Files and programs (in Folder Astra_codes_linux)

On-line can be downloaded also the Windows versions:
http://www.desy.de/~mpyflo/

The main two codes: Bunch generator and Tracking Codes

- -Generator.exe
- -Astra.exe

Astra's Visual applications (pre or post processor),work on the input files or particle distributions

- -Fieldplot.exe (to check cavity, optics and Space Charge fields)
- -Lineplot.exe (to plot the tracking results: evelopes, emittance, Energy, E_spread etc…
- -Postpro.exe (to plot bunch distribution space phases)

Watch out: to use Visualization application, in Linux, run the "./pgxwin_server", in Windows are stand-alone.

(It's also possible to use applications like: gnuplot, python, matlab …., chech the files out-put format on the Astra manual)

Executable must be in the Folder where you need it

Bunch generation @ photocathode

- Check the Astra-Generator's input file with an editor ("**generator-start1.in**")
- Run the Generator and produce the virtual bunch on the photocathode surface (only temporal distribution)

  (the run command at the prompt) #> .\generator imputfile.in

- Check the prompted output

- Run the Astra's post processor **postpro**

  #>.\postpro particlesFileName.ini
  trans. phase space, x,x' and y,y' are rectangular
  long. phase space (z) z,I is a vertical line (all the z are equal 0)
  long. phase space (time) t,I is Gaussian

Gun and drift simulation

- Check the Astra's input file "ProjectName.in" (in this case **Gun_drift.in**)

Check the Gun field "new45.dat" (Standing Wave acc. cavity) and the Gun Solenoid field files "GUNSOL_SPARC_++--.poi" (by gnuplot,or others plotter tools). Check how it is wrote the script gplot_new45. launch it by "./gnuplot plot_new45".

Run the preprocessor **fieldplot** (if not present, move it in your working directory). Check the instruction launch on the Manual (usually ./filedplot Gun_drift)

Check again the Gun field and solenoid field files, by fildplot

- Run Astra

#> .\Astra Gun_drift.in

check the prompted output data, like file name, tracked particles number, etc..

- Run the prostprocessor lineplot

#> .\lineplot ProjectName

check the main beam parameters (emittance, evelope etc)

- In "ProjectName.in" (always **Gun_drift.in** for this case, change run=1 in "run=2", turn-off the space charge "LSPC=false" and then launch Astra again. At the end of the particles tracking, by lineplot click use "next run" button and "previous run" button, in the way to compare the effect given by the Space Charge (ON/OFF)

Linac simulation

- Move from folder ex_1 the farer or last bunch distribution you have just generated (“Gun_drift.0160.001”) into the ex_2 folder. This distribution is close to the Linac first cavity and ready to be accelerated.

- Check the Astra’s input file “ProjectName.in” (in this new case: Linac.in).
  - now we are going to simulate a Traveling Wave (TW) acc. Structure (filed file: “TWS_sparc.dat”)
  - Inside “Linac.in” there are N.3 cavities (under the NameList &CAVITY) S-band, 3 meters long, starting at: 1.75 m, 5.25 m and 8.75 m, from the cathode.
  - Use the preprocessor fieldplot to see:

    All the cavities fields and also the bunch field (fieldplot’s button: “Space Charge Fields). It shows the bunch auto-field (relate to γ, number of macro-particles and other mesh parameters; related to the NameList &CHARGE). This check, in some cases, might be very; especially where the SpaceCharge can be turned-on, again, by compression or focusing.
- Run Astra and using lineplot check emittance, envelope, Energy and Energy spread

Focusing simulation

- Check the Astra's input file "Focusing.in". Start from the last particle distribution at the linac end (Linac.1225.001). Check the quadrupoles in triplet configuration at the NameList &QUADRUPOLE, which is the focusing channel before the interaction point

- Set in the NameList &OUTPUT a Screen() at the Interaction Point (IP) position

- By using the postpro Astra's software analyze the bunch at IP (usually the instruction #> postpro ProjectName.xxxx, run or chech on the manual), xxxx stays for the bunch position (for digits).

- The final focus (the distribution generated at Screen()=IP_position, is no good on the both X,Y plane. It is possible to re-make all the runs by using 4000 macro particles (mp); with this higher macro particles number the final focusing performances are much better. This means that in a case like this, 2000 mp don't give a correct description of the Space Charge.

The "CAIN" code (folder ex_3_scattering)

Move cain2 into your working directory

- The input files of CAIN are named as: "FileName.i".
  We are going to use two different inputs, where the names show the electron bunch energy.
  60MeV.i and 1000MeV.i

  To launch CAIN:
  In Linux : prompt>cain **<** FileName.i
  In Windows: prompt>cain.exe FileName.i

- For the 60MeV.i case edit the input file and change the e-beam energy spread in "sige=0.003" and run the case. Then in "sige=0.00003" and run again. Compare the histogram of photons and electrons energy distributions for the two cases. When the energy spread is higher, the final electron energy distribution does not show any effects. When the energy spread is lower, into the distribution, are showed, very clearly, the electrons that had scattered. Note that the recoil for 60 MeV is negligible
- In the 1GeV case (1000MeV.i), do not touch the input file, run it and check as the recoil start to be relevant.
- For all the case try to compute the Number of photons produced by the analytical formula (in High_Brightness_Beam_Sim_Bacci_Rwanda2016_2.pptx), and by CAIN. (the integral of the istogram. For the istograms use the script in gnuplot or some other codes you prefer)