DESIGN
GRADE DE BRAGG

SEMANA 1

ESTUDO DE REFERENCIAS

ESTUDO DE REFERENCIAS

Ref: T. Erdogan, "Fiber grating spectra," in Journal of Lightwave Technology, vol. 15, no. 8, pp. 1277-1294, Aug. 1997, doi: 10.1109/50.618322.

Para uma grade do tipo FBG, é interessante calcular analiticamente sua transmissão e refletância teorica

Para um caso mais simples as variáveis que podemos controlar são:

Neff, Comprimento da grade, refletância maxima

ESTUDO DE REFERENCIAS

Podemos calcular a através da seguinte equação:

$$r = \frac{\sinh^2\left(\sqrt{\kappa^2 - \hat{\sigma}^2}L\right)}{\cosh^2\left(\sqrt{\kappa^2 - \hat{\sigma}^2}L\right) - \frac{\hat{\sigma}^2}{\kappa^2}}.$$

Logo, so precisamos definir k e $\hat{\sigma}$

ESTUDO DE REFERENCIAS

K pode ser calculado a partir da reflexão maxima:

$$r_{\max} = \tanh^2(\kappa L)$$

$$k = \frac{arctang(\sqrt{r_{max}})}{L}$$

ESTUDO DE REFERENCIAS

E sabendo que:

$$\hat{\sigma} \equiv \delta + \sigma - \frac{1}{2}\frac{d\phi}{dz}$$

Dado que a grade é uniforme: $\frac{d\phi}{dz} = 0$

Desprezando o self-coupling: $\sigma = 0$

Logo: $\hat{\sigma} \equiv \delta = 2\pi n_{\text{eff}}\left(\frac{1}{\lambda} - \frac{1}{\lambda_D}\right)$

ESTUDO DE REFERENCIAS

E sabendo que:

$$\hat{\sigma} \equiv \delta + \sigma - \frac{1}{2}\frac{d\phi}{dz}$$

Dado que a grade é uniforme: $\frac{d\phi}{dz} = 0$

Desprezando o self-coupling: $\sigma = 0$

Logo: $\hat{\sigma} \equiv \delta = 2\pi n_{\text{eff}}\left(\frac{1}{\lambda} - \frac{1}{\lambda_D}\right)$

ESTUDO DE REFERENCIAS

Exemplo 1

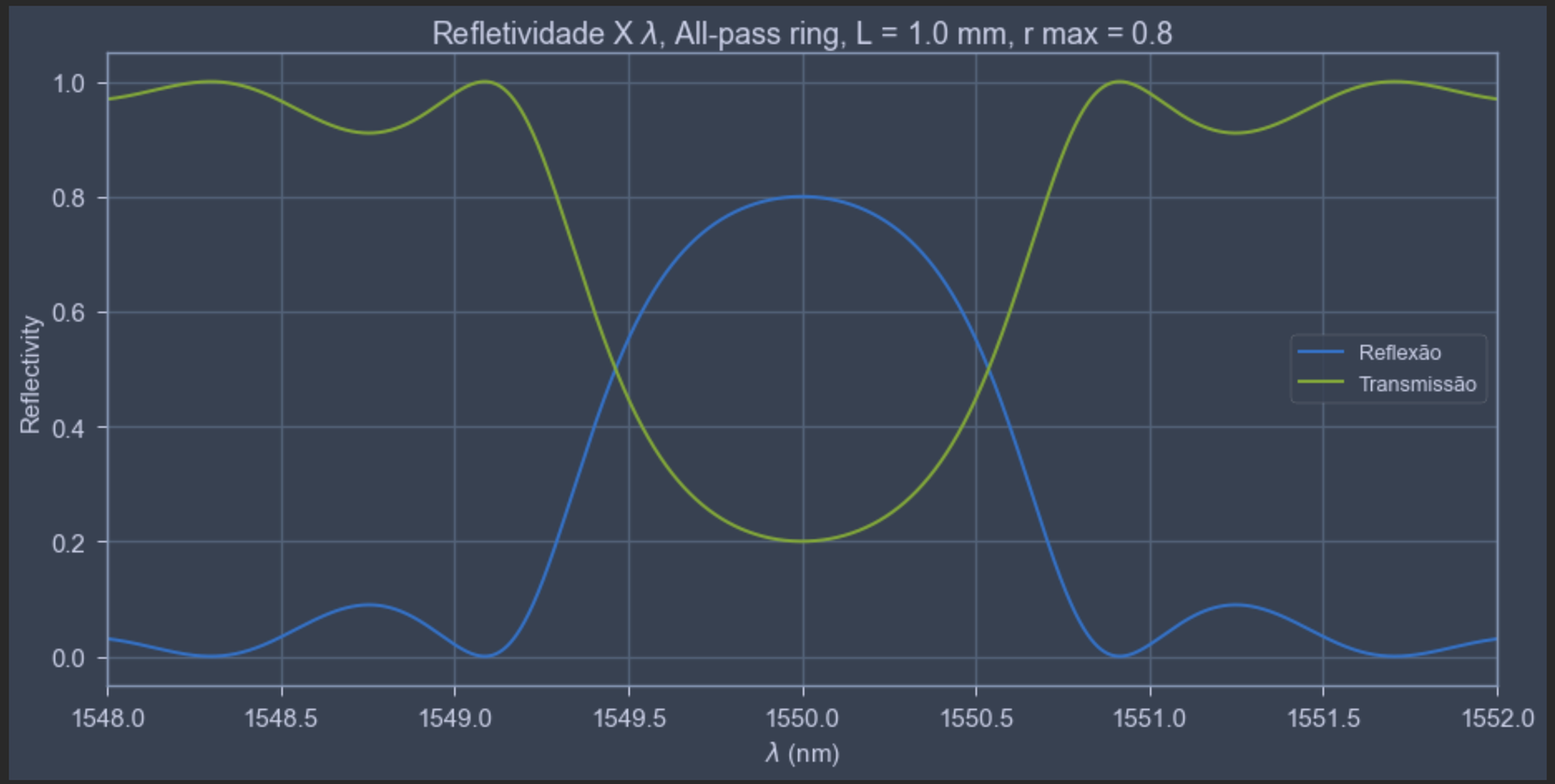
L = 1 mm ,

r max = 0.8,

Comprimento central = 1550 nm

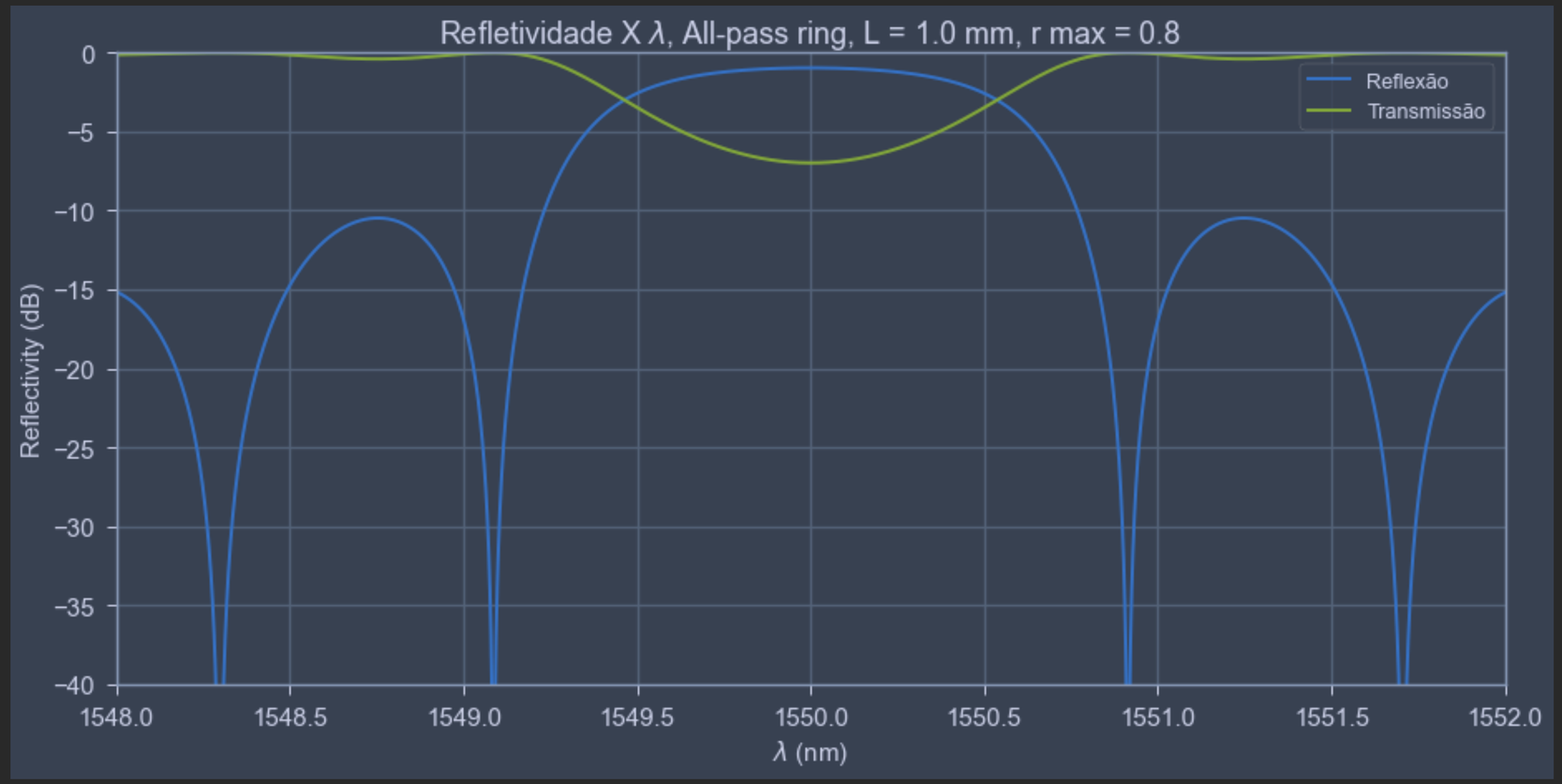
ESTUDO DE REFERENCIAS

Exemplo 1



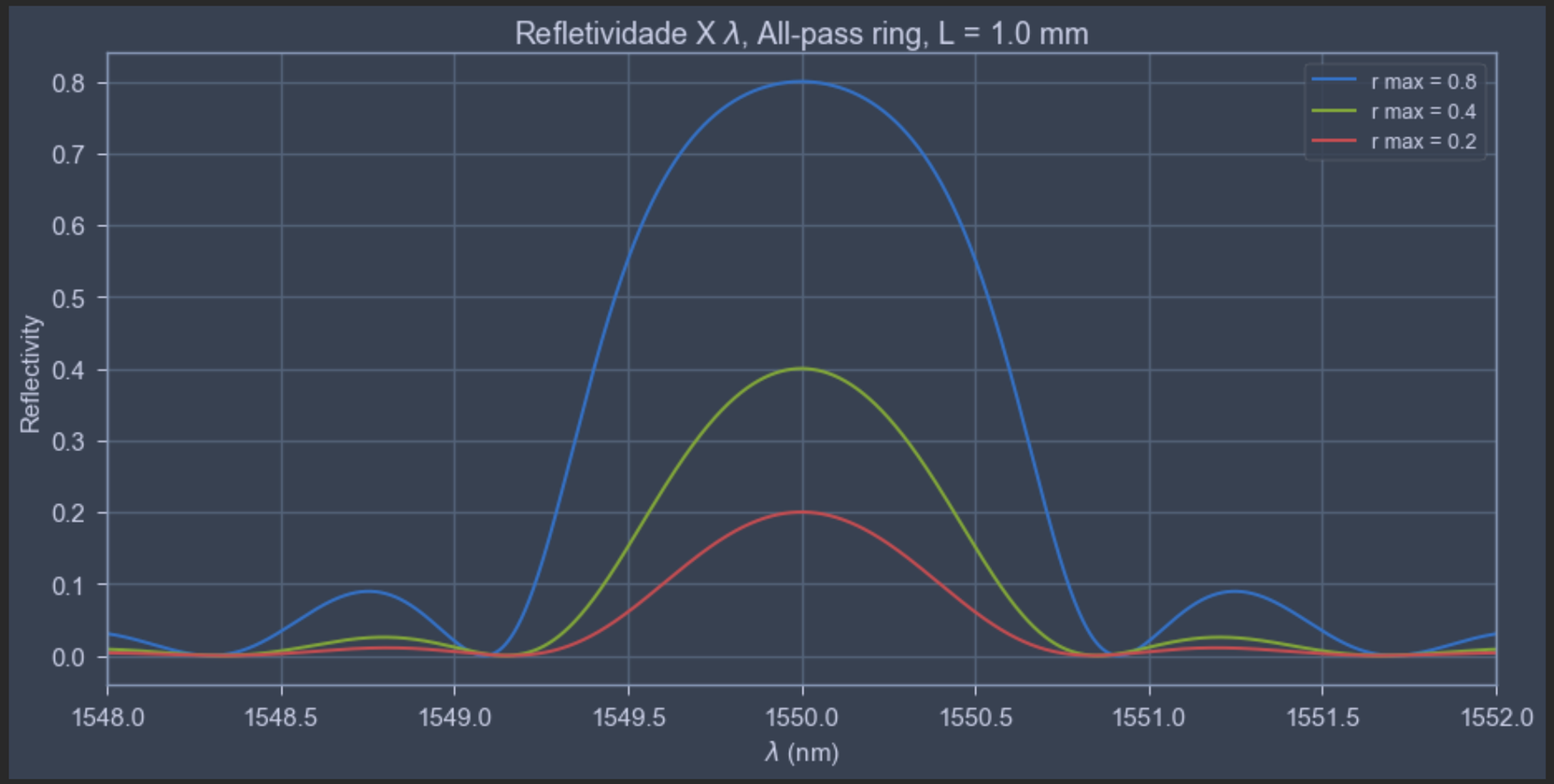
ESTUDO DE REFERENCIAS

Exemplo 1



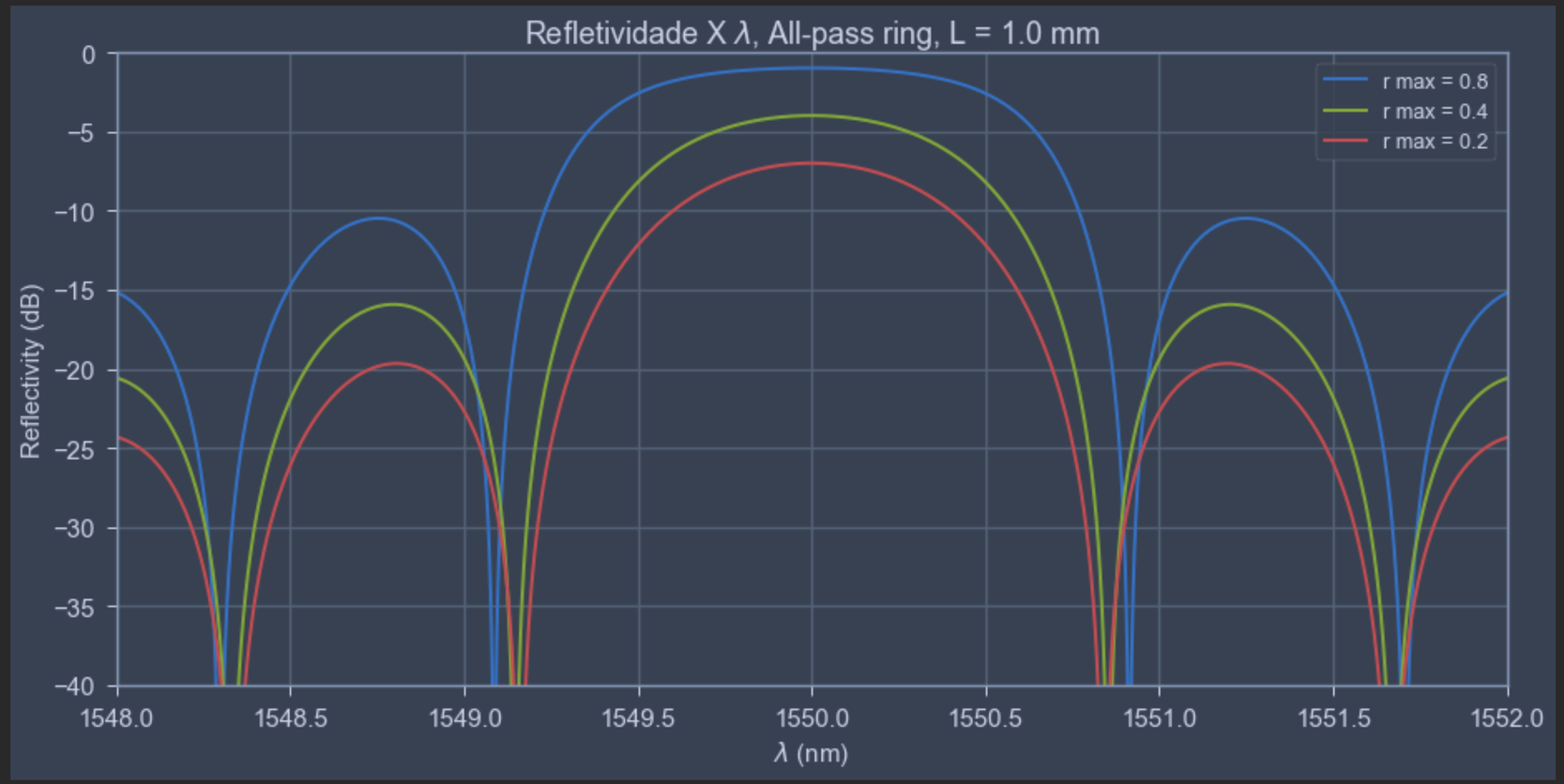
ESTUDO DE REFERENCIAS

Exemplo 1



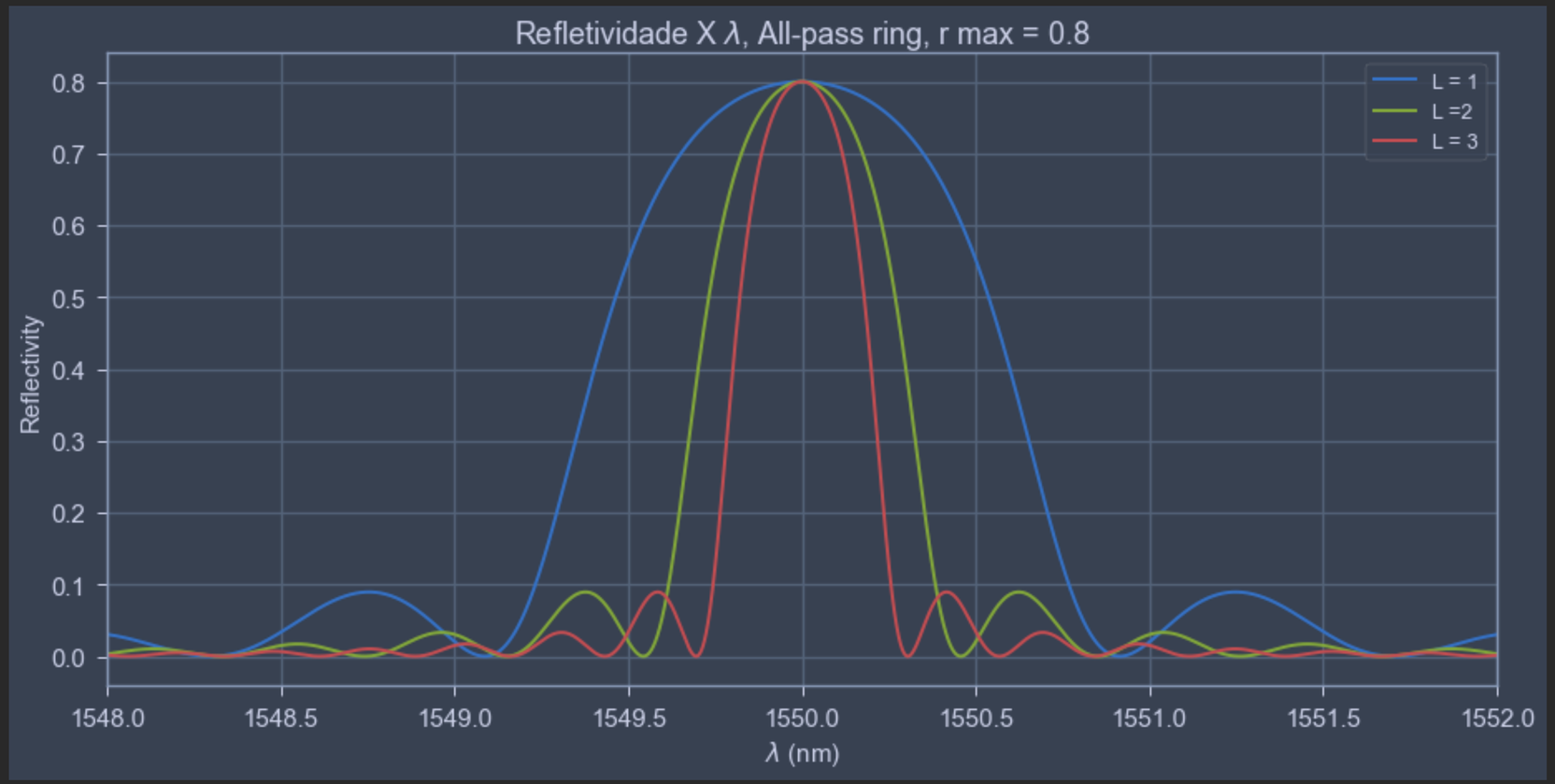
ESTUDO DE REFERENCIAS

Exemplo 1



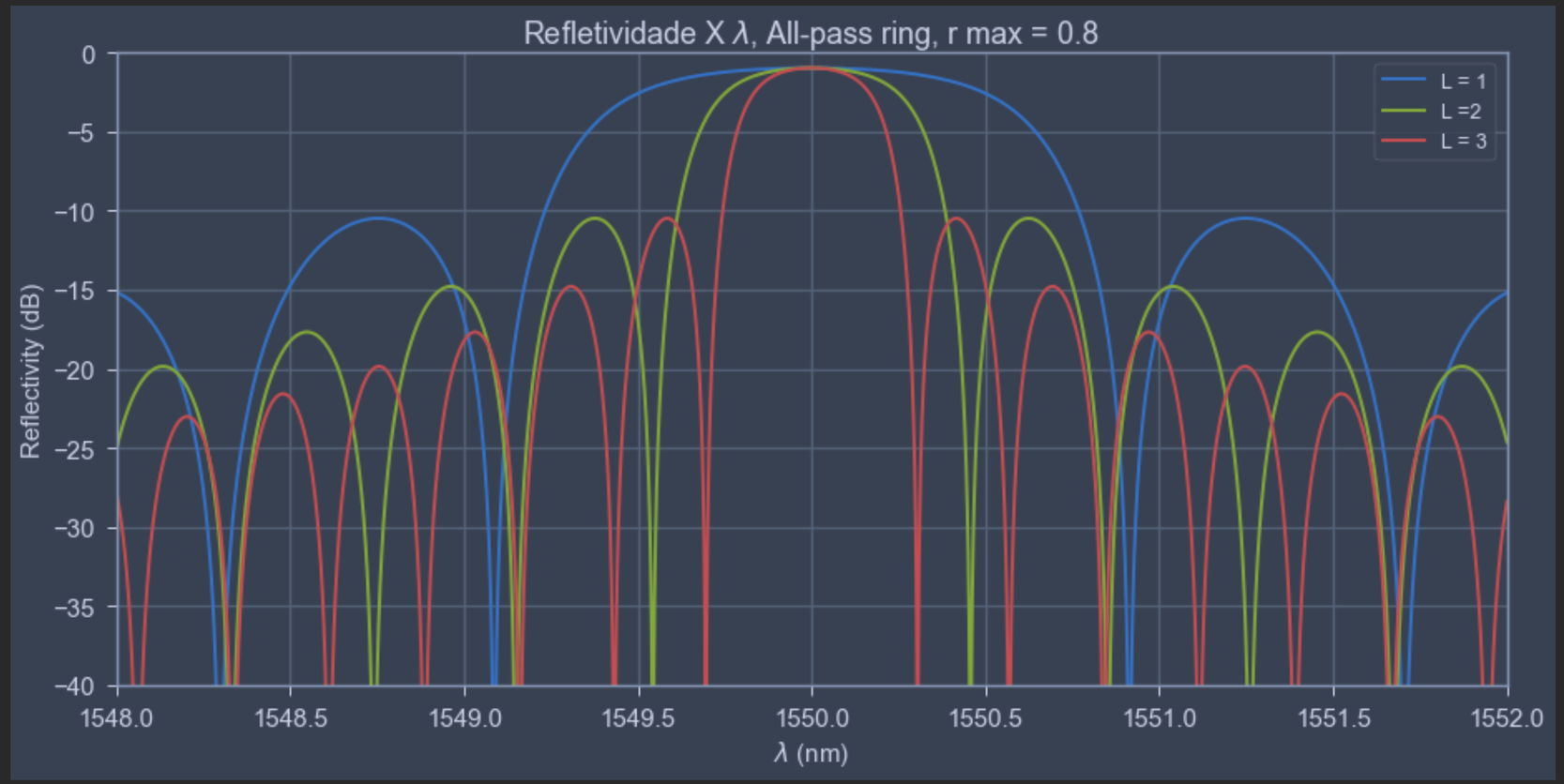
ESTUDO DE REFERENCIAS

Exemplo 1



ESTUDO DE REFERENCIAS

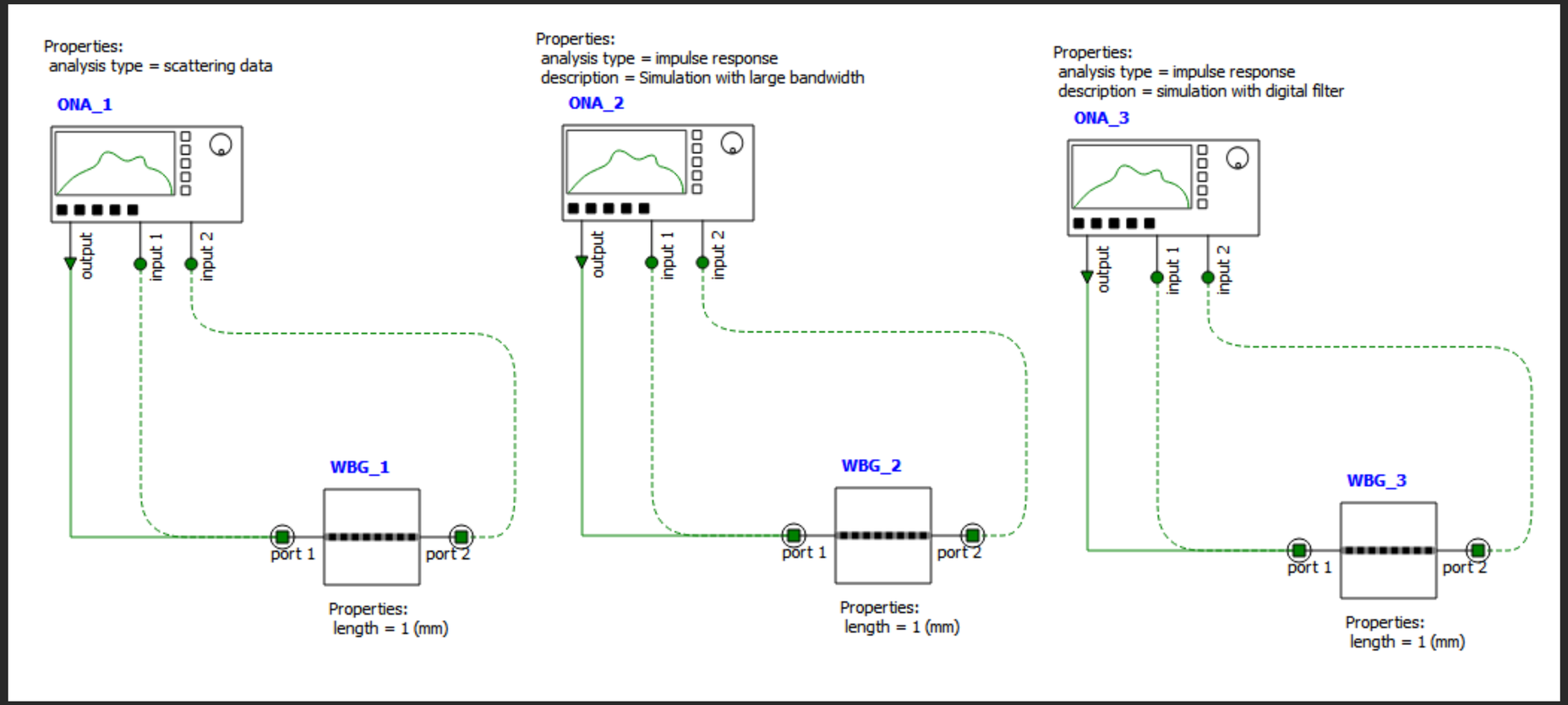
Exemplo 1



ESTUDO DE REFERENCIAS

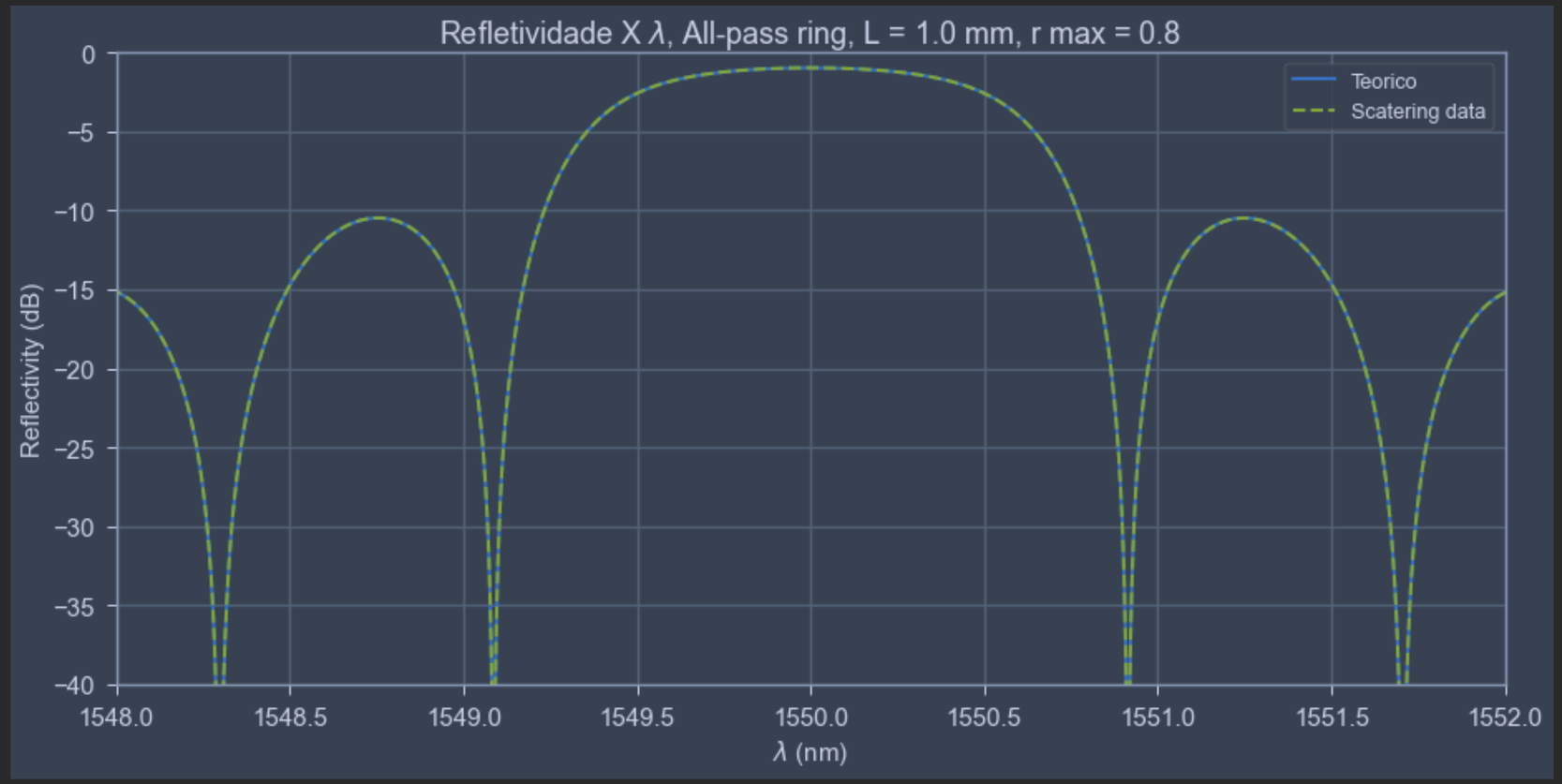
Simulação interconect

Exemplo 1



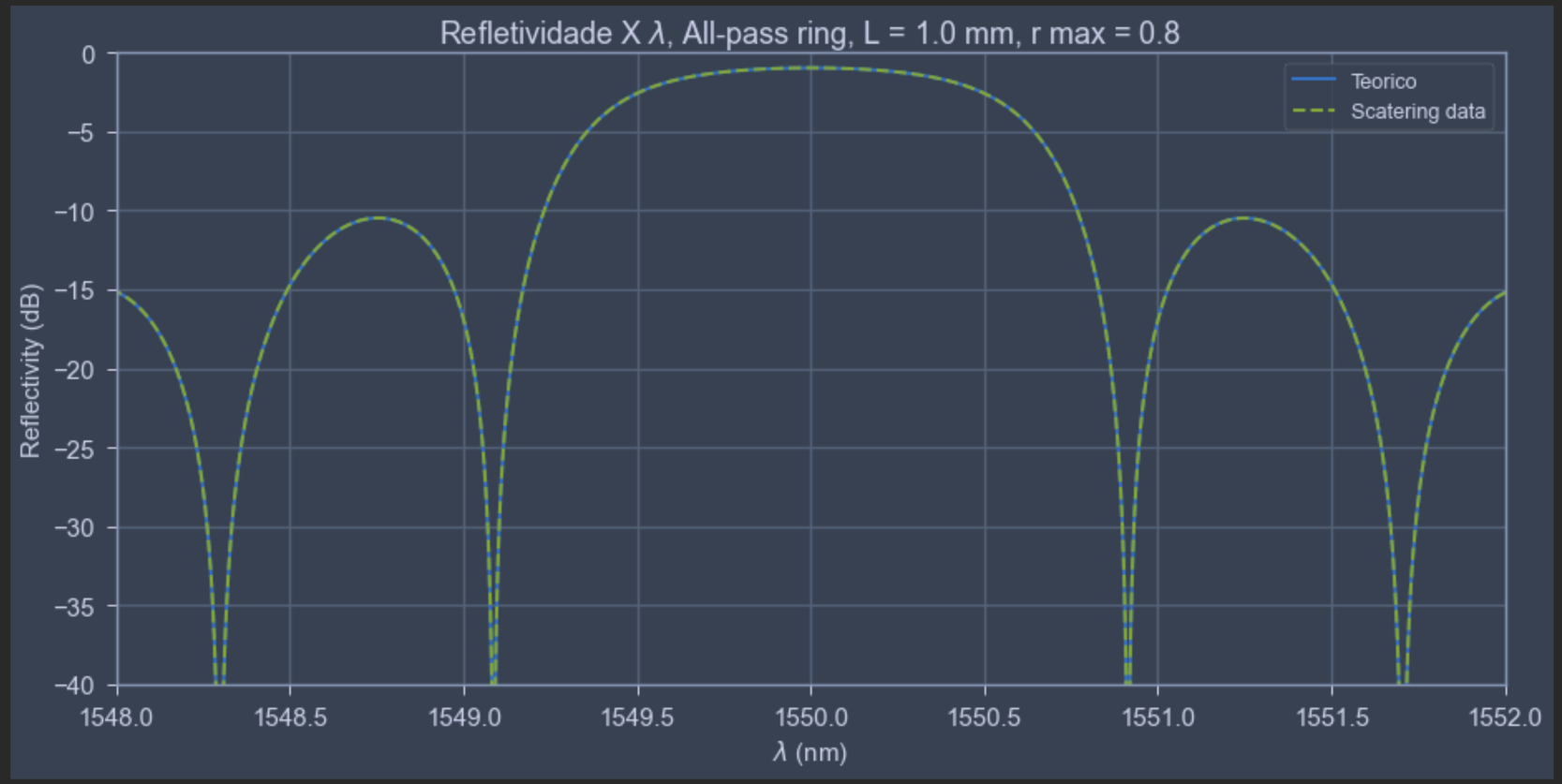
ESTUDO DE REFERENCIAS

Resultados



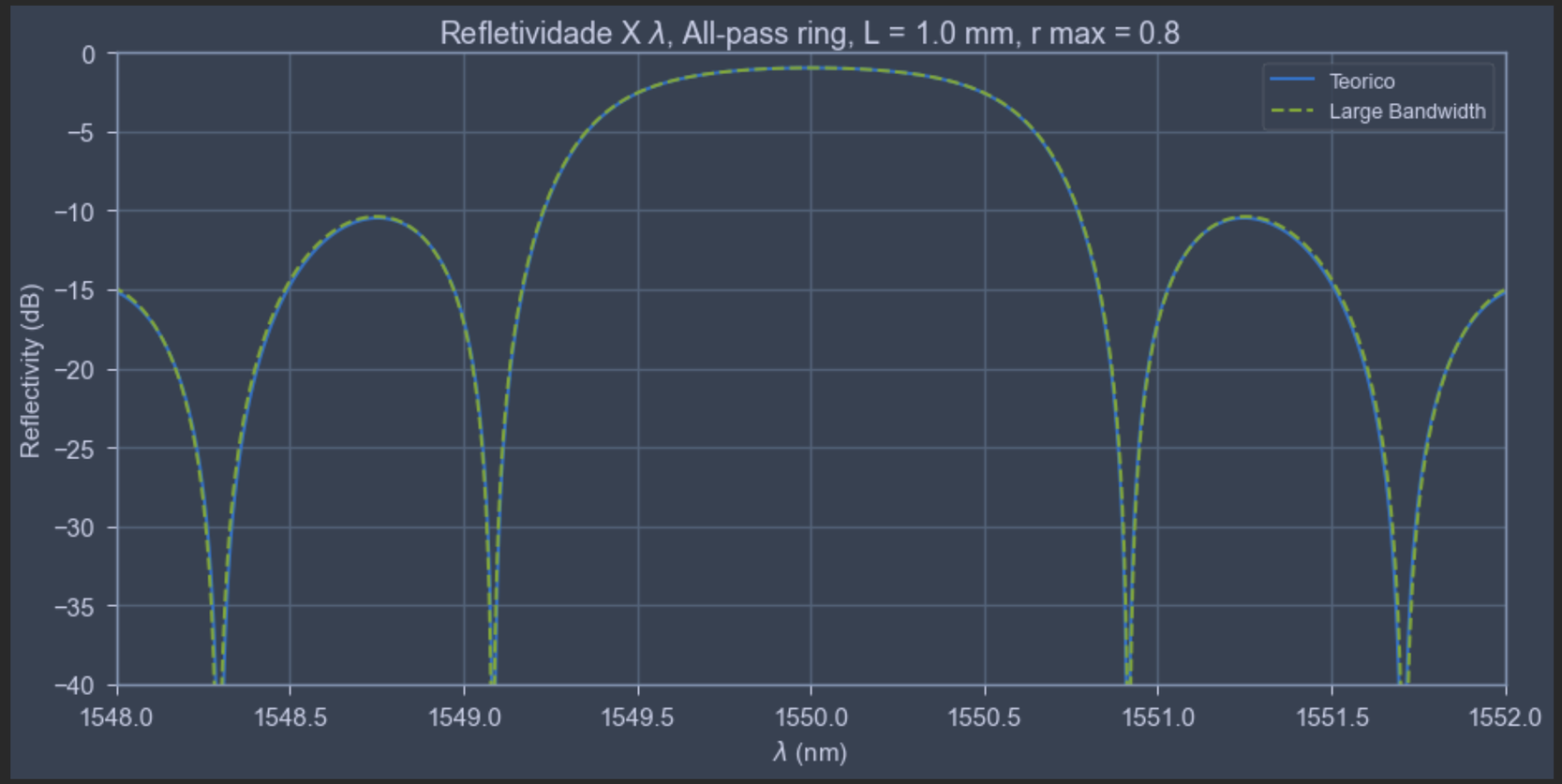
ESTUDO DE REFERENCIAS

Resultados



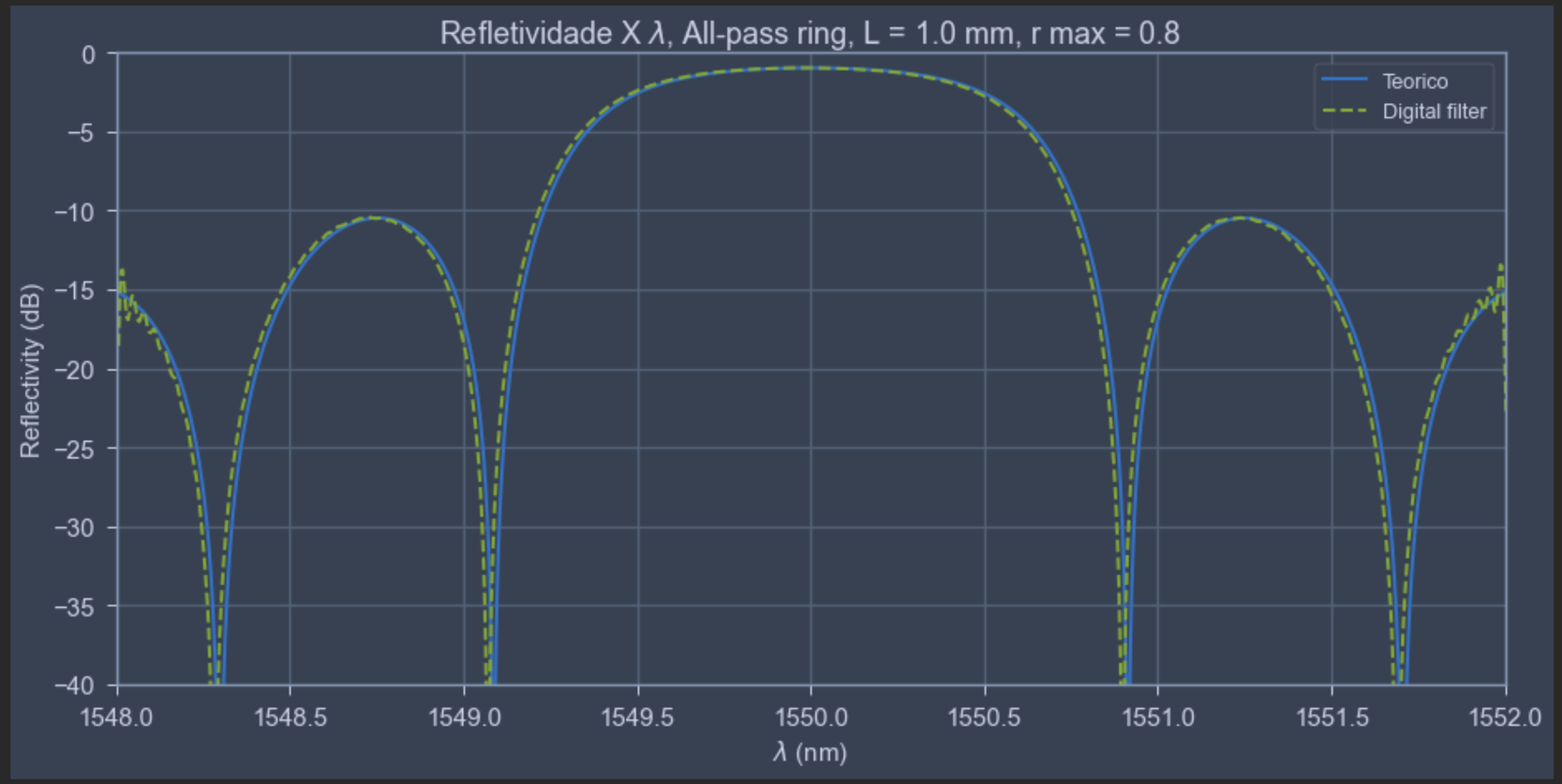
ESTUDO DE REFERENCIAS

Resultados



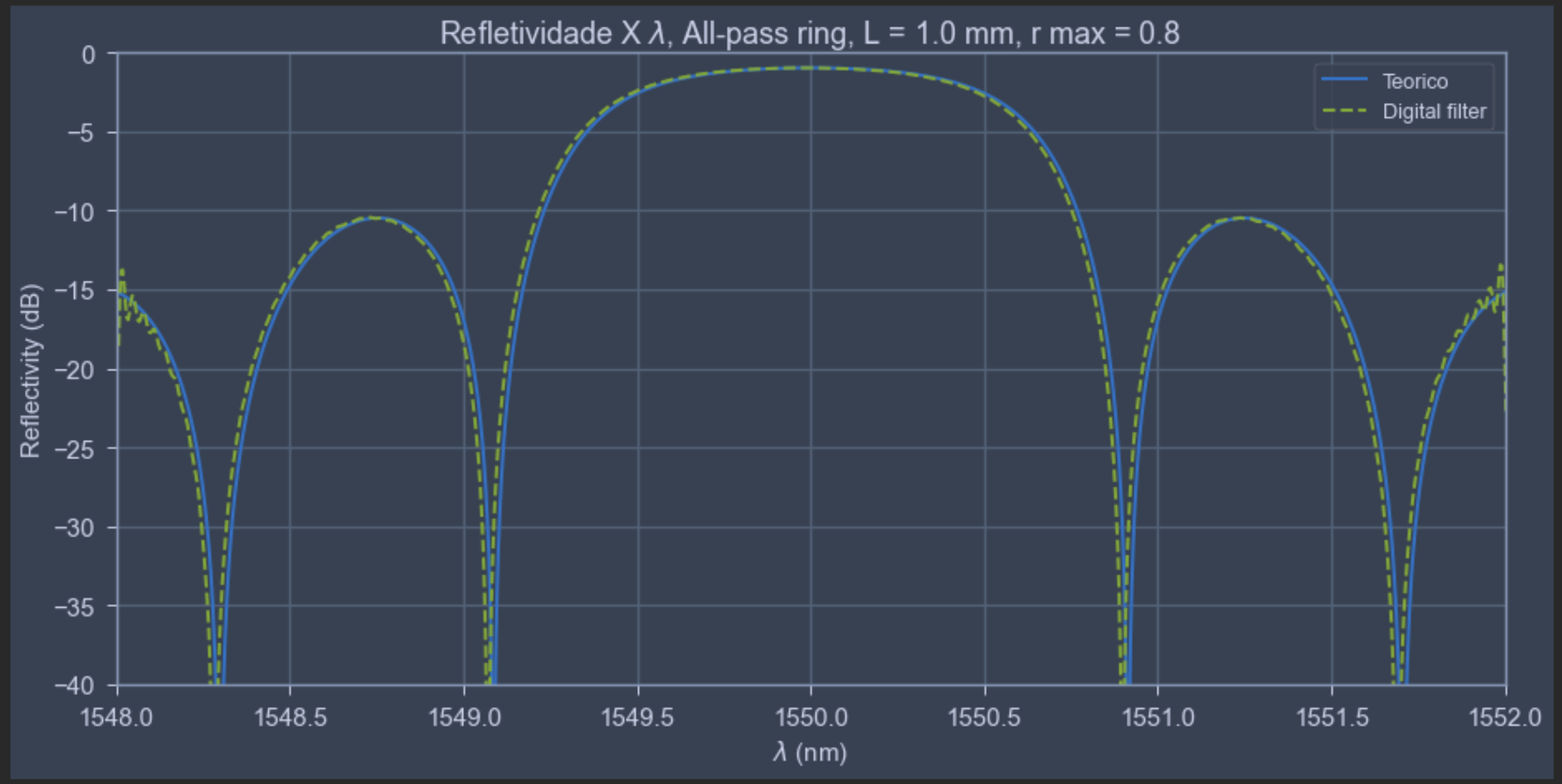
ESTUDO DE REFERENCIAS

Resultados



ESTUDO DE REFERENCIAS

Resultados



SEMANA 2

DESIGN DE FILTRO COM GRADE DE BRAGG

SEMANA 2

Design de filtro com Grade de Bragg

DESIGN

Parametros

Comprimento central = 1540 nm

Fwhm = 20 nm

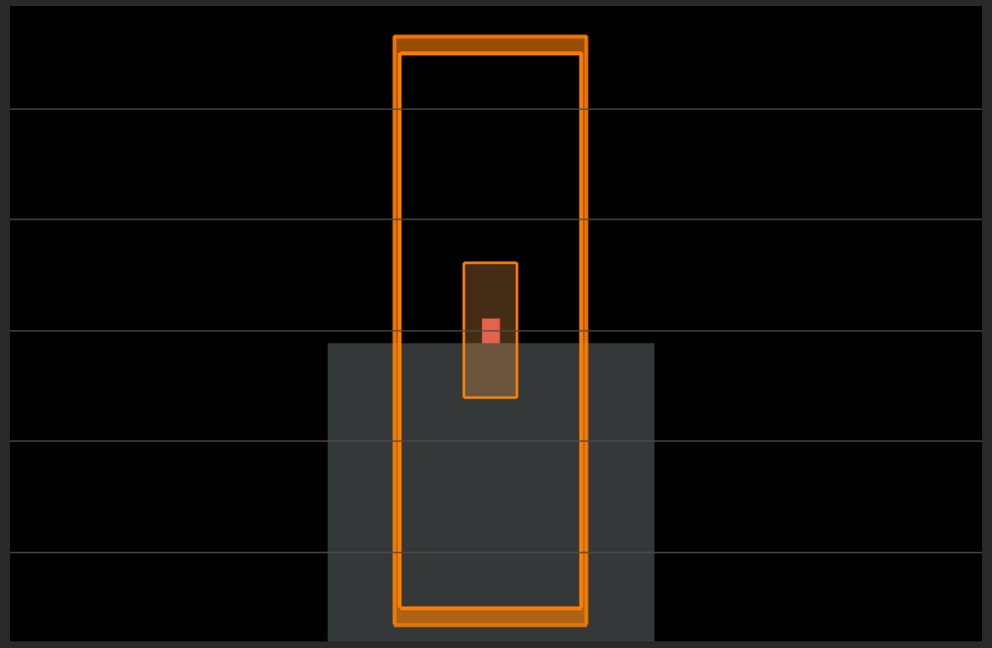
Guia: 450 x 220 nm, SOI

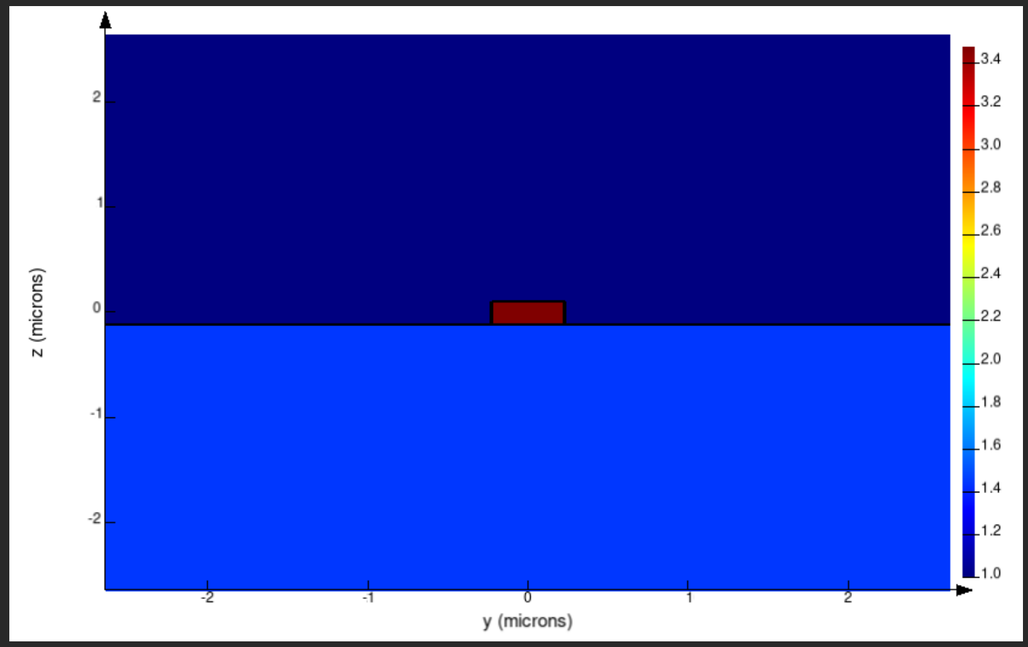
Neff = 2.2875

Ng = 4.5878

DESIGN

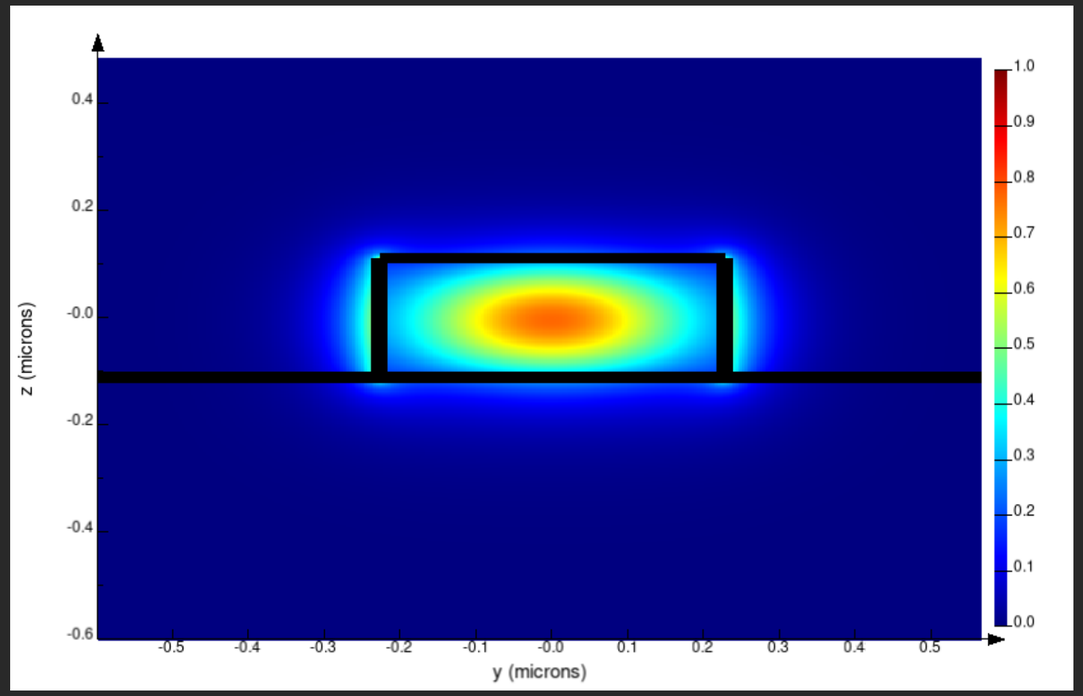
Parametros

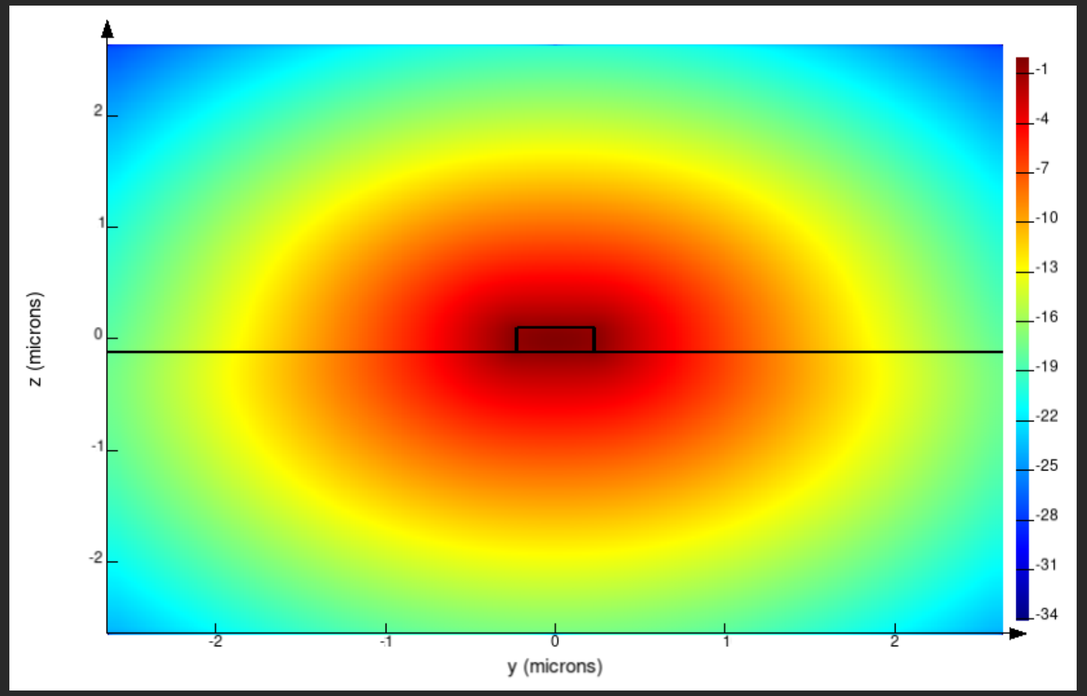




DESIGN

Simulação do guia





mode #	effective index	wavelength (μm)	loss (dB/cm)	group index	TE polarization fraction (Ey)	waveguide TE/TM fraction (%)
1	2.287553-6.070278e-18i	1.54	-2.1512e-12	4.587824-8.341346e-16i	97	68.69 / 82.03
2	1.553599-2.755374e-07i	1.54	-0.097646	3.383983+2.583202e-05i	8	73.55 / 87.94

DESIGN

Parametros:

Para neff = 2.287: Periodo da grade = 336.612 nm

Para Numero de periodos = 100: L = 33.6612 um

Para L = 336.612 um, deltaNeff = 0.09331

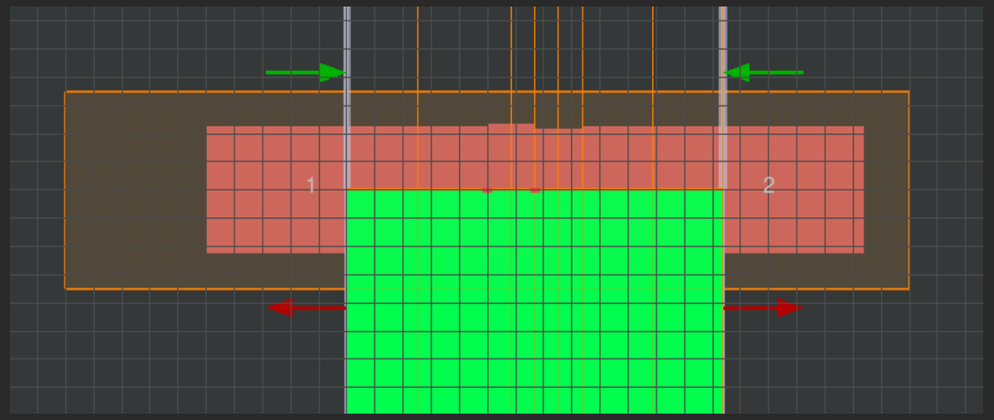
DESIGN

Calculo do Delta W

DESIGN

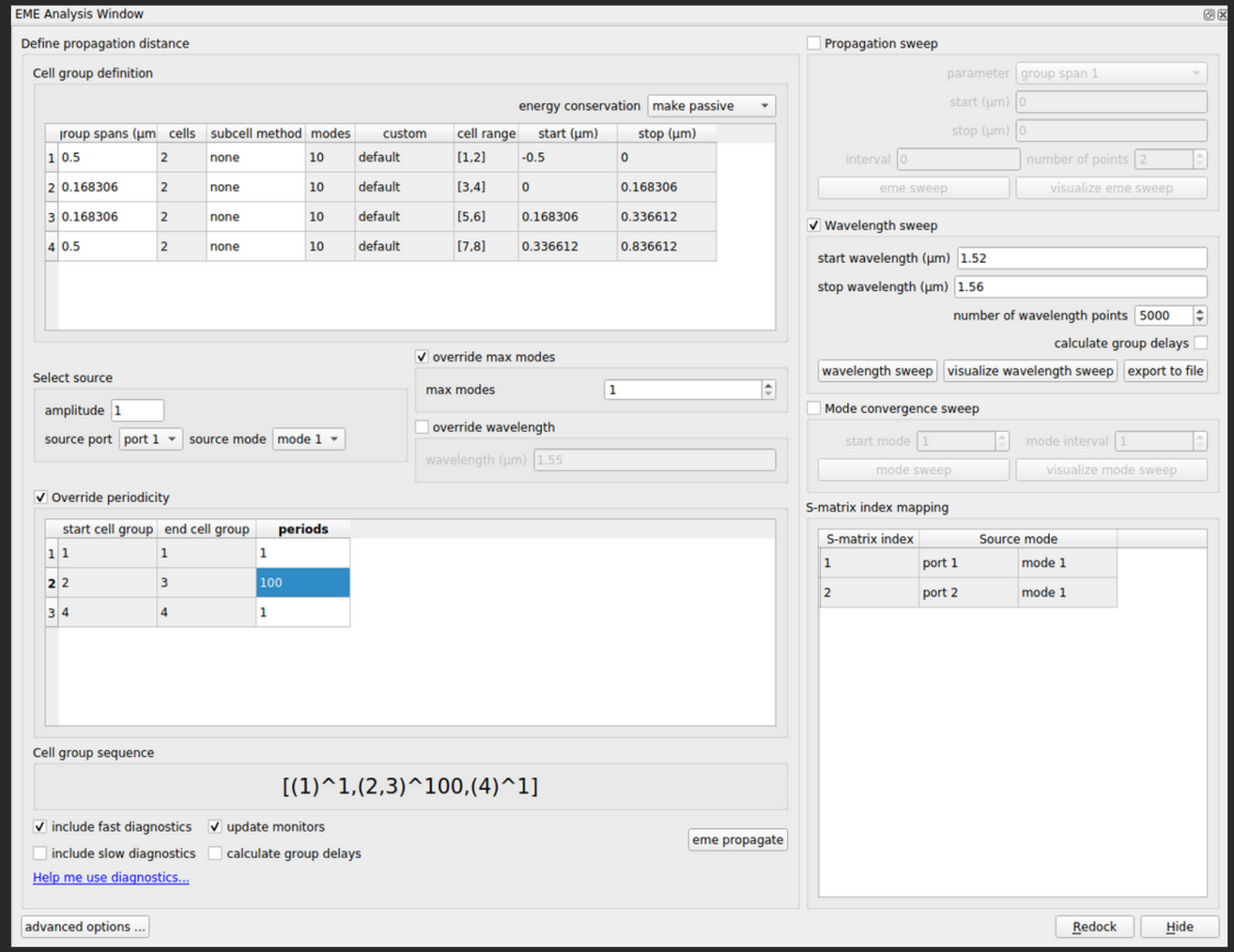
Simulação no EME

#	Name	Type	Value	Unit
1	W	Length	0.45	um
2	altura	Length	0.22	um
3	deltaW	Length	0.0354	um
4	periodo	Length	0.336612	um
5	material	Material	Si (Silicon) - ...	
6	substrato	Material	SiO2 (Glass) -...	



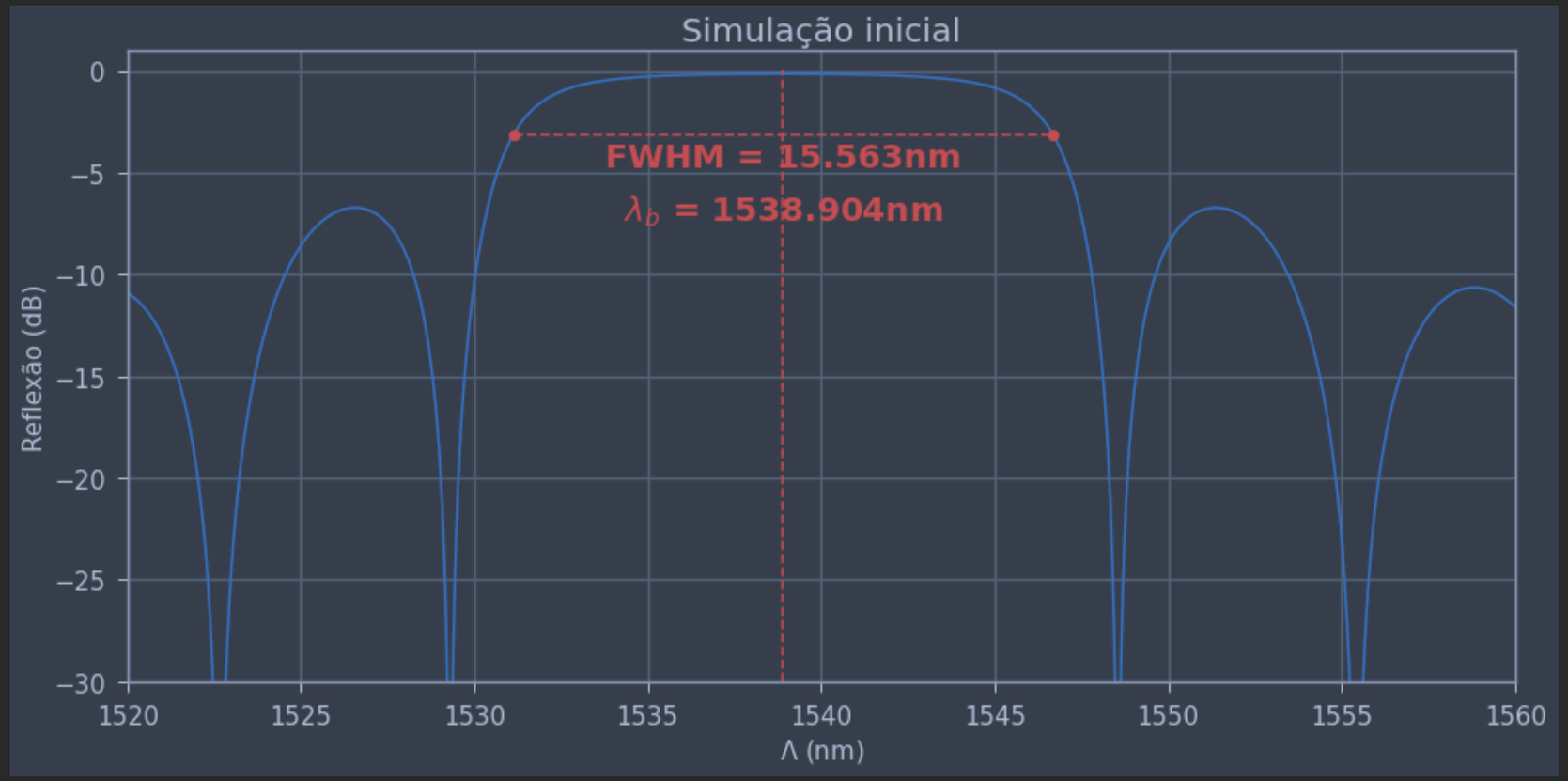
DESIGN

Simulação no EME



DESIGN

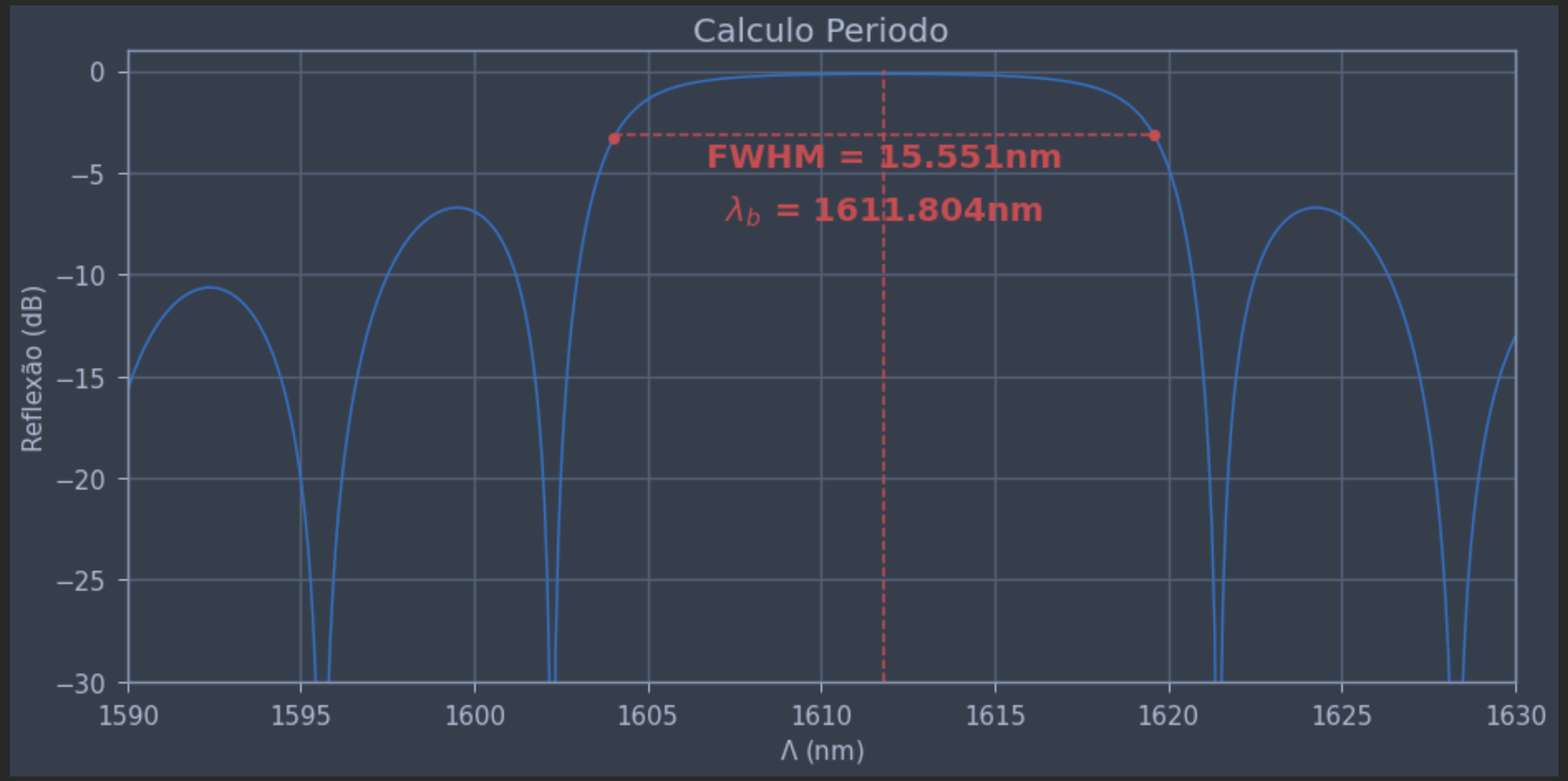
Resultados Iniciais



DESIGN

Calculando novo periodo ideal

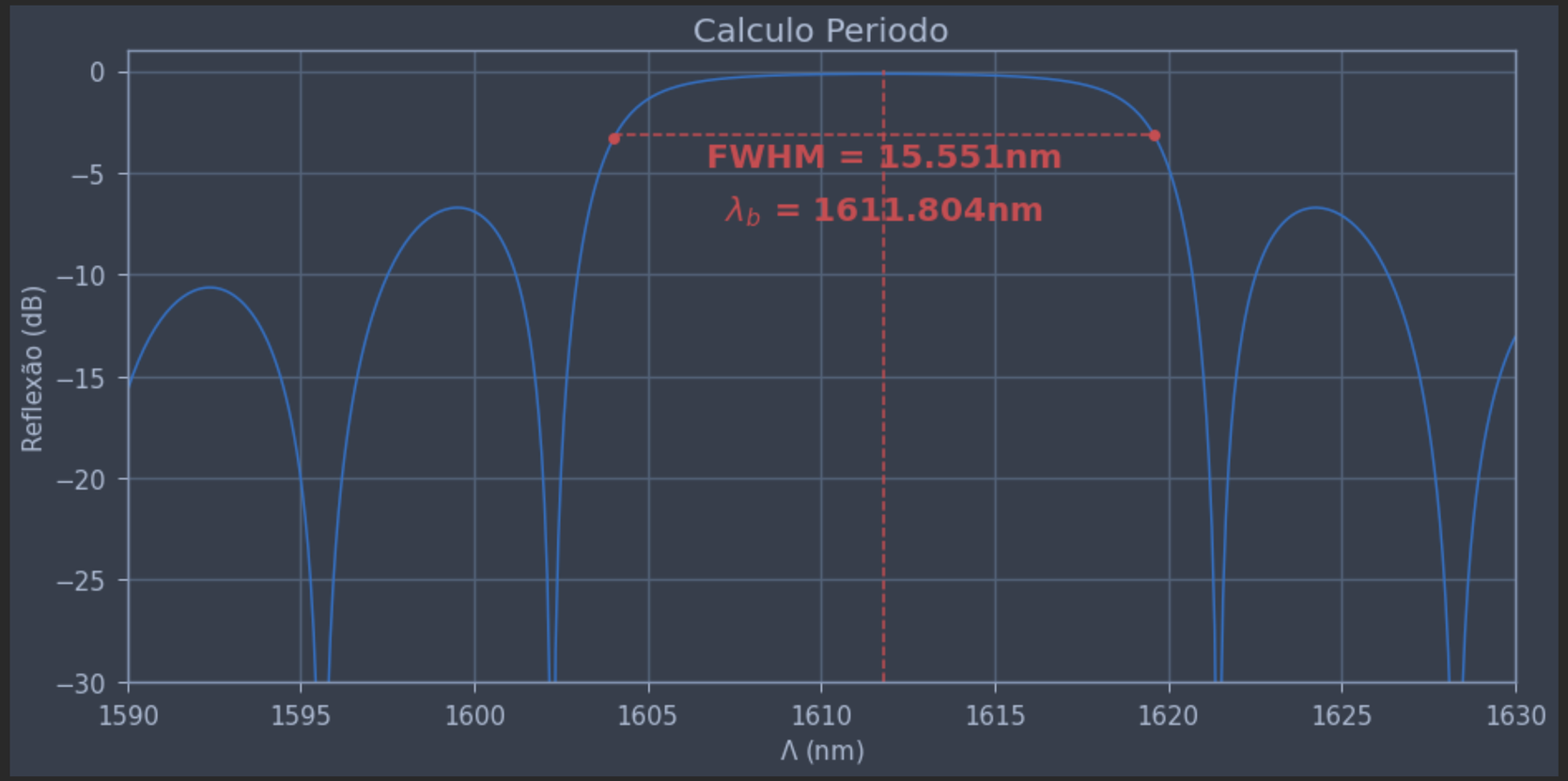
P = 0.3534426 nm (x1.05)



DESIGN

Calculando novo periodo ideal

P = 0.3702732 nm (x1.1)



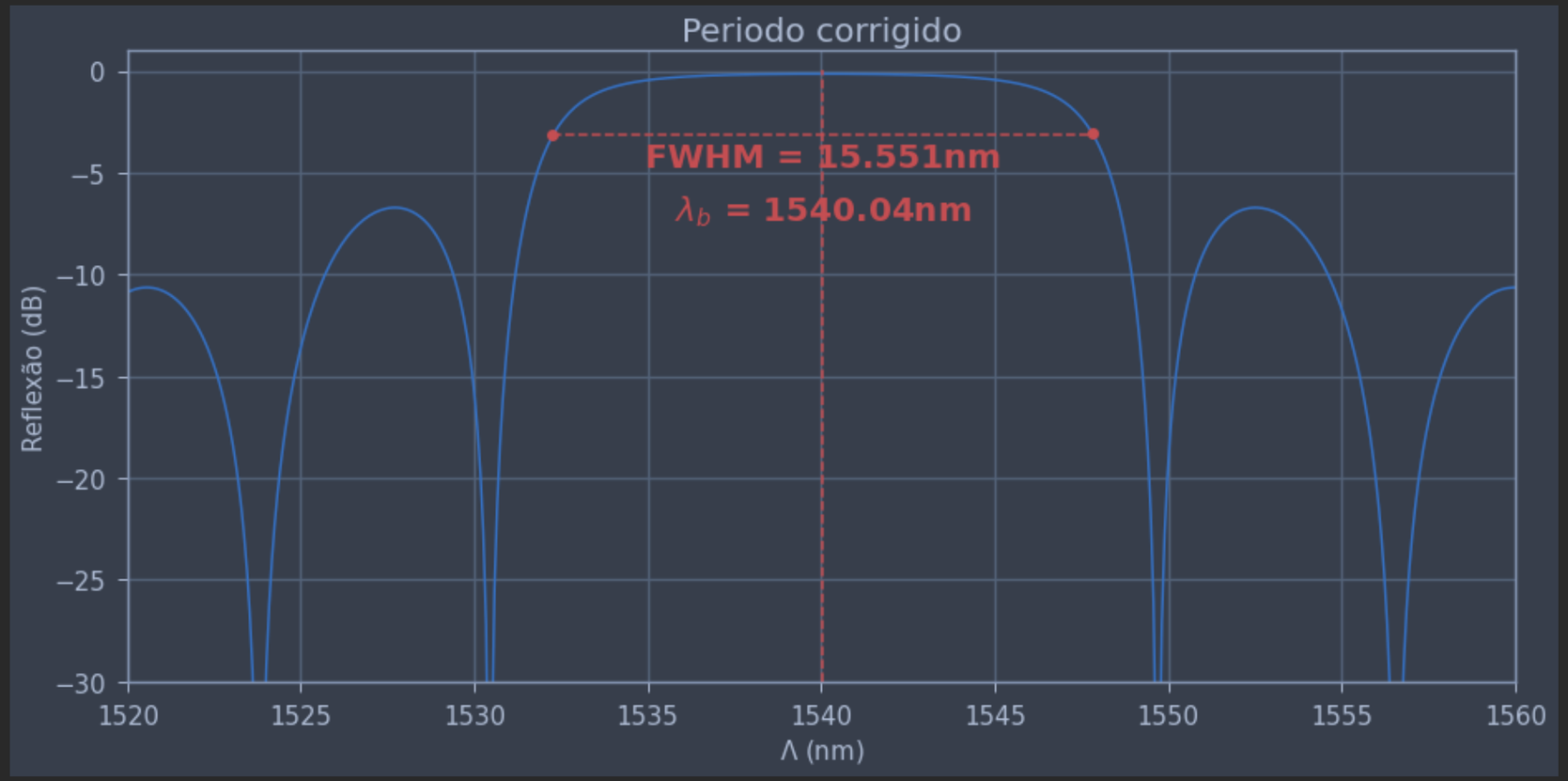
DESIGN

Calculando novo periodo ideal

DESIGN

Novo periodo teorico

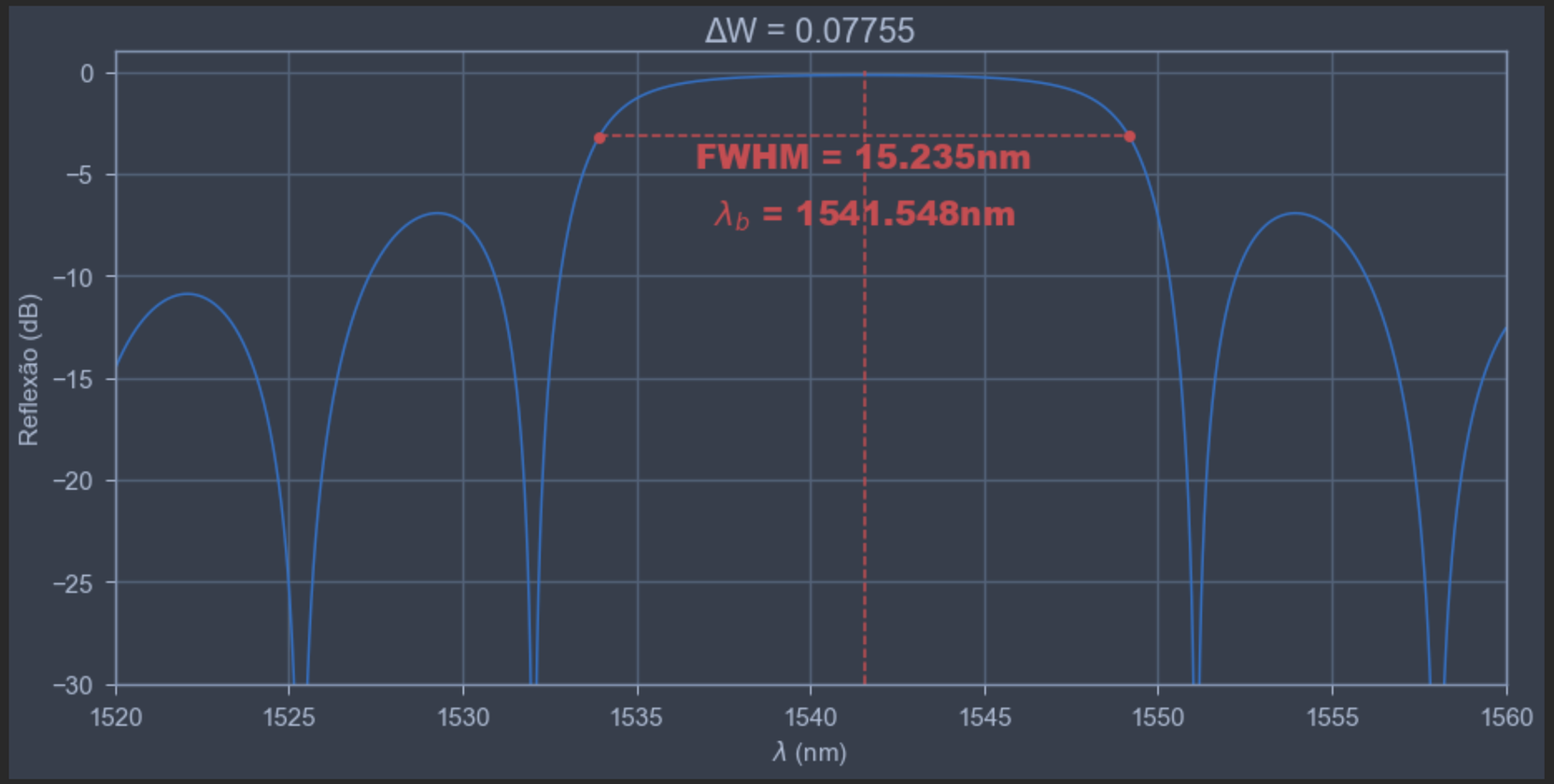
P = 0.337118 um (E = 0.15%)



DESIGN

Corrigindo o FWHM, calculo de ΔW

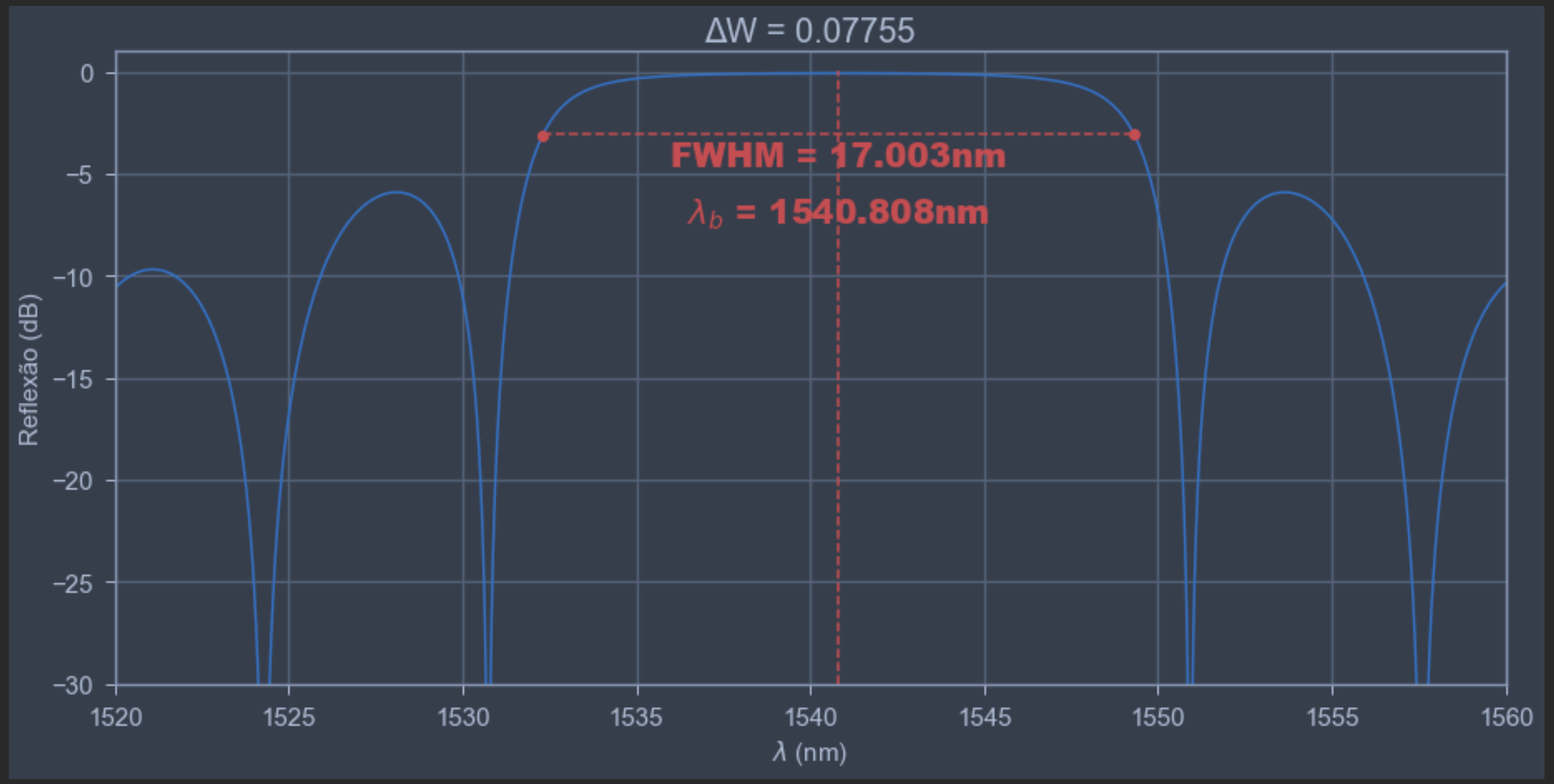
ΔW = 0.03894 (x1.1)



DESIGN

Corrigindo o FWHM, calculo de ΔW

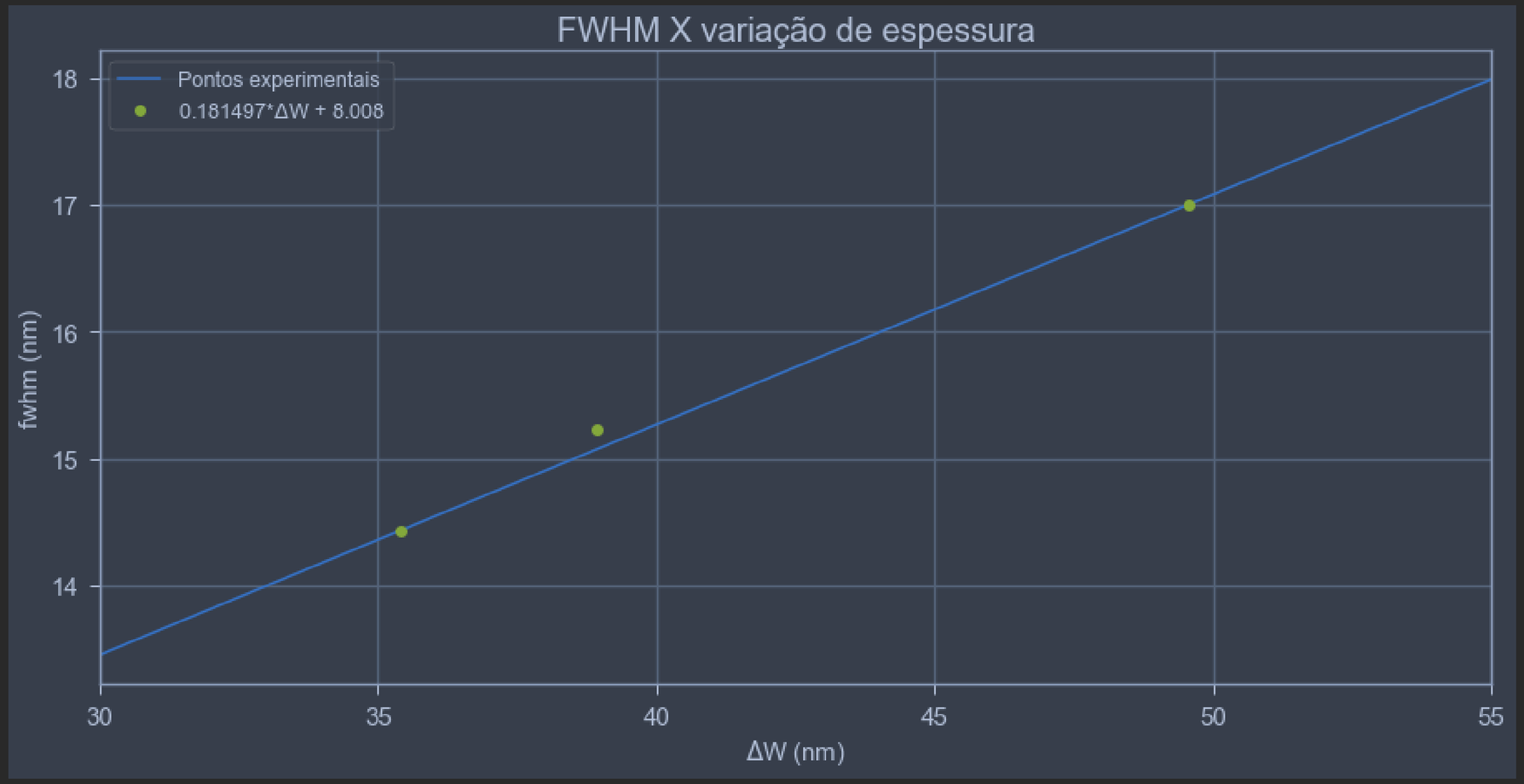
ΔW = 0.04956 (x1.5)



DESIGN

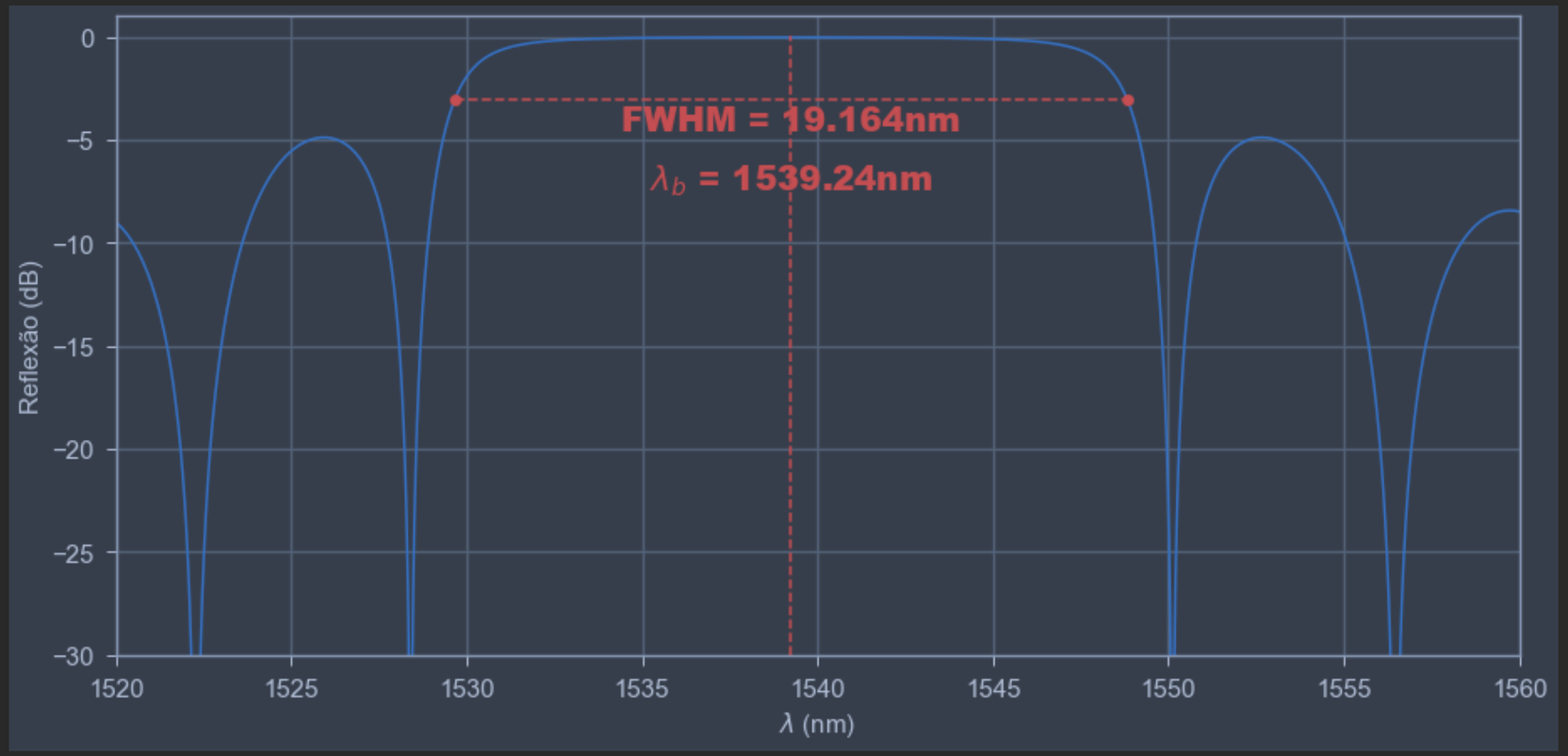
Corrigindo o FWHM, calculo de ΔW

ΔW teorico = 0.0660727 um (E = 87.6%)



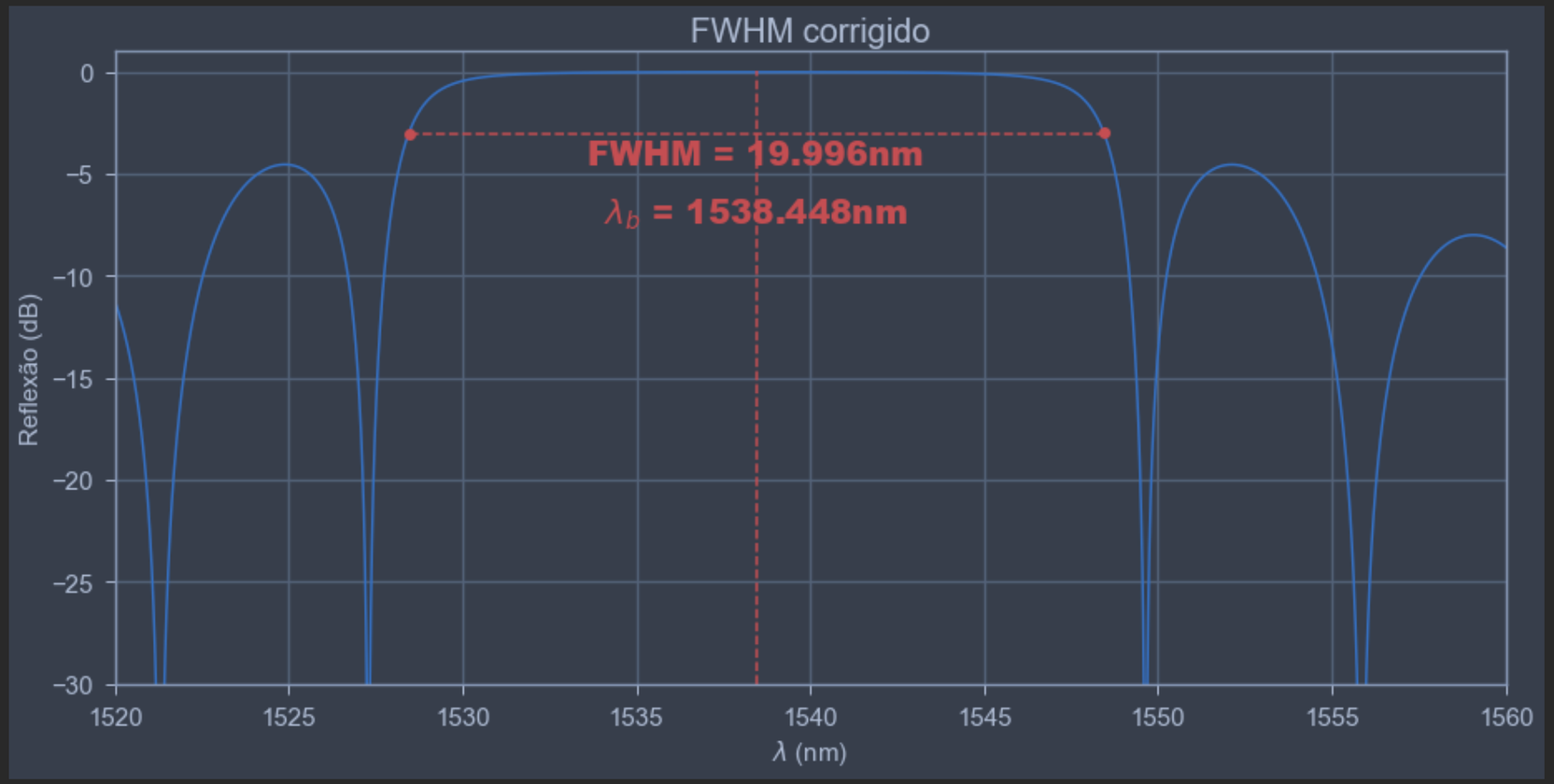
DESIGN

Correção do FWHMW



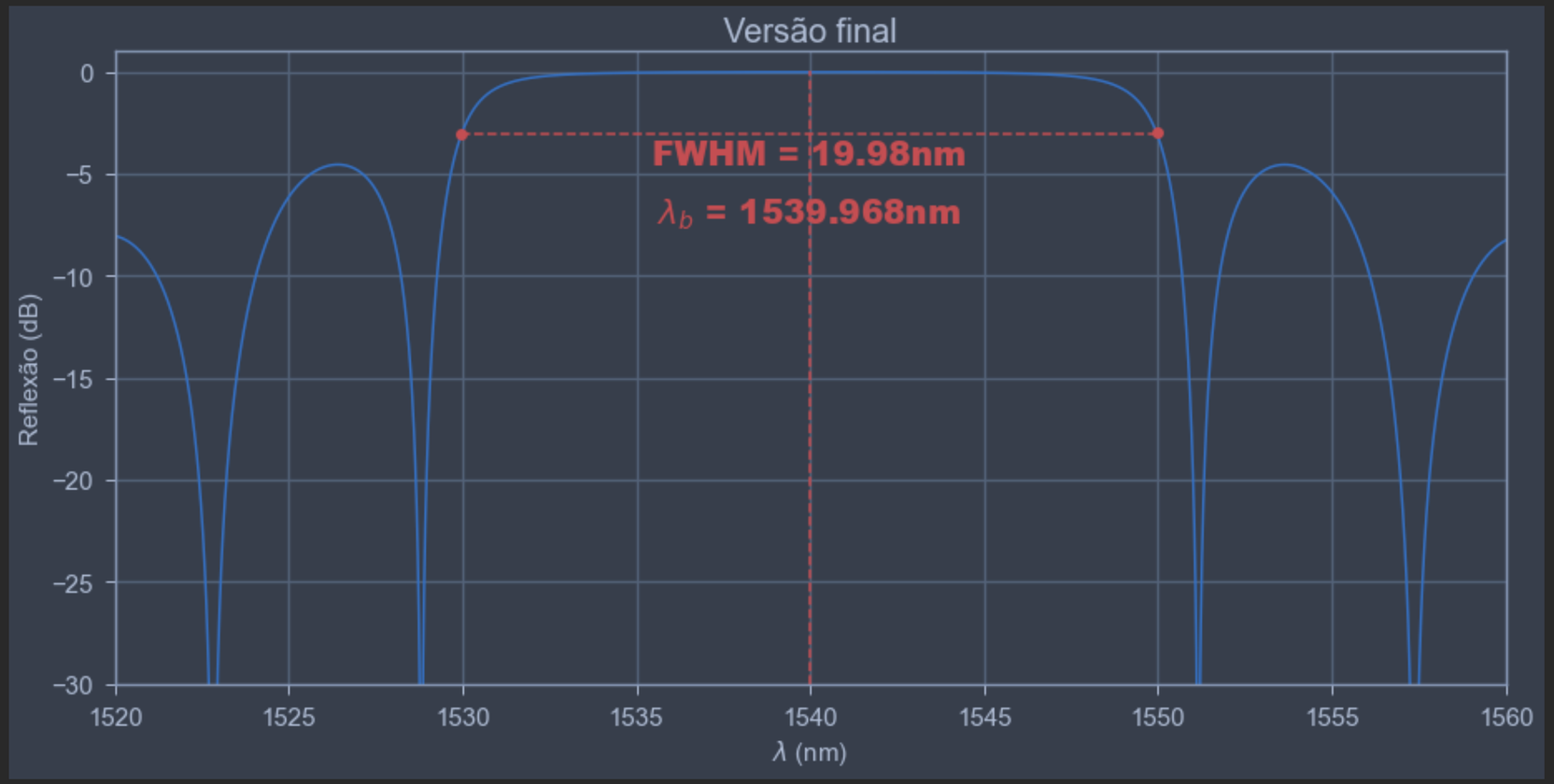
DESIGN

Correção do FWHMW



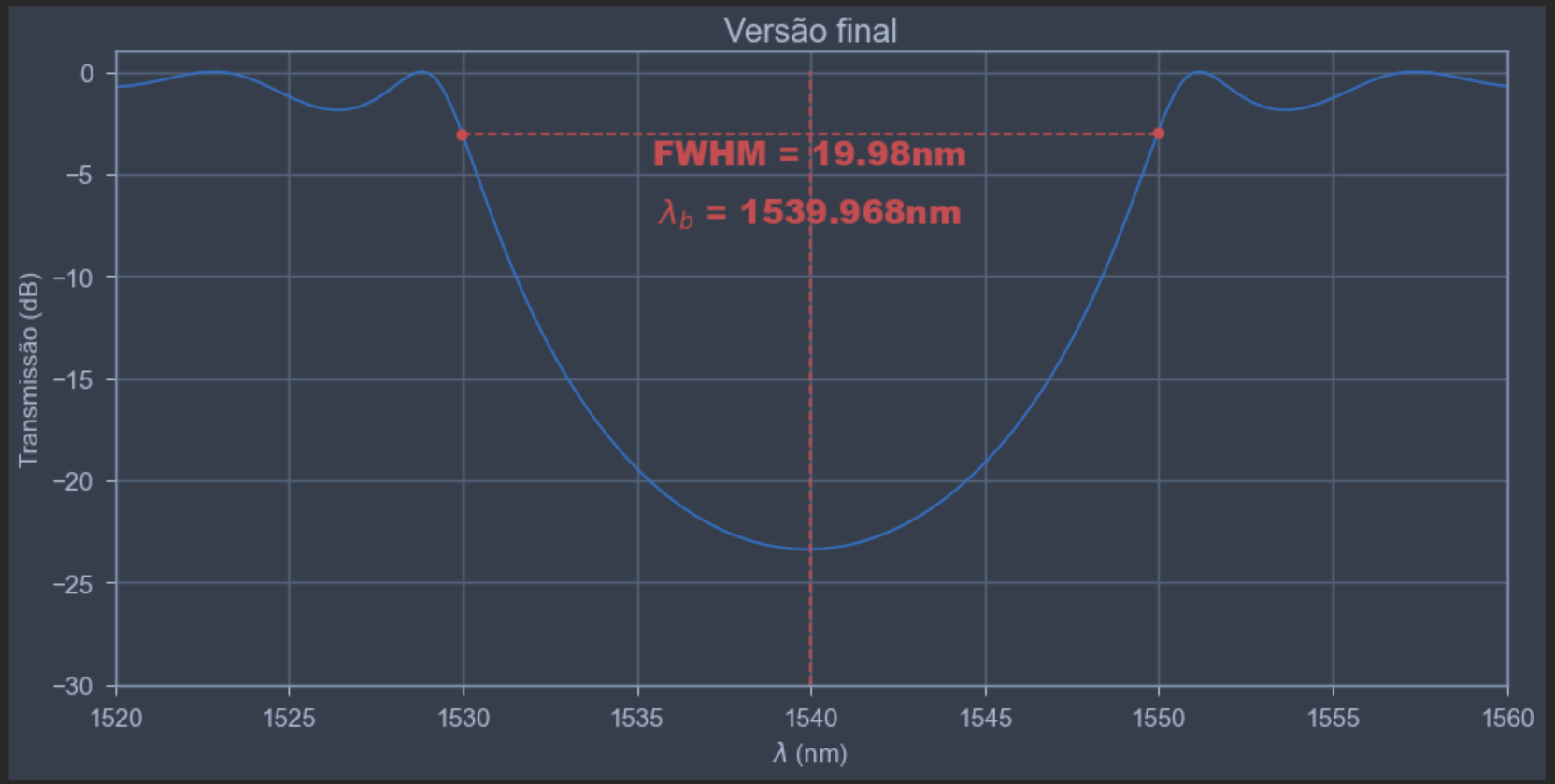
DESIGN

2º correção do periodo



DESIGN

2º correção do periodo



DESIGN

Design Final

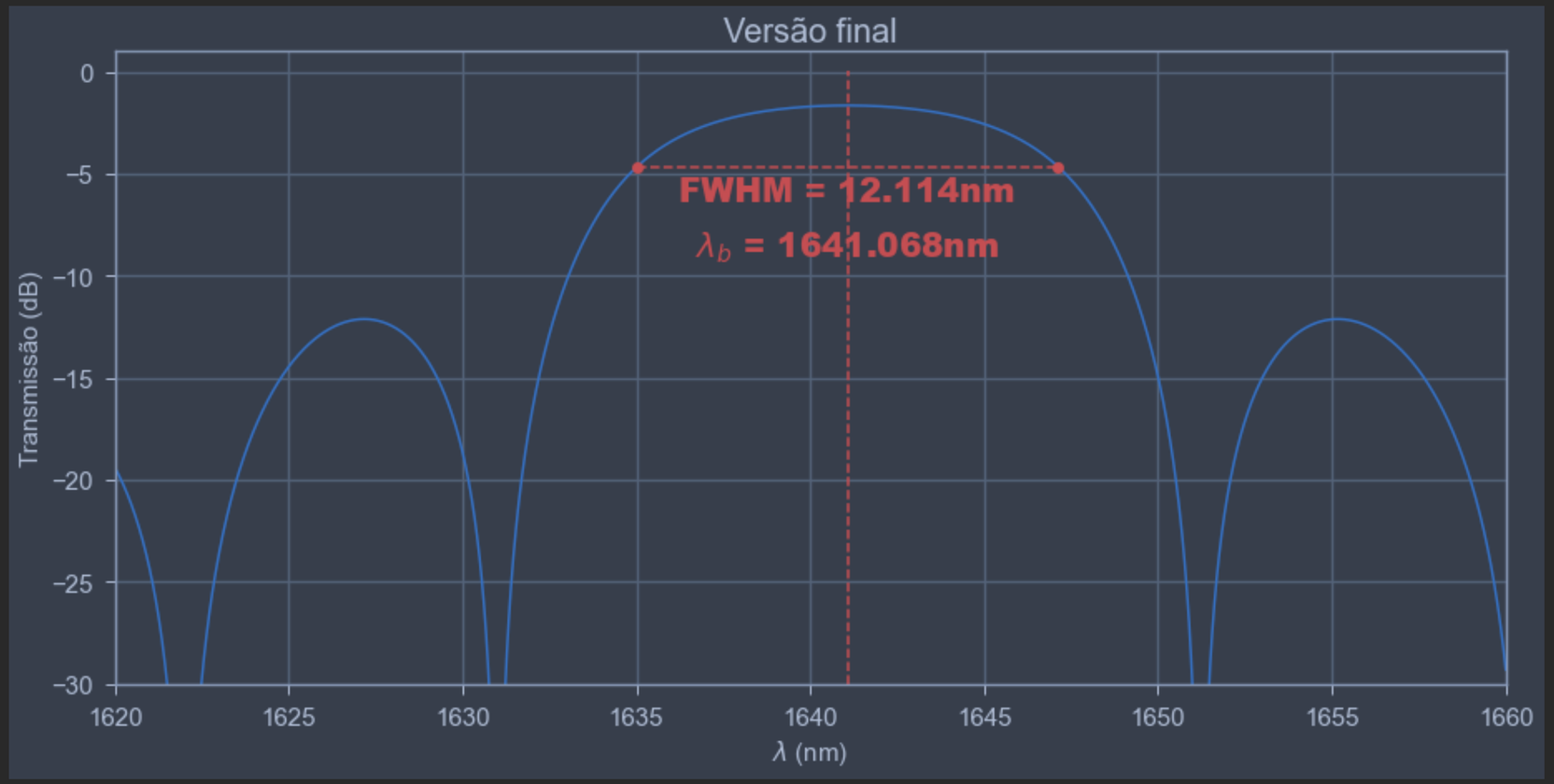
1	W	Length	0,45	um
2	altura	Length	0,22	um
3	deltaW	Length	0,0734068	um
4	periodo	Length	0,338535	um
5	N	Number	100	
6	material	Material	Si (Silicon) - Palik	
7	substrato	Material	SiO2 (Glass) - P...	

DESIGN

ALTERANDO O GUIA PARA 600 NM

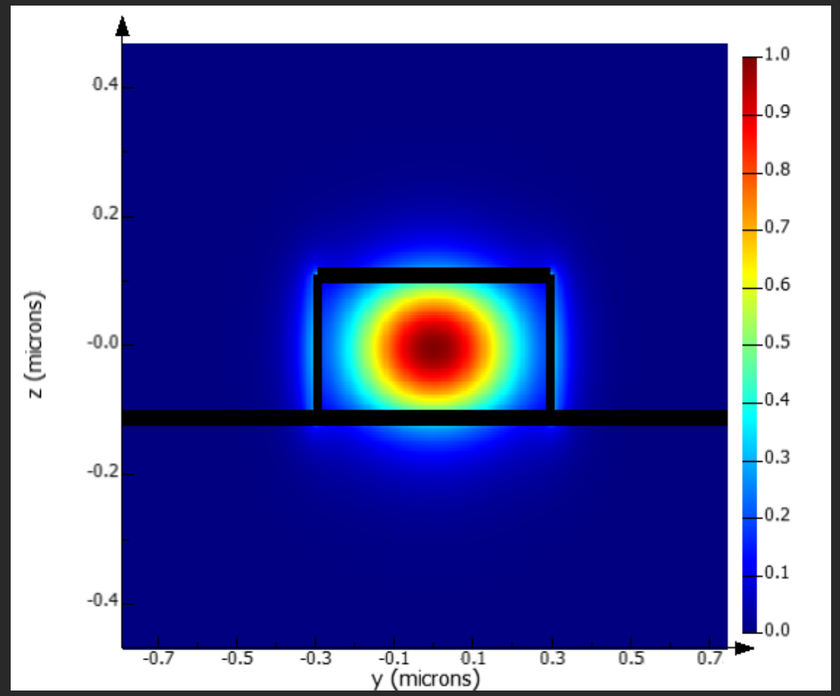
DESIGN

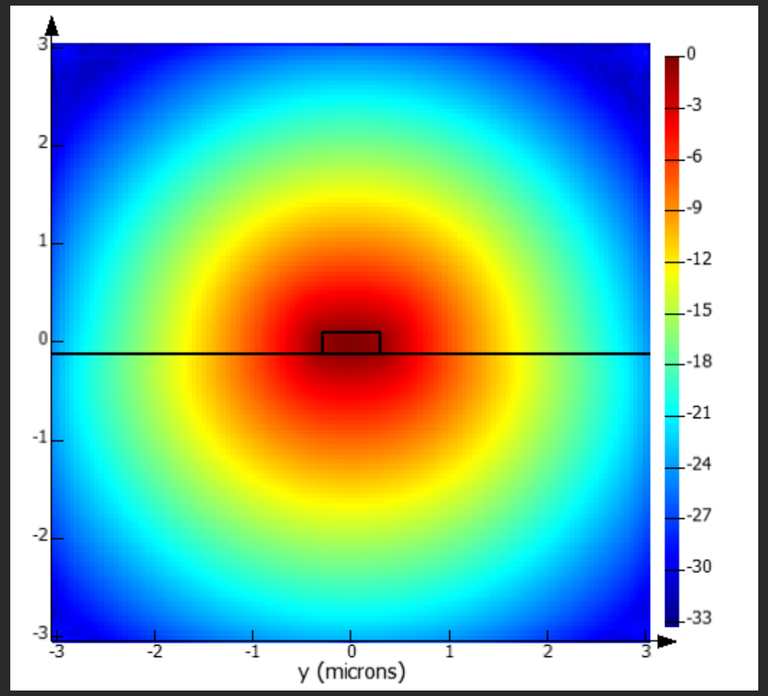
Alterando o guia para 600 nm



DESIGN

Simulação do guia





mode #	effective index	wavelength (μm)	loss (dB/cm)	group index	TE polarization fraction (Ey)	waveguide TE/TM fraction (%)
1	2.537329+8.301567e-17i	1.54	2.9419e-11	4.198189+3.531844e-17i	99	80.25 / 81.12
2	1.667813+5.340745e-11i	1.54	1.8927e-05	3.920935-4.571173e-09i	12	67.94 / 90.11

DESIGN

Parametros:

Para neff = 2.5373

Periodo da grade = 303.468 nm

Para Numero de periodos = 250: L = 75.867 um

Para L = 36.416 um, deltaNeff = 0.05405

Rmax = 0.988

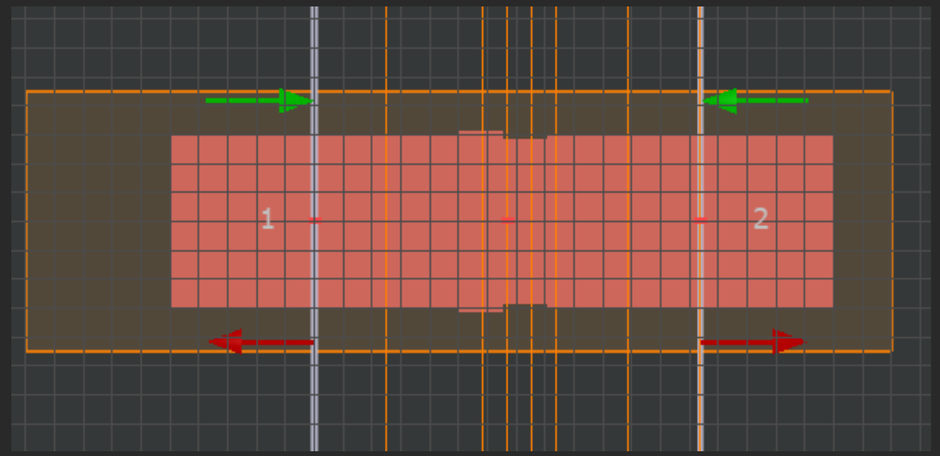
DESIGN

Calculo do Delta W

DESIGN

Simulação no EME

1	W	Length	0,6	um
2	altura	Length	0,22	um
3	deltaW	Length	0,0517	um
4	periodo	Length	0,303469	um
5	material	Material	Si (Silicon) - Palik	
6	substrato	Material	SiO2 (Glass) - P...	
7	N	Number	120	



DESIGN

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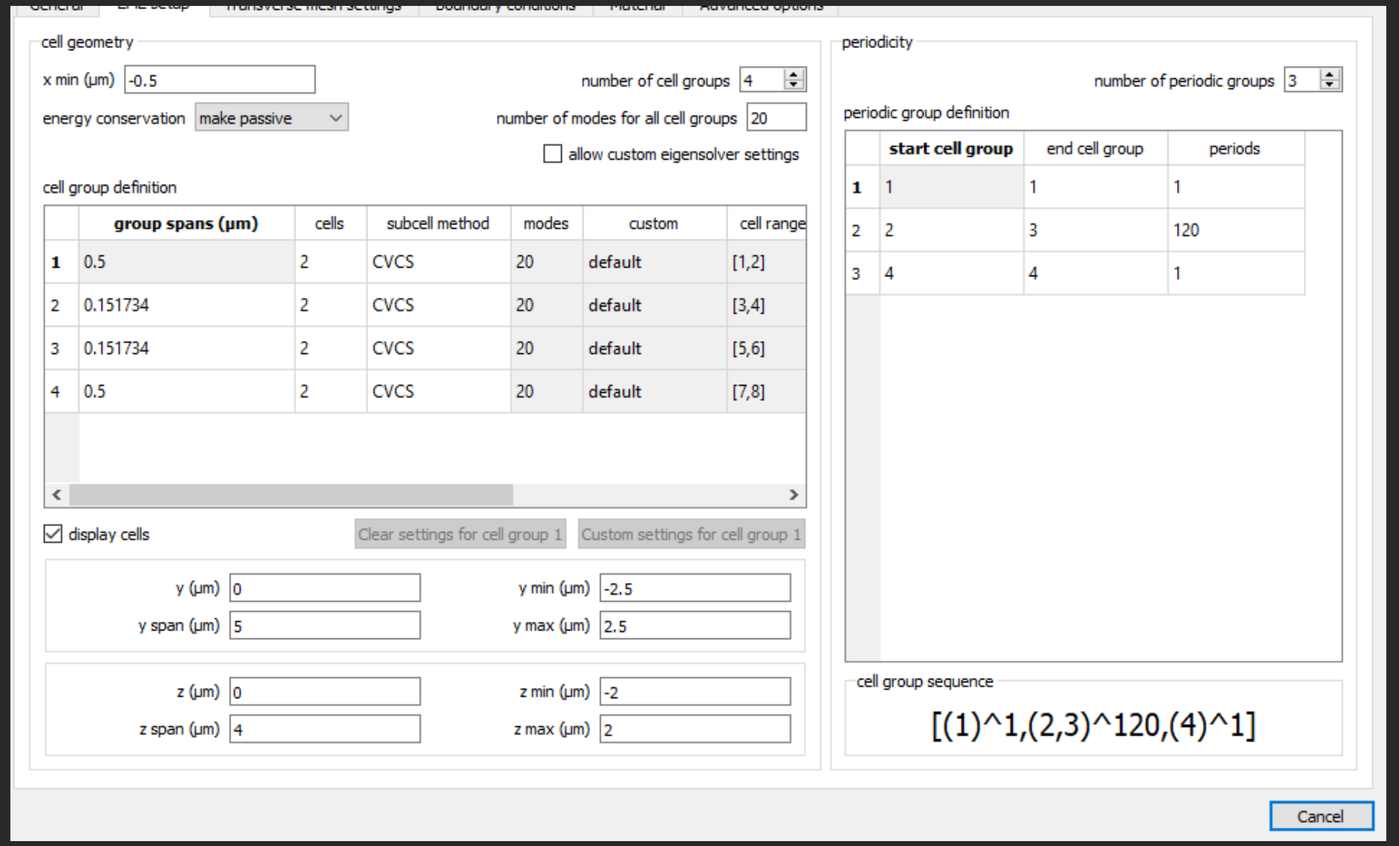
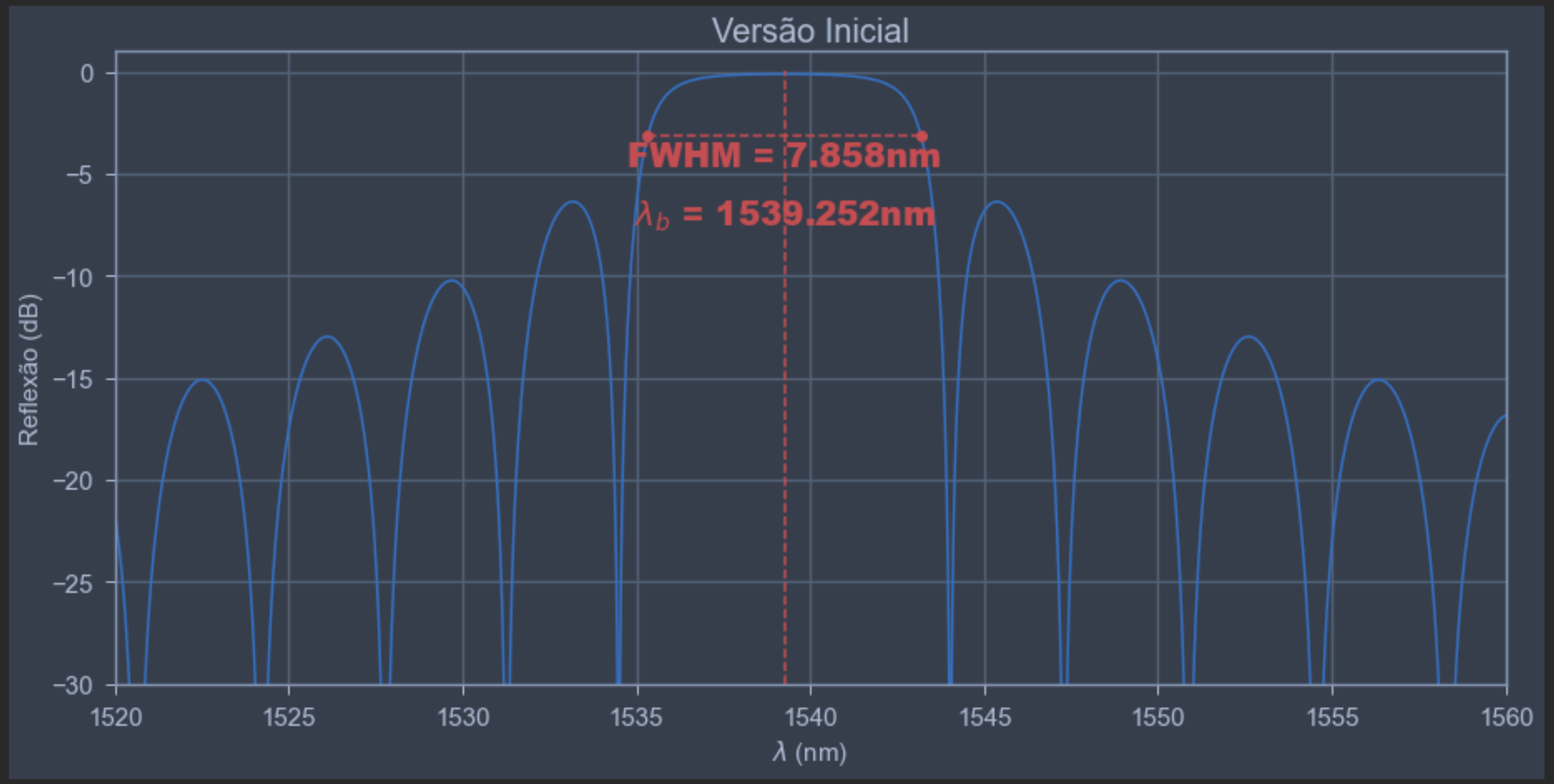


DESIGN

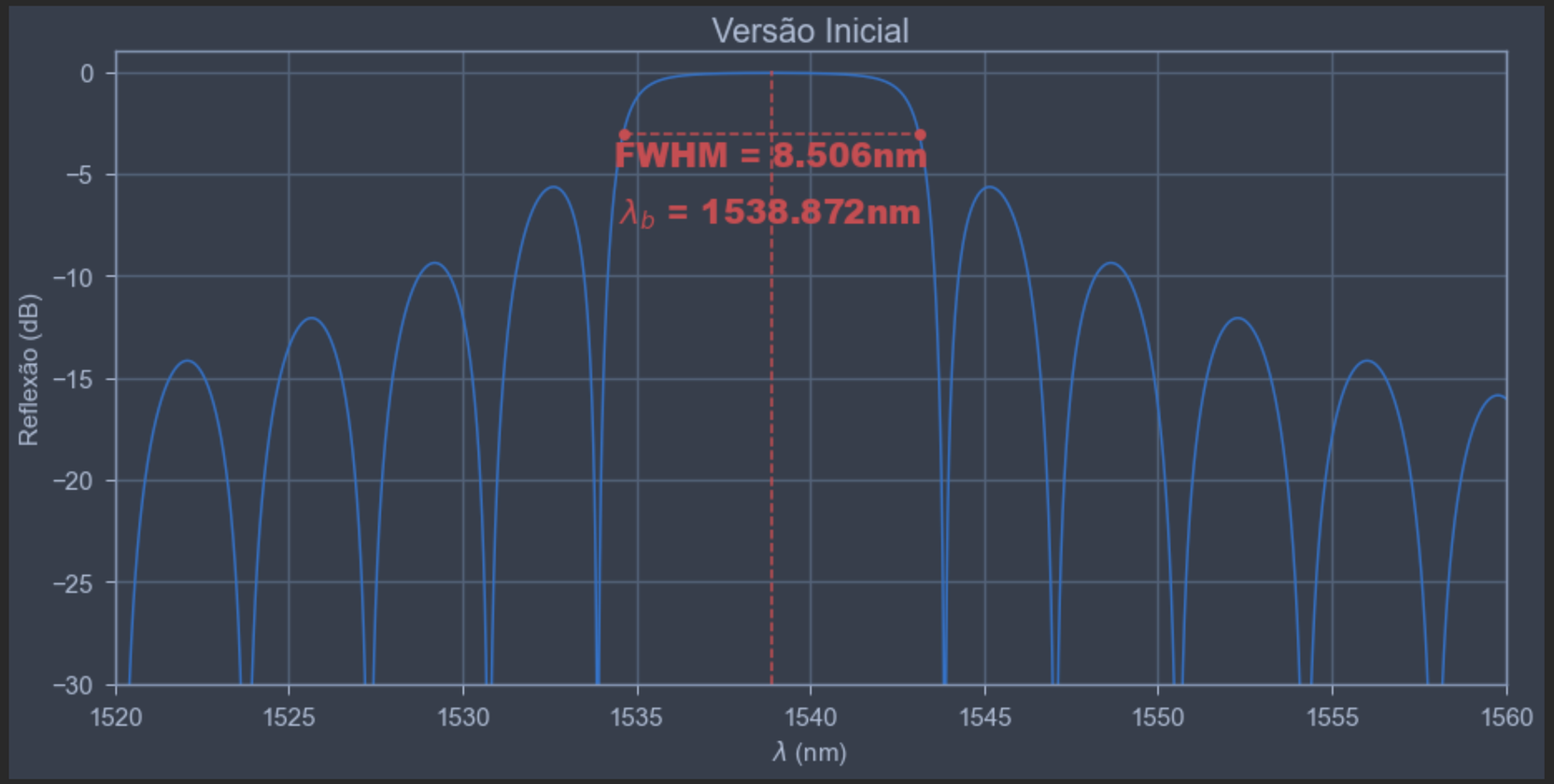
Resultados Iniciais



DESIGN

Correção do FWHM

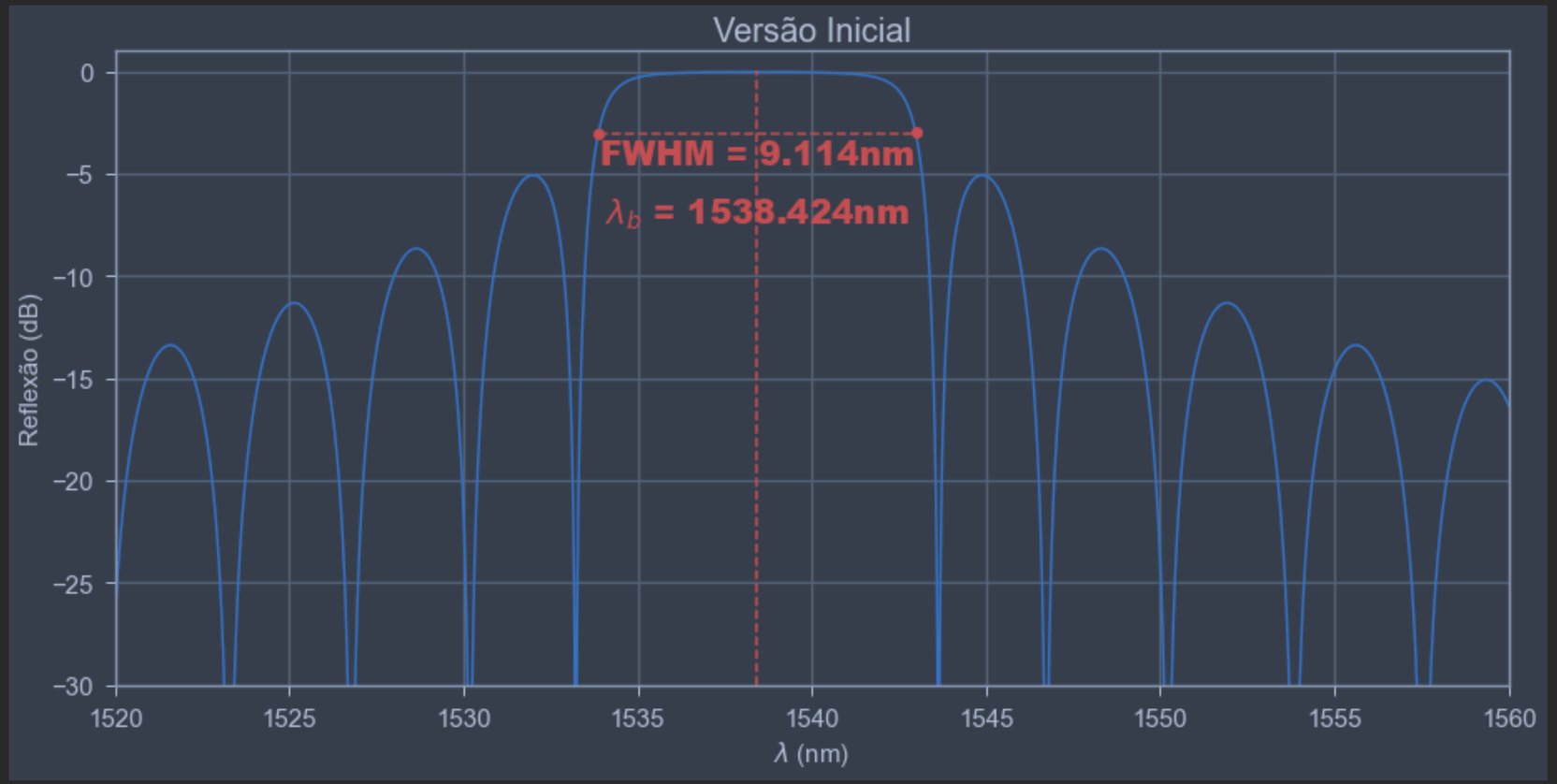
ΔW = 0.064625 (x1.25)



DESIGN

Correção do FWHM

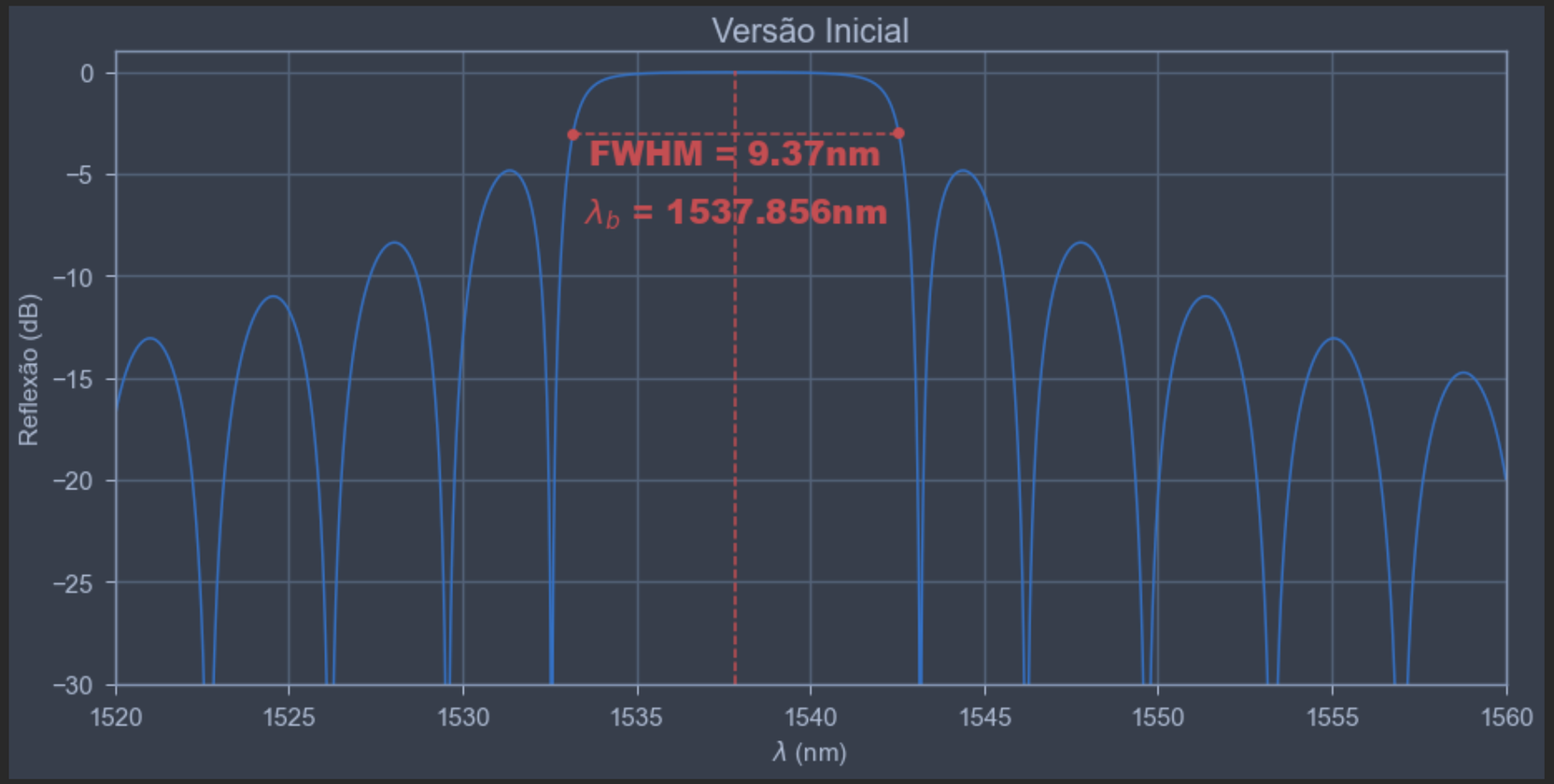
ΔW = 0.07755 (x1.5)



DESIGN

Correção do FWHM

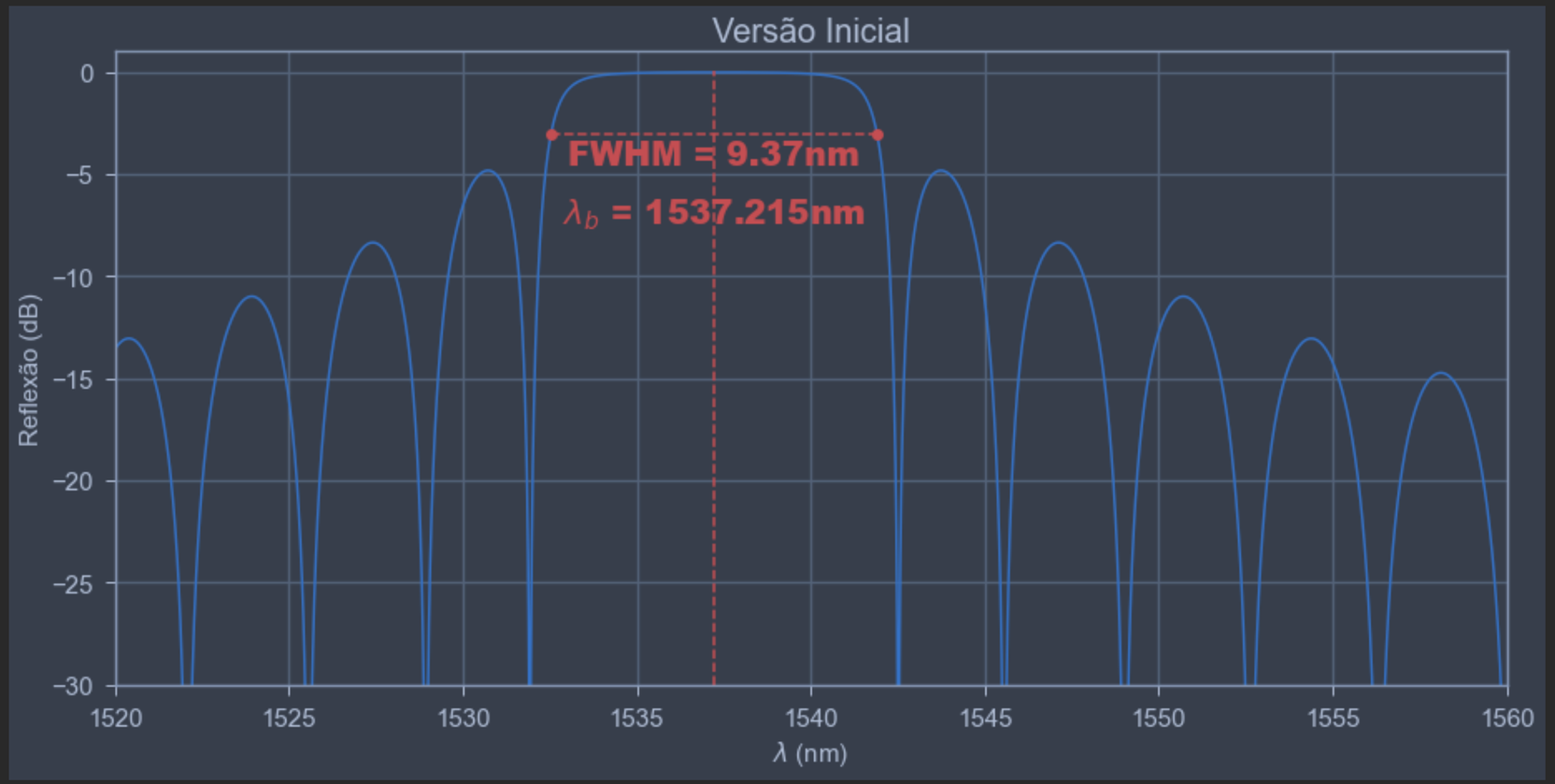
ΔW = 0.090475 (x1.75)



DESIGN

Correção do FWHM

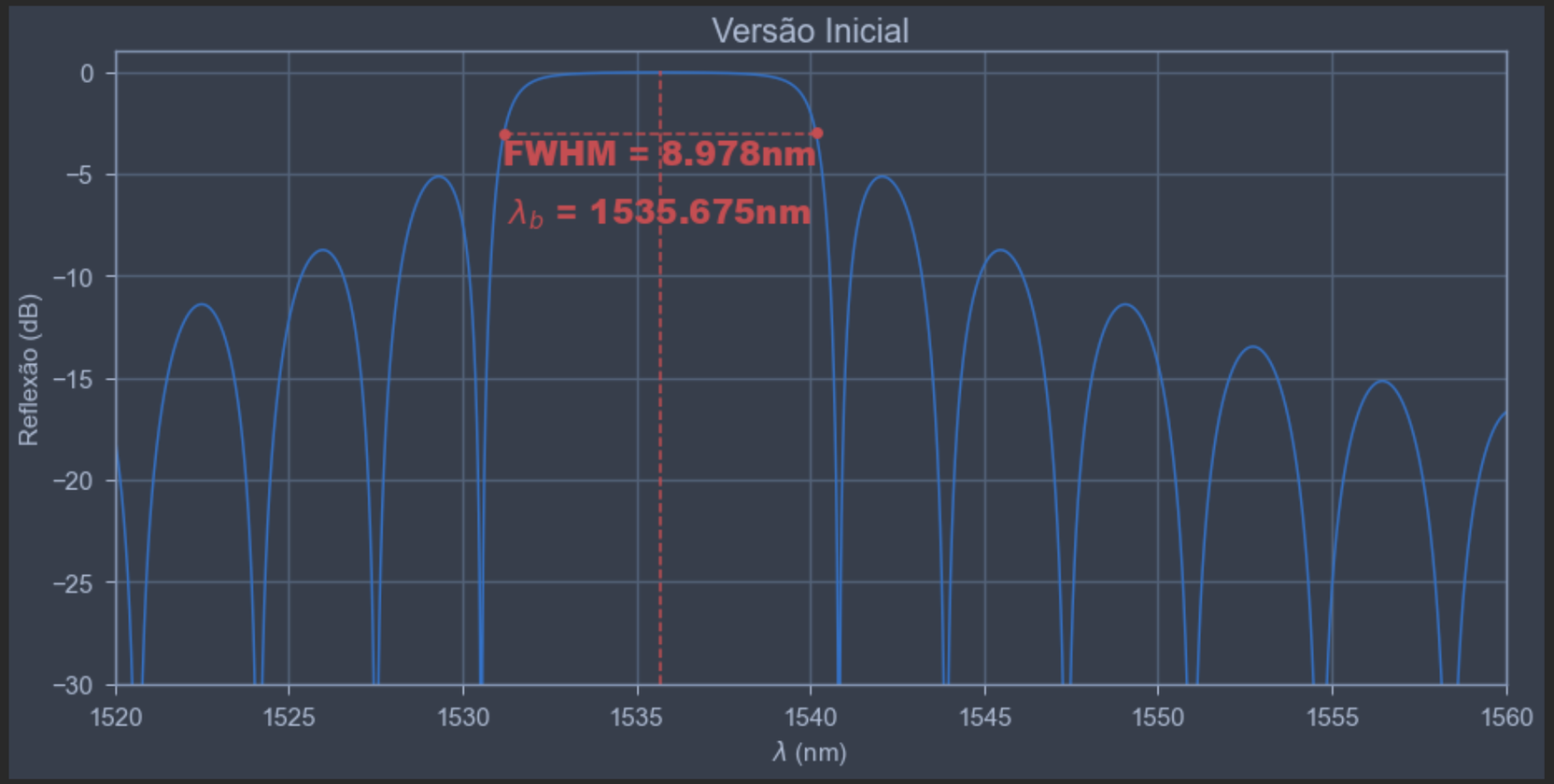
ΔW = 0.1034 (x2)



DESIGN

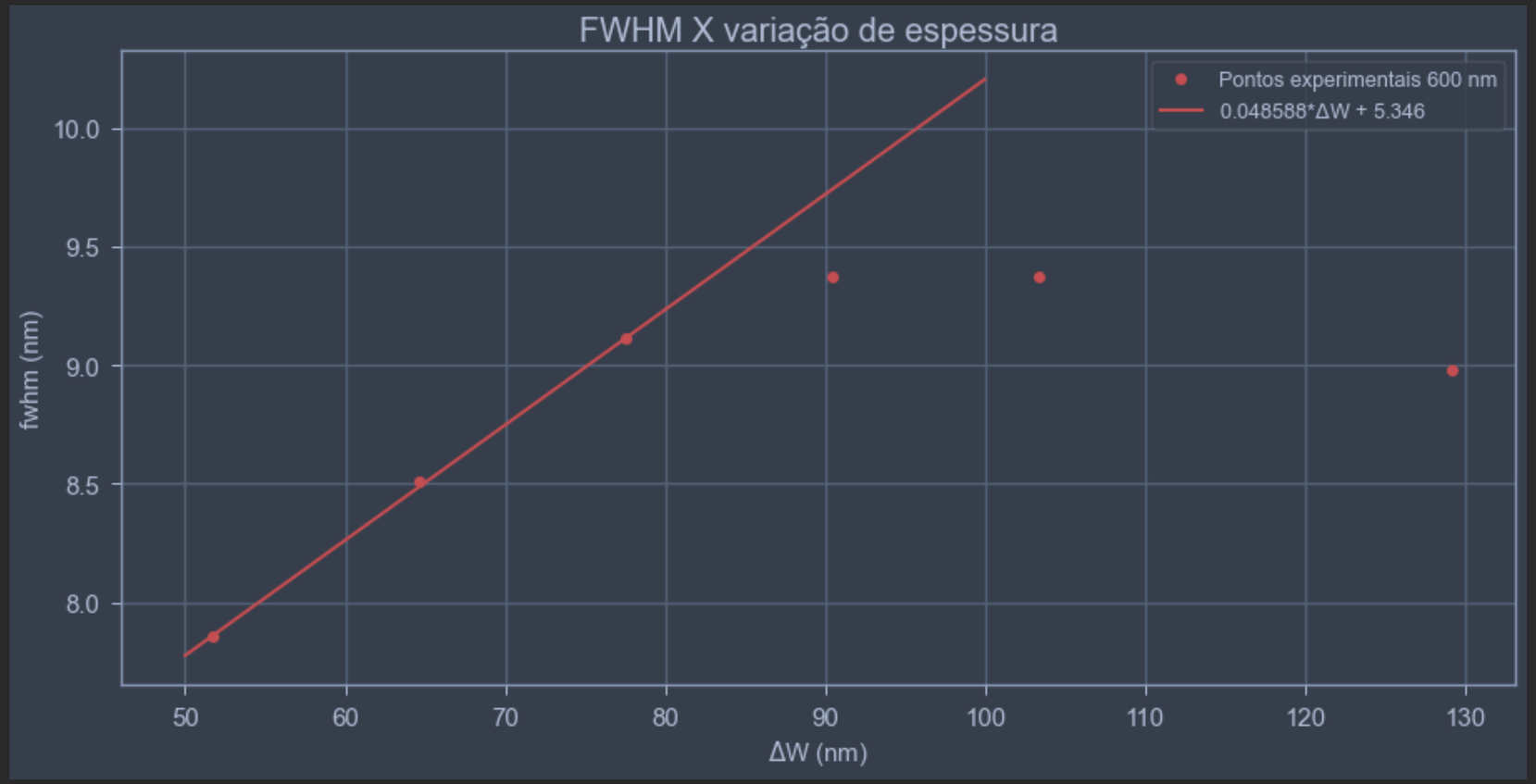
Correção do FWHM

ΔW = 0.12925 (x2.5)



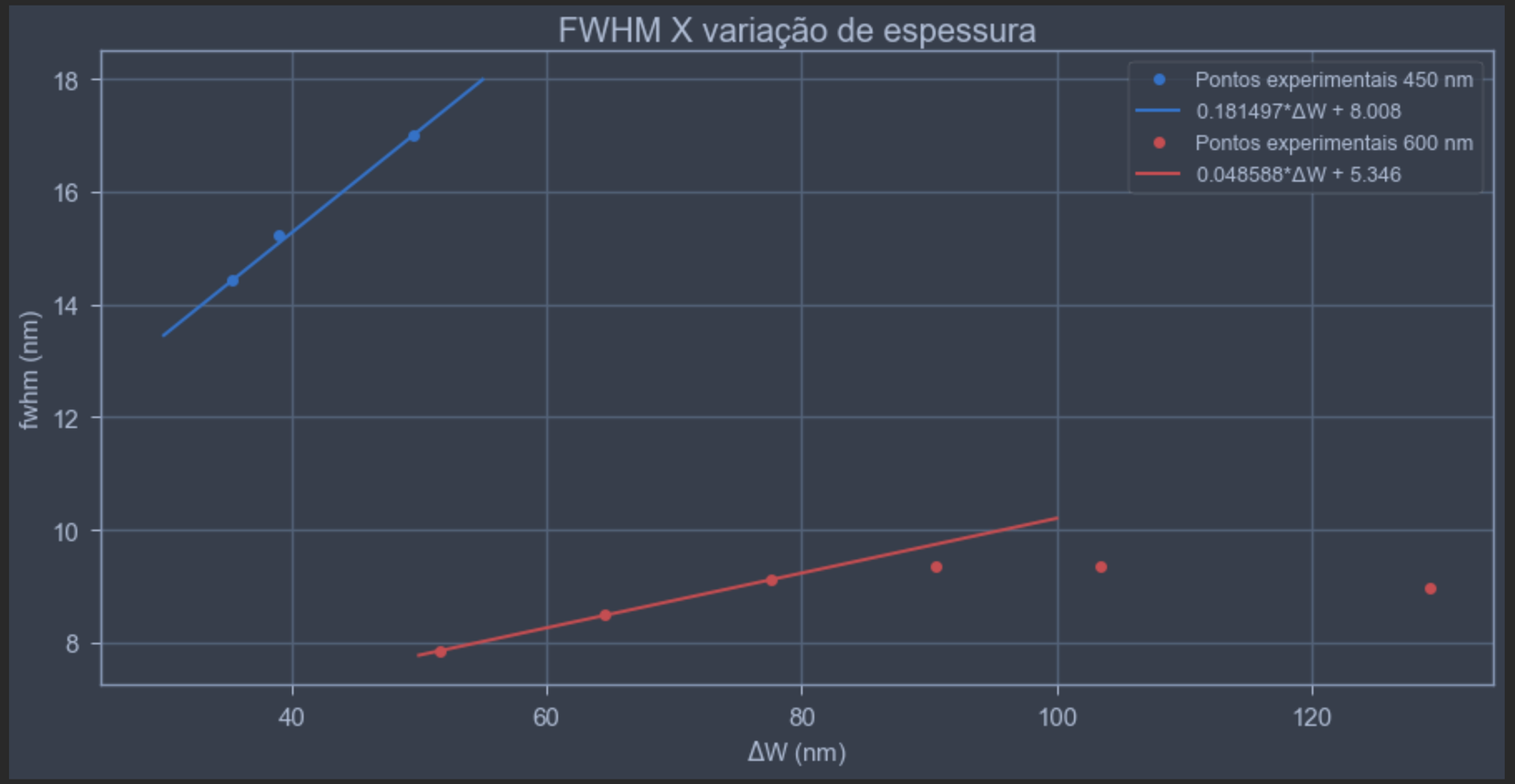
DESIGN

Analise do FWHM



DESIGN

Comparação com a grade anterior

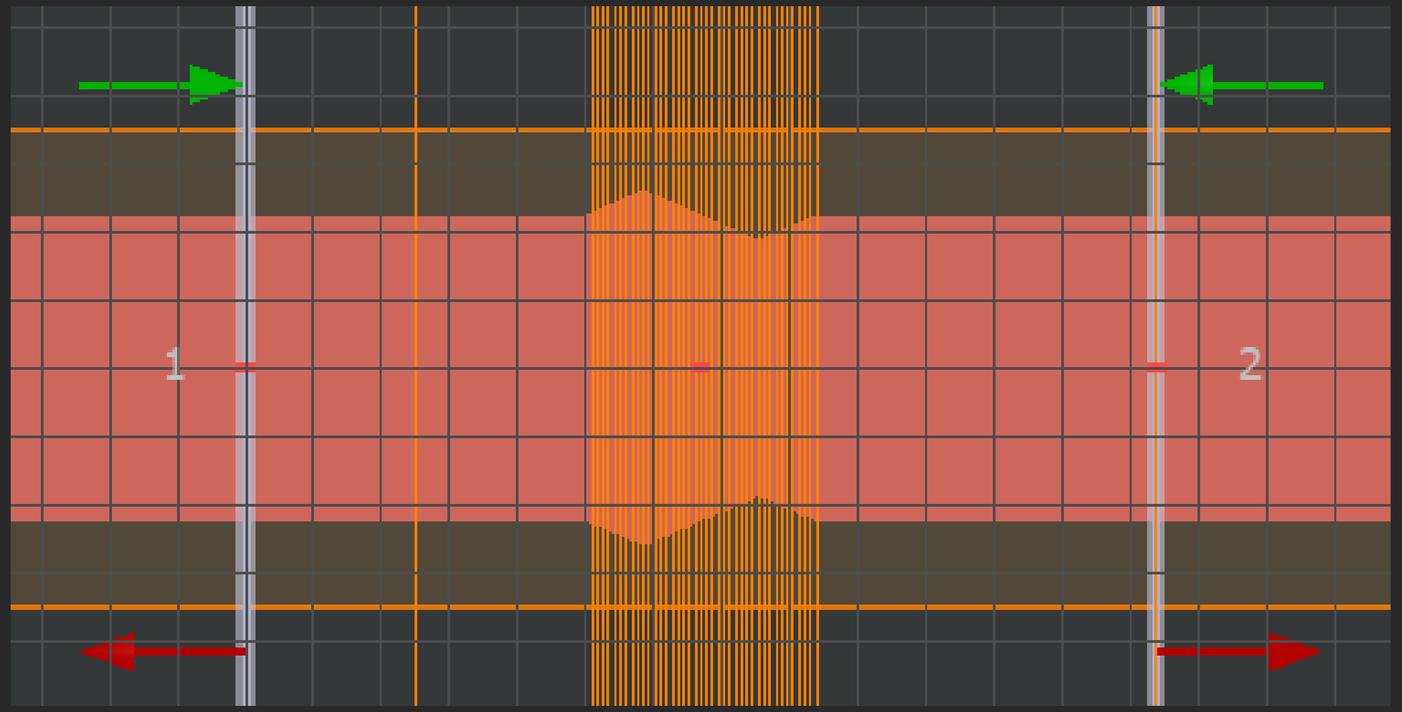


DESIGN

ALTERANDO A GEOMETRIA DA 1 GRADE

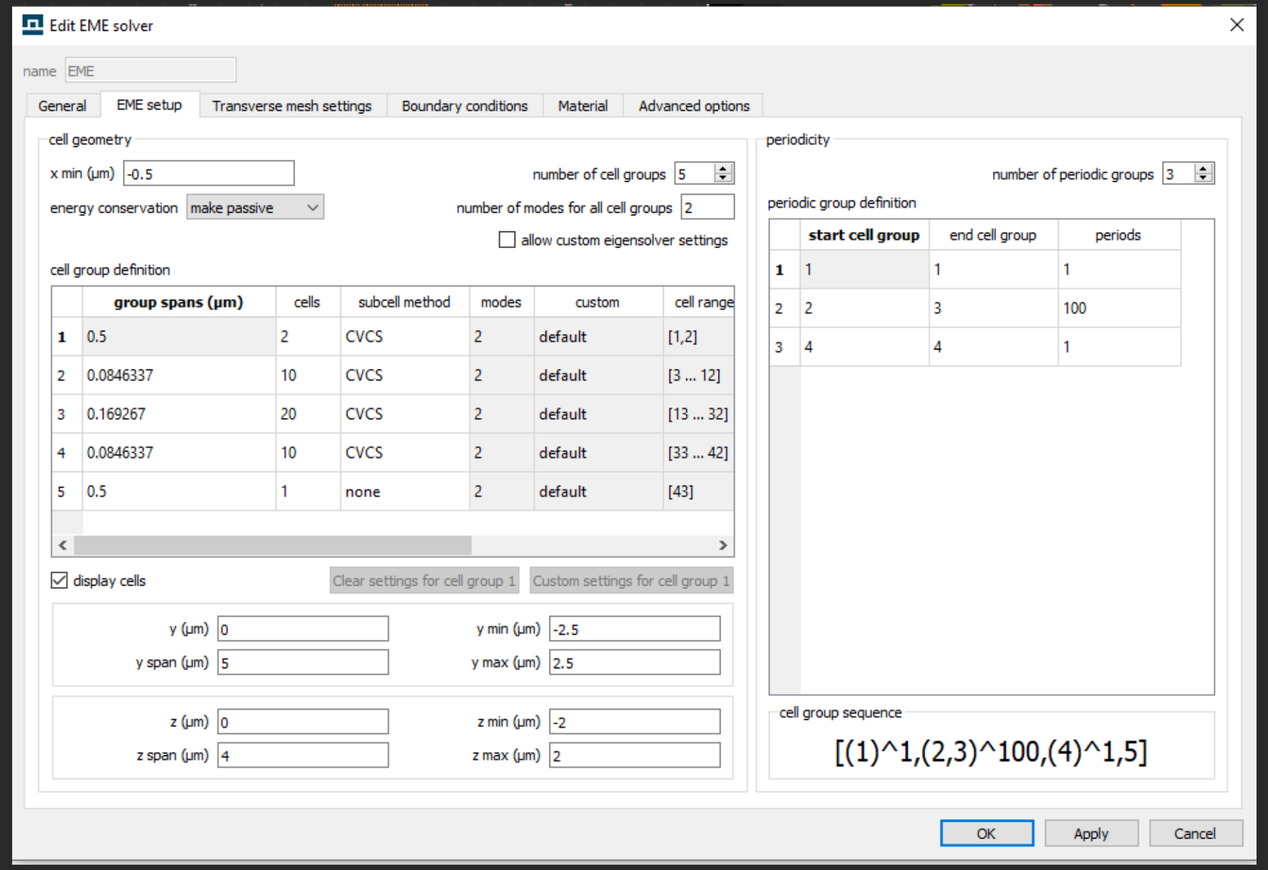
DESIGN

Gemetria triangular



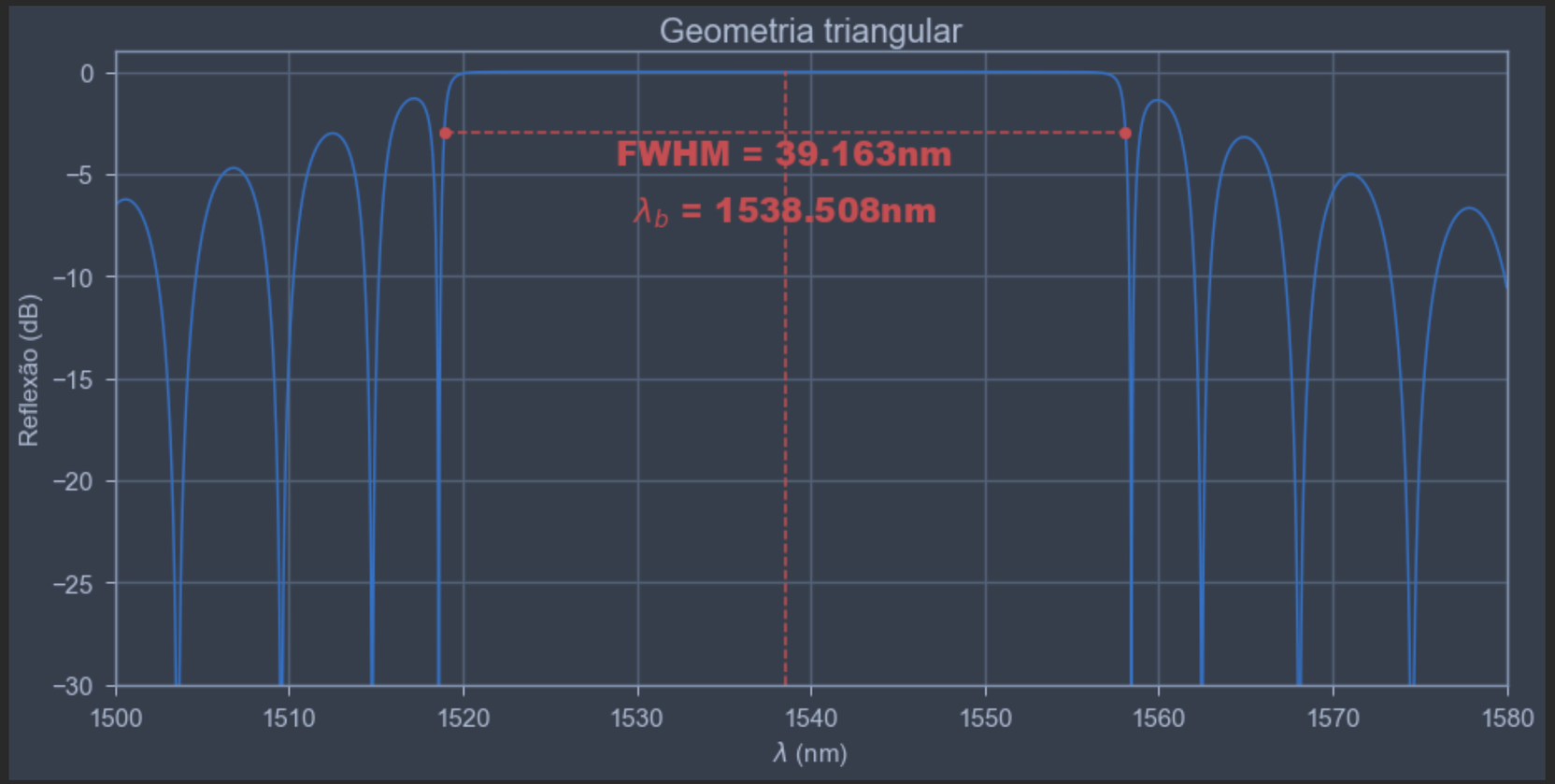
DESIGN

Gemetria triangular



DESIGN

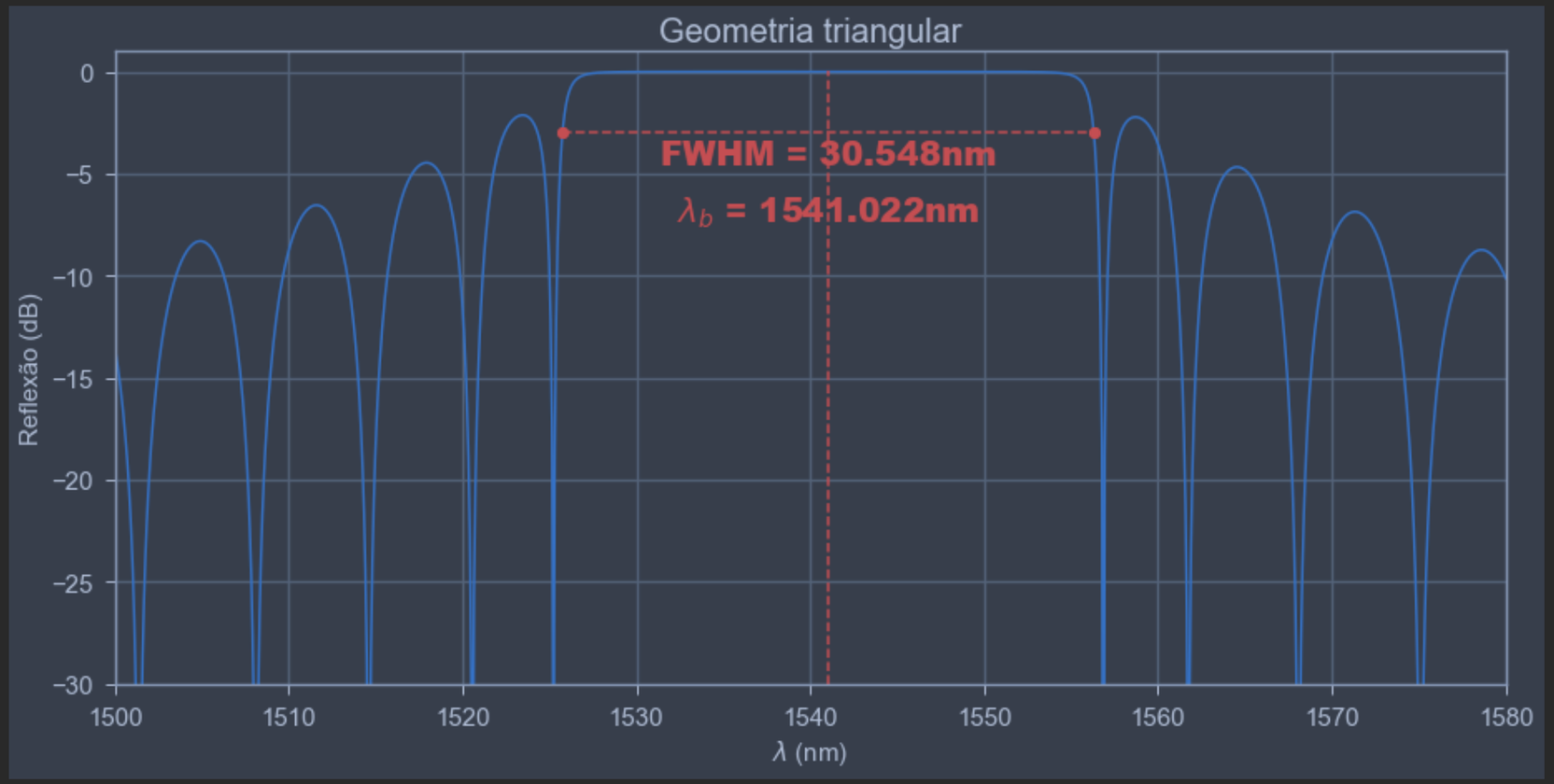
Gemetria triangular



DESIGN

Variando o ΔW

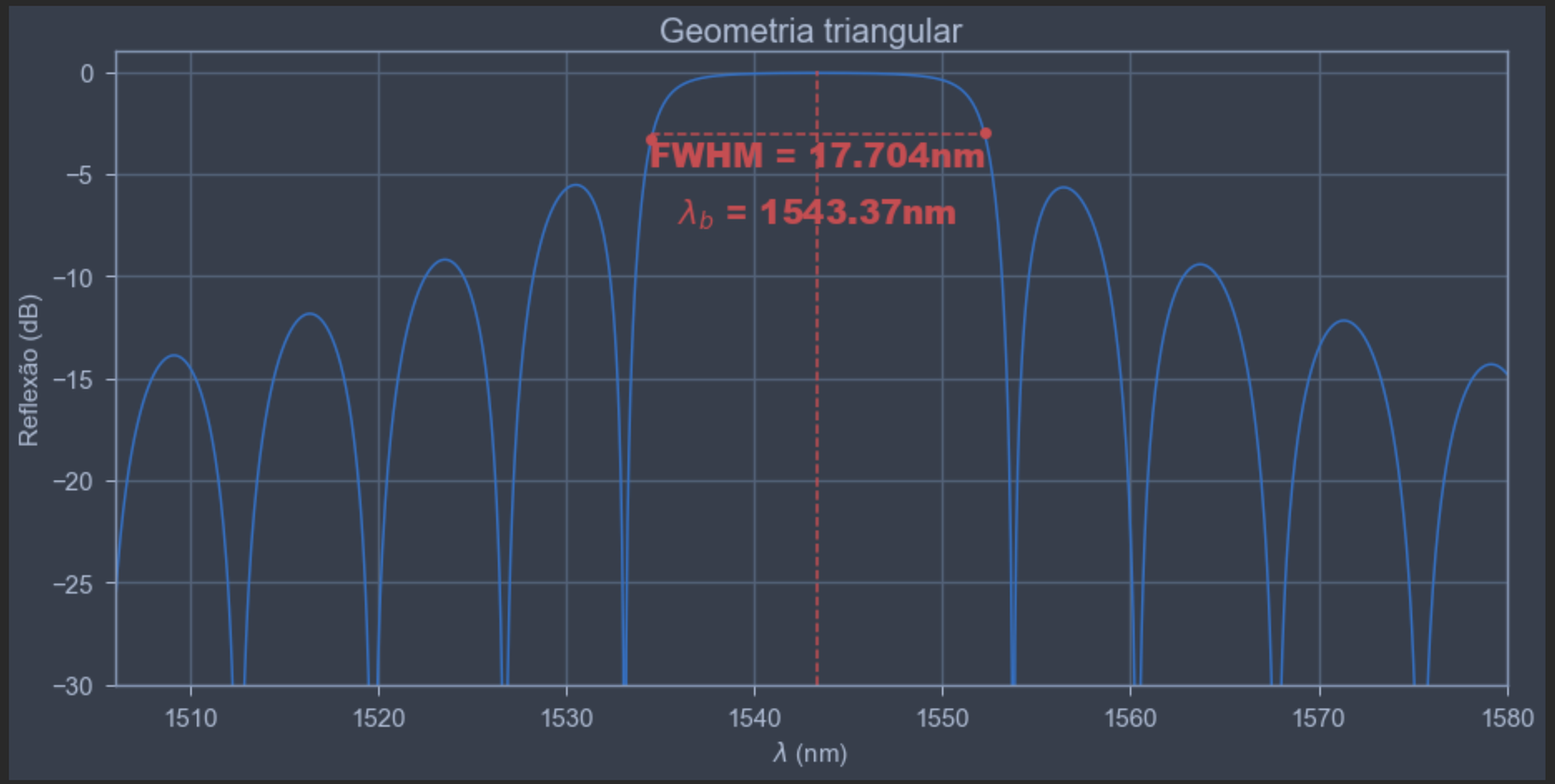
ΔW = 0.0550551 (x0.75)



DESIGN

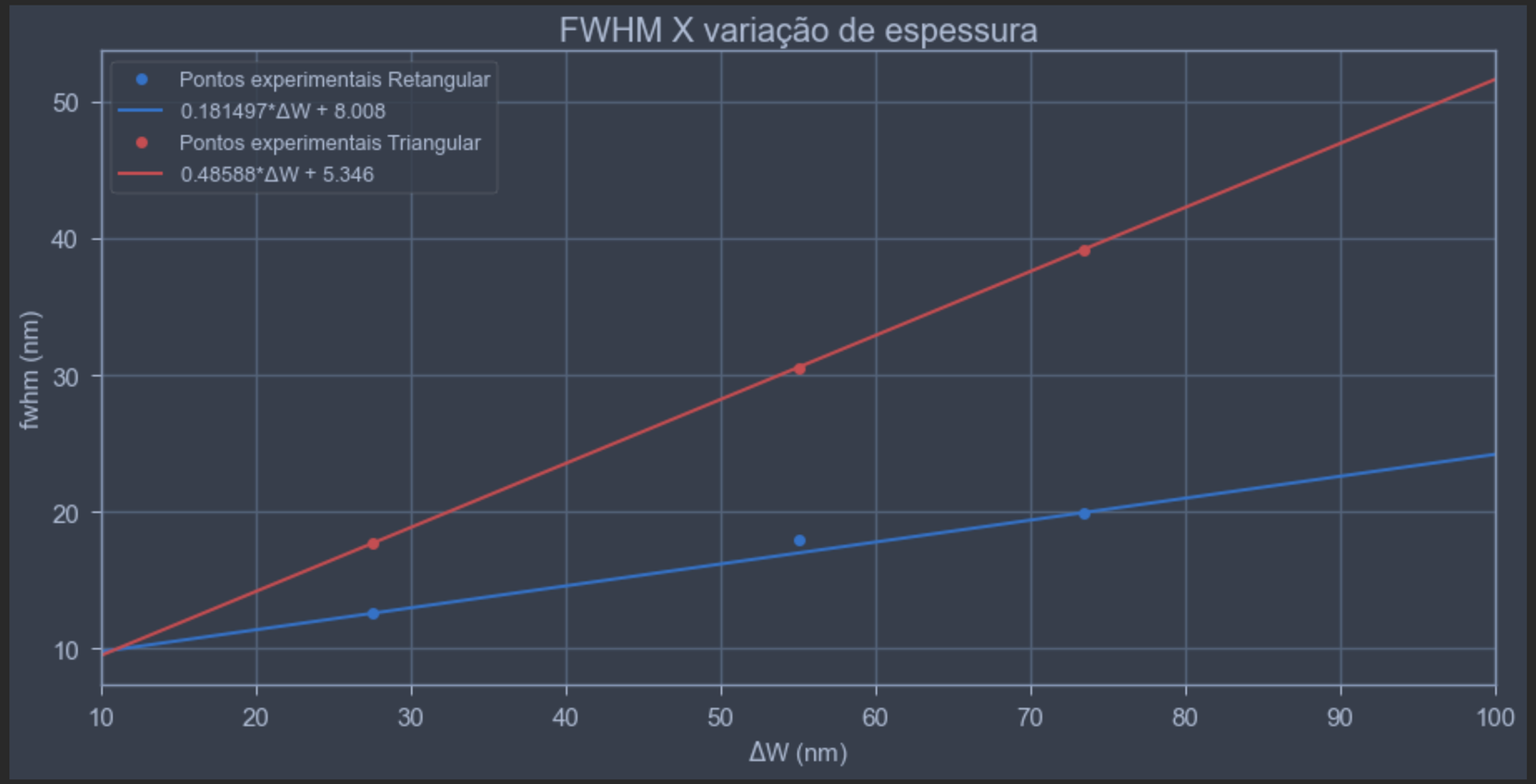
Variando o ΔW

ΔW = 0.02752755 (x0.375)



DESIGN

Comparação entre grades

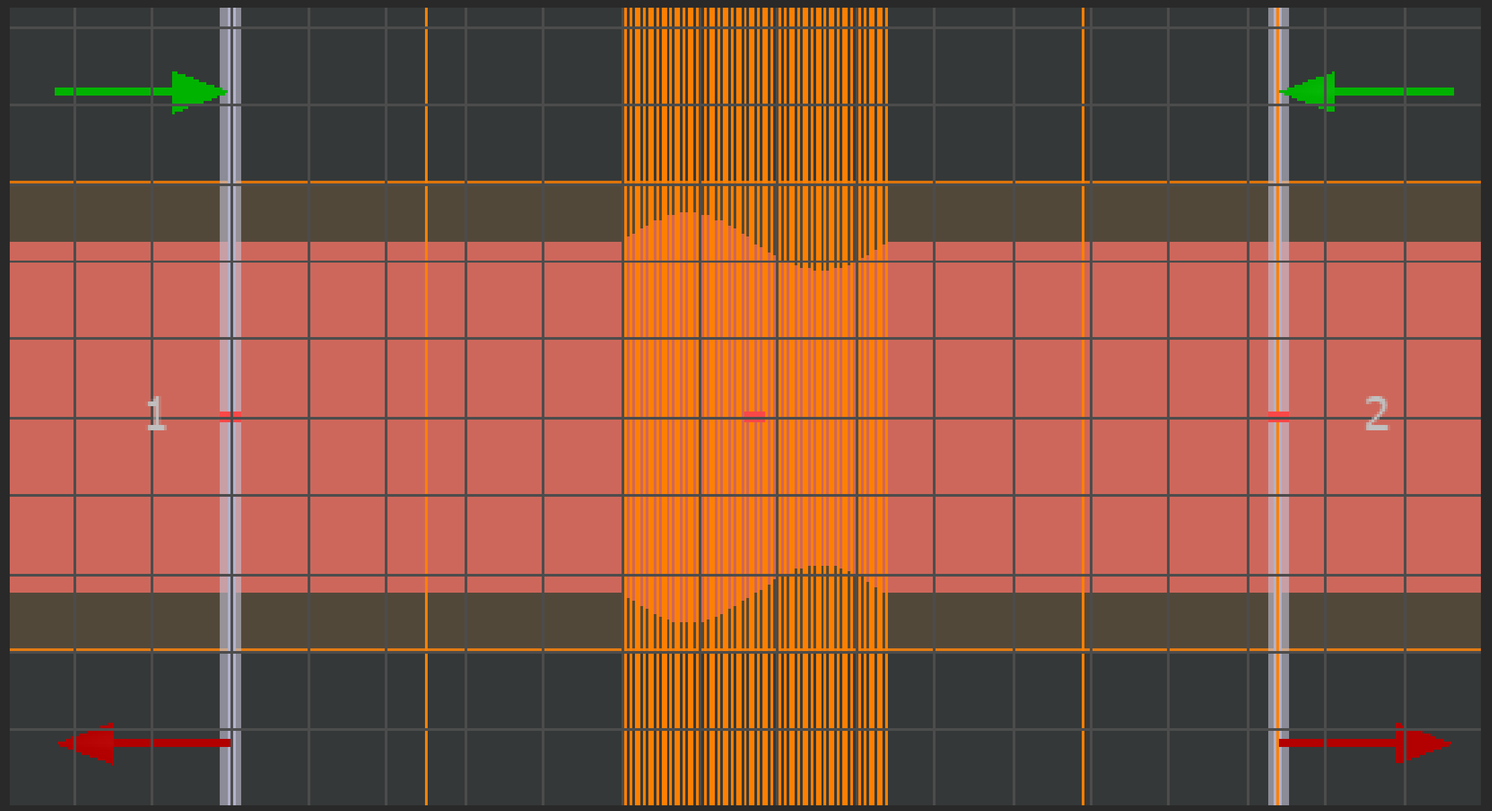


DESIGN

ALTERANDO A GEOMETRIA DA 1 GRADE

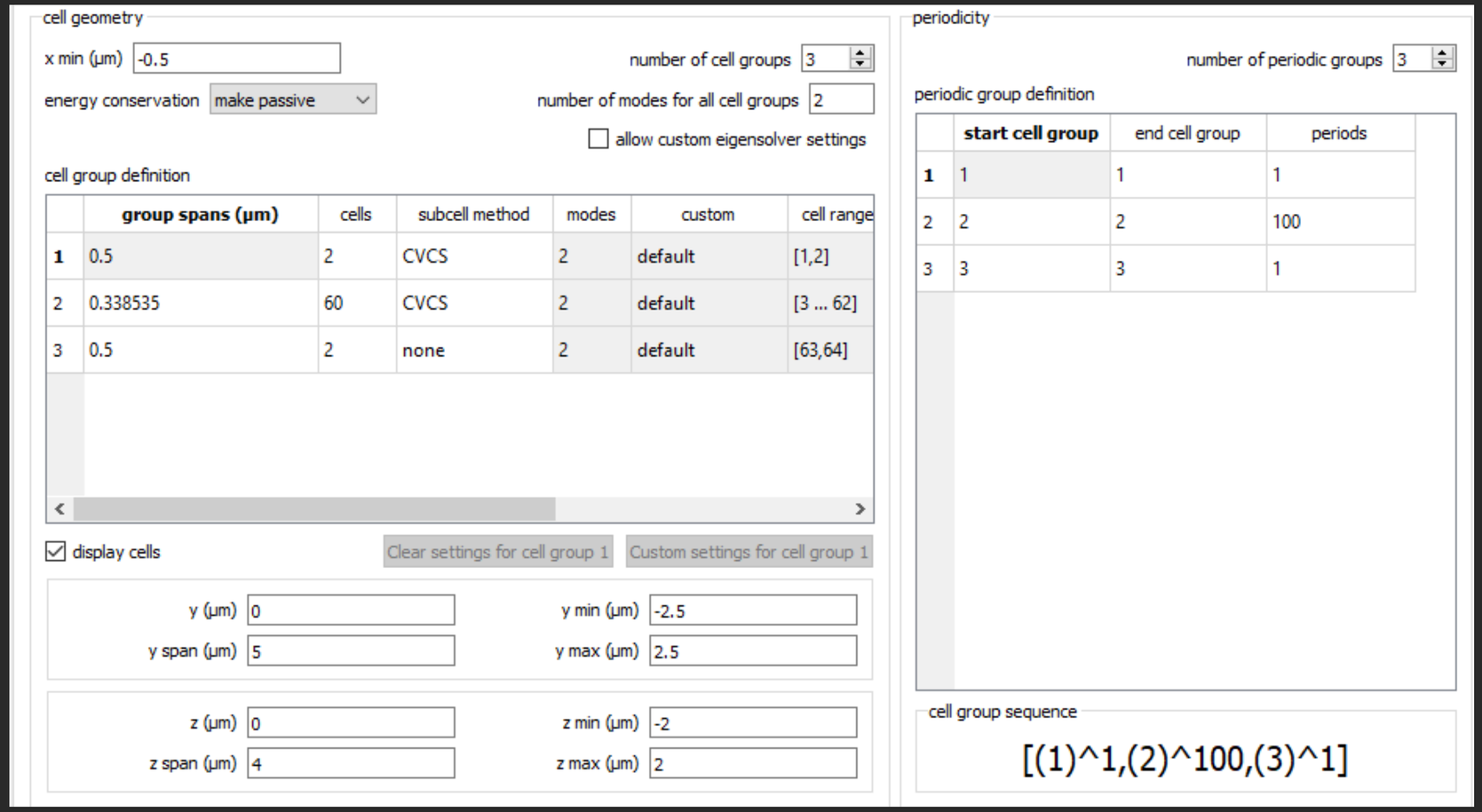
DESIGN

Gemetria Senoidal



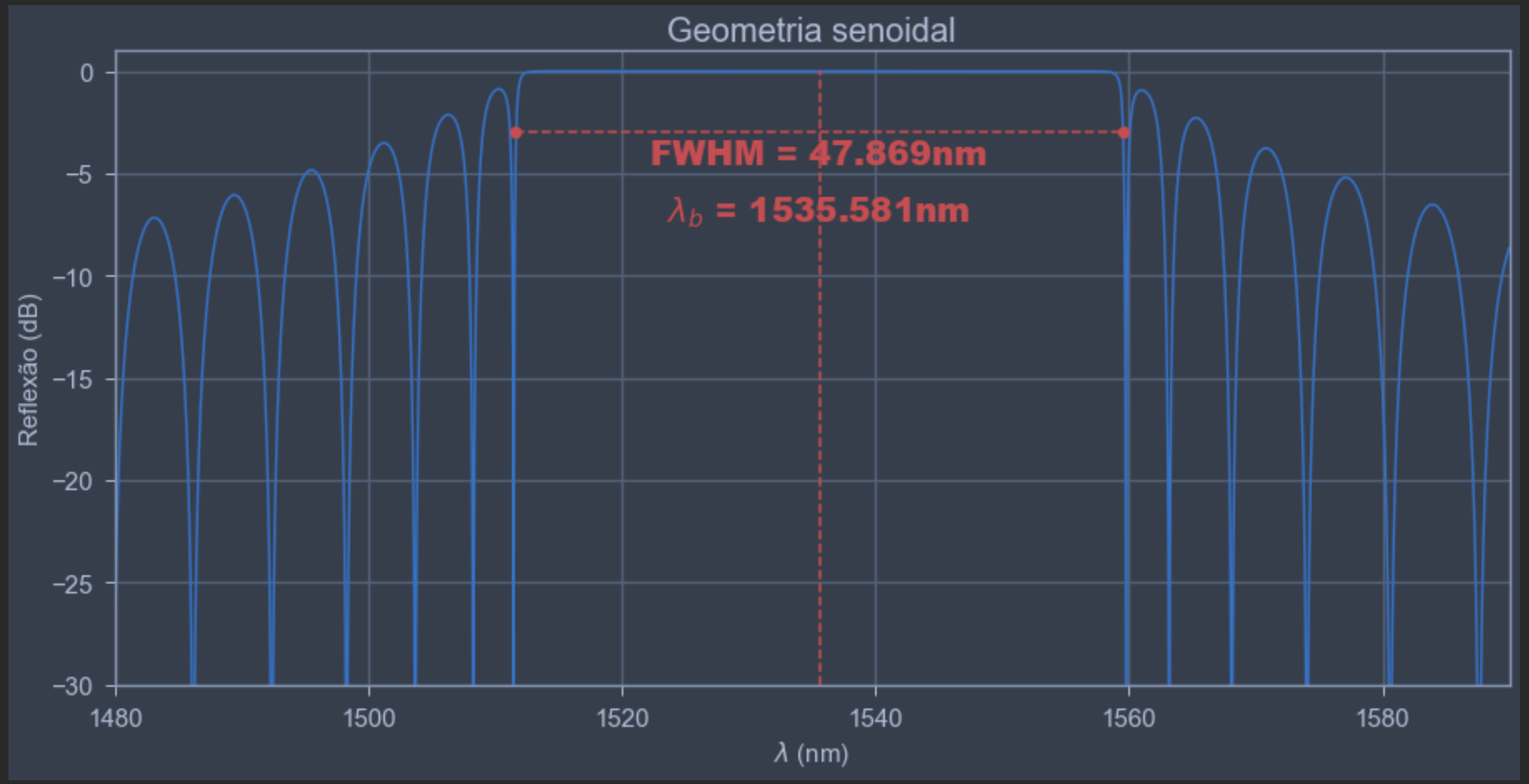
DESIGN

Gemetria triangular



DESIGN

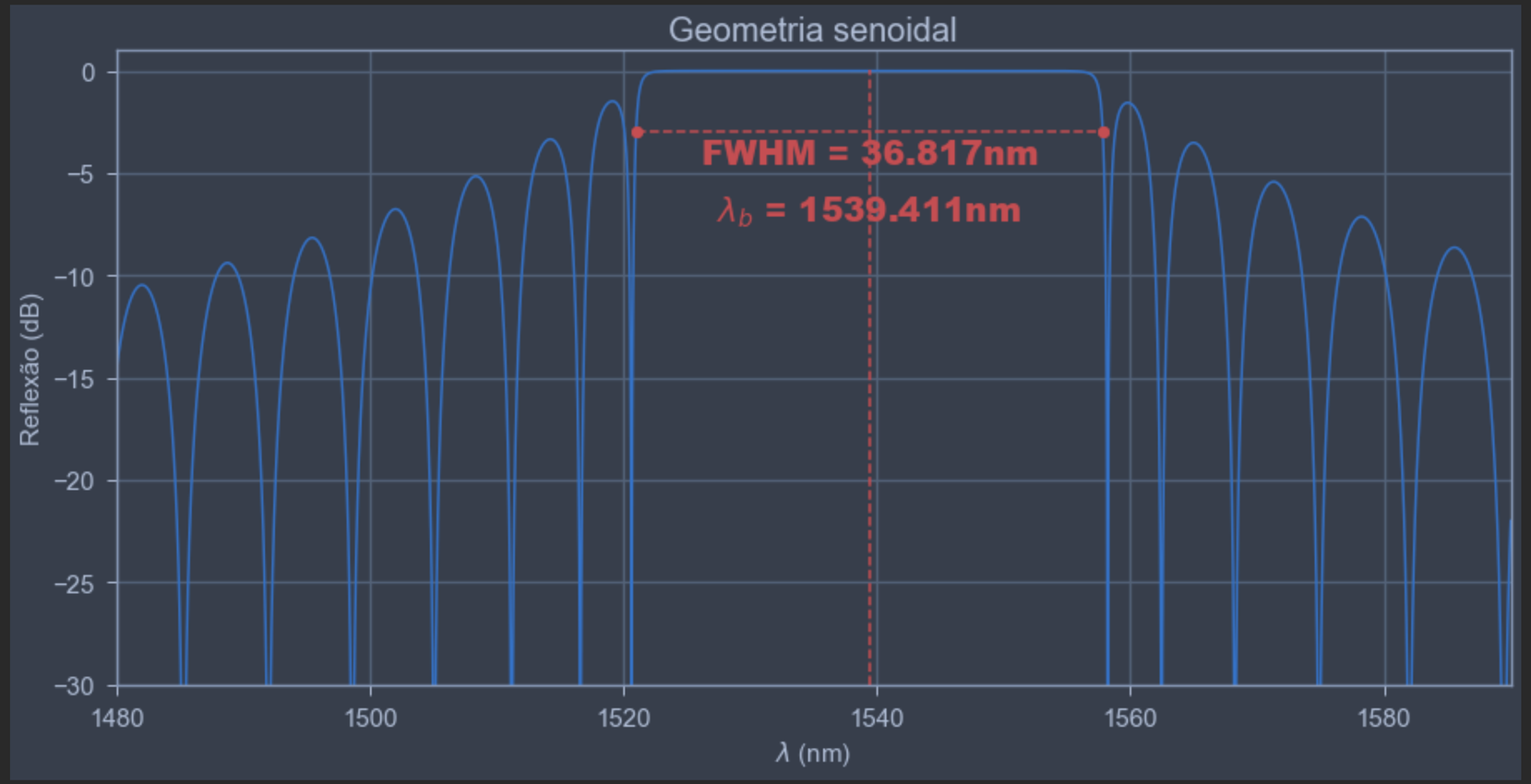
Gemetria triangular



DESIGN

Variando o ΔW

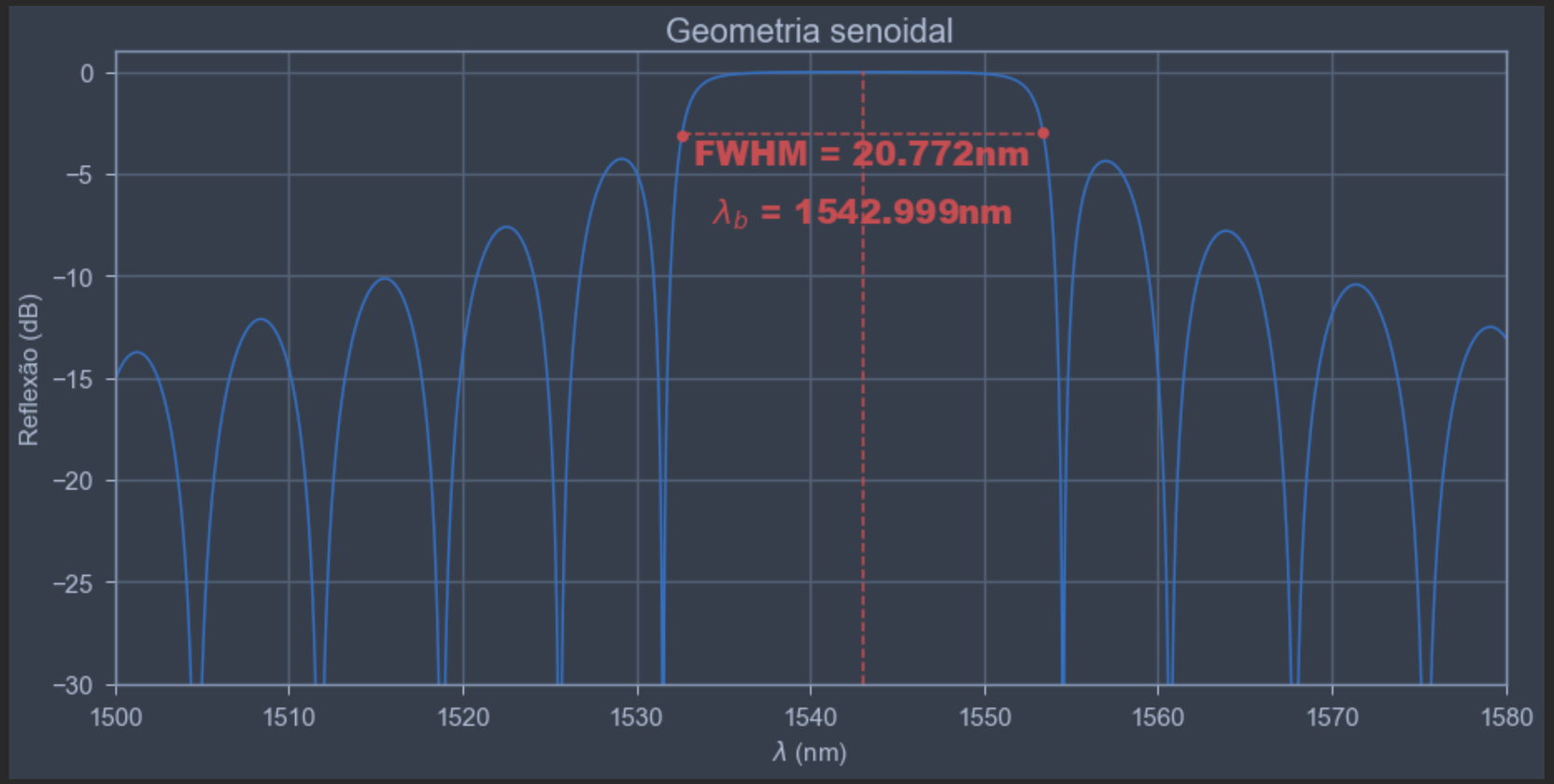
ΔW = 0.0550551 (x0.75)



DESIGN

Variando o ΔW

ΔW = 0.02752755 (x0.375)



DESIGN

Comparação entre grades