# **QHYCCD QHY 42 Camera : first evaluation and parameters measurements**

## **By Bruno Fontaine**

## 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





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)

								leasure	s Window	44		(X	=12.Y=4	235:00.2	9020			- a F
-	-			-	-	10.2014				Den X De	AL Putore	Ontimiz	No.fre	Seal .	V relative	Collard I	1. 000	a l'anna hair
	1.1-1-1-1			1.000						Cenerican Park			1	1.00	Contractory 1	No. of Concerns, No. of	(2) United	a sourcess
Pestore	1.0941	M.,	59991.5	340.	3104.1	-	1.1.1					THE LE	Distant .	144	(a) arrange		OvQre	re 2006348
Aux 207141	Chiese	25872	214/3	25424	25410	21415	PLAN7	254/1	D14/8						Contractor 1			
420 .31104	4	+,000	+.005	+.399	+:001	+.001	+.001	001	+.008				37A3P-1	10 173120	0621-48-40			
Min	7 +.006	008	+.002	+.506	+.000	006	+.002	204	+.001									
92 .81954	1.14.005	+.105	1.008	- 004	4.011		4.005	4,000	+.005									
03 .81451	2 998	. +. 194	+,000		- 1994	+.000	+.000	905	*,001		10.00		+	N				
24 .01803	4,000	+,008	+.004	+.008	+.000	002	+.003	008	008									
05 .01594	5,001	+,000	4.009	001	+.000	1,008	4.000	4,001	+	1.1.1	1.5.1	s	a 188					
Q.6 . \$1495	9. +.005	1.00	+.012	598	+.005	4.002	+.004	993	+.003		+ -							
27 .31763	1 +.002	007	+.008	+.001	001	+.000	4.000	-,001	+.001									
08.01871	8.14.004	+.008	+.004		~.101	221.	+.001	208	+.008									
49.0194	4	+,000	+.001	+,000	4,002	11,998	004	*,003	+,009									
30 .3208/	E +.000	+.007	+.006	002	-,003	00b	4.001	009	+.000									
181	0. +:001	+.016		+.000	+.004	1,108	+.202	4.002	002									
92 . 322.41	NR	+.992	016	*-590	498	*.900	093	12,098	+.002									
100 . 12333	8 +,000	+.008	-,018	001	+.008	+.004	+.008	+.003	+.004									
34	7,008	+.005	+.002	+.102	+.004	+.000	008	004	+.002									
96 . 64 64	1.111	+.913	1,000	194	10101	1,004	+1000		004									
34 .31421	008	7,997	+.001	+ .001	-,908	+,002	+.001	+.002	+.002									
37 . 32704	4 +.001	+.018	+.001	008	001	003	024	*.002	003	21274			1.00	#170.5	1 m m			
94 .02401	a	+.903	4.005	1.994	1.000		4.992	*.998	+						4			5der 0.007
49.32494	+,000	+.995	*.002	+ 995		* (994	+.008	+ 203				- + · · ·	4 44					
40 .31984	0011	- 202	008	001	- 002	008	+.004	004	*.008	1.4	-			1 .				
10.0007		1.098	4.008	- 99	998	P. 992	7,008	1.008	- 197									
42 .8334	* *.000	*,009	002			- 1992	-,008		*,003									
48	002	- 005	- 002				001	-,008	+.008									
244 .0200			- 1988		1.000	1.004	1.000	1.004	*.001									
				*	1.000	*,000		*. av										
AR		+.000	+.004	001	008	001	003	+.000	+.002									
										+0.29	-0.30	+0.31		+0.10	-0.35	+0.34		

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

4								leasure	s Windov	147			3	(X=9.V=4	1:00.29	990			-ce	10-14.00
Chainmathreadt	Deprint	d Name	no Astron		SINCER,	38,20W	NU 101 201	ALK A	lices.	Davi X	Pulk	RatOre	Opening	NoTe:	Koeff	Realize	i de la compañía de la	0 [4]	Dubiel	00115488
Restore	One 1ts	110	Mean 3	5up.	11ine	Maato							Hanual	Dealey	Test	C. 4Paran			Orchered	101116-010
Nue Jaliese	Object.	Daar2	Itari .	Diars.	Starf.	25425	Dier7	Start.	Diary											and there
001 .00642	+.008	+.006	004	+.006	016		+,225	+.204	+.004	1				TASP.	10 20:000	008.25:06:40				
002 .30433	+,002	+,000	+,005	009	+,002	+,000	005	+.003	004						1.0	Sec. 1.				
003 .30678	+.001	+.001	+.000	+,905	· · . 002	212	-,008	+.301	022							1.4				
004	008	+.005	+,008	1,004	*,998		7,098	4.207	-,004				****. to	1. 1. 200	10.2	A	1. 1.			
008 .00784	+.001	008	003	+.002	*,008	+.005	+.008	+.993	008		1.1.1	1.1		1 4						
004 .30428	+,003	007	+.004	+.008	+.001	003	-,204	+.001	+.001		1.1	A 4								
007 .BOREL	+.008	+.008		1.018	004	5.016	018	P.004	+.00T		1.1									
008 .80832	+.008	+,005	+,004	+.001	+.001	018	7.008	+,001	+.001									_	-	
008 .30583	003	+.005	*.005	+.004	+.002	008	008	+.002	+.004											
010 .01084	-:005	+,008	019	+.095	+.985	114	+.191	1.267	*.011											
91018 .00078	+.001	+.000	+.000	+.000	+:001		1.008	+,304	+.008											
013 .91189	+.002	4,002	+.002	009	+.002	+.002	+.002	204	+.00E											
018 .01176	+.003	+,002	11,004	+.098	008	10.018		1,000	+.498											
014 .01228	002	008	+.008	+.001	+.000	004		+,302	+.992											
218 .81291	+.008	+,005	+.002	+.504	001	NT	+,206	4.308	4.004											
214.181989	004	1,006	*.008	*,000	+,014	11,214	-,114	4.205	-,418											
017 .81381	+.008	+.008	+.003	+.000	+,001	- 218	008	+.001	+.002						1.4					
018 01412	003	+.005	+.001	+.007	204	+.002	4.095	4.204	4.004					125 1						
019.31470	+.006		008	1.016	14,002	1.000	1.111	1.000	001		1. 1			1. 6 30	1. 1.				5	4400 0 001484
030	004	001	002	+.005	+.008	+.004	+.008	003	+.003		1910									
001 .81849	008	004	+,004	007	4.005	4.015	4.005	008	008			· ·			Sec. 1		- C.			
022 .01435	*.007	1,004	+,004	11.008	4,002	4,052	4.008	+.601	414							+				
028 .81477	001	+.008	+.008	+.008	+.002	+.012	+:011	+.308	+.004							1.1000				
2224 .01740	-:000	001	+.001	+.001	005	+.005	4.005	+.701	007											
024 .01802	+.000	009	+.008		+.002	4.014	+.008		403											
026 .81844	004	+.001	+.004	008	+:005	+.007	+.004	003	008											
027 .01099	001	4,014	+.001	005	4.005	+.009	4.010		008											
												10			-0.04	-0.00				
Case Laters	10.00	14.11	10.48	14.43	14.11	11.44	14.10	44.78	14.14	10.00	-1		+0.32		+1.30	-0.34		PV.13	1.412	100
and constant																			14	(+10 CR
										Jouile 11P	alaria 1 8.5	+0.00000 k2	+0.00000.8	-0.15840	Dur +0.548	40 John -0 A641	6 Ov.+8 836	1 Dar 133.8	1200	

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).

6 ·	Measures Window ##	(X+81,Y+91):00.30710	and the second second second
Characteristic Descentered Banders (Americany) Haug 201203, 10, 2019 av	0108-2018_00_00_0114 cm	145 PotOne Optimur NoTe Koef Prelative	3 Ov2xid 00003277
Restore One Star Mean 3 Sup Sine Meanin		Manual Destay Test of AlParant	OxPres 00003277
Ban Jafran Copers Deard Deard Deard Dearb Dearb	Star? Start Start		
001 .00700 +.000 +.001 +.001 +.002 +.001008	005 +.000 +.005	WARP-10 2010/2018/22/08:40	
200 100.+ 100.+ 100. + 000.+ 000.+ 78808, 200	+.002 +.001 +.001		
400 .30034001 +.001001 +.000004	*.000 +.001 +.009		
004 .81209 +.001 +.002 +.002 +.003001008	+.000 +.000 +.000		
008 .31367 +.002001001 +.000 +.001 +.000	+.000 +.000 +.000	and the second	
800.+ 100 100 000.+ 101 100.+ 1010.	*.002001 *.001	the second se	
107 31712 +.000003001 +.000 +.000 +.002	+.905 +.958 +.908		
200.* 200 200 100.* 200 200 88828, 900	+.005005 +.000		
009.32032 +.001 +.001 +.000 +.002 +.000 +.000	+.002 +.000 +.008		
10.0 188218 + 0.001 + 0.012 + 0.002 + 0.002 + 0.002 + 0.002	+1005 +1005 +1004		
011 32388 +.000002 +.000 +.002 +.001 +.001	+.000 +.000002		
111 .32582001 +.003 +.000 +.000000000	+.000000 +.000		
918 .82728 +.991 +.990 +.990202 +.000 +.008 -	*.005 *.005 *.008		
004 30887 +.000 +.003001003 +.000 +.001	+.002 +.005 +.000		
015 ,33064 +.001 +.004 +.000 +.000 +.000004	001001 +.000		
254 .33234 +.001 +.002 +.001 +.002 +.001 +.004	4.000		
057 .33402 +.000 +.001 +.001 +.002 +.000 +.003	+.002000 +.000		
018 33548 +,008 +.002 +.001 +.001 +.003001	+.001 +.000001		
314 .80738001001001 +.008008 *.000	*.000 *.000 *.005	Charles and a second second states where the second second	Saw-0.001160
200 + 200 + 200 + 200 + 200 + 200 + 200 + 200	+.000 +.001 +.002		
200 100.+ 100 000.+ 000.+ 100.+ 1001	+.001 +.001 +.000		
192 .34224 +.000 +.002 +.000 +.000 +.000 +.000	*.000 *.000 *.000		
223 34388001001 +.000 +.002001 +.000	-,000 +,000 +,000		
104 .34900003 +.001001003 +.003 +.000	+.000 +.000 +.005		
	-212		4.14
000 41418 01.14 01.80 00.87 01.72 00.84 02.40	01.5x 01.00 00.00	- +04040	100 AM
	Children Little Archite		[E]+10 B
	Incode 11 Facers	and white the well descent and think for white the well described and the set of the set of the set	Over 133 63200
		and the second of the second	

### 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 !