R3B simulations overview

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on behalf of the R3B Simulation and Data Analysis Working Group
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Simulation tools:
- R3BRoot:
  - News on R3BRoot implementation.
- R3BSim (still?): detector-related simulations.

Detector specifics:
- NeuLAND / LAND (scintillator / RPC options, prototypes / full size).
- CALIFA / DH CrystalBall.
- Silicon Tracker.
- Trackers (DCH, GFI), ToF (ToF, mToF, iToF), ancillary detectors...

Final considerations.
R3BRoot: simulation code for R3B

R3BRoot is a FairRoot based program:

- Common data structure and geometry used in simulation and reconstruction.
- G3, G4, (FLUKA) available under a common MC transport user.
- External generators: UrQMD, Pluto, Pythia, DPM, evtGen, external event files (ascii), …
- High modularity: detectors in folders and loading only specific libraries.
- Macros available for running ALADIN/LAND or R3B setups (macros/r3bsim.C).
R3BRoot: administration/services

- SVN repository + TRAC.
- CMake: automatic makefiles.
- Doxygen documentation.
- CDash. CTest automation.
- Grid computing.
R3BRoot: general improvements (D. Bertini)

- GLAD and ALADIN fields map. Full CATIA description for GLAD. A second-order polynomial fit of $B_{\text{Max}} = f(I_c)$ is used to rescale the $B(x,y,z)$ value of the closest measure field map.

- New DCH Digitizer with a more general tracking algorithm.

- Multiple connection of databases:
  - Using ROOT TSQLServer (MySQL, OCI8 Oracle drivers).
  - Priority ordered list of Database.
  - Validation mechanism build-in.
  - Type of connection configured at runtime.
  - Also suited for geometrical description of detectors.
NeuLand: different solutions tested in simulation

Analysis of two different approaches:

- **Scintillator-based detector** (M. Heil GSI, simulations on R3BRoot-geant3):
  - A thickness of 2 m of pure plastic (cube of 2 m) would provide better efficiency for low energy neutrons and superior multi-hit recognition.

- **RPC-based detector**:
  - *Detector response simulation* (Z. Elekes FZD, M. Cherciu, M. Potlog ISS).
    - Tests with 175, 500, 1000 MeV neutrons.
    - Protons kinetic energy and deposited energy in gas cells (also according to SRIM).
    - Charge induced and avalanche propagation included in the model.
    - Comparison with ELBE data.
    - Transmission line based on the telegraph equation for loss-less transmission lines.
    - Successful comparison of efficiency and charge distribution in previous examples.
    - Promising results in (geometrical) cross-talk minimization and matching description.
NeuLand: scintillator-based solution simulation

$E_n = 600\text{MeV}$

M. Heil, GSI.
**NeuLand: RPC-based solution simulation**

**Results:** induced charge in the gas cells for the interactions (NeuLandPoints) close enough to be seen as one event.

Total induced charge in strips available for hit pattern studies.

Ongoing work:
- Find thresholds for total induced charge comparing with ELBE data (e- beam).
- Compare with Upssala data (neutron beam @175MeV) applying these thresholds.

Energy loss of secondary protons. In agreement with SRIM.
CALIFA: calorimeter simulation videoconference (06/04/10)

PROGRAM

- Welcome and introduction (H. Alvarez, USC)
- Geant Simulations for the LUND R3B Prototype (D. DiJulio, LUND)
- Simulating light collection (P. Díaz, USC)
- Simulations of the CALIFA prototypes (A. Henriques, D. Galaviz, Lisbon)
- Endcap Design for the CALIFA calorimeter (J. Sánchez, C. Cruz, A. Perea, O. Tengblad, IEM Madrid)
- Introducing CALIFA v7 in R3BRoot (H. Alvarez, USC)
- Simulations for EXL (H. Moeini, KVI-Univ. Groningen)
- Discussion. Next work.

All talks available in the web address:

http://fpsalmon.usc.es/r3b/videoConf060410/index.shtml
CALIFA: geant4 simulations for R3B prototypes experiments

Experimental setup at Uppsala have been used for validating the simulations:

- 180 MeV protons collimated at crystals (beam spot ~40mm²);
- two different CALIFA prototypes, with two 1mm thick DSSSDs;
- energy resolution for 178.2MeV protons below 1%, follows 5.5/E^{1/2} law.
CALIFA: simulating light collection

Study of light properties in the CALIFA crystals with Geant4:
- Detailed characterization of the optical processes (Unified model).
- Results for different polished and diffuse surfaces, different parameters, evaluation of light output in each case.

- Energy spectra obtained from optical properties:
  - Energy resolution as an statistical effect (662 keV).
  - Different resolution obtained by broadening the statistical distribution of generated photons.

Ongoing work:
- Fix parameters according to our crystals features.
- Optimization of light-guiding part of the crystal.
- LITRANI, BPM approx. under study (IEM-Madrid).

Scintillation yield: 54000/Mev
Resolution scale: 5
Peak resolution: 6%
CALIFA in R3BRoot: v4.0b, v7 ("a" and "b") and DH-XB

- CALIFA STEP files v7.05, v7.07 from CIMA, Univ. Vigo.
- Geometry generated by perl scripts; easy configuration. Wrapping and carbon fiber thicknesses selected by the user before compilation.
- Similar behavior to Geant4 standalone application.
- New candidate geometries for the phoswitch EndCap from IEM-CSIC Madrid.

- Ongoing work on DH Crystal-Ball
Silicon tracker

Silicon tracker in R3BRoot... (previous talk by N. Ashwood Univ. Birmingham)

• Polar angle studies vs. tracker pitch. 2 or 3 barrel layers?
• Energy resolution studies / validation with experimental data.
• Combined tracker + CALIFA simulations requested.

Also from UK contribution (M. Labiche, Daresbury):

• (p,2p) generator available from L. Chulkov (readable using FairASCIIGenerator).
• Cosmics event generator implemented in R3BRoot (calibration algorithms, tests, ...).
R3BRoot: GLAD complete geometry
R3BRoot: cave C setup
We need to improve in several important aspects:

- How we coordinate the work? Mailing lists, forums, meetings...
- What tools people need? What information? Courses for developers...
- Procedures for quality code control, code conventions, CDash/CTest macros, ...