QHYCCD QHY 42 Camera : first evaluation and parameters measurements

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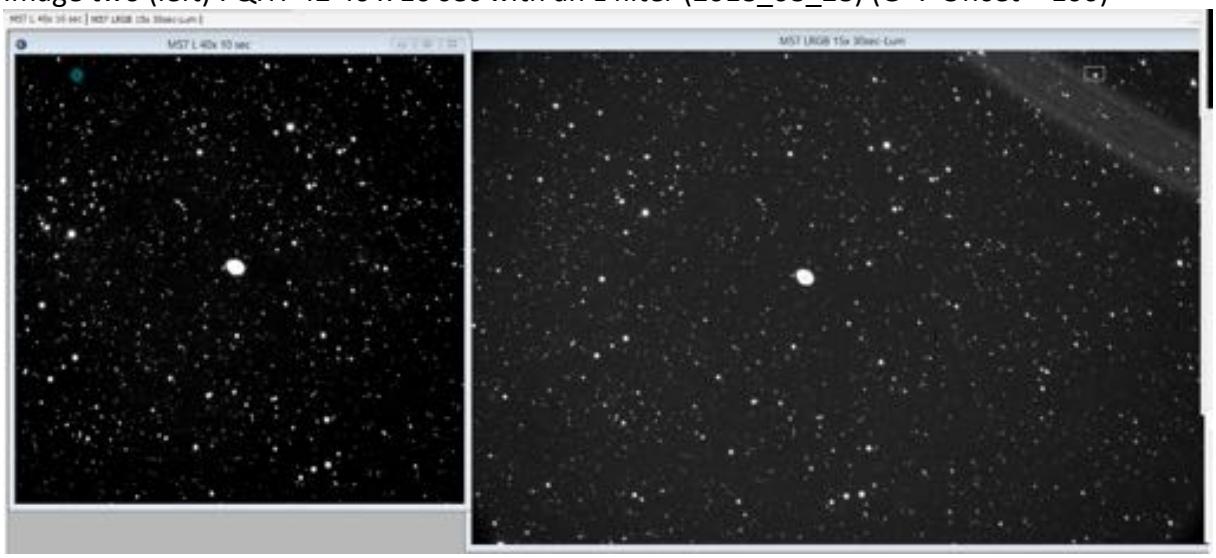
Part 2 : the QHY CCD QHY 42 first lights

Introduction

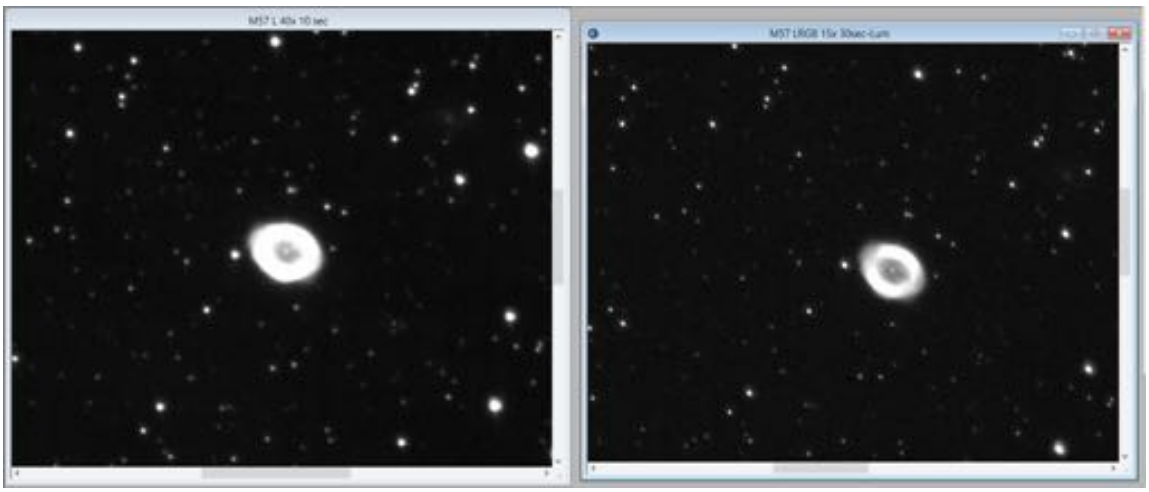
I tried to always compare the QHYCCD QHY42 with the FLI11002 as a reference.
My equipment is an Officina Stellare RILA 400mm F5.2 telescope and an ASA Direct Drive DDM85.

1) Very "First light" on M57

Image one (on the right) : FLI 11002 15 x 30 sec with an L filter (2018/08/02)
Image two (left) : QHY 42 40 x 10 sec with an L filter (2018_08_28) (G=7 Offset = 100)

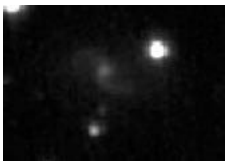
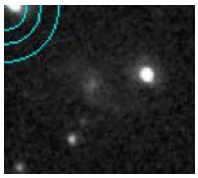


The field of the QHY42 is smaller than the FLI one.
In fact, with 10 seconds exposure time, most stars are completely saturated on the QHY42 image! I did not expect the camera being so fast, with a full well quite limited !
The first lesson with this camera is that you have to take short exposures and then stack them!
Anyhow, the right image appears to be more contrasted than the right one for a similar exposure time.
Zoom 200% on M57 itself :



Number of ADU on a 12 pixel aperture radius : QHY42 : 437.000 ADU (12bits) for 10 seconds (left), FLI : 134.000 for 30 seconds (right); ratio QHY42/FLI = 9.8 (surface)

Focus on a 14.3 mag galaxy in the field : IC1296

QHY 42 :  FLI 11002 : 

On this example, it is possible to distinguish slightly better the galaxy wings on the QHY42 image than on the FLI 11002.

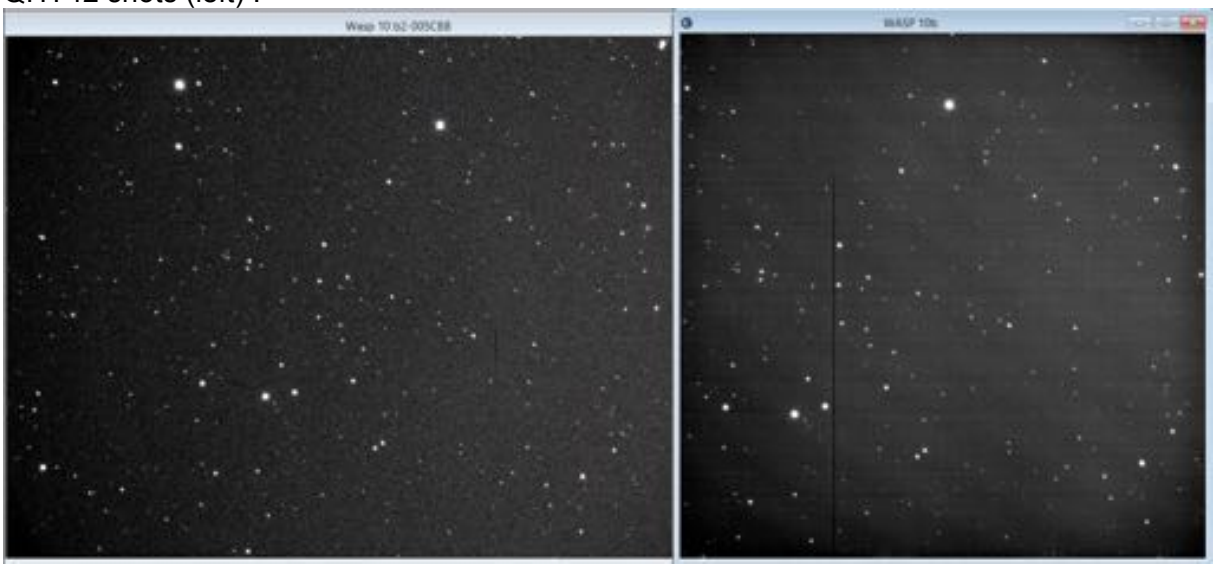
2) Weak star light flux measurement

Comparison between FLI 11002 (2016_11_17) & QHY42 (2018_10_20)
The comparison has been made on WASP 10b exoplanet Field, with a CBB filter (500nm blue cut filter), on a 12 mag star UCAC4 608 :139042.

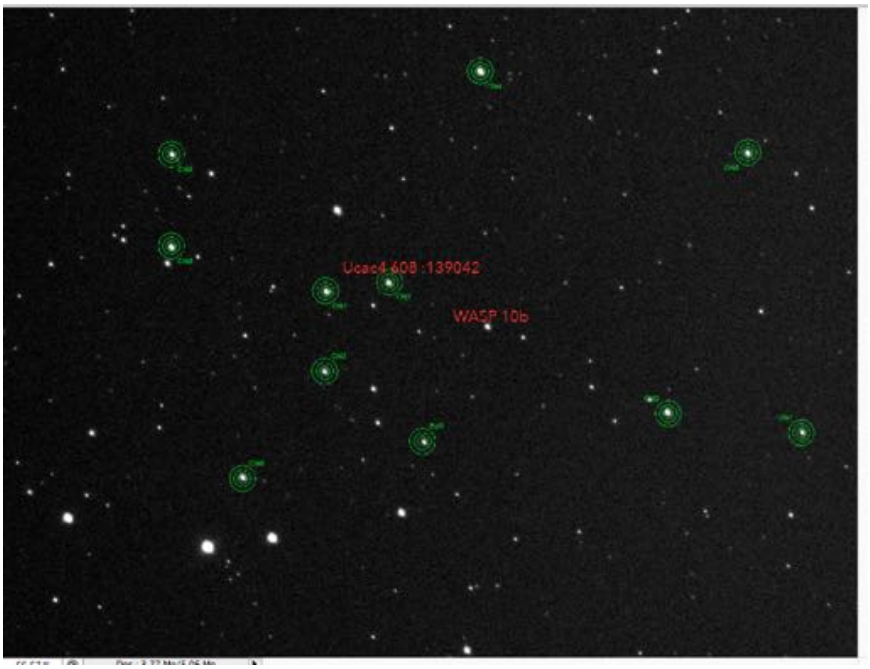
The exposure time for the FLI 11002 camera has been choose to be 60 seconds (-10°C) because it is the maximum before star drifting. The maximum pixel intensity on Wasp10b is 14200 and total intensity 316000 ADU. In one hour, we get only 46 images due to load time image transfer and also a image analysis every 60 seconds to slew the telescope to the right position to compensate telescope drift.

The exposure with the QHY42C camera (Gain= 7 - 0.45 e-/ADU) has been choose to be 2 seconds (-10°C) to avoid saturation. The maximum pixel intensity on Wasp10b is 41000 (2500 in 12bits) and total intensity 733000 ADU (45800 in 12 bits ADU). In one hour, we get only 24 60 seconds images (30 x 2 seconds), due to image transfer (neglectable), 1 second pause (error : to be suppressed) and an image analysis and slew to the corrected position every 60 seconds (every 30 images).

The comparison is made between one 60 seconds FLI 11002 shot (right) and 30 x 2 seconds QHY42 shots (left) :

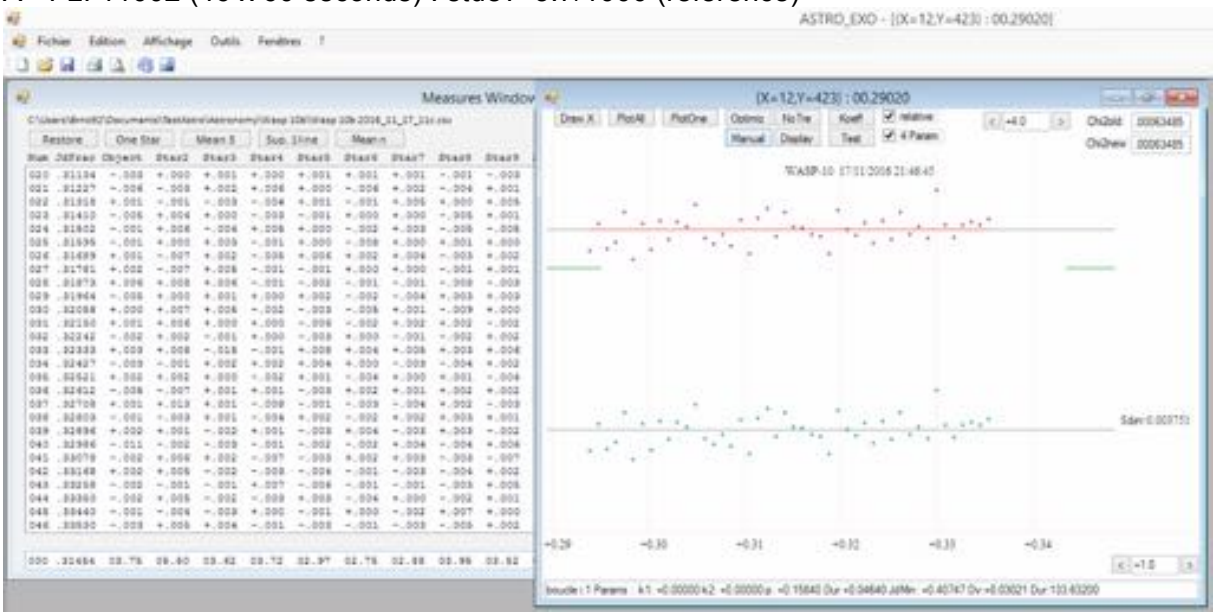


The test has been made measuring the star UCAC4 608 :139042 with 10 surrounding stars on a one hour time length :

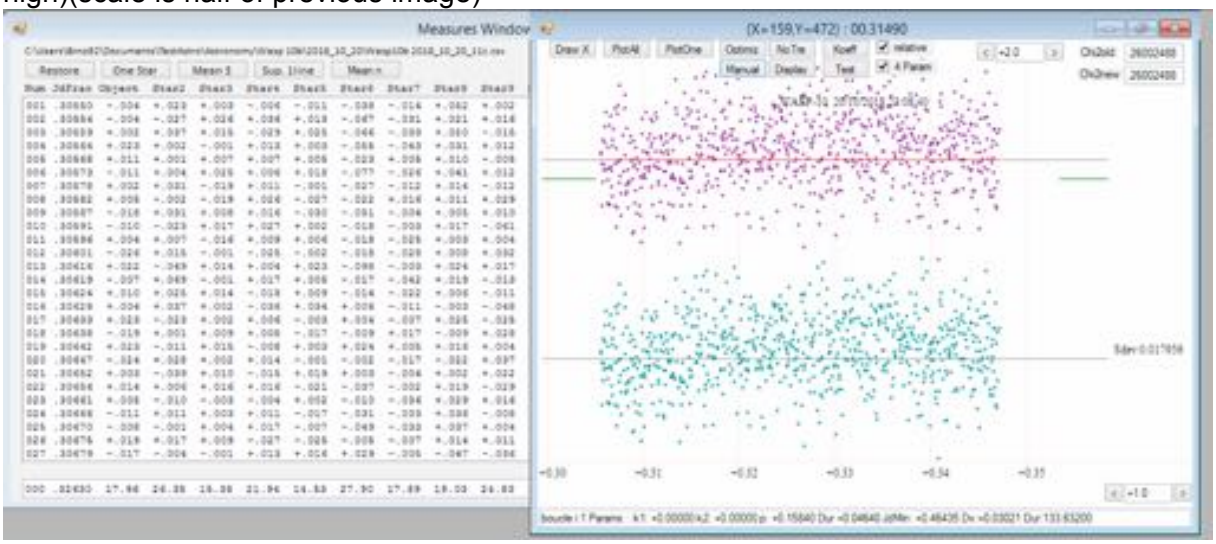


The green line on the right curve is 0.01 mag or 10 mmag) :

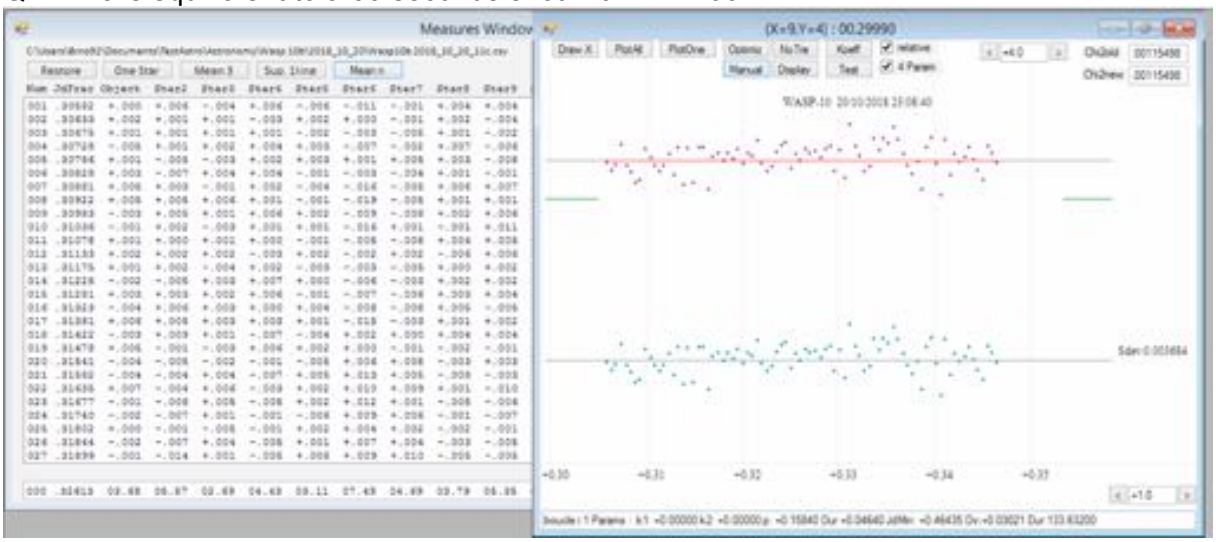
A - FLI 11002 (46 x 60 seconds) : stdev=3.7/1000 (reference)



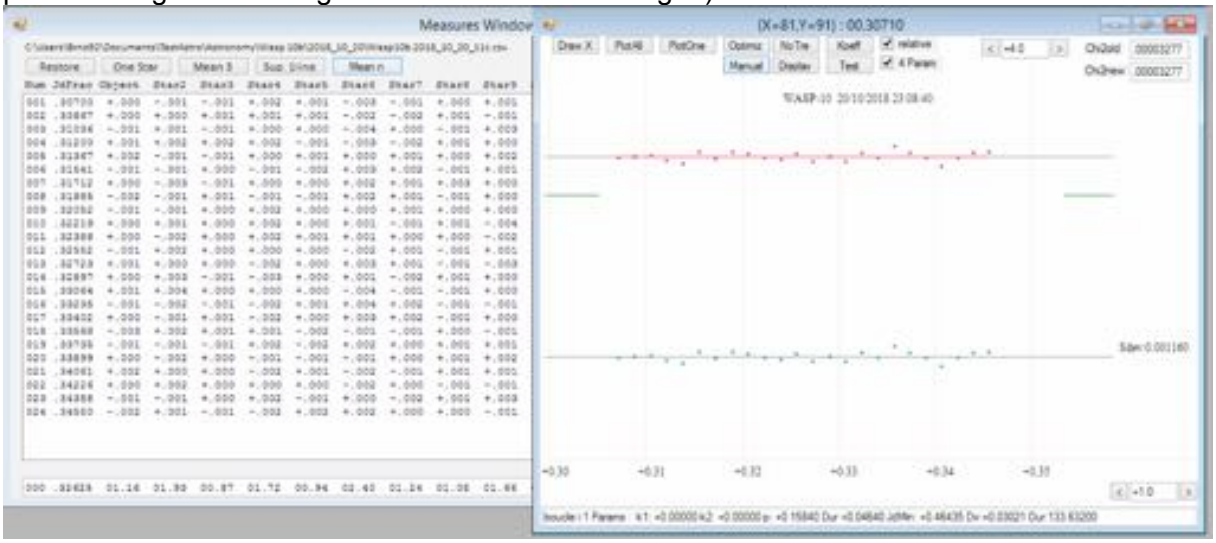
B- QHY 42C 748 x 2 sec : stdev= 18/1000 (for 2 seconds shots, the standard deviation is very high)(scale is half of previous image)



C- QHY 42C 24 x (9 x 2 sec) : stdev= 3.7 / 1000 (this means that an 18 seconds shot with the QHY42c is equivalent to a 60 seconds shot with FLI11002



D- QHY 42C 24x(30x2sec) : stdev= : stdev=1.16/1000 (This means that for a 12 mag star, it is possible to get a millimag error on 60 seconds images).



Conclusion :
QHY 42 performance for star light measurement is much better than FLI11002 as shown by the graphical comparison between A and D results.

The efficiency of the QHY42c with a CBB filter (blue cut at 500 nm) is roughly 3 times compared to the efficiency of the FLI11002 (reaching the same standard deviation in a third of total exposure time).
To attain this result, short shots must be done to avoid saturation of the CCD and then after to be grouped by a number depending on the desired accuracy.
The effect of the read noise is neglectible.
The only drawback is that it requires much more disk space (30 times more in our example !) and more computing power, but the result is very interesting because it makes my 40 cm telescope as performing as a 70 cm, for a much cheaper price !

Comments :
This was my first light measurement. The gain 7 (0.45 e-/ADU) is probably too high with a full well capacity of only 1861 e-, and a gain of 4 is probably better (0.98 e-/ADU), to allow to double the exposition time.
I suppose that these results should be comparable when photographing deep sky objects, but it has to be done to prove it !