Reported by Alexander Huschauer and Magdalena Anna Kowalska

Sabrina Appel, Space Charge Solver in pyORBIT compared to those in PATRIC and Madx

Ji Qiang: Which boundary conditions of Poisson solver are used? à open

Simone: Has a comparison between linear and non-linear lattice already been done? à It is planned to include also non-linearities (especially for the case of the SIS18/100). However, this is not yet included.

Discussion session (chaired by Simone):

Simone: Are the CERN demands sufficiently clear to all the collaborators, do we clearly explain the problems we are facing or is there anything not clear to the community?

Are the required technicalities clear to the community (mechanical offsets, magnetic error tables, correct implementation of linear and non-linear chromaticities, time varying RF- and B-fields, RF gymnastics, combined function magnets, . . .

Concerning the benchmarking process: what's next?

à Jeff Holmes has not yet done the last step of the benchmarking (it is planned for this summer), James Amundson remarked that the benchmarking is basically done for Synergia.

Simone: Could we think of benchmarking the codes vs a given experiment? Should we prepare one explicitly specified experiment in a given machine (or several experiments in different machines as the lattices of the different CERN machines are now available in the different codes) to afterwards make the data available and use it for benchmarking? E.g., we could think of continuing with the PS case, namely using the measurements done together with Giuliano at the PS (which can so far only be simulated using a frozen model). However, this case concerns a 4D resonance - should we rather choose a 2D resonance, where the effect on the beam distribution is be faster? At CERN we are very flexible to measure any experiment we decide on, and we could choose between PSB, PS and SPS.

à Elena remarked that the case of the PSB would be interesting due to the fast dynamics of the machine. It would also be easily possible to create a measurement plateau at a given energy. The multipoles in the PSB are now available with new power supplies.

à Hannes added that one should look at fast phenomena if we want to use PIC codes. Furthermore he mentioned that using the SPS might also be a good choice, as control of chromaticity is possible, octupoles are available, . . .

à James stressed that the complexity of the lattice (its number of elements) is more important than the number of turns to be simulated, as the number of elements determines the speed of the simulation.

à Simone added that simulating a case during acceleration might be complex, as not every code is able to treat acceleration yet (such as MADX-FSC) and that it is important to decide on which resonance we would like to use for the benchmarking.

à Jeff mentioned that he is in favor of experiments for benchmarking.

à James reminded that one has to well choose a certain problem and to clearly define the parameters of interest.

à Simone added that the general advantage of the CERN machines is their availability and the possibility to study many different cases. Additionally, one should always choose the appropriate code for a given problem (i.e., PTC-Orbit in the presented PSB experiment, MADX-FSC in the PS)

It was agreed to continue this discussion during the second discussion session on the next day.

Raymond: To which extent can we profit from the parallelization implemented in PTC-Orbit? Would using 1024 processors instead of 48 be beneficial?

à Jeff replied that PTC-Orbit so far only runs on clusters with moderate size. However, electron cloud simulations run on the NERSC cluster, but the EC model is a special module, which is parallelized itself.

à According to Raymond one can profit from the NERSC cluster, because of its faster processor speed. However, it appears that already at 48 cores the speed of PTC-Orbit saturates.

à James added that Synergia can be used with 10E5 processors. However, this is used for a carefully prepared and studied case, it is always important to adapt the simulation to the specific needs in order to improve the speed.

à Ji mentioned that scalability laws are often not very useful.

à According to James Synergia is set up to benefit from many processors and, therefore, many particles can be used in the simulations. In the case of Synergia running more particles scales well.

Simone: Should we make a list of codes generally available listing their actual capabilities? Possibly on the website of the Space Charge Study Group?

The Excel sheet prepared by Simone will be available for download in the material section of his talk in the morning.

à Elena asked to include also a column for multi-harmonics, which is equally important for the PSB and the PS.

à Simone added that for Batch Compression in the PS it is required to use different harmonics with varying phase.

Ji: What is the peculiarity of a multi-harmonic system, does one just have to add an additional term to the Hamiltonian?

à James replied that it is indeed only an additional term.

Shinji Machida: The benchmarking done with Synergia appears to agree well to MICROMAP, SIMPSONS and MADX-FSC. Therefore, there is no significant difference between PIC and FSC codes in this case.

à James concluded that for this special case FSC is easier to use and produces very good results. However, even though this is a very long simulation the noise does not destroy the results.

à Ji asked how it is possible that the physics between the two different approaches agrees?

à James suggested that one should check whether the beam becomes significantly non-Gaussian during the simulation.