Dark test. What is the influence of the dark temperature and exposure time on the result

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Conclusions:

1) Make at least 50 or more darks to reduce the dark noise. See part 1 and 2.
2) It is possible to correct for a wrong dark temperature. Significant improvement above +10°C. Below +5°C the effect is limited
3) A wrong dark exposure time has only some influence above +10°C. See part 5

table 1

Measured X factor		Dark correction					
		-10 °C	-5 °C	0 °C	+5 °C	+10 °C	+25 °C
Light	-10 °C	1	0.7	0.4	0.2		
	-5 °C	1.0 to 1.6	1	0.6	0.35		
	0 °C	1.0 to 2.2	1.5	1	0.6	0.35	
	+5 °C	2.2 to 3+	1.8 to 2.6	1.6	1	0.6	0.1
	+10 °C		3.3 to 4	2.3 to 3	1.6	1	0.2
	+25 °C				6.1 to 8	4.5	1

Best factors for dark correction

table 2

Noise at X=1		Dark correction					
		-10 °C	-5 °C	0 °C	+5 °C	+10 °C	+25 °C
Light	-10 °C	0.65 e-	1.07 e-	1.05 e-	2.12 e-		
	-5 °C	0.66 e-	0.59 e-	0.83 e-	1.82 e-		
	0 °C	1.20 e-	0.89 e-	0.65 e-	1.21 e-	2.83 e-	
	+5 °C	2.53 e-		0.75 e-	0.75 e-	1.88 e-	16.41 e-
	+10 °C		4.17 e-	3.55 e-	2.23 e-	0.86 e-	14.57 e-
	+25 °C				21.43 e-	19.28 e-	1.73 e-

Noise if dark is applied without correction factor.

table 3

Noise at optimum X factor		Dark correction					
		-10 °C	-5 °C	0 °C	+5 °C	+10 °C	+25 °C
Light	-10 °C	0.65 e-	0.59 e-	0.63 e-	0.67 e-		
	-5 °C	0.64 e-	0.59 e-	0.61 e-	0.67 e-		
	0 °C	0.97 e-	0.75 e-	0.65 e-	0.68 e-	0.73 e-	
	+5 °C	1.57 e-		0.73 e-	0.75 e-	0.75 e-	0.97 e-
	+10 °C		2.06 e-	1.35 e-	0.95 e-	0.86 e-	1.04 e-
	+25 °C				4.47 e-	3.14 e-	1.73 e-

Noise if dark is applied with a factor.

Modelling	
delta Temp	factor
-20	6.05
-15	4.48
-10	2.72
-5	1.65
0	1.00
5	0.61
10	0.37
15	0.22
20	0.14

Empirical factor

factor:=1/(exp(Δt * 0.1)

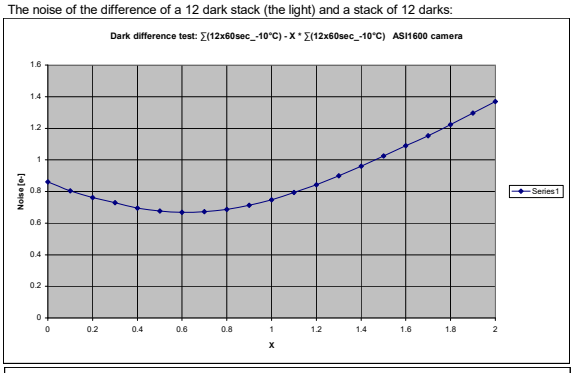
corrected dark:=dark * factor - mean_dark * (1-factor)

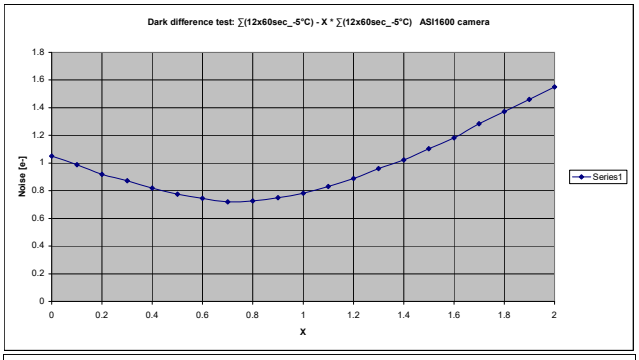
Part 1

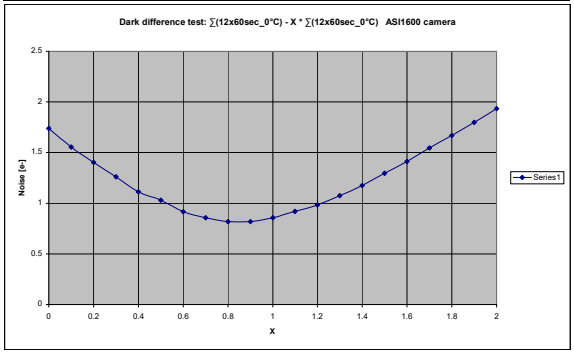
Equal temperature test. Two stacked darks of equal temperature. Assuming one stack is the light the seconds dark stack is subtracted but with a multiplier factor X.
Lowest noise reached for stack1 - X * stack2:

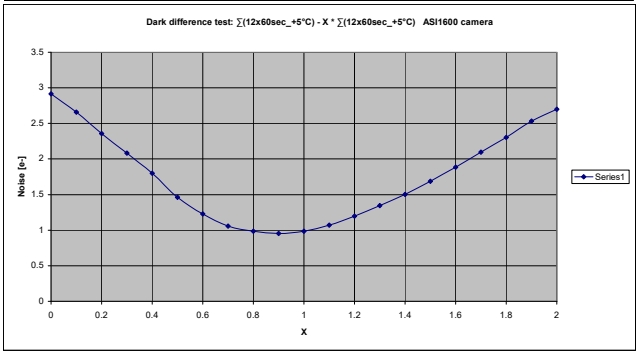
If the number of dark is equals to the number of light, the lowest noise is not reached. The noise of the dark influences the result. Lowering X could help to reduce the noise but would spoil the pedestal value.

The noise of the difference of a 12 dark stack (the light) and a stack of 12 darks:



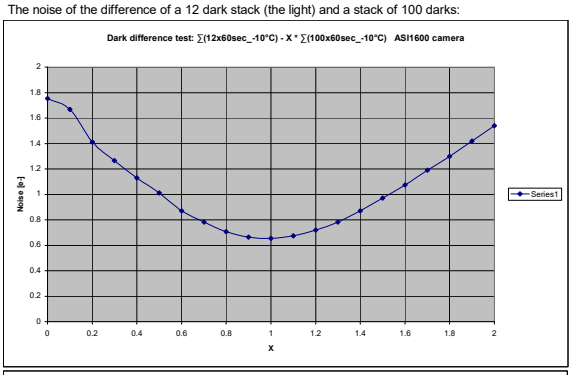


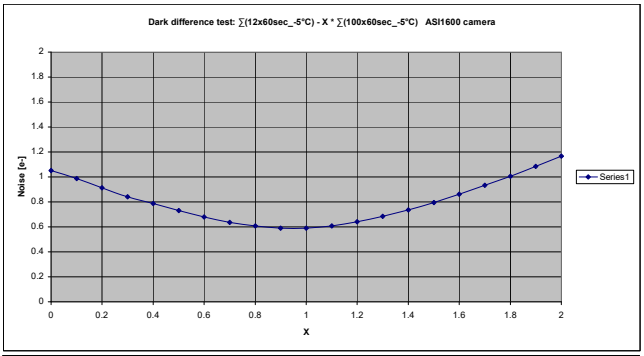


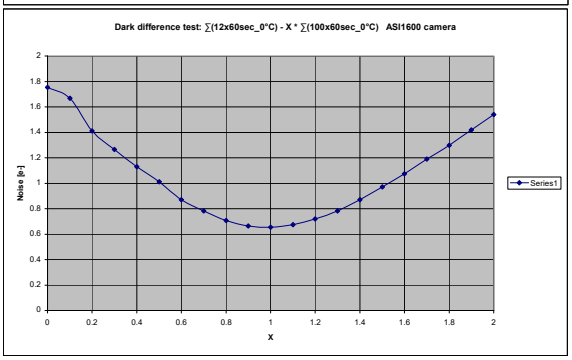


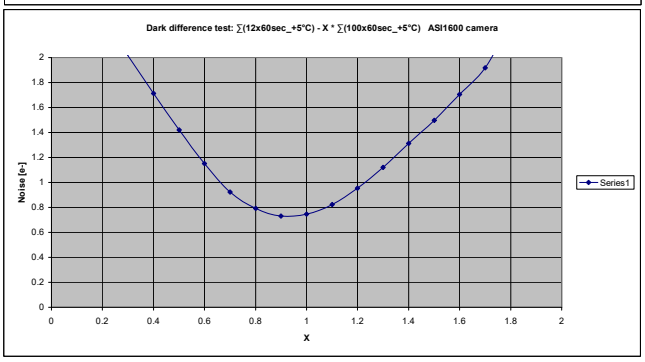
Part 2

The noise of the difference of a 12 dark stack (the light) and a stack of 100 darks:







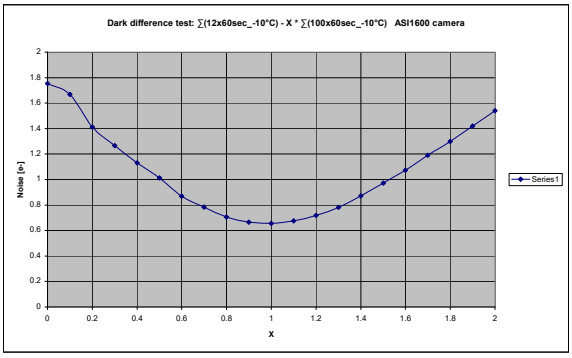


Part 3

A test with a too warm dark:

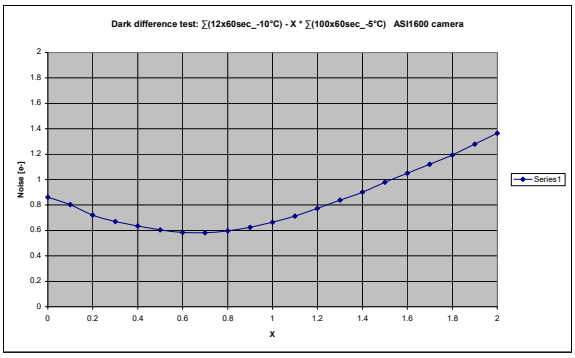
A light stack of -10°C and a dark stack of -10°C. There is an optimum at X=1.0

3.1



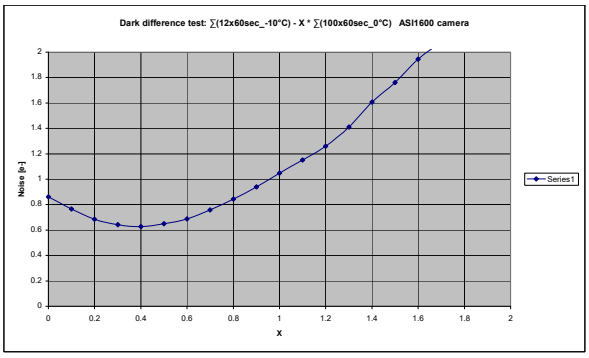
A light stack of -10°C and a dark stack of -5°C. There is an optimum at X=0.7

3.2



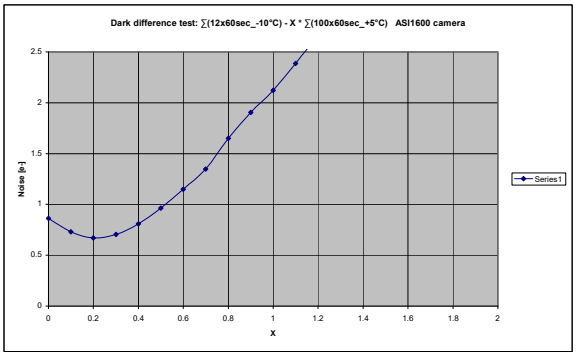
A light stack of -10°C and a dark stack of 0°C. There is an optimum at X=0.4

3.3



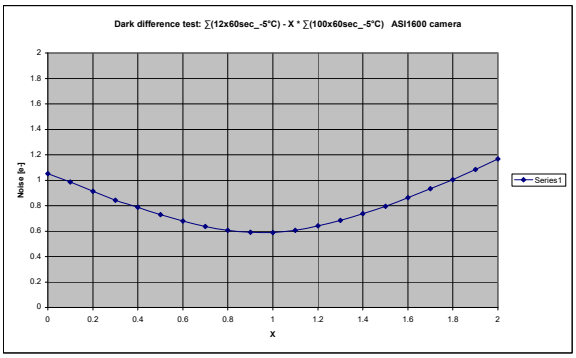
A light stack of -10°C and a dark stack of +5°C. There is an optimum at X=0.2

3.4



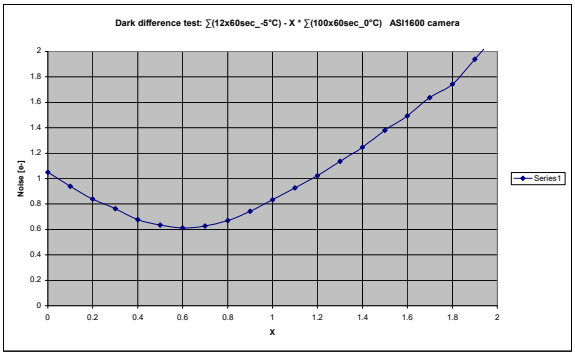
A light stack of -5°C and a dark stack of -5°C. There is an optimum at X=1

3.5



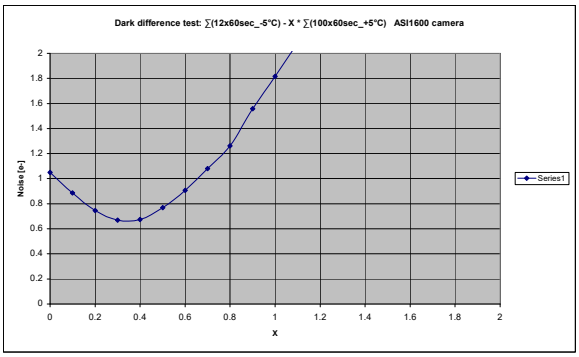
A light stack of -5°C and a dark stack of 0°C. There is an optimum at X=0.6

3.6



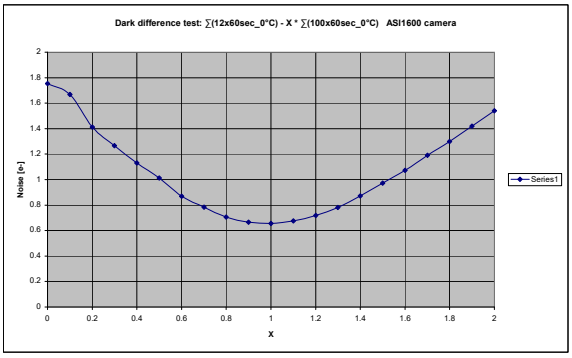
A light stack of -5°C and a dark stack of +5°C. There is an optimum at X=0.35

3.7



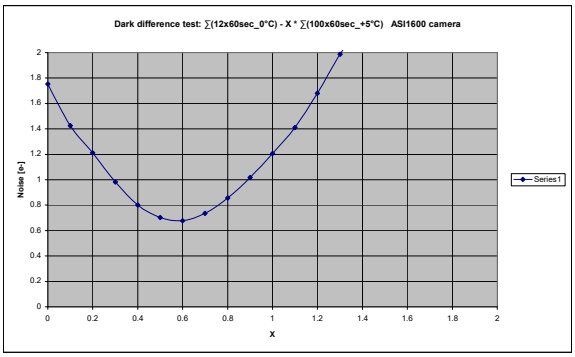
A light stack of 0°C and a dark stack of 0°C. There is an optimum at X=1.0

3.8



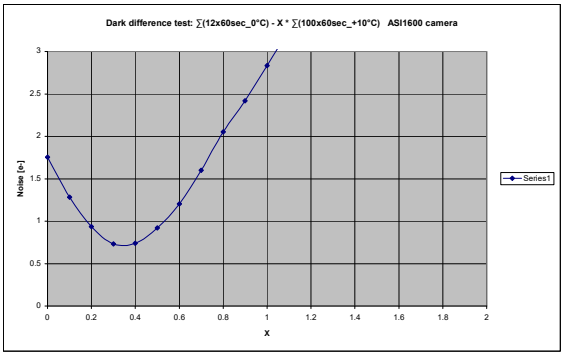
A light stack of 0°C and a dark stack of +5°C. There is an optimum at X=

3.9



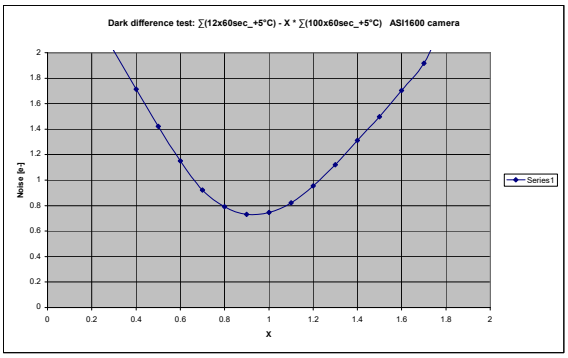
A light stack of 0°C and a dark stack of +10°C. There is an optimum at X=0.35. Noise improvemnet is 1.0 and almost perfect.

3.10



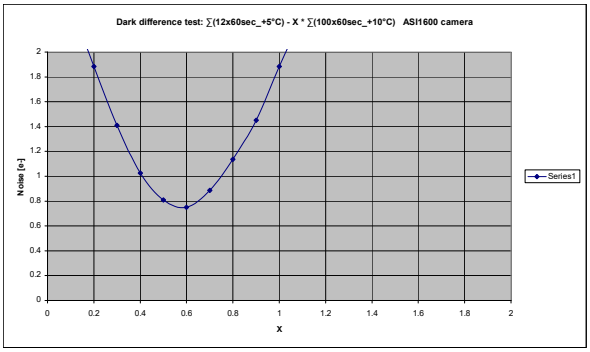
A light stack of +5°C and a dark stack of +5°C. There is an optimum at X=1

3.11



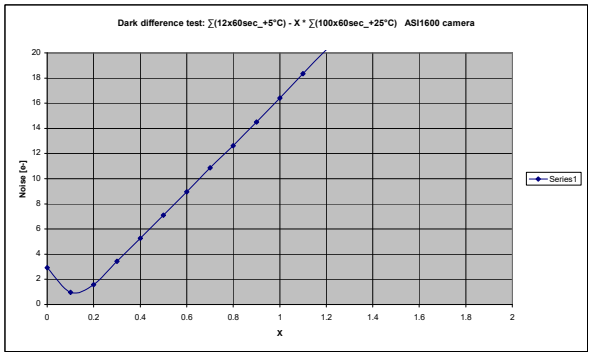
A light stack of 5°C and a dark stack of +10°C. There is an optimum at X=0.6

3.12



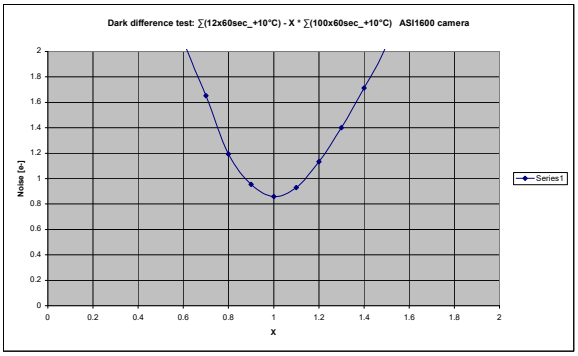
A light stack of 5°C and a dark stack of +25°C. There is an optimum at X=0.1

3.13



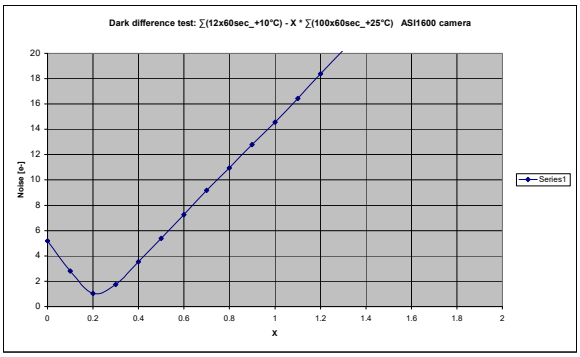
A light stack of +10°C and a dark stack of +10°C. There is an optimum at X=1

3.14



A light stack of 10°C and a dark stack of +25°C. There is an optimum at X=0.2

3.15

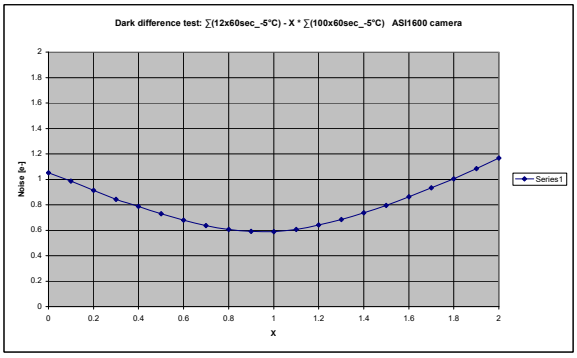


Part 4

A test with a too cold dark:

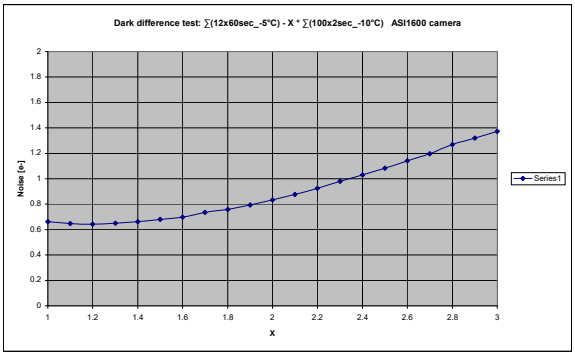
A light stack of -5°C and a dark stack of -5°C. There is an optimum at X=1.0

4.1



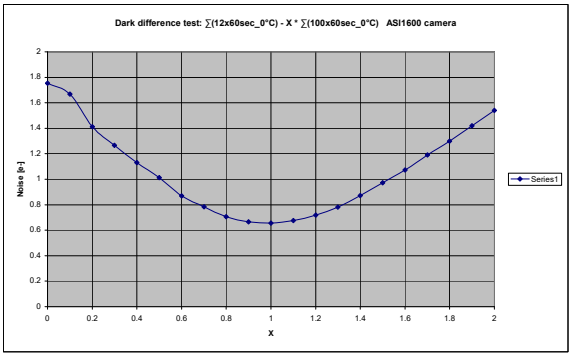
A light stack of -5°C and a dark stack of -10°C. There is an optimum between 1.0 and 1.6. There is no significant noise improvement.

4.2



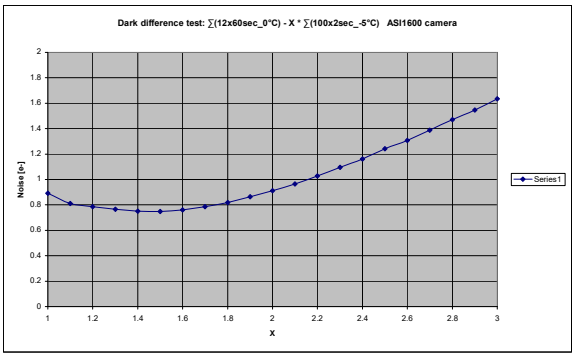
A light stack of 0°C and a dark stack of 0°C. There is an optimum at X=1.0

4.3



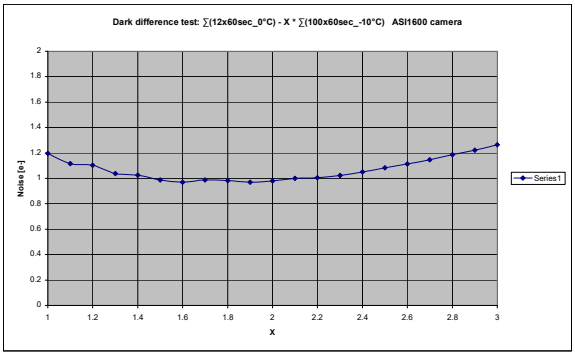
A light stack of 0°C and a dark stack of -5°C. There is an optimum at X=1.5. Noise improvement is about 0.15

4.4



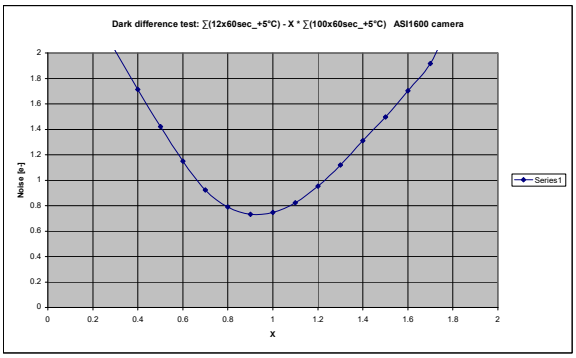
A light stack of 0°C and a dark stack of -10°C. There is an optimum between 1.5 and 2.2. The noise improvement is poor, The noise is higher then normal

4.5



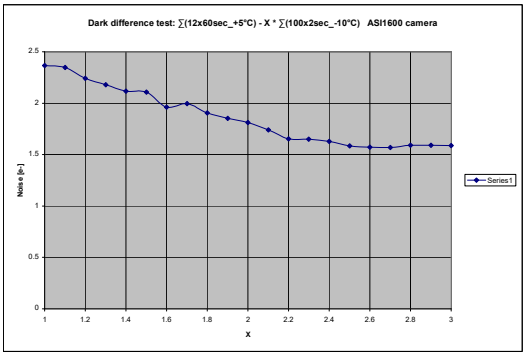
A light stack of +5°C and a dark stack of 0°C. There is an optimum at X=1.0 (or 0.9)

4.6



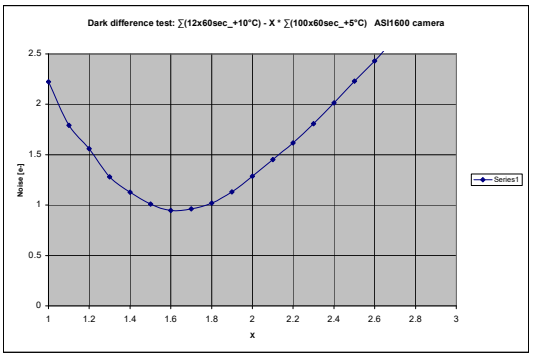
A light stack of +5°C and a dark stack of -10°C. There is an optimum between 2,2 and 3+

4.7



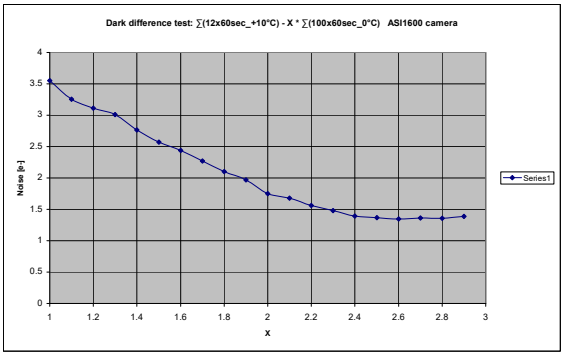
A light stack of +10°C and a dark stack of 5°C. There is an optimum at X=1.6

4.8



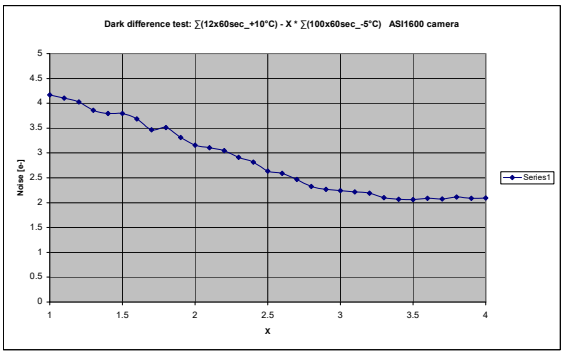
A light stack of +10°C and a dark stack of 0°C. There is an optimum at X=2.3 to 3

4.9



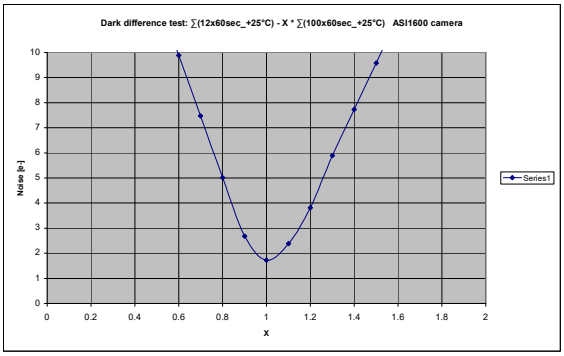
A light stack of +10°C and a dark stack of -5°C. There is an optimum at X=3.3 to 4

4.10



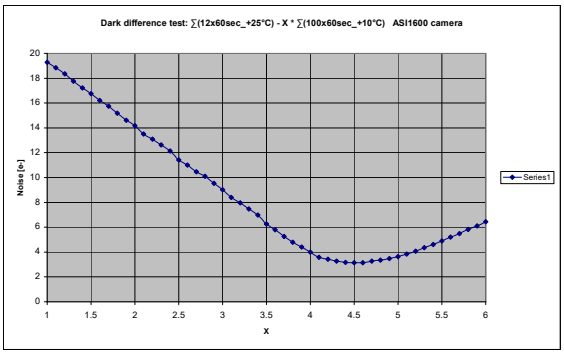
A light stack of +25°C and a dark stack of +25°C. There is an optimum at X=1

4.11



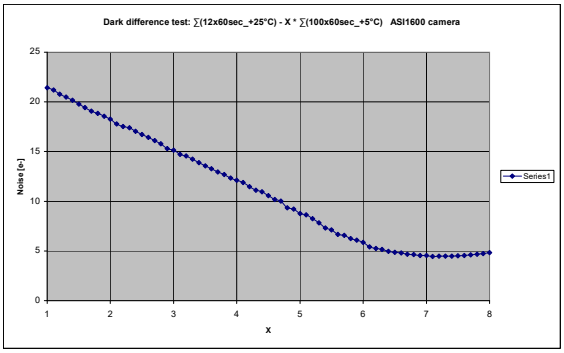
A light stack of +25°C and a dark stack of +10°C. There is an optimum at X=4.5

4.12



A light stack of +25°C and a dark stack of +10°C. There is an optimum at X=B42

4.13

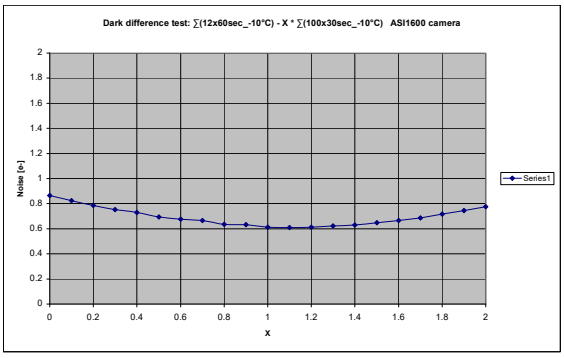


Part 5

Test with shorter dark exposure time

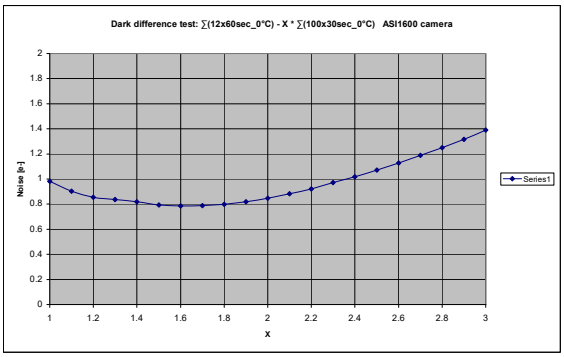
A light stack of -10°C 60 sec and a dark stack of -10°C sec. There is an optimum at around 1.

5.1



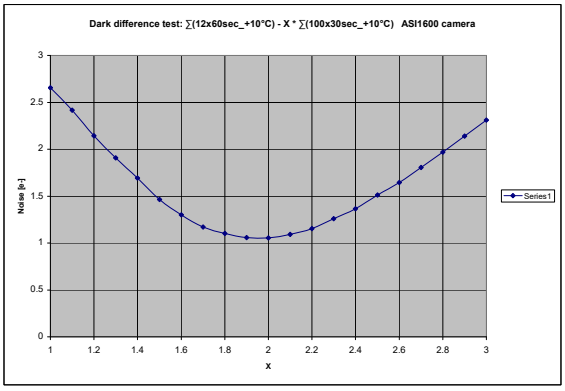
A light stack of +10°C 60 sec and a dark stack of +10°C sec. There is an optimum at around X=1.6

5.2



A light stack of +10°C 60 sec and a dark stack of +10°C sec. There is an optimum at X=2. Noise is about 1 e- higher

5.3

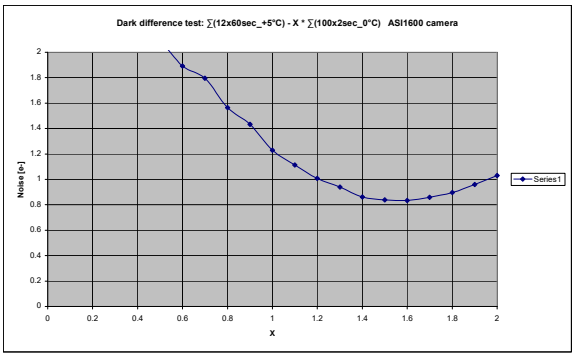


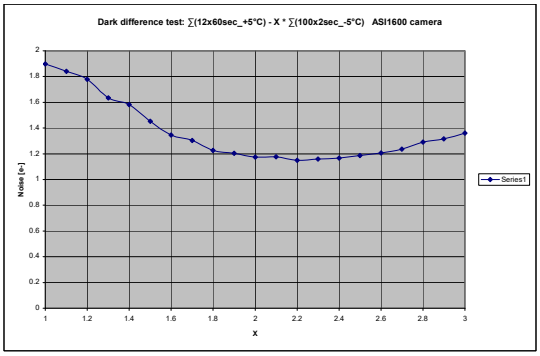
Part 6

Some BIAS test

A light stack of +5°C and a BIAS stack of 0°C. There is an optimum at X=1.6. The noise improvement for *x*=1.6 is almost perfect and noise goes down from 1.2 to 0.8

6.1



A light stack of +5°C and a BIAS stack of -5°C. There is an optimum between 1.8 and 2.6. The noise goes down from 1.95 to 1.2

6.2