Characterization of AOHs for BCM1F

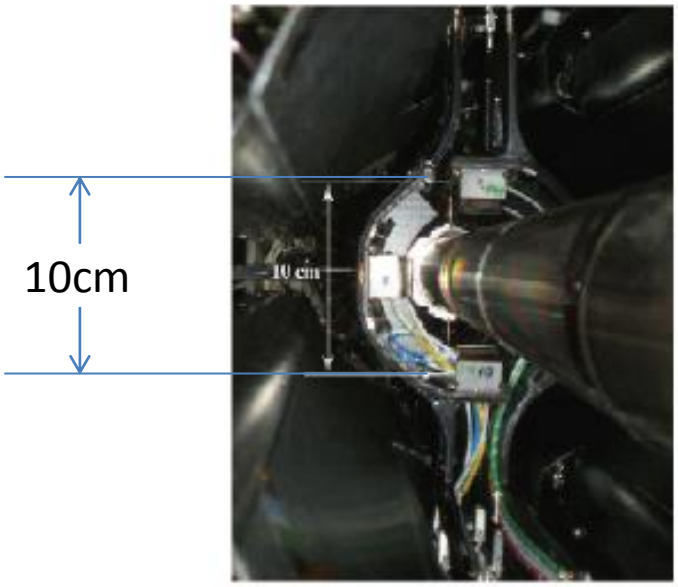
Srinidhi Bheesette

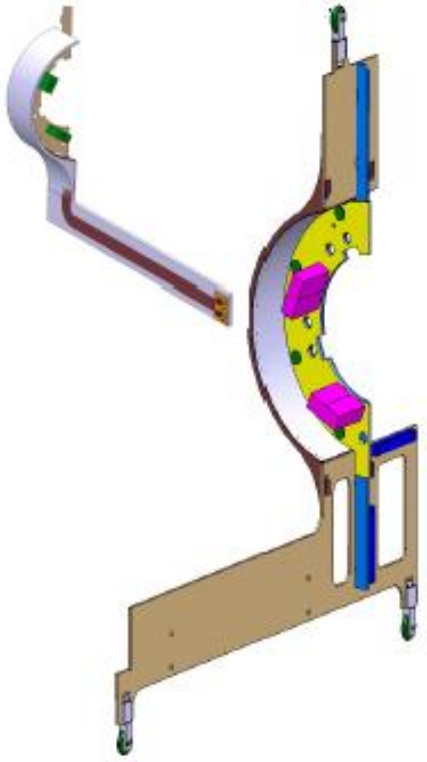
with

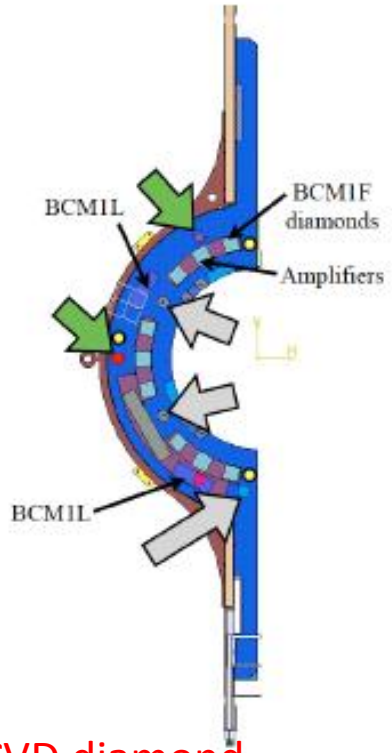
Alan James Bell

Brian Pollack

Beam Condition Monitoring 1Fast



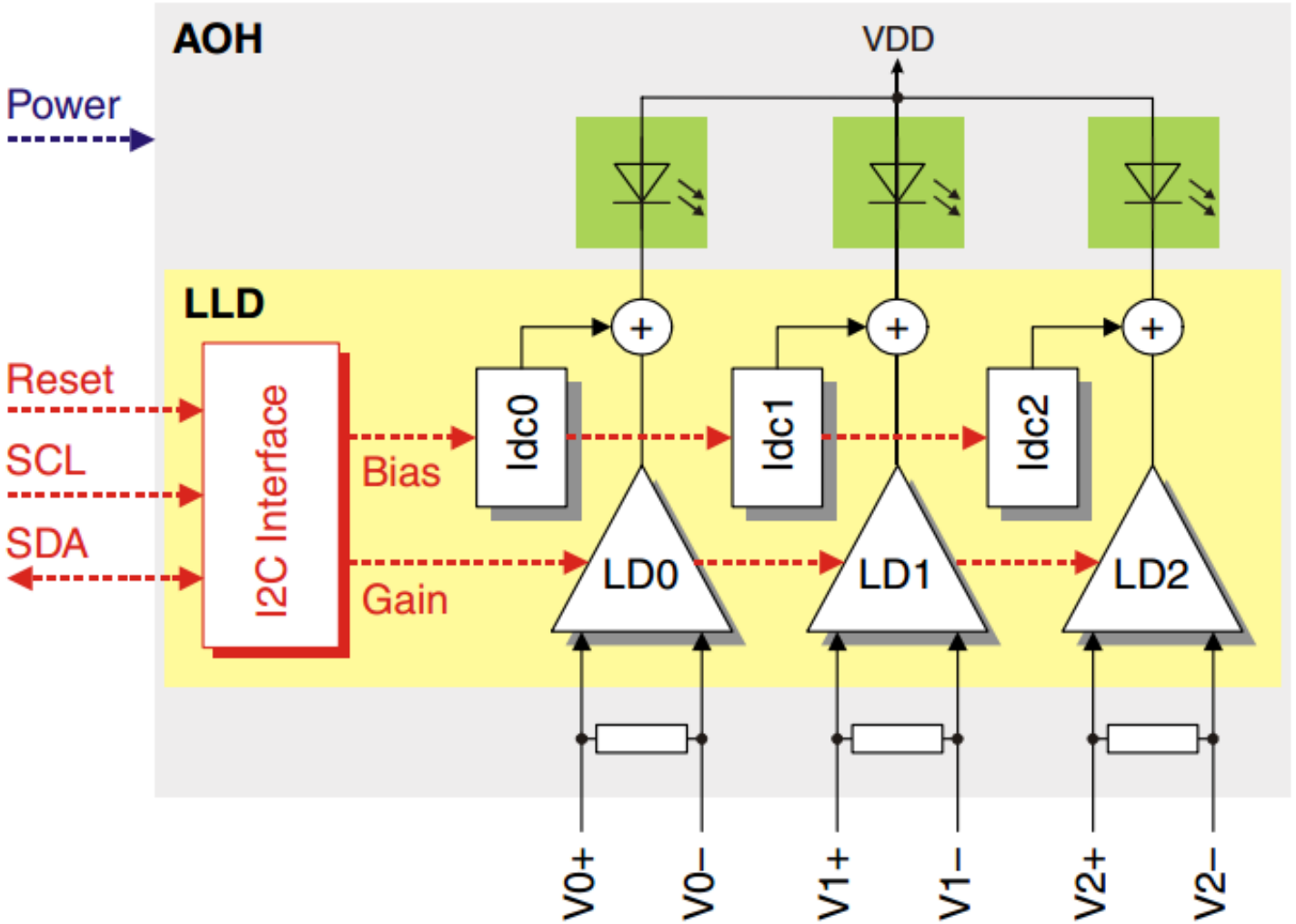




- Previous BCM1F had 4 modules per end, each with 1 cm^2 sCVD diamond.
- Being upgraded to incorporate 12 diamond detectors per end, with a total of 48 channels.
- Used in CMS experiment for:
  - Beam Background Monitoring &
  - Real-Time Luminosity measurement
- System stability is vital!

AOH Boards

The amplified detector signals are converted to optical by the Analog Optohybrid (AOH) which consists of a Linear Laser Driver (LLD) ASIC and three laser diodes.

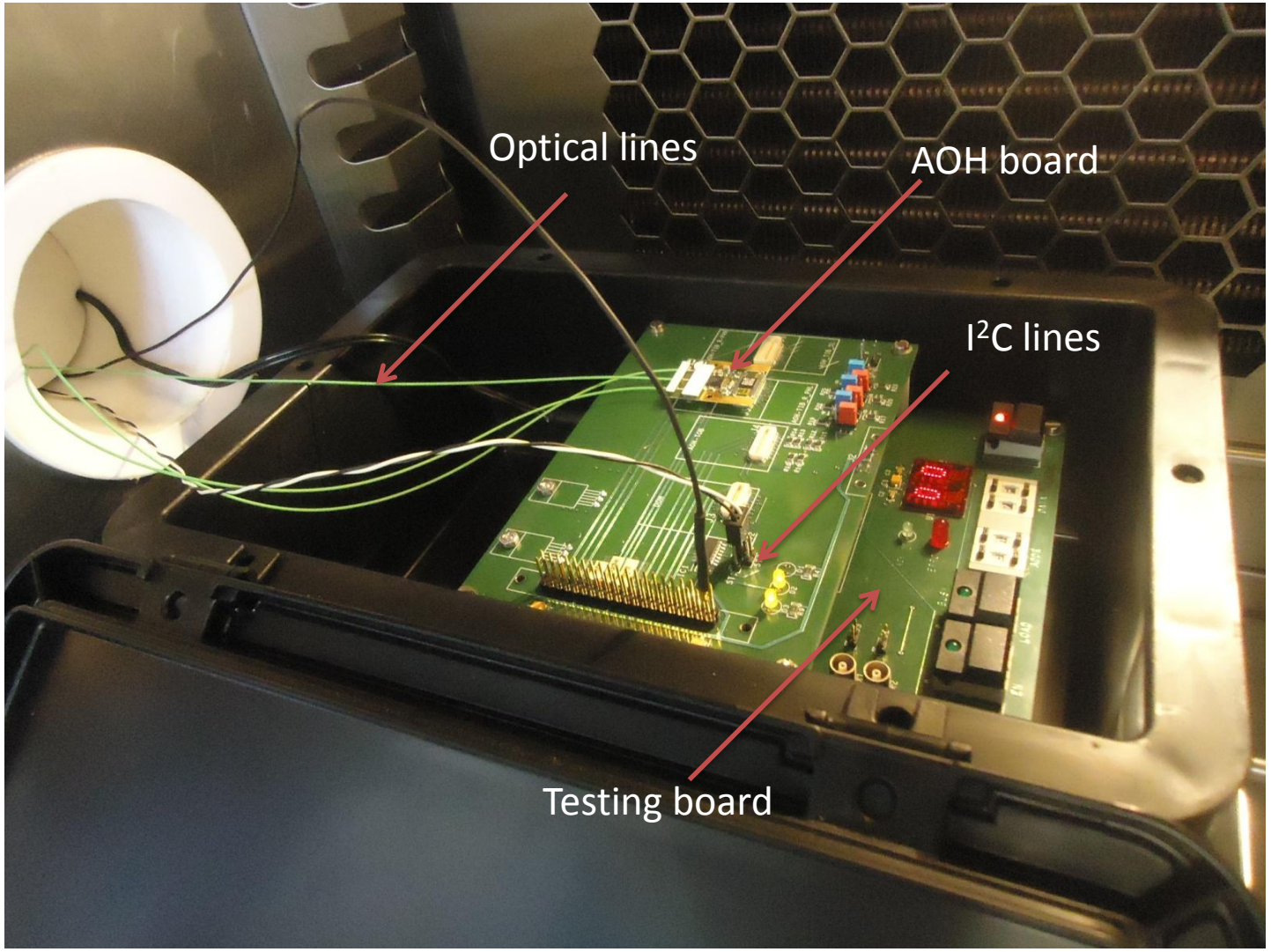


Objective of the tests

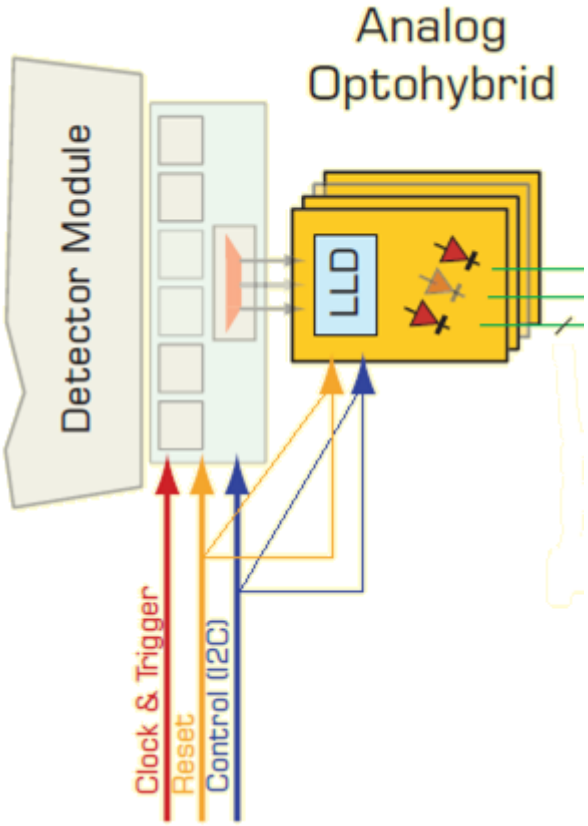
- To understand how the AOHs are effected by:
  - Radiation damage (Long term effect)
  - Temperature (Short & long term effect)
  - Find the optimum bias current values for each laser at the expected operating temperatures when installed in to the BCM1F.
- We need to know the precise behaviour of each component before they are installed in the CMS detector.
- They will be totally inaccessible once installed!

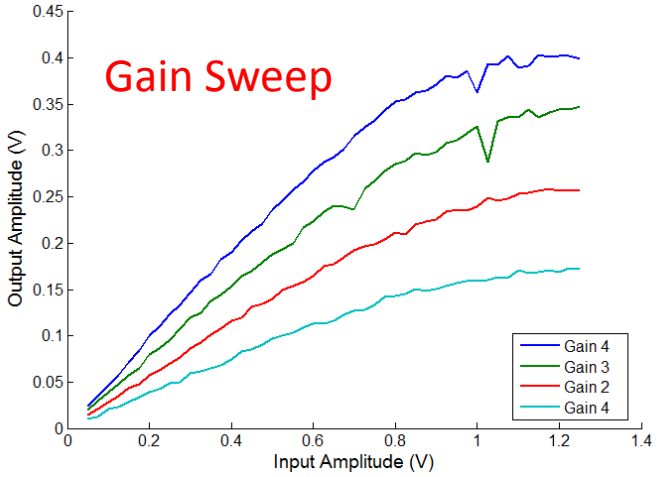
The test setup

The test setup

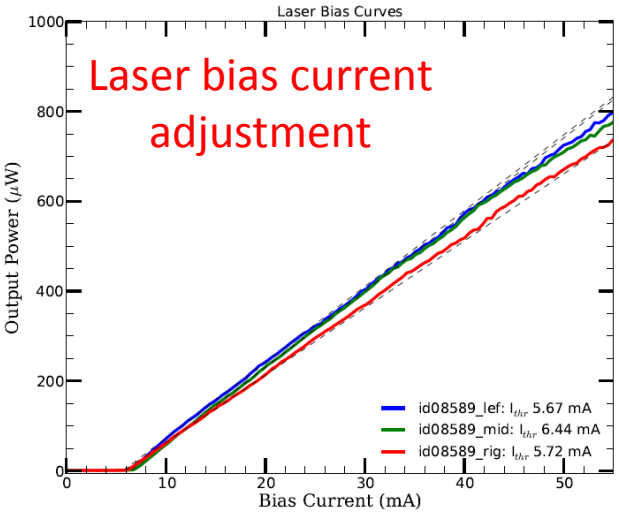


Gain and Bias sweeps



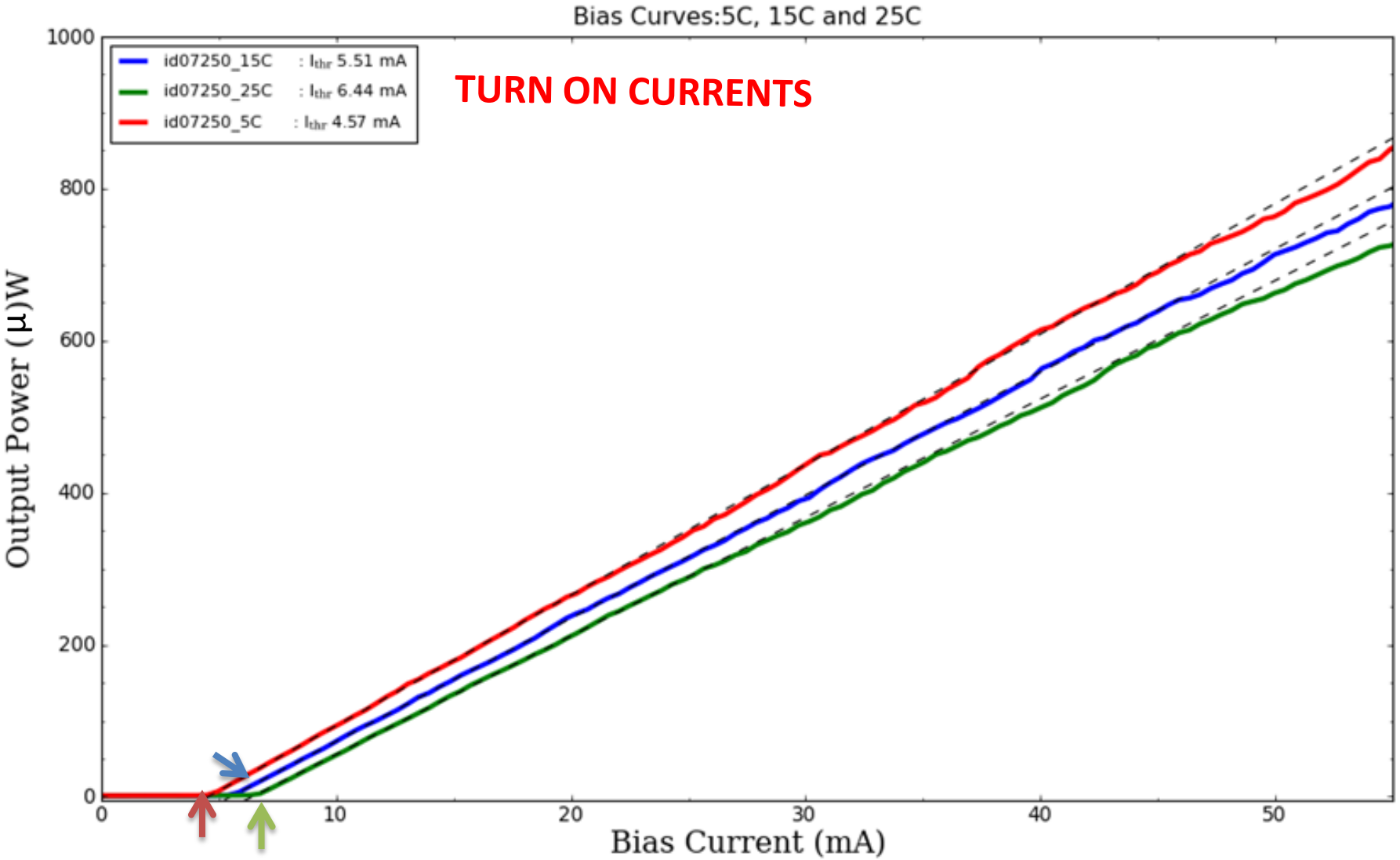


- The AOH boards consist of 4 selectable Gains: 0,1,2 and 3.



- Bias current sets the laser light output without input signal.
- Bias must be set so that the whole signal is transmitted, but not so high to cause unnecessary power consumption.

Comparison of a laser at 5°C, 15°C and 25°C



Laser Temperature Extrapolation

The turn on point is temperature dependent.

Laser Temperature Extrapolation

As an example, using the data points from $25°C$ and $15°C$...

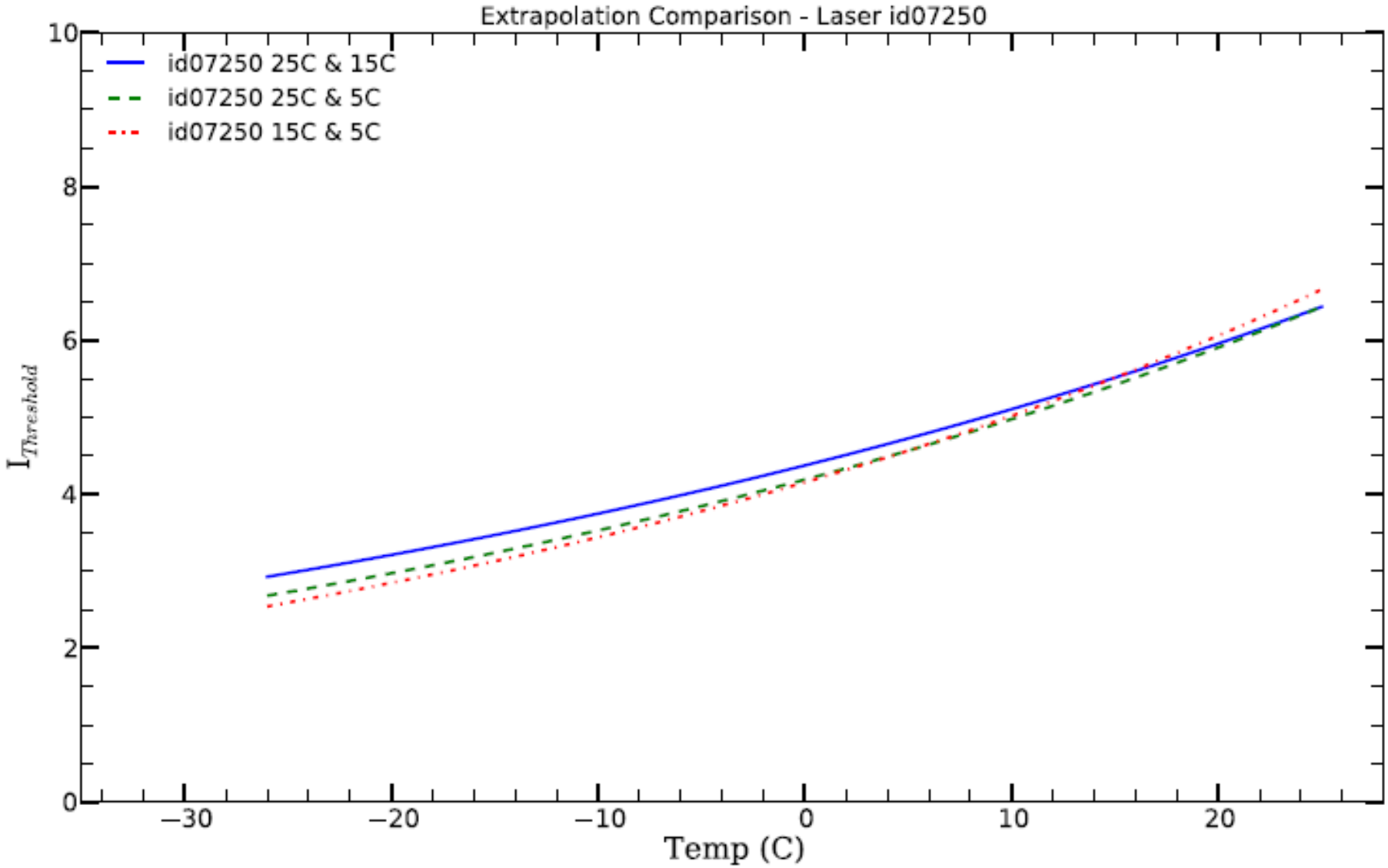
T_0 : Temperature coefficent.
$I_{25°C}$: Turn-on current at $T_{25°C}$
$I_{15°C}$: Turn-on current at $T_{15°C}$

$$T_0 = \frac{(15°C - 25°C)}{ln(I_{15°C}/I_{25°C})}$$

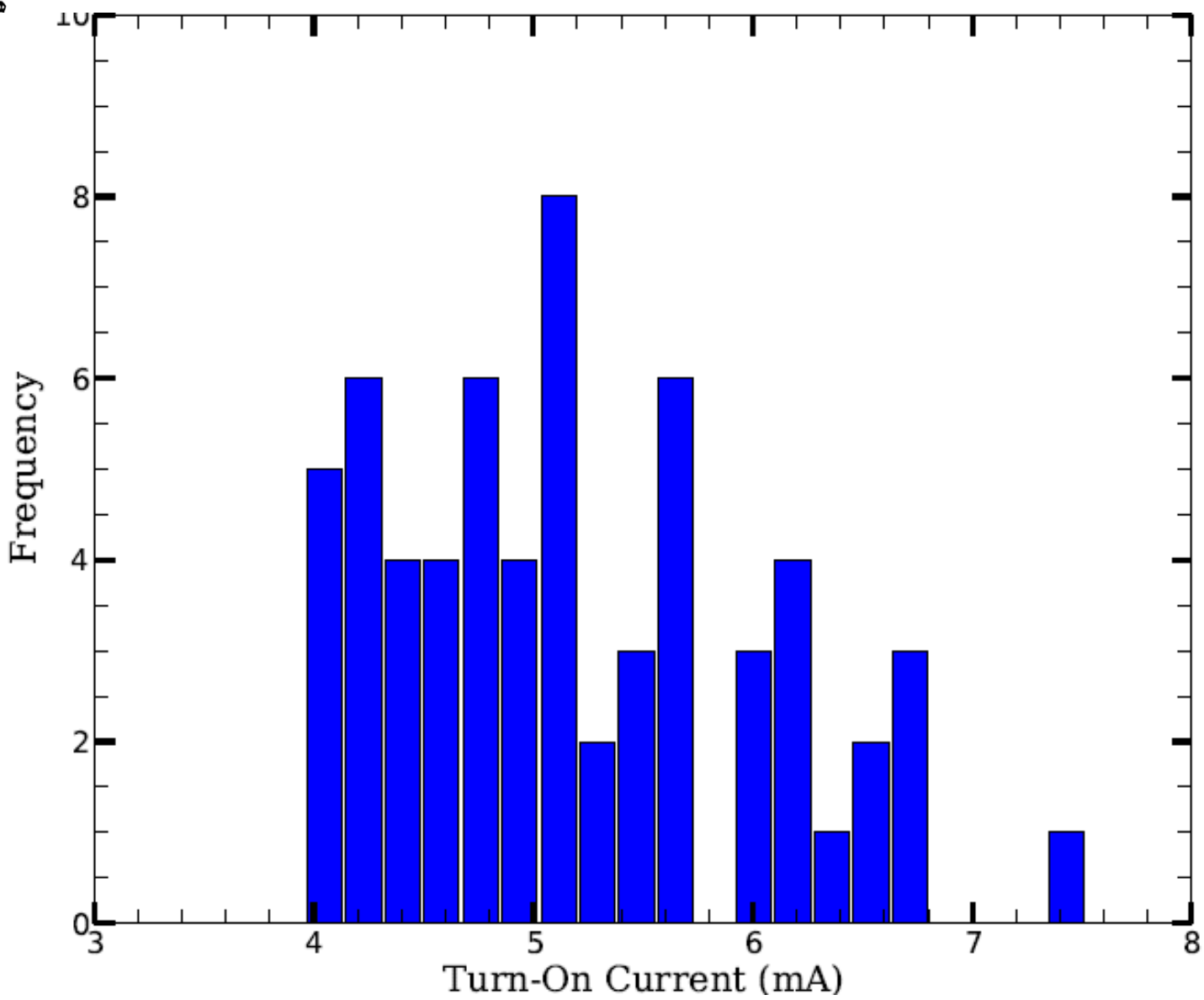
Then, at an extrapolated temperature T, the expected turn-on current I_T will be:

$$I_T = I_{(25°C)} e^{\frac{(T-25°C)}{T_0}}$$

Extrapolation of the laser to -25°C



Turn-on currents of all lasers



Summary and Conclusions

- This work allowed us to choose the best AOH boards available.
- Minimise power consumption.
- Minimise the loading on the cooling system (liquid C_4F_{16})
- Temperature stabilisation will be provided to the installed AOHs
  - Stable signal characteristics
  - Stable $\mathcal{L}$ measurements.

Thank you CERN for providing me with this wonderful opportunity to work with some of the best minds in the world.