The Virtual Geometry Model

I. Hřivnáčová

Institut de Physique Nucléaire (IPNO), Université Paris-Sud, CNRS-IN2P3
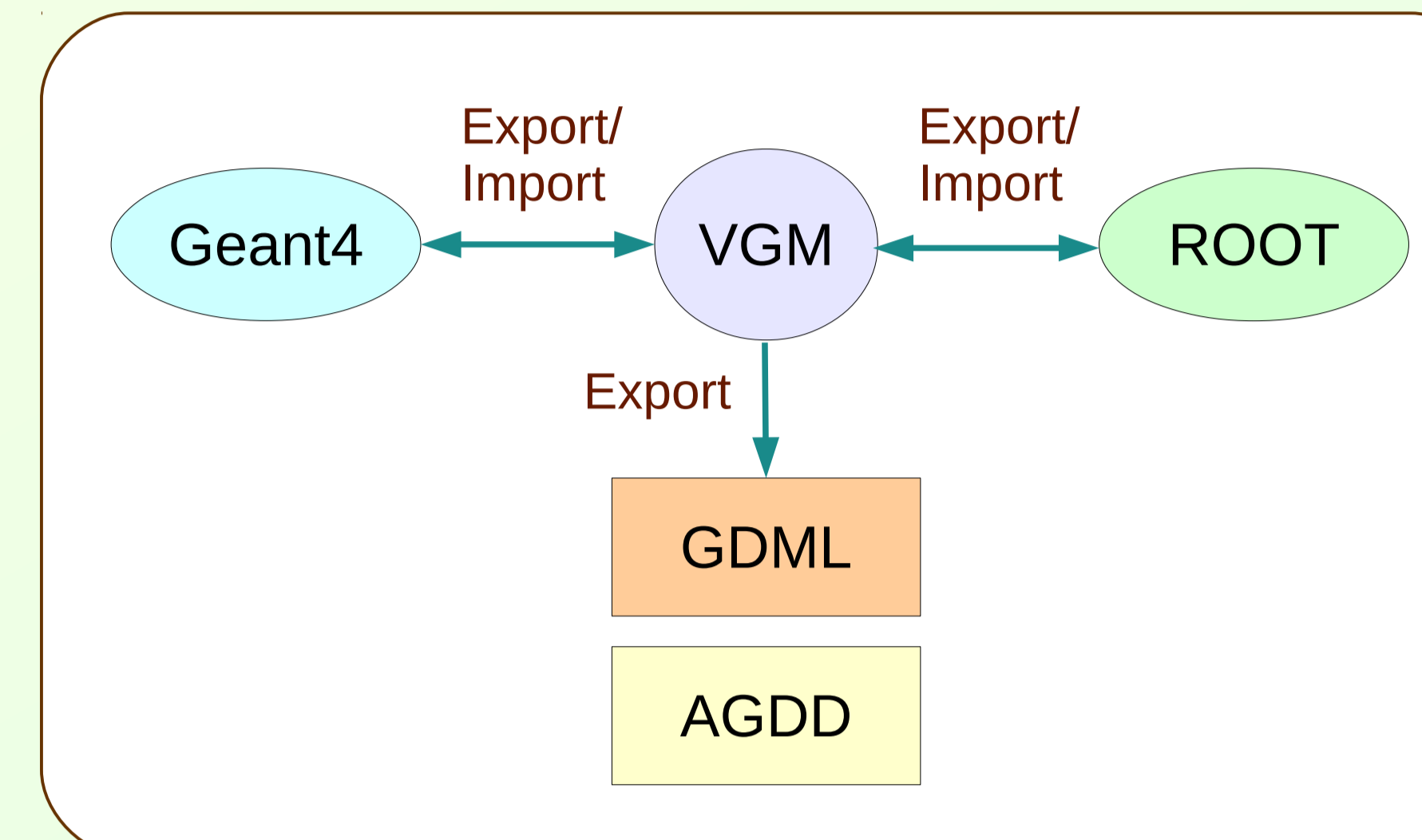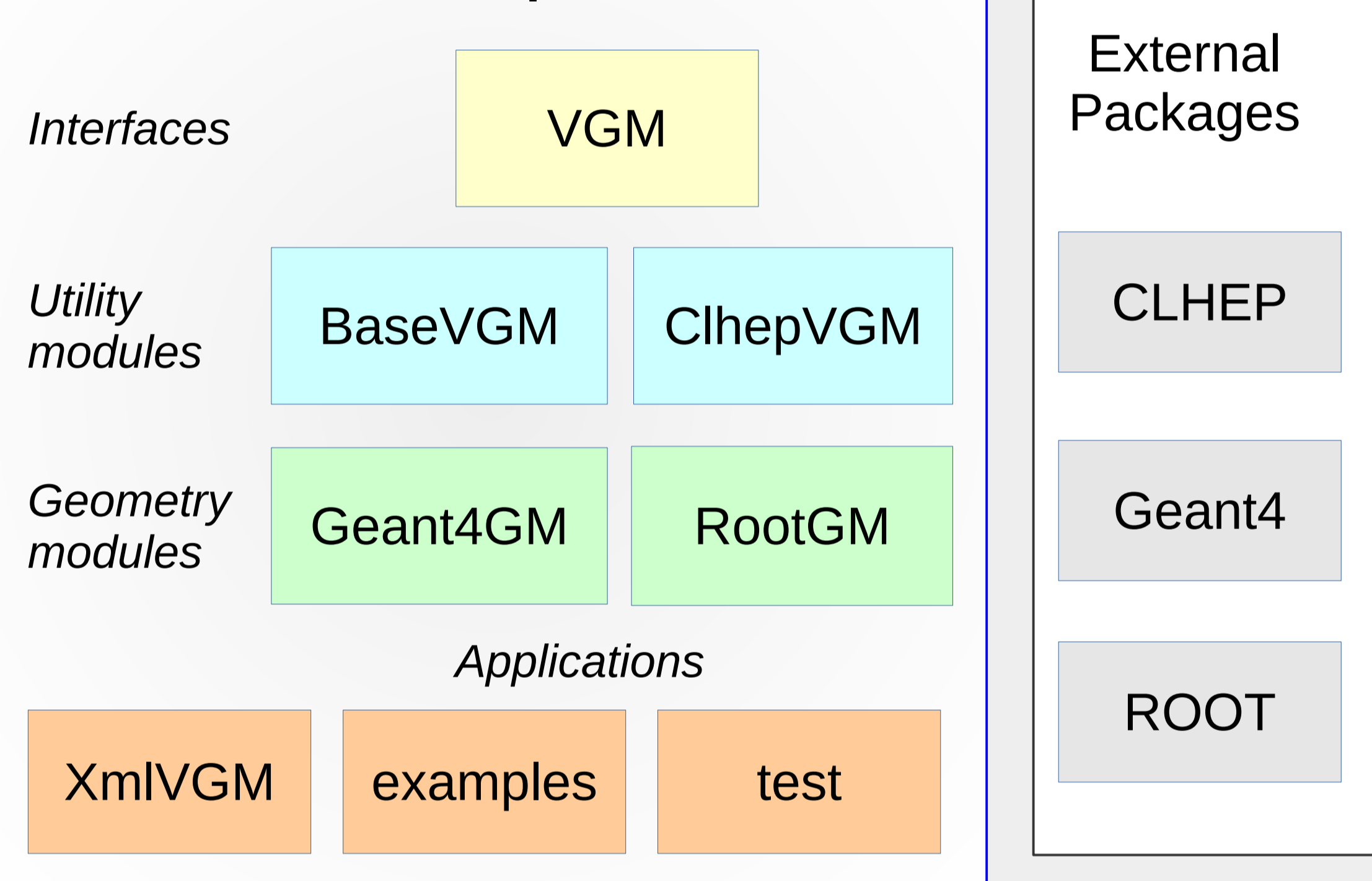
VGM

- The Virtual Geometry Model (VGM) is a geometry conversion tool
- It currently provides conversion between Geant4 and ROOT TGeo geometry models.
  - Its design allows inclusion of another geometry model by implementing a single sub-module instead of writing bilateral converters for all already supported models.
- Last presented at CHEP in 2008, since then under a continuous maintenance and development, following the evolutions of the supported geometry models and adapting to different use cases.
- Integrated in Geant4 VMC for the support of external geometry definition (TGeo with Geant4, Geant4 with Geant3)
- Distributed in GitHub vmc-project organization (since 2017)
  - *See also the CHEP19 contribution #322*

VGM Components

Interfaces	VGM
Utility modules	BaseVGM / ClhepVGM
Geometry modules	Geant4GM / RootGM

Applications: XmlVGM, examples, test

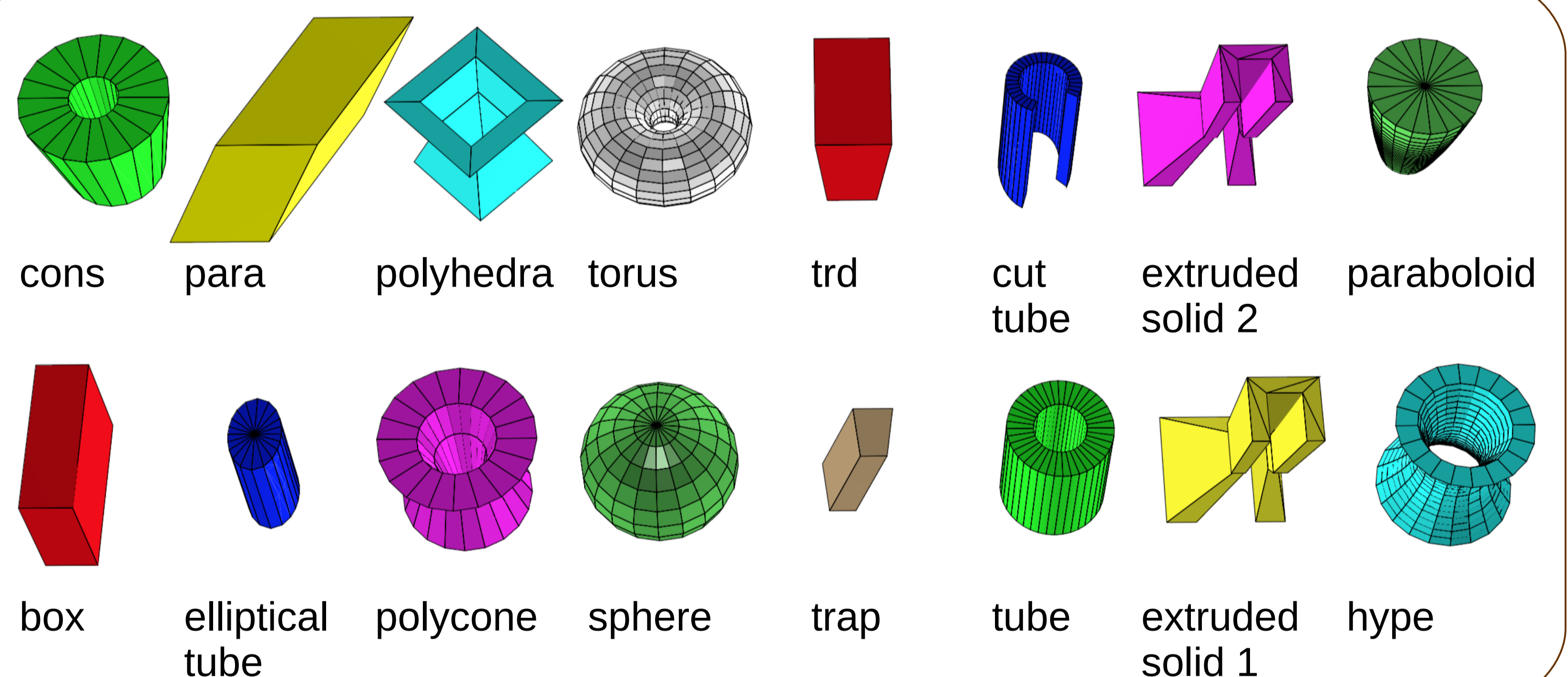External Packages: CLHEP, Geant4, ROOT

Components

- **Interfaces** (VGM)
  - Abstract interfaces to geometry entities used for geometry description (solid, volume, placement, material) and the factories for creating geometries and their import/export
- **Utilities** (BaseVGM, ClhepVGM)
  - Common implementation and utility functions
- **Geometry modules** (Geant4GM, RootGM)
  - Implementation of the VGM interfaces for concrete geometry models
- **XML Exporter** (XmlVGM)
  - Exporters to GDML and AGDD XML formats
- **Examples**
  - Four examples demonstrating geometry conversion (E01,E02) and export in XML (E03, E04)
- **Test**
  - Test application covering most of supported use cases
  - Command line options to select the input/output geometry type, test case (Solids, Placements, …), run mode (Geant4 /G4Root navigation, single solid mode) and other options (debug, ignore, bestMatch)
  - Test suite scripts with reference outputs

Supported Features

- In general: the intersection of supported features in ROOT and Geant4 geometries
  - Plus some features with work-arounds in the other geometry model
- Solids – see on the right
  - And also scaled and displaced solids
- Placements:
  - Simple placements with rotation and reflection
  - Multiple placements: divisions, replicas, assemblies, replicated slices (divisions with gaps)

cons, para, polyhedra, torus, trd, cut tube, extruded solid 2, paraboloid

box, elliptical tube, polycone, sphere, trap, tube, extruded solid 1, hype

Use Cases

- **Geometry bi-lateral conversion** between the supported geometry models (Gent4, ROOT TGeo)
  - Fast, In memory conversion
  - See the code sample on the right
- **Geometry verification**
  - Comparing the outputs with Geant4 native and G4Root navigation in source and target geometries
- Export geometries in **GDML, AGDD**
- **Single solid mode** conversion

```
// Import Geant4 geometry to VGM
Geant4GM::Factory g4Factory;
g4Factory.Import(worldPV);

// Export VGM geometry to Root
RootGM::Factory rtFactory;
g4Factory.Export(&rtFactory);
gGeoManager->CloseGeometry();

// Write converted geometry in ROOT file
gGeoManager->Export("geometry.root");
```

Infrastructure

- **CMake** build system
  - The old build systems (GNUmakefile based, Autoconf, CMT) were removed
- **GitHub** deployment
  - Moved from SourceForge
- **Doxygen**
  - For source code documentation
- **Clang-format**
  - For source code formatting