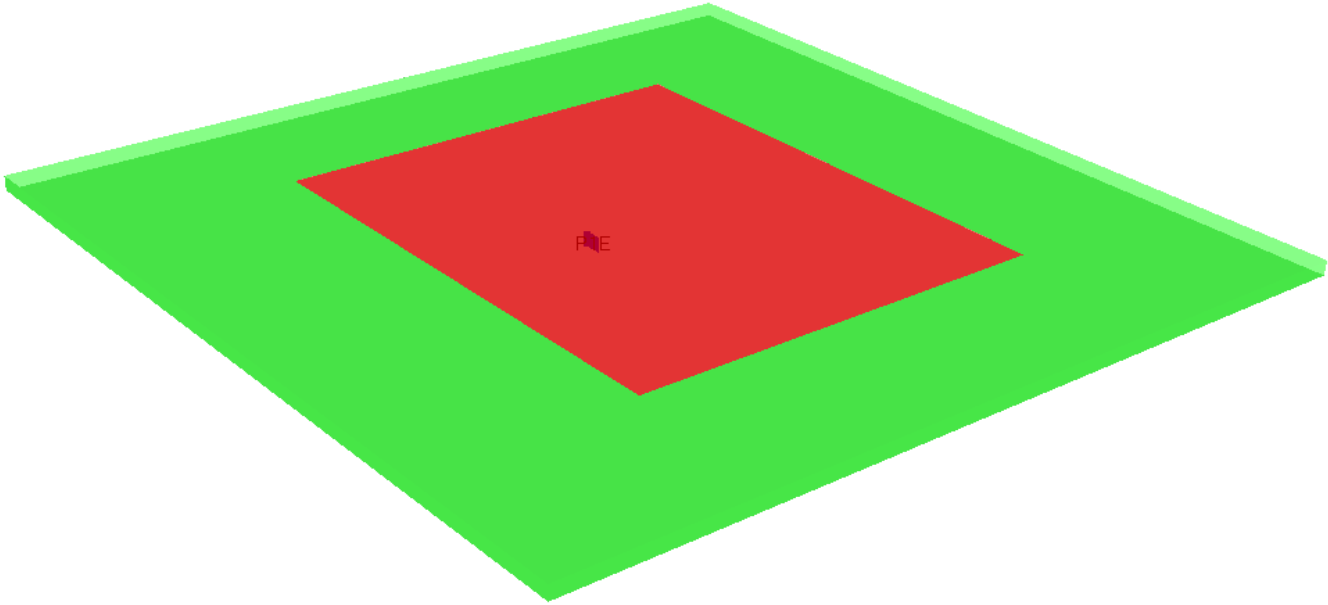
EMPIRE XPU Tutorial

Patch Antenna design

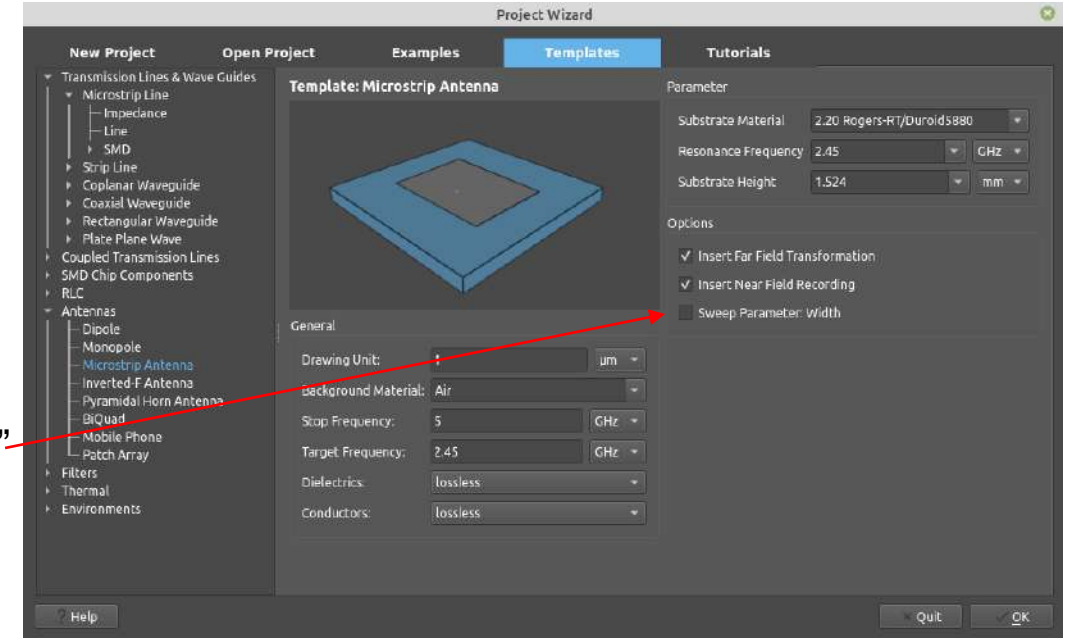
Overview: Topics

- Template wizard
- Basic features
- Simulation
- Postprocessing
- Nearfield
- Farfield
- Tuning



Step 1: Template Wizard

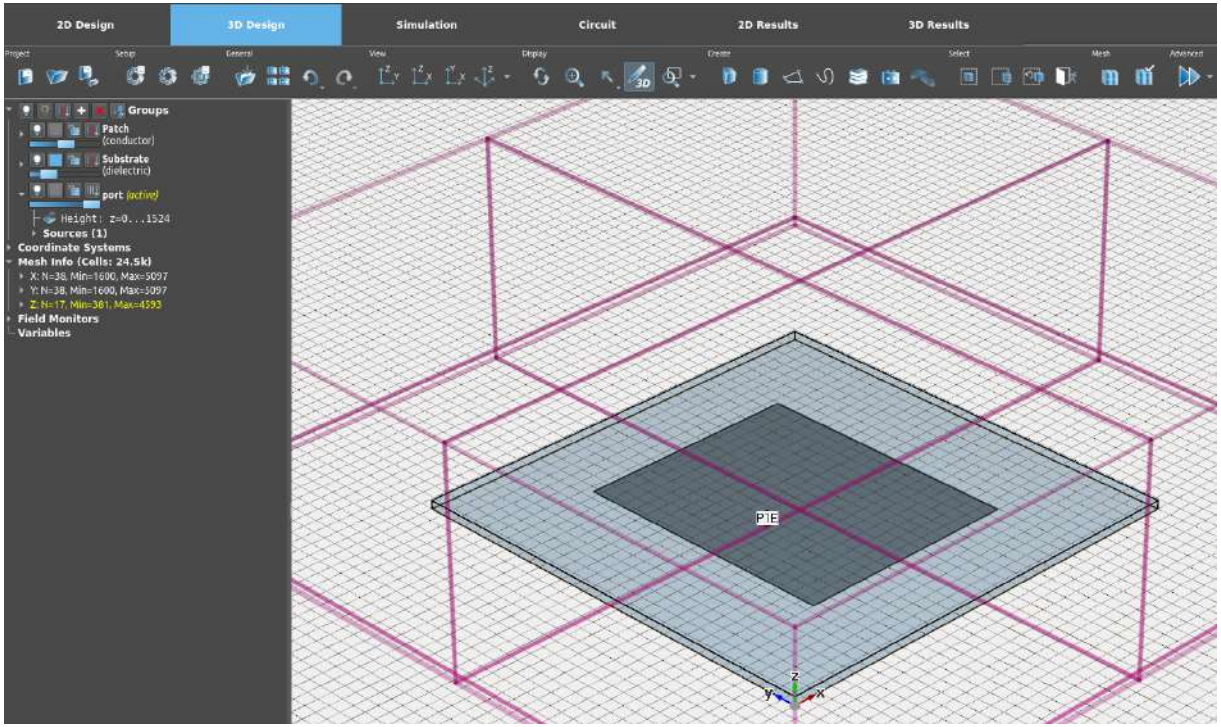
- Start Empire XPU
- Open Templates, Antennas, Microstrip Antenna
- Set the “Resonance Frequency” to 2.45 GHz
- Uncheck “Sweep Parameter: Width”
- Press “Open Selection”
- Select File, Save As, optionally create new folder



Comments:
Using the template “Microstrip antenna…”
• Automatic generation of patch dimensions, substrate, lumped port, near and far field definitions
• Automatic generation of mesh

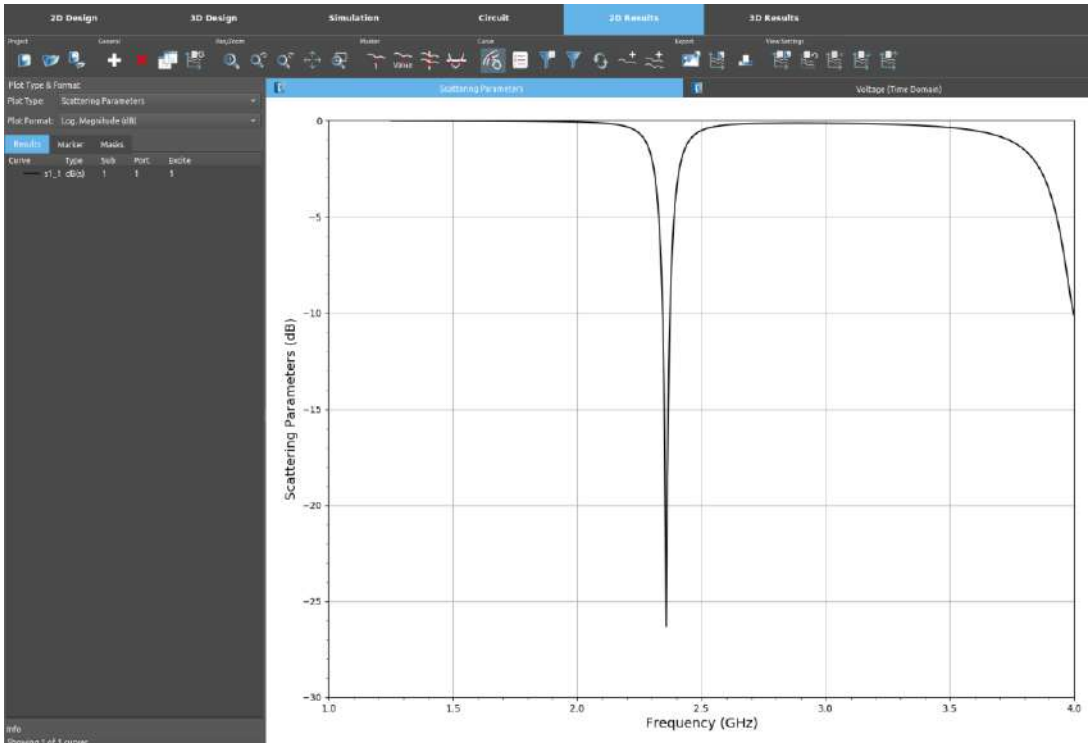
Step 2: Structure Check

- Switch to the 3D Design tab, verify that the design has the following features:
- Groups: Objects and properties
- Sources: Port parameters
- Simulation Setup:
  - Drawing unit
  - Frequency range
  - Accuracy
  - Loss calculation
  - Boundary Conditions
- Mesh Setup:
  - Automatic Meshing
  - Mesh Info: number of cells



Step 3: Simulation

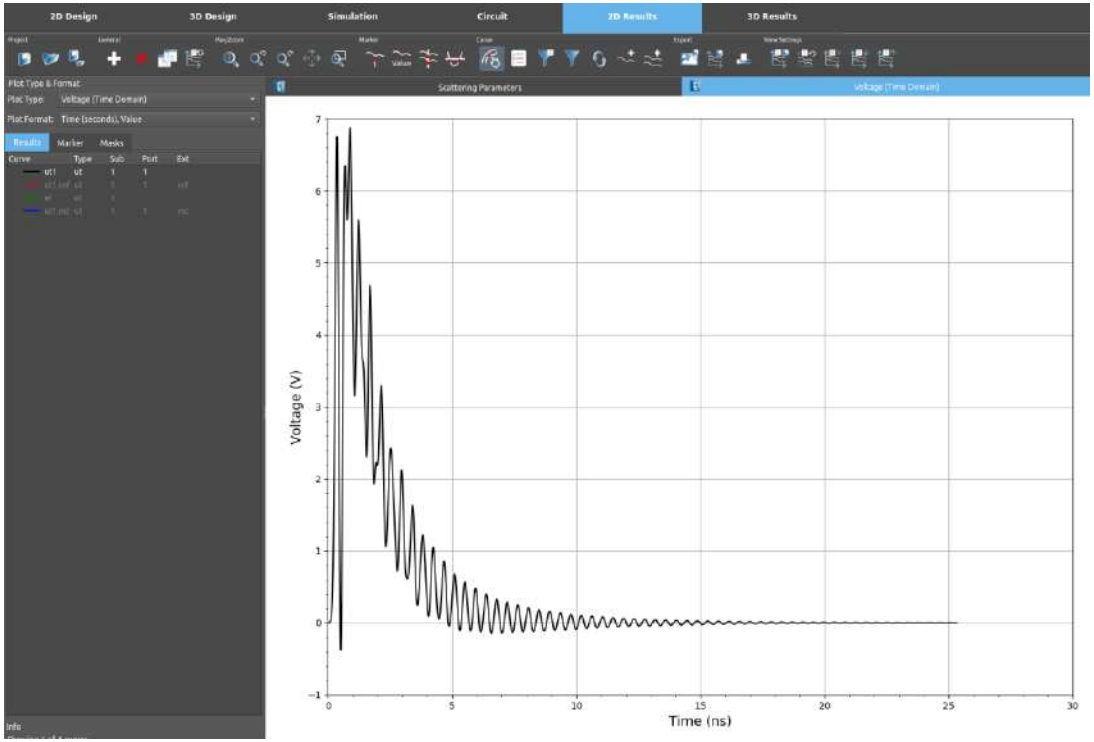
- Switch to the “Simulation” tab. Click on Start Complete Simulation and switch to the 2D Results tab, the result plots should appear shortly
- Select Scattering Parameters as the Plot Type



- *The microstrip antenna from the template wizard will be automatically meshed and the simulation will be started*
- *During the simulation the time pulses are monitored*
- *After the simulation is finished the S-Parameter results are available*

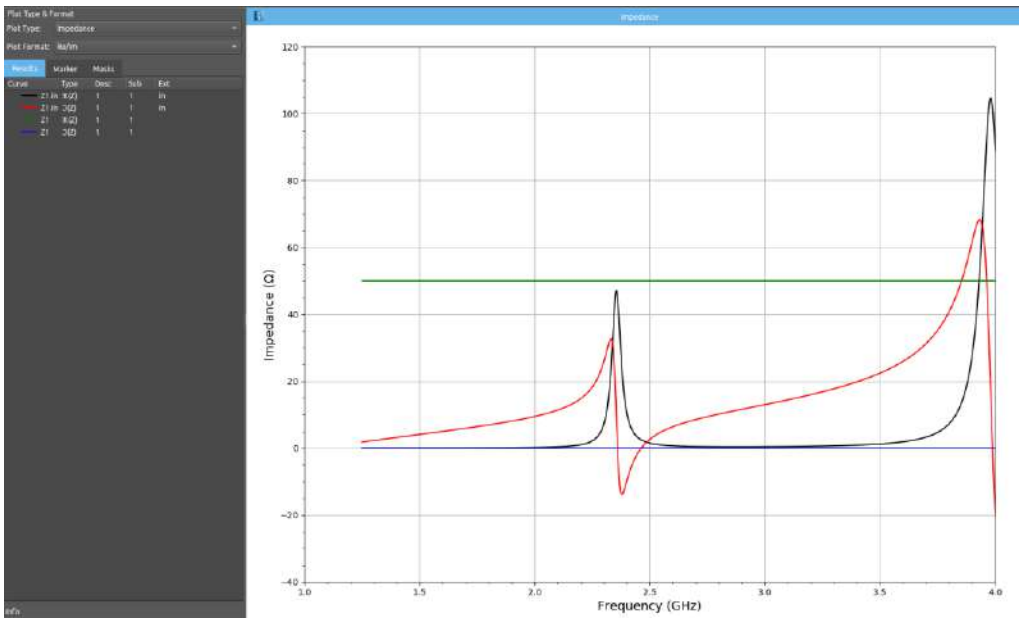
Step 3: Simulation

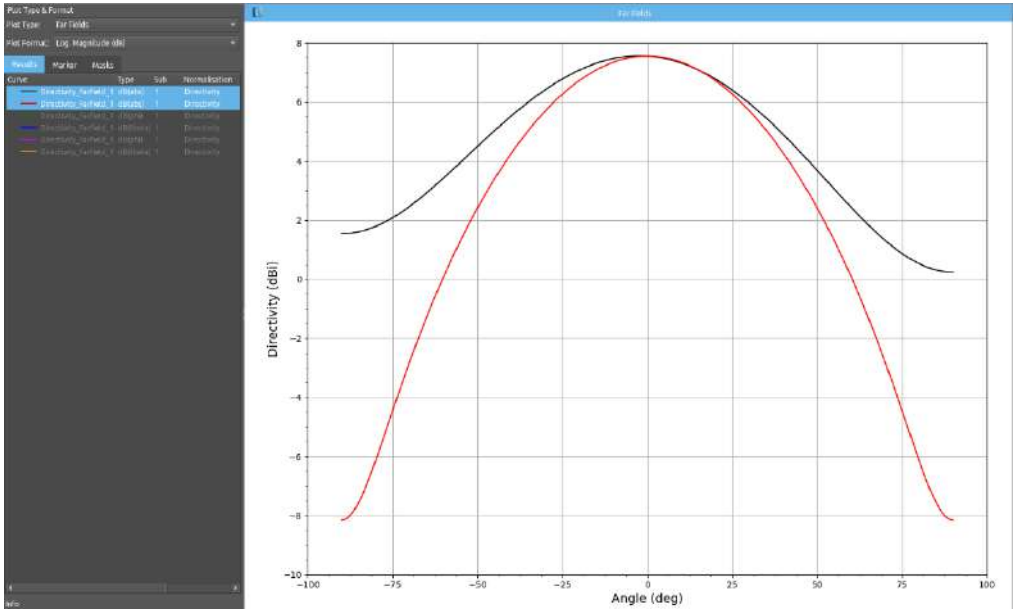
- Add a new result plot
- Select Voltage as the Plot Type



Step 4: Results

- Select Impedance as the Plot Type and check the input impedance
- Select Far Fields as the Plot Type and check the calculated far field



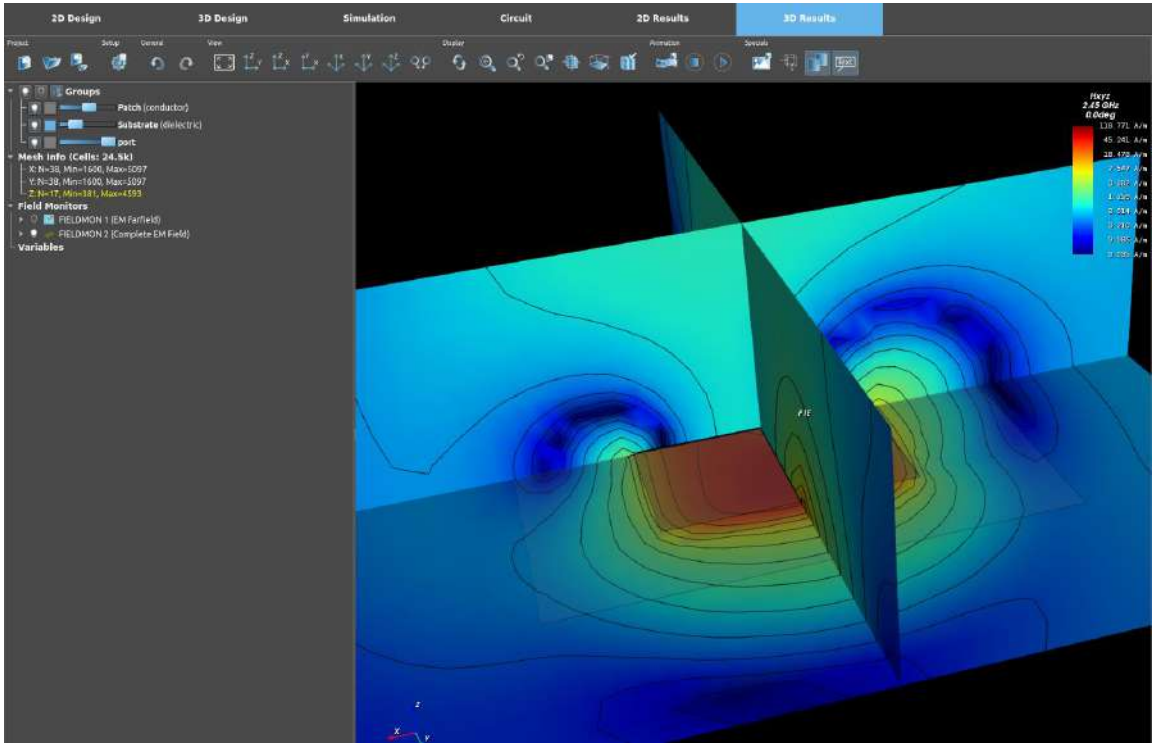


- *By default, all the curves are displayed. Here, only Z1.in is displayed, which is the impedance of the structure seen from Port 1*
- *The far field plot only shows patterns for cuts at angles phi=0° (xz) and phi=90° (yz)*

** In Legend: Select curves "db(eabs)", right click "Show only and autocolor", Button "Autoscale"*

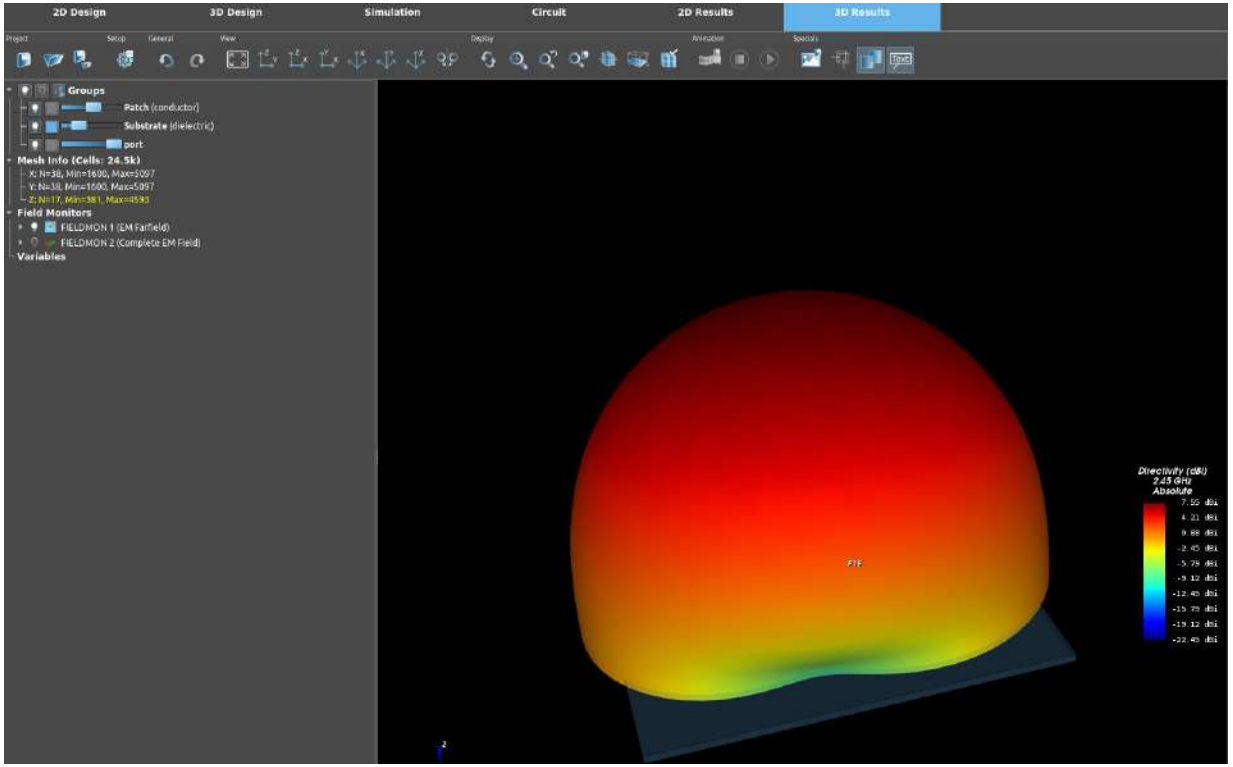
Step 5: Near Field

- Switch to the 3D Results tab
- Select Field Monitors to open Field Monitor overview
- Move sliders to control display planes
- Switch on/off planes

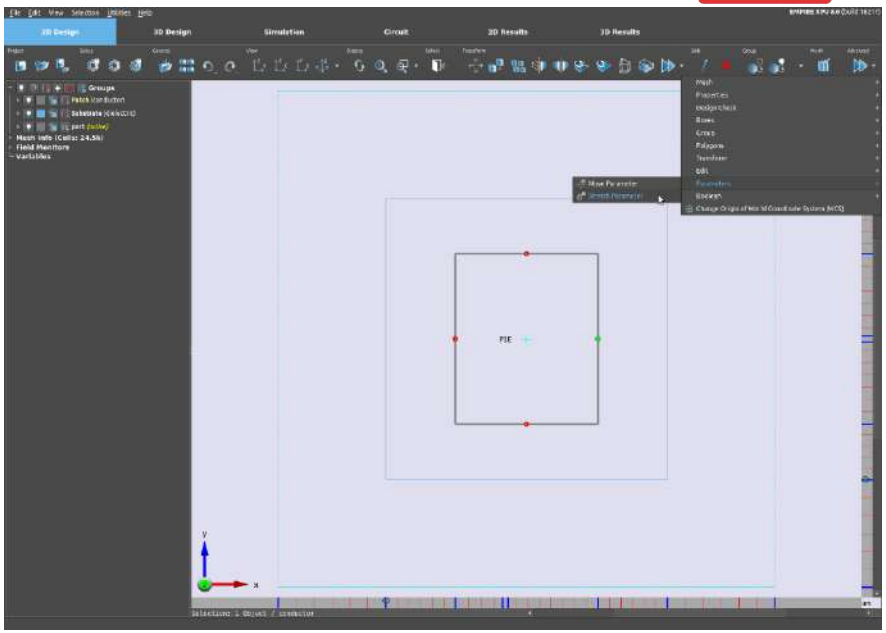


Step 6: Far field

- Turn off visibility of complete EM Field display 
- Turn On visibility of EM Farfield display 
- Press z-Key (Zoom Extents)

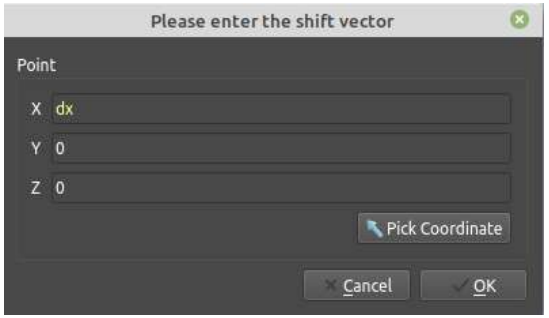


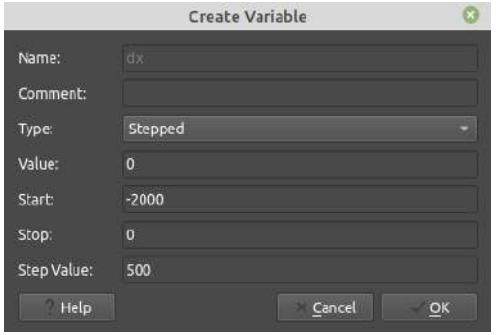
Step 7: Tuning 1



- Switch to 2D Design mode
- Select patch at right side (left click)
- Click on Advanced, Parameter, Stretch Parameter

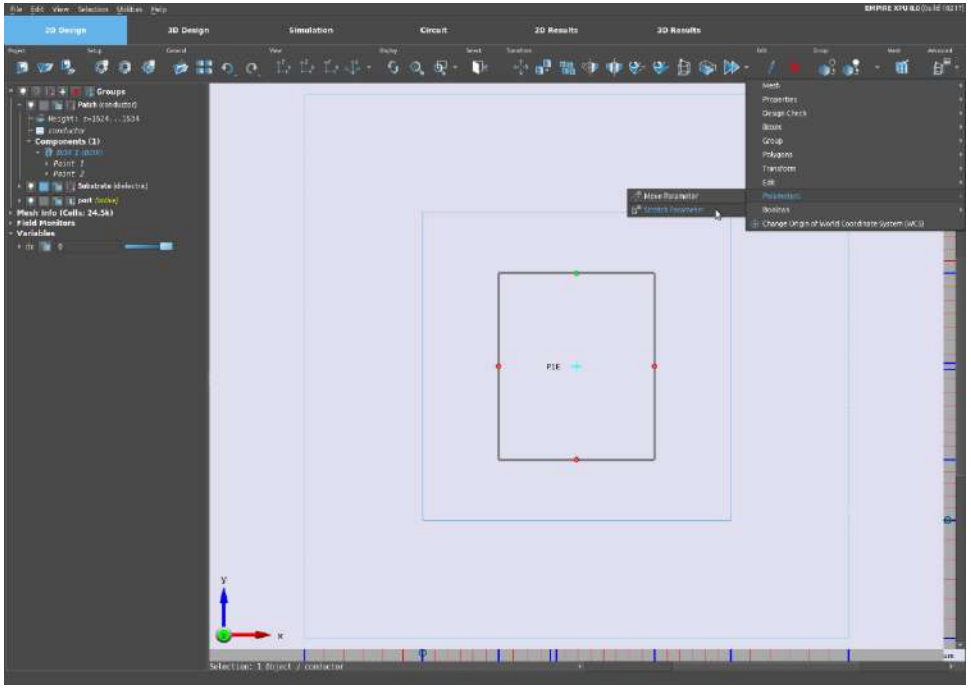
- Enter X: dx as shift vector and confirm with OK
- Set Variable to:
- Type = Stepped
- Value:0, Min: -2000, Max: 0, Step: 500,
- OK



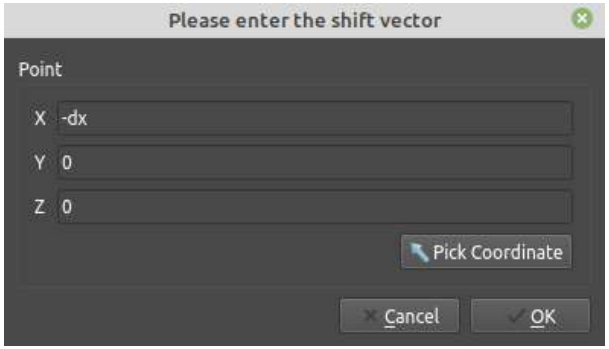


Comment: Parameters may also be added to the coordinates of the elements in the structure list.

Step 7: Tuning 1



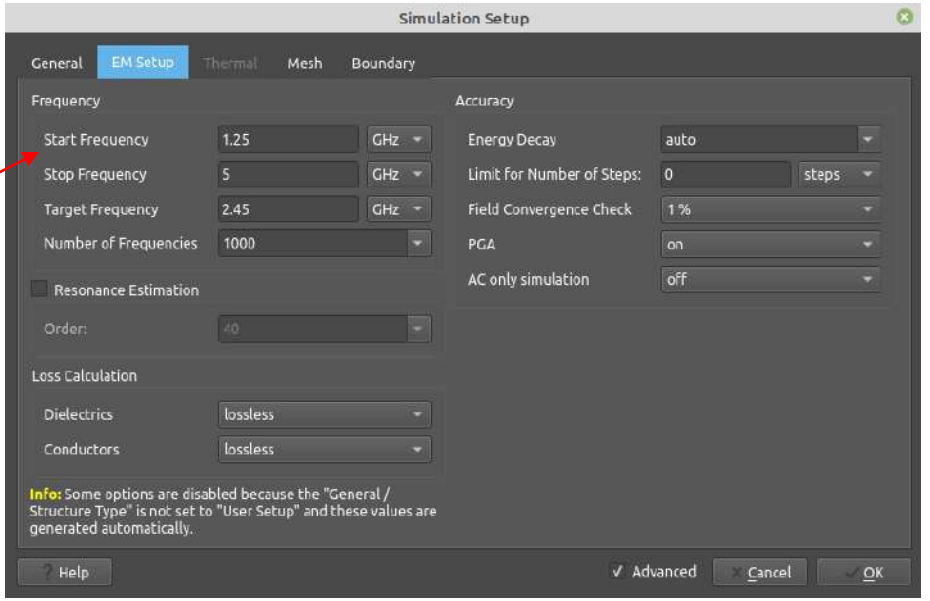
- Select patch at left side
- Click on Advanced, Parameters, Stretch Parameter
- Enter X: -dx as shift vector and confirm with OK
- Open Side menu: Variables and use the slider bar to check the range



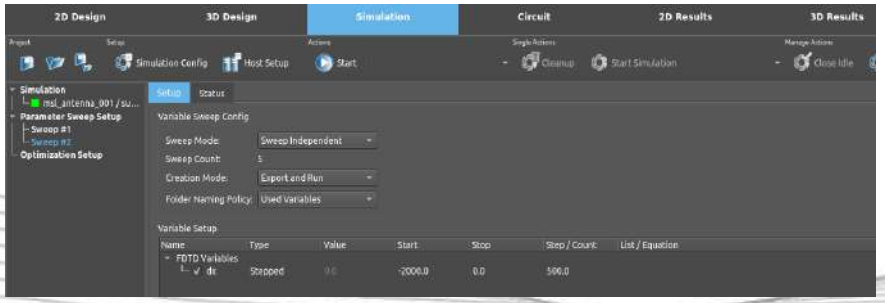
Comment: Varaibles may also be added to the coordinates of the elements in the group list.

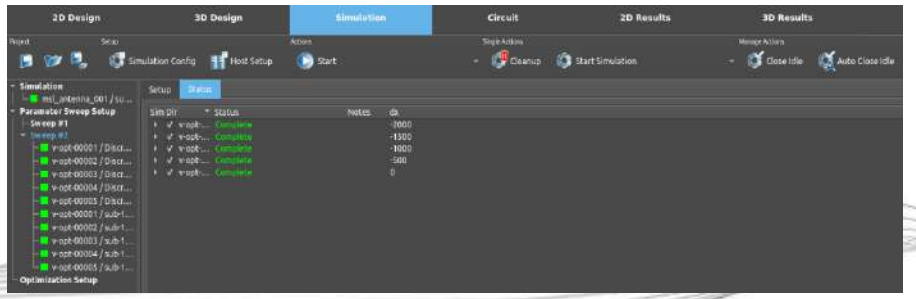
Step 8: Tuning 2

- Click “Simulation Setup”, 
  set „Start Frequency“ to 1.25 GHz,
  “Stop Frequency” to 5 GHz and
  „Target Frequency“ to 2.45 GHz



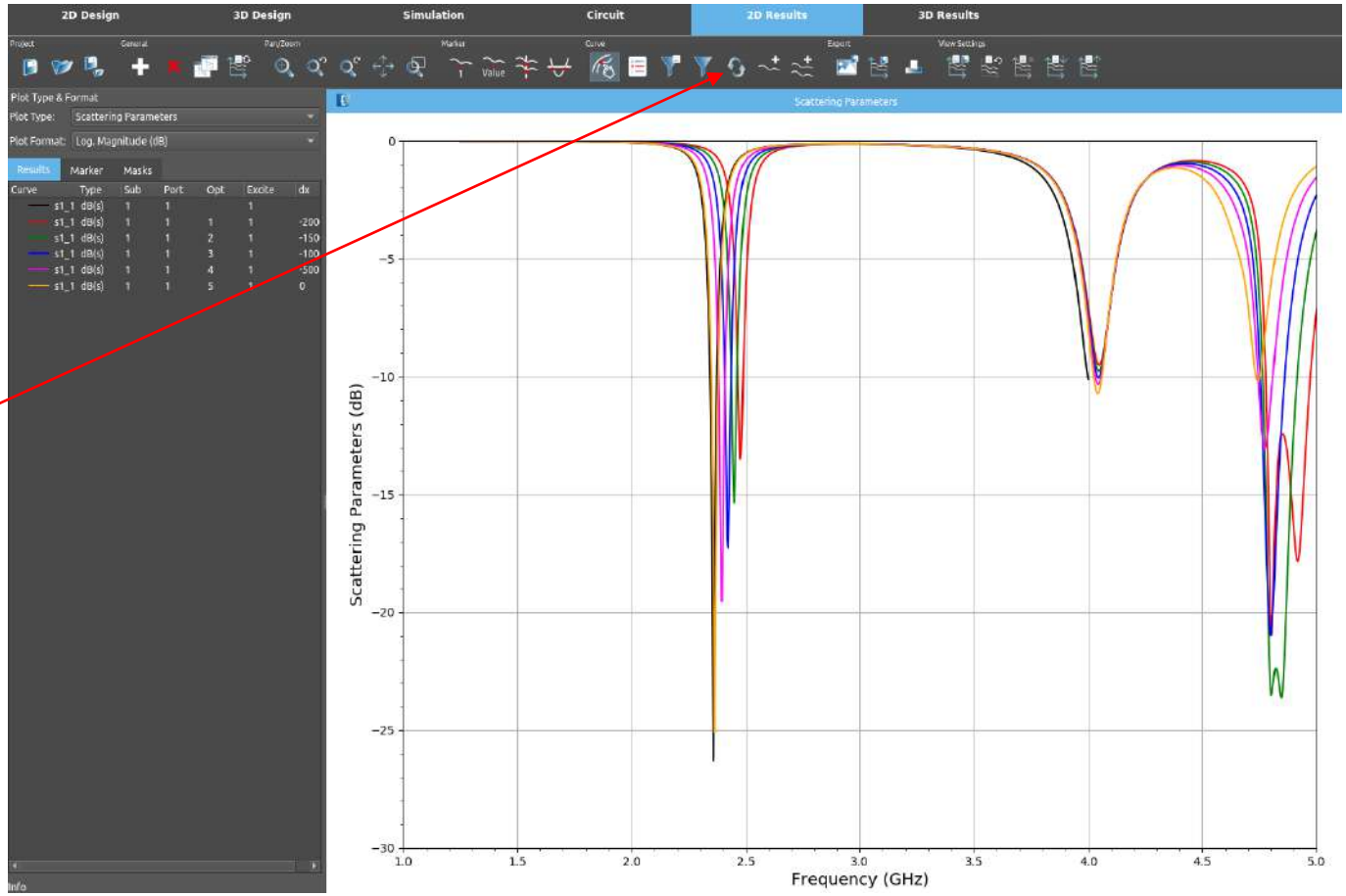
- Click “Simulation” Tab
- Select “Parameter Sweep Setup”
- Click “Create Parameter Sweep”
- Click “Start” to start





Step 9: Tuning 3

- Switch from Simulation to Results - S-Parameters
- Press Update Data



The variation with dx=-500 yields the target frequency of 2.45 GHz

Comment: All results of subsequent simulations can be automatically displayed in the window