Unified Geometry

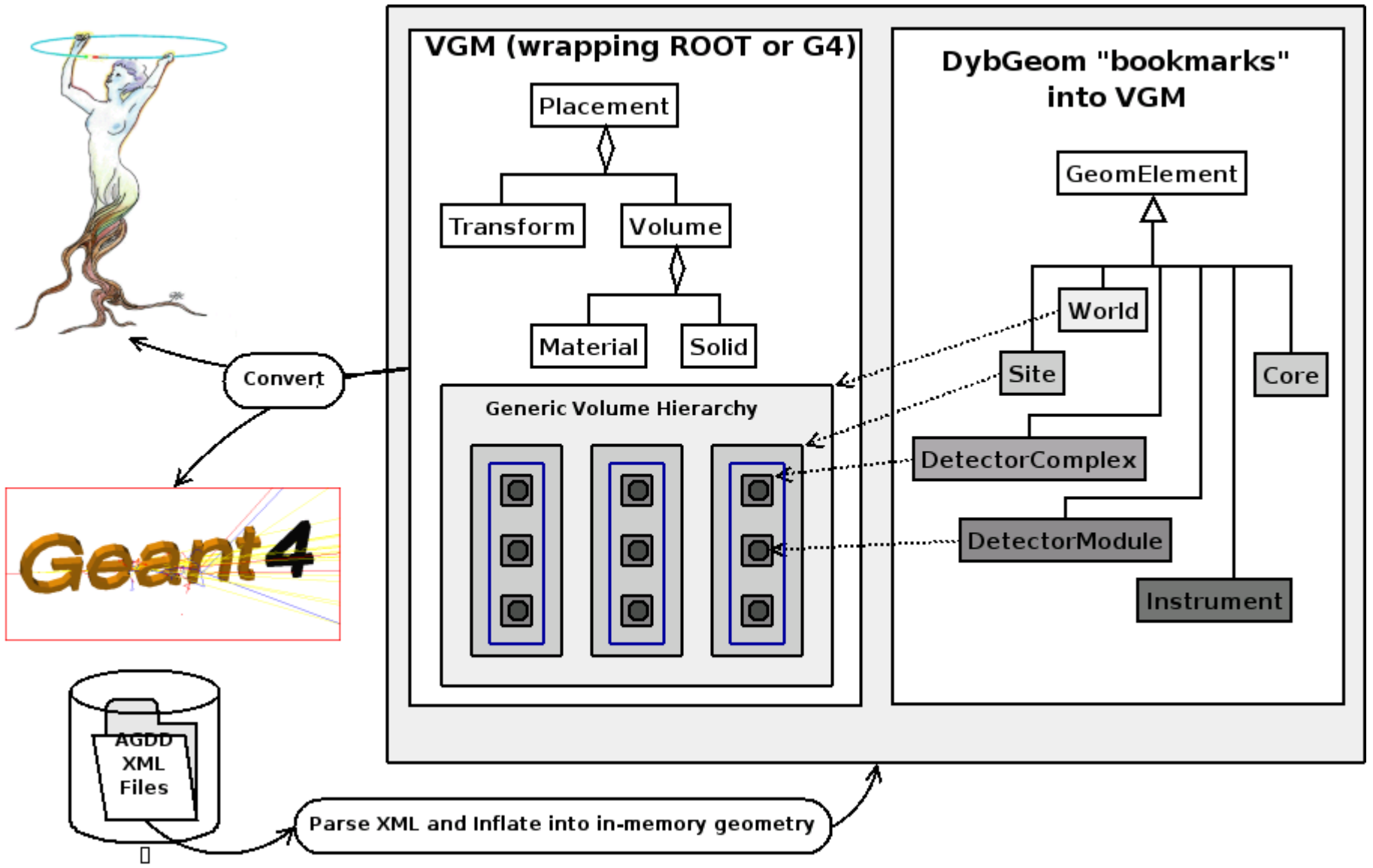
- Motivation
- Overview
- Input from AGDD XML
- Some code details
- Ideas for version control
- Current status and “to do” list.

Motivation

Why not just use hard coded G4 geometry?

- Not maintainable!
- Want consistent detector description for both MC simulation and event reconstruction.
- Handle (mis)alignments.
- Leverage other tools for visualization, verification and versioning.

Overview


VGM (wrapping ROOT or G4)
Placement
Transform
Volume
Material
Solid
Generic Volume Hierarchy
DybGeom "bookmarks" into VGM
GeomElement
World
Site
Core
DetectorComplex
DetectorModule
Instrument
Convert
Geant4
AGDD XML Files
Parse XML and Inflate into in-memory geometry

Input from XML AGDD Schema

Atlas Generic Detector Description (v6)

- XML schema, not much used in Atlas, adopted by STAR (v7)
- Geometry primatives: volumes, solids, placements, elements, materials
- Variables, parameters and arithmetic
- Algorithmic placements and for-loops

No need for exhaustive geometry definition.

Example AGDD XML

```
<?xml version="1.0"?>
<!DOCTYPE AGDD SYSTEM "AGDD.dtd" [
<!ENTITY StandardMaterials SYSTEM
 "StandardMaterials.agdd">
]>
<AGDD DTD_version="v6">
&StandardMaterials;

<section name="Anti nu module"
         version="1"
         top_volume="antinumod">
  <composition name="antinumod">
  ...
  </composition>
</section>
</AGDD>
```

```
<var name="radius" value="5."/>
<var name="height" value="5."/>
<tubs name="antitank" material="Steel"
      Rio_Z="0; radius; height"
      unit_length="m"/>
<tubs name="oil" material="Oil"
   Rio_Z="0; radius-0.01; height-0.01"
   unit_length="m"/>
<tubs material="ScintOil" .../>
<tubs material="GdScintOil" .../>
<composition name="antinumod">
  <posXYZ>
    <volume name="antitank"/>
    <volume name="oil"/>
    ...
  </posXYZ>
</composition>
```

Materials in AGDD

```
<materials version="2.0" ...>

<element symbol="H" >
  <atom  zeff=" 1.0"
         aweight="1.00797"/>
</element>

<element symbol="O" >
  <atom  zeff=" 8.0"
         aweight="15.9995 "/>
</element>

<material name="Water" density="1.0">
  <addelement name="H" natoms="2"/>
  <addelement name="O" natoms="1"/>
</materials>
```

- Can also define isotopes
- Can define material as gas
- Supports element-less material ie vacuum (not supported by ROOT)

Letting AGDD Do the Work

```
<stackZ name="pmt" .../>
<var name="twopi28"
     value="2*pi/28*rad"/>
<var name="nrings" value="21"/>
<foreach index="iz" loops="nrings">
  <var name="z"
  value="height/nrings*iz-height/2"/>
  <mposPhi ncopy="28"
           Phi0="twopi28/2"
           dPhi="twopi28"
           R_Z="radius ; z"/>
    <volume name="pmt"/>
  </mposPhi>
</foreach>
```

Define some PMT (for eg)

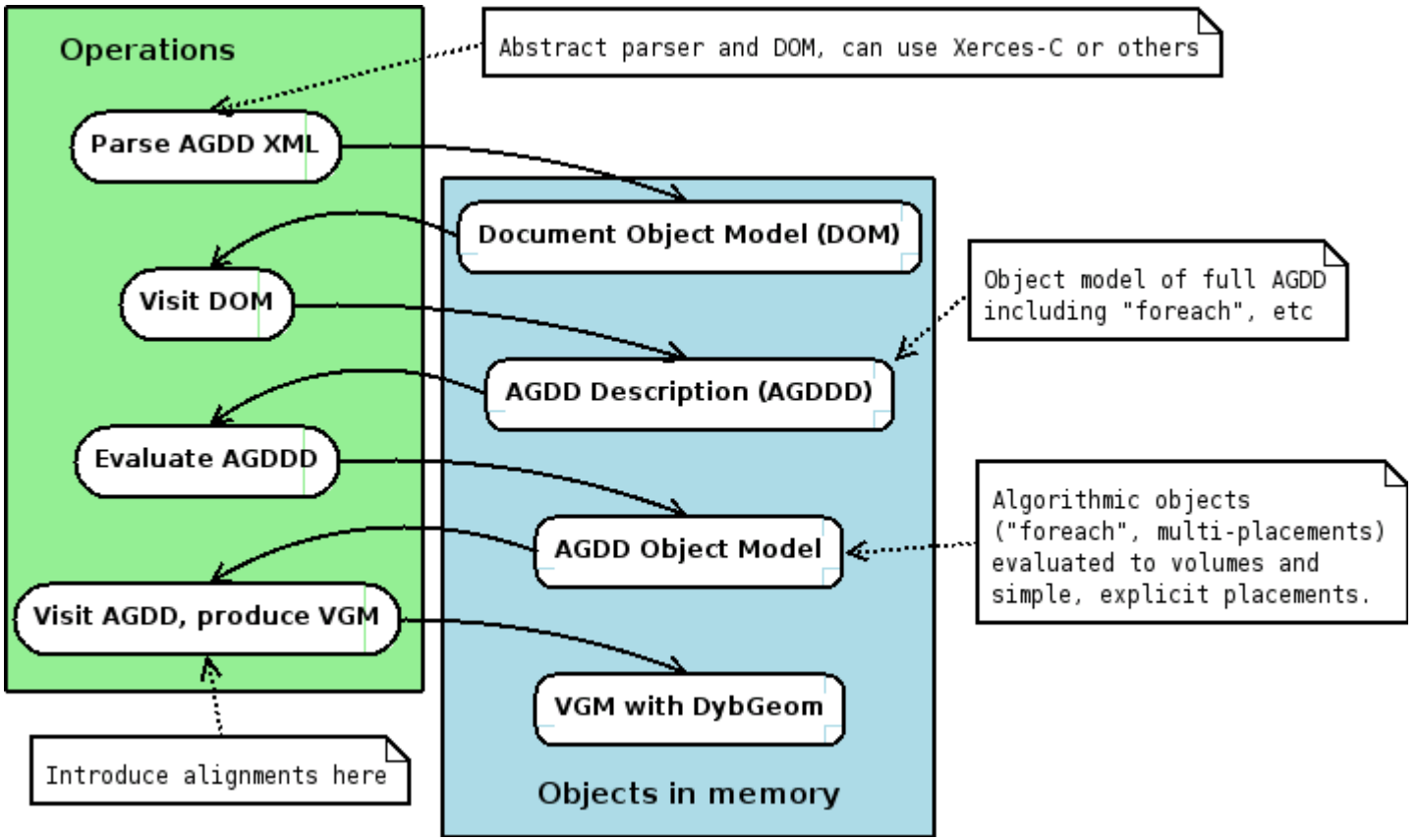
Use variables to hold/calculate parameters.

Loop to make each ring of PMTs

Calculate Z position for each ring

Multi-placement with phi symmetry

Details of Geometry Processing



A Note on Alignment

- AGDD holds ideal, algorithmic geometries
- Can introduce (mis)alignments in AGDD model to VGM step
- For MC studies can provide algorithmic (mis)alignment.

Need to think about how to best store real survey results!

Geometry Version Control

CVS + CMT?

- Create special geometry data package, use CMT versioning to track revisions
- How to allow multiple geometries?
- Need manual intervention and version conventions.
- Maybe good for when we have “official” geometry.

Geometry V.C. (cont)

Git (Linux Kernel V.C.) ?

- Every file or group of files indexed by unique ID (SHA-1 hash of file contents or hash of list of file hashes)
- Store ID in output file header
- G4dyb/reco app can pull XML files from Git server based on ID on cmd. line.
- Individuals can maintain and share local Git repositories.

Geometry V.C. (cont. 2)

Save in ROOT output ?

- Can just dump TGeo object hierarchy into ROOT output file.
- Need code to import back into memory.
- Some information and AGDD compactness lost.
- Probably do this for convenience as well as CVS+CMT and/or GIT.

More thought on geometry V.C. needed!

Current Status

- XML parser implemented (with Xerces-C)
- AGDD code from Atlas mostly incorporated into local copy of VGM
- Inflation to VGM+DybGeom partly done
- VGM author contacted and willing to incorporate this work.

To do

- Complete VGM+DybGeom inflation code
- Add G4dyb DetectorConstructor that uses DybGeom, deprecate/remove old one
- Consider need of supporting AGDD v7 (current schema version, used by STAR experiment and GraXML viewer)
- Get this work (non-DYB stuff) submitted to VGM.