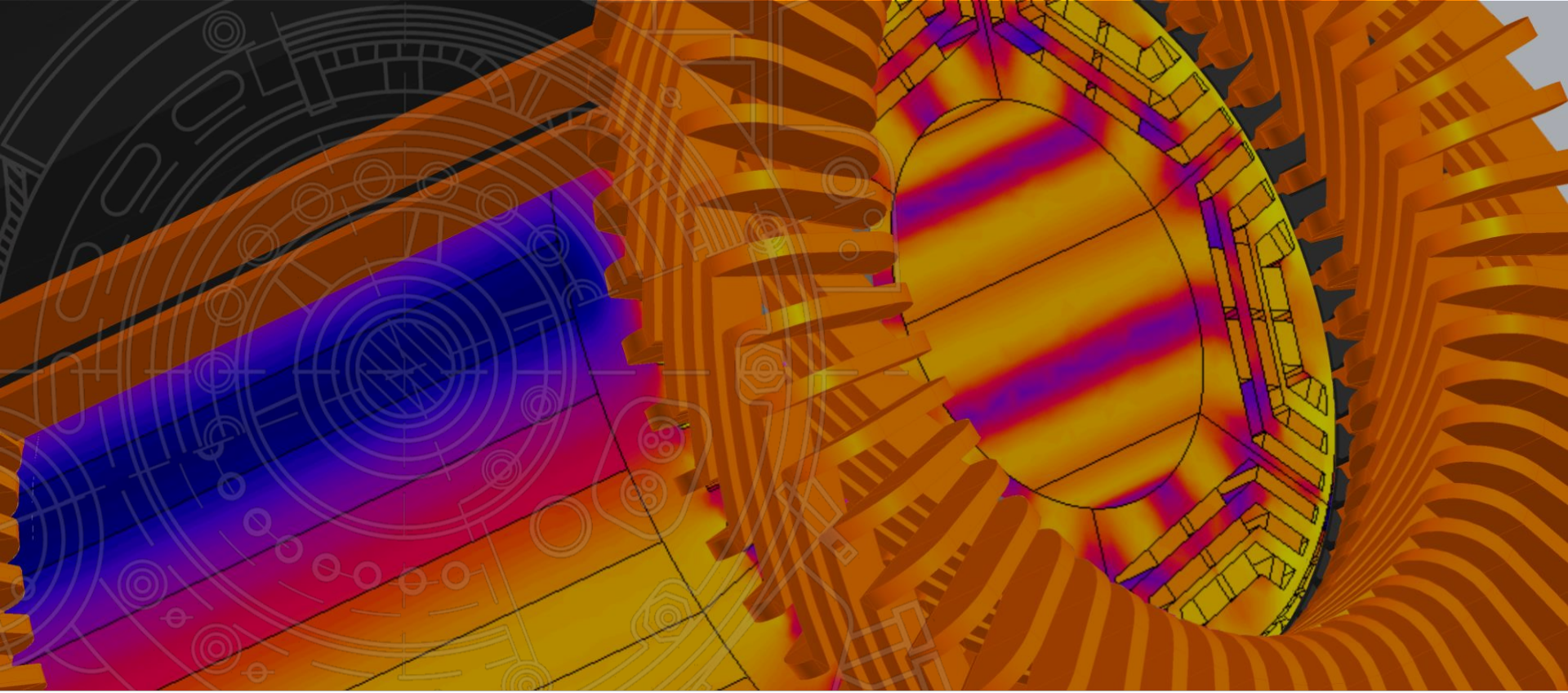

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HELMHOLTZ COIL

Flux 2D : Project step by step

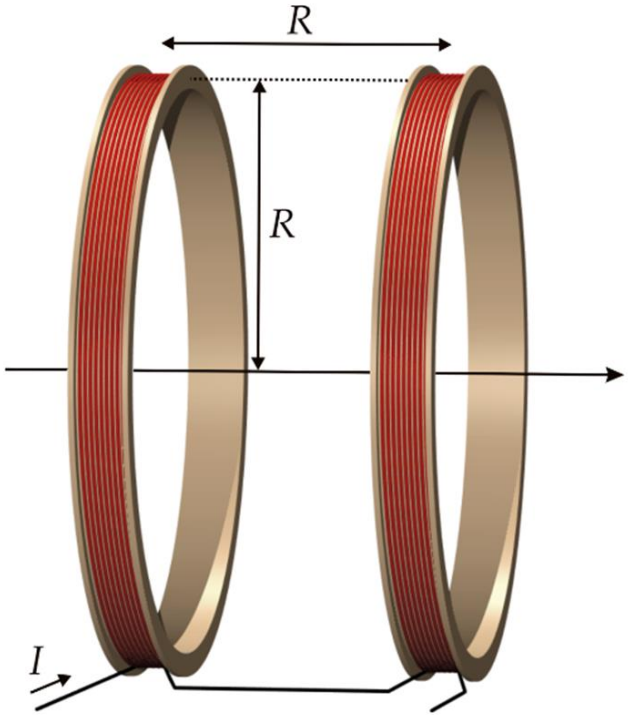
Overall view on the device

A Helmholtz coil is a coil divided into two parts to obtain a constant magnetic field in a large volume inside the coil.

A gap equivalent of the radius of the coil shares the two parts, in order to reach this constant magnetic field inside the coil.

The following tutorial shows how to create a Helmholtz coil of 10 turns for each part in Flux software.

The device will be drawn in Flux using a 2D ax symmetric representation.



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STARTING A NEW PROJECT

Starting a new project : new project

Open Flux 12.1 supervisor

Start a new project

Close the sketcher if necessary (Project > Close sketcher 2D context)

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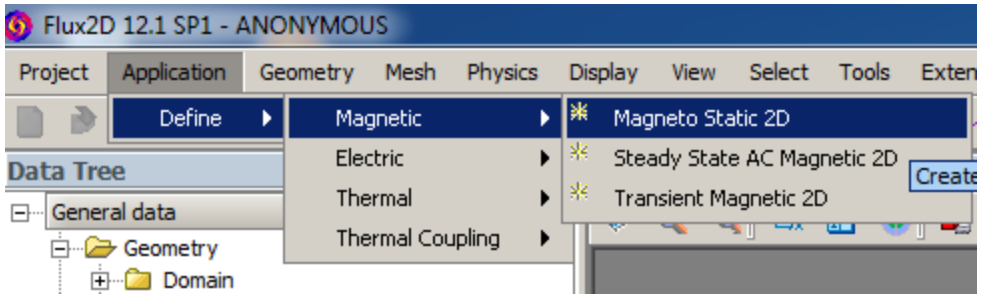
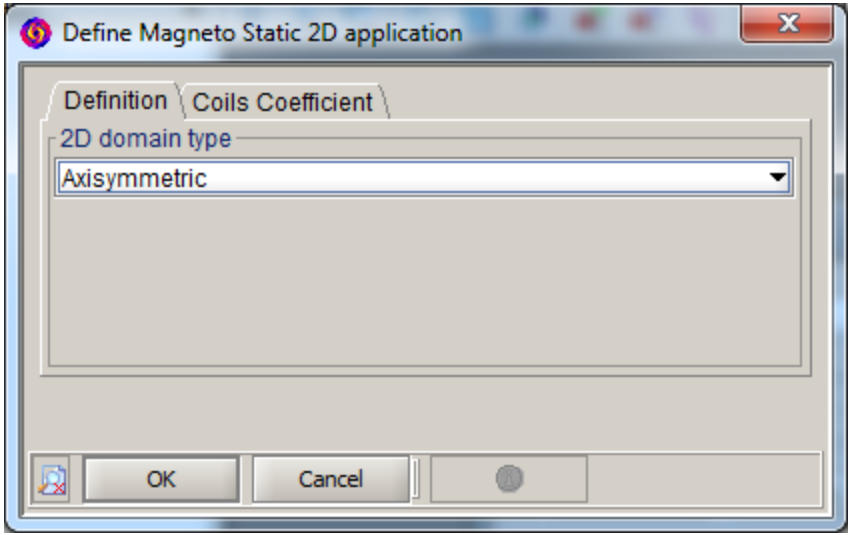
Starting a new project : application

Define a new axi-symmetric magneto-static application (Application > Define > Magnetic > Magneto Static 2D)





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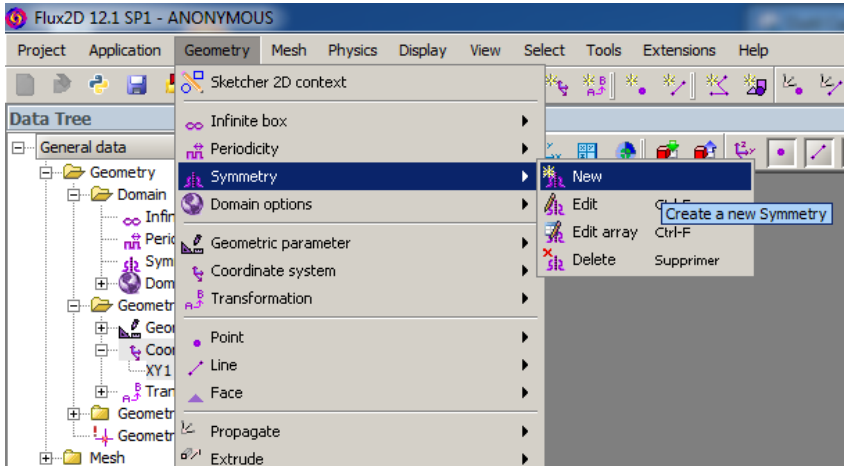
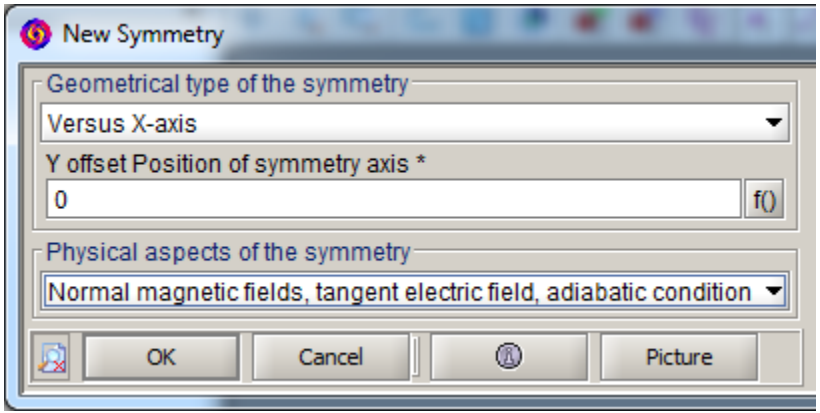
GEOMETRY

Geometry : symmetry

Create a symmetry along X-axis (Geometry > Symmetry > New)





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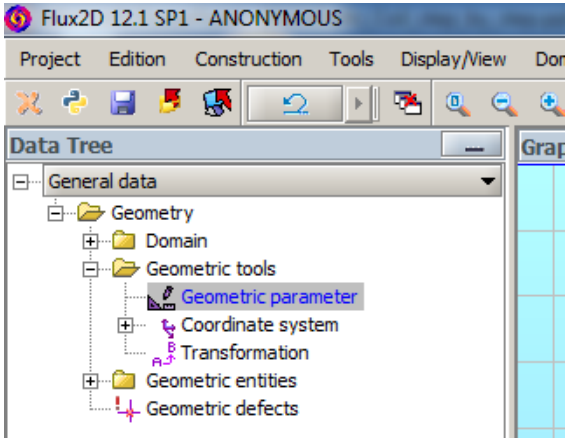
Geometry : geometric parameters

Create two new geometric parameters (Geometry > Geometric tools > Geometric parameter)



Parameter	Expression (mm)
Radius_conductor	0,5
Radius_Coil_Helmholtz	100

Open the Sketcher 2D context (Geometry > Sketcher Context) to start creating the geometry

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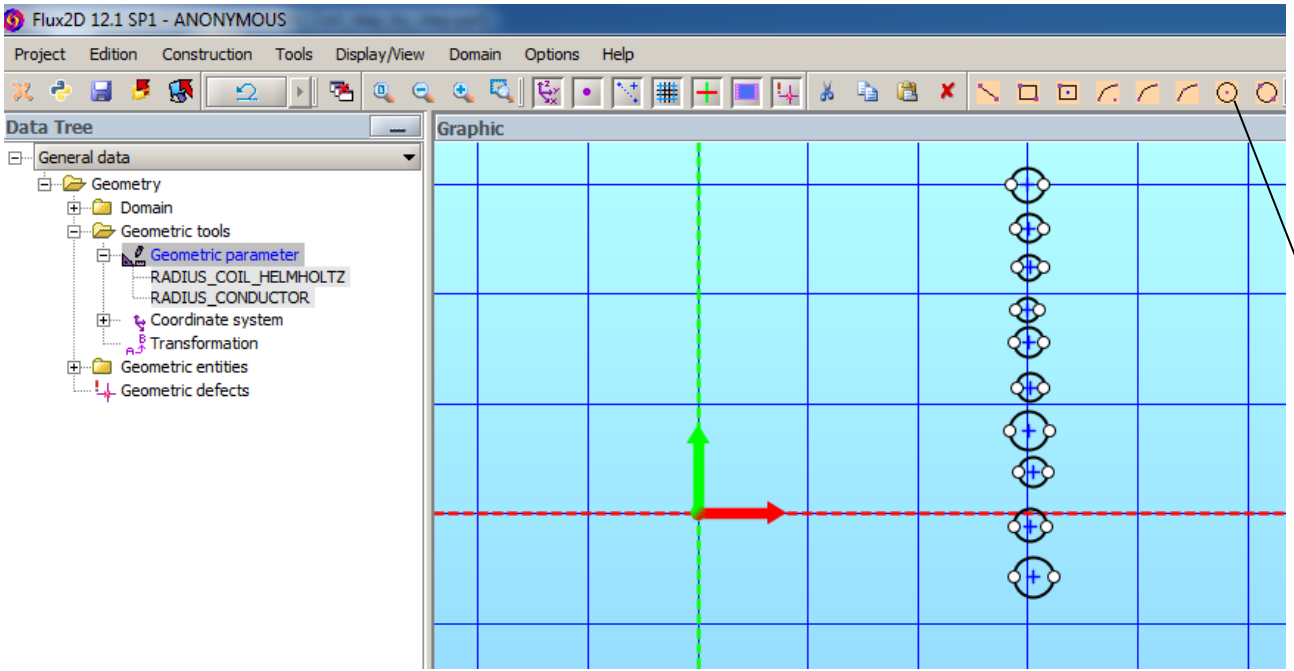
Geometry : the coil

Create 10 random circles in the sketcher (Construction > Circle > Circle center + radius)



Graphical shortcut

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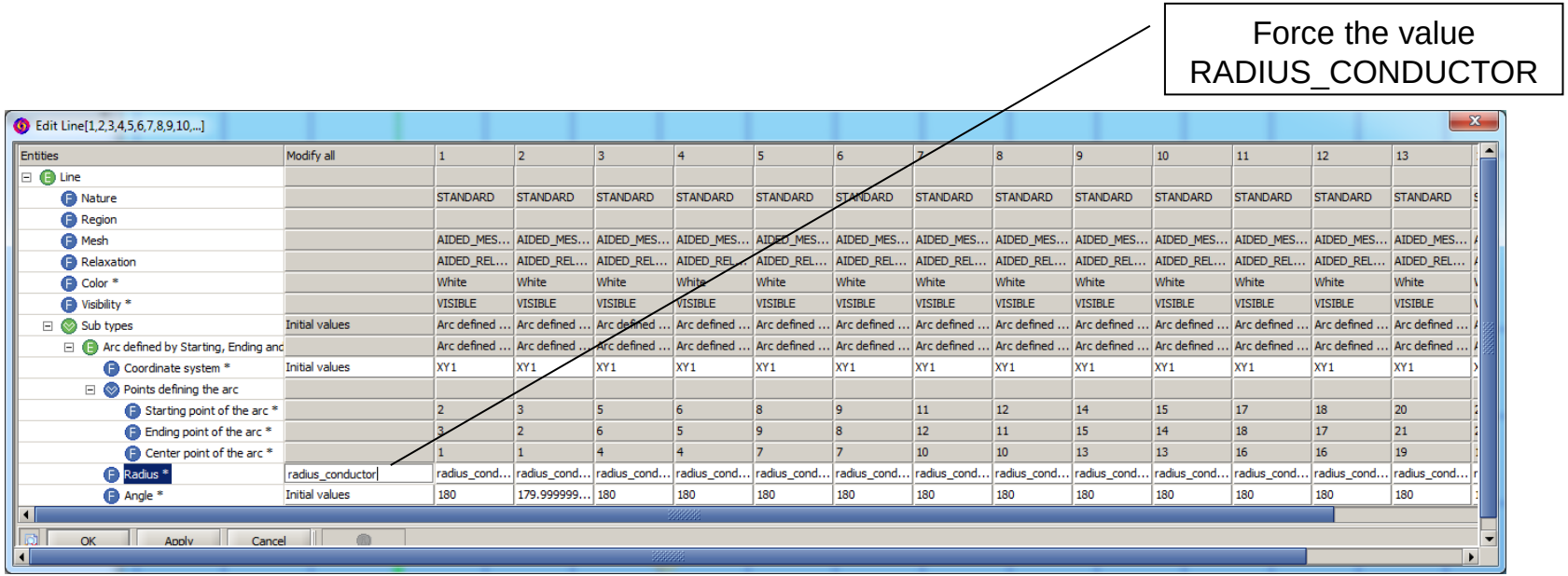
Geometry : radius of wires of the coil

Edit all lines to set a radius of RADIUS_CONDUCTOR (CTRL+CLICK on all line in the data tree > Right click > Edit array)



Geometry : center of the wires of the coil

Edit all centers to give them the following coordinates (Right click on a point > Edit)

Center of circles	X coordinate of the center	Y coordinate of the center	Z coordinate
1	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ+9*RADIUS_CONDUCTOR*1,1	0
2	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ+7*RADIUS_CONDUCTOR*1,1	0
3	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ+5*RADIUS_CONDUCTOR*1,1	0
4	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ+3*RADIUS_CONDUCTOR*1,1	0
5	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ+RADIUS_CONDUCTOR*1,1	0
6	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ-RADIUS_CONDUCTOR*1,1	0
7	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ-3*RADIUS_CONDUCTOR*1,1	0
8	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ-5*RADIUS_CONDUCTOR*1,1	0
9	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ-7*RADIUS_CONDUCTOR*1,1	0
10	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ-9*RADIUS_CONDUCTOR*1,1	0

Geometry : create a rectangle to make thiner the mesh along the X axis

Create a new random line (Construction > Line > Polyline)

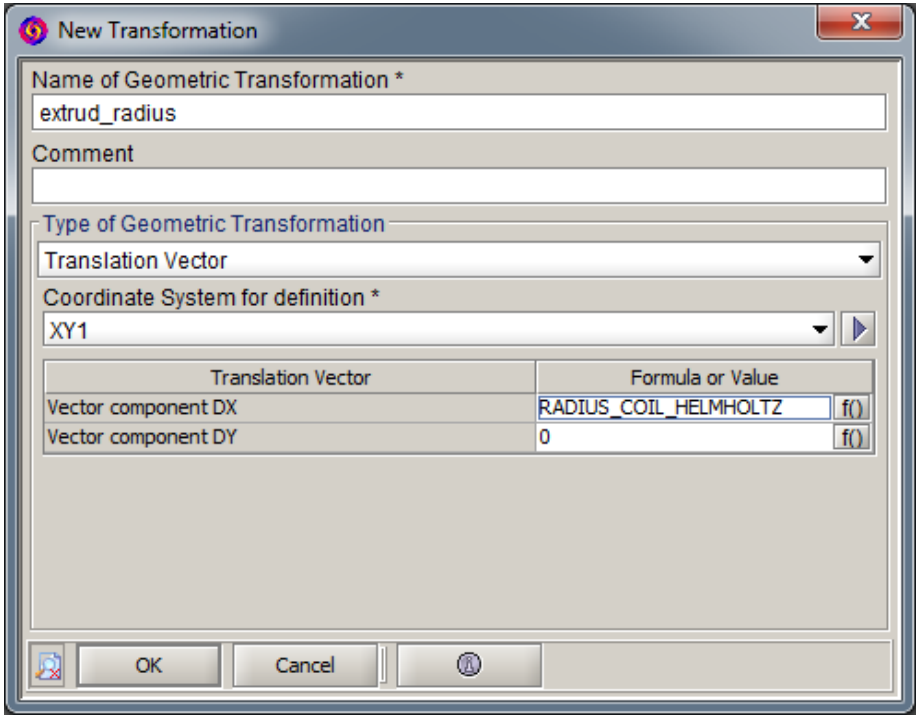
Edit the extremity points of the line, to set the following coordinates (by a right click on the point > Edit)

Extremity points of the line	X coordinate	Y coordinate	Z coordinate
1	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ+9*RADIUS_CONDUCTOR*1,1	0
2	RADIUS_COIL_HELMHOLTZ	0,5*RADIUS_COIL_HELMHOLTZ+7*RADIUS_CONDUCTOR*1,1	0

Close the sketcher context (Project > Close sketcher context)

Geometry : create a rectangle to make thiner the mesh along the axis

Create a new transformation (Geometry > Transformation > New)



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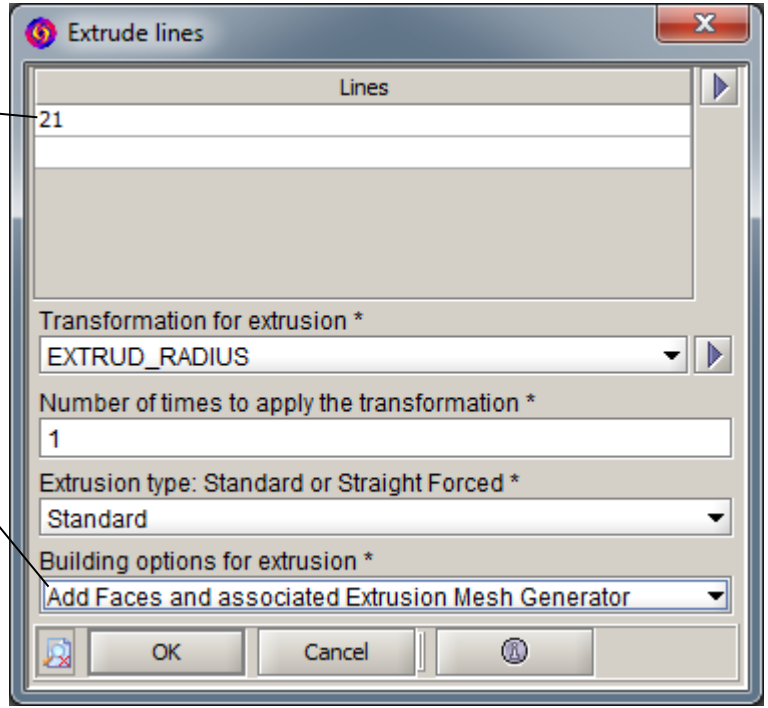
Geometry : create a rectangle to make thiner the mesh along the axis

Extrude the last line created using the transformation EXTRUD_RADIUS (Geometry > Extrude > Extrude lines)

Select the last created line in the sketcher

Select the option « Add Faces and associated Extrusion Mesh Generator



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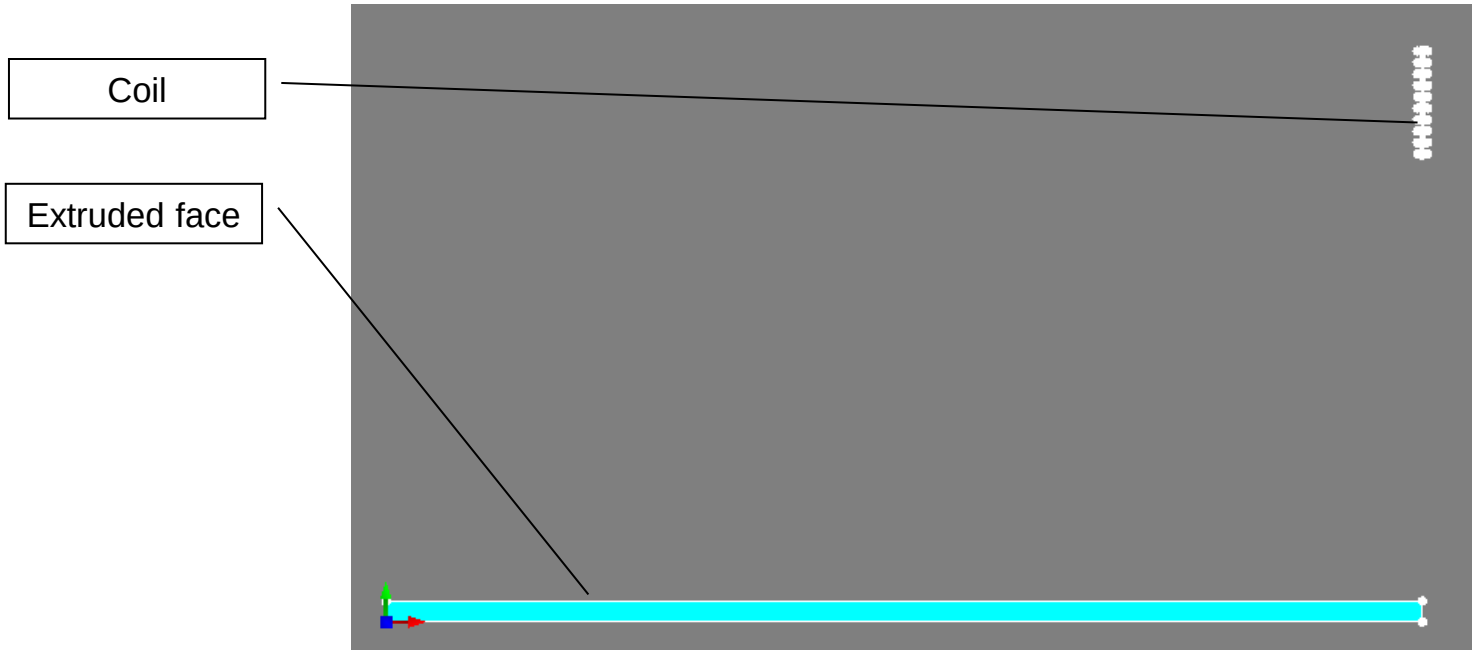
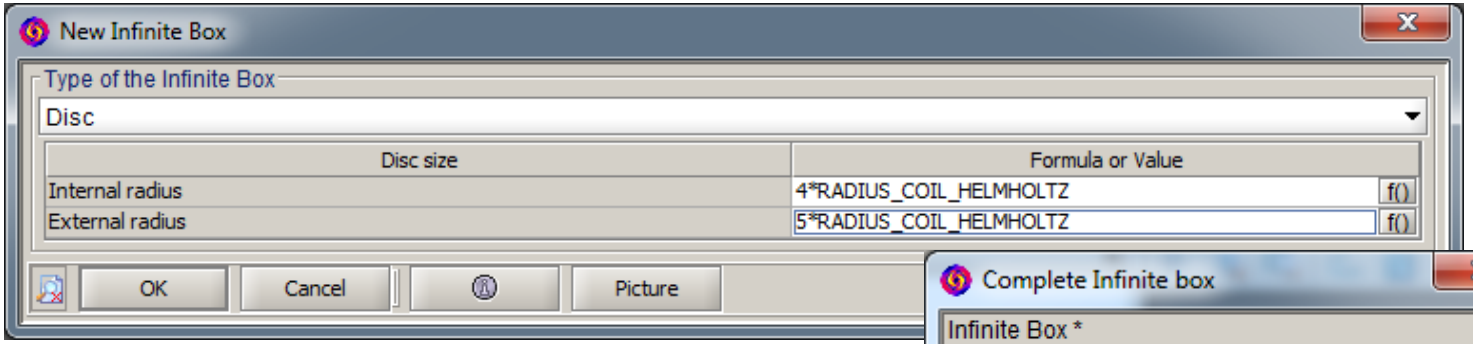
Geometry : before to create infinite box

At this step, the geometry looks as following



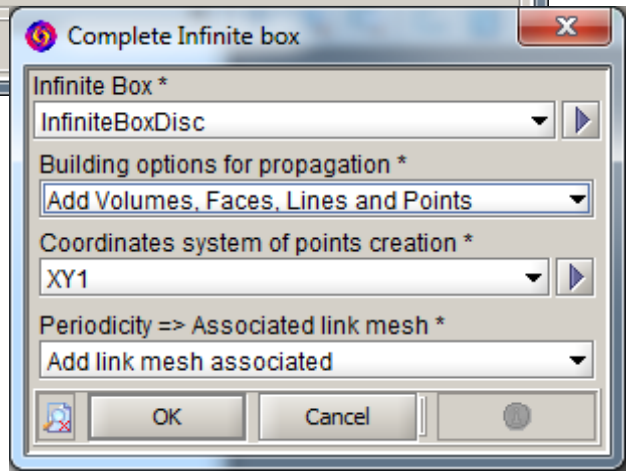
Geometry : infinite box

Create an infinite box depending of RADIUS_COIL_HELMHOLTZ (Geometry > Infinite box > New)



Complete infinite box (Geometry > Infinite box >

Complete infinite box)



All built faces will appear in turquoise

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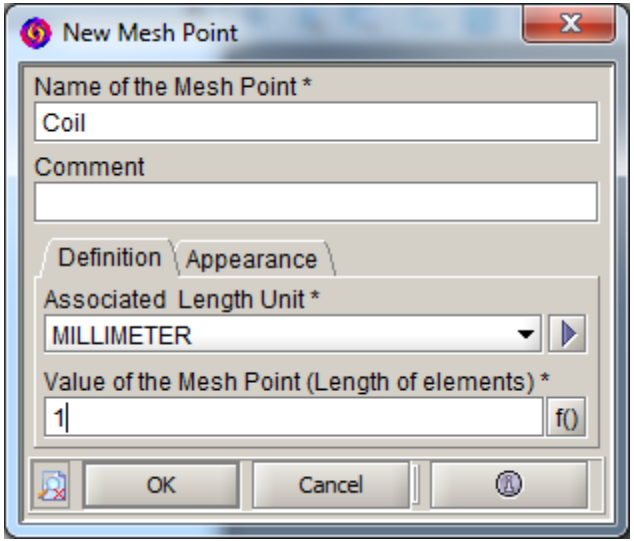
MESH

Mesh : create mesh point

Create a new mesh point for the coil (Mesh > Mesh point > New)



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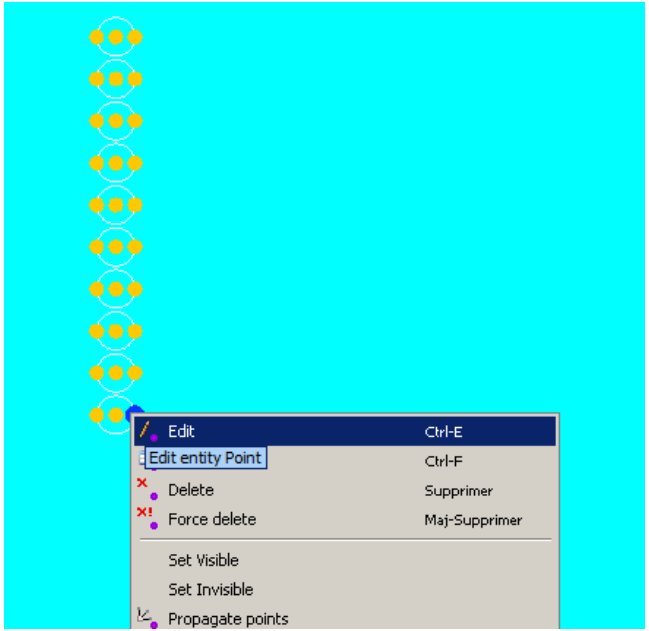
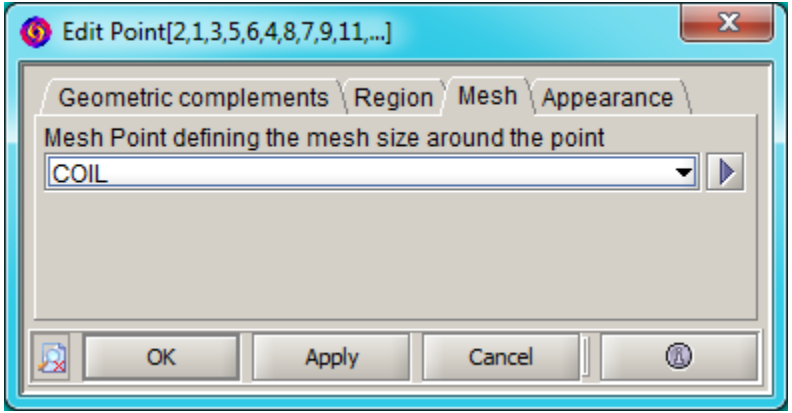
Mesh : assign mesh point

Assign the mesh point to all points defining the 10 turns (CTRL + click on all points on the 10 turns > right click on one of the selected points > Edit > Mesh)





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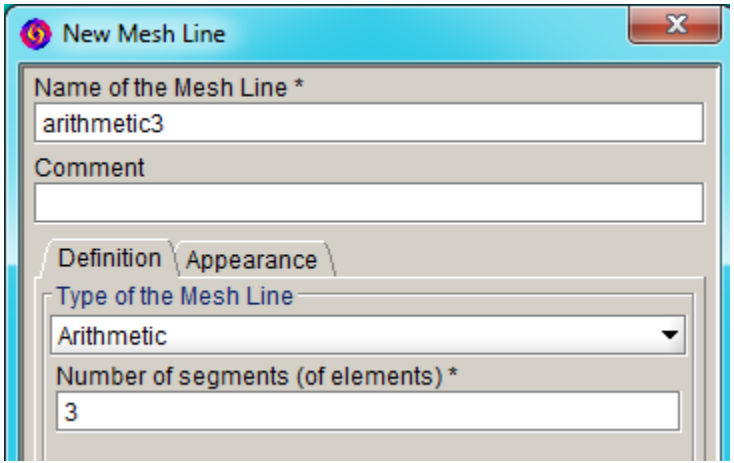
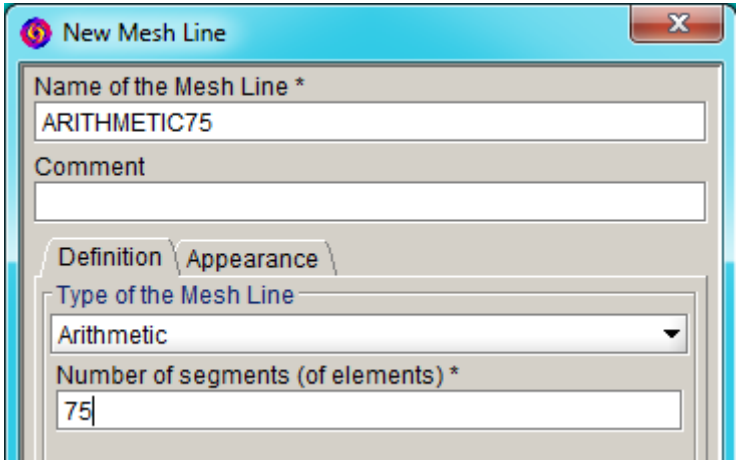
Mesh : create mesh line

Create two mesh line, to make the mesh thinner along the X axis. (Mesh > Mesh Line > New) The two mesh line correspond to the following panels:





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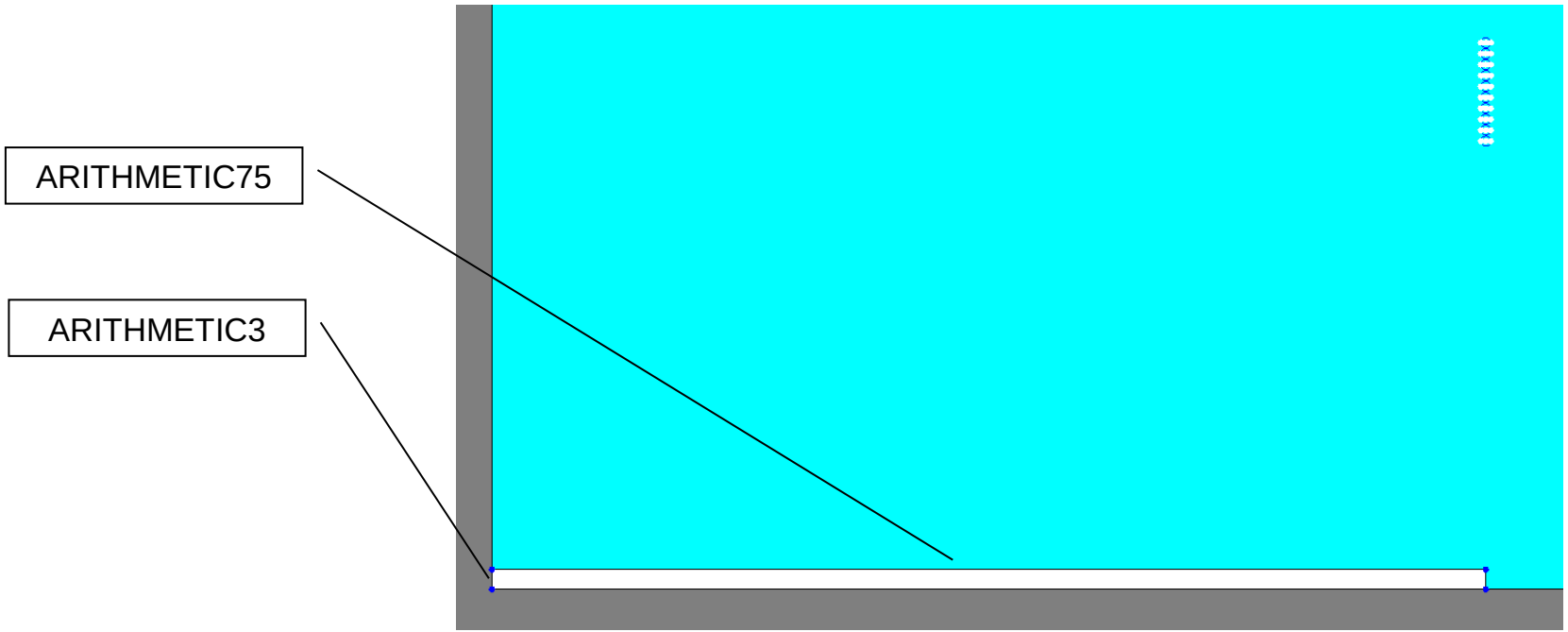
Mesh : assign mesh line

Assign the mesh line as following (right click on a line > Edit > Mesh)

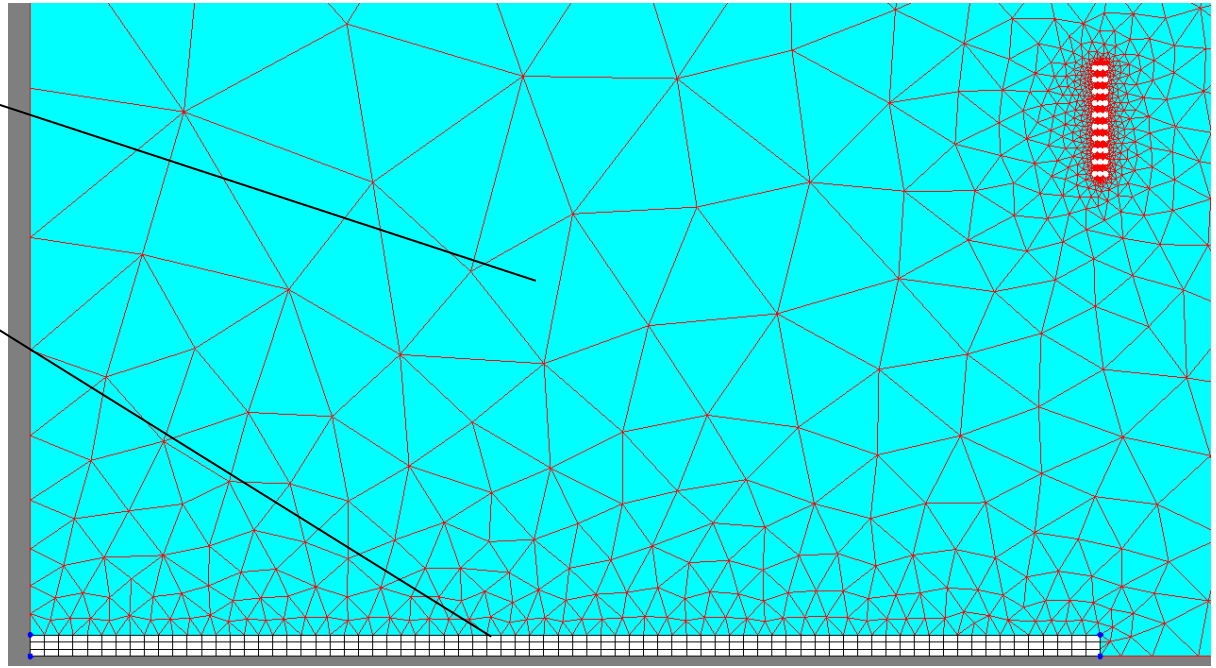


Mesh : mesh the domain

Mesh domain (Mesh > Mesh Domain). The mesh should be as following.

Aided mesh
(triangle elements)

Extrusiv mesh
(squared elements)



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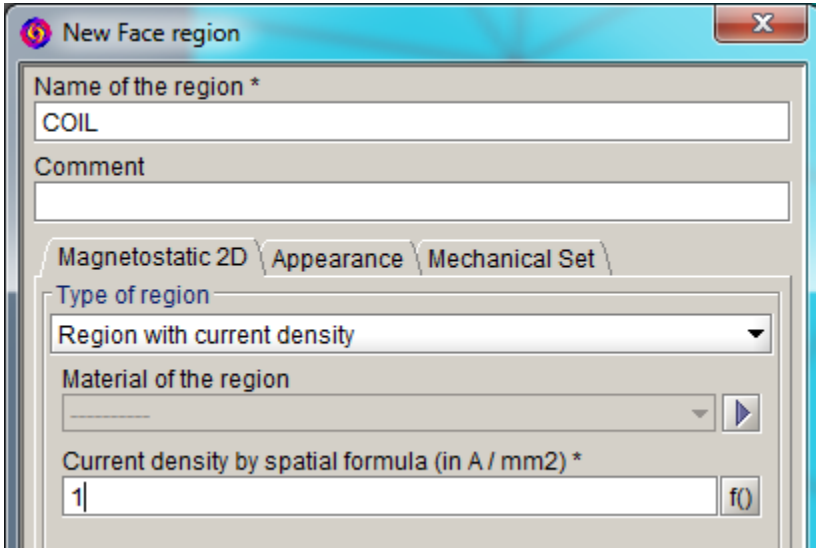
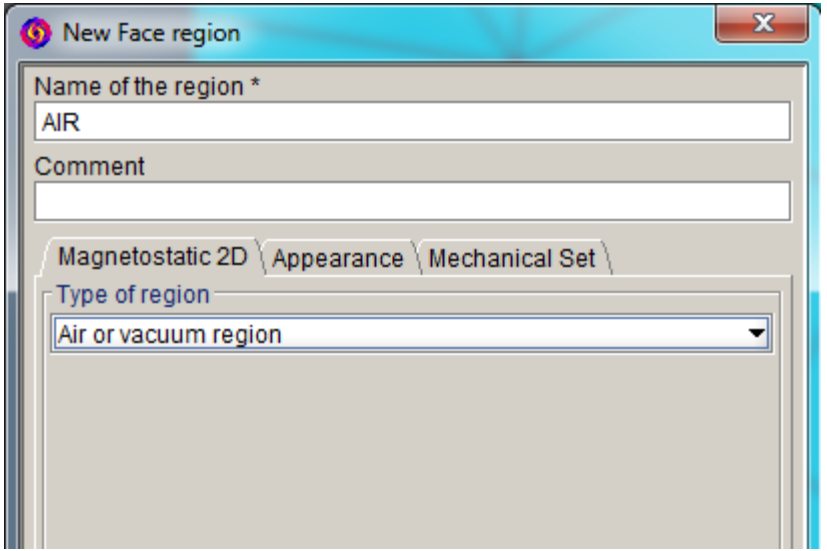
PHYSICS

Physics : create face regions to describe the physics

Create two face regions for the air and the coil (Physics > Face region > New)





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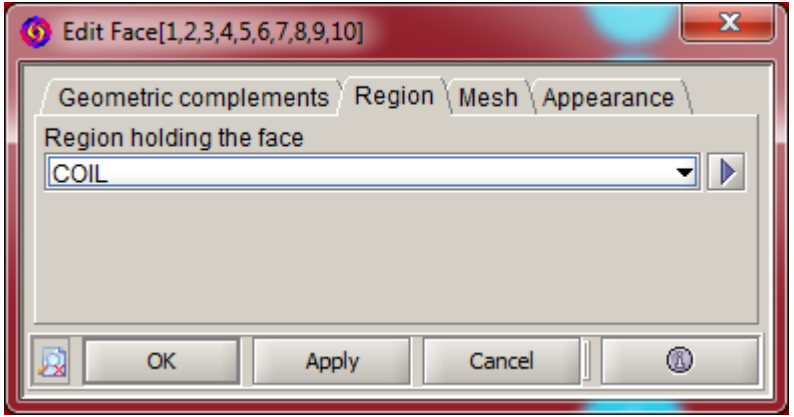
Physics : assign face regions

Assign the COIL region to all faces belonging to the coil (CRTL + click on all faces of the coil > right click on one of the selected faces > Edit > Region > COIL)



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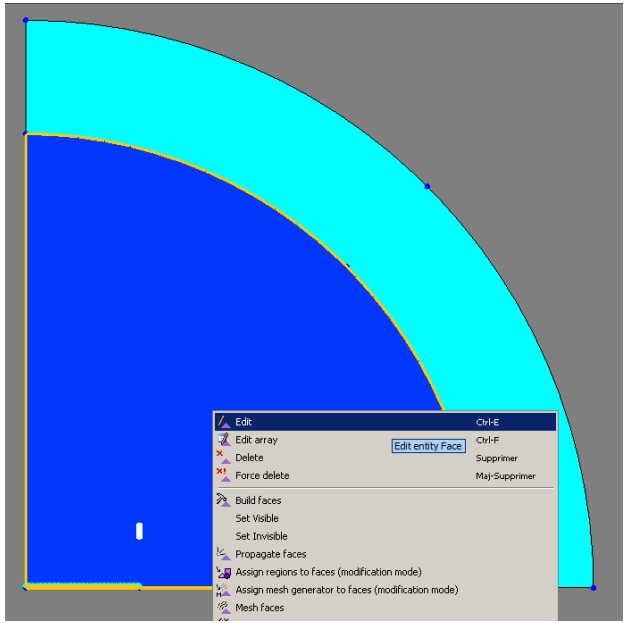
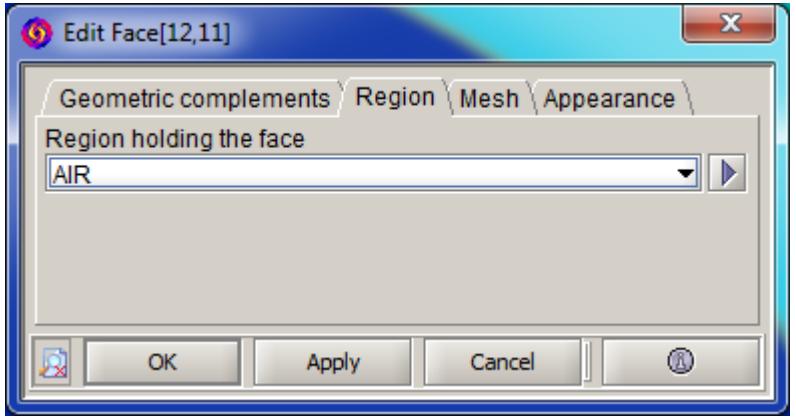
Physics : assign face regions

Assign the AIR region to the two last faces (CRTL + click on the two last faces inside the infinite box > right click on one of the selected faces > Edit > Region > AIR)





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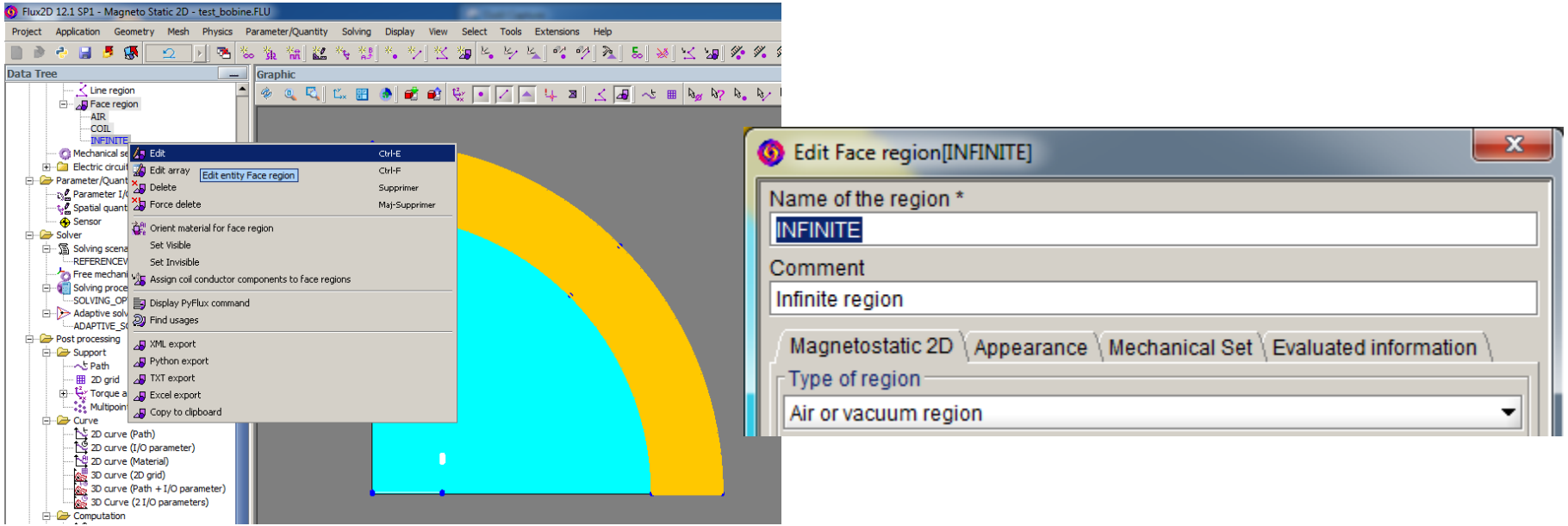
Physics : edit a face region

Validate the box of the Face region INFINITE (In the data tree Physics > Region > Face Region > INFINITE > double click > OK)



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SOLVING

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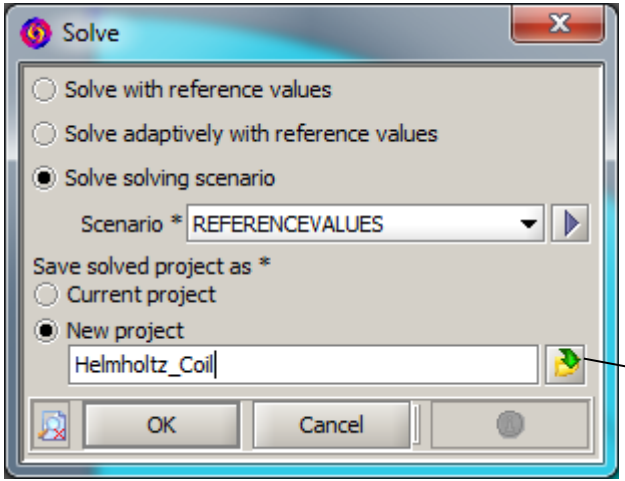
Solving : solve a scenario

Solve the reference scenario (Solving > Solve)



Choose the directory where store the solved file

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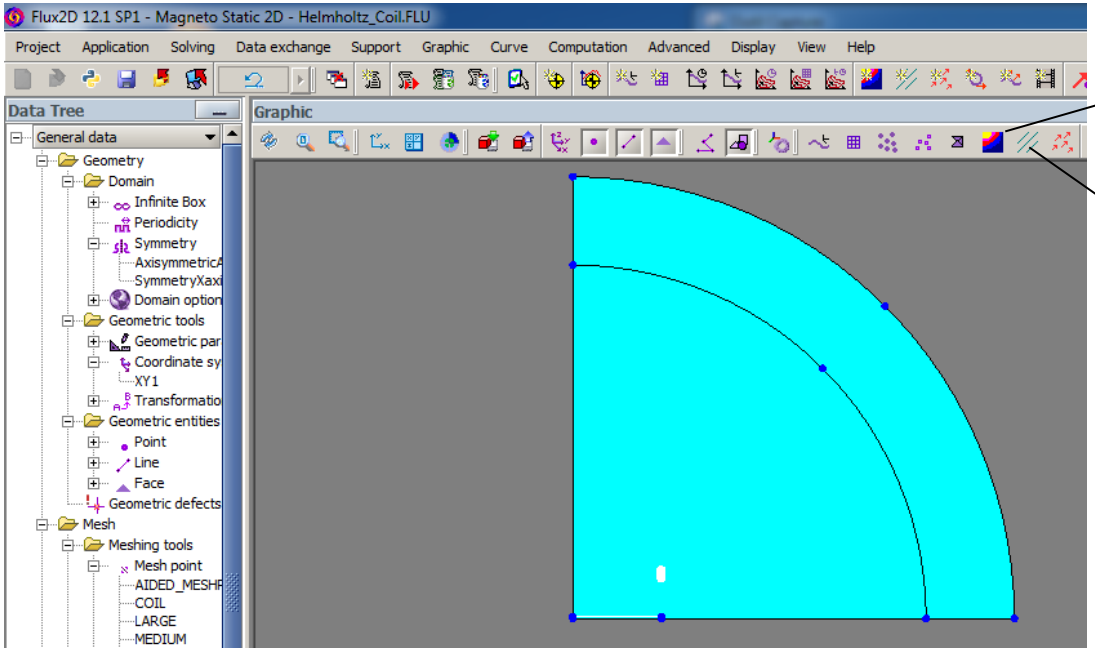
POSTPROCESSING

Postprocessing : display isolines and isovalues of the magnetic field

Directly from the GUI



Display isovalues

Display isolines

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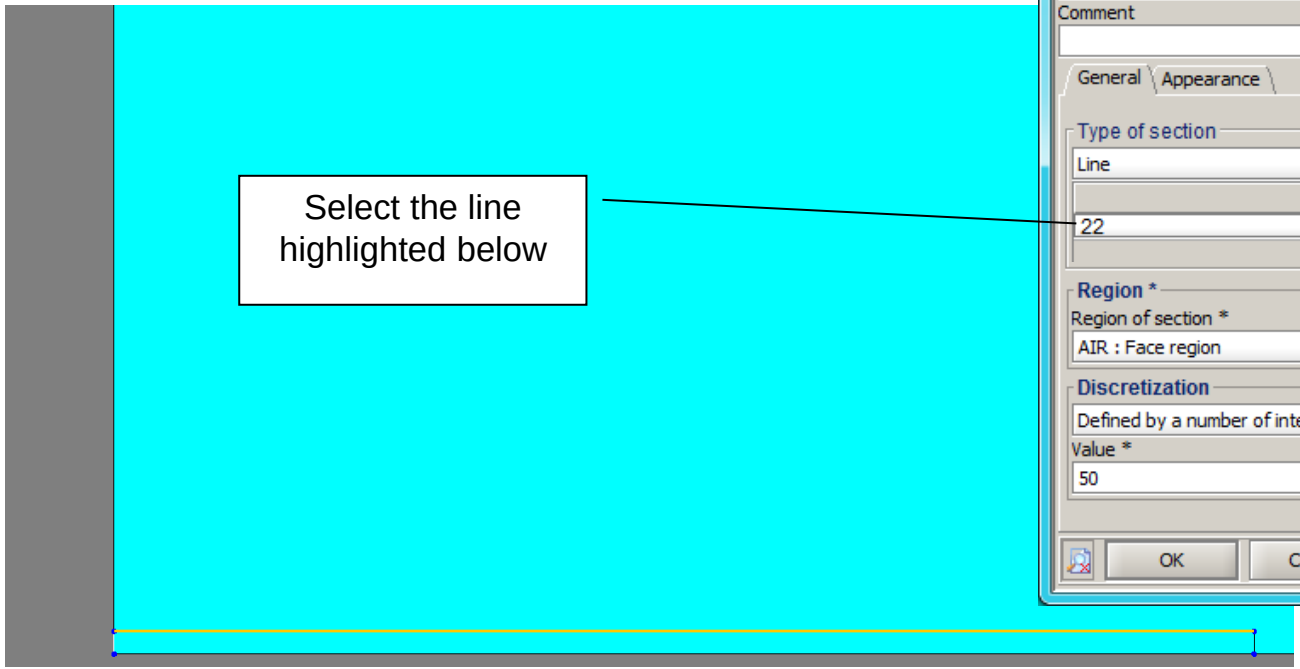
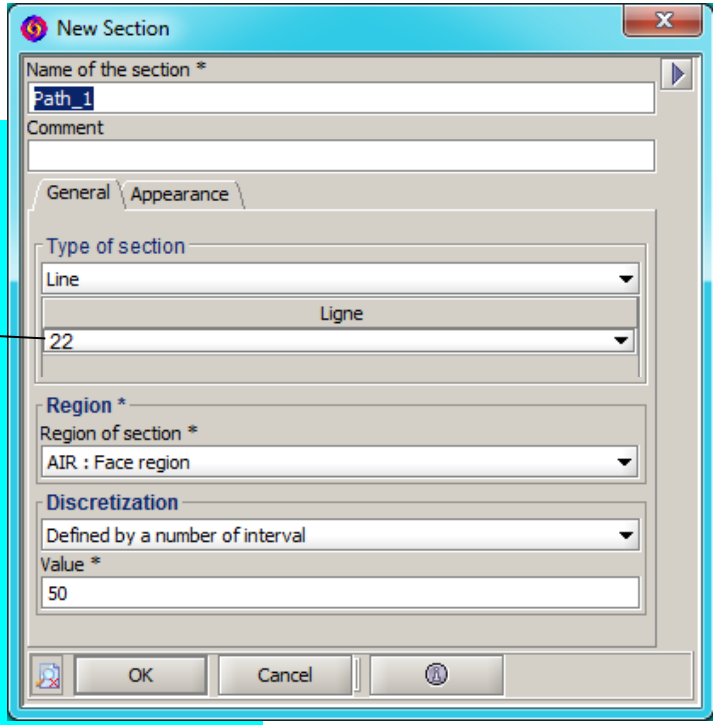
Postprocessing : create a path

Create a path (Support > Path > New > Add)





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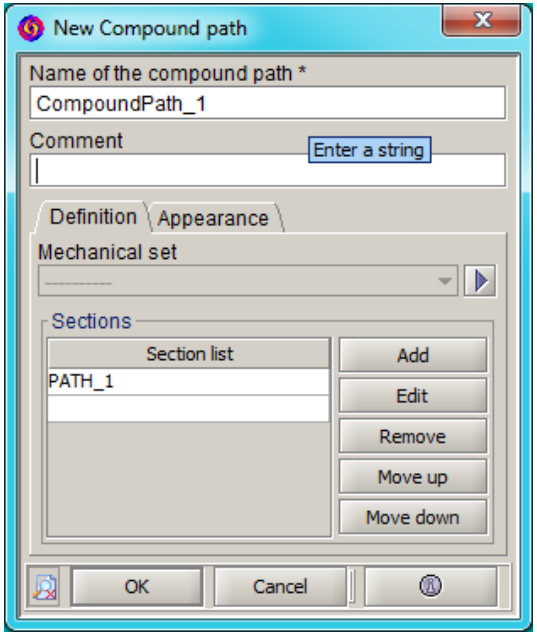
Postprocessing : create a path

The software automaticaly propose to create an other path : quit this window

Validate the compound path pannel



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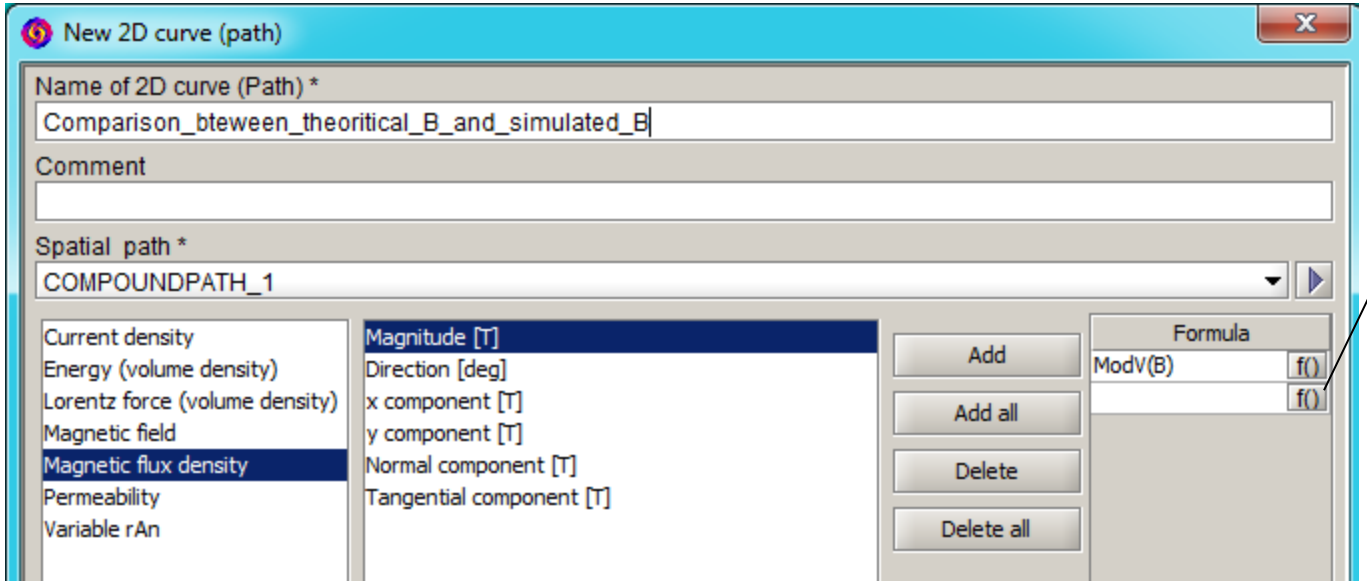
Postprocessing : plot B values on the created path

Create a curve along a path (Curve > 2D curve (Path) > New 2D Curve (Path))



Open the formula box to type the formula of the theoretical B

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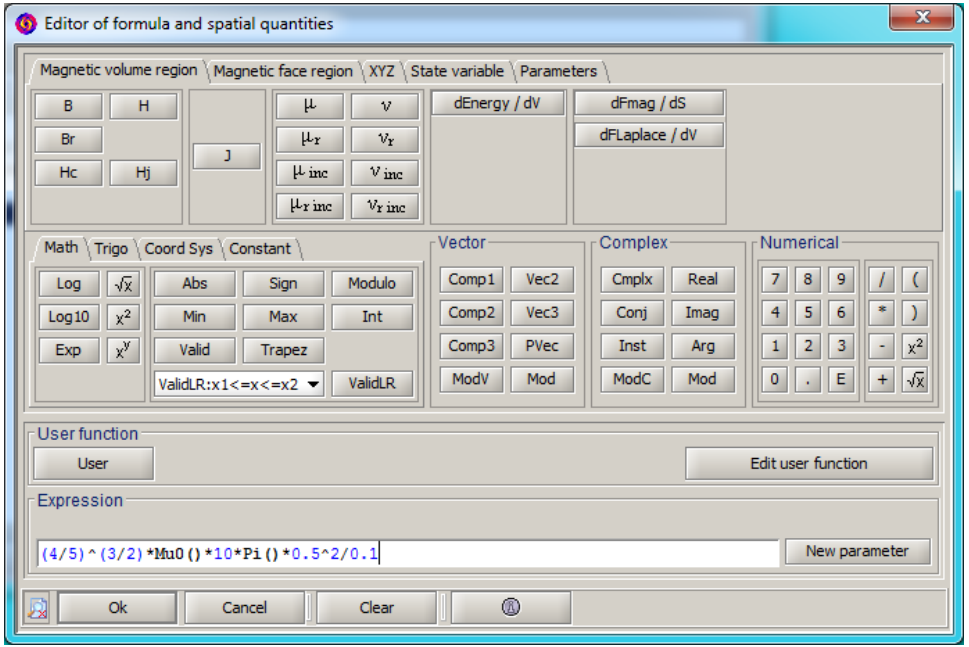
Postprocessing : plot B values on the created path

Type the formula `(4/5)^(3/2)*Mu0()*10*Pi()*0.5^2/0.1`

Validate the box



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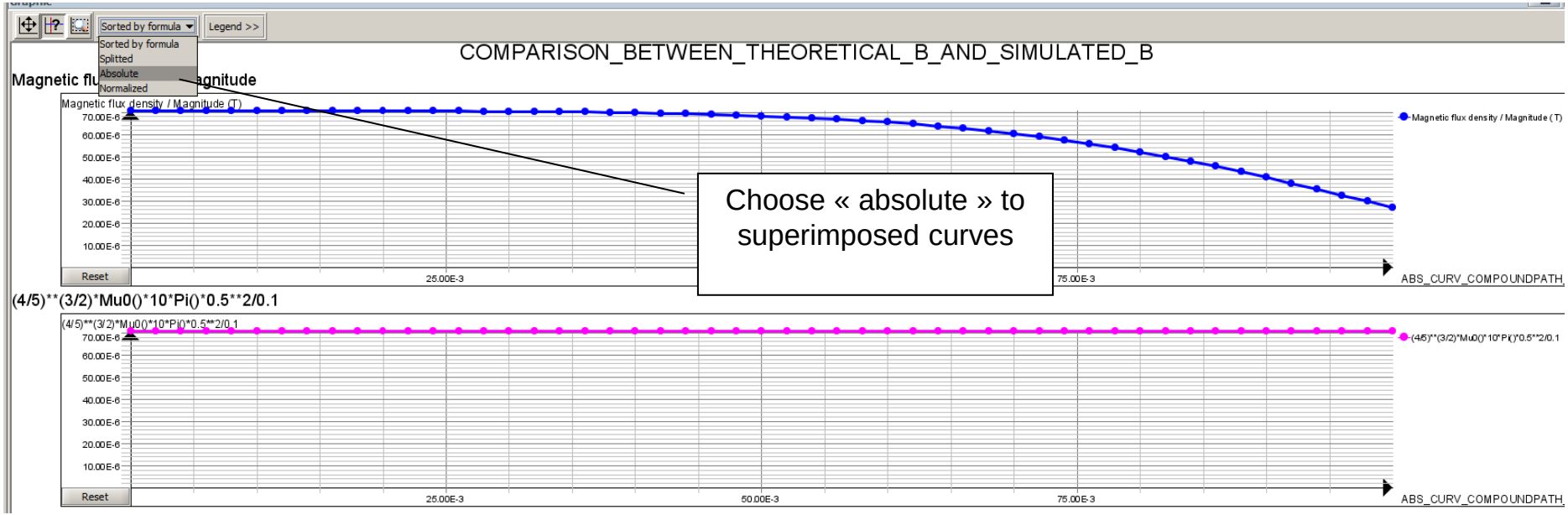
Postprocessing : plot B values on the created path

Superimposed curves



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THANK YOU

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#ONLYFORWARD

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