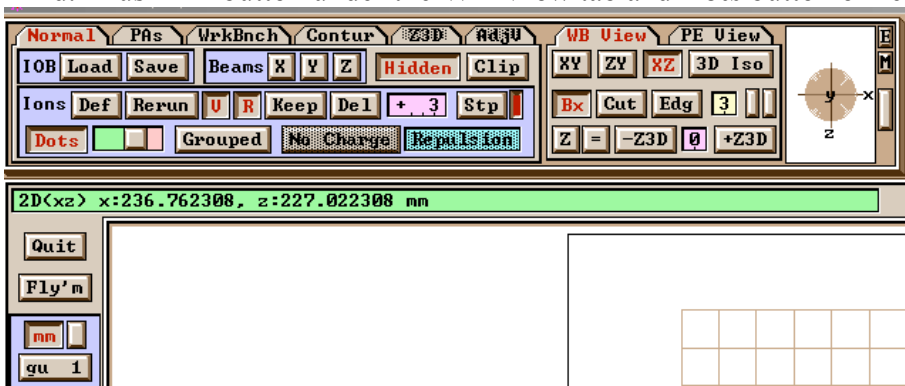


Day 1 – Magnetic and Electrostatic fields

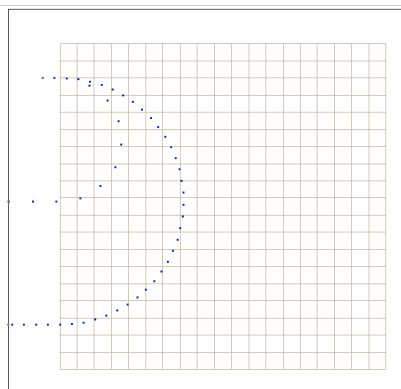
Note: These examples have been developed for use on SIMION version 7. They will work on version 8, but the user interface is different so some of the comments about panels and tabs will not be appropriate, you'll have to work through those changes.

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:

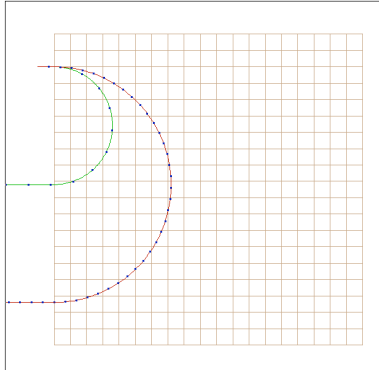
- a. Select Load, then select **the file you want.pa#** (left click when cursor is on the file), then OK.
 - b. Select Refine, set Convergence Objective (lowest green panel) to 5 e-6 or lower.
 - c. Push the Refine Fast Adjust Array button. Refining will take about from one to several minutes depending on the size.
 - d. Push the Remove All PAs from Ram button.
2. Radius of curvature of a charged particle in a uniform magnetic field.
- a. Select **View**
 - b. Move to **Day 1 SIMION**
 - c. Select **Uniform B.IOB**
 - d. Push **XZ** button under the **WB View** tab and **Dots** button on left side of top frame.



- e. Push **Fly'm** button, you will see:



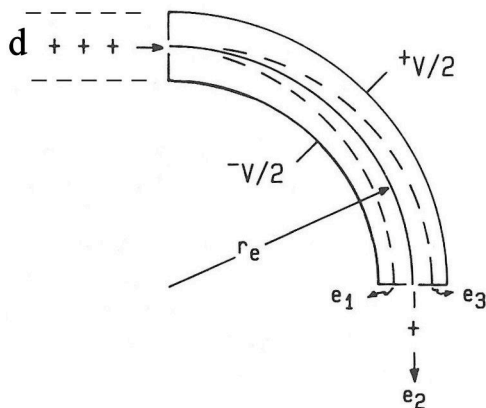
- f. Now push the **Dots** button again, you will see:



$$m = 9.64853 \times 10^{-5} \cdot \frac{qB^2 r^2}{2V_a}$$

- g. Use equation to calculate theoretical radius of curvature, compare with the model. B is 3900 G; V is 100 volts; mass is 100 and 400.
 - h. Push the Def button and change parameters of the ion (energy, mass, charge) and see what happens.
3. Radius of curvature of a charged particle in a cylindrical electrostatic analyzer.
- a. Push Quit; from main menu screen push Remove All Pas from Ram
 - b. Select View
 - c. Select ESA 90.IOB
 - d. Push Fly'm
 - e. Push the PE View button on the upper right. This shows the potential energy map.
 - f. Push the WB View tab.
 - g. Push the Def button and look up the energy of each ion (color).
 - h. Push OK to return to the View screen.
 - i. Push the PAs tab on the top line.
 - j. Push the Fadj tab in the middle row.
 - k. Change the voltages by 100 volts and then push the Fast Adjust PA button.
 - l. Push Fly'm
 - m. Explore changing other variables (mass, for instance), charge, ion energy.

The equations defining the cylindrical electrostatic analyzer are given below.



$$r = \frac{d \cdot m \cdot v^2}{q \cdot V_e} = \frac{2 \cdot d \cdot KE}{q \cdot V_e}$$

a) Electrostatic Analyser

See if the predicted radius agrees with the model.

4. Energy Focusing in a cylindrical ESA.
 - a. Push the Quit button then the Remove All PAs From RAM button.
 - b. If this is the first time this example has been used, go to step c, otherwise skip to step g.
 - c. Select Load, then select ESA 1.pa# (left click when cursor is on the file), then OK.
 - d. Select Refine, set Convergence Objective (lowest green panel) to 5×10^{-6} .
 - e. Push the Refine Fast Adjust Array button. Refining will take about 5 minutes.
 - f. Push the Remove All PAs from Ram button.
 - g. Push View then choose ESA 1.IOB
 - h. Push Fly'm.
 - i. Zoom in and observe the focal point.
 - j. Now push the Def button
 - k. Push the Load Fly button.
 - l. Select the file ESA 1 2 beams.fly
 - m. Select OK, then Fly'm
 - n. Zoom in and observe the separation between the two beams.
 - o. Go to the ion definition screen (choose Def button) and see what the energy difference between the two beams is (look at KE on the bottom left, then change the Trajectory Group number to 2, upper left to see the energy for the next group of ions). Change one, how small of an energy difference might we be able to discriminate with this particular device?

5. For the speedy:
 - a. Go the main menu, push **Remove All PA's from Ram**
 - b. Push the **View** button and select **edge field B.IOB**
 - c. Choose the **XZ** view orientation
 - d. Push **Fly'm**
 - e. What has happened to the trajectories compared to what you saw in section 1.f?
 - f. Move the cursor around just outside the magnet edge and see what the field is.
 - g. Select the **Contur** tab, then select **Both** and push **Draw**; these are the B field contours.
 - h. Push the **Draw** button again to turn off the contours.
 - i. Select the **Normal** tab then push the **Keep** button (to save the trajectory images)
 - j. Select the **Def** button, push **Load .FLY** and select **edge field B offset.fly**
 - k. While in the **XZ** view, zoom in on the trajectories, you will notice an offset.
 - l. Switch to the **XY** view, what has happened to the trajectories? Why? (hint, look closely at the ion emission point).