Release 2022 R1 Highlights

EMA3D Cable

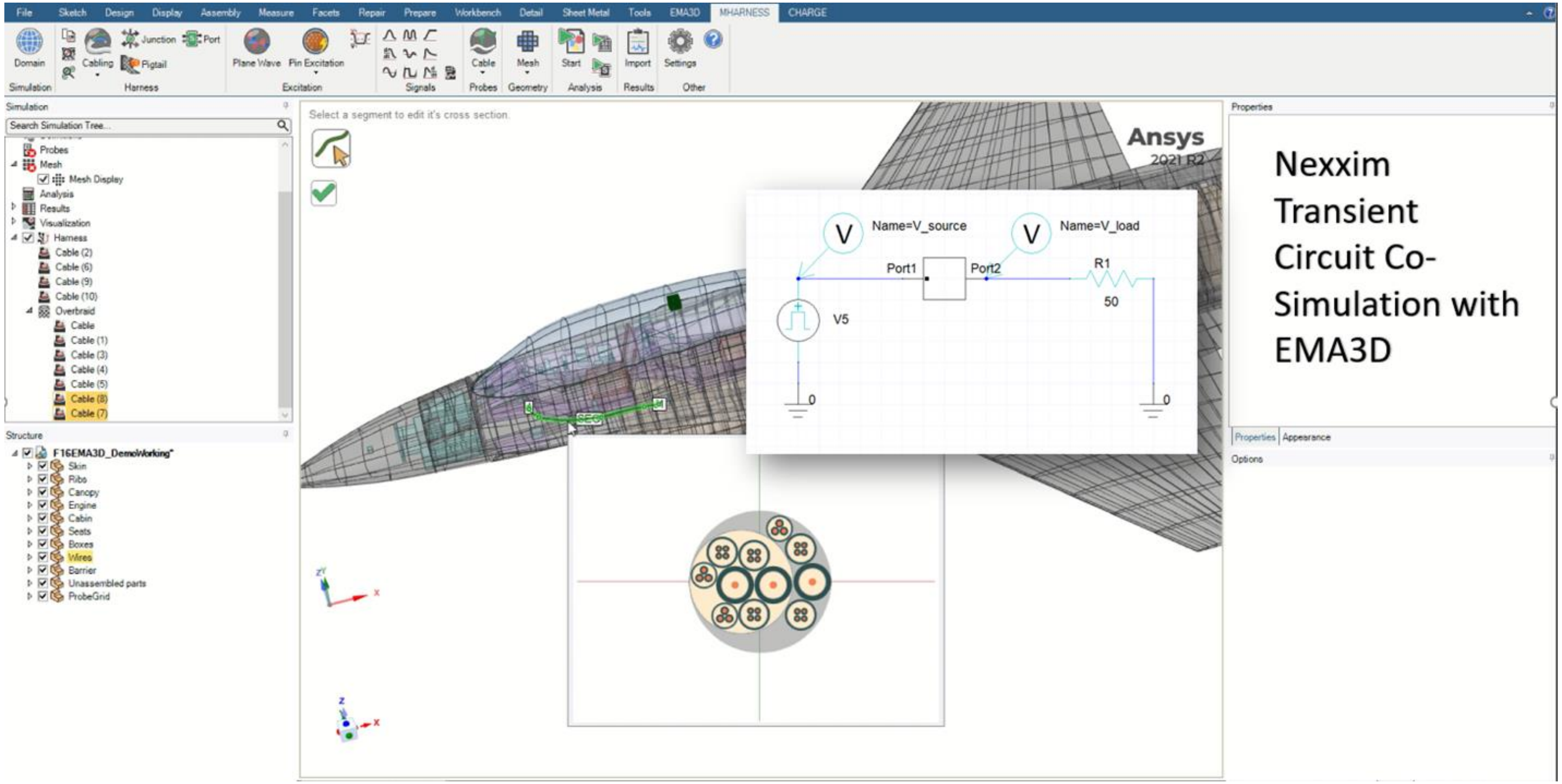
EMA3D Charge

Ansys

EMA3D Cable

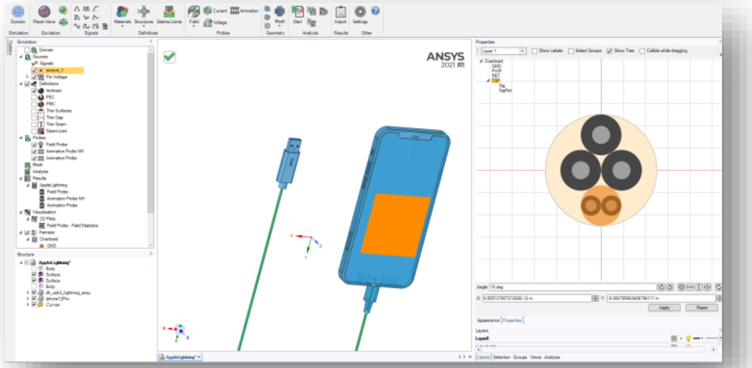
Ansys EMA3D Cable

Device- and Platform-Level Electromagnetic Modeling Solution



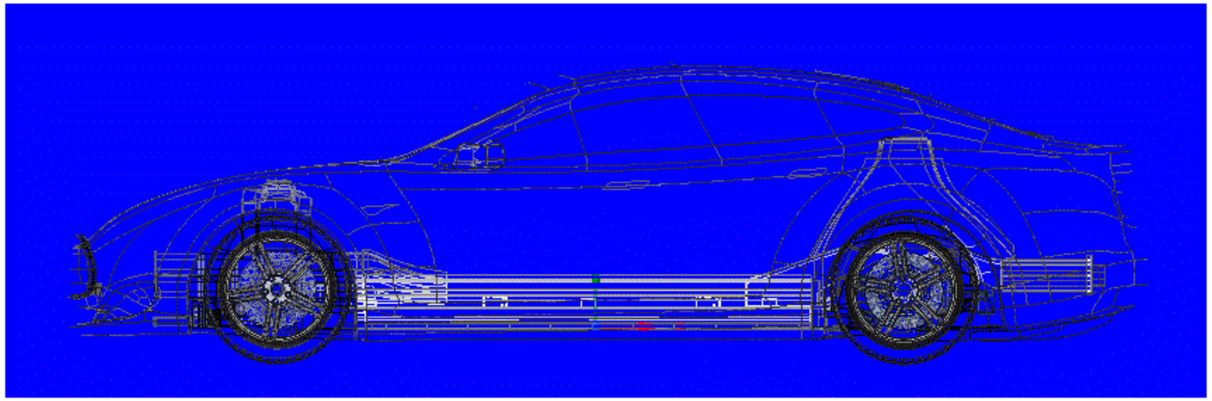
Ansys EMA3D Cable Distinguishing Features

- Accurate
  - Decades of validation heritage of experiment compared to simulation on complex platforms
  - Full wave solution of electromagnetic equations
  - Fully integrated co-simulation with transmission line equations
  - ***New* integrated co-simulation with Nexxim Transient Circuit**
- Easy to use
  - User interface within Ansys SpaceClaim
  - Intuitive for new users
  - Utilize mechanical CAD directly with minimal cleaning or preparation
  - Prepare models of complex platforms and unit enclosures in a fraction of the time of other methods
  - Integrated workflows with Ansys SIwave and Ansys HFSS

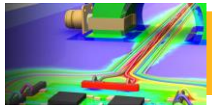


2022 R1 Ansys EMA3D Cable **Featured Updates**

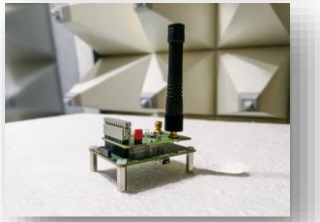
- Introduction of the **EMA3D and Nexxim transient circuit co-simulation** ability will allow engineers to simulate the complexity of devices and platforms down to the circuit level and reduce the time to simulate by >10x
- New **material property and cable libraries** accelerate the process of making and sharing complex full vehicle models benefitting the customers in automotive and aerospace industry.
- **Expanded cable harness connectivity features** allow EMC, E3, and RF Engineers to model true real-world scenarios while designing cables for automotive, aerospace and device manufacturing with ease, more accuracy and lesser time.



How EMA3D Cable New 2022 R1 Features Support Product Design



Electromagnetic Compatibility and Environmental Effects (EMC/E3)



Engineering Challenges

- Designers seek to predict the compatibility of products to meet regulatory or performance limits
- EMC/E3 failure may be due to deficiencies in circuits, printed circuit boards (PCBs), enclosures, cables, grounding, bonding, or materials
- Test failure does not always reveal the cause
- Testing occurs late in the development cycle
- Analysis requires complex 3D geometry, cables, and transient circuits to be solved self-consistently in a co-simulation

Ansys Capabilities

- **EMA3D Cable now co-simulates with Nexxim Transient Circuit**
- Non-linear circuit elements may be modeled self-consistently in the time domain with the 3D and wire simulation
- Complex material property descriptions and multilayered cable constructions may now be reused, shared, and updated by team with the **new Material and Cable Libraries**
- More realistic cable and shield geometries may now be modeled using the **Expanded Cable Harness Connectivity Features**.
- Now any possible configuration in a product may be specified with the least amount of analyst time (10x faster than competitive tools)

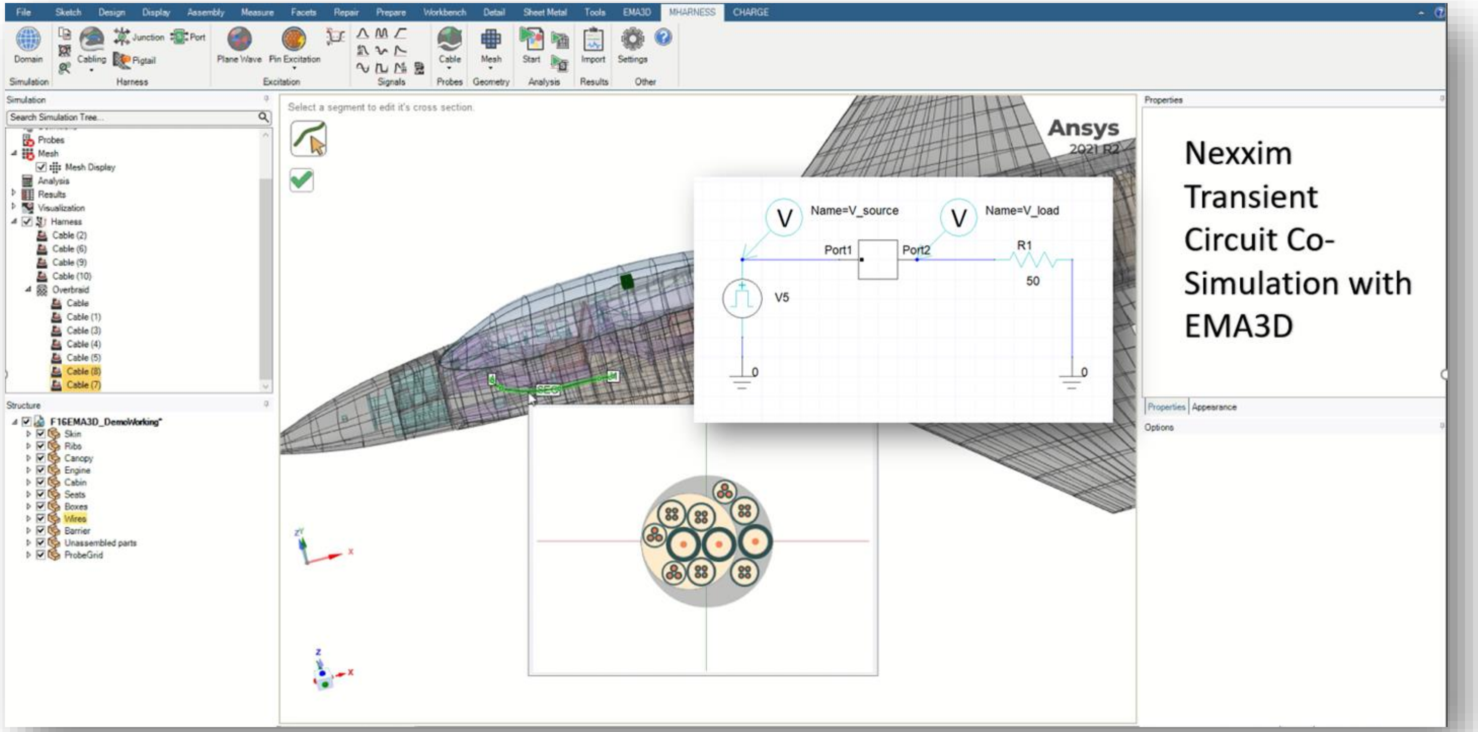
Customer Benefits

- Evaluate all contributions to EMC/E3 of a product early in a program development cycle
- Make circuit, filter, cable, and enclosure design decisions with confidence in the accuracy of predictions
- Iterate through EMC/E3 mitigations quickly to determine their effectiveness
- Save money by removing unnecessary mitigations
- Reduce risk going into EMC/E3 testing
- Shorten development schedules and churn between engineering disciplines

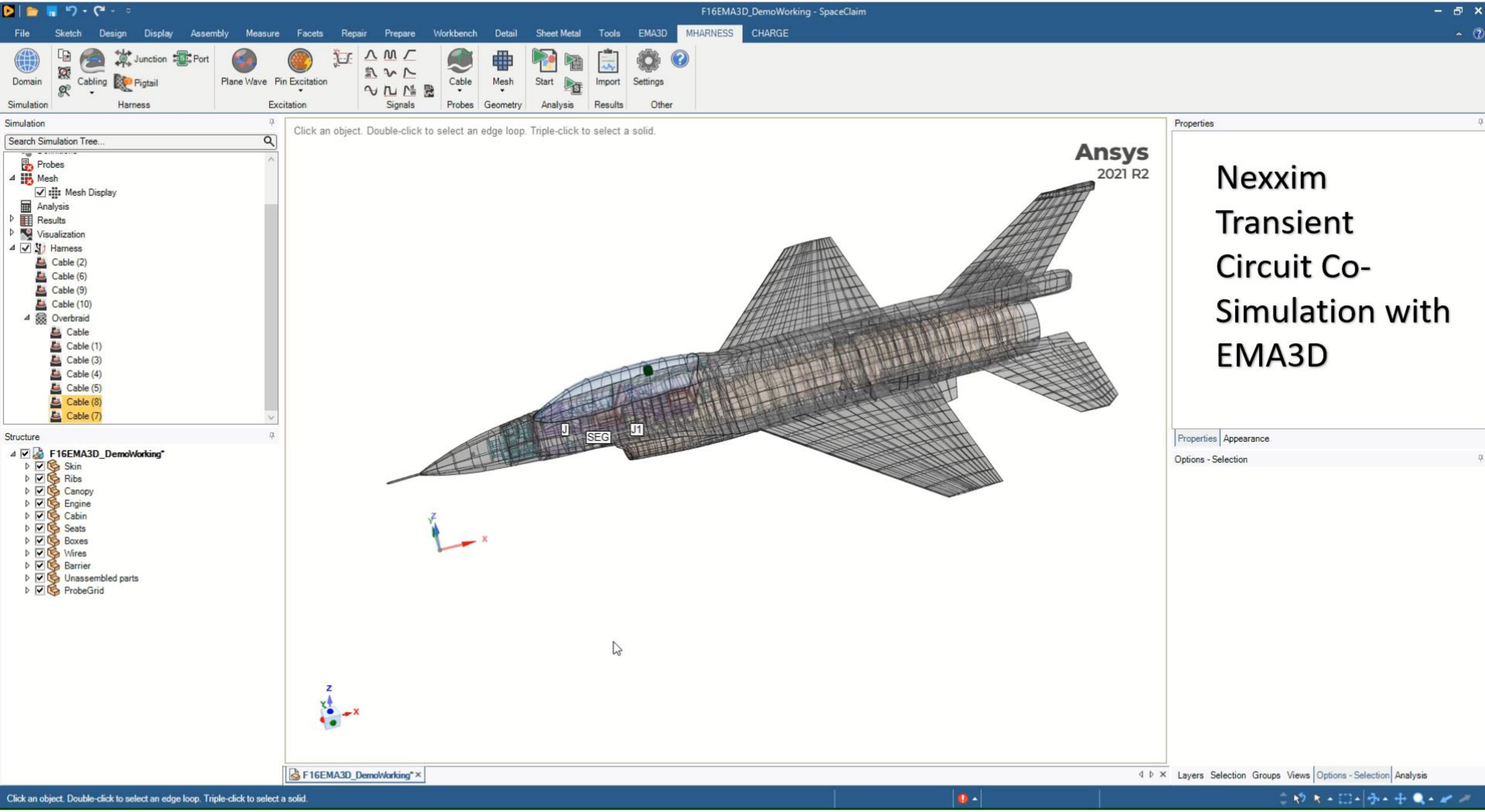
Featured Update 1: EMA3D and Nexxim Transient Circuit Co-Simulation

EMA3D and Nexxim Transient Circuit Co-Simulation

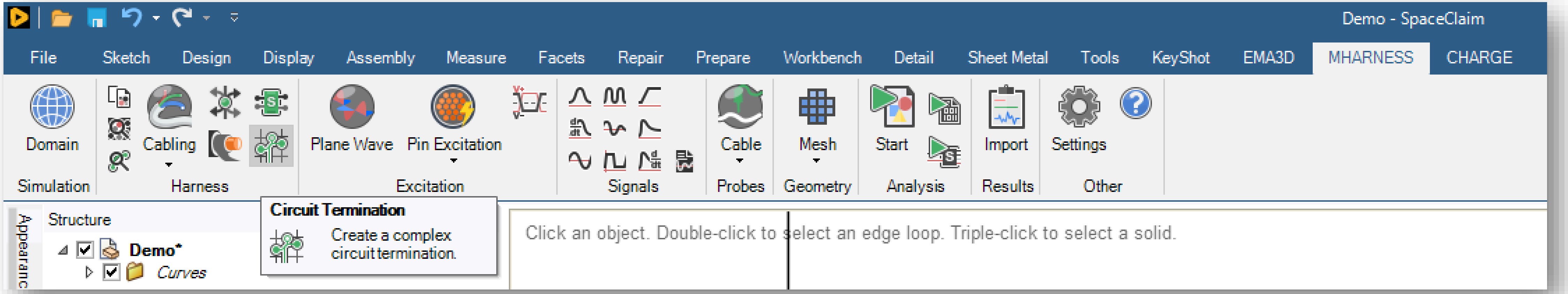
- EMA3D Cables' two existing solvers (EMA3D and MHARNESS) now co-simulate with the Nexxim Transient Circuit solver
- Users specify the 3D geometry for the EMA3D solver
- An arbitrary number of complex cable harnesses may be included in the 3D geometry for the MHARNESS solver
- The termination of any cable conductor may now be a Nexxim circuit
- Any circuit may be modeled as a transient solution with connection to the MHARNESS and EMA3D solvers
- The three solvers proceed in the time-domain as a self-consistent solution



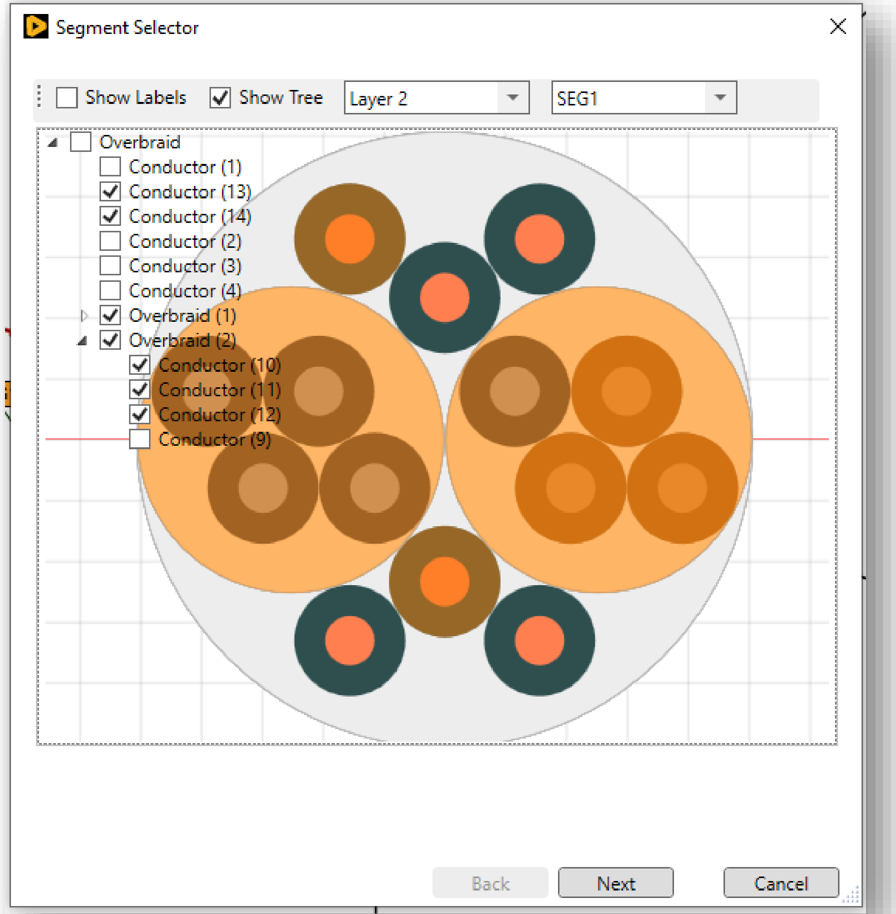
Nexxim Transient Circuit Co-Simulation with EMA3D



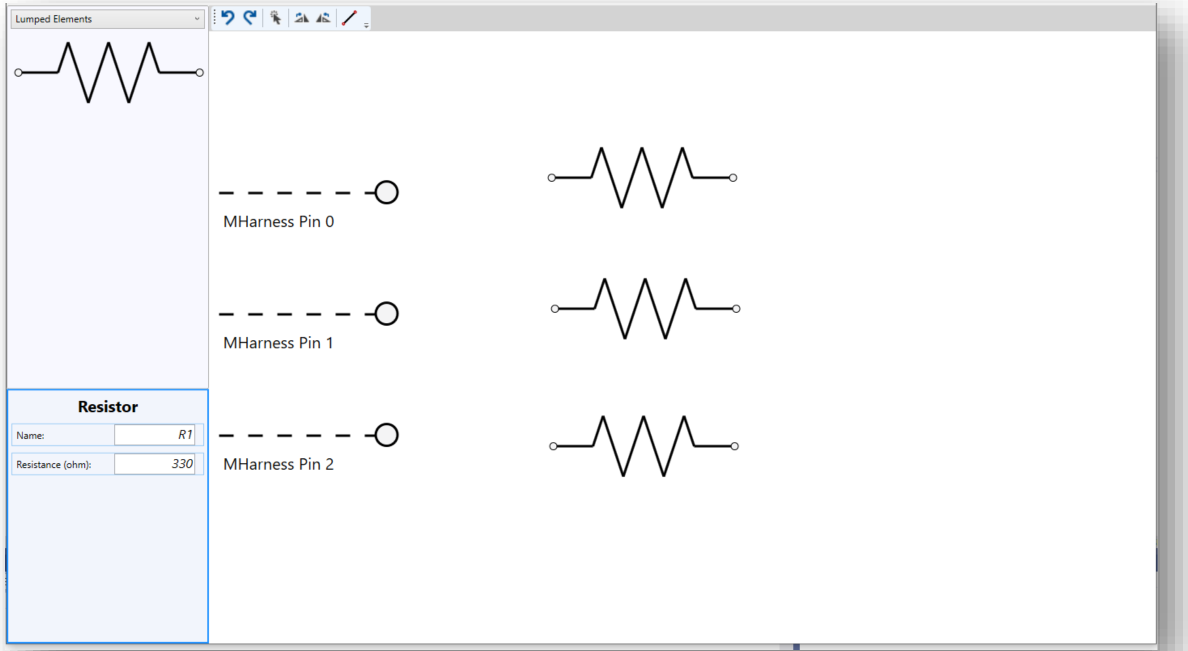
User Interface: Create a complex circuit termination

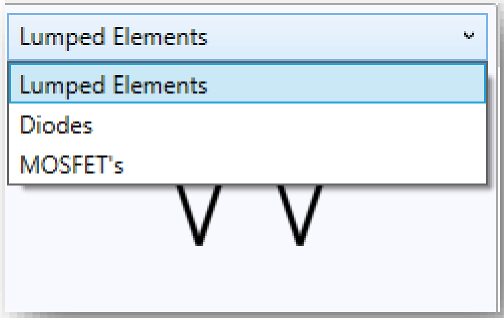


User Interface: Select the conductor with a complex circuit termination



User Interface: Add arbitrary circuit elements to the circuit

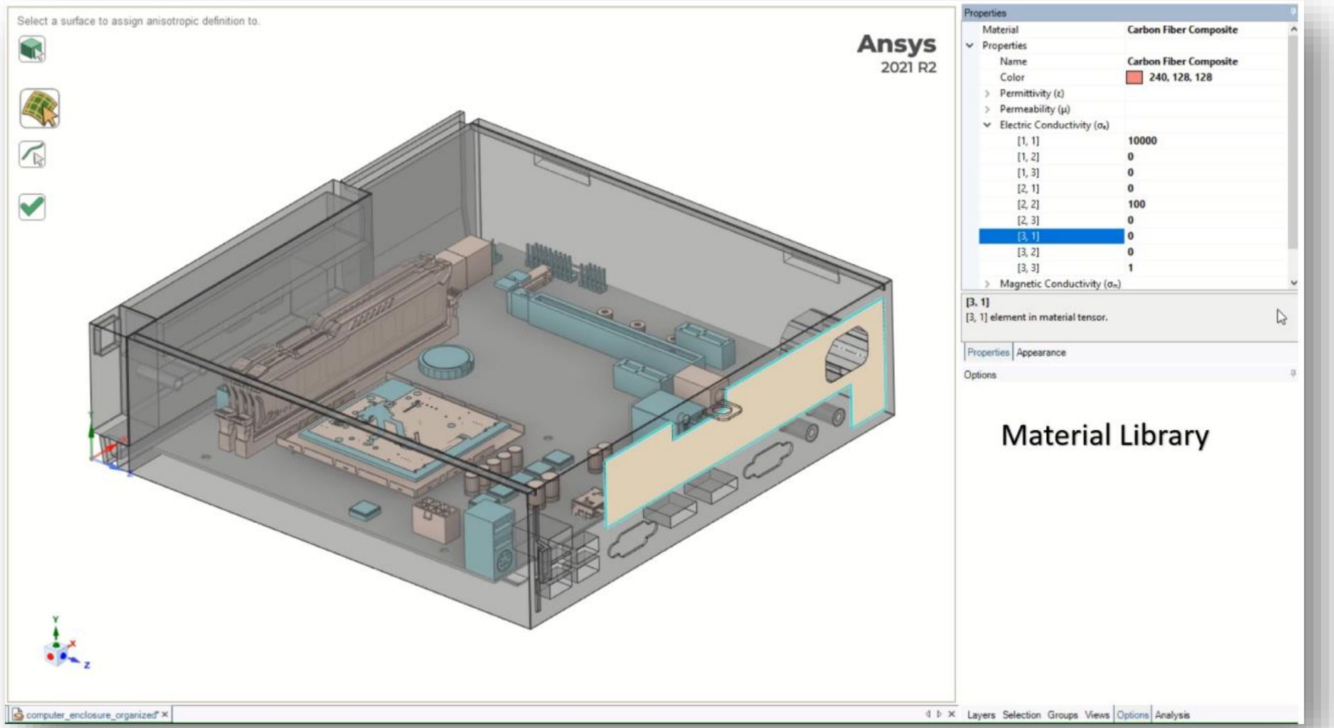


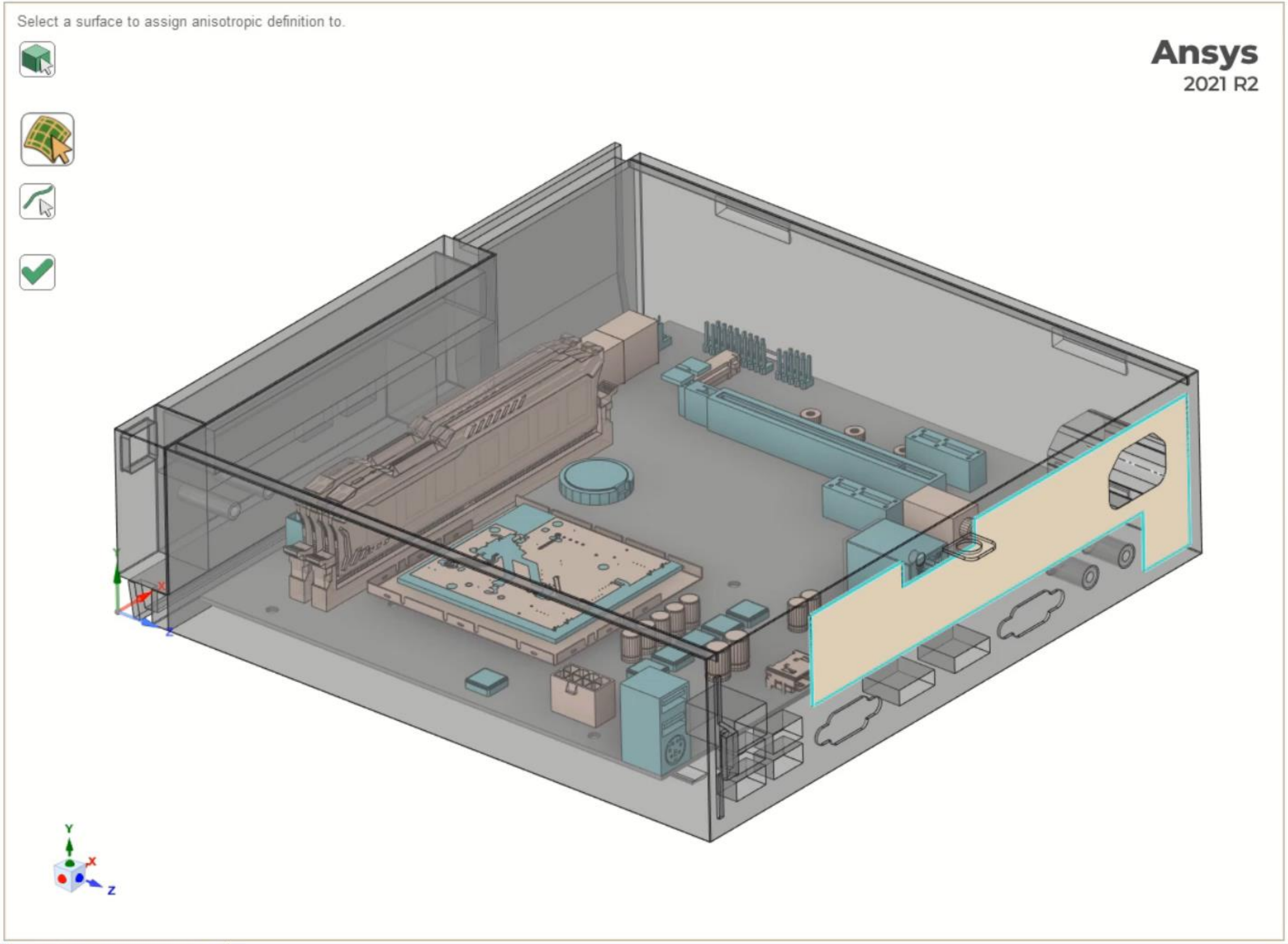


Featured Update 2: Material Property and Cable Libraries

Material Property and Cable Libraries

- EMA3D Cable materials are complex and may include frequency dependence, anisotropies, or other important details
- EMA3D cable harnesses may include multiple shields (braided or foil), multiple conductors, twisting, and a variety of dielectric fills and wraps
- Now EMA3D material properties and cable descriptions may be saved for re-use or shared with colleagues as XML files





Properties

Material	Carbon Fiber Composite
Properties	
Name	Carbon Fiber Composite
Color	240, 128, 128
Permittivity (ε)	
Permeability (μ)	
Electric Conductivity (σ_e)	
[1, 1]	10000
[1, 2]	0
[1, 3]	0
[2, 1]	0
[2, 2]	100
[2, 3]	0
[3, 1]	0
[3, 2]	0
[3, 3]	1
Magnetic Conductivity (σ_m)	

[3, 1]

[3, 1] element in material tensor.

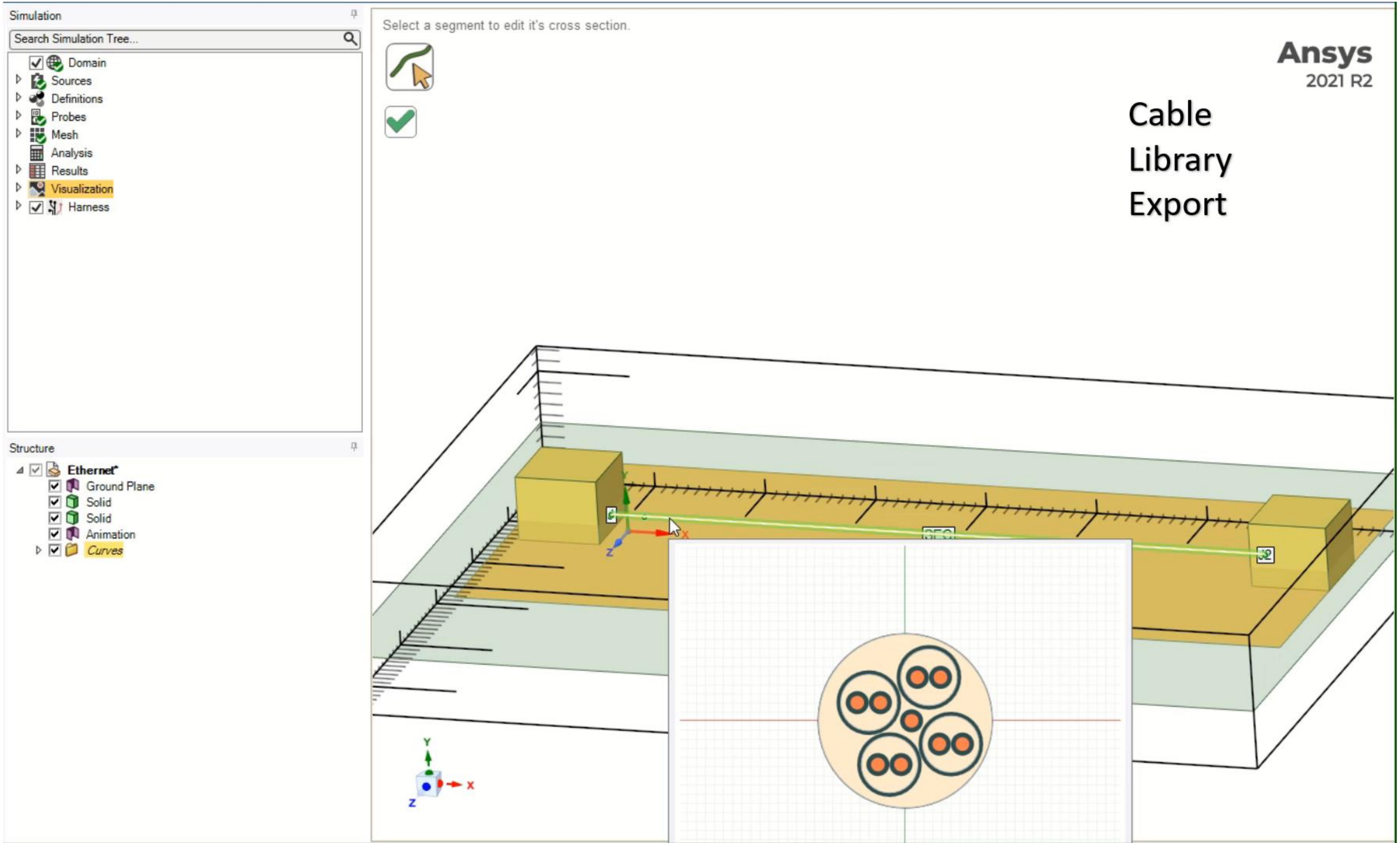
Properties Appearance

Options

Material Library

computer_enclosure_organized* ×

Layers Selection Groups Views Options Analysis

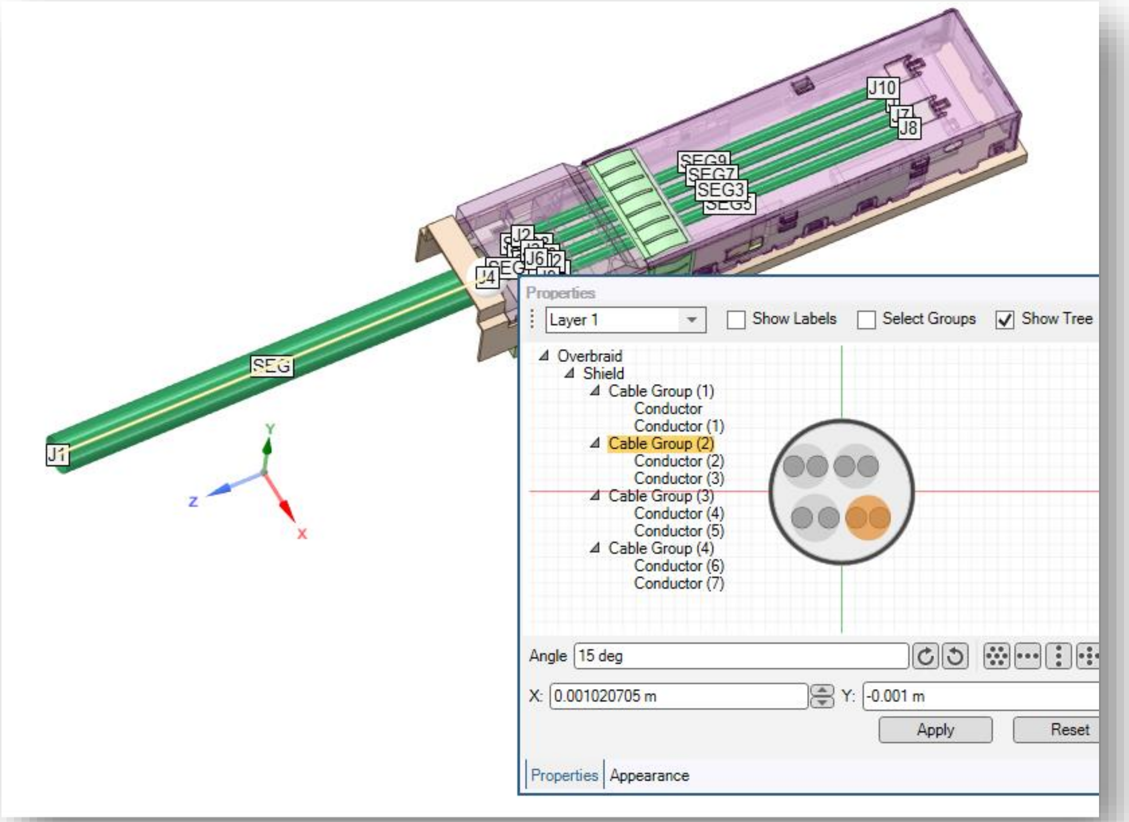


Simulation
Search Simulation Tree...
Domain
Sources
Definitions
Probes
Mesh
Analysis
Results
Visualization
Harness
Structure
Ethernet*
Ground Plane
Solid
Solid
Animation
Curves
Select a segment to edit it's cross section.
Ansys
2021 R2
Cable
Library
Export
Y
X
Z

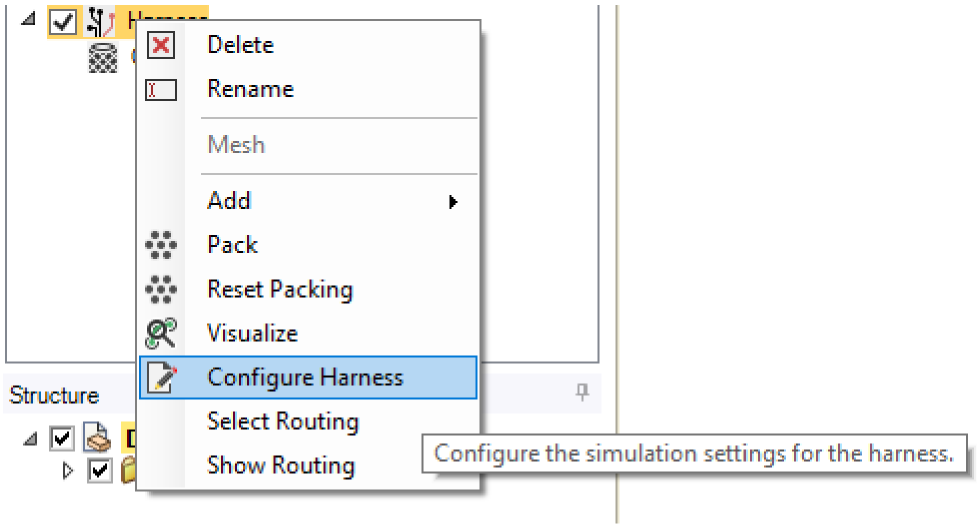
Featured Update 3: Expanded Cable Harness Connectivity Features

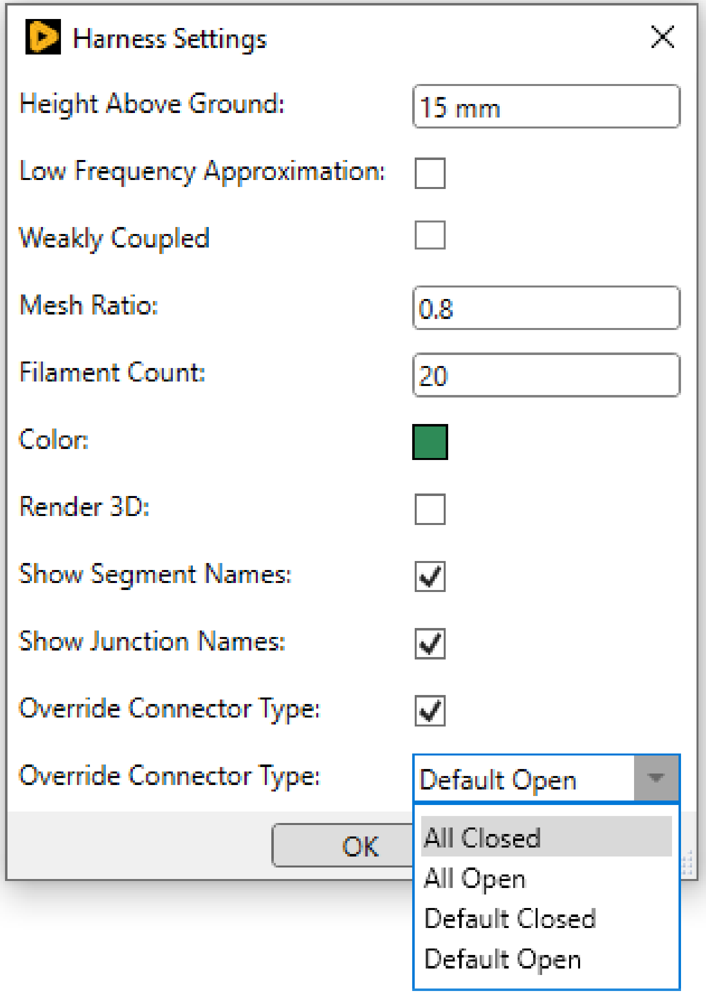
Expanded Cable Harness Connectivity Features

- EMA3D Cable allows for shields and conductors to have a variety of complex terminations
- Real products require for shields to terminate allowing for conductors to contact PCBs
- Conductors may break outside of one or more shields
- The electrical impedance of multiple topological shield levels may be precisely specified by users
- High impedance shield terminations and disconnected shields now properly allow additional electromagnetic coupling, capturing the real-world phenomena
- Competitive products do not allow the same breakdown of topological levels
- Now any physically relevant cable and connector may be properly represented and simulated



Open and Closed MHARNESS Cable Terminations

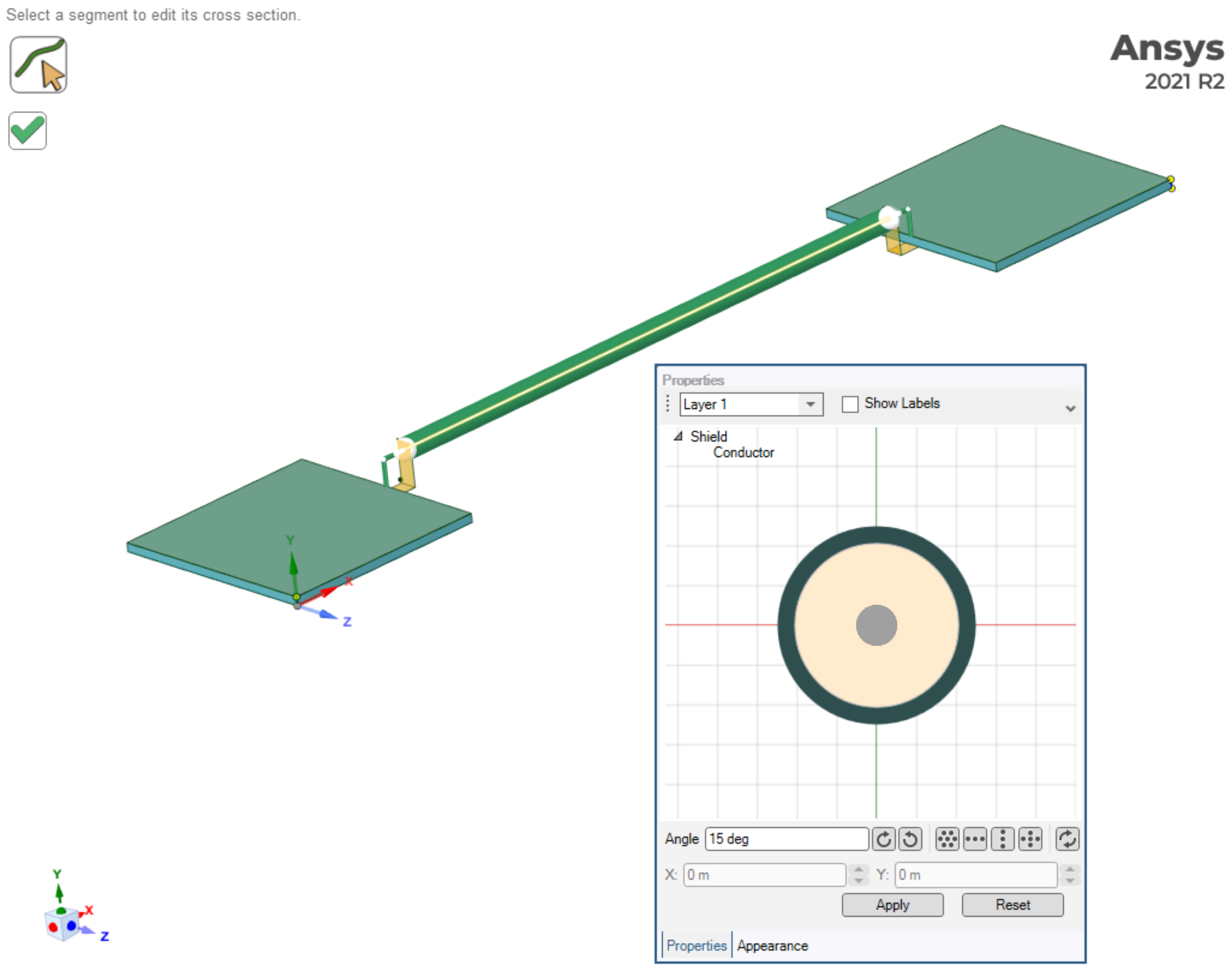




- If the impedance is high enough on the end of a shield, additional fields may couple to the interior of the shield.
- EMA3D Cable gives the user the ability to allow this additional coupling into poorly-terminated cables.
- This behavior is referred to as Connector Type “Open”
- If users prefer the coupling through shields to be independent of the shield termination, the Connector Type “Closed” should be selected

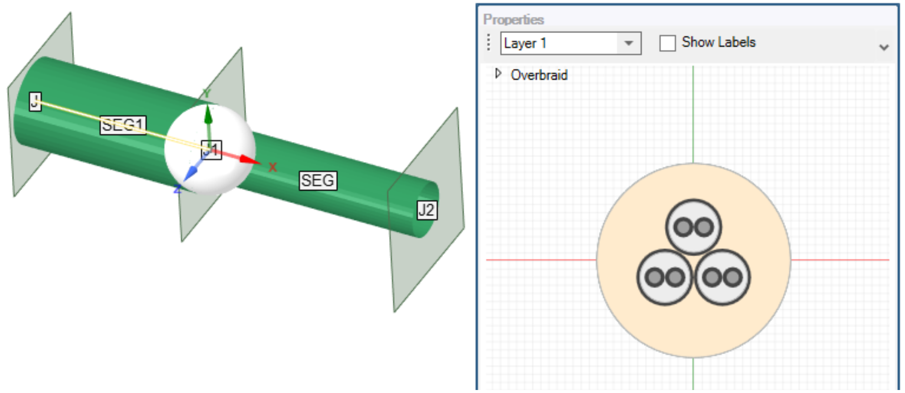
Conductors Breaking Outside of Shields (at 3D surfaces)

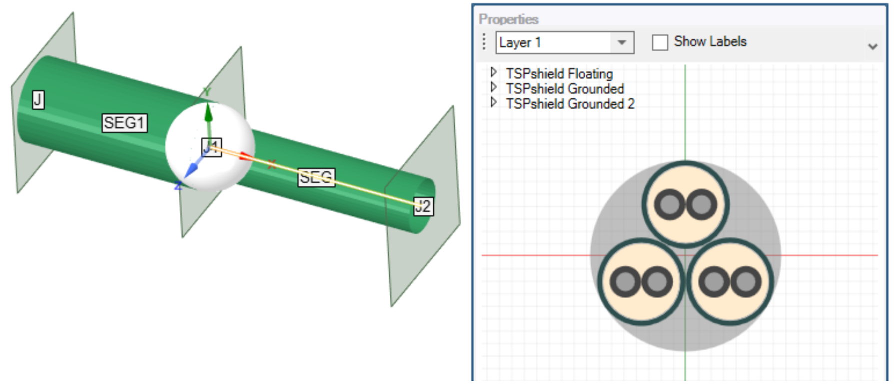
- Conductors or shields that are inside of another shield may break outside of that shield
- In this example, the coax shield terminates in the 3D surface while the coax inner conductor continues outside of the shield
- This shield could have no terminations assigned or use Surrounding Materials termination to track the electrical connection points

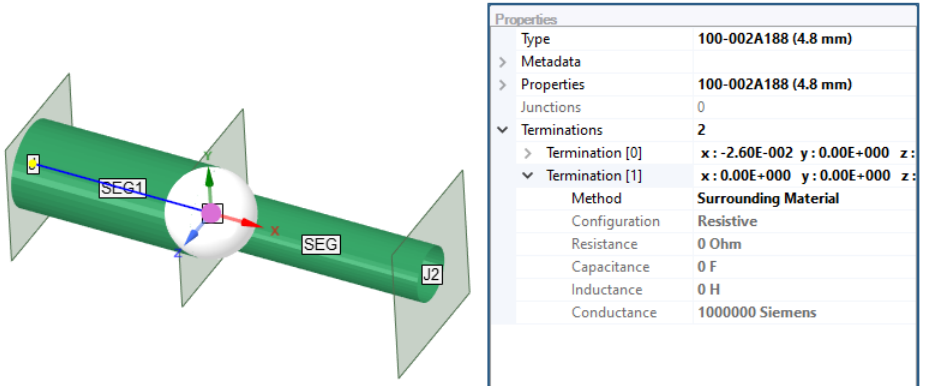


Conductors Breaking Outside of Shields (in air)

- Conductors or shields that are inside of another shield may break outside of that shield
- In this example, the overbraid shield ends with a “Surrounding Material” Termination (which is air in this case) while the three twisted, shielded pairs continue outside of the overbraid





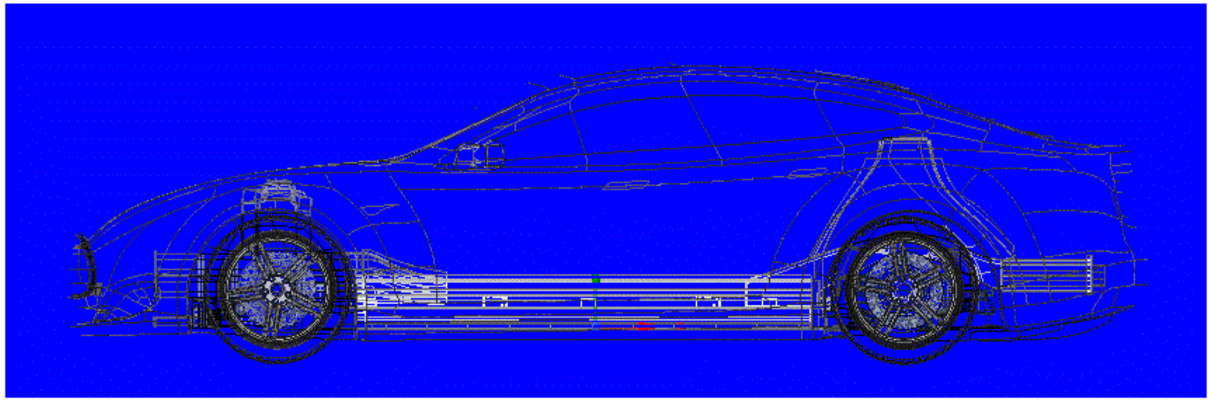


Additional Updates

Ansys

2022 R1 Ansys EMA3D Cable Additional Updates

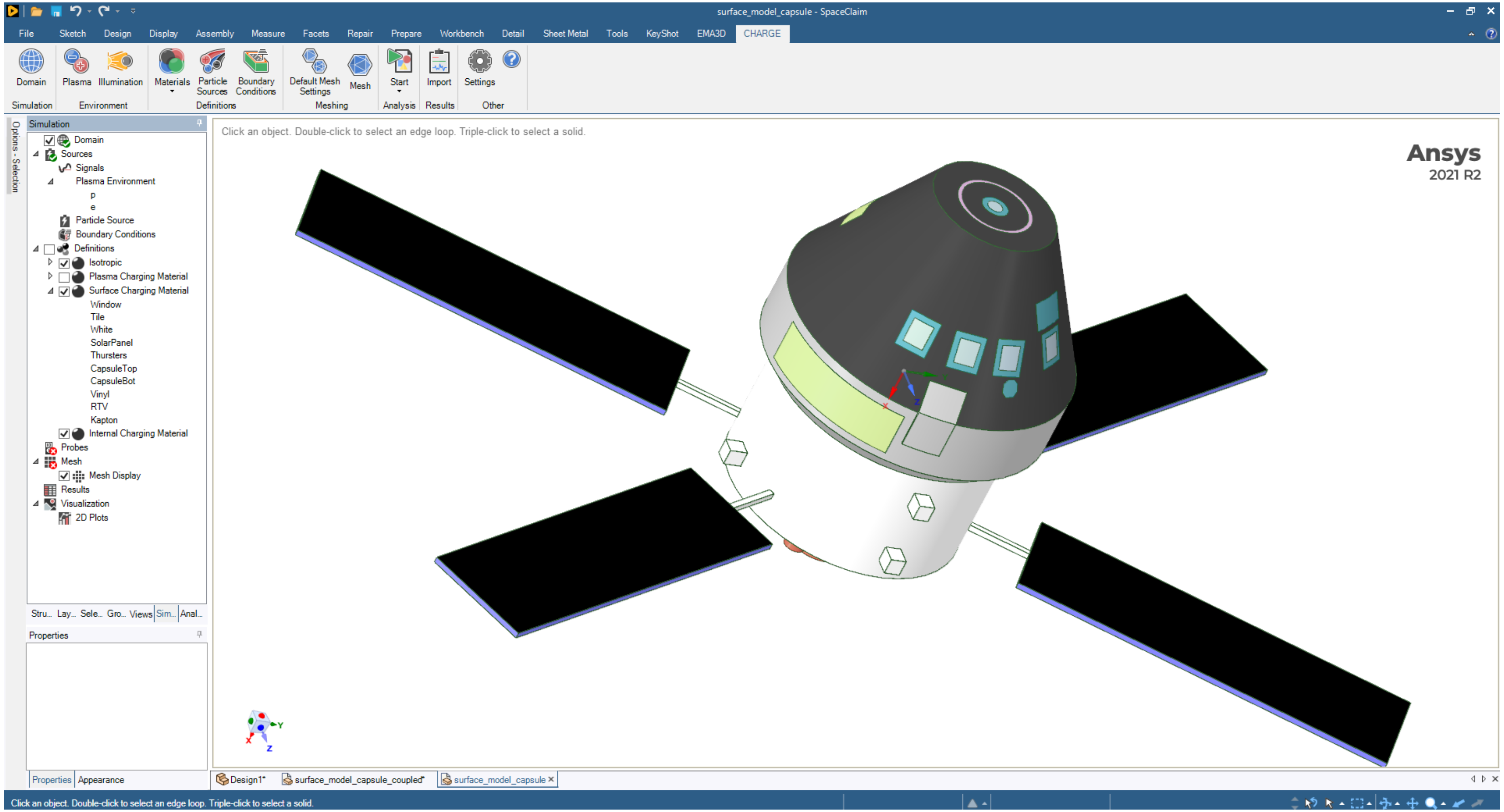
- Performance optimizations to the Mesh Inspect tool to speed up the rendering time on large models
- Added support for using additional ASCII file formats (.nf1) for Near Field Sources
- Linux EMA3D Solver bundled with the installation
- Added pop-up GUIs and Ribbon buttons for the Copy Cross Section & Visualize Cross Section tools.
- Added support for EMA3D Switches
- Added a search bar at the top of the Simulation tree which can be used to filter what items are visible, as well as numerous user interface enhancements
- Updates to meshing engine to support arbitrary radius cable deconfliction
- New *thin wire* structures in 3D
- New tool to define 3D voltage sources



EMA3D Charge

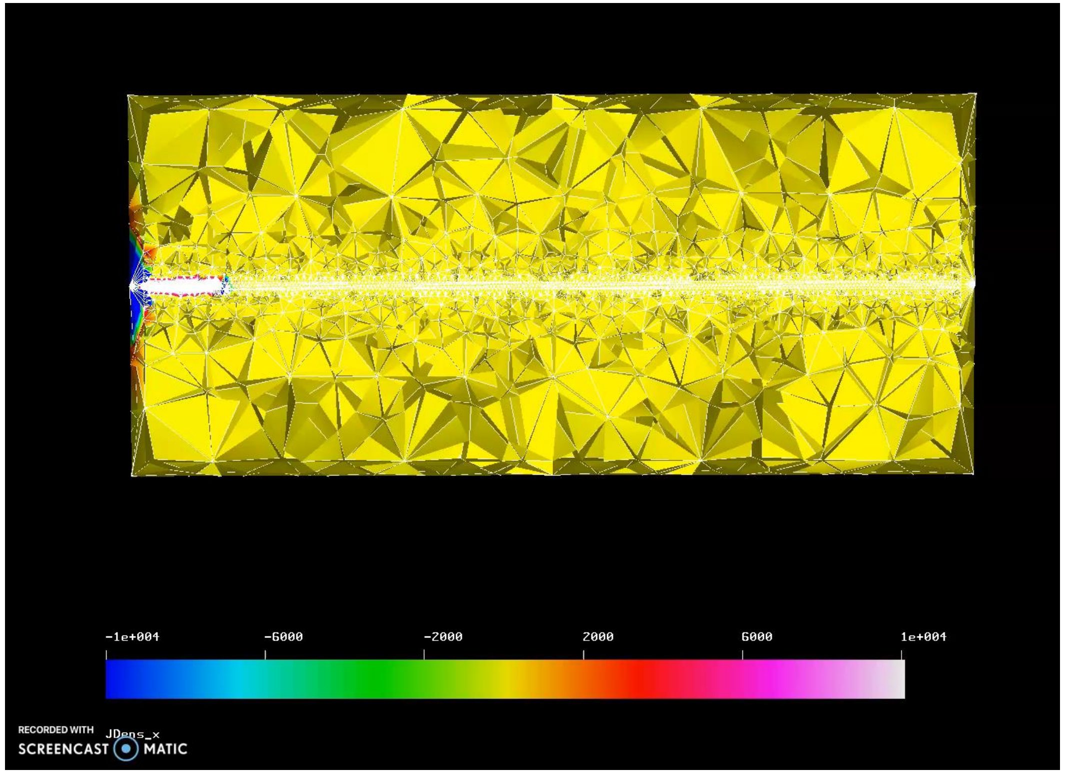
New Product: Ansys EMA3D Charge

Platform Level Charging and Discharging Solution



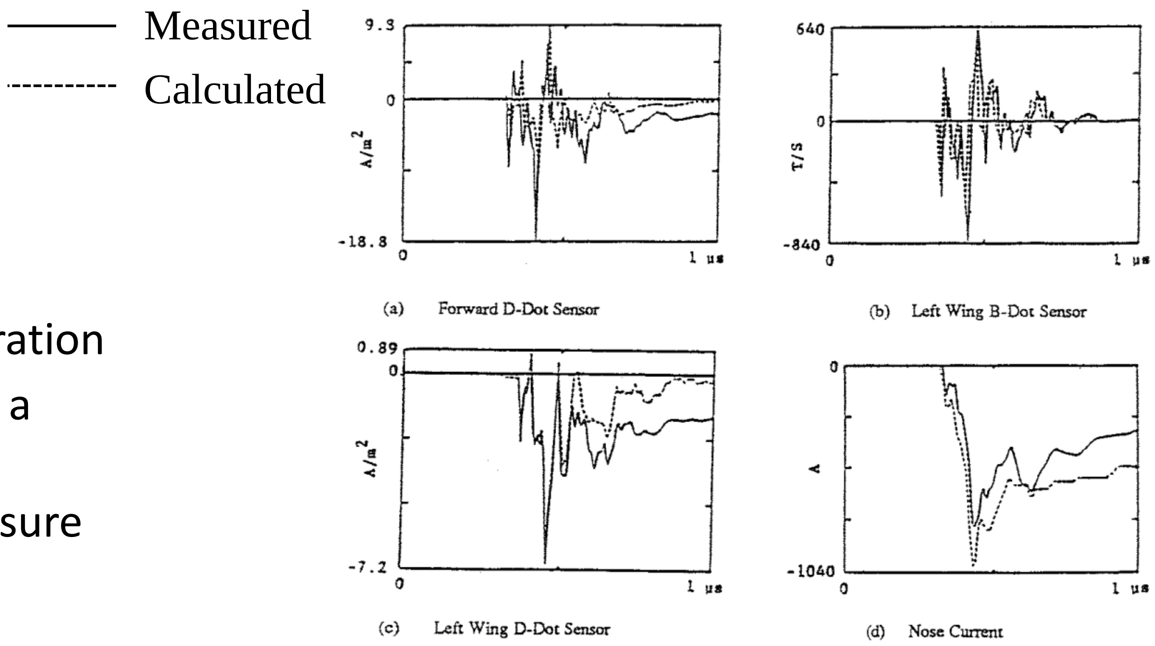
A Toolbox Fully Integrated into one Platform SpaceClaim

- 3D **Finite Difference Time Domain (FDTD)** method with non-linear air chemistry module
  - ➢ **Air ESDs**
- Matrix solution of **Surface Charge Balance** equations
  - ➢ **Surface Charging**
- Full-wave **Finite Element Method (FEM)**
  - ➢ **Internal Charging and Solid ESDs**
- **Monte Carlo (MC) Transport** of energetic particles interacting with bulk materials
  - ➢ **Charging and Radiation Hardening**



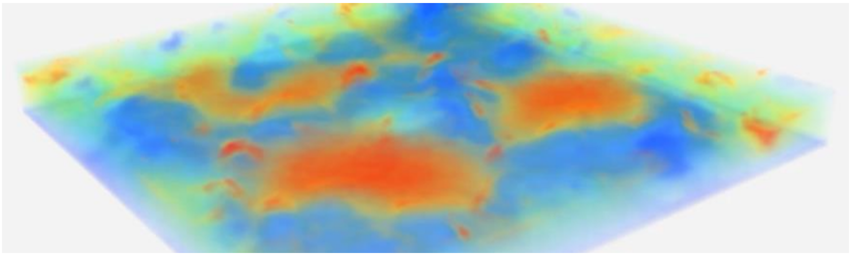
Ansys EMA3D Charge Distinguishing Features

- Accurate
  - Decades of validation heritage of experiment compared to simulation on complex platforms
  - Full wave solution of electromagnetic equations in FEM and FDTD
  - Non-linear air chemistry solution for arc formation in air
  - Stochastic tree model with particle transport for dielectric breakdown
- Easy to use
  - User interface within Ansys SpaceClaim
  - Intuitive for new users
  - Utilize mechanical CAD directly with minimal cleaning or preparation
  - Prepare models of complex platforms and material stack-ups in a fraction of the time of other methods
  - Easily change background properties such as humidity and pressure

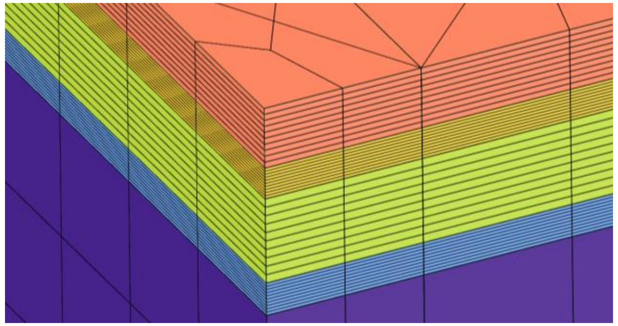


2022 R1 Ansys EMA3D Charge - Highlight Features

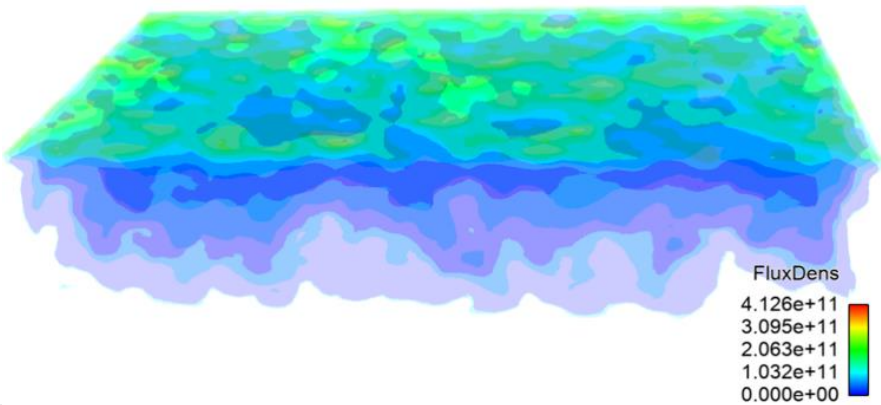
- ESDs in Solids



- Extrusion Mesh for Long Cables and Thin Layers

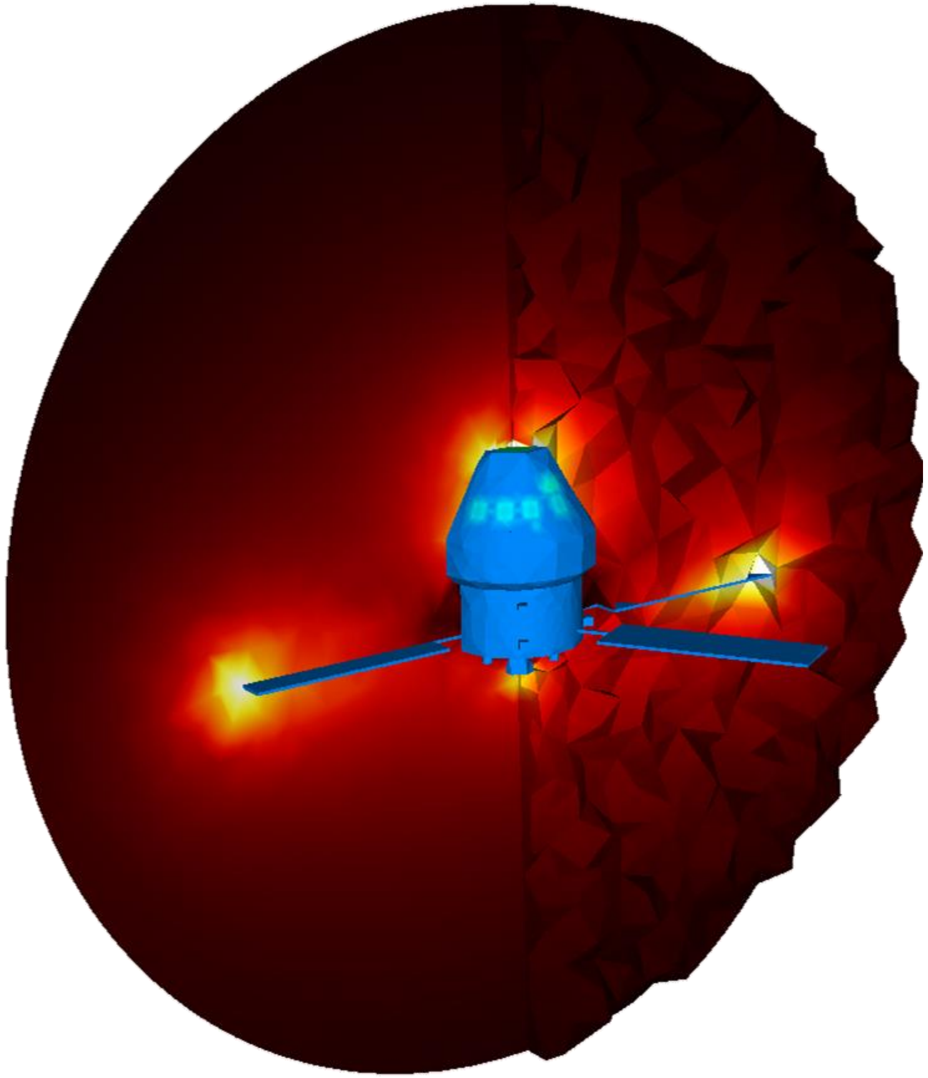


- Radiation Hardening Workflows – Cumulative Dose and Flux in 3D



2022 R1 Ansys EMA3D Charge - Additional Features

- EnSight Integration
- Chassis Potential Bias and Resistance for Surface Charging
- 3D Field Monitoring around Surface Charging Solution – Coupled Simulations
- Additional Charge modeling features
  - Material export
  - New plasma environments: power law and gaussian
  - Direct meshing
  - Stability controls and shielding effects for surface charging simulations
  - Time varying boundary conditions for internal charging



ESDs in Solids

Simulate arcing in solids such as insulators in PCBs or dielectric s in solar panels.

Ansys

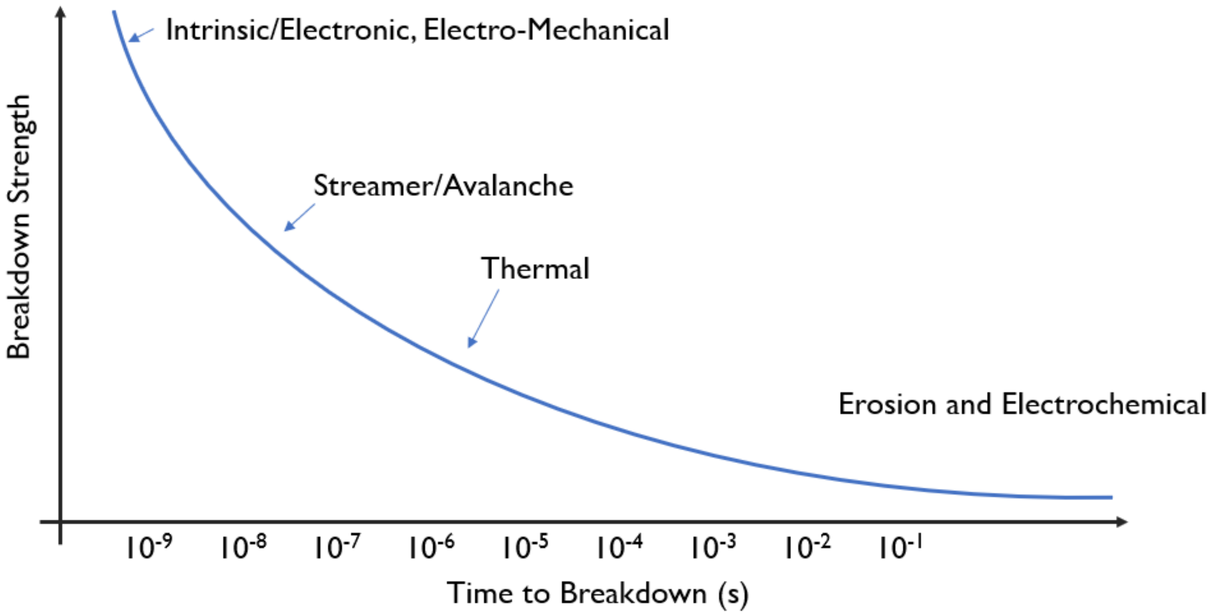
Solid ESD Principles

- The potential and electric field is solved using a full-wave FEM solver.
- The probability of electronic breakdown at each element is calculated by

$$P_i = 1 - e^{-(|E_i| - k*E_{th})/(k*E_{th})}$$

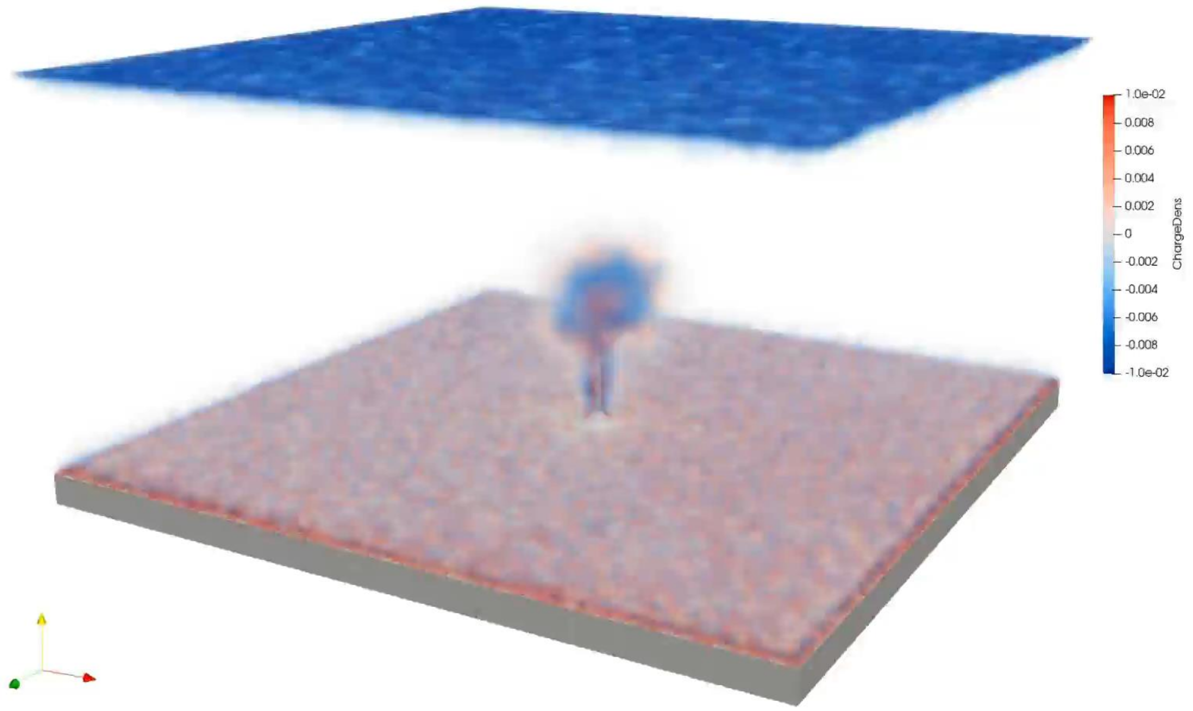
  - $|E_i|$ = Electric Field Magnitude
  - E_{th} = Breakdown Threshold Field Magnitude
  - k = Breakdown Element Local Field Enhancement

- Each element is then randomly determined whether a breakdown occurs using P_i and a uniform distribution.
- During an arc, each element that undergoes breakdown has its conductivity changed to σ_{Intra}. Once the arc event finishes, all arc elements have their conductivity changed to σ_{Post}.

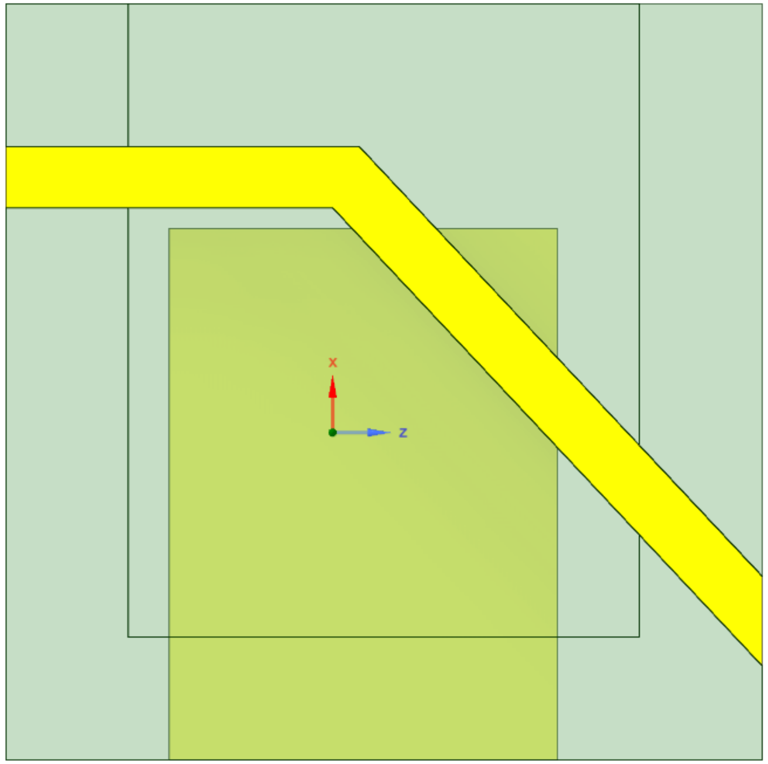


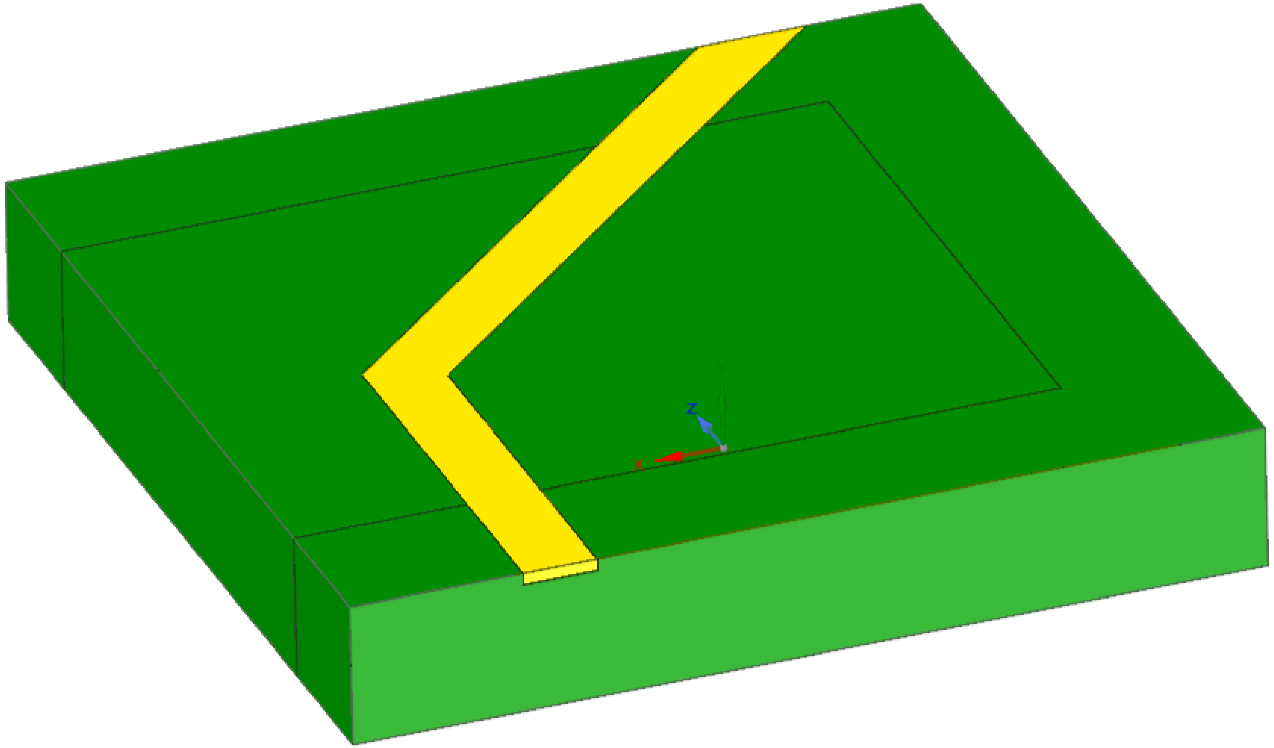
Solid ESD Settings

Charging Type	
Charging Environment	Internal Charging
Flux Source	False
Threshold (MeV)	1
Field Coupling	False
Time	
Internal Charging Time Step (s)	1E-06
Number of Internal Time Steps	10
Charging Options	
Internal Solver	Quasi-Static
Internal Max Iterations	100
Internal Convergance Tolerance	1E-10
Internal Preconditioner	True
Internal Polynomial Order	2
Electrostatic Discharge	
Simulate Breakdown:	False
Neighbor Breakdown Threshold:	0.8
Intra-Breakdown Conductivity (S/m):	1000
Post-Breakdown Conductivity (S/m):	0.01
Breakdown Time Delay (s):	0

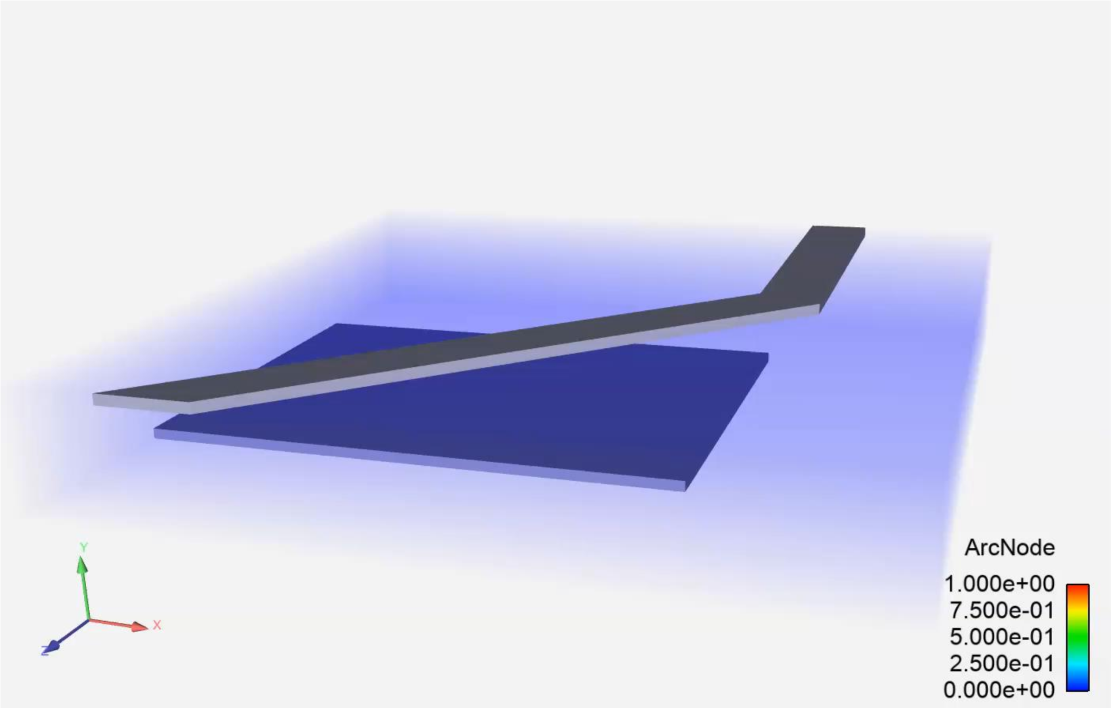


Solid Dielectric Breakdown on PCB

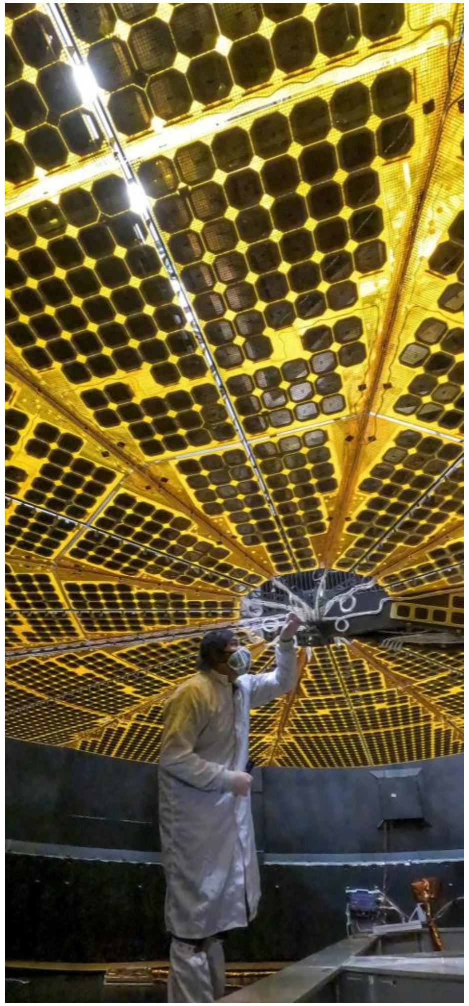


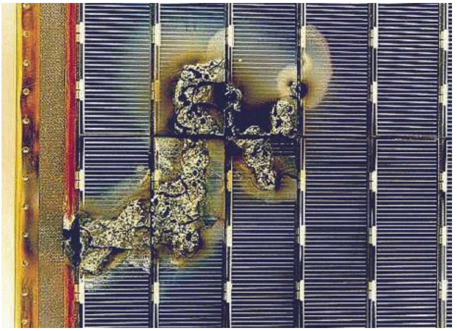


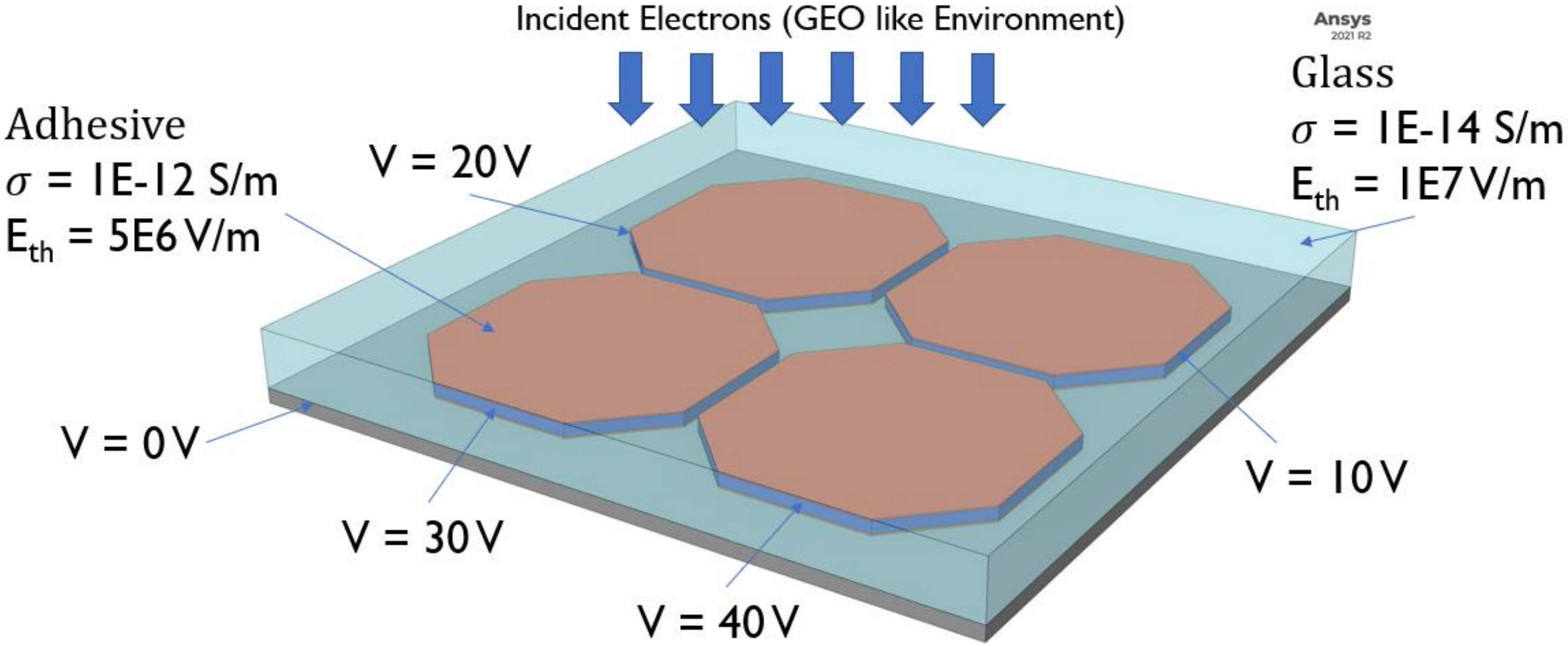
Solid Dielectric Breakdown on PCB – time varying potential



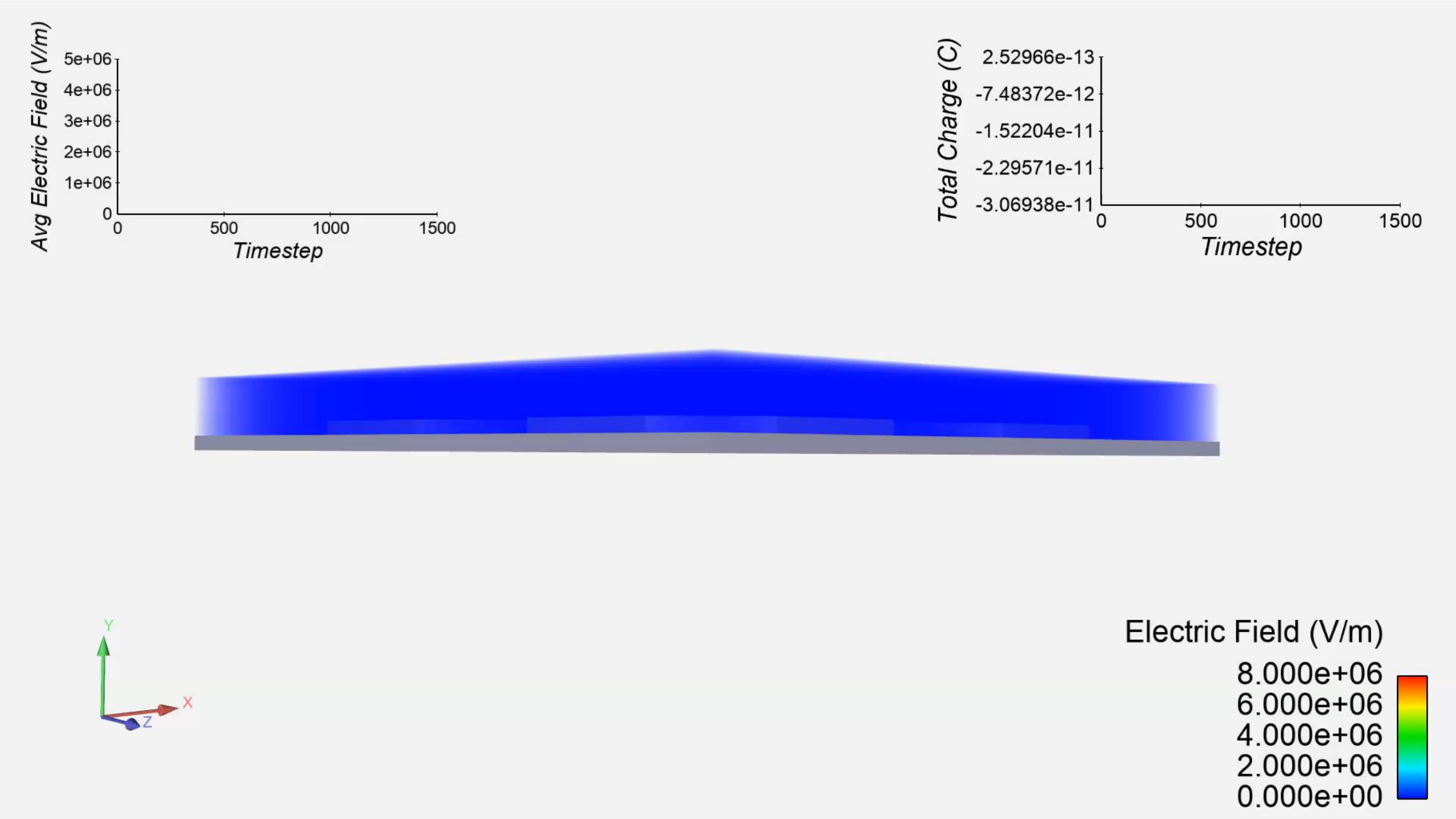
Dielectric Breakdown in Solar Cells







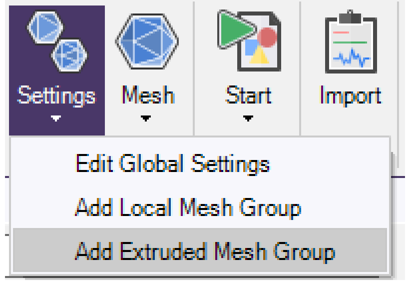
Dielectric Breakdown in Solar Cells



Extrusion Mesh for Long Cables and Thin Layers

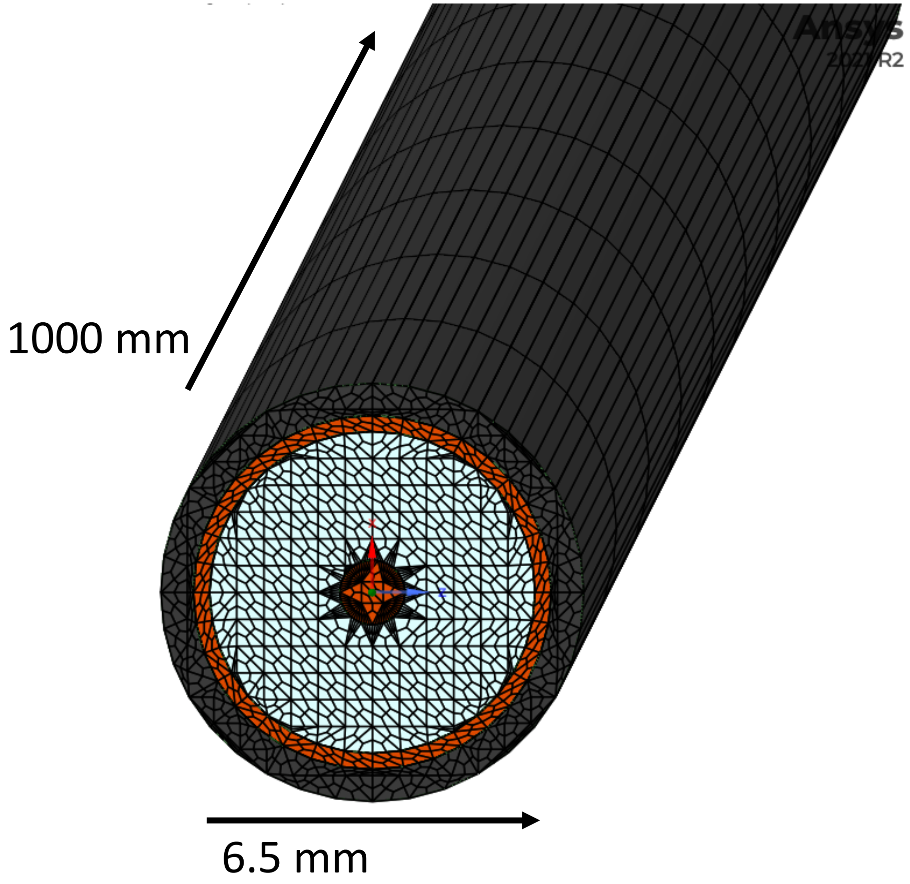
Optimize the number of hexahedron FEM mesh elements for more advanced geometries

Extrusion Settings

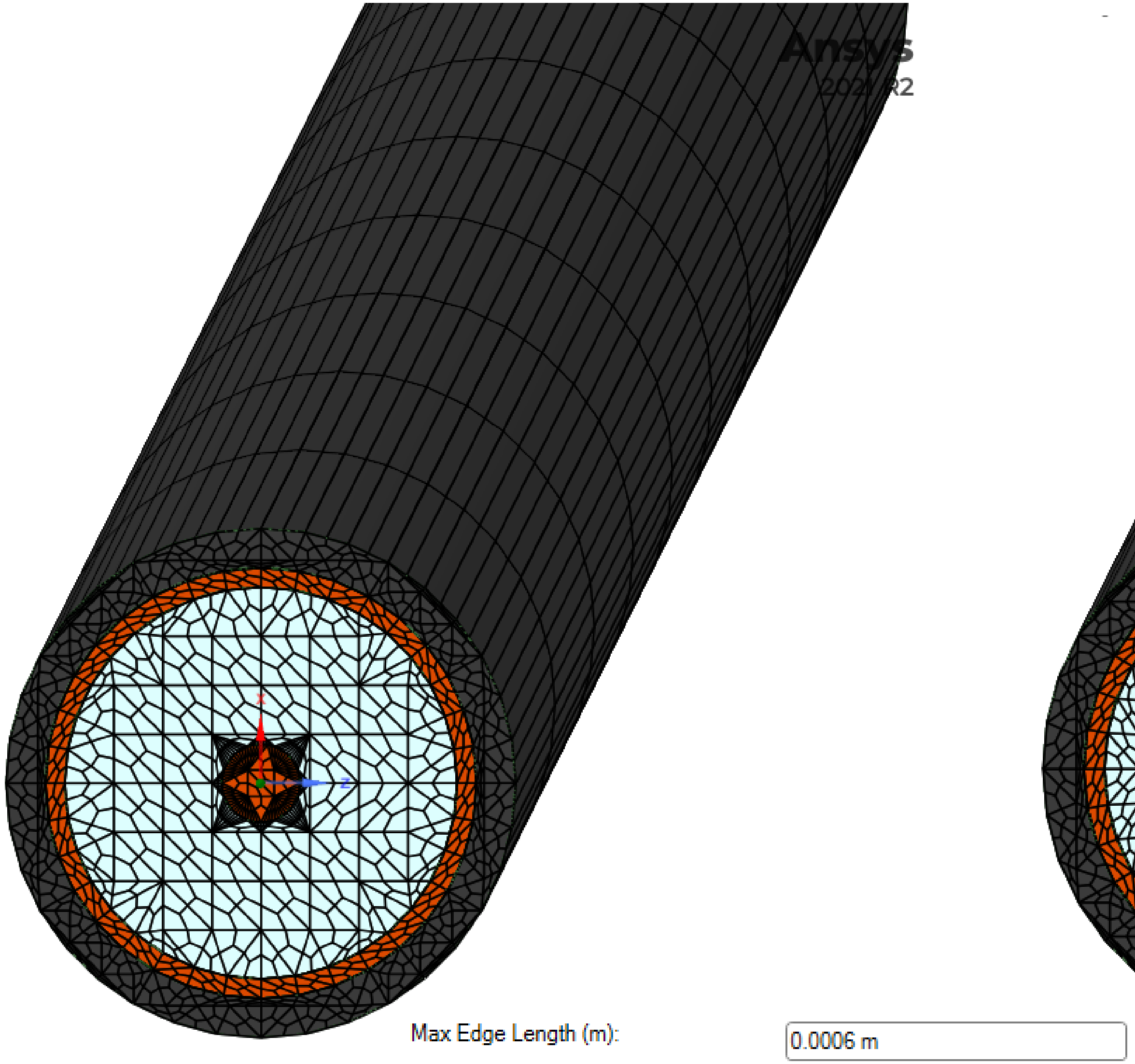


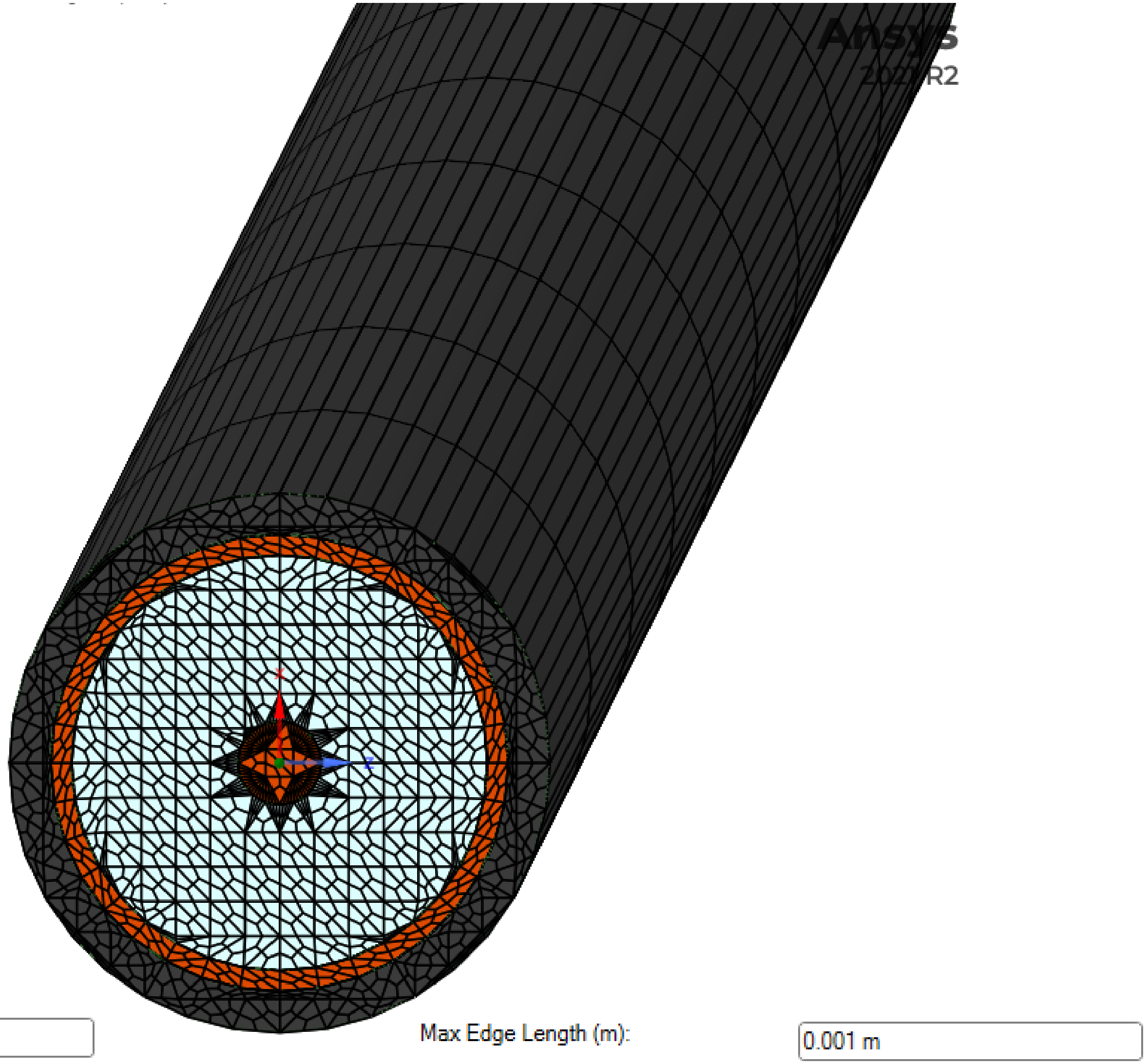
Properties

Advanced Mesh Engine Options	
Extrude Geometry:	True
X-Direction (m):	0
Y-Direction (m):	-1
Z-Direction (m):	0
Subdivisions:	10
SpaceClaim Tessellation Options	
Angle Deviation:	10 deg
Max Aspect Ratio:	0
Max Edge Length (m):	0.0006 m
Surface Deviation:	0.01 m

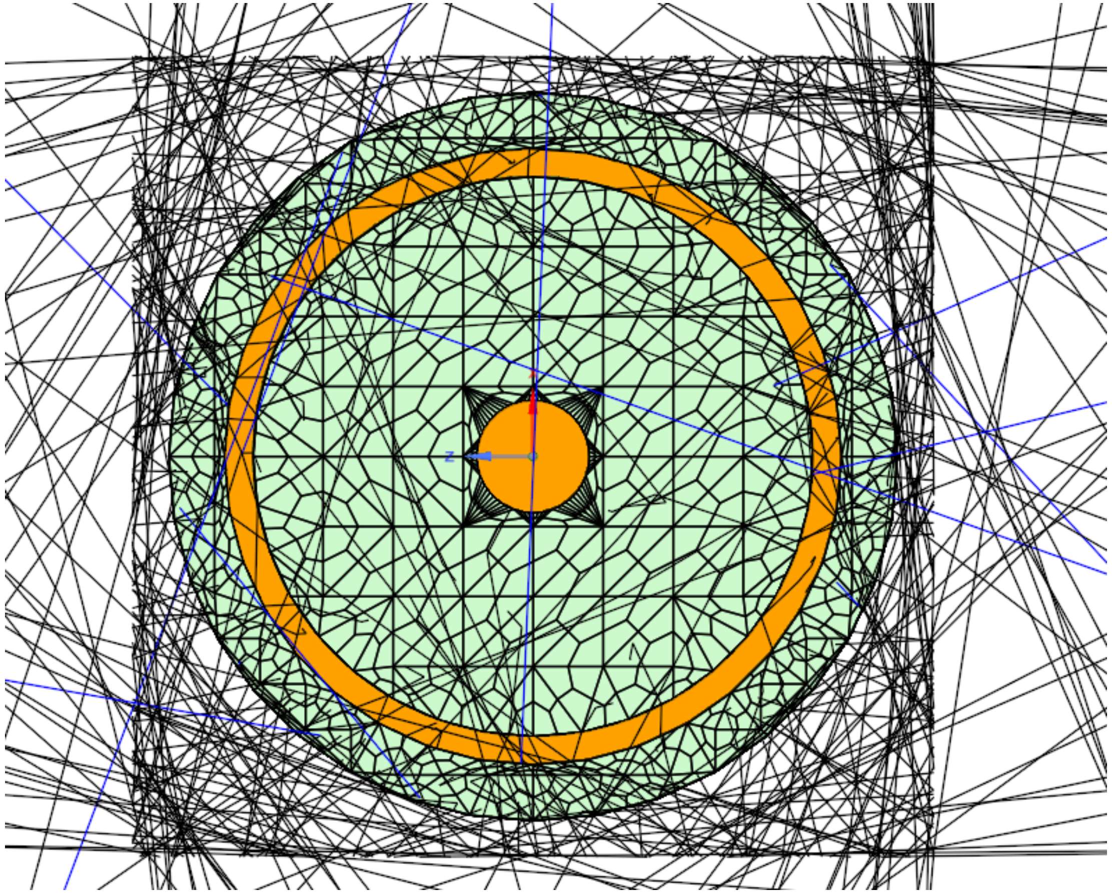


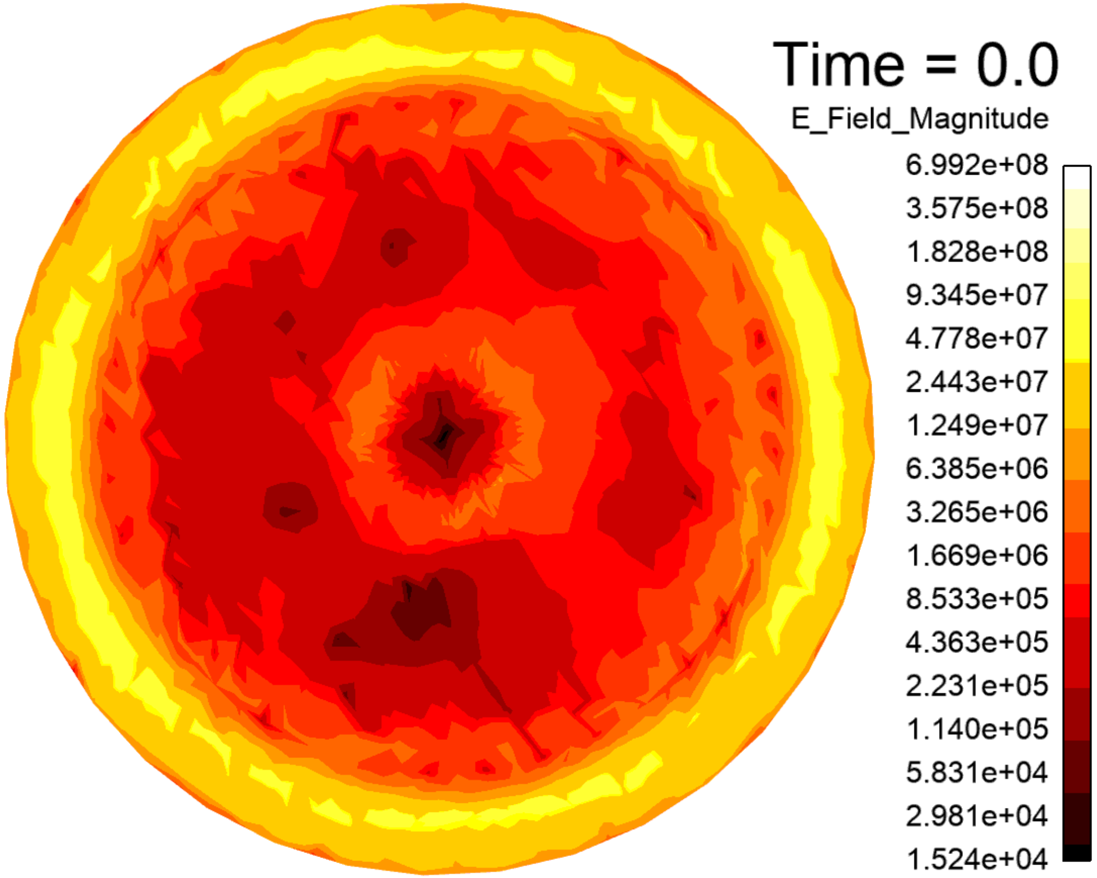
Extrusion Groups for Larger Bodies (Central Dielectric)



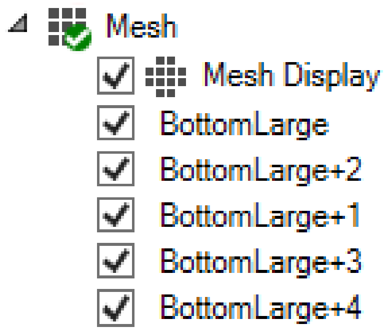


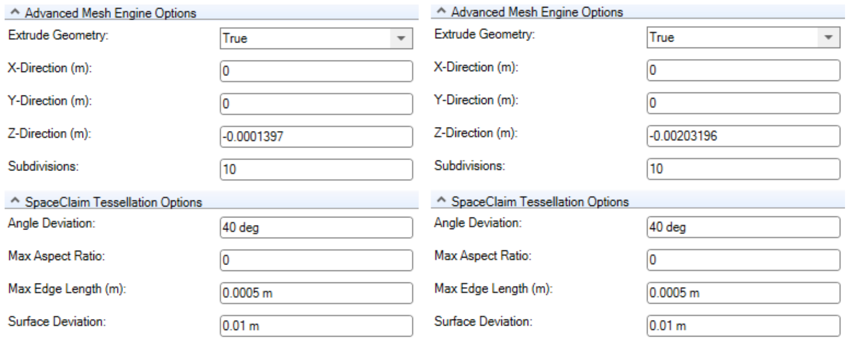
Extrusion Long Cable – From 2 million elements to 20k, and still accurate results!

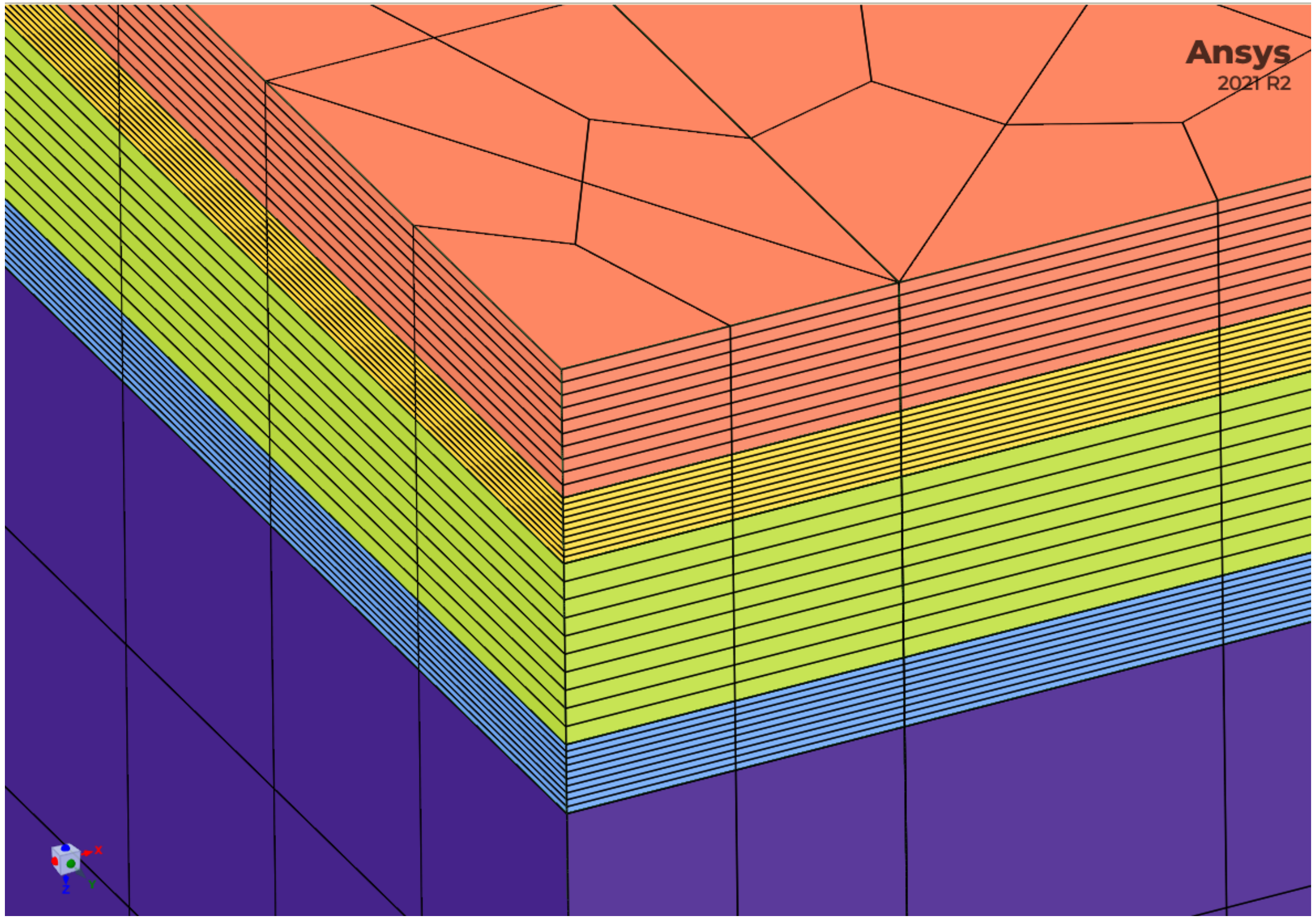




Thin Layers – 10 cells thick for accurate E-field calculations in 1-mil thick layers







Thickness (m):

-10E-05

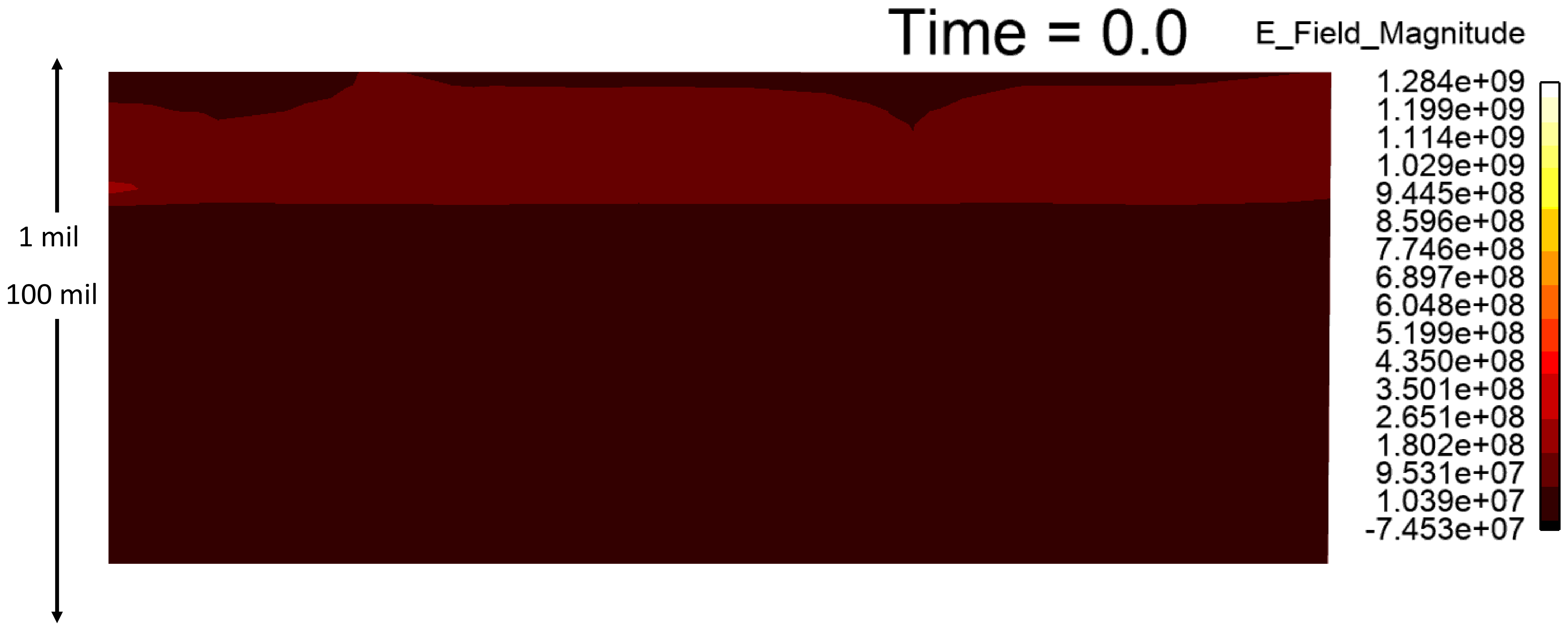
-5E-05

-10.5E-05

-5E-05

-0.002

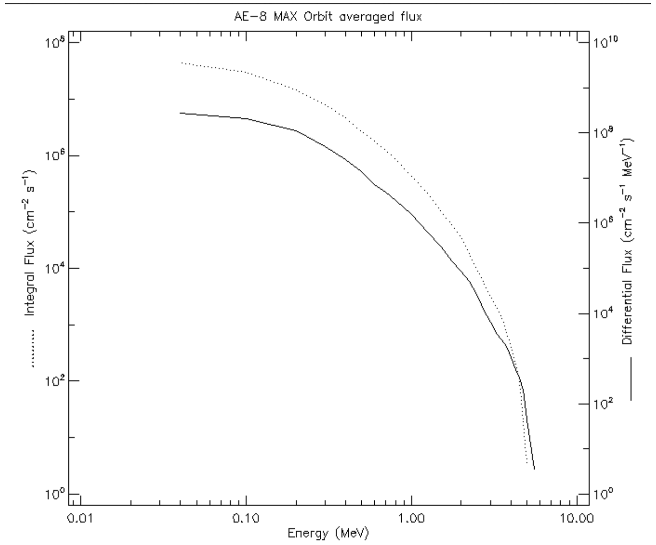
Thin Layers – E-Fields in 1-mil Thick Layer

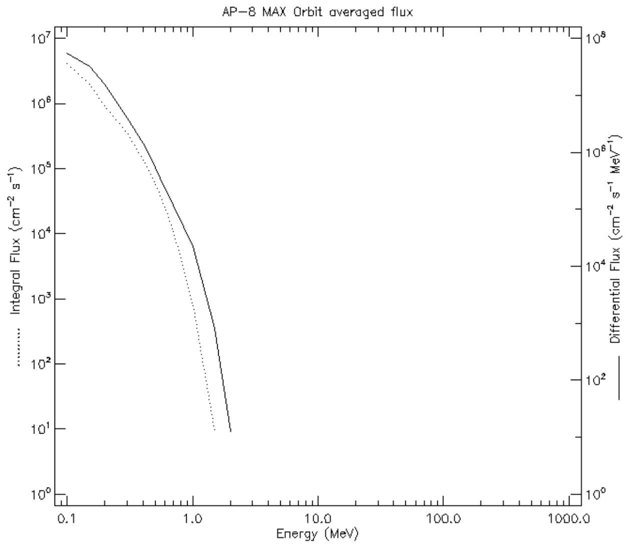


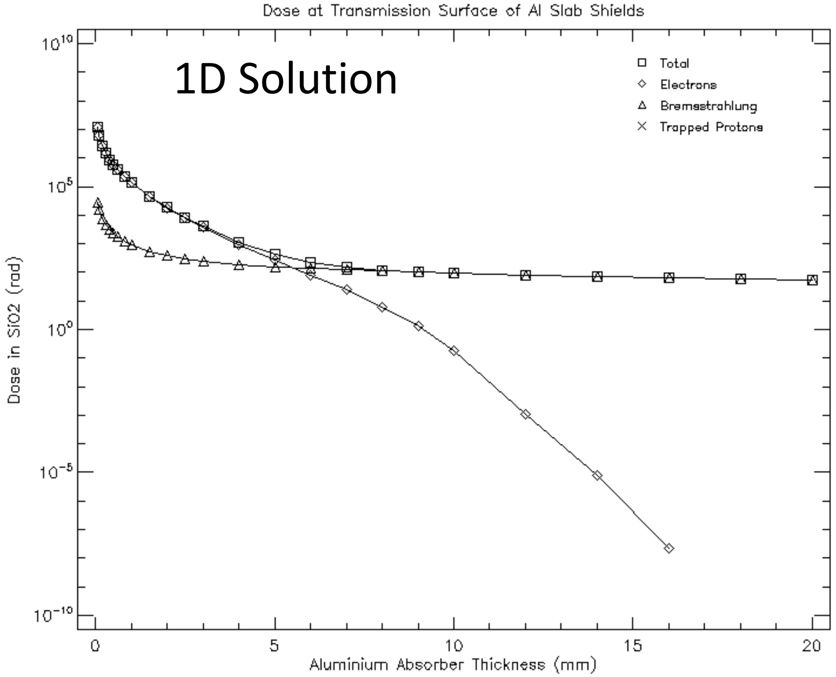
Radiation Hardening Workflows

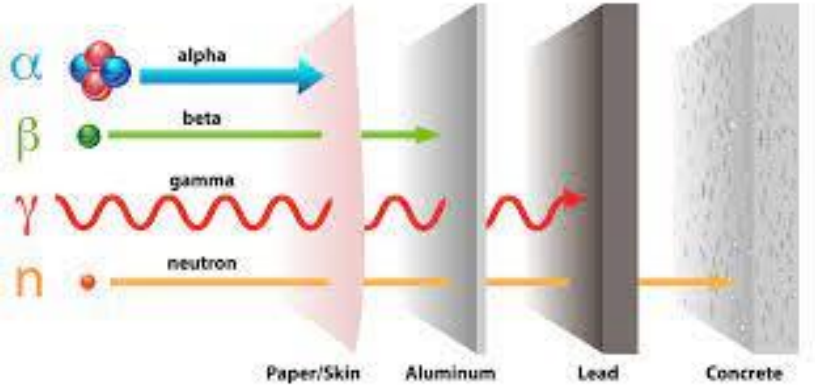
Automatically calculate cumulative dose and flux density

Radiation Hardening – From Spectra to Dose in Si02

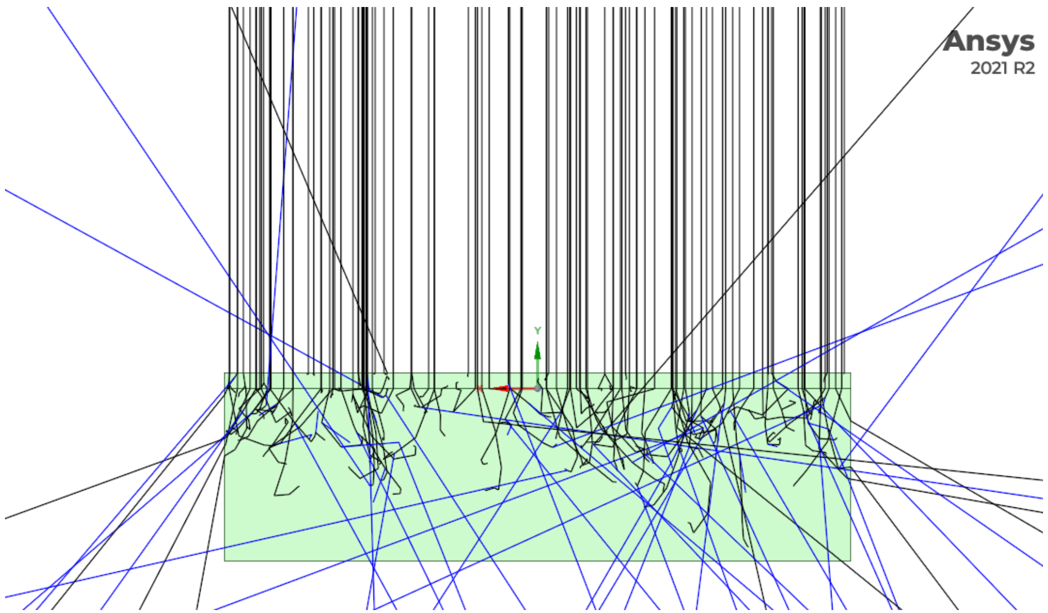


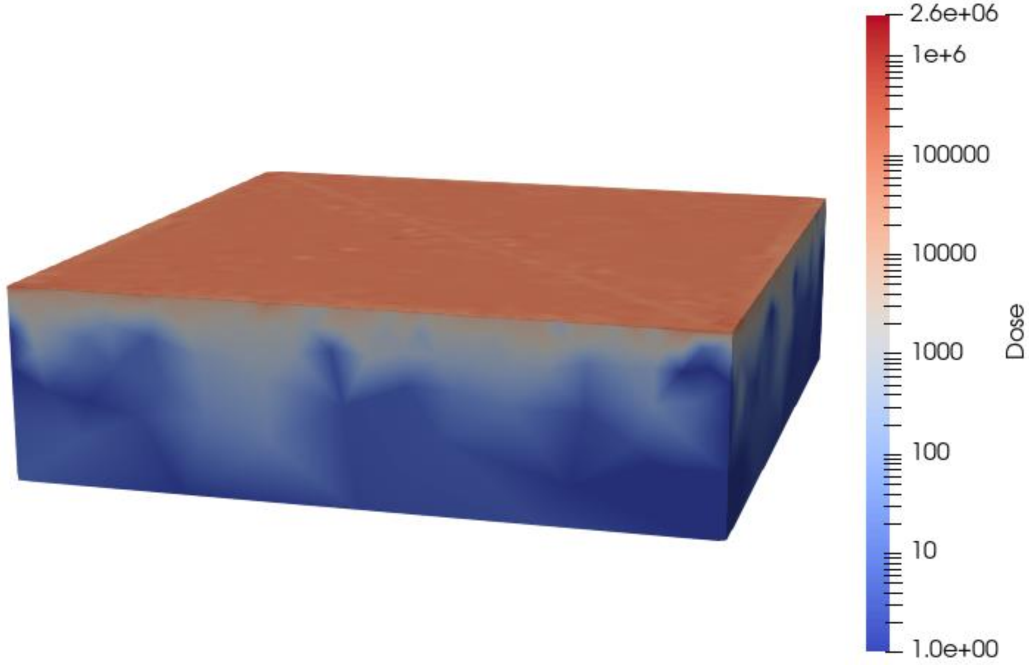


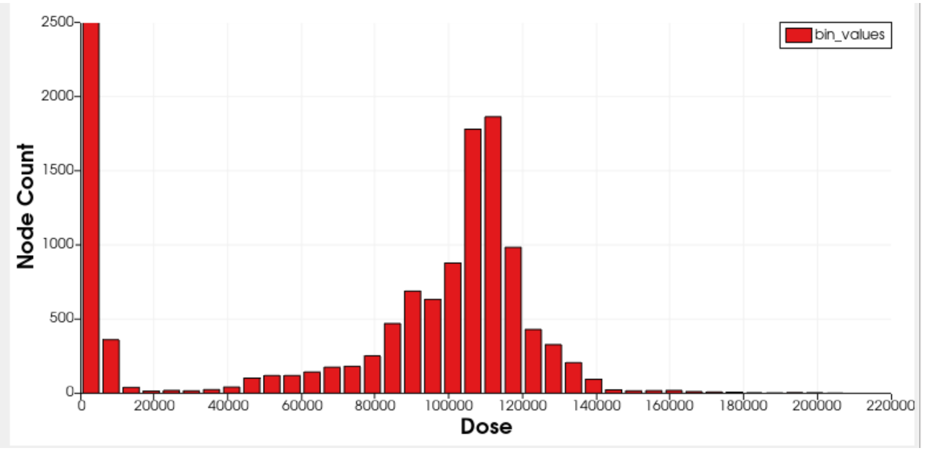


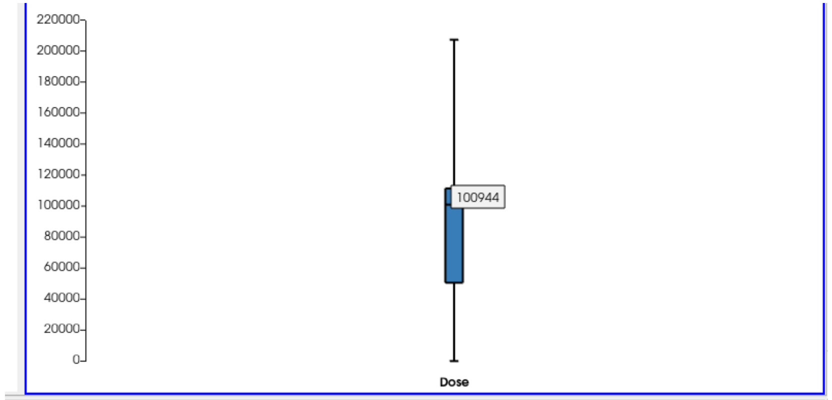


Radiation Hardening – From Spectra to Dose in Si02 in 3D!

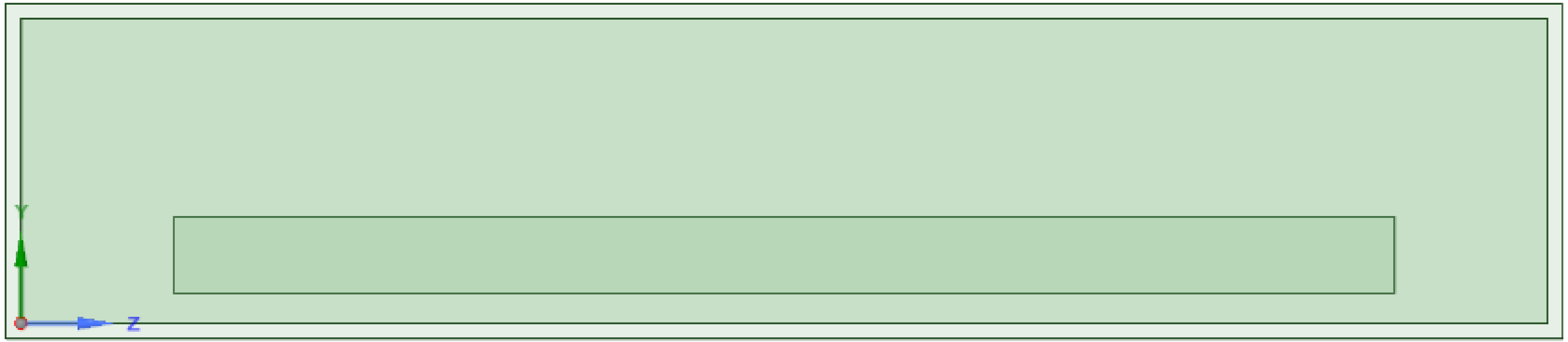


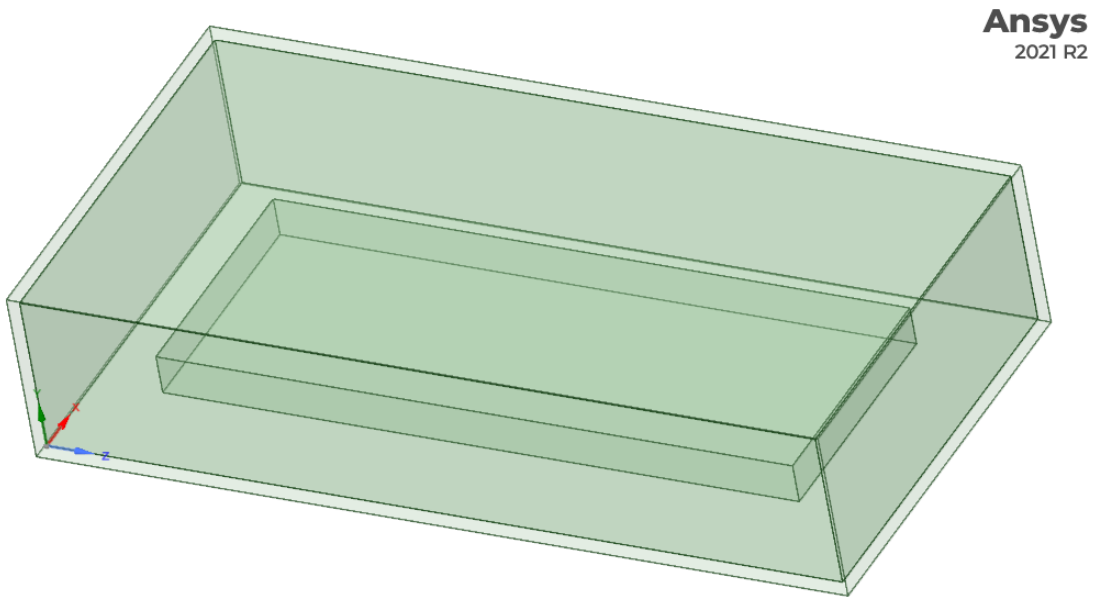


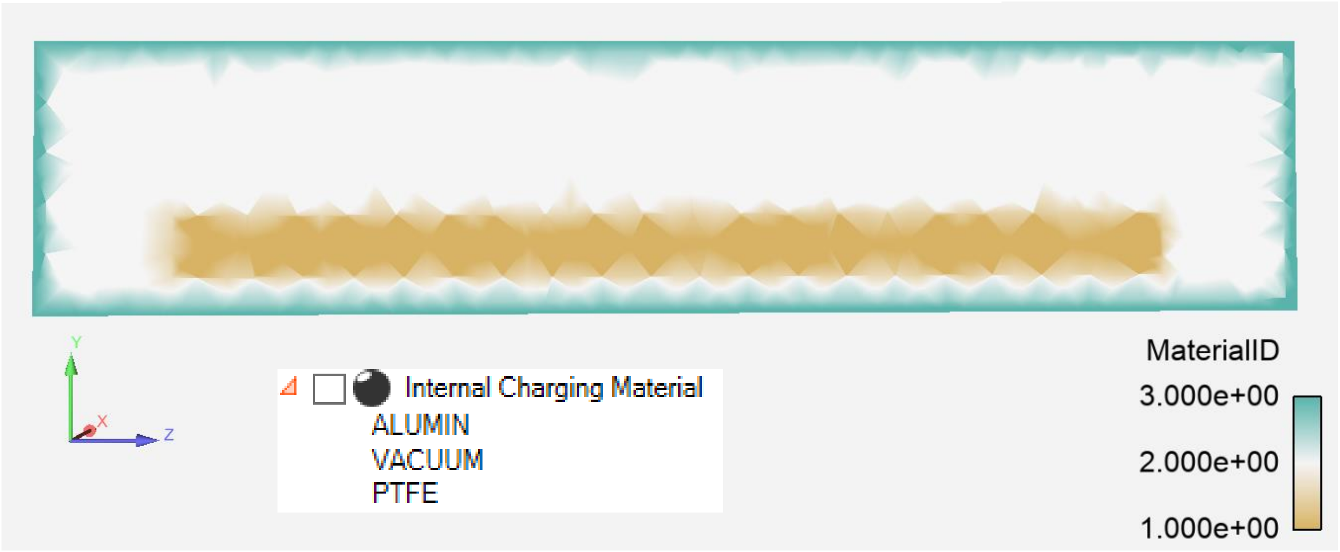




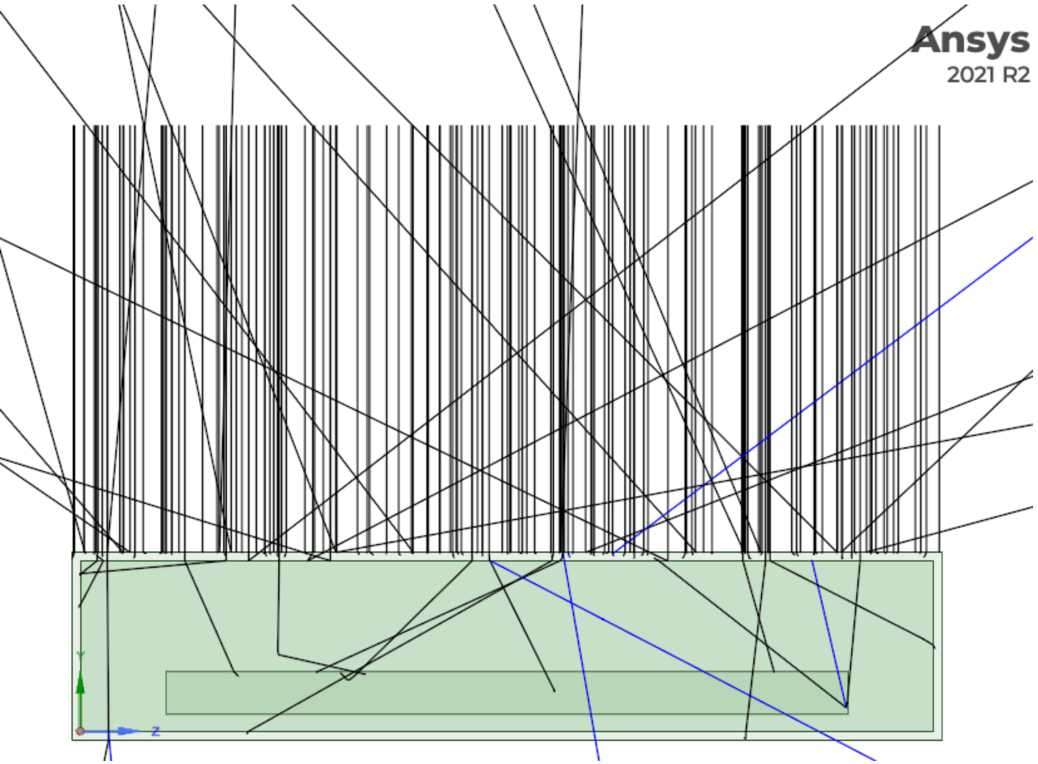
Radiation Hardening – 1-mm Al Shield Electronics Box in 3D Transfering through Radiation Belt

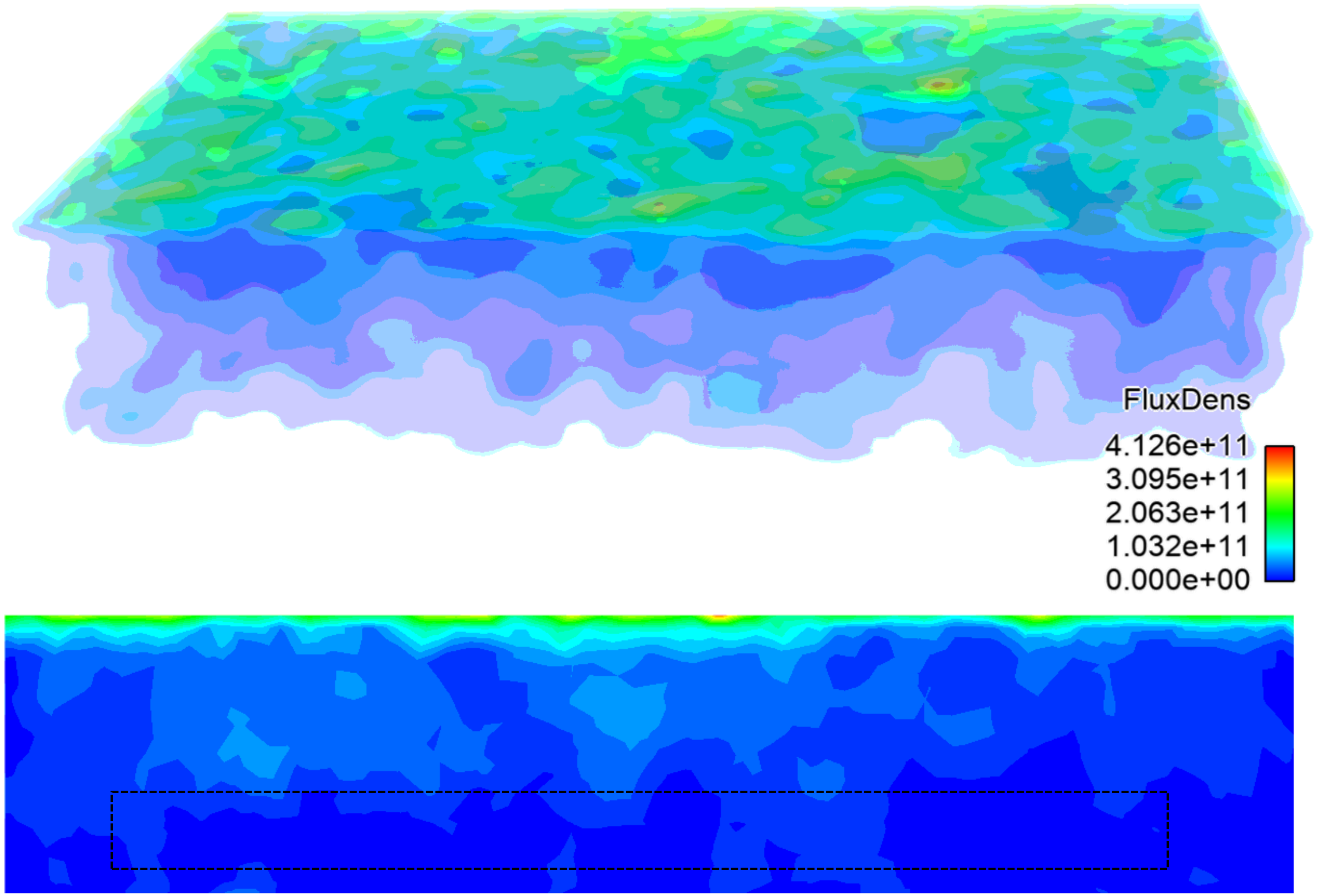




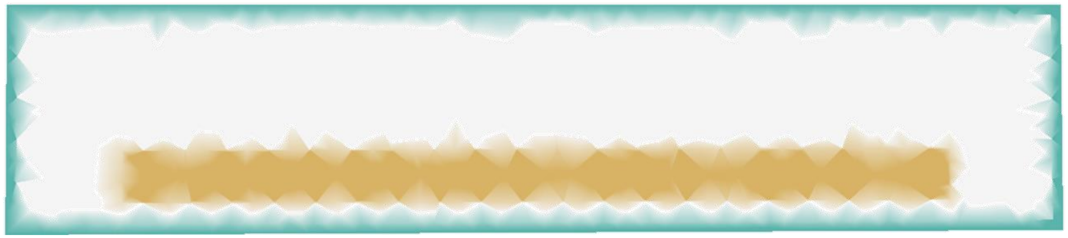


Radiation Hardening – Keep Track of Flux Density in 3D Through the 4-hour Transit

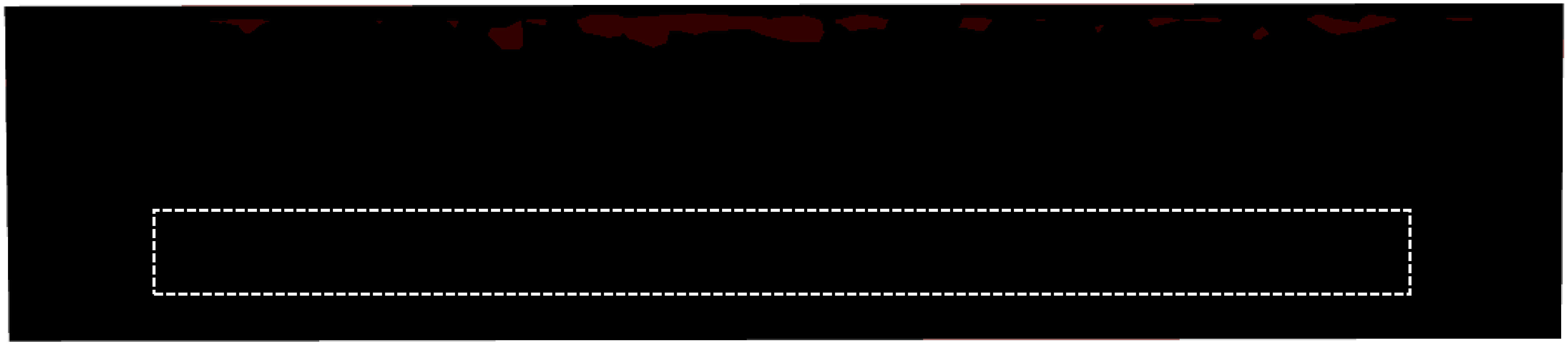


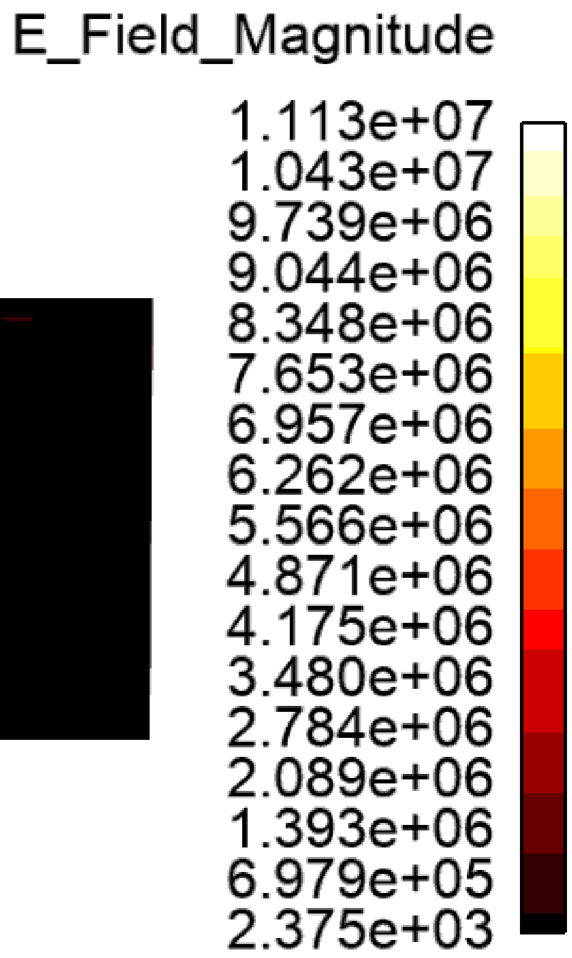


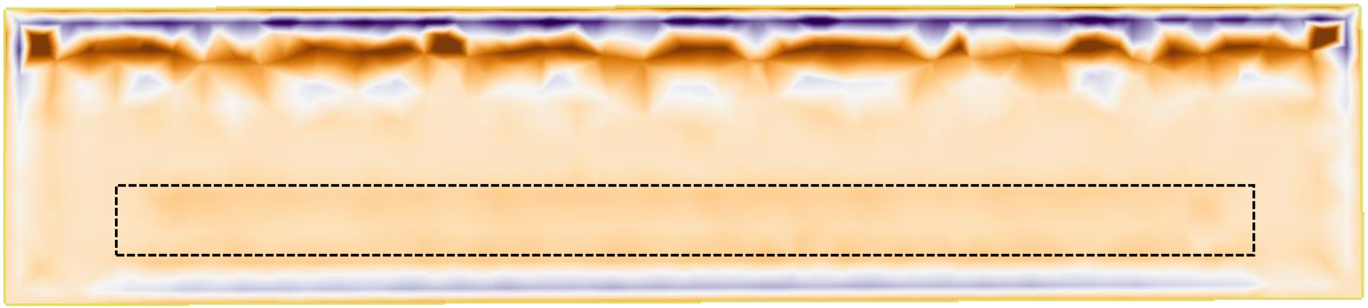
Radiation Hardening – Keep Track of E-Fields in 3D Inside Box



Material ID

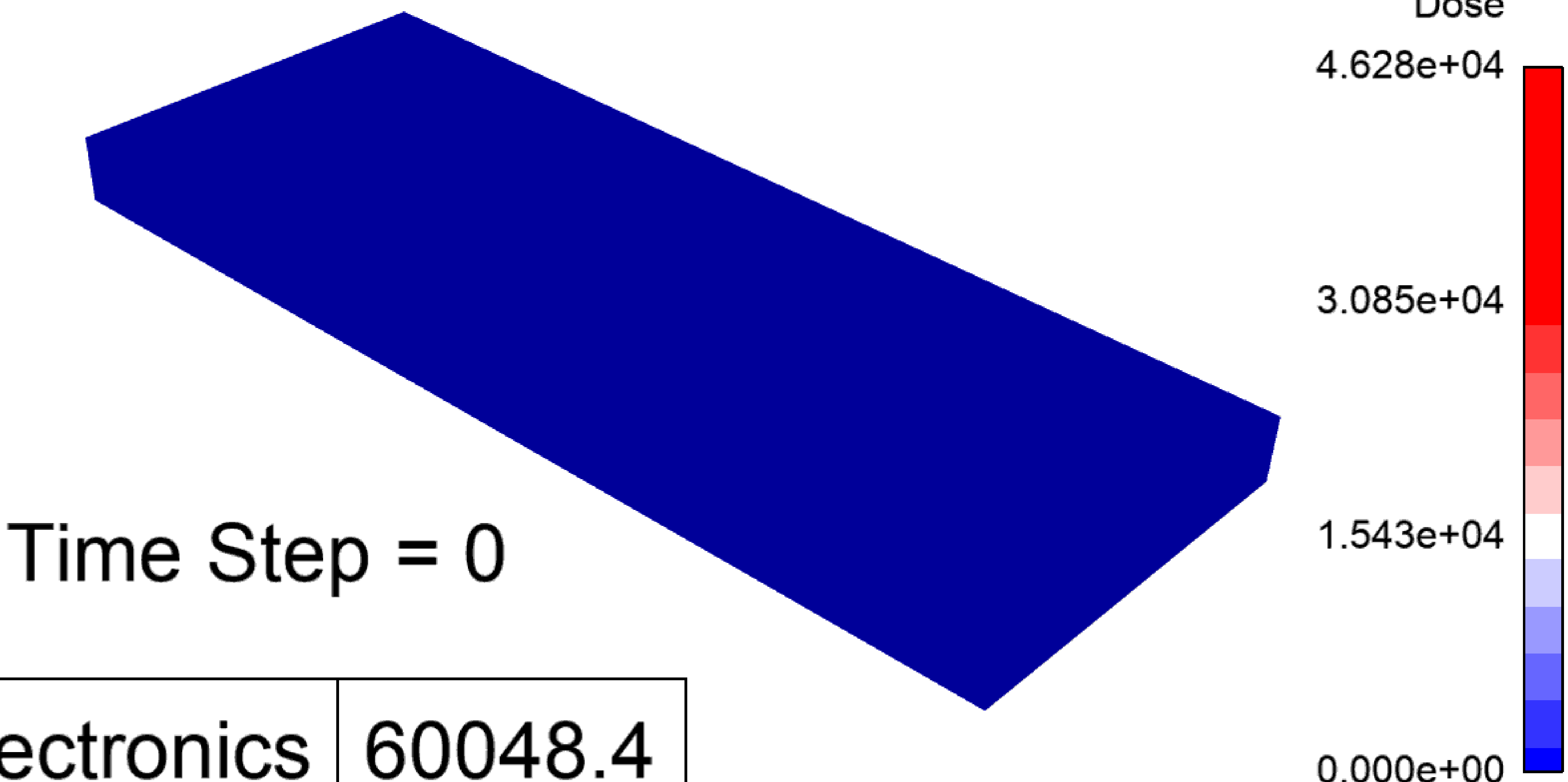






Charge Density
(purple is positive)

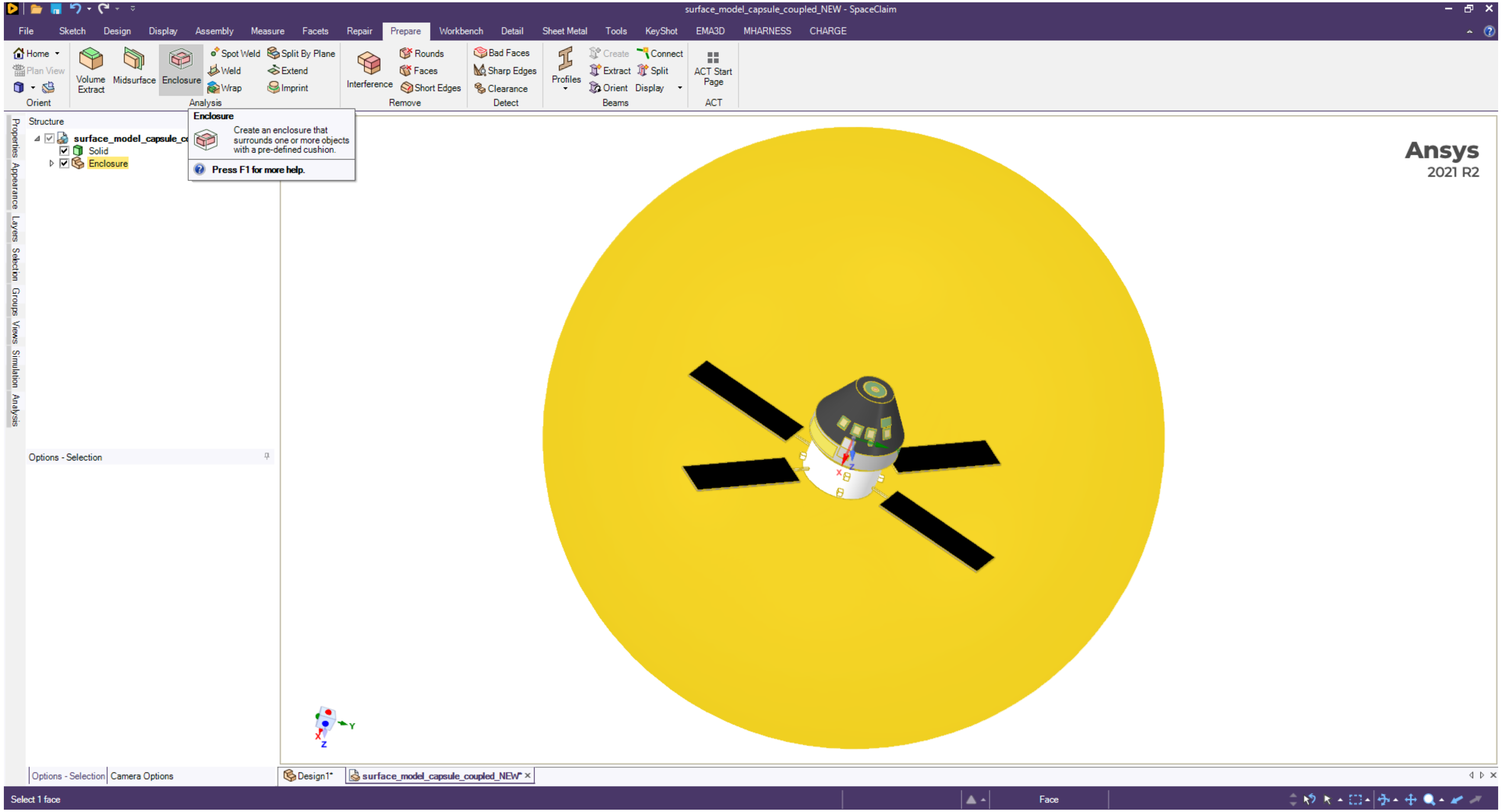
Radiation Hardening – Isolate the Electronics to Study Cumulative Dose (rads) in 3D and the Total Dose



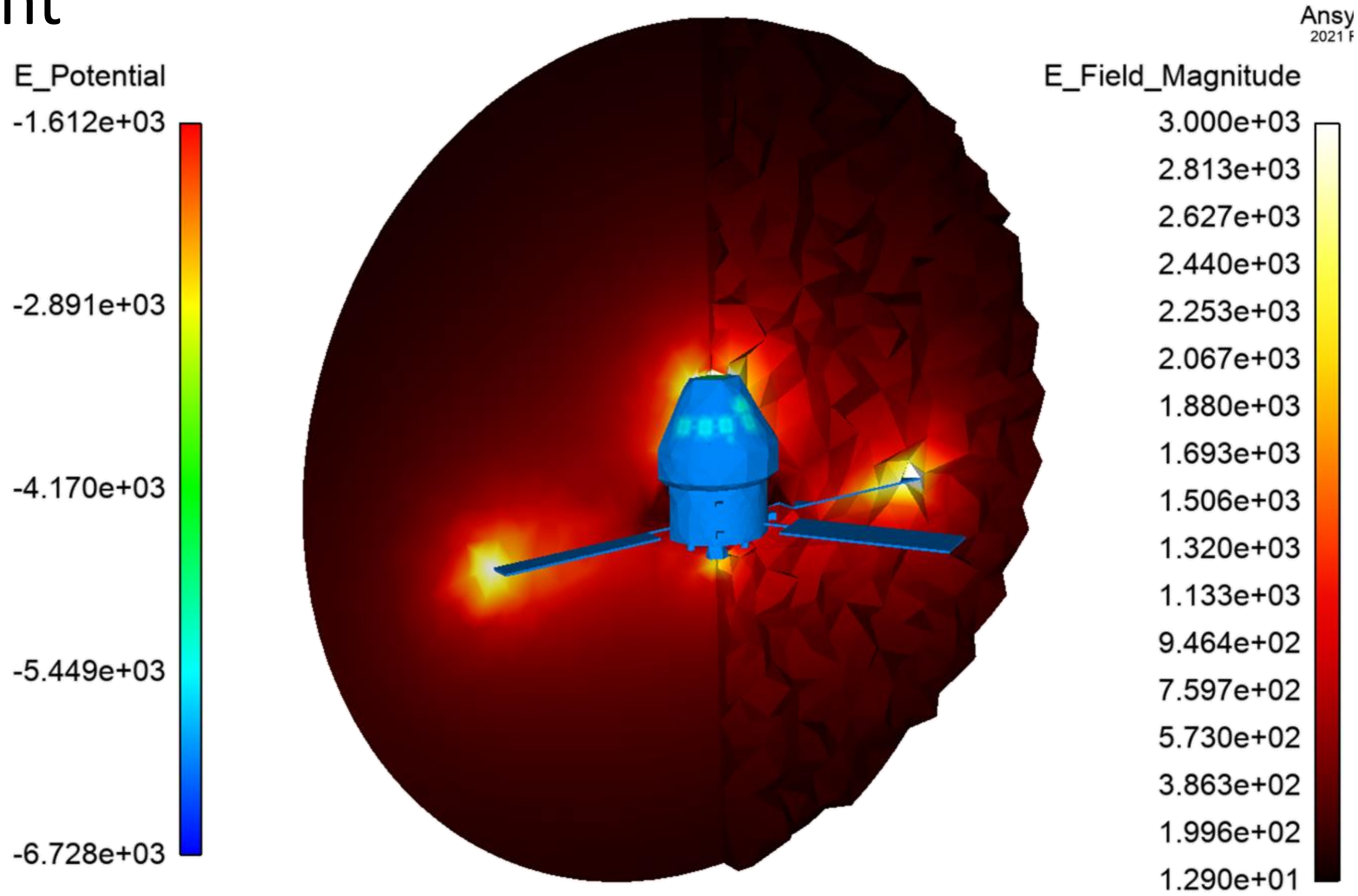
Electronics	60048.4

Additional Features

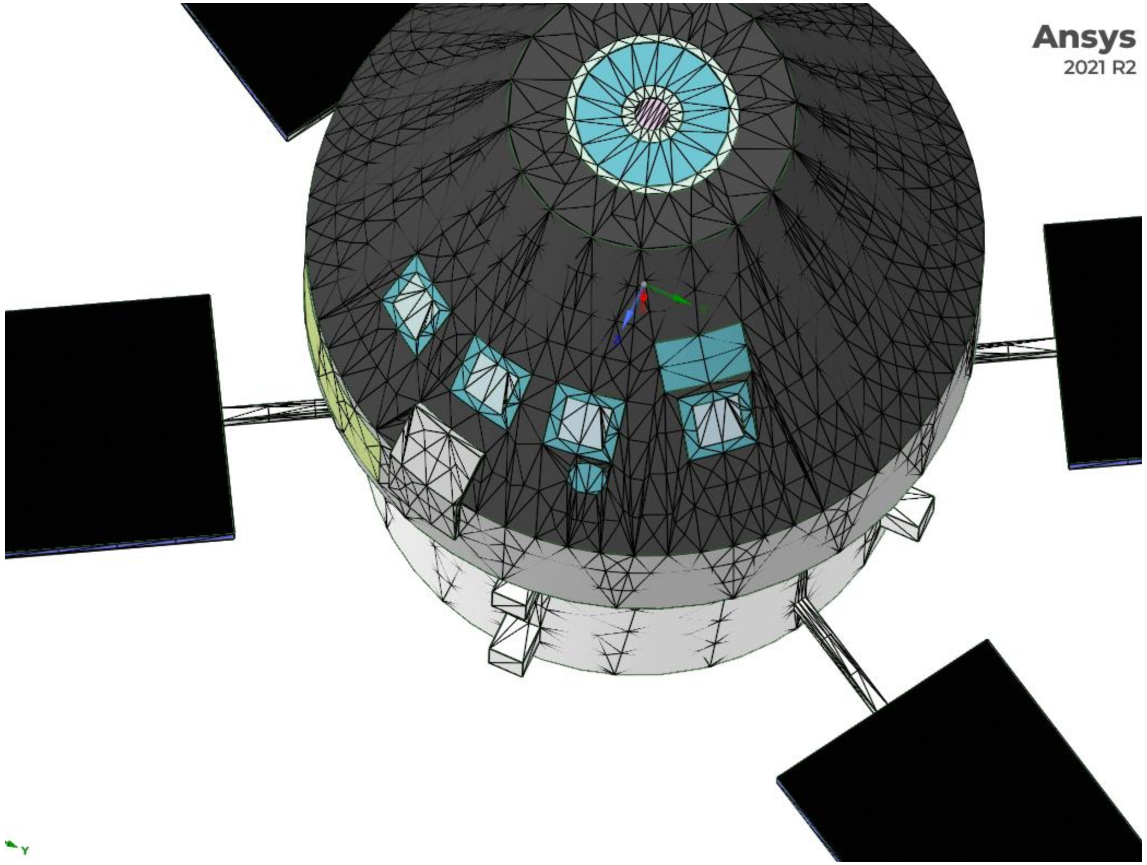
Coupled Surface and Internal Charging Using the Enclosure Tool

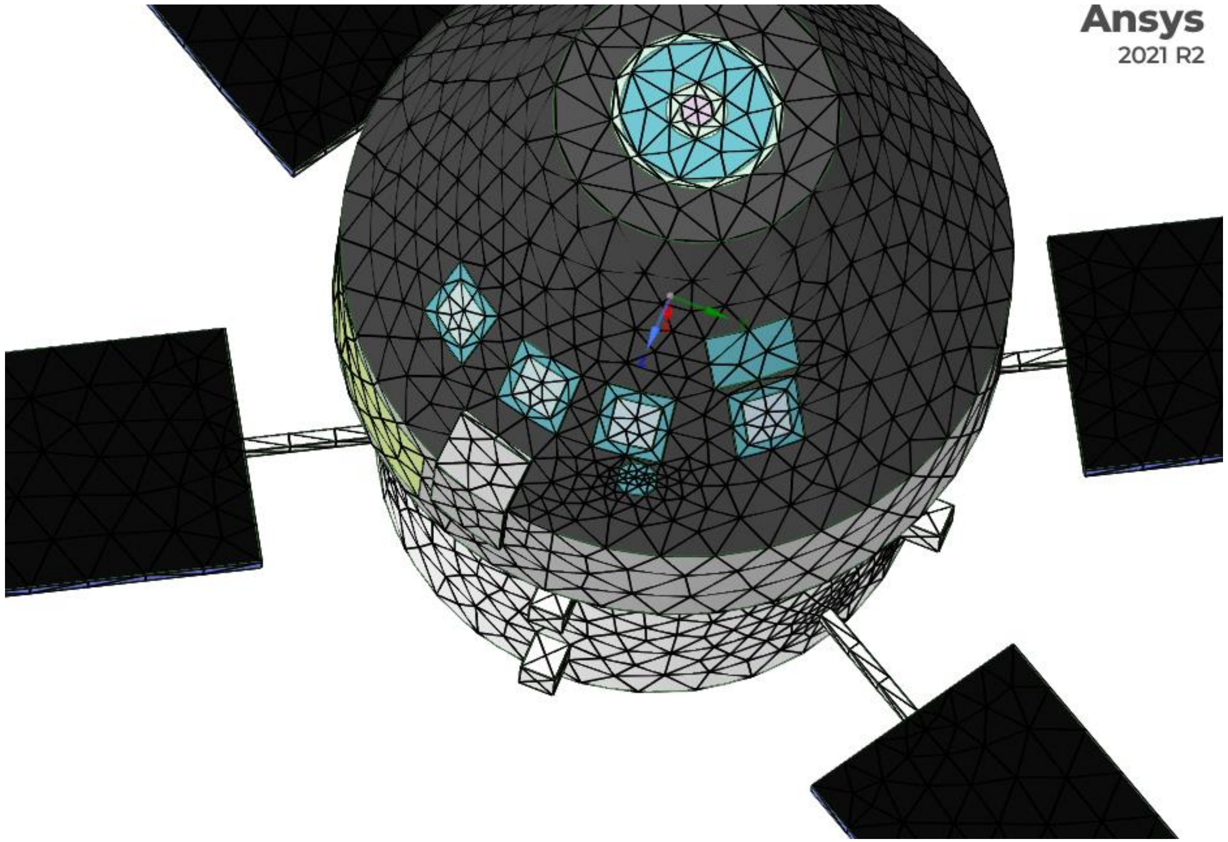


Coupled Surface and Internal Charging Using the Enclosure Tool and EnSight

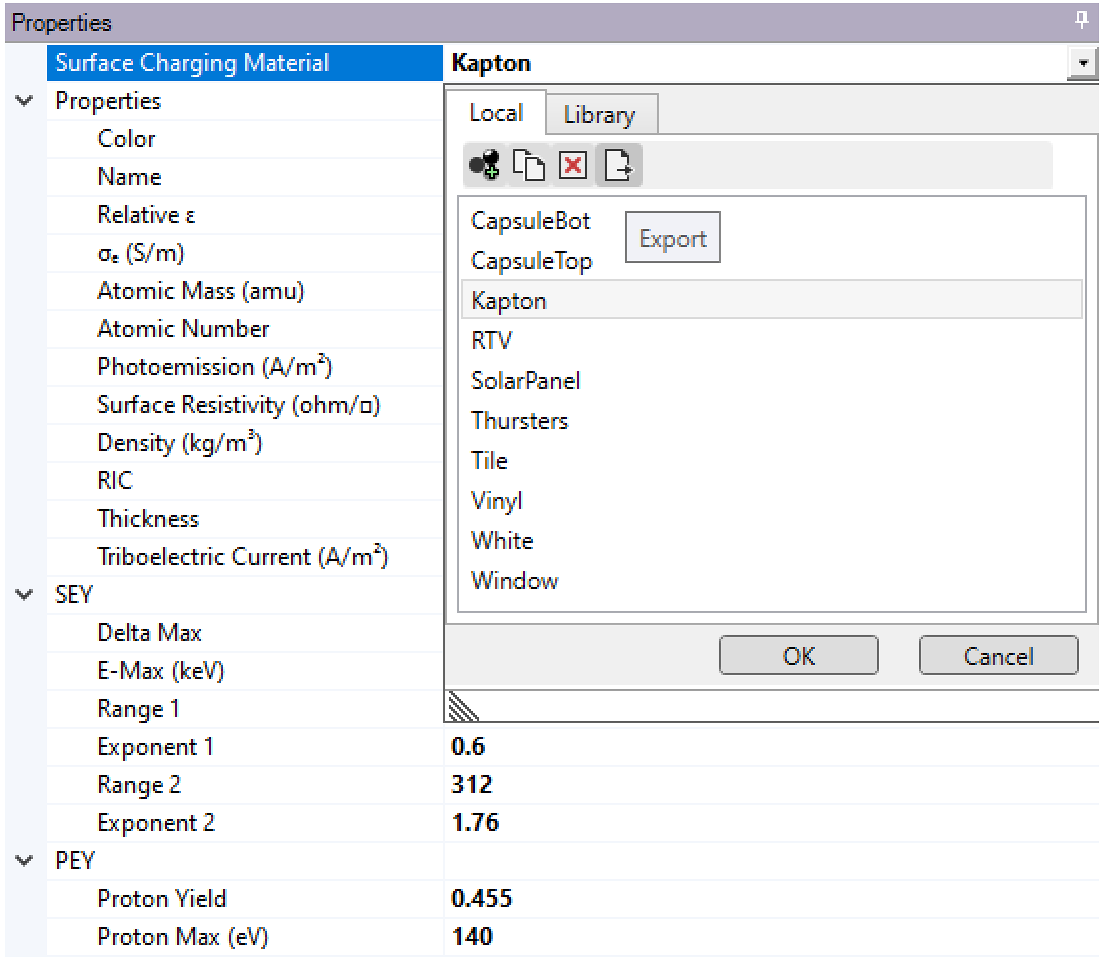


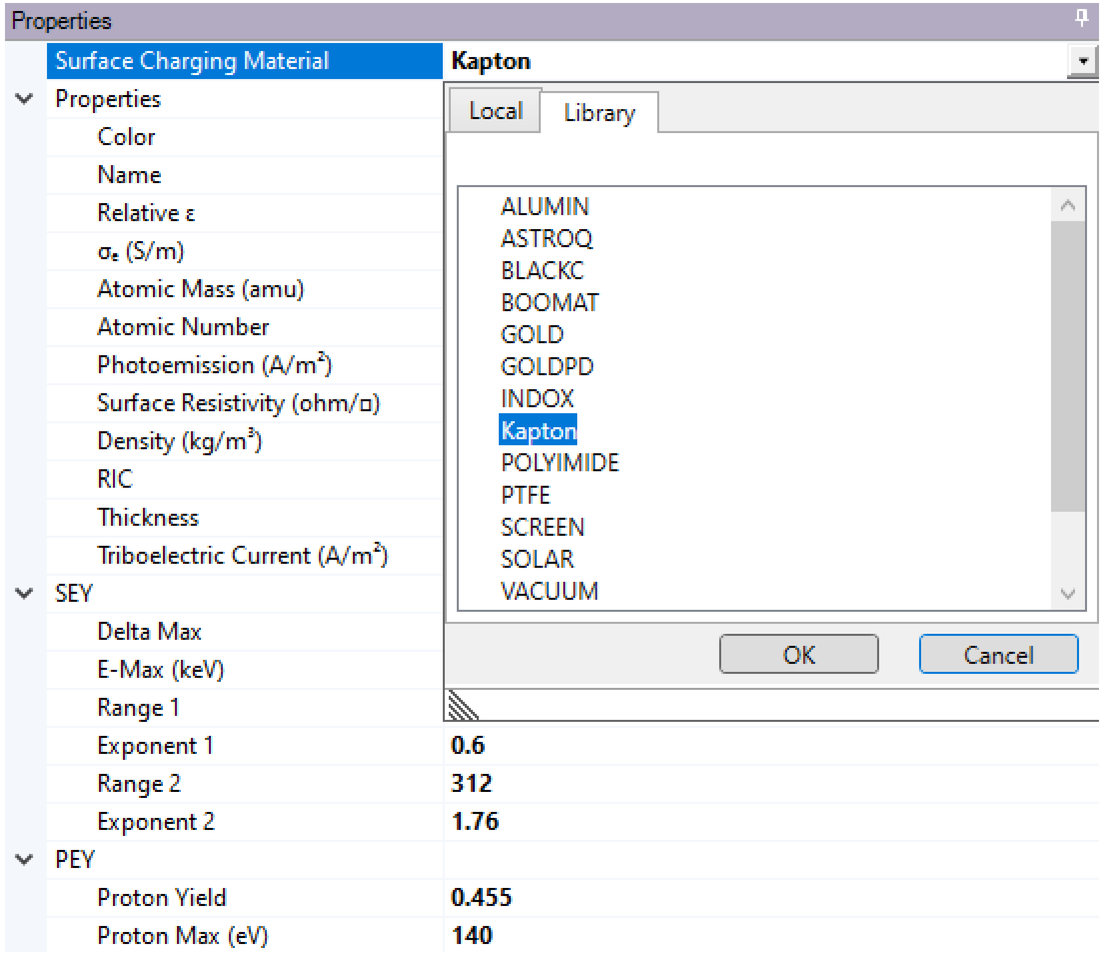
Legacy meshing (left) vs Direct meshing (right) – Improved mesh reliability





Material Export for use Across All Models





Ansys