RIPTIDE

March 2024

Gen-Z **Learner's Dictionary**

Ghosting: *s. m. inv. Comportamento di chi decide di interrompere bruscamente una relazione sentimentale e di scomparire dalla vita del partner, rendendosi irreperibile.*

RIPTIDE

1) Dark noise measurement of ASI533 and ASI249 cameras

3) Camera Test Protocols (+ yesterday's calibration)

4) Which SNR ?

Dark noise measurement of ASI-533 and ASI-249 cameras

Dark noise measurement of ASI-533 and ASI-249 cameras

WHY?

- to measure:
  - the electronic noise of the camera
  - the *blackness* of the black chamber
  - the effect of increasing exposure times

HOW?

- for each camera, acquired images with *ASIImg* software at 3 configurations:
  1) black chamber **closed** & camera sensor **covered**
  2) black chamber **closed** & camera sensor **uncovered**
  3) black chamber **open**

- each acquisition consists of 30 frames at 8 different exposure times:

0.001 – 0.01 – 0.02 – 0.05 – 0.1 – 0.2 – 0.5 - 1. seconds

Dark noise measurement of ASI-533 and ASI-249 cameras

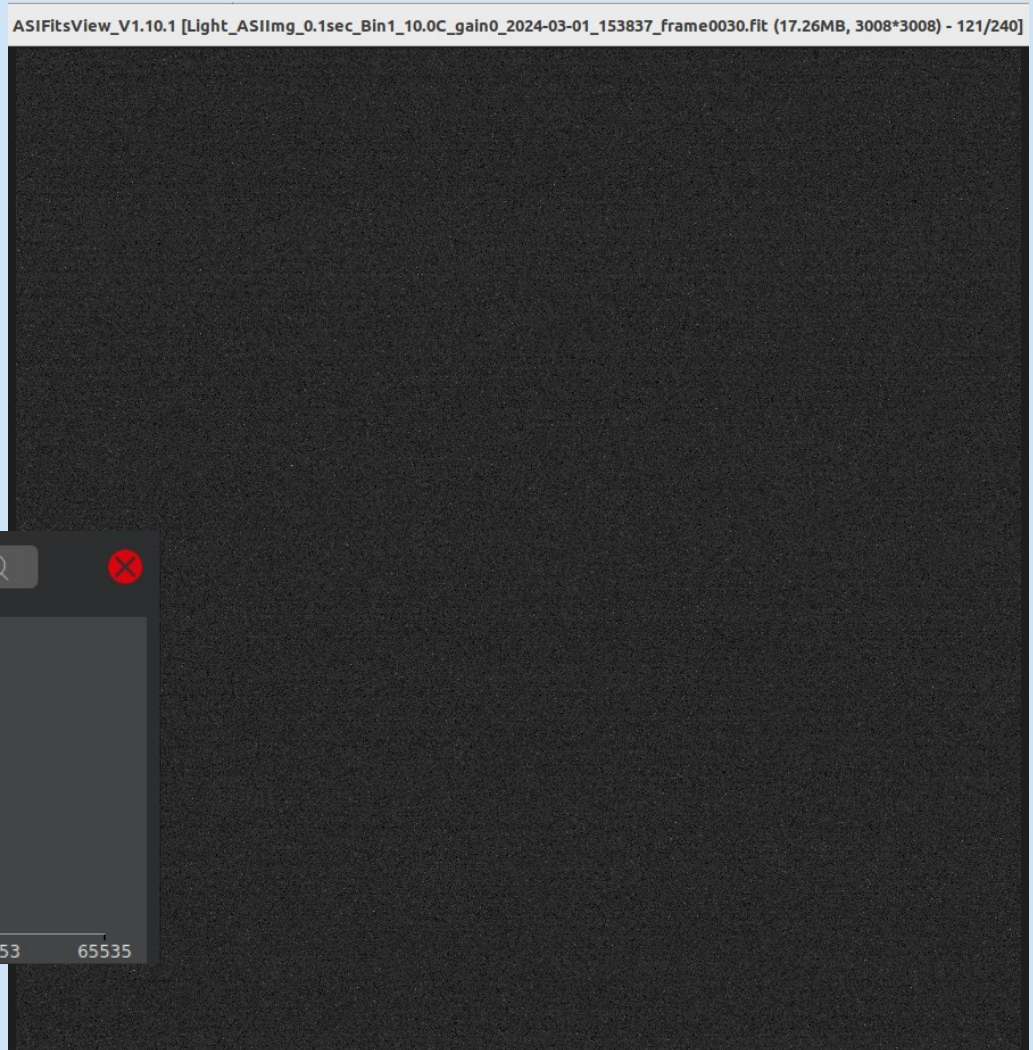
ASI-533
Resolution: 3008 x 3008 pixels
Cooling: ~ -30°C above room temperature
Gain: L(0)

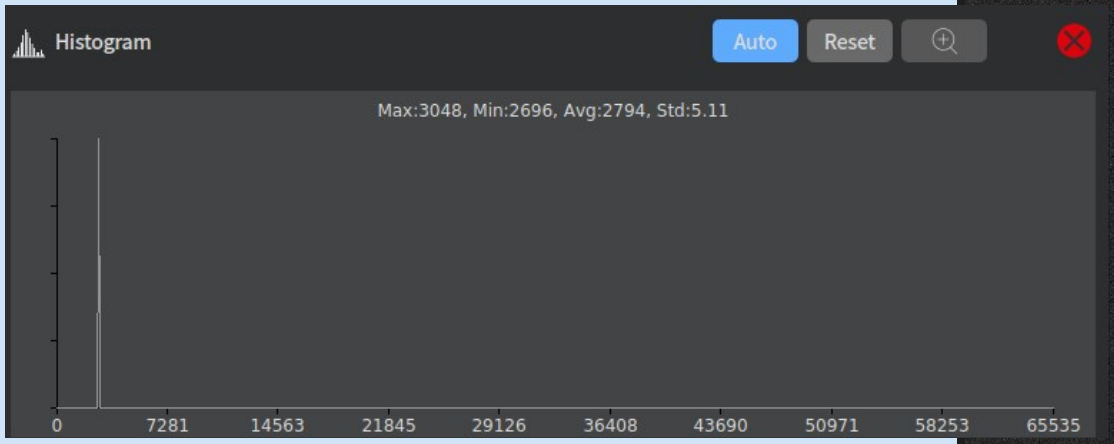
ASI-249
Resolution: 3008 x 3008 pixels
Cooling: ~ -30°C above room temperature
Gain: L(0)

Dark noise measurement of ASI-533 and ASI-249 cameras

IMAGE EXAMPLE:

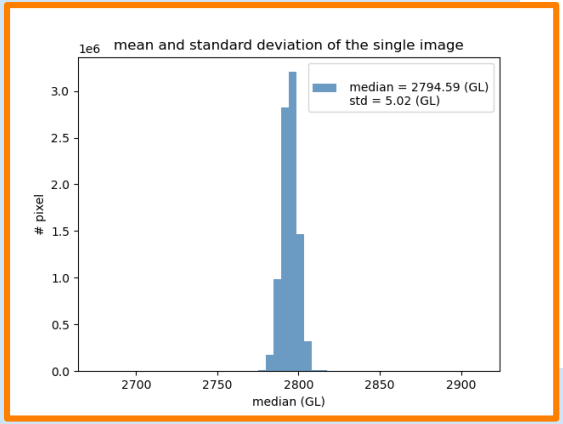
ASI533
Sensor covered
Black chamber closed
Exposure time = 0.1 sec

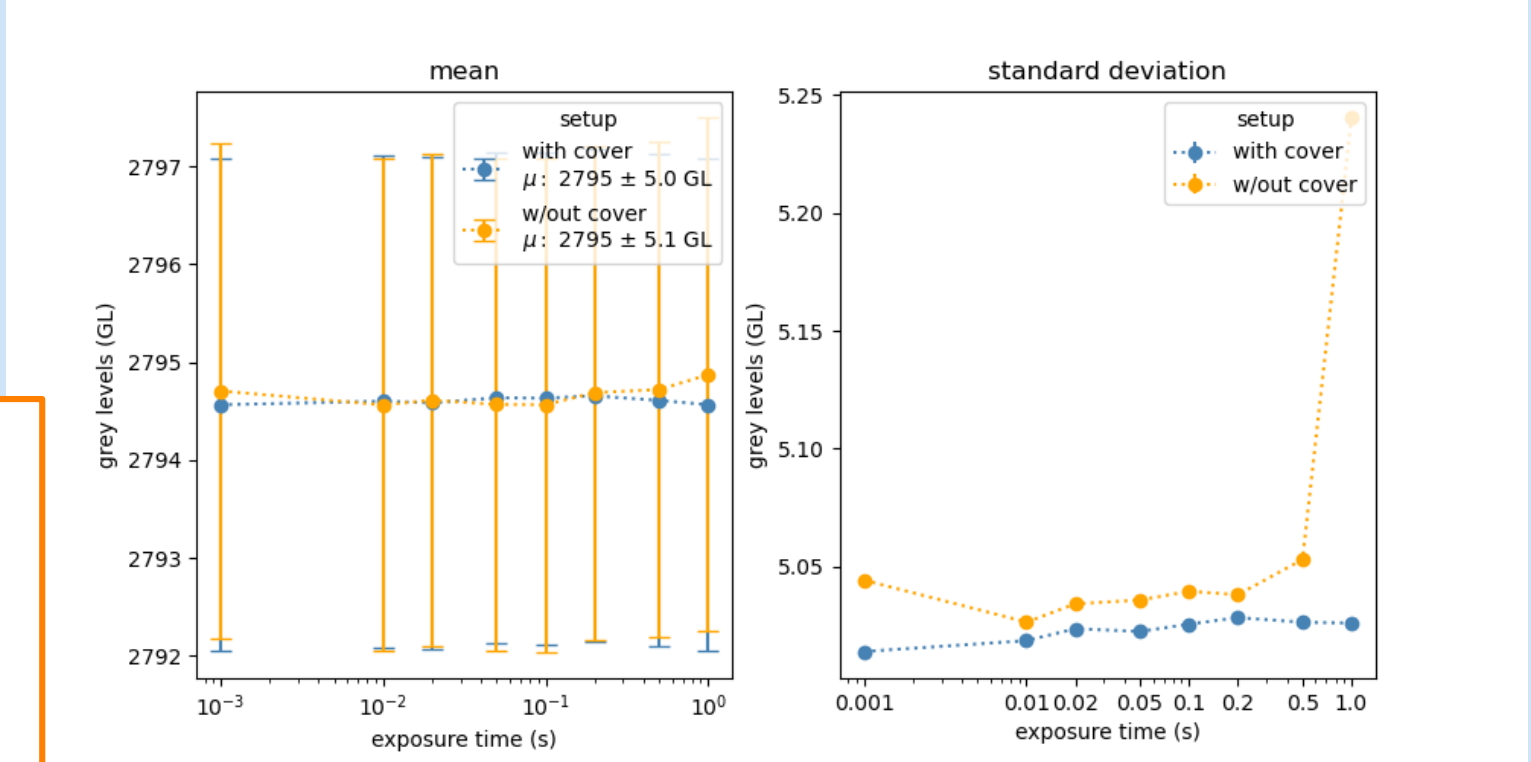




Dark noise measurement of ASI-533 and ASI-249 cameras

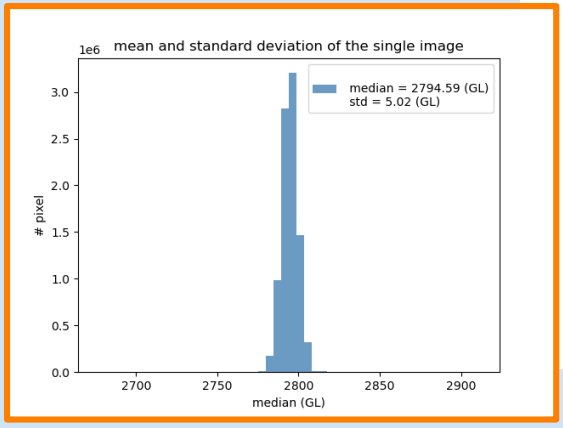
For each configuration, **mean** and **standard deviation** of gray levels between pixels of the **single image**:

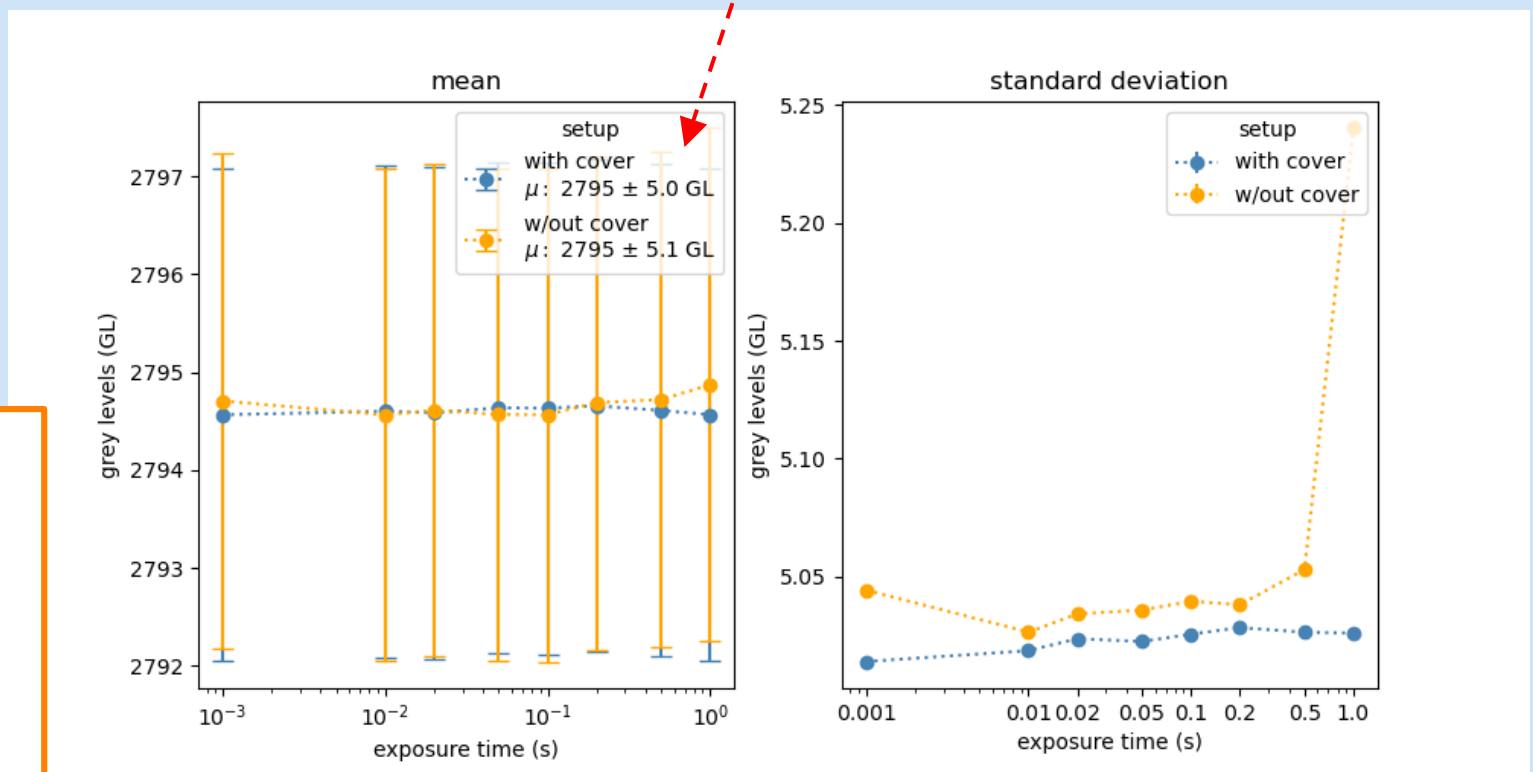




Dark noise measurement of ASI-533 and ASI-249 cameras

For each configuration, **mean** and **standard deviation** of gray levels between pixels of the **single image:**

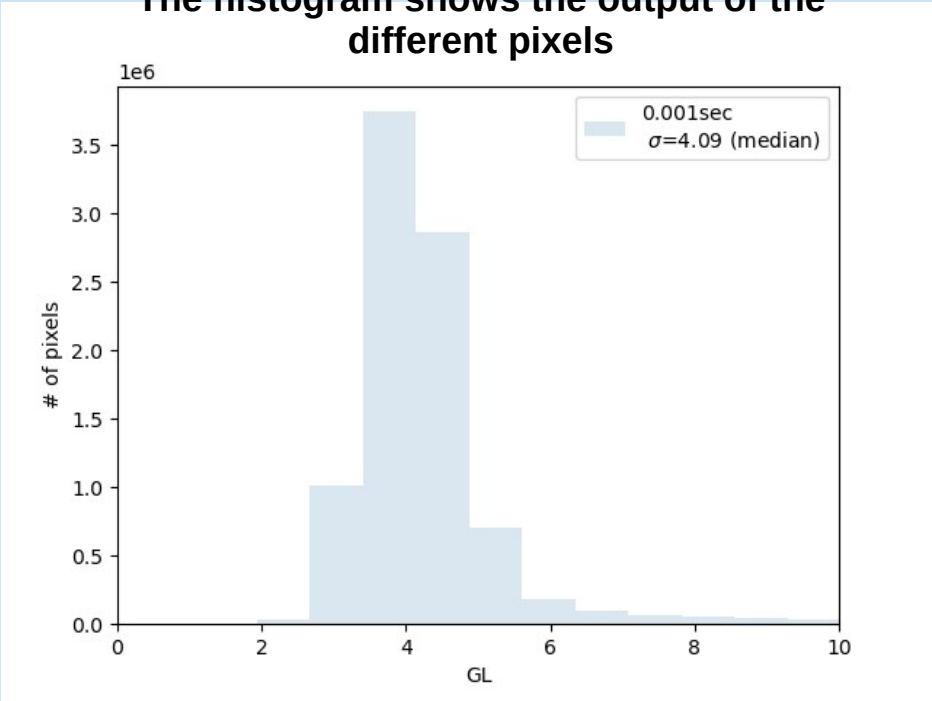




Dark noise measurement of ASI-533 and ASI-249 cameras

ASI-533
Resolution: 3008 x 3008 pixels
Cooling: ~ -30°C above room temperature
Gain: L(0)

Distribution of standard deviation of different images pixel by pixel.
The histogram shows the output of the different pixels



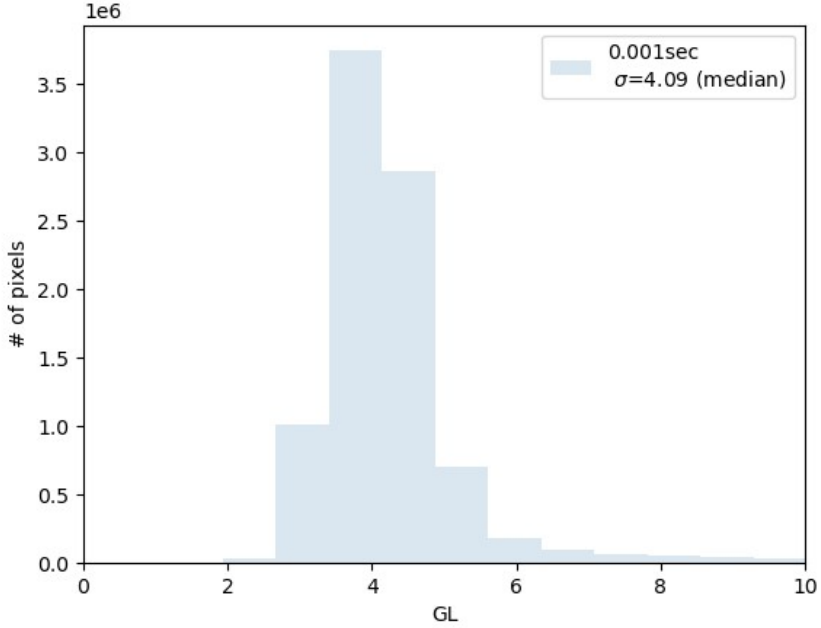
Dark noise measurement of ASI-533 and ASI-249 cameras

ASI-533
Resolution: 3008 x 3008 pixels
Cooling: ~ -30°C above room temperature
Gain: L(0)

	With cup	Without cup
exposure times	std	std
0.001	4.090	4.097
0.010	4.090	4.097
0.020	4.090	4.097
0.050	4.097	4.097
0.100	4.097	4.097
0.200	4.090	4.097
0.500	4.097	4.123
1.000	4.097	4.151

Median value

Distribution of standard deviation of different images pixel by pixel.
The histogram shows the output of the different pixels



Dark noise measurement of ASI-533 and ASI-249 cameras

ASI-533
Resolution: 3008 x 3008 pixels
Cooling: ~ -30°C above room temperature
Gain: L(0)

	With cup	Without cup
exposure times	std	std
0.001	4.090	4.097
0.010	4.090	4.097
0.020	4.090	4.097
0.050	4.097	4.097
0.100	4.097	4.097
0.200	4.090	4.097
0.500	4.097	4.123
1.000	4.097	4.151

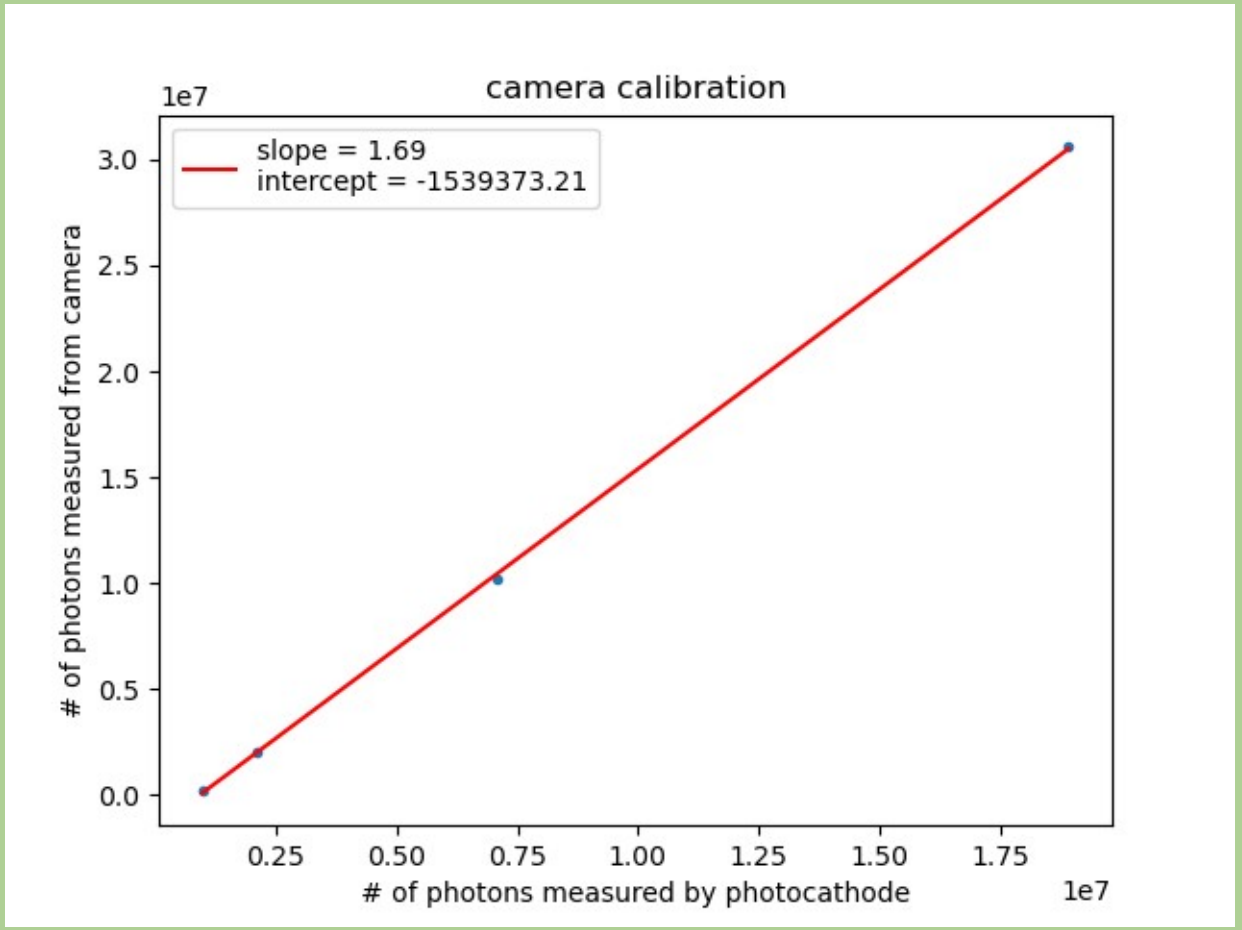
ASI-249
Resolution: 3008 x 3008 pixels
Cooling: ~ -30°C above room temperature
Gain: L(0)

	With cup	Without cup
exposure times	std	std
0.001	11.389	11.187
0.010	11.389	11.389
0.020	11.389	11.389
0.050	11.389	11.389
0.100	11.389	11.389
0.200	11.389	11.389
0.500	11.389	11.389
1.000	11.389	11.389

Camera Calibration

CONTI

Camera Calibration



Camera Test Protocol

step by step processes to evaluate the camera performances.

ImageJ
Image Processing and Analysis in Java

TELEDYNE PHOTOMETRICS
Everywhereyoulook™

Technical Note: Camera Test Protocol

Scientific CMOS, EMCCD and CCD Cameras

Camera Test Protocol

Introduction

The detector is one of the most important components of any microscope system. Accurate detector readings are vital for collecting reliable biological data to process for publication.

To ensure your camera is performing as well as it should be, Photometrics designed a range of tests that can be performed on any microscope. The results of these tests will give you quantifiable information about the state of your current camera as well as providing a method to compare cameras, which may be valuable if you're in the process of making a decision for a new purchase.

This document will first take you through how to convert measured signal into the actual number of detected electrons and then use these electron numbers to perform the tests. The tests in this document make use of ImageJ and Micro-Manager software as both are powerful and available free of charge.

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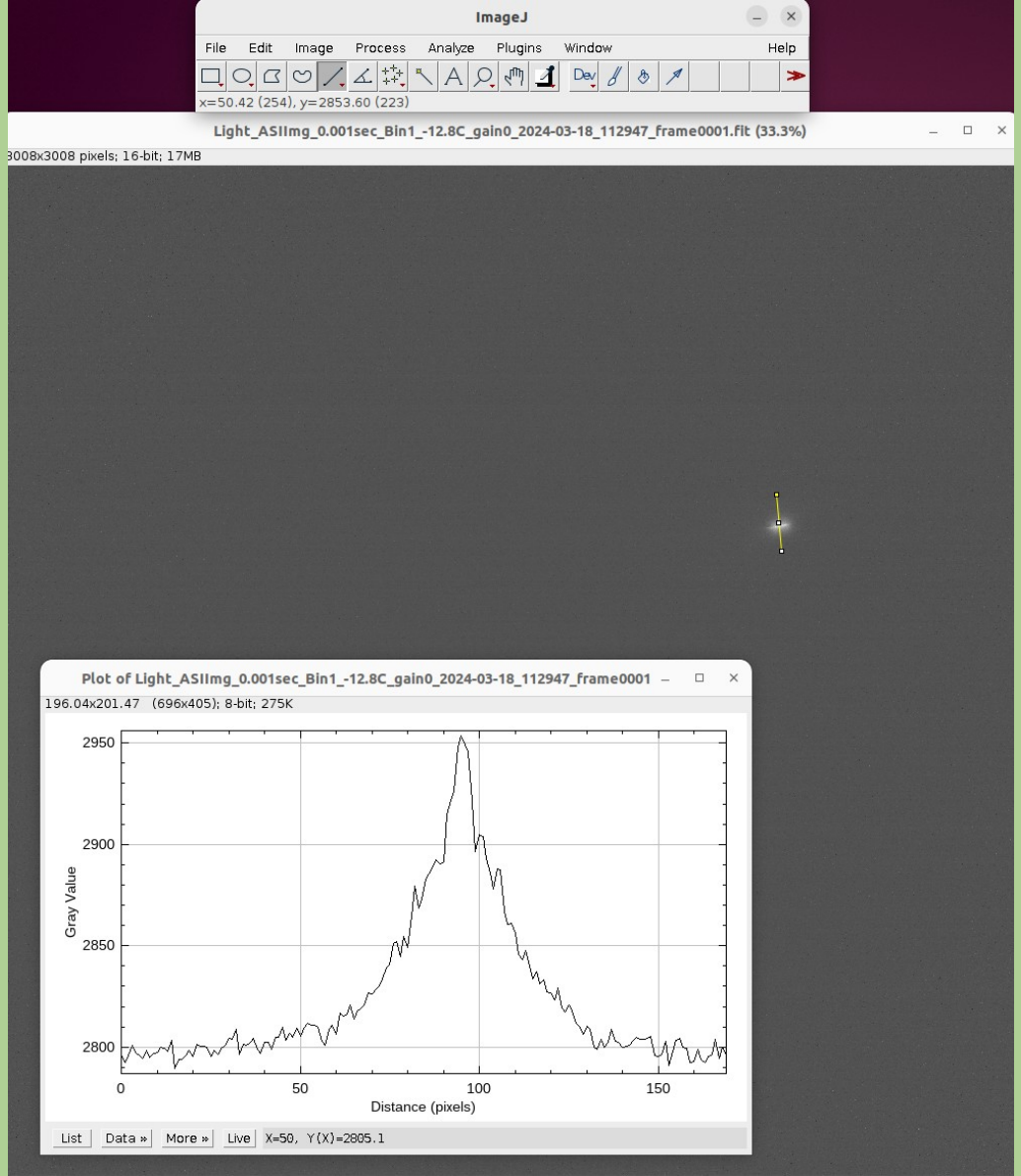


Conversion of signal form GL to e-

Signal in Electrons= (Signal in Grey Levels - Bias)*Gain

Measured the spot made by a
LED at 3.0 V
Exposure time :0.001
EM-gain = 0

Bias and Read Noise

BIAS:

100 frames at exposure time = 0s

- Make the mean of each image and then the mean between the images

ASI533 bias : 2794 GL

READOUT/READ NOISE:

2 frames at exposure time = 0s

- Make the difference of the two frames
- Calculate the standard deviation of the image
- Convert signal in grey level into signal in electrons

ASI533 RN : 3.83 e- rms

Dark Current

The same as readout noise

2 frames at exposure time = 0s

- Make the difference of the two frames
- Calculate the standard deviation of the image
- Convert signal in grey level into signal in electrons

ASI533 DC = 0.015 e- at 5 s exposure time (cooled at -11.2°C)

(trascurabile)

System Gain

The number of gray levels that each photoelectron is converted to. [e-/GL]

-acquire 2 light images (black-chamber open)

-make the mean of the two images

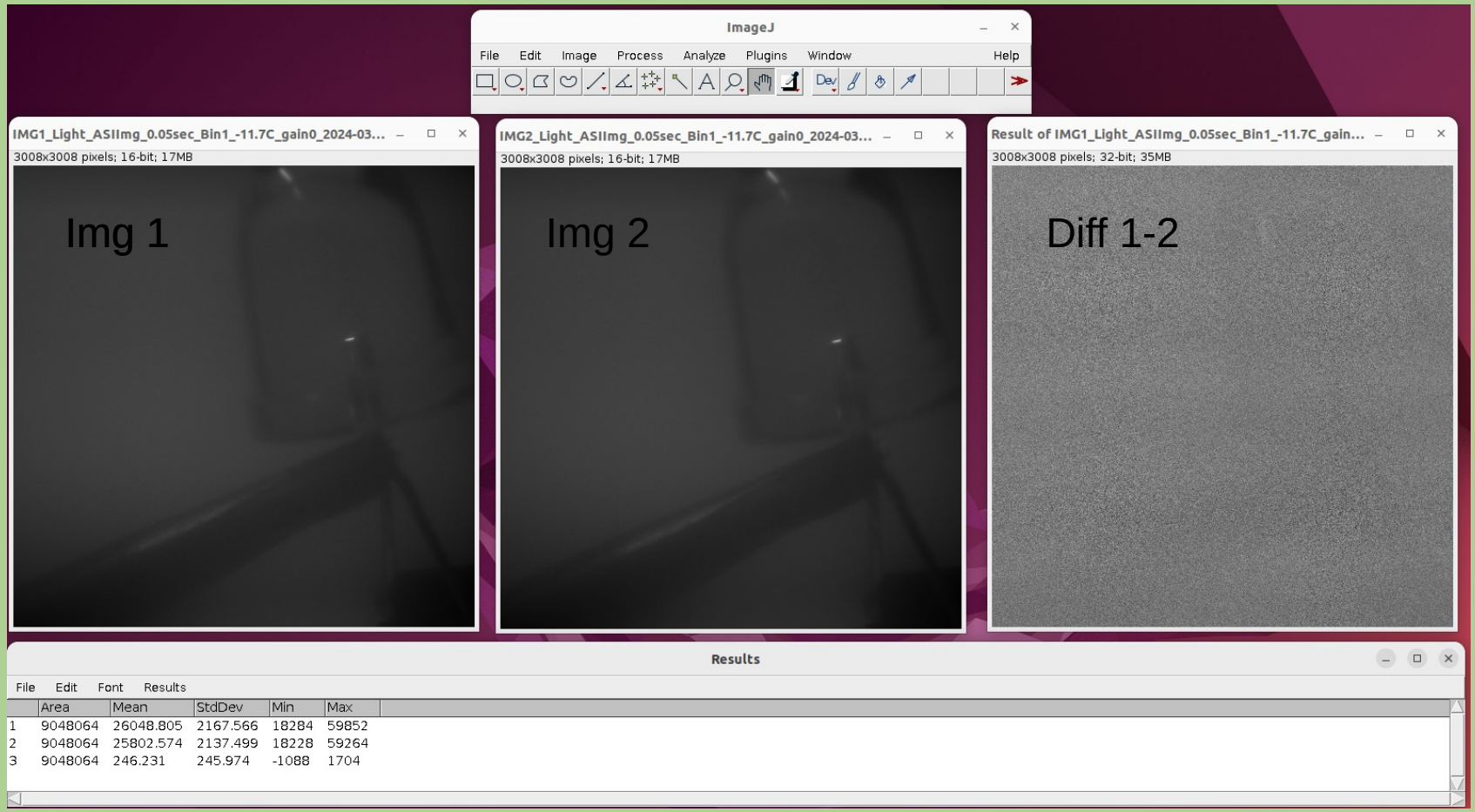
-make the difference of the two and measure the standard deviation of the difference image (Variance = STD / √2)

- repeat at different exposure times (10ms, 20ms, 50ms, 100ms)

$$\text{Gain} = \frac{(\text{Mean}_{\text{Image 1,Image 2}}) - \text{bias}}{\text{Variance}_{\text{Image 1,Image 2}}}$$

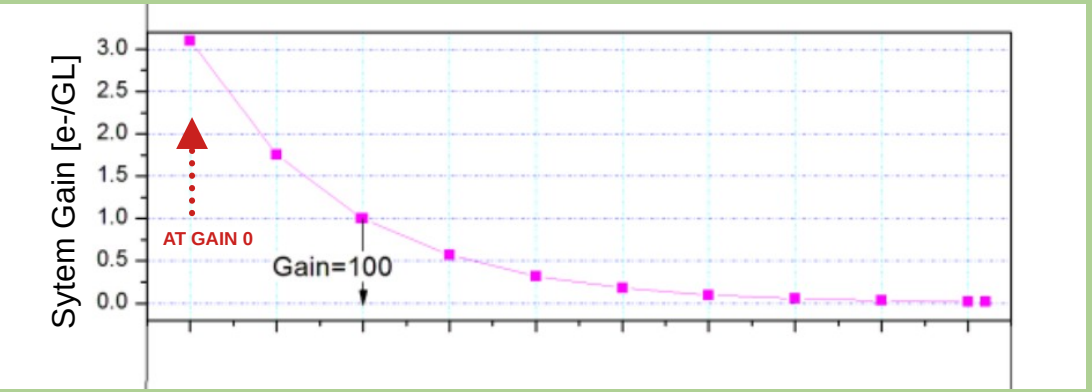
ASI533 system gain = 0.78 e- / GL

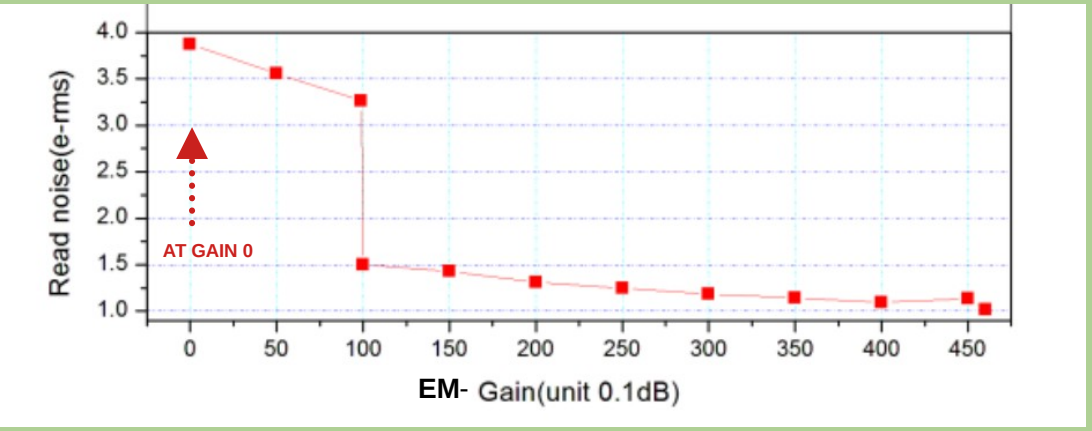
System Gain


ImageJ
File Edit Image Process Analyze Plugins Window Help
IMG1_Light_ASIImg_0.05sec_Bin1_-11.7C_gain0_2024-03...
3008x3008 pixels; 16-bit; 17MB
Img 1
IMG2_Light_ASIImg_0.05sec_Bin1_-11.7C_gain0_2024-03...
3008x3008 pixels; 16-bit; 17MB
Img 2
Result of IMG1_Light_ASIImg_0.05sec_Bin1_-11.7C_gain...
3008x3008 pixels; 32-bit; 35MB
Diff 1-2
Results
File Edit Font Results
Area Mean StdDev Min Max
1 9048064 26048.805 2167.566 18284 59852
2 9048064 25802.574 2137.499 18228 59264
3 9048064 246.231 245.974 -1088 1704

ASI533 Pro

DATASHEET





MYDATA (at EM-Gain = 0):

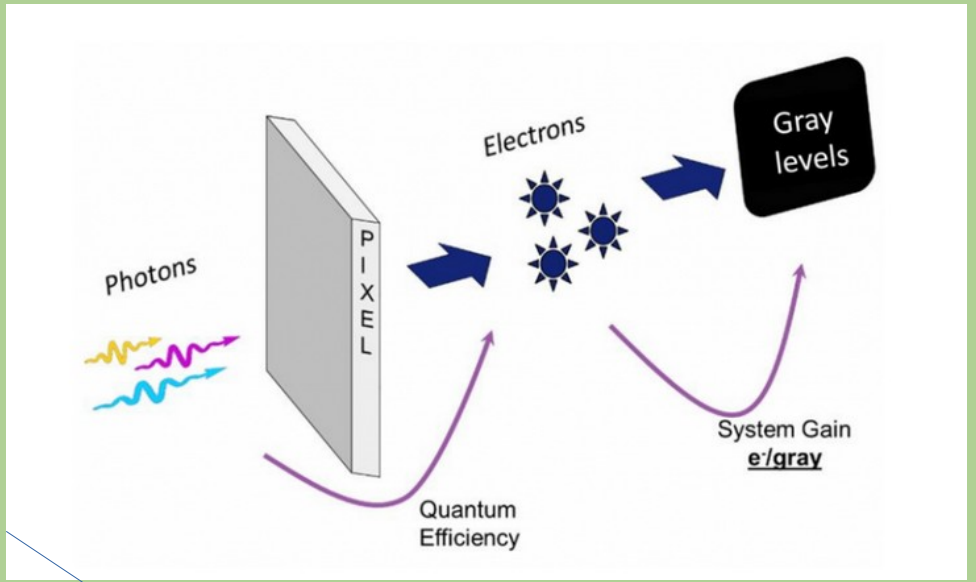
→ Gain = 0.78 e- / GL

→ Read Noise = 3.8 e- rms

Quick check

Quantum efficiency = 0.8

Gain = 0.78 (at EM-Gain=0)



1 photon

= **0.8 e-**

(= 0.8 [e] / (0.78 [e/GL])= 1.025 GL

Recall: Read Noise = 3.8 e- rms

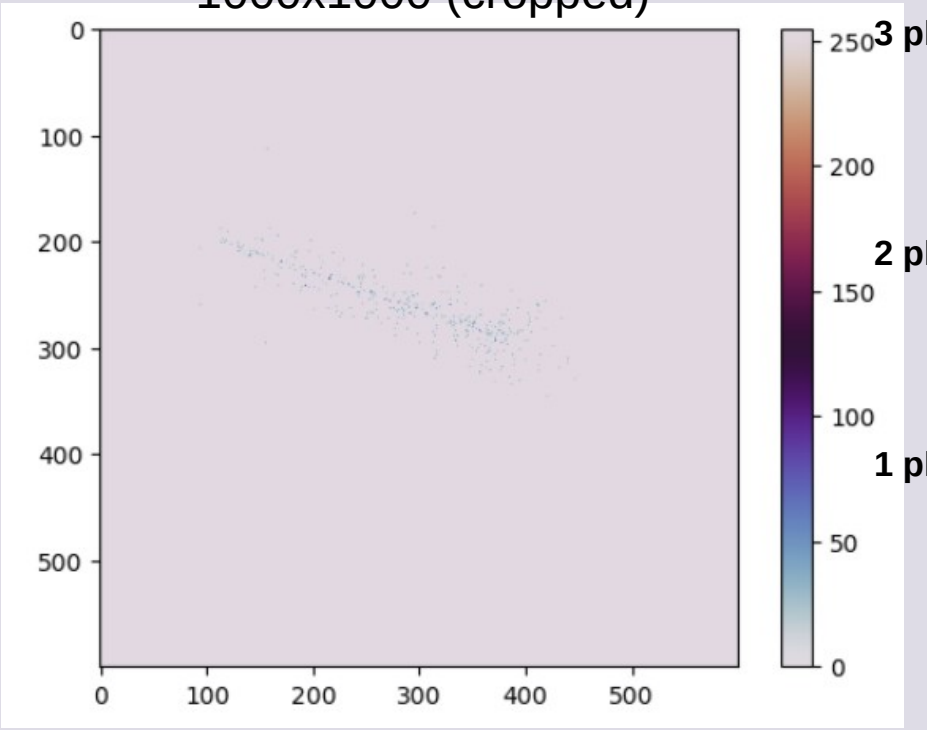
SNR = 0.21 : /

Which SNR is better ?

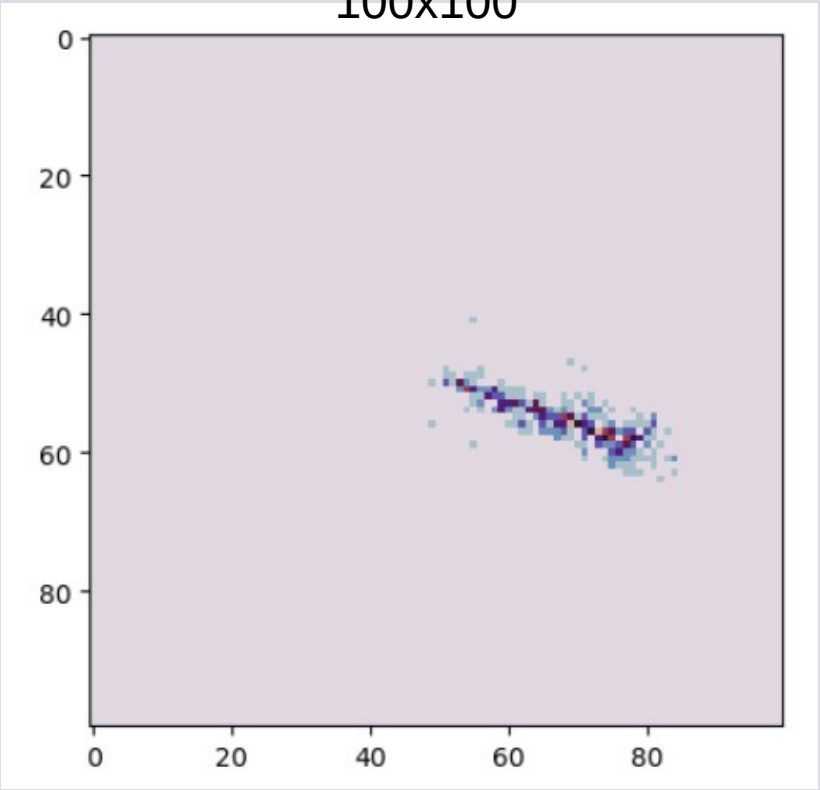
BACK TO MC SIMULATION

30 MeV protons – 10 mm lens radius

1000x1000 (cropped)

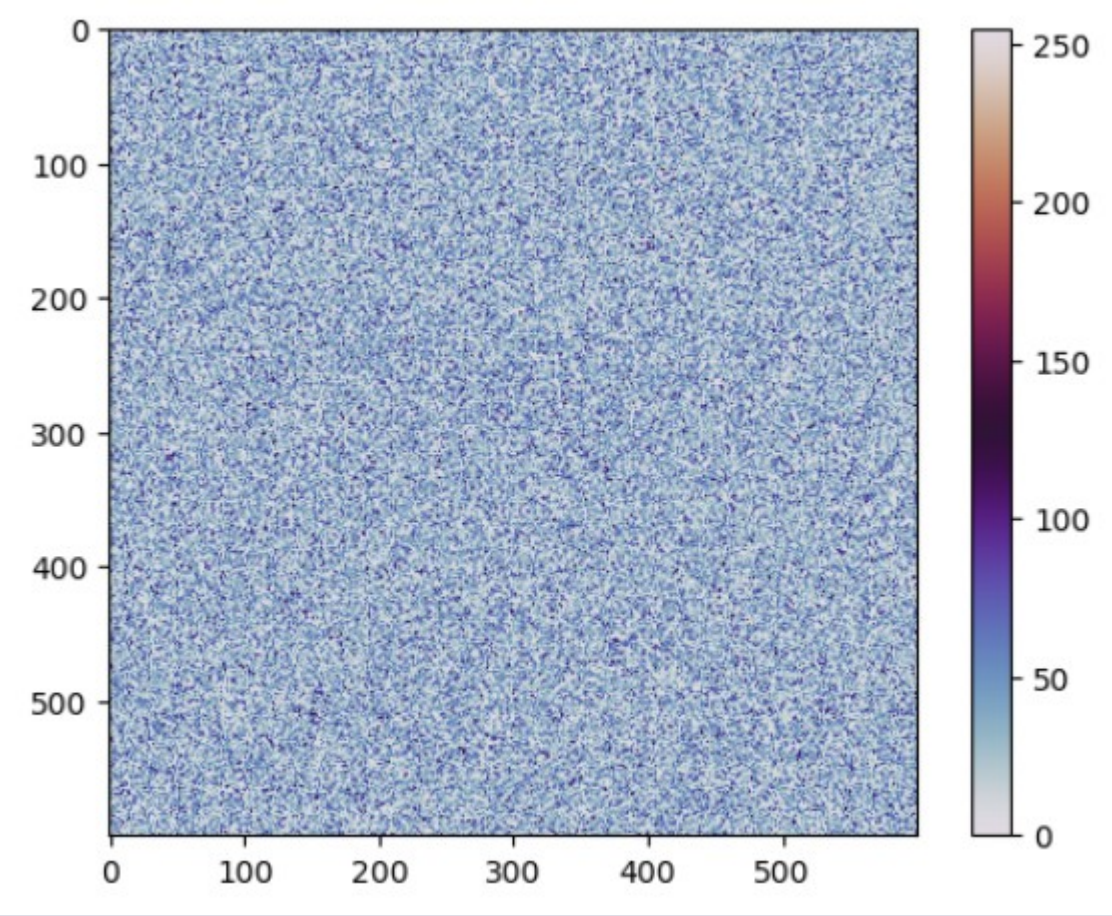


100x100



Which I our SNR target?

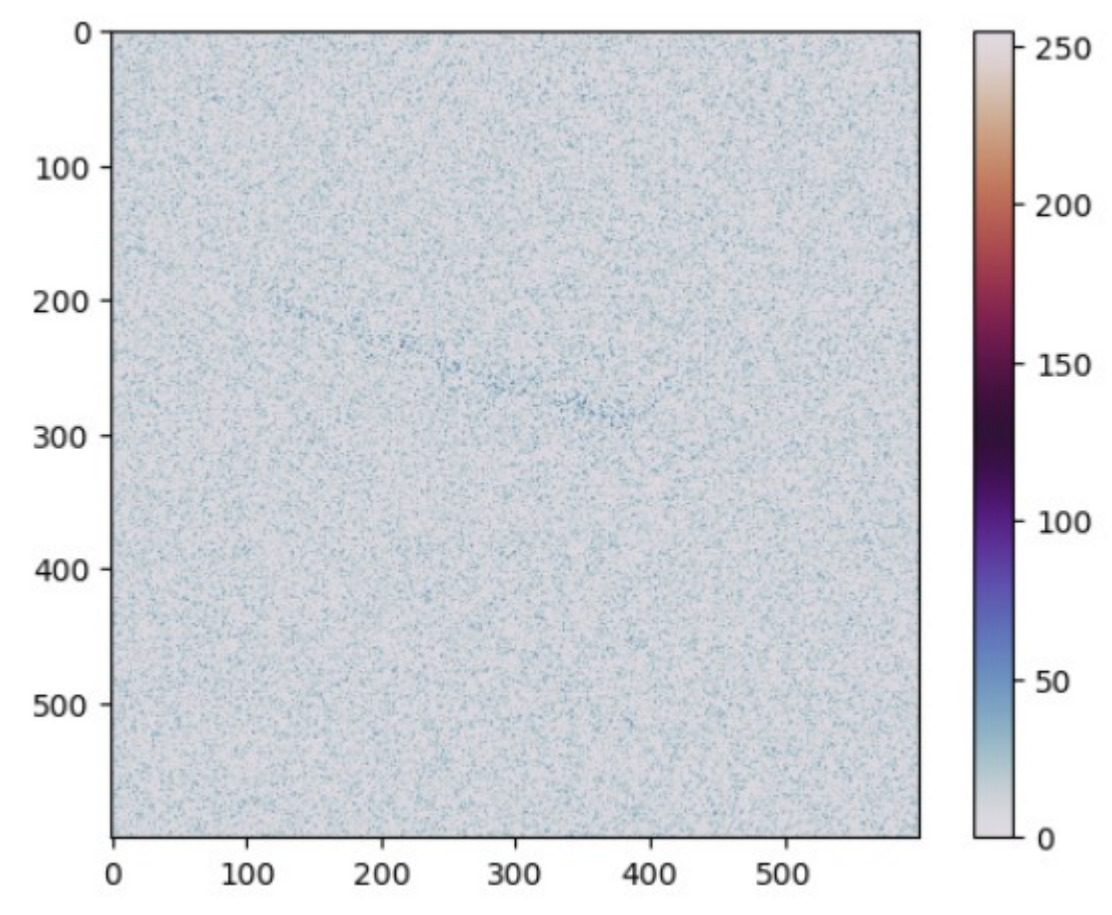
ADDED GAUSSIAN NOISE TO THE IMAGE



SNR = 1

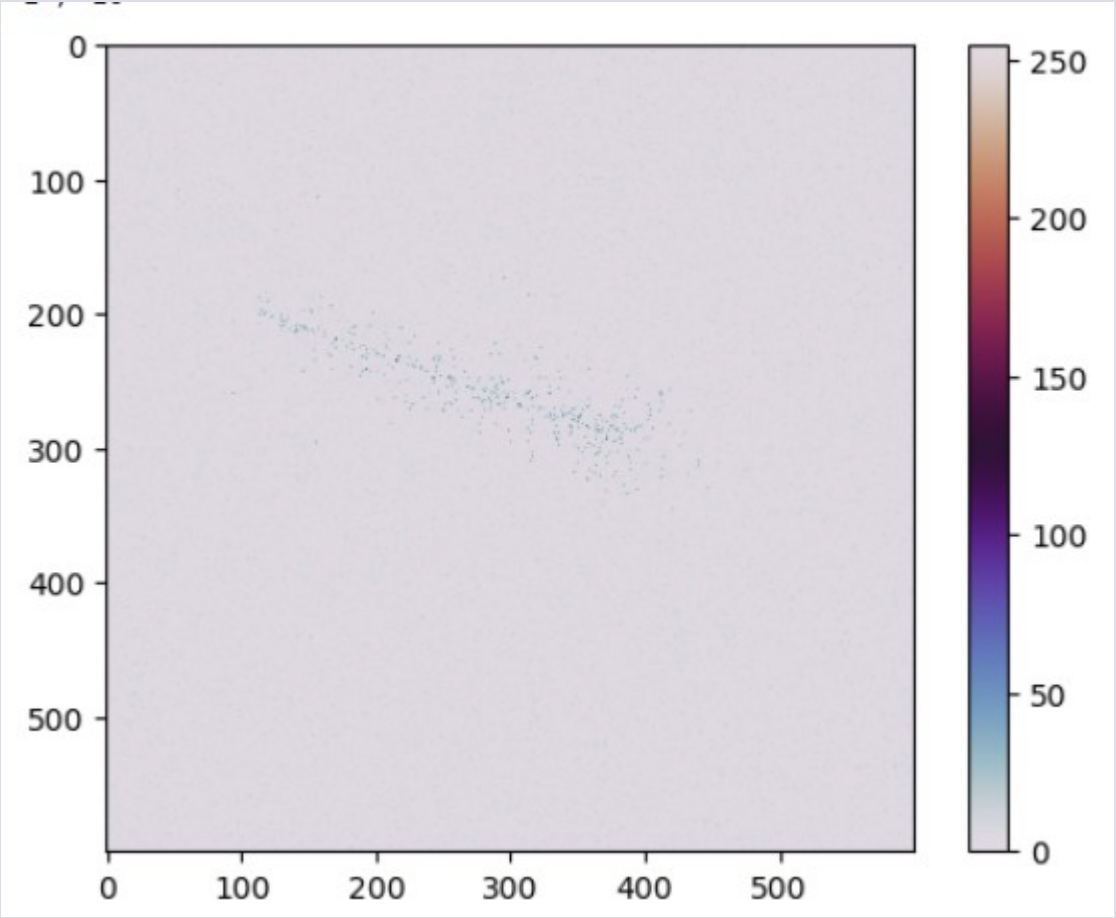
Track is not visible

Which I our SNR target?



SNR = 3
Barely visible

Which I our SNR target?



SNR = 10

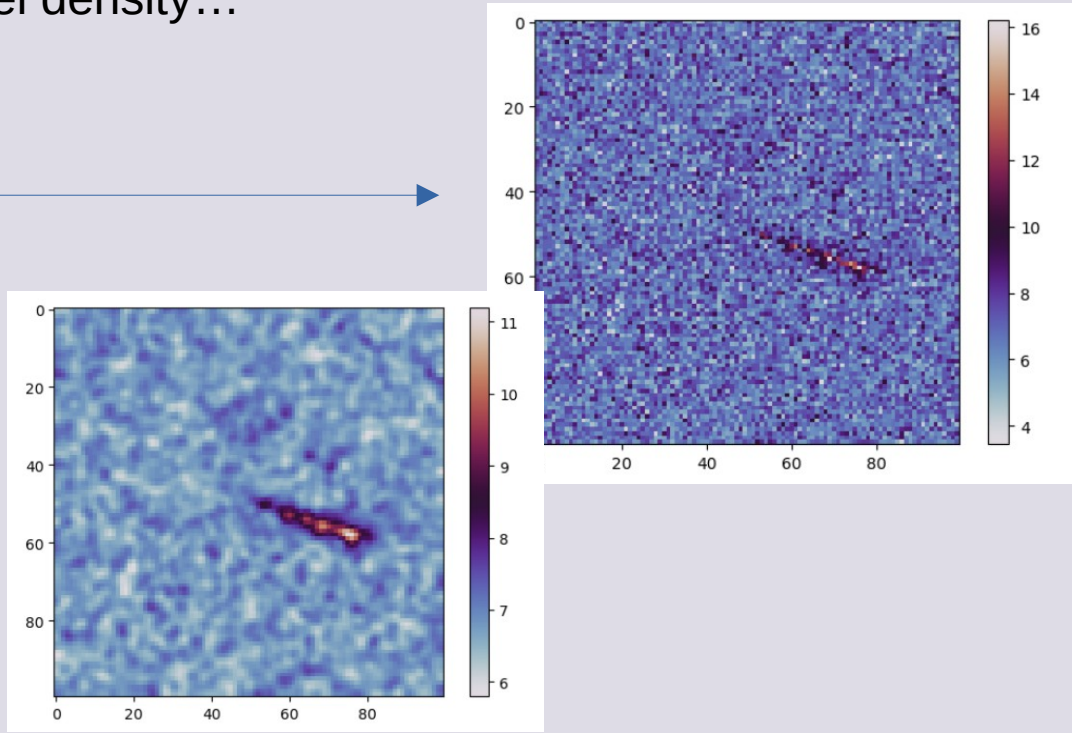
Visible

Which I our SNR target?

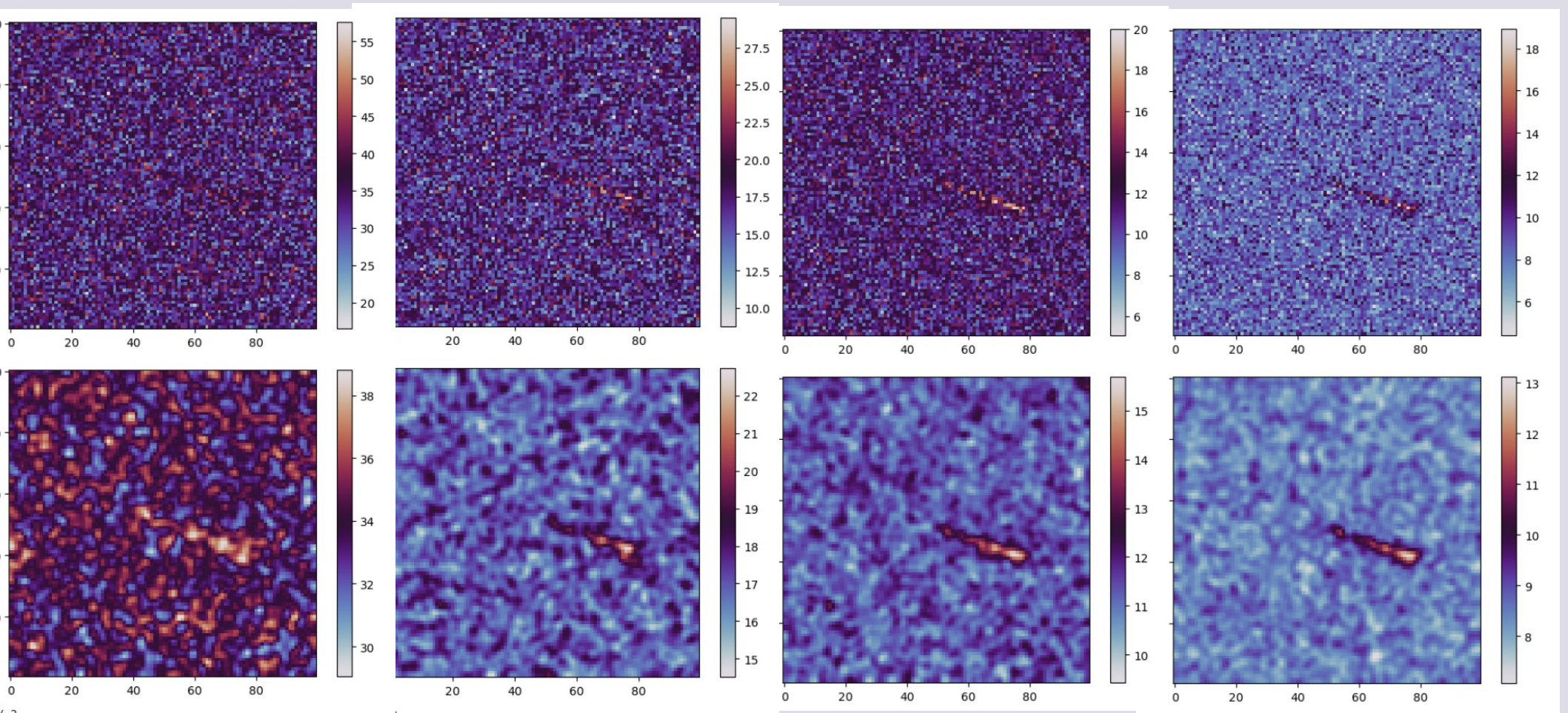
But it is not necessary to look at the single pixel. I just need to identify a region where the track is → could consider the grey level density…

1) dimensionality reduction
(from 1000x1000 to 100x100)

2) Gaussian blur to enhance density features (5x5 gaussian kernel)



Which I our SNR target?



THE END

Misure di gain al variare di EM gain
Misure di read noise al variare di EM-gain

Add noise to riptidemmc simulation

Poi ??
Vedere se I muoni si vedono se riduco l’immagine da 1000x1000 a 10x10
Fare le prove del MCP con il