

Minutes of the Virtual Simulation Leaders

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Recorder: F.Carminati

DRAFT

Garfield report (R.Veenhof)

Meetings:

- RD51 participation in the INSTR14 conference, Novosibirsk [Feb 2014]
- collaborating meeting scheduled in Kolkata, to be combined with an open workshop and a lecture programme for local students [Oct 2014]
- regular "mini weeks" and collaboration meetings at CERN
- lecture programme planned in Van and Bursa [spring]

Activities:

- gain measurements with a view to extracting the excitation energy transfer probability (in collaboration with AGH Warszawa) now completed for most common gas mixtures
- collaboration with Aveiro and Coimbra starting to measure ion mobility and diffusion, in particular for mixtures relevant for experiments that require low ion back-flow

FLUKA report (A.Ferrari for the FLUKA collaboration)

- An intense activity is going on in improving the Phojet/Dpmjet event generator, embedded in Fluka, carried out mostly by a PhD supervised (CERN side) by myself and (KIT Karlsruhe side) by R. Engel. Comparisons with ATLAS and ALICE results at 7 TeV centre-of-mass already show significant improvements with respect to the standard version (which was not too bad anyway). This first batch of improvements is already in production for all CERN accelerator and RP calculations
- Several improvements in the nuclear interactions models have been developed, in particular for (virtual) photonuclear interactions and more in general for initial spin/parity dependent calculations in Fermi break-up. The BME model has been extended down to mass 3 projectiles (3-H and 3-He)
- The Electro Magnetic Dissociation model has been further improved and finally the paper describing the model, the benchmarking, and its application to LHC has been published in PRSTAB where it has been named one of the highlights of the February issue

- A complete built-in model for synchrotron radiation emission on a generic string of magnets has been developed accounting fully for energy, angle and polarization distribution of the emitted radiation. The need arose for calculations for TLep, aka FCCee, which we started in 2013
- The Flair graphical interface has been further improved and expanded. Thanks to the interface and the features implemented in the last years in the code, Fluka is now very user-friendly to the point that more and more universities are using it as a teaching tool in graduate and post-graduate courses. I would like to remind that everything from building the geometry, debugging it, assigning materials, scoring, thresholds, spawning the run on how many CPU's are available, collecting, analysing and plotting the results can be done through Flair on the screen with a few clicks, with no programming or file editing required
- Some (very) preliminary work on GPU use has been performed. A simple test case (porting on GPU's the random number generator) has demonstrated large speed gain factors for that part, and allowed to gain some useful experience.
- The CERN Fluka team, presently 6 staffs and 10-12 fellows, PhD's, PA's, is as usual engaged in a variety of problems/projects spanning the whole list of present and future CERN accelerators.
- Calculations for FCChh and FCCee have already started
- Medical applications of the code are expanding very quickly. In the framework of the ENVISION and ENTERVISION EU programs, where I am the CERN responsible person for the simulation work package, nice developments have been demonstrated towards the possibility of producing accurate predictions for beta+ isotope production and prompt photon emission by therapeutic proton and ion beams
- The number of registered Fluka users since 2005 grew to ~7000. The latest respin Fluka2011.2b.5 has been released on February 3rd 2014, and a new respin will follow next week. A new major release is planned for the second half of 2014
- A beginner Fluka course took place in Dresden in October 2013, the next course (again a beginner one) will take place in May 2013 in Thessaloniki. A special mini course/tutorial will take place at the request of the organizers at the annual meeting of the UK Monte Carlo community, MCNEG14, April 2014 in Liverpool
- The Collaboration membership grew up to 78 members, representing 23 different Institutions all around the world
- The triennial elections for the Fluka Scientific Committee took place at the end of 2013: the newly elected members are A.Mairani, M.Pelliccioni, L.Pinsky, S.Roesler, V.Vlachoudis, who are joining the ex-officio members for a three year mandate. I shall continue as the Collaboration and FSC coordinator.

Geant 4 report (G.Cosmo and W.Pokorsky for the Geant4 collaboration)

Releases:

- The new major release Geant4-10.0 was announced on December 4th as planned. It introduces the ability to efficiently perform event-level parallelism on multi-threaded (MT) capable hardware. Builds can either be done in sequential or MT mode (choice to be made at installation time), compatible with the API defined in previous releases for the sequential mode. This allows for easier transition/porting of the user's code to the new release. A sequential application can still build and run without changes in API with an MT-enabled Geant4 build.

Full event reproducibility is guaranteed in release 10.0, with exact numerical reproduction of events in MT-mode vs. sequential mode. Excellent linear scalability of performance up to a very large number of threads $O(100)$ has been measured on different hardware systems, with memory footprint reduction (footprint varying from 30 to 50 MB/thread depending on the application), and additional gain in event throughput when running in hyper-threading mode on capable hardware.

On the physics side, release 10.0 includes several improvements and extensions in Bertini Cascade (improved two-body final-state angular distributions for nucleon-nucleon and gamma-nucleon collisions; improved the phase-space generation for multi-body final states; added the capability to handle muon capture) and Fritiof/FTF (improvements to hadron-nucleon diffraction dissociation; extended to handle nucleus-nucleus collisions and model re-tuning with enlarged set of thin-target data) models. Production of isomers (long-lived meta-stable nuclides) is enabled by default. Obsolete CHIPS and LEP/HEP models and codes have been completely removed. Improvements in neutron capture, low-energy neutron and inelastic cross-sections. Improvements are in particular expected in the reproduction of hadronic showers when using the FTFP_BERT physics lists.

High-precision neutron data are now provided in compressed form, reducing considerably the size of the G4NDL library.

For EM physics, PAI ionisation models have been reviewed and improved, in particular for the tail delta-electron production spectra for incident electrons. An interface to angular generator is added for the majority of ionisation models and the magnetic monopole ionisation model has been upgraded for very non-relativistic cases. New micro-d0simetry models for ionisation in silicon based on dielectric functions computation are added. The Urban multiple-scattering model has unified and upgraded to the latest version.

Use of fast math functions for log/exp/pow in critical areas of EM processes, bringing about 5% overall CPU speedup.

The AIDA Unified Solids classes are made available in release 10.0 as an optional component, allowing the possibility to replace the standard geometrical primitives as choice at installation time; a limited number of shapes are available, in particular an optimised version of the polycone shape with improved CPU performance. The obsolete BREPs module has been removed. Also, new UI commands for overlaps checks are provided, now based on the built-in generation of random points on solids' surfaces. Release 10.0 also comes with a new framework for physics-based biasing,

based on wrapper and helper classes, and a new module for low-temperature "phonon" physics.

- A new patch release 10.0.p01 was also made available last February. The detailed list of fixes included can be found in the release notes:
<http://cern.ch/geant4/support/Patch4.10.0-1.txt>
- A set of fixes back-ported from release 10.0 have been collected in a new patch to the release 9.6 series, release 9.6.p03, announced on March 20th. The detailed list of fixes included can be found here:
<http://cern.ch/geant4/support/Patch4.9.6-3.txt>

Development:

- The new development plan for Geant4 in 2014 is now available and can be accessed from the Geant4 web site:
http://cern.ch/geant4/support/planned_features.shtml

Courses:

- A series of lectures on Geant4 have been given at the first European School of Instrumentation in Particle & Astroparticle Physics (ESIPAP) which was held from January to March at the Archamps Tecnopole near Geneva.
- A Geant4 tutorial has been held at Stanford University on March 3-6th. Attendees were about 65. There have also been invited talks from Google, Nvidia and Colfax. Google was also presenting Gooda, the Google performance monitoring tool, where Geant4 is being used as test bench.
- A Geant4 course for beginners has taken place at Queen's University in Belfast on January 20-24th, organised by INFN.
- Another tutorial was given at the University of Tokyo on December 17-19th, where a large audience (about 100 attendees) has participated.
- A Geant4 course for graduate students is being organised at Lund on April 7-11th.
- The 2nd MIPEGE Geant4 course for graduate students (plus few invited from various Institutes) will happen on May 19-23rd at Orsay.
- A Geant4 course will also be held at the 11th Seminar for Nuclear, Sub-nuclear and Applied Physics organised near Alghero in Italy by INFN on May 26-30th.
- The GSSI (Gran Sasso Science Institute) is also organising a Geant4 course on May 12-20 for graduate students.
- The American Nuclear Society requested a one-day short course in November 2014 at their Winter Meeting.

Meetings:

- The development plan for 2014 has been presented and reviewed at the last Geant4 Technical Forum held at CERN on March 20th.

- The 10th Geant4 Space Users Workshop will take place at NASA/MSFC in Huntsville, Alabama on May 27-29th.

The LPCC workshop:

On 18-19 March 2014, the second LPCC Detector Simulation Workshop was held at CERN. The agenda is available here:

<https://indico.cern.ch/conferenceDisplay.py?ovw=True&confId=279530>

The goal of the Workshop was to update the assessment of the status of LHC detector simulations, including the validation against data, the definition of the future needs for analysis work and for upgrade R&D studies, and the progress in the development of the tools.

Two important problems, related to electromagnetic physics, have been solved directly by the experiments, without need of changes in Geant4: the Geant4 simulation of the ALICE TPC; the simulation of the impact parameter distribution in LHCb.

Another two important problems, related to Geant4 electromagnetic physics, have seen some progress, although not yet a complete solution, which means that further work is needed by both Geant4 and by the experiments: the tails of the $Z \rightarrow ee$ lineshape; and the lateral electron shower shape.

Related to hadronic physics, there is a general satisfaction, although there is a strong need of more validation studies, in particular with test-beam data, and with recent versions of Geant4 (≥ 9.6).

The changes in lateral hadronic showers that have been reported by the developers, based on simplified calorimeters, still need to be confirmed by data.

For the visible energy, an important issue to be investigated by ATLAS is the determination of the coefficients of the Birks quenching in scintillators. For the Geant4 developers, the main focus will be on energy resolution, which seems to be underestimated at high energies.

Good agreement between Fluka and Geant4 (with neutron HP) has been reported by ATLAS on cavern radiation background; moreover, CMS has reported preliminary good agreement between Geant4 HP and the much faster XS approach.

Regarding the Geant4 versions of interest for Run 2, it seems that G4 9.6 will be used in at least two cases (ATLAS and LHCb), whereas for G4 10, there is general interest to study further its multi-threaded capabilities, and could be also used for production in Run 2 (by CMS and maybe ALICE).

The date for the next, third LPCC Detector Workshop has not yet been decided; however, it has been agreed to have half-day topical meetings, roughly once per year, on dedicated topics of interest related to Geant4 simulations.