

How to use RAA

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Step 1

The RAA code has more than 1000 lines, written in ANSYS-APDL language. Before using the RAA code, make sure you have ANSYS with Multiphysics or Emag license on your computer. In general, the RAA is independent to the version of ANSYS. But we recommend ANSYS 14.5 and ANSYS 15.0. as the first choice.

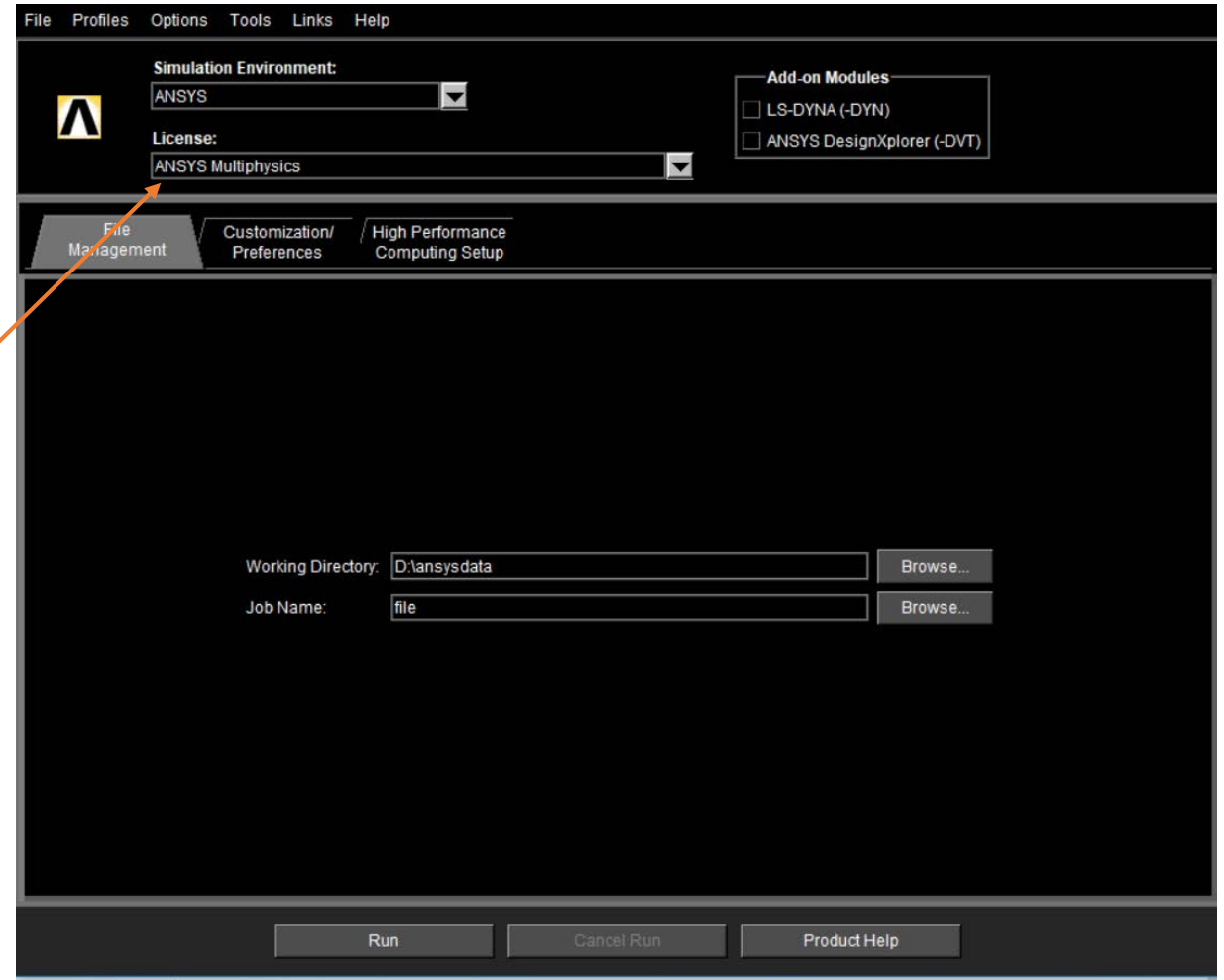
Step 1-1

RUN "Mechanical APDL Product Launcher to set license and Working Directory



Step 1-2

Choose license to Multiphysics or Emag



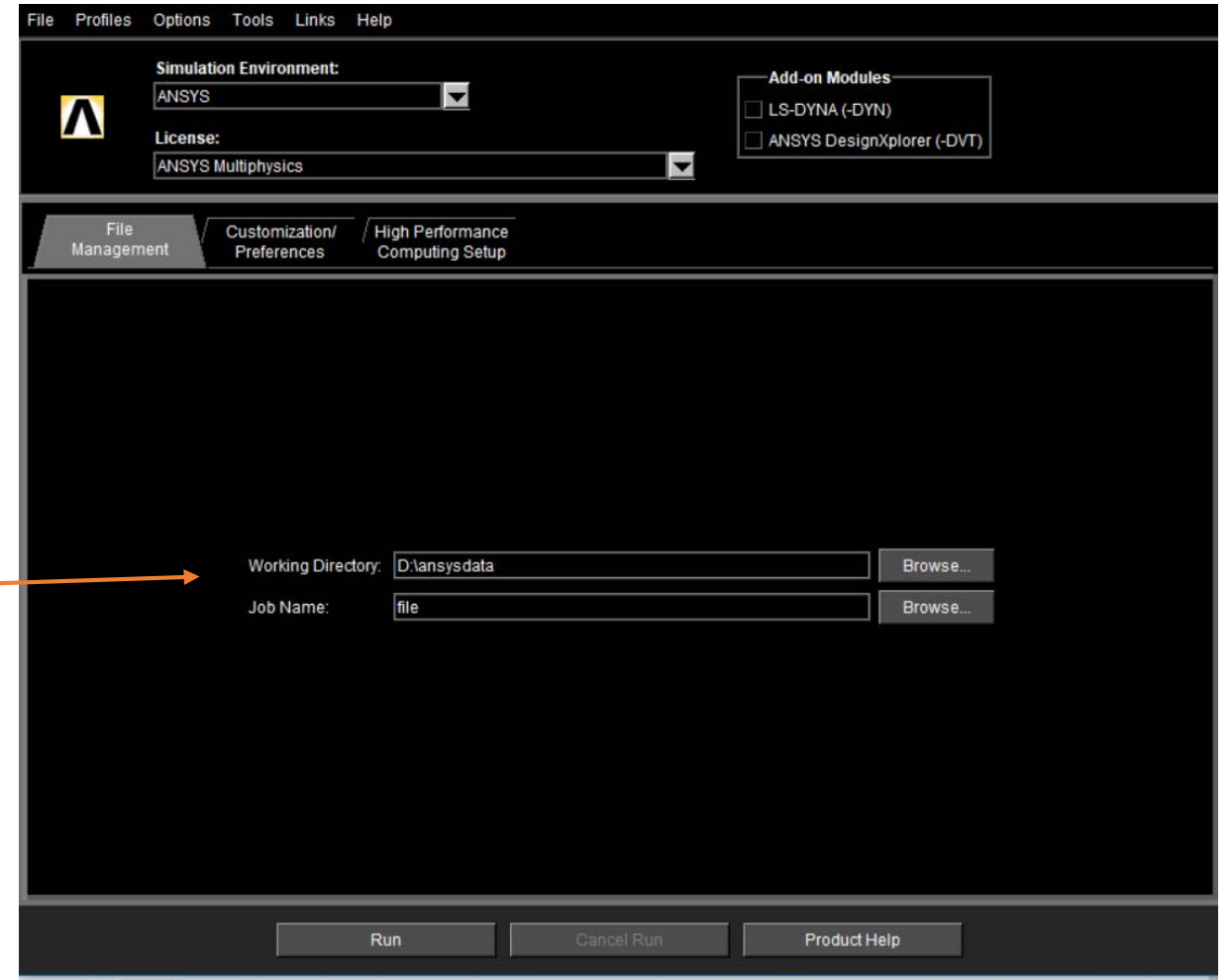
Step 2

Unzip all the “.mac” files into ANSYS working directory.

File description:

1. RAA_YBCO_step.mac ----- Parameter setting File
2. RAA_YBCO_main.mac----- Geometric Modeling
3. RAA_YBCO_loop.mac-----Model iteration
4. RAA_YBCO_cal_up.mac----- Loss Calculation
5. RAA_YBCO_output_up.mac----- Result Output

Set working directory →



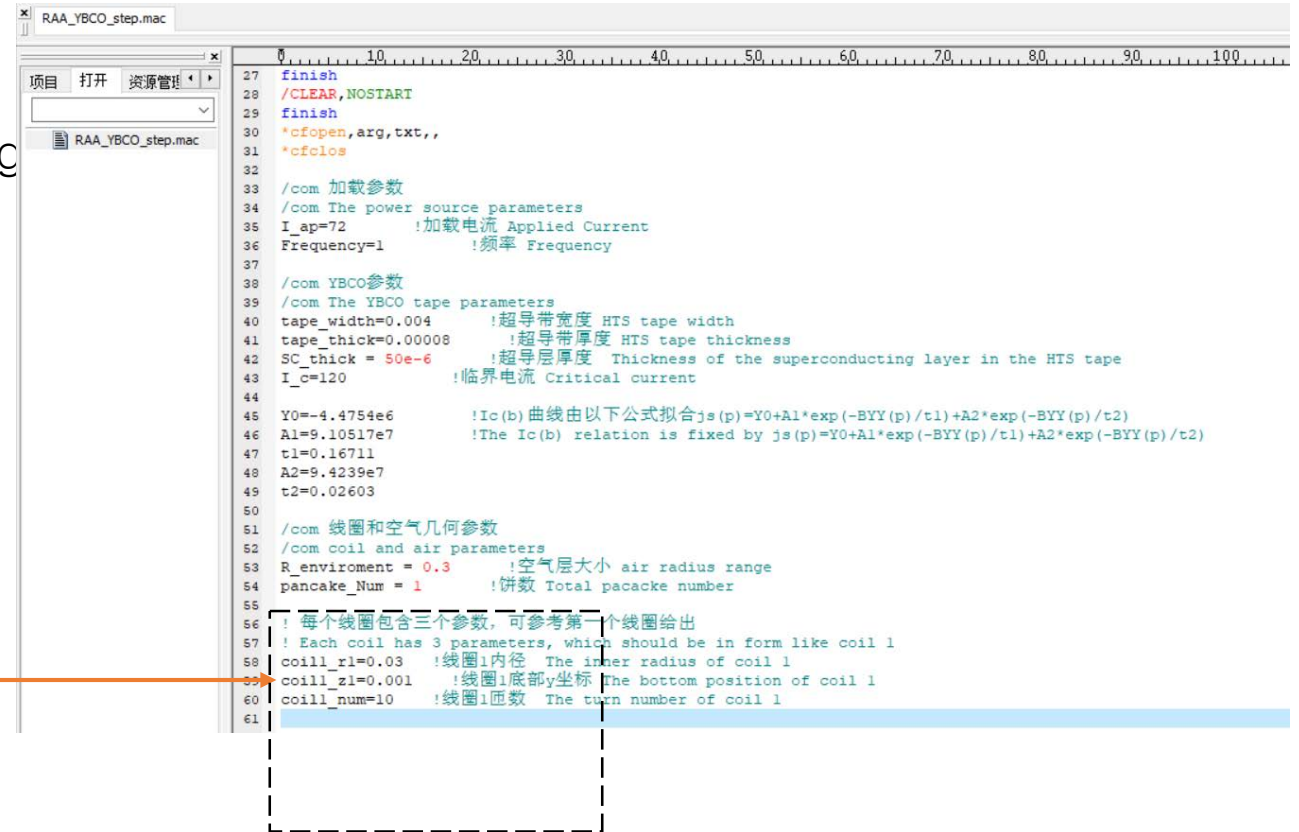
Step 3

The “.mac” file can be edited by any text editing software. We suggest UltraEdit as an editing tool.

File description:

1. RAA_YBCO_step.mac ----- Main File
2. RAA_YBCO_main.mac----- Geometric Modeling
3. RAA_YBCO_loop.mac-----Model iteration
4. RAA_YBCO_cal_up.mac----- Loss Calculation
5. RAA_YBCO_output_up.mac---- Result Output

Set coil parameters, as many as 10 double pancake coils can be built in the model.



```
27 finish
28 /CLEAR,NOSTART
29 finish
30 *cfcopen,arg,txt,,
31 *cfclos
32
33 /com 加载参数
34 /com The power source parameters
35 I_ap=72      !加载电流 Applied Current
36 Frequency=1 !频率 Frequency
37
38 /com YBCO参数
39 /com The YBCO tape parameters
40 tape_width=0.004 !超导带宽度 HTS tape width
41 tape_thick=0.00008 !超导带厚度 HTS tape thickness
42 SC_thick = 50e-6 !超导层厚度 Thickness of the superconducting layer in the HTS tape
43 I_c=120 !临界电流 Critical current
44
45 Y0=-4.4754e6 !Ic(b)曲线由以下公式拟合js(p)=Y0+A1*exp(-BYY(p)/t1)+A2*exp(-BYY(p)/t2)
46 A1=9.10517e7 !The Ic(b) relation is fixed by js(p)=Y0+A1*exp(-BYY(p)/t1)+A2*exp(-BYY(p)/t2)
47 t1=0.16711
48 A2=9.4239e7
49 t2=0.02603
50
51 /com 线圈和空气几何参数
52 /com coil and air parameters
53 R_enviroment = 0.3 !空气层大小 air radius range
54 pancake_Num = 1 !饼数 Total pacacke number
55
56 ! 每个线圈包含三个参数, 可参考第一个线圈给出
57 ! Each coil has 3 parameters, which should be in form like coil 1
58 coil1_r1=0.03 !线圈1内径 The inner radius of coil 1
59 coil1_z1=0.001 !线圈1底部y坐标 The bottom position of coil 1
60 coil1_num=10 !线圈1匝数 The turn number of coil 1
61
```

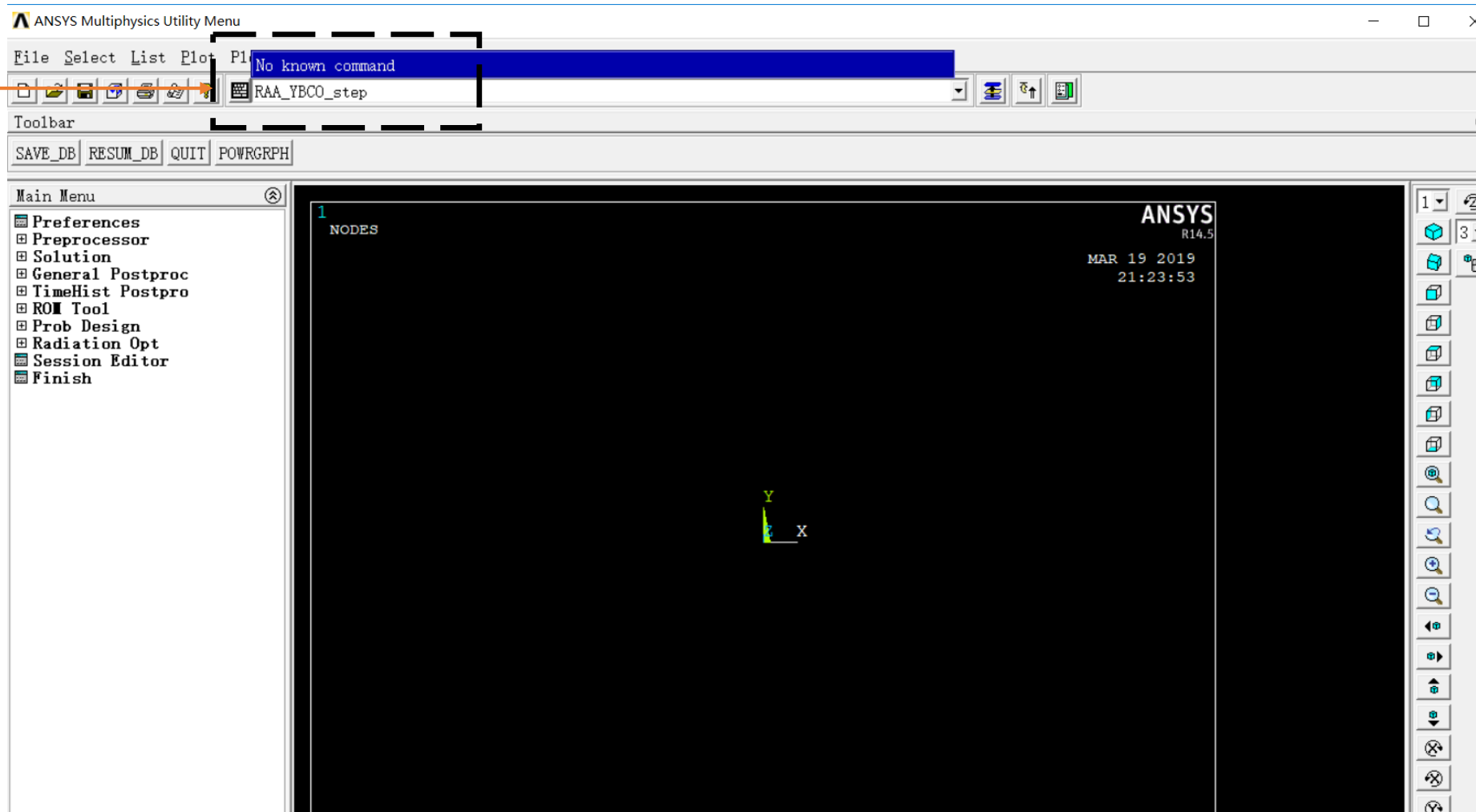
The program will run from file 1 to file 5. For the beginners who do not know so much about ANSYS, do **NOT** change any word from file 2 to 5. All you need to do is editing file 1 in which user can change the tape parameters and coil parameters. After editing the “RAA_YBCO_step.mac”, save the file.

We recommend using default values without changing any parameters for the first run.

Step 4

RUN the ANSYS program; TYPE "RAA_YBCO_step" into the textbox and ENTER

TYPE the
file name



Step 5

When the calculation is finished, open the RAA_YBCO_result.txt file in ANSYS working folder to get the results.

- ❑ The first column indicates the number of the coil.
- ❑ The second column indicates the number of turn in each coil.
- ❑ The third column indicates the excitation current.
- ❑ The fourth column indicates the AC loss in each turn.

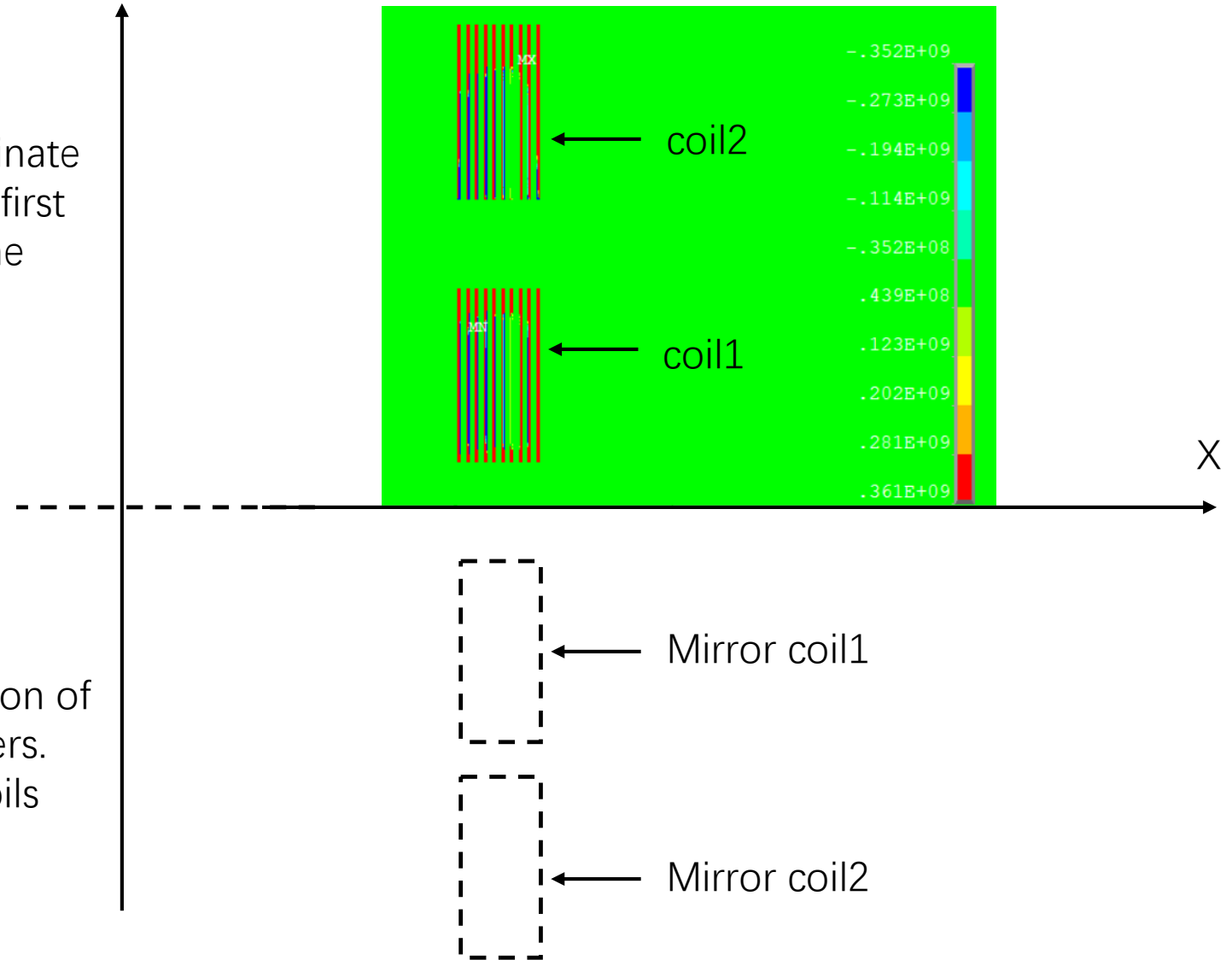
```
1 Total time used:          0.44944 Hour
2 The AC loss of the magnet is      0.907E-02 J/cycle
3
4 Coil_No   turn_No   Current   Loss (J/cycle/m)
5 1         1         60.00    0.139E-02
6 1         2         60.00    0.110E-02
7 1         3         60.00    0.899E-03
8 1         4         60.00    0.728E-03
9 1         5         60.00    0.688E-03
10 1        6         60.00    0.713E-03
11 1        7         60.00    0.736E-03
12 1        8         60.00    0.110E-02
13 1        9         60.00    0.112E-02
14 1       10         60.00    0.137E-02
15 2        1         60.00    0.476E-02
16 2        2         60.00    0.375E-02
17 2        3         60.00    0.329E-02
18 2        4         60.00    0.291E-02
19 2        5         60.00    0.269E-02
20 2        6         60.00    0.263E-02
21 2        7         60.00    0.263E-02
22 2        8         60.00    0.274E-02
23 2        9         60.00    0.321E-02
24 2       10         60.00    0.360E-02
25 2       11         60.00    0.442E-02
26
```

The AC loss of the magnet only takes account the winding in the first quadrant. To get the total loss including the mirror parts, you should multiply the factor of 2. (Please go to Step 6 to understand the mirror parts)

Step 6

Take a close look of current distribution and field distribution on winding

The coil is built in axisymmetric coordinate system and the winding is built in the first quadrant. ANSYS by defaults builds the mirror parts along X-axis



The figures shows the current distribution of the winding based on default parameters. The magnet consists of four 10-turn coils carrying $0.5I_c$.

Enjoy simulation
Enjoy RAA