IPM Sim 2016 workshop

Discussion sessions – main points

March 3

- A. Scope of the project:
  1. the most general IPM simulation (see slide 6, 2nd remark)
  2. something else? (BIF? Electron lenses? Bunch-shape monitor? E-lens?)
  3. technology/existing codes: python? C++? CST?
- B. Initial discussion of resources:
  1. manpower
  2. code repository -> github@CERN.
  3. public webpage (data, benchmarks) -> wiki.
  4. information exchange tool -> wiki (open@CERN), github (@CERN).
  5. documentation (and publications) -> wiki.
  6. budget if any? n/a.
  7. next meetings -> IPM workshop @ GSI in the fall.

March 3/4

- C. Identification of program modules:
  1. Double differential cross section (some work done)
     - remark: in some cases – heave ion hitting light target gas – DDCS for ions may also be needed
  2. rest gas dynamics (gas jet, thermal motion, RF heating of the gas) -> for the future.
  3. external E and B fields (uniform fields, importing field maps)
  4. beam field (gaussian beams, nongaussian beams, multiple bunches for ions, boundary conditions)
     - remark (Rob&Chris): but time dependence of the beam field is important in our monitors. i.e. when the space charge field is present and when it is not. How important the precise tail off of space charge is on the beam profile has not yet been ascertained here, but is an area of future interest for us.
  5. additional transient fields (wakefields)
  6. tracking of electrons/ions
  7. MCP -> J-Parc interested / Channeltron -> ISIS / Semiconductor detector simulation modules -> CERN
  8. electron background (e-Cloud)
  9. impact of bunch field on cross-section (Stark effect)
  10. rest gas ionization by synchrotron radiation
  11. ultra-relativistic: radiative losses

March 3/4

- **D. Definition of interfaces between modules and to other programs (eg. FEM solvers)**
  - Module: Ionisation creater (double differential cross).
  - Module: Static electric & magnetic fields (IPM field cage).
  - Module: Dynamic electric & magnetic fields (space charge fields).
  - Module: Charged particle tracking.

- **E. Other tasks**
  1. Comparison of various codes (benchmarking).
  2. Code validation experiments.
  3. Correction algorithms.
  4. Theoretical calculations (Giuliano) and comparison with codes results.
  5. Impact on the beam.

March 3/4

- F. Common statement/plan document (MoU)

Additional remarks

- Rob&Chris:
  1. we're interested in the detector performance for different ion species, different gas pressures, beam energies etc.
  2. but the precise range of applicability of the code is important to define. Are we modelling from the precise beam dynamics to the profile as observed on the computer monitor in the control room including all the gas interactions, detector performance, electronics etc?
  3. that validation of the code against theory is not enough, comparison against other (destructive) profile measurements is necessary to truly be confident of the monitor's performance.

code	implementation	tracking	benchmarks	remarks
GSI	C++	E, B	None.	Bugs in the code (to be corrected), uniform external fields. Tracking 3D.Need to correct relativisitic part. Add Gaussian space charge dstn.
pyECLOUD	python	E, B	c.f. SPS/LHC IPM data; Not conclusive.	Uniform ex fields, relativistic.
FNAL	matlab	E, B	None.	Free space boundary conditions. 3D tracking.
ESS	matlab	E, B	Started c.f. Kenichiro's code.	Free space boundary conditions. 3D tracking.
CEA	C++	E, ions	Correction of beam profile; Nice results at 90keV.	Round DC beam. Lorentz solver for E-field.
ISIS	C++	E	Correction of beam profile; Good in range 70 MeV - 800 MeV; beam sizes & intensities.	Assumes DC beam. Import CST electric fields.
Kenichiro	python	E, B	c.f. pyECLOUD; Good agreement.	Field maps (CST/poisson), relativisitc beam. 3D tracking. Will soon introduce analytical gaussian beam.

Ideas

- Plotting-tracking module (for studies or eg. nonuniform fields)
- Another space charge correction coeffcient