New EM developments

Summary of Parallel 1A
(https://indico.cern.ch/event/1307331/sessions/502113/)

X-Ray reflection process – Helmut Burkhardt

X-Ray reflection process

Ideas as presented in the **59th Geant4 Technical Forum on April 6**

implementation strategy further discussed with

Vladimir Ivantchenko, Mihaly Novak and Gerardo Ganis

basic implementation concepts and naming for new process

discussed and agreed in the **EM physics meeting in June**

electromagnetic/xrays/src/G4XrayReflection.cc, hh   G4EmProcessSubType

extend TestEm16 (Synchr.Rad.) to test X-Ray reflection

GetMeanFreePath   calling Reflectivity routine providing value between 0 and

PostStepDoIt   reflect on surface

Acknowledgement, advice on modeling

Roberto Kersevan, Marton Ady / CERN and G4 collaborators Daren Sa

Strong motivation :   FCC-ee studies, with in particular FCC-MDI Ma

TestEm16, TestReflection scan in angle

```
/testem/det/GeomFile  Box_1m_Cu.gdml
/gun/energy 10 keV
/analysis/h1/set 4 100 0 0.01005      # histogram for angle scan
# angle=5e-05
/gun/position  0  2.49999999895833e-05 -0.499999999375 m
/gun/direction 0 -4.99999999791667e-05 0.99999999875
/run/beamOn 1000
# angle=0.00015
/gun/position  0  7.499999971875e-05 -0.499999994375 m
/gun/direction 0 -0.0001499999994375 0.99999998875
/run/beamOn 1000
```
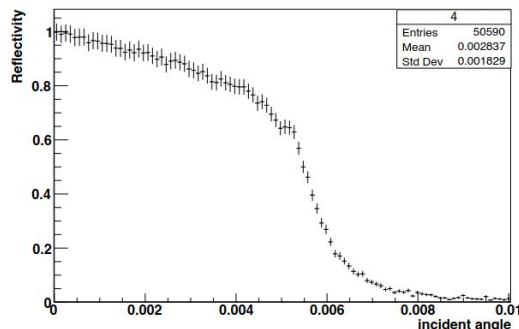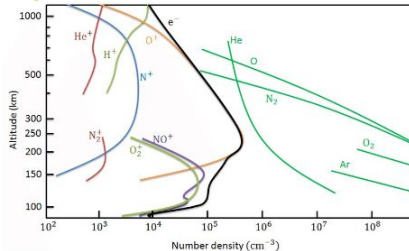
/testem/phys/SetXrayReflectionRoughness 5 nm
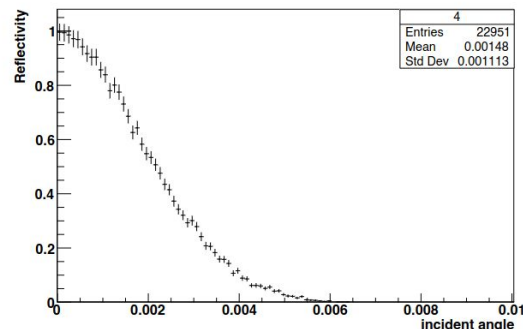
Development of new low energy EM models to describe ionisation in the atmosphere – Francesca Nicolanti
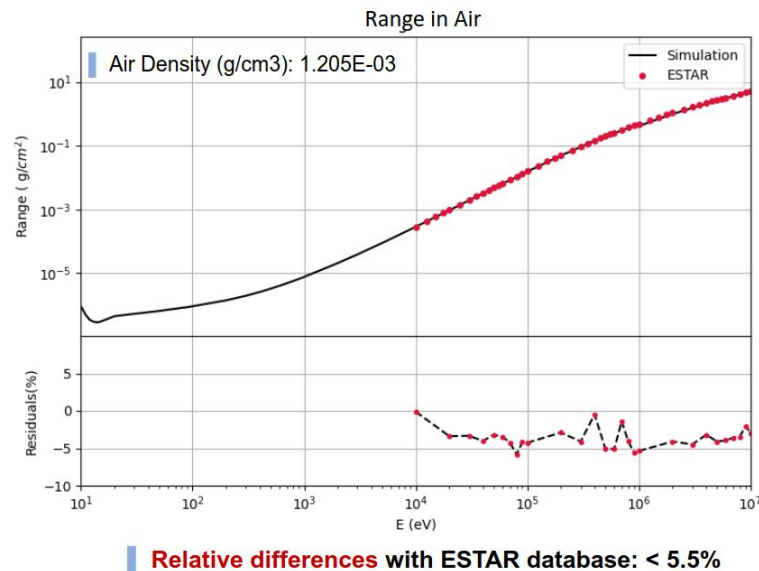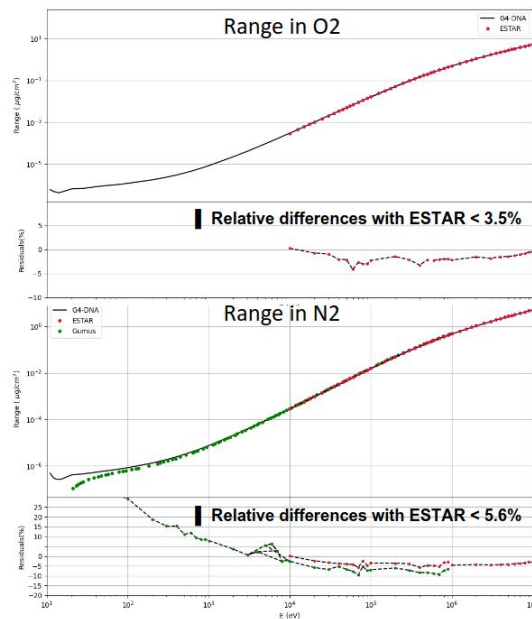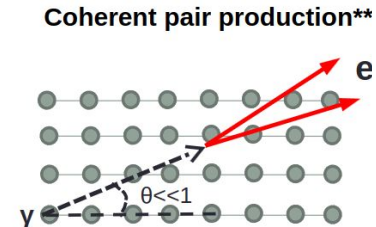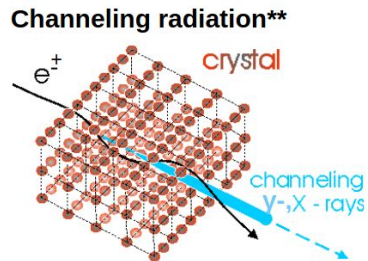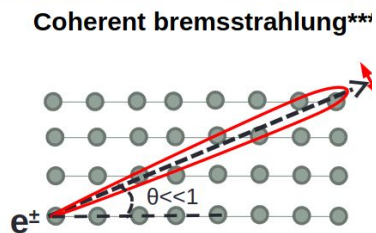
Geant4 channeling and Baier-Katkov models and their applications in accelerator physics, particle physics and space science – Alexei Sytov

The idea: MC simulations of coherent effects in a crystal

Channeling*

θ_{L0}

Channeling

Channeling radiation**

crystal

e^+

channeling γ-, X - rays

Coherent bremsstrahlung***

$e^\pm$ — θ<<1

Coherent pair production**

γ — θ<<1 — e

*J. Stark, Zs. Phys. 13, 973–977 (1912); J. A. Davies, J. Friesen, J. D. McIntyre, Can J. Chem. 38, 1526–1
**M.A. Kumakhov, Phys. Lett. A 57(1), 17–18 (1976)
***B. Ferretti, Nuovo Cimento 7, 118 (1950); M. Ter-Mikaelian, Sov. Phys. JETP 25, 296 (1953).
**** H. Uberall, Phys. Rev. 103, 1055 (1956).

First simulations with Geant4 channeling model: beam deflection by a bent crystal
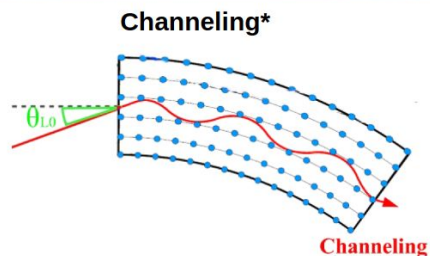
855 MeV electrons   15 μm thick bent crystal

θ_L
θ_L

VR

volume reflection (VR)

Channeling

Geant simulations vs experiment

— channeling, data
— channeling, Geant4
— VR, data
— VR, Geant4

channeling

θ_x [μrad]

Counts (normalized)

*A. Sytov et al. JKPS 83, 132–139 (2023)

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Activities and EM developments at LNS Catania – Pablo Cirrone

Group presentation

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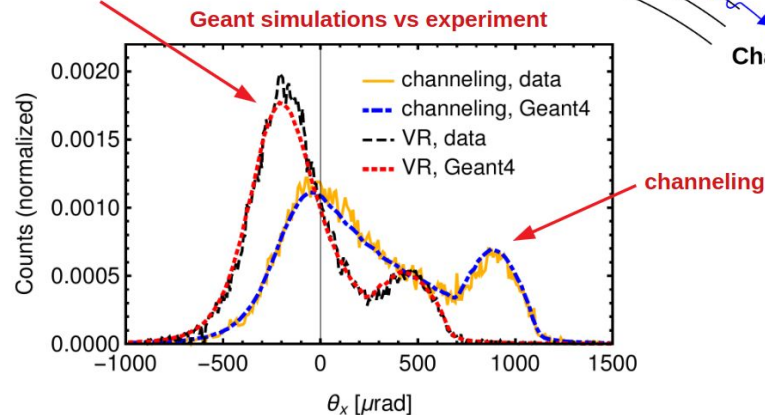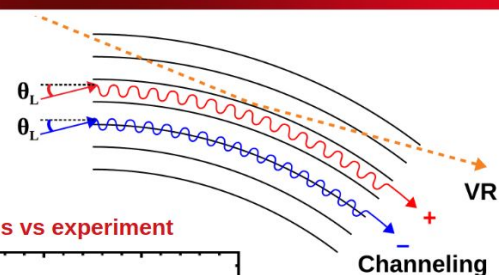
INFN-LNS group is active **since 2002**

G.A.Pablo Cirrone: responsible for "hadrontherapy" and "radiobiolo...
examples
pablo.cirrone@lns.infn.it

Serena Fattori: contact person for UHDR simulations in Geant4-DNA...
Geant4-DNA tutorials (chem6)
serena.fattori@lns.infn.it

Alberto Sciuto: machine learning development in Geant4 / Geant4-D...
alberto.sciuto@lns.infn.it

Giada Petringa: LET/RBE simulations vs. microdosimetric data
giada.petringa@lns.infn.it

Luciano Pandola: Coordination of the EM Working Group; Maintena...
bug fix of Penelope; STT shifts; Evolution Task Force
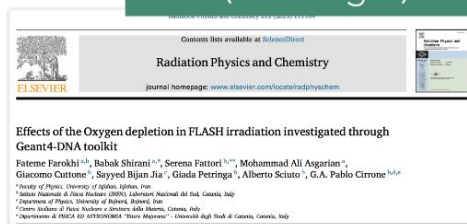luciano.pandola@lns.infn.it

A **new post-doc** will join the group on November 2023

G4DNA activities: chemical side

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Oxygen depletion studies with Geant4-DNA: Geant4-DNA (scavenger) compared to TRAX-CHEM

Radiation Physics and Chemistry
journal homepage: www.elsevier.com/locate/radphyschem

Effects of the Oxygen depletion in FLASH irradiation investigated through Geant4-DNA toolkit

Fateme Farokhi [a,b], Babak Shirani [b,*], Serena Fattori [b,**], Mohammad Ali Asgarian [a], Giacomo Cuttone [b], Sayyed Bijan Jia [c], Giada Petringa [b], Alberto Sciuto [b], G.A. Pablo Cirrone [b,d,e]

[a] Faculty of Physics, University of Isfahan, Isfahan, Iran
[b] Istituto Nazionale di Fisica Nucleare (INFN), Laboratori Nazionali del Sud, Catania, Italy
[c] Department of Physics, University of Bojnord, Bojnord, Iran
[d] Centro Siciliano di Fisica Nucleare e Struttura della Materia, Catania, Italy
[e] Dipartimento di FISICA ED ASTRONOMIA "Ettore Majorana" - Università degli Studi di Catania, Catania, Italy

Radiotherapy and Oncology
journal homepage: www.thegreenjournal.com

Original Article

May oxygen depletion explain the FLASH effect? A chemical track structure analysis

Daria Boscolo [a], Emanuele Scifoni [b], Marco Durante [a,c,*], Michael Krämer [a], Martina C. Fuss [a]
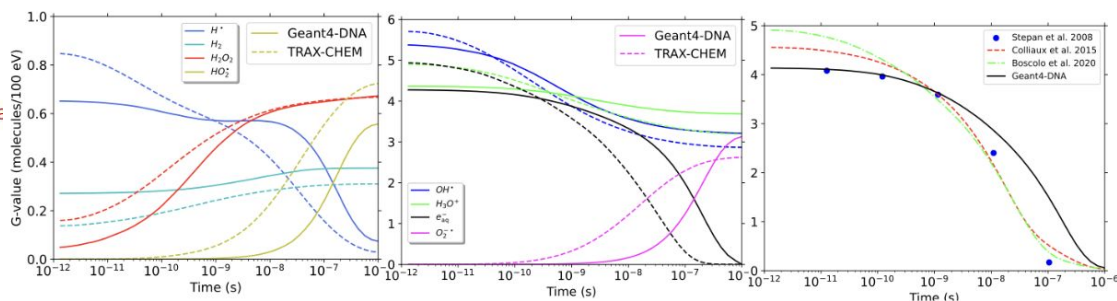
(2023) doi.org/10.1016/j.radphyschem.2023.111184

G-values of different radiolitic species after **proton and electron irradiation**.
--> Study of the **oxygen depletion** hypothesis in comparison with TRAX-CHEM

Discussion on EM bug reports and problems – Vladimir Ivantchenko

Bugzilla bug ...

- The state of the problem:
  - Green – responsible perso...
  - Red – responsible person ...
  - Blue – responsible person ...

- 2543 (V. Ivanchenko) Muon/...
  - Compared to 10.7 pair cro...
  - This is due to the default ...
  - User feedback is needed t...

- 2542 (V. Ivanchenko) Particle...
  - This is a continuation of cl...
  - Should be fixed in 11.1.p0...
  - User feedback pending to ...

- 2532 (V. Ivanchenko) Position...
  - Code of the Lindhard-Sore...
  - Several validations were p...
  - Conclusion at this worksho...

- 2524 (V.Ivanchenko) Ionisatio...
  - Likely problem of user – to...
  - Any volunteer to address/...

Geant4 Forum

- Many tanks to Geant4 members who actively participate is discussion with users
  - Susanna Guatelli, Daren Sawkey, Mike Kelsey, Hoang Tran, Michel Maire
  - There are many requests from novice users
    - Often incorrect questions, when user do not understand basic things
    - We may have a hint how to improve our documentation
  - Sometimes indeed a real problem is raised
    - Sometimes a new requirement to Geant4 may be formulated
- For today there are ~5 EM questions in the Forum without answers