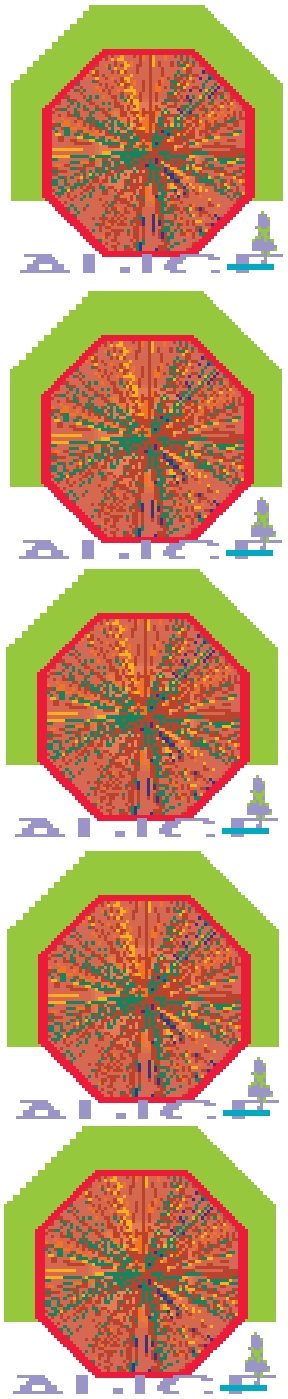

ALICE Geant4 Simulation

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For the ALICE Collaboration

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BNL, 9 April 2000

Outline

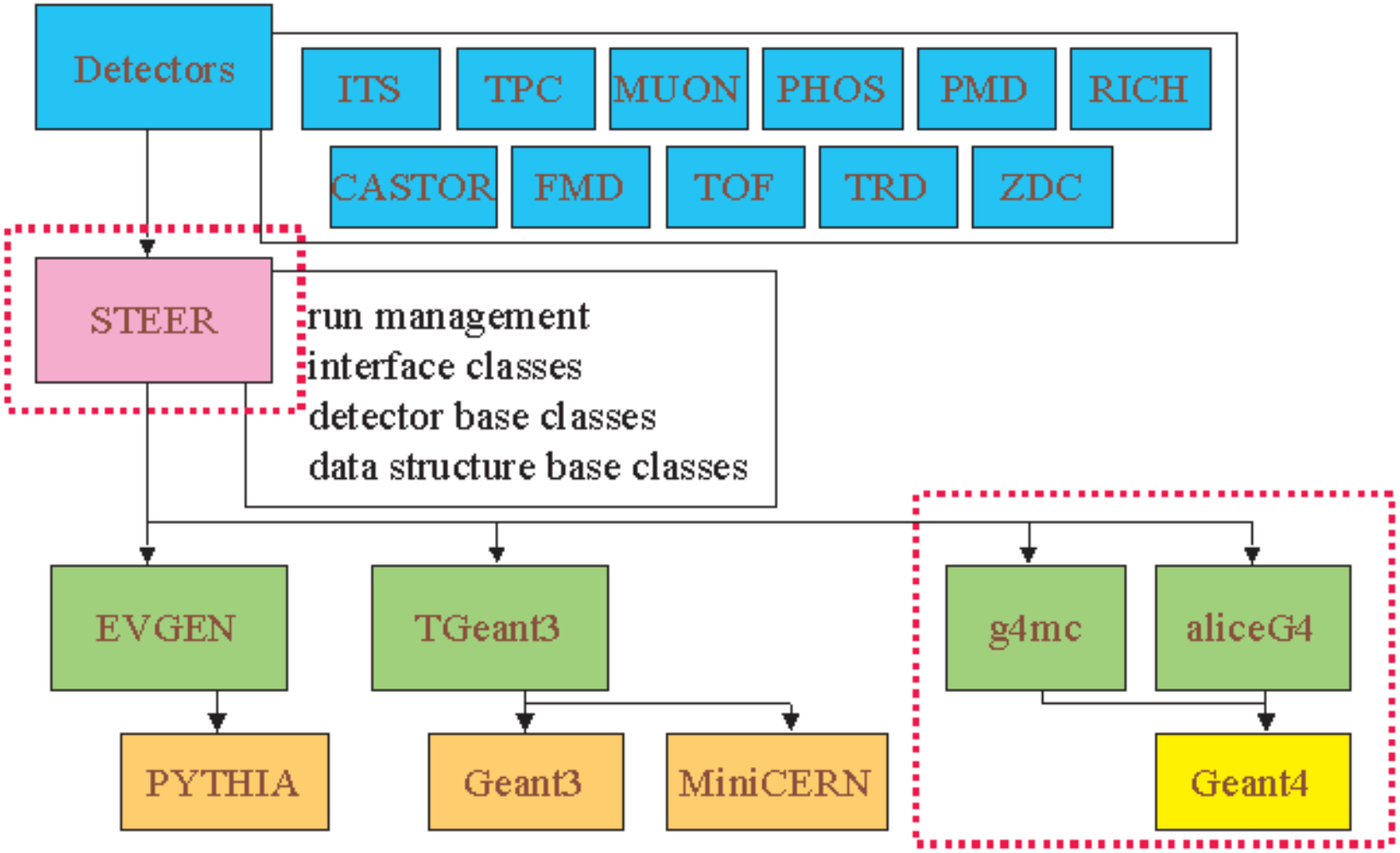
- AliRoot framework
  - aliceg4, g4mc
    mediators between AliRoot and Geant4
- Alice Geant4 specific classes (aliceg4)
- MC Implementation for G4 (g4mc)
- Present status
- Summary

AliRoot Framework

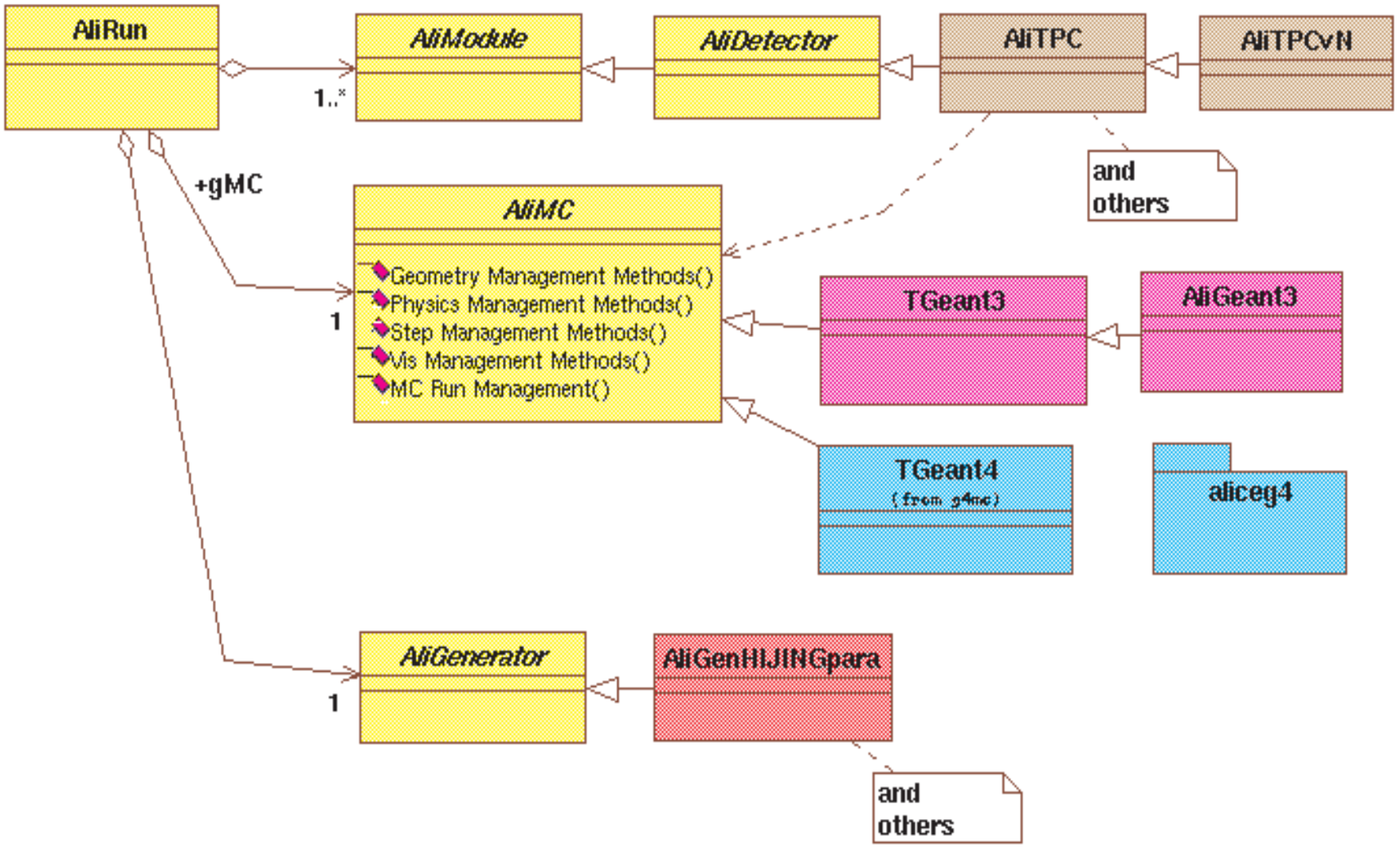
- AliRoot framework = ALICE off-line framework for simulation, reconstruction and analysis
  - Object Oriented methodology, C++, based on ROOT
  - plus Geant3 and some more code in FORTRAN,
- AliRoot framework provides:
  - central run control
  - concept of modules

    each detector is represented by a module object
  - persistency (IO) - it takes care of storing of simulated data
  - interface to event generators
  - ...

AliRoot Framework Components



AliRoot Framework
Run Control



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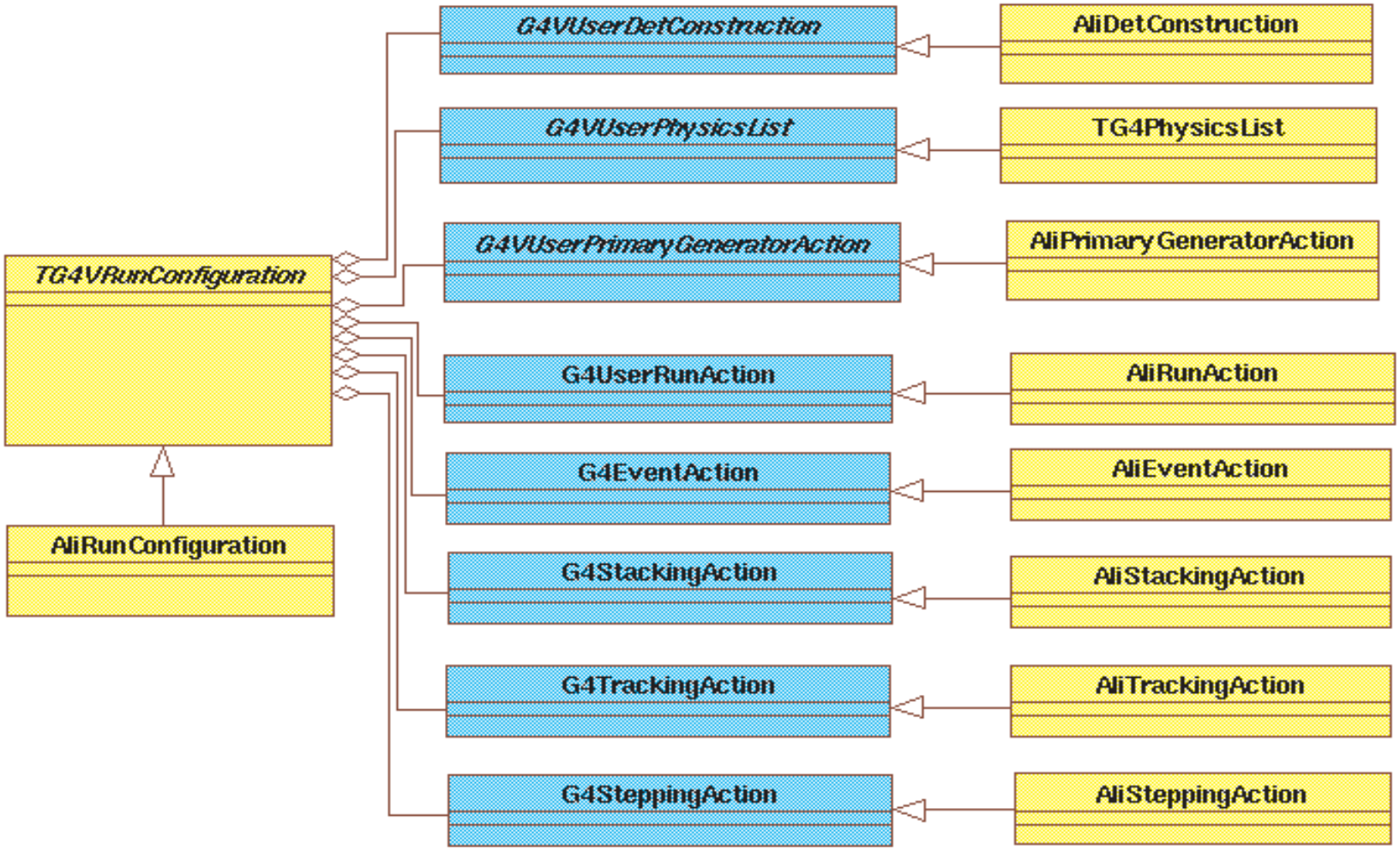
aliceg4
AliRunConfiguration

- Provides "user action" classes
  - "user actions" let G4 kernel know user's demands
- The mandatory classes (derived from G4 abstract base classes):
  - AliDetConstruction - detector geometry, materials (AliModule)
  - AliPrimaryGeneratorAction -event generator (AliGenerator)
  - the physics list mandatory class is provided by g4mc
- The customizing classes (derived from G4 base classes):
  - AliSteppingAction - detecting and stopping of looping particles
  - AliTrackingAction - storing hits per primary track (AliRun)
  - AliStackingAction - stacking particles
  - AliEventAction - begin/end of event (AliRun)
  - AliRunAction - begin/end of Run (AliRun)

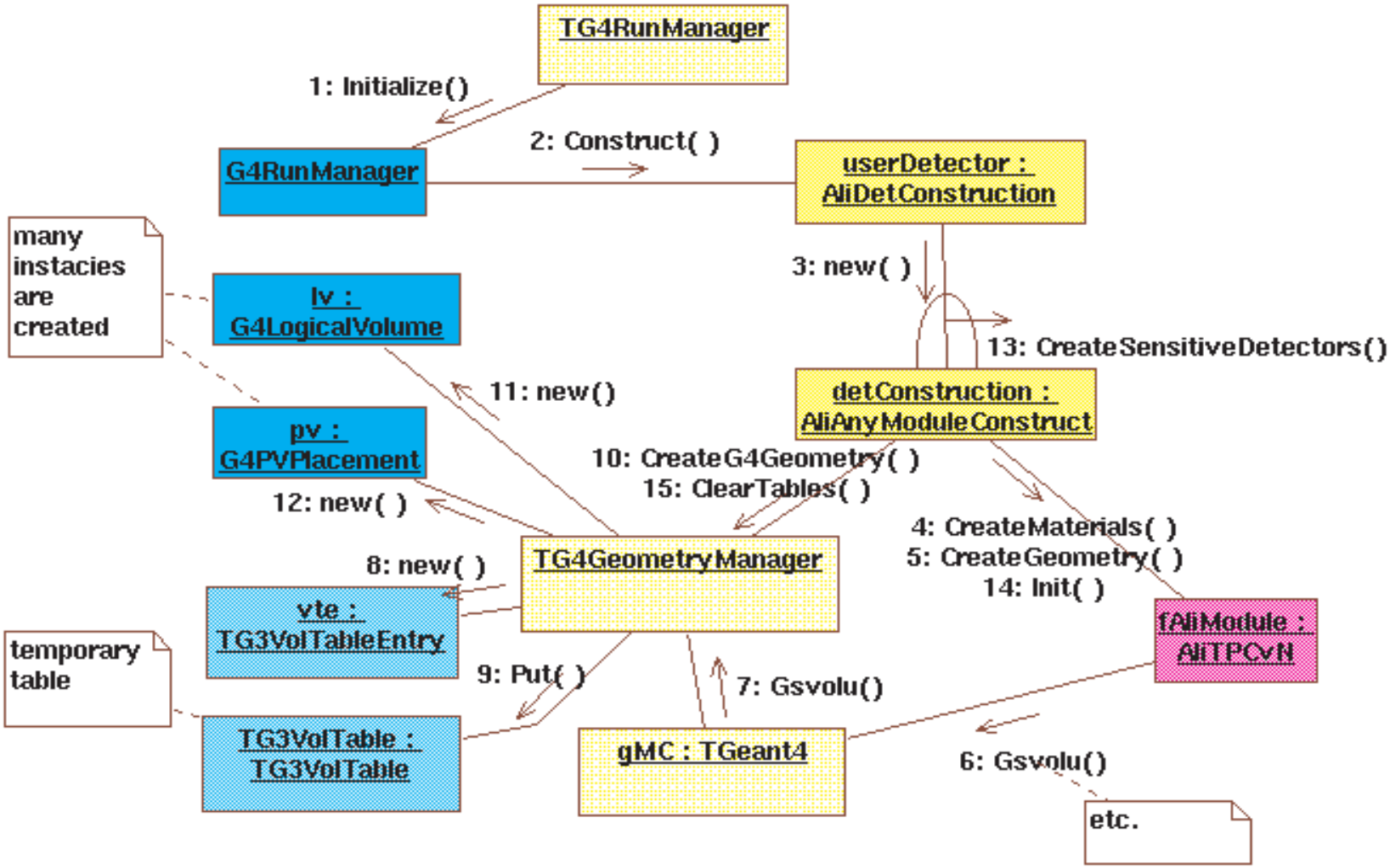
aliceg4
AliRunConfiguration



aliceg4
Detector Construction

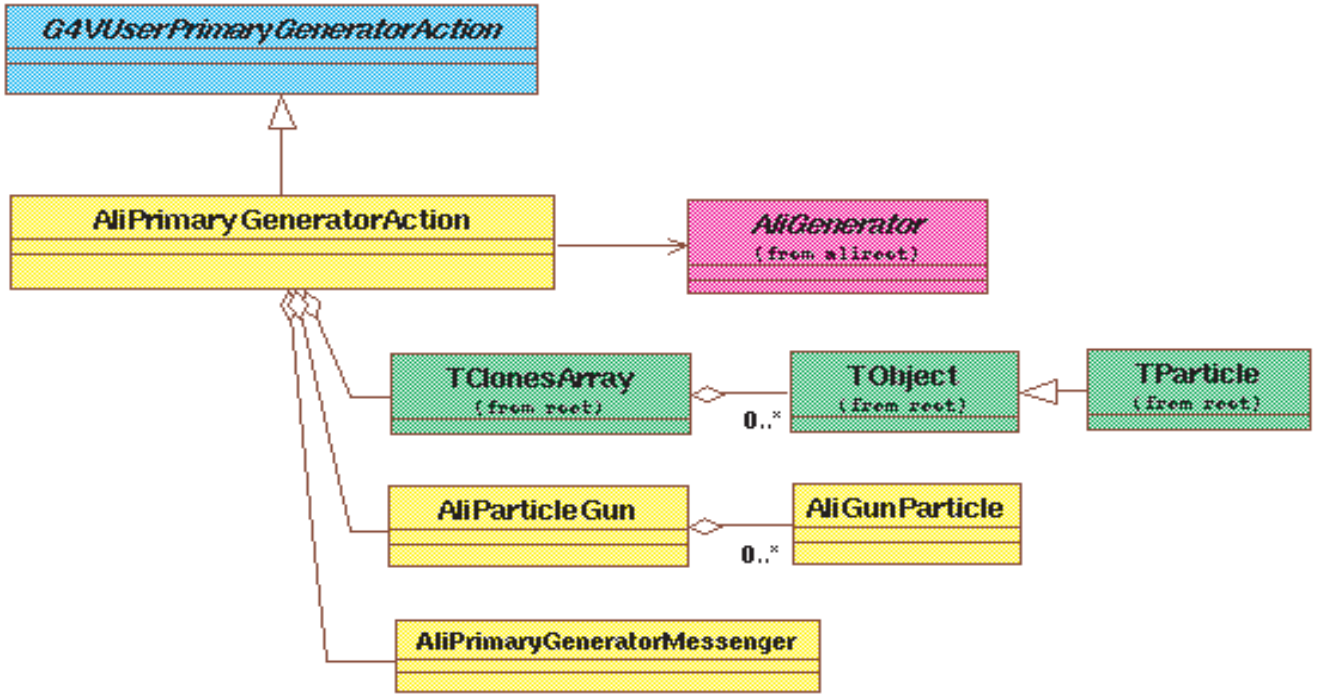
- Class AliDetConstruction
- Constructs G4 geometry
  - AliModule::CreateGeometry(), CreateMaterials()
  - using Monte Carlo interface
- Enables to combine
  - **single detector constructions** (when the detector is built independently)
  - and **more detector construction** (when a set of dependent detectors is constructed alltogether)
- Detector setup can be defined in two ways:
  - in "standard" Config.C macro
    detectors are constructed all together
  - interactively (/alDet/switchOn, /alDet/switchOff commands)
    only dependent detectors are built together

aliceg4
Detector Construction

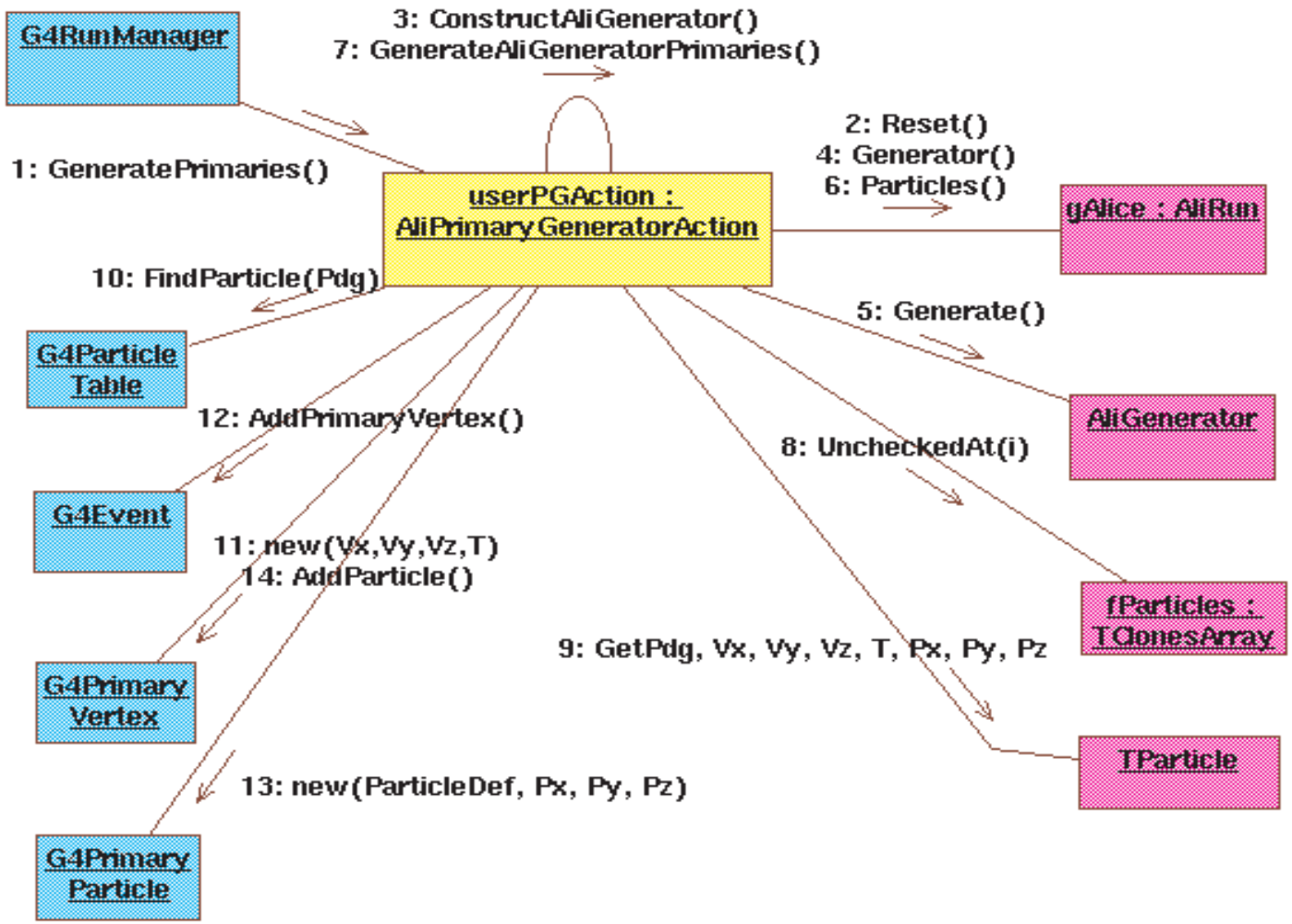


aliceg4
Primary generator

- Class AliPrimaryGeneratorAction
- Generator of primary particles (AliGenerator) from AliRoot
- Particle gun for testing



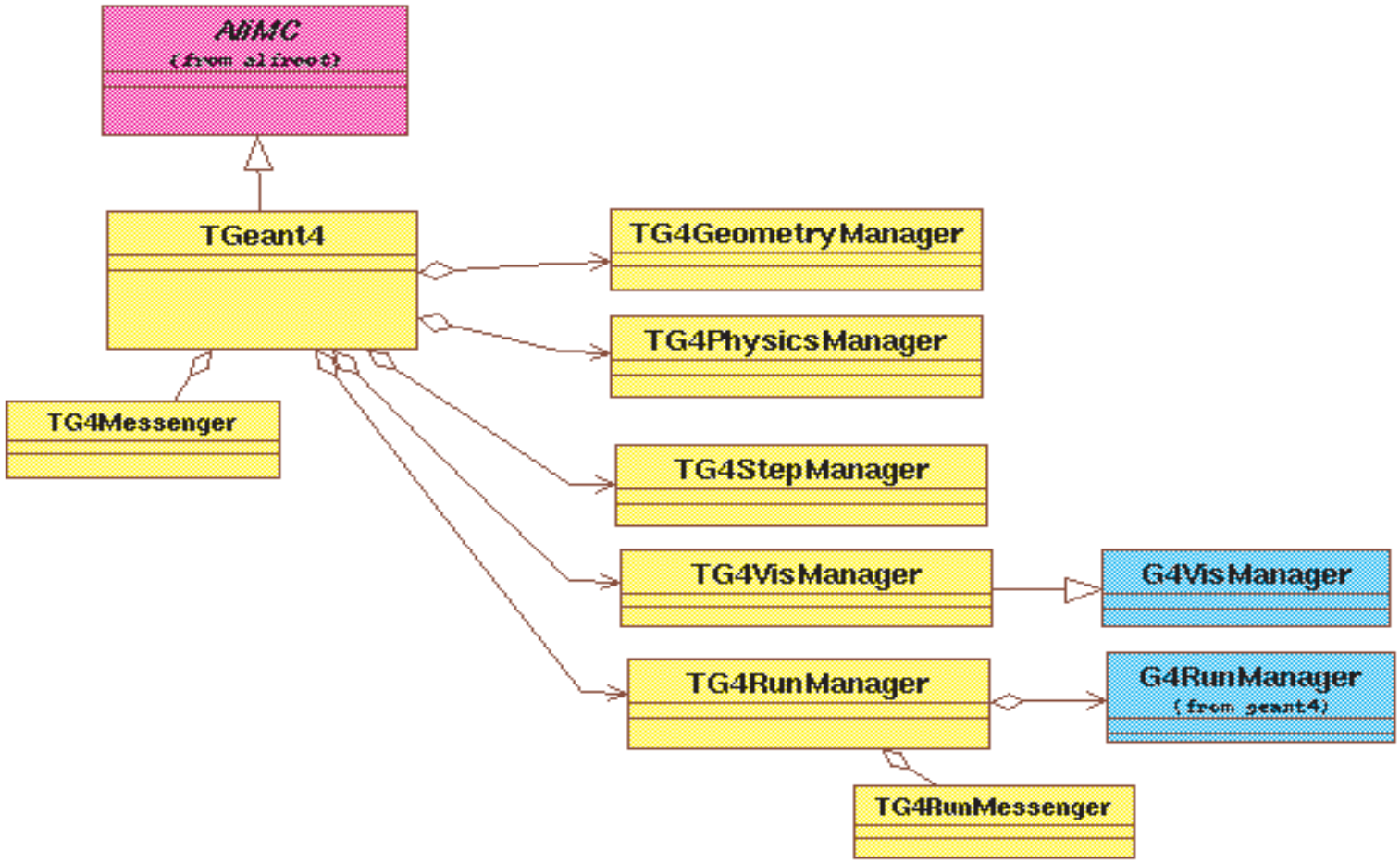
aliceg4
Primary generator



g4mc
Monte Carlo Interface

- Pure abstract class AliMC
- It has been developed as generalization of G3 functions for definition of simulation task
- Provides methods for
  - geometry description definition
  - physics process control
  - access functions to tracking particle properties
  - visualization
- In G4 implementation each domain is covered by its manager class:
  - geometry, physics, stepping, visualization, run
- each manager uses corresponding category(ies) of G4

g4mc
Monte Carlo Interface



g4mc
Geometry Manager

- Geometry manager as client of **g3tog4**
  - stand-alone tool provided by Geant4 for automatic conversion of G3 geometry
- This development resulted to our contribution to g3tog4 in Geant4
  - included in Geant4 V1.0 release
- In difference from standard usage of g3tog4 the input geometry is not the ZEBRA file (converted to ASCII file) but the C++ code in detector classes in AliRoot
  - for debugging reasons the ASCII file can be generated from AliRoot, read back and process by standard g3tog4 tool, too

g4mc
Geometry Manager

- Almost all G3 options for geometry definition are supported
  - passing parameters from mother volume to its daughters
  - divided volumes - represented by replicated physical volumes in G4 (G4PVReplica)
- Unsupported option: "MANY"
  - "MANY" option substitutes lack of Boolean operations in G3 geometry

g4mc
Physics Manager

- Physics manager provides G4 physics list construction from G3 cuts and physics process control parameters
- G3 tracking media parameters are applied to G4 logical volumes with usage of
  - user limits (derived class from G4UserLimits)
  - special cuts process (derived class from G4VProcess)
  - special flags (process control) process (derived class from G4VProcess)
- In development
  - design work already done, most of implementation work, too
  - some of G3 parameters are not yet supported
  - more testing needed

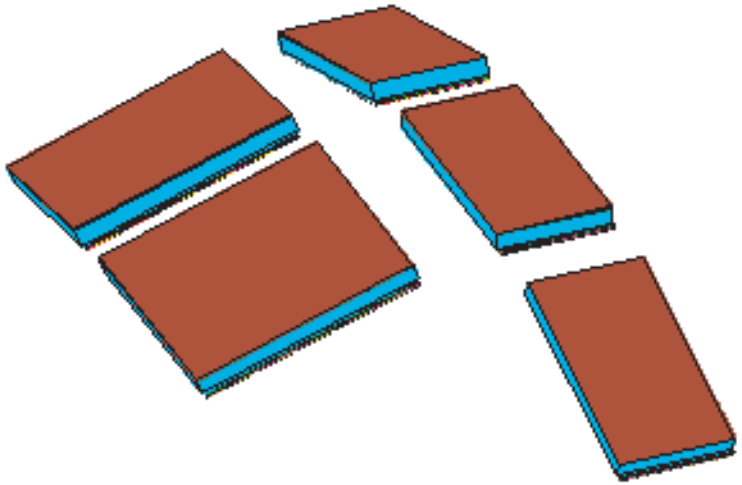
g4mc Step Manager

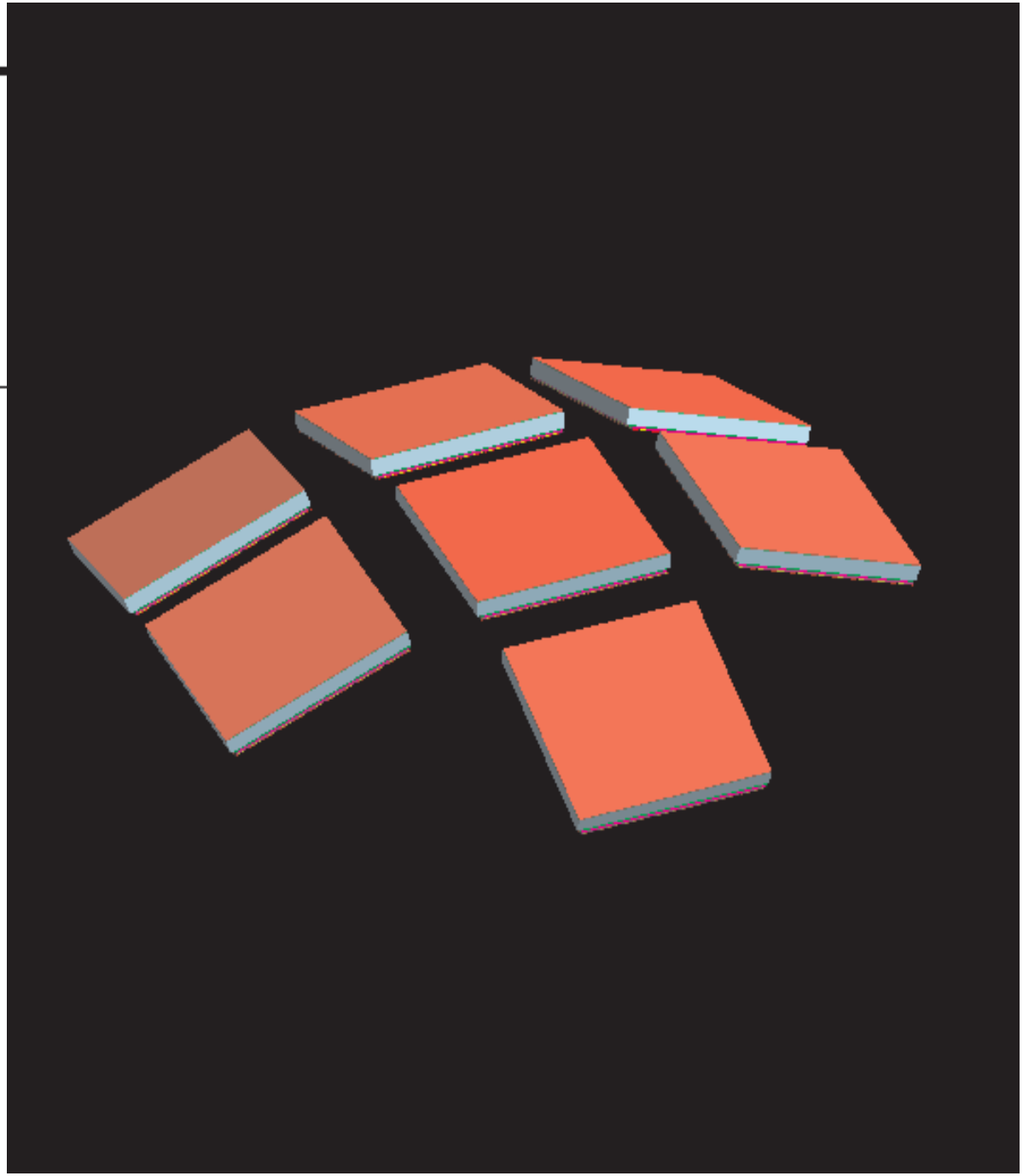
- Step manager provides access functions to tracking particle properties during stepping

g4mc
Visualization Manager

- Visualization manager implements visualization methods from Monte Carlo
  - Geant3-like interface
  - not all optins are supported
- DrawDDD.C, ViewDDD.C macros from AliRoot work with G4 graphics
  - some pictures are not exactly the same yet

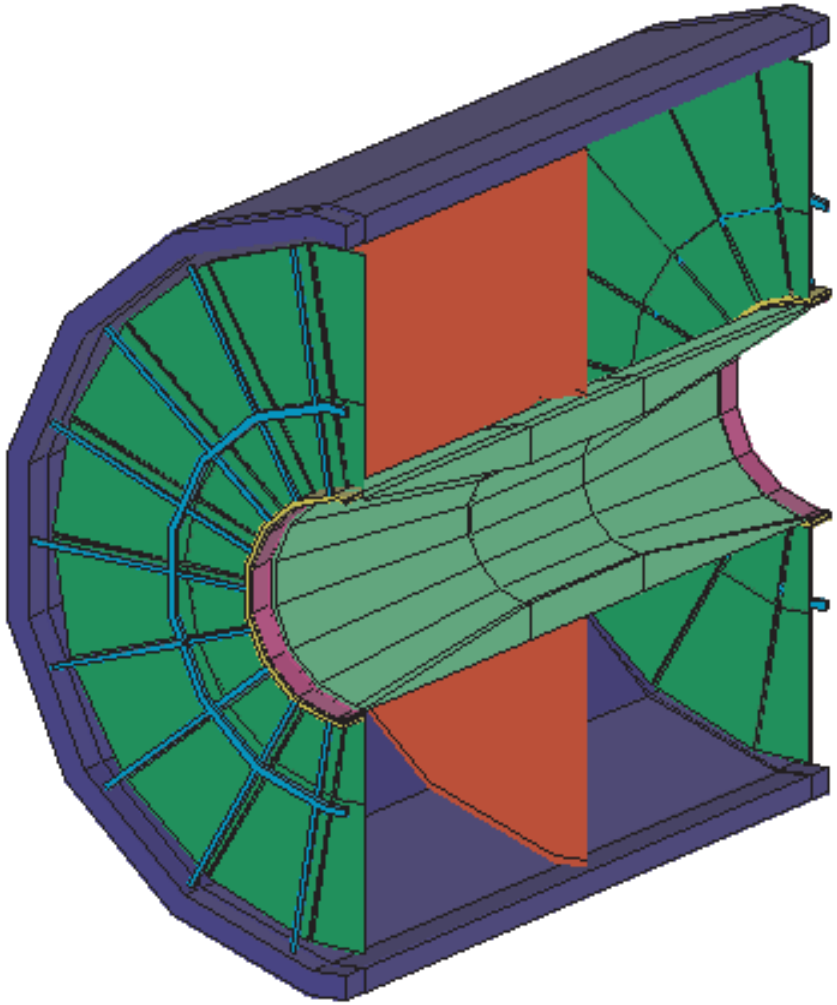
Ring Imaging Cherenkov

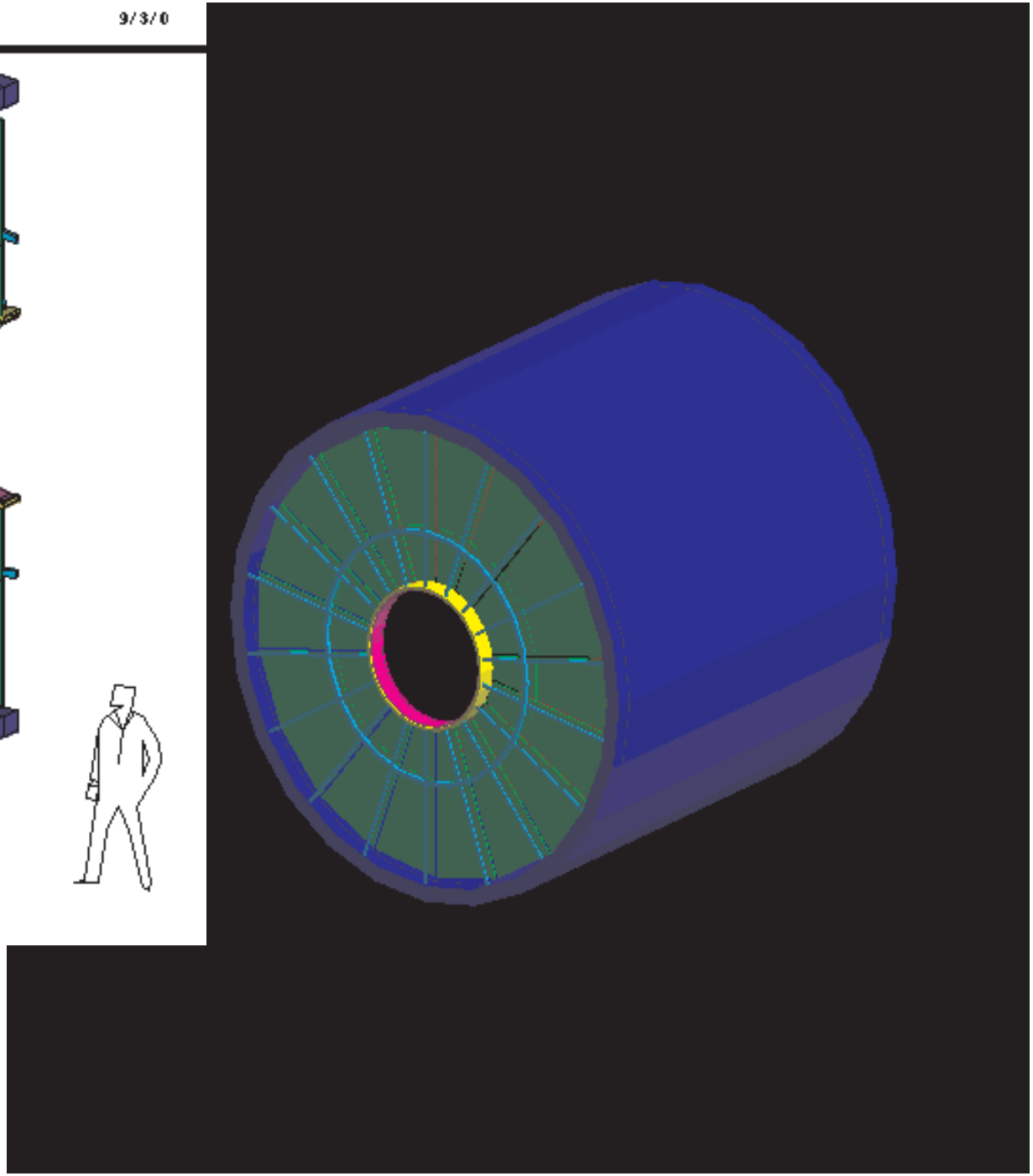




Time Projection Chamber

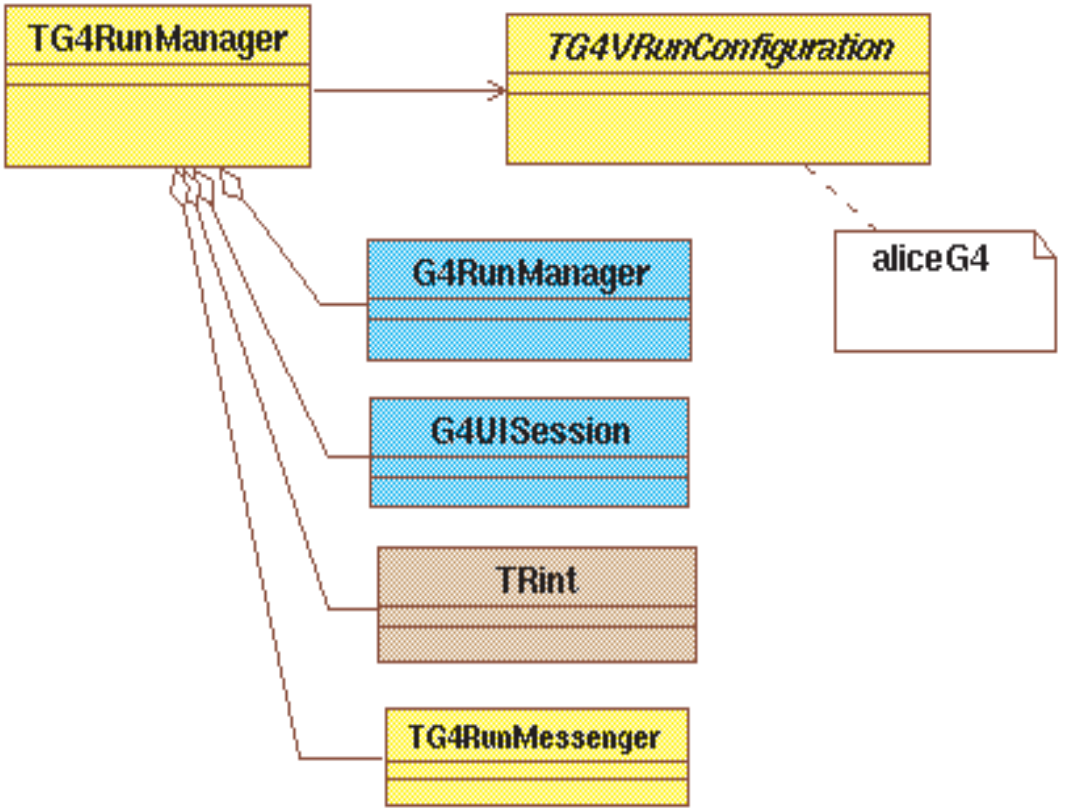
9/3/0





g4mc
Run Management

- Run manager provides Geant4 run management control
- Switching between G4 (G)UI and Root UI



g4mc (G)UI

- The execution of G4 simulation can be controlled both interactively and via macro
- several (G)UIs are provided by G4
  - based on commands structured in "Unix" like directories:

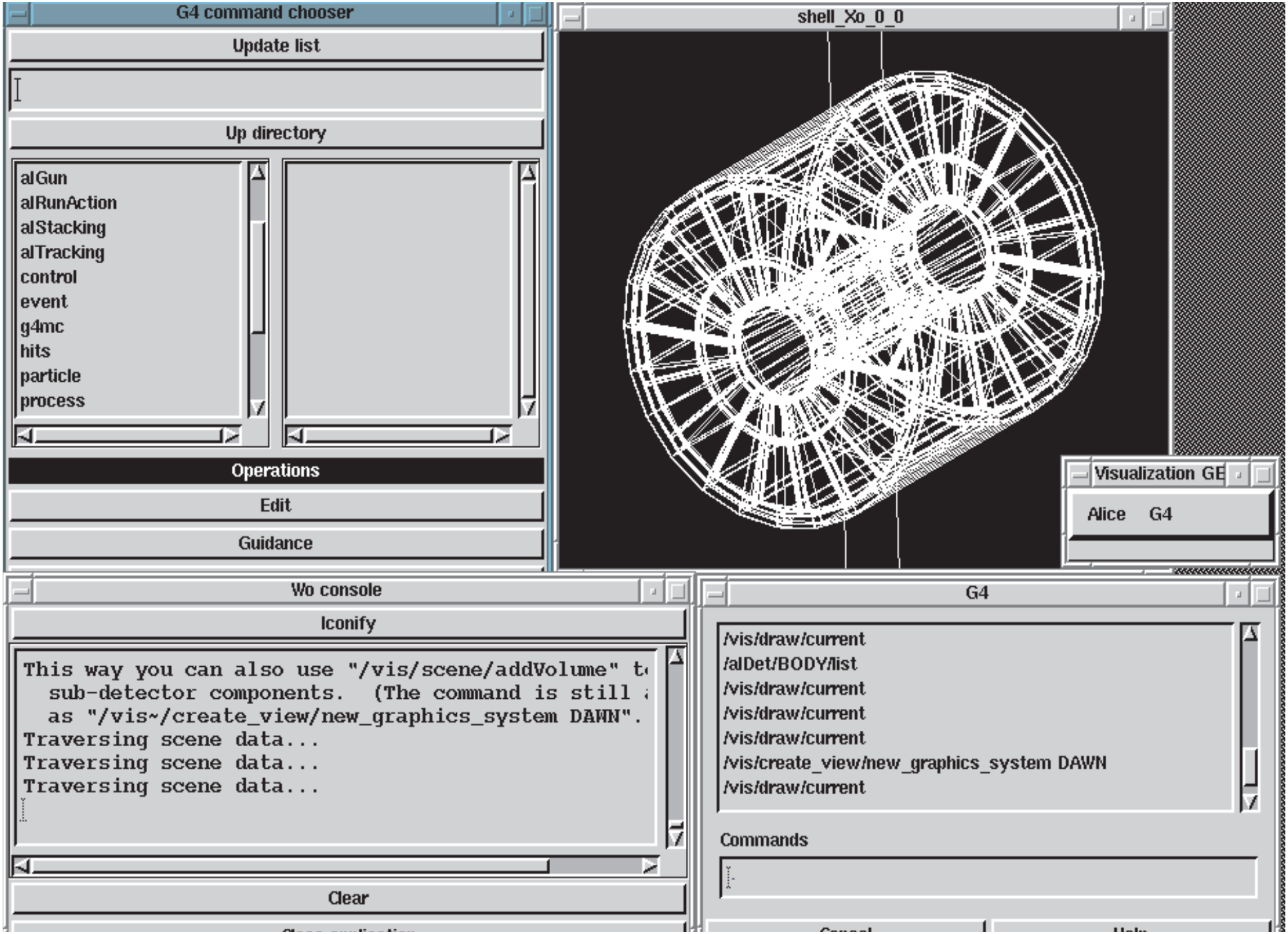
    PreInit> /run/initialize

    Idle> /run/beamOn
- ROOT UI using Root interactive shell, too

  root [0] gAlice->Init();

  root [1] gAlice->Run();
- Limitations:

  AliRoot objects are not accessible from G4 UIs and G4 objects are not accessible from Root UI


G4 command chooser
Update list
Up directory
alGun
alRunAction
alStacking
alTracking
control
event
g4mc
hits
particle
process
Operations
Edit
Guidance
shell_Xo_0_0
Visualization GE
Alice G4
Wo console
Iconify
This way you can also use "/vis/scene/addVolume" t
sub-detector components. (The command is still
as "/vis~/create_view/new_graphics_system DAWN".
Traversing scene data...
Traversing scene data...
Traversing scene data...
Clear
G4
/vis/draw/current
/alDet/BODY/list
/vis/draw/current
/vis/draw/current
/vis/draw/current
/vis/create_view/new_graphics_system DAWN
/vis/draw/current
Commands

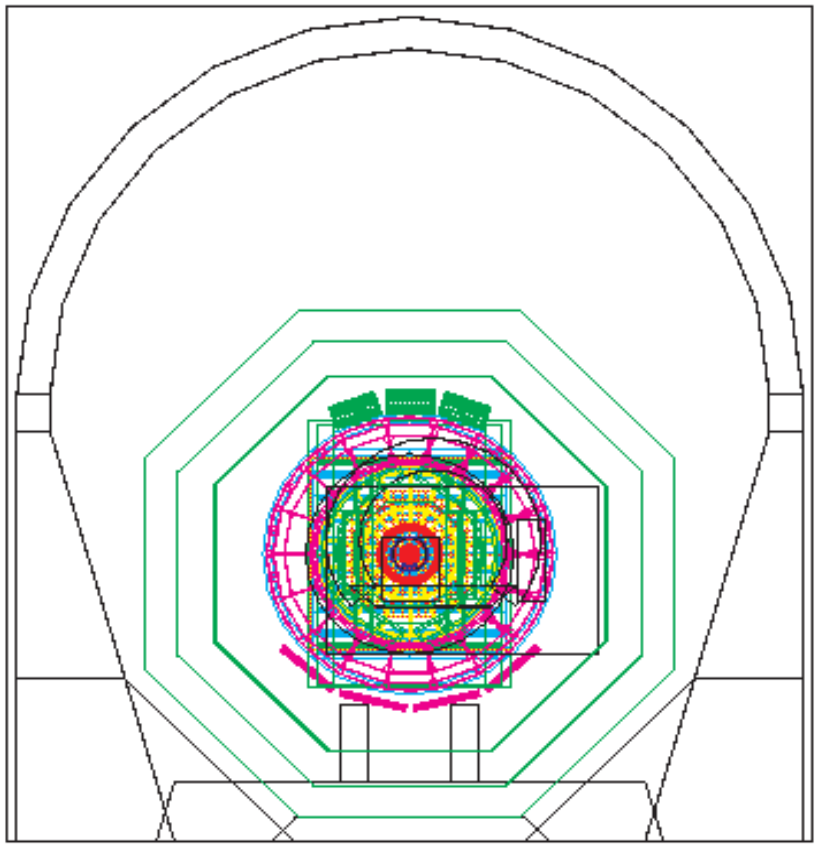
Present Status
Geometry

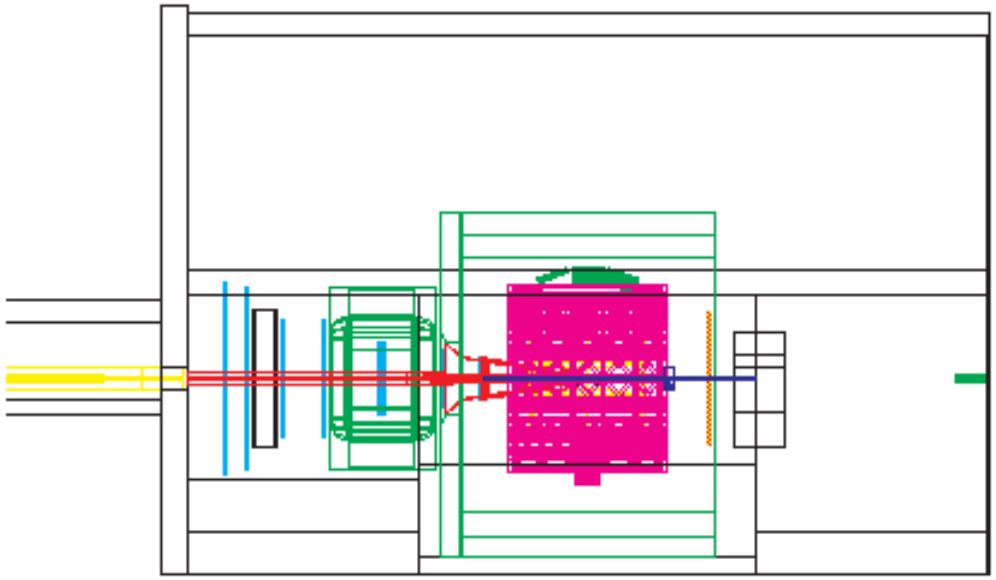
- Geant4 geometry of all detectors (defined in AliRoot) can be built
- But "MANY" option is not supported
- This causes incorrect handling of the detector geometries with "MANY" by Geant4 navigator
  - some volumes are ignored in tracking
  - eg. ITSv5 - the default ITS version

Present Status
Geometry

Detectors: TPCv0, RICHv0, FMDV1, CASTORv0, MUONv0, PHOSv1, PMDv0, ZDCv0

Structutres: HALL, ABSO, DIPOv1, FRAMEv0, MAG, PIPEv0, SHIL





Present Status
Tracking

- 10000 primaries test
- HIJING event generator
- Default AliRoot detectors setup (from Config.C)
  - without RICH
- "Default" G4 physics list
  - G3 cuts and process control not applied
- Several problems have appeared and have to be understood but
- Event has finished with success (= without an error exit)

Summary

- Complete ALICE Geant4 geometry
  - "MANY" option needs a solution
- Physics "setup" has to be defined in a G4 way
  - automatical porting of G4 cuts and process control parameters is not yet available
- Tracking with "real" particles has been started
  - a few minor problems has appeared and need to be understood

Short term goal:

To provide the G4 simulation prototype to users (= AliRoot developers) to invite them to participate on G4 geometry and physics validation