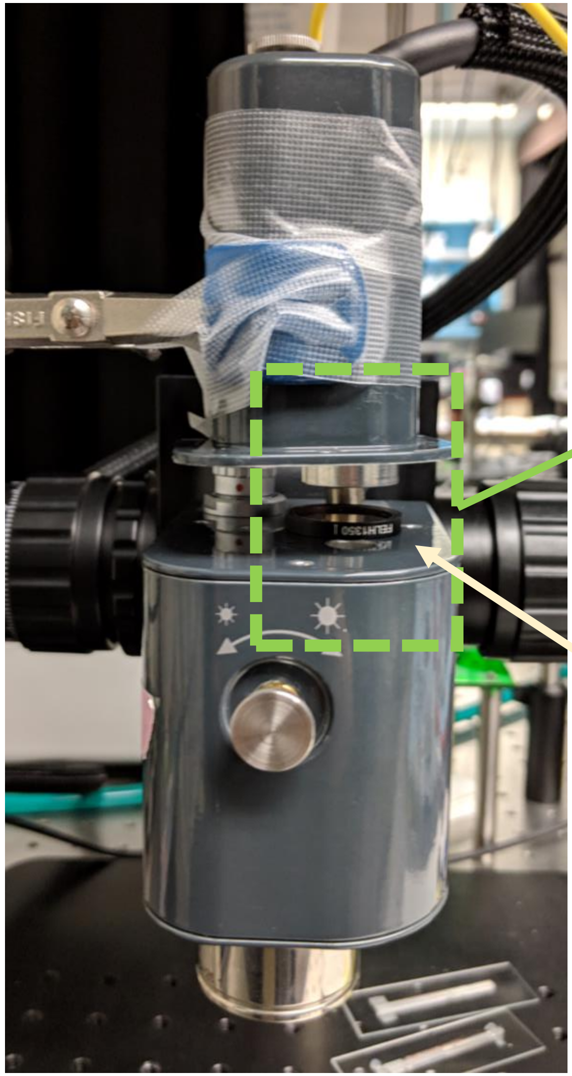
Telesto Wavelength Calibration

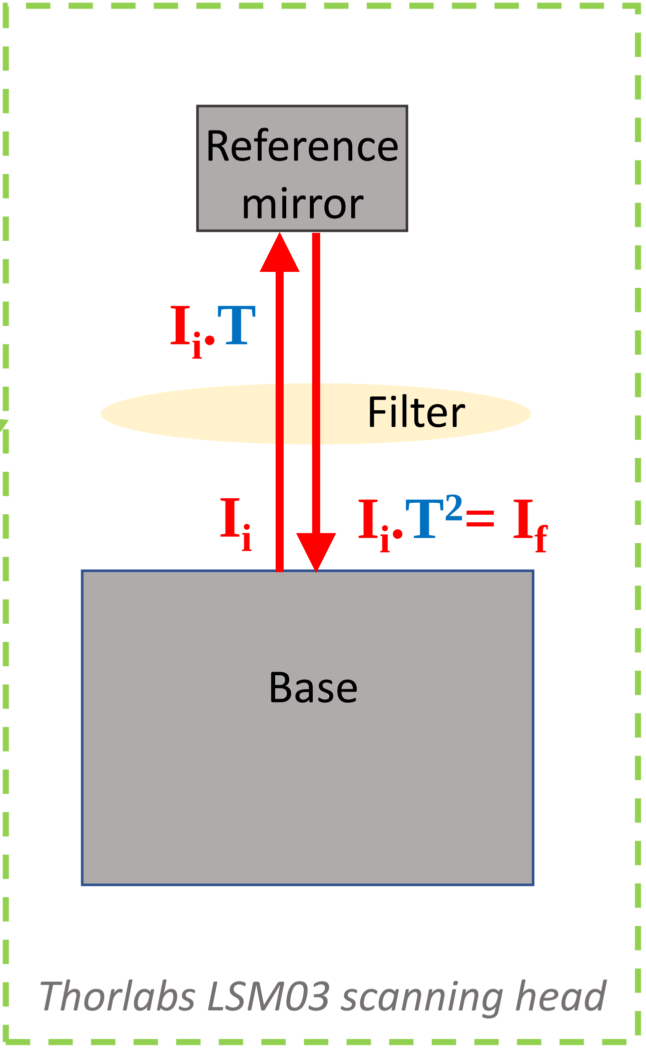
Brooke Krajancich

12/04/2018

Procedure



Filter

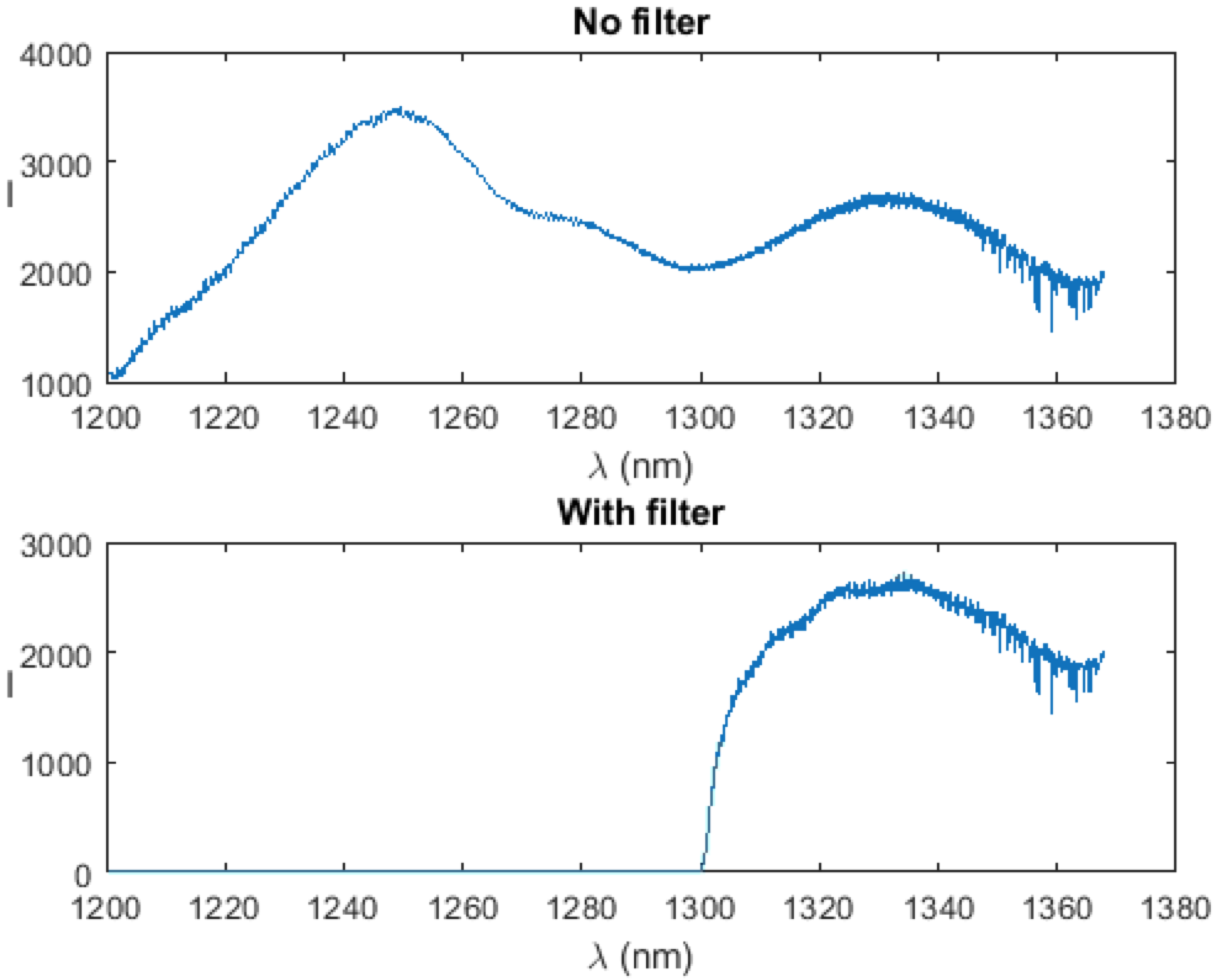


- Obtain apodizations with and without Thorlabs FTLH1300 long pass filters in the reference arm path (transmission = T)
- Repeat for Thorlabs FTLH1350 filter
- Then, derive double transmission by:

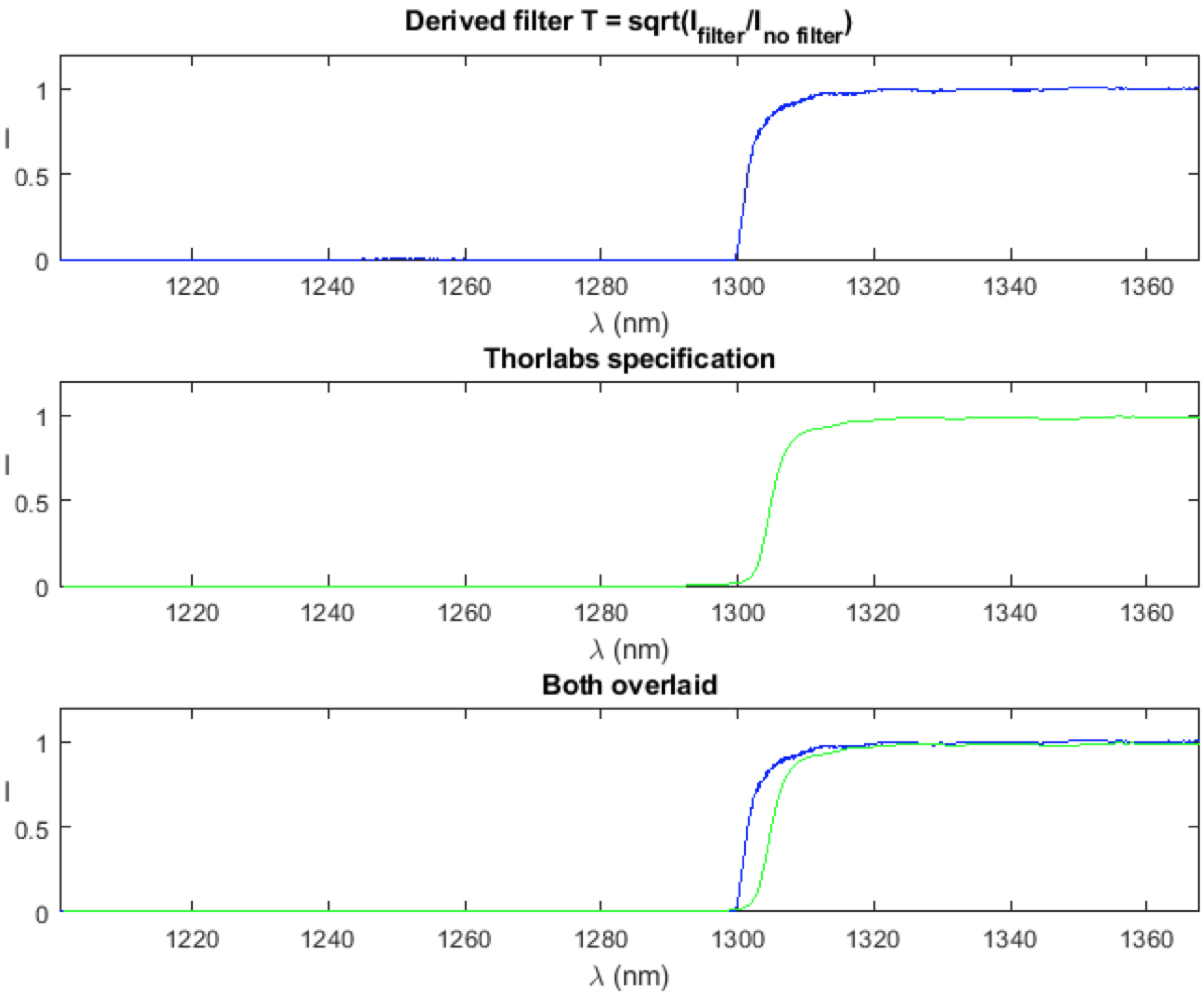
$$\boxed{T = \sqrt{\frac{I_f}{I_i}}}$$

- Compare to transmission curve data (excel spreadsheet) provided on product specification webpage
- Optimise transformation (dilation and translation) of lambda values to make derived transmission best fit with specification

Apodization - 1300nm



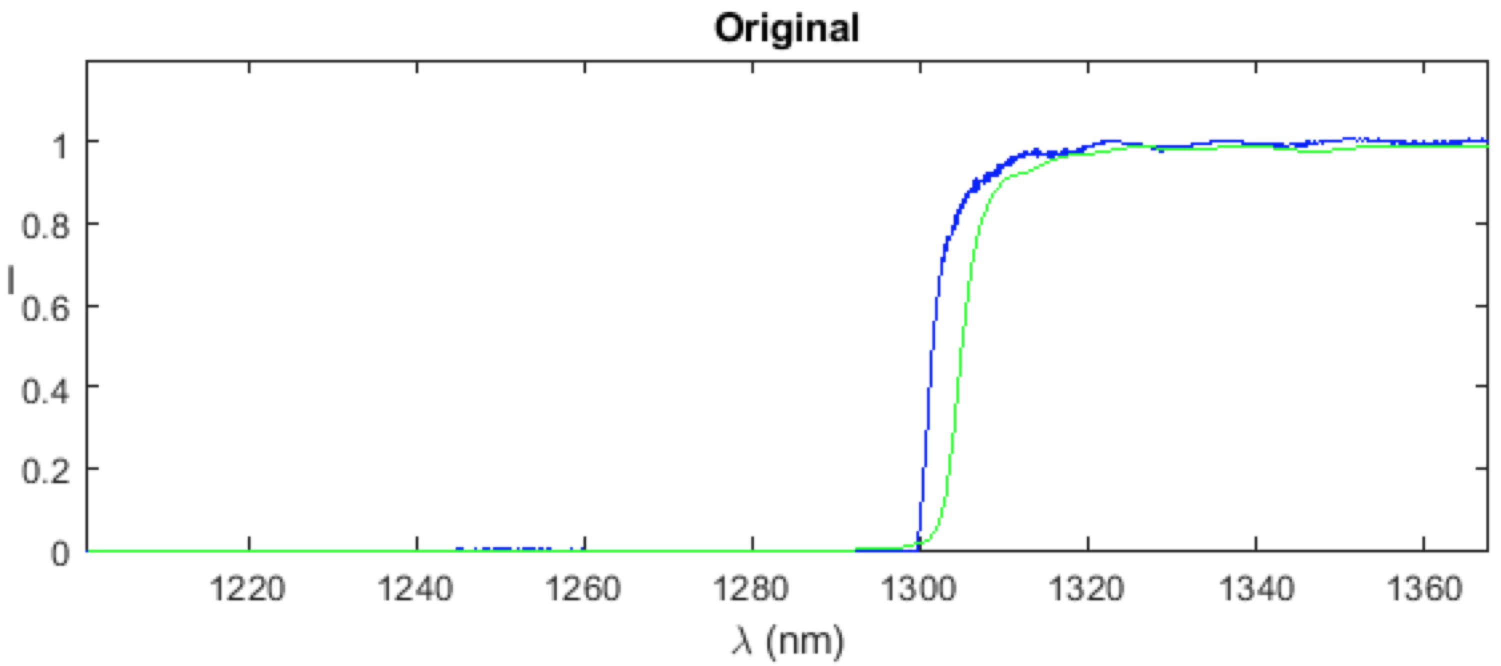
Experimentally derived transmission vs. Thorlabs filter specification – 1300nm

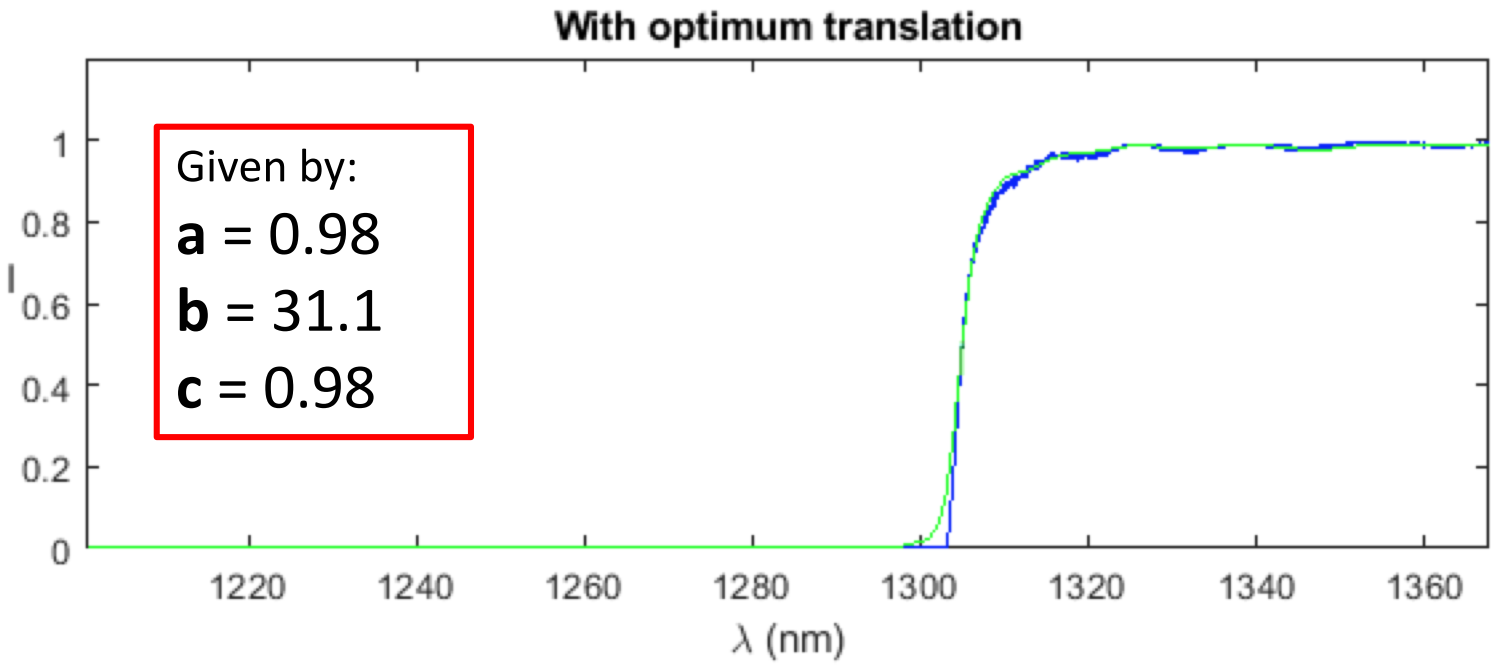


Optimally transforming experimental T to match Thorlabs

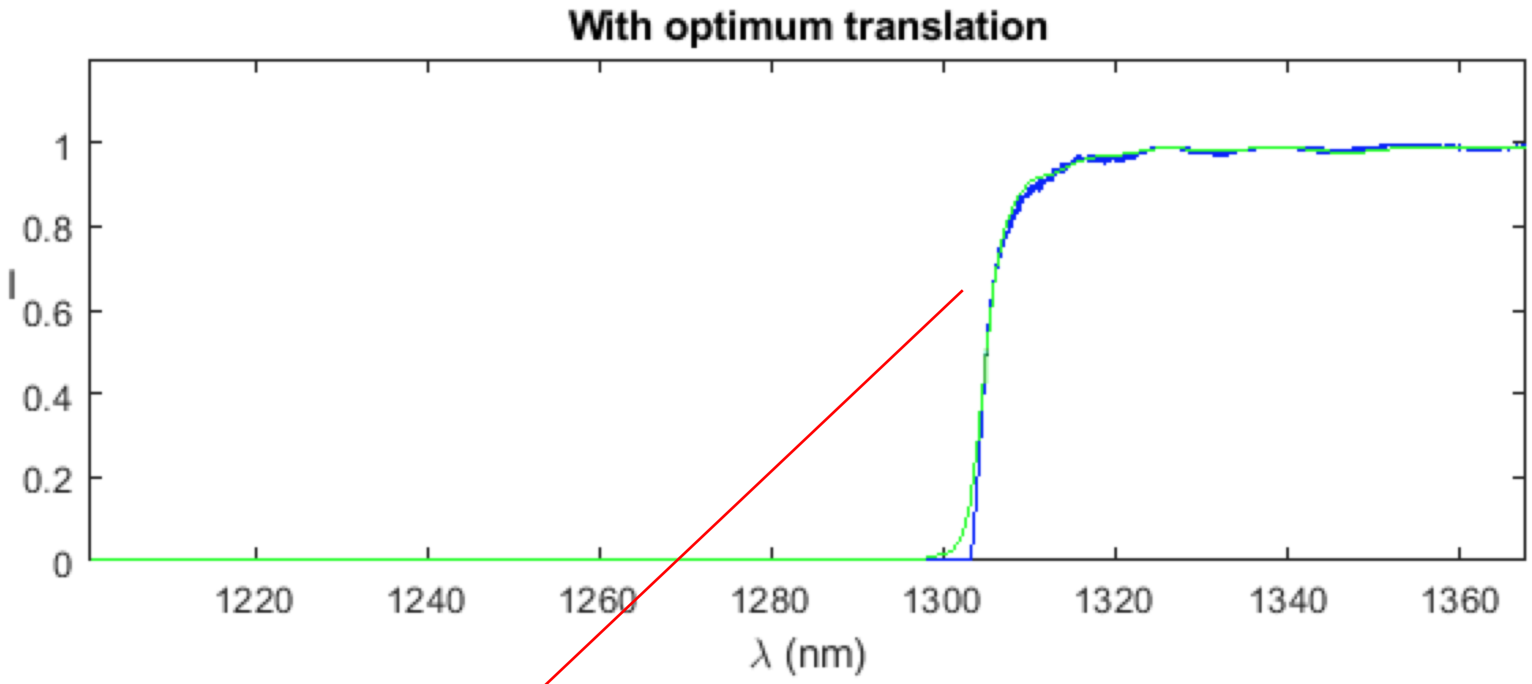
- Transform according to:

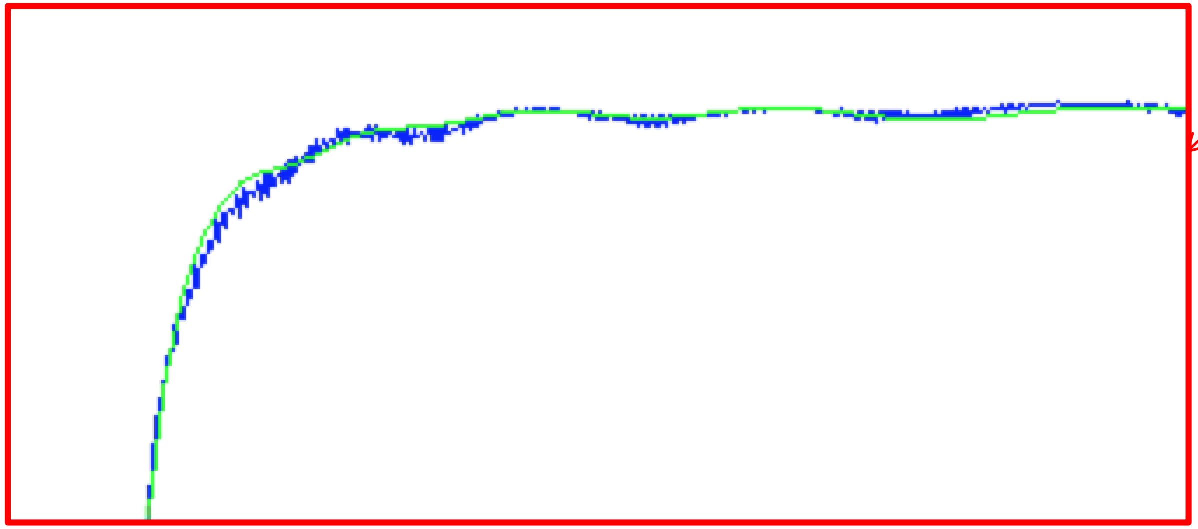
  c.I(a(λ+b))
- Vary **a** , **b** and **c** to minimize sum of the absolute value of the residuals
- Optimum given to 2d.p. for **a** and **c** and 1d.p. for **b**
- $\lambda_{min} \approx \mathbf{0.98} \times (\mathbf{1200.56} \times \mathbf{31.1}) = \mathbf{1207.0\ nm}$
- $\lambda_{max} \approx \mathbf{0.98} \times (\mathbf{1367.75} \times \mathbf{31.1}) = \mathbf{1370.9\ nm}$



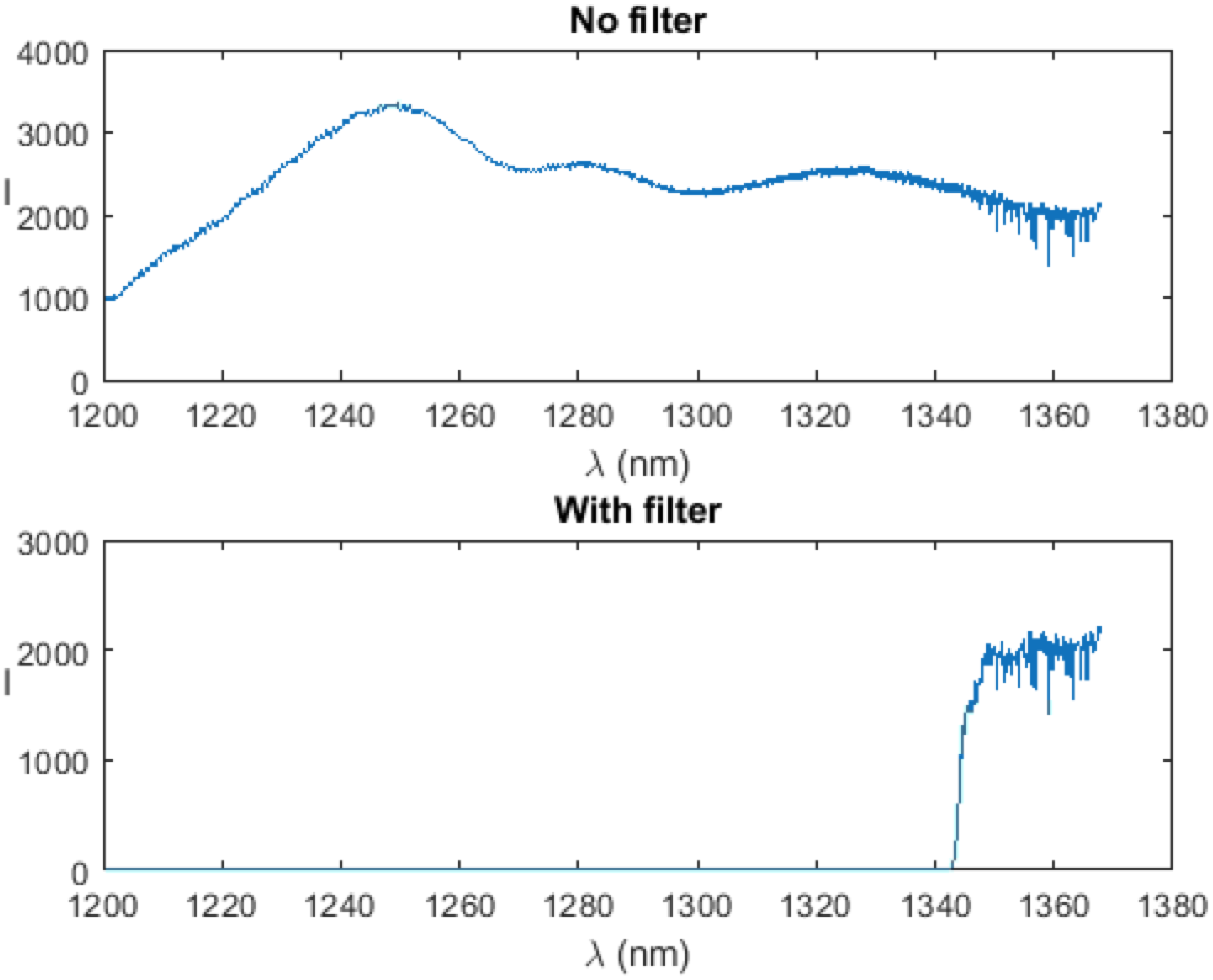


Looking more closely – a surprisingly good correspondence!

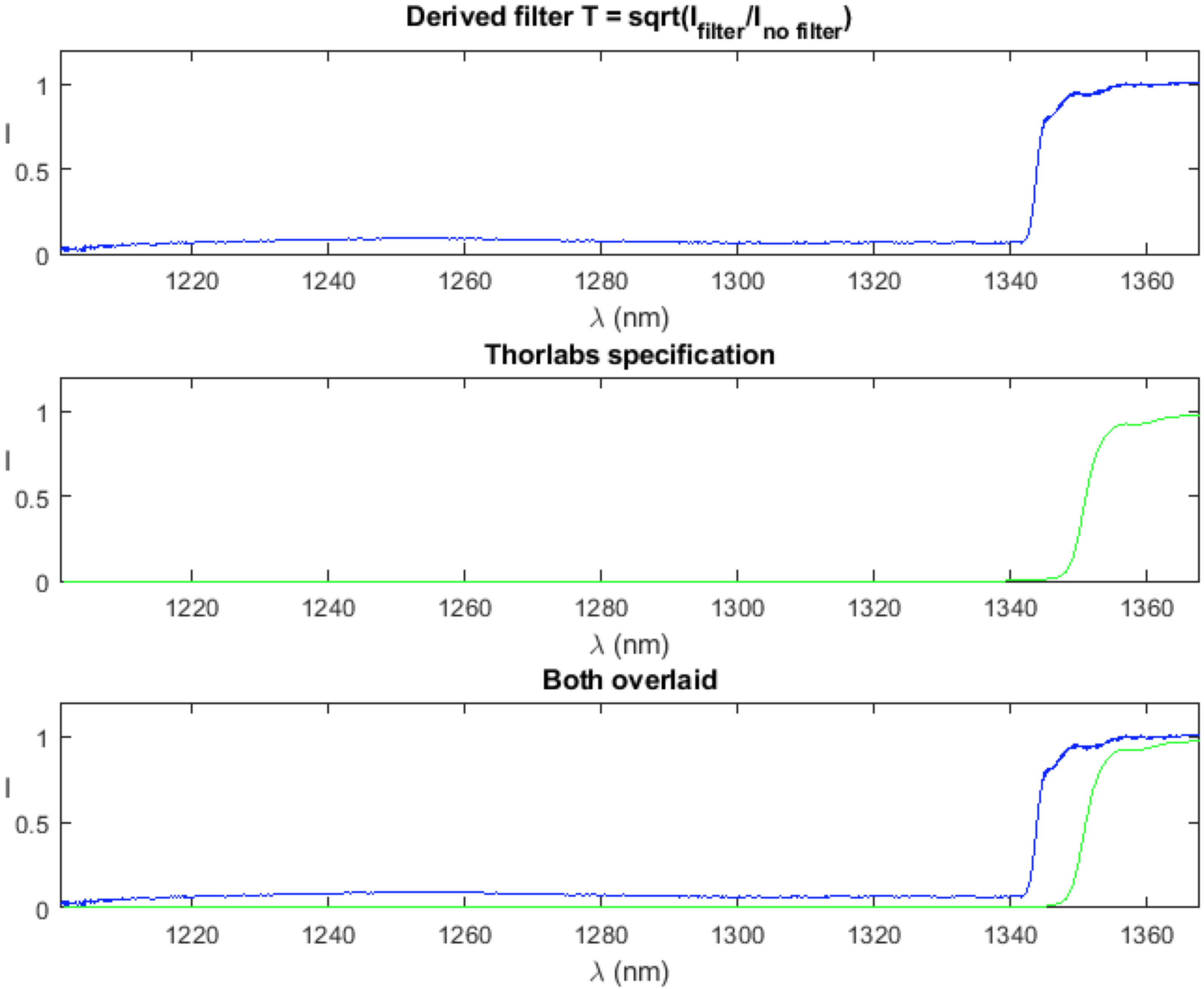




Apodization – 1350nm



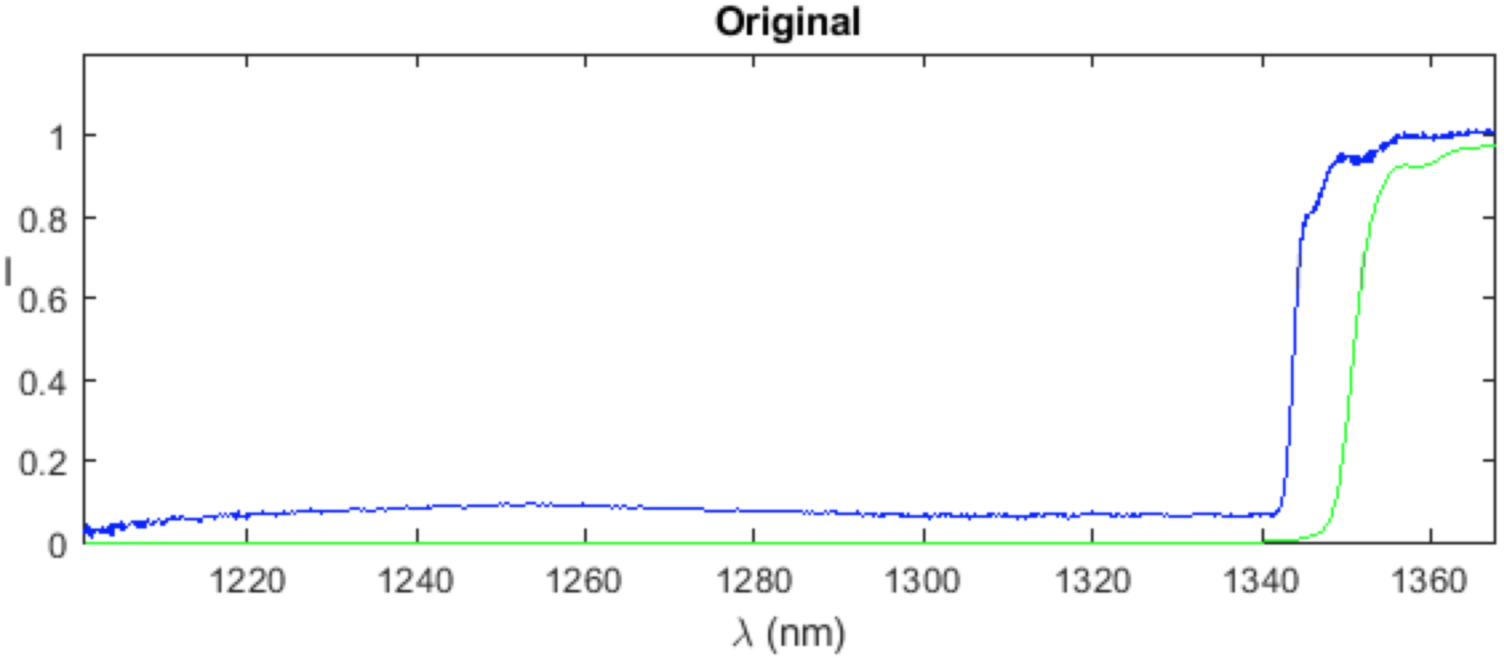
Experimentally derived transmission vs. Thorlabs filter specification – 1350nm

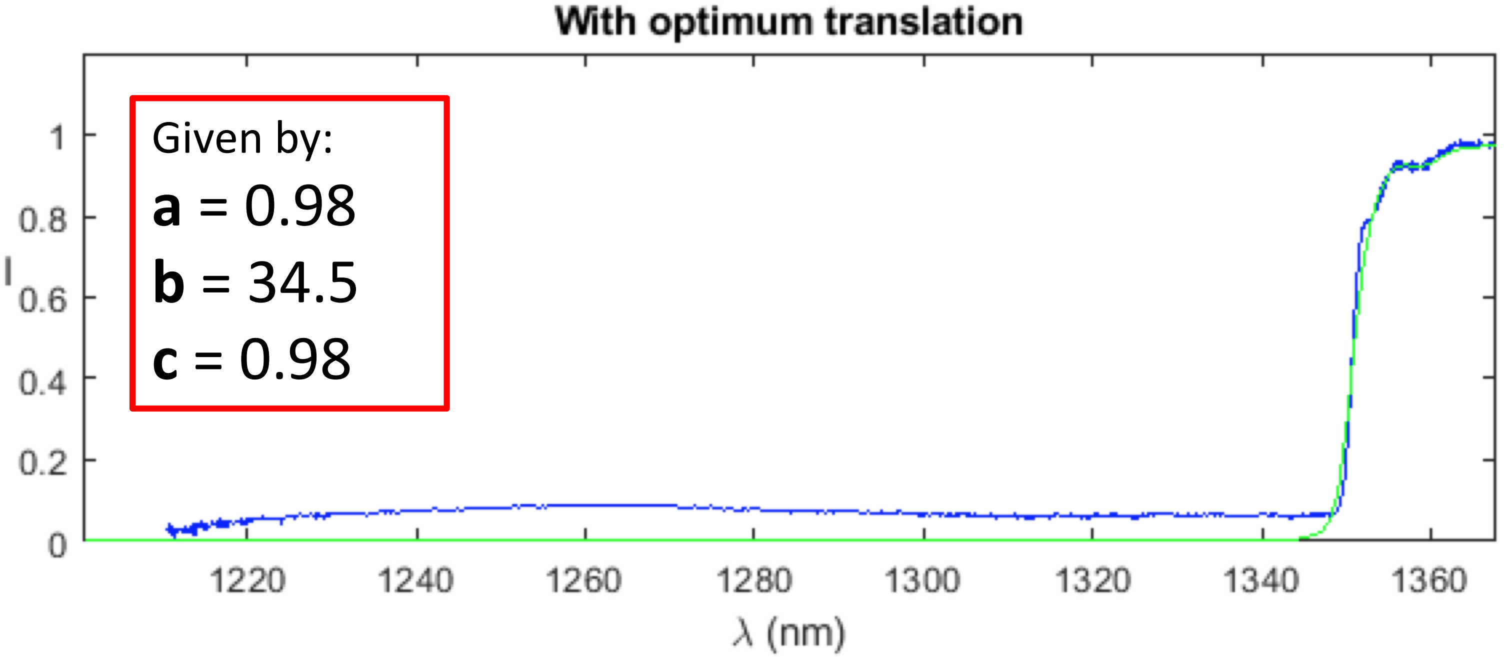


Optimally transforming experimental T to match Thorlabs

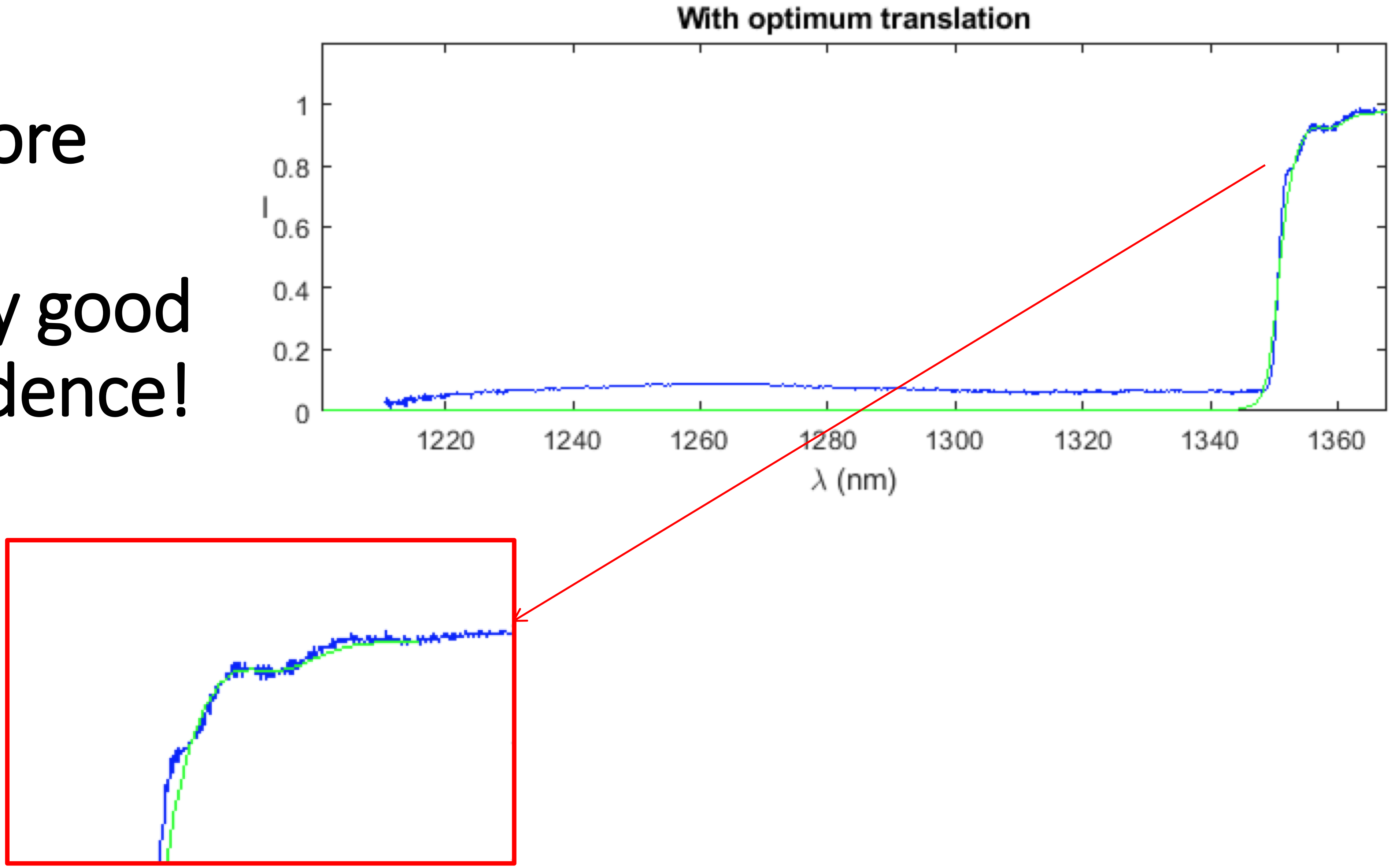
- Transform according to:

  c.I(**a**(λ+**b**))
- Vary **a** , **b** and **c** to minimize sum of the absolute value of the residuals
- Optimum given to 2d.p. for **a** and **c** and 1d.p. for **b**
- $\lambda_{min} \approx \mathbf{0.98 \times (1200.56 \times 34.5)} = \color{red}{\mathbf{1210.4\ nm}}$
- $\lambda_{max} \approx \mathbf{0.98 \times (1367.75 \times 34.5)} = \color{red}{\mathbf{1374.2\ nm}}$





Looking more closely – a surprisingly good correspondence!



1300 vs 1350 filters

1300

Given by:
a = 0.98
b = 31.1
c = 0.98

1350

Given by:
a = 0.98
b = 34.5
c = 0.98

Calculating…

$\mathbf{b_{av}} = 32.8$

Then:

- $\lambda_{min} \approx \mathbf{0.98 \times (1200.56 \times 32.8) = 1208.69\ nm}$
- $\lambda_{max} \approx \mathbf{0.98 \times (1367.75 \times 32.8) = 1372.5\ nm}$

Giving:

$\boldsymbol{\lambda_{min}}: 1200.56 \longrightarrow 1208.69\ nm$
$(\Delta = 8.13)$

$\boldsymbol{\lambda_{max}}: 1367.75 \longrightarrow 1372.54\ nm$
$(\Delta = 4.79)$