Next steps for cut tube support in ACTS

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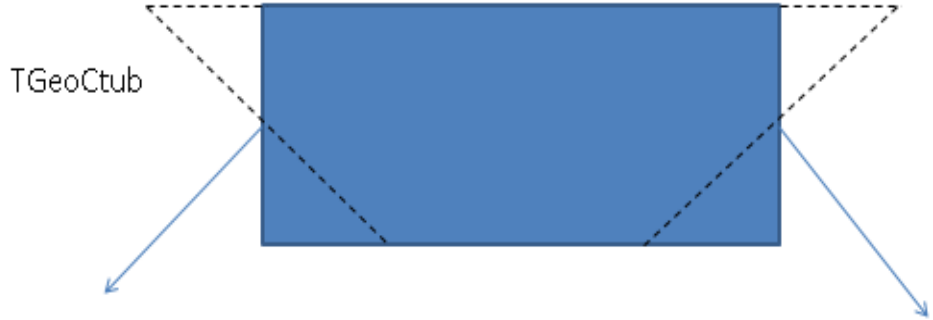
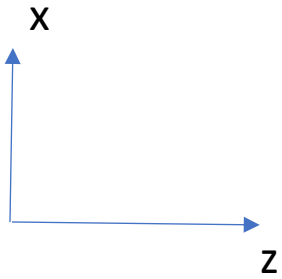
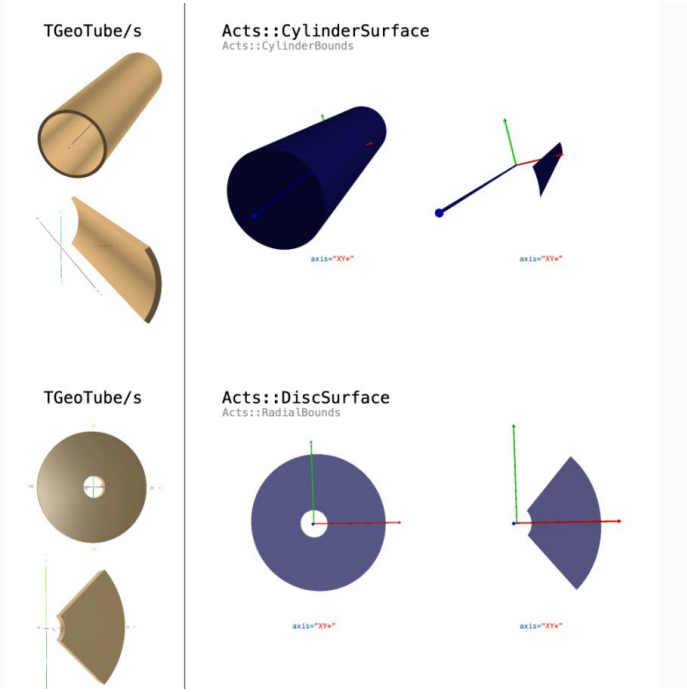
1. Extend TGeoTubeConversionTests.cpp with a TGeoCtub




```
/// CylinderBounds also supports beveled sides defined by an angle.
/// Different angles can be defined on both sides of the cylinder.
/// A postive angle is defined as "extruding" from the defined Zlength,
/// while a negative angle is "intruding" on the Zlength.
/// +    -           -   +
///  ____________________
/// \  |  /         \  |  /
///  \ | /           \ | /
///   \|/_____________\|/
///     2 * ZhalfLength
```





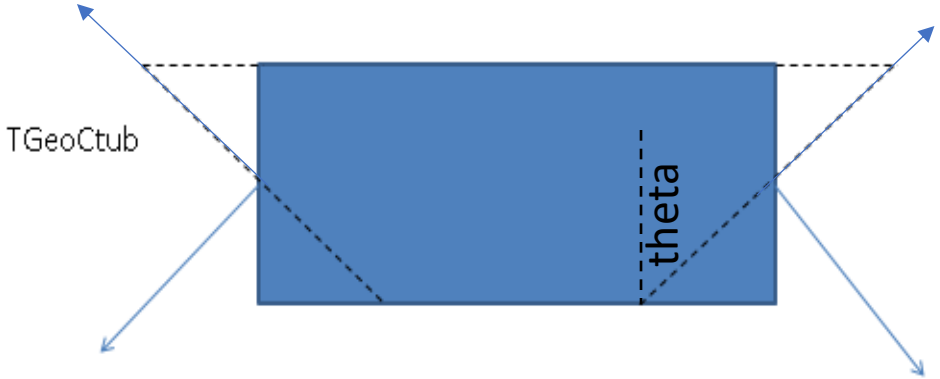
ACTS cylinder surface

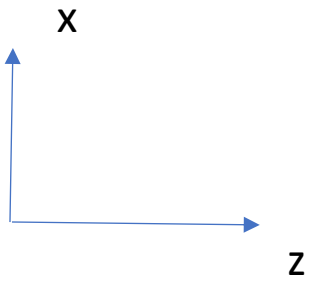
Question:

- Is there a straight correspondence between the end cuts defined by normals in TGeoCtub and the angles in ACTS cylinder surface?
- How are the allowed axes for transformation determined for ACTS surfaces?

1 a) Extend Acts::TGeoSurfaceConverter::cylinderComponents and Acts::TGeoSurfaceConverter::discComponents to support TGeoCtub

Question: Why is the condition "halfZ>deltaR" used before checking if the shape is tube segment when defining cylinder bounds but not disc bounds? [**Notes from meeting:** Look into commit history and follow up with Andreas]





cos(theta) = (0,0,1) * (nxmax, nymax, nzmax) where theta is a bevel angle.
Surface_halfz= TCtubHalfz- rmax * tan(theta)

How is the directional ambiguity resolved?
Is the TGeoCtub rotated so that the plane cutting the tube is parallel to y-axis?

TGeoCtub is not allowed for discSurfaces. So, there is no natural way to extend the unit test for disc/endcaps similar to cylinder/barrels in this case. Force extend it for consistency or provide a warning?

2. Extend Acts::DD4hepLayerBuilder::endcapLayers and Acts::DD4hepLayerBuilder::centralLayers to support TGeoCtub

- How is a simple TGeoTube supported?

```
root [15] TGeoMedium *vacuum = new TGeoMedium("vacuum", 1, new TGeoMaterial("vacuum"));
root [16] TGeoVolume *vol_tub = gGeoManager->MakeTube("TUB_VOL", vacuum, 2, 4,10);
root [17] TGeoTube* tub = dynamic_cast<TGeoTube*>(vol_tub->GetShape())
(TGeoTube *) 0x278c330
root [18] TGeoTubeSeg* tubs = dynamic_cast<TGeoTubeSeg*>(vol_tub->GetShape())
(TGeoTubeSeg *) nullptr
```

- Where is the information from phi range?
- Are there any DD4Hep unit tests that need to be updated?

```
TGeoShape* geoShape =
    detElement.placement().ptr()->GetVolume()->GetShape();
// create the proto layer
ProtoLayer pl(gctx, layerSurfaces);

if (detExtension->hasValue("r_min", "envelope") &&
    detExtension->hasValue("r_max", "envelope") &&
    detExtension->hasValue("z_min", "envelope") &&
    detExtension->hasValue("z_max", "envelope")) {
  // set the values of the proto layer in case enevelopes are handed over
  pl.envelope[Acts::binR] = {detExtension->getValue("r_min", "envelope"),
                             detExtension->getValue("r_max", "envelope")};
  pl.envelope[Acts::binZ] = {detExtension->getValue("z_min", "envelope"),
                             detExtension->getValue("z_max", "envelope")};
} else if (geoShape != nullptr) {
  TGeoTubeSeg* tube = dynamic_cast<TGeoTubeSeg*>(geoShape);
  if (tube == nullptr)
    ACTS_ERROR(
        " Cylinder layer has wrong shape - needs to be TGeoTubeSeg!");
```

Notes from meeting:
The DD4Hep plugin is essentially a TGeo converter. There is room for improvement in it. Not to be taken at face value- Whitney A.