

# High speed camera ?

Jan Mánek

Czech Astronomical Society

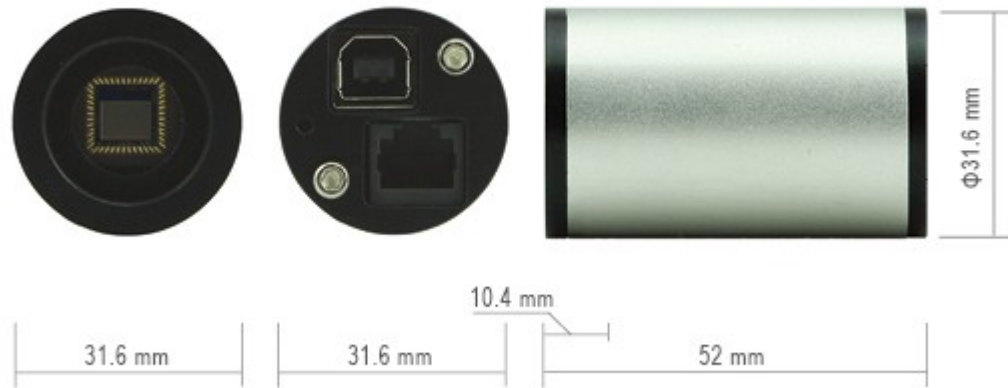
ESOP XXXIII, Prague, CZ, August 30-31, 2014

# QHY5L-II M version (important is the "L" and mono)

- 1/3" APTINA CMOS MT9M034 sensor with maximum sensitivity at ~550nm (rather different from commonly used Watec cameras)
- physical chip size 4.83x3.63mm
- pixel size 3.75x3.75 microns
- connected and powered via USB (2.0 is speed minimum)

# QHY5L-II M version

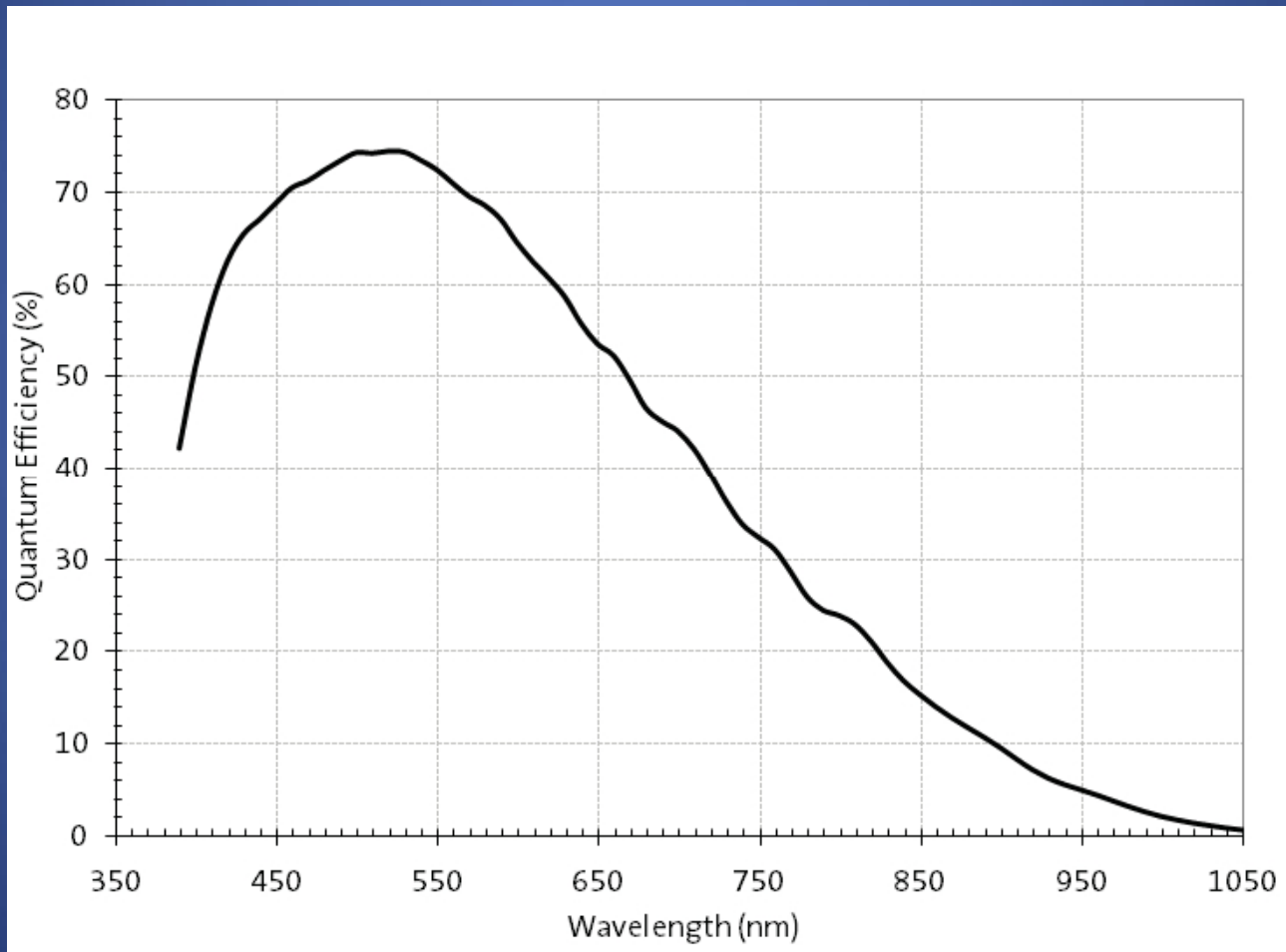
## SIZE AND INTERCEPT



# QHY5L-II M version



# QHY5L-II M version



# QHY5L-II M version

- 45g without parfocalising ring
- fully digital output, no A/D conversions
- maximum image resolution 1280x960 pixels
- minimum image resolution 320x240 pixels
- optimal for asteroid occn. is 2x2 binning mode giving 640x480 resolution and 12-bit
- can work at up to 200fps in 8-bit mode, 100fps in 12-bit

## QHY5L-II M version

- fps is related to the recording image resolution and bit depth : larger image size -> lower maximum fps
- recording at 200fps can be done only at 320x240@8-bit, which is a small central part of chip cutout
- not cooled

# QHY5L-II M version recording software EZplanetary

- can record to multiple file formats, for occultations are interesting uncompressed AVI, or SER (or FITS) files
- can apply on-the-fly dark frame correction
- inserts time directly into the video image and inserted time is end of exposure time
- inserts currently wrong fps into AVI files and no fps/exposure/bit depth info in SER files



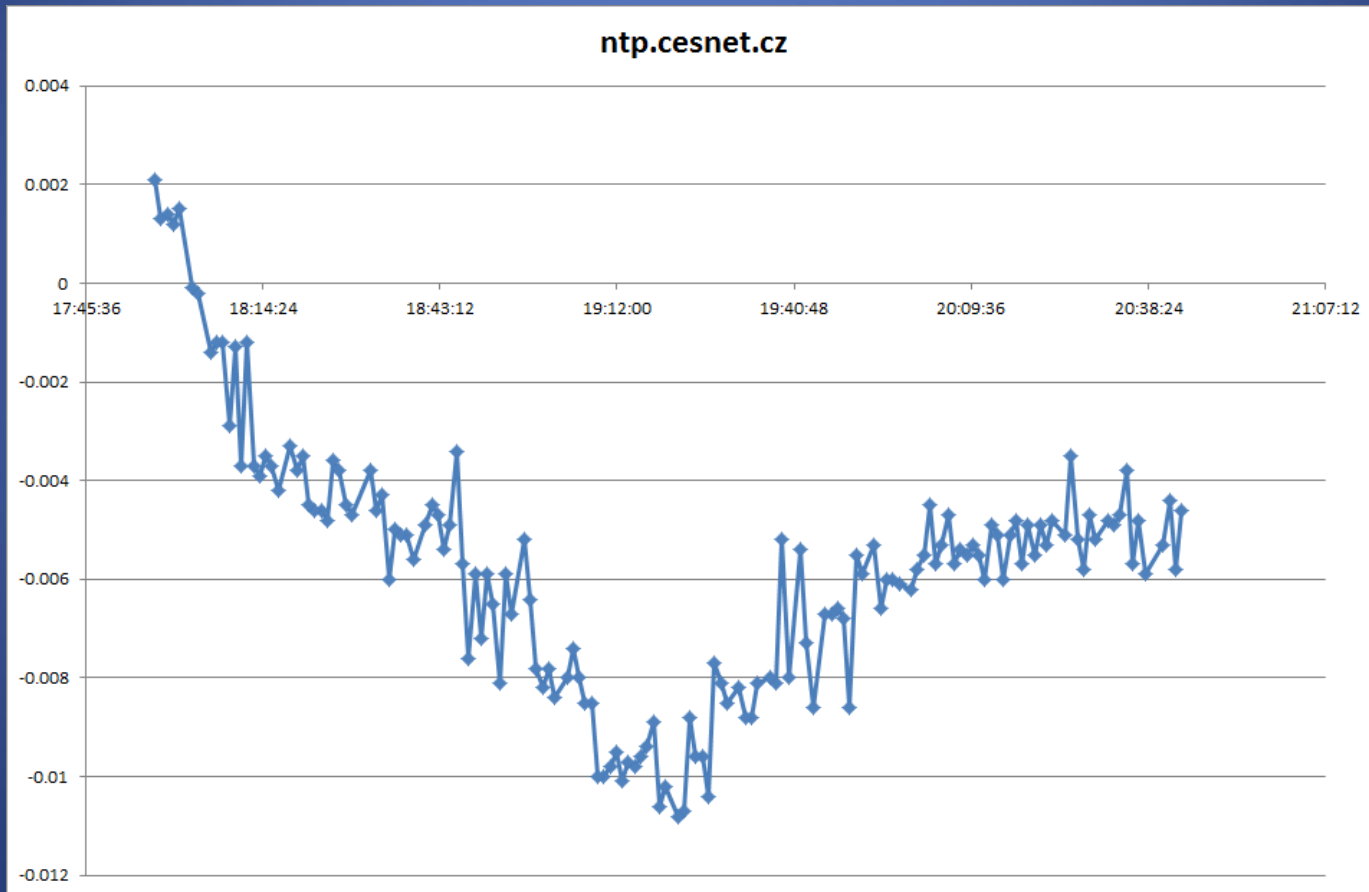
# QHY5L-II M version recording software EZplanetary

- both AVI and SER output formats may be processed with latest Tangra3 (3.1.10) in usual manner
- Limovie can process these AVI files too
- Limovie reflects and correctly uses the high fps in diffraction fits
- OccuRec of Hristo Pavlov can also work with the camera, but NTP time insertion is somewhat problematic now (at least for me)

# QHY5L-II M version ? time ?

- EZplanetary inserts time directly into the video image and inserted time is end of exposure time
- I have free running PC time, which is NTP monitored, so I have an offset to apply to inserted times
- I've made checks so I'm quite sure about accuracy of inserted time to be at 5ms or better -  
ON MY TWO SYSTEMS ONLY !

# QHY5L-II M version ? time ?



# QHY5L-II M version

## Current knowledge/pitfalls

- I have no certainty of how good/stable will be time on other PC systems
- it's important NOT to set PC time during/around the recording, to have enough data and smooth NTP offset info
- AVI recordings have wrong fps internally, before processing them a change of fps should be done in VirtualDub if further Limovie evaluation is needed

# QHY5L-II M version

## Current knowledge/pitfalls

- I see frame dropouts and inserted time seems to shows some jitter, one must be very cautious with evaluation
- I've added camera's MT9M034 chip sensitivity curve to CCDSpectralSensitivity.csv for Limovie diffraction fits
- NTP offset monitoring is done via "NTP monitor" to be found here  
<http://www.satsignal.eu/software/net.htm>

# QHY5L-II M version

## Current knowledge/pitfalls

- field size for full chip is 20.5'x15.3' at 810mm focal length
- field size for 320x240 is 5.1'x3.8' only at 810mm focal length

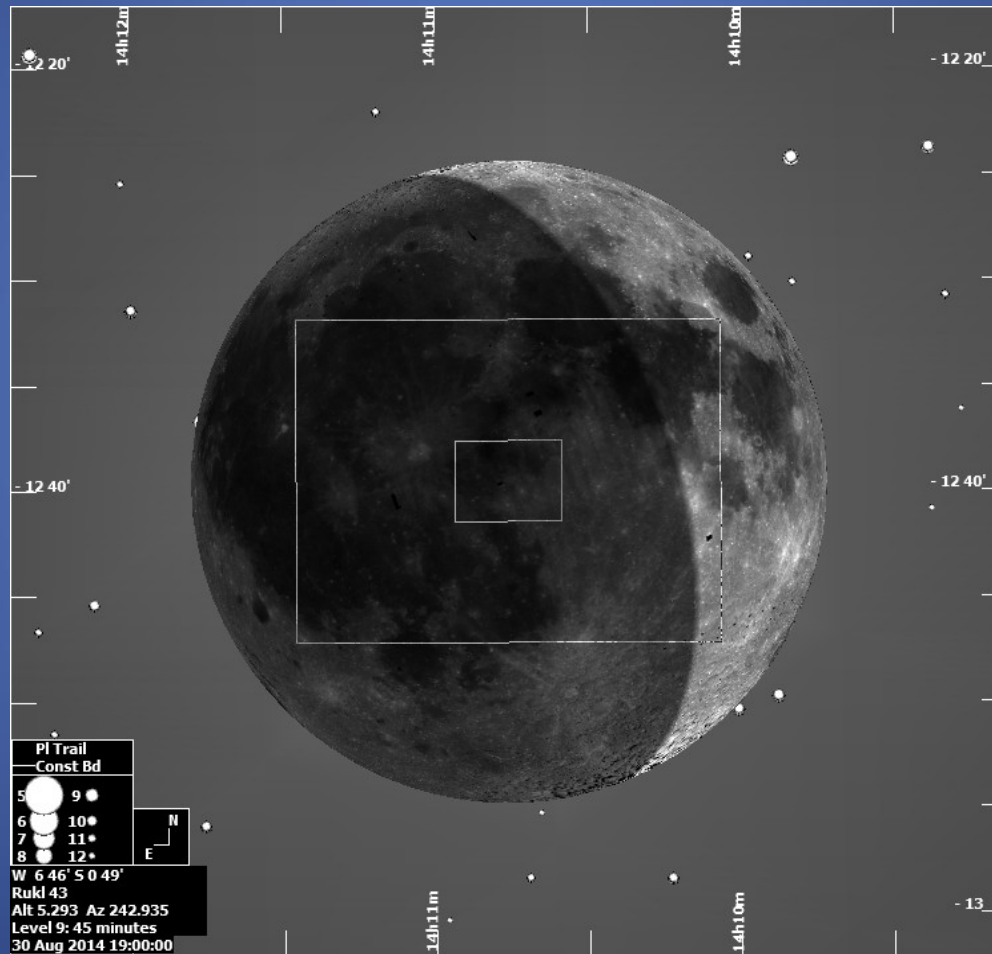
# QHY5L-II M version

## Current knowledge/pitfalls



# QHY5L-II M version

## Current knowledge/pitfalls





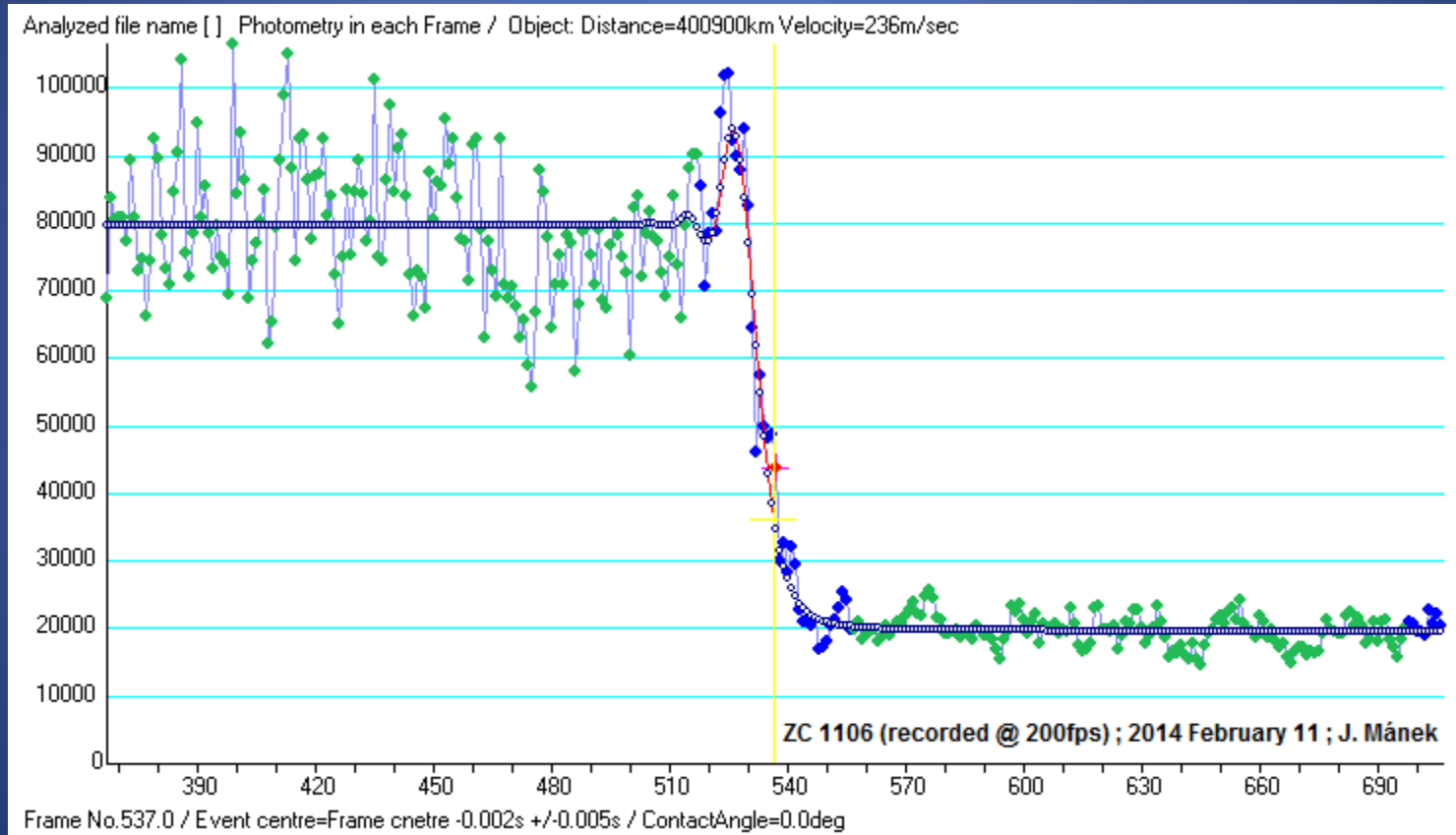
# QHY5L-II M version

## Current knowledge/pitfalls

- at 200fps the limit for evaluation on my 8" Newton is around 7th mag
- I have recorded and reported several double stars at 50 to 200fps
- with 200fps are opening new horizons where diffraction effects play the role instead of step effects at component separations smaller than ~60ms for total occultation
- the important limitation at high fps rates seems to be scintillation on small telescopes

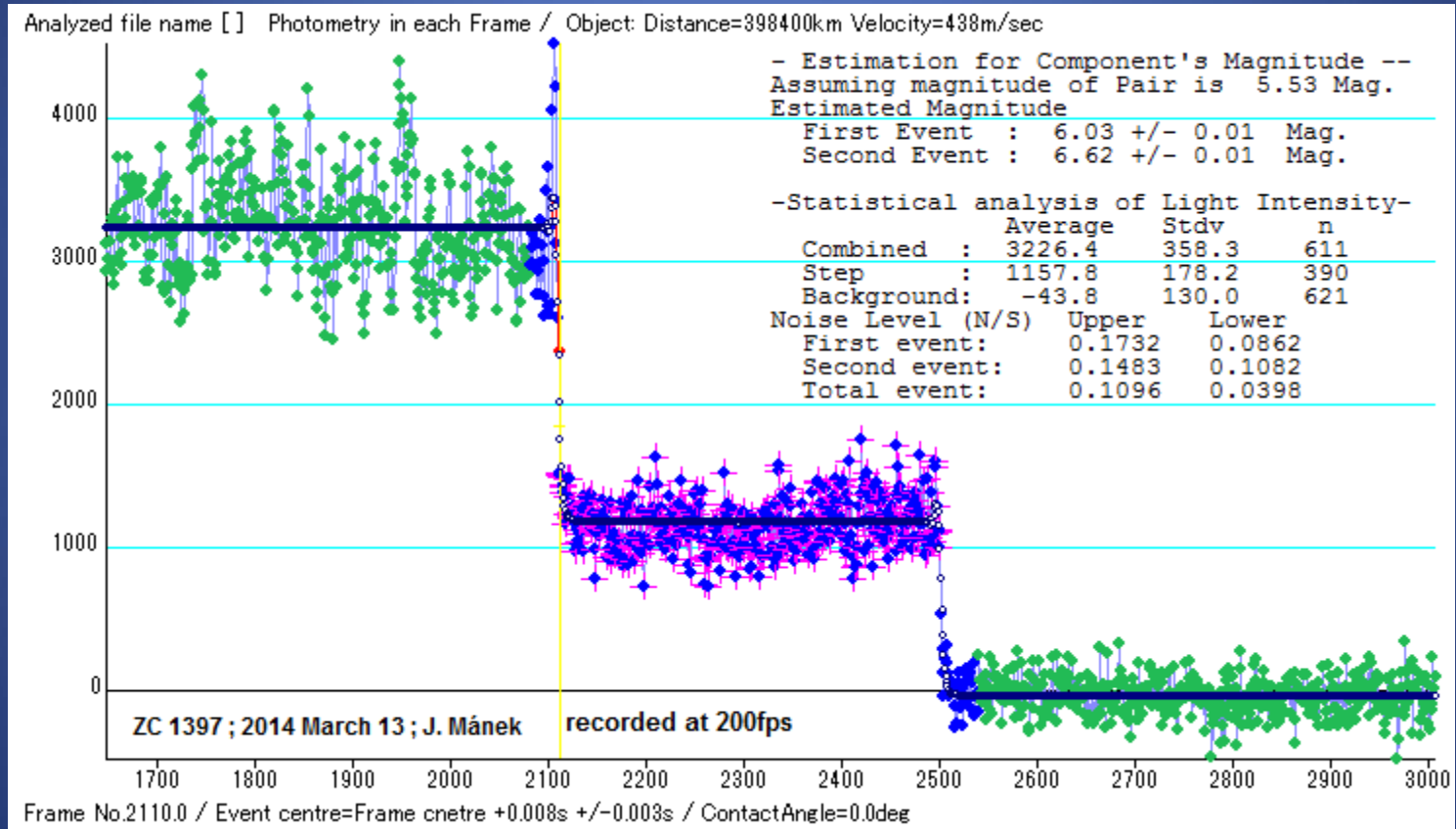
# QHY5L-II M version

## Current knowledge/pitfalls



# QHY5L-II M version

## Current knowledge/pitfalls



# QHY5L-II M version

## Current knowledge/pitfalls

Analyzed file name [ ] Photometry in each Frame / Object: Distance=361700km Velocity=669m/sec

- Estimation for Component's Magnitude --  
Assuming magnitude of Pair is 6.39 Mag.  
Estimated Magnitude

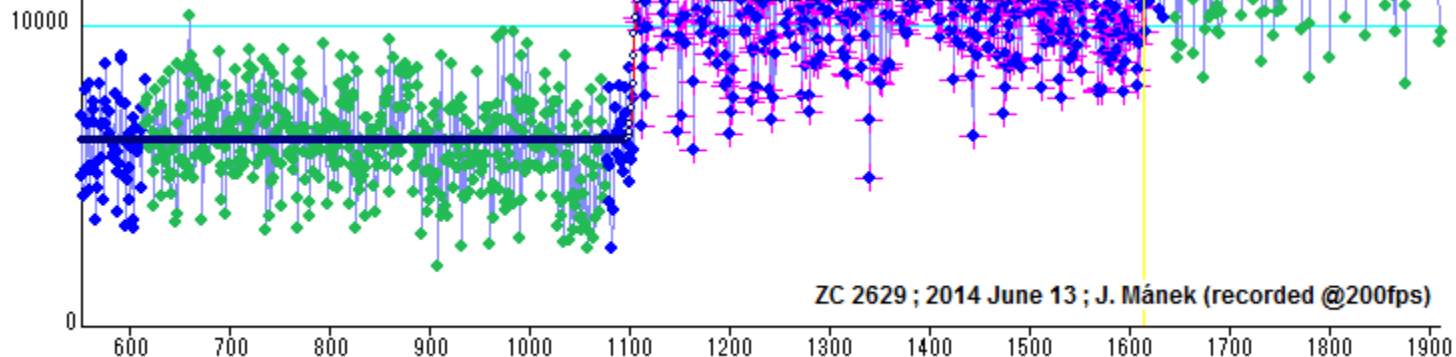
First Event : 6.89 +/- 0.04 Mag.  
Second Event : 7.48 +/- 0.07 Mag.

-Statistical analysis of Light Intensity-

	Average	Stdv	n
Combined :	14019.6	2802.6	781
Step :	11150.6	2061.3	511
Background:	6190.6	1503.7	461

Noise Level (N/S)	Upper	Lower
First event:	0.4156	0.3032
Second event:	0.9769	0.7185
Total event:	0.3580	0.1921

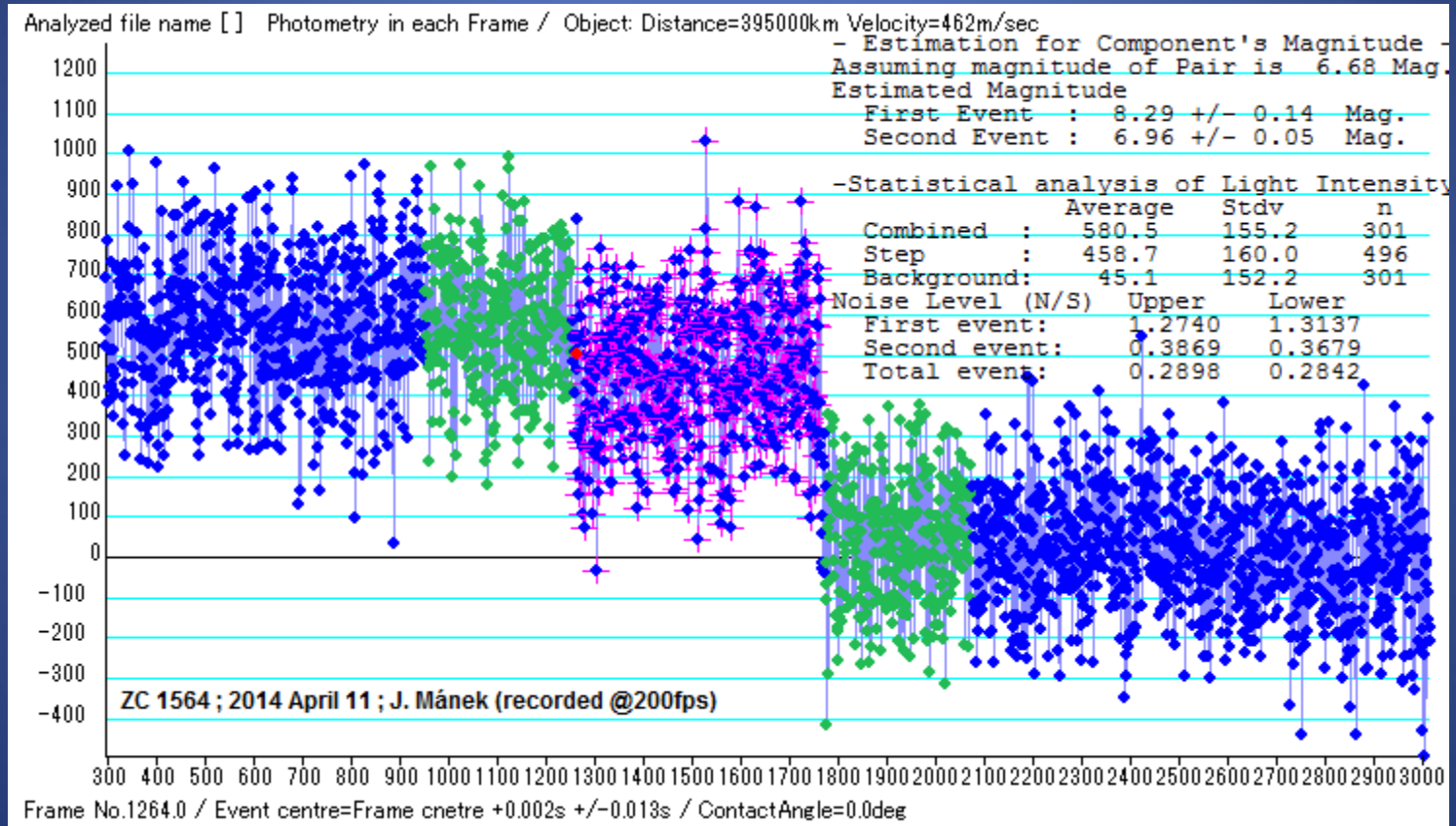


ZC 2629 ; 2014 June 13 ; J. Mánek (recorded @200fps)

Frame No.1615.0 / Event centre=Frame centre -0.012s +/-0.020s / ContactAngle=0.0deg

# QHY5L-II M version

## Current knowledge/pitfalls



## QHY5L-II M version

- I see high potential, but many problems too
- At this moment I can't say this camera is a general *WOW* to be used by everyone, there are real problems to keep eye on

QHY5L-II M version  
cropped video : 200fps->20fps



# QHY5L-II M version similar cameras

- ASI120MM Mono
- Celestron Skyris 132M
- possibly some other using the same chip or providing same fps and image parameters