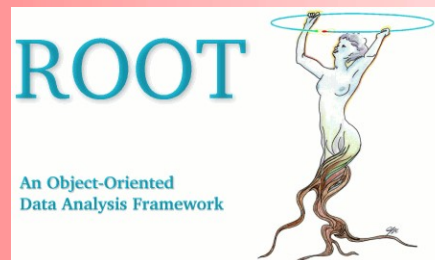
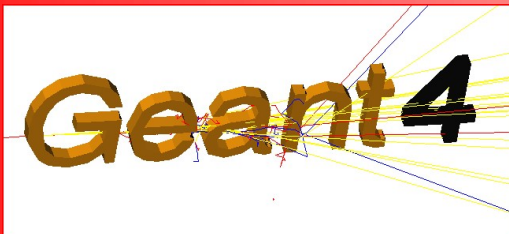


Nuovo Corso – Laurea Magistrale in Fisica & Laurea
Magistrale in Astrofisica e Fisica dello Spazio

Simulazione Montecarlo di rivelatori di particelle

Docenti

Prof. G Gorini, Dr. G. Croci, Dr. A Muraro



Modalità del corso

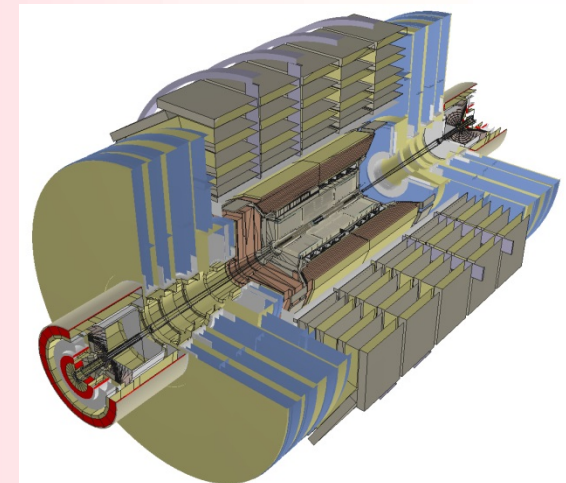
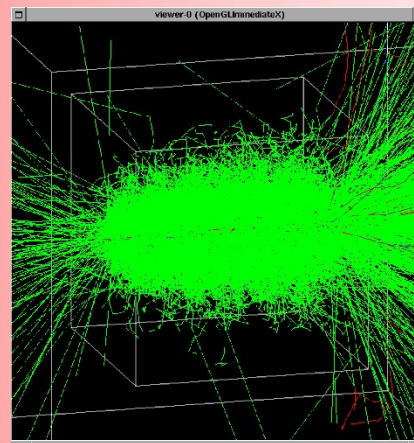
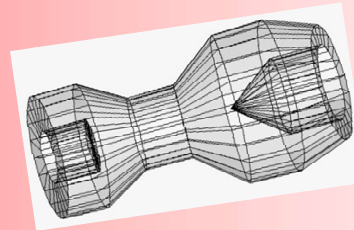
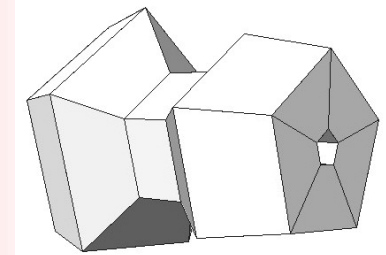
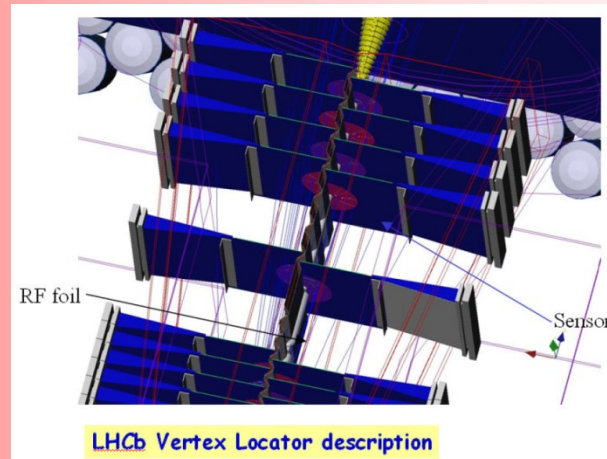
- Corso in modalità **Blended-Learning** (lezioni frontali + sessioni di laboratorio + **parte on-line**)
 - Sito: <http://elearning.unimib.it/course/view.php?id=7156>
 - Necessaria l'iscrizione
 - Sul sito saranno presenti
 - Slides mostrate a lezione con materiale integrativo
 - Registrazione delle lezioni in presenza
 - Quiz per autovalutazione per ogni argomento
 - Esercizi per ogni argomento
 - Argomenti divisi per settimane (in base al programma svolto a lezione)
 - I docenti saranno disponibili via chat per periodi pre-determinati per aiutare a svolgere gli esercizi (di simulazione numerica)
 - Lo studente lavora da casa «come se fosse in laboratorio informatico»
 - Possibilità di web-conference
- **Esame**
 - Necessario risolvere un esercizio per argomento (tra quelli proposti)
 - Redazione relazione scritta su uno degli esercizi svolti
 - Orale verte sulla relazione più domande di carattere generale

Programma Schematico

- Interazione radiazione/materia
- Funzionamento rivelatori di radiazione (in particolare a gas)
- Simulazione MC di rivelatori con Geant4 + analisi dati utilizzando Root
- Simulazione MC di rivelatori a gas usando Garfield++ e metodi di calcolo ad elementi finiti (F.E.M finite elements methods)
- Simulazione completa utilizzando Geant4+Garfield++
- Sessione di laboratorio per misure con rivelatori a gas (GEM gas electron multiplier) per confronto dati reali/simulazione
- Macchina virtuale fornita agli studenti con G4 e garfield già funzionanti (il link si trova sul sito)

Geant4

- Detector simulation tool-kit from HEP
- Full functionality: detector geometry, tracking, physics, I/O
- Offers alternatives, allows for tailoring
- Based on Object Oriented programming (c++)
- Requirements from:
 - current and future HEP experiments
 - medical and space science applications
- World-wide collaboration
- ROOT used to analyze data

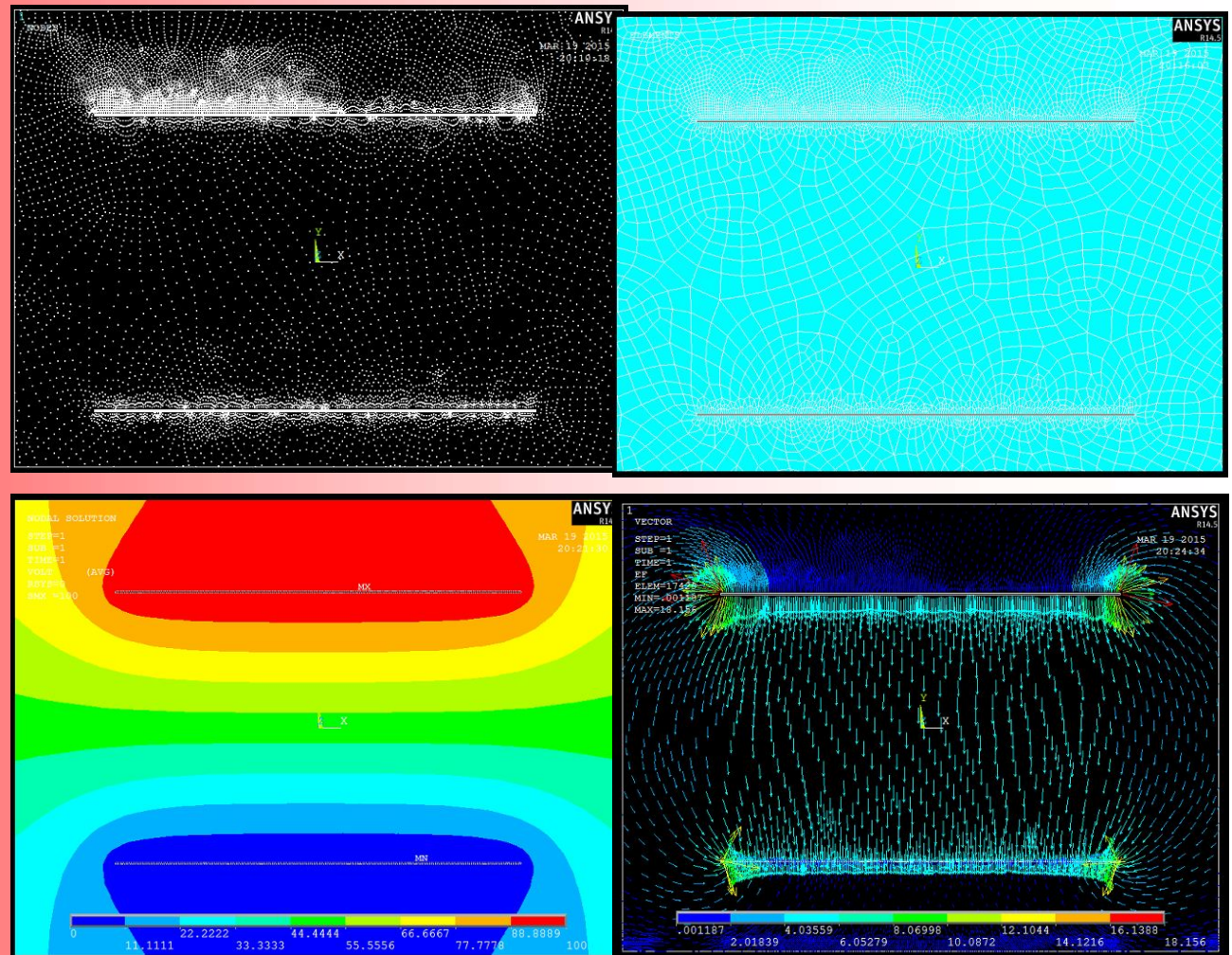


VERY POWERFULL TOOL FOR DETECTOR SIMULATIONS

CAN HANDLE ANY TYPE OF PARTICLE (NEUTRAL AND CHARGED)

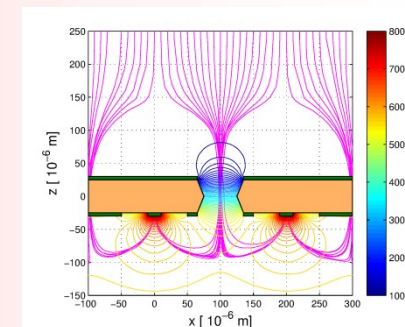
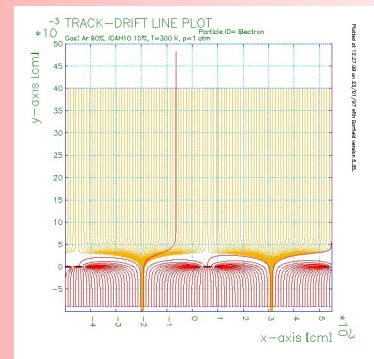
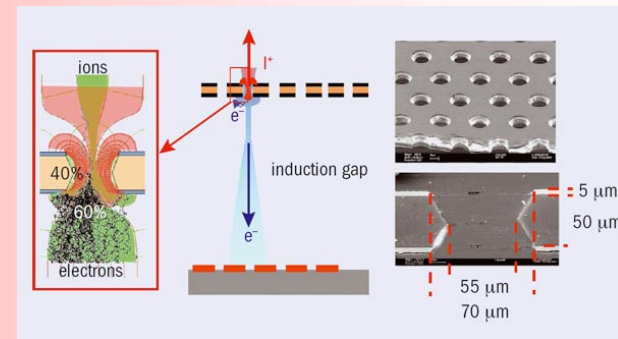
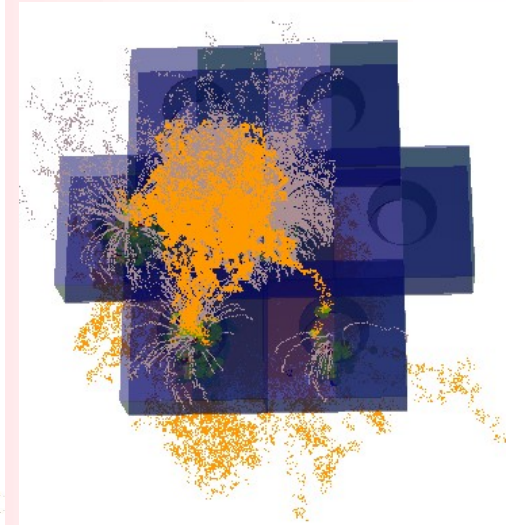
FEM simulation software: ANSYS

- Programma di Calcolo ad elementi Finiti (F.E.M)
- In generale è un programma «Multiphysics»
 - Analisi meccaniche
 - Analisi di fluidi
 - Analisi EM
- Nel corso verrà per analisi elettrostatiche
- Software non-free



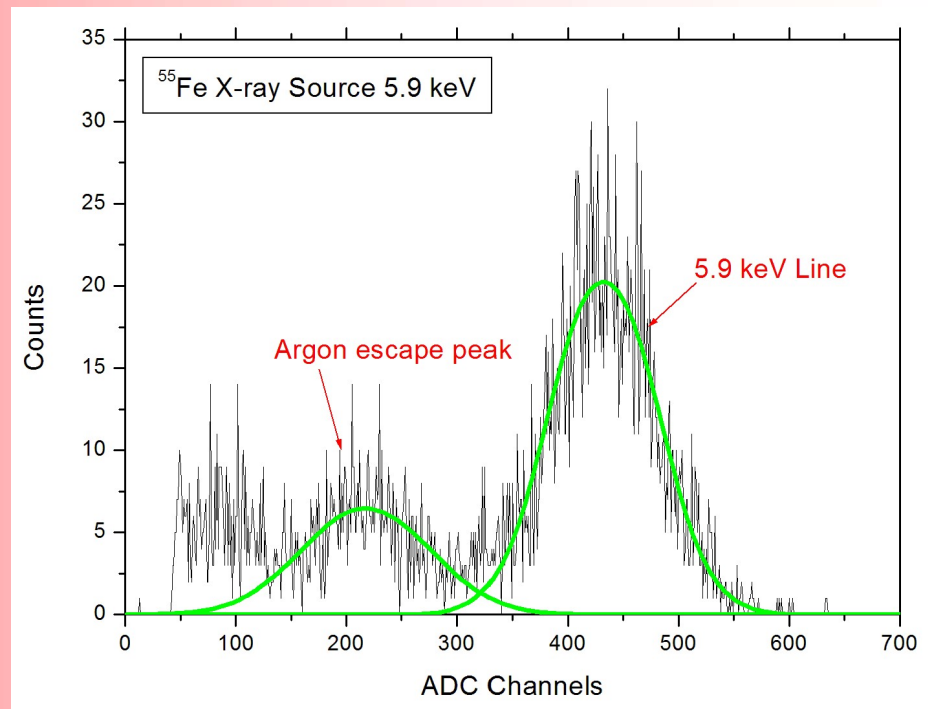
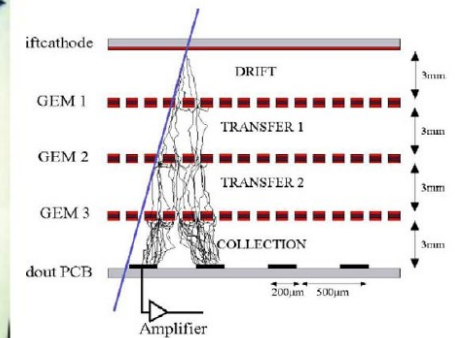
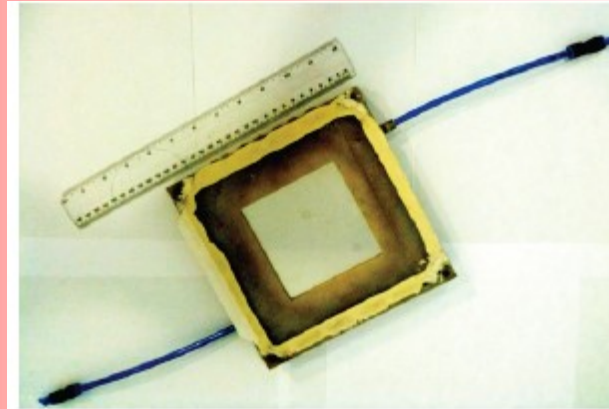
Garfield++

- MC Program used for the simulation of gas based detectors from Multi-wire proportional chamber to Micropattern gaseous detector. Recently also simulation of silicon devices has been introduced
- Describes transport of electron and ions in gas (interface with Magboltz)
- Needs a FEM program for the calculation of field maps
- Describes the signal generated on the read-out anode
- Widely used by the MPGD community
- CERN based collaboration (RD51)
- Interface with Geant4
- Based on OO c++ programming



Laboratory Session on GEM based detectors

- Measurement with a Triple GEM detector prototype and an X-Rays source (^{55}Fe)
 - Measurement of PH spectrum
 - Measurement of Gas Gain
- Analogic read-out system
- Use different Ar/Co₂ gas mixtures
- You will be able to compare the simulation results with the real data



Libri di Testo

- **Glenn F. Knoll, Radiation Detection and Measurement, John Wiley & Sons Inc**
- **F. Sauli, Gaseous Radiation Detectors: Fundamentals and Applications, Cambridge Monographs on Particle Physics, Nuclear Physics and Cosmology,**
- **Geant-4 Guide for Application Developer**
<http://geant4.web.cern.ch/geant4/UserDocumentation/UsersGuides/ForApplicationDeveloper/fo/BookForAppliDev.pdf>
- **Garfield++ Manual**
<http://garfieldpp.web.cern.ch/garfieldpp/documentation/UserGuide.pdf>
- **Ansys web-site : <http://www.ansys.com>**