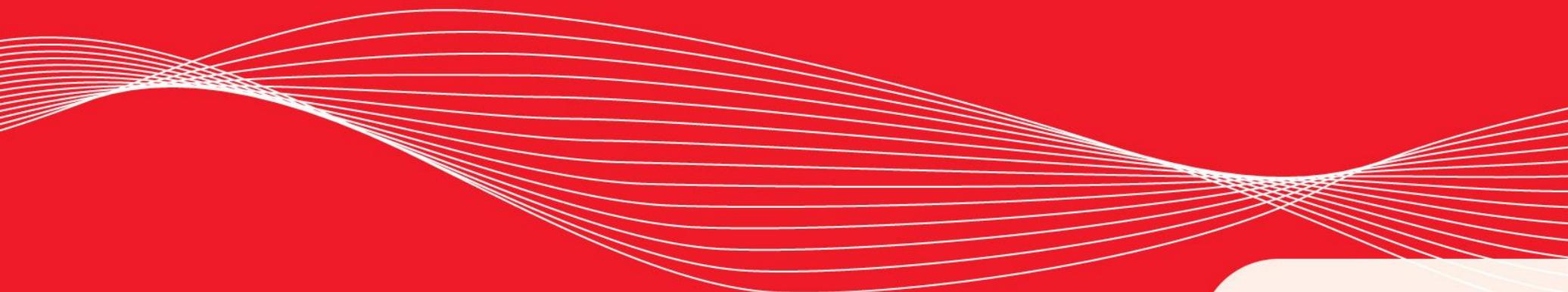


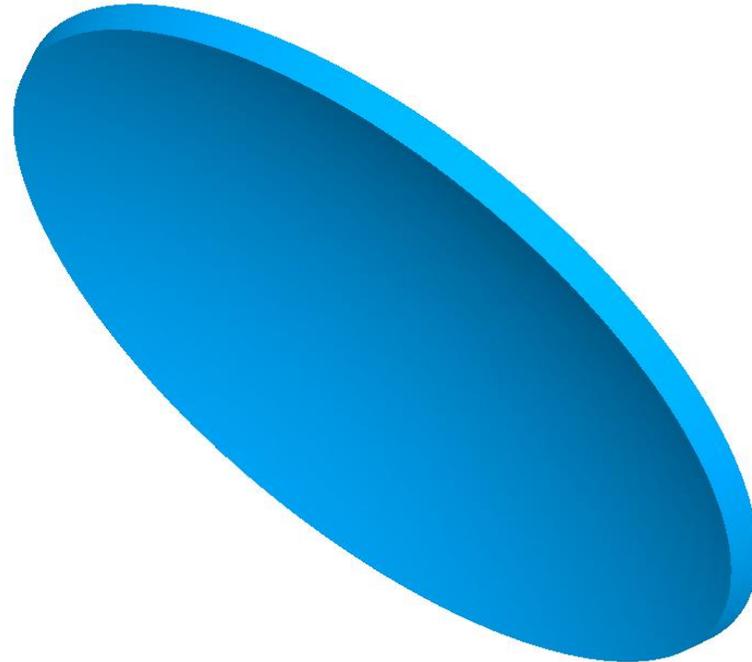
EMPIRE XPU Tutorial

3D Design - Reflector with Feed



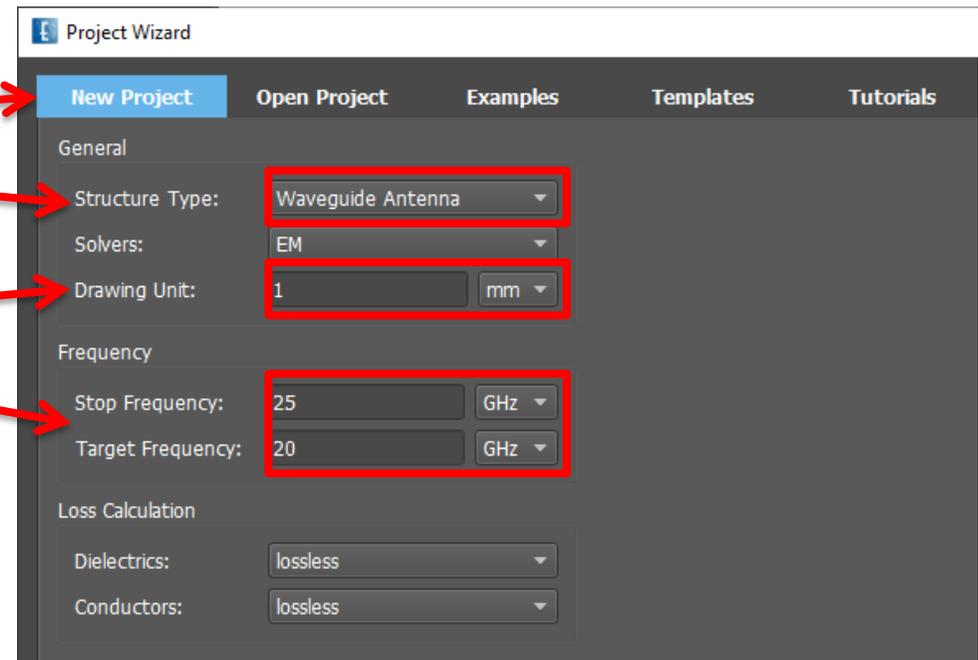
Overview: Topics

- Parabolic dish
- Waveguide port
- Support post
- Far field
- Near field



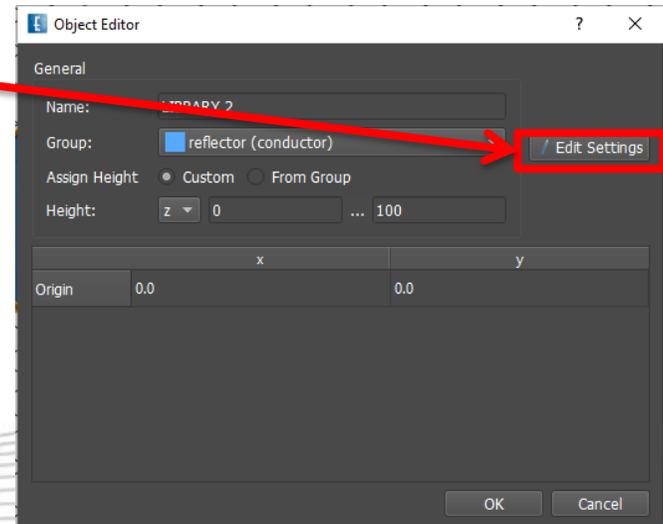
Step 1: Set Simulation Parameters

- Start EMPIRE XPU from Desktop
- Select “New Project” tab
- Set “Structure Type” = Waveguide Antenna
- Set „Drawing Unit“ = 1mm
- Set “Stop frequency” = 25 GHz,
“Target frequency” = 20 GHz,
- Click OK
- Save project in a new folder



Step 2: Reflector Definition

- Right click on “#001”, Edit Name: “reflector”
- Click „Create Library Object“, select „3D Surface“ Tab, click „Parabolic Dish“
- Center Point: Move cursor to origin 0,0,0, left click
- Radius : $r=75$ (zoom out, move cursor $-x$ to snap even coordinates)
- Focal distance: $dw=100$ (zoom out, move cursor $+z$)
- Click „Edit Settings“
- Set horizontal resolution $vres=1$, Thickness $t=1$,
- OK, Zoom Extents



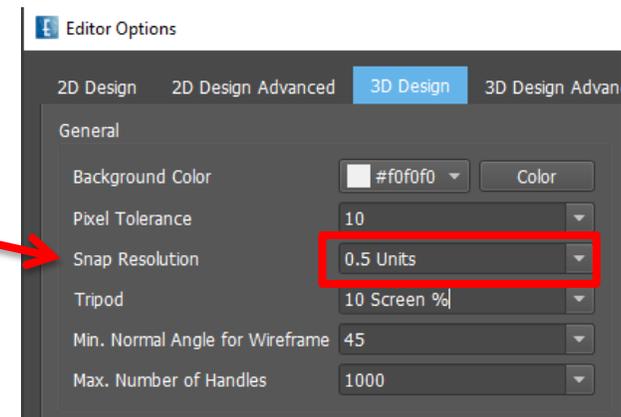
Comment:

* Use „Wheel backward“ to zoom out and \uparrow to pan to access value with cursor
The point defines the center and the height specifies the focus of the dish

Step 3: Define Waveguide Port



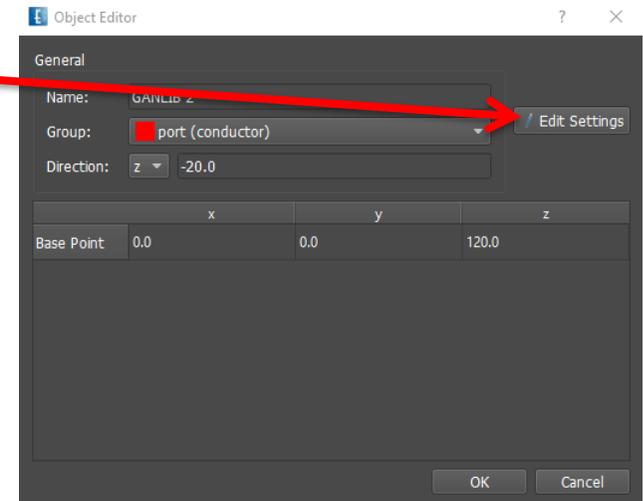
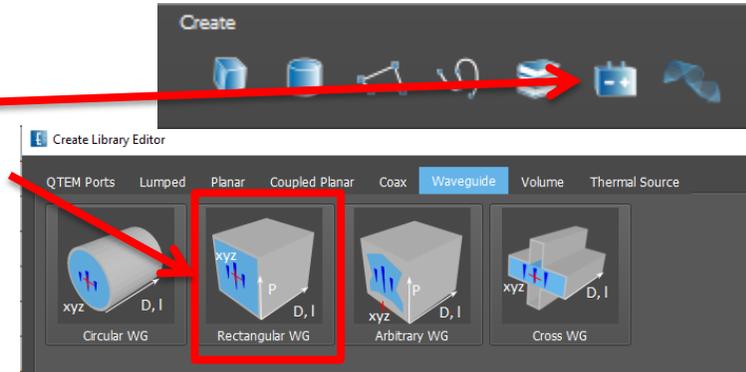
- Create new group
- Rename to "port", change color
- Set Grid "z=100"
- Enable „Stay on Grid“ snap mode
- Open editor options
- Tab 3D Design: Set Snap resolution to „0.5 Units“
- Close window
- Switch to top view , zoom in



*Comment: The **stay on grid snap mode** forces snap points to be always on the grid (and not on objects below / above the grid)*

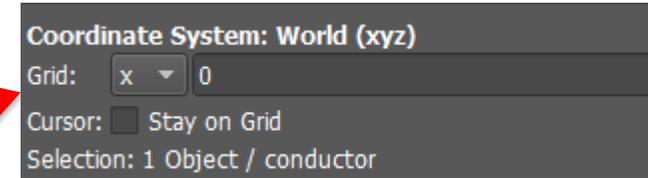
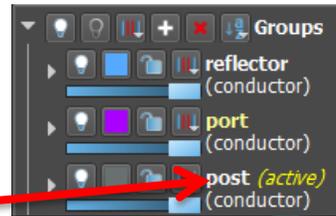
Step 4: Define Waveguide Port

- Click 'Create Source', switch to "Waveguide" tab, select 'Rectangular WG'
- First Point: Click at $x=-5, y=-2.5, z=100$
- Second Point: Click at $x=+5, y=+2.5, z=100$
- Rotate (e.g. drag right mouse to the top)
- Height (z-position)*: Click at $z=120$
- Click "Edit Settings"
- Verify width Width=10, Height=5
Correct if needed
- Close window
- Switch to iso-z view, zoom extents

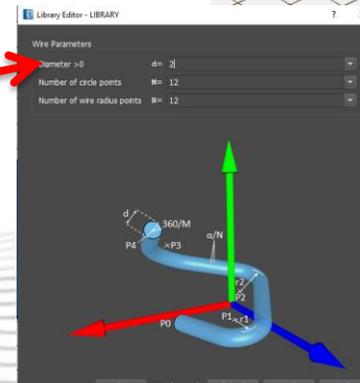
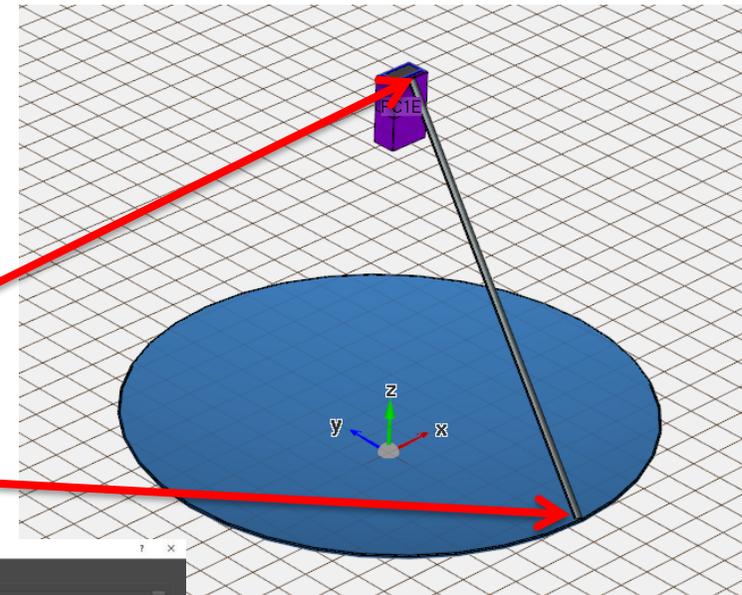


Comment: *Use „up“ key ↑ to access z=120

Step 5: Support Post



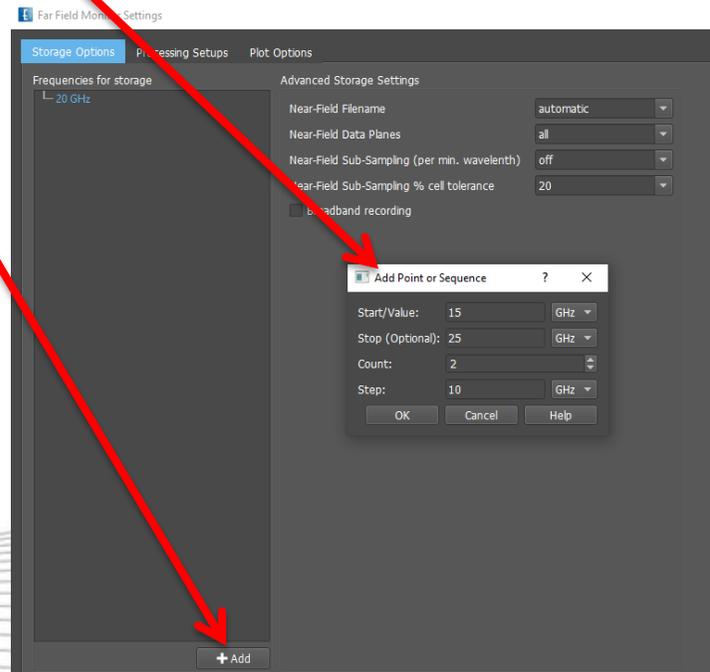
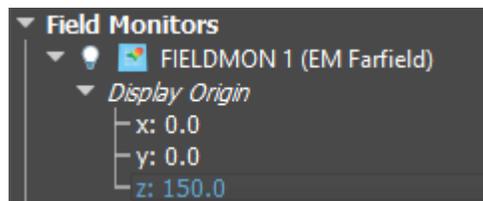
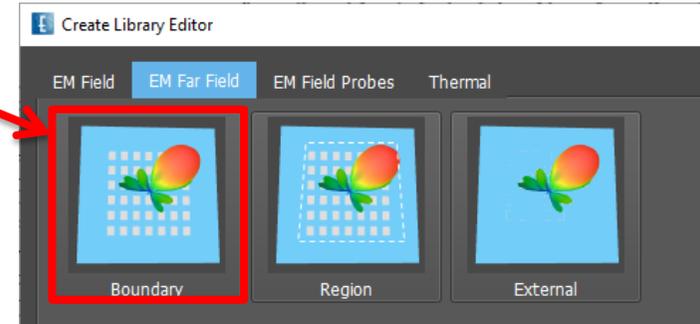
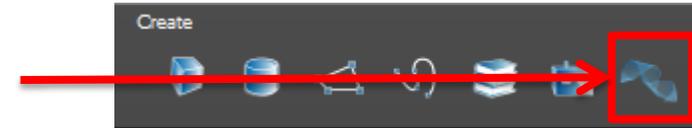
- Create new group
- Rename to “post”, change color
- Set Grid “x=0”
- Uncheck “Stay on grid”
- Click “Create Library Object”, Tab 3D Wire
- Select “3D N-Point”, zoom to port
- First Point:
Move cursor to 0,-3.5,120, left click 2x*
- Second Point:
Move cursor to 0, -75, 14.xxx, left click 2x
- Long left click to finish
- Click “Edit Settings”, set diameter d=2



Comment: 2x left click on same position to confirm height $du = 0$

Step 6: Far Field setup

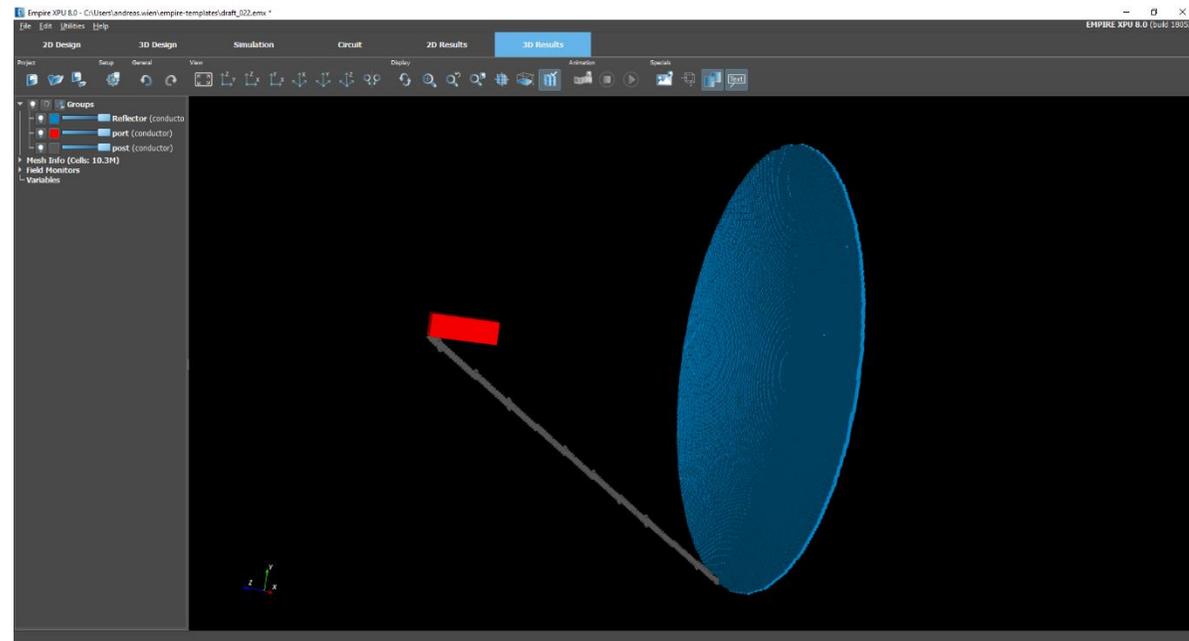
- Click “Create Field Monitors”
- Create new EM Far Field - Boundary
- Click „Add“ button
- Add Frequency points for 15e9, 25e9
- Close with OK
- Open Field Monitors
- Set Display origin z=150



Comment: The defined display origin point defines the origin of the 3D Farfield pattern display

Step 7: Mesh

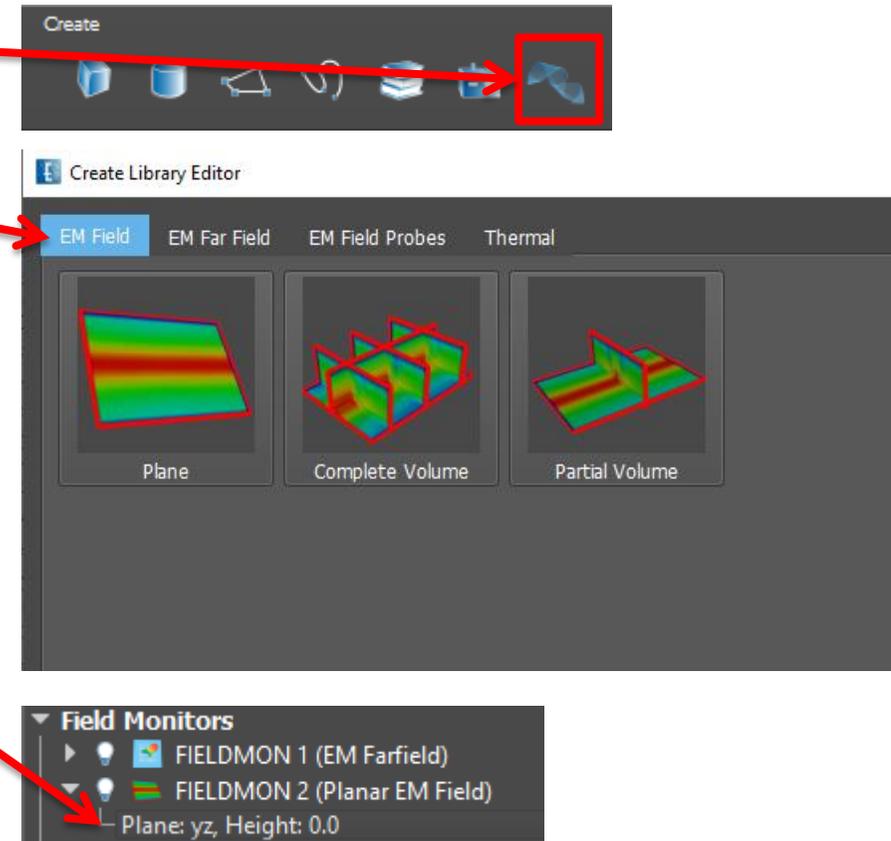
- Click “Create Mesh”
 - Click “Meshed 3D Structure”
- to check the meshed model of the reflector and feed*
- Click 3D Design to return to regular view



*Comment: * This switches to the 3D Display mode*

Step 8: Near Field Setup

- Click “Create Field Monitor”
- Keep default frequency
OK
- Open FIELDMON 2 (Planar EM Field)
- Double Click “Plane”
set plane to yz at x=0



Comments:

- The Near Field will be stored at the previously set target frequency (step 1, 20 GHz).

Step 9: Simulation

- Click “Start Simulation”
- Confirm OK

The screenshot shows the EMPIRE XPU software interface. The top toolbar contains a 'Setup' button and a 'Start Simulation' button (represented by a play icon). A red arrow points from the 'Start Simulation' button to a dialog box titled 'Start Simulation'. The dialog box contains the following text:

Start a complete simulation?

Note: This may overwrite already existing results!
Use the simulation tab for more detailed simulation setups.

Options

- Save Project
- Discretize
- Auto Mesh

Buttons: OK, Cancel, Help

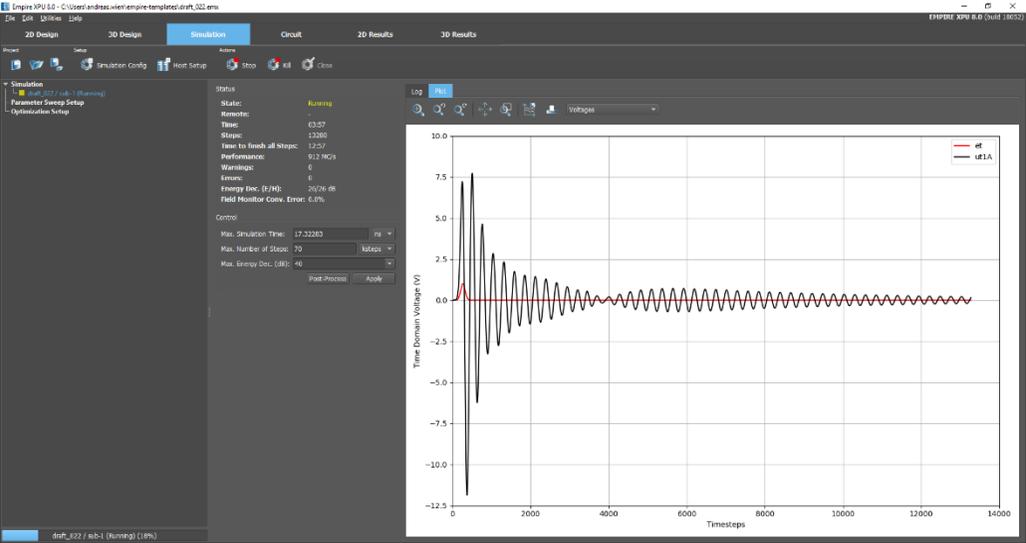
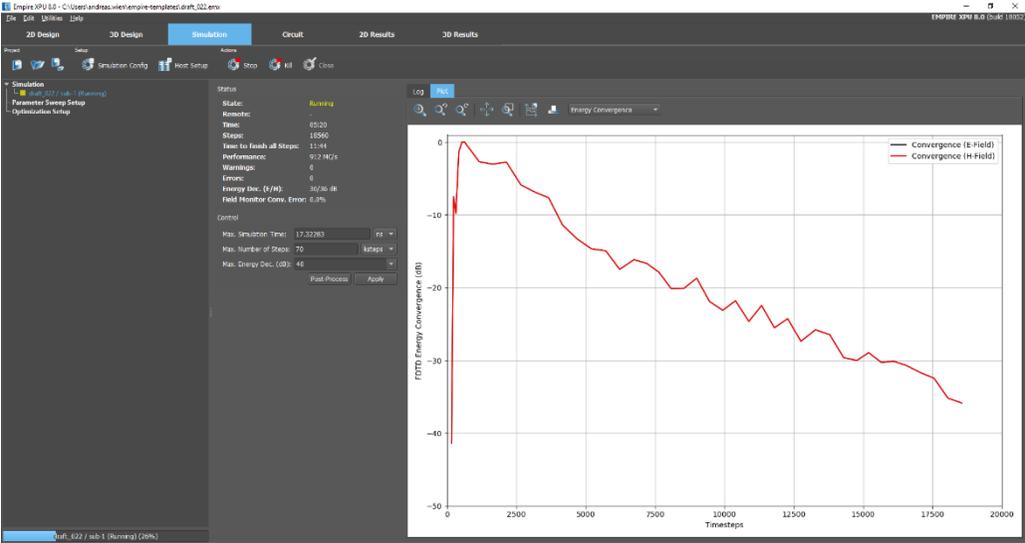
The background software interface shows the 'Simulation' tab selected. The 'Simulation' panel on the left includes 'Parameter Sweep Setup' and 'Optimization Setup'. The 'Status' panel shows 'State: Setup', 'Remote: -', 'Time: 00:08', and 'Steps: 1'. The 'Control' panel includes 'Max. Simulation Time: 0 s', 'Max. Number of Steps: 100 ksteps', and 'Max. Energy Dec. (dB): 40'. The 'Log' window displays the following text:

```
python -s -O -u C:\EMPIRE~1.00\empire\newkem_2\nk.py +7375622d315c6479296
+
+ This is the EMPIRE XPU V8.00, Build 18036 kernel (C) IMST GmbH 1998-2019
+ CWD is C:\Users\andreas.wien\empire-templates\draft_019\sub-1
+ ARGS are ["+7375622d315c64726166745f303139"]
+ PID is 9296
+
+ Running in 64 bit Mode on Windows
+ Using GCC compiler
+
+ Dielectrics are simulated lossless
+ Conductors are simulated lossless
+
+ PGA
+ 2d is switched on
+ 3d is switched on
+
+ Simulation Starting Thu Oct 24 15:13:35 2019
+
+ CPU found 'INTEL(R) CORE(TM) I7-7700HQ CPU @ 2.80GHZ'
+ Assuming 2,500 MBytes L2/L3 Cache per Core
+
+ Using AVX+FMA3 vectorisation Extension in 1 cpu groups, 4 cores altogether
+
+ Geometry w/o abc: 202x239x208
+ Geometry: 224x251x221
+ Size: 240x252x221 = 13.366 MCells
+ Number of Objects: 44
+ Objects out of Area: 7
+ Parts out of Area: 0
+
+ Memory Estimation:
+ Main Field 305,925 MBytes
+ Overhead 56,434 MBytes
+
+ Boundaries 51,574 MBytes
+ n2ff Storage 25,636 MBytes
+ dumpbox Storage 2,300 MBytes
+ wg Storage 42,305 Kbytes
+ pga Storage 59,948 MBytes (during setup)
+
+ -----
+ 501.859 MBytes
+
+ Electric loss setup: <first><vol><surf><line><conc><coeff><last><last>
+ Magnetic loss setup: <first><vol><surf><line><conc><coeff><last><last>
+ Electric material setup: <first><vol><surf><line>+++++
```

Step 10: TD monitor

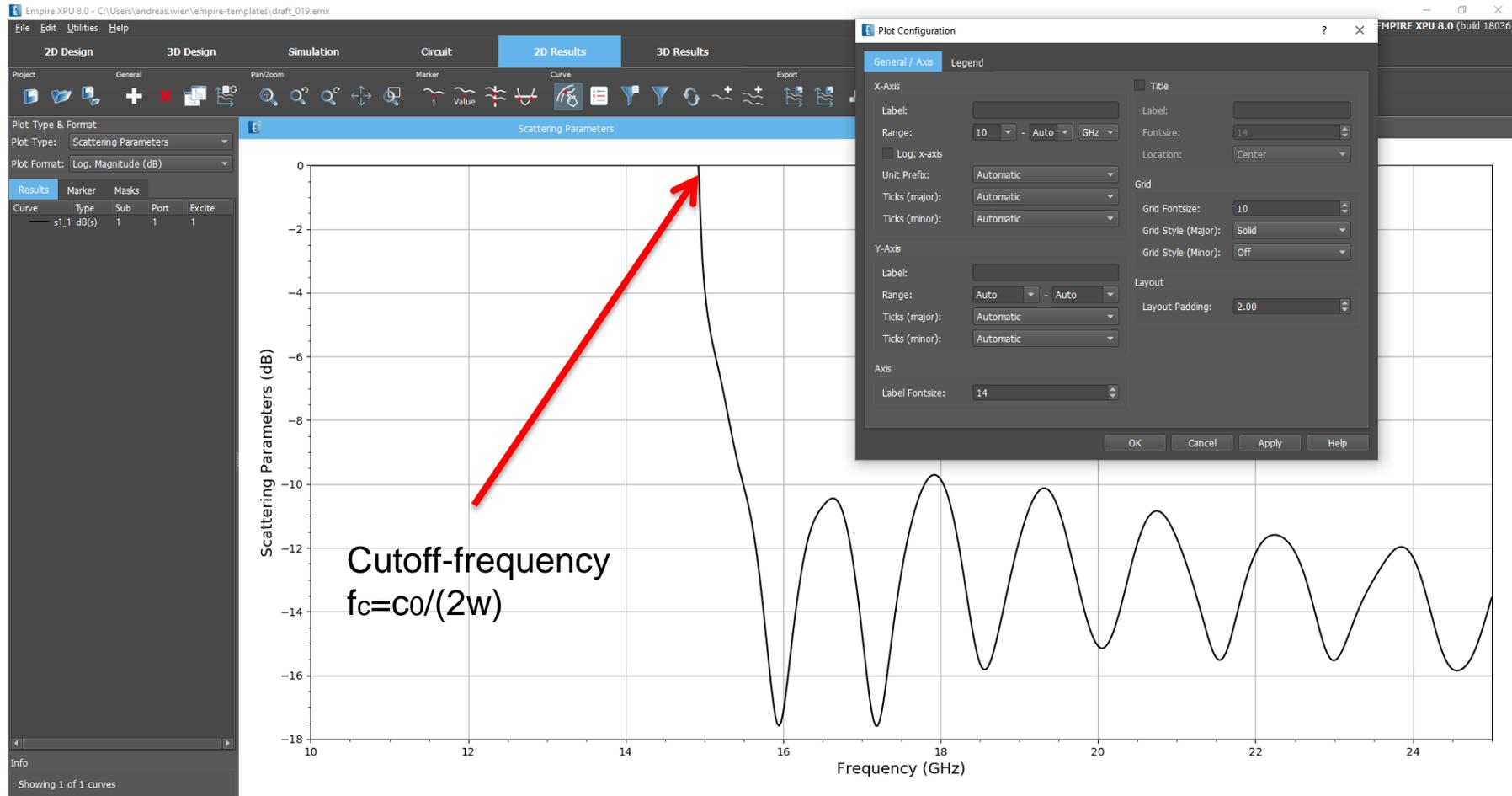
Energy vs. time

Voltage vs. time



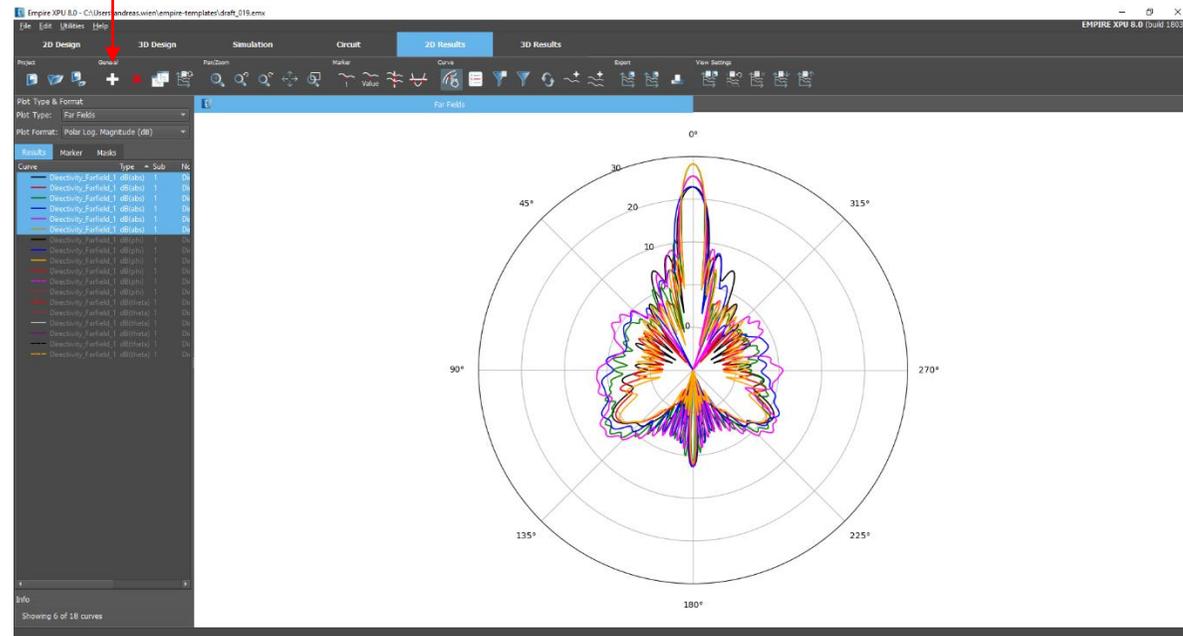
Step 11: S-Parameter

- Switch to 2D Results tab, right click for plot configuration



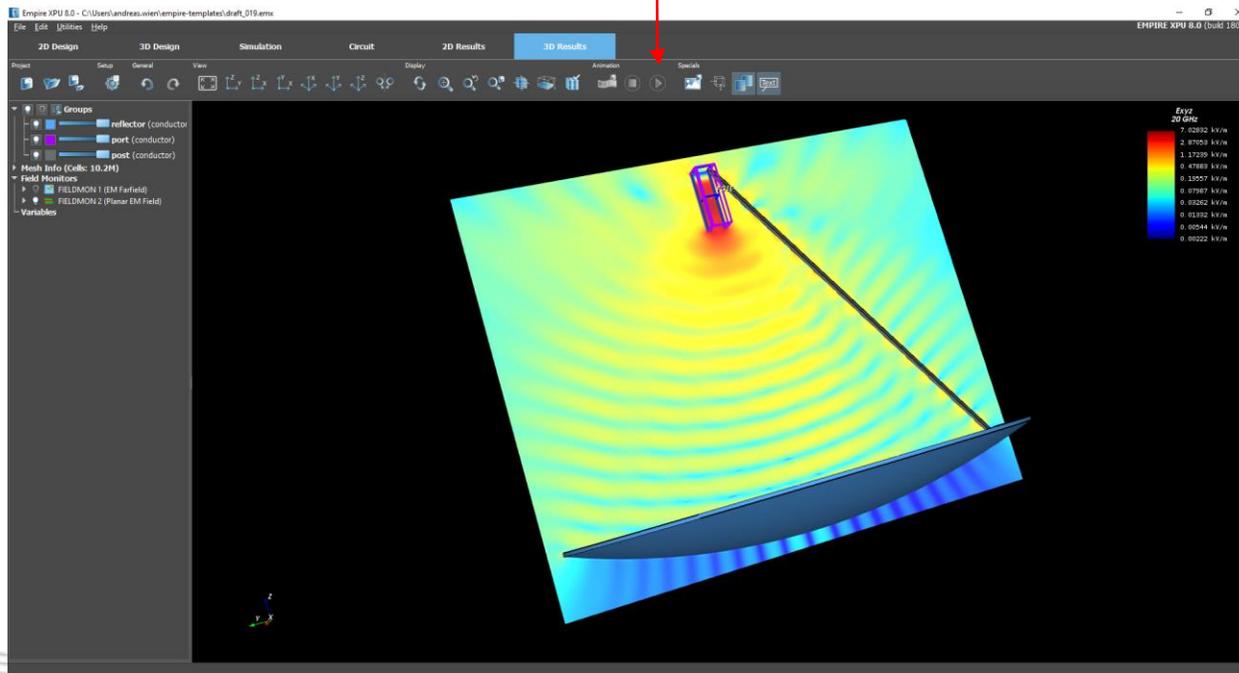
Step 12: Far Field

- Create a new plot
- Plot Type: “Far Field”
- Select Format: “e() farfield polar (dB)”
- Click in Type column to sort
- Select the top 6 curves, right click and choose ‘Show only and autocolor’
This adds Eabs files for 15, 20, 25 GHz, for $\phi=0$ and for $\phi=90$



Step 13: Near Field

- Switch to 3D Results
- Switch off EM Farfield
- Open Monitor 2: EM Planar EM Field
- Select Parameters → 3D Plot Options
 - Set Animation Loop : phase_15_deg
 - Close window with OK
- Click Start to display the animation



Step 14: 3D Far Field

- Turn off near field Monitor and turn on farfield Monitor 1

