Progress in the Arcadia project

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Results on ARCADIA chip with Laser

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In partnership with:

Tasks from the last meeting

1. **Find the optimal point on the Z-axis where the laser spot is minimized (expected to be at most 10 µm)** to investigate whether the pixel provides a uniform reading, regardless of the location within the pixel.

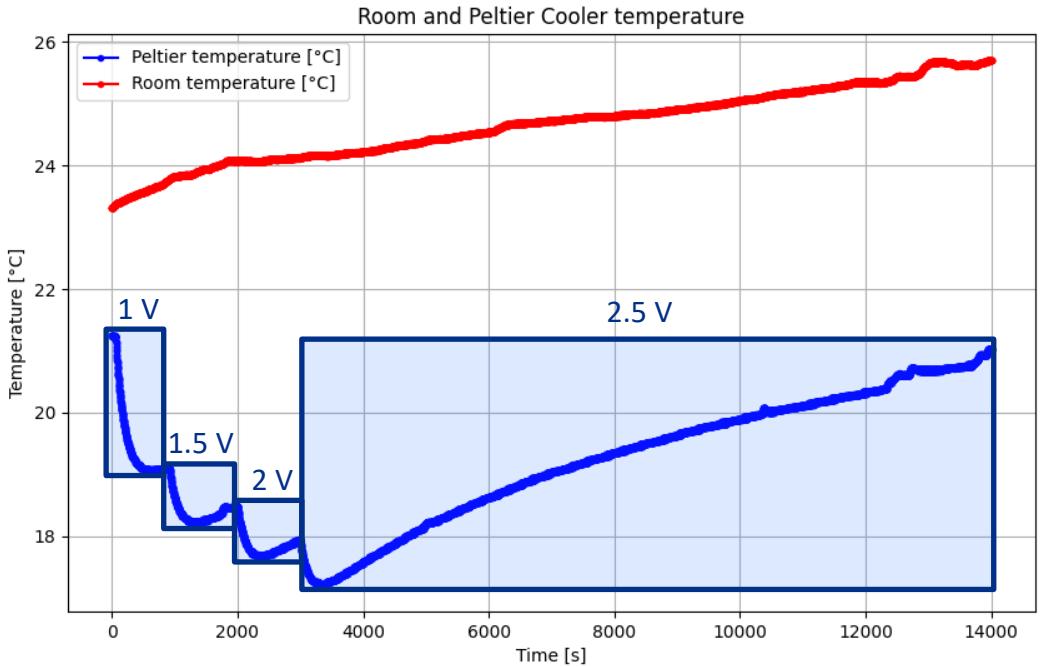
2. **Control the temperature inside the box in the Arcadia Setup** to better characterize the variation of the threshold with temperature. To achieve this, we need to understand the Peltier-cooled surface in the Scanning TCT.

3. Redo S-curve and perform the VCASN threshold vs. temperature characterization with the Particulars laser.

Peltier Cooler

Due to the sensitivity changes of the MAP sensor caused by temperature variations, it is necessary to control (cool) this variable.

As shown in the figure, low voltage can achieve a cooling effect of a few degrees; however, it is still affected by room temperature. Therefore, some type of control is needed to maintain the temperature within an appropriate range, minimizing the impact of room temperature, as well as a water flow to dissipate the heat generated.



Behavior of the Peltier Cooler over time at different voltages

Particulars Laser Characterize

Minimum Laser Spot

*Details of each device in the backup

	CCD camera	Diode	LGAD (in progress)
FWHM approx. (um)	8	60	25
Max. attenuation for laser detection (%)	99	87	99

- Each device has its own sensitivity, I believe the results cannot be directed compared between them; they will only serve to give an idea of the beam and the sensitivity of the device itself.
- But we still have the question: Why does a diamond shape appear on the MAPS sensor when the Particulars laser is operating at high power?

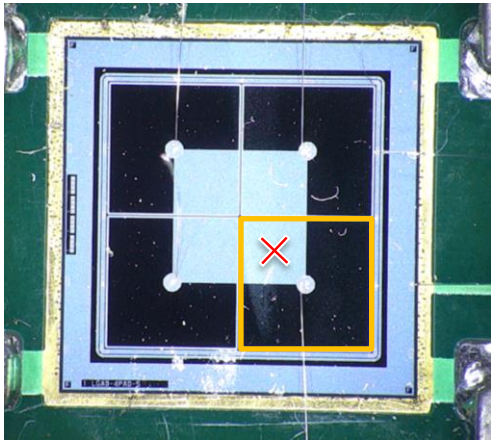
Fermilab

Particulars Laser Characterize

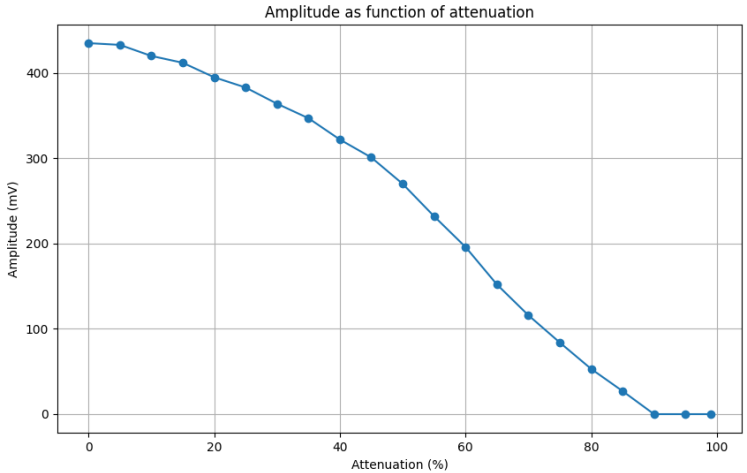
Attenuation Effect on the Laser Spot

*More details in the backup

With the CCD camera, the FWHM remained relatively constant despite changes in attenuation; however, using the LGAD, there is an apparent increase in the area where the laser is detected.



Laser position and pad used in the LGAD



Detection of the laser while in the metallized area from the pad based on attenuation

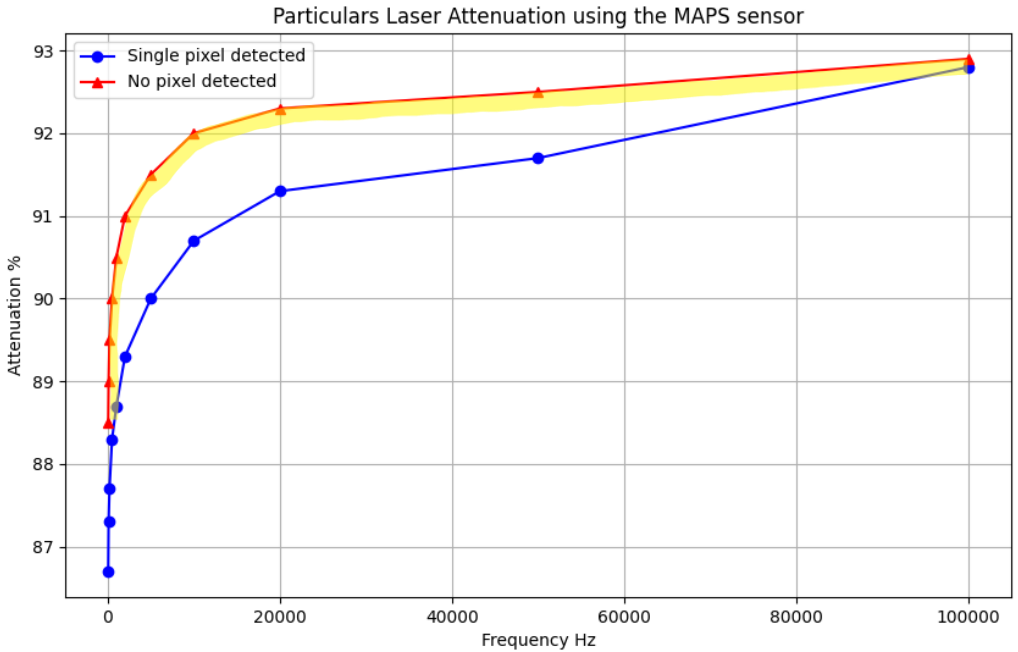
Next Steps

1. Enable the Peltier cooler with water flow and a temperature control system to avoid being affected by room temperature.
2. Automate testing and data collection to find the focus more efficiently and accurately. So far this is done manually but it is slow.
3. **Investigate whether the pixel provides a uniform reading, regardless of the location within the pixel.**

Next Steps (cont.)

For the last task, the yellow area indicates the range of attenuation values that should be worked with, as this would represent the minimum laser spot for the MAPS sensor.

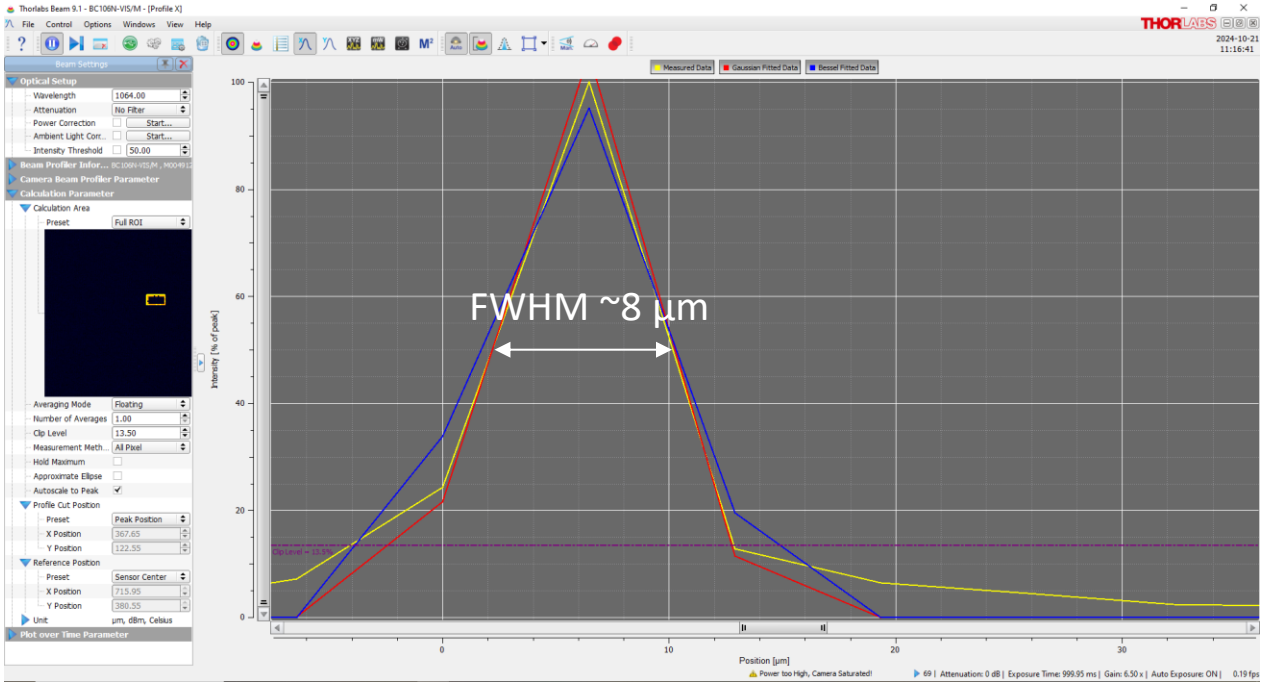
Below the blue curve is where the diamond shape begins to appear.



Detection on a single pixel and no detection curves: Attenuation vs Frequency

Thank you

Particulars Laser Characterize (CCD Camera BC-106N-VIS/M)



Measurement of the Particulars Laser using the CCD camera
(yellow curve is the data).
Laser with a 10 kHz trigger frequency and 95% attenuation.

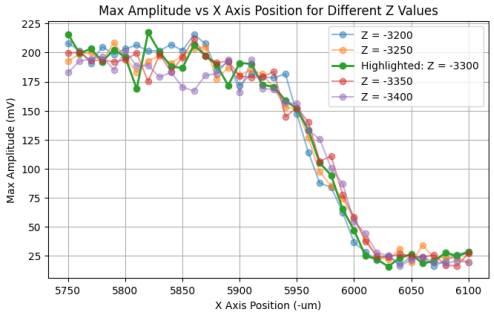
Particulars Laser Characterize (Diode)

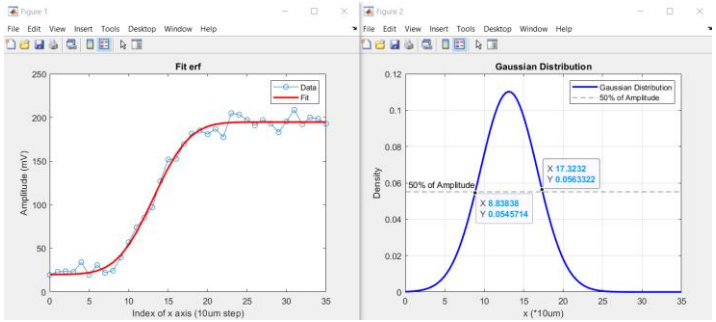
- With the diode, a **laser spot of approximately 60 µm was found**; however, unlike the CCD camera, **the laser was no longer detected at about 87% attenuation**.

Obtain measurements from the diode for different X values (toward the metal) and different Z values (optical distance).

Obtain the error function from the amplitude as a function of X for various Z values.

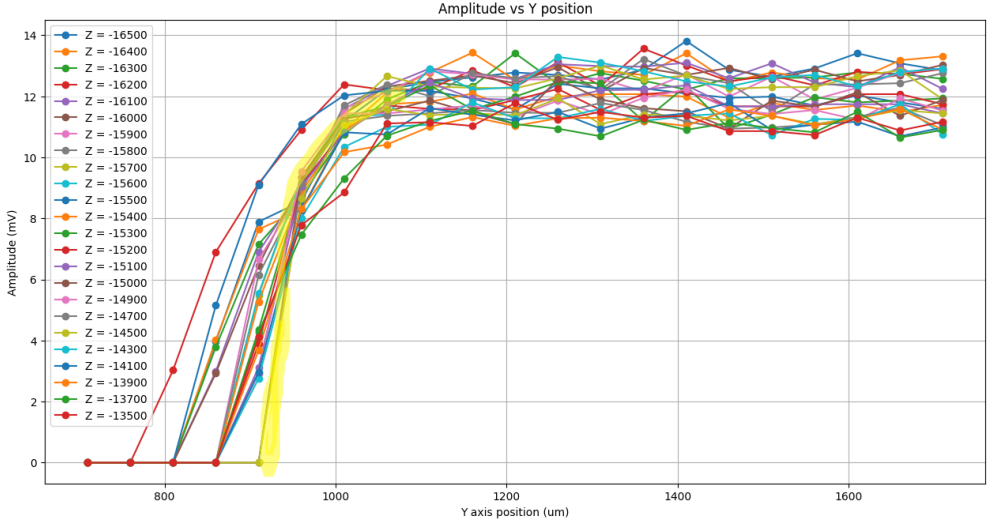
From the parameters σ and µ of the error function, obtain the Gaussian distribution and use it to calculate the FWHM for each Z value.

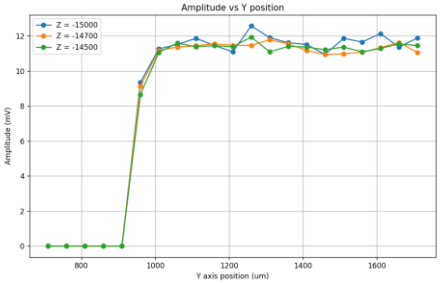




Particulars Laser Characterize (LGAD – in progress)

- Using the same Diode method for the LGAD, a laser spot of approximately 25 µm was found; unlike the diode, the LGAD was still able to detect a signal even with 99% attenuation, like the CCD camera.

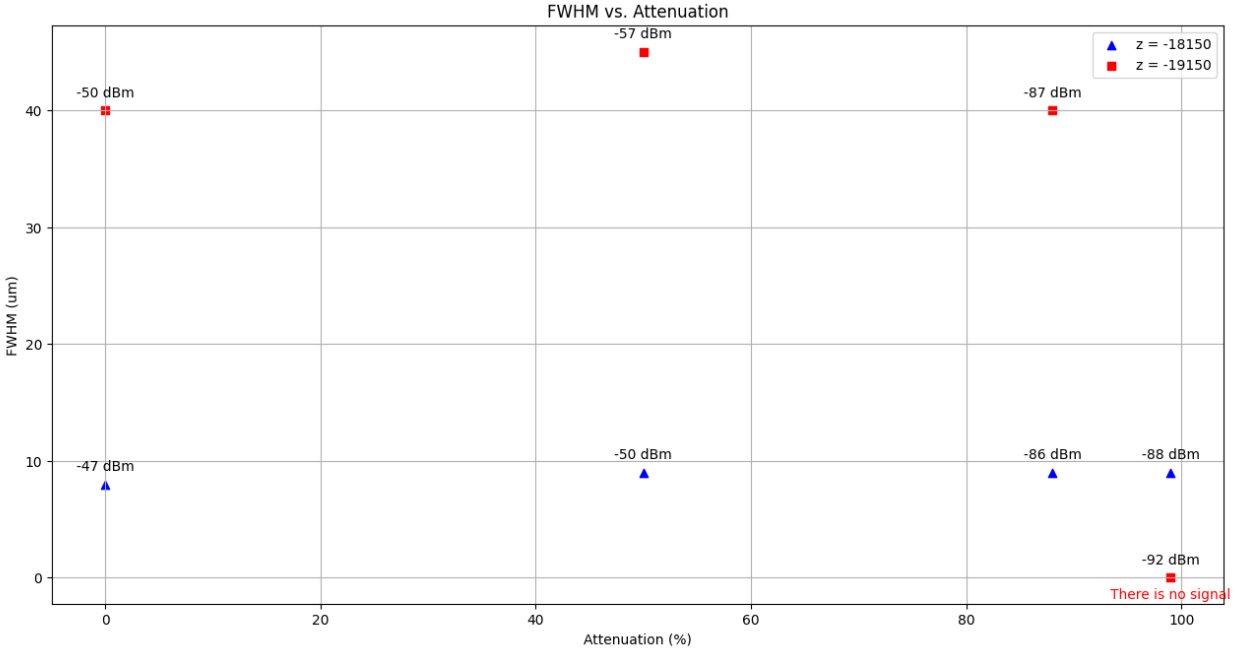




The best curve is selected for the analysis. A step size of 50 µm is used, but this value can be reduced for increased accuracy.

Particulars Laser Characterize (CCD Camera)

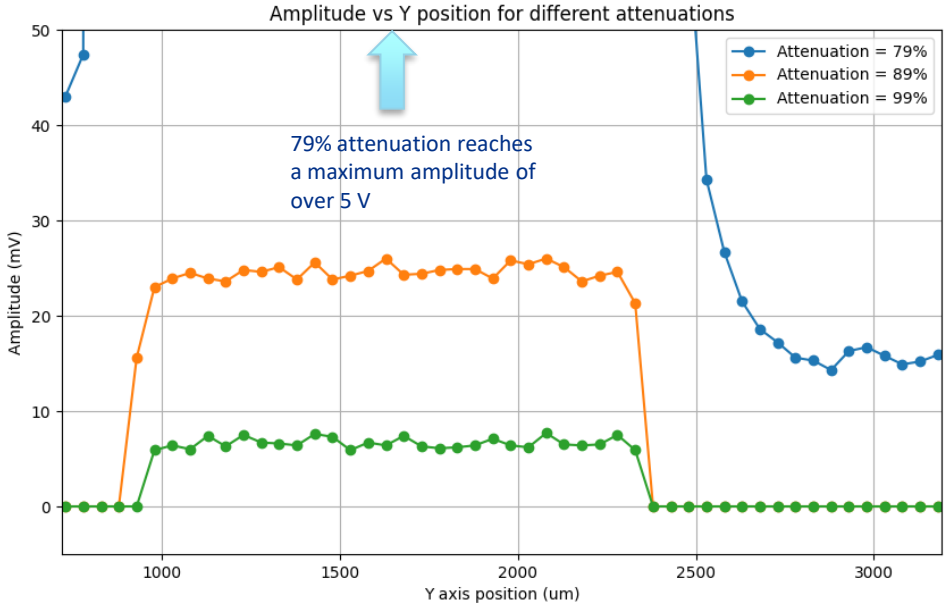
Attenuation Effect on the Laser Spot



Behavior of the laser spot under various attenuations for the same position.
Z is the optical distance.

Particulars Laser Characterize (LGAD – in progress)

Attenuation Effect on the Laser Spot



Behavior of the laser spot under various attenuations for the same path.