

# Edge Coupler

Moisés de Araújo Oliveira

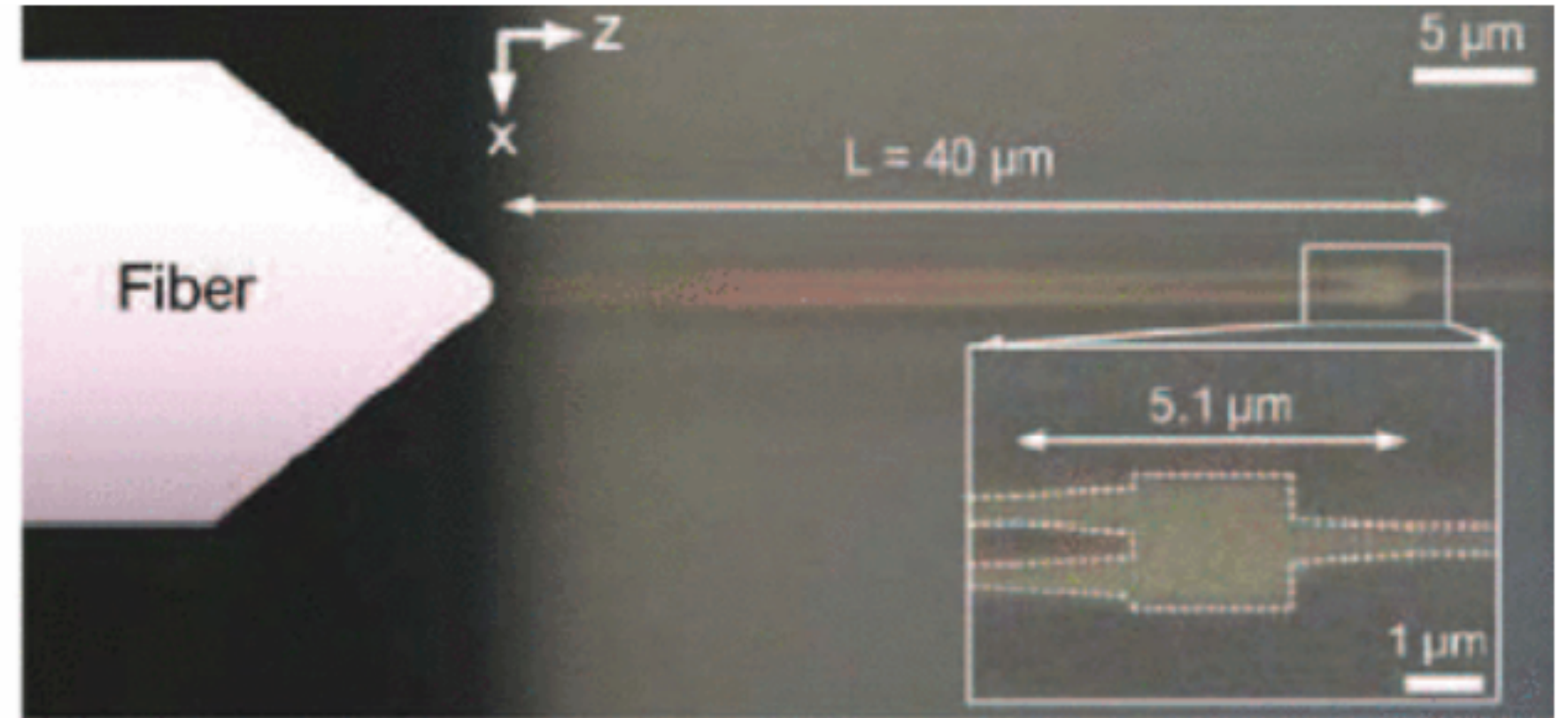
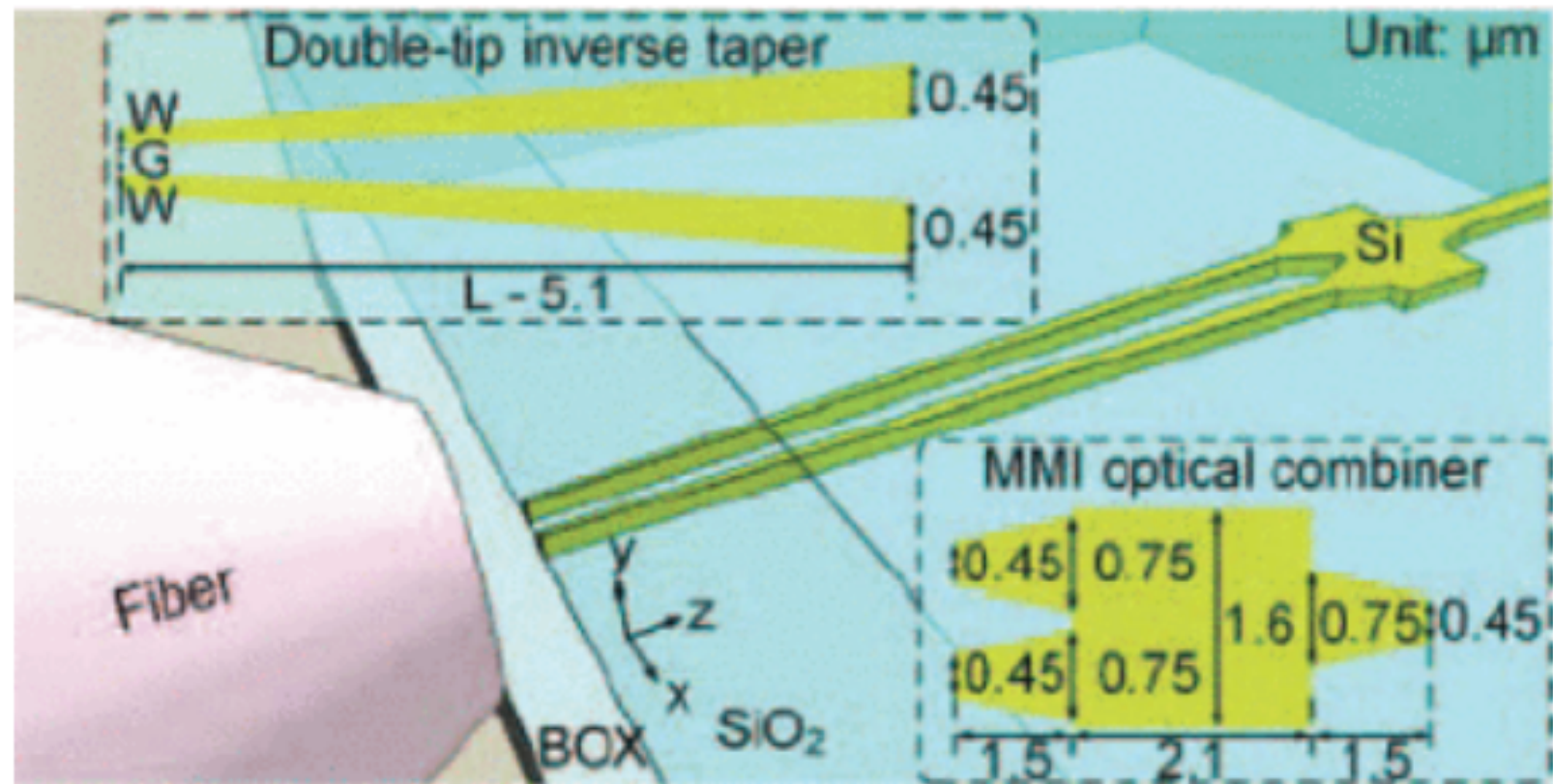
# Referência

J. Wang et al., "Low-loss and misalignment-tolerant fiber-to-chip edge coupler based on double-tip inverse tapers," 2016 Optical Fiber Communications Conference and Exhibition (OFC), Anaheim, CA, USA, 2016, pp. 1–3.

# Double-tip Inverse Taper

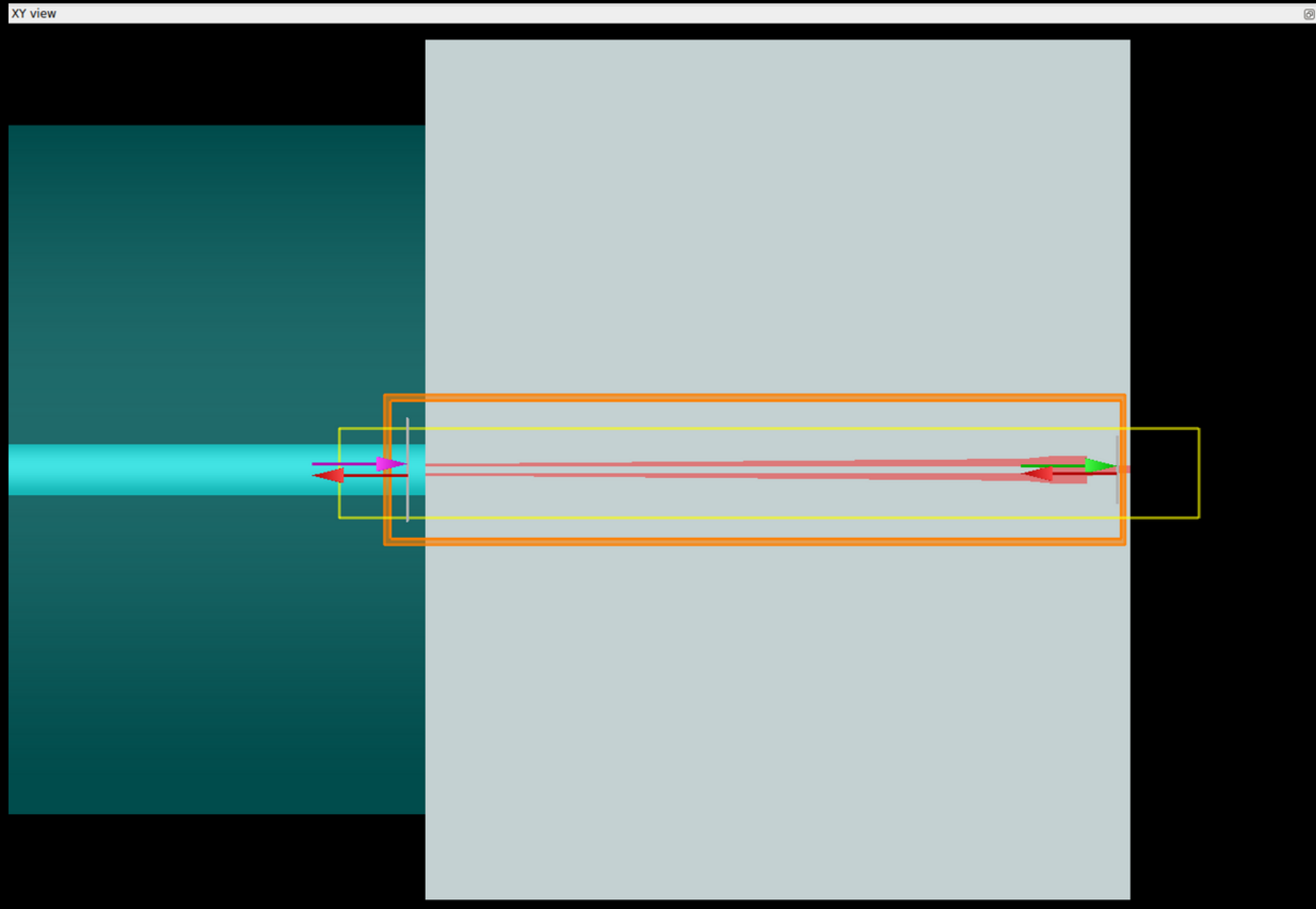
- maior grau de liberdade para design
- maior coeficiente de acoplamento
- tolerância ao desalinhamento
-

# Design



semana 1

# Design – FDTD



# FDTD SETTINGS

name

General Geometry Mesh settings Boundary conditions Advanced options

dimension

simulation time (fs)

simulation temperature (K)

background material

index

name

General Geometry Mesh settings Boundary conditions Advanced options

PML settings

x min bc

x max bc

y min bc

y max bc

z min bc

z max bc

☐ allow symmetry on all boundaries

type

☒ same settings on all boundaries

profile	standard
layers	8
kappa	2
sigma	1
polynomial	3
alpha	0
alpha polynomial	1
min layers	8
max layers	64

☒ extend structure through pml

☐ auto scale pml parameters

Bloch boundary conditions

☒ set based on source angle

bloch units

kx

ky

kz

name

General Geometry Mesh settings Boundary conditions Advanced options

x ( $\mu\text{m}$ )  x min ( $\mu\text{m}$ )

x span ( $\mu\text{m}$ )  x max ( $\mu\text{m}$ )

y ( $\mu\text{m}$ )  y min ( $\mu\text{m}$ )

y span ( $\mu\text{m}$ )  y max ( $\mu\text{m}$ )

z ( $\mu\text{m}$ )  z min ( $\mu\text{m}$ )

z span ( $\mu\text{m}$ )  z max ( $\mu\text{m}$ )

General Geometry Mesh settings Boundary conditions Advanced options

mesh type

Mesh accuracy

mesh accuracy

High accuracy.  
Please check memory requirements before running simulations.

Time step

dt stability factor

dt (fs)

Minimum mesh step settings

min mesh step ( $\mu\text{m}$ )

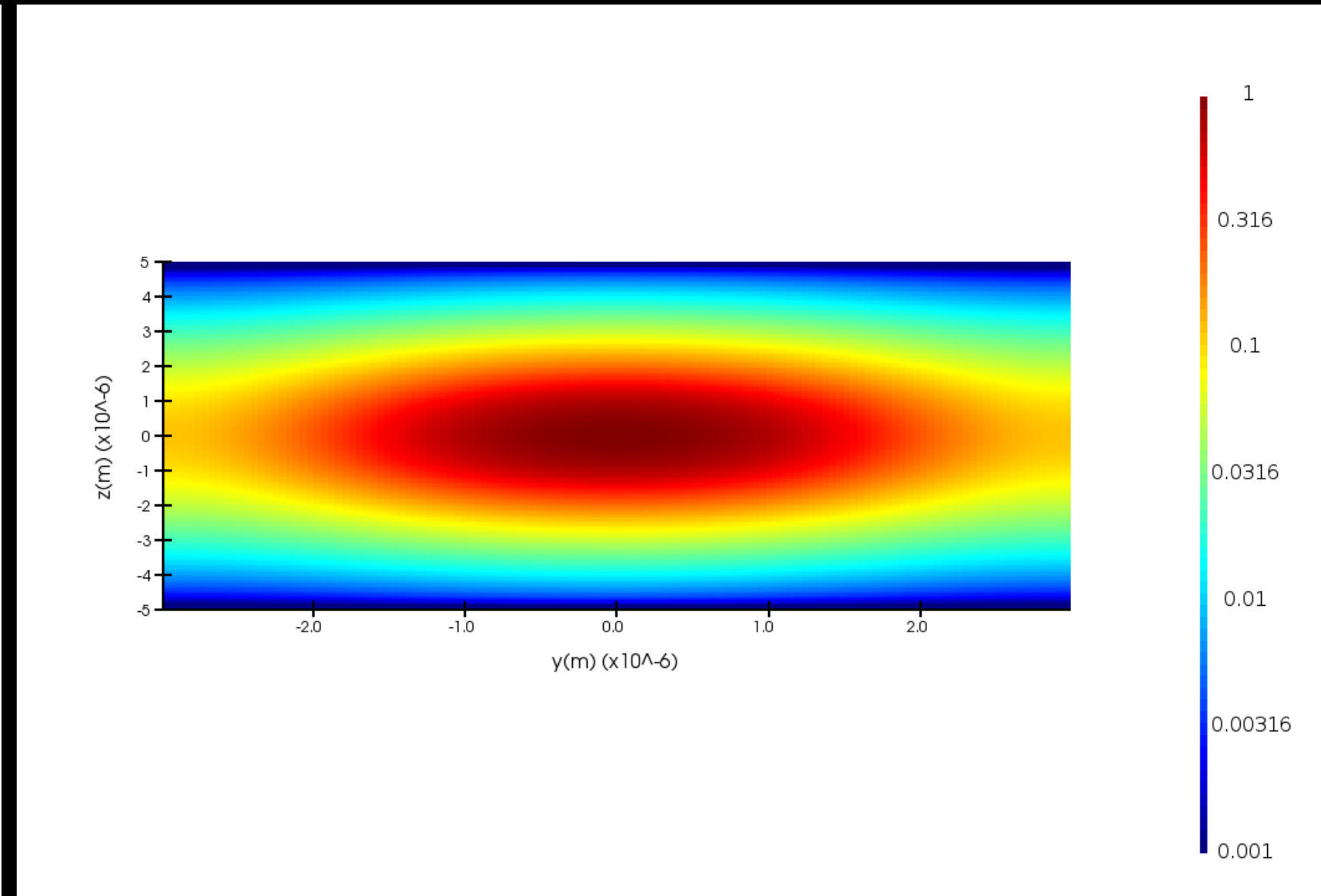
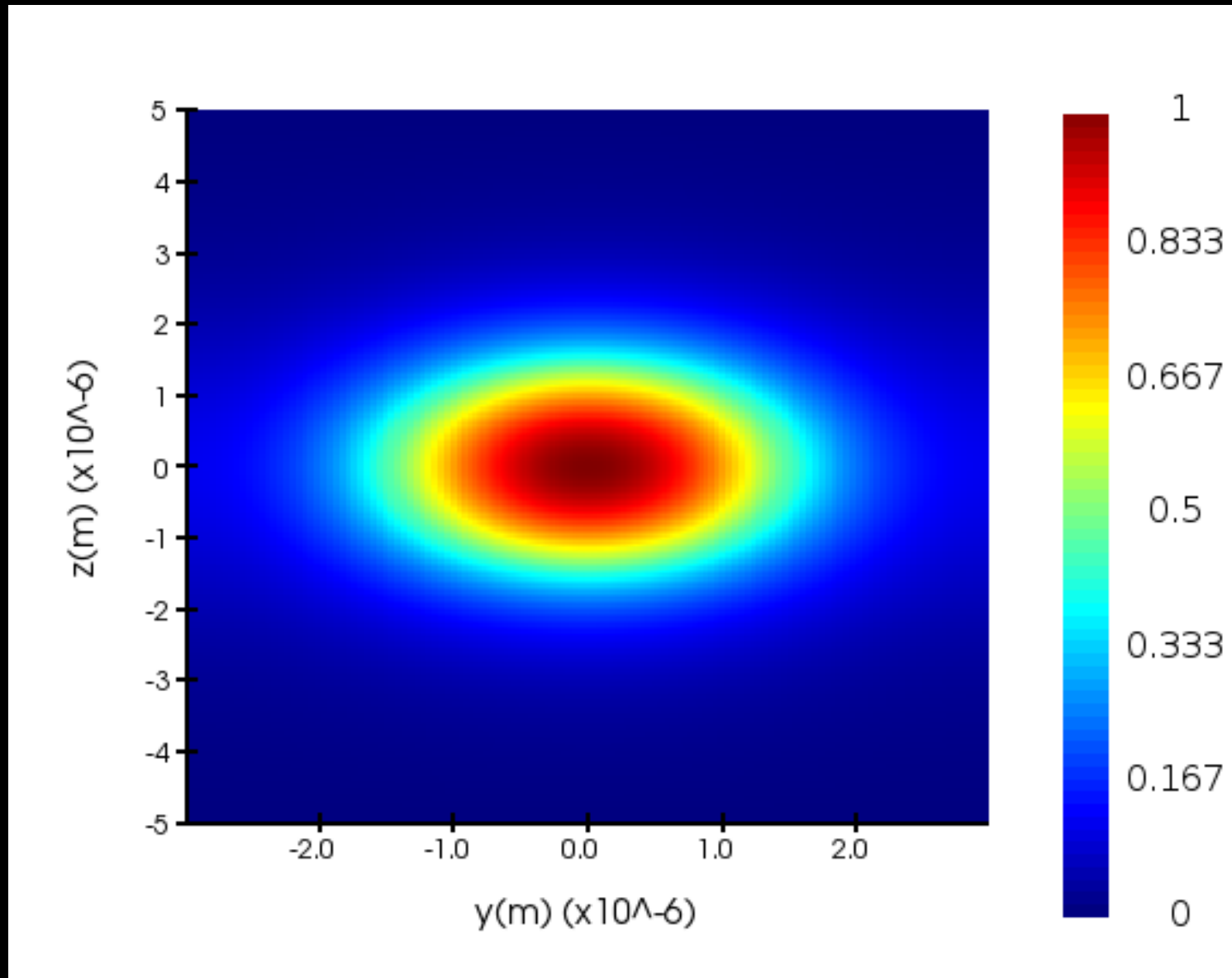
Mesh refinement

mesh refinement

[How do I choose?](#)



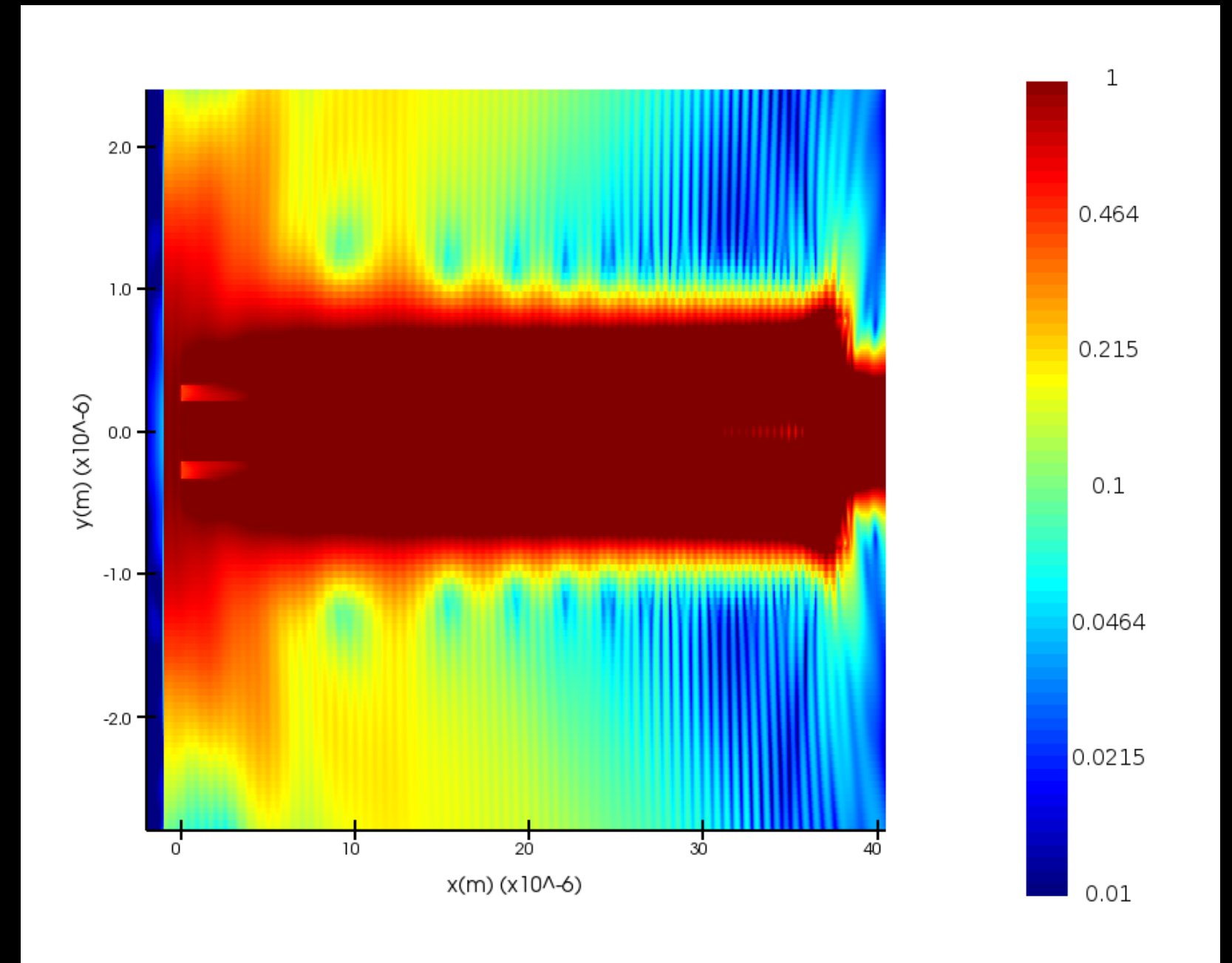
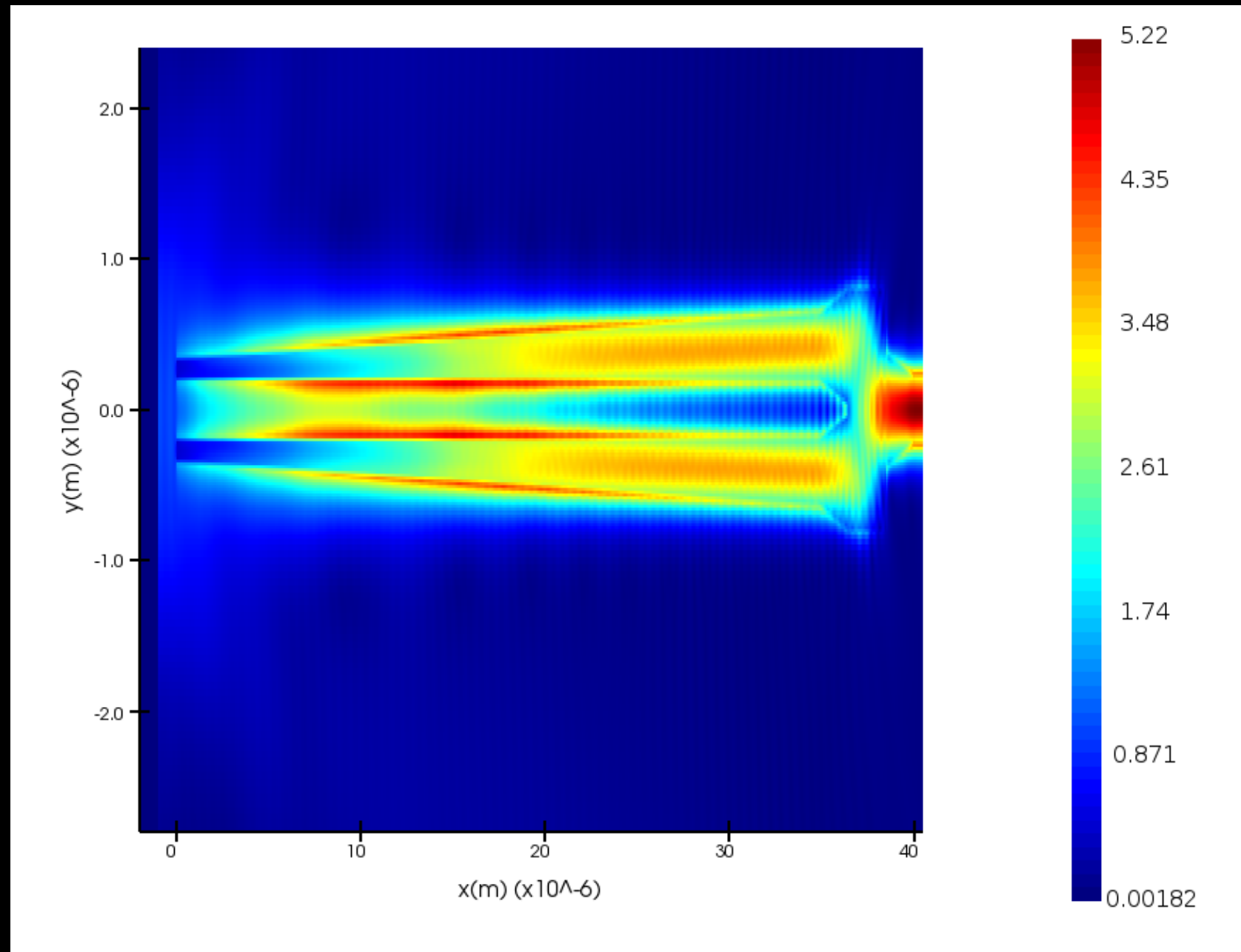
# TE MODE INPUT FIELD IN THE FIBER



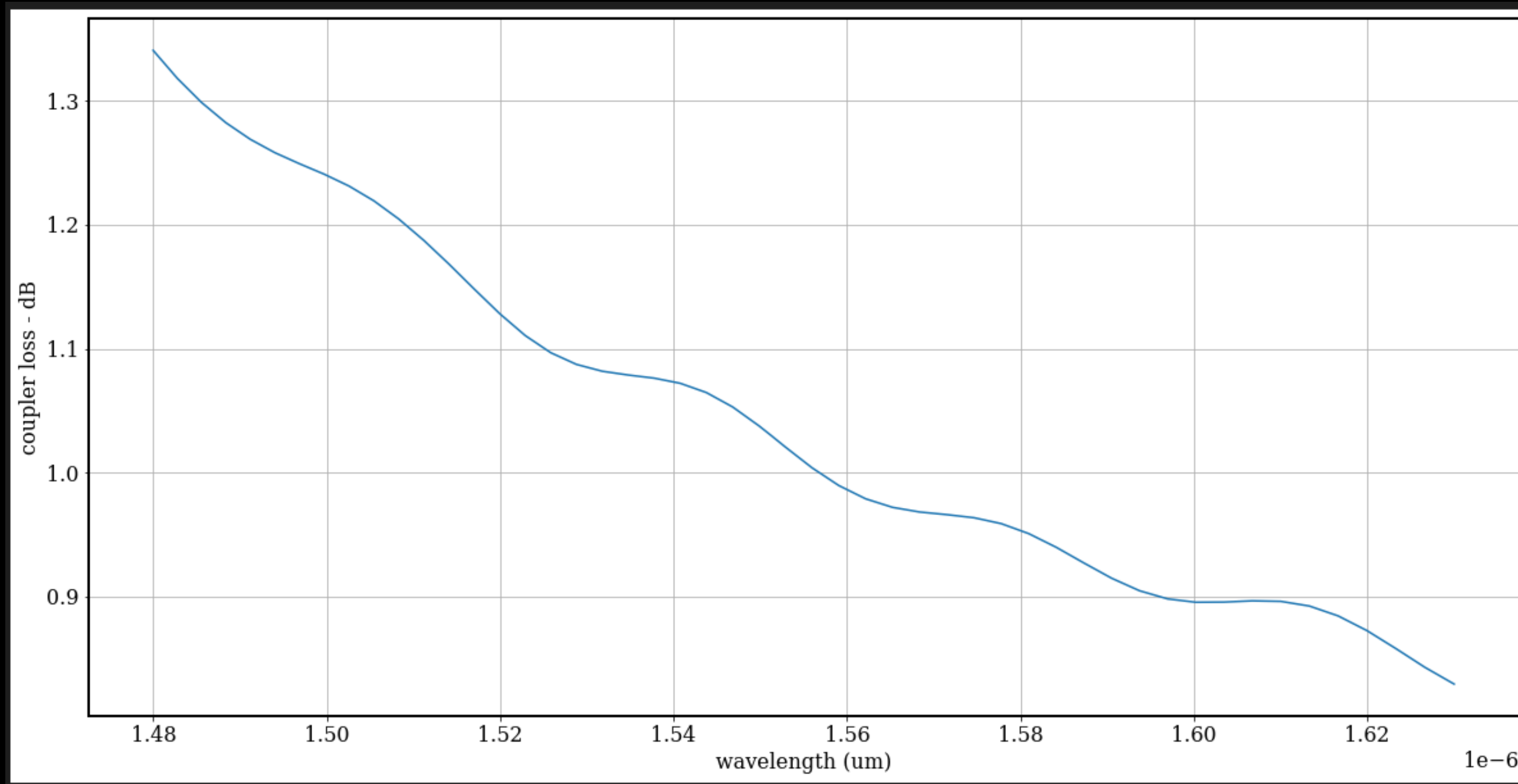
$y$  span = 6  $\mu\text{m}$   
 $z$  span = 10  $\mu\text{m}$



# DISTRIBUIÇÃO DE CAMPO

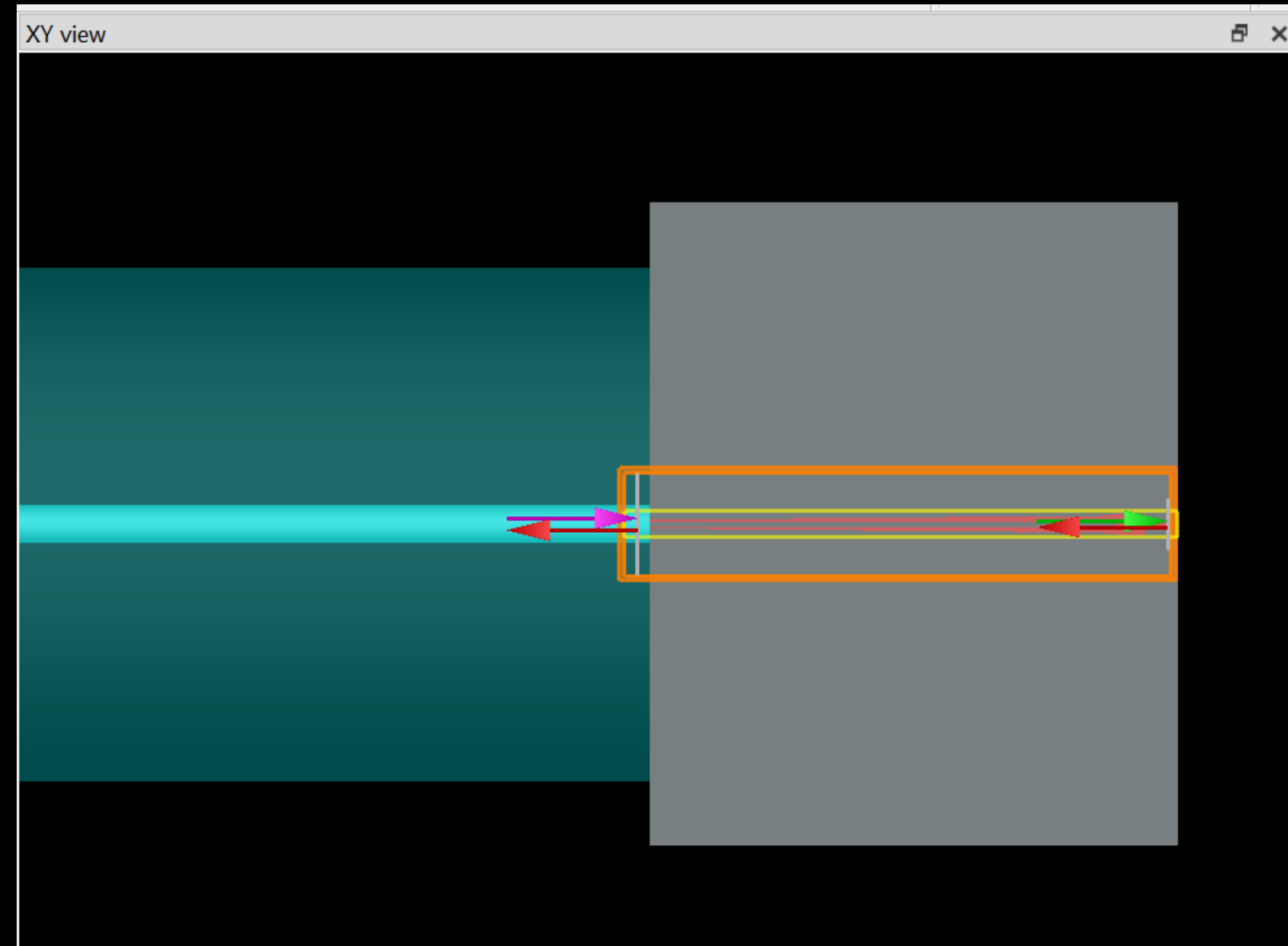


# COUPLING LOSS



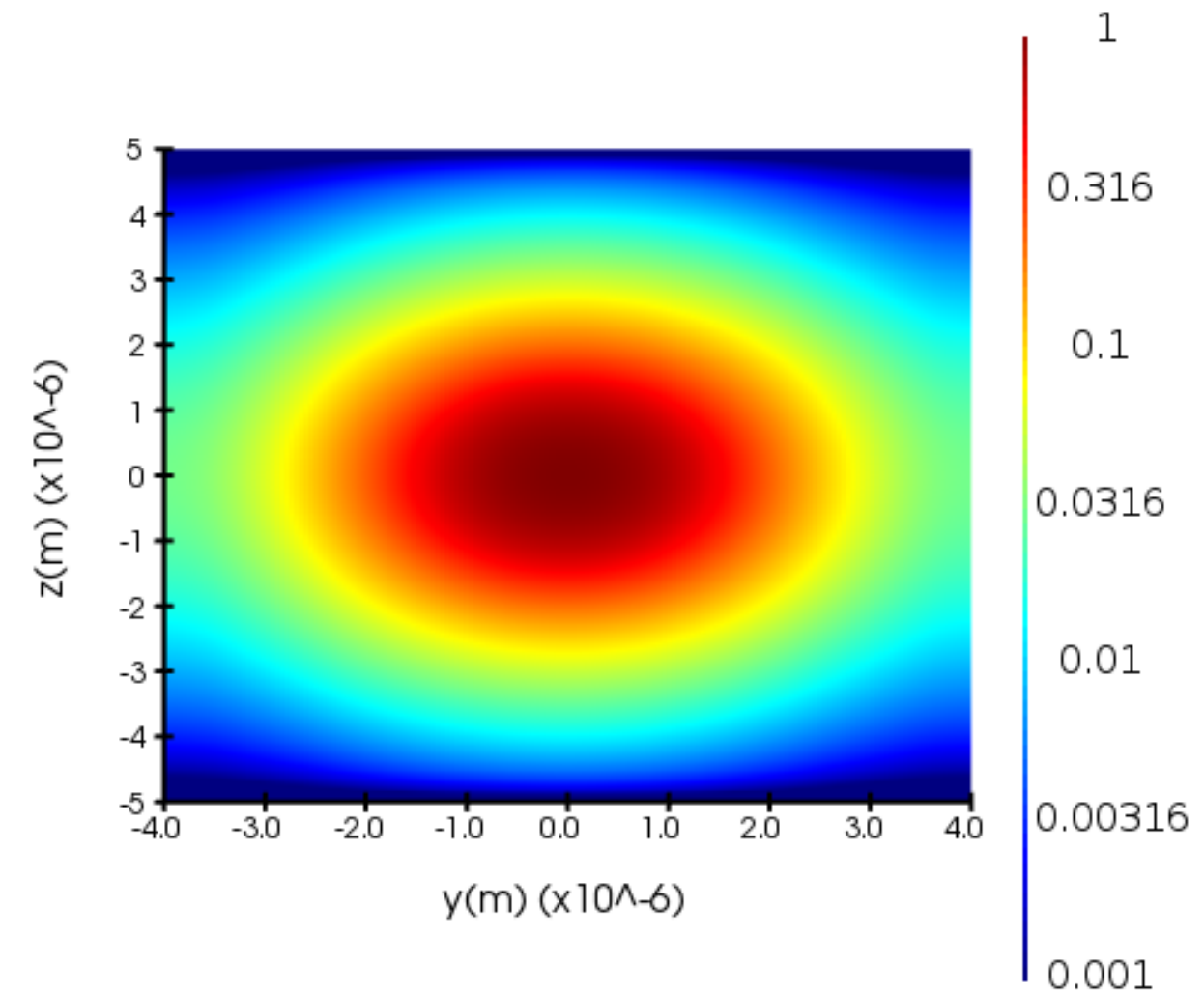
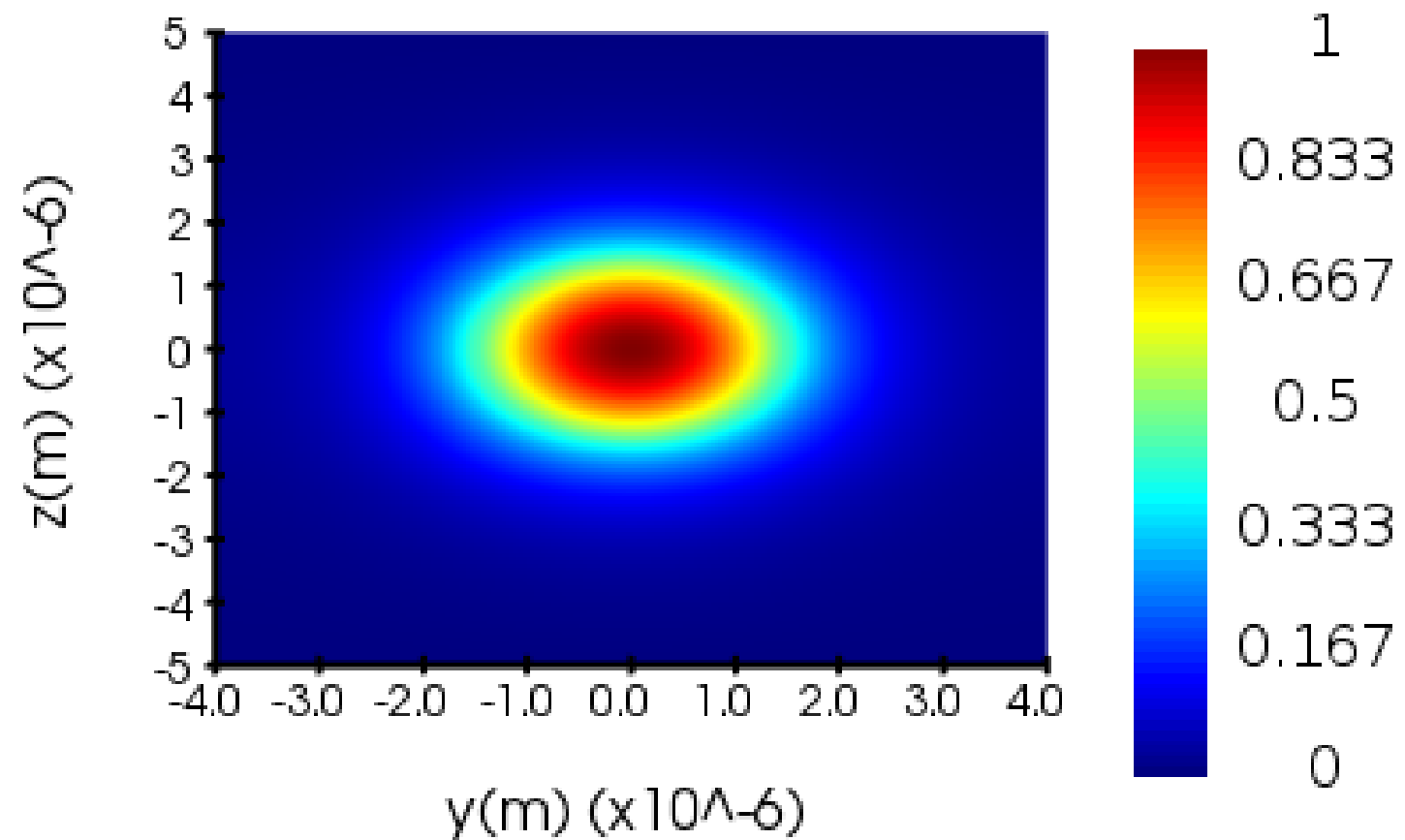
semana 2

06/03 - 17/03



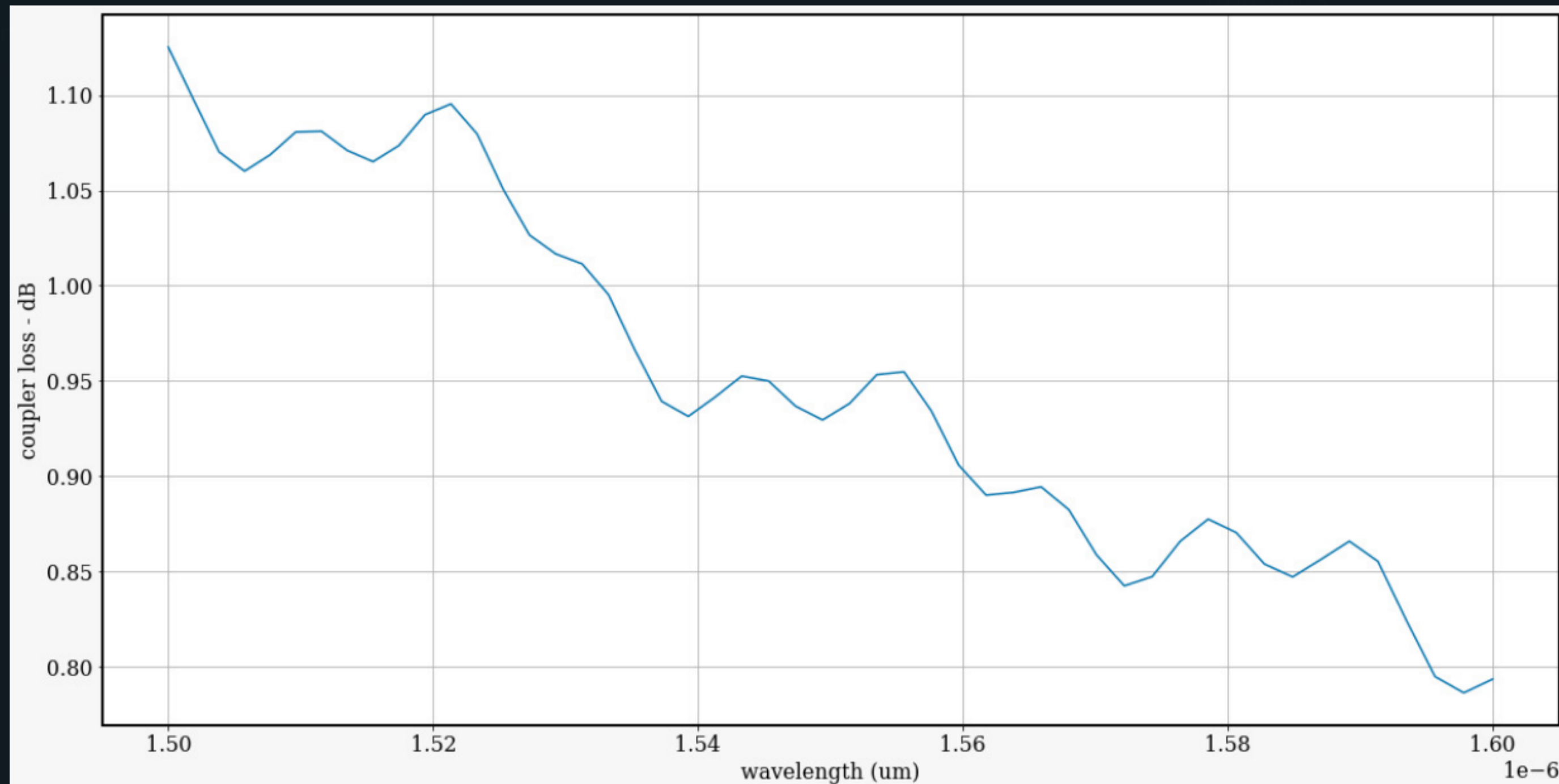
- o yspan da porta de entrada foi aumentada para 8um
- a condição de fronteira para z min foi mudada para symmetric
- o mesh utilizado foi de 5

# TE MODE INPUT FIELD IN THE FIBER



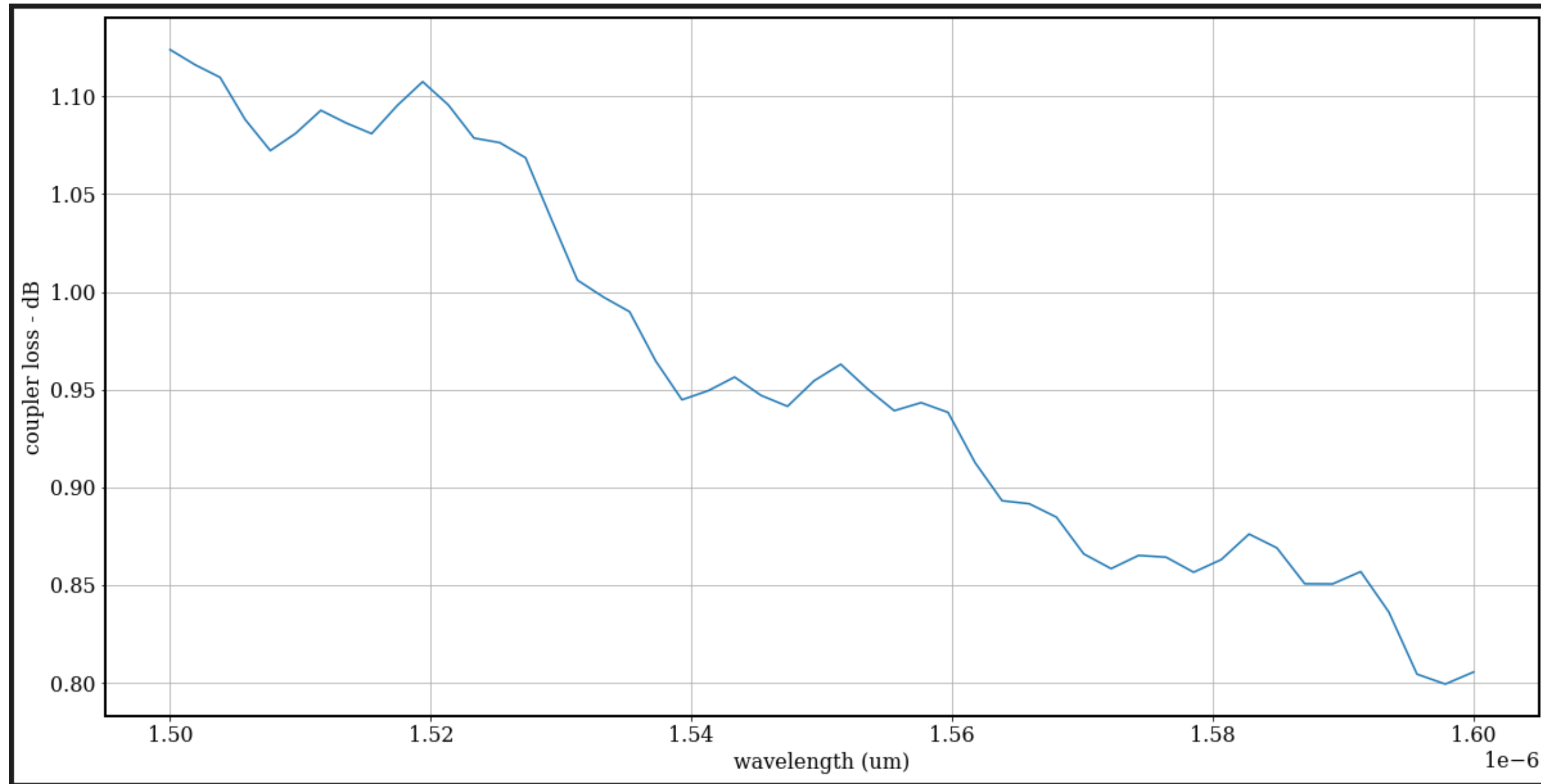
$y$  span = 8  $\mu\text{m}$   
 $z$  span = 10  $\mu\text{m}$

# COUPLING LOSS



- o autoshutoff level foi de  $5e-4$
- simulation time estava em 1200 fs
- o problema para esse caso foi a convergência da simulação

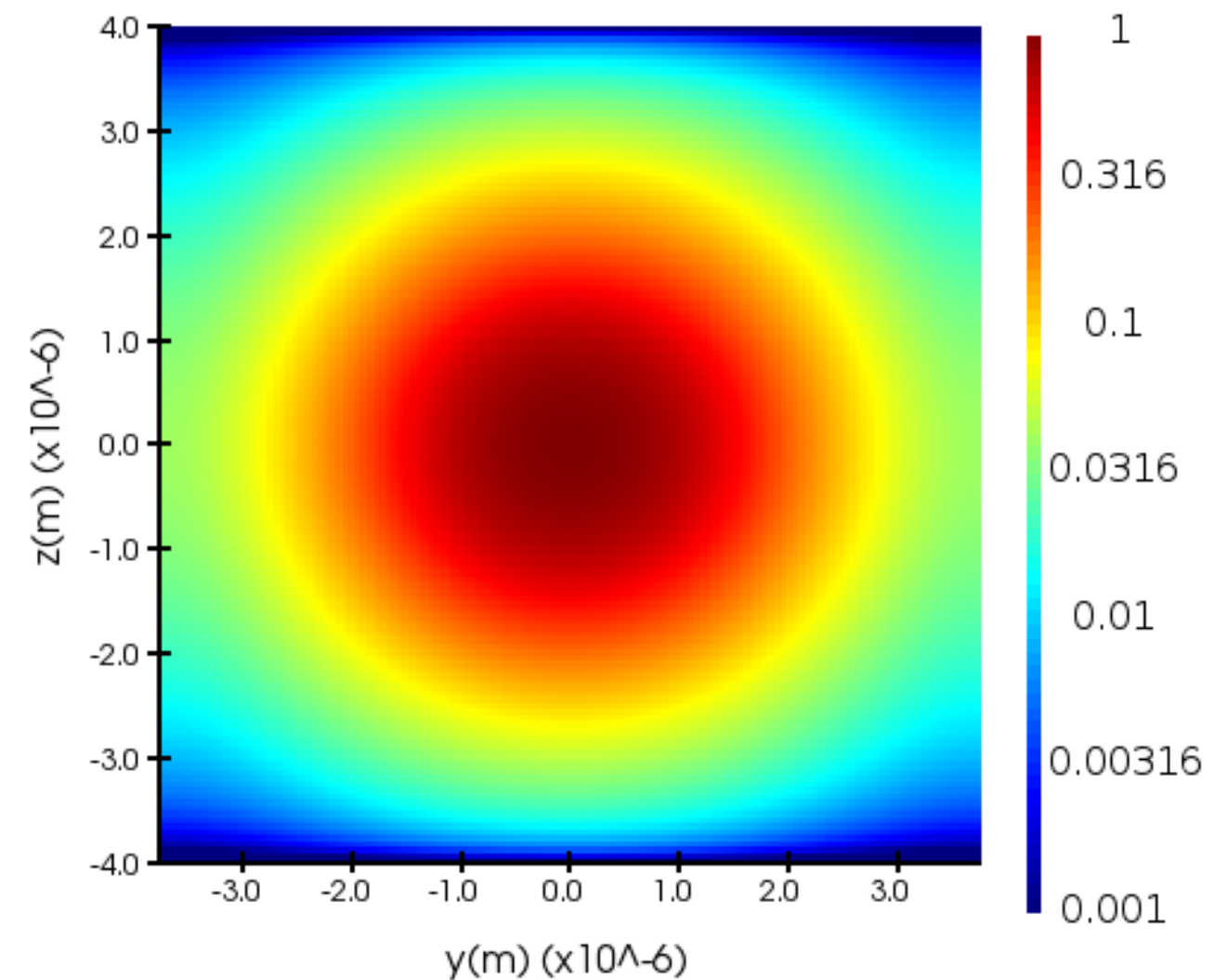
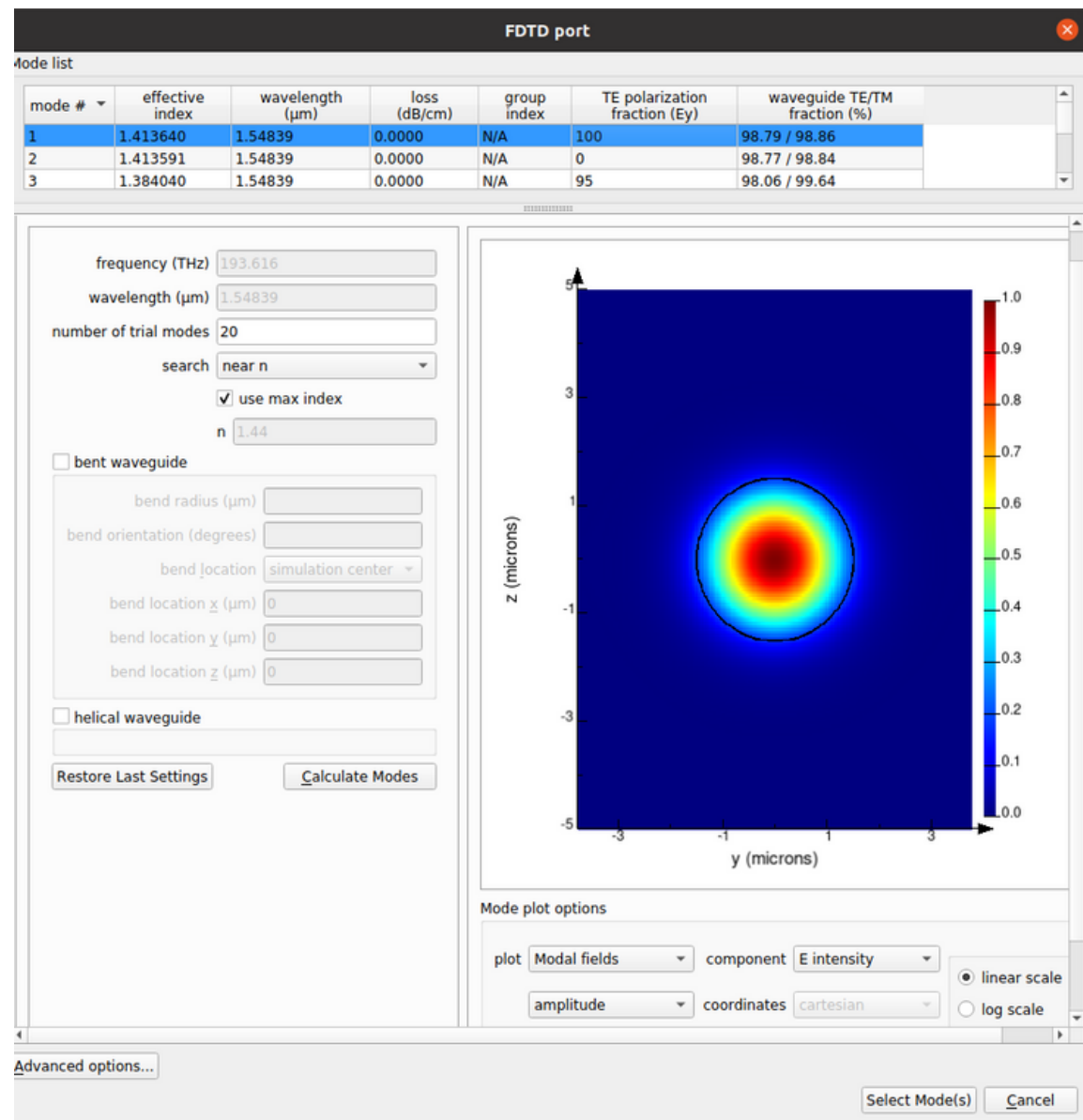
- **setando o DT STABILITY FACTOR para 0.95**
- **aumentando o simulation time para 1500 fs**



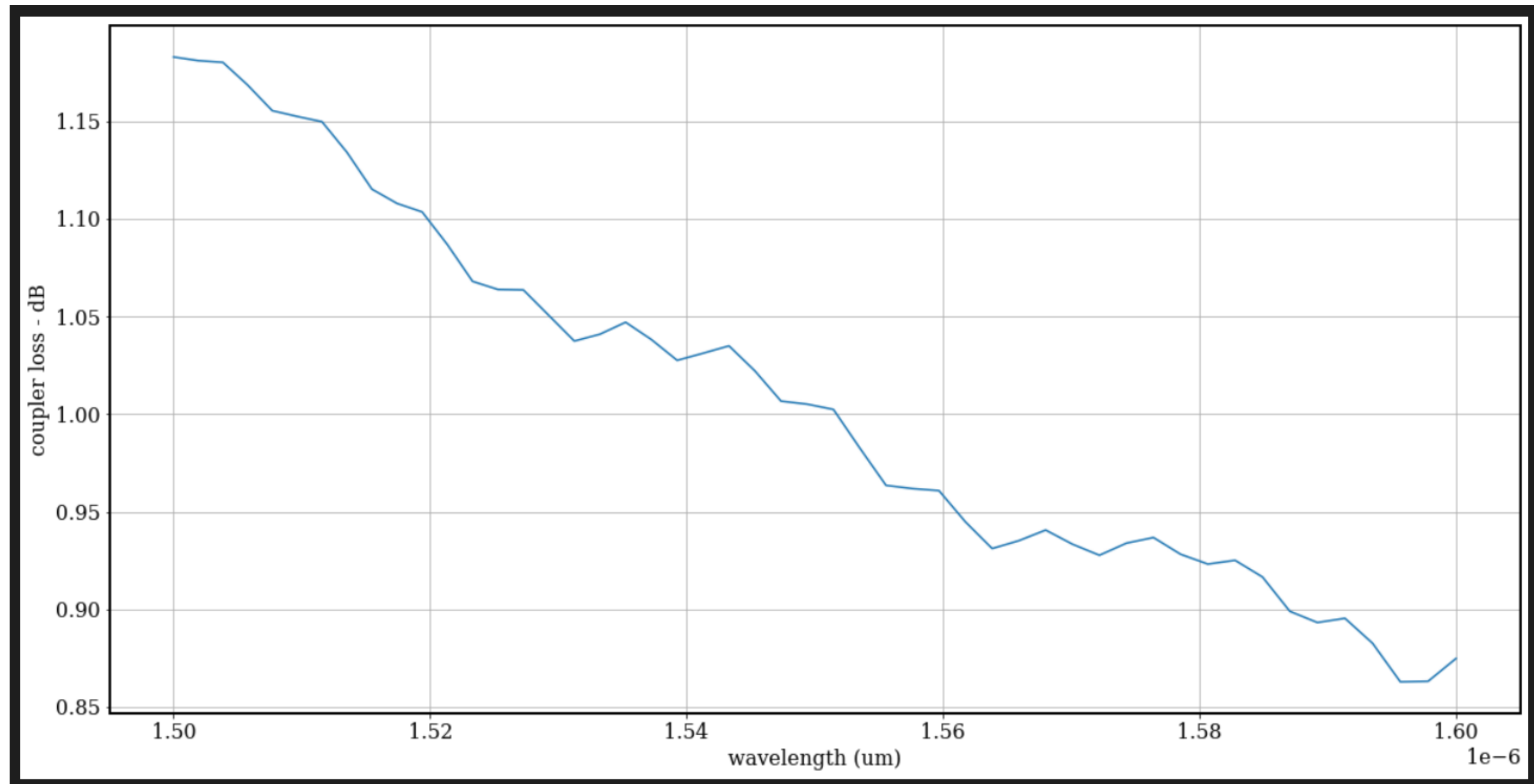
- **o autoshutoff level foi de  $3.3e-4$**
- **mais uma vez temos um problema na convergência**



- mudando o zspan da porta de excitação para 8um
- setando a condição de fronteira em zmin para PML



- setando o mesh para 3
- deixando o simulation time em 1500 fs
- DT stability factor em 0.99

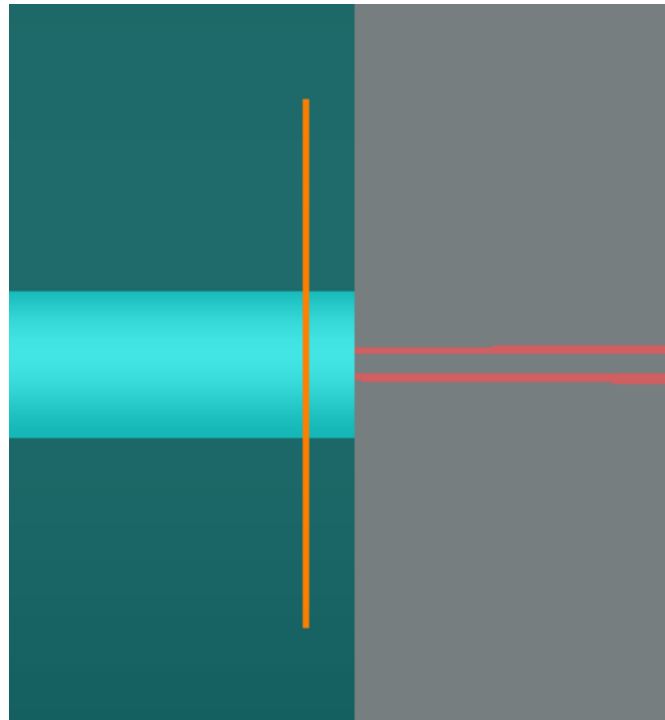


- o autosutoff level foi em torno de  $2.2 \times 10^{-4}$
- mais uma vez temos um problema na convergência

# SEMANA 3

17/03 - 24/03

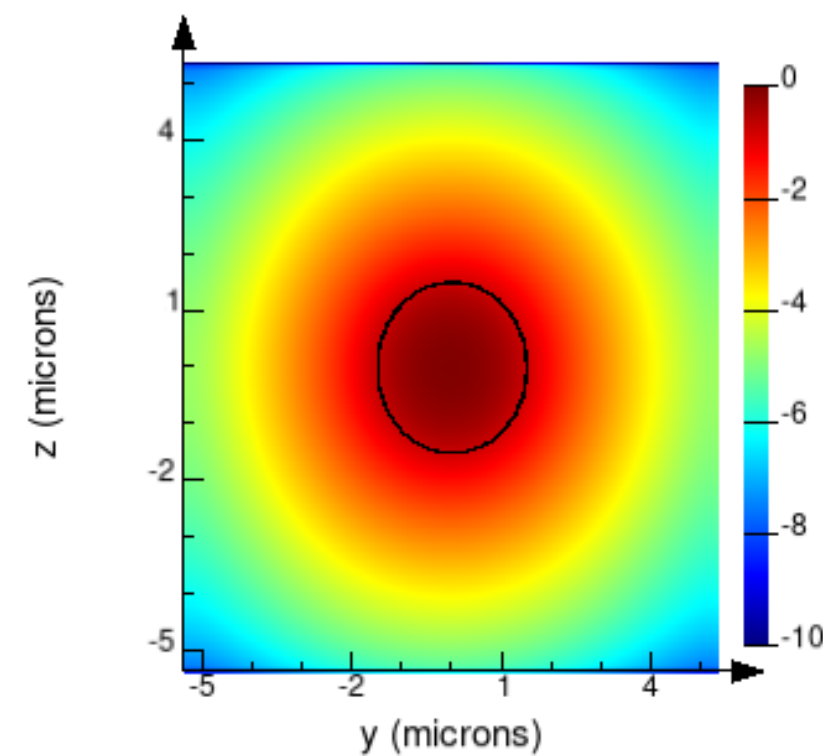
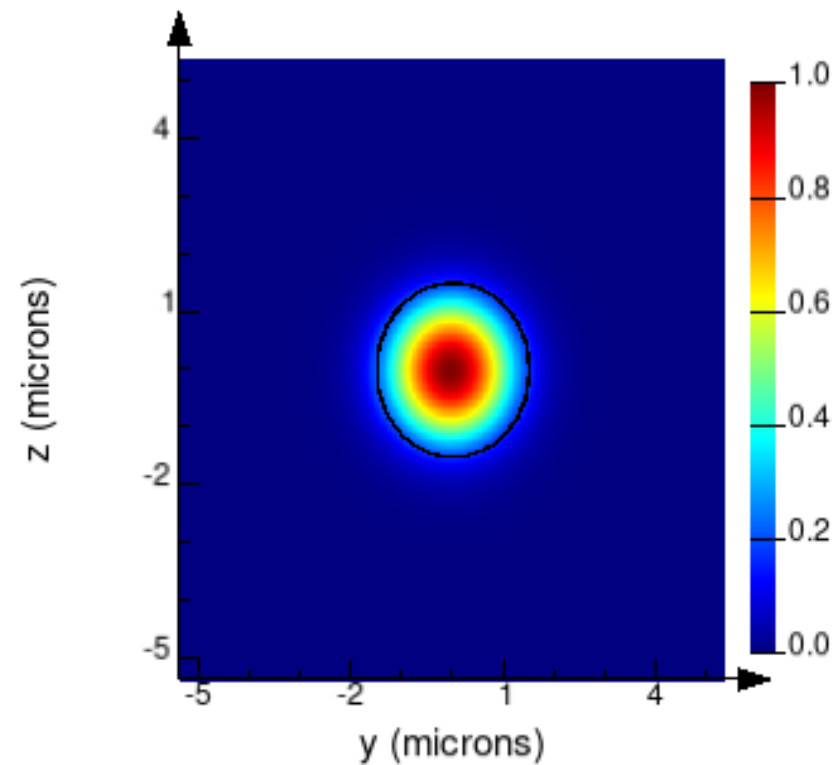
# INPUT PORT NO FDE



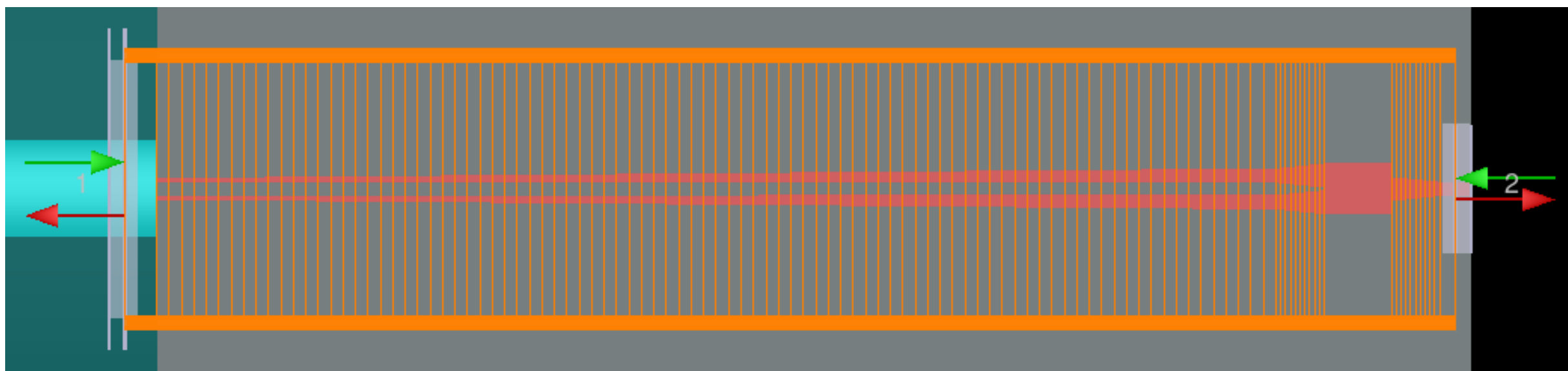
## Geometria da fibra:

- core radius = 1.5  $\mu\text{m}$
- $n_{\text{core}} = 1.44$
- cladding radius = 20  $\mu\text{m}$
- $n_{\text{cladding}} = 1.383$
- MFD = 3.3  $\mu\text{m}$

- Análise inicial com:
- mesh cells = 300
- yspan = 10  $\mu\text{m}$
- z span = 10  $\mu\text{m}$
- Z min BC = Symmetric
- Z max BC = PML
- Y min BC = PML
- Y max BC = PML
- min step mesh = 1e-6



# SIMULAÇÃO NO EME



**SOI waveguide**

## EME SETTINGS:

- **y min BC = PML**
- **y max BC = PML**
- **z min BC = Symmetric**
- **z max BC = PML**
- **y span = 10  $\mu\text{m}$**
- **z span = 10  $\mu\text{m}$**
- **min mesh step = 1e-6**

## Port 1 settings:

- **y span = 10  $\mu\text{m}$**
- **z span = 10  $\mu\text{m}$**

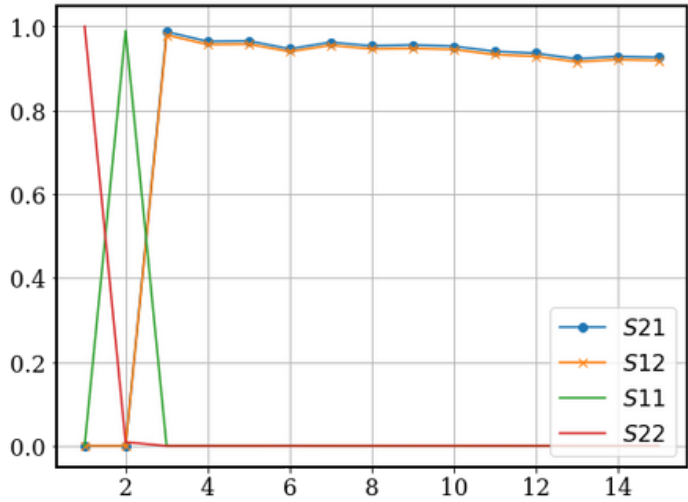
## Port 2 settings:

- **y span 4  $\mu\text{m}$**
- **z span = 4  $\mu\text{m}$**

cell group definition

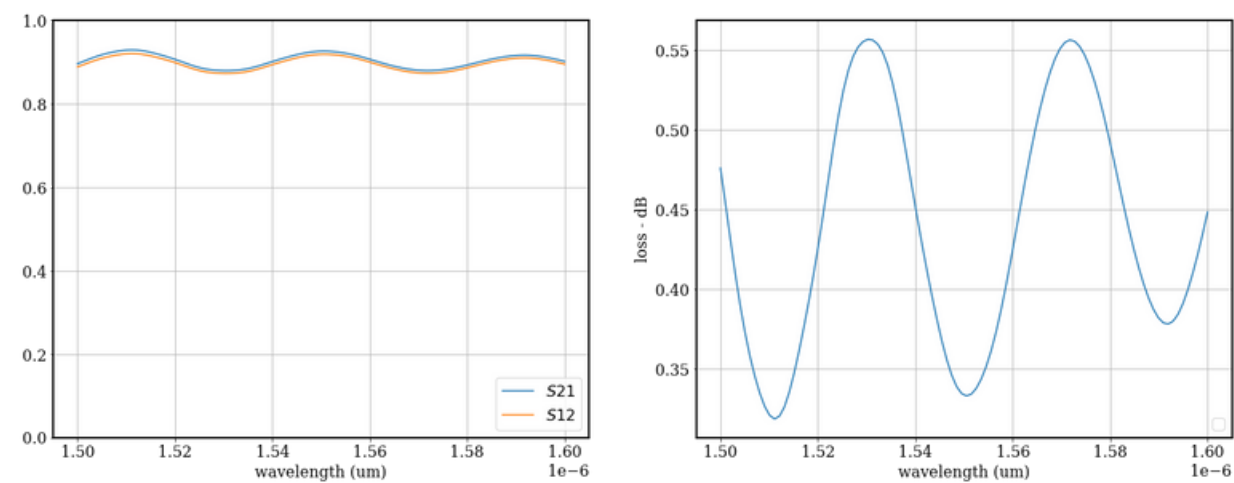
	group spans ( $\mu\text{m}$ )	cells	subcell method	modes	custom	cell range	start ( $\mu\text{m}$ )
1	1	1	none	15	default	[1]	-1
2	34.9	90	CVCS	15	default	[2 ... 91]	-6.66134e-16
3	1.5	10	CVCS	15	default	[92 ... ...]	34.9
4	2.1	1	none	15	default	[102]	36.4
5	1.5	10	CVCS	15	default	[103 .....]	38.5
6	0.5	1	none	15	default	[113]	40

## mode convergence sweep

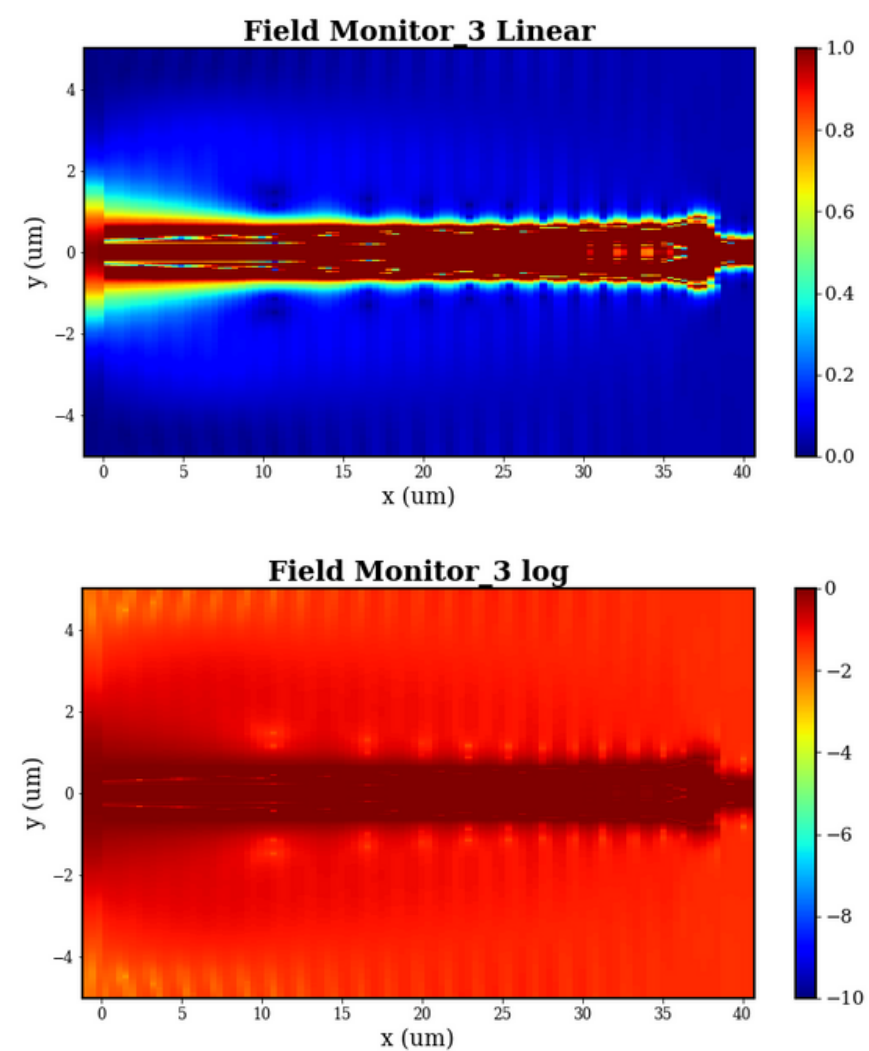
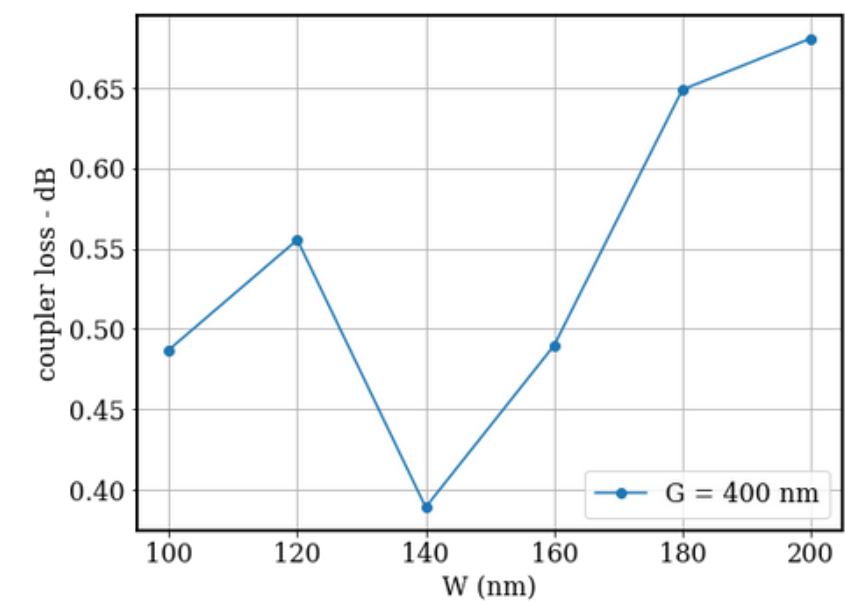


# Results

## wavelength sweep



## EME sweep



## referência

