED Brightness
Variation of Recorded Time on Fram
LED Brightness
4. Polynomial fit for BKG. (if necessary)
Range for BKG
Degree of fit curve
5. Click above graph at a Magenta dot near front the end
selected frame: No.
Frame of PPS rising.: No.
6. Spread area of Blue dots for fitting to lin
. Fit to line, and obtain the calibrate Time from the brightness of LED's PPS
8. Check result
Mean recorded time delays
seconds from most probable time
result of regression analysis of 1PPS LED. Estimated Error is
seconds
Average time stamp delay for measured PPS emission (UTC)
6. Add the obtained value and record it in Memory
9. Apply to photometric analysis
Case A: Single point caliblation
(1) Click "Apply to Analysis" button.
(2) Close this windows. Check analyzed time.
Case B: Multiple point caliblation
If you've anlyzed accurate time head of video now..
(1) Click "Add" button => memory analyzed time.
(2) Do Photometry for 1PPS LED pulse
on the end of video stream.
(6) Close this windows. Check analyzed time.
Memory
Delete
Add
Apply to Analysis
Recorded PC Time,,,Obtained UTC from LED Si
Frm.,Frame End ,,,Frame Center,,,Frame End,
No. ,HH,MM,SS.SSSSSSS,HH,MM,SS.SSSS,HH,
0,14,39,16.2703283,14,39,16.2162,14,39,16.265
1,14,39,16.3696297,14,39,16.3155,14,39,16.365
2,14,39,16.4689312,14,39,16.4148,14,39,16.464
3,14,39,16.5682327,14,39,16.5141,14,39,16.563
4,14,39,16.6675341,14,39,16.6134,14,39,16.663
5,14,39,16.7668356,14,39,16.7127,14,39,16.762
6,14,39,16.8661370,14,39,16.8120,14,39,16.861
7,14,39,16.9654385,14,39,16.9113,14,39,16.961
8,14,39,17.0647400,14,39,17.0106,14,39,17.060
9,14,39,17.1640414,14,39,17.1099,14,39,17.159
10,14,39,17.2633429,14,39,17.2092,14,39,17.25
11,14,39,17.3626444,14,39,17.3085,14,39,17.35
-0.0044885msec
Ofs=4.3685178
Edit30
Odd
Frame
Color Value
FWHM
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
Passed Point (Frame.)
Frame1
Frame2
Set
Clr
Direction Setting
Width
Gap
Aperture
Backgound
Even
Odd
Frame
Set radius to recorded
Radius
Inner
Outer
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
DShow
Frame Rate
Field Order
Even first
Odd first
Graph
Current Object
A
B
C

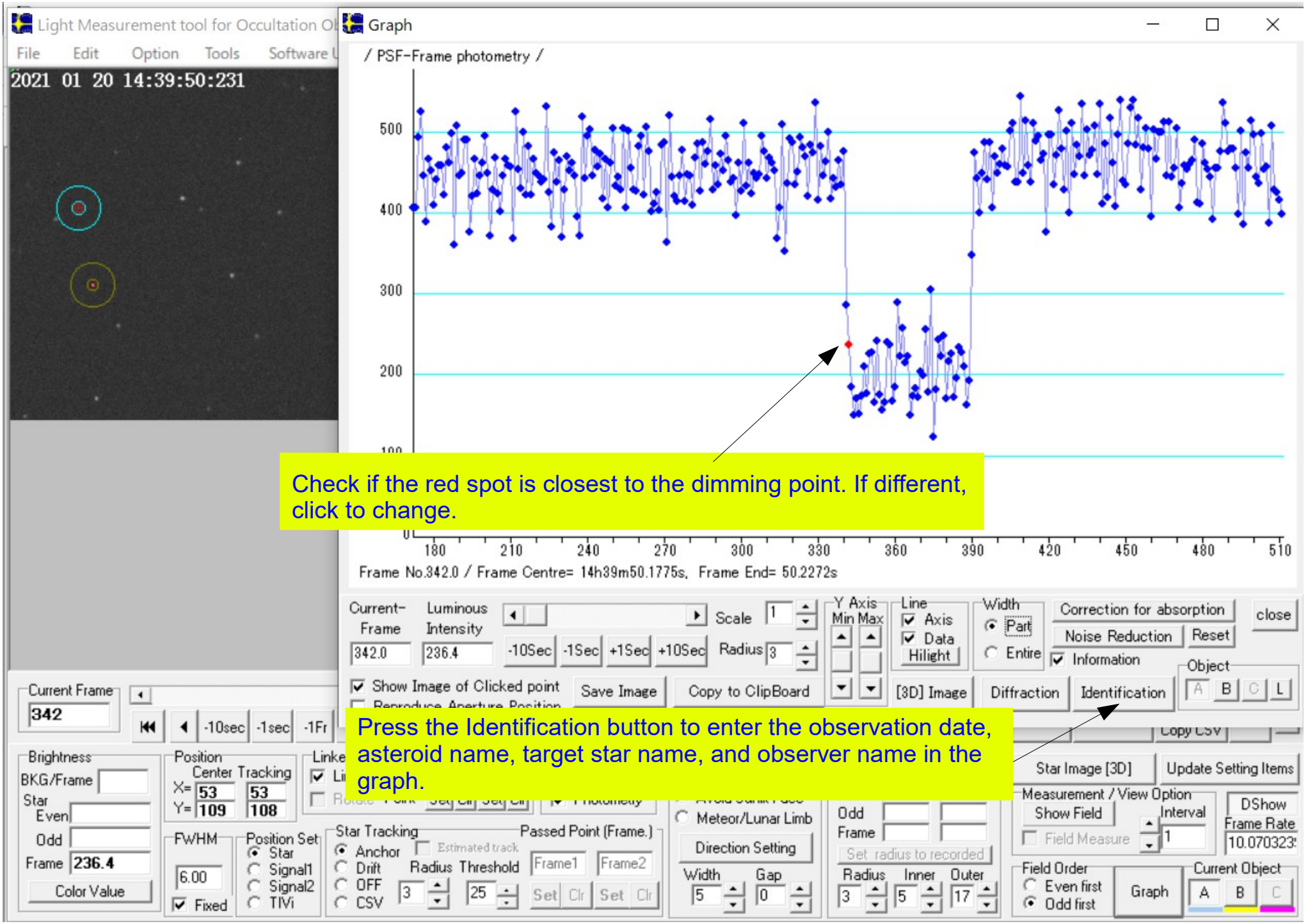

Time correction using 1PPS LED
Recorded time correction data
Recorded time delays
Seconds.from 1PPS signal on every
frames.
1. Verification of the time PC recorded.
2. See and check above graph..
3 Change graph to LED Brightness
Variation of Recorded Time on Fram
LED Brightness
4. Polynomial fit for BKG. (if necessary)
Range for BKG
Degree of fit curve
5. Click above graph at a Magenta dot near front the end point of decrease.
selected frame: No.
Frame of PPS rising.: No.
6. Spread area of Blue dots for fitting to lin
7. Fit to line, and obtain the calibrate Time from the brightness of LED's PPS
8. Check result
Mean recorded time delays
seconds from most probable time
result of regression analysis of 1PPS LED. Estimated Error is
seconds
Scale
9. Apply to photometric analysis
Case A: Single point caliblation
(1) Click "Apply to Analysis" button.
(2) Close this windows. Check analyzed time.
Case B: Multiple point caliblation
If you've anlyzed accurate time head of video now..
(1) Click "Add" button => memory analyzed time.
(2) Do Photometry for 1PPS LED pulse
(5) Click "Apply to Analysis" button.
(6) Close this windows. Check analyzed time.
Memory
1 00088 14:39:25.00436
Delete
Add
Apply to Analysis
Recorded PC Time,,,Obtained UTC from LED Si
Frm.,Frame End ,,,Frame Center,,,Frame End,
No. ,HH,MM,SS.SSSSSSS,HH,MM,SS.SSSS,HH,
0,14,39,16.2703283,14,39,16.2162,14,39,16.265
1,14,39,16.3696297,14,39,16.3155,14,39,16.365
2,14,39,16.4689312,14,39,16.4148,14,39,16.464
3,14,39,16.5682327,14,39,16.5141,14,39,16.563
4,14,39,16.6675341,14,39,16.6134,14,39,16.663
5,14,39,16.7668356,14,39,16.7127,14,39,16.762
6,14,39,16.8661370,14,39,16.8120,14,39,16.861
7,14,39,16.9654385,14,39,16.9113,14,39,16.961
8,14,39,17.0647400,14,39,17.0106,14,39,17.060
9,14,39,17.1640414,14,39,17.1099,14,39,17.159
10,14,39,17.2633429,14,39,17.2092,14,39,17.25
11,14,39,17.3626444,14,39,17.3085,14,39,17.35
-0.0044885msec
Ofs=4.368517
Edit30
BKG/Frame
Star
Even
Odd
Frame
Color Value
Center Tracking
X=
Y=
FWHM
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Link
Rotate
Passed-
Frame1
Frame2
Point
Set
Clr
Tracking
Photometry
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
Passed Point (Frame.)
Standard
Avoid Sunlit Face
Meteor/Lunar Limb
Direction Setting
Width
Gap
Aperture
Backgound
Even
Odd
Frame
Set radius to recorded
Radius
Inner
Outer
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
DShow
Frame Rate
Field Order
Even first
Odd first
Graph
Current Object
A
B
C

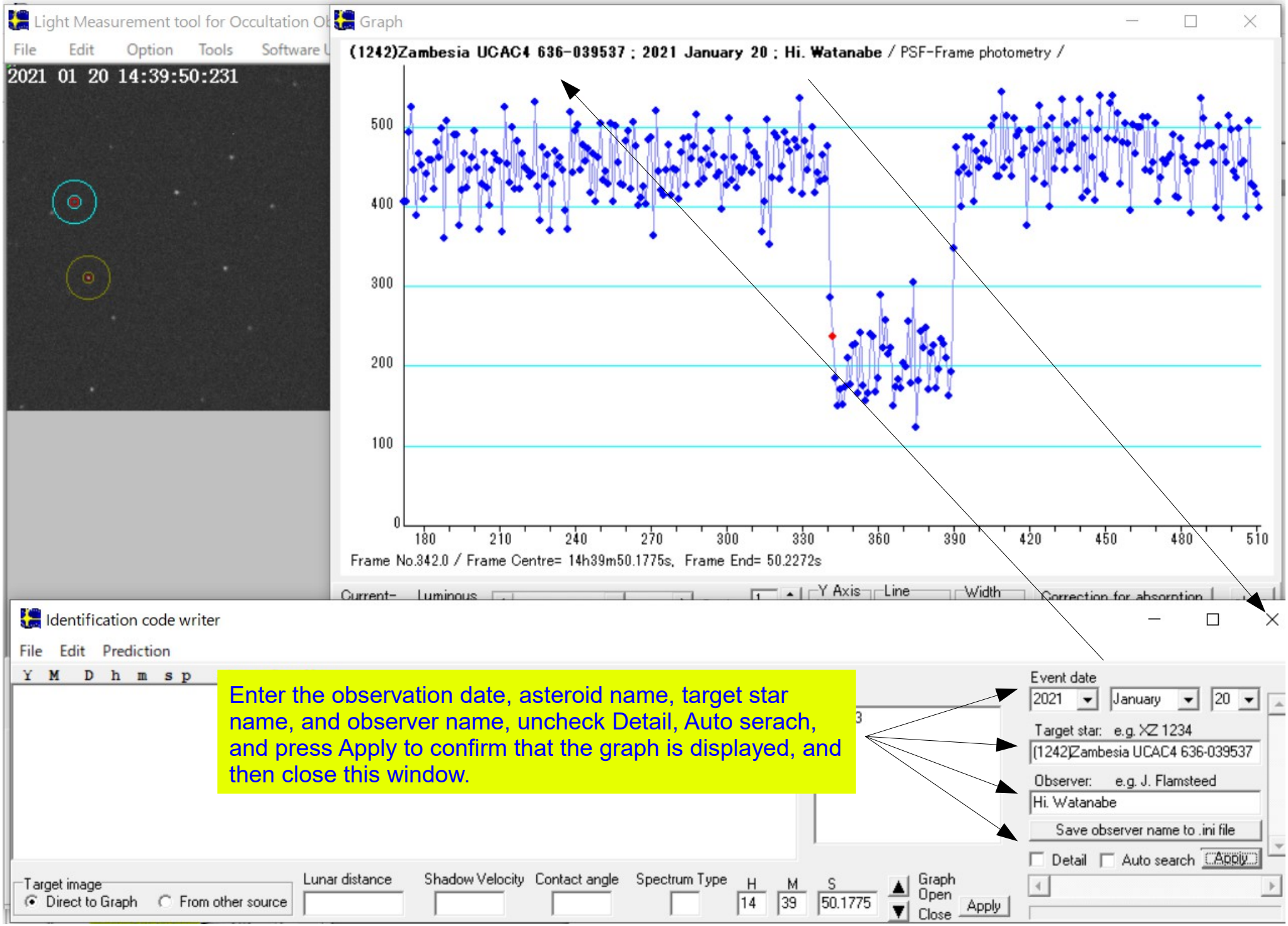

Time correction using 1PPS LED
200
100
0
Recorded PC Time,,,Obtained UTC from LED Si
Frm.,Frame End ,,,Frame Center,,,Frame End,
No. ,HH,MM,SS.SSSSSSS,HH,MM,SS.SSSS,HH,
0,14,39,16.2703283,14,39,16.2164,14,39,16.26
1,14,39,16.3696297,14,39,16.3157,14,39,16.36
2,14,39,16.4689312,14,39,16.4150,14,39,16.46
3,14,39,16.5682327,14,39,16.5143,14,39,16.56
4,14,39,16.6675341,14,39,16.6136,14,39,16.66
5,14,39,16.7668356,14,39,16.7129,14,39,16.76
6,14,39,16.8661370,14,39,16.8122,14,39,16.86
7,14,39,16.9654385,14,39,16.9115,14,39,16.96
8,14,39,17.0647400,14,39,17.0108,14,39,17.06
9,14,39,17.1640414,14,39,17.1101,14,39,17.15
10,14,39,17.2633429,14,39,17.2094,14,39,17.25
11,14,39,17.3626444,14,39,17.3087,14,39,17.35
-0.0042893msec
Ofs=-2.1008967
Edit30
9. Apply to photometric analysis
Case A: Single point caliblation
If there is a group of similar points several times in the same video file, move and repeat P.22-23 to add to Memory.
(3) Open this window and analyze time.
(4) Click "Add" button => memory analyzed time.
(5) Click "Apply to Analysis" button.
(6) Close this windows. Check analyzed time.
Memory
1 00088 14:39:25.00436
2 00229 14:39:39.00617
3 00380 14:39:54.00069
4 00521 14:40:08.00210
Delete
Add
Apply to Analysis
Recorded time delays
-0.00698
Seconds.from 1PPS signal on every
10
frames.
99.30x10=993.0
1. Verification of the time PC recorded.
2. See and check above graph..
3 Change graph to LED Brightness
Variation of Recorded Time on Fram
LED Brightness
4. Polynomial fit for BKG. (if necessary)
Range for BKG
2.5
Degree of fit curve
8
5. Click above graph at a Magenta dot near front the end point of decrease.
selected frame: No.
501
Frame of PPS rising.: No.
521
6. Spread area of Blue dots for fitting to lin
-7
2
7. Fit to line, and obtain the calibrate Time from the brightness of LED's PPS
Scale
8. Check result
Mean recorded time delays
-0.0042893
seconds from most probable time
result of regression analysis of 1PPS LED. Estimated Error is
0.000030848
seconds
BKG/Frame
Star
Even
Odd
Frame
451.0
Color Value
Center Tracking
X=
47
47
Y=
110
108
FWHM
6.00
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Link
Passed-
Frame1
Frame2
Rotate
Point
Set
Clr
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
3
25
Passed Point (Frame.)
Tracking
Photometry
Standard
Avoid Sunlit Face
Meteor/Lunar Limb
Direction Setting
Width
Gap
5
0
Aperture
Backgound
Even
Odd
Frame
Set radius to recorded
Radius
Inner
Outer
3
5
17
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
1
DShow
Frame Rate
10.070323
Field Order
Even first
Odd first
Graph
Current Object
A
B
C

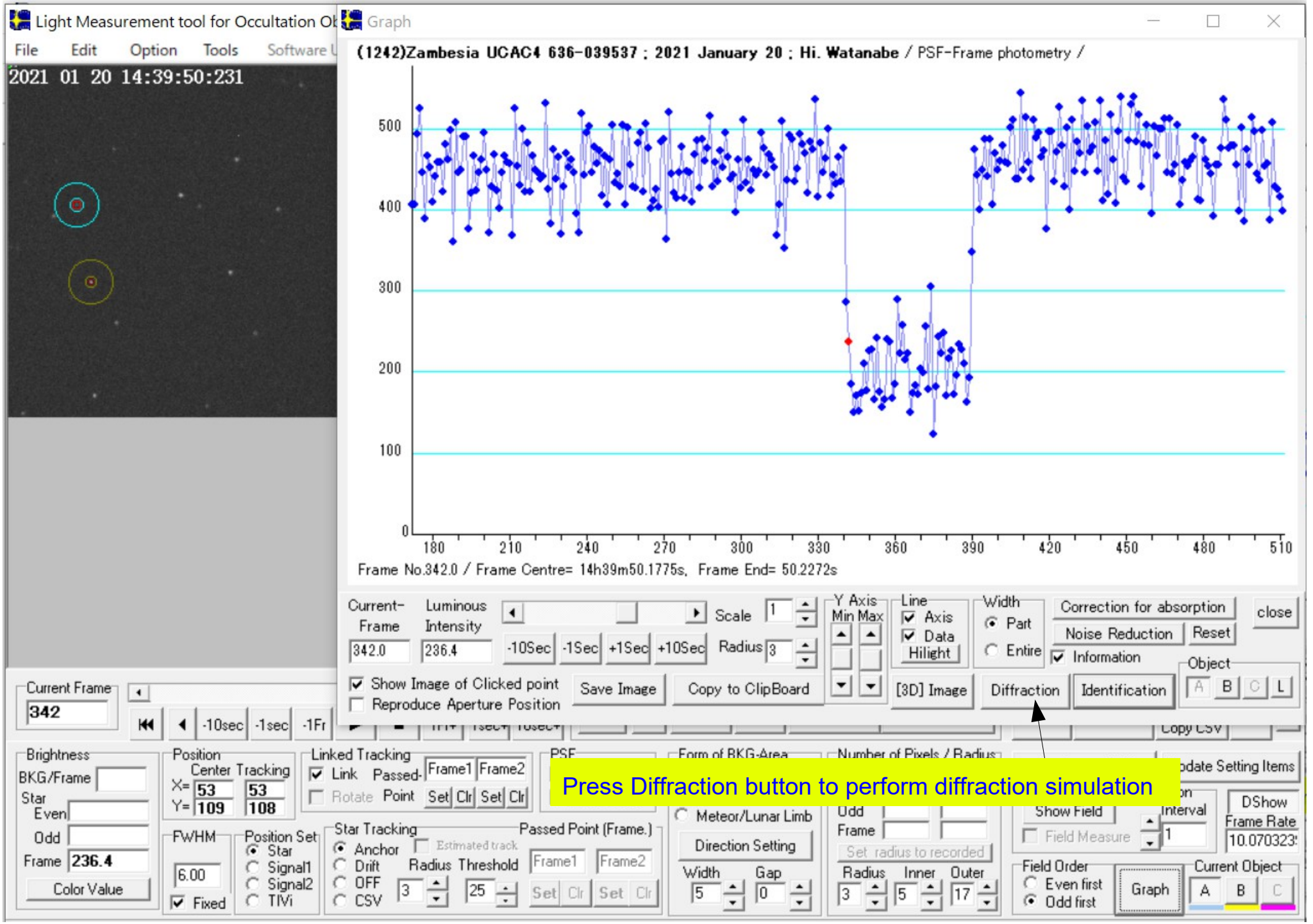

Time correction using 1PPS LED
200
100
0
Recorded PC Time,,,Obtained UTC from LED Si
Frm.,Frame End ,,,Frame Center,,,Frame End,
No. ,HH,MM,SS.SSSSSSS,HH,MM,SS.SSSS,HH,I
0,14,39,16.2703283,14,39,16.2164,14,39,16.26
1,14,39,16.3696297,14,39,16.3157,14,39,16.36
2,14,39,16.4689312,14,39,16.4150,14,39,16.46
3,14,39,16.5682327,14,39,16.5143,14,39,16.56
4,14,39,16.6675341,14,39,16.6136,14,39,16.66
5,14,39,16.7668356,14,39,16.7129,14,39,16.76
6,14,39,16.8661370,14,39,16.8122,14,39,16.86
7,14,39,16.9654385,14,39,16.9115,14,39,16.96
8,14,39,17.0647400,14,39,17.0108,14,39,17.06
9,14,39,17.1640414,14,39,17.1101,14,39,17.15
10,14,39,17.2633429,14,39,17.2094,14,39,17.25
11,14,39,17.3626444,14,39,17.3087,14,39,17.35
-0.0042893msec
Ofs=-2.1008967
Edit30
9. Apply to photometric analysis
Case A: Single point caliblation
(1) Click "Apply to Analysis" button.
(2) Close this windows. Check analyzed time.
Case B: Multiple point caliblation
If you've anlyzed accurate time head of video now..
(1) Click "Add" button => memory analyzed time.
(2) Do Photometry for 1PPS LED pulse
on the end of video stream.
(3) Open this window and analyze time.
(4) Click "Add" button => memory analyzed time.
(5) Click "Apply to Analysis" button.
(6) Close this windows. Check analyzed time.
Memory
1 00088 14:39:25.00436
2 00229 14:39:39.00617
3 00380 14:39:54.00069
4 00521 14:40:08.00210
Delete
Add
Apply to Analysis
Recorded time delays
-0.00698
Seconds.from 1PPS signal on every
10
frames.
99.30x10=993.0
1. Verification of the time PC recorded.
2. See and check above graph..
3 Change graph to LED Brightness
Variation of Recorded Time on Fram
LED Brightness
4. Polynomial fit for BKG. (if necessary)
Range for BKG
2.5
Degree of fit curve
8
5. Click above graph at a Magenta dot near front the end point of decrease.
selected frame: No.
Scale
6. Spread area of Blue dot
7. Fit to line, and obtain the
8. Check result
Mean recorded time delays
result of regression analysi
When you have collected as much data as you need, press Apply to Analysis.
When the bar graph immediately above reaches the right end, close this screen.
BKG/Frame
Star
Even
Odd
Frame
451.0
Color Value
Center Tracking
X=
47
47
Y=
110
108
FWHM
6.00
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Link
Passed-
Frame1
Frame2
Rotate
Point
Set
Clr
Set
Clr
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
3
25
Passed Point (Frame.)
Frame1
Frame2
Set
Clr
Set
Clr
Tracking
Photometry
Standard
Avoid Sunlit Face
Meteor/Lunar Limb
Direction Setting
Width
Gap
5
0
Aperture
Background
Even
Odd
Frame
Set radius to recorded
Radius
Inner
Outer
3
5
17
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
1
DShow
Frame Rate
10.070323
Field Order
Even first
Odd first
Graph
Current Object
A
B
C

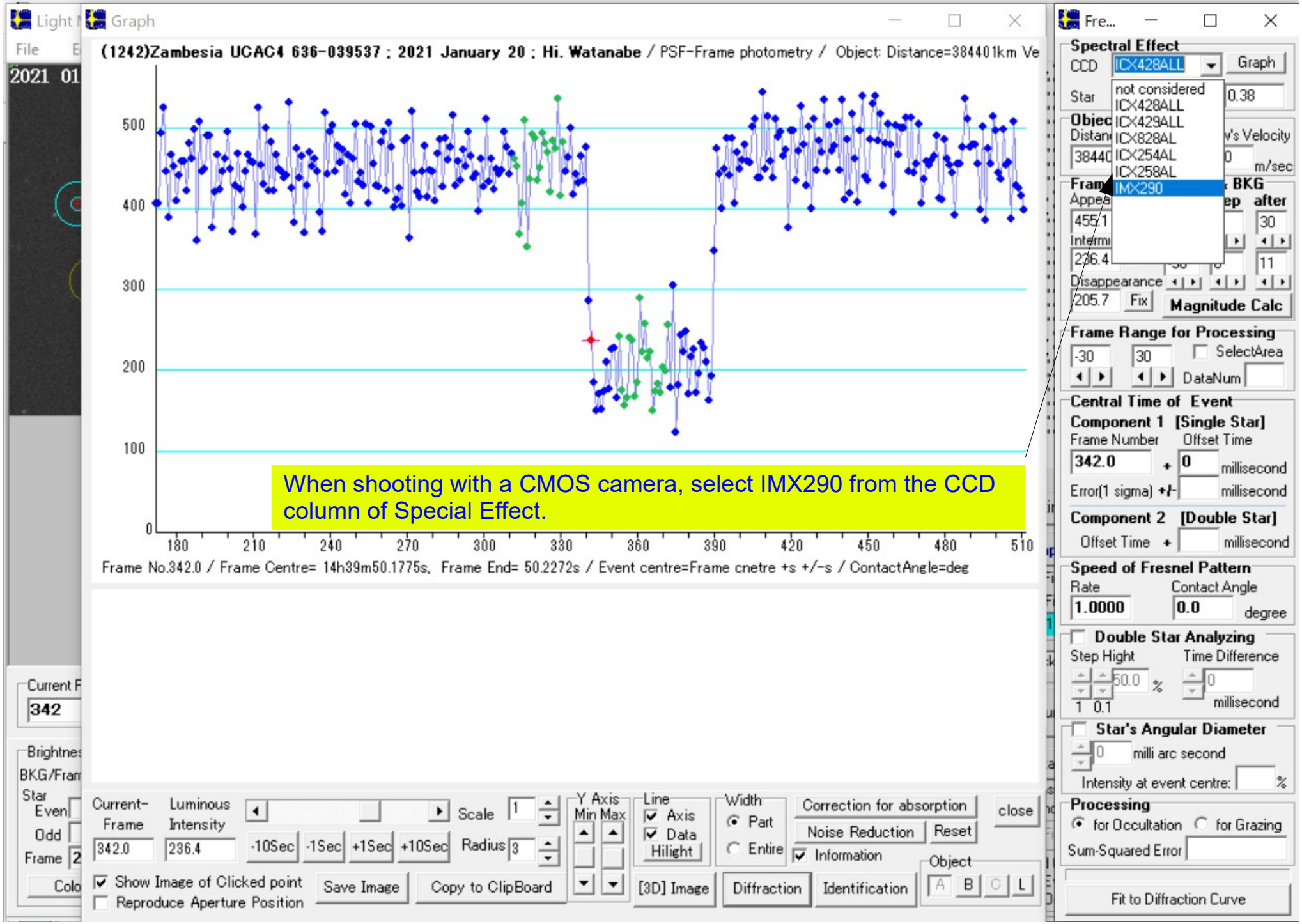

Light Measurement tool for Occultation Observation using Video Recorder [Limovie 0.9.99.5A(Aqua)-5b]
File
Edit
Option
Tools
Software Update
2021 01 20 14:40:15:752
Operation guide
Control
Hide
Show
Asteroid timing guide
Operation Guide
SharpCap Timing Analysis
More
End Time of Field Exposure (Field1=Centre of Frame)
h
m
s [Field1]
[Field2]
Threshold
S1
S2
14
40
15.6981
15.7477
80
Sharp
C:¥Users¥rockh¥Desktop¥SharpCap Captures¥20:
The date and time frame turns light blue when the time is corrected.
After confirming this, press the Graph button.
Current Frame
599
-10sec
-1sec
-1Fr
1Fr+
1sec+
10sec+
Measurement
1Frame
DEL
START
STOP
DataRemove
SaveToCSV-File
Capture
Open AVI
Load CSV
Copy CSV
Exit
Brightness
BKG/Frame
Star
Even
Odd
Frame
451.0
Color Value
Position
Center
Tracking
X=
47
47
Y=
110
108
Linked Tracking
Link
Passed-
Frame1
Frame2
Rotate
Point
Set
Clr
Set
Clr
PSF
Tracking
Photometry
Form of BKG-Area
Standard
Avoid Sunlit Face
Meteor/Lunar Limb
Direction Setting
Width
Gap
5
0
Number of Pixels / Radius
Aperture
Backgound
Even
Odd
Frame
Set radius to recorded
Radius
Inner
Outer
3
5
17
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
1
DShow
Frame Rate
10.070323
FWHM
6.00
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
3
25
Passed Point (Frame.)
Frame1
Frame2
Set
Clr
Set
Clr
Field Order
Even first
Odd first
Graph
Current Object
A
B
C


Light Measurement tool for Occultation Ob
File
Edit
Option
Tools
Software U
2021 01 20 14:40:15:752
Graph
/ PSF-Frame photometry /
500
400
300
200
100
0
0 30 60 90 120 150 180 210 240 270 300 330 360 390 420 450 480 510 540 570
Current-Frame
Luminous Intensity
-10Sec
-1Sec
+1Sec
+10Sec
Scale
1
Radius
3
Y Axis Min Max
Line
Axis
Data
Hilight
Width
Part
Entire
Correction for absorption
Noise Reduction
Reset
close
Information
Object
A
B
C
L
[3D] Image
Diffraction
Identification
Current Frame
599
To enlarge a part of the graph, click where you want to see the red dot and press Width-Part
Increase Scale value for further expansion
Brightness
BKG/Frame
Star
Even
Odd
Frame
451.0
Color Value
Position
Center
Tracking
X=
47
47
Y=
110
108
Link
Passed-
Frame1
Frame2
Rotate
Point
Set
Clr
Tracking
Photometry
Standard
Avoid Sunlit Face
Aperture
Backgound
Even
Star Image [3D]
Update Setting Items
Measurement / View Option
Interval
1
DShow
Frame Rate
10.070323
FWHM
6.00
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Star Tracking
Anchor
Drift
OFF
CSV
Estimated
Radius
Thres
3
25
Set
Clr
If correction using tracking stars is not necessary due to the influence of clouds etc., make B invisible.
5
0
3
5
17
Even first
Odd first
Graph
Current Object
A
B
C


Light Measurement tool for Occultation Ob
File
Edit
Option
Tools
Software U
2021 01 20 14:39:50:231
Graph
/ PSF-Frame photometry /
500
400
300
200
180
210
240
270
300
330
360
390
420
450
480
510
Frame No.342.0 / Frame Centre= 14h39m50.1775s, Frame End= 50.2272s
Check if the red spot is closest to the dimming point. If different, click to change.
Press the Identification button to enter the observation date, asteroid name, target star name, and observer name in the graph.
Current-Frame
Luminous Intensity
342.0
236.4
-10Sec
-1Sec
+1Sec
+10Sec
Scale
Radius
Y Axis Min Max
Line
Axis
Data
Hilight
Width
Part
Entire
Correction for absorption
Noise Reduction
Reset
close
Information
Object
A
B
C
L
Show Image of Clicked point
Save Image
Copy to ClipBoard
[3D] Image
Diffraction
Identification
Current Frame
342
-10sec
-1sec
-1Fr
Brightness
BKG/Frame
Star
Even
Odd
Frame
236.4
Color Value
Position
Center
Tracking
X=
Y=
53
53
109
108
FWHM
6.00
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
3
25
Passed Point (Frame.)
Frame1
Frame2
Set
Clr
Meteor/Lunar Limb
Direction Setting
Width
Gap
5
0
Odd Frame
Set radius to recorded
Radius
Inner
Outer
3
5
17
Star Image [3D]
Update Setting Items
Measurement / View Option
Show Field
Field Measure
Interval
1
DShow
Frame Rate
10.070323
Field Order
Even first
Odd first
Graph
Current Object
A
B
C


Light Measurement tool for Occultation Ob
File Edit Option Tools Software U
2021 01 20 14:39:50:231
Graph
(1242)Zambesia UCAC4 636-039537 ; 2021 January 20 ; Hi. Watanabe / PSF-Frame photometry /
500
400
300
200
100
0
180 210 240 270 300 330 360 390 420 450 480 510
Frame No.342.0 / Frame Centre= 14h39m50.1775s, Frame End= 50.2272s
Current= Luminous
Y Axis Line Width Correction for absorption
Identification code writer
File Edit Prediction
Y M D h m s p
Enter the observation date, asteroid name, target star name, and observer name, uncheck Detail, Auto serach, and press Apply to confirm that the graph is displayed, and then close this window.
Event date
2021 January 20
Target star: e.g. XZ 1234
(1242)Zambesia UCAC4 636-039537
Observer: e.g. J. Flamsteed
Hi. Watanabe
Save observer name to .ini file
Detail Auto search Apply
Target image
Direct to Graph From other source
Lunar distance
Shadow Velocity
Contact angle
Spectrum Type
H M S
14 39 50.1775
Graph Open Close
Apply


Light Measurement tool for Occultation Ob
File
Edit
Option
Tools
Software U
2021 01 20 14:39:50:231
Graph
(1242)Zambesia UCAC4 636-039537 ; 2021 January 20 ; Hi. Watanabe / PSF-Frame photometry /
500
400
300
200
100
0
180
210
240
270
300
330
360
390
420
450
480
510
Frame No.342.0 / Frame Centre= 14h39m50.1775s, Frame End= 50.2272s
Current-Frame
342.0
Luminous Intensity
236.4
-10Sec
-1Sec
+1Sec
+10Sec
Scale
1
Radius
3
Y Axis Min Max
Line
Axis
Data
Hilight
Width
Part
Entire
Correction for absorption
Noise Reduction
Reset
close
Information
Object
A
B
C
L
Show Image of Clicked point
Reproduce Aperture Position
Save Image
Copy to ClipBoard
[3D] Image
Diffraction
Identification
Current Frame
342
-10sec
-1sec
-1Fr
Brightness
BKG/Frame
Star
Even
Odd
Frame
236.4
Color Value
Position
Center Tracking
X=
53
53
Y=
109
108
Linked Tracking
Link
Rotate
Passed-Point
Frame1
Frame2
Set
Clr
FWHM
6.00
Fixed
Position Set
Star
Signal1
Signal2
TIVi
Star Tracking
Anchor
Drift
OFF
CSV
Estimated track
Radius
Threshold
3
25
Passed Point (Frame.)
Meteor/Lunar Limb
Direction Setting
Width
Gap
5
0
Odd
Frame
Set radius to recorded
Radius
Inner
Outer
3
5
17
Show Field
Field Measure
Interval
1
DShow
Frame Rate
10.070323
Field Order
Even first
Odd first
Graph
Current Object
A
B
C
Press Diffraction button to perform diffraction simulation

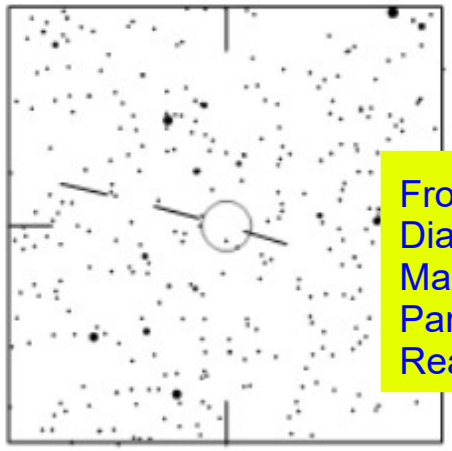

Graph
(1242)Zambesia UCAC4 636-039537 ; 2021 January 20 ; Hi. Watanabe / PSF-Frame photometry / Object: Distance=384401km Ve
500
400
300
200
100
0
180
210
240
270
300
330
360
390
420
450
480
510
Frame No.342.0 / Frame Centre= 14h39m50.1775s, Frame End= 50.2272s / Event centre=Frame cnetre +s +/-s / ContactAngle=deg
When shooting with a CMOS camera, select IMX290 from the CCD column of Special Effect.
Spectral Effect
CCD
ICX428ALL
Graph
not considered
ICX428ALL
ICX429ALL
ICX828AL
ICX254AL
ICX258AL
IMX290
Star
0.38
m/sec
Disappearance
205.7
Fix
Magnitude Calc
Frame Range for Processing
-30
30
SelectArea
DataNum
Central Time of Event
Component 1 [Single Star]
Frame Number
Offset Time
342.0
0
millisecond
Error(1 sigma) +/-
millisecond
Component 2 [Double Star]
Offset Time
millisecond
Speed of Fresnel Pattern
Rate
Contact Angle
1.0000
0.0
degree
Double Star Analyzing
Step Hight
Time Difference
50.0
%
millisecond
Star's Angular Diameter
milli arc second
Intensity at event centre:
%
Processing
for Occultation
for Grazing
Sum-Squared Error
Fit to Diffraction Curve
Current-Frame
Luminous Intensity
342.0
236.4
-10Sec
-1Sec
+1Sec
+10Sec
Scale
Radius
Show Image of Clicked point
Reproduce Aperture Position
Save Image
Copy to ClipBoard
Y Axis
Min Max
Line
Axis
Data
Hilight
Width
Part
Entire
Correction for absorption
Noise Reduction
Reset
Information
close
Object
A
B
C
L
[3D] Image
Diffraction
Identification

1242 Zambesia occults UCAC4 636-039537 on 2021 Jan 20 from 14h 30m to 14h 52m UT

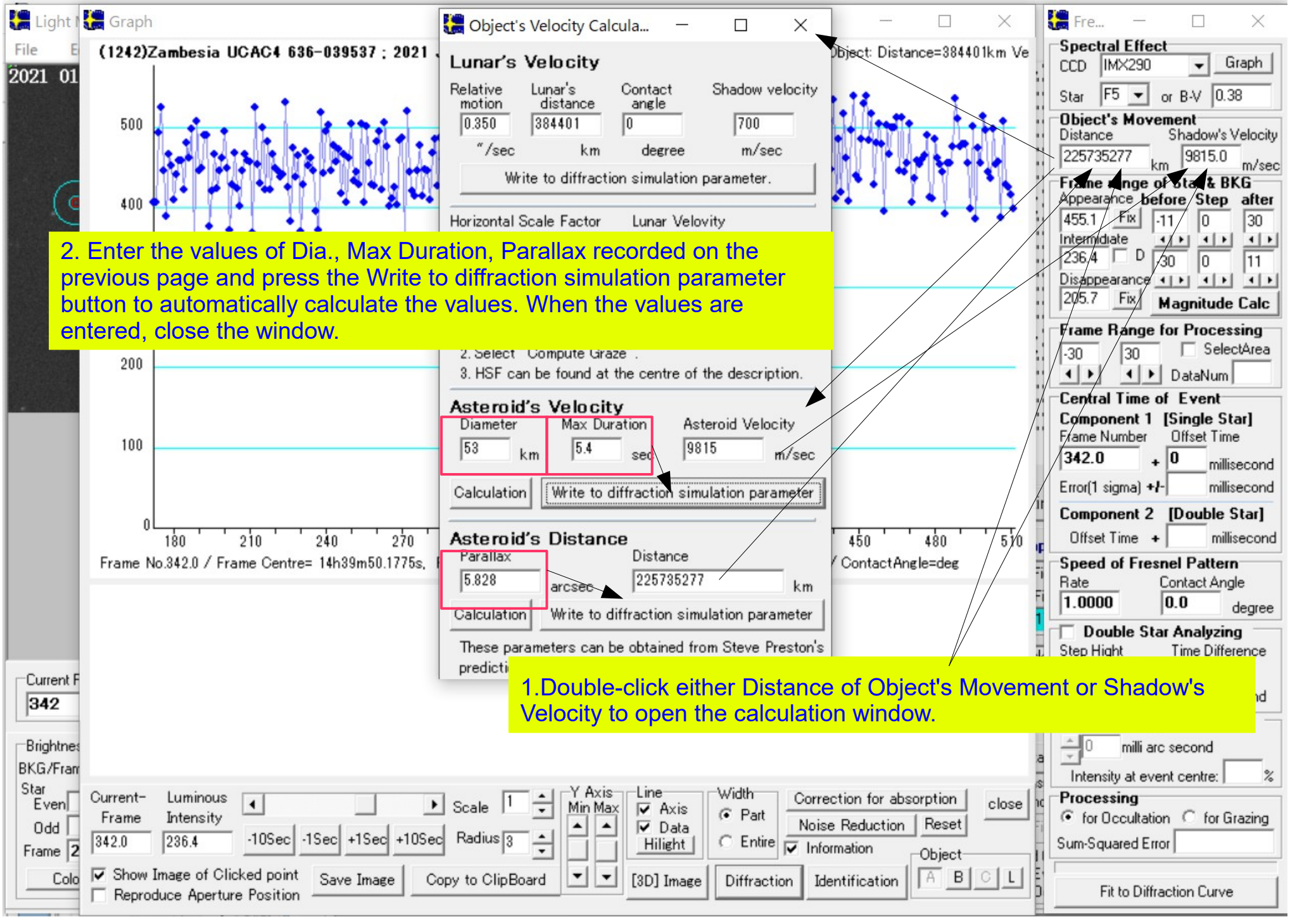
```
Star:            Dia < 0.1 mas
 Mv 13.5; Mb 14.4; Mr 12.9
 RA =  7  2 55.6086 (astrometric)
Dec =  37  4 52.396    ...
[of Date:  7  4 21,  37  2 59]
  Prediction of 2021 Jan 17.0
Reliable not available
```

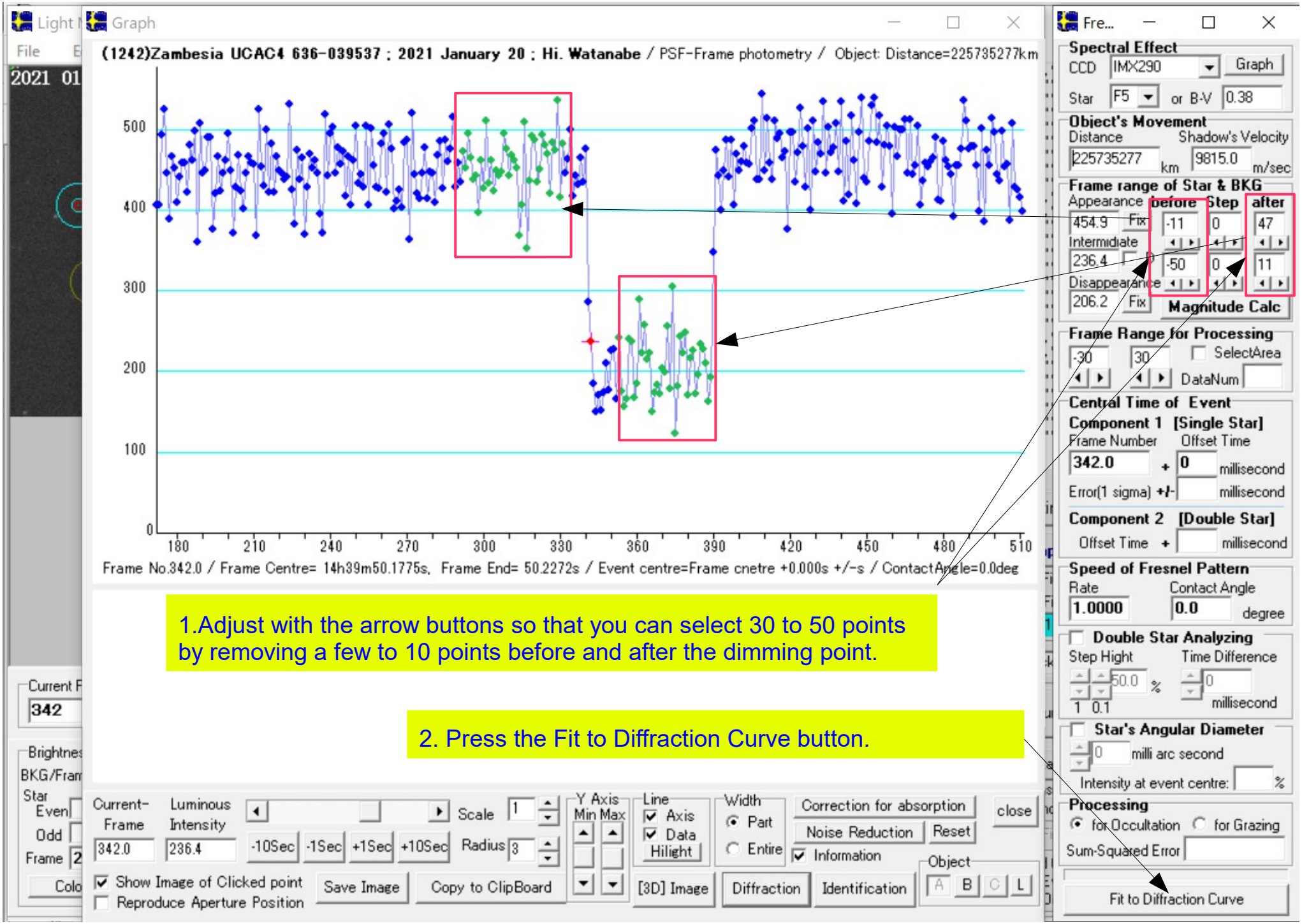
```
Max Duration =  5.4 secs
    Mag Drop =  1.0 (1.0r)
Sun :   Dist = 157°
Moon:   Dist =  77°
     :  illum = 47 %
E 0.047"x 0.047" in PA 90
```

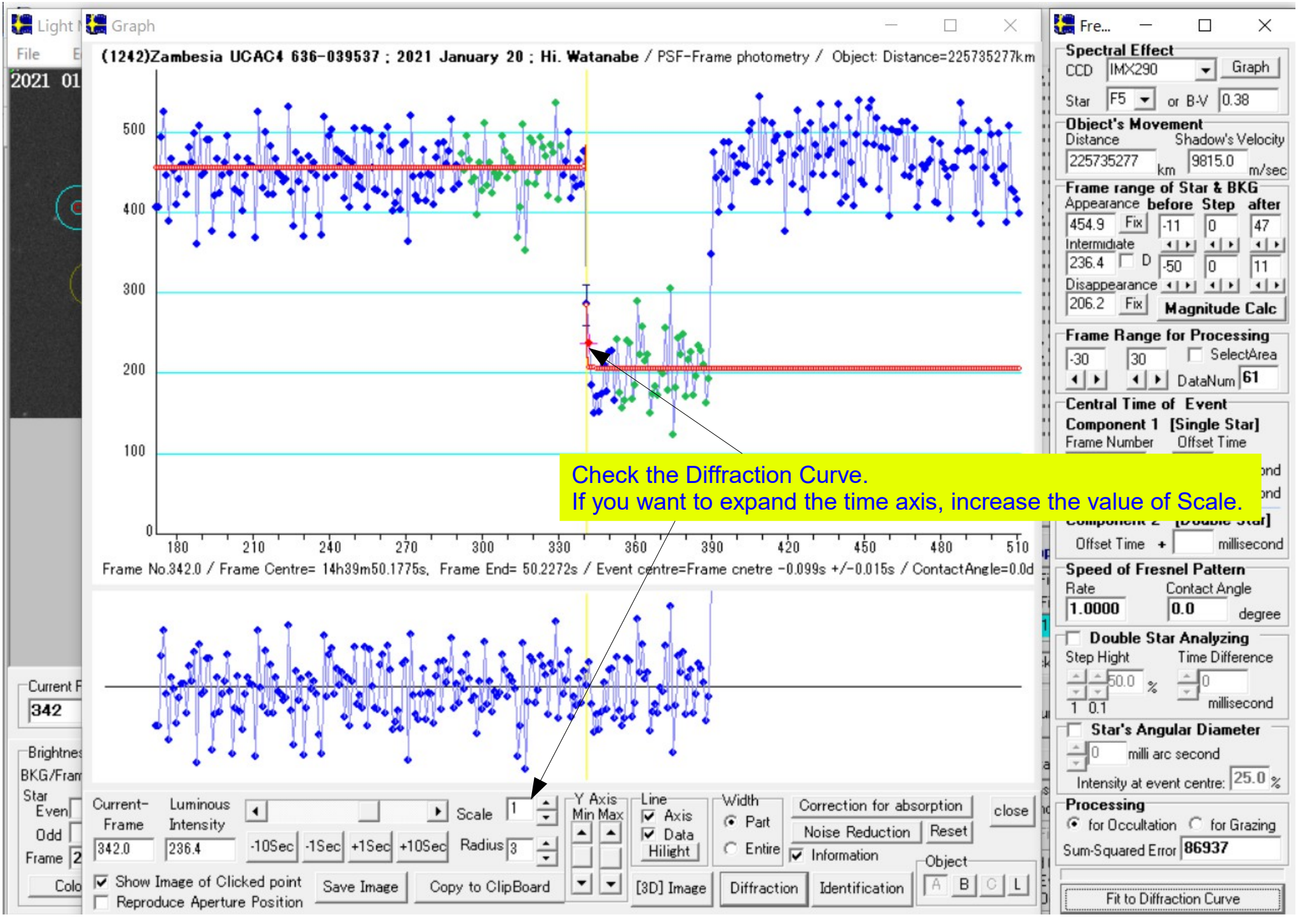
```
Asteroid:
  Mag = 13.8
  Dia =  53 ±3km, 0.048"
Parallax = 5.828"
Hourly dRA =-2.553s
  dDec = -8.68"
JPL2021/01/17, Star+PeakEphemUncert
```



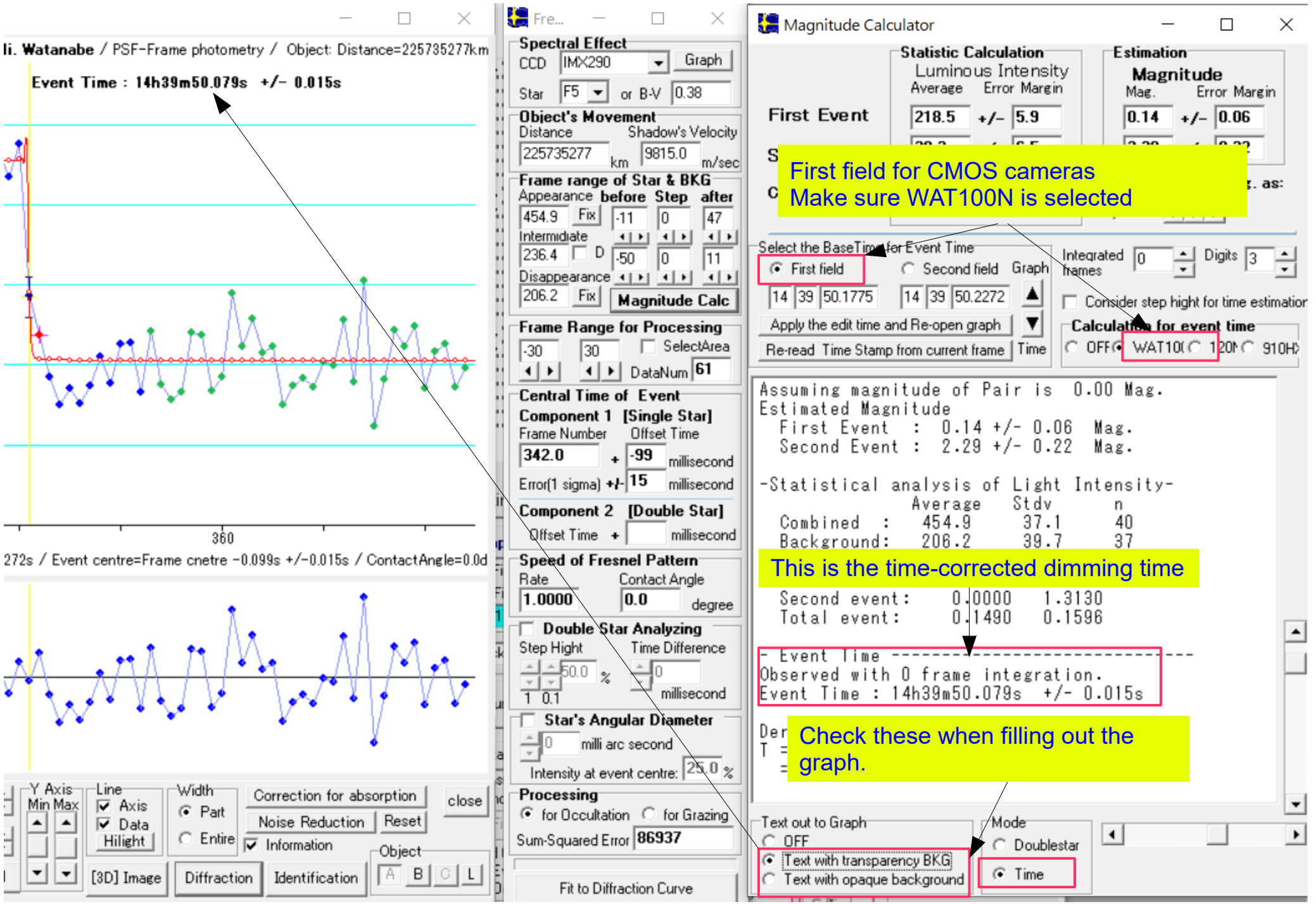
From Preston's forecast and Occult's forecast screen
Dia.
Max Duration
Parallax
Read the data.


Graph
(1242)Zambesia UCAC4 636-039537 : 2021
Object's Velocity Calcula...
Lunar's Velocity
Relative motion
Lunar's distance
Contact angle
Shadow velocity
0.350
384401
0
700
"/sec
km
degree
m/sec
Write to diffraction simulation parameter.
Horizontal Scale Factor
Lunar Velocity
2. Select "Compute Graze".
3. HSF can be found at the centre of the description.
Asteroid's Velocity
Diameter
Max Duration
Asteroid Velocity
53
km
5.4
sec
9815
m/sec
Calculation
Write to diffraction simulation parameter
Asteroid's Distance
Parallax
Distance
5.828
arcsec
225735277
km
Calculation
Write to diffraction simulation parameter
These parameters can be obtained from Steve Preston's
Frame No.342.0 / Frame Centre= 14h39m50.1775s,
/ ContactAngle=deg
Spectral Effect
CCD
IMX290
Graph
Star
F5
or B-V
0.38
Object's Movement
Distance
Shadow's Velocity
225735277
km
9815.0
m/sec
Frame Range of Star & BKG
Appearance
before
Step
after
455.1
Fix
-11
0
30
Intermidiate
236.4
D
-30
0
11
Disappearance
205.7
Fix
Magnitude Calc
Frame Range for Processing
-30
30
SelectArea
DataNum
Central Time of Event
Component 1 [Single Star]
Frame Number
Offset Time
342.0
+
0
millisecond
Error(1 sigma) +/-
millisecond
Component 2 [Double Star]
Offset Time
+
millisecond
Speed of Fresnel Pattern
Rate
Contact Angle
1.0000
0.0
degree
Double Star Analyzing
Step Hight
Time Difference
milli arc second
Intensity at event centre:
%
Processing
for Occultation
for Grazing
Sum-Squared Error
Fit to Diffraction Curve
Current-Frame
Luminous Intensity
342.0
236.4
-10Sec
-1Sec
+1Sec
+10Sec
Scale
1
Radius
3
Y Axis
Min
Max
Line
Axis
Data
Hilight
Width
Part
Entire
Correction for absorption
Noise Reduction
Reset
Information
close
Object
A
B
C
L
Show Image of Clicked point
Reproduce Aperture Position
Save Image
Copy to ClipBoard
[3D] Image
Diffraction
Identification
2. Enter the values of Dia., Max Duration, Parallax recorded on the previous page and press the Write to diffraction simulation parameter button to automatically calculate the values. When the values are entered, close the window.
1.Double-click either Distance of Object's Movement or Shadow's Velocity to open the calculation window.


Graph
(1242)Zambesia UCAC4 636-039537 ; 2021 January 20 ; Hi. Watanabe / PSF-Frame photometry / Object: Distance=225735277km
Frame No.342.0 / Frame Centre= 14h39m50.1775s, Frame End= 50.2272s / Event centre=Frame cnetre +0.000s +/-s / ContactAngle=0.0deg
1.Adjust with the arrow buttons so that you can select 30 to 50 points by removing a few to 10 points before and after the dimming point.
2. Press the Fit to Diffraction Curve button.
Spectral Effect
Object's Movement
Frame range of Star & BKG
Frame Range for Processing
Central Time of Event
Component 1 [Single Star]
Component 2 [Double Star]
Speed of Fresnel Pattern
Double Star Analyzing
Star's Angular Diameter
Processing
Magnitude Calc
Fit to Diffraction Curve
Show Image of Clicked point
Reproduce Aperture Position
Save Image
Copy to ClipBoard
Diffraction
Identification
[3D] Image
Correction for absorption
Noise Reduction
Reset
close


Graph
(1242)Zambesia UCAC4 636-039537 ; 2021 January 20 ; Hi. Watanabe / PSF-Frame photometry / Object: Distance=225735277km
Frame No.342.0 / Frame Centre= 14h39m50.1775s, Frame End= 50.2272s / Event centre=Frame cnetre -0.099s +/-0.015s / ContactAngle=0.0d
Check the Diffraction Curve.
If you want to expand the time axis, increase the value of Scale.
Spectral Effect
Object's Movement
Frame range of Star & BKG
Frame Range for Processing
Central Time of Event
Speed of Fresnel Pattern
Double Star Analyzing
Star's Angular Diameter
Processing
Magnitude Calc
Fit to Diffraction Curve


Graph
(1242)Zambesia UCAC4 636-039537 ; 2021 January 20 ; Hi. Watanabe / PSF-Frame photometry / Object: Distance=225735277km
The range of vertical line is the error of light intensity +/-1σ
Horizontal line range is time error +/- 1σ
Yellow line is the estimated dimming time
1. Press the Magnitude Calc button to know the estimated dimming time.
Frame No.342.0 / Frame Centre= 14h39m50.1775s, Frame End=
Spectral Effect
CCD IMX290
Graph
Star F5
or B-V 0.38
Object's Movement
Distance
Shadow's Velocity
225735277 km
9815.0 m/sec
Frame range of Star & BKG
before Step after
Disappearance
206.2 Fix
Magnitude Calc
Frame Range for Processing
SelectArea
DataNum 61
Central Time of Event
Component 1 [Single Star]
Frame Number
Offset Time
342.0
-99 millisecond
Error(1 sigma) +/- 15 millisecond
Component 2 [Double Star]
Offset Time + millisecond
Speed of Fresnel Pattern
Rate
Contact Angle
1.0000
0.0 degree
Double Star Analyzing
Step Hight
Time Difference
50.0 %
millisecond
Star's Angular Diameter
milli arc second
Intensity at event centre: 25.0 %
Processing
for Occultation
for Grazing
Sum-Squared Error 86937
Fit to Diffraction Curve
Current-Frame
Luminous Intensity
342.0
236.4
-10Sec -1Sec +1Sec +10Sec
Scale 4
Radius 3
Y Axis Min Max
Line Axis Data Hilight
Width Part Entire
Correction for absorption
Noise Reduction
Reset
Information
close
Object A B C L
Show Image of Clicked point
Reproduce Aperture Position
Save Image
Copy to ClipBoard
[3D] Image
Diffraction
Identification


First field for CMOS cameras
Make sure WAT100N is selected
This is the time-corrected dimming time
Check these when filling out the graph.
Magnitude Calculator
Statistic Calculation
Luminous Intensity
Estimation
Magnitude
First Event
Select the BaseTime for Event Time
First field
Second field
Graph
Integrated frames
Digits
Consider step hight for time estimation
Calculation for event time
Apply the edit time and Re-open graph
Re-read Time Stamp from current frame
Time
Assuming magnitude of Pair is 0.00 Mag.
Estimated Magnitude
First Event : 0.14 +/- 0.06 Mag.
Second Event : 2.29 +/- 0.22 Mag.
-Statistical analysis of Light Intensity-
Combined : 454.9 37.1 40
Background: 206.2 39.7 37
Second event: 0.0000 1.3130
Total event: 0.1490 0.1596
Event Time
Observed with 0 frame integration.
Event Time : 14h39m50.079s +/- 0.015s
Text out to Graph
OFF
Text with transparency BKG
Text with opaque background
Mode
Doublestar
Time
Spectral Effect
CCD
IMX290
Graph
Star
F5
or B-V
0.38
Object's Movement
Distance
Shadow's Velocity
225735277
km
9815.0
m/sec
Frame range of Star & BKG
Appearance
before
Step
after
Intermidiate
Disappearance
Magnitude Calc
Frame Range for Processing
SelectArea
DataNum
61
Central Time of Event
Component 1 [Single Star]
Frame Number
Offset Time
342.0
-99
millisecond
Error(1 sigma) +/-
15
millisecond
Component 2 [Double Star]
Offset Time
Speed of Fresnel Pattern
Rate
Contact Angle
1.0000
0.0
degree
Double Star Analyzing
Step Hight
Time Difference
Star's Angular Diameter
milli arc second
Intensity at event centre:
Processing
for Occultation
for Grazing
Sum-Squared Error
86937
Fit to Diffraction Curve
li. Watanabe / PSF-Frame photometry / Object: Distance=225735277km
Event Time : 14h39m50.079s +/- 0.015s
360
272s / Event centre=Frame cnetre -0.099s +/-0.015s / ContactAngle=0.0d
Y Axis
Min Max
Line
Axis
Data
Hilight
Width
Part
Entire
Correction for absorption
Noise Reduction
Reset
Information
close
Object
[3D] Image
Diffraction
Identification