Day 2 – Ion Sources

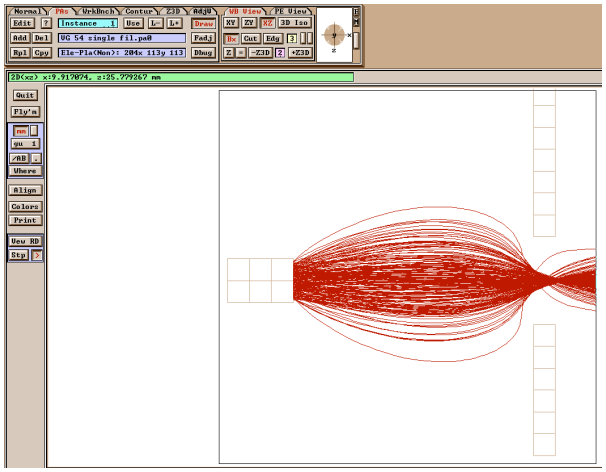
To run these examples the large PA# files must be refined first, once they are refined and saved they no longer need to be refined when running the examples. The procedure to refine a file is:

a. Select Load, then select **the file.pa#** (left click when cursor is on the file), then OK.
b. Select Refine, set Convergence Objective (lowest green panel) to 5 e-6 or lower.
c. Push the Refine Fast Adjust Array button. Refining will take about from one to several minutes depending on the size.
d. Push the Remove All PAs from Ram button.

Here are the files that need to be refined in this section:

- 2D as built source.pa#
- generic ei.pa#
- ICP 1.pa#
- 54 single offset.pa#
- double.fil.pa#
- no shld.pa#
- offset fil.pa#
- offset side fil.pa#
- test.pa#
- VG 54 single fil.pa#

1. Thermal ion sources
    a. Single filament
        i. VG 54 lens with single filament
            1. emission size
                a. From the main menu select View then go to VG Lens under Day 2 SIMION directory and choose 54 single.iob
                b. Push the XZ button on the WB View tab to rotate the view
                c. Push the Fly'm button; note that the ions are stopped just before they exit the lens, this is so that we can easily count them.
                d. Zoom in on the source region using the +Z3D button until you have the view shown below:



e. Rotate the views to get an idea of what region of the filament the ions are being emitted from.
f. Push the View RD button on the left side of the screen, a window will appear showing you the number of ions that made it through the lens.
g. Push the Fly'm button and enter a 1 for the _rerun value, then Fly. Note the variation in the number of ions that make it out of the lens.
h. Push the Fly'm button again to stop the ions, push it again to start them and change the _z_random_offset_mm to 0.1 mm. Does the transmission efficiency change?
i. Now change the Y random offset; what effect does this have; why? (Hint, look at the XY view of the whole lens).

2. emission position
   a. Push the Fly'm button and change the _y_Random_Offset_mm value to 2 then Fly a few sets and note the transmission efficiency. Did it change much? Why7
   b. Push the Def button under the Normal Tab, in the ion definition screen change the First y value to 50 gu, select OK, then Fly'm. Does this change the efficiency? Why?
   c. Push the Def button under the Normal Tab, in the ion definition screen change the First y value back to 55 gu. Push Fly'm, change the _z_random_offset_mm to 0.1 mm, note the efficiency.
   d. Push the Def button, change the First z value to 56.7 then fly some ions. Has the transmission efficiency changed? Why?
3. angular effect
   a. Push the Def button, on the ion definition screen push Load .fly, then choose 54 single.fly and OK. Select Fly'm, then push the As Defined button then Fly. This is the baseline set of trajectories, note the efficiency.
   b. Fly the ions again, this time change the _Cone_Angle_Off_Vel_Axis to 0 degrees, how does this affect the transmission efficiency? Try some other angles.
4. energy effect
   a. In the ion definition screen change the First ion's KE to 1 eV then on the Fly'm screen push the As Defined button and fly the ions. How does this change the efficiency, can you see why? Change the initial energy to 0.01 eV and fly more ions.
5. offset filament position
   a. Push the Quit button to return to the main menu, push Remove All PA's from Ram, then push View and select 54 single offset.iob, select the XZ view and Fly'm.
   b. Zoom into the filament region and note the offset position of the center filament; what effect has this had on the efficiency?

b. Triple filament

i. VG 54 with triple filament
    1. Select Quit, then Remove All PA's from Ram, then View, select 54 Triple.Iob; zoom in on the filament region so you can see the geometry of this source, then Fly'm.
        a. Change various parameters such as position, energy, angle as you did for the single filament system.
    2. Offset side voltage bias
        a. Select the tab PAs, the push the Fadj button, and change panel number 2 setting to 8001, push Fast Adjust PA, then Fly'm. How has this effected the trajectories? Choose some other voltages for the side filament, change both side filament voltages, etc.
    3. offset side filament
        a. Select Quit, then Remove All PA's from Ram, then View offset side fil..Iob
        b. Select XZ view and Fly'm, zoom into filament region. Note that one side filament has been offset 1 grid unit (0.4 mm in this case, or ½ a filament width) toward the center filament How has this affected the trajectories and the efficiency?
    4. offset center filament effect
        a. Select Quit, then Remove All PA's from Ram, then View offset center fil..Iob
        b. Select XZ view and Fly'm, zoom into filament region. Note that the center filament has been offset 1 grid unit (0.4 mm in this case, or ½ a filament width) toward one side filament How has this affected the trajectories and the efficiency?

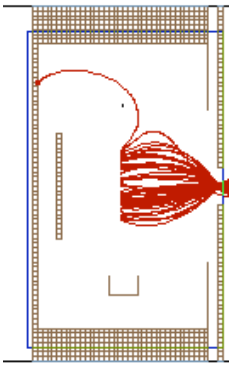
c. Double filament
    i. Modified VG – This is the VG 54 lens with a double filament geometry, it is only hypothetical but demonstrates the basics.
        1. From the main menu first Remove all PAs from Ram, the push View and select 54 double.iob; switch to XZ view and Fly'm.
        2. Make small changes in the filament and can voltages and observe the effects.
        3. Investigate the effect of the initial energy on the ion trajectories.
        4. Investigate the effect of the starting position of the ions (use the Def button to access the ion definition screen).

2. Electron Impact ion source
    a. Generic EI source
        i. Electrons
            1. From main menu Remove All PAs from Ram
            2. Push View, look in the EI lens directory, select generic ei.iob.
            3. Push Fly'm, these are electrons emitted from the filament, note that they spread out throughout the volume.
            4. Push the PAs tab, change the instance number to 2 (source mag.pa0), then push Fadj and set value to 50, push Fast Adjust PA.

5. Now Fly'm again, note that the electrons are now constrained by the magnetic field. Adjust the view so you can see the spiral path the electrons take in the field. Adjust the magnetic field strength to see its effect on the electron trajectories.

ii. Ions

1. Push the Normal tab, select Def, select Load.fly, select ions.fly, push Fly'm and change the _x_Random_Offset_mm to 0, the _y_Random_Offset_mm to 30 and Fly.
2. Push the PAs tab, select Instance 2 (source mag.pa0), push Edit, change Xwb to -150, push OK (this moves the magnet temporarily out of the way so we can see the potential energy surface of the lens).
3. Zoom into the lens region using the +Z3D button so you have the following view



4. Push Fly'm, switch to the PE View to see how the lens is working, you may need to increase the Relief to ~1.0.
5. Fly'm again, this time set _x_Random_Offset_mm to 5 mm. Zoom in and look at the potential difference between where the various ions are formed, what would the energy spread be for these conditions.

3. ICP – much like the EI source, energy differences probably worse.
   a. Generic ICP source
      i. Space Charge
         1. From main menu Remove All PAs from Ram
         2. Push View, look in the ICP directory, select ICP Simulation.iob
         3. On the Normal Tab page push Dots, move the slider all the way to the right, push Grouped, and push the button No Charge until it says Coul Repl (coulomb repulsion).
         4. Set the trajectory quality to 0 (pink panel under button labeled Hidden)
         5. Fly'm, set _rerun to 1 note the transmission efficiency (ignore the first output).
         6. Change the Coulomb value to 5.0 e-12C, Fly'm. What has happened?
         7. Explore other charge values and lens voltage settings.