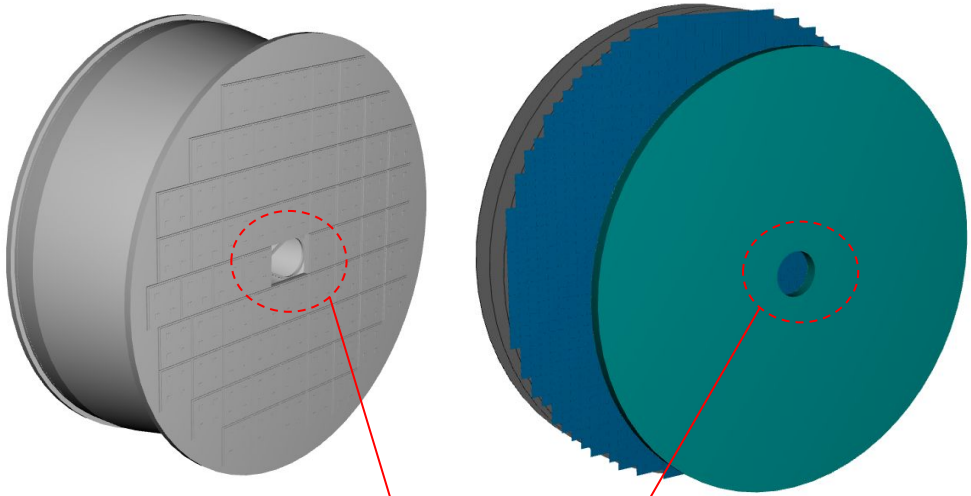
pfRICH Implementation in DD4Hep

Oct 3, 2023

Problem, Consueses and Plan



CAD import

Standalone Geant4 import

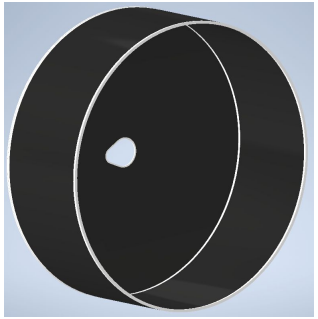
Beampipe implementation

Currently:

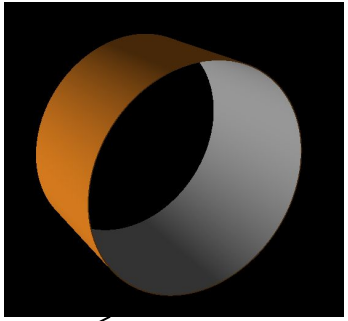
- **Two implementations:**
  - CAD import
  - Standalone Geant4 import
- **Problem:**
  - Neither implementations work within the ePIC DD4Hep framework
  - CAD import: significantly increase the overhead of the simulation
  - Standalone: doesn't remain non-standard beam pipe features
  - Both are not ideal
- **Consueses:**
  - A new implementation is needed
  - The new pfRICH shouldn't increase the simulation overhead
  - The new implementation should preserve the critical features from the CAD (such as the beam pipe geometry)

Ambitious plan, how do we do this?

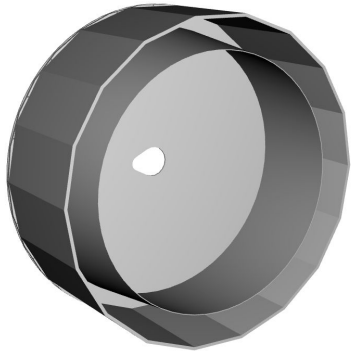
Tentative Plan



pfRICH outer shell CAD GDML

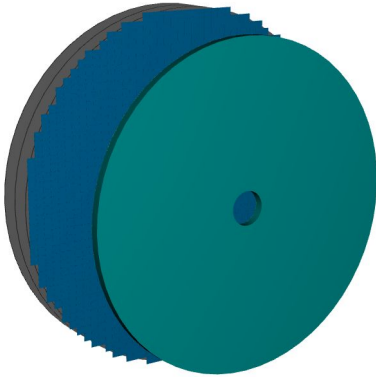


Geant4 Object xml



Step 1: Setting up a hybrid (CAD import-xml description) base xml description in DD4Hep

- Preserve CAD feature, serve as bridge between CAD and Geant4



Step 2: Rewrite/improve PFRICH_geo.cc, to parse the gdml geometry and merge the existing detector components (regular shaped)

Where we are

Step 3: Testing
GDML outer shell will be outside of the Cherenkov volume, and will be it will be excluded if it is identified to increase the simulation overhead

Step 4: Writing a geometry cross-checking software (between Geant4 vs CAD)

And

Reconstruction

Update on Step 2

DD4hep_GdmlDetector.cpp

PFRICH_geo.cpp

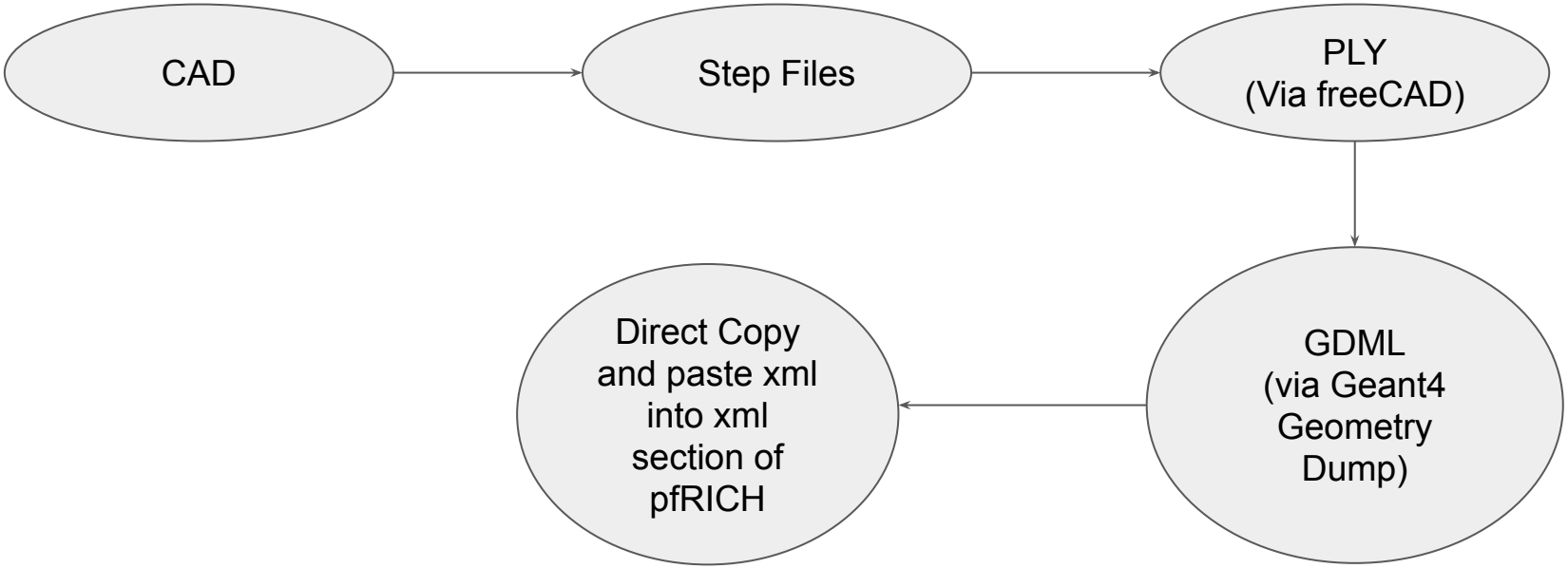
BarrelHCalCalorimeter_geo.cpp

```
// Copyright (C) 2022 Christopher Dilks, Sylvester Joosten

//----------------------------------
//  pfRICH: Proximity Focusing RICH
//  Author: C. Dilks
//----------------------------------

#include "DD4hep/DetFactoryHelper.h"
#include "DD4hep/OpticalSurfaces.h"
#include "DD4hep/Printout.h"
#include "DDRec/DetectorData.h"
#include "DDRec/Surface.h"

#include <XML/Helper.h>

// ROOT includes
#include "TGDMLParse.h"
#include "TGDMLWrite.h"
#include "TGeoElement.h"
#include "TGeoManager.h"
#include "TInterpreter.h"
#include "TUri.h"

using namespace std;
using namespace dd4hep;
using namespace dd4hep::rec;

// create the detector
static Ref_t createDetector(Detector& description, xml_h e, SensitiveDetect
{
```

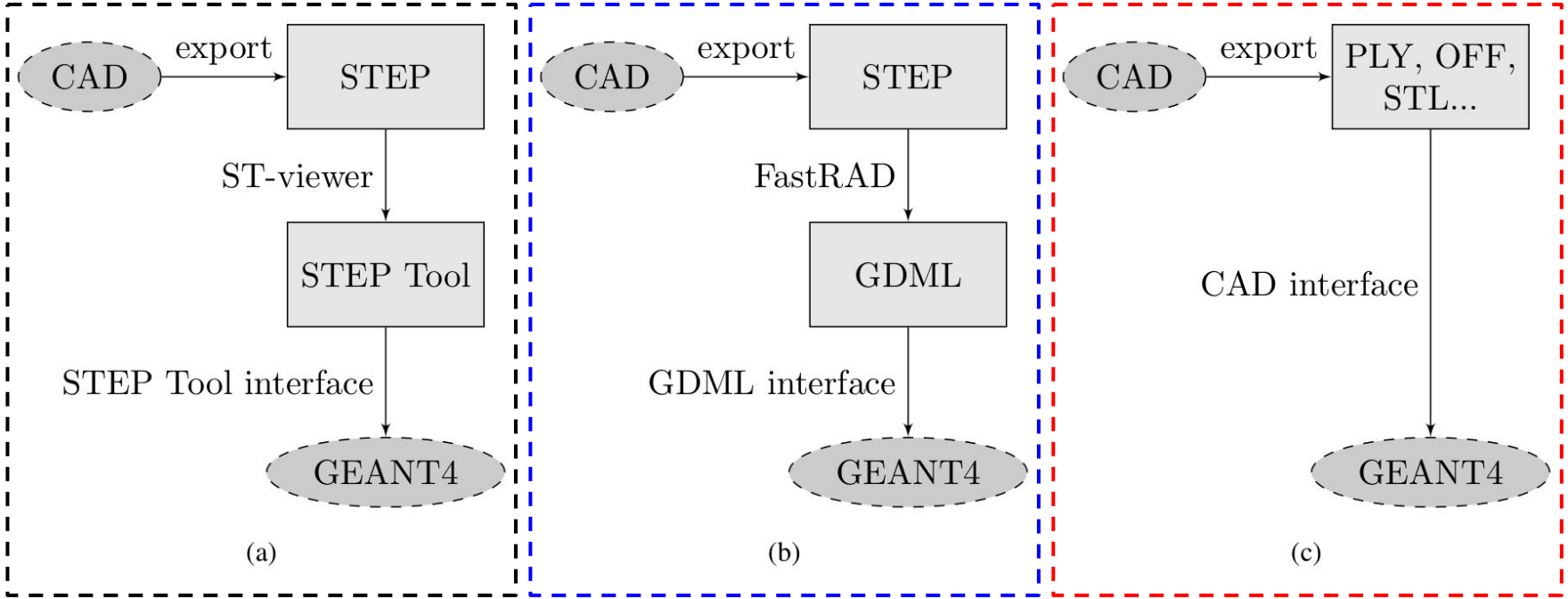
PFRICH_geo_v1.cpp

Branch:
https://github.com/billlee77/epic/tree/pfRICH

Documentation on Step 1



From CAD to Geant4 Model



Method 1

Indirect method

Method 2

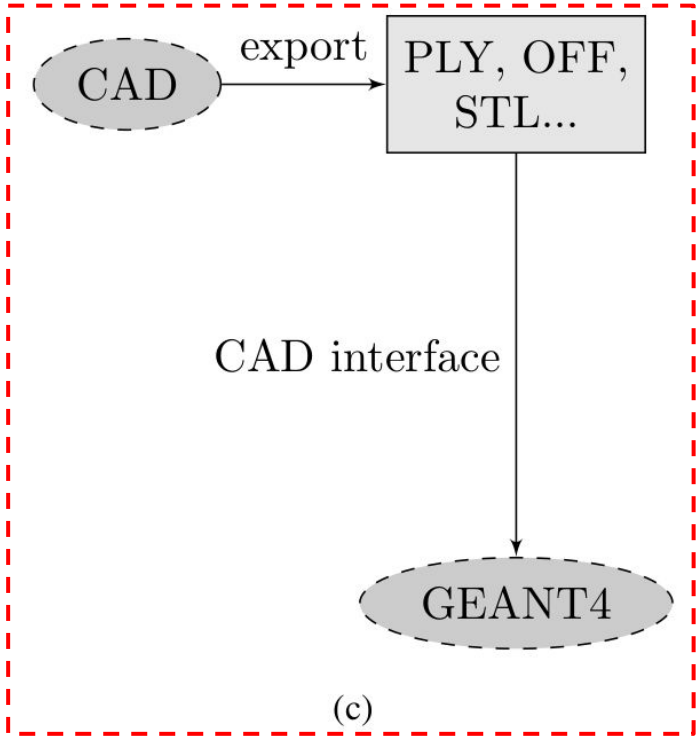
Indirect method

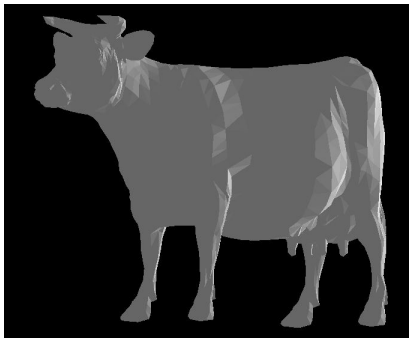
Method 3

Direct method

https://arxiv.org/pdf/1105.0963.pdf

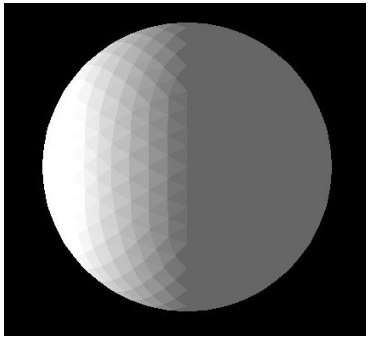
CADMesh Plugin





cow.obj

rabbit.stl



rabbit.ply

https://github.com/christopherpoole/CADMesh