Experimental Techniques in Particle Physics

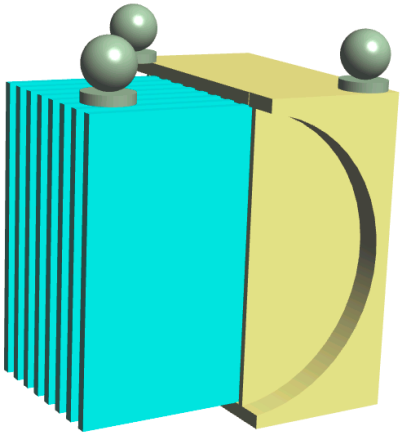
Geant4: Remarks on Evaluation Test and Exam

Andreas Nowack
nowack@physik.rwth-aachen.de
RWTH Aachen University

WS 2020/21

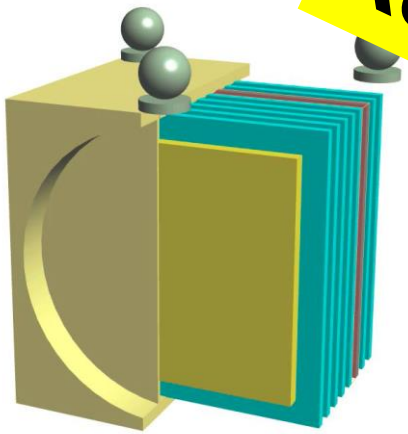
Evaluation Test: Perspective Views

Recap

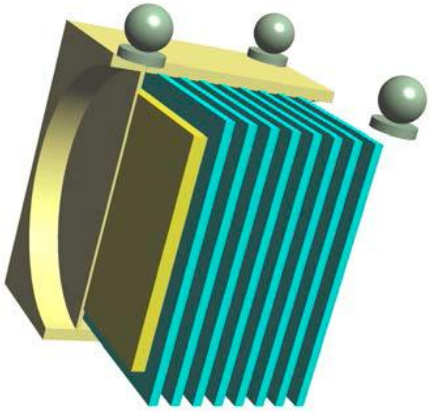


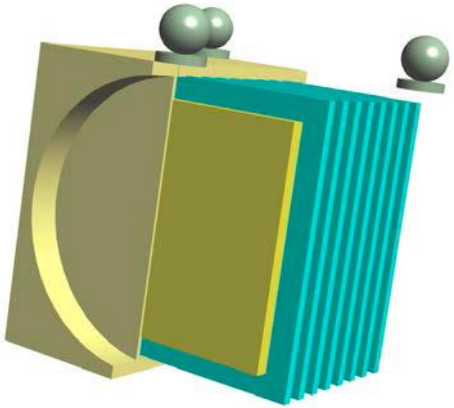
Front View

Side View



Back View





Evaluation Criteria

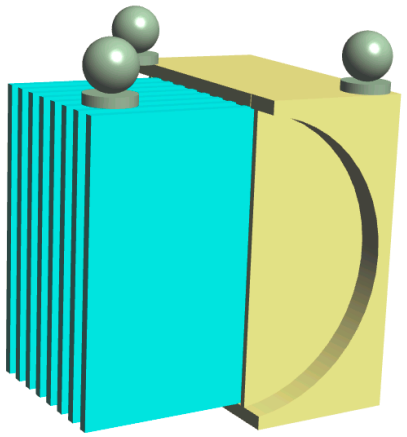
- more than 40 criteria:
  - general code quality
    - Does it compile
    - Is it readable and understandable?
  - visual inspection of the simulation
    - Does it look correctly?
    - Is the geometry test successful?
  - inspection of source code
    - material definitions
      - What is defined and how?
    - geometry setup
      - dimensions, materials
      - Boolean operations, replication
      - hierarchy of volumes
      - colors/invisible volumes

Common Remarks

- writing code
  - indentation can structure the code
  - use meaningful names, names should not be misleading
  - comments can be very useful to understand the code one year later
  - try to be efficient
    - e.g.: if no rotations are needed simply use NULL pointer
    - rotation with 0° has no effect

- experimental hall
  - usually it is not filled with vacuum
  - fill it with air
  - do not forget auxiliary volumes

- relative position of detector layers and tooling balls
  - front and back side of the setup are different



Front View

Common Remarks: Material Definitions

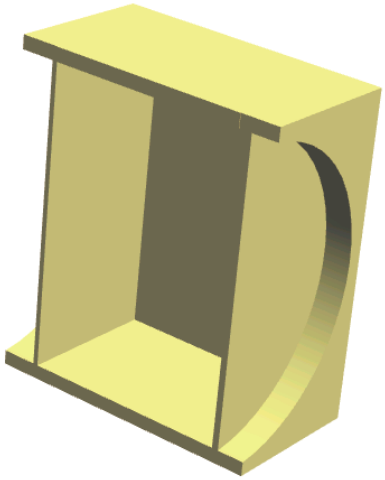
- be careful with symbols of chemical elements
  - e.g. Tl (Thallium) ≠ Te (Tellurium)

- silica
  - not glass
  - pure SiO_2
  - NIST database: G4_SILICON_DIOXIDE

- use NIST database
  - reduces possible sources of errors

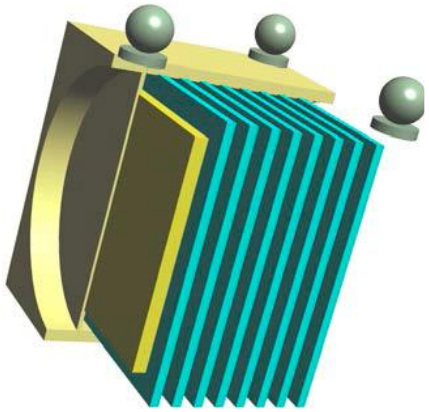
Common Remarks: Hierarchy of Volumes

- housing does not need to/should not be hollow
  - subtraction of a box means that the inner part does not belong to the object
    - strange in terms of hierarchy



- simply place the box with detector layers inside the housing (without a hole)

- advantages:
  - less Boolean operations
  - clear hierarchical structure



Common Remarks: Unions vs Auxiliary Volumes

- Unions:
  - avoid only touching surfaces
  - there should be a real overlap

- use auxiliary volumes
  - place daughter objects in it
  - eases repeated placements

Tooling Ball

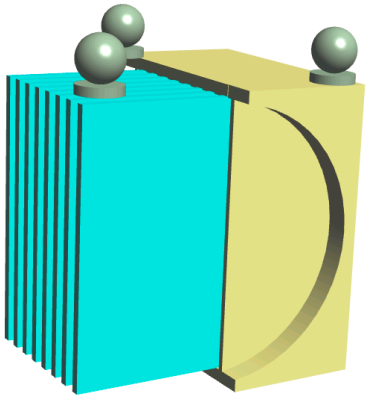
- advantages of auxiliary volumes:
  - less Boolean operations
  - clear hierarchical structure

Common Remarks: Boolean Operations and Surfaces

- Subtractions and Unions:
  - avoid touching surfaces
  - both solids should not share one or more edges
  - possible error:

```
ERROR: G4VSceneHandler::RequestPrimitives
  Polyhedron not available for BoxCylinderUnion
  Touchable path: World 0 PhysicalBoxTubsUnion 0
  This means it cannot be visualized on most systems (try RayTracer).
  1) The solid may not have implemented the CreatePolyhedron method.
  2) For Boolean solids, the BooleanProcessor, which attempts to create
     the resultant polyhedron, may have failed.
```

- example: entrance window
  - use a cylinder longer than 7 cm



Exam

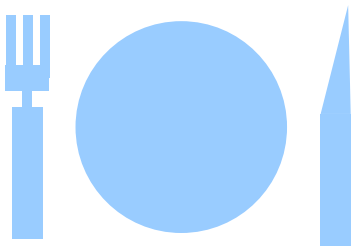
- What you should know and what can occur:
  - general principles and concepts in Geant4
  - capabilities of Geant4
  - explaining a Geant4 code fragment
  - explaining the purpose of a known Geant4 class
  - understanding of the underlying physical principles
  - completing a short simple code fragment
  - choosing the correct code fragment from given alternatives
  - explaining how to build a given geometry, material, … in terms of necessary steps (no line of code necessary)

- What will not occur:
  - a complex task like this evaluation test
  - writing a functioning piece of code without any help
  - exact knowledge of the spelling of names of Geant4 classes and methods

Exam: Examples

- How do you build the material CsI(Tl 5%) in Geant4?

- How do you build this geometry?
  (all parts have the same thickness)



- What is the purpose of this code fragment?

```
void DetectorPhysEventAction::BeginOfEventAction(const G4Event* aEvt) {
  G4cout << "Start of Event" << G4endl;
}
```