



# IOTA/ES Workshop

# QHY 174M GPS

2020 February 29

Archenhold-Sternwarte Berlin

Local Organising Team: Konrad Guhl, Christian Weber, Nikolai Wünsche | all IOTA/ES

# Agenda

11.00 Welcome

## Part 1: Introduction to basic use

11.10 Presentation and live demonstration

12.00 Workshop on your own computer

13.00 Lunch break

## Part 2: Introduction to advanced use

13.30 Presentation and live demonstration

14.15 Workshop on your own computer

15.45 Wrap up and outlook

16.00 End of workshop





IOTA/ES Workshop

# QHY 174M GPS

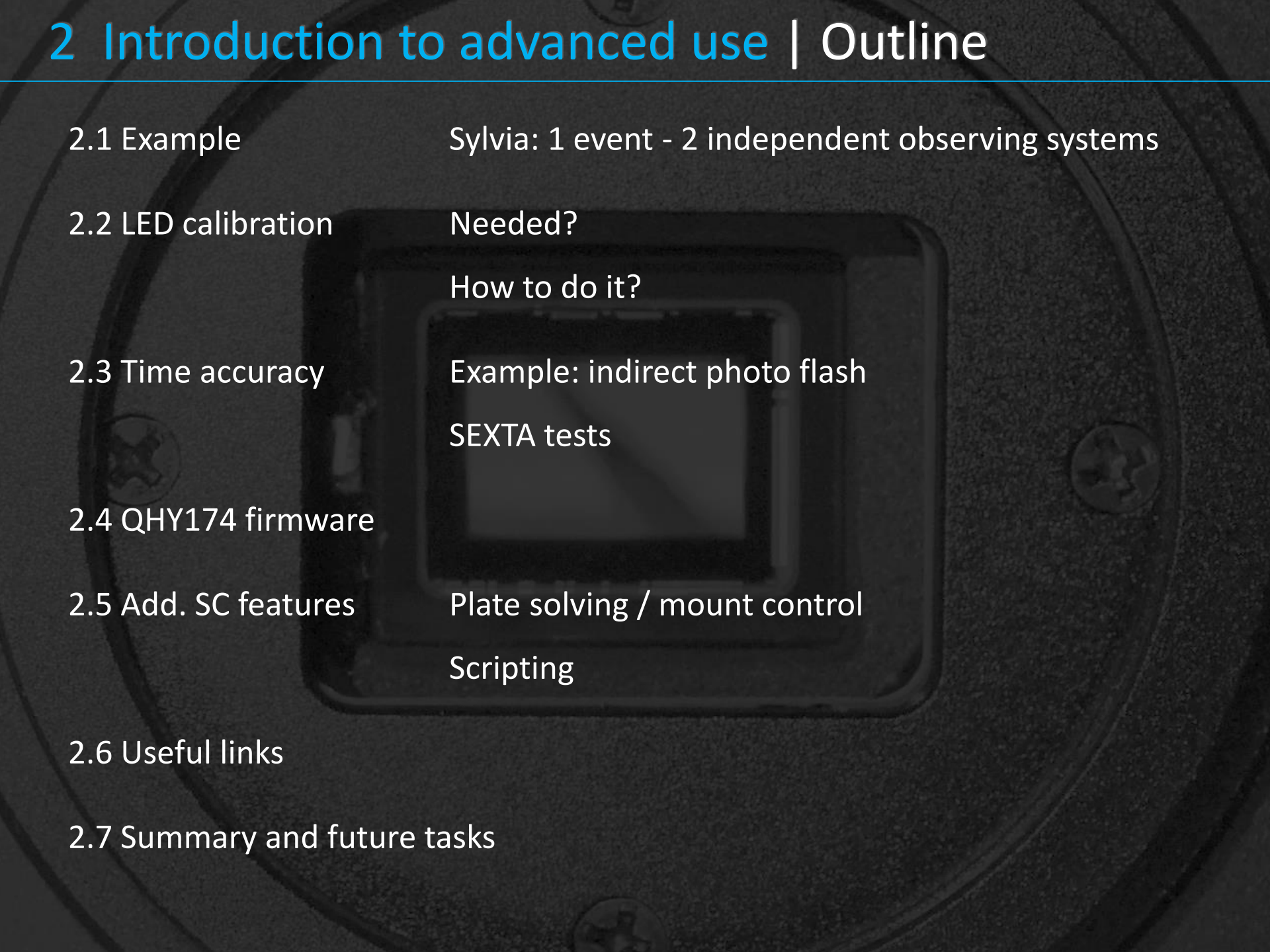
## 2 Introduction to Advanced Use

2020 February 29

Archenhold-Sternwarte Berlin

Christian Weber | IOTA/ES

## 2 Introduction to advanced use | Outline

- 
- 2.1 Example                      Sylvia: 1 event - 2 independent observing systems
  - 2.2 LED calibration            Needed?  
How to do it?
  - 2.3 Time accuracy              Example: indirect photo flash  
SEXTA tests
  - 2.4 QHY174 firmware
  - 2.5 Add. SC features            Plate solving / mount control  
Scripting
  - 2.6 Useful links
  - 2.7 Summary and future tasks

# 2.1 Example | Sylvia: 1 event - 2 independent observing systems

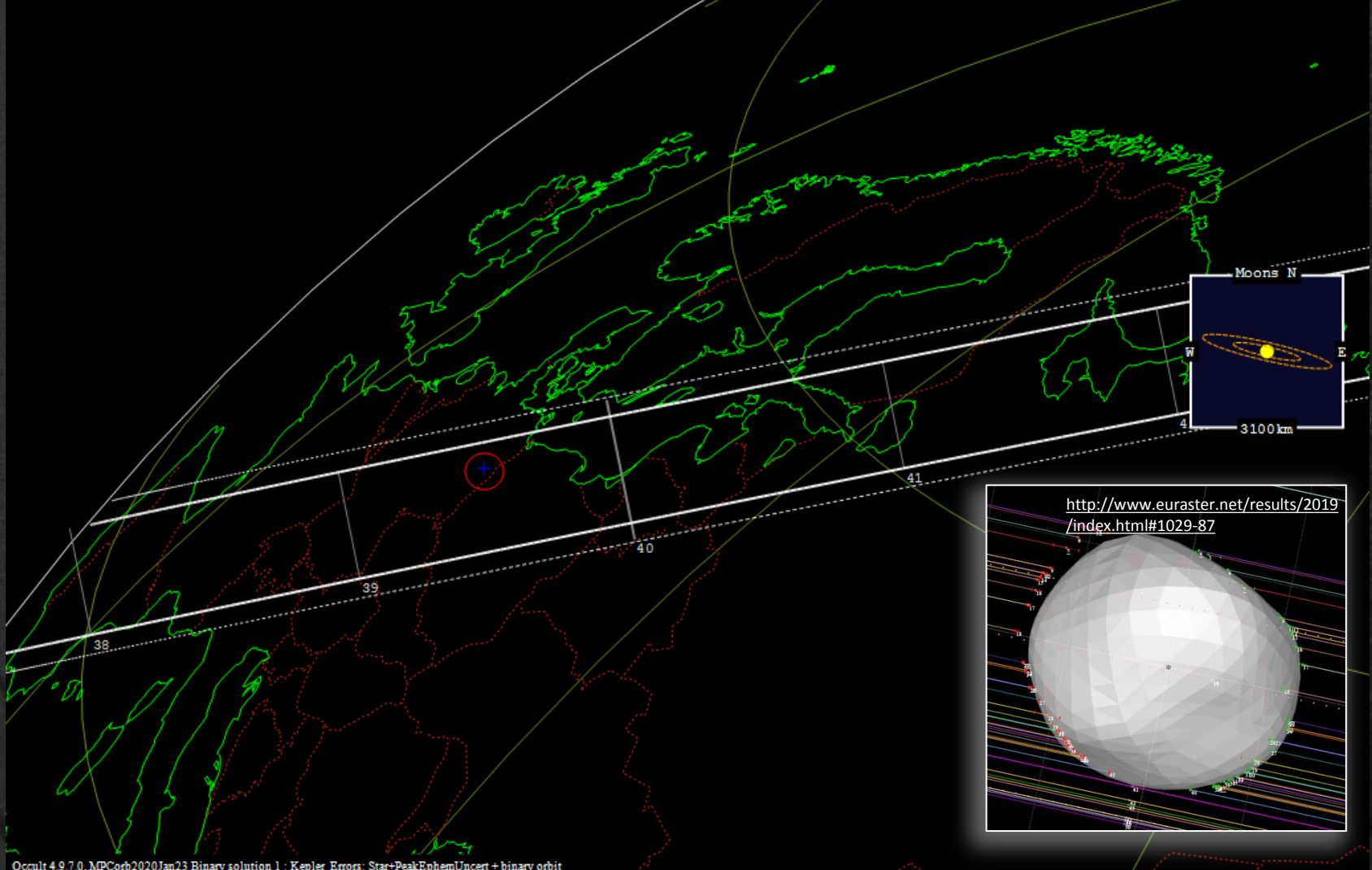
87 Sylvia #1 occults TYC 1932-00469-1 on 2019 Oct 29 from 23h 37m to 23h 49m UT

Star:  
Mag V = 9.9; B = 10.7; R = 9.5  
RA = 8 21 1.7487 (BCRS)  
Dec = 25 57 43.126  
[of Date: 8 22 12, 25 53 53]  
Prediction of 2020 Feb 15.0

Max Duration = 23.0 secs  
Mag Drop = 3.3 (3.3r)  
Sun : Dist = 95°  
Moon: Dist = 119°  
: illum = 5 %  
E 0.020"x 0.019" in PA 90

Asteroid: (in DAMIT, ISAM)  
Mag = 13.2  
Dia = 286km, 0.114"  
Parallax = 2.544"  
Hourly dRA = 1.296s  
dDec = 3.53"

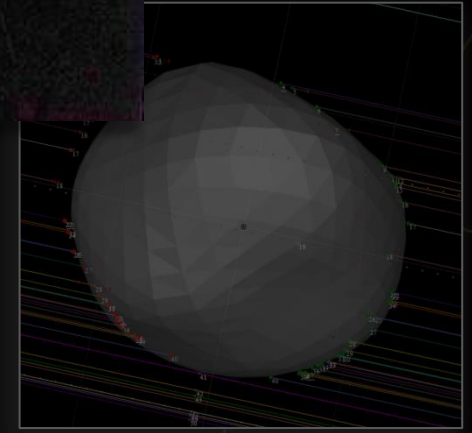
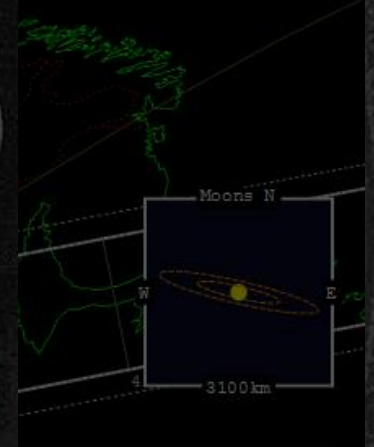
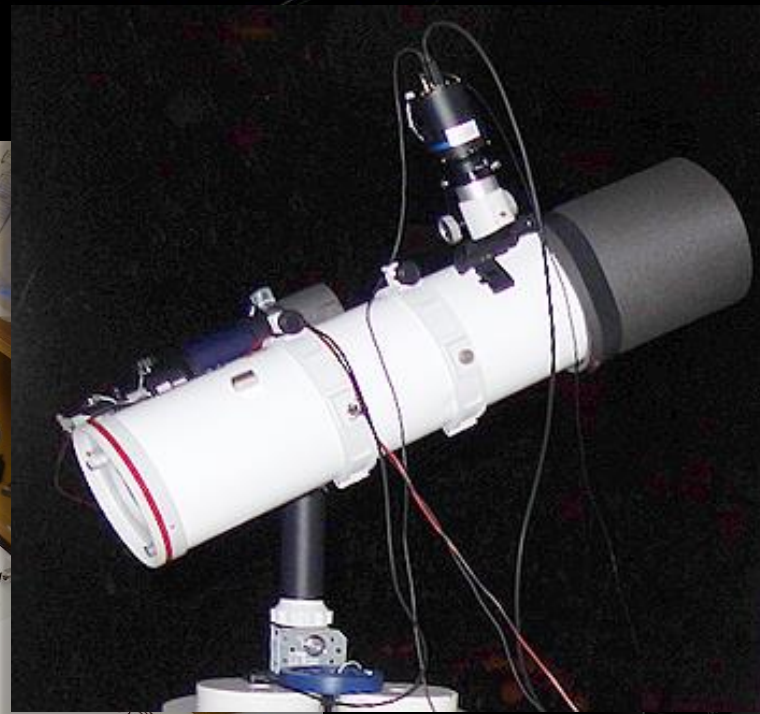
2 moons. {Romulus} 11km at 1351km, Period 3.654days, {Remus} 11km at 702km, Period 1.373days Orbit@Miriade



# 2.1 Example | Sylvia: 1 event - 2 independent observing systems

```
87 Sylvia #1 occults TYC 1932-00469-1 on 2019 Oct 29 from 23h 37m to 23h 49m UT
Star:
Mag V = 9.9; B = 10.7; R = 9.5
RA = 228 21 1.7487 (BCRS)
Dec = 25 57 43.126
[of Date: 8 22 12, 25 53 53]
Prediction of 2020 Feb 15.0
Max Duration = 23.0 secs
Mag Drop = 3.3r
Sun : Dist = 110000000
Moon: Dist = 110000000
illum = 0.999999999
E 0.020"x 0.019" in PA 90
Asteroid: (in DAMIT, ISAM)
Mag = 13.2
Dia = 386km, 0.114"
Parallax = 0.644"
Hourly dRA = 1.296s
dDec = 3.53"
```

2 moons. (Romulus) 11km at 1351km, Period 3.654days, (Remus) 11km at 702km, Period 1.373days Orbit@Miriade



# 2.1 Example | Sylvia: 1 event - 2 independent observing systems

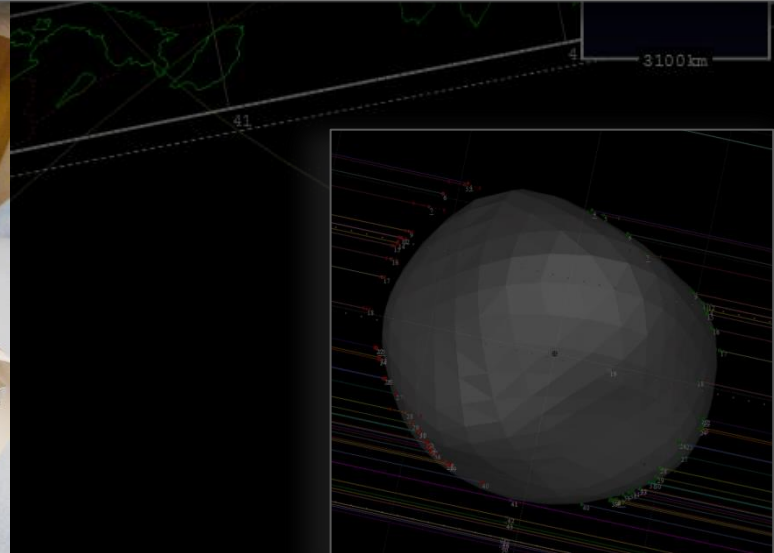
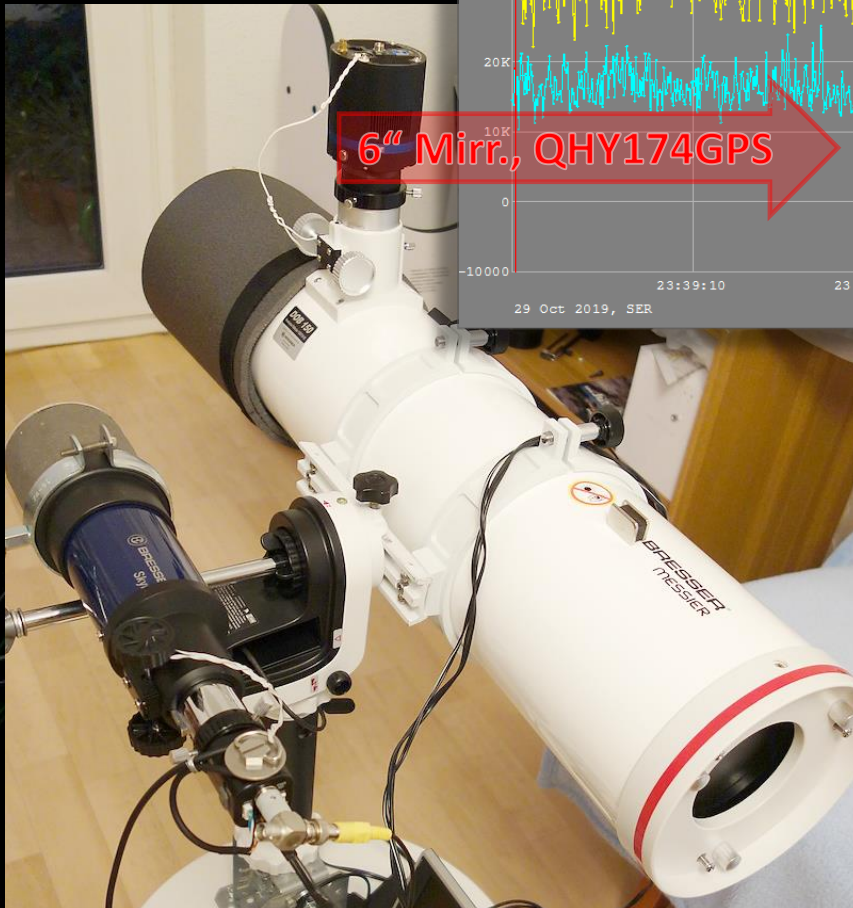
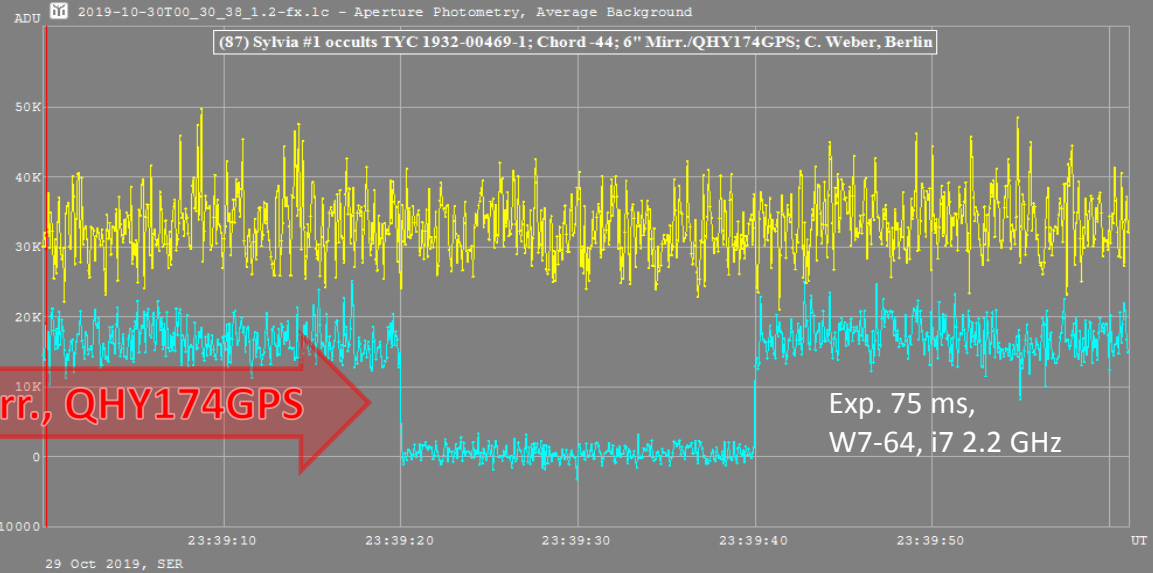
87 Sylvia #1 occults TYC 1932-00469-1 on 2019 Oct 29 from 23h 37m to 23h 49m UT

Star:  
Mag V = 9.9; B = 10.7; R = 9.5  
RA = 21 1 7487 (BCRS)  
Dec = 57 43 126  
[of Date: 8 22 12, 25 53 53]  
Prediction of 2020 Feb 15.0

Max Duration = 23.0 secs

Asteroid: (in DAMIT, ISAM)

2 moons. (Romulus) 11km at 1351km, Period 3.



# 2.1 Example | Sylvia: 1 event - 2 independent observing systems

87 Sylvia #1 occults TYC 1932-00469-1 on 2019 Oct 29 from 23h 37m to 23h 49m UT

Star:  
Mag V = 9.9; B = 10.7; R = 9.5  
RA = 21 1 7487 (BCRS)  
Dec = 25 57 43.126  
[of Date: 8 22 12, 25 53 53]  
Prediction of 2020 Feb 15.0

Max Duration = 23.0 secs

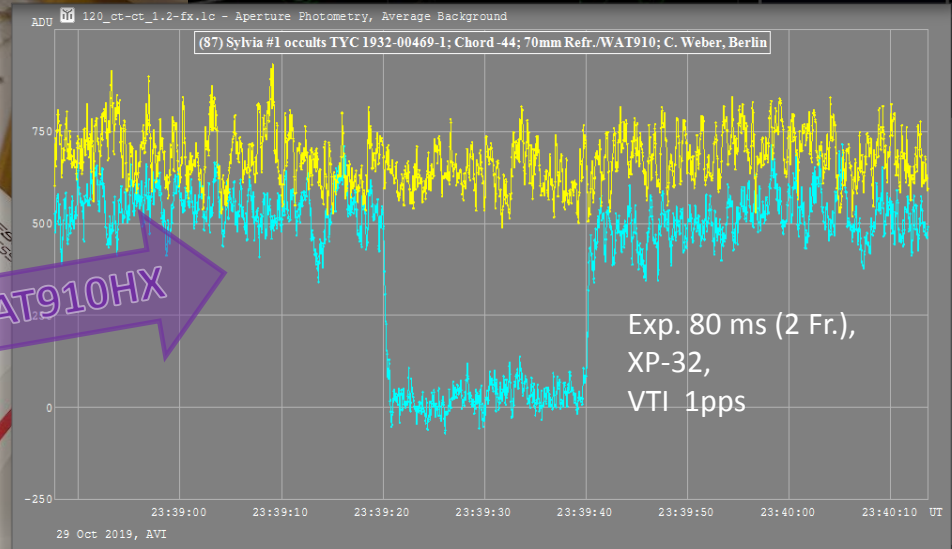
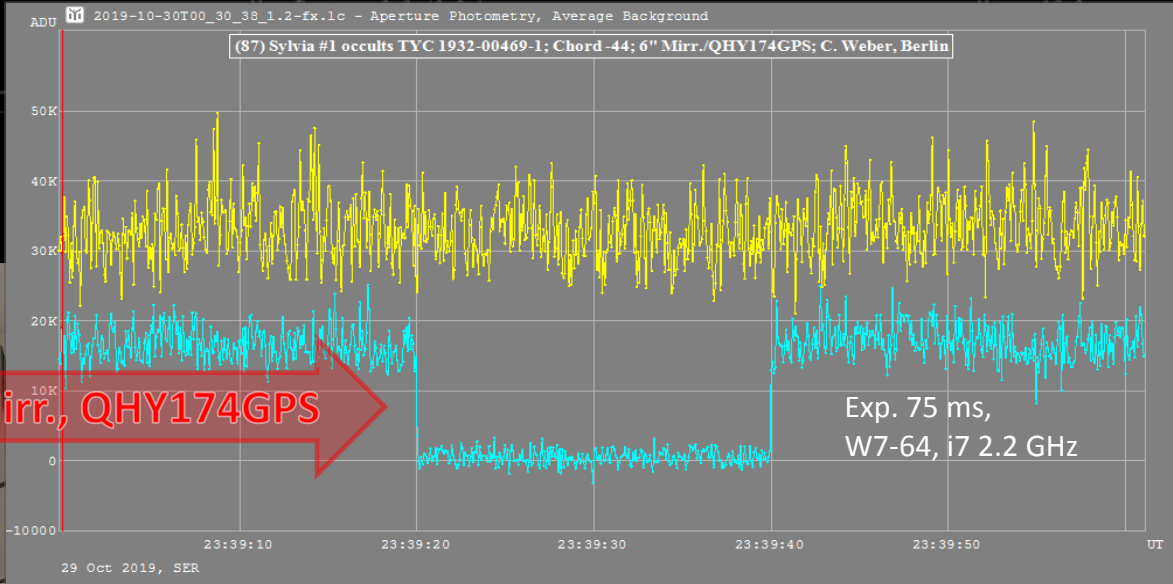
Asteroid: (in DAMIT, ISAM)

2 moons. (Romulus) 11km at 1351km, Period 3.



6" Mirr., QHY174GPS

70/280 Refr., WAT910HX

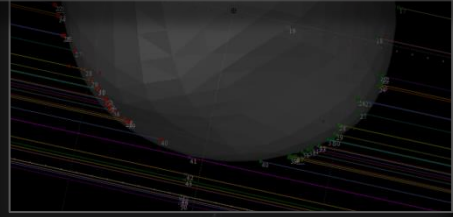
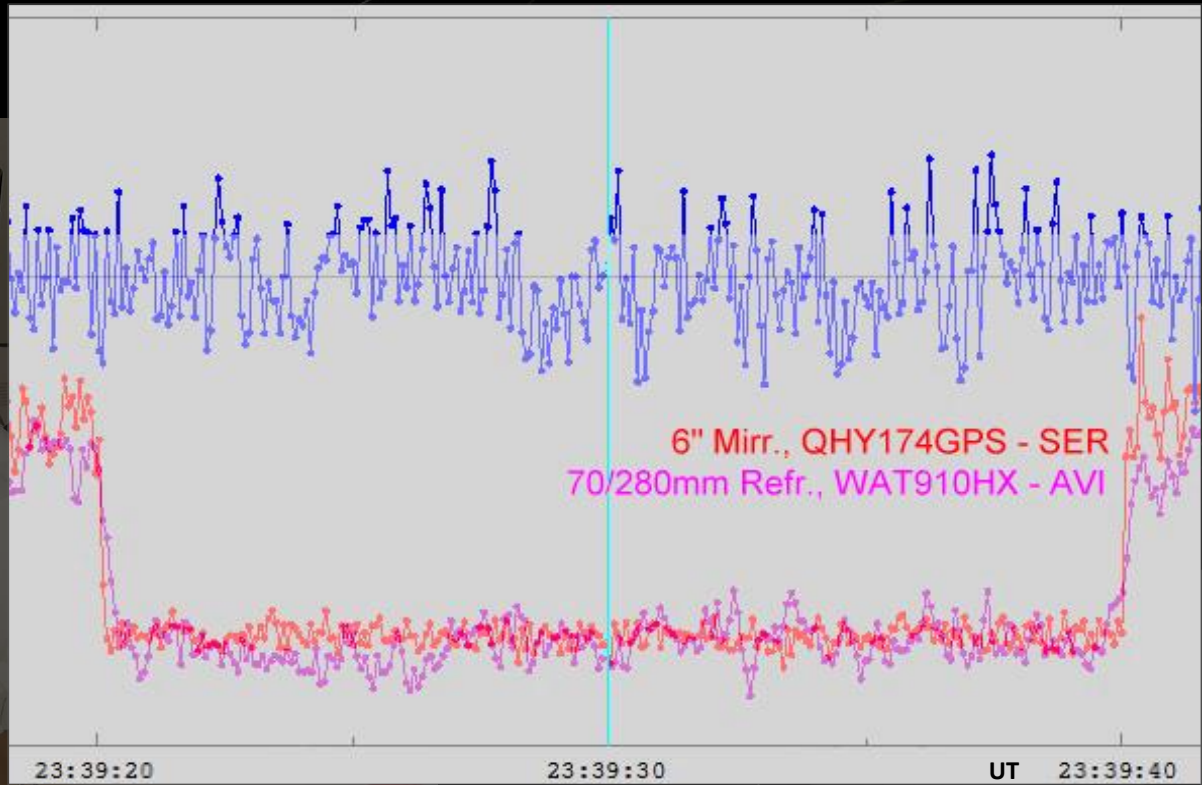
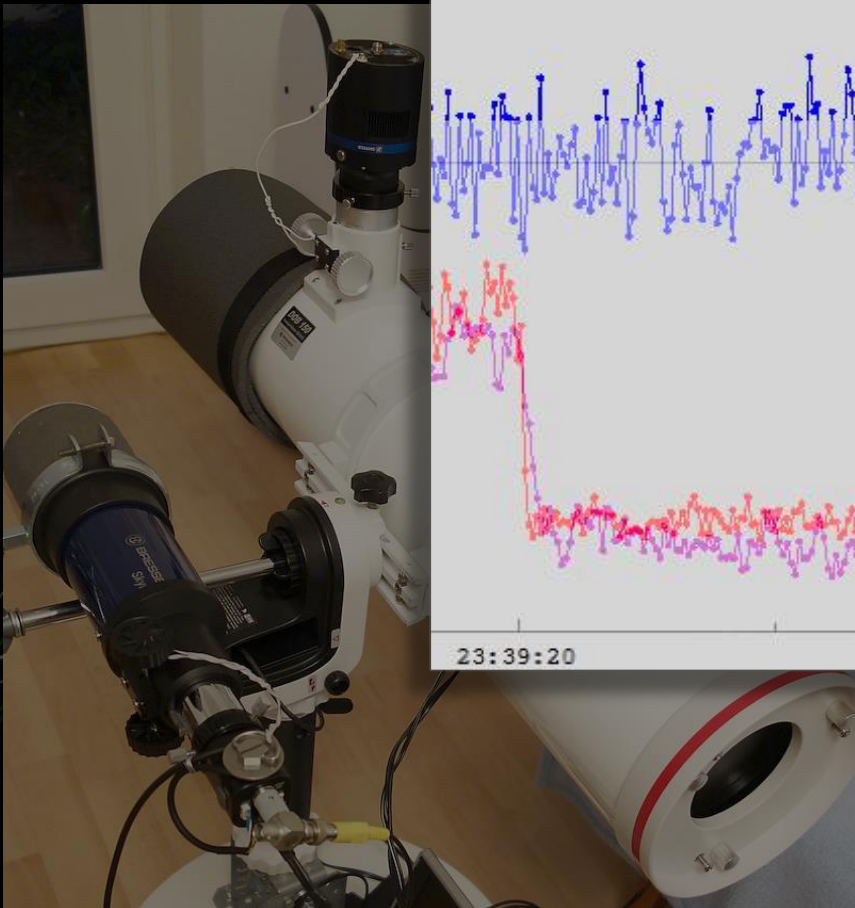




# 2.1 Example | Sylvia: 1 event - 2 independent observing systems

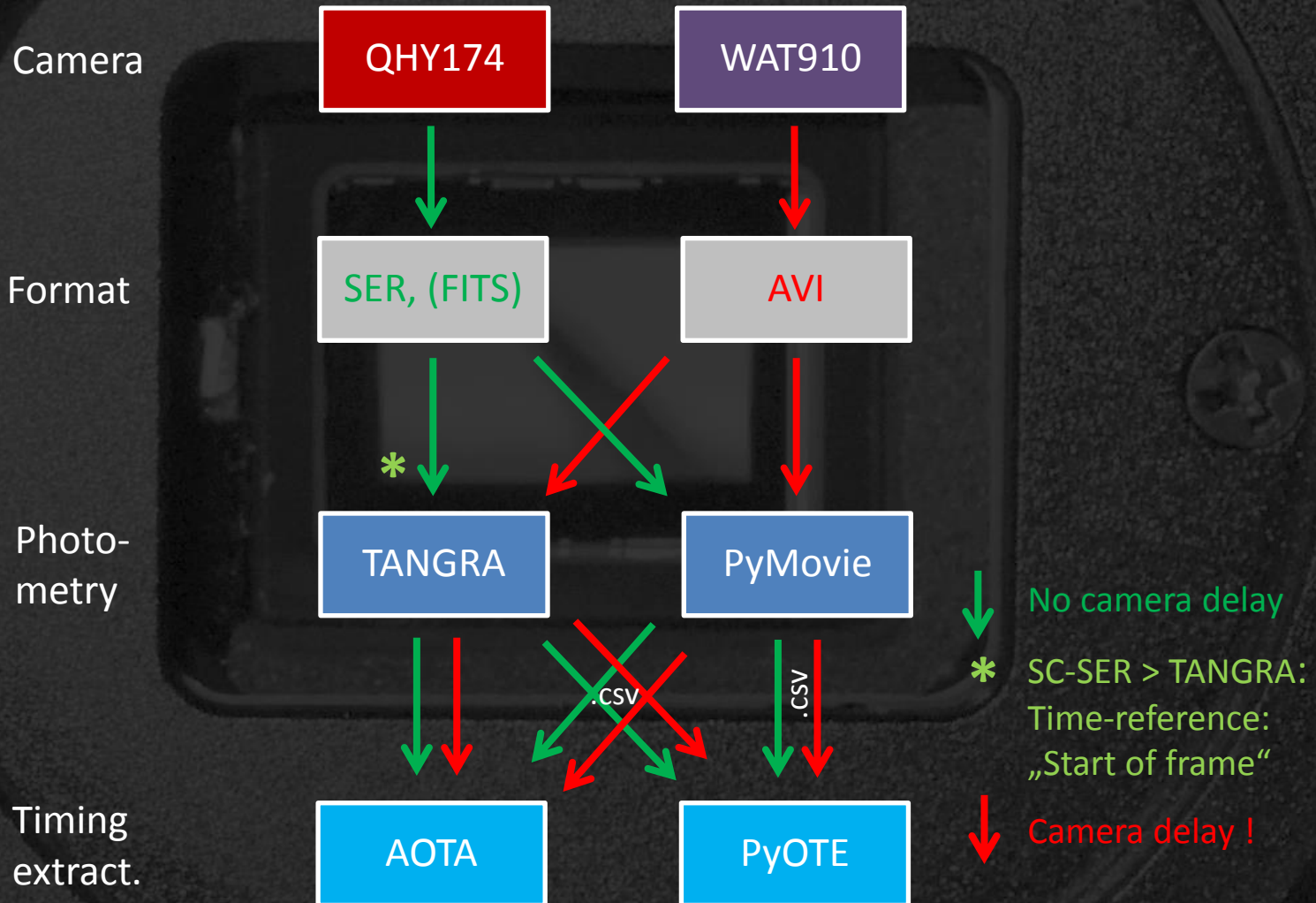
```
87 Sylvia #1 occults TYC 1932-00469-1 on 2019 Oct 29 from 23h 37m to 23h 49m UT
Star:
Mag V = 9.9; B = 10.7; R = 9.5
RA = 225 21 1.7487 (BCRS)
Dec = 25 57 43.126
[of Date: 8 22 12, 25 53 53]
Prediction of 2020 Feb 15.0
Max Duration = 23.0 secs
Mag Drop = 3.3r
Sun : Dist = 149.600 AU
Moon: Dist = 384.400 km
illum = 99.9%
E 0.020"x 0.019" in PA 90
Asteroid: (in DAMIT, ISAM)
Mag = 13.2
Dia = 386km, 0.114"
Parallax = 1.2964"
Hourly dRA = 1.2964"
dDec = 3.53"
```

2 moons. (Romulus) 11km at 1351km, Period 3.654days, (Remus) 11km at 702km, Period 1.373days Orbit@Miriade



## 2.1 Example | Sylvia: 1 event - 2 independent observing systems

Data reduction pipeline, camera delay handling

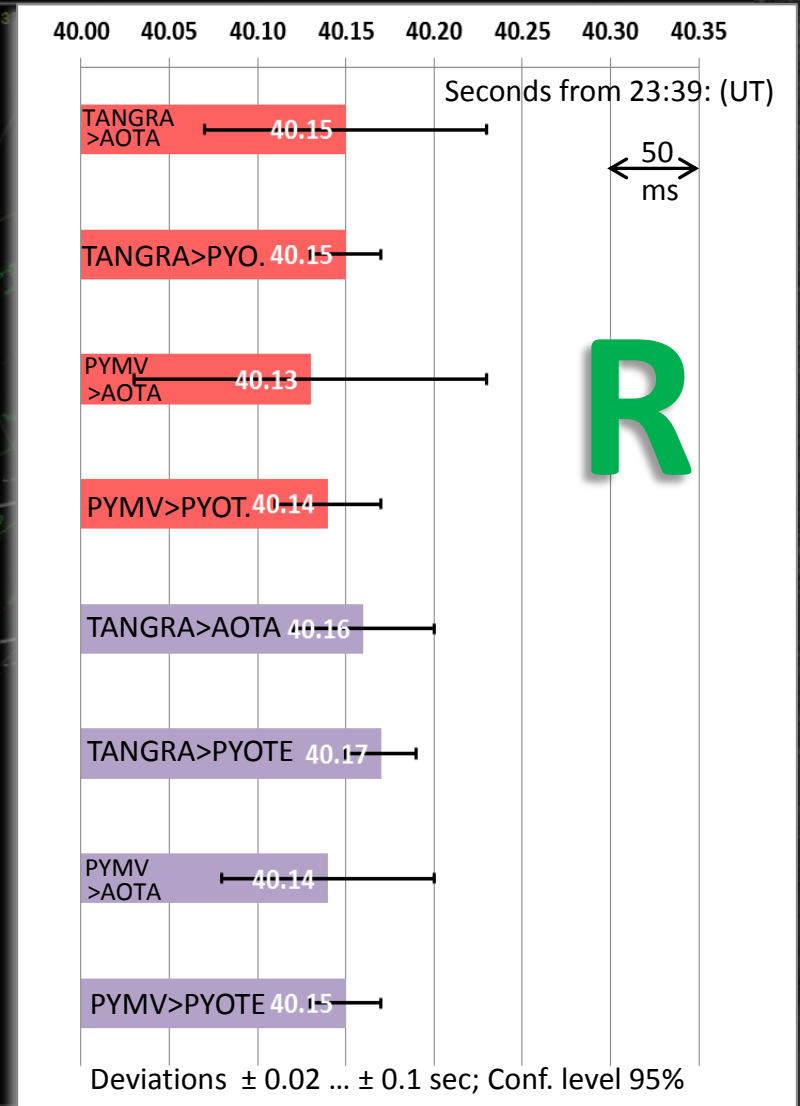
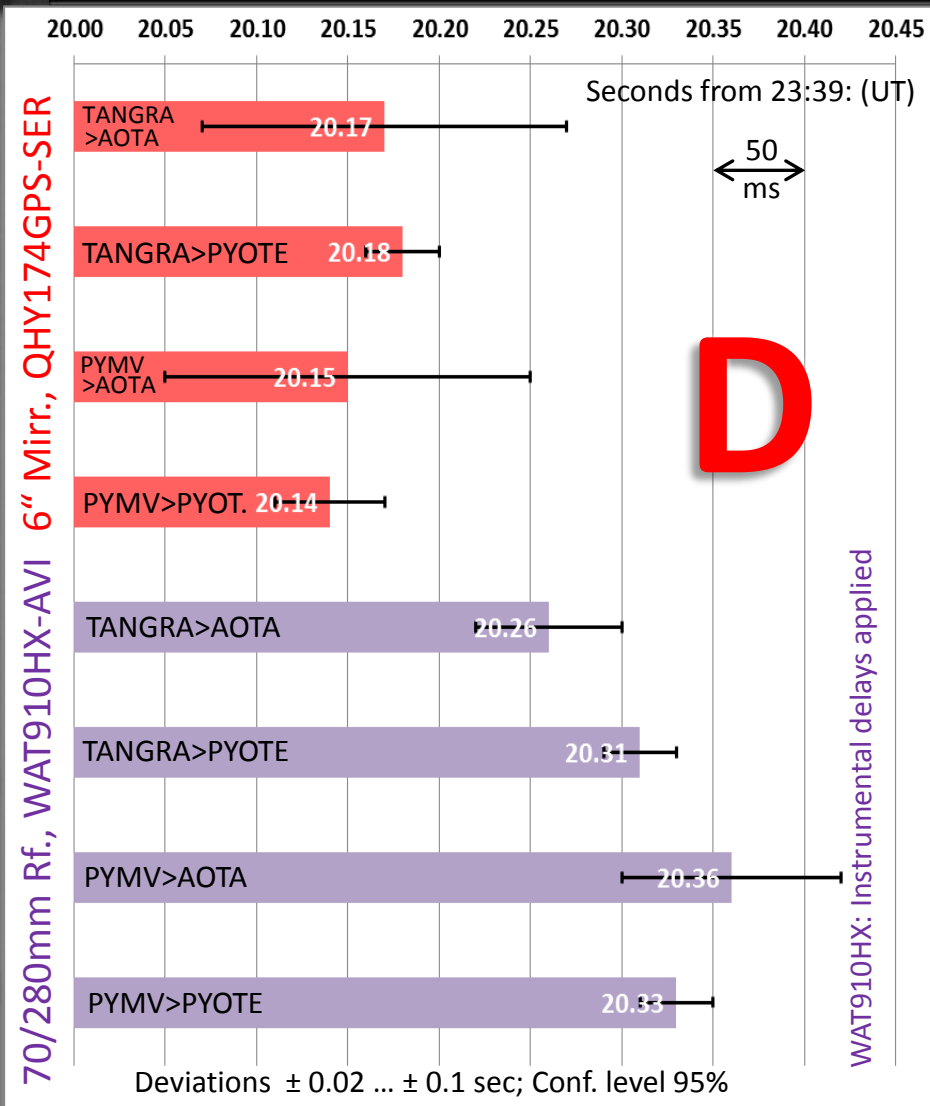


# 2.1 Example | Sylvia: 1 event - 2 independent observing systems

87 Sylvia #1 occults TYC 1932-00469-1 on 2019 Oct 29 from 23h 37m to 23h 49m UT

Star: Max Duration = 23.0 secs Asteroid: (in DAMIT, ISAM)  
 Mag V = 9.9; B = 10.7; R = 9.5 Mag Drop = (3.3r) Mag = 13.2  
 RA = 22 17 49.7487 (BCRS) Sur. Dis. = 0.003 AU Dist. = 2.12 AU  
 Dec = 44 59 59.89 (J2000) E 0.020"x 0.019" in PA 90 Hourly dRA = 1.038  
 Prediction of 2020 Feb 15.0 dDec = 3.53"

## Dependence of D, R on the observation systems and reduction methods

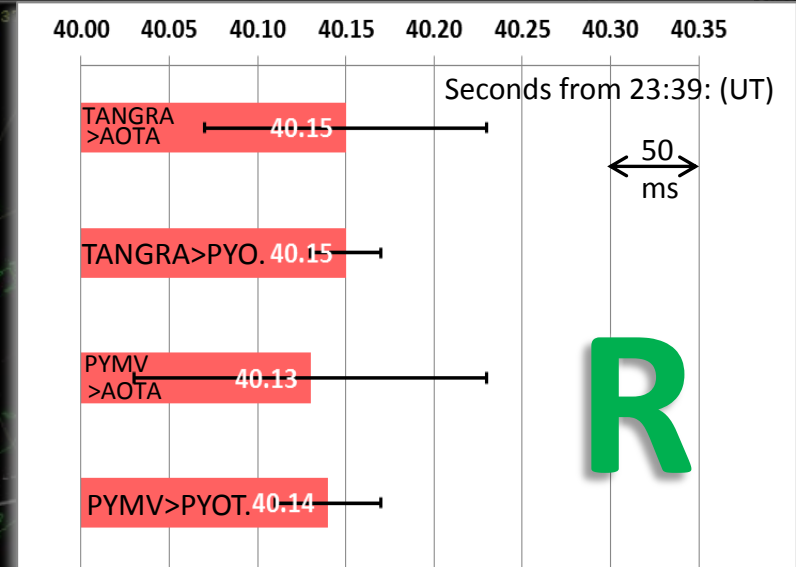
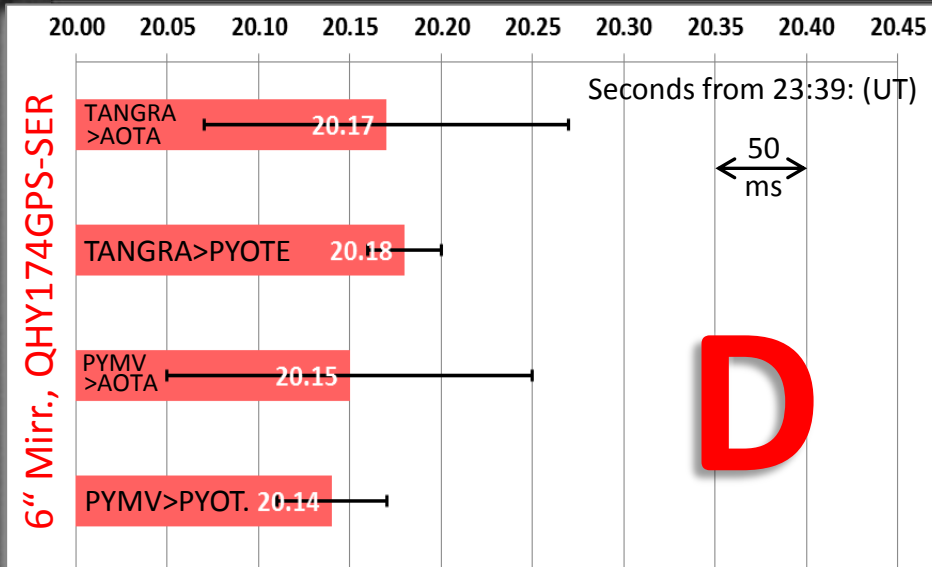


# 2.1 Example | Sylvia: 1 event - 2 independent observing systems

## QHY174GPS detailed settings

```

87 Sylvia #1 occults TYC 1932-00469-1 on 2019 Oct 29 from 23h 37m to 23h 49m UT
Star:
Mag V = 9.9; B = 10.7; R = 9.5
Max Duration = 23.0 secs
Mag Drop = (3.3r)
Sun: Dist = 110.0 AU
Moon: Dist = 110.0 AU
Prediction of 2020 Feb 15.0
E 0.020"x 0.019" in PA 90
Asteroid: (in DAMIT, ISAM)
Mag = 13.2
Dia = 0.86km, 0.114"
Parallax = 1.29644"
Hourly dRA = 1.29644"
dDec = 3.53"
    
```



Output Format=SER file (\*.ser)  
 Binning=1x1  
 Capture Area=480x300  
 Colour Space=MONO16  
 Pan=600  
 Tilt=420  
 Force Still Mode=Off  
 Enable Live Broadcast=Off  
 USB Traffic=4  
 Offset=400  
 Amp Noise Reduction=Off  
 Frame Rate Limit=Maximum  
 Gain=460

Exposure=75  
 Calibration End Pos (Fine)=1000  
 Calibration End Pos (Coarse)=0  
 Calibration Start Pos (Fine)=0  
 Calibration Start Pos (Coarse)=0  
 GPS Calibration LED=Off  
 GPS=On  
 Timestamp Frames=On  
 Contrast=0  
 Brightness=0  
 Gamma=1  
 Temperature=-20  
 Target Temperature=-20

Cooler Power=215(Auto)  
 Banding Threshold=35  
 Banding Suppression=0  
 Apply Flat=None  
 Subtract Dark=None  
 #Black Point  
 Display Black Point=0  
 #MidTone Point  
 Display MidTone Point=0.5  
 #White Point  
 Display White Point=1  
 TimeStamp=2019-10-29T23:30:38.06  
 SharpCapVersion=3.2.6109.0

# 2.1 Example | Sylvia: 1 event - 2 independent observing systems

87 Sylvia #1 occults TYC 1932-00469-1 on 2019 Oct 29 from 23h 37m to 23h 49m UT

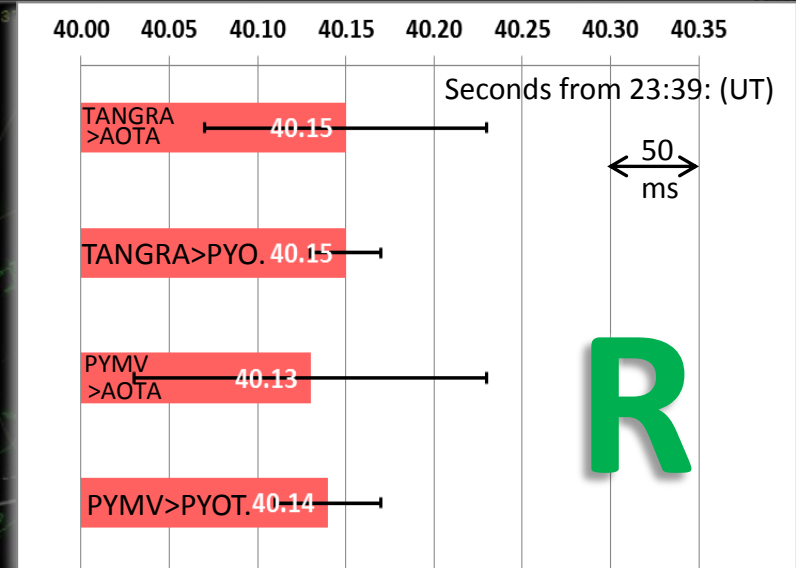
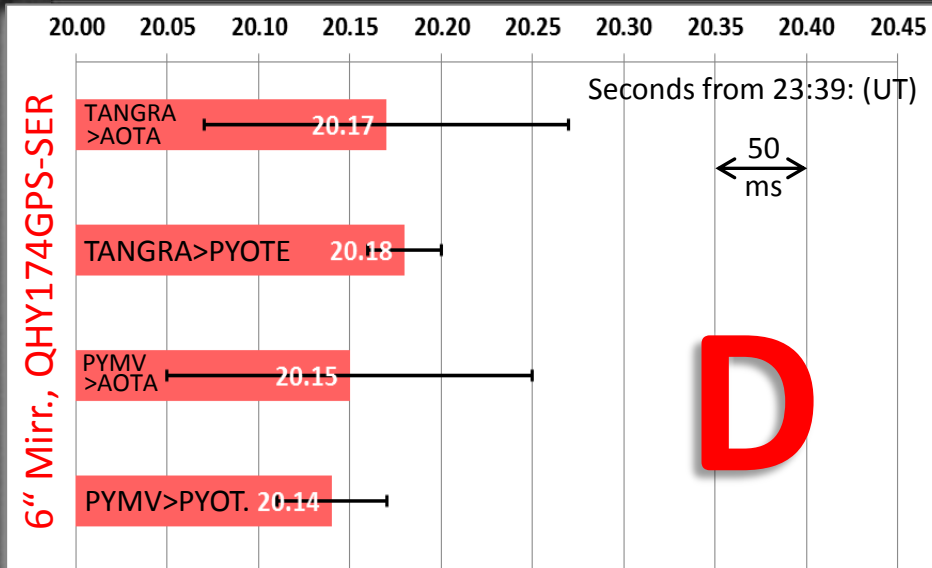
QHY174GPS detailed settings - **calibrated?**

```

Star:
Mag V = 9.9; B = 10.7; R = 9.5
Max Duration = 23.0 secs
Mag Drop = 3.3 (3.3r)
Sun - Alt = 10.0; Az = 100.0
Moon - Alt = 9.0; Az = 100.0
Prediction of 2020 Feb 15.0
E 0.020"x 0.019" in PA 90
    
```

```

Asteroid: (in DAMIT, ISAM)
Mag = 13.2
Dia = 0.86km, 0.114"
Parallax = 1.6644"
Hourly dRA = 1.296s
dDec = 3.53"
    
```



Output Format=SER file (\*.ser)

Binning=1x1

Capture Area=480x300

Colour Space=MONO16

Pan=600

Tilt=420

Force Still Mode=Off

Enable Live Broadcast=Off

USB Traffic=4

Offset=400

Amp Noise Reduction=Off

Frame Rate Limit=Maximum

Gain=460

Exposure=75

Calibration End Pos (Fine)=1000

Calibration End Pos (Coarse)=0

Calibration Start Pos (Fine)=0

Calibration Start Pos (Coarse)=0

GPS Calibration LED=Off

GPS=On

Timestamp Format=YYMMDD

Contrast=100

Brightness=0

Gamma=1

Temperature=-20

Target Temperature=-20

Cooler Power=215(Auto)

Banding Threshold=35

Banding Suppression=0

Apply Flat=None

Subtract Dark=None

#Black Point

Display Black Point=0

#MidTone Point

Display MidTone Point=0.5

#White Point

Display White Point=1

TimeStamp=2019-10-29T23:30:38.06

SharpCapVersion=3.2.6109.0

**No calibration**

Yellow: calibration affecting

## 2.2 LED calibration | Needed ?

Who calibrates? ... Almost no one

And why not? ... Too complicated, not to understand

Why should one? ... Exploiting the full power of the camera ( $\mu$ -sec precision promised instead of ms)

... Relevant for high precision timing events

... W/o calibration there can be problems with frame rate, GPS, ...

... Latest SC versions require calibration

What affects? ... Binning + Capture Area *Height* + 8/16bit + USB-Traffic + Exposure Time

Is it complicated? ... No ! **How to do it?**

## 2.2 LED calibration | Needed ?

Who calibrates? ... Almost no one

And why not? ... Too complicated, not to understand

Why should one? ... Exploiting the full power of the camera ( $\mu$ -sec precision promised instead of ms)

PYMW

... Relevant for high precision timing events

... W/o calibration there can be problems with frame rate, GPS, ...

... Latest SC versions require calibration

What affects? ... Binning + Capture Area *Height* + 8/16bit + USB-Traffic + Exposure Time

Is it complicated? ... No ! **How to do it? >>> Turn the LED on > off / off > on**

# 2.2 LED calibration | How to do it ?

Old calibration system:

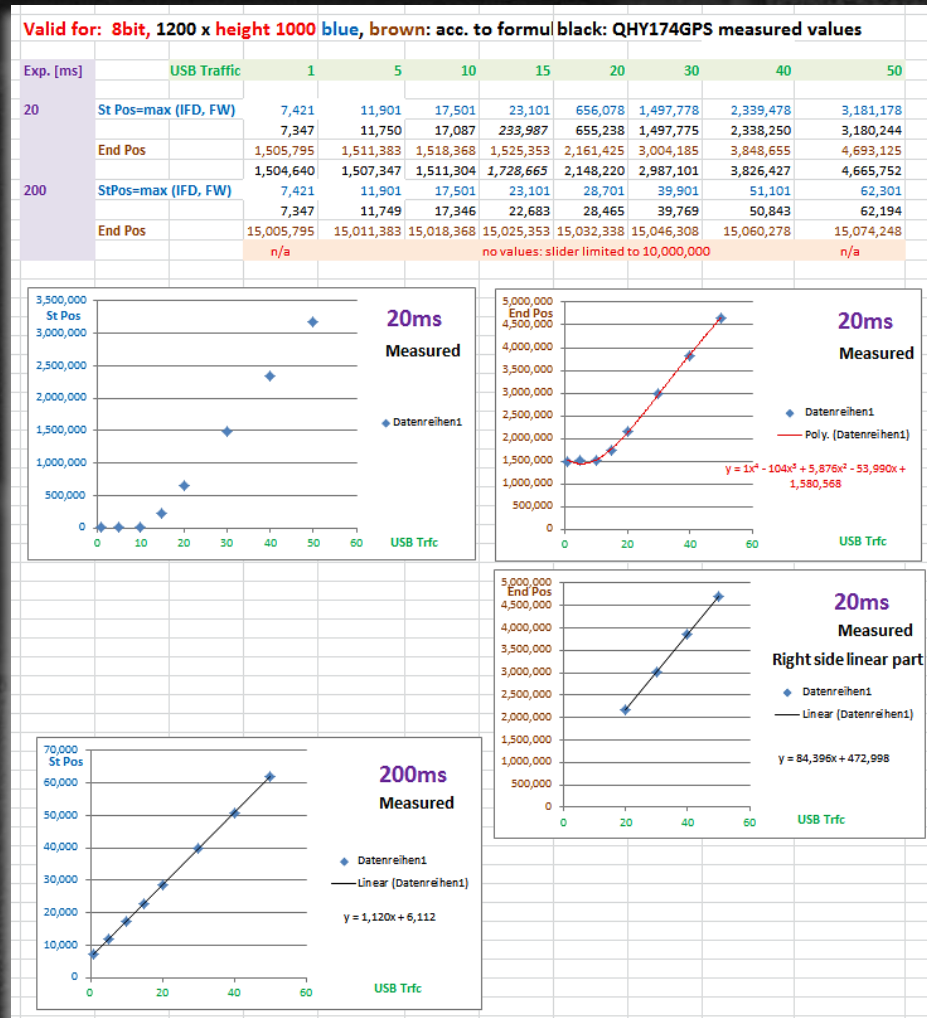
- Calibration End Pos (Fine)=1000
- Calibration End Pos (Coarse)=0
- Calibration Start Pos (Fine)=0
- Calibration Start Pos (Coarse)=0

Extensive tests

(„Reverse engineering“)

<https://forums.sharpcap.co.uk/viewtopic.php?f=28&t=2241&start=30>

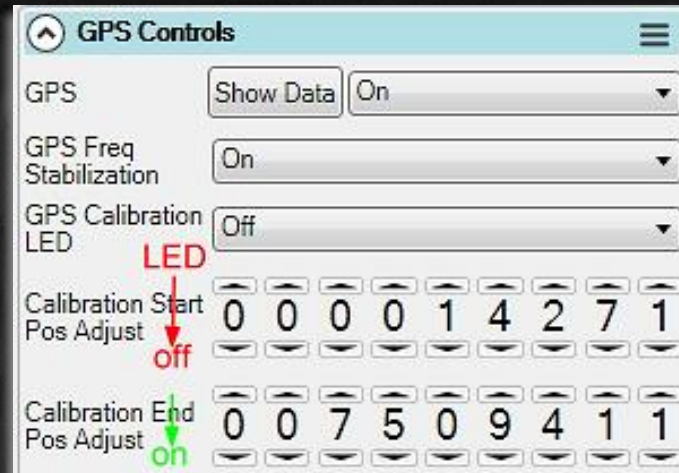
PYMV





## 2.2 LED calibration | How to do it ?

New calibration system: Auto setting of calibration parameters, only fine adjustment required (since SC 3.2.6226.0)

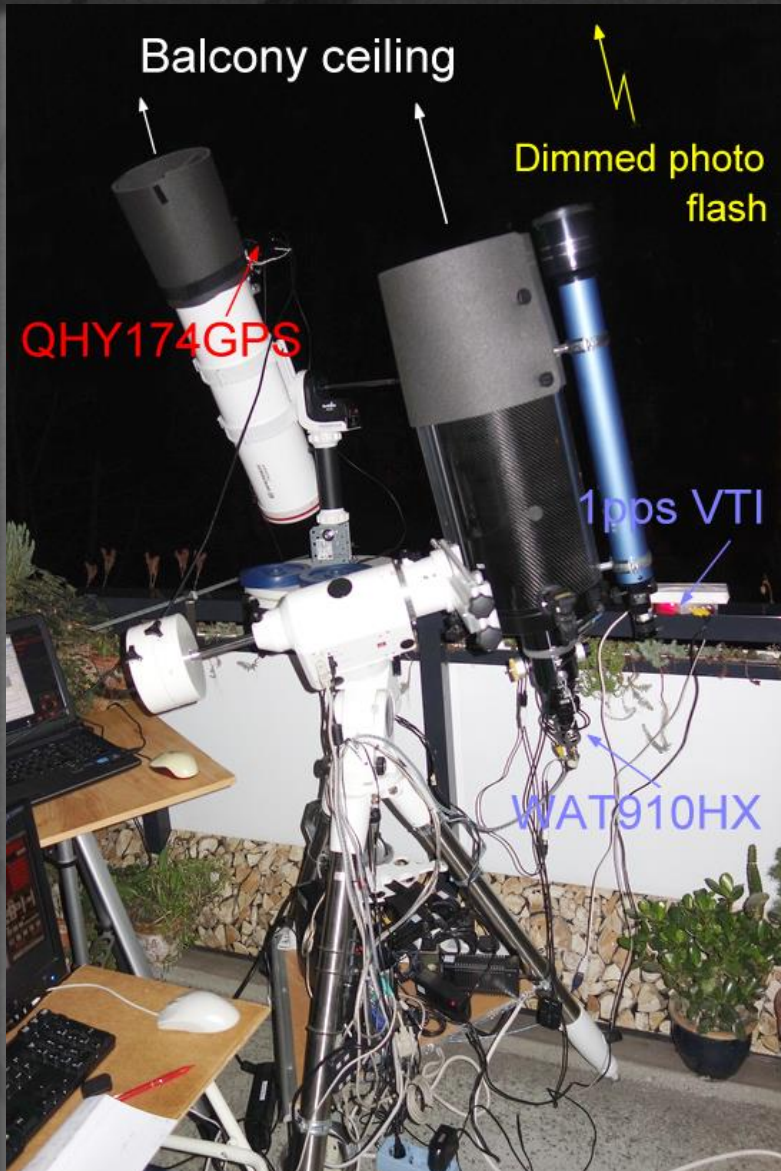


After final verification (e.g. dependencies on various hardware configurations) some further SC improvements are planned.

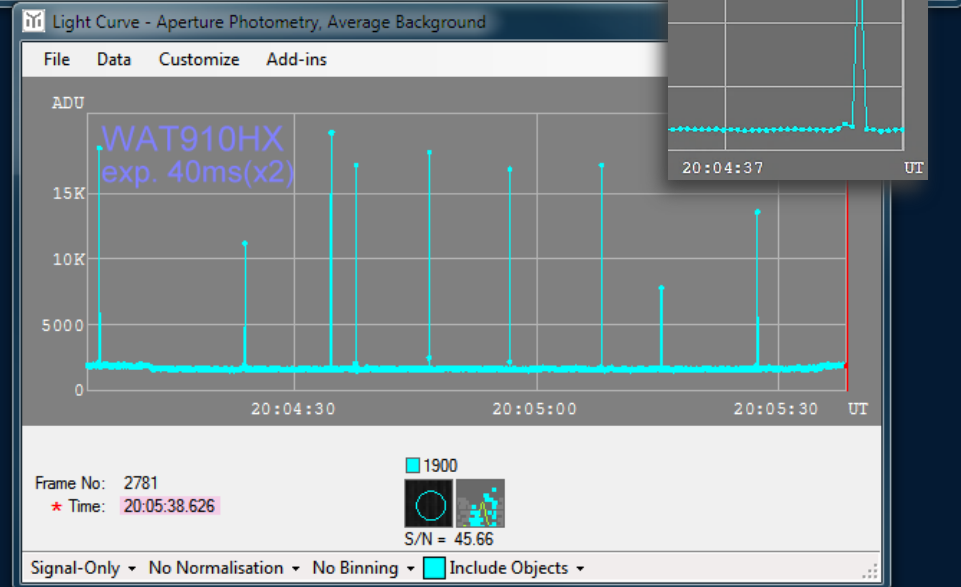
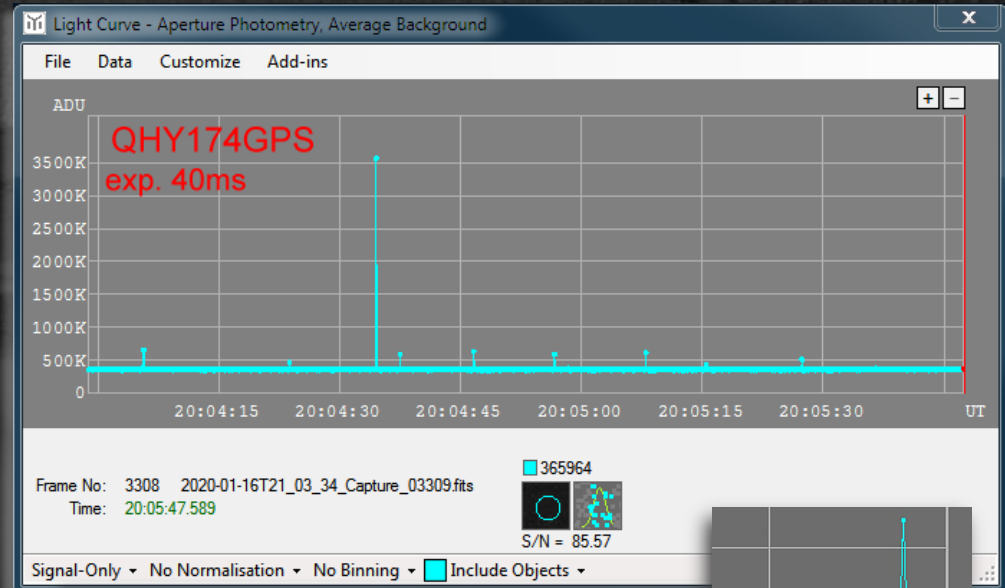
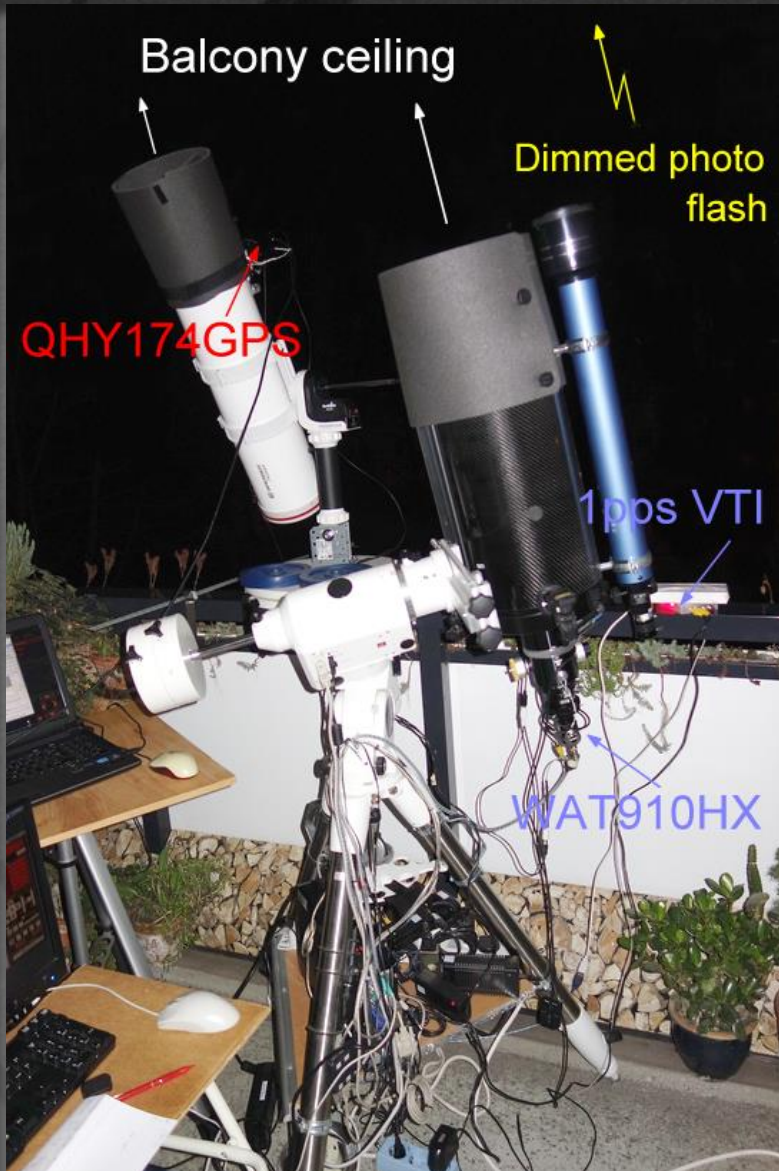
Example calibrated state :                      own camera    vs. IOTA camera

Calibration End Pos Adjust	=7509411	=7509413
Calibration Start Pos Adjust	=14271	=14277

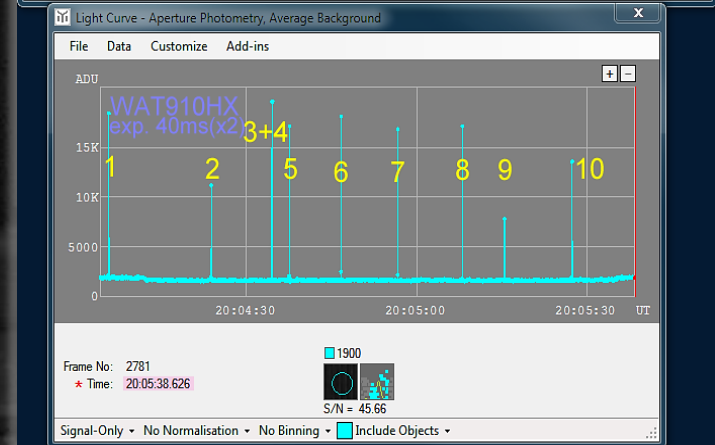
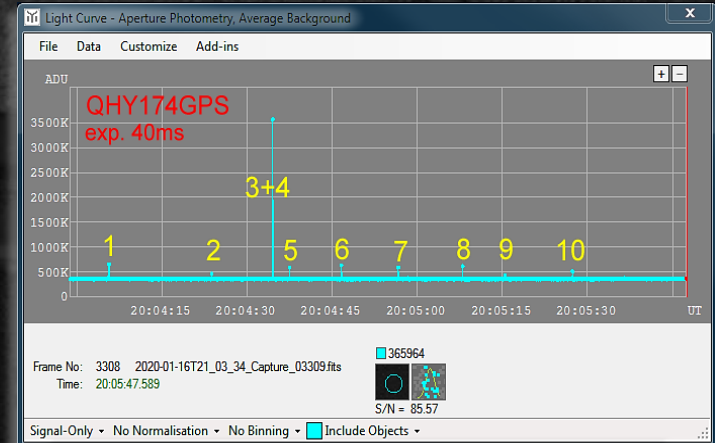
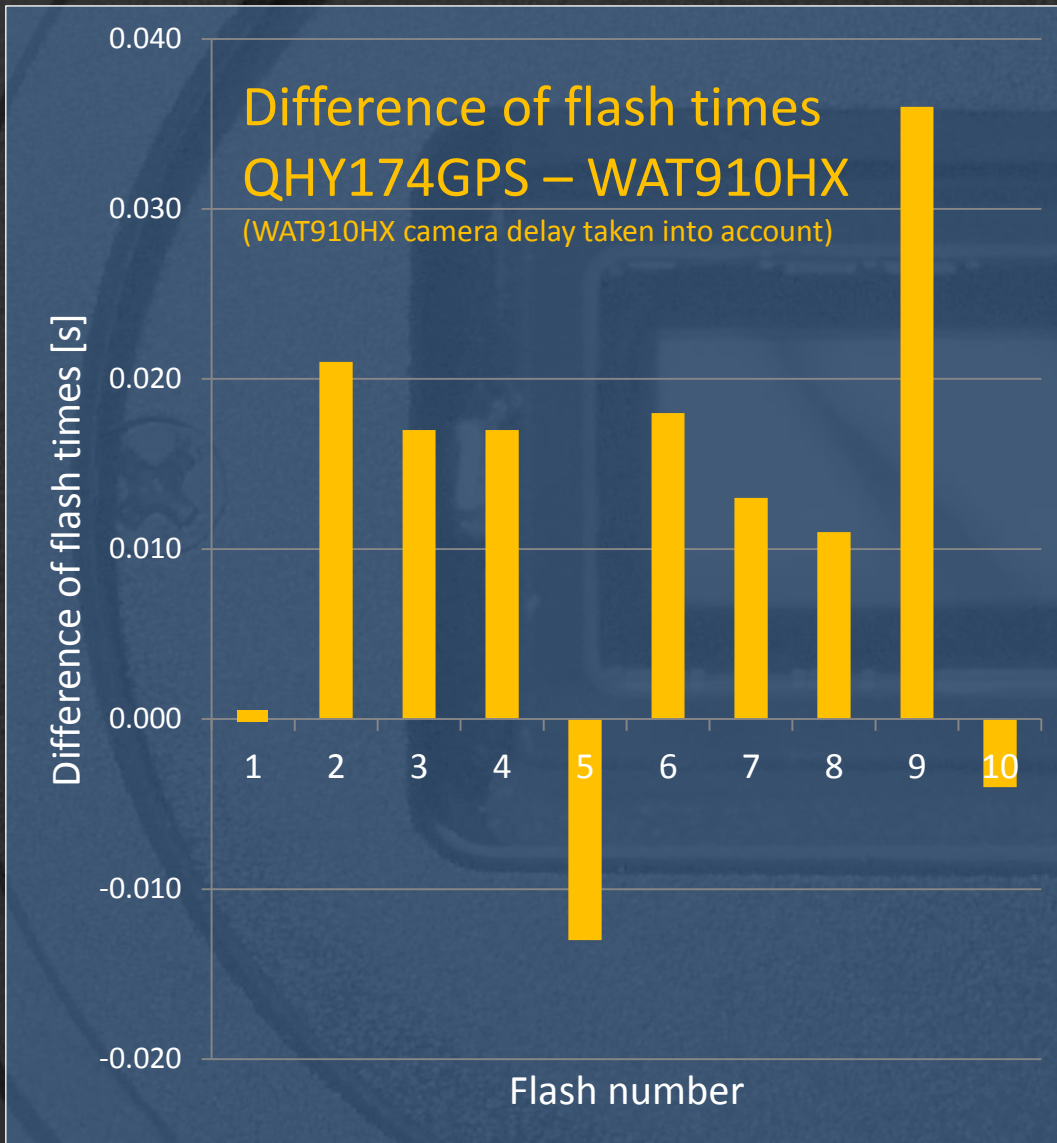
## 2.3 Time accuracy | Example: indirect photo flash



# 2.3 Time accuracy | Example: indirect photo flash



## 2.3 Time accuracy | Example: indirect photo flash



## 2.3 Time accuracy | SEXTA tests

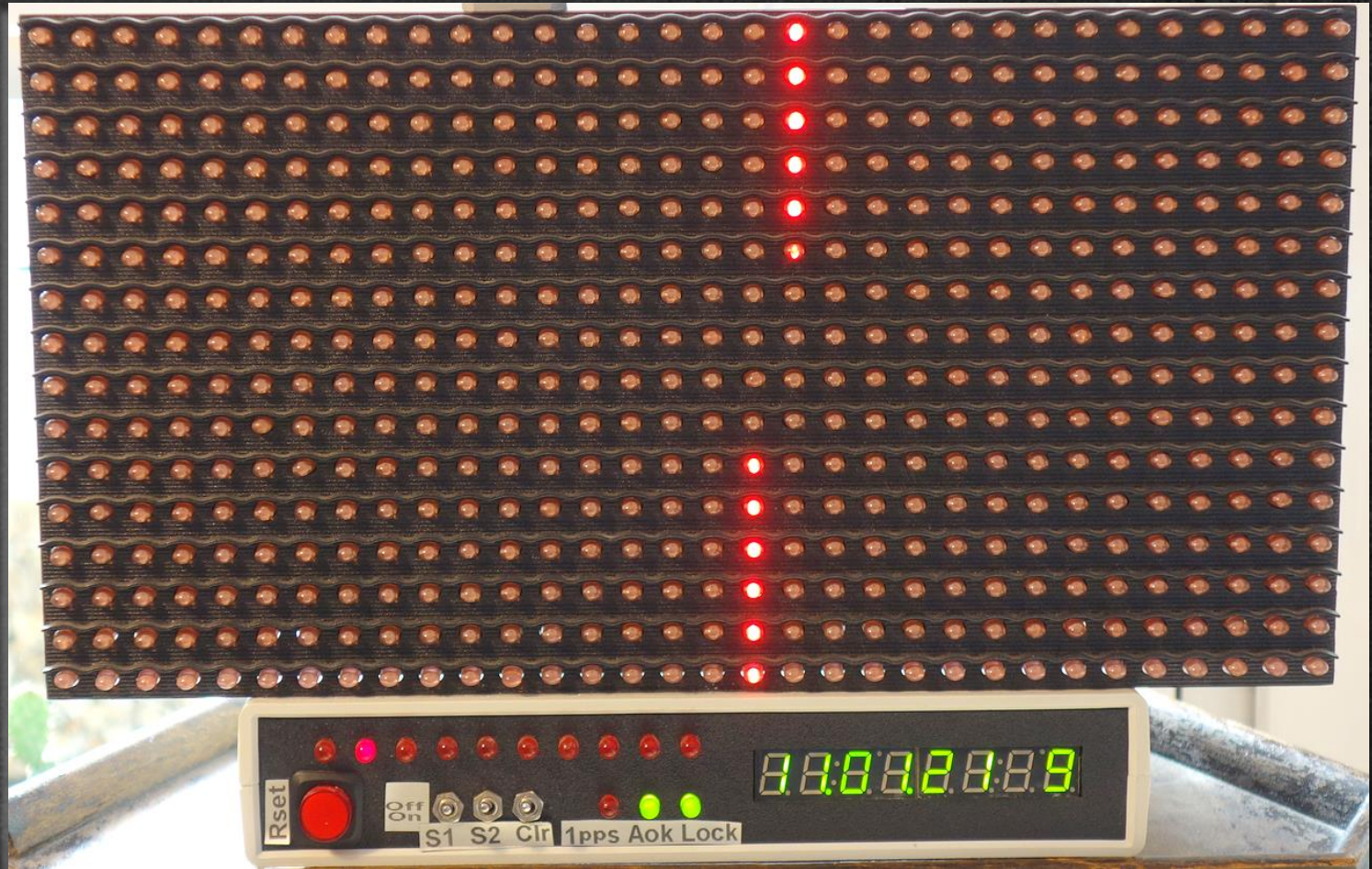
SEXTA (Southern EXposure Timing Array; T. Barry, D. Gault)

500 LED

Min. sweep  
time 1s

Time reso-  
lution 2ms

Time accu-  
racy 0.2ms



# 2.3 Time accuracy | SEXTA tests

## SEXTA Reader

SEXTA reader v15

File Edit Utilities

Open Map Stamp Batch

2020 02 23 16:02:39.1172914

Preferred format

FITS  JPEG

BMP  PNG

Image

Sweep = 1 sec

Load Image

Load map  with images

Manual White = 45874

Black = 13762

Recompose

Read optical time stamp

--

2020-02-23T17\_02\_34\_Capture\_00044.fits

	Time Stamps	Central time	Start time	Stop time	Exposure
Start LED	<b>Optical</b>	9.167	9.117	9.217	0.100
058					
Stop LED	<b>FITS</b>		9.117		0.100
108	<b>File</b>	2020-02-23 16:02:39.1172914			--

Hold down Shift while moving the mouse over the map to read off the LED number and time of illumination.

## 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example

Hardware



Sigma Zoom 18-50mm 1:3.5-5.6

## 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example; camera settings

Orange: calibration relevant settings

100ms\_16bit\_  
480x300\_1x1\_tr3;  
30s FITS sequ.





## 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example; camera settings - **default (no calibration)**

Orange: calibration relevant settings

100ms\_16bit\_  
480x300\_1x1\_tr3;  
30s FITS sequ.

Output Format=FITS files (\*.fits)

Binning=1x1

Capture Area=480x300

Colour Space=MONO16

Pan=776

Tilt=412

Force Still Mode=Off

Enable Live Broadcast=Off

USB Traffic=3

Offset=20

Amp Noise Reduction=Off

Frame Rate Limit=Maximum

Gain=100

Exposure=100

Calibration End Pos Adjust=7506827

Calibration Start Pos Adjust=9661

GPS Calibration LED=Off

GPS Freq Stabilization=On

GPS=On

Timestamp Frames=On

Contrast=0

Brightness=0

Gamma=1

Temperature=33

Target Temperature=0

Cooler Power=255(Auto)

Banding Threshold=35

Banding Suppression=0

Apply Flat=None

Subtract Dark=None

#Black Point

Display Black Point=0

#MidTone Point

Display MidTone Point=0.5

#White Point

Display White Point=1

TimeStamp=2020-02-23T16:02:34.9

SharpCapVersion=3.2.6232.0

## 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example; camera settings - **calibrated**

Orange: calibration relevant settings

100ms\_16bit\_  
480x300\_1x1\_tr3;  
30s FITS sequ.

Output Format=FITS files (\*.fits)

Binning=1x1

Capture Area=480x300

Colour Space=MONO16

Pan=776

Tilt=412

Force Still Mode=Off

Enable Live Broadcast=Off

USB Traffic=3

Offset=20

Amp Noise Reduction=Off

Frame Rate Limit=Maximum

Gain=100

Exposure=100

Calibration End Pos Adjust=7509411

Calibration Start Pos Adjust=14271

GPS Calibration LED=Off

GPS Freq Stabilization=On

GPS=On

Timestamp Frames=On

Contrast=0

Brightness=0

Gamma=1

Temperature=33

Target Temperature=0

Cooler Power=255(Auto)

Banding Threshold=35

Banding Suppression=0

Apply Flat=None

Subtract Dark=None

#Black Point

Display Black Point=0

#MidTone Point

Display MidTone Point=0.5

#White Point

Display White Point=1

TimeStamp=2020-02-23T16:02:34.9

SharpCapVersion=3.2.6232.0

# 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example (100ms\_16bit\_480x300\_1x1\_tr3; 30s FITS sq.; cal.)

SharpCap  
Screenshot

The screenshot displays the SharpCap Pro interface. The main window shows a camera feed of a star field with a timestamp '2020 02 23 16:06:42:4235598' and a digital readout '16.0642 9'. A 'GPS Status' window is overlaid on the bottom right, showing the following data:

```
Status      : Locked
Sequence #  : 24651
Latitude   : 52.0062155
Longitude  : 13.0075800
Start      : 2020-02-23T16:06:42.0000000Z
Start (us) : 423559.8
End        : 2020-02-23T16:06:42.0000000Z
End (us)   : 523495.0
Now        : 2020-02-23T16:06:42.0000000Z
Now (us)   : 523494.9
PPS Counter: 10000000
Exp. (us)  : 99935.2
Sys Clock  : 0.010s behind GPS
System/GPS offset stable for : 0:13:29
```

The interface also includes a 'Camera Control Panel' on the right with various settings for capture profiles, format, area, and camera controls. The status bar at the bottom indicates 'Previewing : 2473 frames (0 dropped) in 0:04:07, 9.8 fps' and 'GPS: 16:06:42Z \*\*\*Locked\*\*\*'.

# 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example (100ms\_16bit\_480x300\_1x1\_tr3; 30s FITS sq.; cal.)

PyMovie > PyOTE: dropped frames?

The screenshot shows the PyMovie 2.5.6 interface. The main window displays a video frame with a star pattern and a histogram on the right. The histogram shows a peak at approximately 70,000. The video frame has a timestamp of 2020-02-23 16:03:04.7495562 and a digital readout of 16.0304 9. The interface includes a menu bar, a toolbar, and a status bar. A blue overlay in the center of the image contains the following text:

PyOTE:  
TimeDelta: 0.100126 seconds per reading  
Timestamp error rate: 0.00%

The status bar at the bottom of the PyMovie window shows the current frame is 299 out of 299, and the auto-run PyOTE checkbox is checked. The status bar also includes buttons for write csv, plot, current frame, stop frame, mark, Return to 'mark', and clear data.

## 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example (100ms\_16bit\_480x300\_1x1\_tr3; 30s FITS sq.; cal.)

SEXTA reader: Two consecutive frames



2020-02-23T17\_02\_34\_Capture\_00044.fits

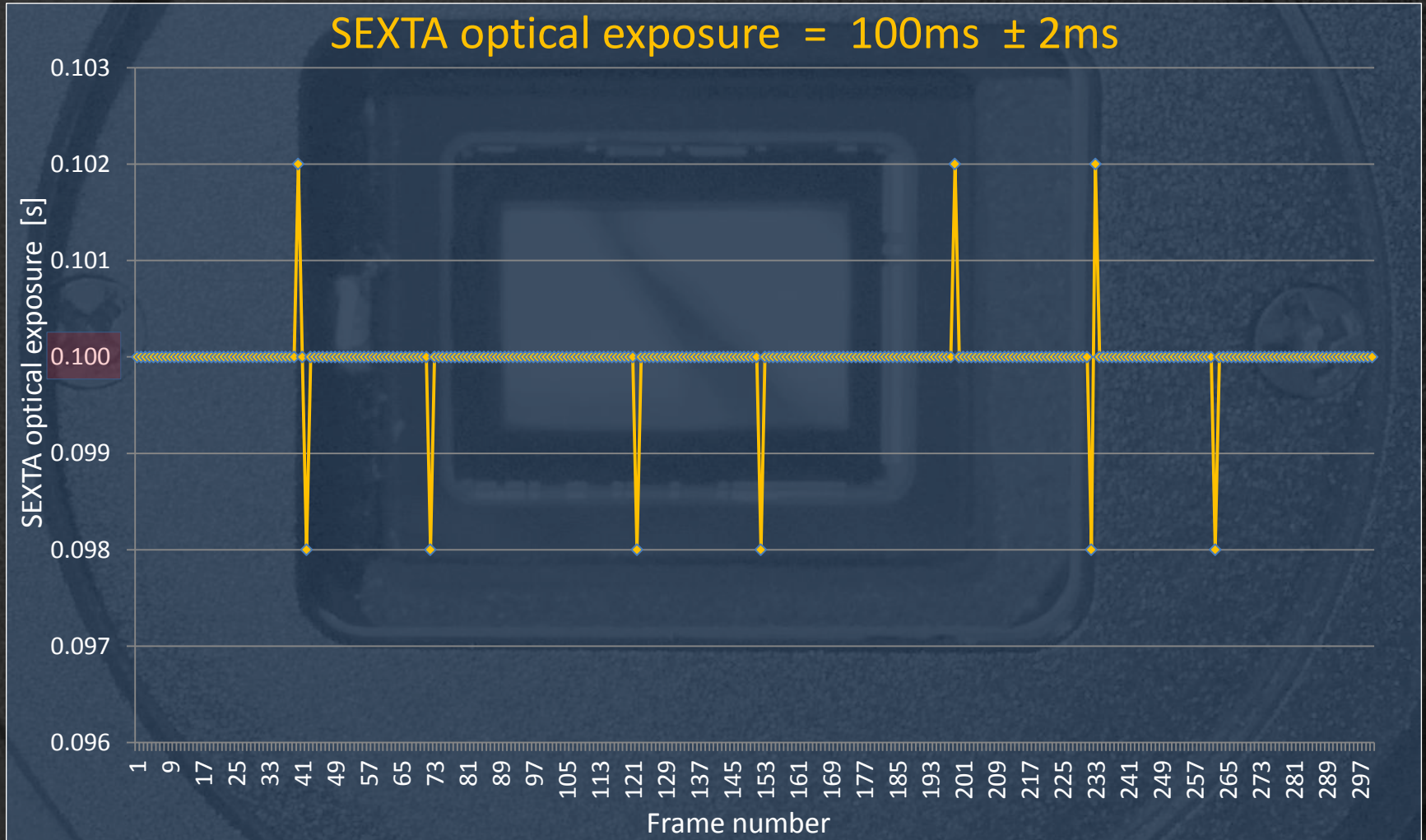
	Time Stamps	Central time	Start time	Stop time	Exposure
Start LED	<b>Optical</b>	9.167	9.117	9.217	0.100
058					
Stop LED	<b>FITS</b>		9.117		0.100
108	<b>File</b>	2020-02-23 16:02:39.1172914			--

2020-02-23T17\_02\_34\_Capture\_00045.fits

	Time Stamps	Central time	Start time	Stop time	Exposure
Start LED	<b>Optical</b>	9.267	9.217	9.317	0.100
108					
Stop LED	<b>FITS</b>		9.217		0.100
158	<b>File</b>	2020-02-23 16:02:39.2174174			--

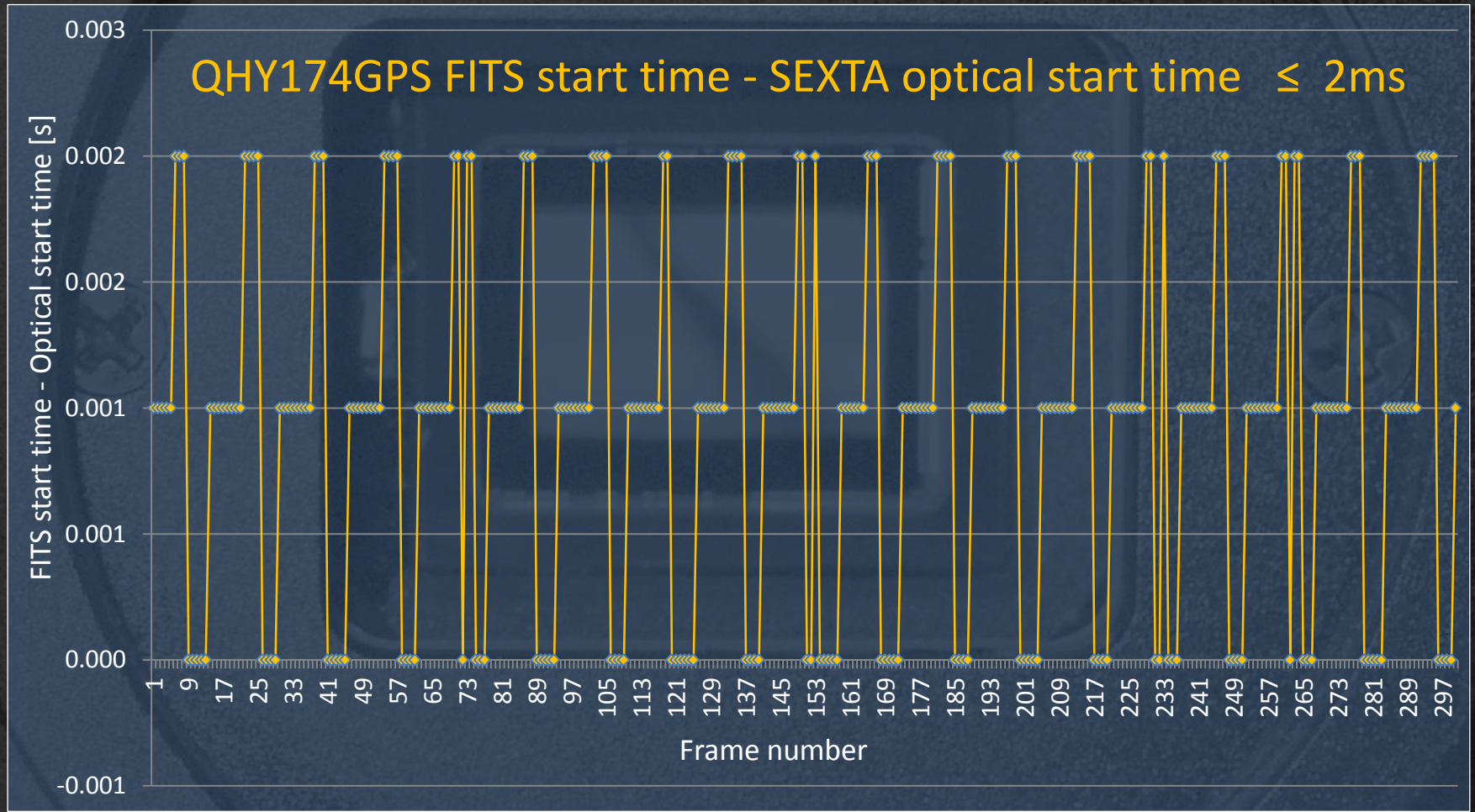
## 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example (100ms\_16bit\_480x300\_1x1\_tr3; 30s FITS sq.; cal.)



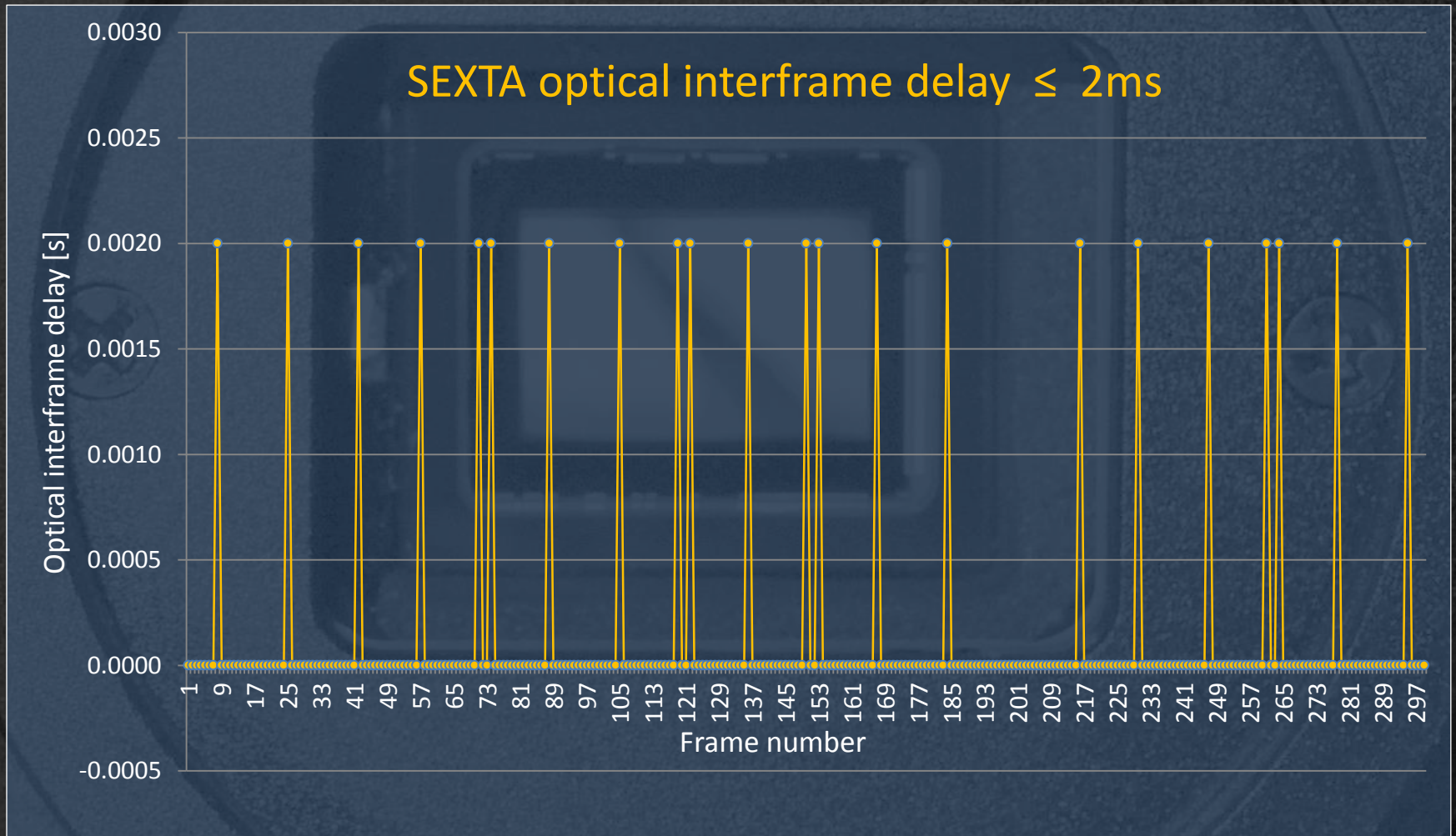
## 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example (100ms\_16bit\_480x300\_1x1\_tr3; 30s FITS sq.; cal.)



## 2.3 Time accuracy | SEXTA tests

SEXTA QHY174GPS test example (100ms\_16bit\_480x300\_1x1\_tr3; 30s FITS sq.; cal.)





## 2.3 Time accuracy | SEXTA tests

SEXTA summary of performed tests (SEXTA temporal resolution 2ms)

QHY174GPS (30s FITS sequ.)	100ms_16bit_ 480x300_1x1_tr3	50ms_16bit_ 1440x900_2x2_tr5	40ms_16bit_ 480x300_1x1_tr3	40ms_16bit_ 480x300_1x1_tr3	20ms_16bit_ 480x300_1x1_tr3
-------------------------------	---------------------------------	---------------------------------	--------------------------------	--------------------------------	--------------------------------

\* System: Intel i7 2.2GHz, RAM 16GB, W7 Hm. Prem. - 64bit, SSD; SC: 3.2.6232.0, 32bit, Pro; all with the same camera

## 2.3 Time accuracy | SEXTA tests

SEXTA summary of performed tests (SEXTA temporal resolution 2ms)

QHY174GPS (30s FITS sequ.)	100ms_16bit_ 480x300_1x1_tr3	50ms_16bit_ 1440x900_2x2_tr5	40ms_16bit_ 480x300_1x1_tr3	40ms_16bit_ 480x300_1x1_tr3	20ms_16bit_ 480x300_1x1_tr3
SC calibrated	y	y	y	n	y
FPS reached *	10	20	25	25	~ 48.5
PyOTE time-stamp error rate	0%	0%	0%	0%	0.808% 12 dropped fr.

\* System: Intel i7 2.2GHz, RAM 16GB, W7 Hm. Prem. - 64bit, SSD; SC: 3.2.6232.0, 32bit, Pro; all with the same camera

## 2.3 Time accuracy | SEXTA tests

SEXTA summary of performed tests (SEXTA temporal resolution 2ms)

QHY174GPS (30s FITS sequ.)	100ms_16bit_ 480x300_1x1_tr3	50ms_16bit_ 1440x900_2x2_tr5	40ms_16bit_ 480x300_1x1_tr3	40ms_16bit_ 480x300_1x1_tr3	20ms_16bit_ 480x300_1x1_tr3
SC calibrated	y	y	y	n	y
FPS reached *	10	20	25	25	~ 48.5
PyOTE time-stamp error rate	0%	0%	0%	0%	0.808% 12 dropped fr.
Max. deviation SEXTA optical exp. / Frames w. dev.	± 2ms 3%	± 2ms 1.3%	± 2ms 1.2%	± 2ms 3%	± 2ms 1.5%
QHY FITS start time – SXT. opt. start t. / Frames w. diff. > 0	≤ 2ms 69%	≤ 2ms 67%	≤ 2ms 70%	≤ 2ms 60%	≤ 3ms 70%
SEXTA optical inter- frame delay / Cases w/o intf. dev.	≤ 2ms 93%	≤ 2ms -	≤ 2ms -	≤ 2ms 90%	- 2ms ... 22ms 90%

\* System: Intel i7 2.2GHz, RAM 16GB, W7 Hm. Prem. - 64bit, SSD; SC: 3.2.6232.0, 32bit, Pro; all with the same camera

M. Buie, SWRI, reported analogous QHY174GPS SEXTA results („Size and Shape Constraints of (486958) Arrokoth from Stellar Occultations” <https://arxiv.org/abs/2001.00125> )

## 2.4 QHY174GPS firmware

Obviously, all IOTA QHY174GPS cameras have the same firmware ...

There is a firmware version that supports (at least) more GPS data, e.g. GPS\_ALT ...

```
Listner - [C:\capture\GPSLog_2020-02-12T20_34_32-10872.log]
Datei Bearbeiten Optionen Hilfe
System Time (UTC), Status, Sequence Num, GPS Start Frame Time, GPS End Frame Time, Lat, Long, RAW Lat, RAW Long, System-GPS (s), NumSats, Altitude, FixTime, FixQuality, HDop, RawData
2020-02-12T20:34:32.3760905Z, BadData, 0, 1995-10-10T00:00:00.0000000Z, 1995-10-10T00:00:00.0000000Z, 0.0000000, 0.0000000, 0, 0, 768256472.35
2020-02-12T20:34:32.5531006Z, PartialData, 25, 2020-02-12T20:34:32.5503724Z, 2020-02-12T20:34:32.6503259Z, 0.0000000, 0.0000000, 0, 0, -0.10
2020-02-12T20:34:32.7551121Z, PartialData, 27, 2020-02-12T20:34:32.7506674Z, 2020-02-12T20:34:32.8506210Z, 0.0000000, 0.0000000, 0, 0, -0.10
2020-02-12T20:34:32.8571180Z, PartialData, 28, 2020-02-12T20:34:32.8508149Z, 2020-02-12T20:34:32.9507685Z, 0.0000000, 0.0000000, 0, 0, -0.09
```

With the cameras came some hardware that could be needed for upgrade. However, its implementation is said to be complicated, see e.g.

<https://forums.sharpcap.co.uk/viewtopic.php?f=28&t=2241&sid=c79cccf8a4d7133994a07845ea8f4eb9&start=20#p11696>

Possible future task ...



# 2.5 Additional SC features | Plate solving / mount control

## SC mount control

SharpCap Settings

General Hardware Filenames Memory Plate Solving

Focuser: None

Filter Wheel: None

Mounts: Generic Hub

Connect hardware automatically when opening a camera

**ASCOM**

SharpCap (v3.2.6086) - QHY174M - C:\Users\Administrator\AppData\Local\Temp\tmp3586.tmp.png - E\

File Cameras Options Capture Tools Scripting Help

Start Capture Quick Capture Stop Capture Pause Snapshot Live Stack Target Name: FX: None Zoom:

Mount synced to RA=05:56:12,Dec=07:23:56N, re-centering on target at RA=05:56:13,Dec=07:24:38N (offset of 0.01 degrees)

Brightness 0.0

Contrast 0.0

Timestamp Frames On

**Thermal Controls**

Cooler Power Auto 255

Target Temperature 8

Temperature 23.0

**Preprocessing**

Subtract Dark Browse... None

Apply Flat Browse... None

Banding Suppression 0

Banding Threshold 35.0

**Display Histogram Stretch**

**Scope Controls**

Generic Hub  Connected

Az 116:17:50 Rate: 1"/s

Alt +27:36:11 Setup

RA 05:56:18

Dec 07:22:19N Tracking

Temp 23.0C, Target 8.0C

Cartes du Ciel - Chart\_1 C: 1h40m +28°17' L:+04°53'

File Edit Setup View Chart Telescope Window Update Help Alt/Az coord. TAN

Chart\_1 Chart\_2

UCAC4-591-004129

Alt/Az coord. TAN

Apparent

Berlin K

EQ

2019-12-04

20h46m55s (CET)

Mag:11.1/15.0,1.1'

FOV:+04°52'58"

UCAC4-591-004129

GPS Status

Memory: 1

Az: +179°40'31.8" Alt: +66°02'24.3"  
RA: 01h40m01.07s DE: +28°17'07.8" Star: UCAC4-591-004129 Visual magnitude: 12.003 Colour index B-V: 1.042  
Rise: 1h34m33.57s DE: -28°32'57.9" Culmination: 20h52m56s Set: 05h59m44s Az: 322°21'

Control

Alignment Star

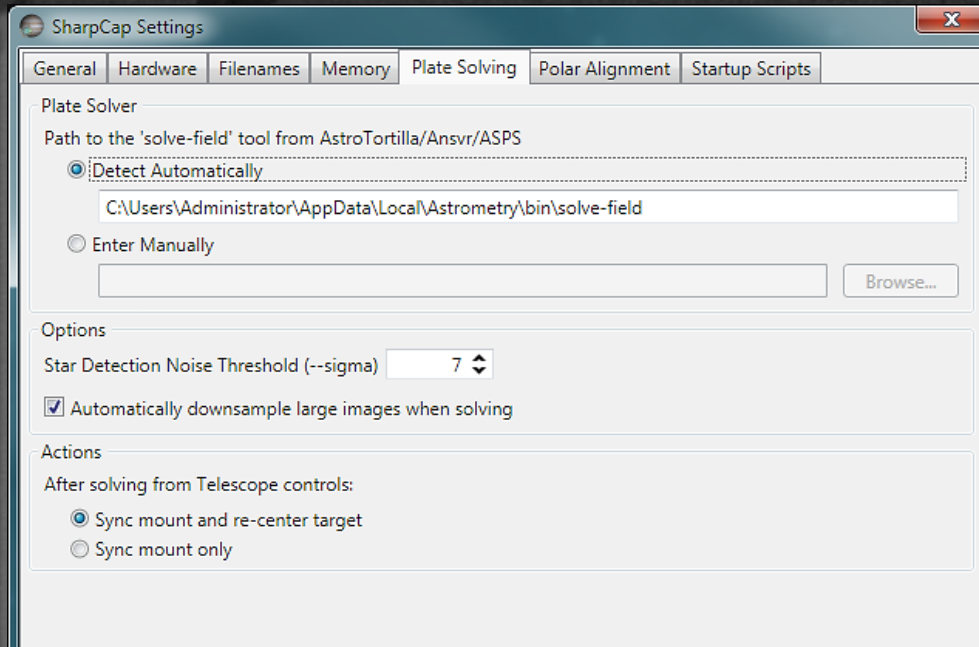
Deep Sky Utility

User Objects Settings

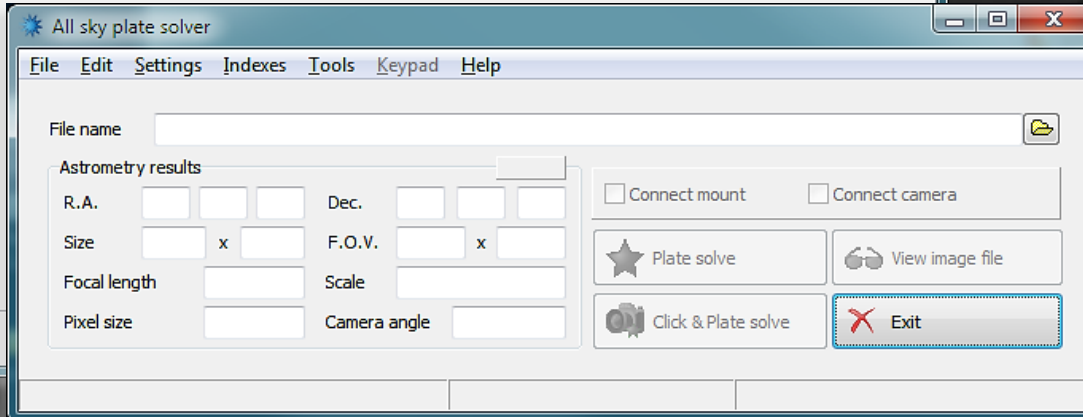
Advanced

# 2.5 Additional SC features | Plate solving / mount control

## SC plate solving



Name	Erw.	Grösse	↑Datum
⬆️[.]		<DIR>	10/05/19 16:39
ic2000_pos.txt		518,344	07/11/11 16:49
ngc2000.dat		1,282,922	07/11/11 16:49
ngc2000_pos.txt		767,926	07/11/11 16:49
ngc2000names.dat		10,187	07/11/11 16:49
ngc2000-readme.txt		16,360	07/11/11 16:49
index-4107.fits		164,995,200	11/02/15 15:21
index-4108.fits		94,550,400	11/02/15 15:22



Name	Erw.
⬆️[.]	
[bin]	
[dev]	
[etc]	
[home]	
[lib]	
[temp]	
[tmp]	
[usr]	

[http://www.astrogb.com/astrogb/All\\_Sky\\_Plate\\_Solver.html](http://www.astrogb.com/astrogb/All_Sky_Plate_Solver.html)

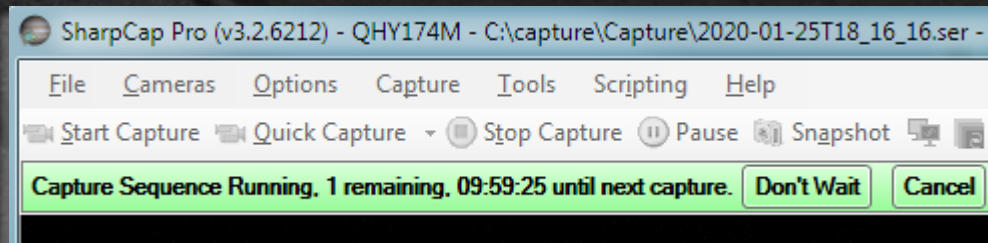
## 2.5 Additional SC features | Scripting

Scripting with Pro-version only;

Example: scheduling <https://forums.sharpcap.co.uk/viewtopic.php?t=2263>

```
#TEST SC 3.2.6212.0 pro SCRIPTING - Simple Sequence  
#see https://forums.sharpcap.co.uk/viewtopic.php?f=14&t=102
```

```
SharpCap.SelectedCamera = SharpCap.Cameras.Find(lambda x:x.DeviceName == 'QHY174M')  
# Setup a capture limited to 60s, then 36000s wait, repeat 2 times  
import clr  
clr.AddReference("SharpCap")  
from SharpCap.UI import CaptureLimitType  
SharpCap.SelectedCamera.CaptureConfig.CaptureLimitType = CaptureLimitType.TimeLimited  
SharpCap.SelectedCamera.CaptureConfig.CaptureLimitValue = 60  
SharpCap.SelectedCamera.CaptureConfig.CaptureSequenceCount = 2  
SharpCap.SelectedCamera.CaptureConfig.CaptureSequenceInterval = 36000  
#start the capture  
SharpCap.SelectedCamera.PrepareToCapture()  
SharpCap.SelectedCamera.RunCapture()
```



## 2.6 Useful links

SER-Player <https://sites.google.com/site/astropipp/ser-player#downloads>

FitsWork <https://www.fitswork.de/software/>

Skychart / CDC <https://sourceforge.net/projects/skychart/>

PyMovie <http://occultations.org/observing/software/pymovie/>

PyOTE <http://occultations.org/observing/software/ote/>

SEXTA <https://www.kuriwaobservatory.com/SEXTA/SEXTA.html>

<https://arxiv.org/abs/1503.05705>

SC Forum <https://forums.sharpcap.co.uk/index.php>

ADV format <https://forums.sharpcap.co.uk/viewtopic.php?f=8&t=2237>

ASCOM <https://ascom-standards.org/>



## 2.7 Summary and future tasks

Summary:

QHY174GPS

Stable and reproducible in its parameters

Largely identical behavior of different individual copies

Strongly requires appropriate hardware to reach its full power

Within the temporal resolution of SEXTA  $\sim 2\text{ms}$  time accuracy

For occultation work only SharpCap suitable

Very careful adjustment of various parameters required

Seems to be a little less sensitive than e.g. WAT910HX

## 2.7 Summary and future tasks

Open points / proposals:

Firmware	Existing upgrade only provides additional GPS data (e.g. GPS_ALT) or further improvements? How to get and how to upgrade safely; warranty?
LED-calibr.	Further tests (e.g. dependencies on various hardware)
Time acc.	Further tests (would require a SEXTA with increased time resolution)
Sensitivity	Comparison QHY174 - integrating cameras (e.g. WAT910HX)
ADV	SharpCap ADV support to develop
Worksheet	To develop for practical occultation work

Many thanks to:

Robin Glover      For providing and continuous development  
of SharpCap

Hristo Pavlov      Developer of TANGRA

Dave Herald      Developer of Occult / AOTA

Bob Anderson      Developer of PyMovie, PyOTE

Th. Midavaine      For providing a SEXTA device (developed by  
Tony Barry and Dave Gault)

IOTA/ES      For providing a QHY174GPS test model

Colleagues of the worldwide community for suggestions  
and valuable discussions

**Thank You**