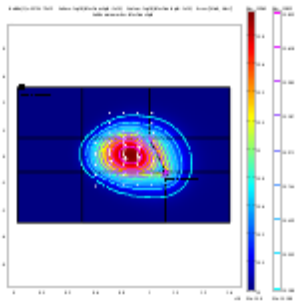
COMSOL Model Report



1. Table of Contents

2. Model Properties

Property	Value
Model name	
Author	
Company	
Department	
Reference	
URL	
Saved date	Jul 13, 2007 4:00:50 PM
Creation date	Mar 13, 2007 3:30:49 PM
COMSOL version	COMSOL 3.3.0.511

File name: D:\My Documents\Work\Time Programme\Time 2003-2006\E03T 15 A high-flux rubidium\Topics\Finite Element Simulator\AxSim Caltech AlGaAs Microdisk Resonator\Caltech_AlGaAs_Microdisk_v6.mph

Application modes and modules used in this model:

- Geom1 (2D)
  - Weak Form, Subdomain

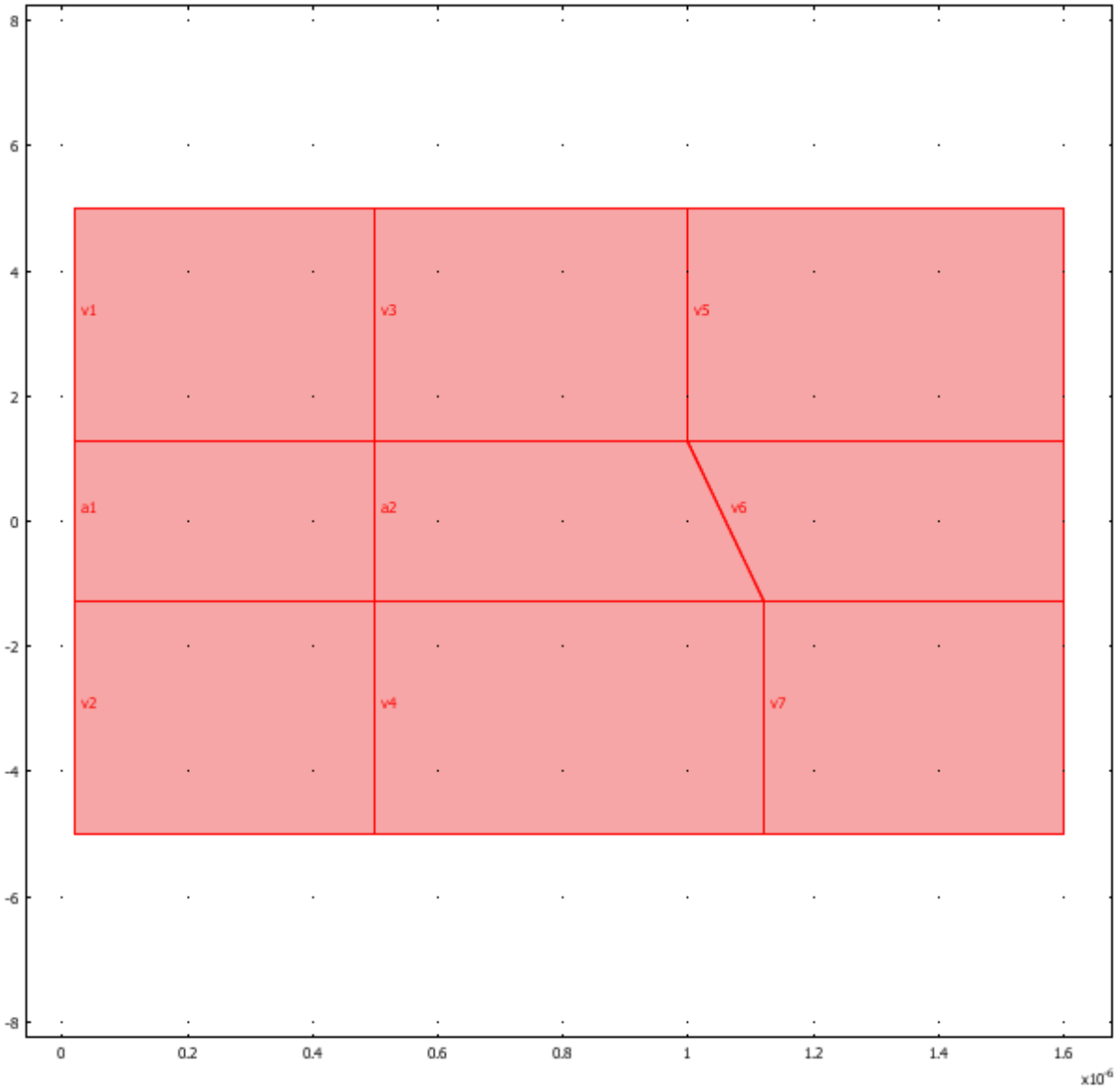
3. Constants

Name	Expression	Value	Description
c	299792458	2.997925e8	speed of light (exact!)
k	2*pi/c	2.095845e-8	
fc	k^2	4.392566e-16	constant used internally --do not modify
alpha	1.0	1	penalty coefficient on Div H
M	11	11	azimuthal mode order
delta_e	0.0	0	fractional increment (for determining filling factors)
e1	n_AlGaAs^2*(1+delta_e)	11.2896	relative permittivity of isotropic_dielectric_1
e2	1.0	1	ditto for isotropic_dielectric_2
delta_eperp1	0*1e-3	0	fractional increment (for determining filling factors)
eperp1	9.2725*(1+delta_eperp1)	9.2725	relative permittivity of uniaxial_dielectric_1 perpendicular to cylindrical axis
delta_epara1	0*1e-3	0	fractional increment (for determining filling factors)
epara1	11.3486*(1+delta_epara1)	11.3486	relative permittivity of uniaxial_dielectric_1 parallel to cylindrical axis
eperp2	1.0	1	relative permittivity of uniaxial_dielectric_2 perpendicular to cylindrical axis
epara2	1.0	1	ditto but parallel to cylindrical axis
e_293K_alumina	9.8	9.8	relative permittivity of alumina at room temperature
eperp_4K_sapph_UWA	9.2725	9.2725	UWA values for cryogenic HEMEX sapphire
epara_4K_sapph_UWA	11.3486	11.3486	
eperp_293K_sapph	9.407	9.407	nominal room temperature values for same
epara_293K_sapph	11.62	11.62	
eperp_4K_sapph_NPL	9.2848	9.2848	NPL values
epara_4K_sapph_NPL	11.3660	11.366	
n_silica	1.4457	1.4457	refractive index of thermally grown silica (Fig B.2, p. 172 of Kippenberg's thesis)
n_AlGaAs	3.36	3.36	average refractive index of GaAs and AlGaAs layers (p. 172 of Srinivasan)
mf	2.374616e14	2.374616e14	match frequency
ttgH	1	1	
ttgE	0	0	
rectangle_mf	2.376629e14	2.376629e14	
circle_mf	2.374616e14	2.374616e14	
mixing_angle	45	45	Electric-Magnetic Mixing Angle (in degrees)
cMW	sin(mixing_angle * pi /180)	0.707107	Magnetic-Wall-ness
cEW	cos(mixing_angle * pi /180)	0.707107	Electric-Wall-ness
tngM	1	1	
tngE	0	0	

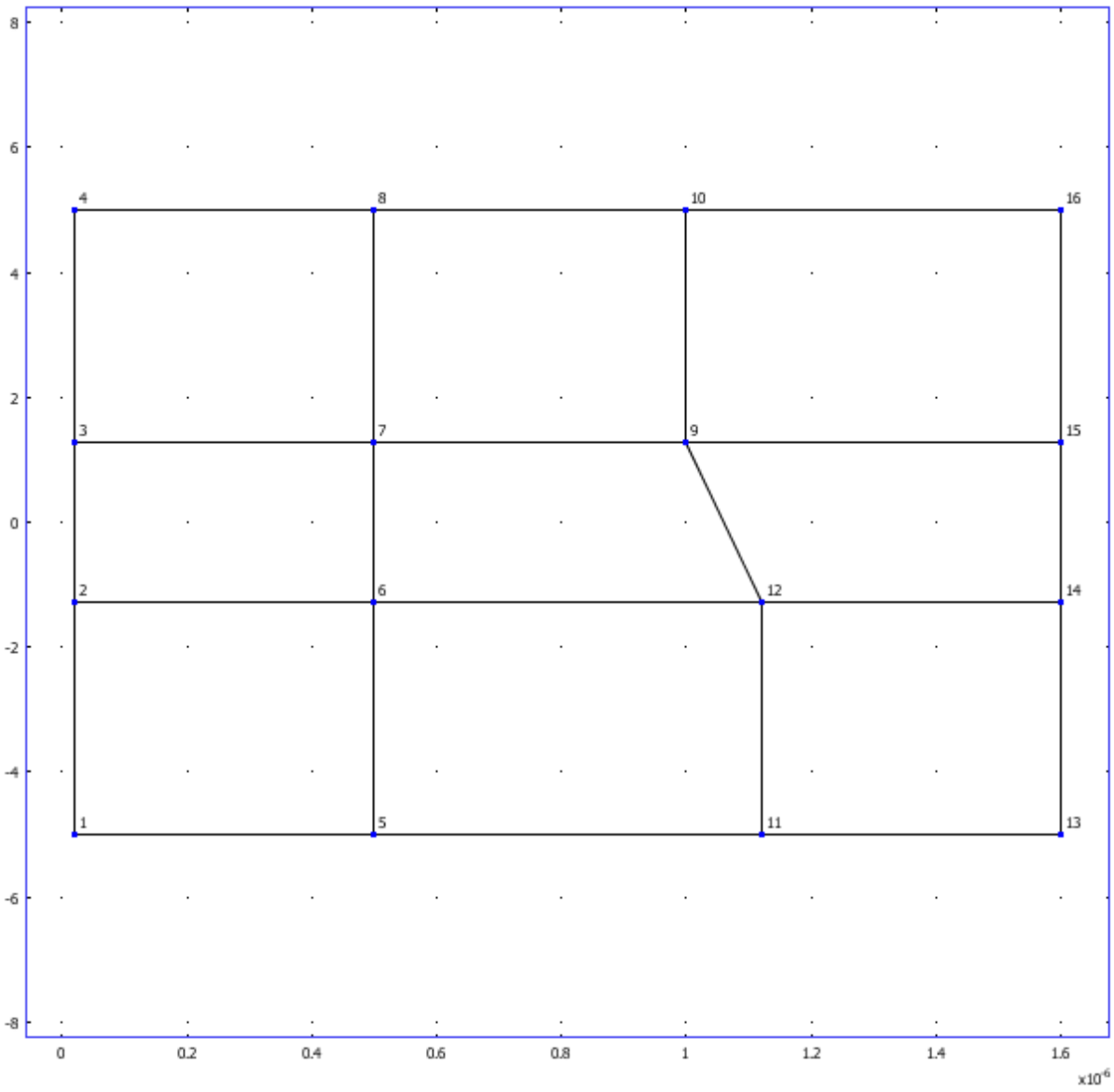
4. Geometry

Number of geometries: 1

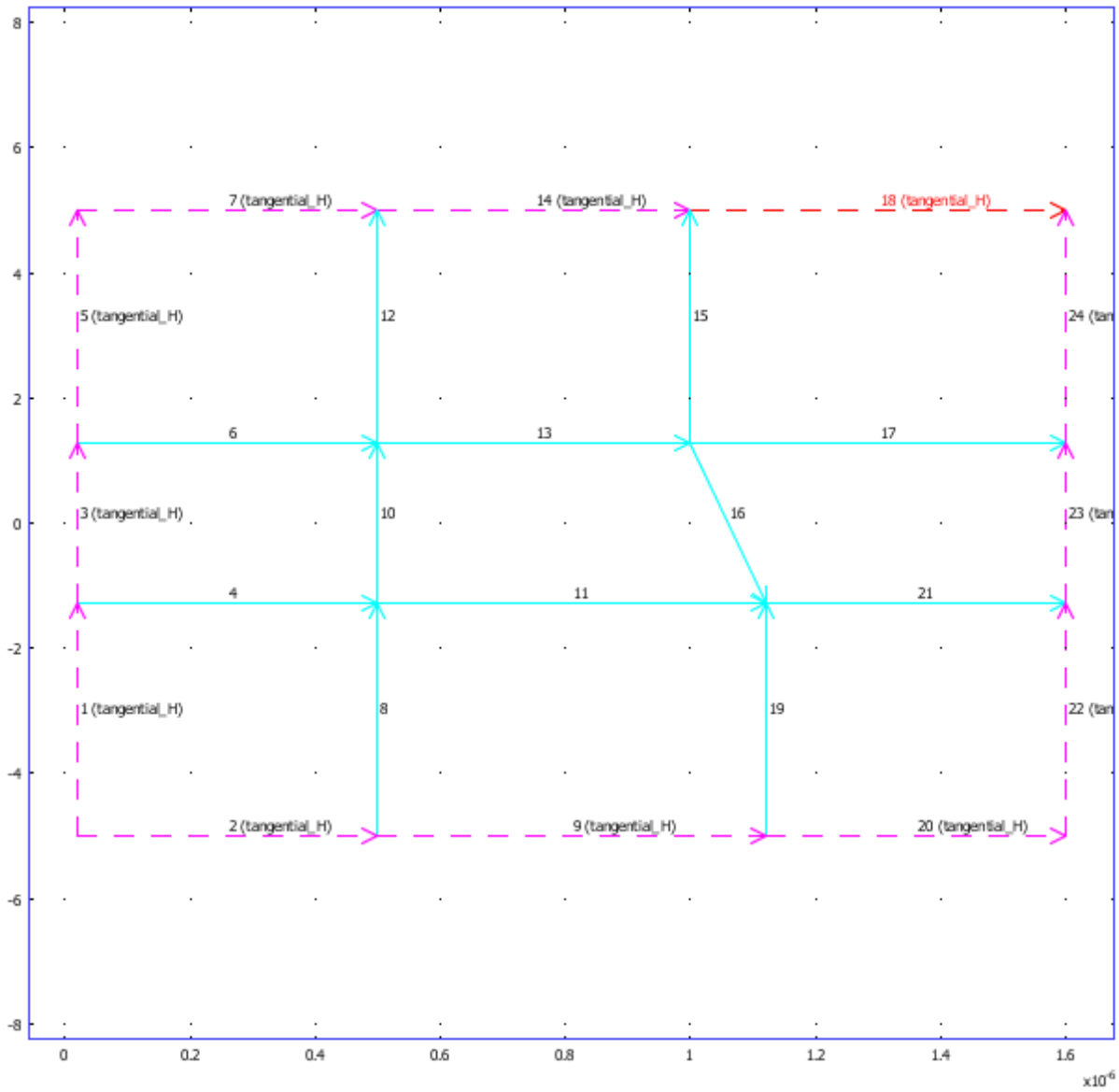
4.1. Geom1



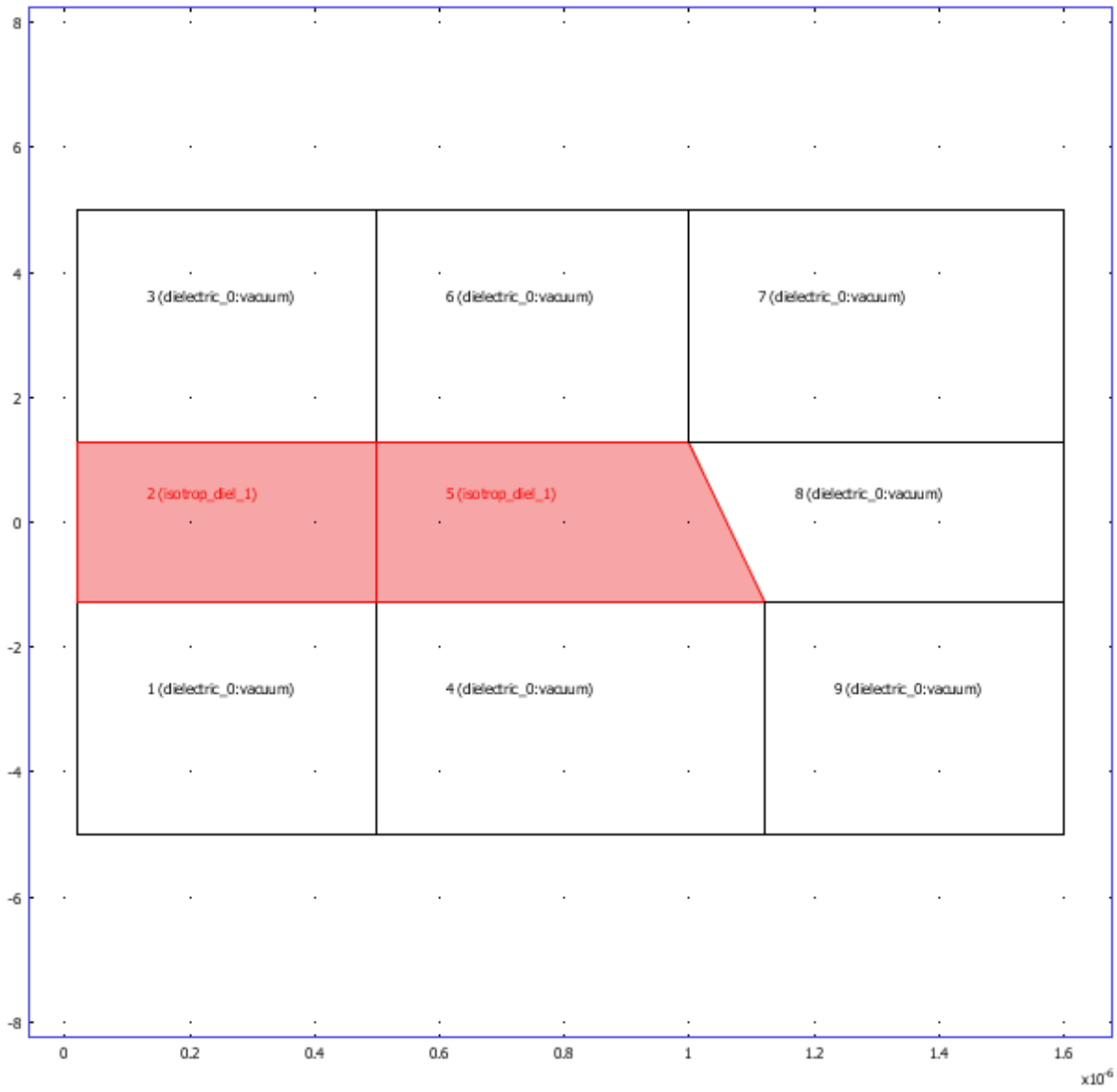
4.1.1. Point mode



4.1.2. Boundary mode



4.1.3. Subdomain mode



5. Geom1

Space dimensions: 2D

Independent variables: r, z, z2

5.1. Scalar Expressions

Name	Expression
DivH	(Hrad-Hazi*M+(Haxiz+Hradr)*r)/r
Drad	(Haxi*M-Haziz*r)/r
Dazi	-Haxir+Hradz
Daxi	(Hazi-Hrad*M+Hazir*r)/r
Erad	Drad/erel
Eazi	Dazi/erel
Eaxi	Daxi/erel
comment	1

MagAziSqrd	imag(Hazi)^2
MagTransSqrd	real(Haxi)^2+real(Hrad)^2
ElecAziSqrd	real(Eazi)^2
ElecTransSqrd	imag(Eaxi)^2+imag(Erad)^2

5.2. Expressions

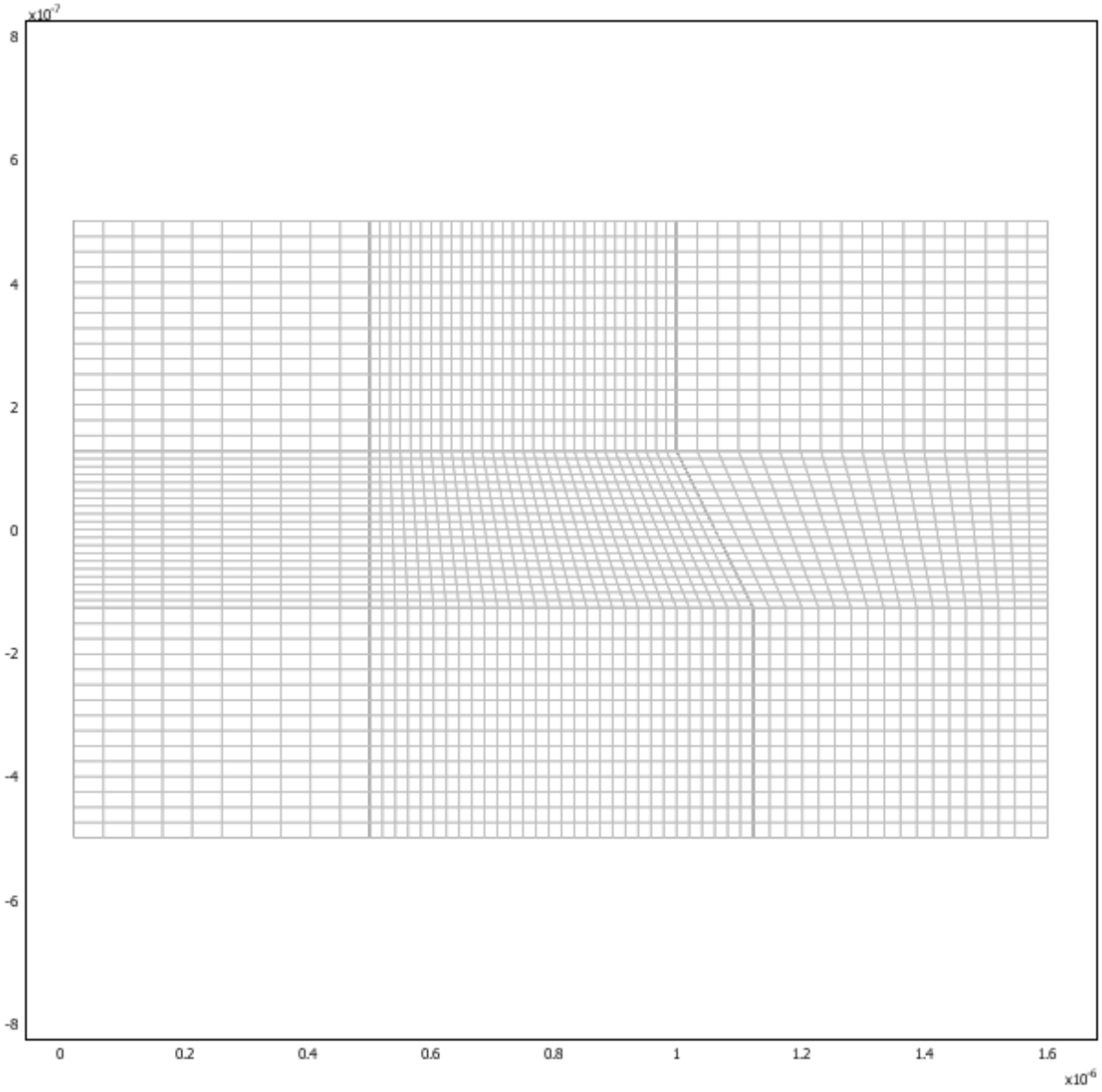
5.2.1. Subdomain Expressions

Subdomain	1, 3-4, 6-9	2, 5
erel	1.0	e1

5.3. Mesh

5.3.1. Mesh Statistics

Number of degrees of freedom	35451
Number of mesh points	3009
Number of elements	2900
Triangular	0
Quadrilateral	2900
Number of boundary elements	432
Number of vertex elements	16
Minimum element quality	0.496
Element area ratio	0.179



5.4. Application Mode: Weak Form, Subdomain (Axisymmetric)

Application mode type: Weak Form, Subdomain

Application mode name: Axisymmetric

5.4.1. Application Mode Properties

Property	Value
Default element type	Lagrange - Quadratic
Wave extension	Off
Frame	Frame (rz)
Weak constraints	Off

5.4.2. Variables

Dependent variables: Hrad, Hazi, Haxi, Hrad_t, Hazi_t, Haxi_t

Shape functions: shlag(2,'Hrad'), shlag(2,'Hazi'), shlag(2,'Haxi')

Interior boundaries not active

5.4.3. Point Settings

Point		1-16
style		**{0,{0,0,255}}**

5.4.4. Boundary Settings

Boundary		1-3, 5, 7, 9, 14, 18, 20, 22-24
name		**tangential_H**
constr term (constr)		**{Hrad*nr+Haxi*nz;0;0}**

5.4.5. Subdomain Settings

Subdomain		1, 3-4, 6-9	2, 5
name		**dielectric_0:vacuum**	**isotrop_diel_1**
weak term (weak)		**{-(Haziz*M*test(Haxi))+Hazir*test(Hazi) +Hazi*test(Hazir)-Hrad*M*test(Hazir)- Haxi*M*test(Haziz)-Hazir*M*test(Hrad) +(Haxi*M^2*test(Haxi)+(Hazi-Hrad*M)*(test (Hazi)-M*test(Hrad)))/r+r*((Haxir-Hradz)*test (Haxir)+Hazir*test(Hazir)+Haziz*test(Haziz)- Haxir*test(Hradz)+Hradz*test(Hradz));alpha* (Hrad*test(Haxiz)-Hazi*M*test(Haxiz)- Haxiz*M*test(Hazi)-Hradr*M*test(Hazi) +Haxiz*test(Hrad)+Hradr*test(Hrad)+(- (Hrad*M*test(Hazi))+Hazi*M^2*test(Hazi) +Hrad*test(Hrad)-Hazi*M*test(Hrad))/r +Hrad*test(Hradr)-Hazi*M*test(Hradr)+r* (Haxiz*test(Haxiz)+Hradr*test(Haxiz) +Haxiz*test(Hradr)+Hradr*test(Hradr)));0}**	**{(-(Haziz*M*test(Haxi))+Hazir*test(Hazi) +Hazi*test(Hazir)-Hrad*M*test(Hazir)- Haxi*M*test(Haziz)-Hazir*M*test(Hrad) +(Haxi*M^2*test(Haxi)+(Hazi-Hrad*M)*(test (Hazi)-M*test(Hrad)))/r+r*((Haxir-Hradz)*test (Haxir)+Hazir*test(Hazir)+Haziz*test(Haziz)- Haxir*test(Hradz)+Hradz*test(Hradz)))/e1; alpha*(Hrad*test(Haxiz)-Hazi*M*test(Haxiz)- Haxiz*M*test(Hazi)-Hradr*M*test(Hazi) +Haxiz*test(Hrad)+Hradr*test(Hrad)+(- (Hrad*M*test(Hazi))+Hazi*M^2*test(Hazi) +Hrad*test(Hrad)-Hazi*M*test(Hrad))/r +Hrad*test(Hradr)-Hazi*M*test(Hradr)+r* (Haxiz*test(Haxiz)+Hradr*test(Haxiz) +Haxiz*test(Hradr)+Hradr*test(Hradr)));0}**
dweak term (dweak)		**{fc*r*(Haxitt*test(Haxi)+Hazitt*test(Hazi) +Hradtt*test(Hrad));0;0}**	**{fc*r*(Haxitt*test(Haxi)+Hazitt*test(Hazi) +Hradtt*test(Hrad));0;0}**

6. Solver Settings

Solve using a script: off

Auto select solver	On
Solver	Eigenvalue
Solution form	Automatic
Symmetric	On
Adaption	Off

6.1. Direct (SPOOLES)

Solver type: Linear system solver

Parameter	Value
Pivot threshold	0.1
Preordering algorithm	Minimum degree

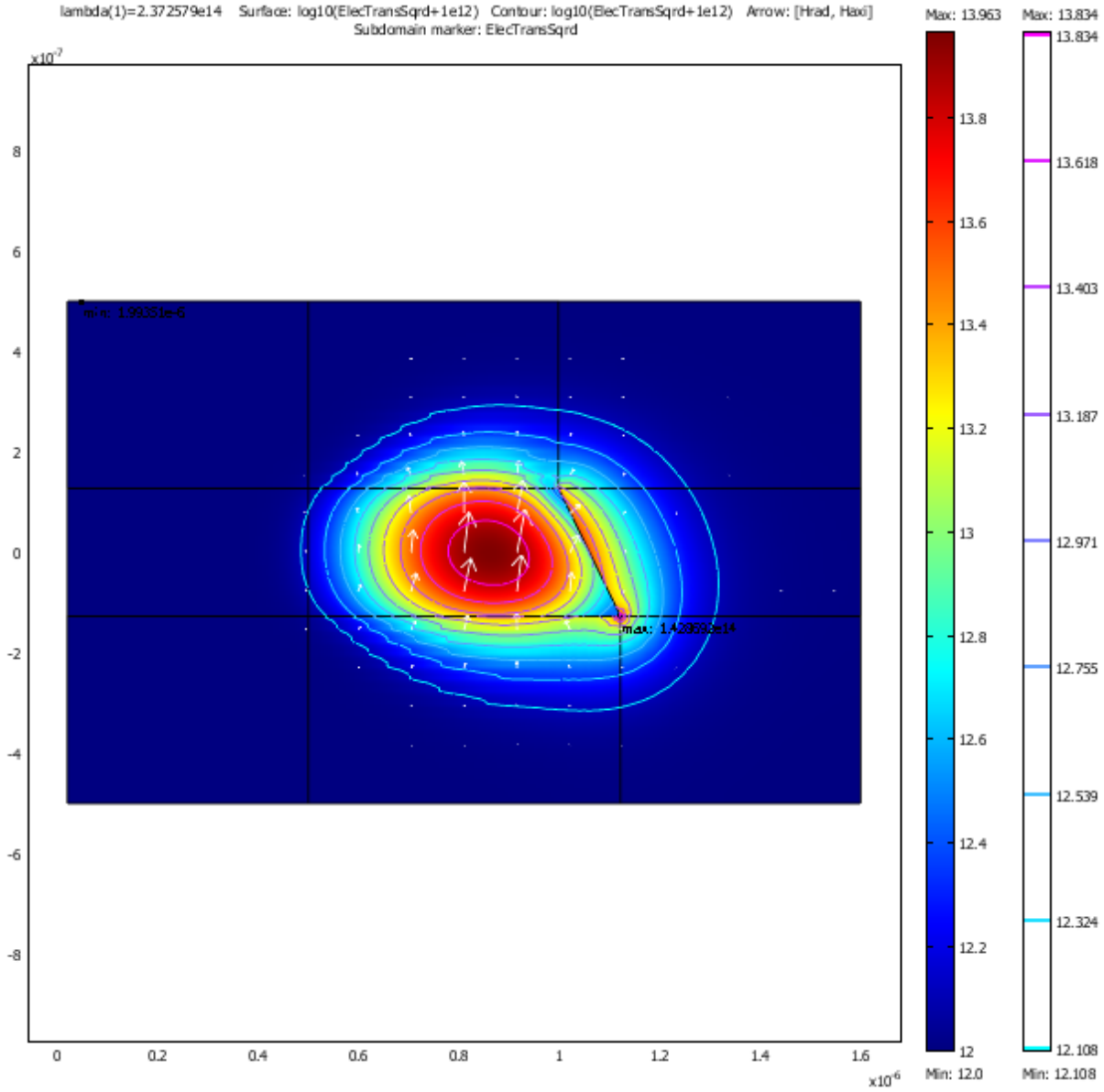
6.2. Eigenfrequency

Parameter	Value
Desired number of eigenvalues	10
Search for eigenvalues around	0
Eigenvalue tolerance	0.0
Maximum number of eigenvalue iterations	300
Dimension of Krylov space	0

6.3. Advanced

Parameter	Value
Constraint handling method	Elimination
Null-space function	Automatic
Assembly block size	5000
Use Hermitian transpose of constraint matrix and in symmetry detection	On
Use complex functions with real input	Off
Stop if error due to undefined operation	On
Type of scaling	Automatic
Manual scaling	
Row equilibration	On
Manual control of reassembly	Off
Load constant	On
Constraint constant	On
Mass constant	On
Damping (mass) constant	On
Jacobian constant	On
Constraint Jacobian constant	On

7. Postprocessing



7.1. Eigenvalue

2.3725792044509397E14
2.5951635435243088E14
2.87023006148756E14
2.9969587844188525E14
3.2333897866423275E14
3.3420975774066306E14
3.4236888117572875E14
3.649658686640717E14
3.761001851148672E14
3.824976228716352E14

8. Variables

8.1. Subdomain

Name	Description	Expression
absHradx_Axisymmetric	|grad(Hrad)|	sqrt(Hradr^2+Hradz^2)
abscu1x_Axisymmetric	|c*grad(Hrad)|	sqrt(cu1r^2+cu1z^2)
absHazix_Axisymmetric	|grad(Hazi)|	sqrt(Hazir^2+Haziz^2)
abscu2x_Axisymmetric	|c*grad(Hazi)|	sqrt(cu2r^2+cu2z^2)
absHaxix_Axisymmetric	|grad(Haxi)|	sqrt(Haxir^2+Haxiz^2)
abscu3x_Axisymmetric	|c*grad(Haxi)|	sqrt(cu3r^2+cu3z^2)