Digital Video Cameras:

SharpCap Timestamps

AND

TANGRA

Christian Weber | IOTA/ES

2020 May 07

SC Timestamps | Preface

There is a growing number of occultation observations with digital video cameras, some of them with integrated GPS.

The QHY174GPS (https://www.qhyccd.com) camera ist the first CMOS camera with built - in GPS timing and in this aspect a real alternative to the usual analogue video technology. Various worldwide occultation results are known gotten with this camera. However, because of the complex system QHY174GPS – SharpCap (currently for occultation work the only suitable control software, https://www.sharpcap.co.uk) – data reduction /photometry software, there is a deep learning curve that must be gone by the users. In a workshop at the Archenhold-Sternwarte Berlin the basics and the advanced use of this camera have been studied (http://www.iota-es.de/qhy174gps_workshop.html).

The swiss DVTI Camera, a second camera with integrated GPS, is under development (https://groups.io/g/d-vti-cam/).

In the meantime, questions about timestamping came up. Some tests with a SEXTA device (https://www.kuriwaobservatory.com/SEXTA/SEXTA.html) I made in preparation for the Berlin Workshop, some further ones in the last time.

Just now we also have a new Tangra version 3.7.2 (http://www.hristopavlov.net/Tangra3/) with greatly improved support for digital video cameras.

In this tutorial I'll give some instructions how the QHY174GPS SC timestamps work together with Tangra.

The test system used was mainly a notebook with Intel i7 2.2GHz, RAM 16GB, W7 Home Premium - 64bit, SSD; SharpCap 3.2.6248.0, 32bit, Pro, the SEXTA device and a camera QHY174GPS (mono, cooled). The times are usually UT.

SharpCap processes various high-precision time information provided by the QHY174GPS camera (or, in case of no GPS, basing on the system time) and timestamps the output files accordingly. So far ADV is not yet available, there are FITS sequences and SER format records possible. The latter is not a dedicated occultion work format.

To fully utilize the potential of the QHY174GPS camera, LED calibration is strongly recommended. To avoid dropped frames see the Berlin Workshop files. The GPS antenna needs an unobstructed view to the sky.

It is recommended to activate the SC GPS-logging to check whether the GPS data was valid for particular frames.

QHY174GPS in GPS locked state:

The SC timestamp is the GPS ***start exposure***

In GPS locked and calibrated state, with suitable hardware and approbriate SC settings you will get an overall timing accuracy of 1…2ms.

There are no camera delays to be considered.

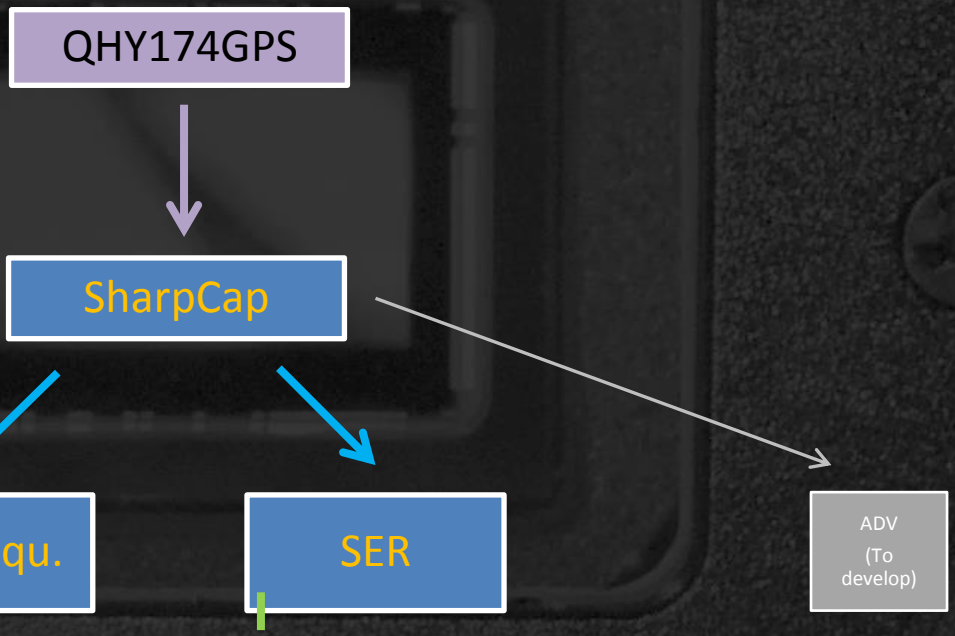
Digital video cameras without GPS and QHY174GPS without/lost GPS lock:

The SC timestamp is the frame ***end time*** (the time, the frame is received by SC). However, for FITS sequences, SC provides with the header DATE-OBS an *estimated* frame *start time*

The time reference is the system time (with all it's inaccuracies).

SC Timestamps | Overview - GPS locked

UTC synchronized time signals



UTC synchronized SC timestamps

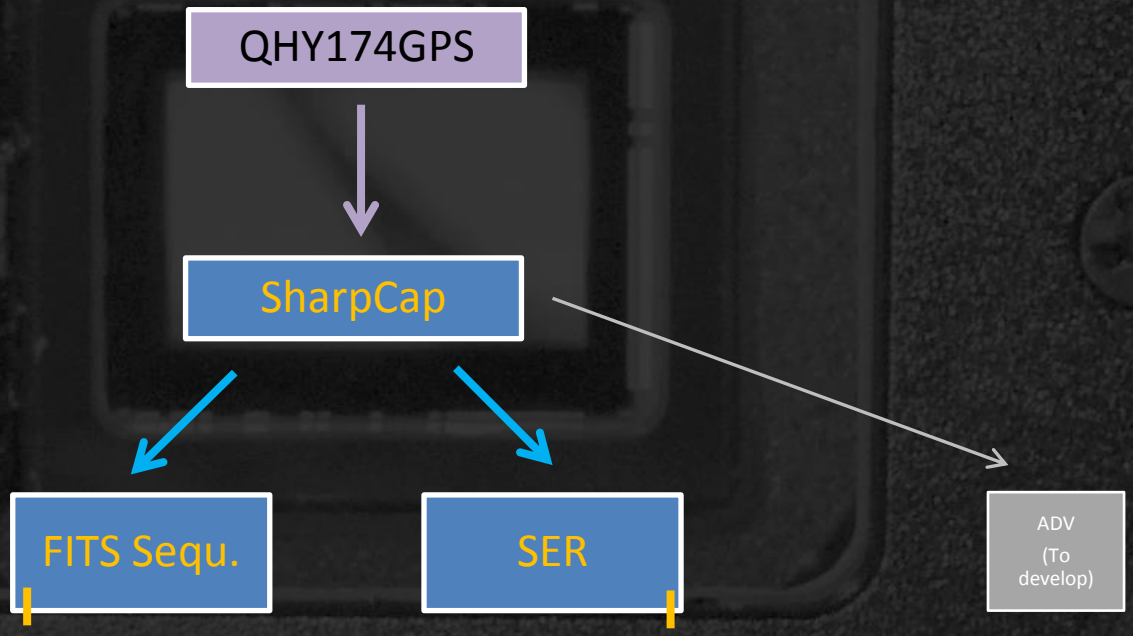
GPS *start exposure* (DATE-OBS)

Page 6

GPS *start frame*

Page 9

UTC synchronized time signals



System time synchronized SC timestamps

Sytem clock *estimated* *frame start* (DATE-OBS)

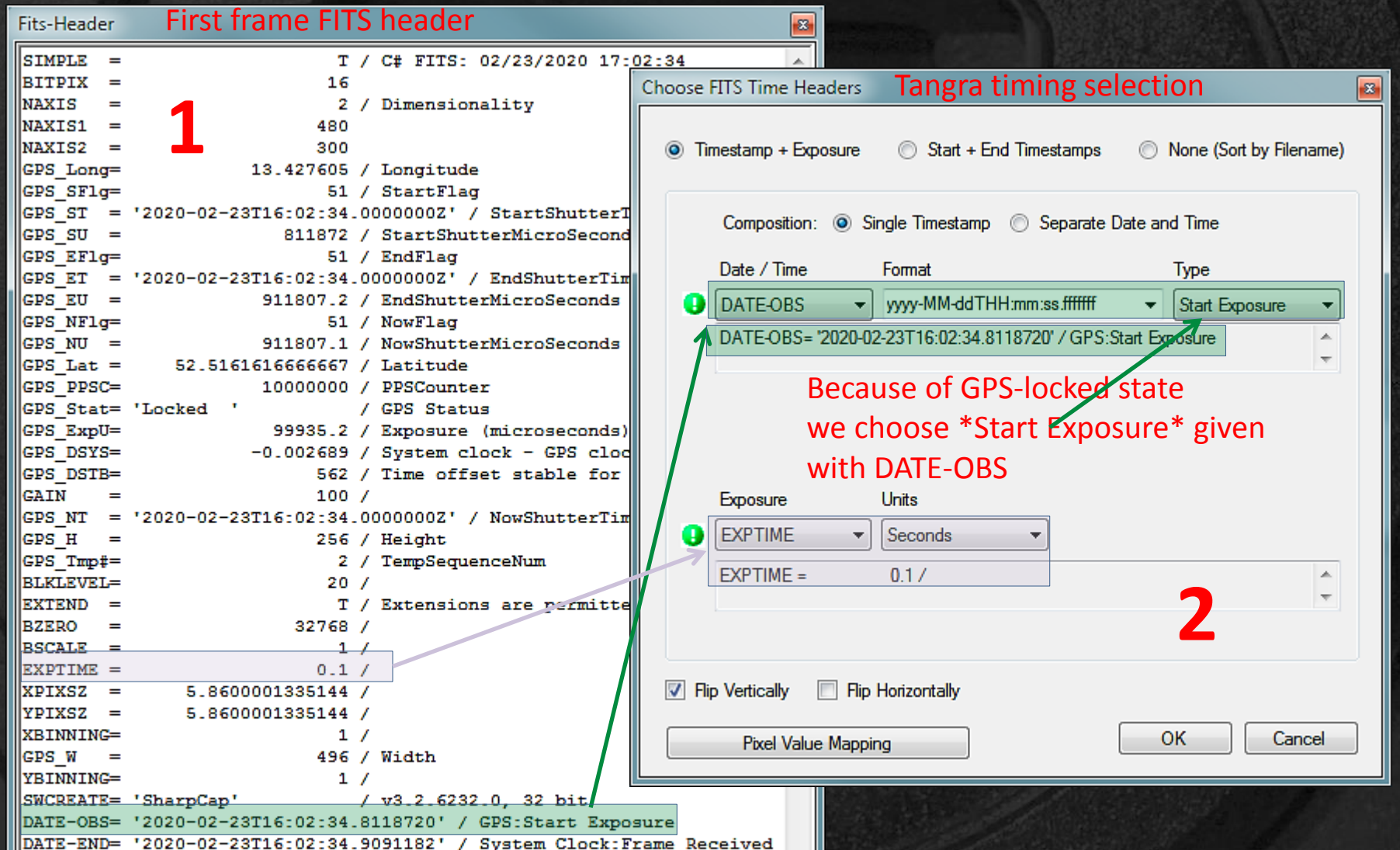
Page 12

Frame recei-ved system time

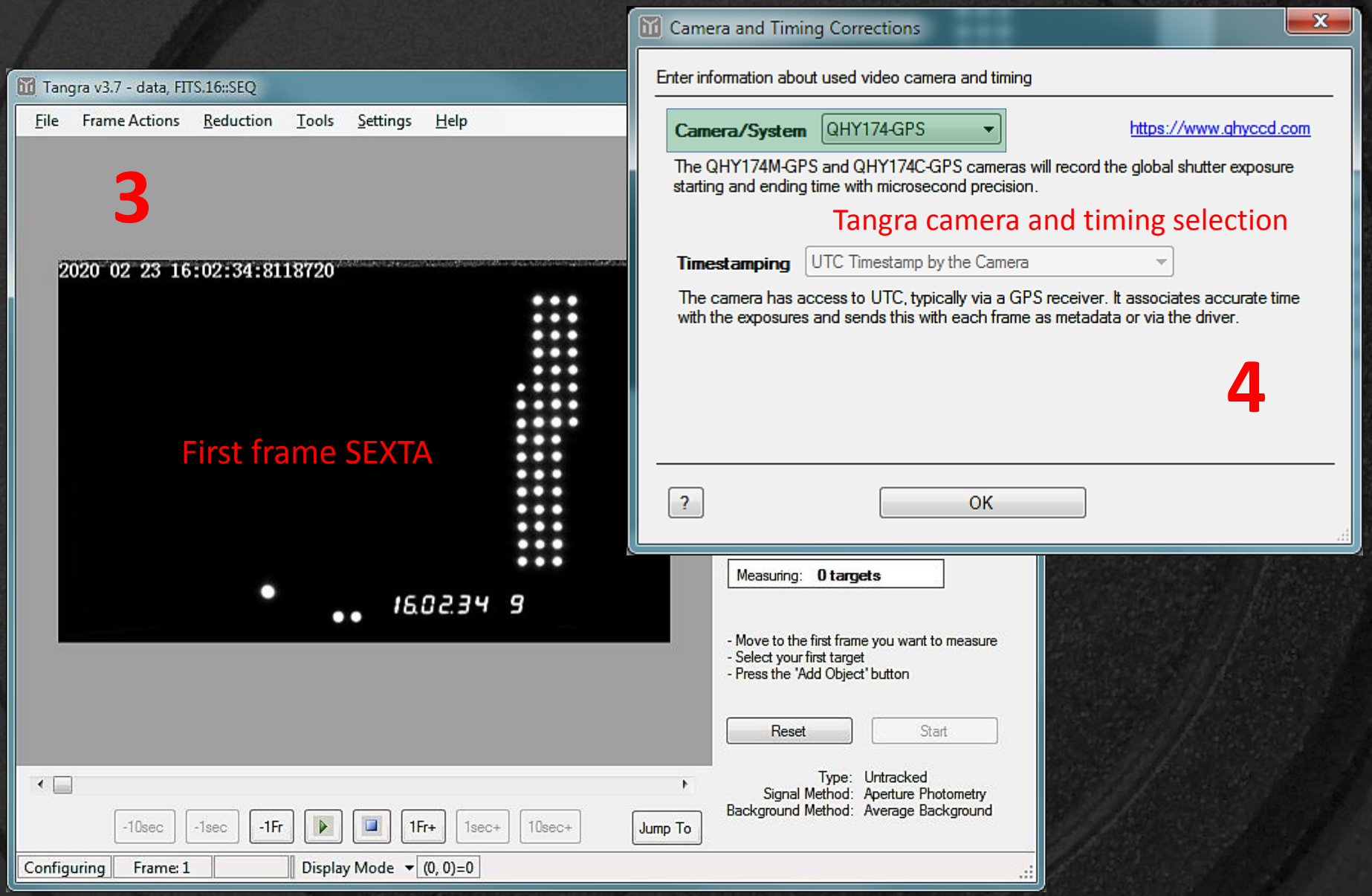
Page 15

SC Timestamps | GPS locked - Tangra FITS sequ.

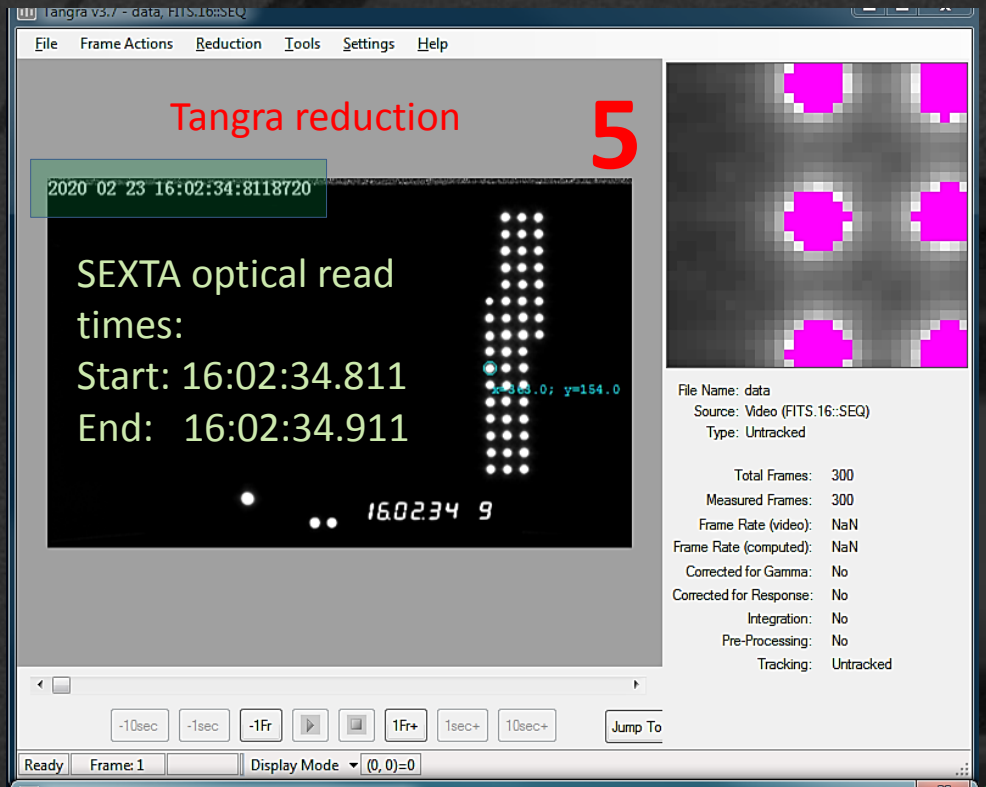
In the following, a sample workflow for a QHY174GPS (locked) 100ms FITS sequence is shown. The pictures refer to the first frame of the sequence.



SC Timestamps | GPS locked - Tangra FITS sequ. 7



SC Timestamps | GPS locked - Tangra FITS sequ.

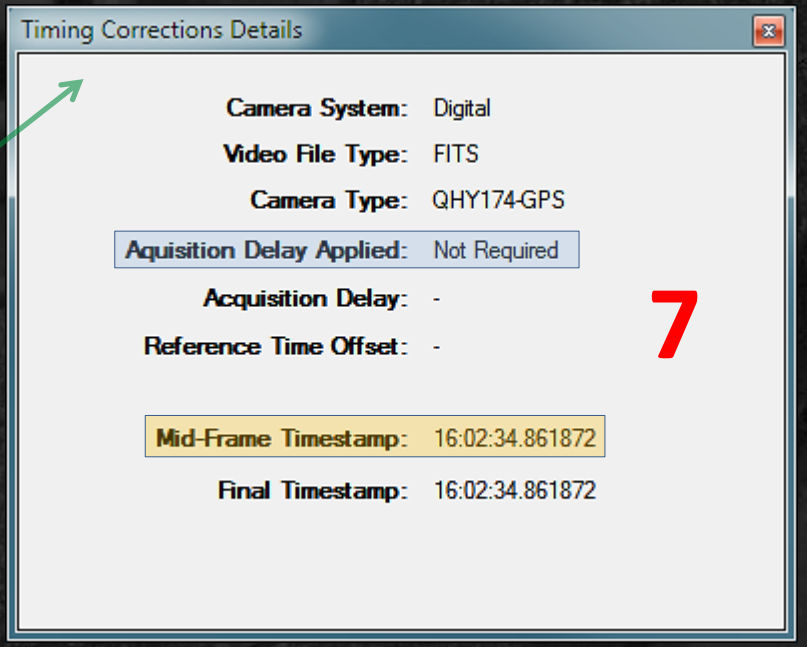


Because of GPS-locked state we selected *Start Exposure* given with DATE-OBS.

Tangra light curves show *Mid-frame* timestamps:
(Start Exp. .811s) + ½ (0.1s) = (Mid-fr. .861)

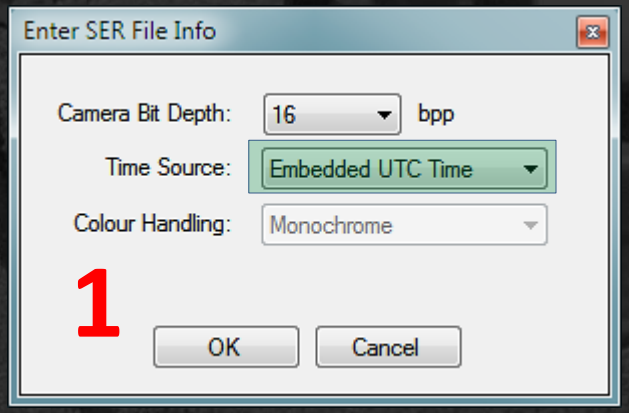
Timing corrections are not required.

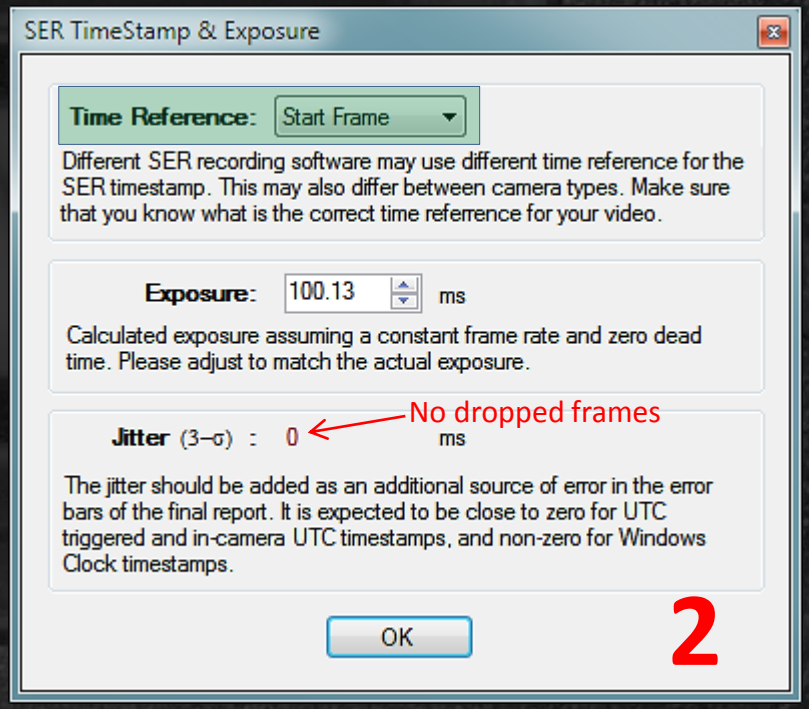
The SEXTA optical read times agree with the times from camera/SC.



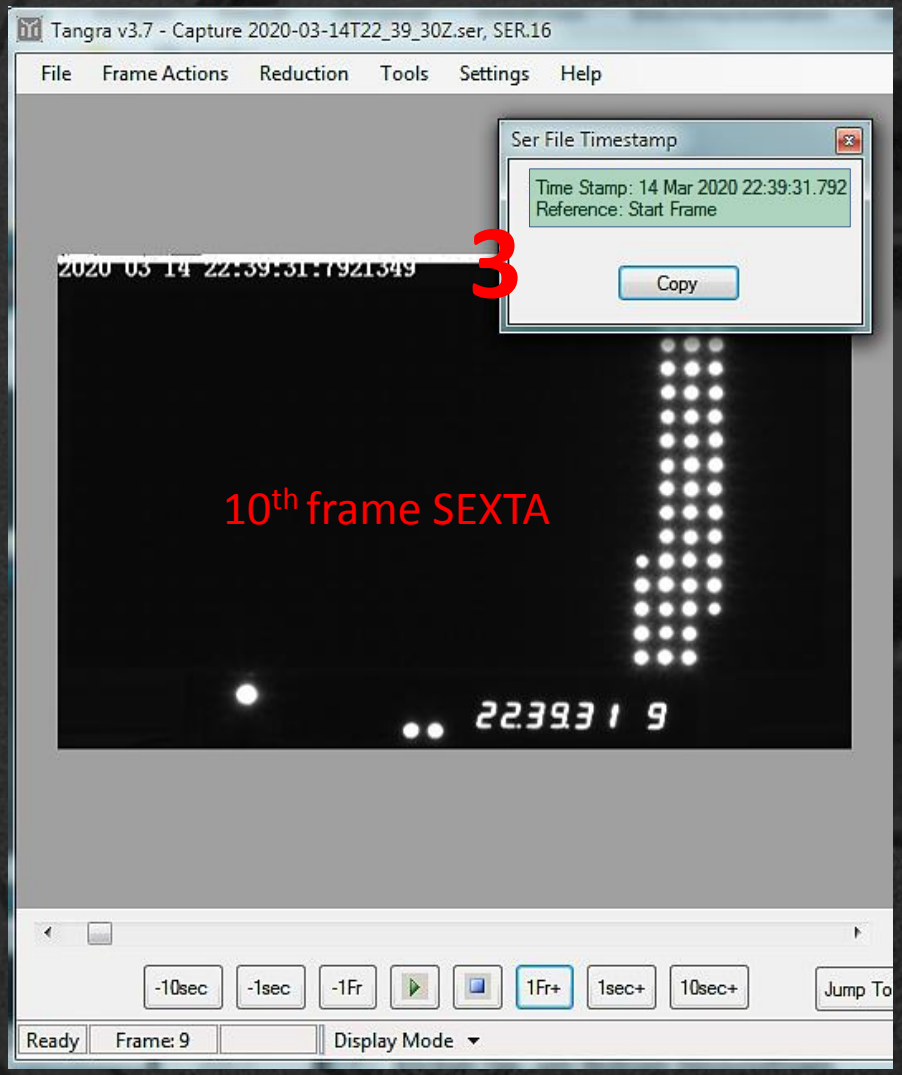
In the following, a sample workflow for a QHY174GPS (locked) 100ms SER video is shown. The pictures refer to the 10th frame of the sequence.

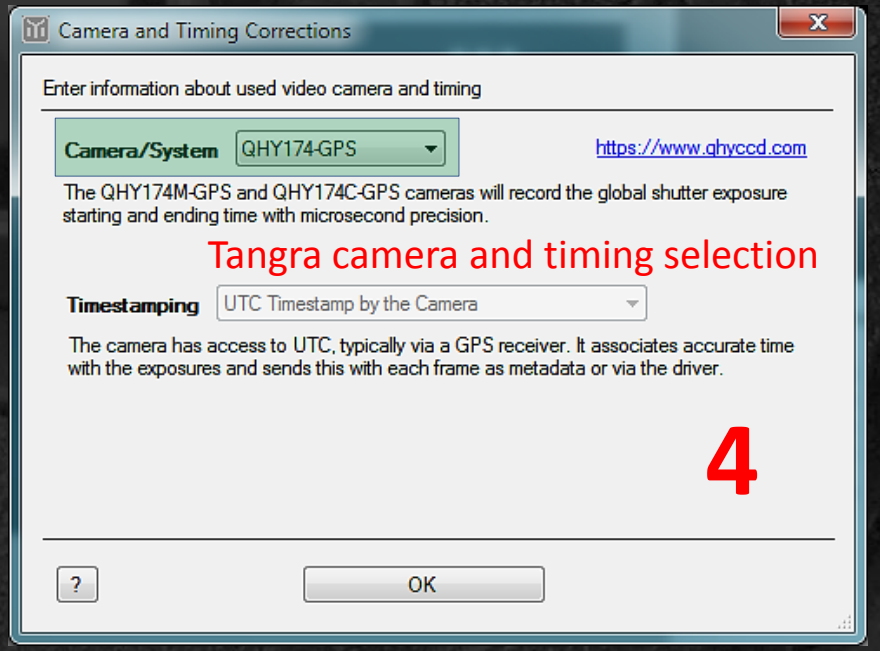
Because of GPS-locked state we choose *Start Frame*



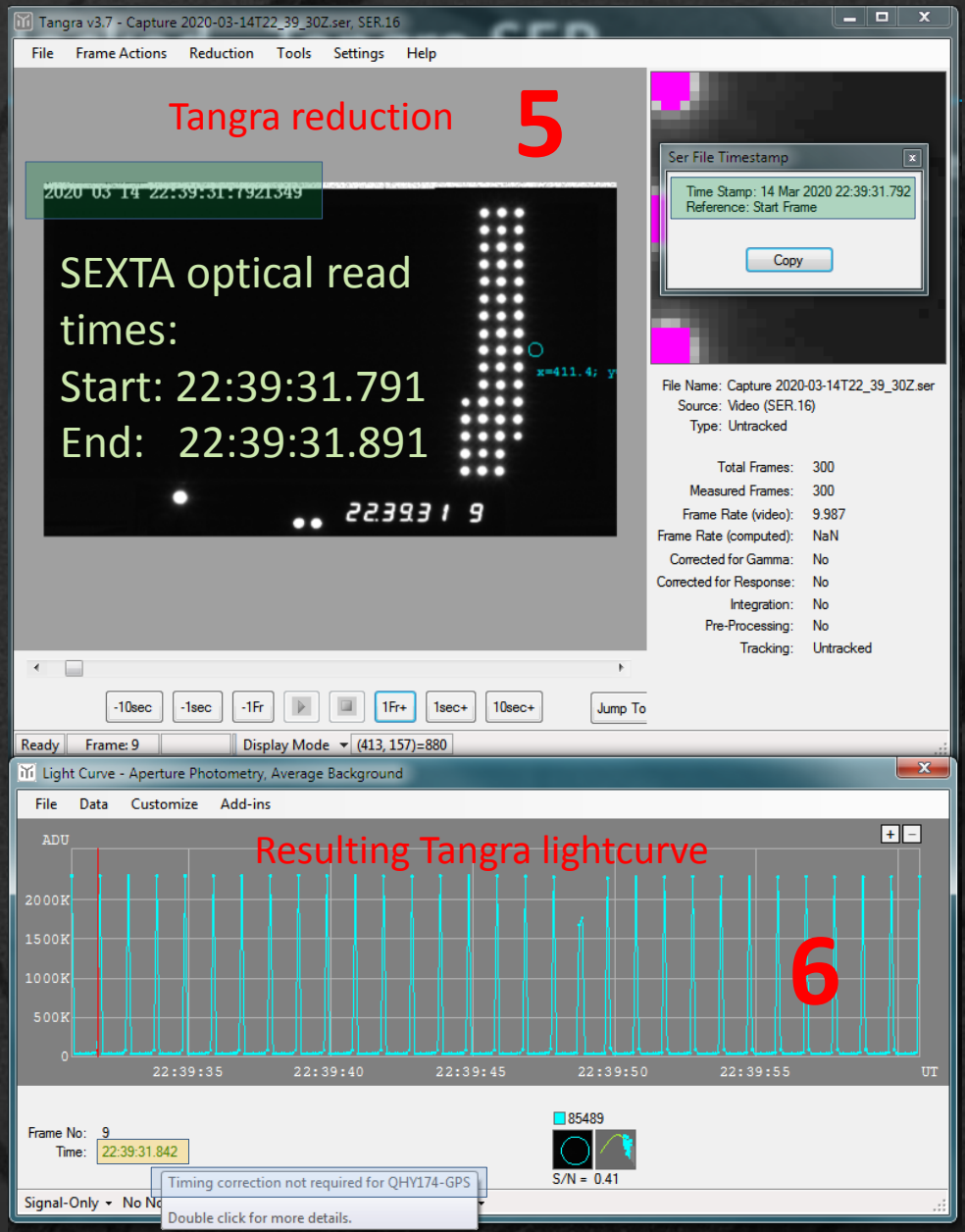


SC Timestamps | GPS locked - Tangra SER





SC Timestamps | GPS locked - Tangra SER

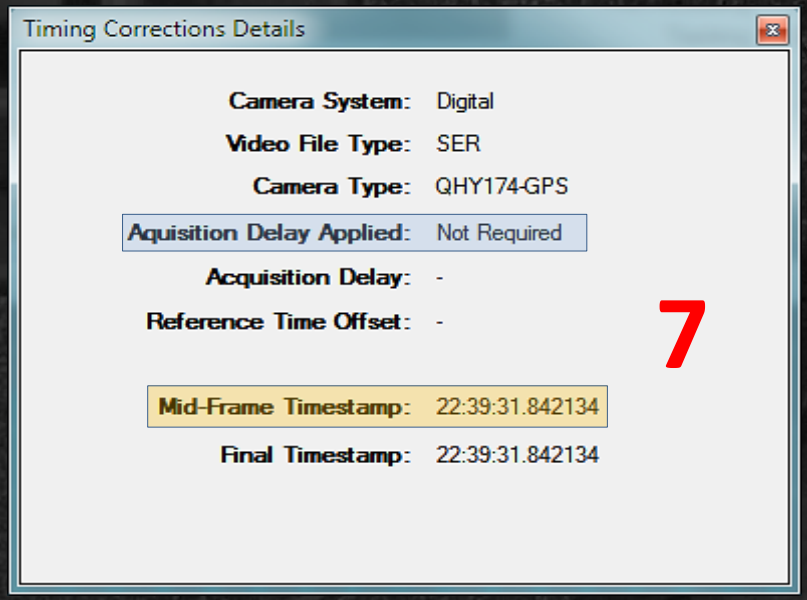


Because of GPS-locked state we selected *Start Frame*

Tangra light curves show *Mid-frame* timestamps:
(Start Exp. .792s) + ½ (0.1s) = (Mid-fr. .842)

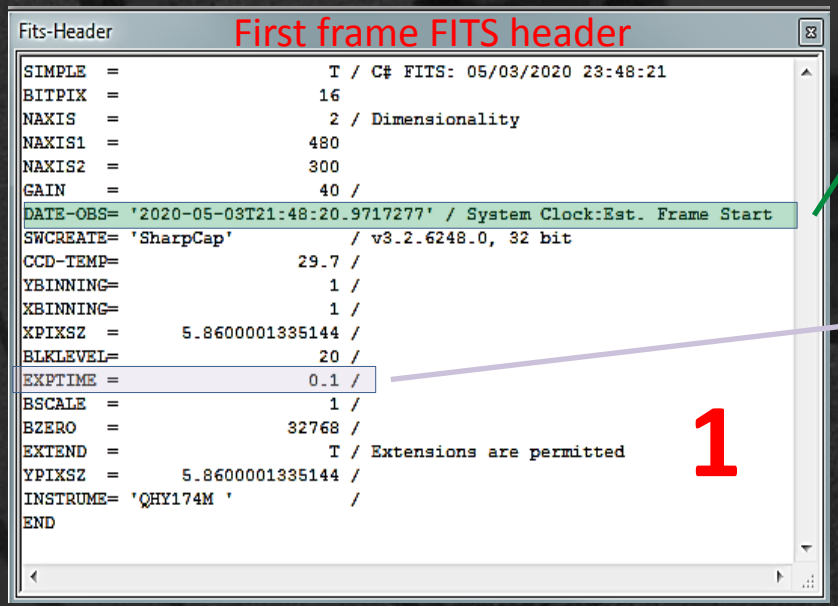
Timing corrections are not required.

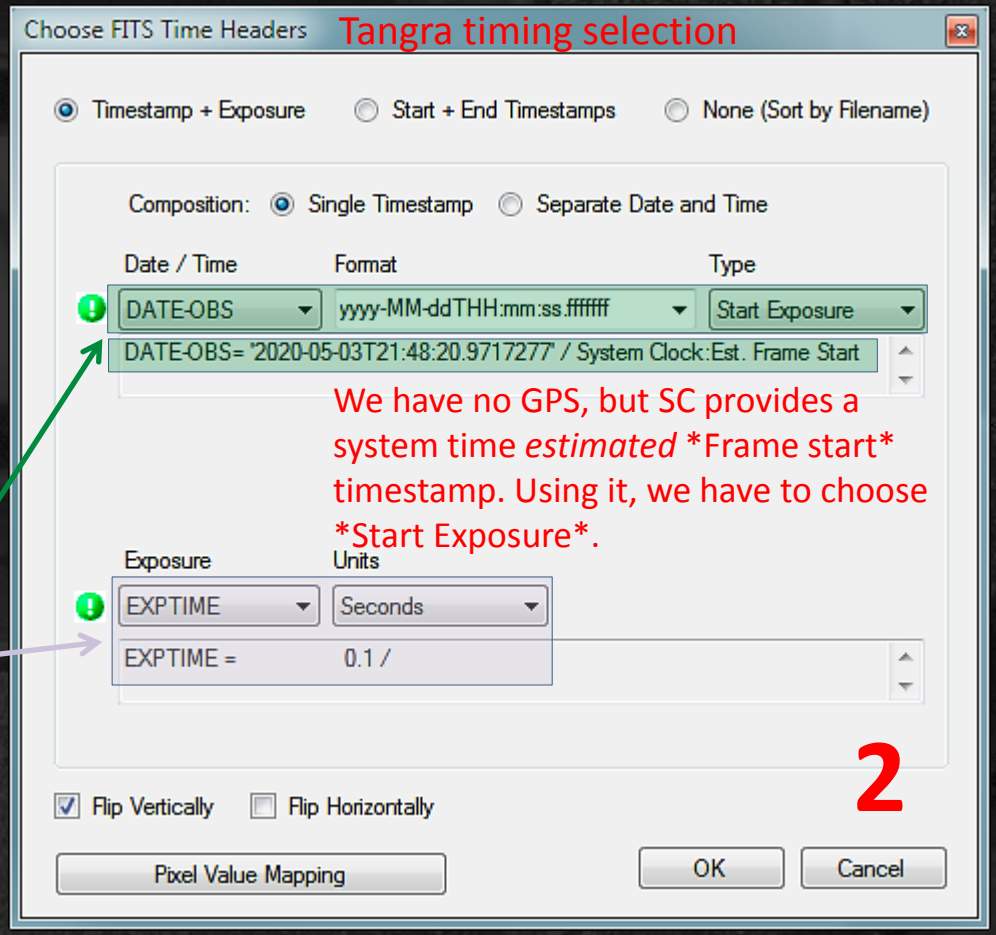
The SEXTA optical read times agree with the times from camera/SC.



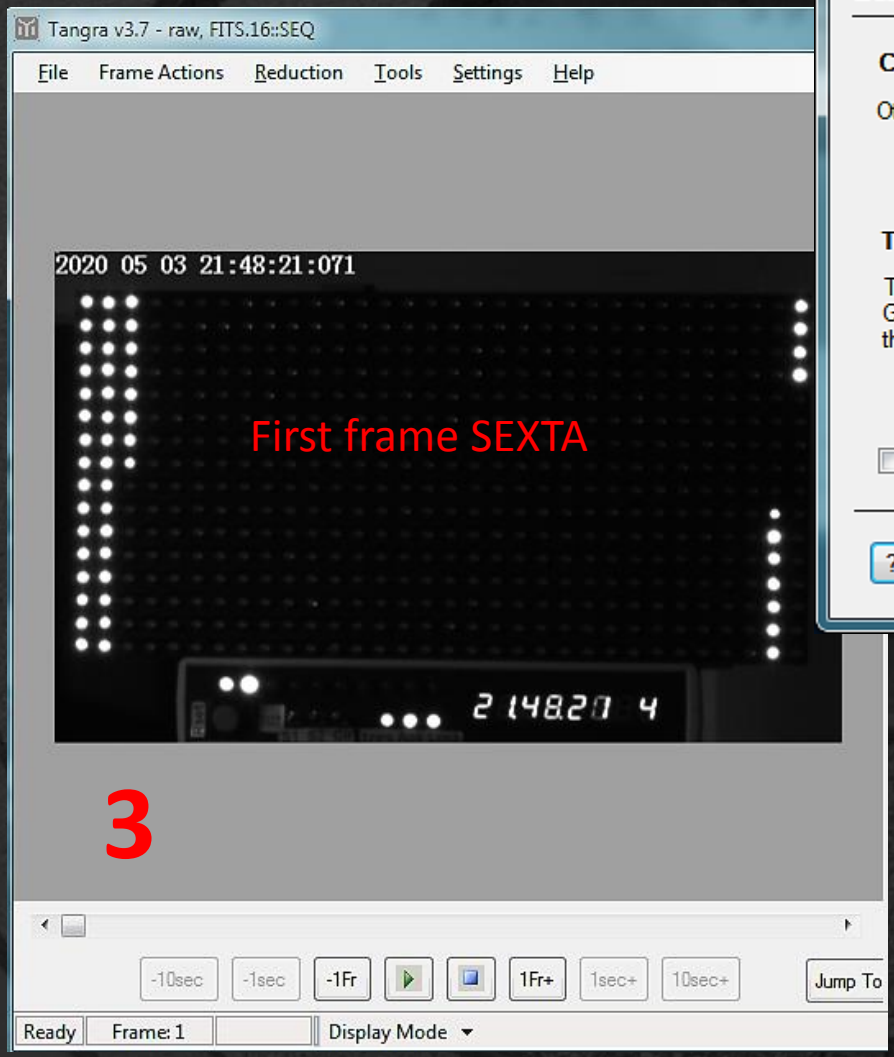
SC Timestamps | No GPS - Tangra FITS sequ.

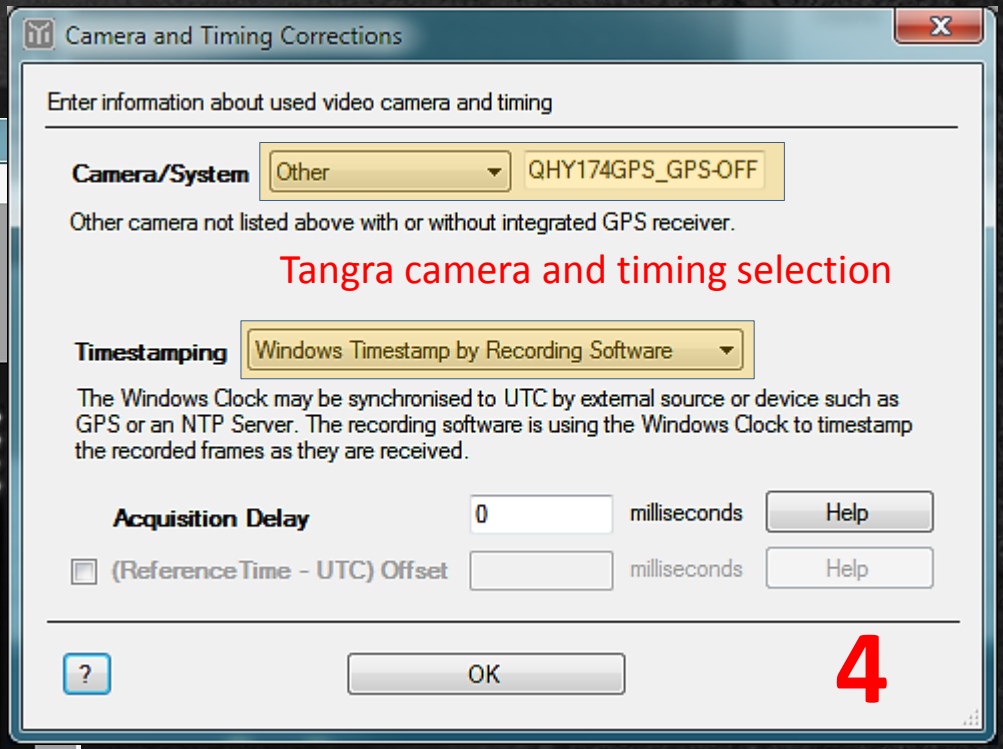
In the following, a sample workflow for a QHY174GPS with GPS off for a 100ms FITS sequence is shown. The pictures refer to the first frame of the sequence.





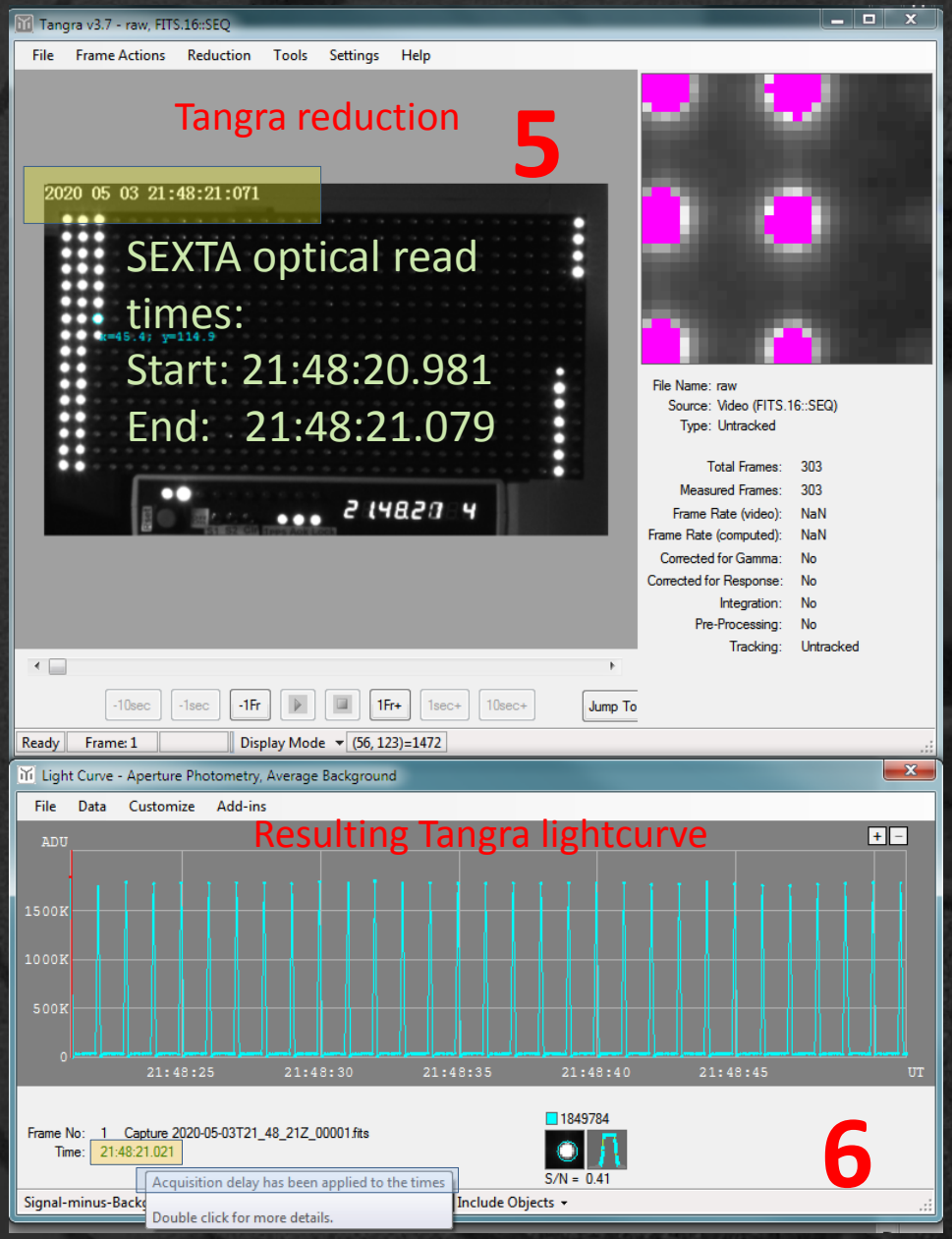
SC Timestamps | No GPS - Tangra FITS sequ.





Within this example, acquisition delay and time offset are not considered.
For information see Tangra help.
Acquisition delay is set to be 0.

SC Timestamps | No GPS - Tangra FITS sequ.



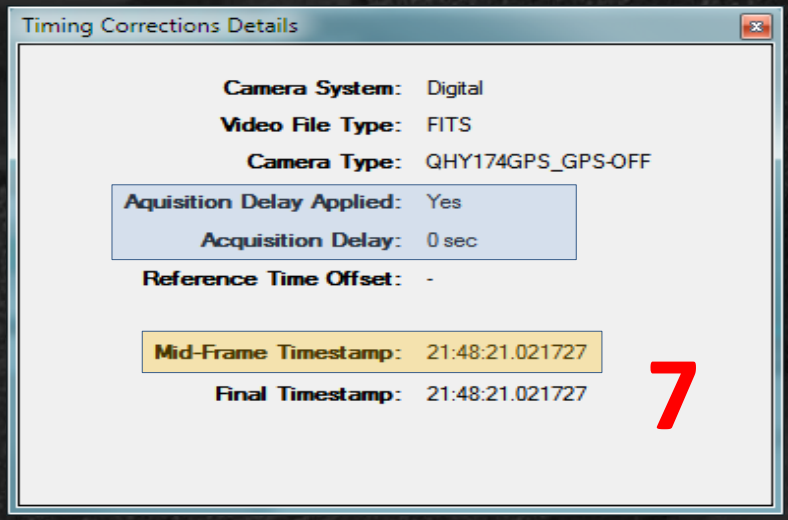
Without GPS, the in-frame timestamp refers to the system time frame received.

From DATE-OBS, the *estimated* *frame start* time is 21:48:20.971

Tangra light curves show *Mid-frame* timestamps.

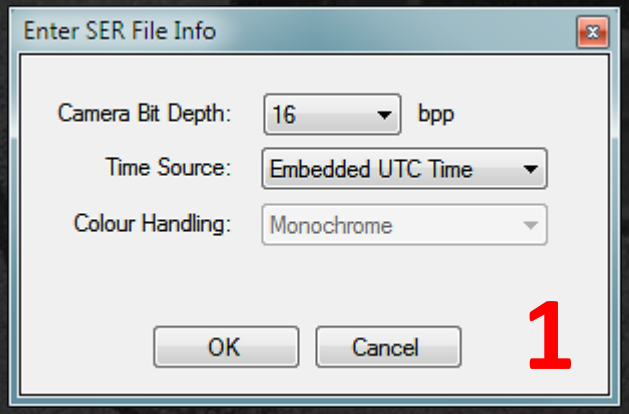
Timing corrections are not considered.

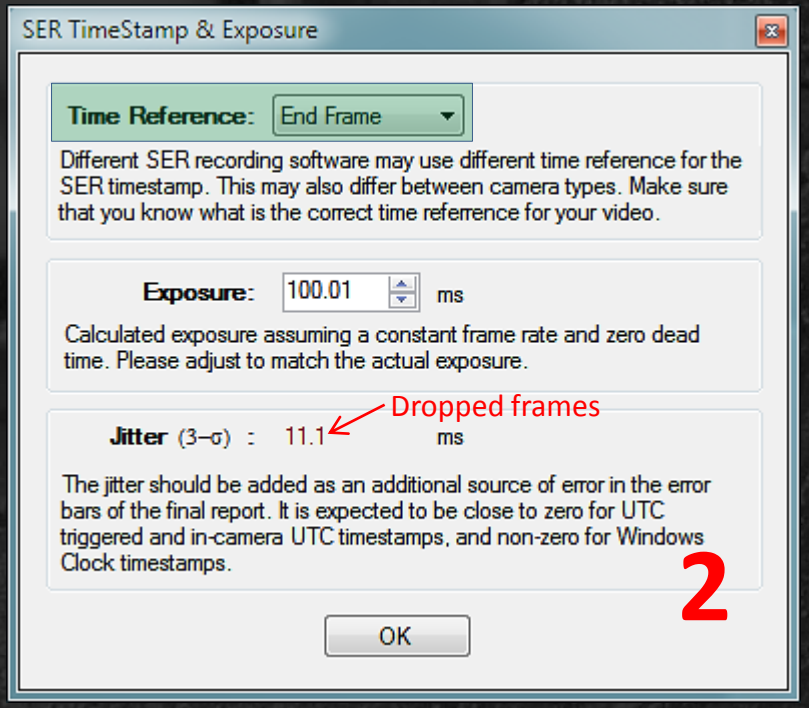
The system time based SC timestamps are ~10ms behind the SEXTA optical read times .



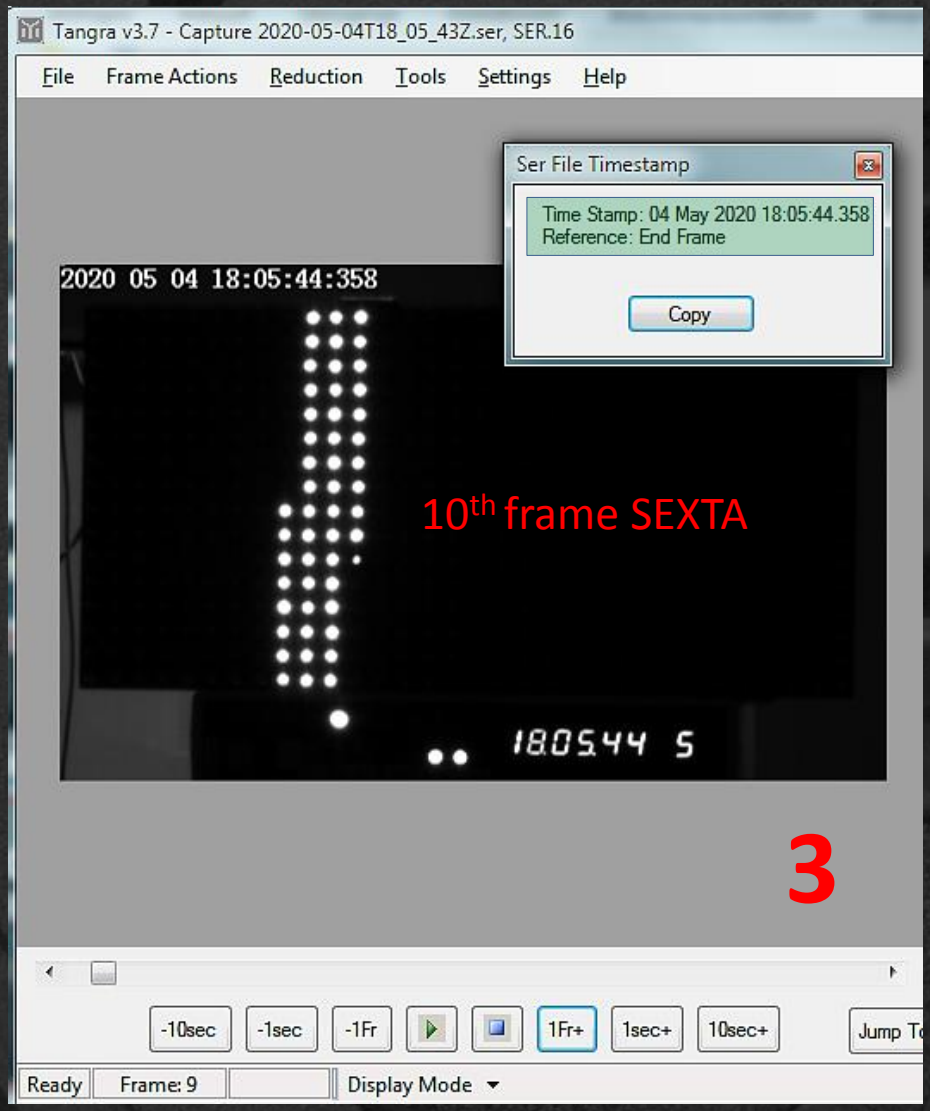
In the following, a sample workflow for a QHY174GPS with GPS off for a 100ms SER video is shown. The pictures refer to the 10th frame of the sequence.

Because of no GPS
we choose *End Frame*

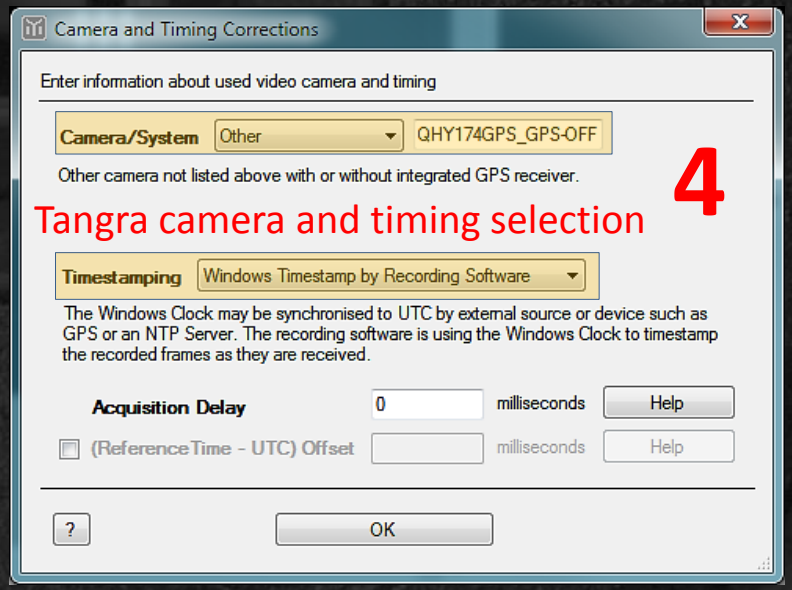




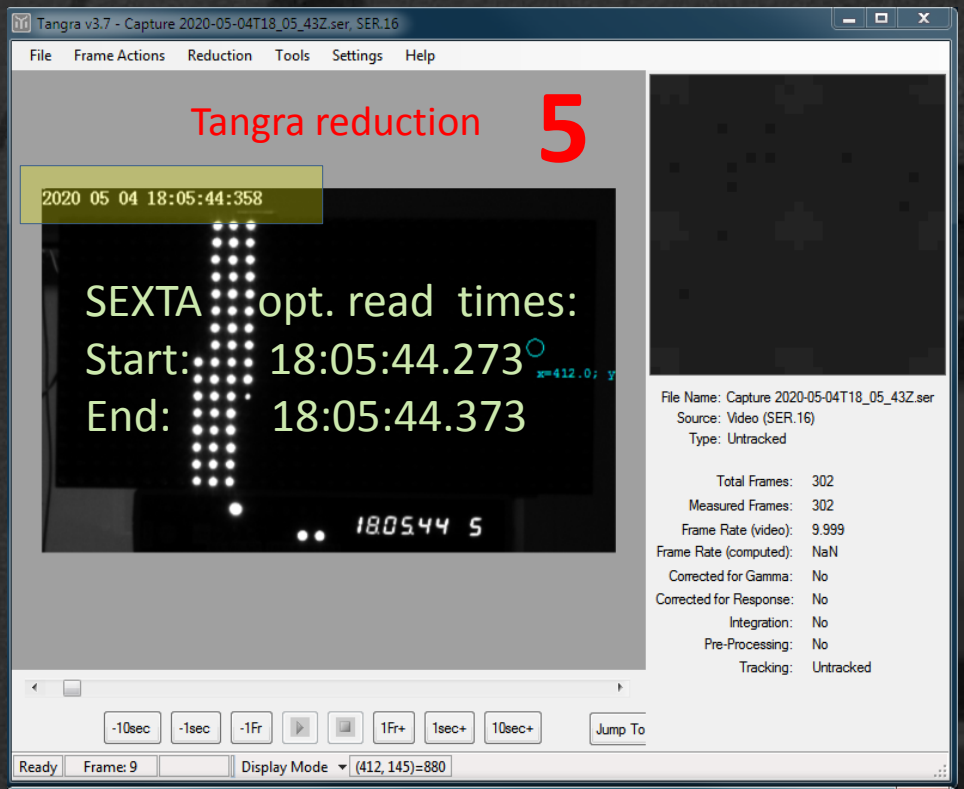
SC Timestamps | No GPS - Tangra SER

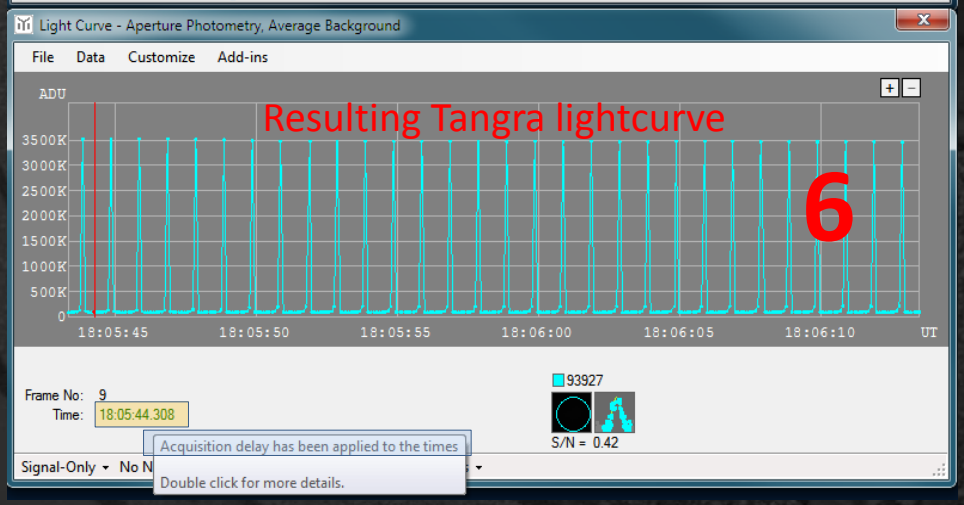


Within this example, acquisition delay and time offset are not considered. For information see Tangra help. Acquisition delay is set to be 0.



SC Timestamps | No GPS - Tangra SER



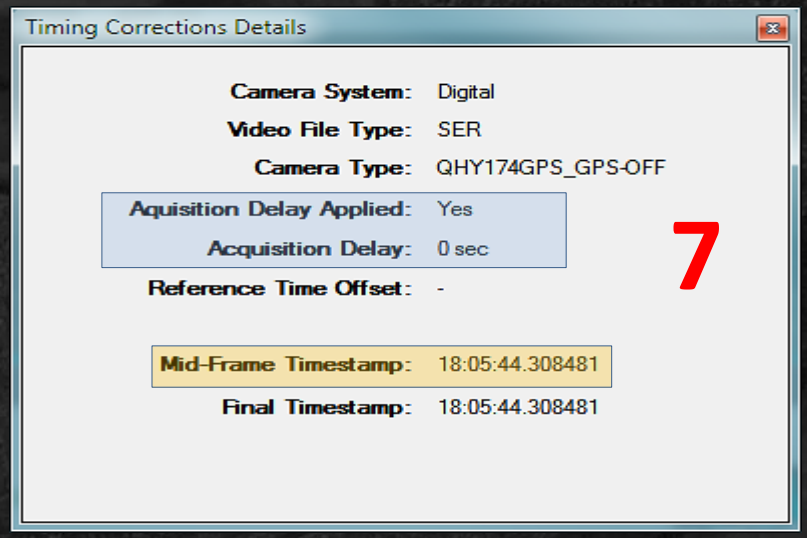


Without GPS, the in-frame timestamp refers to the system time frame received.

Tangra light curves show *Mid-frame* timestamps.

Timing corrections are not considered.

The system time based SC timestamps are ~15ms behind the SEXTA optical read times .



Many thanks to:

Robin Glover	SharpCap developer
Hristo Pavlov	Developer of TANGRA
Th. Midavaine	For providing a SEXTA device (developed by Tony Barry and Dave Gault)

Colleagues of the worldwide community for suggestions and valuable discussions.

To contact me use the planoccult list or
camera@iota-es.de