

# Bragg Grating

Week 3

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# OBJECTIVES

- Verify the grating results changes with different parameters
- Verify how the length impact the grating.

# CONSTANT VALUES 0.45NM GUIDE

Using Lambda = 1550nm and 25nm FWHM

Using FDE solver on an straight 0.22um tall, 0.45um thickness waveguide, we can get the constants we need to start projecting the grating.

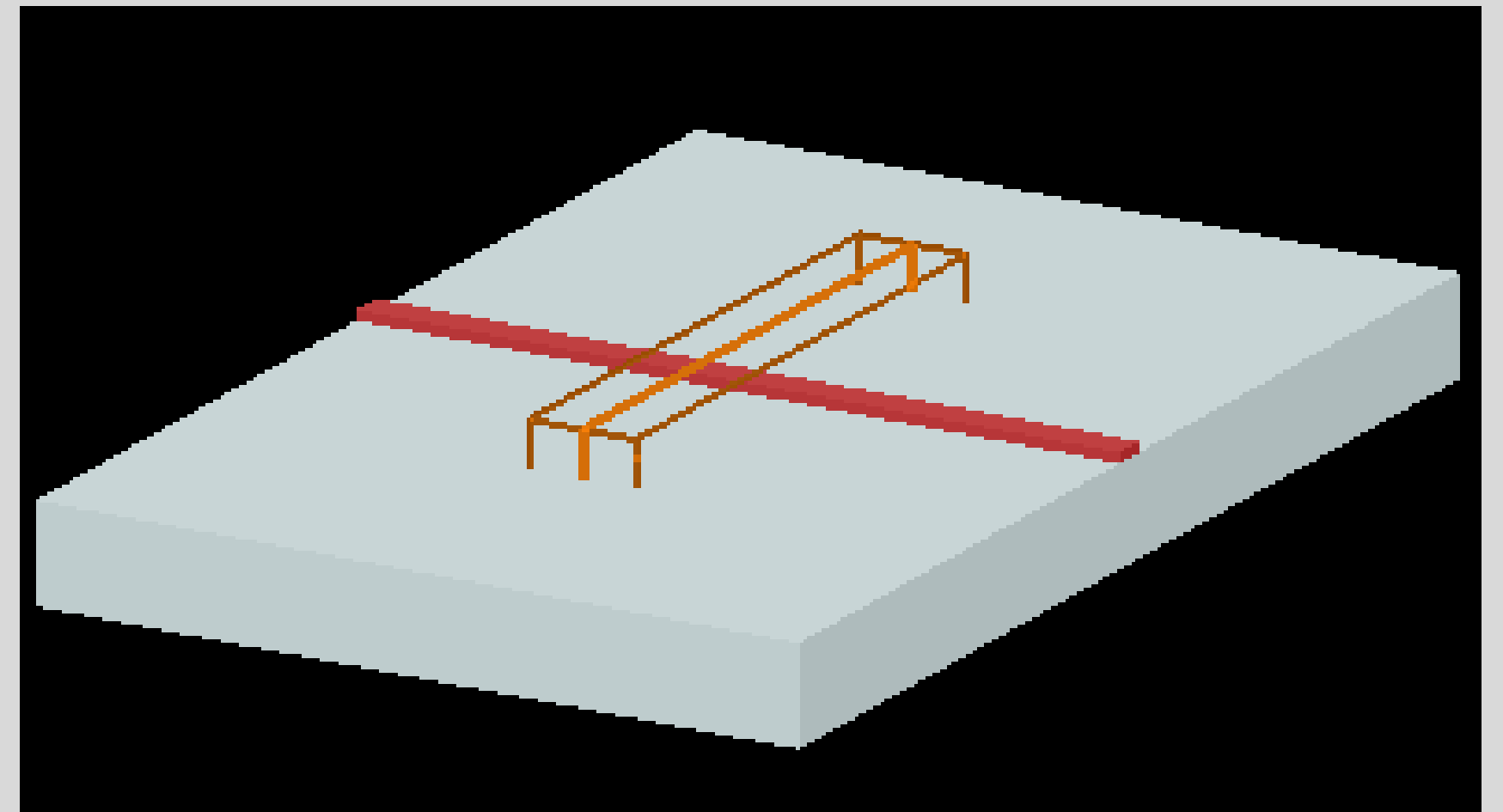
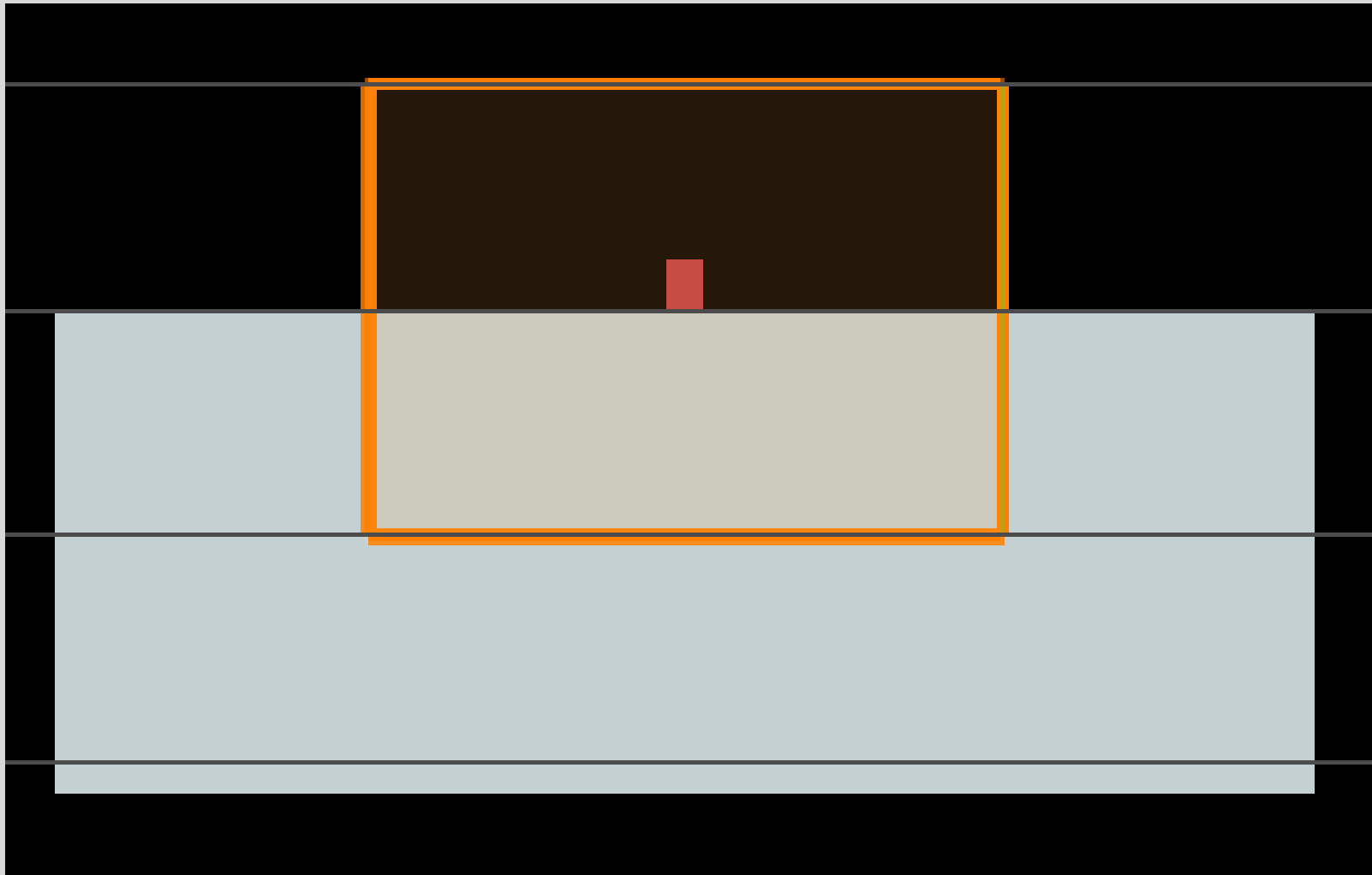
$$N_{eff} = 2.27;$$

$$N_g = 4.60;$$

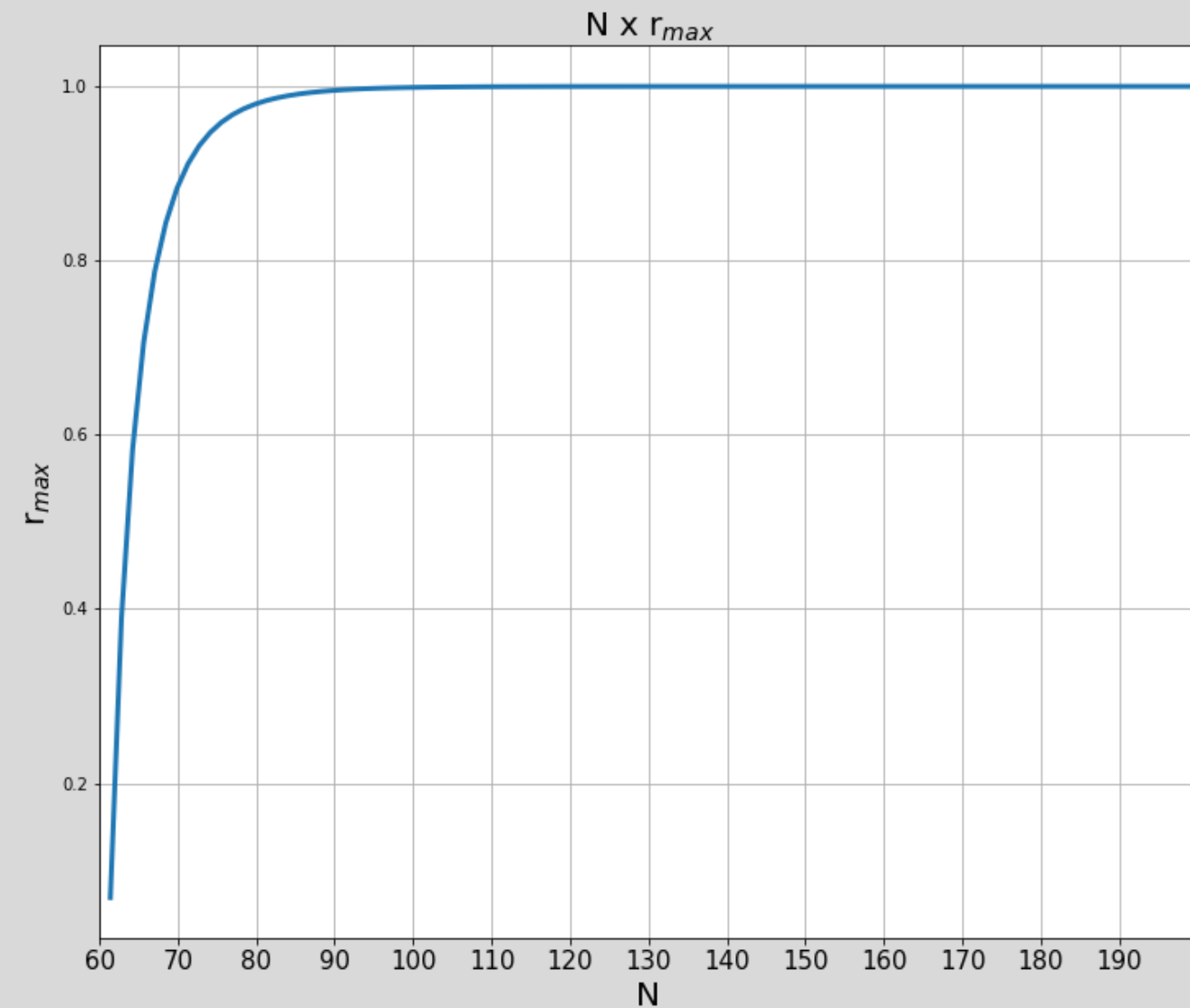
Grating Period = 341.41nm. (Theoretical Value)

# CONSTANT VALUES

Mode



# CALCULATING THE NUMBER OF PERIODS



Used value:

$N = 82$

Theoretical results:

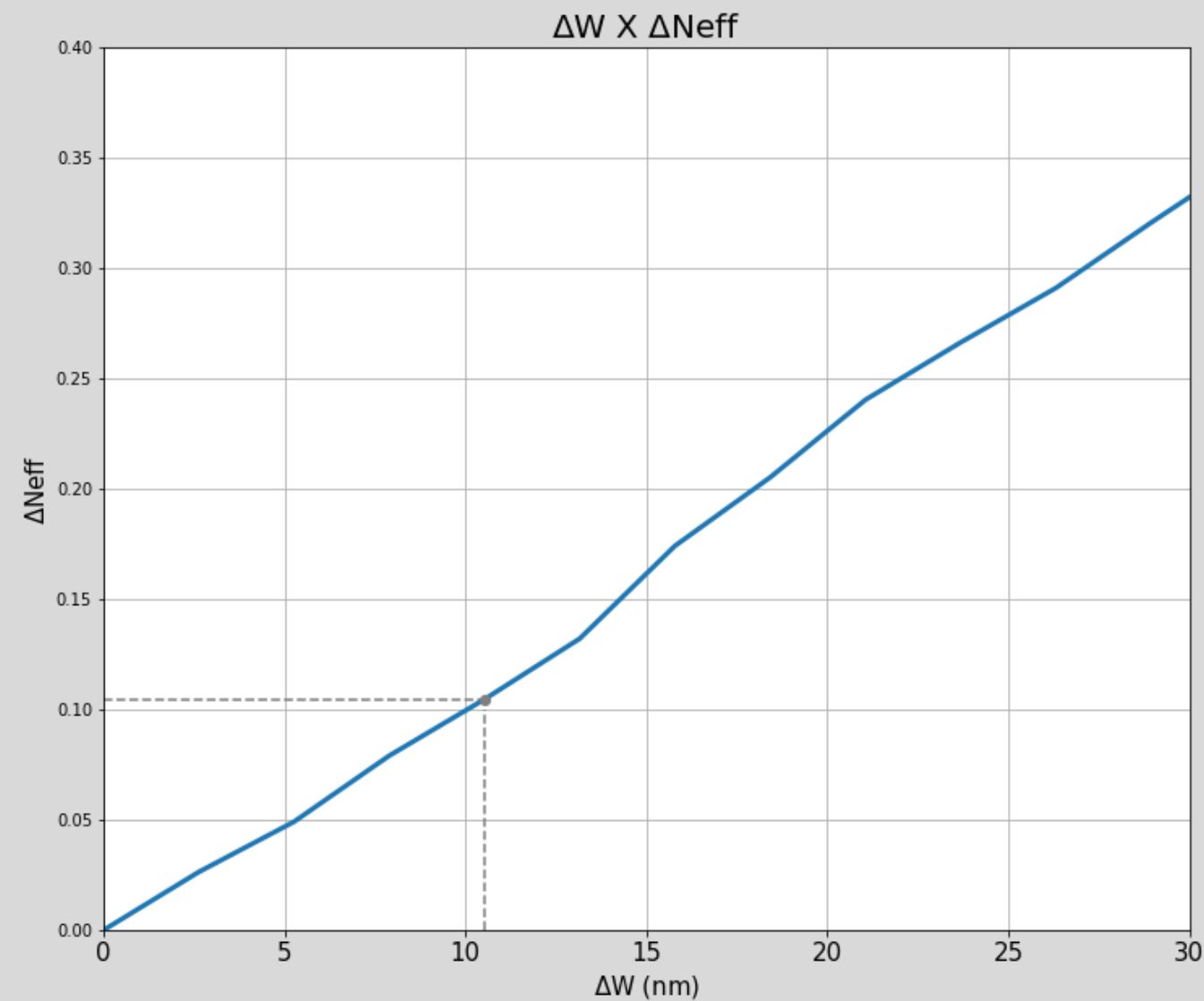
$r_{max} = 1$

$L = 40.97\mu\text{m}$

$\Delta N_{eff} = 0.1$

# $\Delta W \times \Delta N_{eff}$

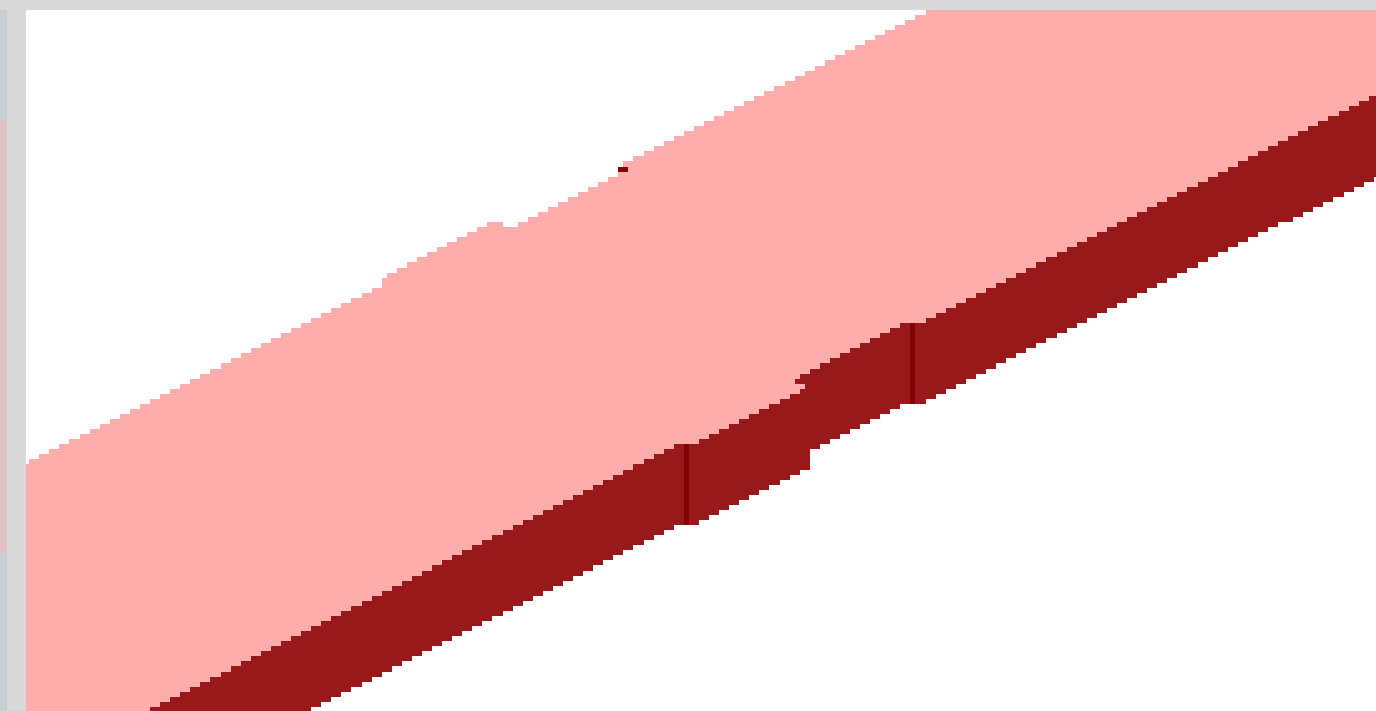
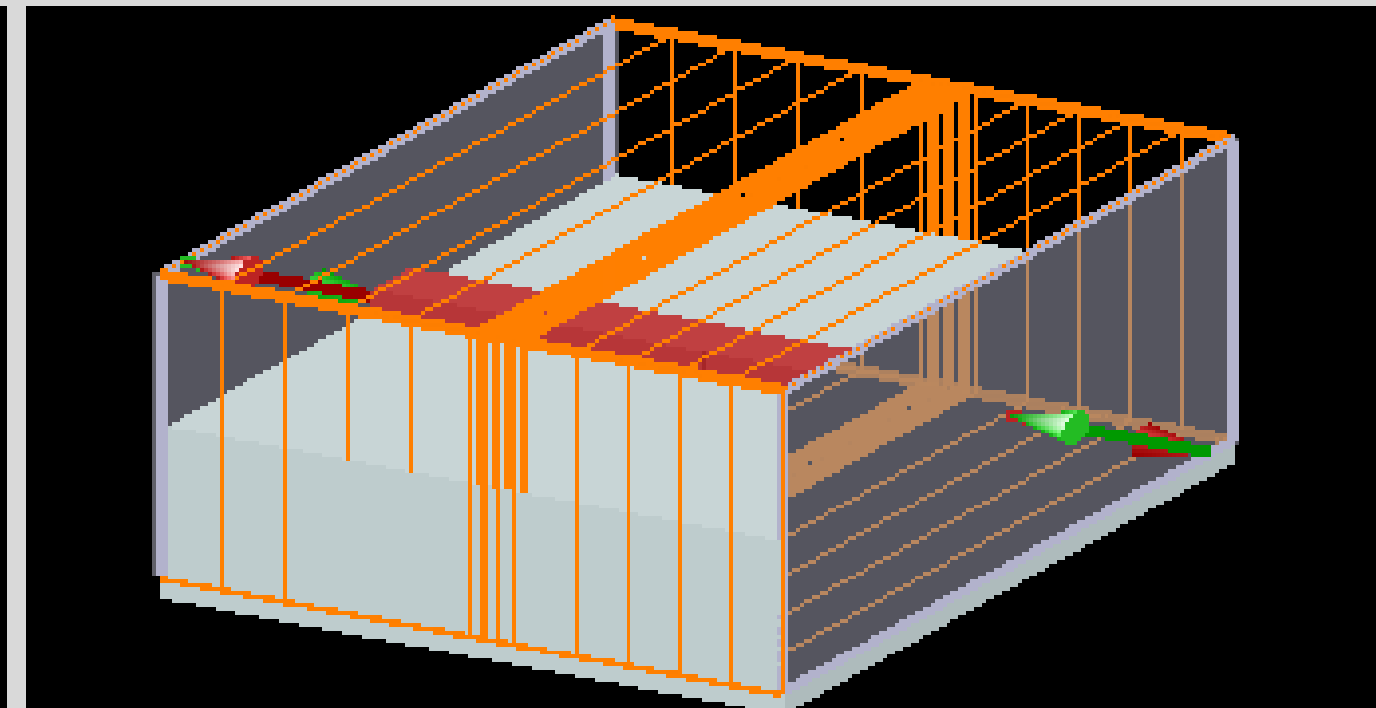
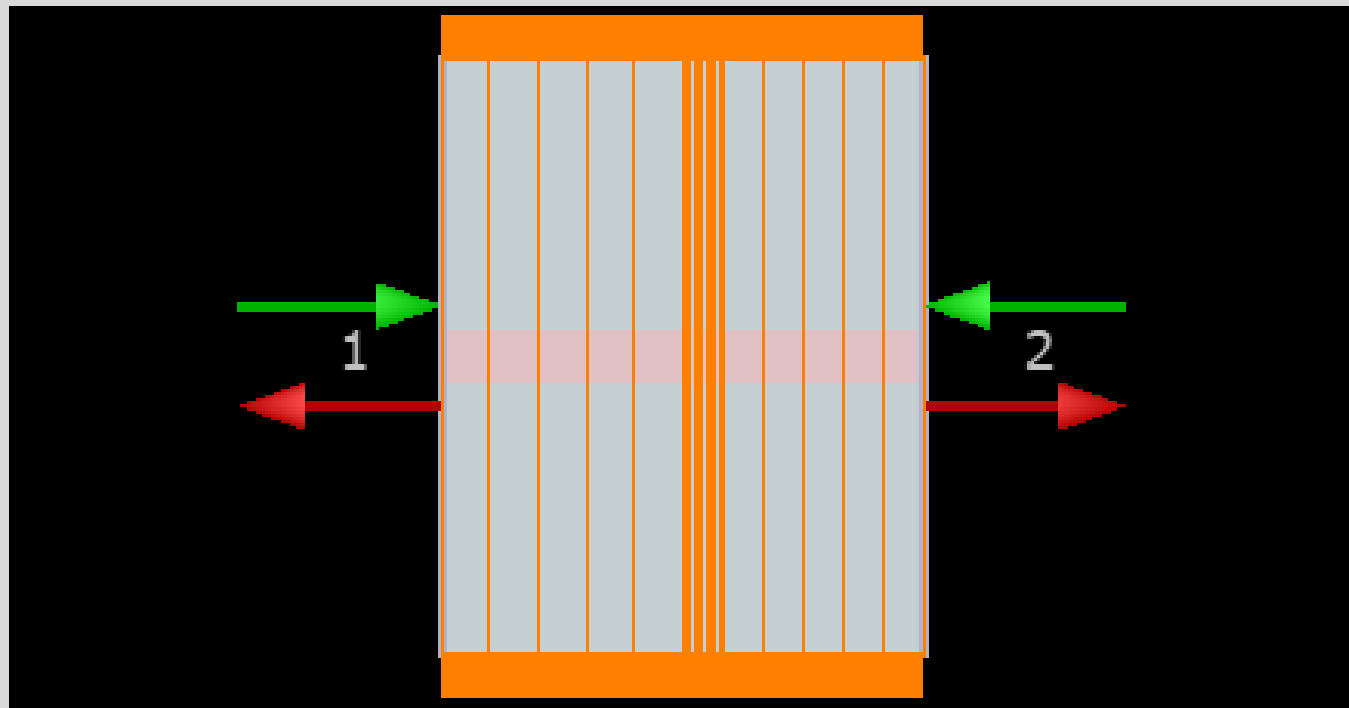
Finding the  $\Delta W$  to be used on the grating



With  $\Delta N_{eff} = 0.1$  we have:  
 $\Delta W = 10.53\text{nm}$

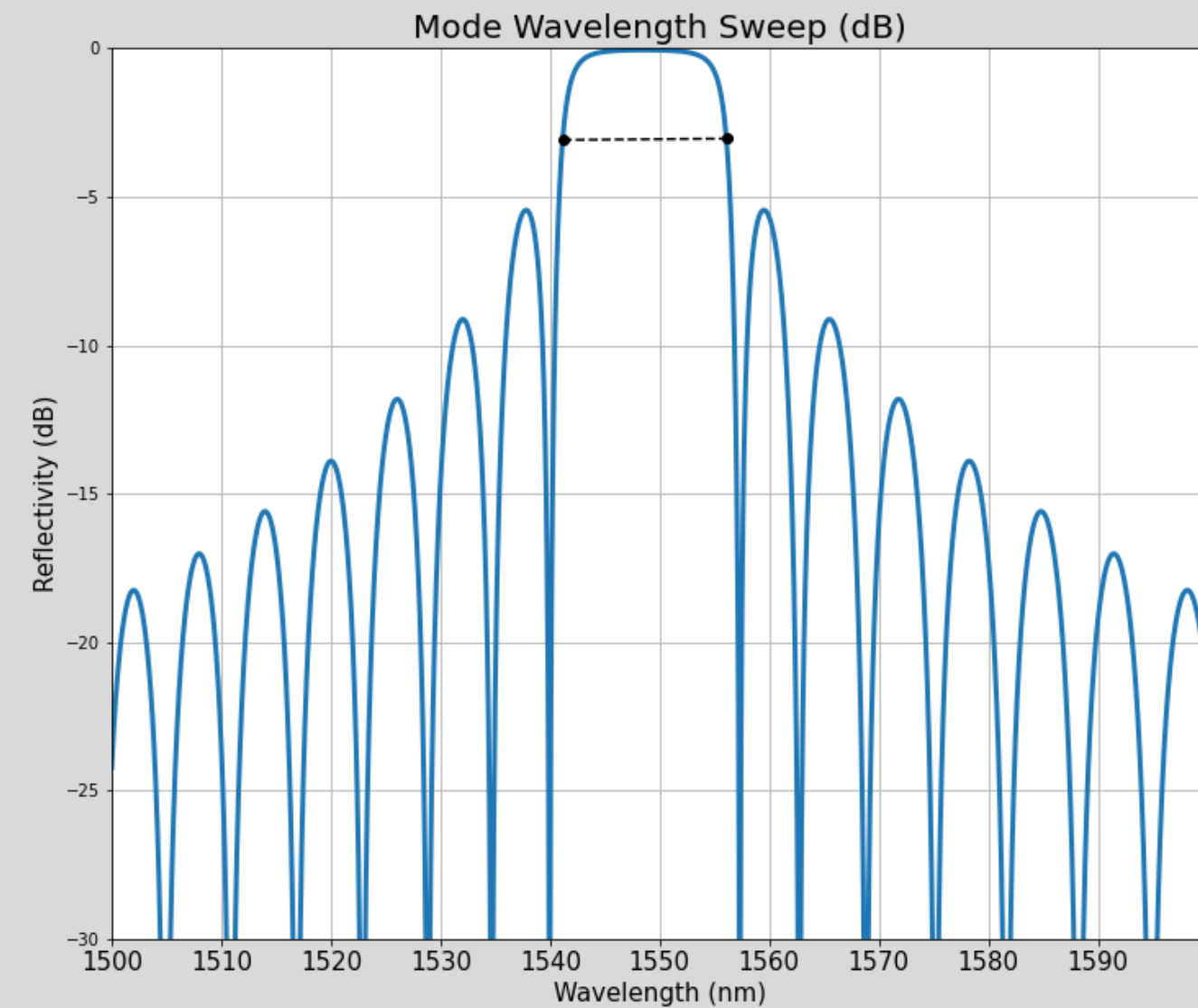
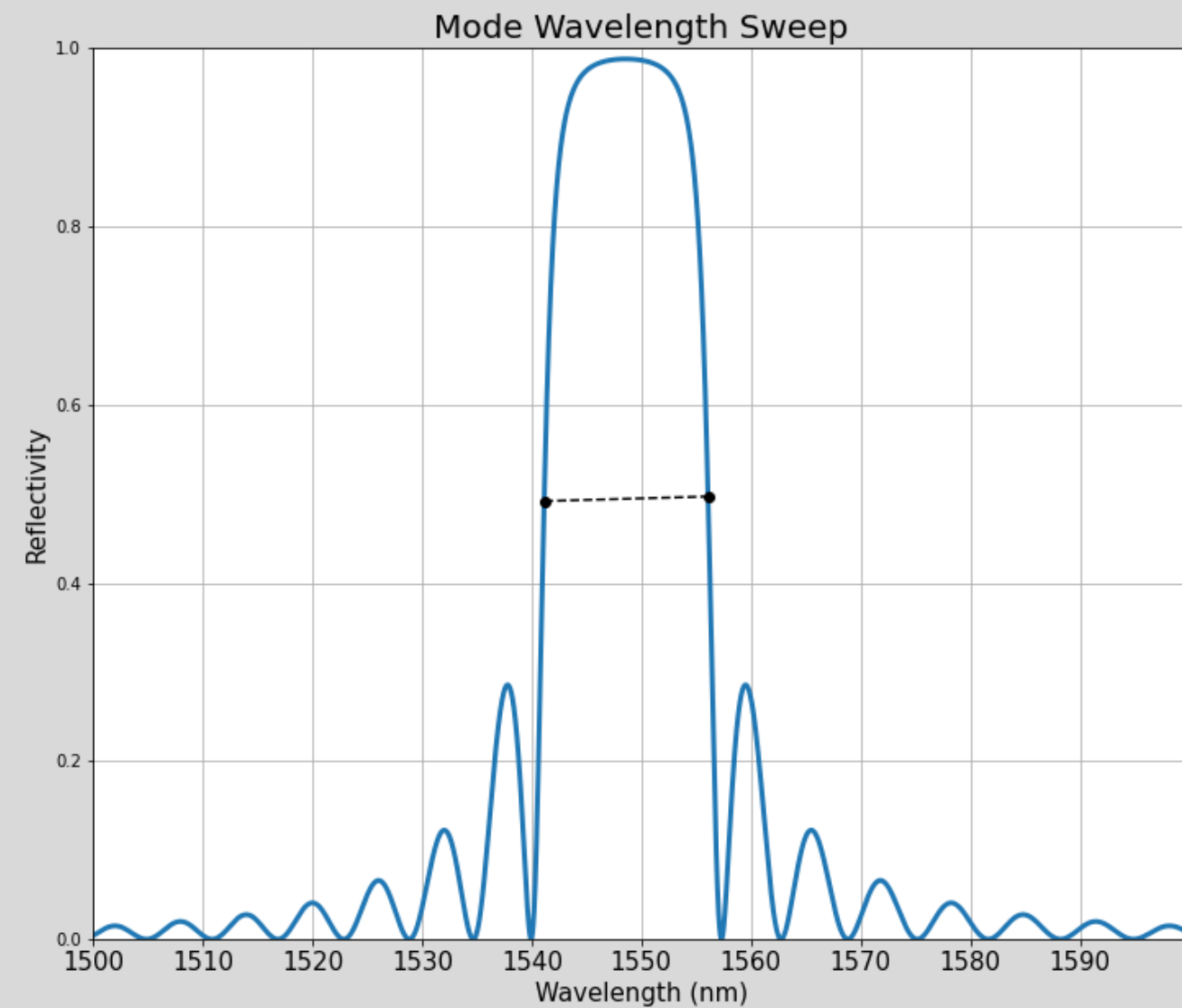
# DESIGN

## Lumerical mode



# THEORETICAL GRAPHICS

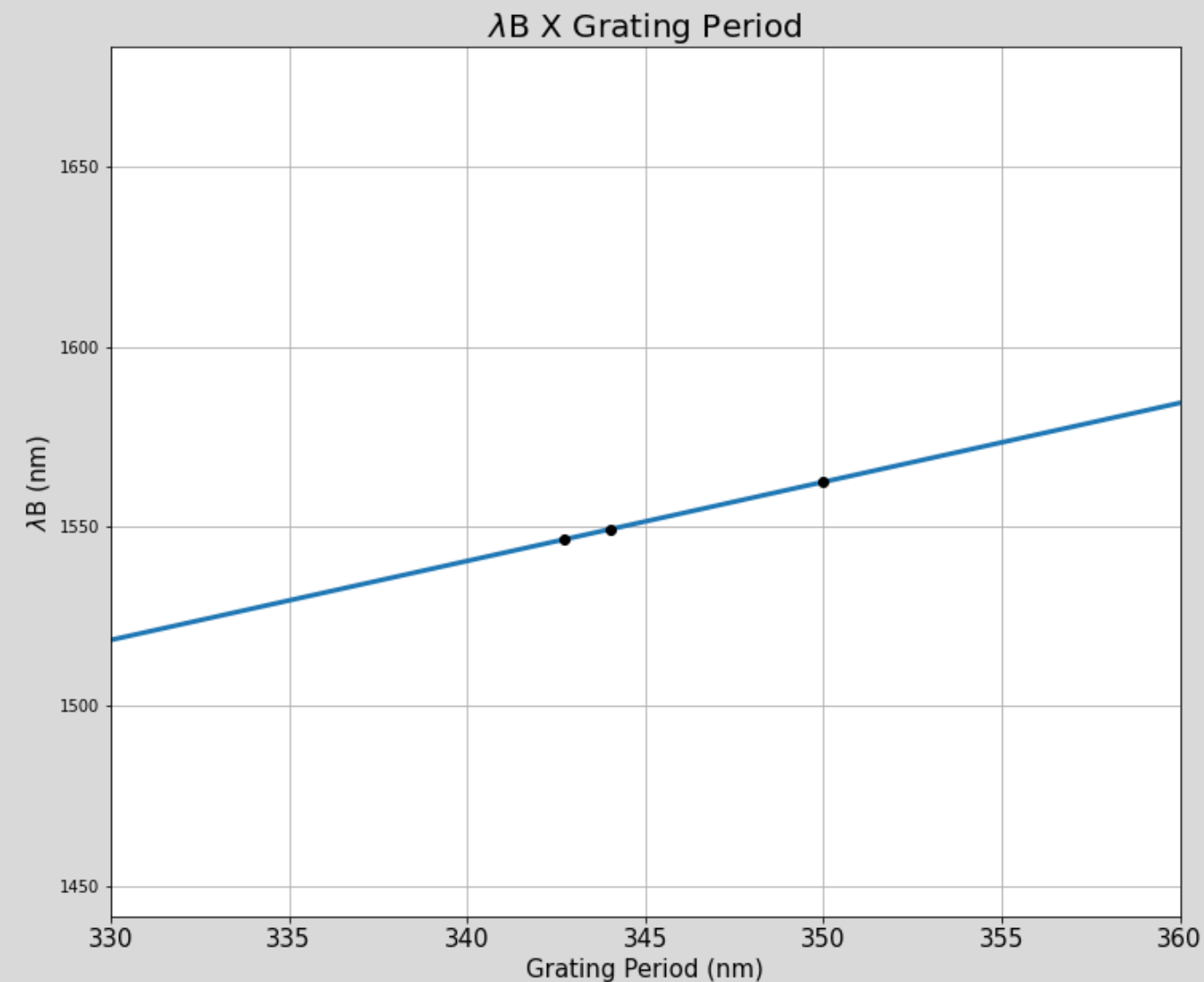
$N = 120$  (FWHM = 15nm)





# OPTIMIZATION

Using  $\Delta W = 24\text{nm}$  (Experimental Value)

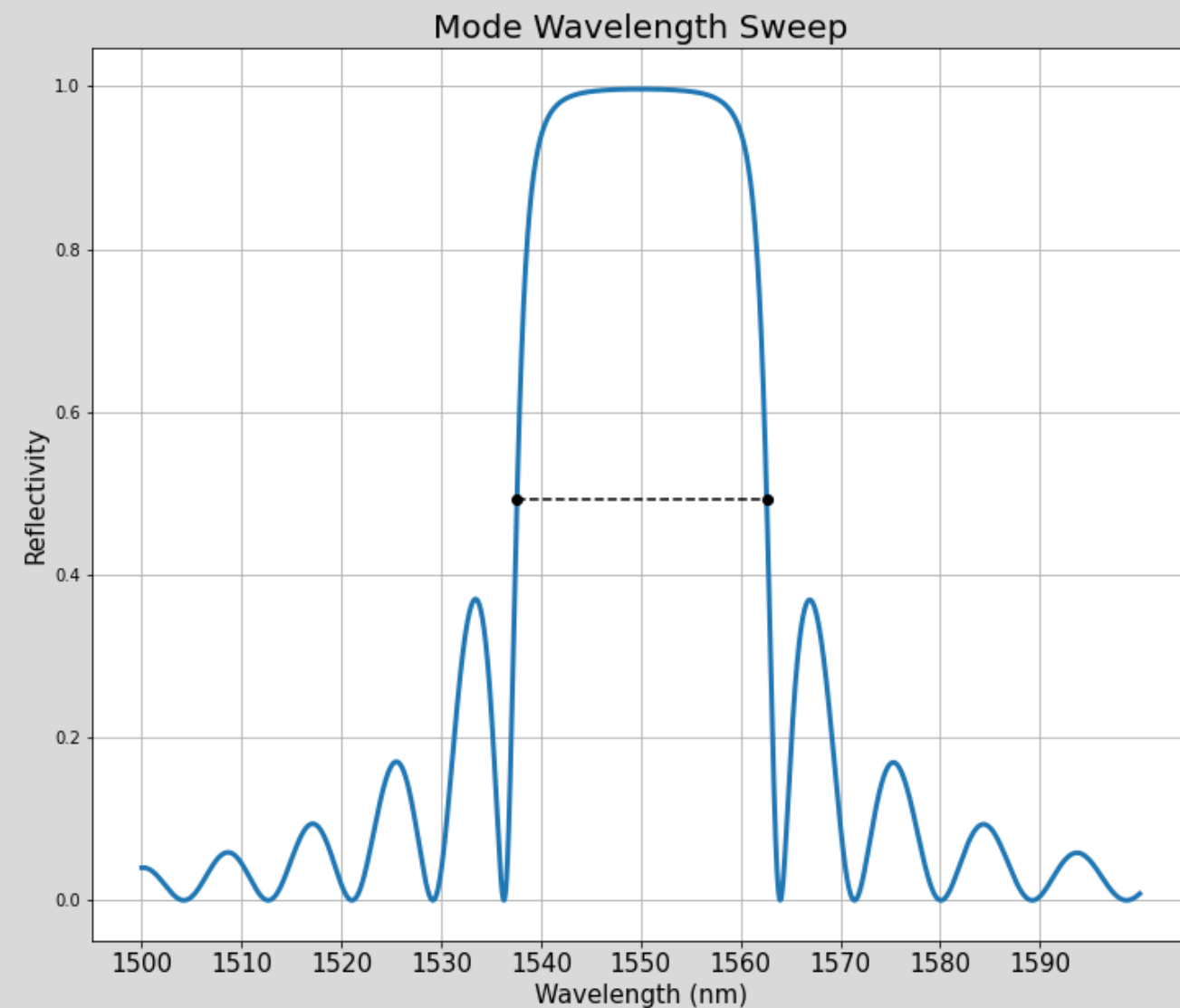


$$y = 2.197x + 793.392 \text{ (nm)}$$

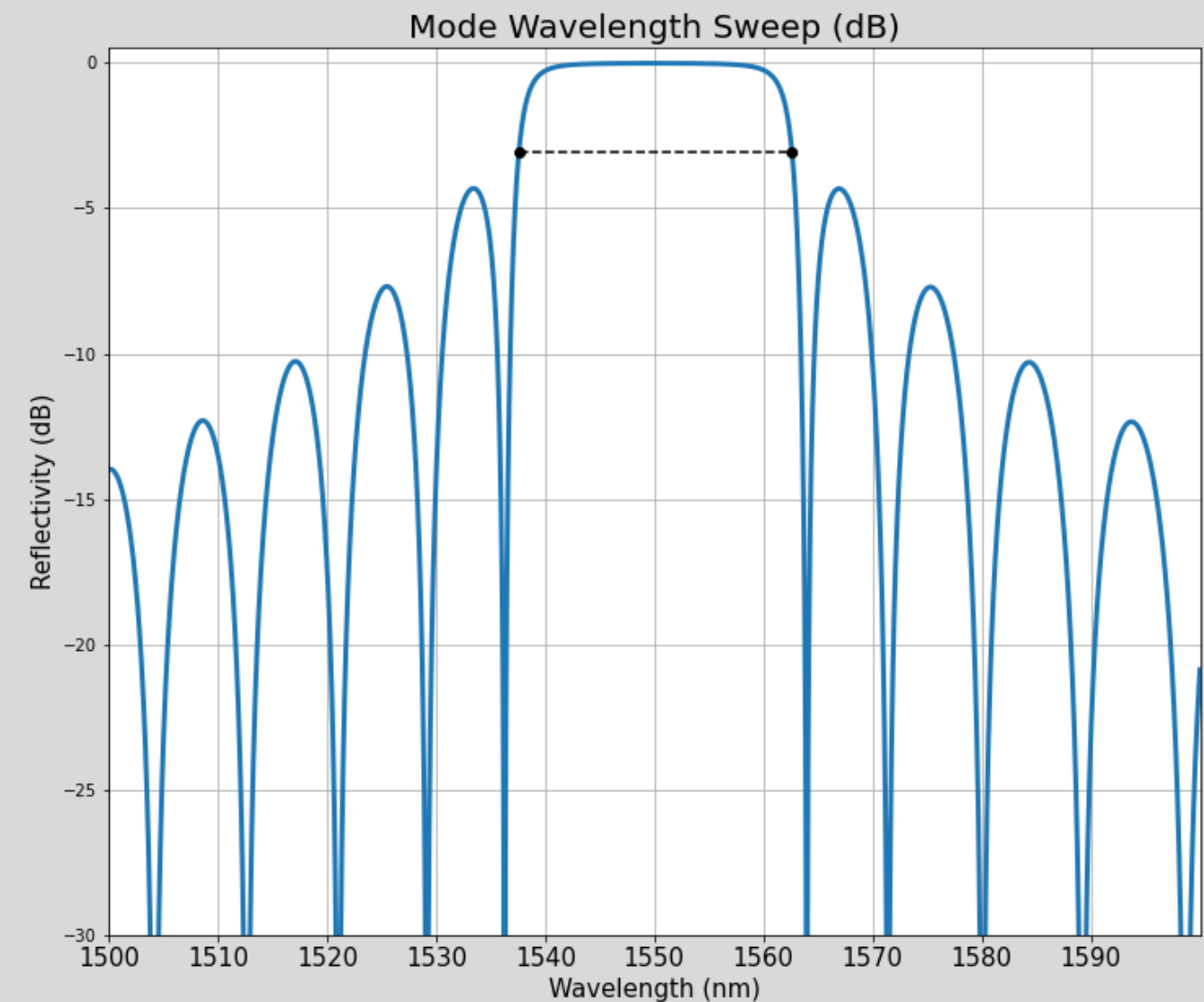
For  $\lambda_B = 1550\text{nm}$   
Grating Period =  $344.3777\text{nm}$

# OPTIMIZATION

Final Result 0.45nm Guide (N = 82)



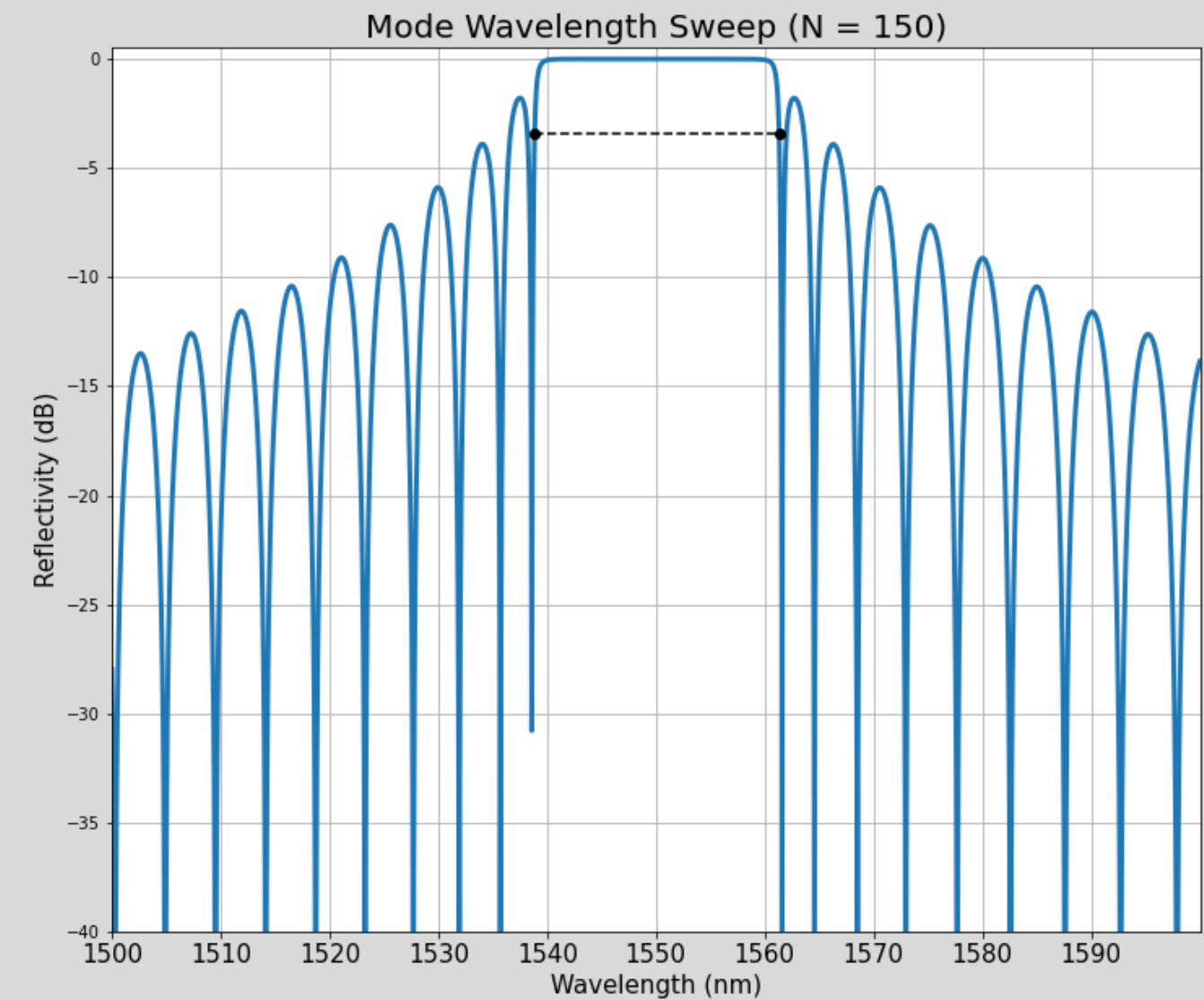
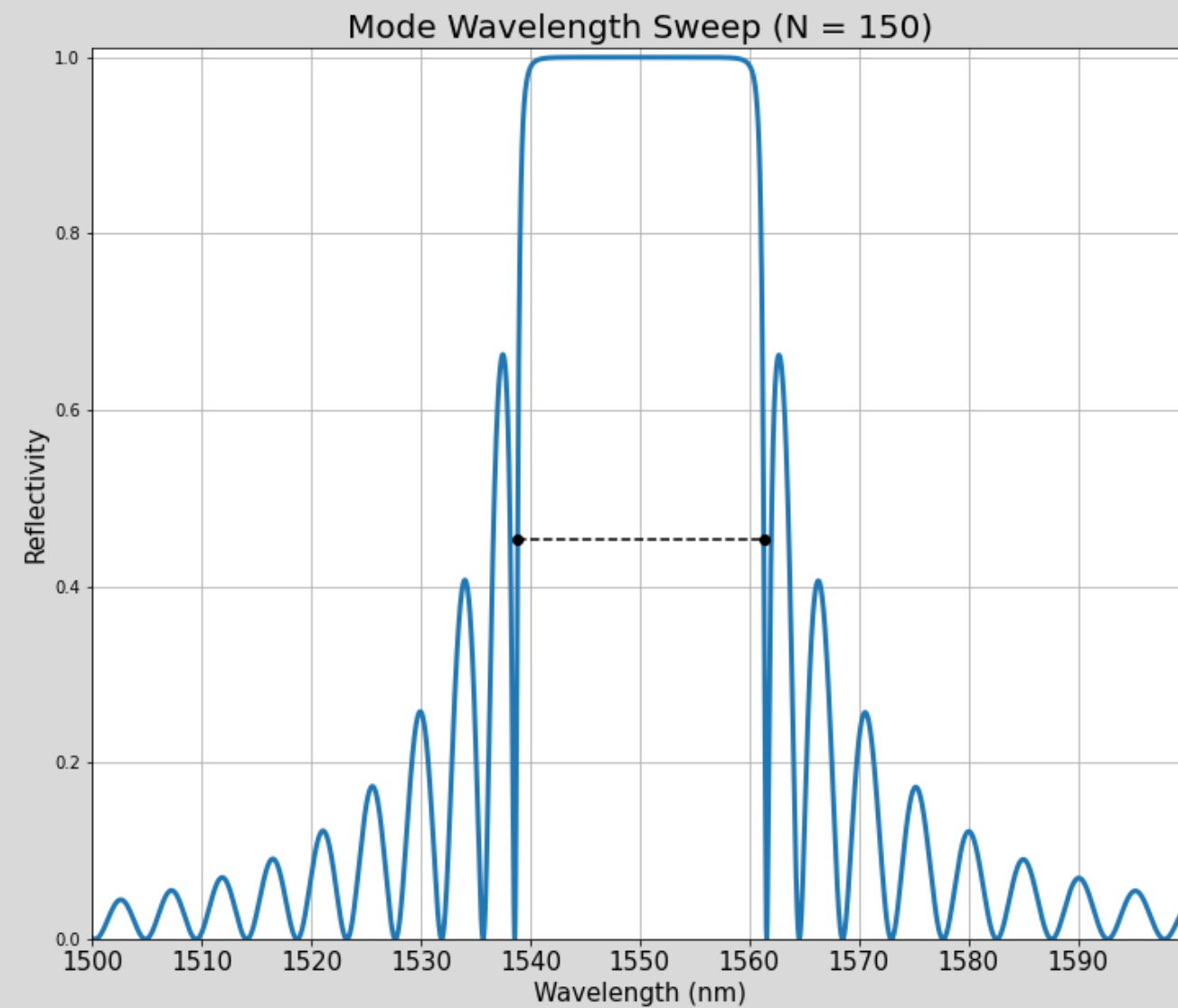
$\lambda_B = 1550.01\text{nm}$  (0.0006% Error)



FWHM = 25.025nm (0.1% Error)

# N VARIATION

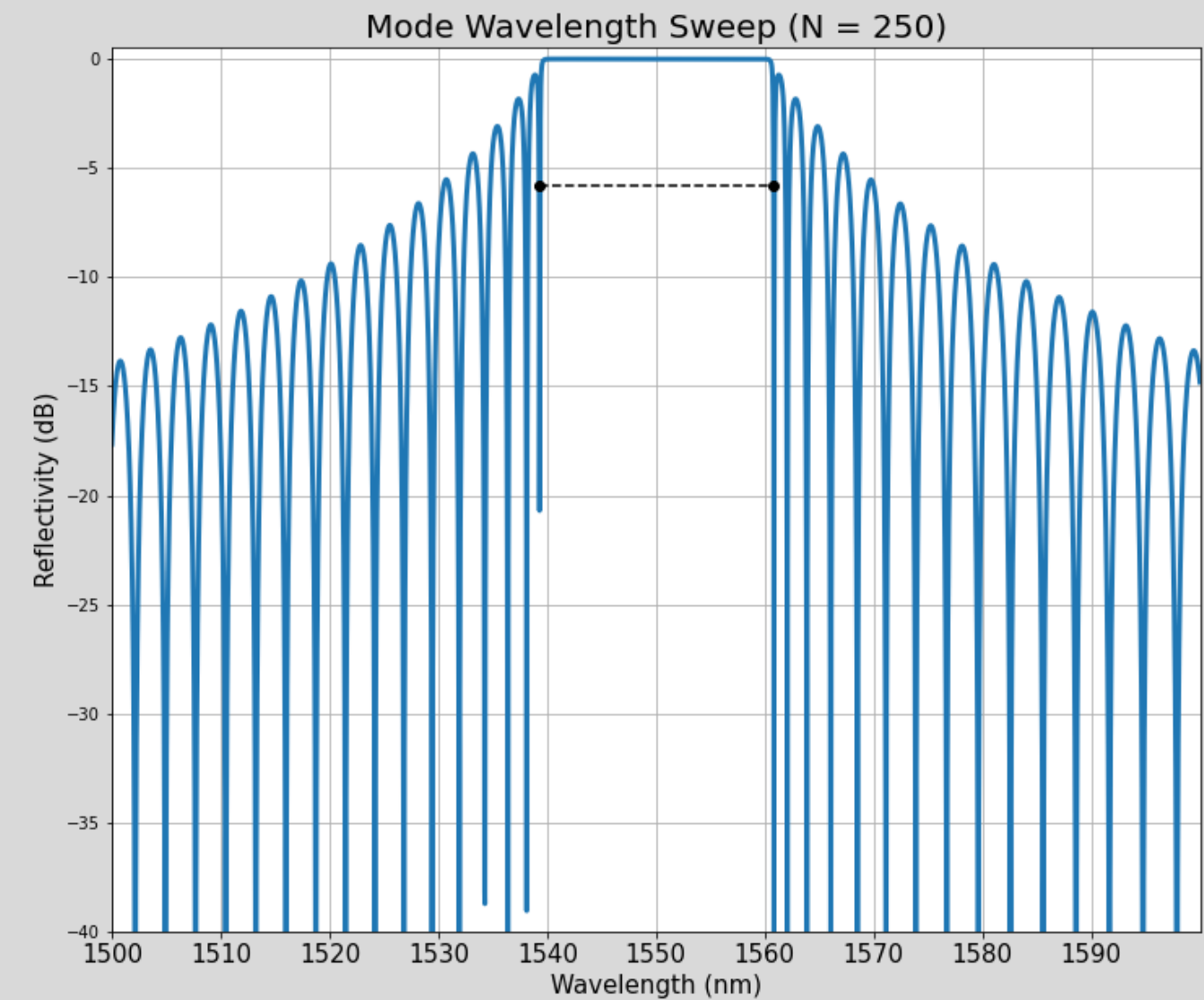
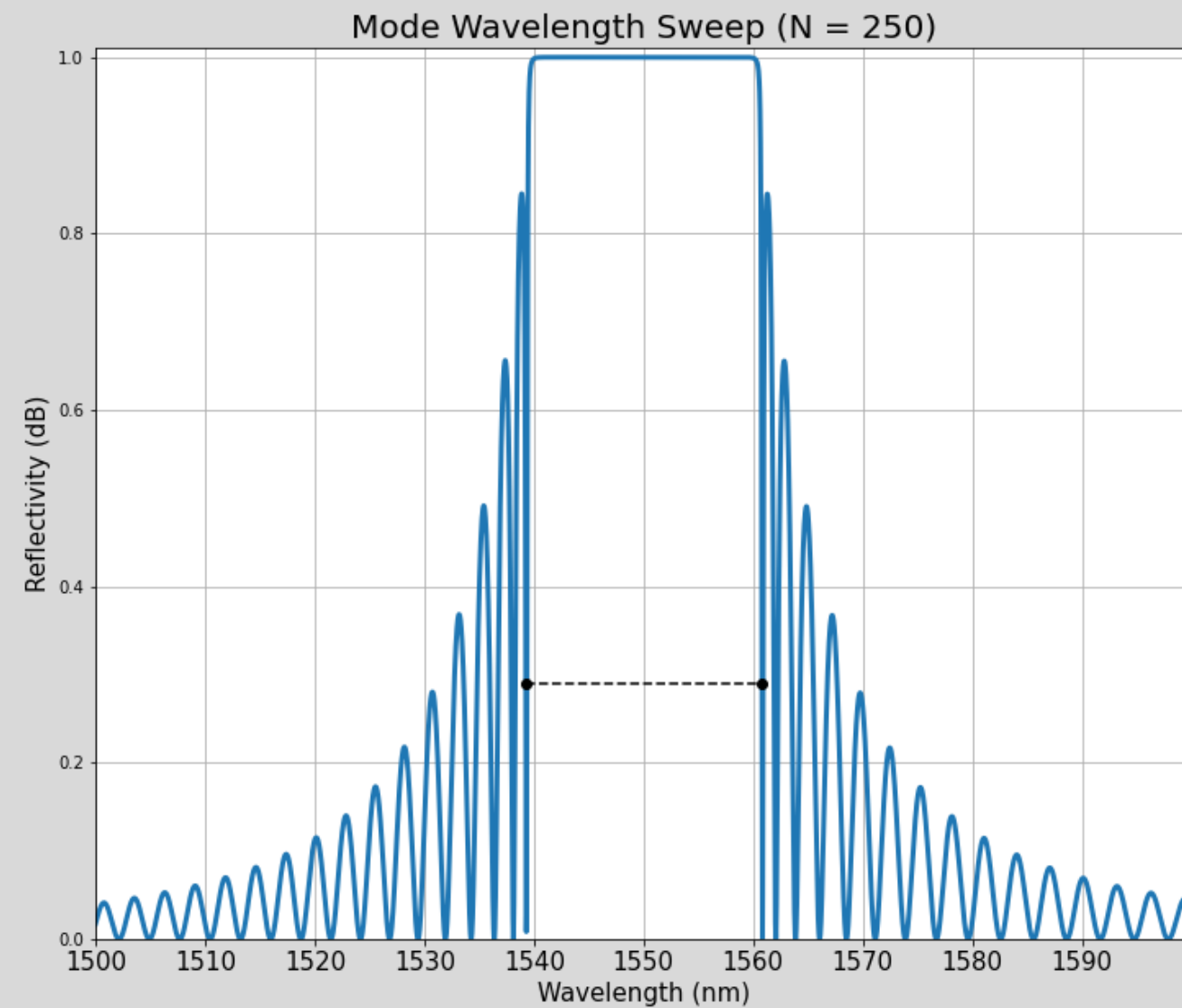
Final Result 0.45nm Guide (N = 150)



FWHM = 22.4645nm

# N VARIATION

Final Result 0.45nm Guide (N = 250)



FWHM = 21.444nm

# CONSTANT VALUES 0.6NM GUIDE

Using Lambda = 1550nm and 25nm FWHM

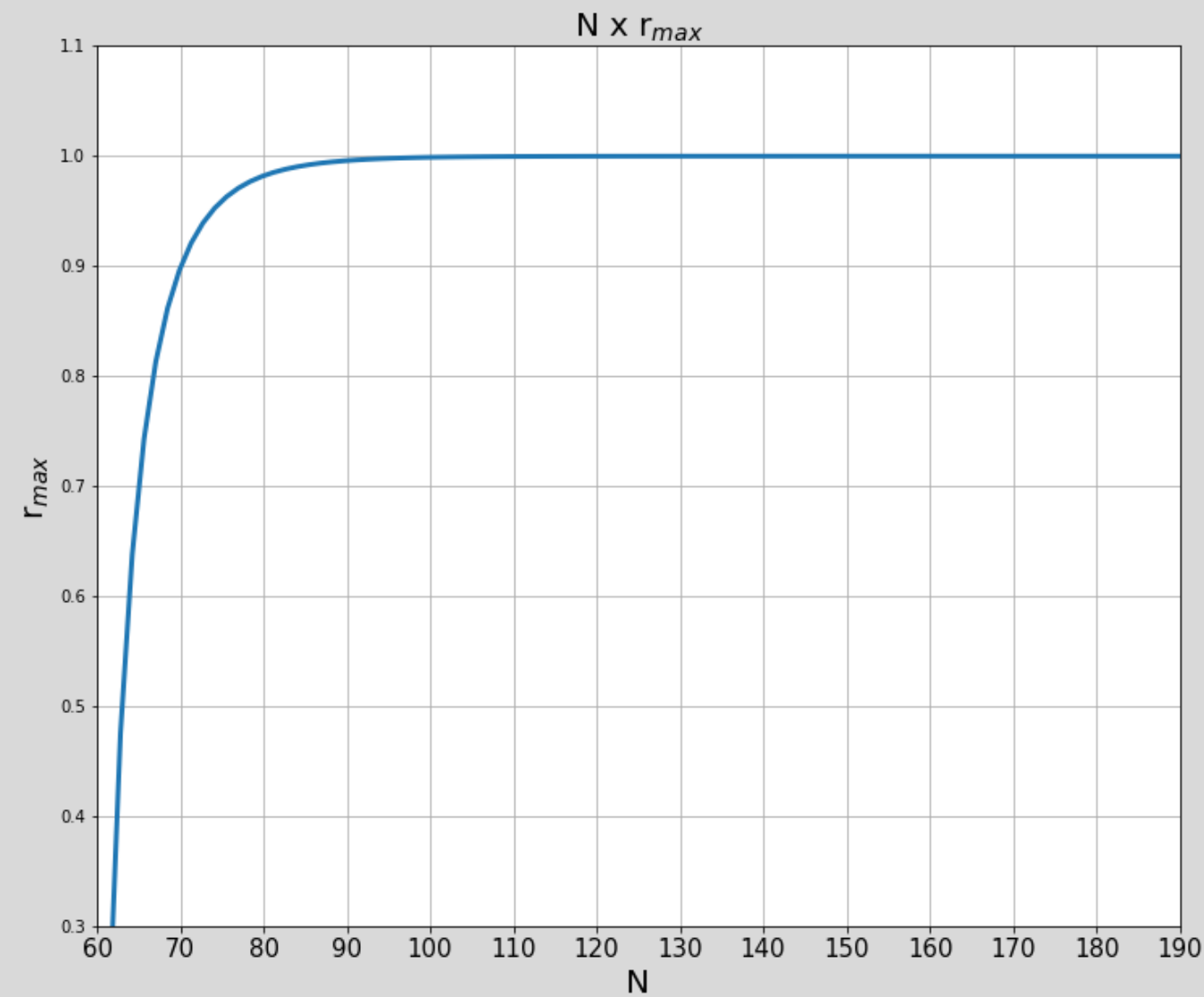
Using FDE solver on an straight 0.22um tall, 0.6um thickness waveguide, we can get the constants we need to start projecting the grating.

$$N_{eff} = 2.53;$$

$$N_g = 4.20;$$

Grating Period = 341.41nm. (Theoretical Value)

# CALCULATING THE NUMBER OF PERIODS



Used value:

$$N = 130$$

Theoretical results:

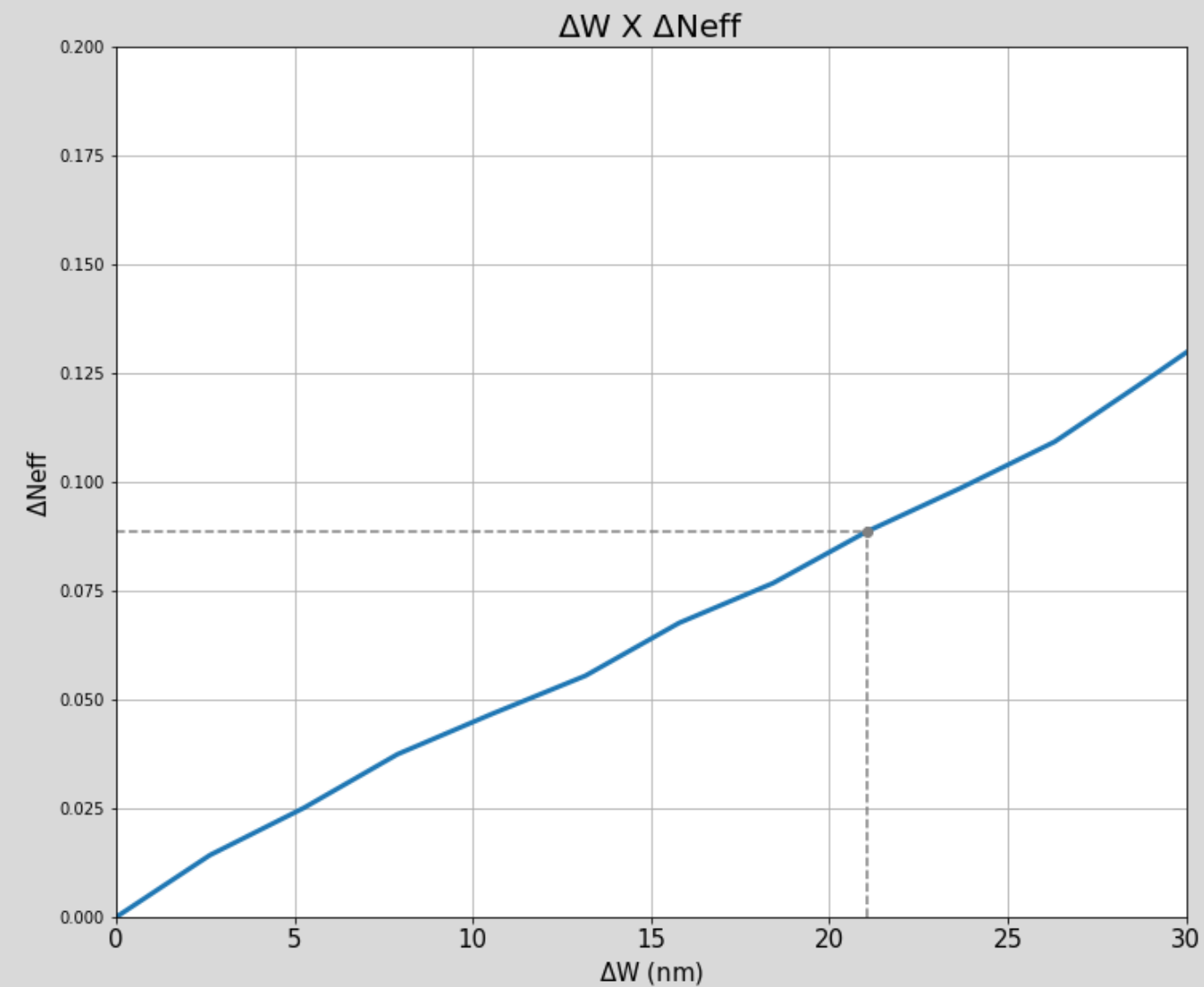
$$r_{max} = 1$$

$$L = 39.82 \mu\text{m}$$

$$\Delta N_{eff} = 0.09$$

# $\Delta W \times \Delta N_{eff}$

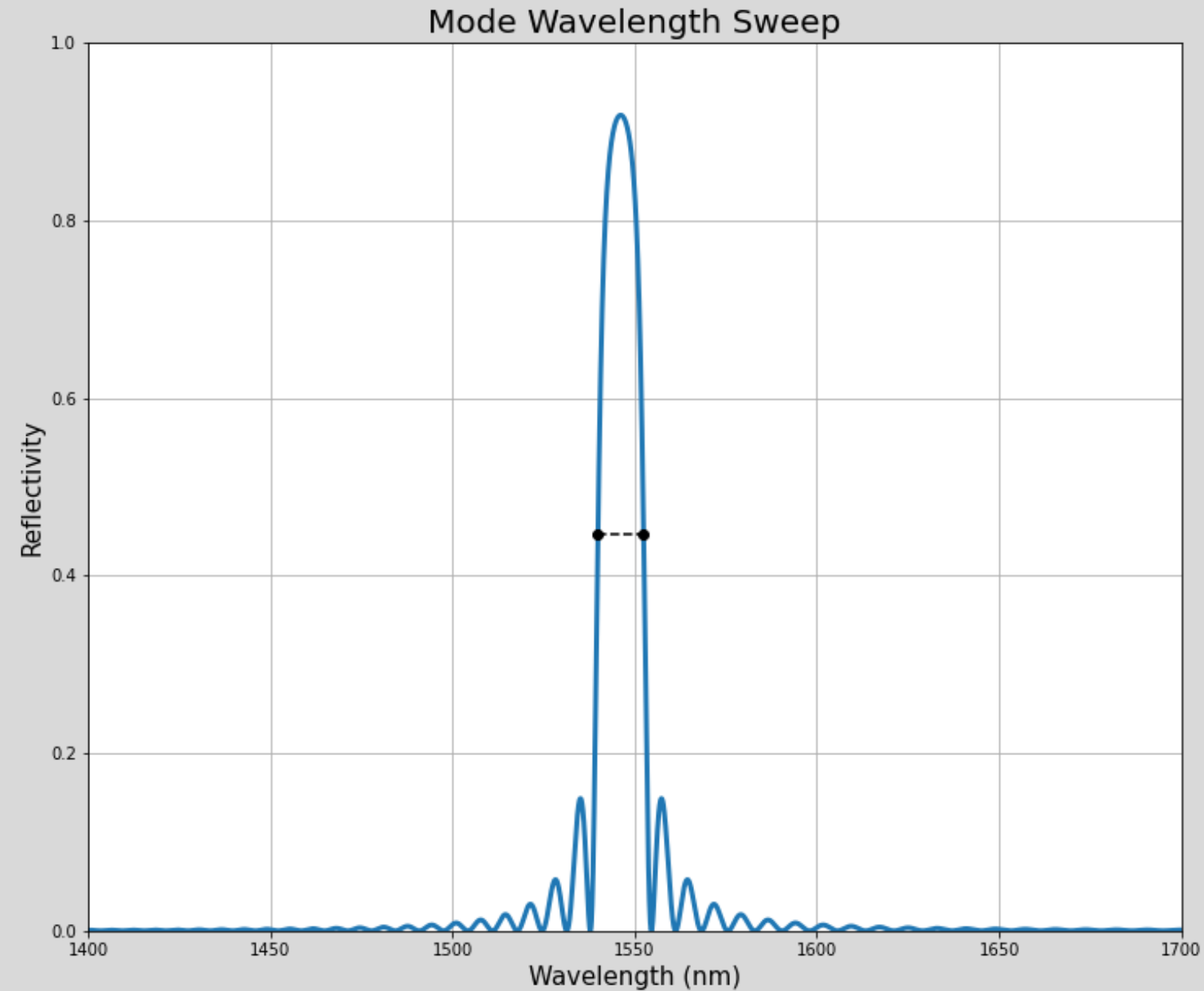
Finding the  $\Delta W$  to be used on the grating



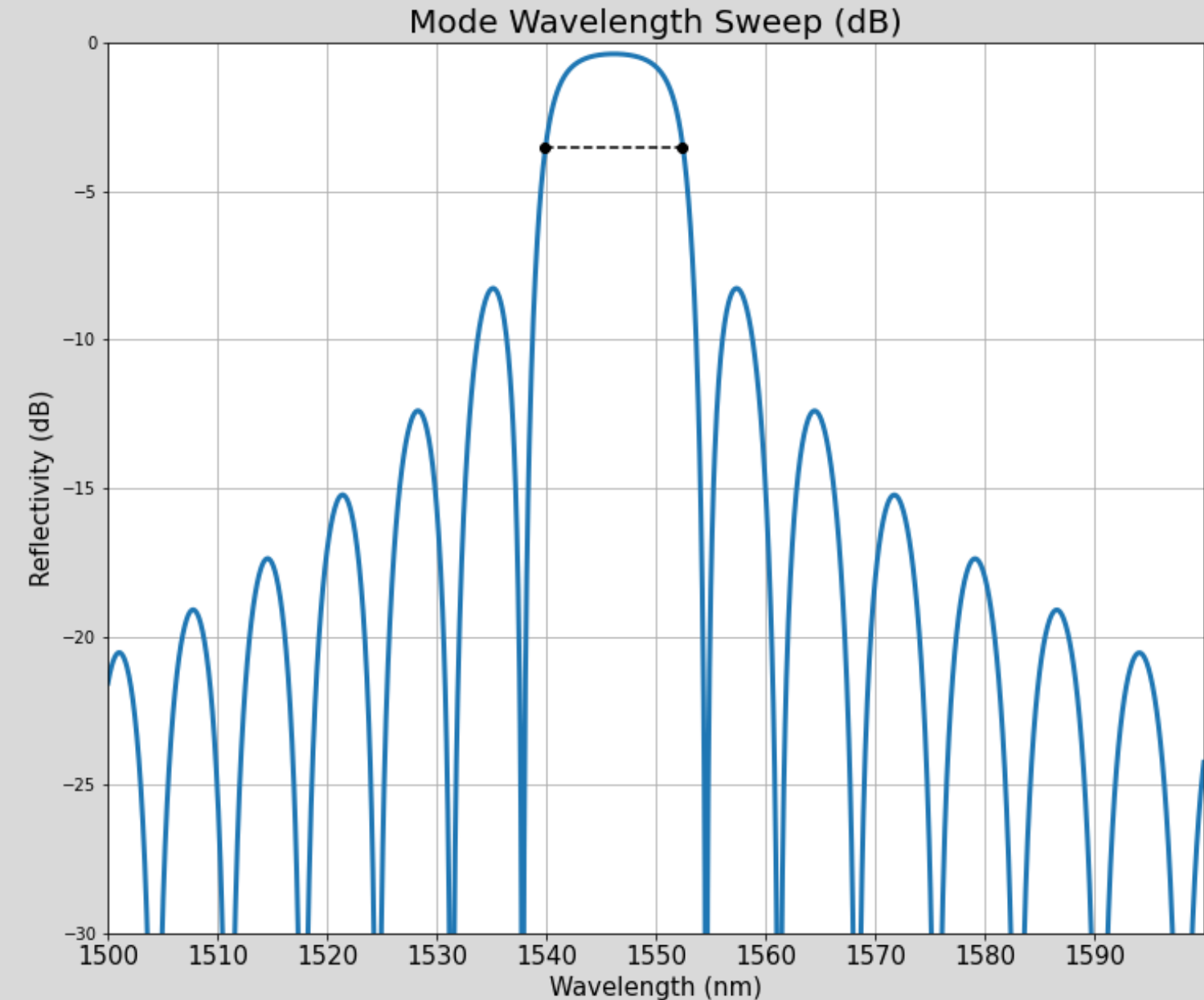
With  $\Delta N_{eff} = 0.09$  we have:  
 $\Delta W = 21.05\text{nm}$

# THEORETICAL GRAPHICS

$N = 130$  (FWHM = 15nm)



FWHM = 12.5425nm

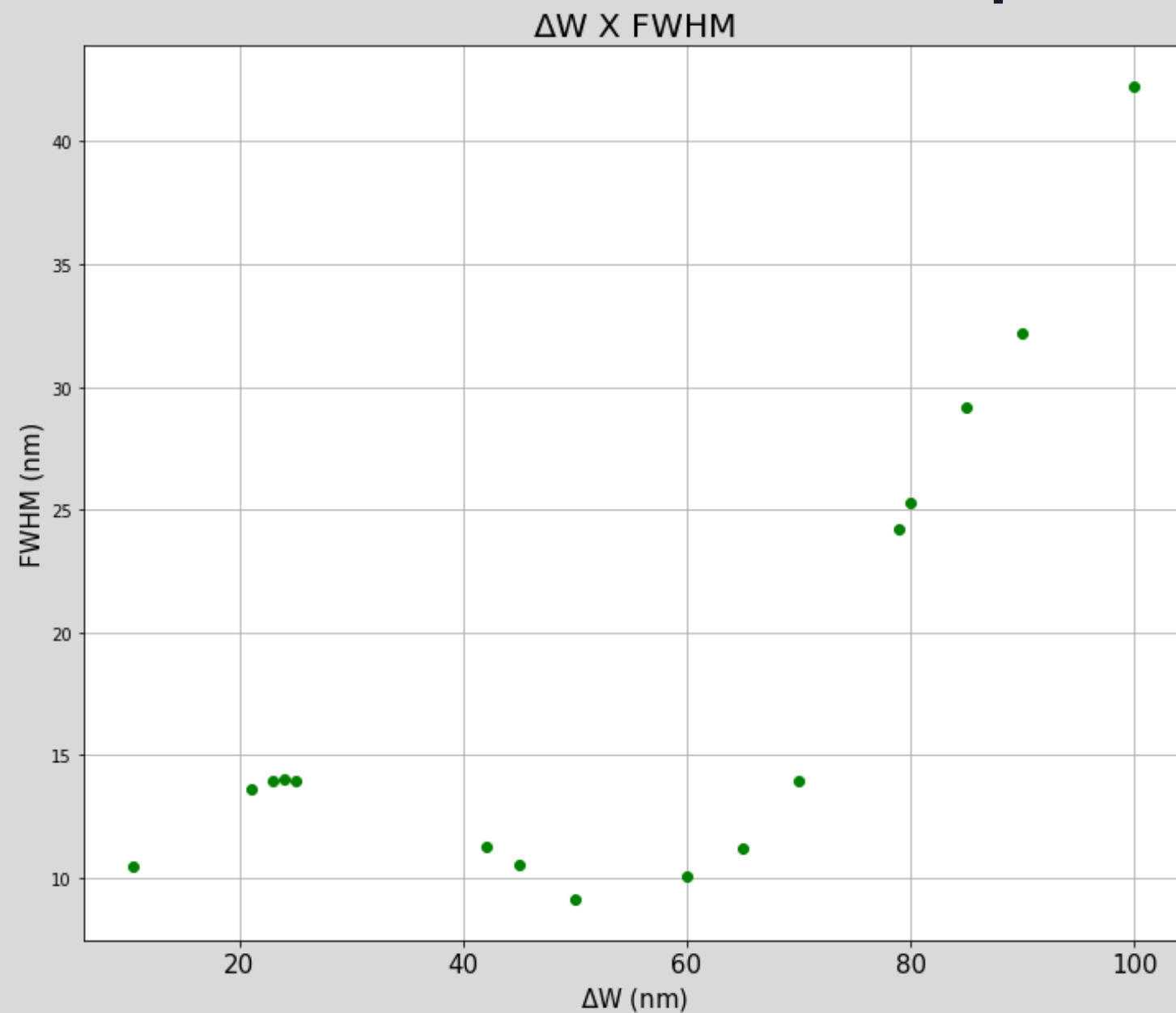


$\lambda_B = 1546.19\text{nm}$



# DELTA W X FWHM

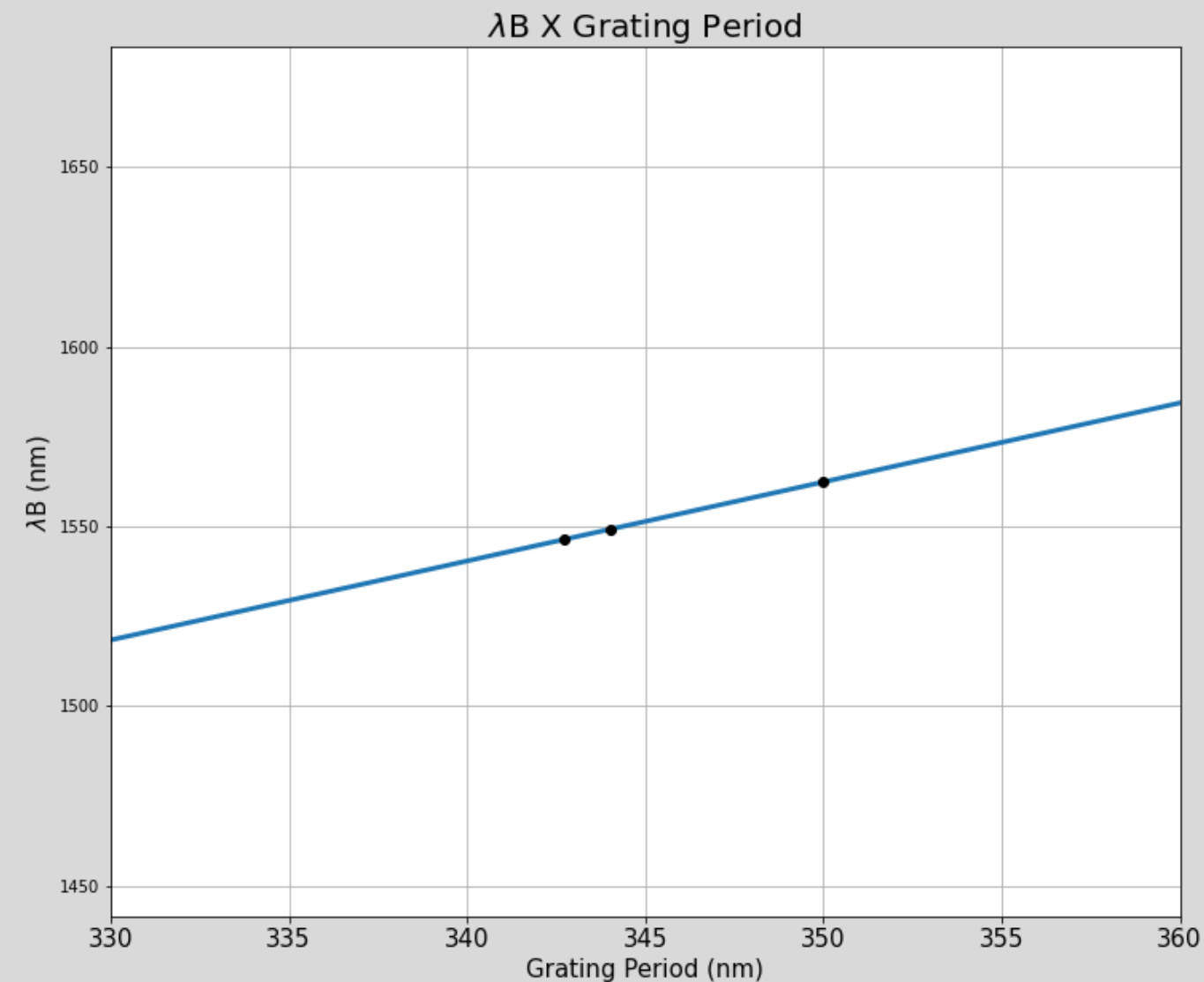
## Experimental Points



As we can see the FWHM values are very hard to predict on an 0.6nm and can be only obtained by simulations. Therefore this guide is difficult to be implemented

# OPTIMIZATION

Using  $\Delta W = 24\text{nm}$  (Experimental Value)

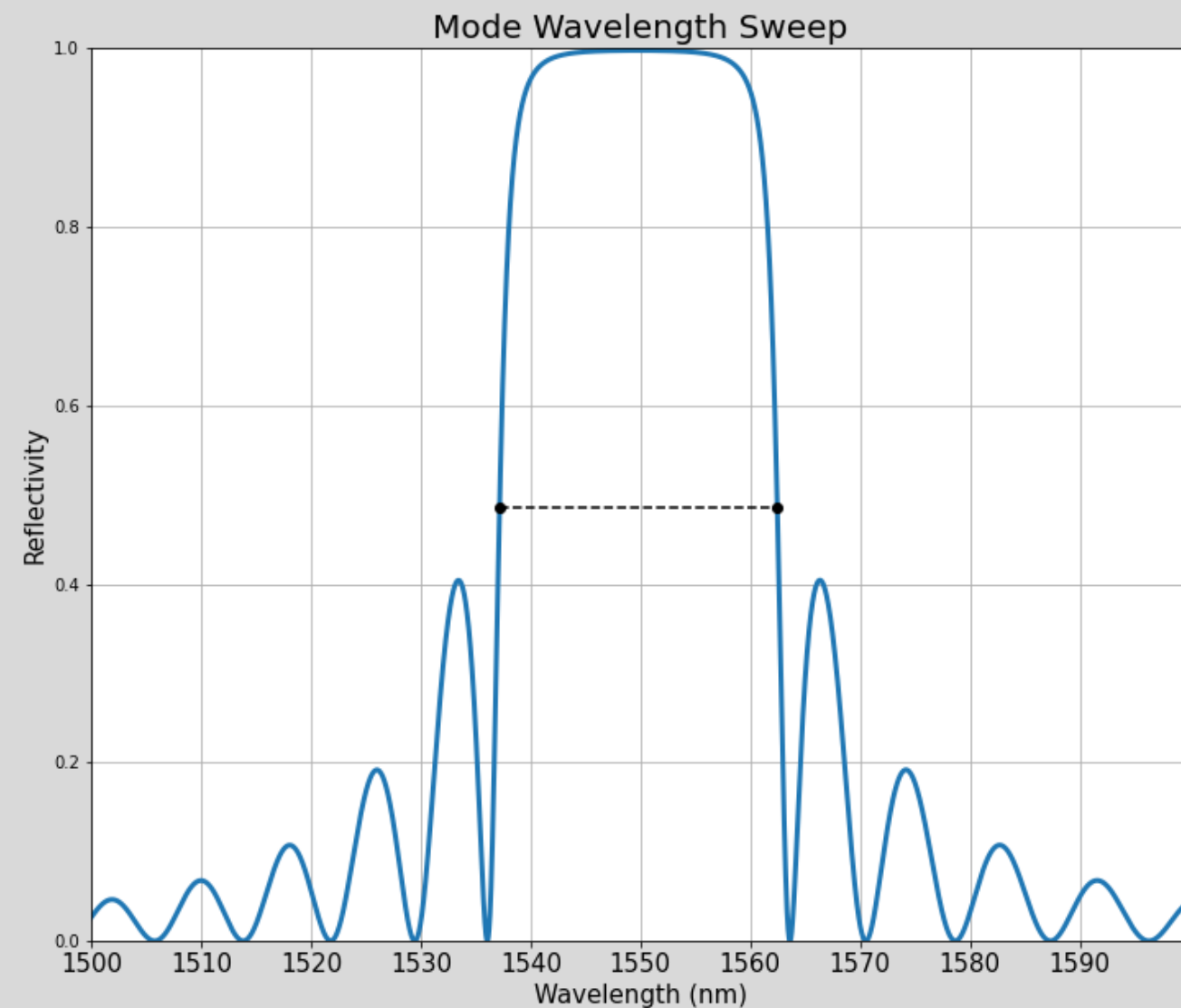


For  $\lambda_B = 1550\text{nm}$

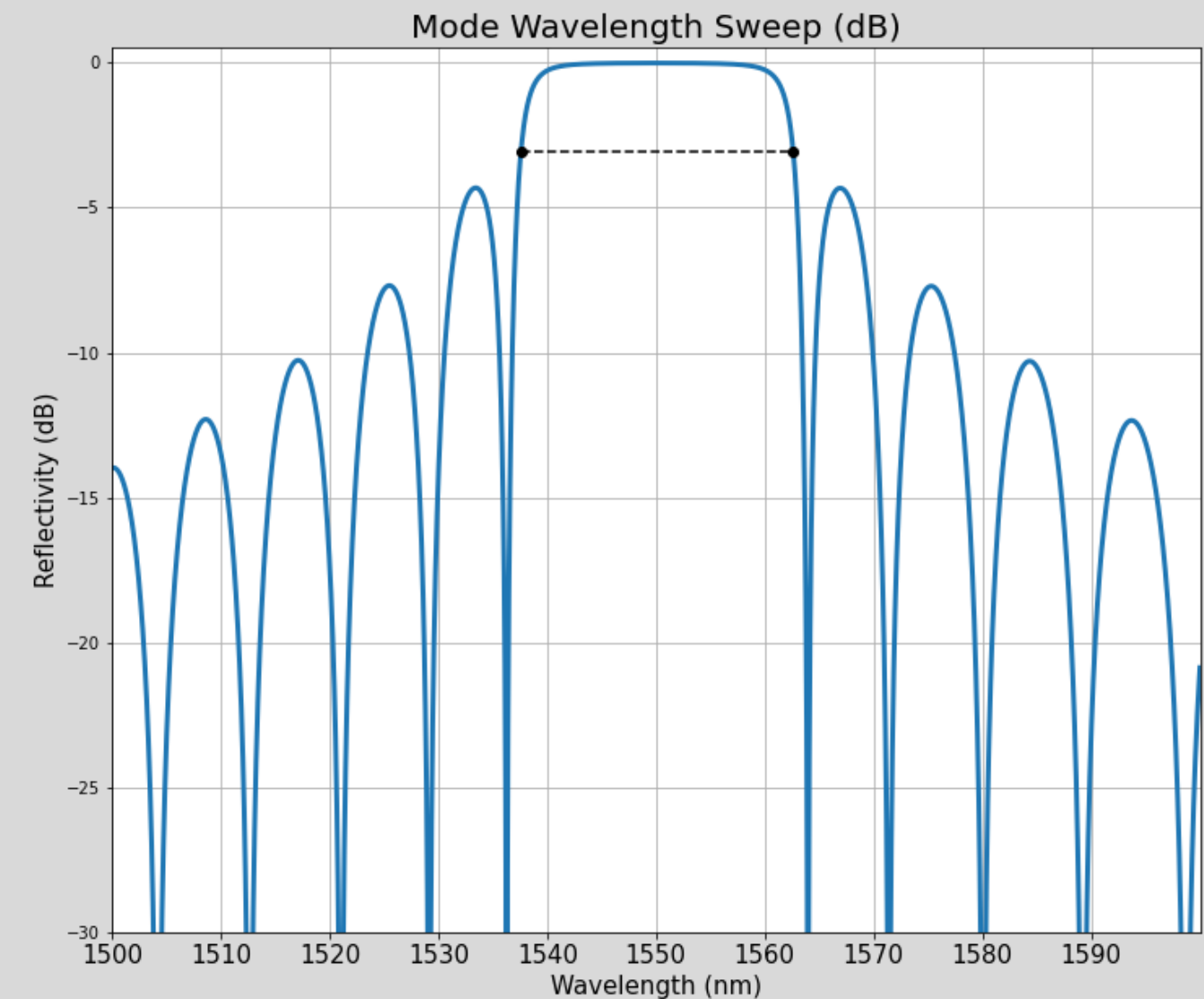
Grating Period =  $317.3210\text{nm}$

# OPTIMIZATION

Final Result 0.45nm Guide (N = 100)



$\lambda_B = 1549.73\text{nm}$  (0.17% Error)



FWHM = 25.2851nm (1.14% Error)

# CONCLUSION

As we can see, when we increase the number of periods the filter noise increase as well.

The 0.45nm grating is more predictable and therefore it may be better than the 0.6nm grating due to an more linear variation of FWHM.