LightABLE Production Status

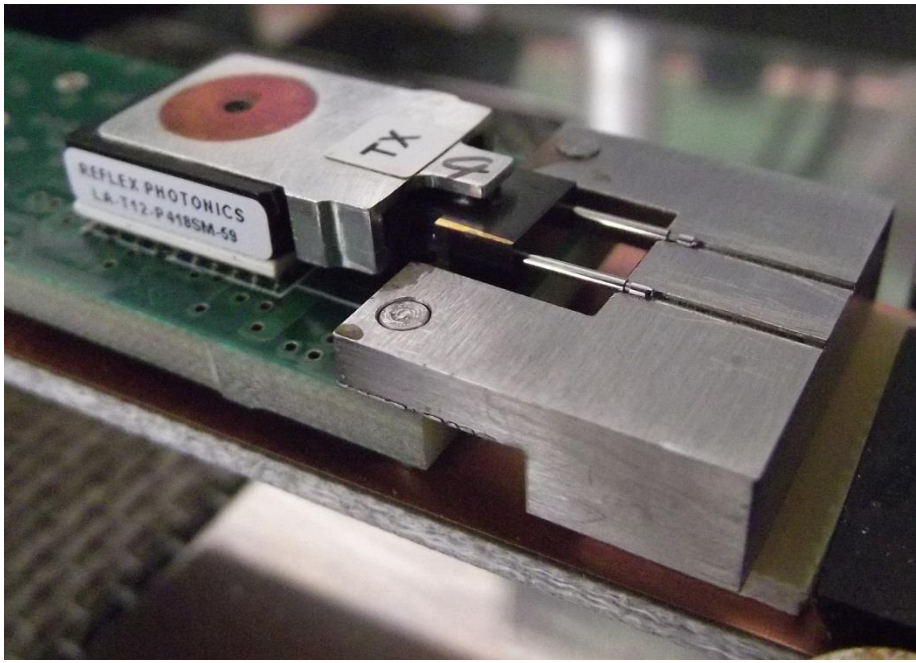
CERN, Mini opto-workshop 21/3/14

Changes Since Design Review

- **Essential:**
  - **Make it easier for Infineon SMC connector to connect to LTx in USA15**
  - **Improve thermal management**
- **Highly desirable: Allow option of decreasing optical power from LTx in case of saturation for DORIC4A.**
- **Mechanical reliability, consider use of under-fill for LightABLE BGA.**

Mechanical Changes

- **Make mate/demate with Infineon SMC easier.**
  - **Shortened length of MT guide pins.**
  - **Added groove near end that was cut to help with gluing. End sticking out is the uncut end.**
  - **Use long guide pins in jig during reflow. Ensures that guide pins will be in the correct location and pointing the correct way.**

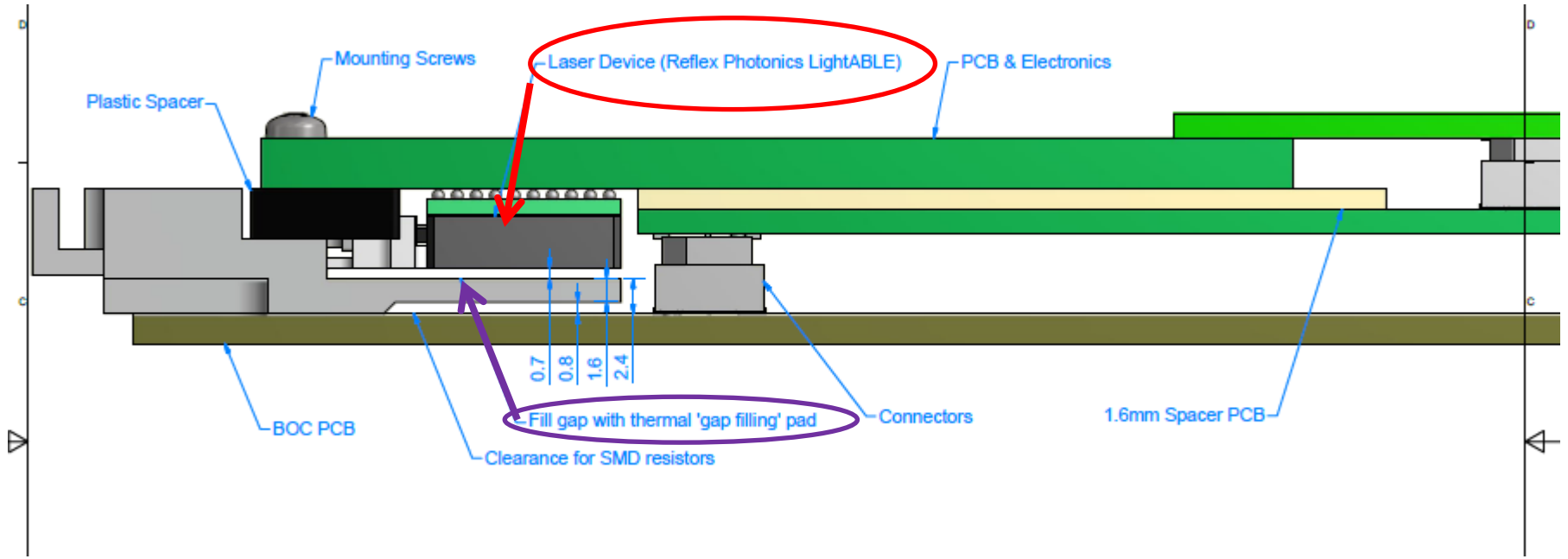


Underfill

- **Decided against use of underfill for BGA**
  - **Mismatch in CTE.**
  - **Very little insertion force required.**
  - **100 mate/demate cycles with monitoring of power every 10 cycles ➔ no changes**
  - **Thermal cycling: no change in power.**

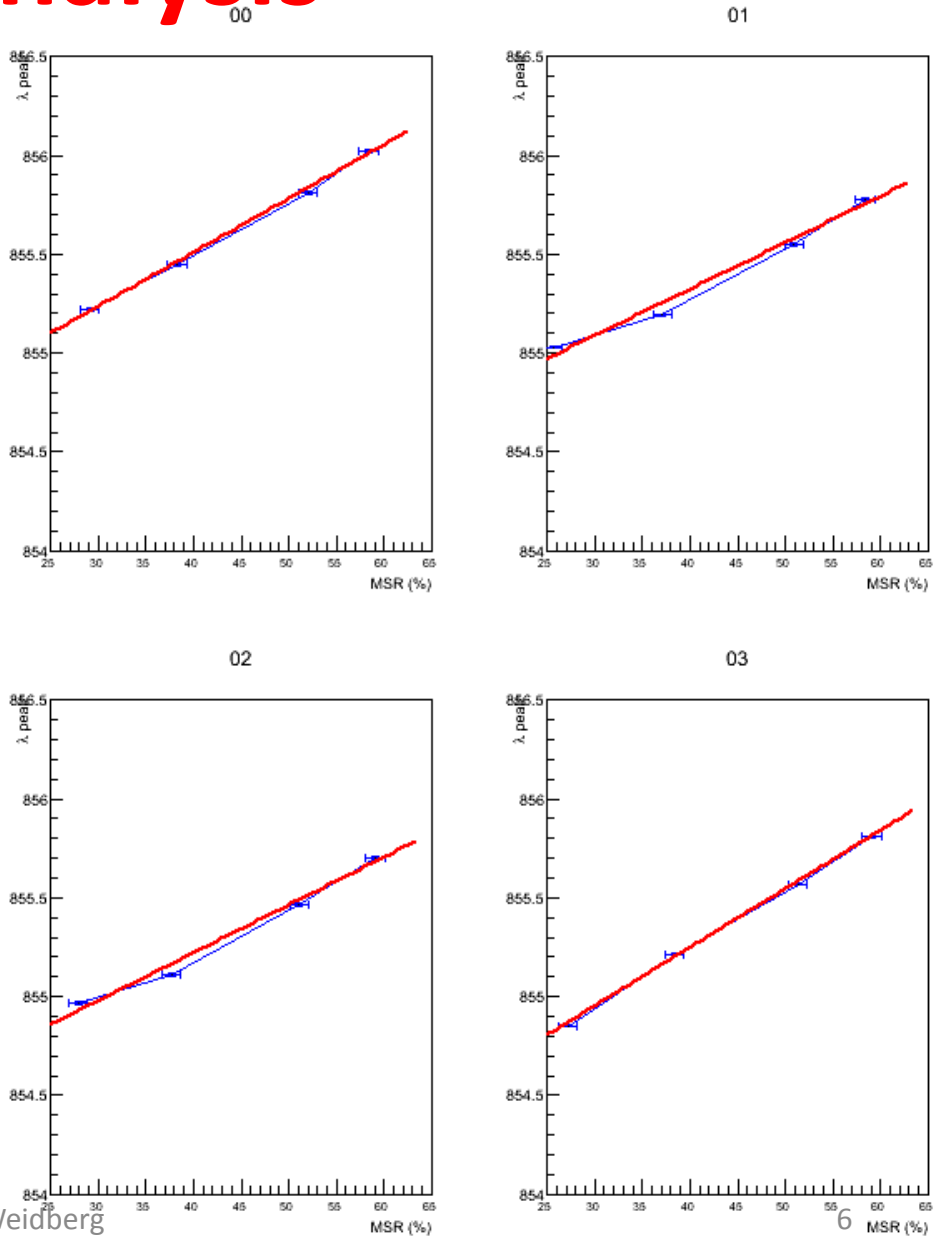
Cooling

- **Thermal path from LightABLE to front panel via Thermal Gap Filler (3 Wm/K)**
- **OSA analysis ➔ ΔT from junction to ambient =20°C (➔ next slide).**



OSA Analysis

- Measure Peak wavelength λ_p
- Scan Mark: Space Ratio (MSR) and measure λ_p
- Plot λ_p versus MSR
- Fit slope and extrapolate to 50%.
- Use calibration $d\lambda_p/dT$ ➔ ΔT
- Fit Results variable in quality but reasonable consistency



We can use a microprocessor to drive the LightABLE Engine's I2C inputs, and the SPI lines currently used for the MDACs can be used to drive the µProc

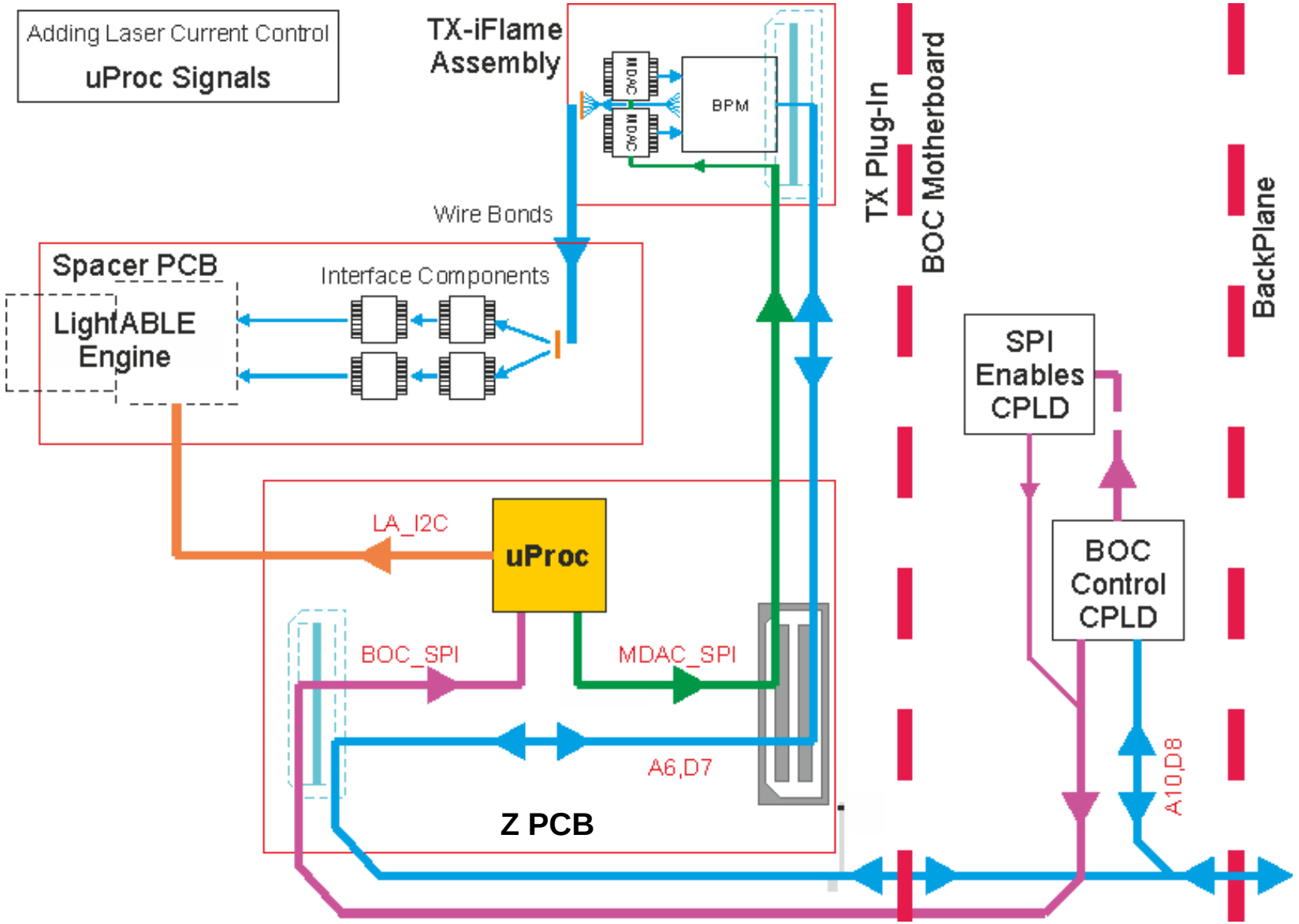
But the MDACS we must still give the right output current for the interface circuit

- This could be done using the µProc's SPI lines
- It could be carried out when the µProc is initialised
- The MDAC_CLR command (one of the BOC_SPI signals) could be used to force a uProc initialisation

This is what it would look like:

Maurice Goodrick

AtLinks LightABLE- uProc Connections

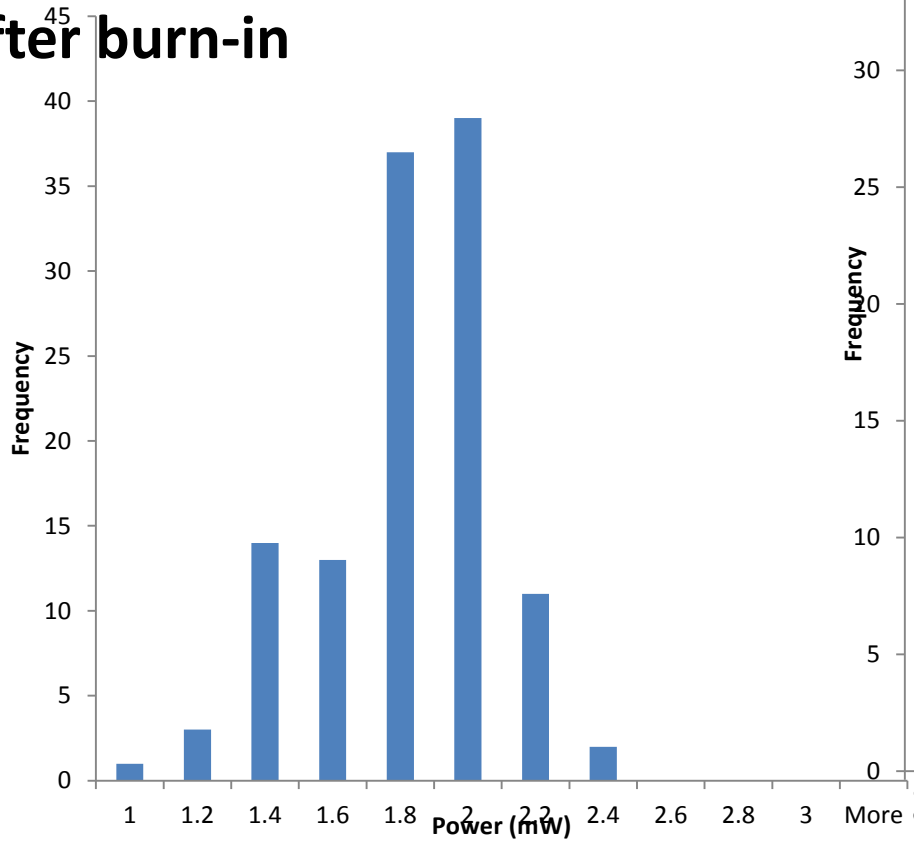


Production Status

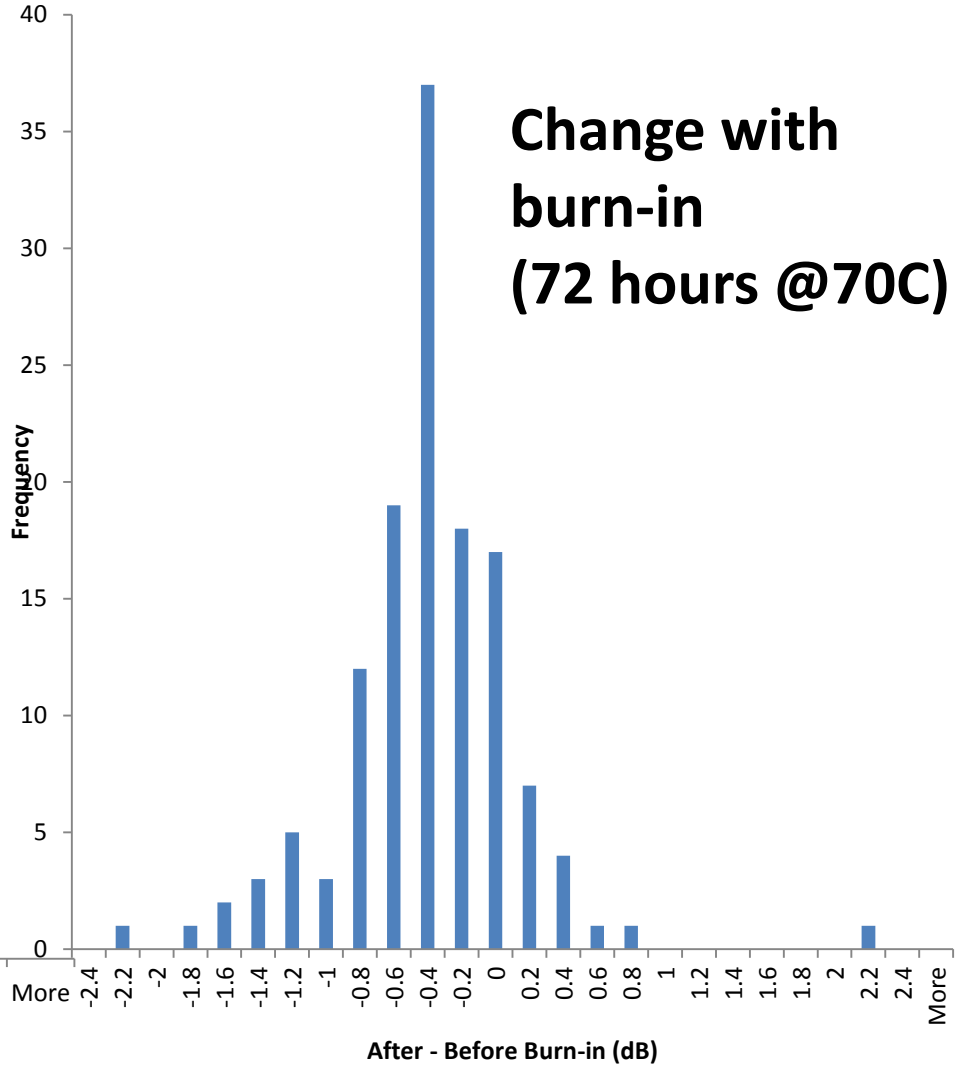
- **328 LightABLEs delivered.**
  - **Delivery should be completed by end March.**
- **Two flavours of PCB produced and components mounted (except LightABLE).**
- **123 LTx assembled.**
  - **10 burn-in complete, now @ Cambridge for QA**
  - **16 in oven for burn-in.**
  - **Rest either at RAL waiting for wire bonding or at Oxford waiting for burn-in.**
- **Production rate between 20 to 40/ week.**

QA: Optical Power LTx

<Optical Power> LTx @ 50% duty cycle, after burn-in

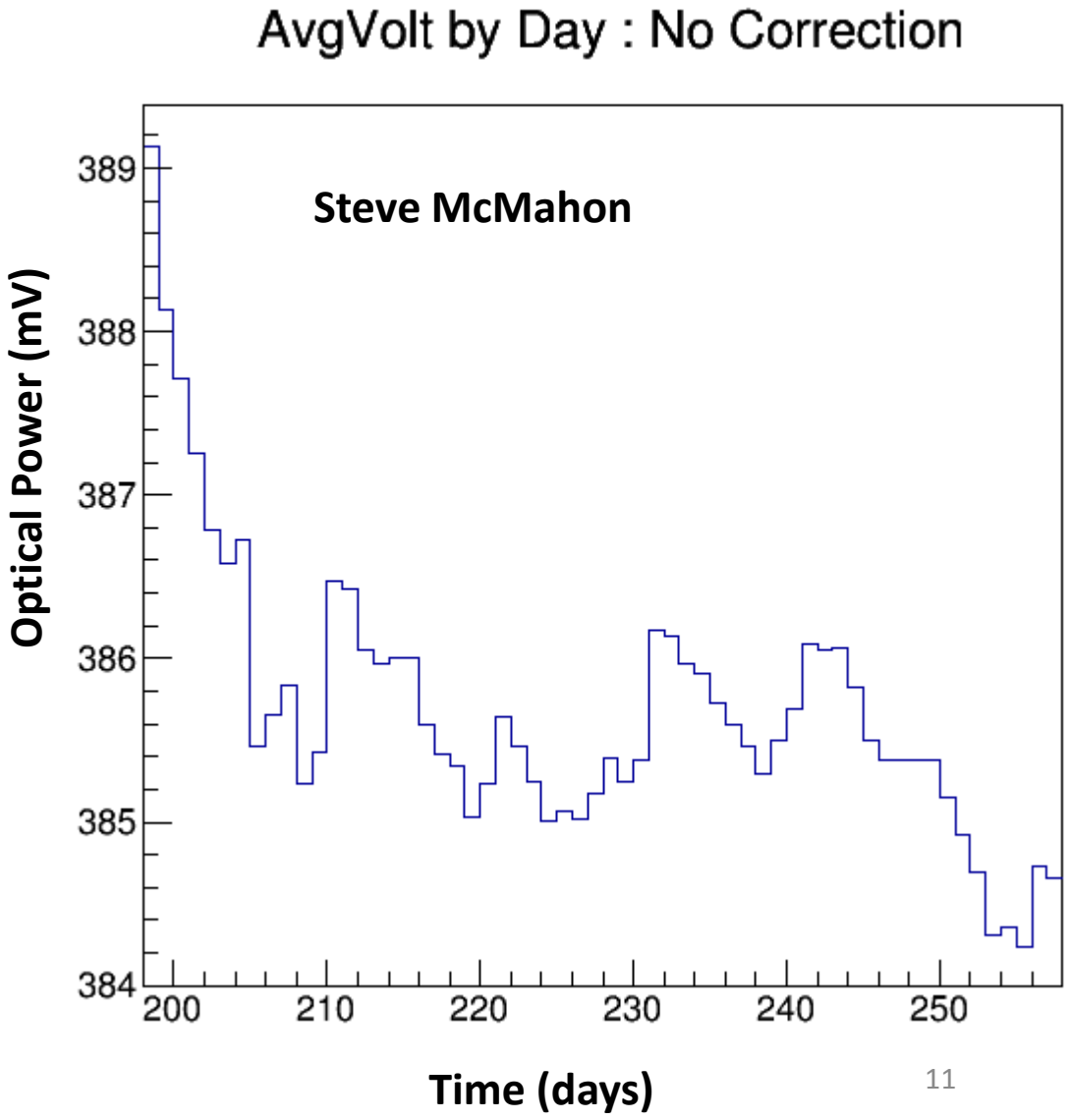


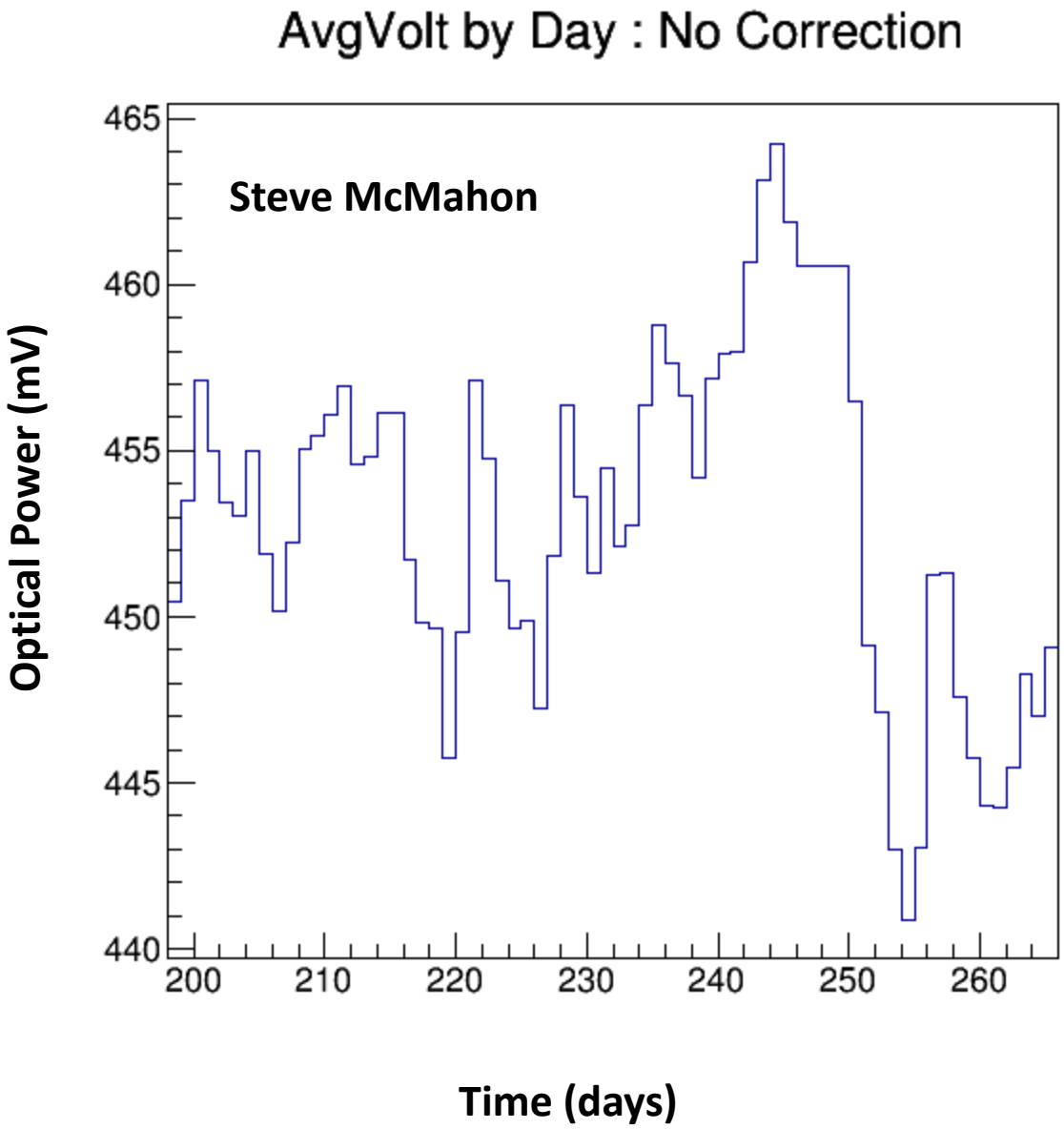
Change with burn-in (72 hours @70C)



LTx in SR1

- LTx optical power.
- No T correction
- Initial decrease ~1%.
  - No burn-in preformed for this array ➔ probably ok but should run longer




AvgVolt by Day : No Correction
Steve McMahon
Optical Power (mV)
465
460
455
450
445
440
200
210
220
230
240
250
260
Time (days)

Summary

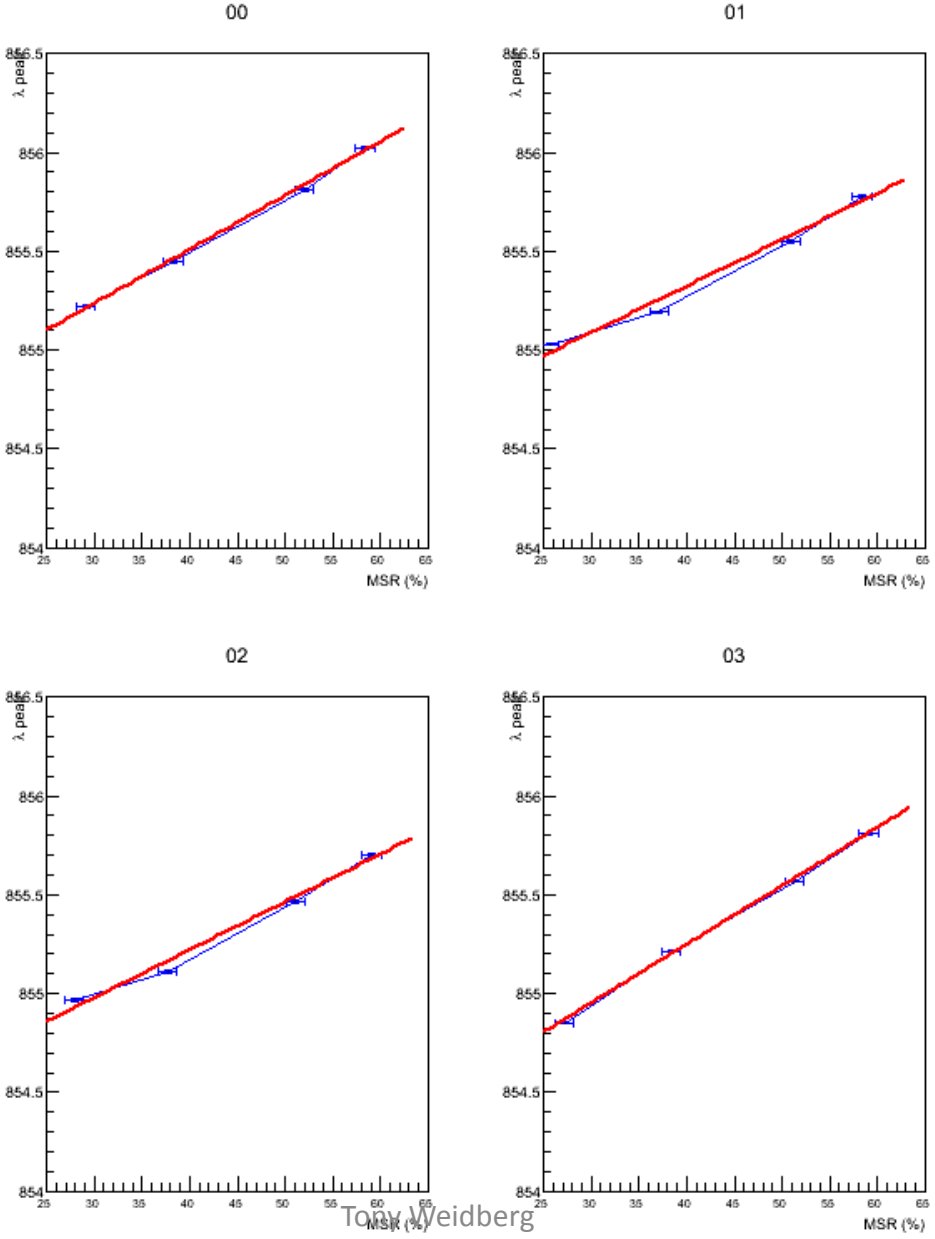
- **Improvements following design review have been implemented.**
- **Production well underway.**
- **Populate one crate in USA-15 in May**
- **Need to continue long-term optical power monitoring in SR1 and USA-15.**

Backup Slides

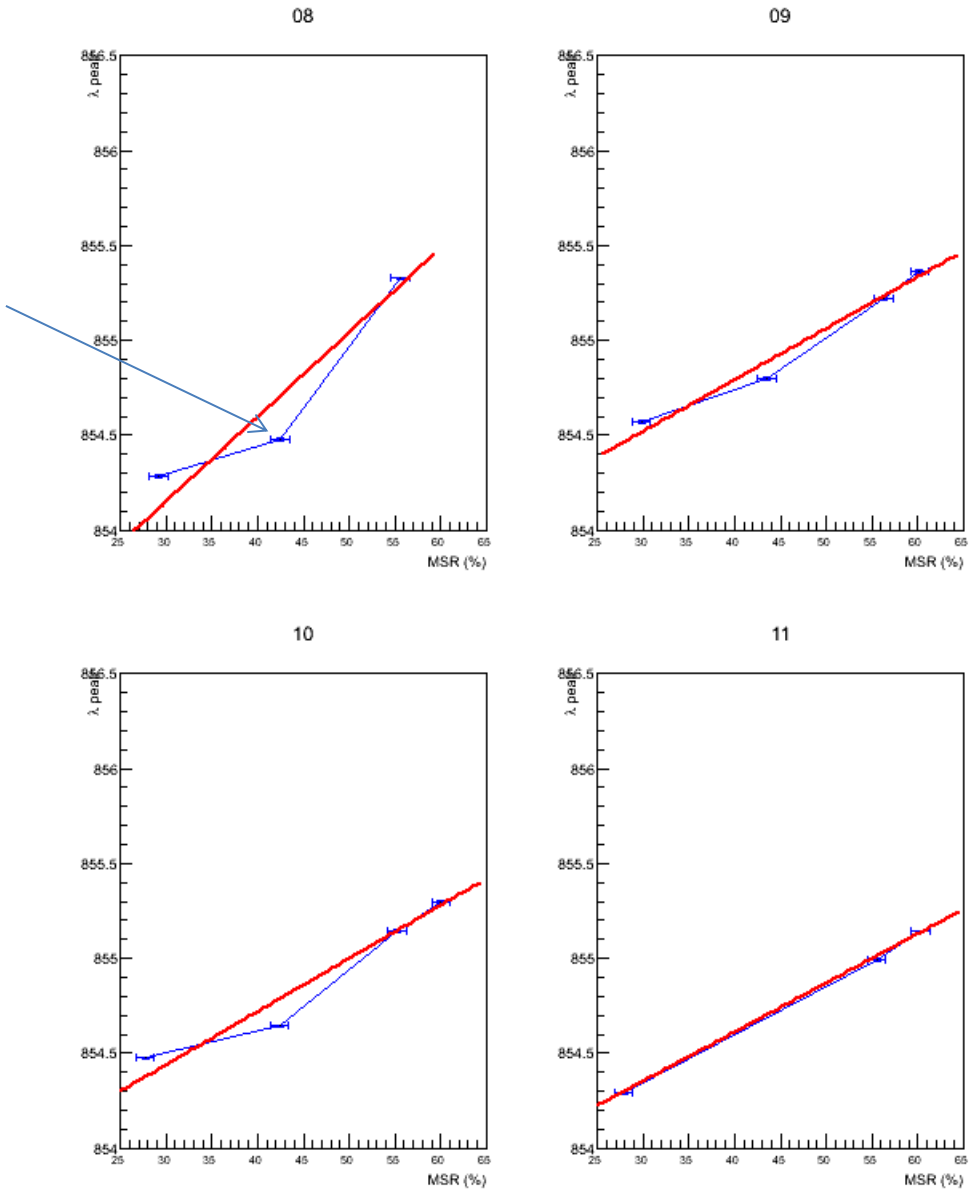
OSA Thermal Studies

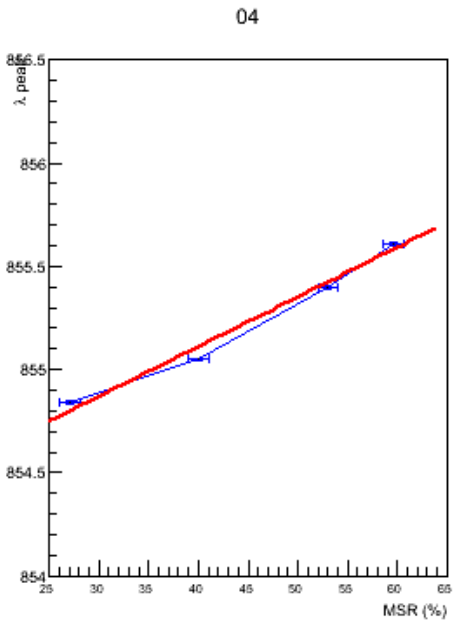
- New metalwork for front panel of BOC
  - Takes heat through thermal pad → metalwork → outside crate
- OSA measured for 12 channels from first LTx with micro on board.
- OSA spectra taken at MSR settings of 0, 10, 20 and 24 (maximum value which gave clean waveform).
- Very crude peak finding
  - Found λ_{max} corresponding to maximum power
  - Found λ_1 and λ_2 corresponding to peak power -3dB
  - Best estimate $\lambda_{peak} = (\lambda_1 + \lambda_2)/2$
  - Used difference between λ_{peak} and λ_{max} as estimate of error.
  - Error on MSR set to 1% (guess)
  - Fit λ_{peak} vs MSR ➔ next slides

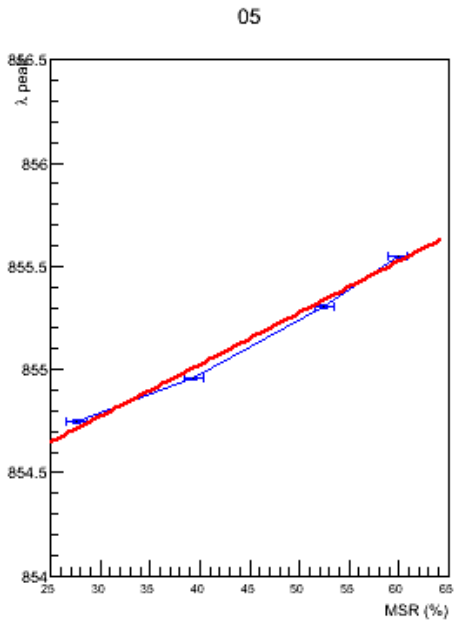
Fit Results variable in quality but reasonable consistency



Check this point (see next slide)




04
λ peak
856.5
856
855.5
855
854.5
854
25
30
35
40
45
50
55
60
65
MSR (%)


05
λ peak
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856
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855
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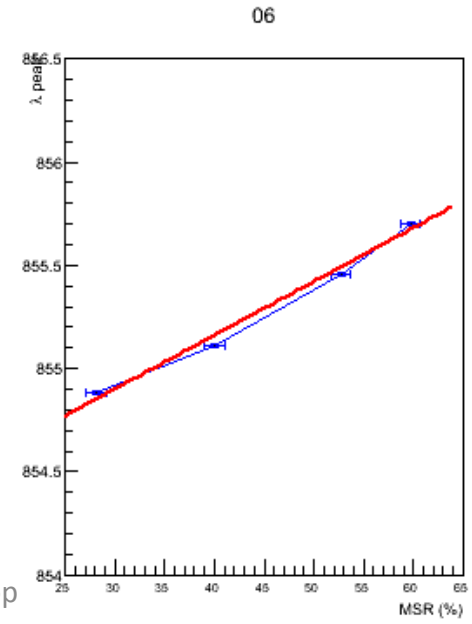
854
25
30
35
40
45
50
55
60
65
MSR (%)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60
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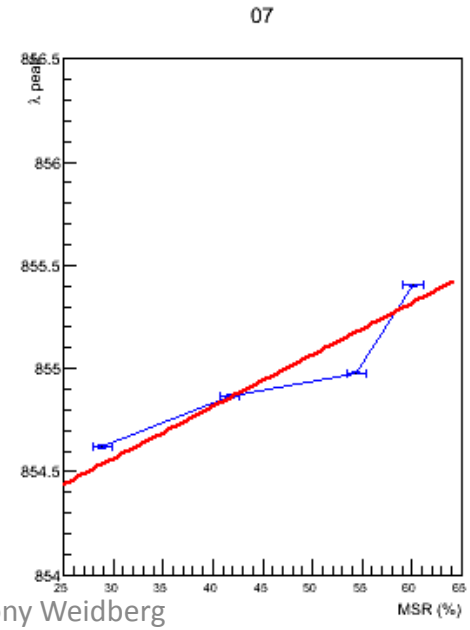
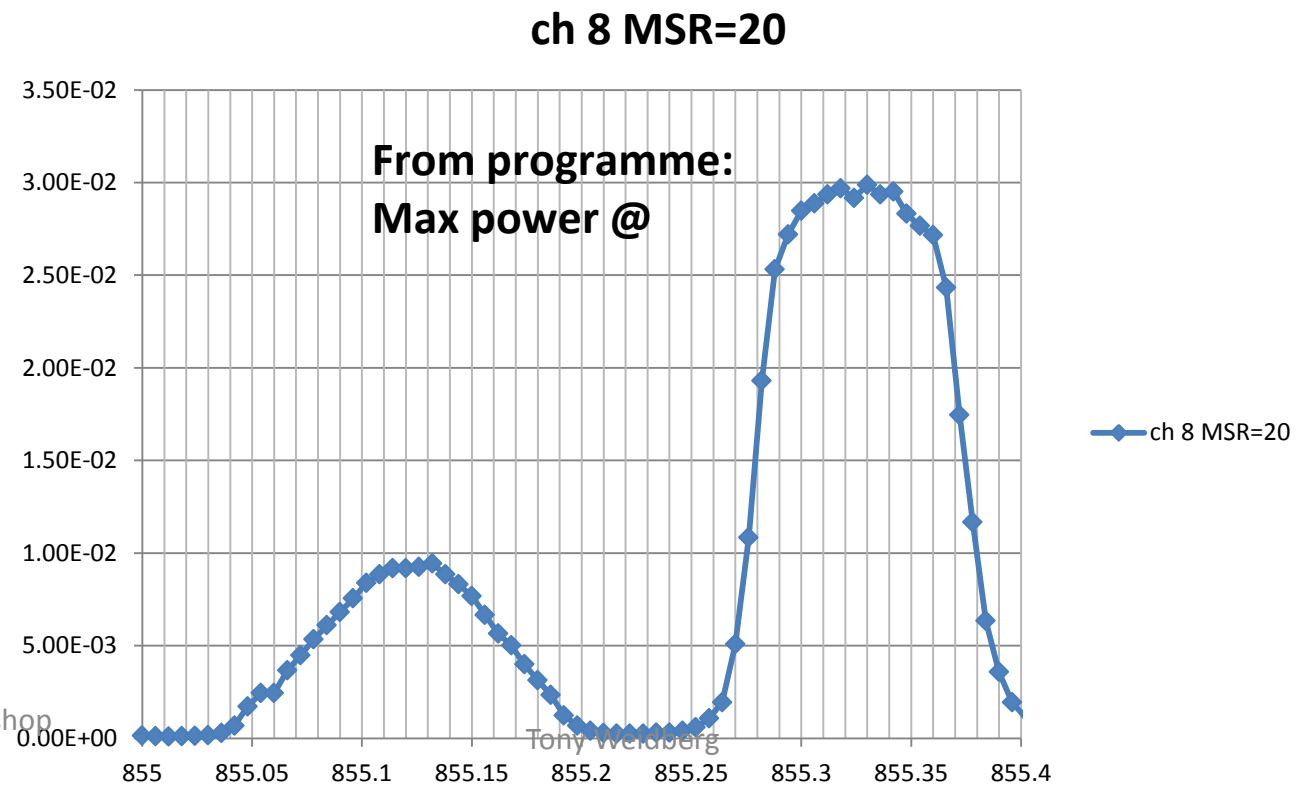
MSR (%)


07
λ peak
856.5
856
855.5
855
854.5
854
25
30
35
40
45
50
55
60
65
MSR (%)

Check Channel 8 MSR=20

- Spectra looks ok
- Programme found reasonable results
- 3 sigma effect ➔ doesn't change conclusions



Summary

- Fits to each channel for slope
- Use Carlos's analysis for temperature sensitivity
  - $d\lambda/dT=0.0673$ nm/K
- Extrapolate to 50% duty cycle
- $\Delta T = 20 \pm 4$ C
- Improved thermal performance compared to previous study $\Delta T = 29$ to 43 C.
  - Improved metalwork takes heat through thermal pad to outside of crate.

channel	slope
0	0.0273
1	0.0235
2	0.0242
3	0.0296
4	0.0241
5	0.0251
6	0.0260
7	0.0251
8	0.0445
9	0.0271
10	0.0280
11	0.0259