

ALICE Geant4 Simulation

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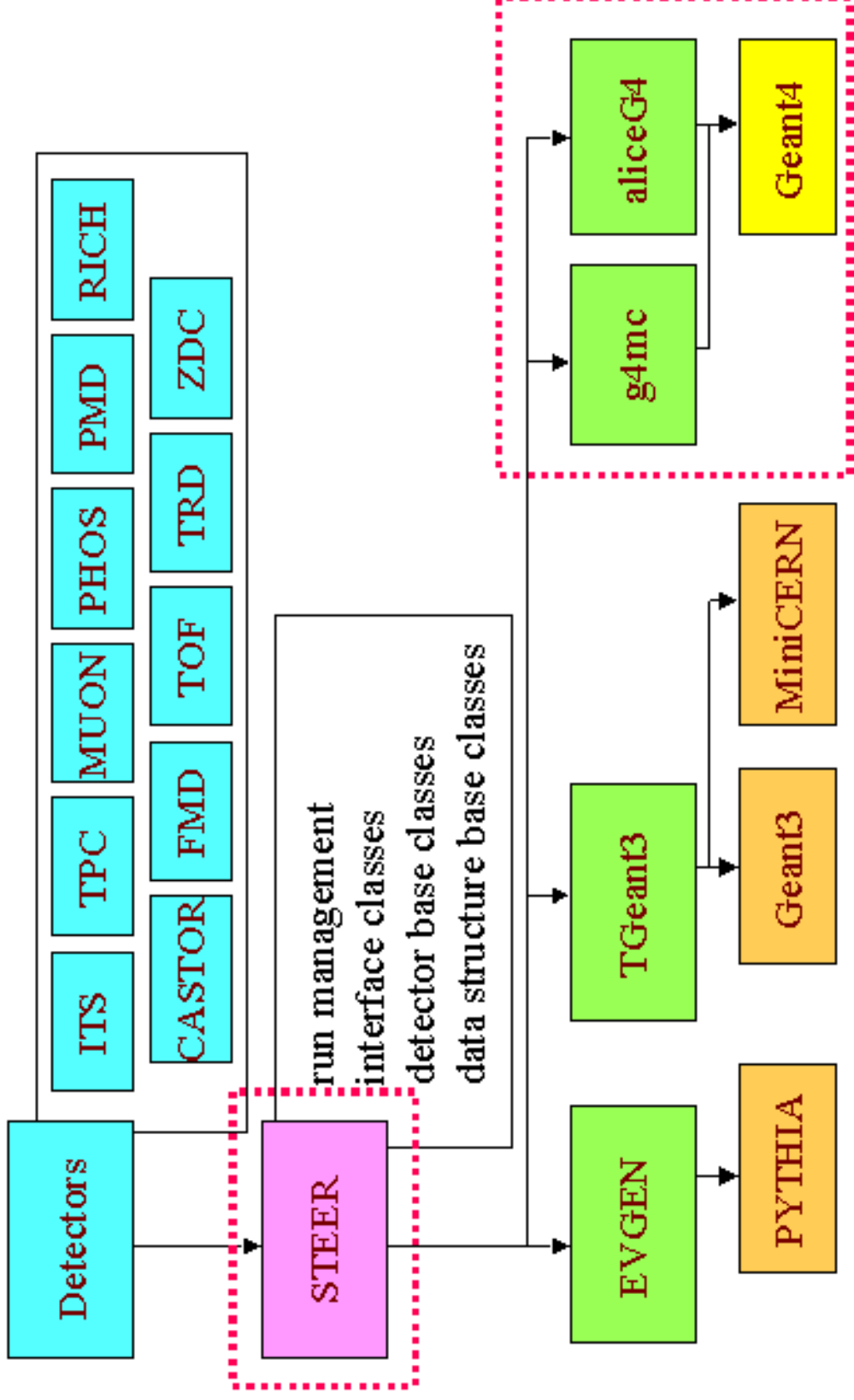
Outline

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

AliRoot Framework

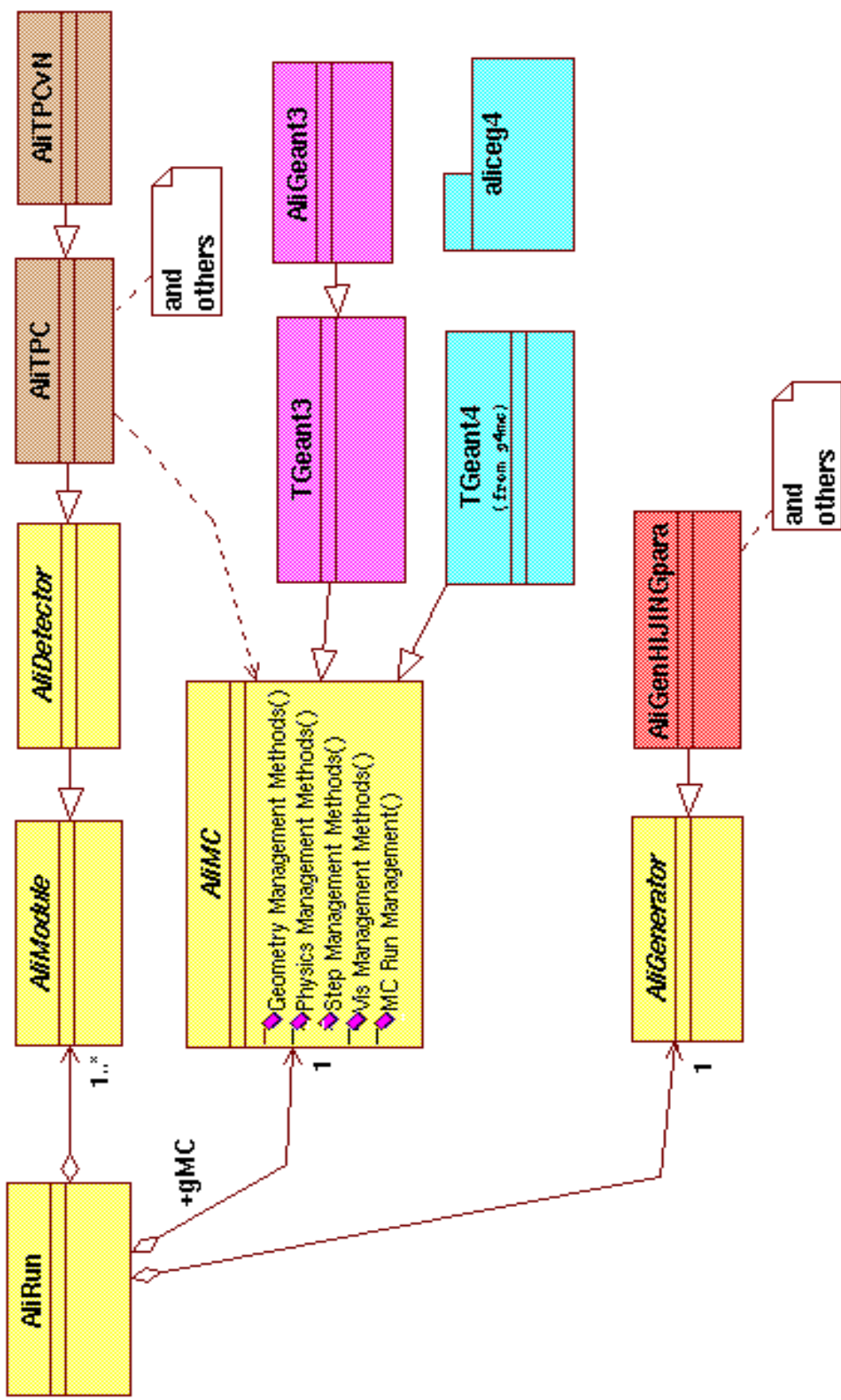
- AliRoot framework = ALICE off-line framework for simulation, reconstruction and analysis
 - Object Oriented methodology, C++, based on ROOT
 - plus Geant3 and some more code in FORTRAN,
- AliRoot framework provides:
 - central run control
 - concept of modules
 - each detector is represented by a module object
 - persistence (IO) - it takes care of storing of simulated data
 - interface to event generators
 - ...

AliRoot Framework Components



AliRoot Framework

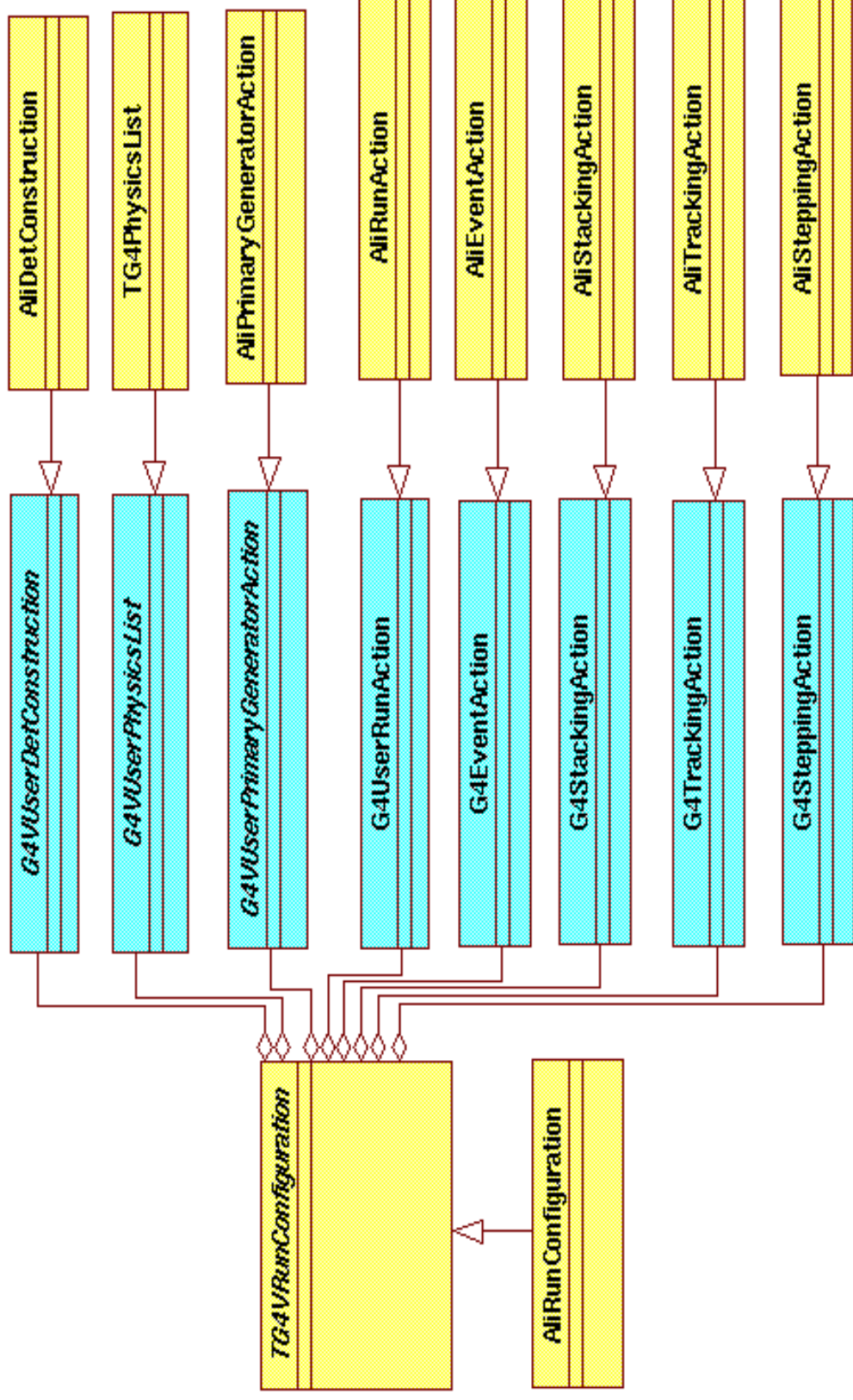
Run Control



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)

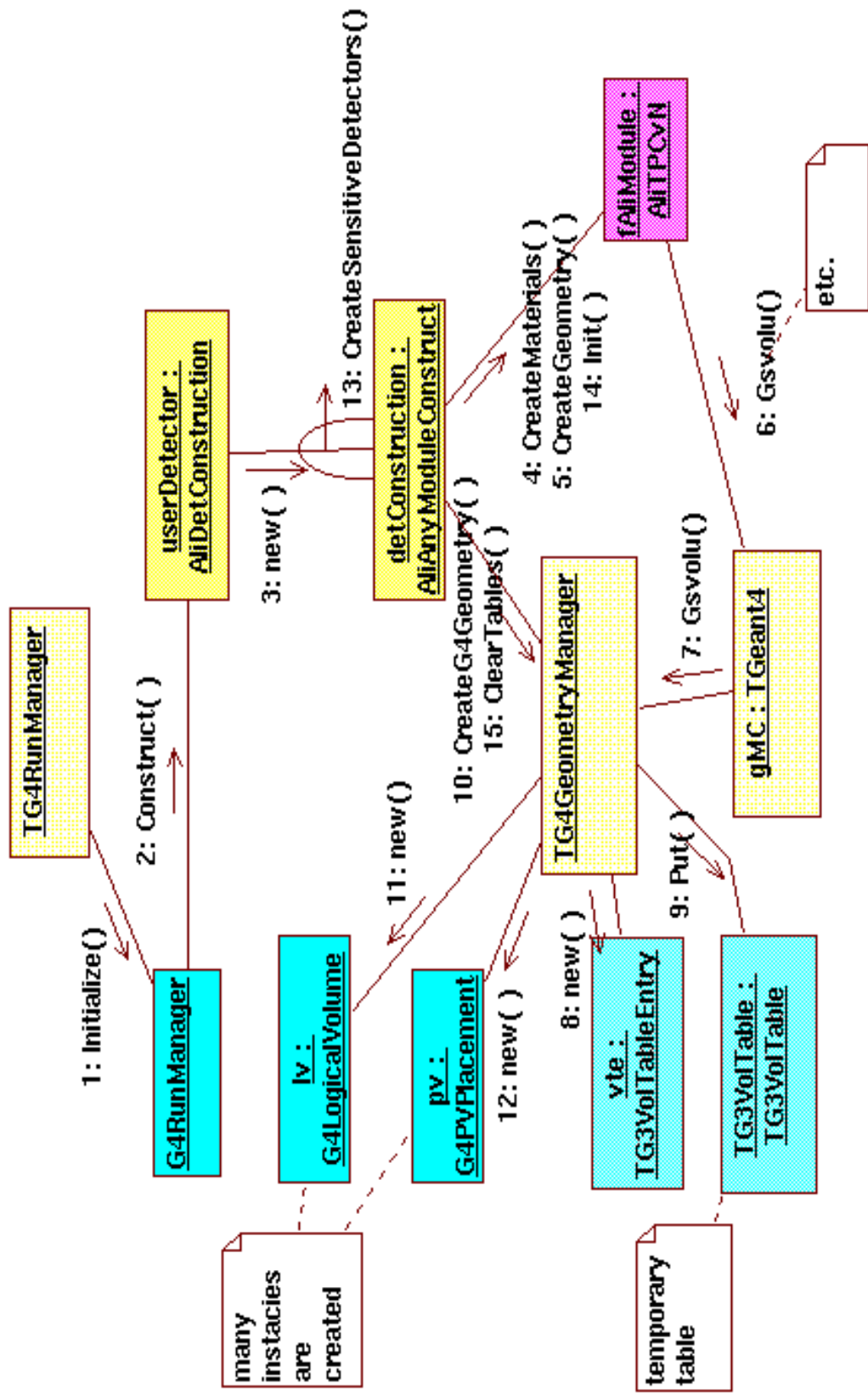
aliceg4 AliRunConfiguration



aliceg4 Detector Construction

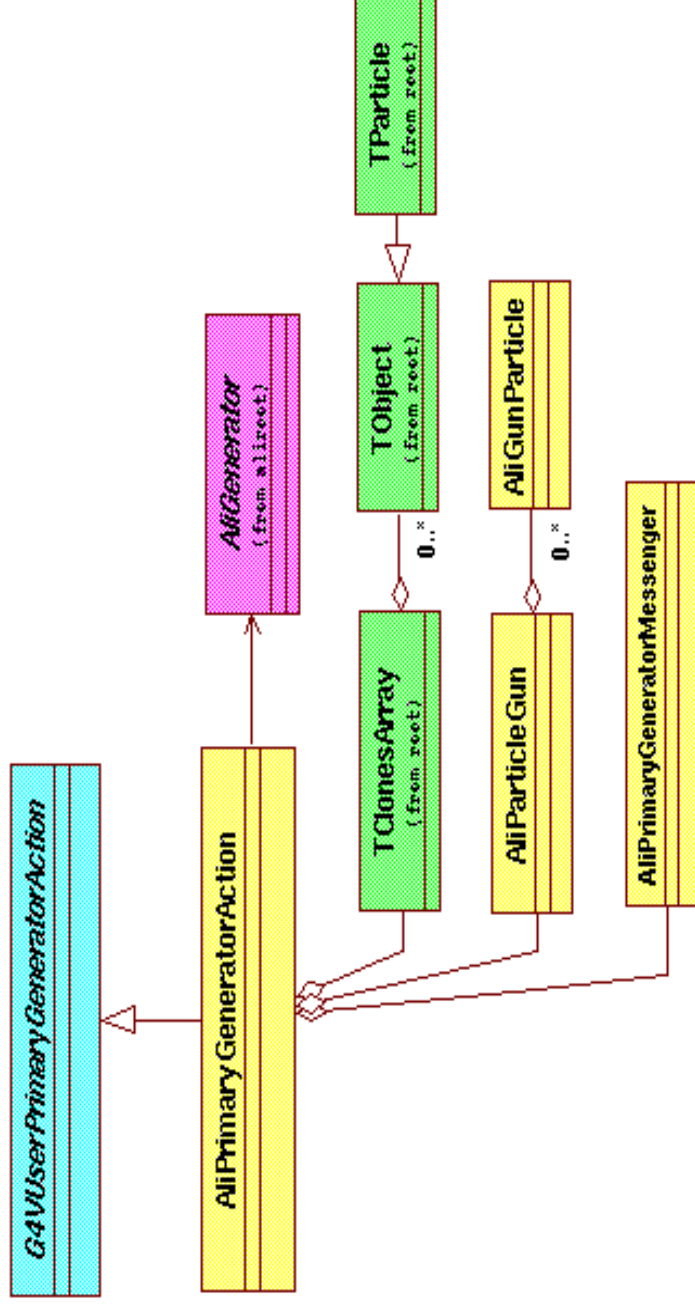
- Class `AliDetConstruction`
- Constructs G4 geometry
 - `AliModule::CreateGeometry()`, `CreateMaterials()`
 - using Monte Carlo interface
- Enables to combine
 - **single detector constructions** (when the detector is built independently)
 - and **more detector construction** (when a set of dependent detectors is constructed altogether)
- 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

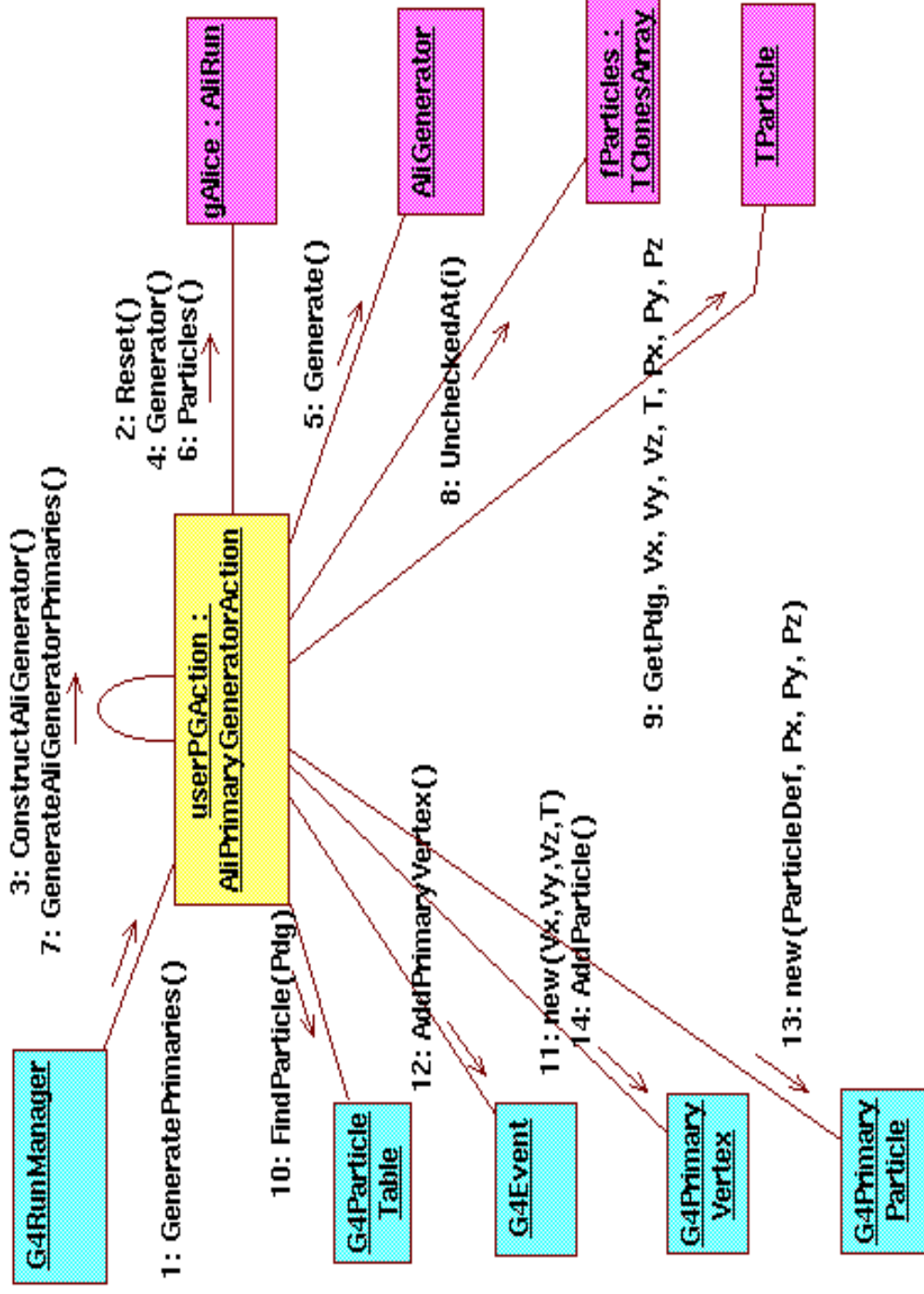


aliceg4 Primary generator

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



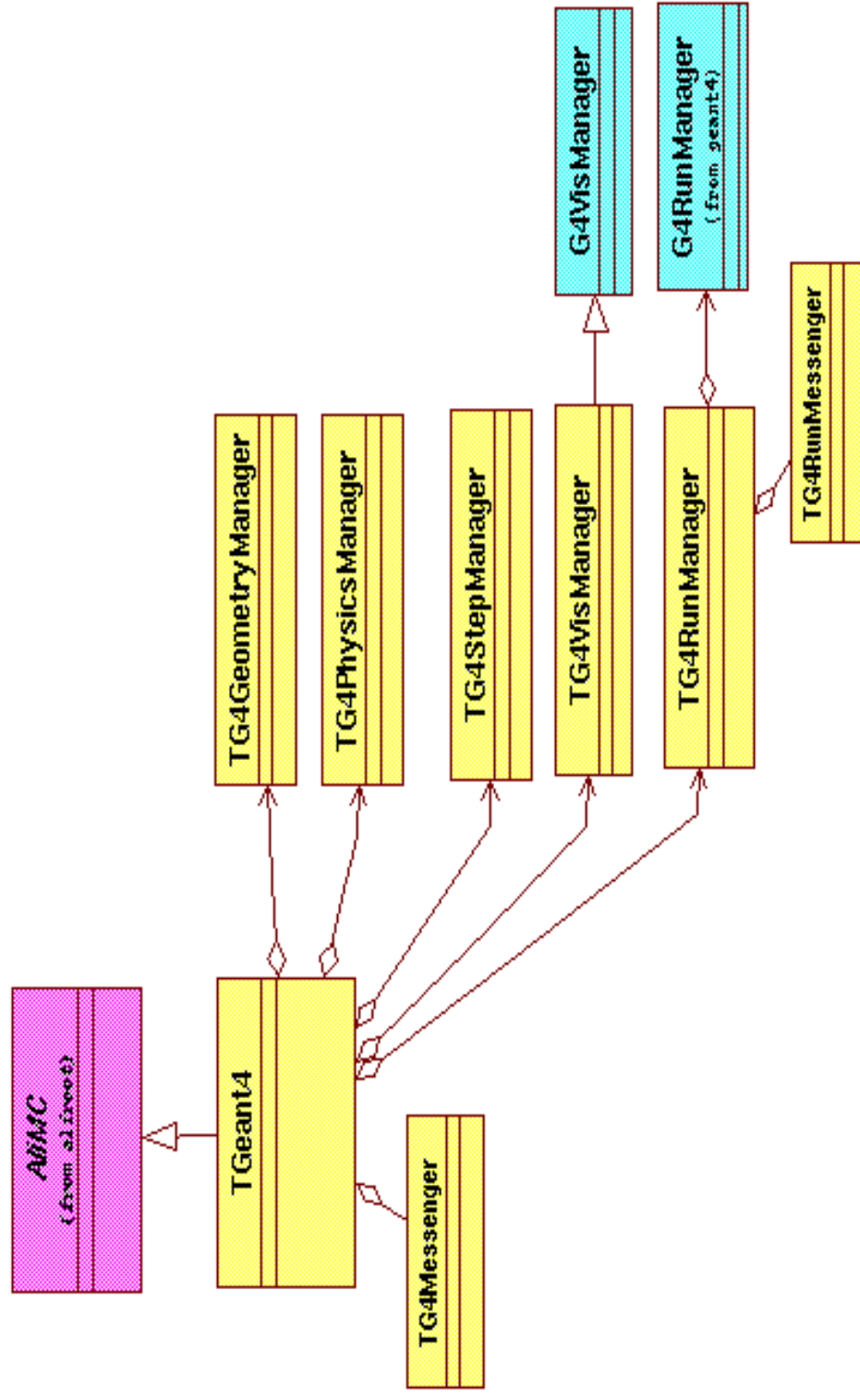
aliceg4 Primary generator



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

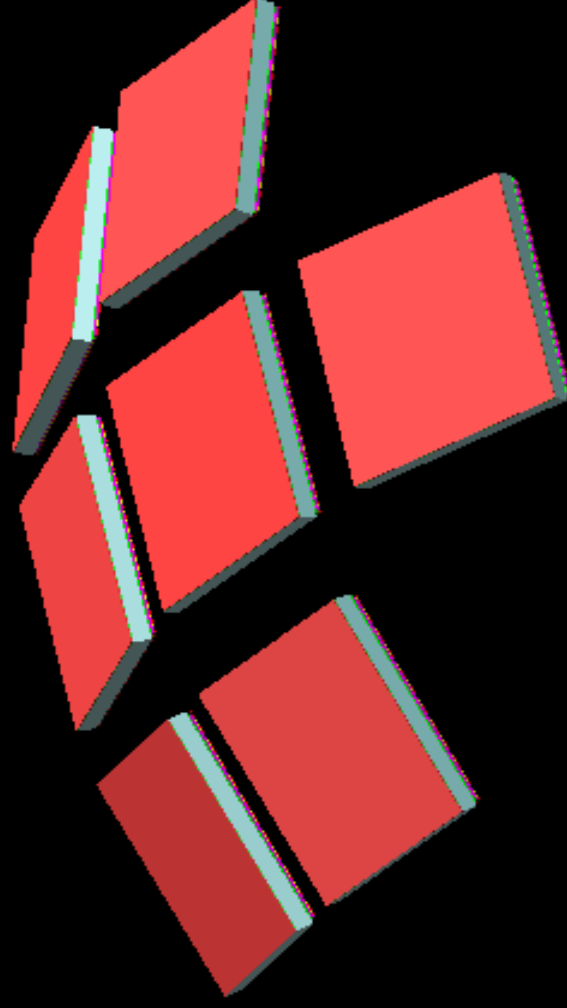
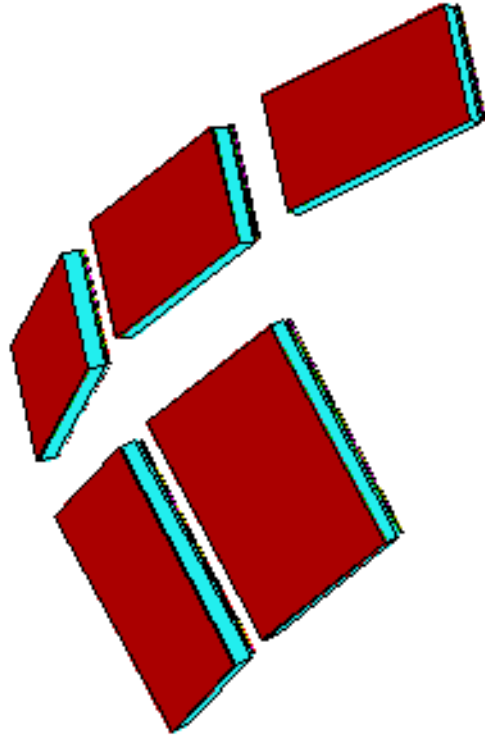
g4mc Step Manager

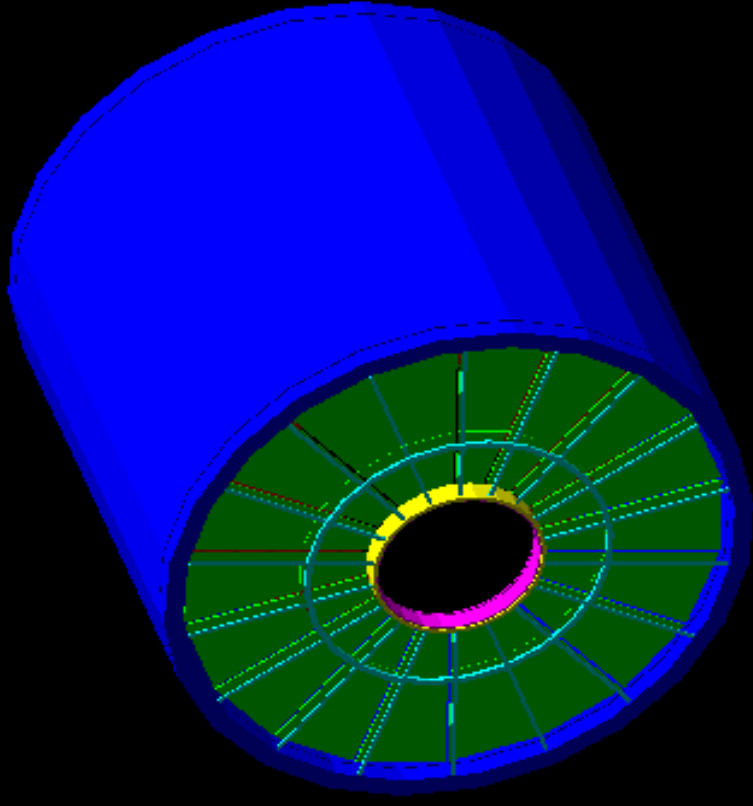
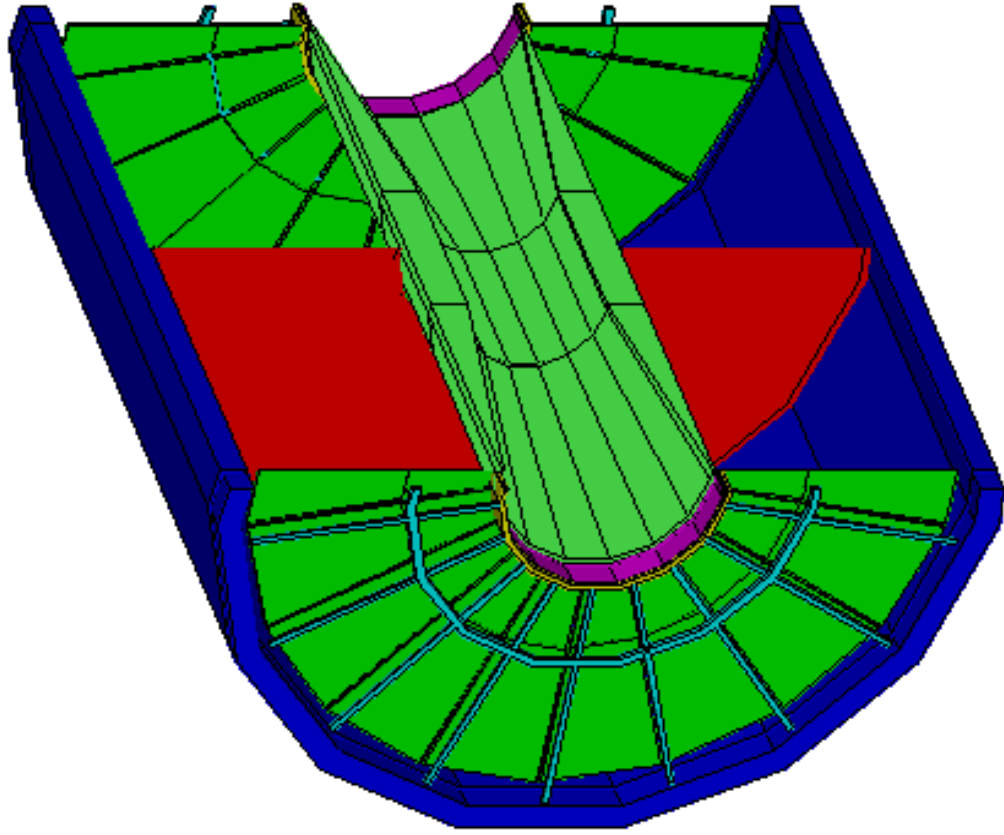
- Step manager provides access functions to tracking particle properties during stepping

g4mc Visualization Manager

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

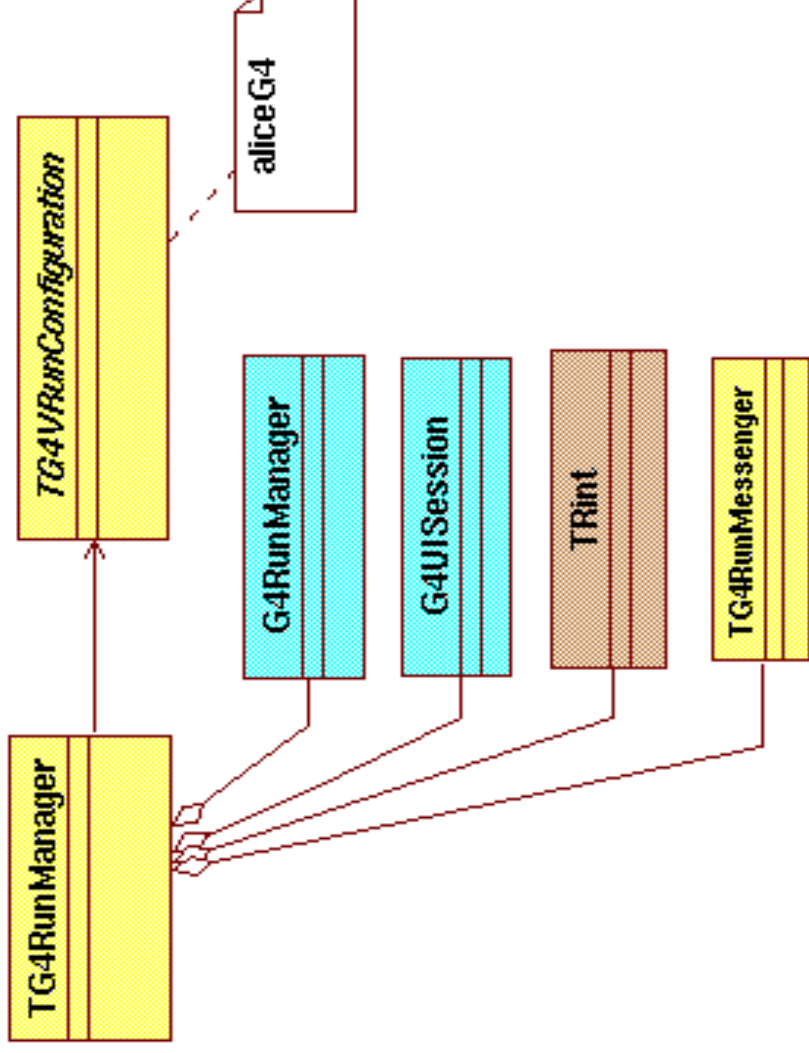
Ring Imaging Cherenkov





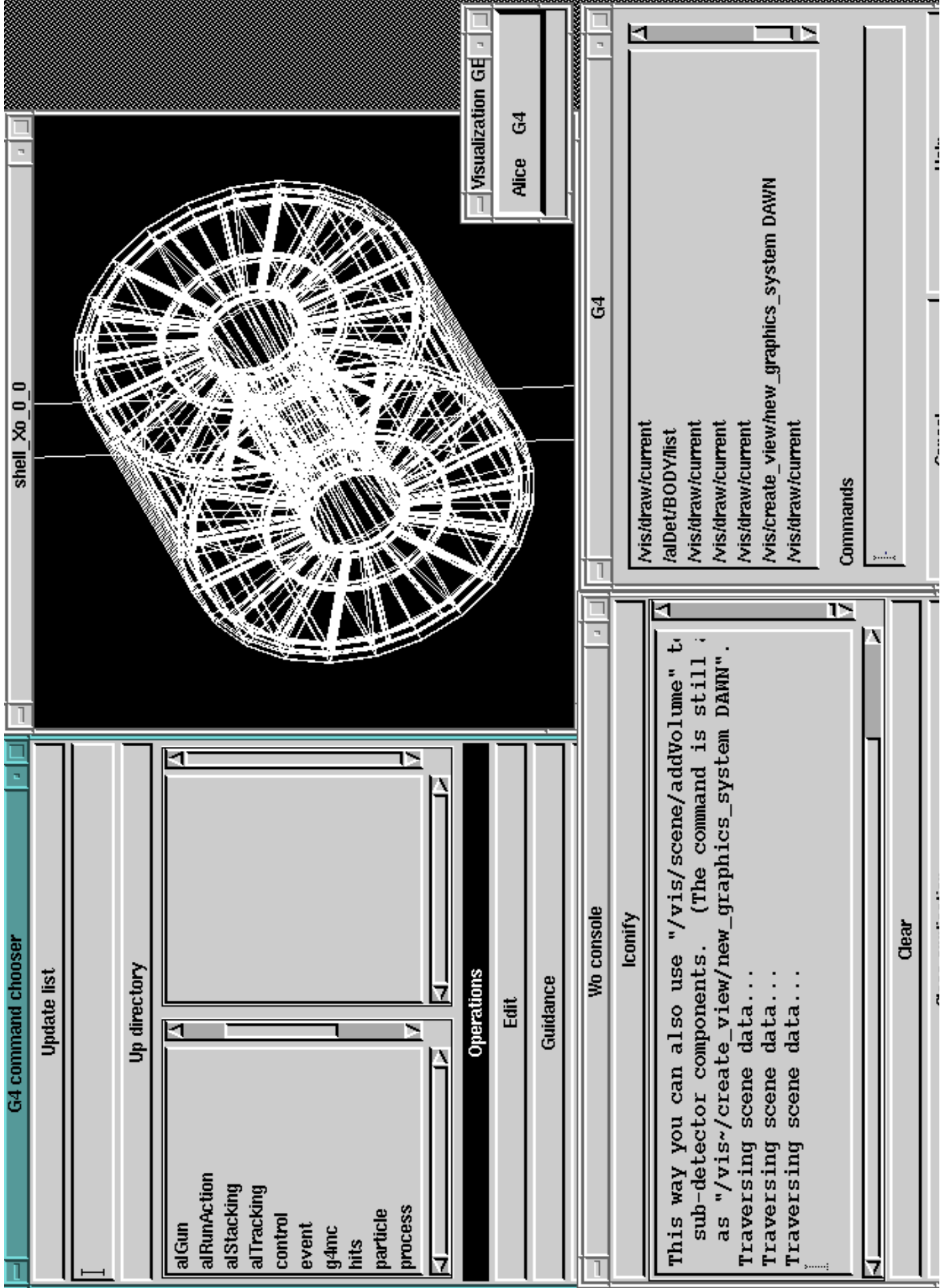
g4mc Run Management

- 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

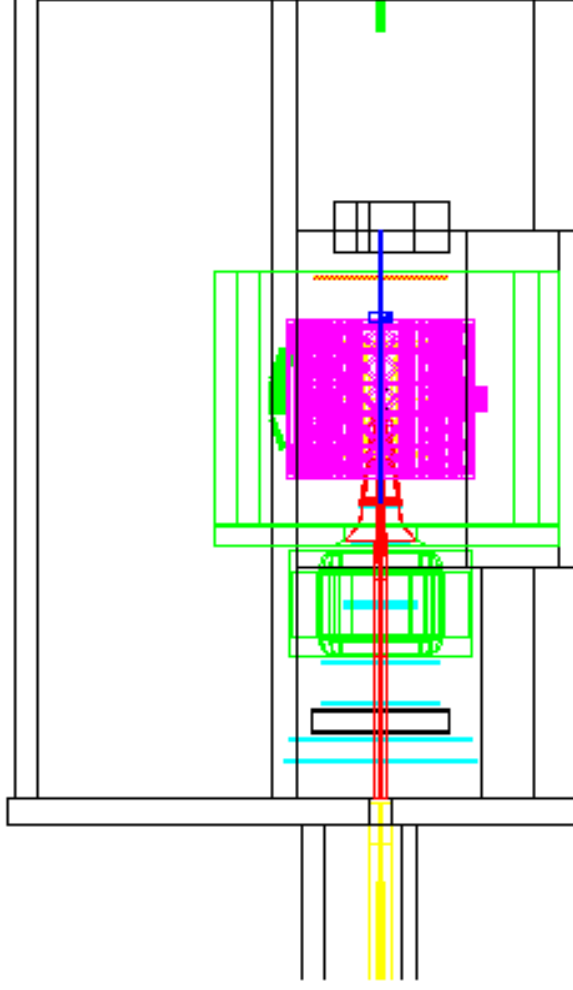
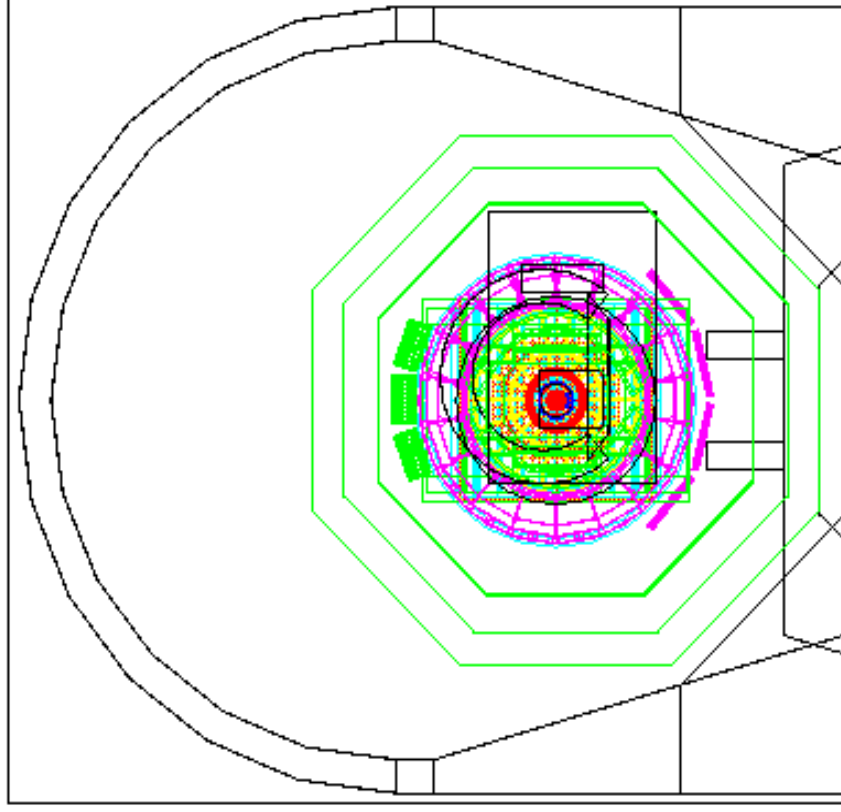


Present Status Geometry

- 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
 - automatic 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