

EM-Twin Exposure Tutorial

Ka-band horn antenna: APD evaluation

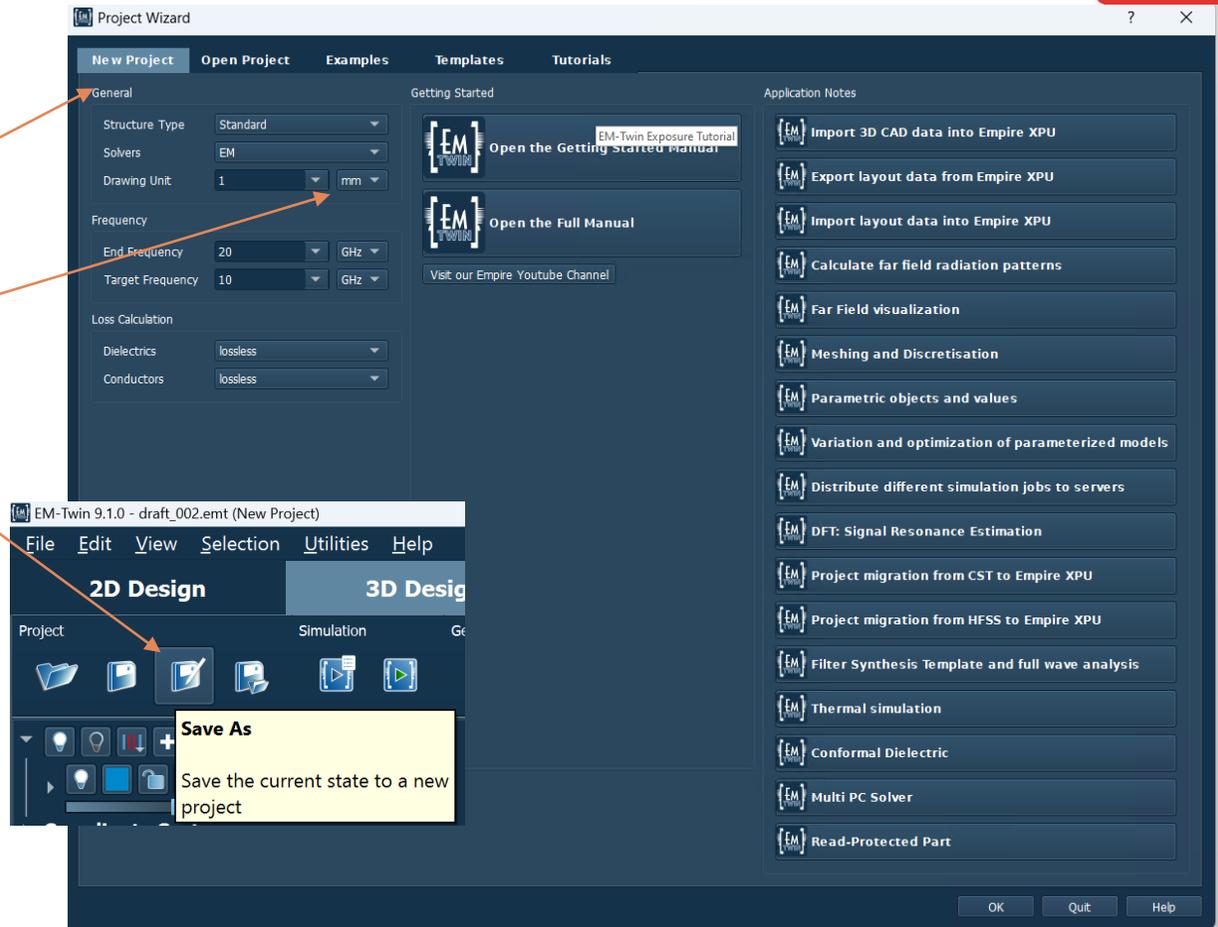


Overview

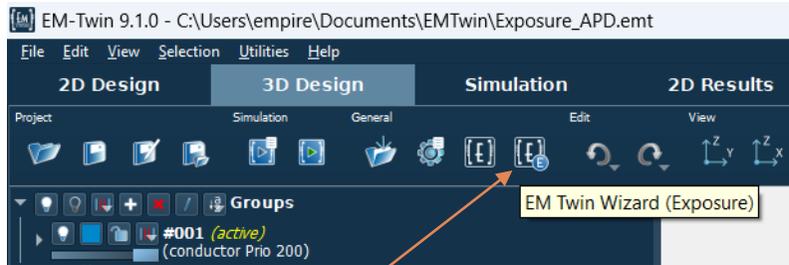
- New project creation
- Using the Exposure Wizard
- Antenna digital twin creation
- Phantom definition
- Field source placement
- Simulation set-up
- Parameter Sweep
- Near field and APD evaluation

Start

- Start EM-Twin
- Select “New Project”
- Change Drawing Unit to mm
- Press OK
- Press Save as & create a storage folder and enter file name, e.g., “Exposure_APD”
- Press Save



Wizard step 1: CAD Import



- Under 3D Design > General, click on the icon “EM Twin Wizard (exposure)”

Wizard step 2: Create source

- Select option Convert R+S Format
- Locate folder with the R&S measurement data and left-click on folder name (R_S_data_HSA_30GHz)
 - The frequency must be selected if an antenna has been measured at several frequency points and if the corresponding nearfield currents have been created*
- Click Close once the import is finished
 - This way, the source file for the antenna digital twin*
 - “R_S_data_HSA_30GHz_30000MHz.surf.dat” is created in the project folder.*
 - The 3D radiation pattern of the source will be shown in the Wizard if it is available (not in this example)*

The screenshot shows the EM Twin Wizard (Exposure) software interface. The main window displays a 3D radiation pattern of an antenna source, with a color-coded field distribution and a 3D coordinate system (x, y, z). The 'Place and Setup Antenna Field Source' dialog is open, showing two options: 'Convert R+S Format (folder containing NFFF_InputData and NFFF_OutputData)' and 'Convert EMPIRE 2D-near-field Format ("Farfield_*.txt" file)'. The 'Convert R+S Format' option is selected. Below the options, there is a 'Select Surf-Dat File:' field and a large empty area for file selection. The 'Importing Current Based 2D Nearfield Data' dialog is also open, showing a list of files to import. The list contains the following entries:

```

IP 1 0 0
IP 1 0 2
IP 1 0 3
IP 1 0 5
IP 1 1 0
IP 1 1 2
IP 1 1 3
IP 1 1 5
IP 2 0 0
IP 2 0 1
IP 2 0 3
IP 2 0 4
IP 2 1 0
IP 2 1 1
IP 2 1 3
IP 2 1 4
  
```

The dialog also shows a 'Finished' status and buttons for 'Save Log', 'Clear Log', 'Close', and 'Help'.

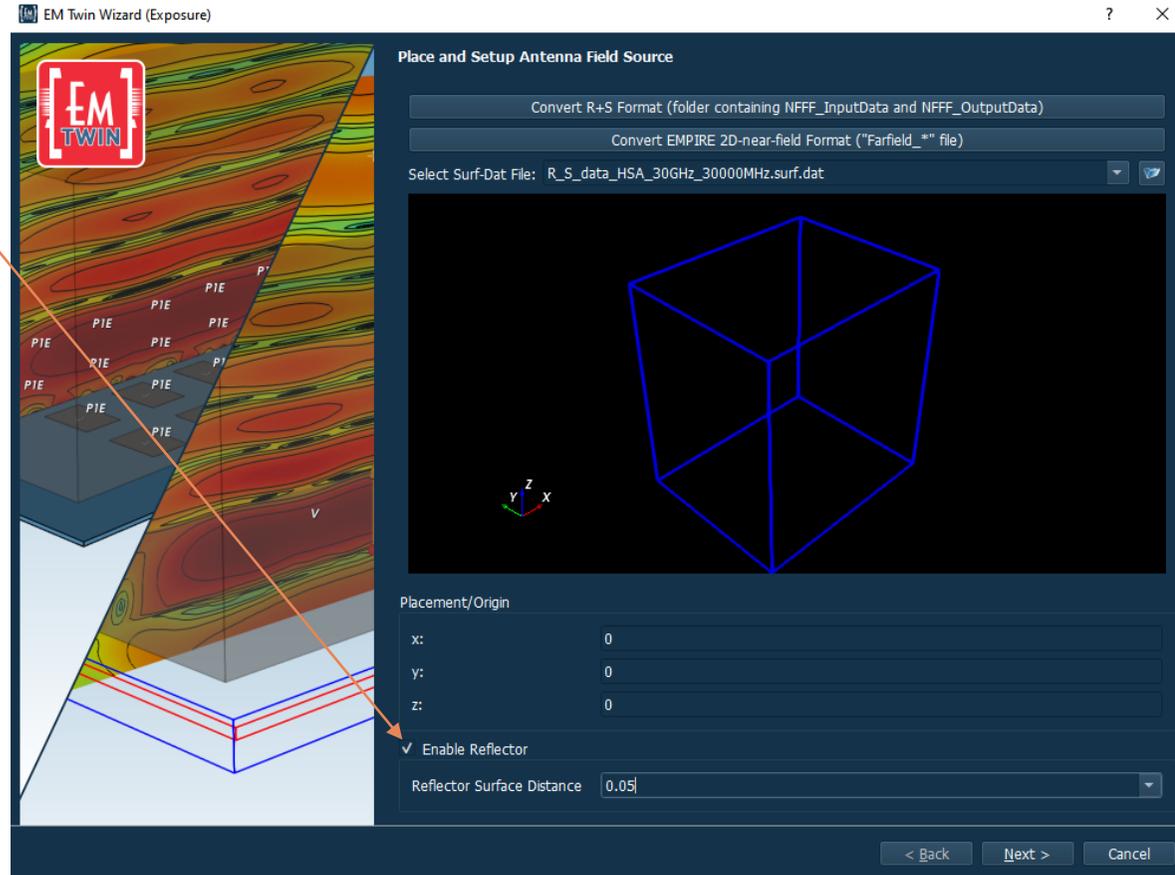
Wizard step 3: Field source configuration

- Click 'Enable Reflector'
- Set Reflector Surface Distance to 0.05

The field source is usually transparent to electromagnetic fields while the real antenna contains usually several metal parts. Defining a reflector inside the field source builds a more realistic digital antenna twin source setup. Electromagnetic waves are often reflected from the phantom so that a volume with standing waves exists between the phantom and the antenna.*

Optionally the Reflector Surface Distance can be set to "automatic" to create a variable with which the distance can be swept with a distance about $\lambda/2$ in small steps to ensure that the worst case exposure is evaluated.

- Press Next

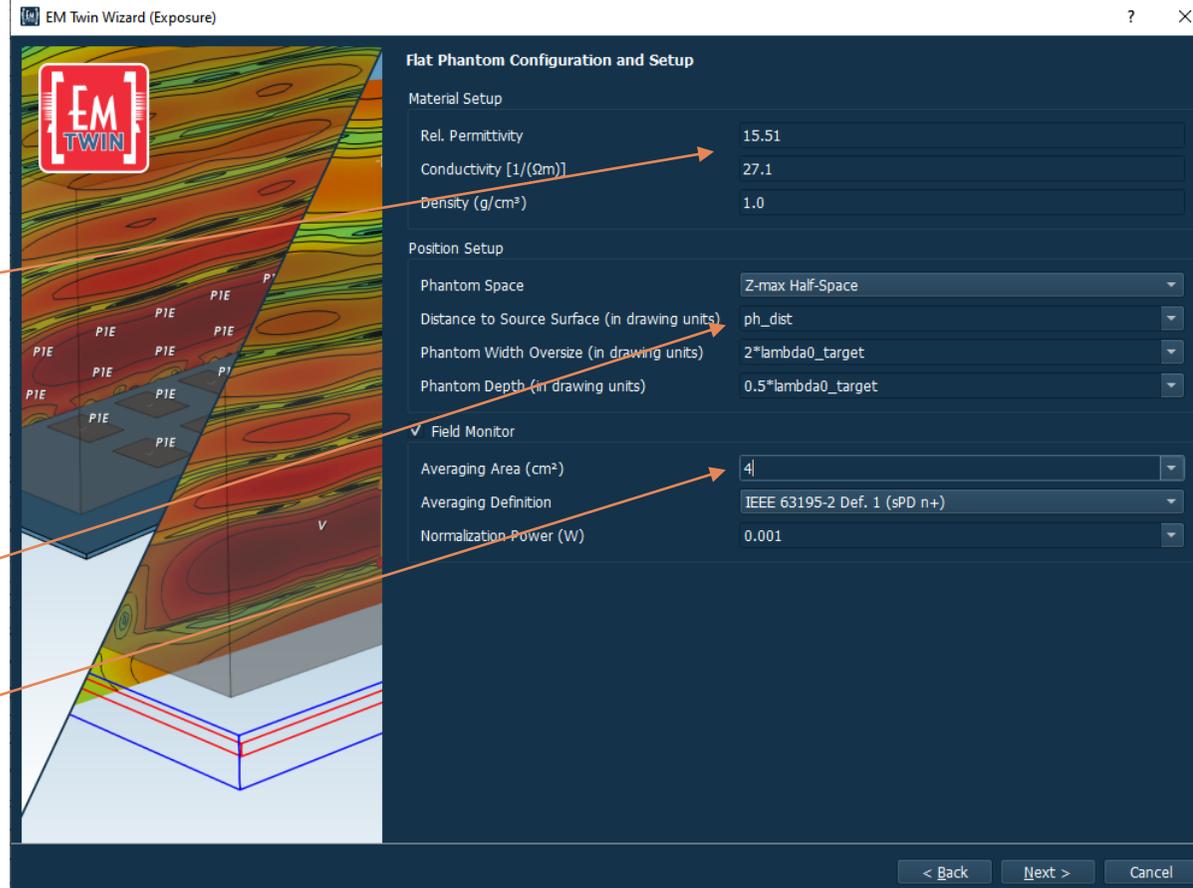


* IEEE Journal publication: Absorbed Power Density Assessment Using Simulation-Augmented Over-The-Air Measurement
<https://ieeexplore.ieee.org/document/10440586>

Wizard step 4: Flat phantom setup

This step defines the flat phantom for the exposure investigation. Permittivity and Conductivity must be defined for the antenna frequency. (30 GHz in our case)

- Define permittivity as 15.51
- Define Conductivity as 27.1
- Define a variable to investigate a few phantom distances in one simulation setup (open pull down menu and select ph_dist)
- Set Averaging Area to 4 cm²
- Click Next



EM TWIN Wizard (Exposure)

Flat Phantom Configuration and Setup

Material Setup

Rel. Permittivity	15.51
Conductivity [1/(Ωm)]	27.1
Density (g/cm ³)	1.0

Position Setup

Phantom Space	Z-max Half-Space
Distance to Source Surface (in drawing units)	ph_dist
Phantom Width Oversize (in drawing units)	2*lambda0_target
Phantom Depth (in drawing units)	0.5*lambda0_target

Field Monitor

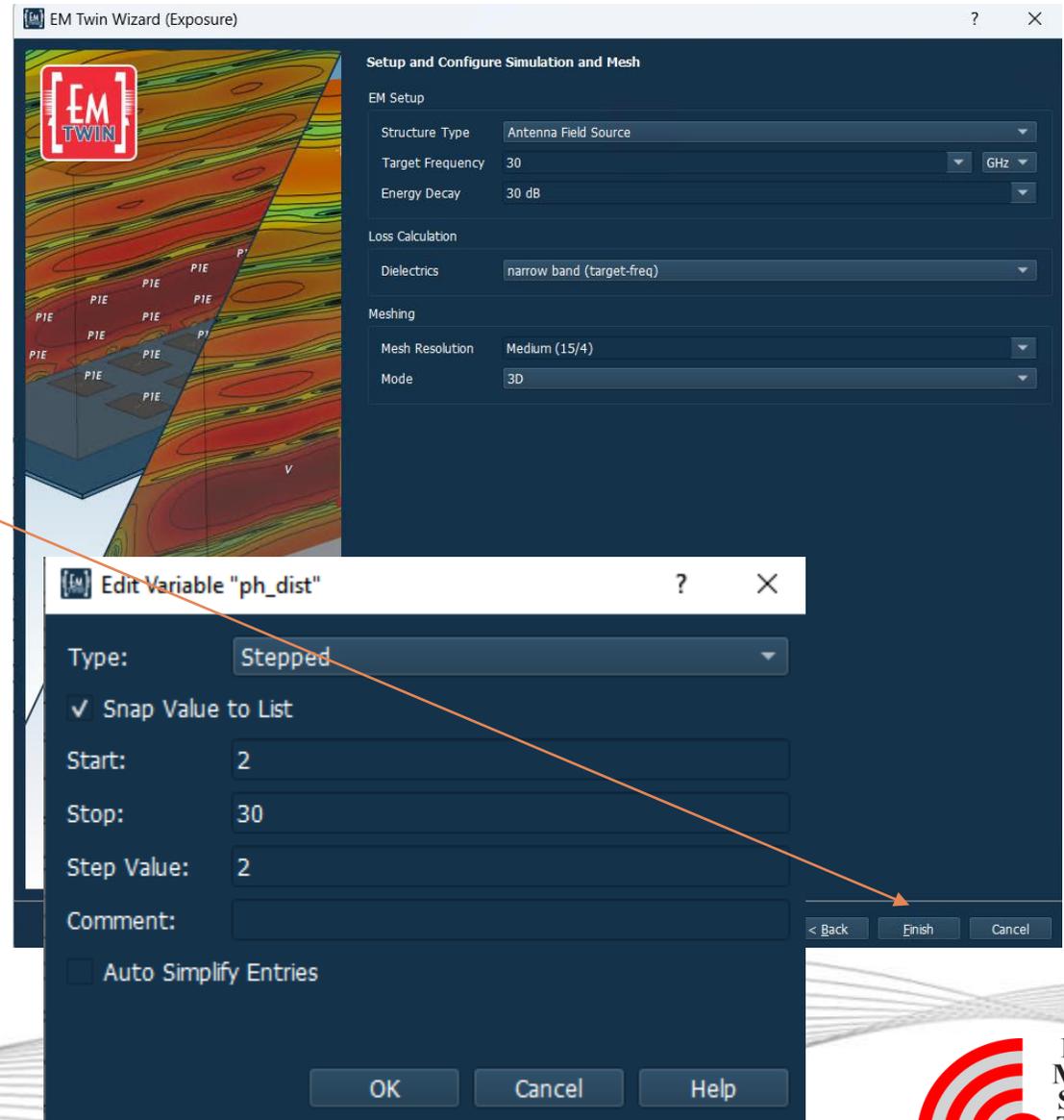
Averaging Area (cm ²)	4
Averaging Definition	IEEE 63195-2 Def. 1 (sPD n+)
Normalization Power (W)	0.001

< Back Next > Cancel

Wizard step 5: Simulation set-up

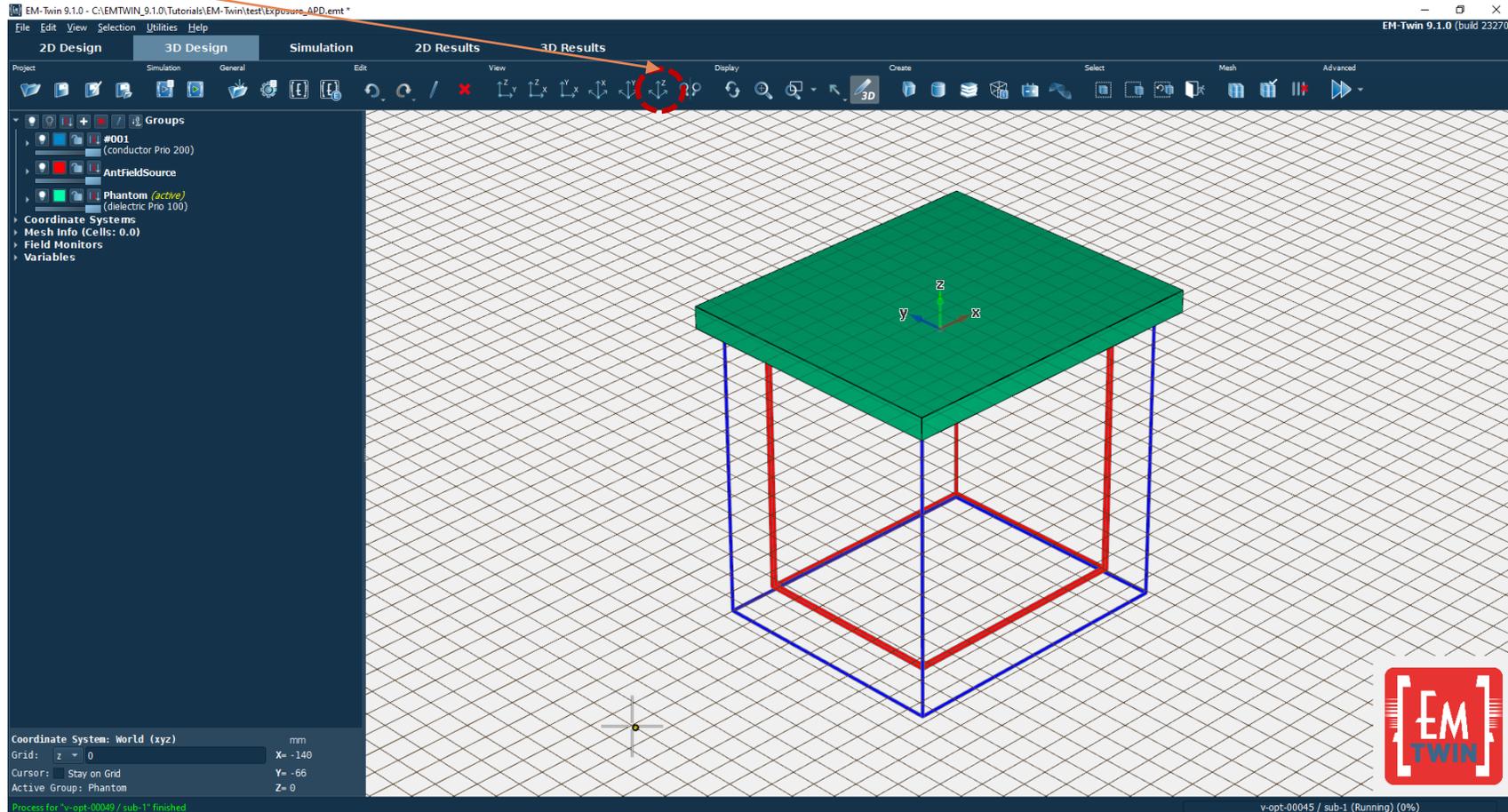
*Simulation and mesh settings can be adjusted in this step.
The default settings do not need to be changed for this tutorial*

- **Click Finish**
*The variable which defines the distance between the antenna and the phantom is defined in the next step.
We want to look at several distances.*
- **Switch Type from Constant to Stepped**
Enter the following values:
Start: 2
Stop: 30
Step Value: 2
- **Press OK**



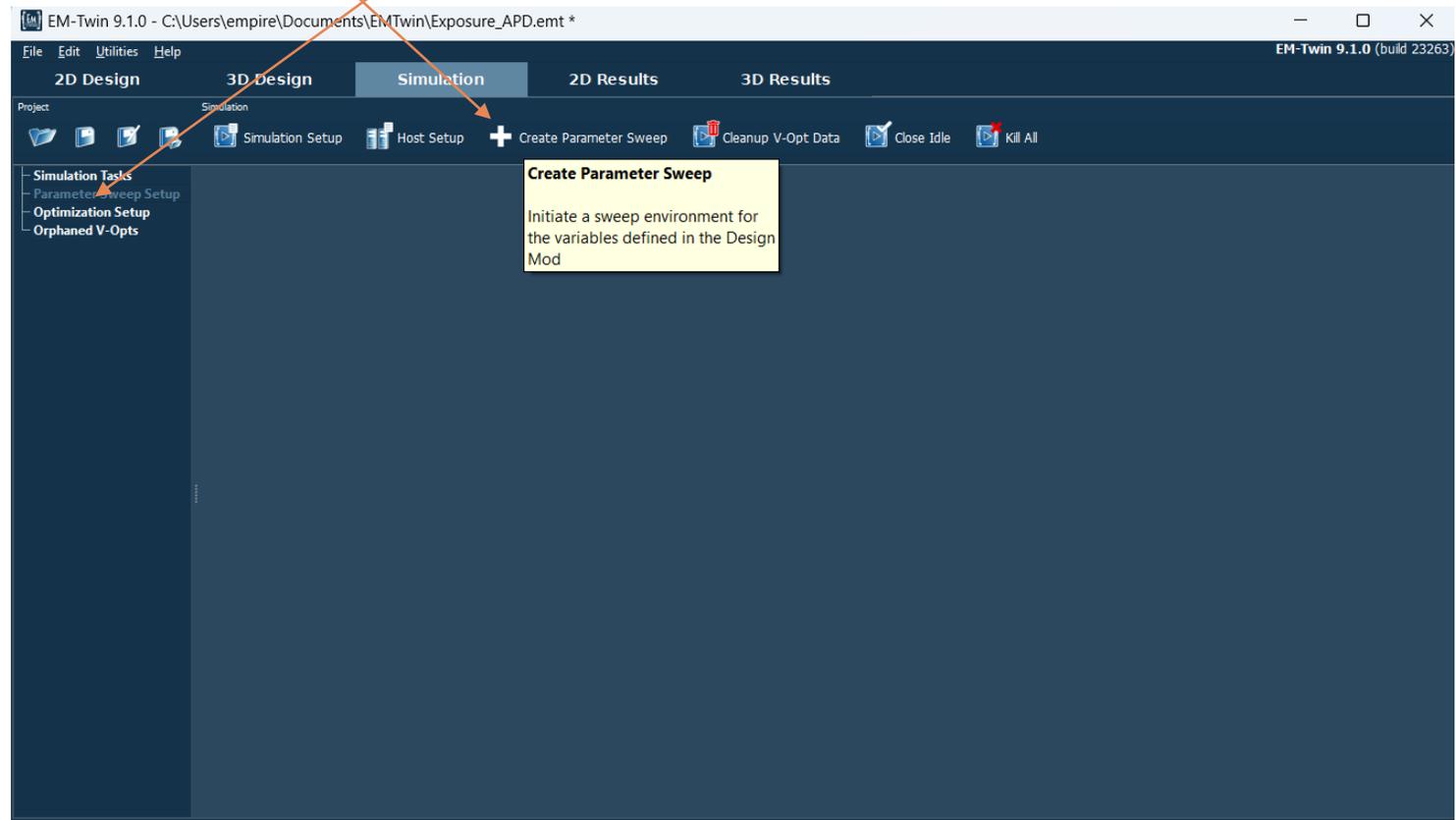
Step 6: Model check

- Switch to 3D Design mode
- Select Iso-z view and check model



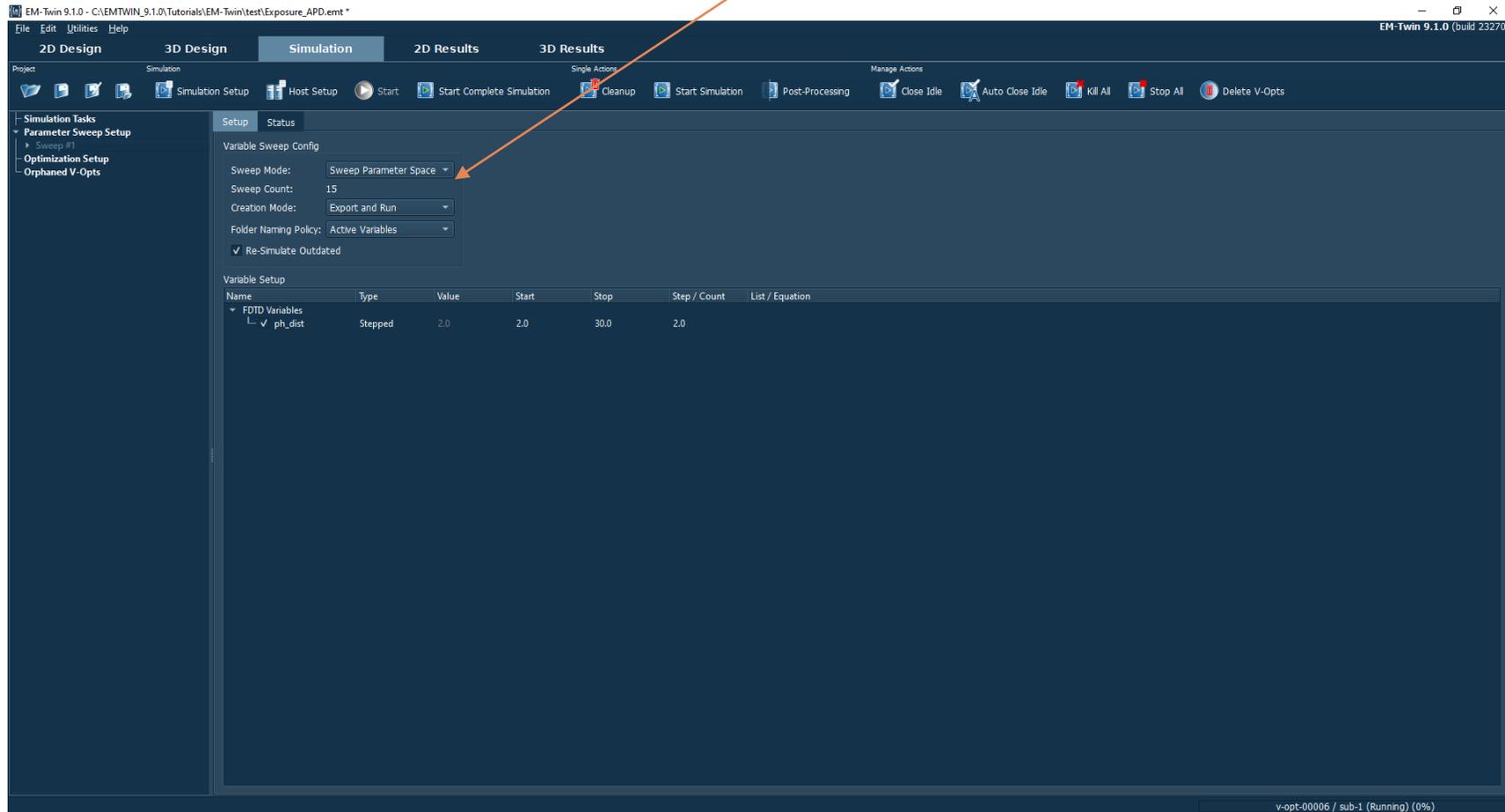
Step 7: Parameter Sweep

- Switch to Simulation Tab
- Select “Parameter Sweep Setup” on the left
- Click on Create Parameter Sweep
- Confirm sweep



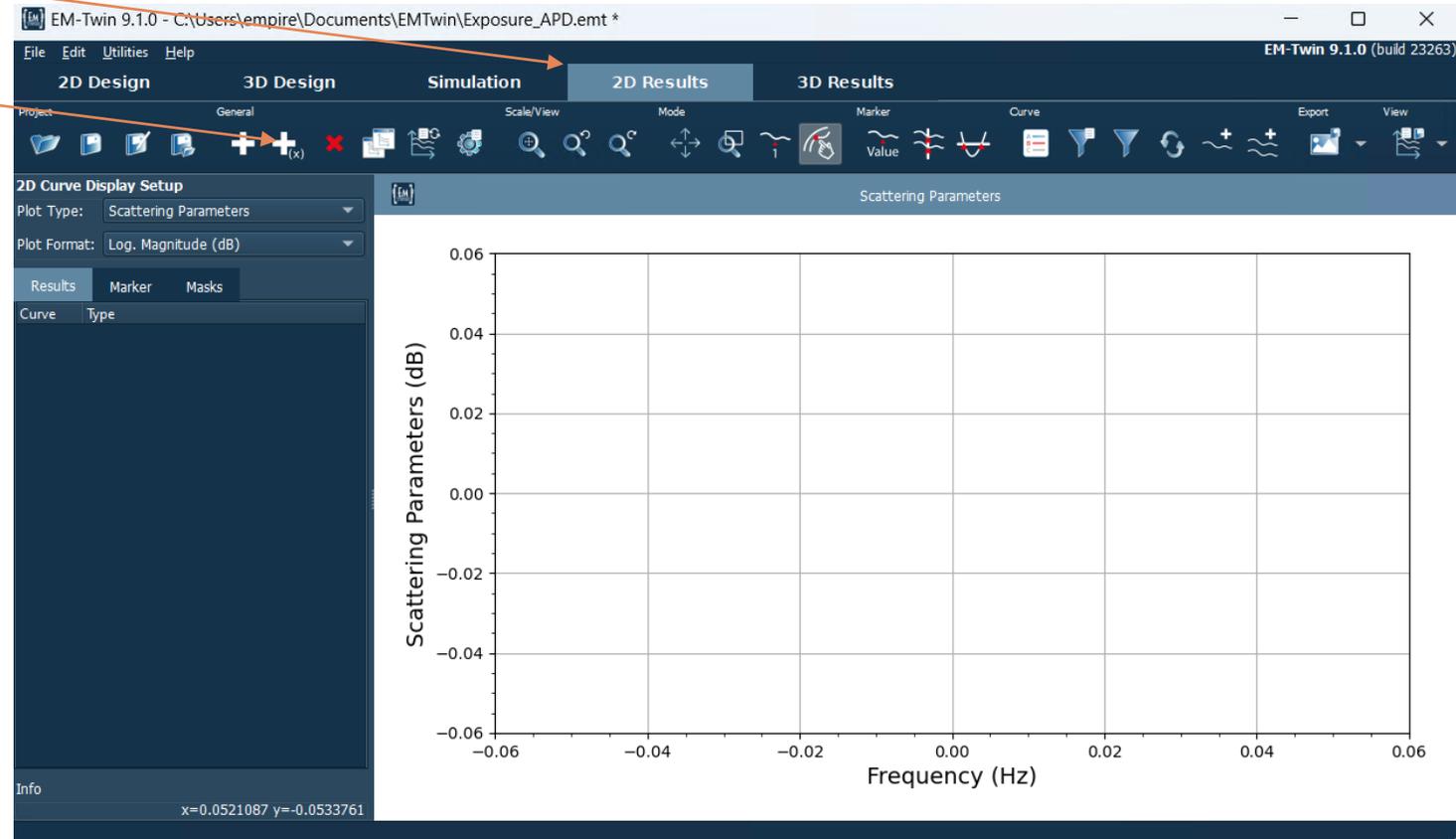
Step 8: Setup parameter sweep

- Change Sweep mode from 'Sweep independent' to 'Sweep Parameter Space'
- Click "Start" and wait to finish (15 simulations)



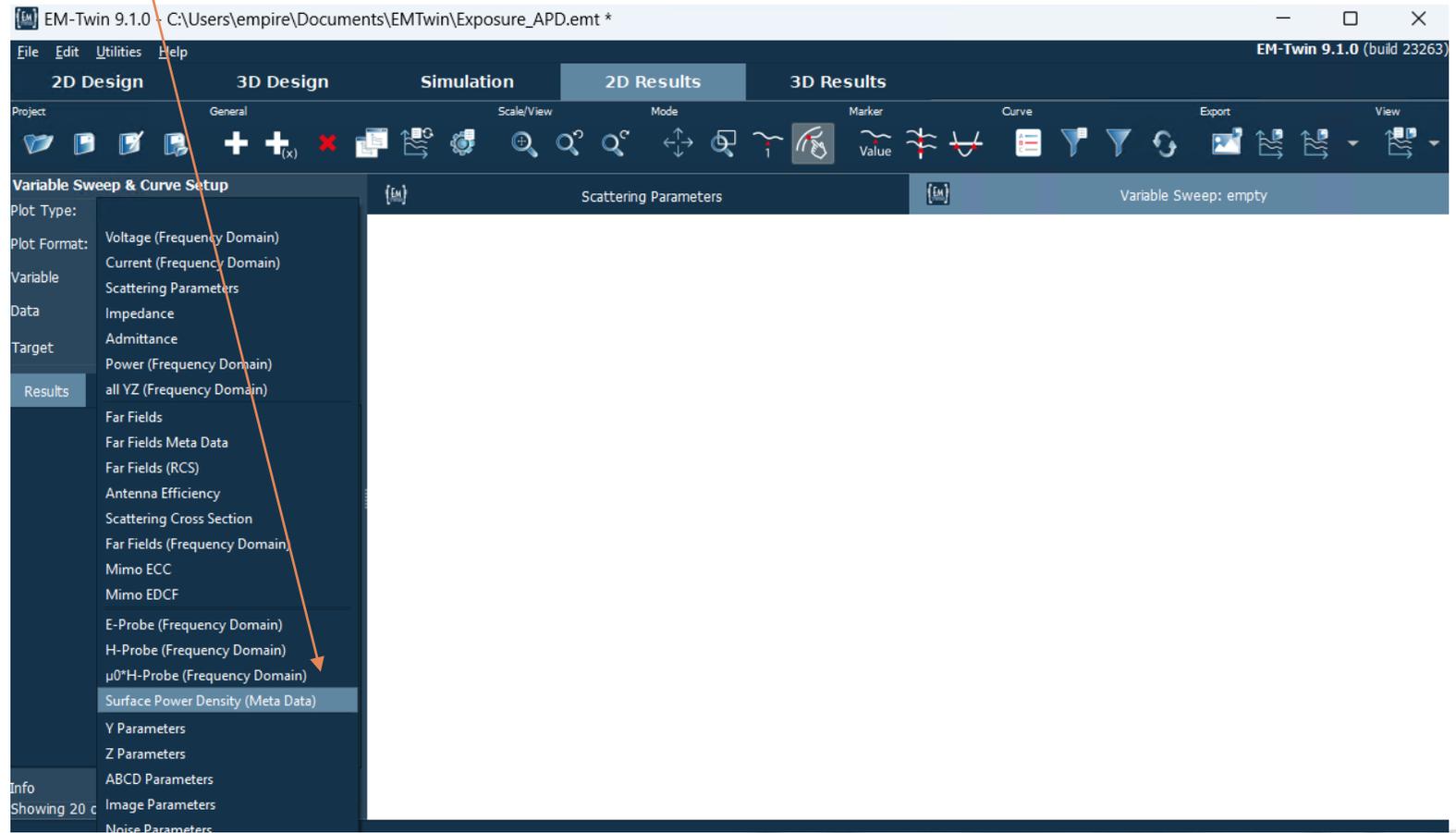
Step 9: 2D Results

- Switch to 2D Results
- Press *Add Sweep Results*



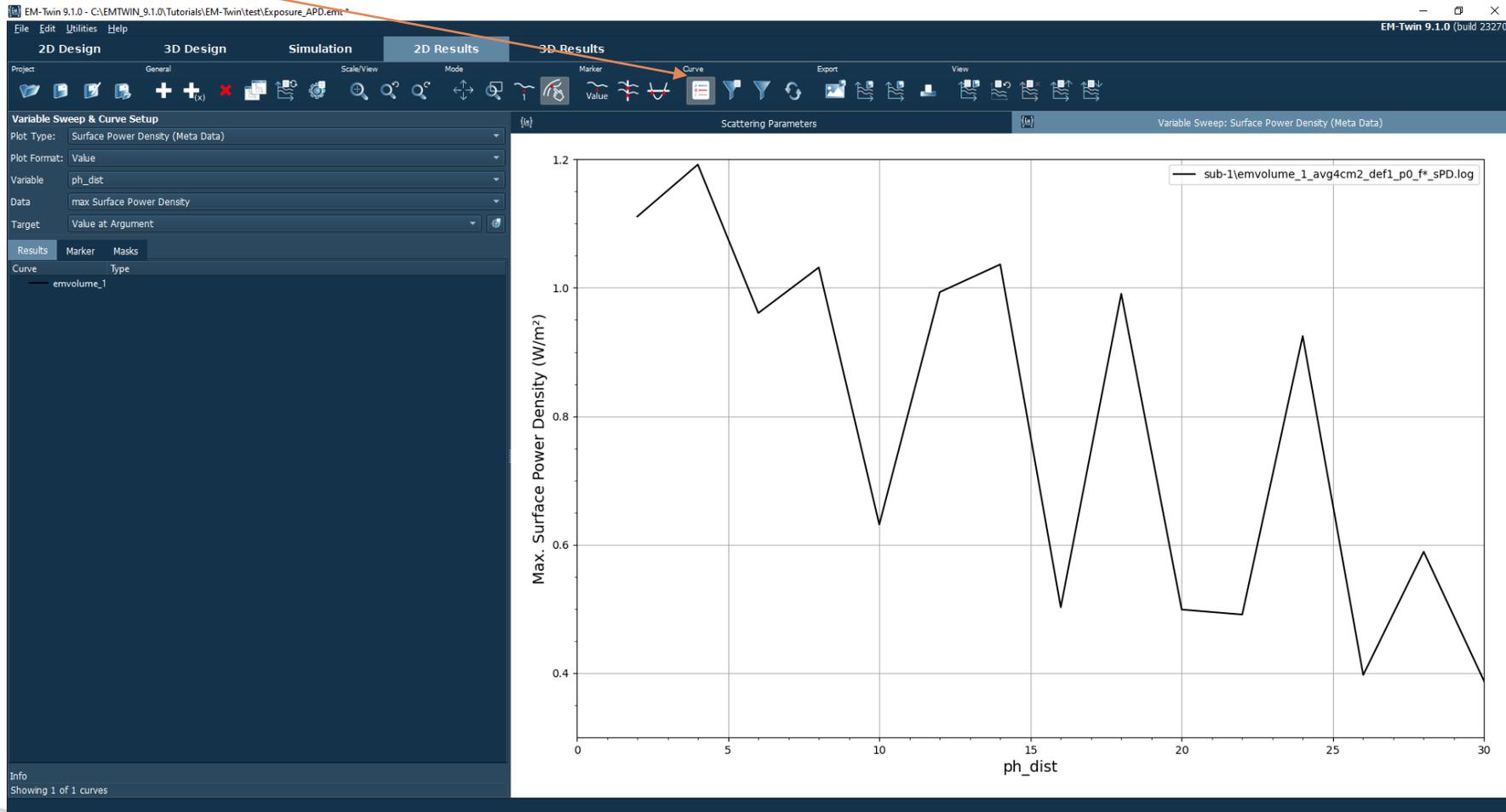
Step 10: 2D Results

- Change Plot Type to Surface Power Density (Meta Data)



Step 11: 2D Results

- Enable legend



Step 12: 3D Results APD distribution

1. Switch to 3D Results & Turn off group phantom (left click on light bulb)
2. Open Variables and adjust variable values to show dedicated APD distribution

