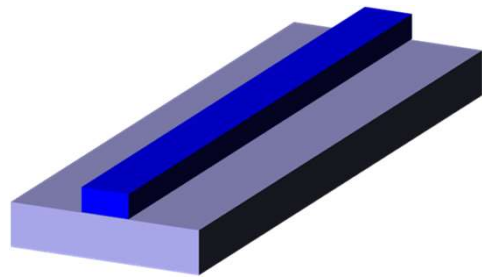




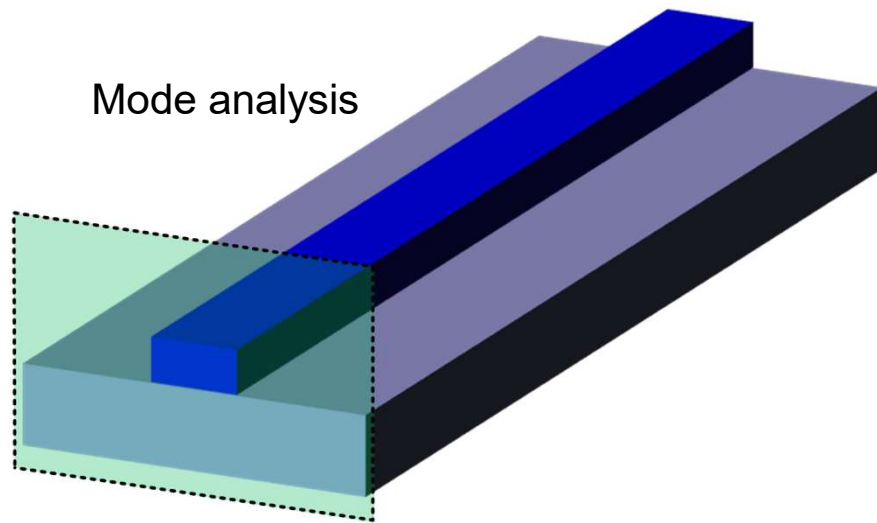
# P&S COMSOL® Design: Simulations of Optical Components Tutorial 4: Optical Waveguide I

Manuel Kohli & Raphael Schwanninger & Tobias Blatter

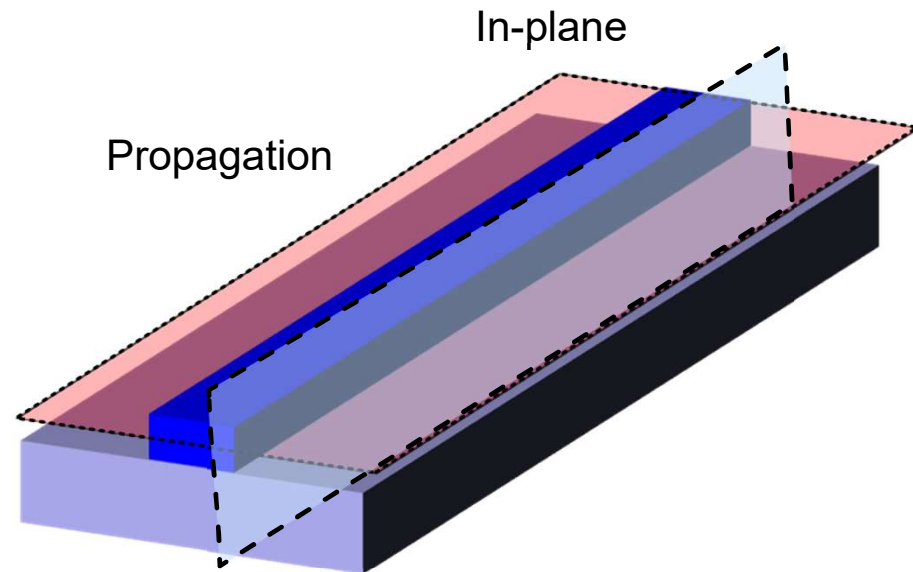
# Waveguiding in COMSOL



Out-of-plane



Mode analysis



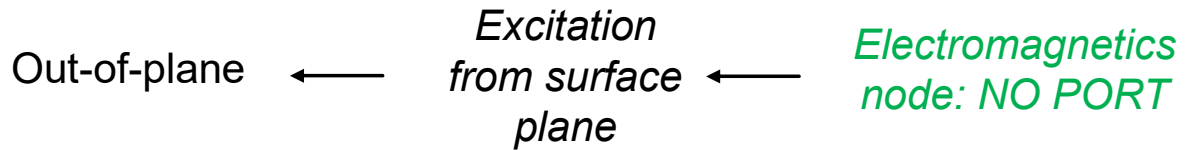
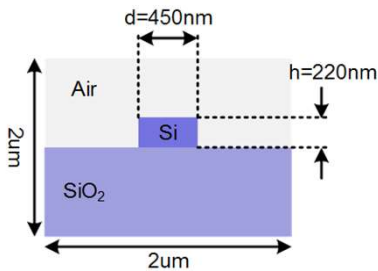
In-plane

Propagation

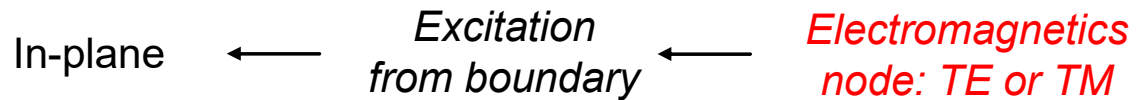
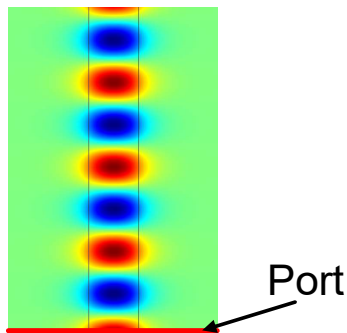
# Waveguiding in COMSOL

- Propagation
  - *Out-of-plane: Ports are not defined* (eigenvalue solution to the whole geometry)
  - *In-plane: Ports need to be defined* (eigenvalue solution to the defined port)

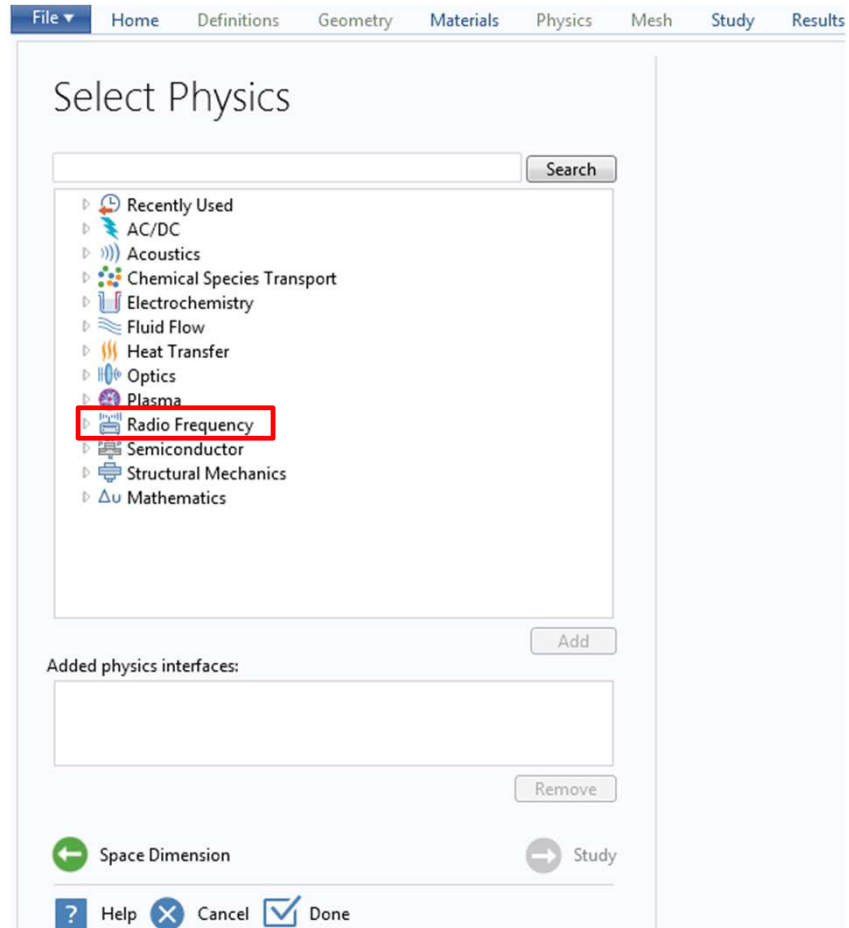
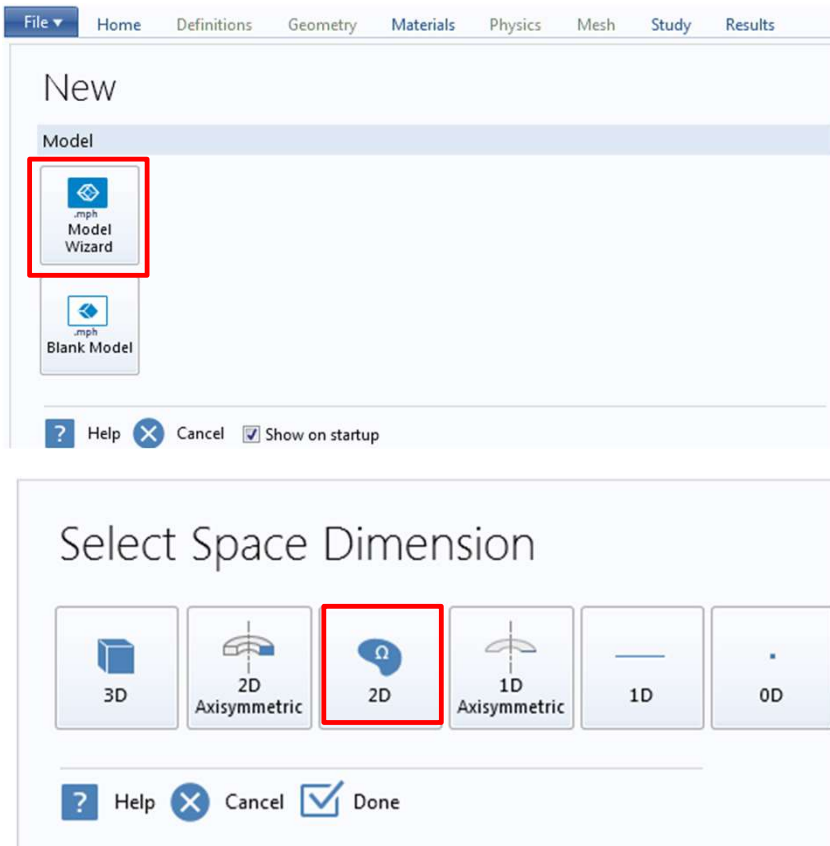
Next week



TODAY



# Set up Environment



# Set up Environment

File Home Definitions Geometry Materials Physics Mesh Study Results

## Select Physics

Search

- Recently Used
- AC/DC
- Acoustics
- Chemical Species Transport
- Electrochemistry
- Fluid Flow
- Heat Transfer
- Optics
- Plasma
- Radio Frequency
  - Electromagnetic Waves, Frequency Domain (emw)**
  - Electromagnetic Waves, Time Explicit (ewte)
  - Electromagnetic Waves, Transient (temw)
  - Transmission Line (tl)
- Semiconductor
- Structural Mechanics
- Mathematics

Add

Added physics interfaces:

- Electromagnetic Waves, Frequency Domain (emw)

Remove

← Space Dimension → Study

? Help × Cancel  Done

## Electromagnetic Waves, Frequency Domain

The Radio Frequency, Electromagnetic Waves, Frequency Domain interface is used to solve for time-harmonic electromagnetic field distributions.

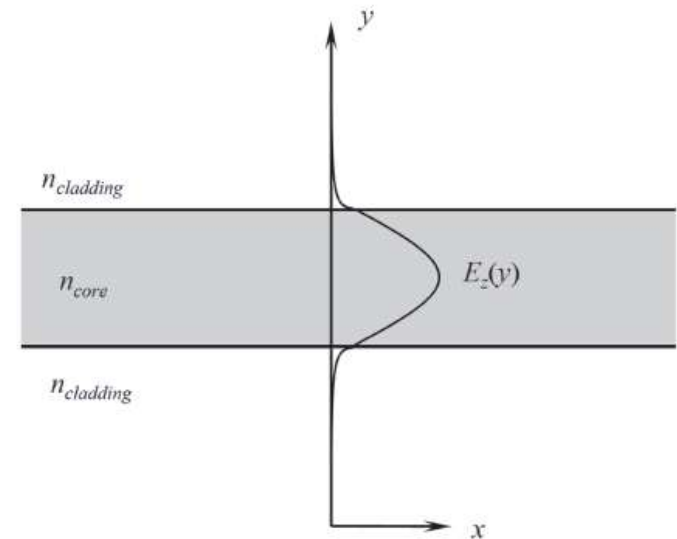
For this physics interface, the maximum mesh element size should be limited to a fraction of the wavelength. The domain size that can be simulated thus scales with the amount of available computer memory and the wavelength. The physics interface supports the study types Frequency Domain, Eigenfrequency, Mode Analysis, and Boundary Mode Analysis. The Frequency Domain study type is used for source driven simulations for a single frequency or a sequence of frequencies. The Eigenfrequency study type is used to find resonance frequencies and their associated eigenmodes in resonant cavities.

This physics interface solves the time-harmonic wave equation for the electric field.

# Set up Environment

## Parameters

Name	Expression	Value
$\lambda_0$	1550[nm]	1.55E-6 m
$n_{\text{core}}$	1.5	1.5
$n_{\text{cladding}}$	1	1
$h_{\text{core}}$	2.5[um]	2.5E-6 m
$h_{\text{cladding}}$	7[um]	7E-6 m
$w_{\text{slab}}$	50[um]	5E-5 m
$f_0$	$c_{\text{const}}/\lambda_0$	1.9341449E14...



# Define: Mesh & Port Definition & Study

- Port Definition
  - Left «excitation» port
  - Right «collection» port
  - Type off port: Numeric
- Mesh
  - Cladding: finer
  - Core:  $\lambda_0/n_{\text{core}}/4$
- Study
  - Right click → Study Steps → Boundary Mode analysis ( Has to be Step 1)
    - Set frequency
    - Desired number of modes : 1
    - Search for modes around:  $n_{\text{core}}$
  - Same for Port 2

# Study

- Show E-field in waveguide
  - Which field component has to be plotted?
- 1D- Plots
  - Show Field at Port 1
- Replace Port 2 with Perfect Electric Conductor
  - What changes?
- Investigate the confinement of the wave to waveguide using a parameter sweep and no changing of the geometry
  - Port 2 active
  - Which parameter needs to be swept (talk to lecturers)?
  - What can you see?
- Disable Parametric sweep, Change the number of allowed modes and study the E-fields

