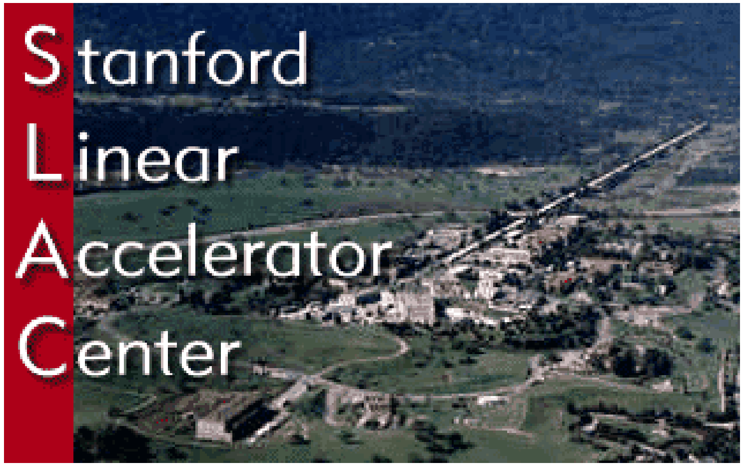



# Introduction to Geant4

Makoto Asai (SLAC Computing Services)

Geant4 Tutorial Course @ DESY

September 30th, 2003

# Contents

- General introduction and brief history
- Highlights of user applications
- Geant4 kernel
  - Basic concepts and kernel structure
  - User classes
- Geant4 user support processes

# General introduction and brief history

# What is Geant4?

- Geant4 is the successor of GEANT3, the world-standard toolkit for HEP detector simulation.
- Geant4 is one of the first successful attempt to re-design a major package of HEP software for the next generation of experiments using an Object-Oriented environment.
- A variety of requirements also came from heavy ion physics, CP violation physics, cosmic ray physics, astrophysics, space science and medical applications.
- In order to meet such requirements, a large degree of functionality and flexibility are provided.
- G4 is not only for HEP but goes well beyond that.

# Flexibility of Geant4

- In order to meet wide variety of requirements from various application fields, a large degree of functionality and flexibility are provided.
- Geant4 has many types of geometrical descriptions to describe most complicated and realistic geometries
  - CSG, BREP, Boolean
  - STEP compliant
  - XML interface
- Everything is open to the user
  - Choice of physics processes/models
  - Choice of GUI/Visualization/persistency/histogramming technologies

# Physics in Geant4

- It is rather unrealistic to develop a uniform physics model to cover wide variety of particles and/or wide energy range.
- Much wider coverage of physics comes from mixture of theory-driven, parameterized, and empirical formulae. Thanks to polymorphism mechanism, both cross-sections and models (final state generation) can be combined in arbitrary manners into one particular process.
  - Standard EM processes
  - Low energy EM processes
  - Hadronic processes
  - Photon/lepton-hadron processes
  - Optical photon processes
  - Decay processes
  - Shower parameterization
  - Event biasing technique

# Physics in Geant4

- Each cross-section table or physics model (final state generation) has its own applicable energy range. Combining more than one tables / models, one physics process can have enough coverage of energy range for wide variety of simulation applications.
- Geant4 provides sets of alternative physics models so that the user can freely choose appropriate models according to the type of his/her application.
- Several individual universities / physicists groups are contributing their physics models to Geant4. Given the modular structure of Geant4, developers of each physics model are well recognized and credited.

# Geant4 – Its history and future

- Dec ′94 - Project start
- Apr ′97 - First alpha release
- Jul ′98 - First beta release
- Dec ′98 - Geant4 0.0 release
- Jul ′99 - Geant4 0.1 release
- ...
- Jun ′03 - Geant4 5.2 release
- Dec ′03 - Geant4 6.0 release (planned)
- We currently provide two to three public releases and beta releases bimonthly in between public releases every year.

# Geant4 Collaboration

Stanford Linear Accelerator Center

HARP

CERN IT/API – Applications for Physics & Infrastructure

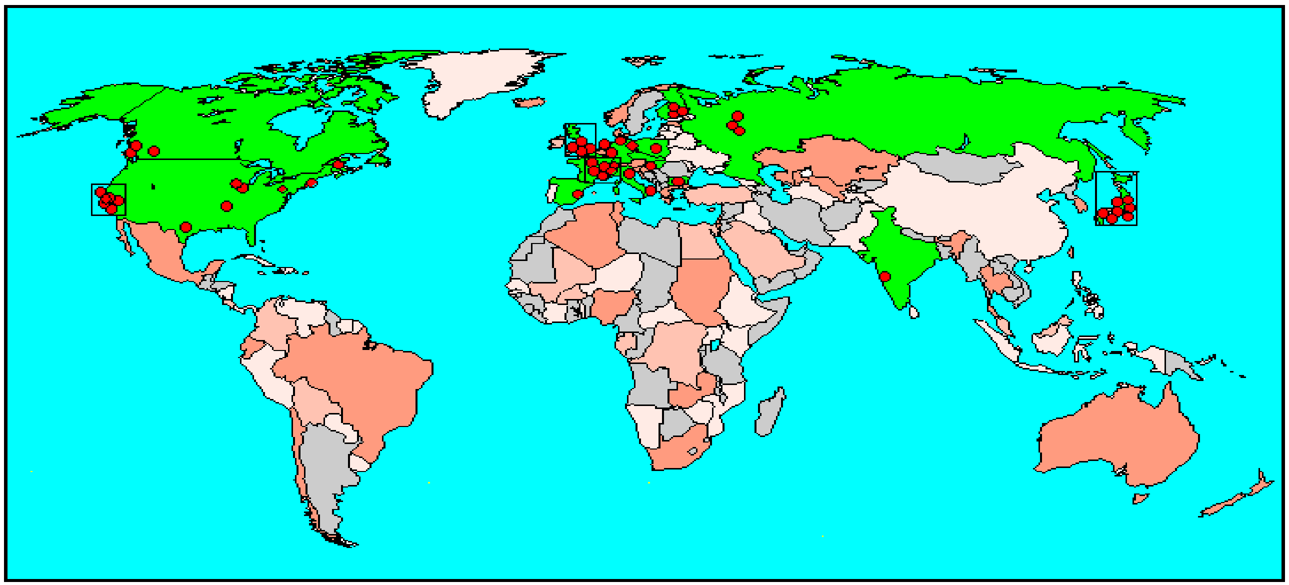
KEK

esa

BaBar

ATLAS

TERA – Fondazione per Adroterapia Oncologica



CMS

INFN – ISTITUTO NAZIONALE DI FISICA NUCLEARE

Российская Академия Наук Физический Институт имени П.Н.Лебедева ФИАН

Lebedev

LHCb

IN2P3

Univ. Barcelona

PPARC

Helsinki Inst. Ph.

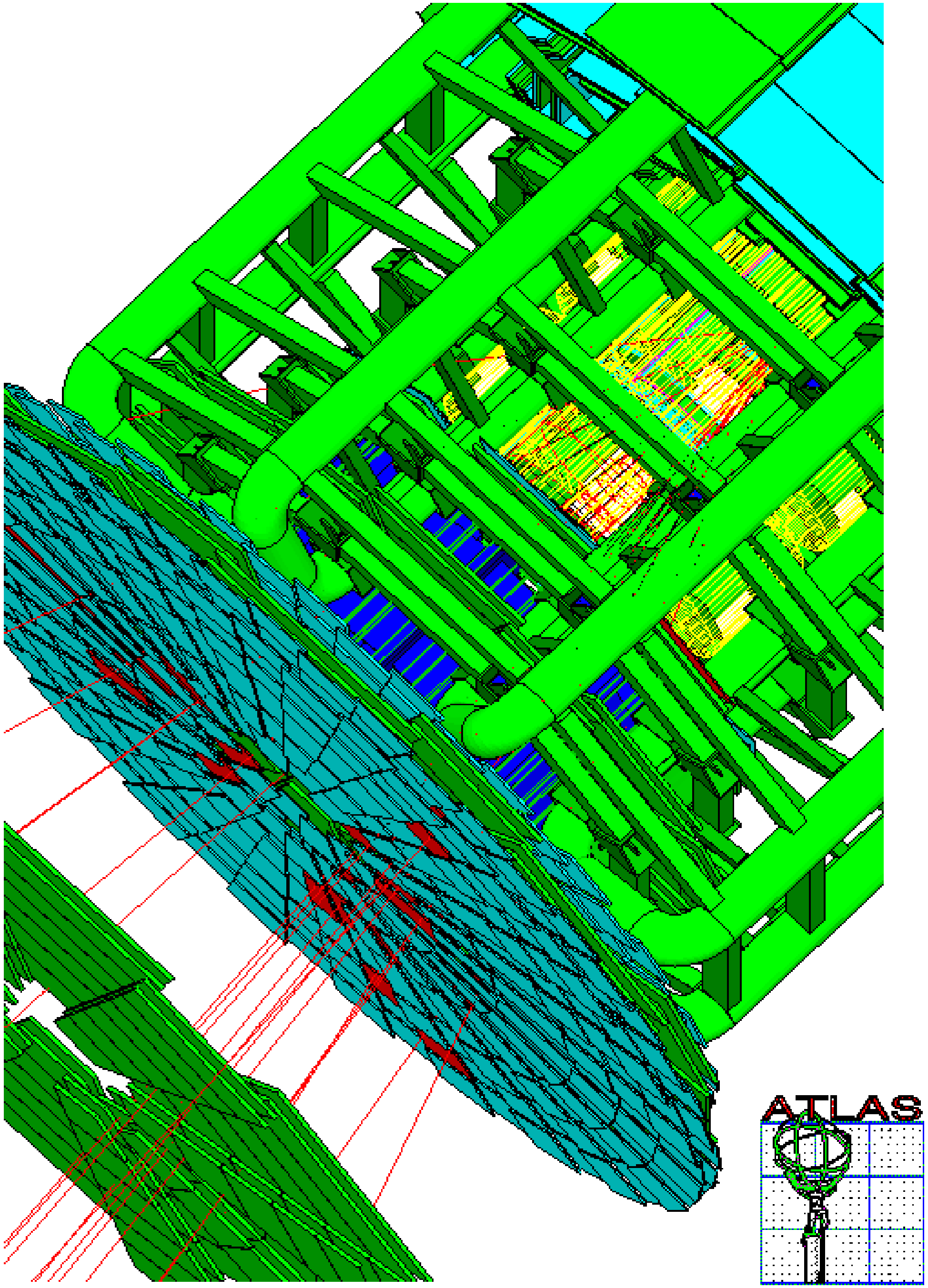
Jefferson Lab

Collaborators also from non-member institutions, including
Budker Inst. of Physics
IHEP Protvino
MEPHI Moscow
Pittsburg University

# Highlights of Users Applications

# Geant4 in HEP

- ATLAS (CERN-LHC)
- 22 x 22 x 44 $m^3$
- 15,000 ton
- 4 million channels
- 40 MHz readout

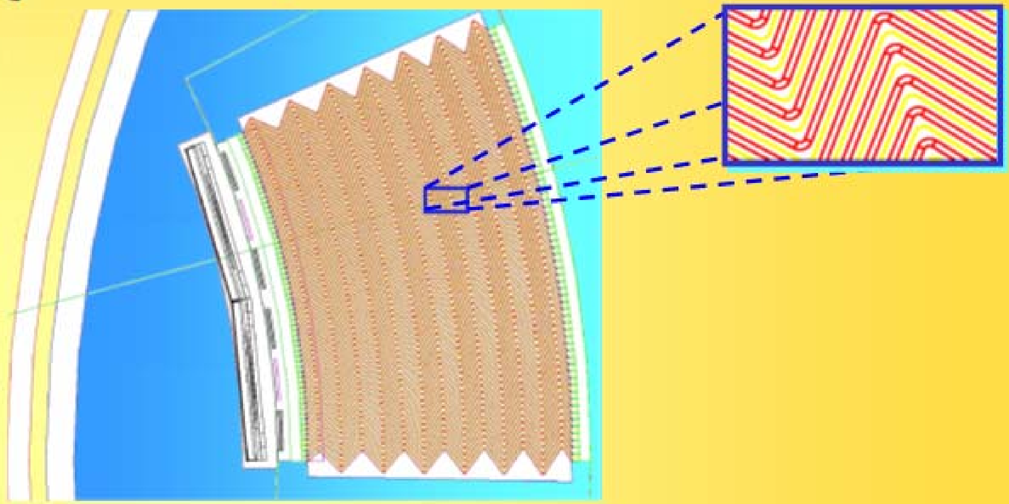


Peter Loch
University of Arizona
Tucson, Arizona 85721

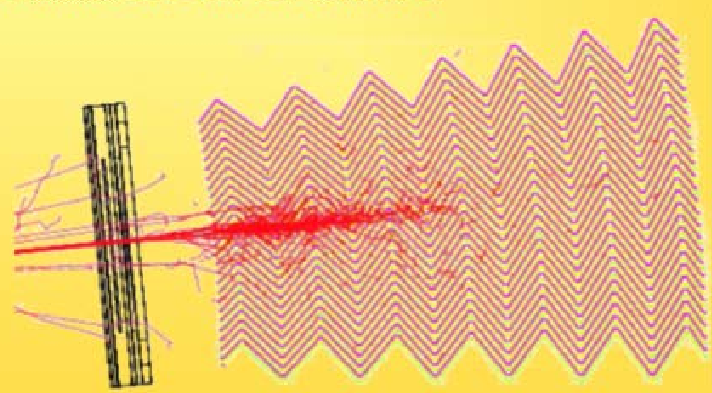
# Geant4 Setups (2)

Forward Calorimeter (FCal) Testbeam Setup


Electromagnetic Barrel Accordion Calorimeter



10 GeV Electron Shower

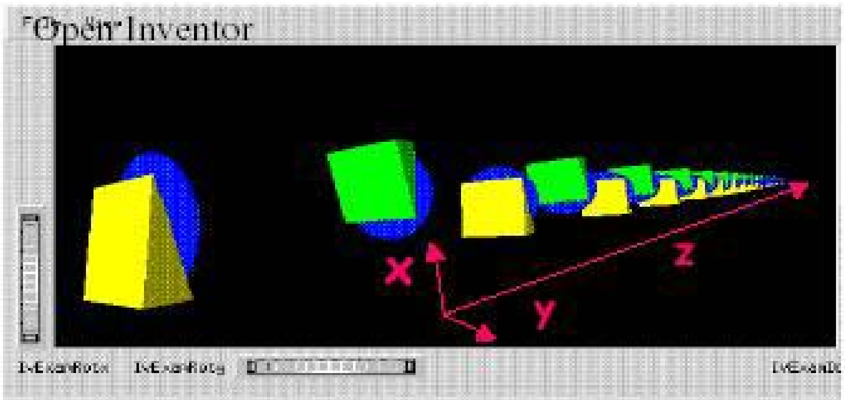


# Geant4 for beam transportation

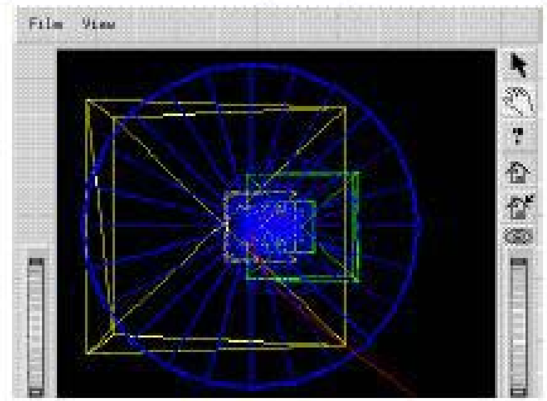
## Example: Helical Channel

Published in proc. of PAC 2001 (Fermilab-Conf-01-182-T)

72 m long solenoidal + dipole field with wedge absorbers and thin cavities




$$B_{xy} = B_T \cos,\sin\left(\frac{2p}{L} z\right) \qquad B_z = B_0$$

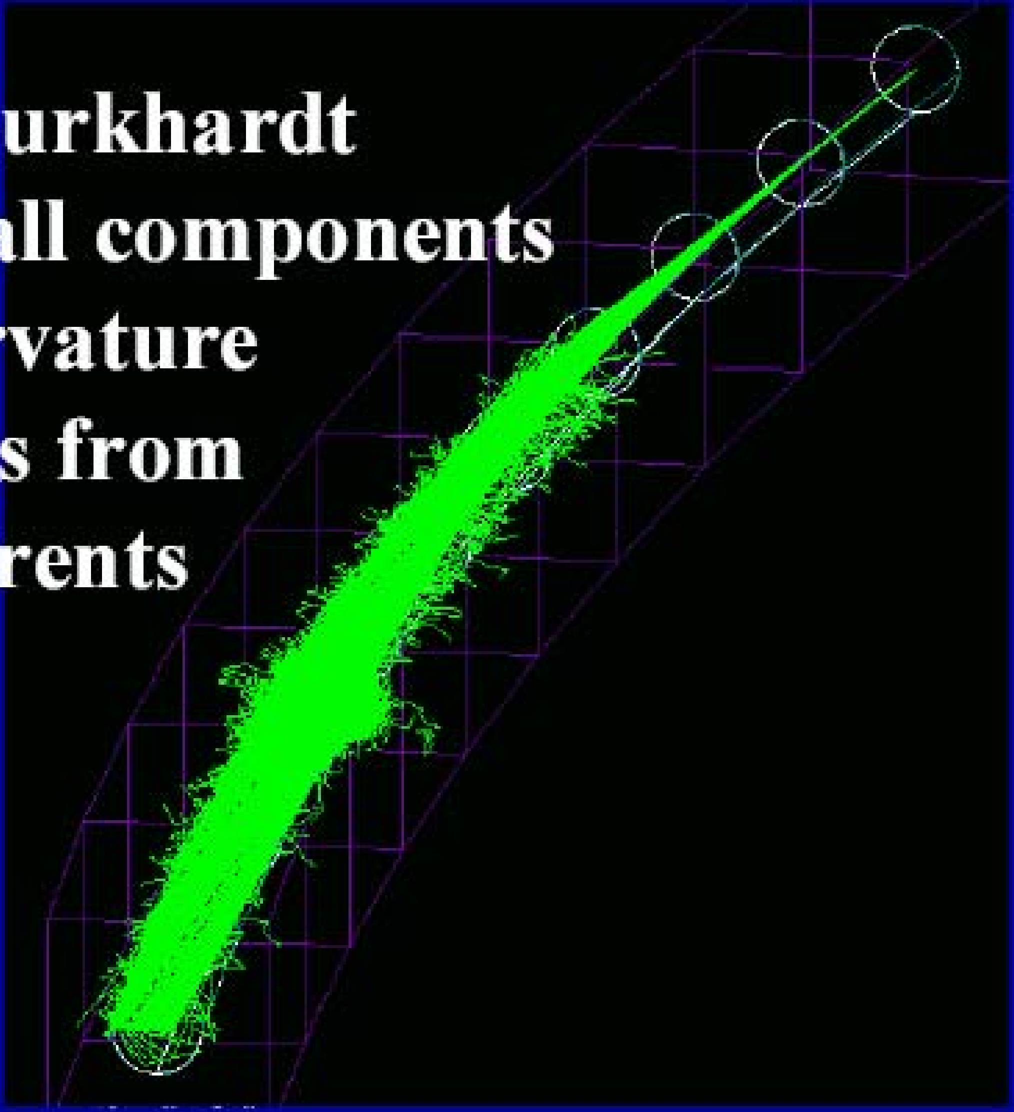



**Other simulations:**

- Alternate Solenoid Channel (sFoFo), published in proceedings of PAC2001 and Feasibility Study II for a Neutrino Factory at BNL (2001)
- Bent Solenoid Channel, presented at Emittance Exchange Workshop, BNL 2000
- Low Frequency r.f. Cooling Channel, presented at International Cooling Experiment Workshop, CERN 2001
- Cooling Experiment (MICE) Simulation (in progress)

# Synchrotron Radiation

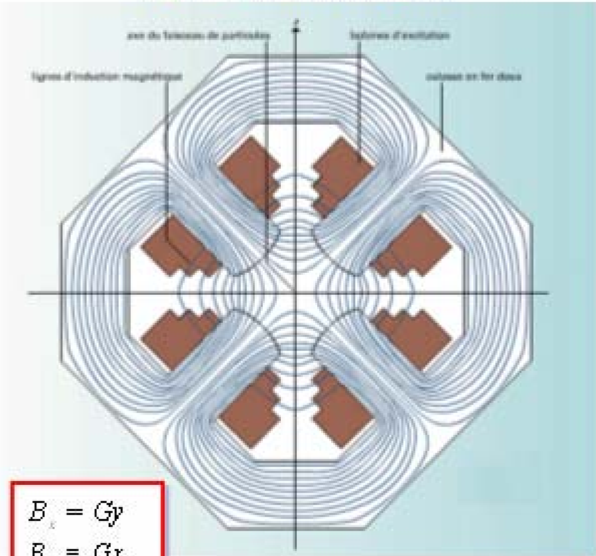
- Generator of H. Burkhardt
- Implemented for all components
- Based on local curvature
- Individual photons from individual parents



# Ray tracing in perfect quadrupoles

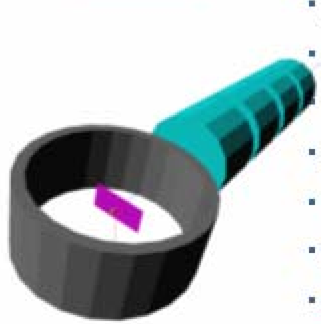
***In our microbeam line, four quadrupoles to focus the beam***

***A pure quadrupole field***



$B_x = Gy$
$B_y = Gx$
$B_z = 0$

***G is the field gradient***

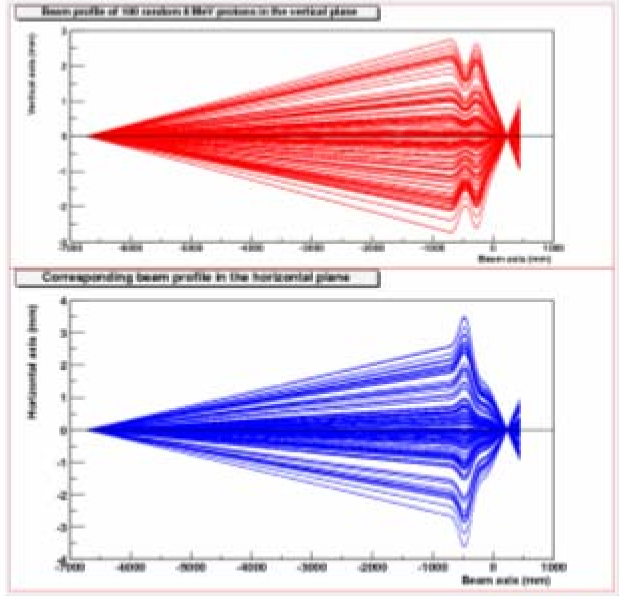


- Focus$_1$ Defocus$_2$ F$_2$ D$_1$ "Russian" configuration
- Quad length = 15 cm, gap radius = 1 cm, distance between quads = 4 cm
- $G_1 = -G_4 = 5.8928$ T/m and $G_2 = -G_3 = -14.6466$ T/m
- proton or alpha beam
- gaussian T = 8 MeV or 2 MeV (standard deviation is 4 keV)
- angular divergence : 0.5 m rad
- gaussian position distribution of **10 µm FWMH**

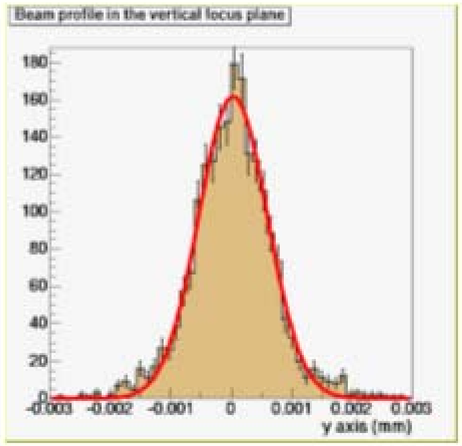
***GEANT4.1+P01 predicts :***

- Focus plane position : **230.15 ± 0.05 mm**
- FWMH of beam in image plane : **1.3 µm**
- **same prediction as the OXRAY code :**

focus plane position : 230.1 ± 0.1 mm
FWMH = 1.1 µm




*GEANT4 4.1+P01*

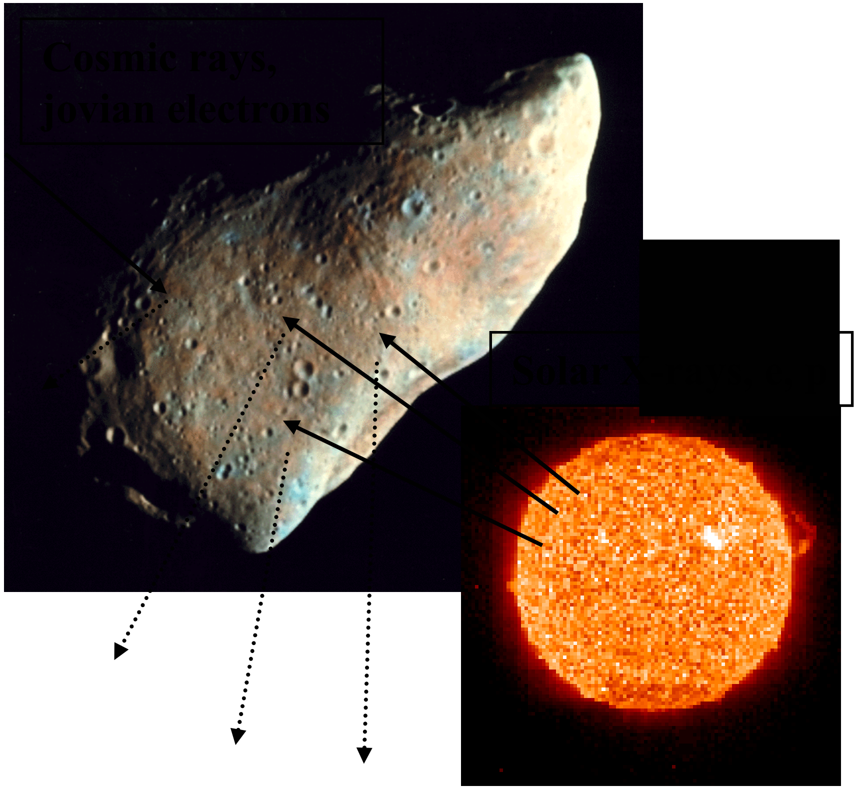



*GEANT4 4.1+P01*

# Geant4 in space science

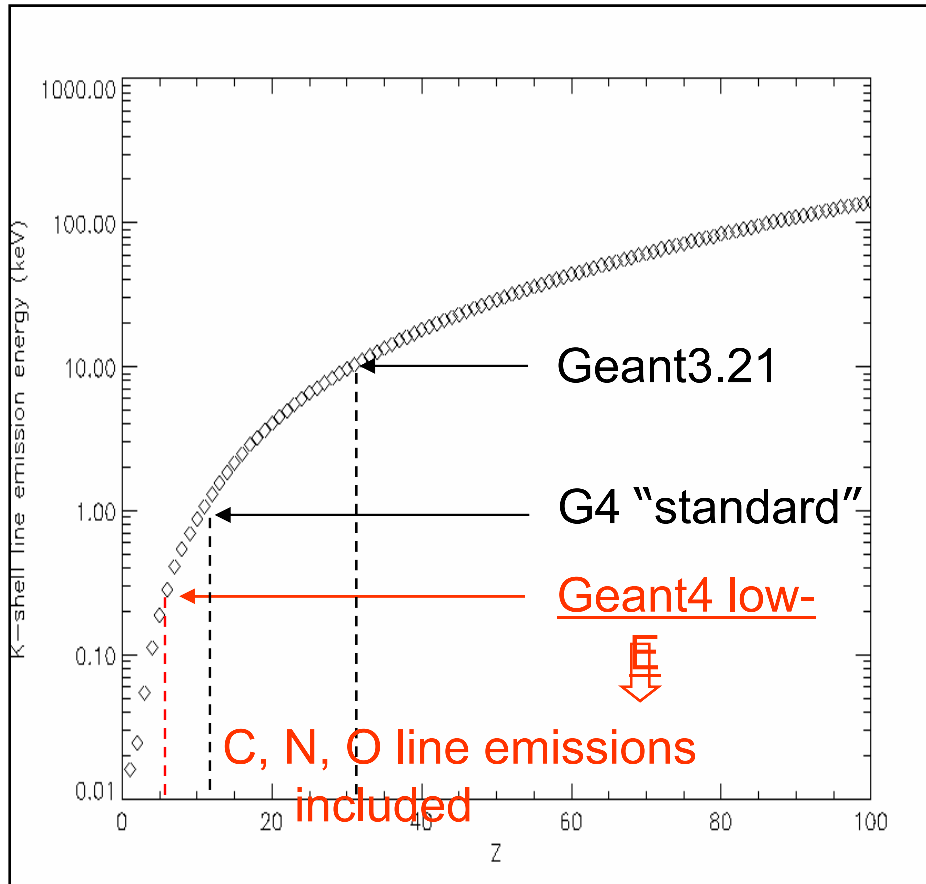
ESA Space Environment & Effects Analysis Section

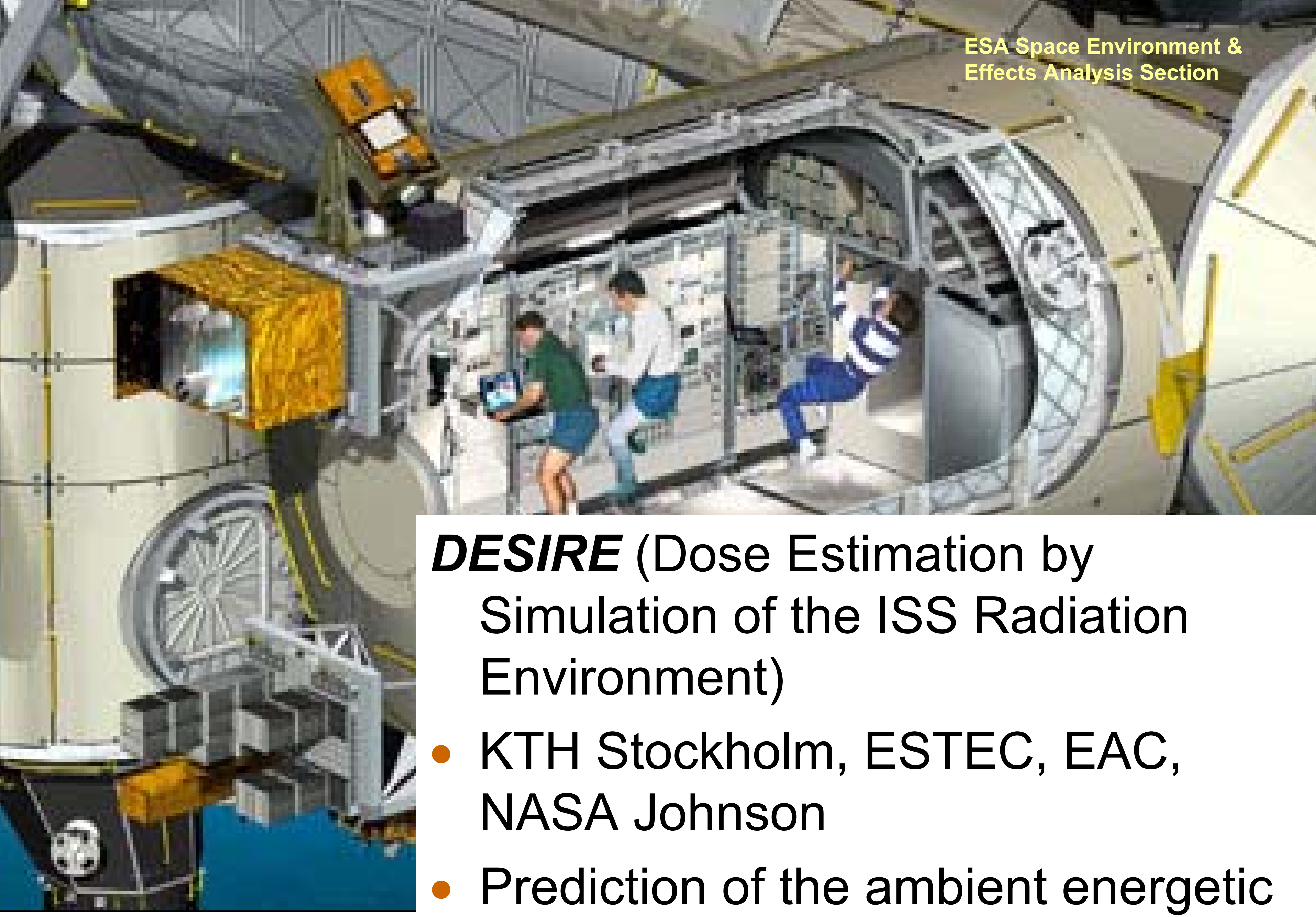
## X-Ray Surveys of Asteroids and Moons



*Courtesy SOHO EIT*

Induced X-ray line emission: indicator of target composition
(~100 μm surface layer)

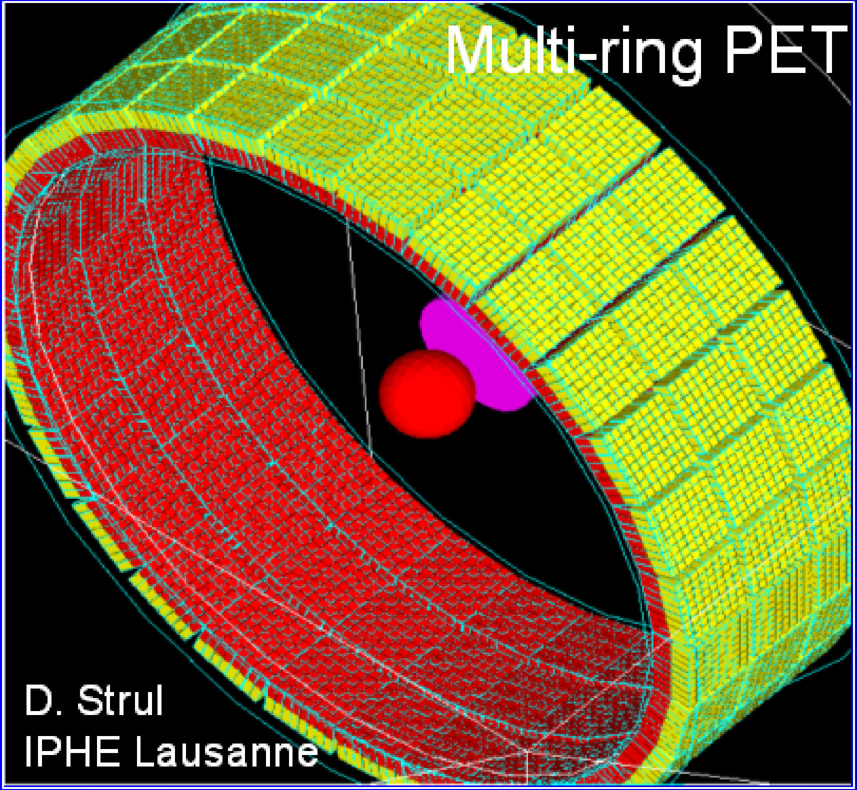


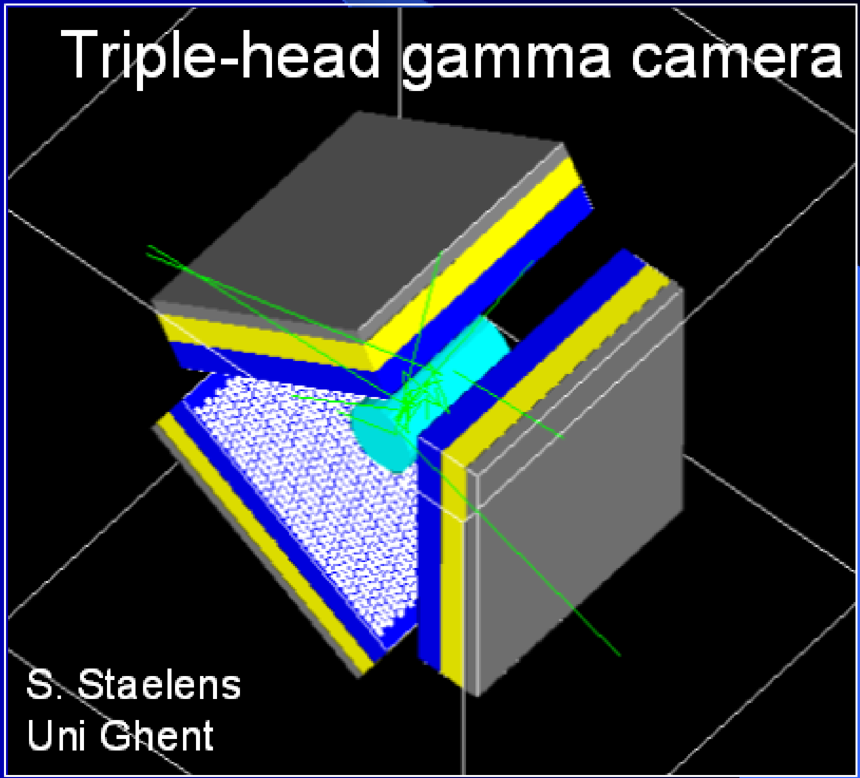


***DESIRE*** (Dose Estimation by Simulation of the ISS Radiation Environment)

- KTH Stockholm, ESTEC, EAC, NASA Johnson
- Prediction of the ambient energetic particle environment (**SPENVIS** &

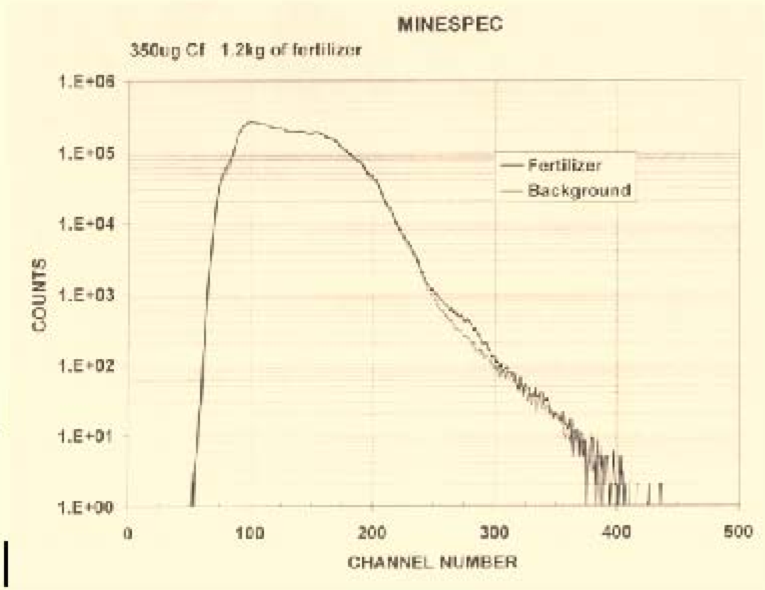
# Geometry examples of GATE applications

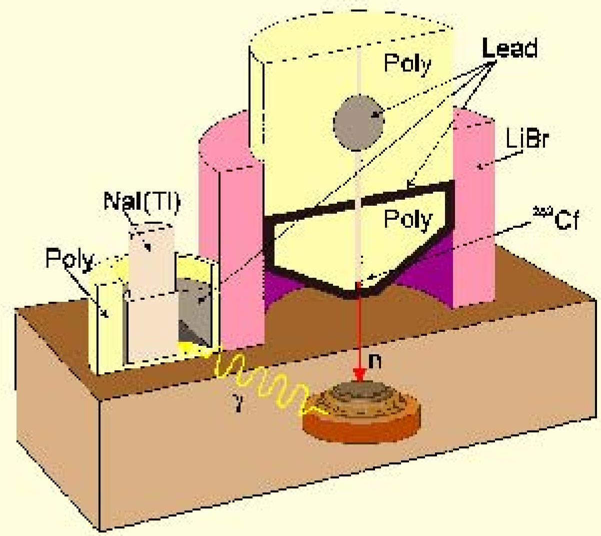


# Thermal Neutron Activation

- TNA detects explosive by properties of constituents
  - High concentration of N
  - Does not ID explosive
- Can confirm presence of all surface laid or shallow AT mines in few seconds to 1 minute
- AT up to 20 cm deep and large AP mines in < 5 minutes



# Full Simulations

For next generation linear collider experiment


LCDROOT/LCDG4 MOKKA JUPITER

Common GEANT4 executable

Runtime geometry

Generic Hit output

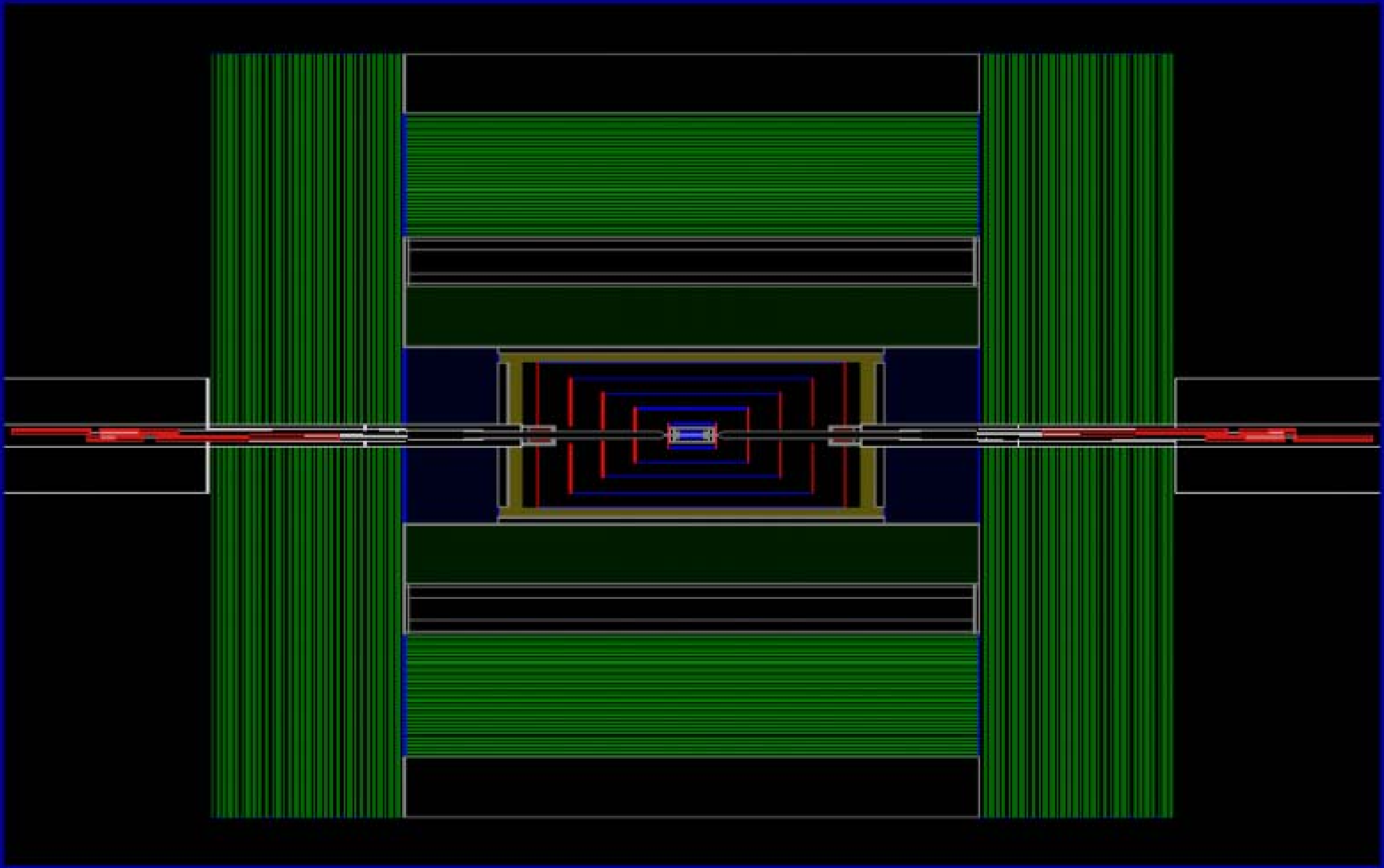
Courtesy of N.Graf (SLAC)

# LCD/Mokka

- First version of mysql / xml interface exists
- SD detector fully modeled including beamline elements.
- Several TESLA detector versions modeled.
- LCIO output implemented in beta version.
- Interfaces to HEPEVT and STDHEP and background files implemented.
- Interface to AIDA integrated.

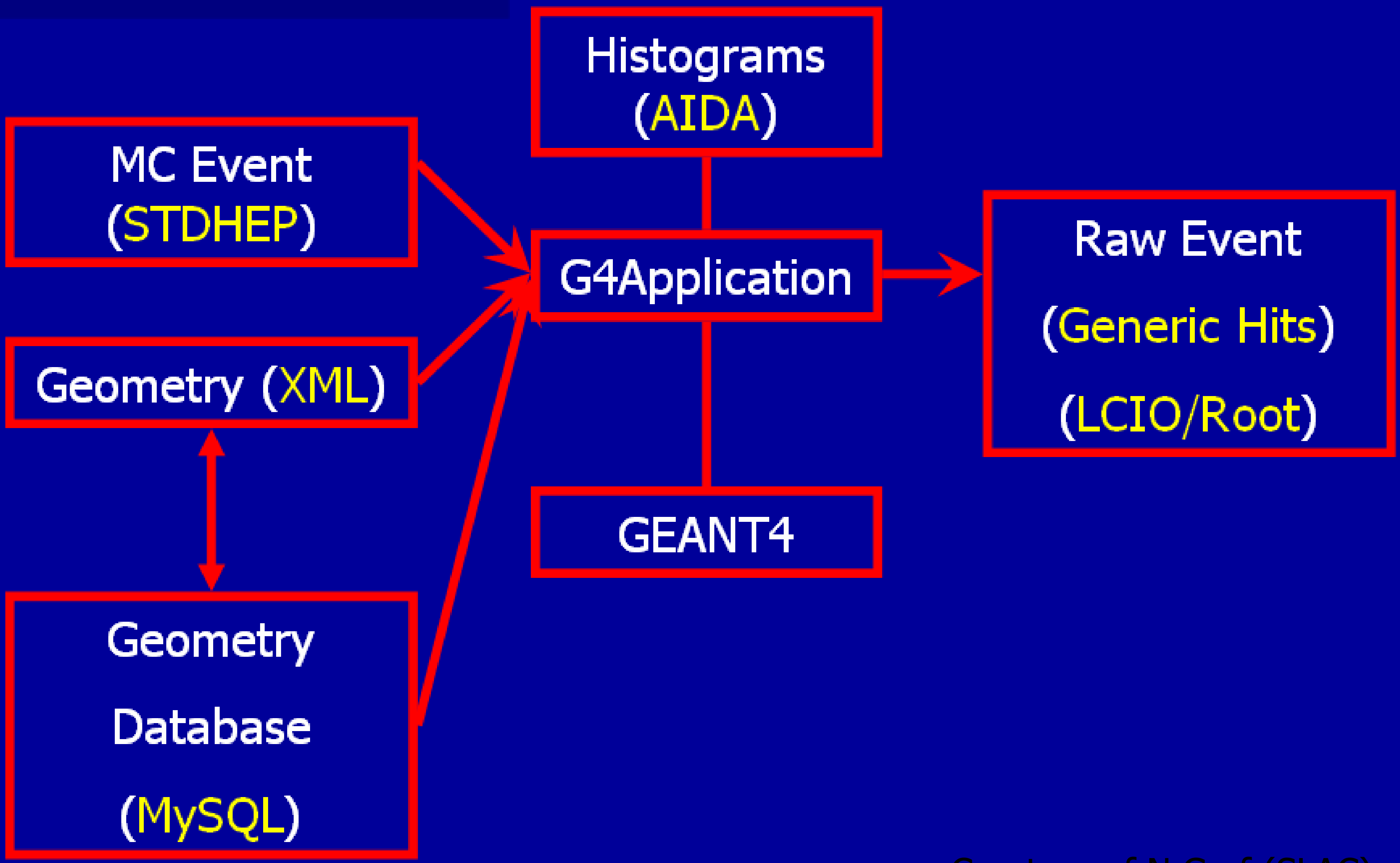
Courtesy of N.Graf (SLAC)

# SD in Mokka



Courtesy of N.Graf (SLAC)

# LC Detector Full Simulation

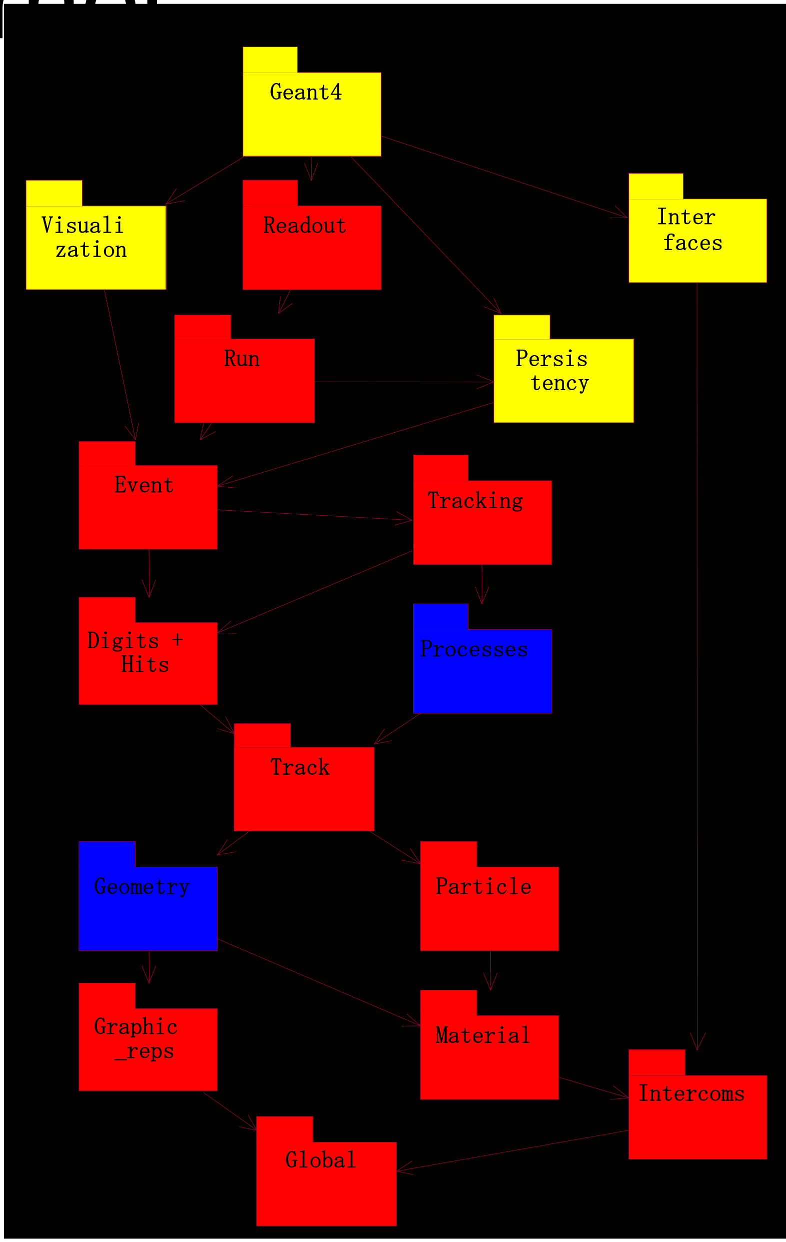



Courtesy of N.Graf (SLAC)

# Basic concepts
# and kernel structure

# Geant4 kernel

- Geant4 consists of 17 categories.
  - Independently developed and maintained by WG(s) responsible to each category.
  - Interfaces between categories (e.g. top level design) are maintained by the global architecture WG.
- Geant4 Kernel
  - Handles run, event, track, step, hit, trajectory.
  - Provides frameworks for geometrical representation and physics processes.



# Run in Geant4

- As an analogy of the real experiment, a run of Geant4 starts with "Beam On".
- Within a run, the user cannot change
  - detector geometry
  - settings of physics processes

    ---> detector is inaccessible during a run
- Conceptually, a run is a collection of events which share the same detector conditions.
- At the beginning of a run, geometry is optimized for navigation and cross-section tables are calculated according to materials appear in the geometry and the cut-off values defined.
- G4RunManager class manages processing a run, a run is represented by G4Run class or a user-defined class derived from G4Run.

# Event in Geant4

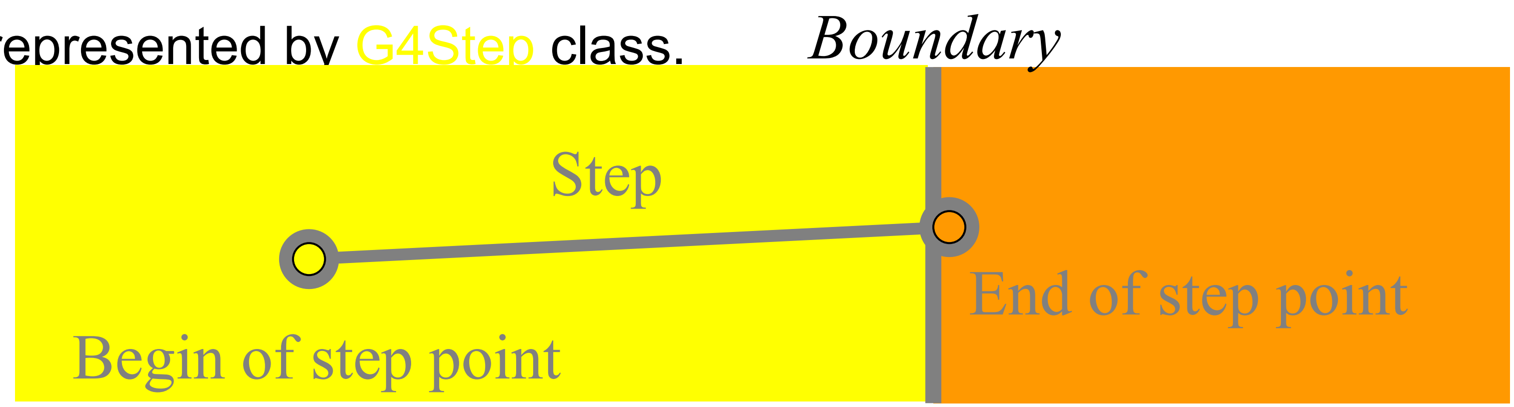
- At beginning of processing, an event contains primary particles. These primaries are pushed into a stack.
- When the stack becomes empty, processing of an event is over.
- G4EventManager class manages processing an event.
- G4Event class represents an event. It has following objects at the end of its processing.
  - List of primary vertexes and particles (as input)
  - Hits collections
  - Trajectory collection (optional)
  - Digits collections (optional)

# Track in Geant4

- Track is a snapshot of a particle.
  - It has only position and physical quantities of current instance.
- Step is a “delta” information to a track.
  - Track is not a collection of steps.
- Track is deleted when
  - it goes out of the world volume
  - it disappears (e.g. decay)
  - it goes down to zero kinetic energy and no “AtRest” additional process is required
  - the user decides to kill it
- No track object persists at the end of event.
  - For the record of track, use trajectory class objects.
- G4TrackingManager manages processing a track, a track is represented by G4Track class.

# Step in Geant4

- Step has two points and also "delta" information of a particle (energy loss on the step, time-of-flight spent by the step, etc.).
- Each point knows the volume (and material). In case a step is limited by a volume boundary, the end point physically stands on the boundary, and it logically belongs to the next volume.
  - Because one step knows materials of two volumes, boundary processes such as transition radiation or refraction could be simulated.
- G4SteppingManager class manages processing a step, a step is represented by G4Step class.



# Particle in Geant4

- A particle in Geant4 is represented in three layers of classes.
- G4Track
  - Position, geometrical information, etc.
  - This is a class representing a particle to be tracked.
- G4DynamicParticle
  - "Dynamic" physical properties of a particle, such as momentum, energy, spin, etc.
  - Each G4Track object has its own and unique G4DynamicParticle object.
  - This is a class representing an individual particle (which is not necessarily to be tracked).
- G4ParticleDefinition
  - "Static" properties of a particle, such as charge, mass, life time, decay channels, etc.
  - G4ProcessManager which describes processes involving to the particle
  - All G4DynamicParticle objects of same kind of particle share the same G4ParticleDefinition.

# Tracking and processes

- Geant4 tracking is general.
  - It is independent to
    - the particle type
    - the physics processes involving to a particle
  - It gives the chance to all processes
    - To contribute to determining the step length
    - To contribute any possible changes in physical quantities of the track
    - To generate secondary particles
    - To suggest changes in the state of the track
      - e.g. to suspend, postpone or kill it.

# Processes in Geant4

- In Geant4, particle transportation is a process as well, by which a particle interacts with geometrical volume boundaries and field of any kind.
  - Because of this, shower parameterization process can take over from the ordinary transportation without modifying the transportation process.
- Each particle has its own list of applicable processes. At each step, all processes listed are invoked to get proposed physical interaction lengths.
- The process which requires the shortest interaction length (in space-time) limits the step.
- All processes are derived from G4VProcess abstract base class. Each particle has its individual G4ProcessManager class object which holds a vector of assigned processes.

# Process and step

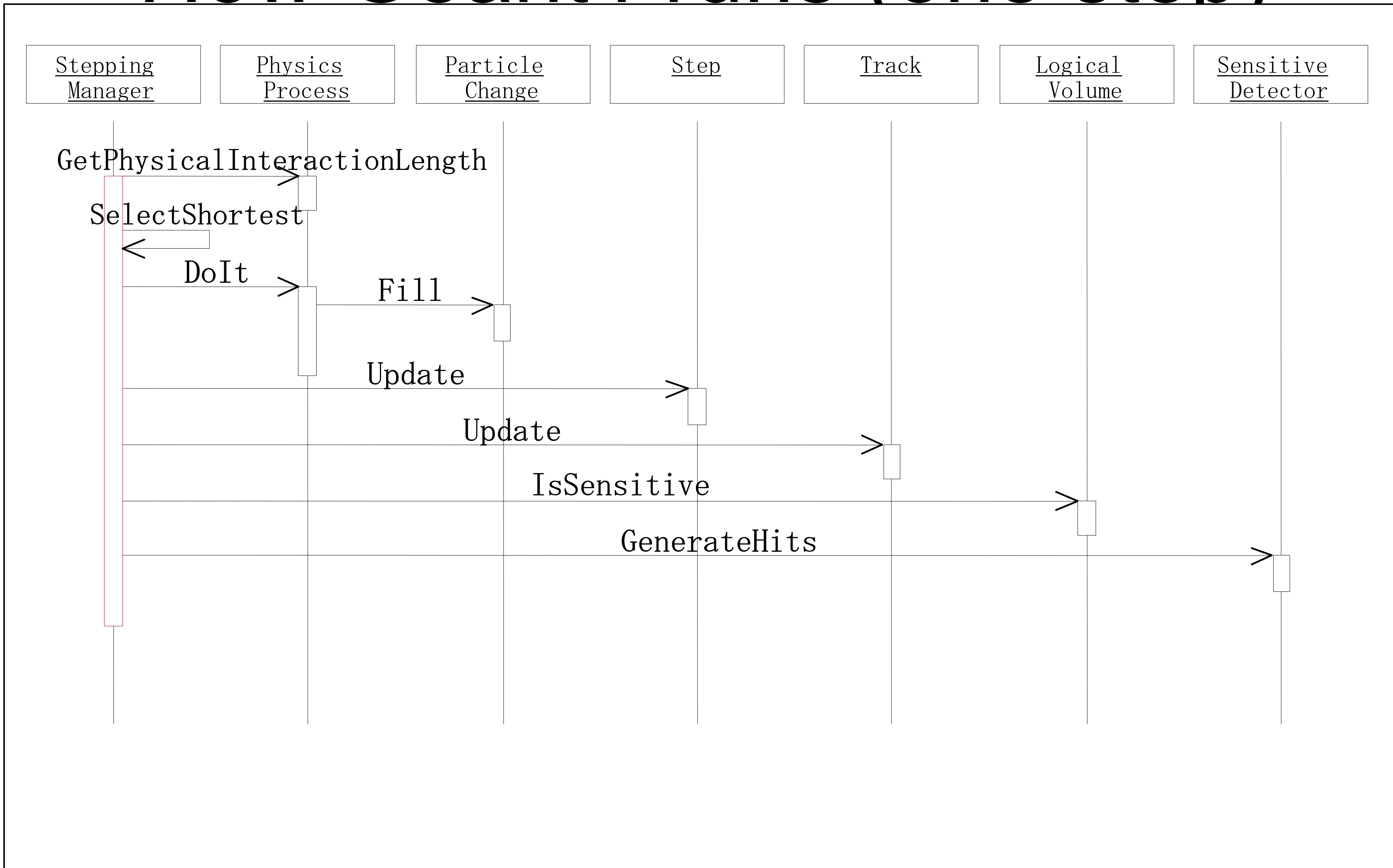
- Each process has one or combination of the following natures.
  - AtRest
    - e.g. muon decay at rest
  - AlongStep
    - e.g. Celenkov process
  - PostStep
    - e.g. decay on the fly
- Each process involving to a step replies a concrete object of G4ParticleChange which affects on a step/track.

# Volume

- Three conceptual layers
  - G4VSolid -- *shape, size*
  - G4LogicalVolume -- *daughter physical volumes,*
    *material, sensitivity, user limits, etc.*
  - G4VPhysicalVolume -- *position, rotation*
- Hierarchal three layers of geometry description allows maximum reuse of information to minimize [redacted]

G4VSensitiveDetector [redacted]

# How Geant4 runs (one step)



# Cuts in Geant4

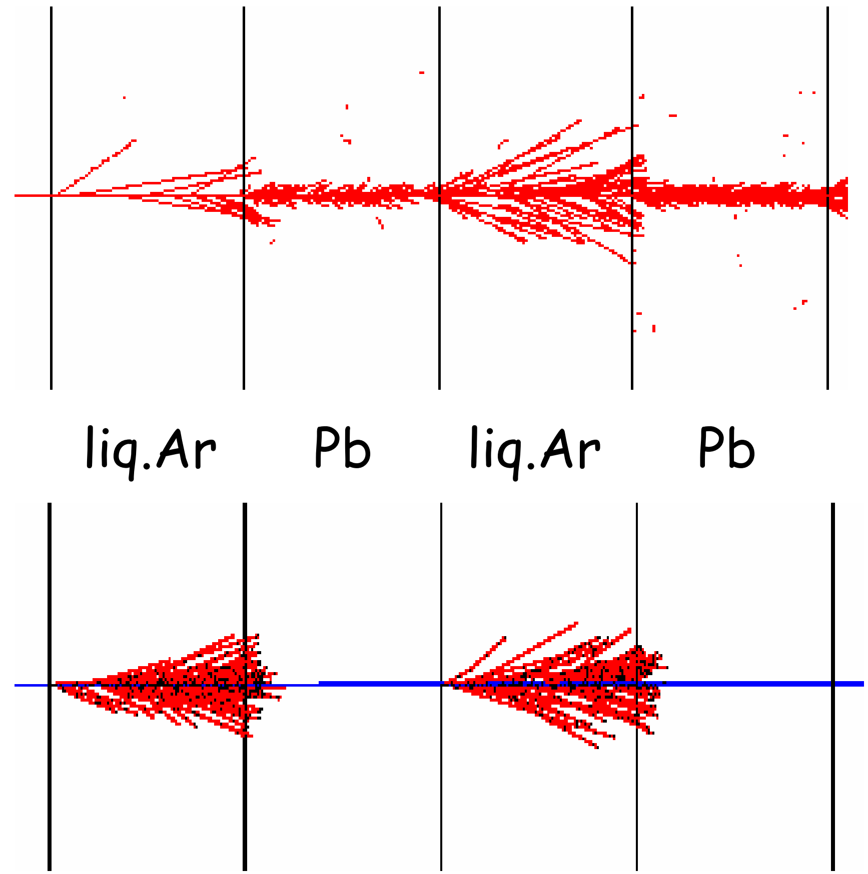
- A Cut in Geant4 is a production threshold.
  - Only for physics processes that have infrared divergence
  - Not tracking cut, which does not exist in Geant4
- Energy threshold must be determined at which discrete energy loss is replaced by continuous loss
  - Old way:
    - Track primary particle until cut-off energy is reached, calculate continuous loss and dump it at that point, stop tracking primary
    - Create secondaries only above cut-off energy, or add to continuous loss of primary for less energetic secondaries
  - Geant4 way:
    - Specify range (which is converted to energy for each material) at which continuous loss begins, track primary down to zero range
    - Create secondaries only above specified range, or add to continuous loss of primary for secondaries of less energetic and not reaching to the volume boundary

# Energy cut vs. range cut

- 500 MeV/c proton in liq.Ar (4mm) / Pb (4mm) sampling calorimeter

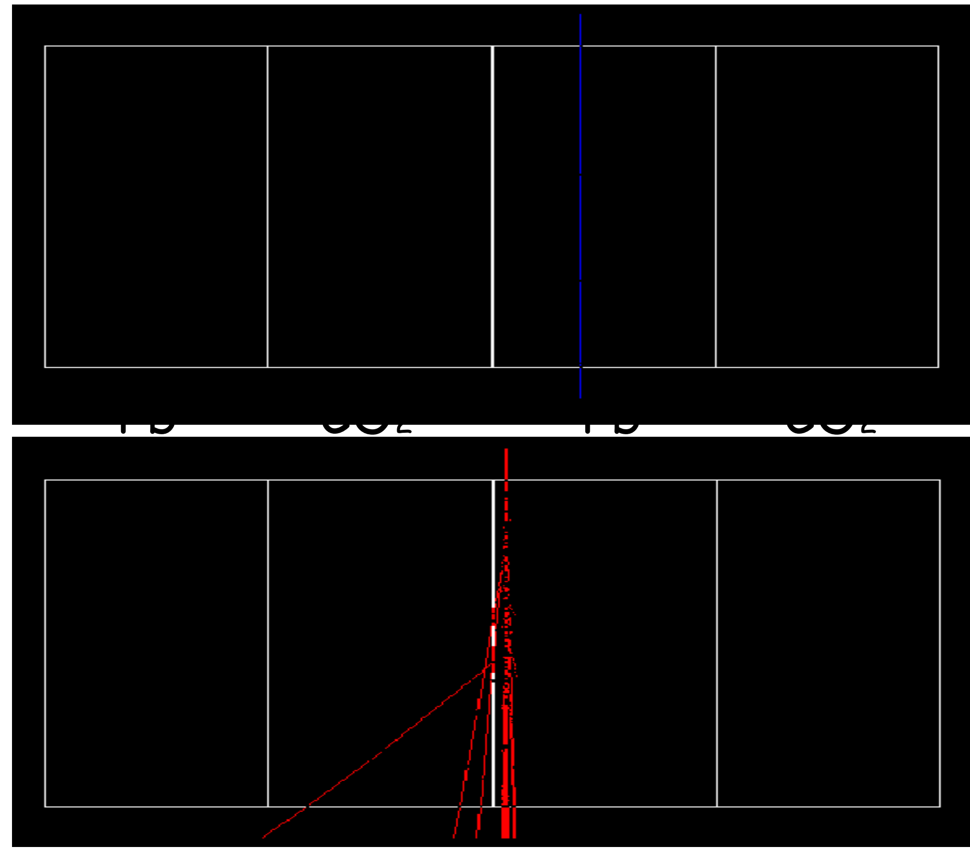
- Geant3 (energy cut)
  - Ecut = 450 keV

- Geant4 (range cut)
  - Rcut = 1.5 mm
  - Corresponds to Ecut in liq.Ar = 450 keV, Ecut in Pb = 2 MeV



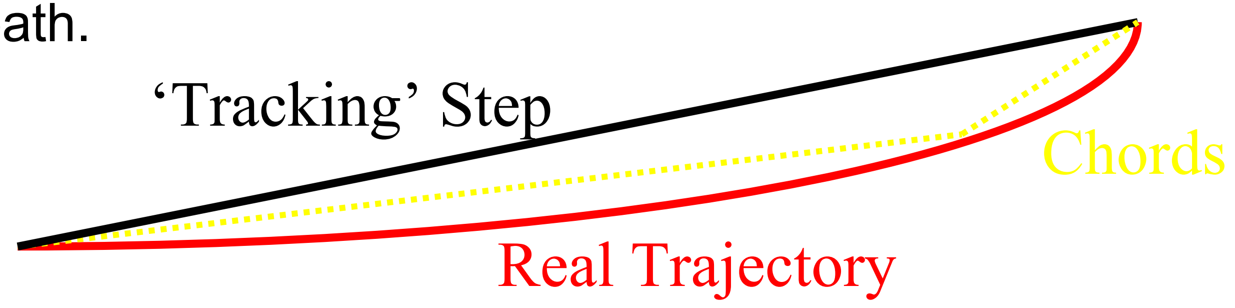
# Range cut vs. geometrical safety

- Even though a secondary is less energetic than the defined range cut, it can penetrate to the next volume (and actual range can be longer than the range cut) if it is born close to the geometrical boundary.
- Range cut is applied only if the range of the particle is shorter than the geometrical safety.
  - Such particle cannot penetrate.
  - Geometrical safety is the isotropic shortest distance to the geometrical boundary.



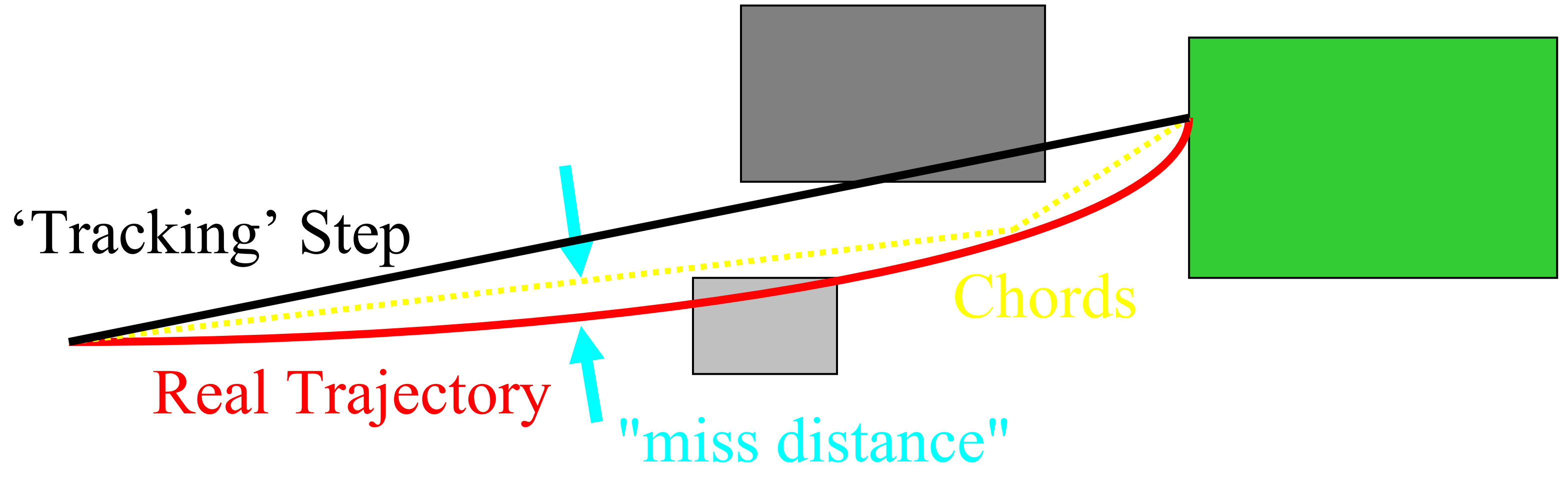
# Field integration

- In order to propagate a particle inside a field (e.g. magnetic, electric or both), we solve the equation of motion of the particle in the field.
- We use a Runge-Kutta method for the integration of the ordinary differential equations of motion.
  - Several Runge-Kutta 'steppers' are available.
- In specific cases other solvers can also be used:
  - In a uniform field, using the analytical solution.
  - In a nearly uniform field (BgsTransportation/future)
  - In a smooth but varying field, with new RK+helix.
- Using the method to calculate the track's motion in a field, Geant4 breaks up this curved path into linear chord segments.
  - We determine the chord segments so that they closely approximate the curved path.



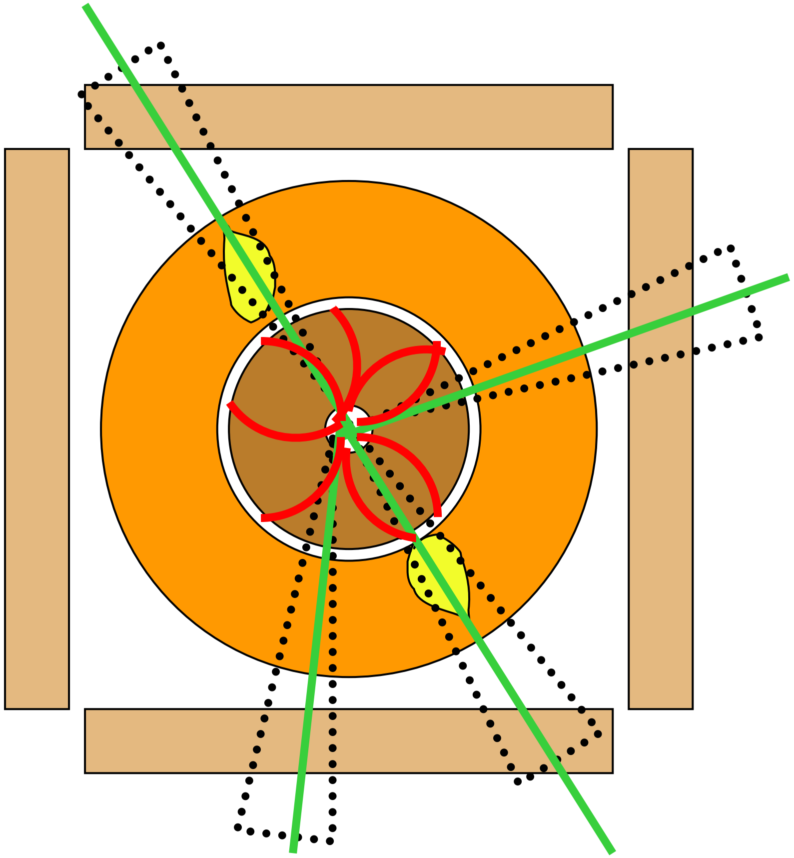
# Tracking in field

- We use the chords to interrogate the G4Navigator, to see whether the track has crossed a volume boundary.
- User can set the accuracy of the volume intersection,
  - By setting a parameter called the "miss distance"
    - It is a measure of the error in whether the approximate track intersects a volume.
- One physics/tracking step can create several chords.
  - In some cases, one step consists of several helix turns.



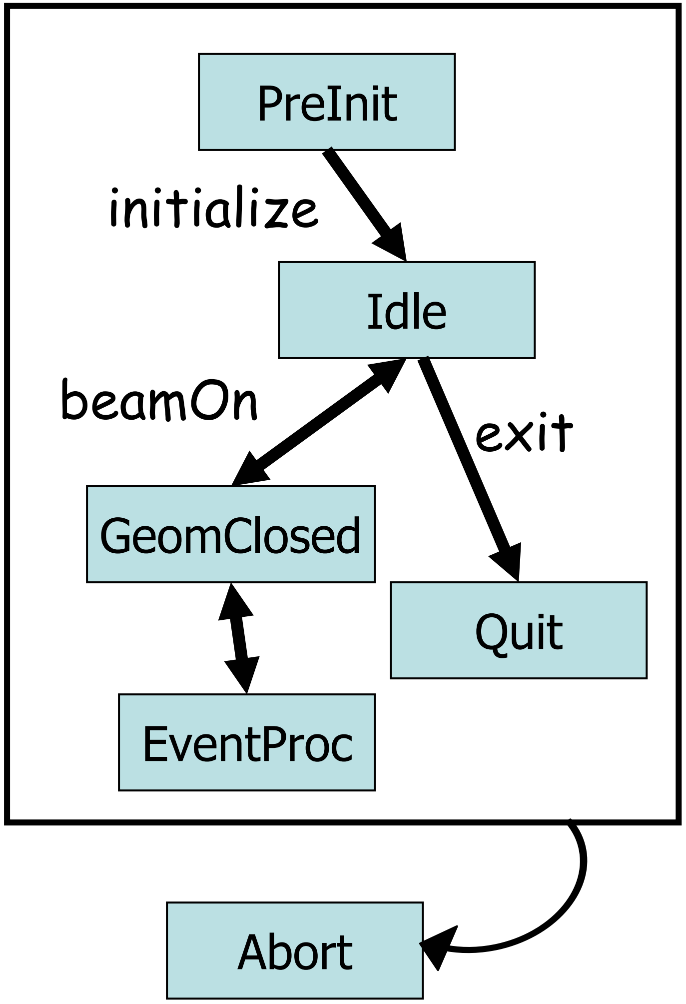
# Stack

- Track is a class object, thus it is easy to treat suspending or postponing tracks. For example,
  - Suspend tracks at the entrance of calorimeter, i.e. simulate all tracks in tracking region before generating showers.
  - Suspend a "looper" track after certain time and postpone it to next event.
  - Prioritized tracking without performance cost
- Stacks are managed by G4StackManager with user's G4UserStackingAction.
- Well-thought prioritization/abortion of tracks/events makes entire simulation process much more efficient.



# Geant4 as a state machine

- Geant4 has six application states.
  - G4State_PreInit
    - Material, Geometry, Particle and/or Physics Process need to be initialized/defined
  - G4State_Idle
    - Ready to start a run
  - G4State_GeomClosed
    - Geometry is optimized and ready to process an event
  - G4State_EventProc
    - An event is processing
  - G4State_Quit
    - (Normal) termination
  - G4State_Abort
    - A fatal exception occurred and program is aborting



# Unit system

- Internal unit system used in Geant4 is completely hidden not only from user’s code but also from Geant4 source code implementation.
- Each hard-coded number must be multiplied by its proper unit.

```
radius = 10.0 * cm;
kineticE = 1.0 * GeV;
```

- To get a number, it must be divided by a proper unit.

```
G4cout << eDep / MeV << “ [MeV]” << G4endl;
```

- Most of commonly used units are provided and user can add his/her own units.
- By this unit system, source code becomes more readable and importing / exporting physical quantities becomes straightforward.
  - For particular application, user can change the internal unit to suitable alternative unit without affecting to the result.

# G4cout, G4cerr

- G4cout and G4cerr are *ostream* objects defined by Geant4.
  - G4endl is also provided.
- Some GUIs are buffering output streams so that they display print-outs on another window or provide storing / editing functionality.
  - The user should not use std::cout, etc.
- The user should not use std::cin for input. Use user-defined commands provided by intercoms category in Geant4.

# User classes

# User classes

- Initialization classes
  - Invoked at the initialization
    - G4VUserDetectorConstruction
    - G4VUserPhysicsList
- Action classes
  - Invoked during an event loop
    - G4VUserPrimaryGeneratorAction
    - G4UserRunAction
    - G4UserEventAction
    - G4UserStackingAction
    - G4UserTrackingAction
    - G4UserSteppingAction
- main()
  - Geant4 does not provide *main().*

  Note : classes written in yellow are mandatory.

# Describe your detector

- Derive your own concrete class from G4VUserDetectorConstruction abstract base class.
- In the virtual method *Construct()*,
  - Instantiate all necessary materials
  - Instantiate volumes of your detector geometry
  - Instantiate your sensitive detector classes and set them to the corresponding logical volumes
- Optionally you can define
  - Regions for any part of your detector
  - Visualization attributes (color, visibility, etc.) of your detector elements

# Select physics processes

- Geant4 does not have any default particles or processes.
  - Even for the particle transportation, you have to define it explicitly.
- Derive your own concrete class from G4VUserPhysicsList abstract base class.
  - Define all necessary particles
  - Define all necessary processes and assign them to proper particles
  - Define cut-off ranges applied to the world (and each region)
- Geant4 provides lots of utility classes/methods and examples.
  - "Educated guess" physics lists for defining hadronic processes for various use-cases.

# Generate primary event

- Derive your concrete class from G4VUserPrimaryGeneratorAction abstract base class.
- Pass a G4Event object to one or more primary generator concrete class objects which generate primary vertices and primary particles.
- Geant4 provides several generators in addition to the G4VPrimaryParticlegenerator base class.
  - G4ParticleGun
  - G4HEPEvtInterface, G4HepMCInterface
    - Interface to /hepevt/ common block or HepMC class
  - G4GeneralParticleSource
    - Define radioactivity

# Optional user action classes

- All user action classes, methods of which are invoked during “Beam On”, must be constructed in the user’s *main*() and must be set to the RunManager.

- G4UserRunAction
  - G4Run* GenerateRun()
    - Instantiate user-customized run object
  - void BeginOfRunAction(const G4Run*)
    - Define histograms
  - void EndOfRunAction(const G4Run*)
    - Store histograms
- G4UserEventAction
  - void BeginOfEventAction(const G4Event*)
    - Event selection
    - Define histograms
  - void EndOfEventAction(const G4Event*)
    - Analyze the event

# Optional user action classes

- G4UserStackingAction
  - void PrepareNewEvent()
    - Reset priority control
  - G4ClassificationOfNewTrack ClassifyNewTrack(const G4Track*)
    - Invoked every time a new track is pushed
    - Classify a new track -- priority control
      - Urgent, Waiting, PostponeToNextEvent, Kill
  - void NewStage()
    - Invoked when the Urgent stack becomes empty
    - Change the classification criteria
    - Event filtering (Event abortion)

# Optional user action classes

- G4UserTrackingAction
  - void PreUserTrackingAction(const G4Track*)
    - Decide trajectory should be stored or not
    - Create user-defined trajectory
  - void PostUserTrackingAction(const G4Track*)
- G4UserSteppingAction
  - void UserSteppingAction(const G4Step*)
    - Kill / suspend / postpone the track
    - Draw the step (for a track not to be stored as a trajectory)

# The main program

- Geant4 does not provide the *main*().
- In your *main(),* you have to
  - Construct G4RunManager (or your derived class)
  - Set user mandatory classes to RunManager
    - G4VUserDetectorConstruction
    - G4VUserPhysicsList
    - G4VUserPrimaryGeneratorAction
- You can define VisManager, (G)UI session, optional user action classes, and/or your persistency manager in your *main()*.

# Select (G)UI

- In your *main*(), according to your computer environments, construct a G4UIsession concrete class provided by Geant4 and invoke its *sessionStart*() method.
- Geant4 provides
  - G4UIterminal -- C- and TC-shell like character terminal
  - G4GAG -- Tcl/Tk or Java PVM based GUI
  - G4Wo -- Opacs
  - G4JAG -- Interface to JAS (Java Analysis Studio)
  - G4UIBatch -- Batch job with macro file

# Visualization

- Derive your own concrete class from G4VVisManager according to your computer environments.
- Geant4 provides interfaces to graphics drivers
  - DAWN -- Fukui renderer
  - WIRED
  - RayTracer -- Ray tracing by Geant4 tracking
  - OPACS
  - OpenGL
  - OpenInventor
  - VRML

# Environment variables

- You need to set following environment variables to compile, link and execute Geant4-based simulation.
  - Mandatory variables
    - G4SYSTEM – OS (e.g. Linux-g++)
    - G4INSTALL – base directory of Geant4
    - G4WORKDIR – your temporary work space
    - CLHEP_BASE_DIR – base directory of CLHEP
  - Variables for physics processes in case corresponding processes are used
    - G4LEVELGAMMADATA - photon evaporation
    - G4LEDATA - cross-sections for Low-E EM module
    - G4RADIOACTIVEDATA - radioactive decay
    - NeutronHPCrossSections - neutron cross-section
  - Additional variables for GUI/Vis/Analysis

# (Graphical) User Interfaces

- Geant4 kernel is independent to any specific GUI technology.
- Geant4 provides several alternative (G)UIs or interfaces to external GUI packages. The user can choose one or more of them according to computer environment / need.
  - Character terminal (csh and tcsh(bash)-like terminal)
  - Xm, Xaw, Win32, variations of the upper terminals by using a Motif, Athena or Windows widget to retrieve commands
  - GAG, a fully Graphical User Interface and its extension GainServer of the client/server type
  - OPACS, an OPACS/Wo widget manager implementation in conjunction with the OPACS visualization system.
  - JAG, an interface to JAS (Java Analysis Studio)
  - User can connect his/her own GUI to Geant4

# Visualization

- Geant4 kernel is independent to any specific visualization technology.
- Geant4 provides several alternative visualization drivers or interfaces to external visualization drivers. The user can choose one or more of them according to computer environment / need.
  – OpenGL viewers
  – FukuiRenderer (DAWN)
  – VRML builder
  – WIRED
  – Wo, Xo (OPACS)
  – OpenInventorX (OIX)
  – RayTracer
  – User can connect his/her own visualization driver to Geant4
- Some example figures are given with introduction of users applications in this presentation

# User Support

# User Support

- Geant4 Collaboration offers extensive user supports.
  - Users workshops
  - Tutorial courses
  - HyperNews and mailing list
  - Bug reporting system
  - Requirements tracking system
  - Daily “private” communications
  - New implementation - Technical Forum

# Geant4 users workshop

- Users workshops were held or are going to be held hosted by several institutes for various user communities.
  - KEK - Dec.2000, Jul.2001, Mar.2002, Jul.2002, Mar.2003, Jul.2003
  - SLAC - Feb.2002
  - Spain (supported by INFN) - Jul.2002
  - CERN - Nov.2002
  - ESA - Jan.2003, Jan.2004 (planned)
    - dedicated to space-related users
  - Helsinki - Oct.2003
  - Local workshops of one or two days were held or are planned at several places.

# Geant4 tutorials / lectures

- In addition to the users workshops, many tutorial courses and lectures with some discussion time slots were held for various user communities.
  - CERN School of Computing
  - Italian National School for HEP/Nuclear Physicists
  - MC2000
  - MCNEG workshop
  - KEK, SLAC, DESY, FNAL, INFN, Frascati, Karolinska, GranSasso, etc.
  - ATLAS, CMS, LHCb
  - Tutorials/lectures at universities
    - U.K. - Imperial
    - Italy - Genoa, Bologna, Udine, Roma, Trieste
- Near future tutorial courses
  - DESY (Sept.30 - Oct.02, 2003)
  - IEEE NSS/MIC @ Portland, Oregon (Oct.19, 2003)
  - FNAL (Oct.27 - Oct.29, 2003)

# HyperNews

- HyperNews system was set up in April

[ Membership | Subscriptions | Recent Index | Search | Geant4 Home | Feedback | Help ]

## Geant4 HyperNews Forums

**Welcome to the Geant4 HyperNews system.**

The Geant4 collaboration welcomes user participation in this forum through the exchange of questions about and experiences with the Geant4 toolkit. When possible, developers will monitor these contributions and provide assistance. To report a problem or program error please use the Geant4 Problem Reporting System.

The following list is a short guide to what you can do from this page:

- To read a forum, click on the title of the forum in one of the available indices. Available indices include a Time Ordered Index, and a Recent Post Index.
- To post a new message (start a new thread) in a forum, click on the `Add Message` button at the bottom of the forum page. One can also use email.
- To create a membership, follow the directions here.
- To edit your membership information in the system, go to the Membership page.
- To subscribe (once you are a member) to any forum or to see what forums you are currently subscribed to, go to the Central HyperNews Subscription Page. You can also see who else is subscribed to a forum from there.
- To search the messages in the HyperNews system, go to the HyperNews Search Page.
- To request a new forum be created, use the Request a New Forum page.

# HyperNews

- 19 categories
- Not only “user-developer”, but also “user-user” information exchanges are quite intensive.

**Categorized Index of Forums**

- Control of runs, events, tracks, particles
- Experimental Setup
- General matters
- Interfaces
- Physics

Control of runs, events, tracks, particles
- Event and Track Management
- Particles
- Run Management

Experimental Setup
- Fields: Magnetic and Otherwise
- Geometry
- Hits, Digitization and Pileup

General matters
- Documentation and Examples
- HyperNews System Announcements
- Hypernews Testing
- Installation and Configuration
- User Requirements

Interfaces
- (Graphical) User Interfaces
- Analysis
- Persistency
- Visualization

Physics
- Electromagnetic Processes
- Fast Simulation, Transportation & Others
- Hadronic Processes
- Physics List

# HyperNews is quite active

## Event and Track Management

This forum is a discussion of steps, tracks, events and the event manager.

**Messages** Inline Depth: 0 1 All Outline Depth: 1 -1 +1 All

102. Track leaving mother volume *by Andreas, 8/20/03* NEW
    1. Re: Track leaving mother volume *by michel maire, 8/20/03* NEW
101. tracking/analyzing deStep info on one entire run *by David, 8/11/03*
    1. Re: tracking/analyzing deStep info on one entire run *by Makoto Asai, 8/11/03*
        1. Re: tracking/analyzing deStep info on one entire run *by David, 8/11/03*
        2. Re: tracking/analyzing deStep info on one entire run *by David, 8/18/03* NEW
            1. Re: tracking/analyzing deStep info on one entire run *by michel maire, 8/20/03* NEW
100. How to get the name of the volume a track is in? *by Mark Polsen, 8/09/03*
    1. Re: How to get the name of the volume a track is in? *by Makoto Asai, 8/09/03*
    2. Re: How to get the name of the volume a track is in? *by Mark Polsen, 8/11/03*
99. Howto make G4Track information persistent? *by Mark Polsen, 8/06/03*
    1. Re: Howto make G4Track information persistent? *by Makoto Asai, 8/09/03*
98. Track Length of Primary Particle *by turbo, 8/05/03*
    1. Re: Track Length of Primary Particle *by michel maire, 8/05/03*
97. How to stop secondary particles? *by Lei Zhu, 8/04/03*
96. Final particle energy access from G4Trajectory *by Danek Kotlinski, 8/03/03*
95. Cerenkov process *by Megan Lehnherr, 7/30/03*
    1. Re: Cerenkov process *by Peter Gumplinger, 7/30/03*
    -> Re: Cerenkov process *by Megan Lehnherr, 7/31/03*
    -> Re: Cerenkov process *by Peter Gumplinger, 8/01/03*
94. TrackingManager *by Vinzenz Bildstein, 7/30/03*
    1. Re: TrackingManager *by Takashi Sasaki, 8/03/03*
93. CT Simulation *by Lei, 7/18/03*
    1. Re: CT Simulation *by Vladimir IVANTCHENKO , 7/18/03*
92. How to see if a track will intersect a volume before throwing it? *by Andrew Hoover, 7/14/03*
    1. Re: How to see if a track will intersect a volume before throwing it? *by Makoto Asai, 7/14/03*
91. G4Step and Total Energy Deposition *by Bob Weller, 6/26/03*
    1. Re: G4Step and Total Energy Deposition *by Vladimir Ivantchenko , 6/27/03*
90. Killing primaries *by m.j.carson@sheffield.ac.uk, 6/25/03*
    1. Re: Killing primaries *by Makoto Asai, 6/25/03*
89. How to gain the position of the particle by using G4Track *by chen yong, 5/26/03*
    1. Re: How to gain the position of the particle by using G4Track *by Vladimir IVANTCHENKO , 5/26/03*
88. G4VUserTrackInformation is broken (or at least VERY fragile) *by Tom Roberts, 5/20/03*
    1. Re: G4VUserTrackInformation is broken (or at least VERY fragile) *by Makoto Asai, 5/20/03*
87. Question on name of produced nucleon *by Alexander Dietz, 5/14/03*
86. Problems to access data on LCapture *by Alexander Dietz, 5/13/03*
85. How to end a track manually? *by Dvorak, 4/23/03*
    1. Re: How to end a track manually? *by Vladimir IVANTCHENKO , 4/23/03*
        1. Re: How to end a track manually? *by Dvorak, 4/23/03*

# Some postings are novice...

More | Next | Prev. | Out

## Where can I find the FORTRAN type source code of simulation?

*Base:* Documentation and Examples
*Keywords:* FORTRAN source code
*Date:* Thu, 13 Sep 2001 02:22:31 GMT
*From:*

```
I am trying to find some source codes of FORTRAN type to learn to
do my simulation work.But I do not know where they are because
I am a novice of GEANT4.
Please,help me.
```

More | Next | Prev. | Out

**Messages** Inline Depth: 0 | 1 | All Outline Depth: 1 | -1 | +1 | All

1. Re: Where can I find the FORTRAN type source code of simulation? *by Makoto Asai, 9/13/01*

Add Message to: **"Where can I find the FORTRAN type source code of simulation?"**

# Some are excellent users contribution

More Next Prev. Out

## Re: Clean abort of run

*Base:* Run Management
*Re:* Clean abort of run
*Keywords:* abort run
*Date:* Fri, 26 Jul 2002 10:05:24 GMT
*From:*

```
Hi Mario,

We had the same requirement for our project. The solution we found was
to set-up a signal handler class: when the user sends a stop signal,
this class aborts the run, then returns to the normal execution of the
simulation. I've included a typical example of code below, and some
comments at the end of this mail

prototypes:
--------
namespace MySignalHandler
{
    G4int Install(void);

    void QuitSignalHandler(int sig);
};

implementation:
-----------
G4int MySignalHandler::Install()
{
  // Install the signal handler for SIGQUIT only
  if (signal(SIGQUIT,QuitSignalHandler) == SIG_ERR) {
    G4cerr << G4endl << "Warning! Could not install handler for CTRL-\\
```

# Technical Forum

- In the Technical Forum, the Geant4 Collaboration, its user community and resource providers discuss:
  - major user and developer requirements, user and developer priorities, software implementation issues, prioritized plans, physics validation issues, user support issues
- The Technical Forum is open to all interested parties
  - To be held at least 4 times per year (in at least two locales)
- The purpose of the forum is to:
  - Achieve, as much as possible, a mutual understanding of the needs and plans of users and developers.
  - Provide the Geant4 Collaboration with the clearest possible understanding of the needs of its users.
  - Promote the exchange of information about physics validation performed by Geant4 Collaborators and Geant4 users.
  - Promote the exchange of information about user support provided by Geant4 Collaborators and Geant4 user communities.
- First Technical Forum meeting at TRIUMF during this collaboration meeting, followed by one at CERN in October.