RIPTIDE

January 2024

Aussie ~~Gen Z~~ Learner's Dictionary

Give it a burl: exclamation. *Attempt something, give it a try.*

RIPTIDE

1) MCP Sensor characterization using diffraction pattern

Setup

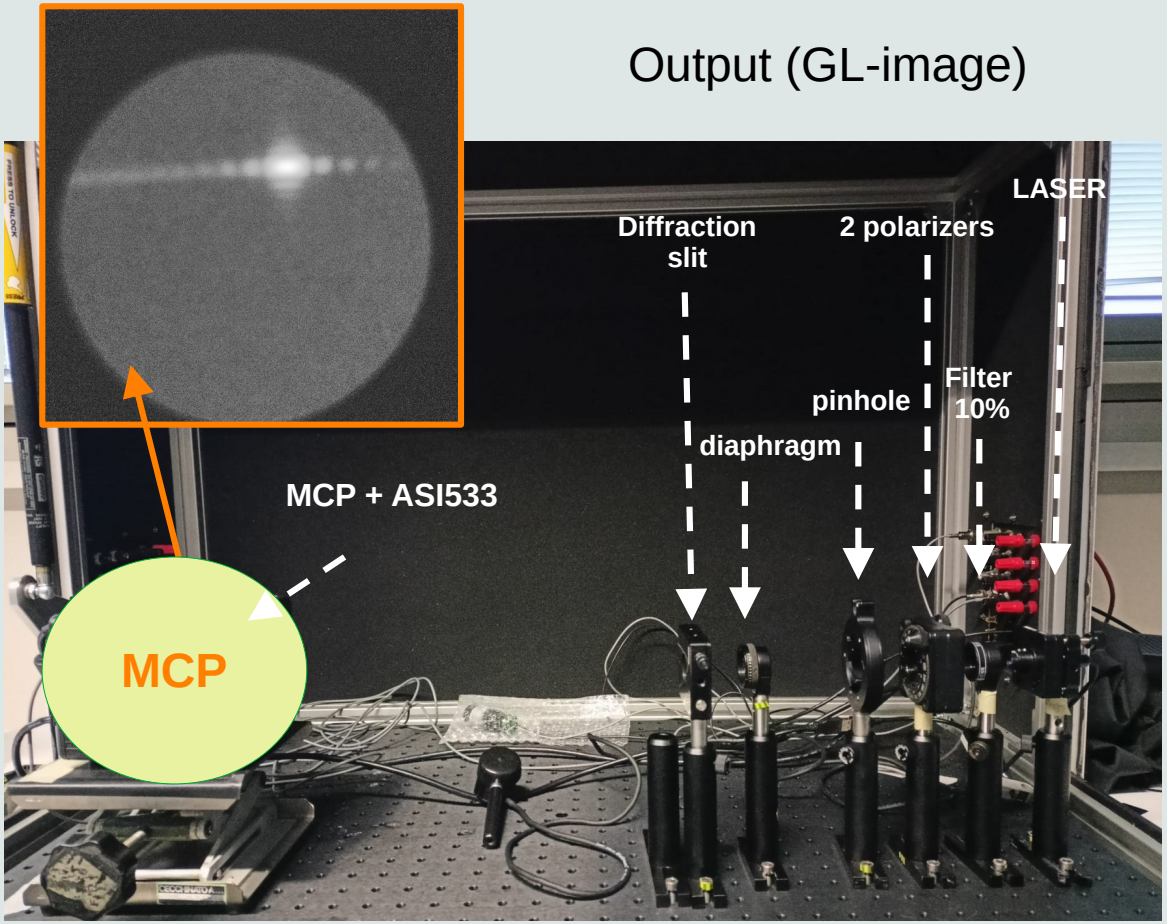
Objective: to *estimate* the lowest amount of photons that is possible to detect in the sensor camera.

Laser wavelenght : 405 nm
Exposue time : 500 ms

Total amount of light exiting from the slit measured with a **powermeter.**

Power : 9.6 x 10^{-4} nW

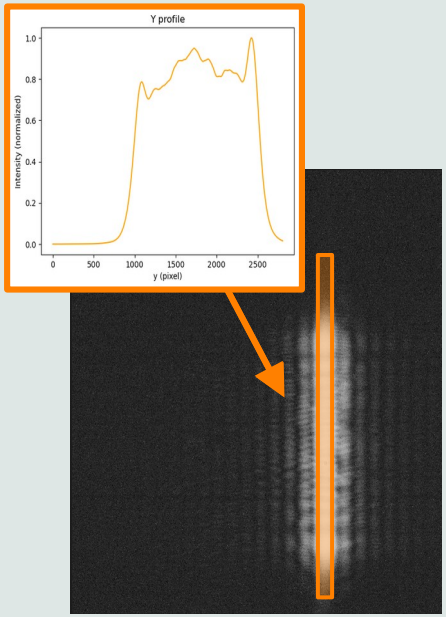
Output (GL-image)



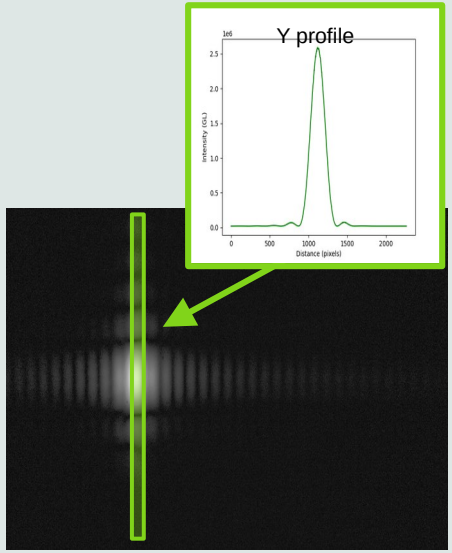
Comparison with ASI533 and ORCA

Due to different setup and acquisition system.
NB: contrast was enhanced to visualize the diffraction pattern.

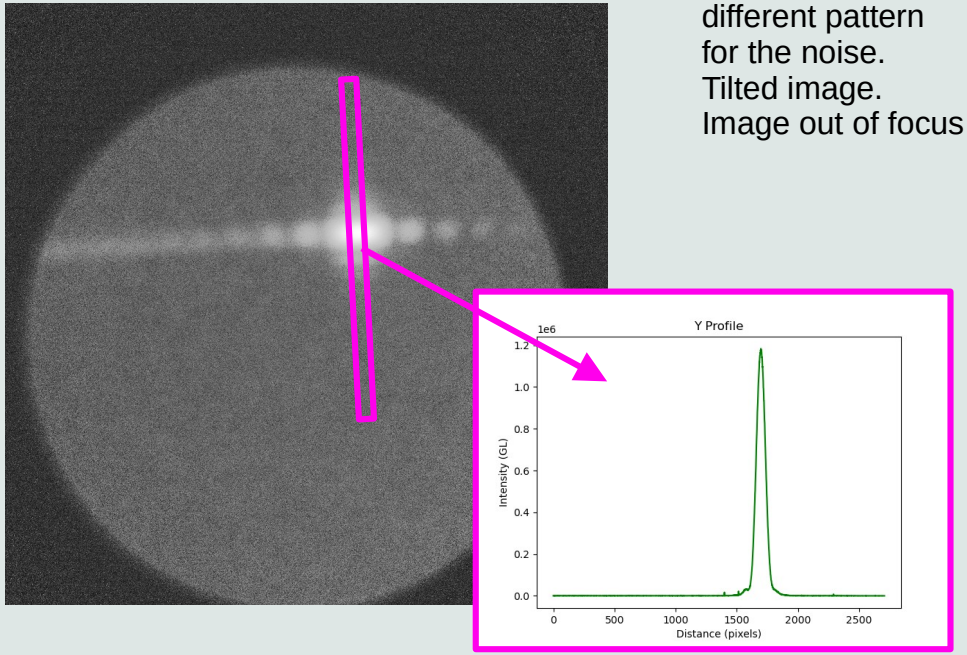
ASI533 pro



ORCA-Quest



MCP



different pattern
for the noise.
Tilted image.
Image out of focus

Steps of the analysis (the same as MCP)

1) Image rotation to make the diffraction pattern horizontal

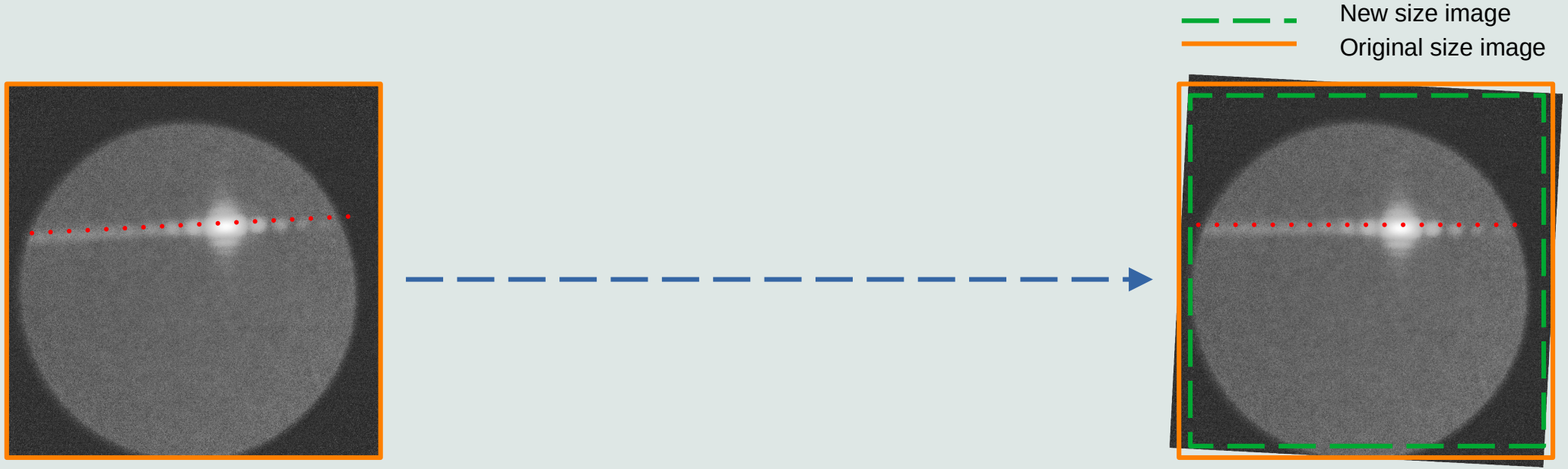
2) Bias subtraction and GL to photon conversion

3) Selection of **five** pixel width row

4) Peaks identification **using binomial averaging** and data extrapolation

1) Image rotation to make the diffraction pattern horizontal

Rotation is applied to make the diffraction pattern perfectly horizontal.



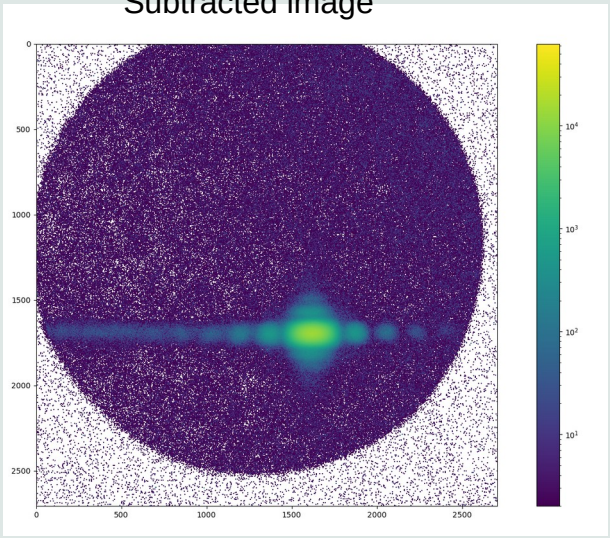
The rotation angle was estimated as the angle for which the maximum point of the y-Profile was alligned.

2) Bias subtraction and GL to photon conversion

- Select a region where there was no signal (highlighteed in figure)
- extract μ and σ from gaussian fit
  - μ is the bias
  - σ is the statistical noise fluctuation due to the MCP

- Bias subtracted image = Image - μ

Subtracted image



BIAS = 2990 GL
MCP noise = 110 GL

Once the bias is subtracted, the GL scale was converted in number of photons

$$Img = Img \times \frac{n_{photon}}{n_{GL}}$$

n_{GL} : total number of GL in the image (BIAS subtracted)

n_{photon} : total number of photons exiting from the slit:

λ_{photon} = 405 nm $\dashrightarrow$ $E_{photon} = \frac{hc}{\lambda} = 3.06\,eV$

$Power = 9.6 \times 10^{-4}\,nW = 5.99 \times 10^{6}\,eV$

$T_{\exp} = 500\,ms$

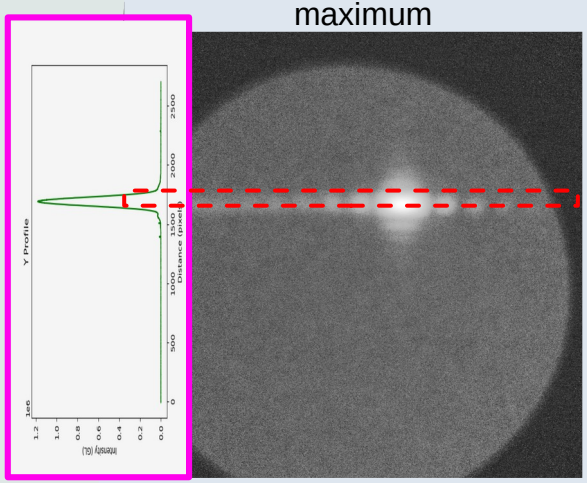
$$n_{photon} = \frac{Power\,[eV] \times T_{\exp}}{E_{photon}}$$

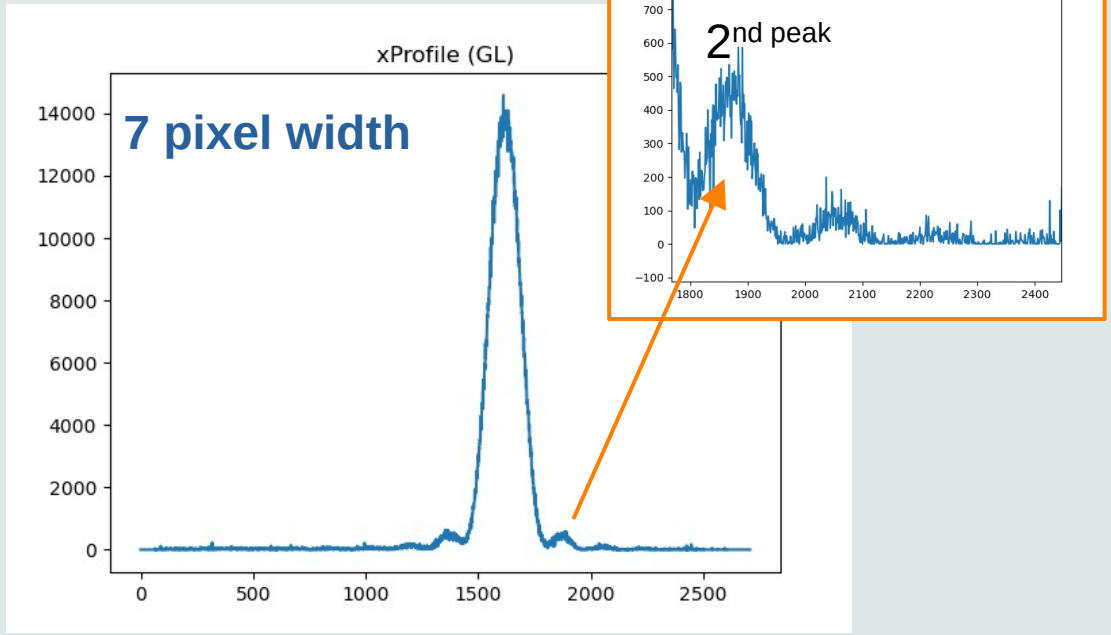
 # photon / # GL = 0.0039 (= 3.35 ASI 533) (= 0.133 ORCA)

3) Selection of few pixel width row and GL to photon conversion

From Y profile, the central row of the diffraction pattern was obtained.

7 pixel selection around yProfile maximum



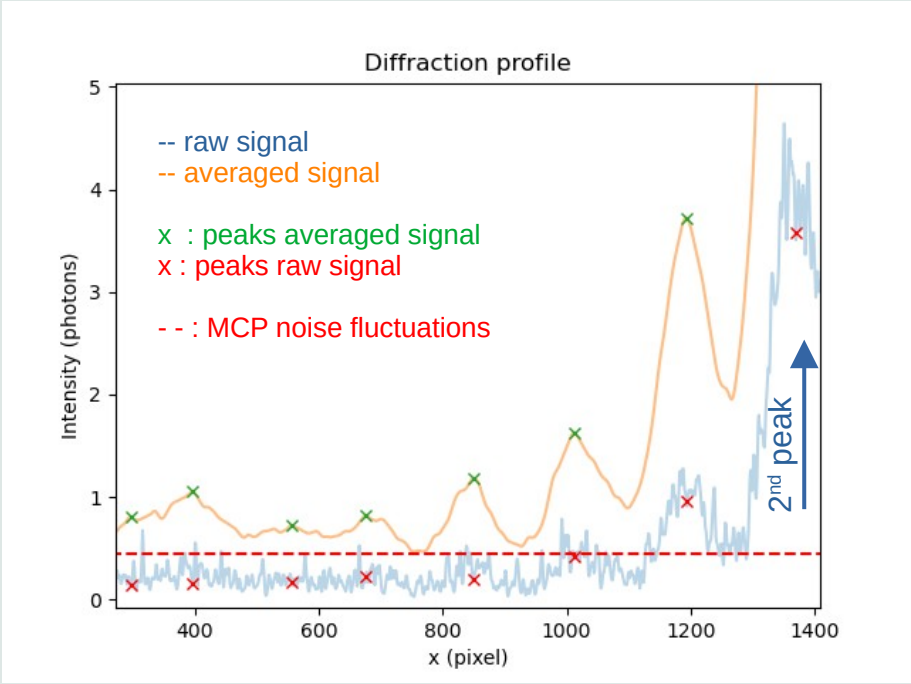


Less peaks are visible wrt ORCA (but less photons reached the sesor)

ORCA : 0.2 nW
MCP: 9.6E-4 nW

4) Peaks identification and data extrapolation

We can see single photon per pixel !!!



Averaged signal = convolved with binomial + uniform distribution

	2	5	10	20	30	50
0	114.1 ± 0.7	114.8 ± 1.4	114.3 ± 1.3	113.0 ± 1.7	111.4 ± 2.9	106.2 ± 7.6
1	4.4 ± 0.1	4.2 ± 0.3	4.1 ± 0.3	3.9 ± 0.4	3.8 ± 0.5	3.3 ± 0.8
2	1.0 ± 0.0	1.0 ± 0.1	1.0 ± 0.1	1.1 ± 0.1	1.0 ± 0.2	0.9 ± 0.2
3	0.4 ± 0.1	0.4 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.4 ± 0.1	0.4 ± 0.1
4	0.3 ± 0.1	0.3 ± 0.1	0.3 ± 0.1	0.3 ± 0.1	0.3 ± 0.1	0.3 ± 0.1
5	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1
6	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1
7	0.3 ± 0.0	0.3 ± 0.0	0.3 ± 0.1	0.3 ± 0.1	0.3 ± 0.1	0.3 ± 0.1
8	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1
9	0.1 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1

All the peaks further than the 3rd are under the MCP noise

The end

- MCP photon conversion is higher than single-photon camera (0.004 VS 0.133 phot/GL)

- The binomial convolution could be used also to enhance contrast in the images (to find the peaks)

- Next Month: nothing. I will write the proceeding for ANP conference.

E infatti è ciò che ho fatto ---->

The paper

26 September 2024

Applied Nuclear Physics 2024 (ANP2024) - Applied Radiation and Isotopes

Link

Submission deadline: **20 January 2025**

ANP 2024 is the second edition of the Applied Nuclear Physics series of conferences, after the first successful one held in Prague in 2021 (ANP 2021). ANP 2024 is supported by the European Physical Society.
ANP 2024 is organized under the aegis of the Hellenic Nuclear Physics Society (HNPS), a non-profit organization formed in 1990, being the official body of nuclear scientists in Greece. The conference will focus on applications of nuclear physics to energy, health, space, security, environment, material science, preservation, and the study of cultural heritage.

Only full-length papers and review articles will be considered for publication, subject to peer review by a minimum of two reviewers. There are no page limits although the length of the paper should be appropriate for the material being presented.

While the deadline for submissions is **3rd February 2025**, papers will be published electronically as soon as they are accepted. We will compile all special issue articles online as virtual special issue, making your article visible on the ScienceDirect website. All articles will be typeset at no cost to the author; there is a charge for printing color figures although there is no charge for color figures on the electronic version.

The paper

A versatile method for calibrating and comparing optical sensors in low luminosity conditions.

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Abstract

This paper describes a comparative study of three optical readout systems for the RIPTIDE detector, focusing on their performance under extreme low luminosity conditions. The systems analyzed include the ASI533MM-PRO from ZWO, the ORCA-Quest2 from Hamamatsu, and an MCP-based setup build specifically. The key aspect of this study is the novel method used to compare the optical systems, based on the diffraction pattern produced by coherent light (e.g., a laser) passing through a single slit. The intensity distribution of the diffraction peaks is analytically linked to the photon sensitivity and noise characteristics of the detectors. A calibrated photo-diode and potentiometer were used to quantify the total light intensity, which was then correlated with the Grey Level output recorded by each system. The results show that the ASI533MM-PRO exhibited the lowest photon sensitivity and highest background noise, while the ORCA-Quest2 demonstrated lower noise and was capable of detecting photons with high precision. The MCP setup, despite its higher background noise, benefited from light amplification, enabling detection of lower photon densities. This method of comparison provides a robust framework for evaluating optical readout systems for high-precision, low-luminosity applications like the RIPTIDE detector.

Keywords: Optical, Photons, Calibration, Sensor, RPTI, Scintillation,, imaging, neutron, detector

Leggete e correggetene tutti...
E mi raccomando, siate il più severi possibile.

Grazie

The paper

Main doubts:

- error on the potentiometer for ORCA and MCP?? (e successiva propagazione degli errori)
- names of MCP and POTENTIOMETER

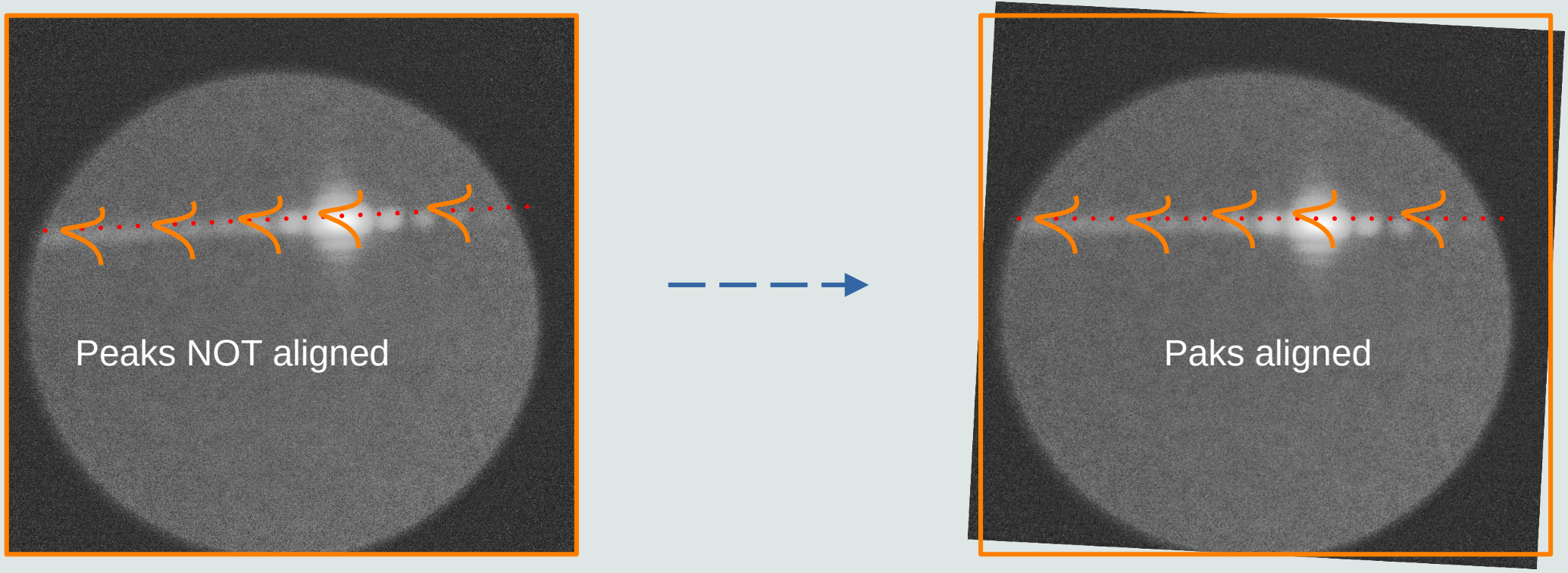
- lista fondi
- acknoledgements??
- Author contribution (CreDiT), manco so dove devo metterlo

- varie ed eventiali

THE END

1) Image rotation to make the diffraction pattern horizontal

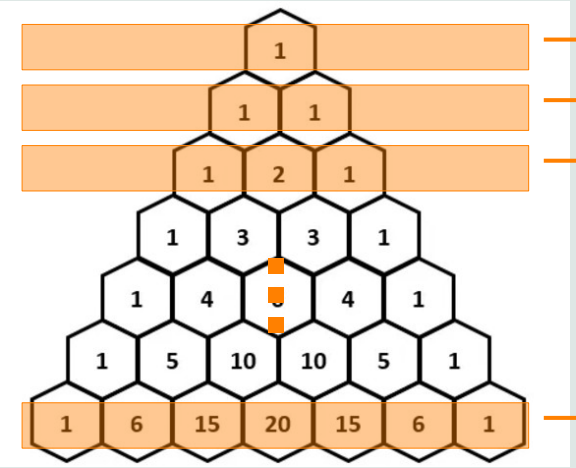
Rotation is applied to make the diffraction pattern perfectly horizontal.



2) Binomial convolution

- Convolution with binomial function was used in order to enhance the peaks.

- The weights for the convolution has been obtained from Pascal's triangle:



Window = 1
Window = 2
Window = 3

Window = 7

After binomial convolution, an average convolution with the same window of the binomial was performed in order to smooth the signal.