

MC-INFN

LNS activity in 2014 and plan for 2015

MC-INFN: motivation and configuration

- GEANT4 and FLUKA experiments closed in 2010
 - The new wider MC-INFN started in 2011
 - Main news: “cold fusion” of GEANT4 and FLUKA
- Not a merge of the two toolkits!
..... but a *common space to share experiences, ideas,*
- Exploit the INFN experience in the Monte Carlo field in a common project
 - *development and maintenance of the GEANT4 and FLUKA codes and some applications in different fields* (huge activity in medical applications)
- 6 INFN Sections: LNS, ISS, PG, MI, PV.DTZ, BO
 - Possible entry of **FE** for 2015 (Geant4)
 - Both for the GEANT4 and FLUKA sub-groups, some components are active official members of the respective international collaboration
 - Common activity in dissemination
 - One or two general meetings per year; two GEANT4 specific
 - National (Co)-Responsibles: **Luciano Pandola** (LNS), **Paola Sala** (Mi)
 - Local LNS Responsible: **G.A.P. Cirrone (F. Romano since July 2014)**

LNS contributions

- Coordination, code development and test activities in the ***Advanced Examples*** WP of GEANT4
 - L. Pandola (coordinator), F. Romano (deputy). P. Cirrone coordinator up to Feb14
 - Three examples (medical physics) under the direct responsibility of the LNS group: hadrontherapy, gammaknife, iort_therapy
- Development activity in the ***Low Energy Electromagnetic Physics*** WG
 - L. Pandola (deputy coordinator of the WG)
 - Development and maintenance of the physics models based on Penelope
 - Implementation of the general classes for the LET calculation in the Geant4 kernel (under discussion)
- Validation of physics models of Geant4
 - Physics validation, mainly in a framework of medical applications
 - Electromagnetic models (Penelope, bremsstrahlung), hadronic (fragmentation, nuclear inelastic)
- User support, dissemination, website maintenance and coordination
 - Collaboration with ELI, coordination with radiobiology groups for LET/RBE data

MC-INFN: LNS activity in 2014

- Advanced Example WG :
 - 😊 – Migration of examples to native analysis tools (> 50%)
 - 😊 – Migration of examples to multi-thread (> 50%)
 - 😊 – Coordination of the activities, system testing shifts
- Maintenance and development of the *Hadrontherapy* example
 - 😊 – Implementation of LEM-interface for RBE calculations
 - 😐 • Test and debug of the LEM II and III
 - 😊 – Test of a prototype version of interface with the Geant4-DNA models for the computation of RBE
 - 🙁 – Simulation of transport line for protons with active beam scanning
 - 😐 – Merge of "Full" internal version of *Hadrontherapy* released in the GEANT4 public release (currently on-demand)
- Maintenance of the Gamma Knife example (released in Dec 2012)
- Upgrade and validation ELIMED transport beam line simulation

MC-INFN: LNS activity in 2014 (..cont)

- Low Energy WG :
 - 😊 – Development, validation and optimization of the low-energy physics models based on Penelope
 - 😊 – Maintainance and possible bug-fix of the Penelope and Livermore low-energy models. Monitoring of computational performance and improvement of code quality
 - 😐 – Implementation of the classes for the RBE computation in the kernel of Geant4 (low-energy library)
- Validation of physics models, especially for medical physics
 - 😊 – EM models (bremsstrahlung)
 - 😊 – Hadronic models (fragmentation, nuclear interactions)
 - 😊 – Collaboration for research teams in radiobiology for the measurement of cell survival rates after irradiation by protons and C ions (validation of LET/RBE computation)
- User support and dissemination
 - 😊 – Training courses
 - 😐 – Maintainance of the national website
 - 😊 – Collaboration with the Praga group for the simulation of the ELIMED experiment

Talks and papers 01/2014 - today

- Papers and proceedings

- S. Tropea et al., "Measurement of Fragment Production Cross Sections in ^{12}C - ^{12}C and ^{12}C - ^{197}Au Reactions at 62 A MeV for Hadrontherapy and Space Radiation Protection", *Acta Phys. Pol B* 45 (2014) 565
- F. Romano et al., "A Monte Carlo study for the calculation of the average linear energy transfer (LET) distributions for a clinical proton beam line and a radiobiological carbon ion beam line"
Phys. Med. Biol. 59 (2014) 2863-2882.
- V. Scuderi et al., Development of an energy selector system for laser driven proton beam applications
NIMA 740 (2014) 87-93

- Presentations given at international conferences

- L. Pandola, ICCMSE2014 (Athens), April 2014

Courses and theses 01/2014 - today

- Four GEANT4 international courses:
 - “*Geant4 beginners course*”, Belfast (UK), January 2014
 - “*Geant4 course*”, GSSI (Italy), May 2014
 - “*XI Seminar on Software for Nuclear, Subnuclear and Applied Physics*” Alghero (Italy), May 2014
 - “*Monte Carlo Course*”, TRISEP2014, SNOLAB, Canada, June 2014
- Support to other projects requiring GEANT4 simulations:
TPS, MIMO_BRAGG, RADIOSTEM, ELIMED, ESA-Biorad

MC-INFN: external collaborations

- FZU (Prague) and Queen's University (Belfast), for ELIMED simulations
- IBFM-CNR-LATO (Palermo) for DICOM interface and advanced examples developments
- For LET simulations in radiobiological experiments:
 - Università di Napoli
 - ISS (Roma)
 - INFN-LNL, Legnaro
 - Vinca Institute, Belgrade
 - Queen's University, Belfast
- INFN Sezione di Torino, for radiobiological modelling
- ESA project, for GEANT4-DNA simulations

MC-INFN: milestones 2014

- Giugno 2014: release di Geant4 contenente eventuali correzioni e bug fix sui modelli elettromagnetici Penelope e/o sugli advanced examples, nella modalità multi-thread → **100%**
- Giugno 2014: completamento della migrazione dei moduli di analisi degli advanced examples all'interfaccia g4analysis nativa → **90%**
- Giugno 2014: confronto dei modelli di interazione nucleare inelastica con dati su target spessi tessuto-equivalenti. → **100 %**

- Dicembre 2014: sottomissione a rivista di un articolo globale della Collaborazione Geant4 → **on track**
- Dicembre 2014: migrazione nella doppia modalità (sequenziale e multi-thread) di almeno il 50% degli advanced examples di Geant4 →**on track (actually done)**
- Dicembre 2014: test e debug dei modelli radiobiologici tramite l' applicazione *Hadrontherapy* come use-case → **on track**
- Dicembre 2014: inclusione delle classi per la simulazione dell' esperimento ELIMED nella versione pubblica di *Hadrontherapy* e confronto degli output con dati acquisiti nelle facility laser → **on track**

MC-INFN: LNS planned activity in 2015

- Advanced Example activity at Collaboration level
 - Coordination, code migration and improvement
- Low-energy EM activity at Collaboration level
 - Maintenance, development and debug of the Penelope models
 - Maintenance and bug fix of Livermore models, code quality iteration
 - RBE modeling as a Geant4 kernel class (LowEn package)
- Validation activity at Collaboration level
 - Electromagnetic and hadronic physics
- Maintenance and development of the *Hadrontherapy* ex.
 - Use-case of LET and RBE classes (cont'd)
 - Inclusion of the whole transport beamline ELIMED simulation in the public version
- Maintenance and development of the *GammaKnife* ex.
- Complete simulation of the ELIMED beam line
 - transport beam line and diagnostic/dosimetry detectors
 - simulation of alternative procedures for treatment planning
- User support, dissemination, website maintenance and coordination activity

Participants and financial req. (2014)

Candiano Giacomo	50%	associato
Cirrone G.A. Pablo	15% (+15% UE-ESAAO17146)	dipendente
D'Urso Davide	50%	associato
Favetta Marco	30%	associato
Licciardello Tiziana	20%	associato
Pandola Luciano	30%	dipendente
Pisciotta Pietro	50%	associato
Romano Francesco	0% (+100% UE-ESAAO17146)	dipendente
Russo Giorgio	60%	associato
Sabini Maria Gabriella	20%	associato
Sardina Daniele	50%	associato
Schillaci Francesco	30%	associato
Stancampiano Concetta	50%	associato
Tramontana Antonella	30%	associato
Varisano Annagrazia	80%	associato

TOTAL 5.7 FTE (+ 1.15) = 6.85

2014

Nat./int. travels (MC-INFN meetings, Collaboration Workshop, Release of the code) (*) Conferenza ICCMSE su invito (L. Pandola)	35.0 k€ + 1.5 k€ (*)	20 k€ + 1.5 k€
Inventory	6.0 k	Anticipati al 2013

Participants and financial req. (2015)

Preliminary

Candiano Giacomo	50%	associato
Cirrone G.A. Pablo	15% (+15% UE-ESAAO17146)	dipendente
D'Urso Davide	50%	associato
Licciardello Tiziana	20%	associato
Pandola Luciano	30%	dipendente
Romano Francesco	0% (+100% UE-ESAAO17146)	dipendente
Russo Giorgio	60%	associato
Sabini Maria Gabriella	20%	associato
Schillaci Francesco	30%	associato
Stancampiano Concetta	50%	associato
Tramontana Antonella	30%	associato

TOTAL 3.55 FTE (+ 1.15) = 4.70

2015

Nat./int. travels

(MC-INFN meetings, Collaboration Workshop,
Release of the code)

25.0 k€