

# **MC-INFN**

**LNS activity in 2015 and plan for 2016**

# 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)
- 7 INFN Sections: **LNS**, **ISS**, **PG**, **MI**, **PV.DTZ**, **FE.DTZ**, **RM2.DTZ**
- 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: **L. Pandola**

# LNS contributions

- Coordination, code development and test activities in the *Advanced Examples* WP of GEANT4
  - L. Pandola (coordinator), F. Romano (deputy).
  - 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 2015

- Advanced examples WG :

- 😊 – general coordination of the working group "Advanced Examples" of Geant4
- 😊 – Migration of more tests and advanced examples to the Multi-Thread mode, also as a benchmark of Geant4 10.1
- 😐 – Code review to better profit of the MT functionality in the Geant4 Advanced Examples (which were all designed to be run in sequential mode)
- 😐 – Maintenance and development of the *Hadrontherapy* example
  - Implementation (in the local version) of the most recent LEM models
  - Feasibility study for the coupling of the specific Geant4-DNA models in Hadrontherapy
- 😊 • Upgrade of the class for the simulation of the ELIMED beam line. Implement a realistic version of the beam line elements
  - Porting of the most recent developments (RBE calculations, ELIMED beam line) into the public version of Hadrontherapy (ready-for-release)
- 😐 – Maintenance and development of the *gamma\_knife* example
  - Improve computational performance in MT mode

# MC-INFN: LNS activity in 2015 (..cont)

- Low Energy WG :

-  – Development, validation and optimization of the low-energy EM models based on the Penelope Monte Carlo code
-  – Maintenance and bug-fix of the specific EM models based on Penelope and Livermore. Code maintenance, fix of Coverity defects, improvement of computational performance, also in MT mode
-  – Regular monitoring of the performance (results + CPU time) of the EM models with benchmark applications
-  – Calculation of DSB (double strand break) by using the models provided by the Geant4-DNA category. Feasibility study of an interface to calculate the final RBE from the output provided by Geant4-DNA
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- User support and dissemination
  -  – Training courses
  -  – Maintenance of the national website
  -  – Collaboration with the Praga group for the simulation of the ELIMED experiment
  -  – Collaboration with research groups in radiobiology for the modeling (tailored to Monte Carlo applications) of the cell survival rate after irradiation with protons and carbon ions.

# 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 2015

- Giugno 2015: release di Geant4 contenente eventuali correzioni e bug fix sui modelli elet-tromagnetici Penelope e/o sugli advanced examples, nella modalità multi-thread. → **100%**

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- Dicembre 2015:: migrazione nella doppia modalità (sequenziale e multi-thread) di tutti gli advanced examples di Geant4 e dei tests sotto responsabilità del gruppo → **on track**
- Dicembre 2015: implementazione in Hadrontherapy della linea ELIMED completa, inclusi i rivelatori per la dosimetria e le differenti configurazioni iniziali di input. Primi calcoli preliminari per lo shielding a diverse energie. → **on track**
- Dicembre 2015: Completamento dell'interfaccia del LEM in Hadrontherapy anche per i recenti modelli LEM e coupling preliminare con output dei modelli Geant4-DNA → **to be started**

# MC-INFN: LNS planned activity in 2016

- 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'ed)
  - Inclusion of the whole transport beamline ELIMED simulation in the public version
- Maintenance and development of the *Gamma\_knife* ex.
- Deliver simulation of the ELIMED beam line  
User support, dissemination, website maintenance and coordination activity



# Participants and financial req. (2015)

		Ricercatori				
	Nome	Età	Contratto	Qualifica	Aff.	%
1	Candiano Giacomo		Associato	Specializzando	CSN V	50
2	Cirrone Giuseppe	+20% PP-IRPT	Dipendente	Ricercatore	CSN V	20
3	D'Urso Davide		Associato	Specializzando	CSN V	50
4	Licciardello Tiziana		Associato	Specializzando	CSN V	30
5	Pandola Luciano		Dipendente	Ricercatore	CSN II	30
6	Pisciotta Pietro		Associato	Laureato	CSN V	70
7	Raffaele Luigi		Associato	Dirigente Fisico I livello	CSN V	50
8	Russo Giorgio		Associato	Ricercatore	CSN V	30
9	Sabini Maria Gabriella		Associato	Dirigente di Ricerca	CSN V	60
10	Salamone Vincenzo		Associato	Ricercatore	CSN V	50
11	Schillaci Francesco		Associato	Ricercatore	CSN V	60
12	Scuderi Valentina		Associato	Borsista Post doct.	CSN III	20
13	Valastro Lucia Maria		Associato	Dirigente di Ricerca	CSN V	50
Numero Totale Ricercatori					13	FTE: 5.7

**TOTAL 5.7 FTE (+ 0.20) = 5.9 FTE**

**2015**

## Nat./int. travels

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

25.0 k€

**20 k€(\*)**

**(\*) Global for all Geant4 groups (total request: 44 k€)**

# Participants and financial req. (2016)

## Preliminary

Similar number of FTE expected for 2016 (between 5 and 6 FTE)

<b>Nat./int. travels</b> (MC-INFN meetings, Collaboration Workshop, Release of the code)	25.0 k€
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