Minutes of the ABP Computing Working Group meeting

24th May 2017

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The grace period for migration to HTCondor is over, 90% of resources have been physically moved to HTCondor (10% on LSF available until end of 2017), from now on it is expected that users have successfully moved to HTCondor to launch their batch jobs. The HPC at the CNAF (Bologna) for CERN is almost ready to be used. First tests will be carried out by the present users of the other cluster (Gianni, Annalisa), and then next in the line are the users of space charge simulations in order to carry out as soon as possible the 'acceptance' test mentioned in the collaboration agreement (based on PyORBIT). As soon as these first tests are successfully carried out, the LSF groups can be created and all interested users will be able to launch jobs on this cluster. A meeting for Octave users (few thousands users, 5-10 developers working at the same time, with J. Eaton being the main author) was organized at CERN under the suggestion of A. Latina (slides). This was done in collaboration with the IT department (which provided the support of J. Evans and M. Gaillard). Since Octave is considered as a possible free alternative to Matlab, this subject is of interest of IT. Usually Octave scripts can work directly in Matlab (if they do not use specific toolkits), while the opposite is not true because the language in Octave is richer. About 30-40 people attended all the sessions (out of the 86 registered). The timetable was set up together with the Octave developers and can be looked up in the slides. Users come quite diverse fields. Octave will be possibly also taught at CERN through training courses to promote its use use instead of Matlab. About 600 people have Octave installed on their Windows machines at CERN.

The development of the RF-Track code was driven by the TULIP project (high gradient proton linac for medical applications). For this linac, which uses S-band backward travelling-wave accelerating structures with an initial β of 0.38, a multi-dimension optimization process for its transmission with different levels of RF power, field strength, etc. was needed based on a flexible and fast tool. RF-Track has many features: it tracks different types of particles from $\beta \ll 1$ to ultrarelativistic, can handle arbitrary electromagnetic field maps, implements high-order integration algorithms. It is a C++ library originally conceived as parallel. It runs multi-core, i.e. it can use as many cores as available on the machine on which it runs but it cannot run on different machines. It makes use of GSL and FFTW. Since both Octave and Python offer powerful toolboxes for numerical experimentation, e.g. multidimensional optimisations, fitting routines, data analysis, control tools, etc. RF-Track can be easily loaded from both. Input and output files have standard formats (ASCII, binary, HDF5, DST) The beam can be propagated in space (along the longitudinal coordinate of the accelerator, s) or in time. Several integration algorithms for the equations of motion are implemented (e.g. leapfrog, explicit GSL, implicit GSL, analytical when possible). The elements through which the beam can be propagated are RF structures, static field regions, quadrupoles and drifts. When propagating through 3D field maps of magnetic and electric fields, it is first made sure that the provided maps are divergence free or curl free, respectively, or else they are corrected to be such. Though this code was originally intended only for low intensity proton linacs, it has been later extended to simulate ion sources and rings. Space charge is included in the calculation (from whatever mixture of particles is being tracked) and also the interaction with an electron cooler (electrons are not macroparticles, but the interaction of each ion or antiproton with a ‘fluid’ of electrons is described) or with another counter-propagating beam (beam-beam). Examples of applications for CERN machines include the Pb ion source, the Linac4 RFQ, the electron cooling in LEIR, tracking of electrons and protons in the AWAKE beam lines. The code is presently being documented and will be improved to include indirect space charge, intra-beam scattering, etc. The typical duration of simulations is few minutes to half an hour for linac, source, RFQ, while it takes up to 16 hours to track 10e5 particles with e-cooling over 10e5 turns.

Due to the ABP Group meeting + BBQ on Thursday 8 June, the next meeting will also take place on a Wednesday (7 June) in Room 6-R-012. The CET code for luminosity optimization will be presented by Tom Mertens.