Subject: Geometry Problems
Posted by Stefan Pflueger on Tue, 19 Apr 2016 12:47:11 GMT
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Hello everybody,

I wanted to inform you about a problem we have been dealing with the last week concerning our lumi detector geometry. Since this can also affect many other detector subsystems I wanted to share this with you. After an update of the fairroot (FairRoot-v-15.03) and external packages (mar15), we discovered that our 2 dimensional angular acceptance all of a sudden showed almond like shaped inefficiencies on the edges of our modules.

We analyzed the situation and came to the conclusion that this effect arises from the geometry not being constructed or simulated as we wanted.
We have 10 modules aligned around the beampipe in circle. Each module consists of a diamond support and cooling structure having glued on 5 MuPix sensors on its front and 5 more on this back face. The problem was that the diamond structure was constructed from a circle (or complete tube segment) and then being cut to the appropriate dimensions via a CompositeShape.

```
876     // ****************************** cvd cooling support discs ************************
877     // the cvd disc shape
878     TGeoTube* shape_cvd_disc = new TGeoTube("shape_cvd_disc", 0.,
879             cvd_disc_rad, cvd_disc_thick_half);
880     // The inner beam pipe defines the inner acceptance region for the cvd cut_out
881     TGeoTube* shape_cvd_cutout_inner = new TGeoTube("shape_cvd_cutout_inner",
882             0., inner_rad, 1.);
883     // finally cvd discs will be cut at the left and right down to 36 degree in phi
884     // for that we subtract tube segments
885     TGeoTubeSeg* shape_cvd_disc_cut_side = new TGeoTubeSeg(
886             "shape_cvd_disc_cut_side", 0., outer_rad, 1.,
887             +delta_phi / 2. / pi * 180.,
888             -delta_phi / 2. / pi * 180.);
889     // before: cvd disc was moved to the displaced position around the z axis
890     // now: segments for the cut are moved off centered and cvd disc remains in the
center
891     TGeoRotation* cvd_rotation = new TGeoRotation("cvd_rotation", 0, 0, 0);
892     TGeoTranslation* cvd_translation = new TGeoTranslation("cvd_translation",
893             -cvd_disc_dist, 0, 0);
894     TGeoCombiTrans* cvd_combtrans = new TGeoCombiTrans(*cvd_translation,
895             *cvd_rotation);
896     cvd_combtrans->SetName("cvd_combtrans");
897     cvd_combtrans->RegisterYourself();
898     TGeoCompositeShape
899     *shape_cvd_support =
900             new TGeoCompositeShape(
901                     "shape_cvd_support",
902
"(shape_cvd_disc-shape_cvd_cutout_inner:cvd_combtrans-shape_cvd_disc_cut_side:cvd_co
mbtrans)");
903
```

```
904       TGeoVolume* lmd_vol_cvd_disc = new TGeoVolume("lmd_vol_cvd_disc",
905                 shape_cvd_support, fgGeoMan->GetMedium("HYPdiamond"));
906       lmd_vol_cvd_disc->SetLineColor(9);
```

The problem was that when we visually checked the geometry, everything seemed just fine. However in the simulation, the diamond was not cut off but the full circular shaped remained! Hence we observed a twice as high material budget on the edges of our modules that created this inefficiency in the acceptance.

The red circle drawn into this picture would show where the diamond wafer would be sitting and its shows that it perfectly aligns with this almond like shape in the acceptance.
So simply changing this diamond shape to a tube segment with the correct phi and radii from the beginning on, prevented this overlap from appearing and the acceptance looked fine again.

```
// the cvd disc shape
886       double gap_between_disc_and_support_structure(0.025); // 250 mu gap
887       TGeoTubeSeg* shape_cvd_disc = new TGeoTubeSeg("shape_cvd_disc", inner_rad,
888                 lmd_cool_sup_inner_rad - gap_between_disc_and_support_structure,
889                 cvd_disc_thick_half, -delta_phi / 2. / pi * 180.,
890                 +delta_phi / 2. / pi * 180.);
891
892       TGeoRotation* cvd_rotation = new TGeoRotation("cvd_rotation", 0, 0, 0);
893       TGeoTranslation* cvd_translation = new TGeoTranslation("cvd_translation",
894                 -cvd_disc_dist, 0, 0);
895       TGeoCombiTrans* cvd_combtrans = new TGeoCombiTrans(*cvd_translation,
896                 *cvd_rotation);
897       cvd_combtrans->SetName("cvd_combtrans");
898       cvd_combtrans->RegisterYourself();
899
900       //this next line is pretty stupid but it made the work for the better geometry minimal
901       //otherwise I would have to do some deeper digging and reworking...
902       TGeoCompositeShape *shape_cvd_support = new TGeoCompositeShape(
903                 "shape_cvd_support",
904                 "(shape_cvd_disc:cvd_combtrans+shape_cvd_disc:cvd_combtrans)");
905
906       TGeoVolume* lmd_vol_cvd_disc = new TGeoVolume("lmd_vol_cvd_disc",
907                 shape_cvd_support, fgGeoMan->GetMedium("HYPdiamond"));
908       lmd_vol_cvd_disc->SetLineColor(9);
```

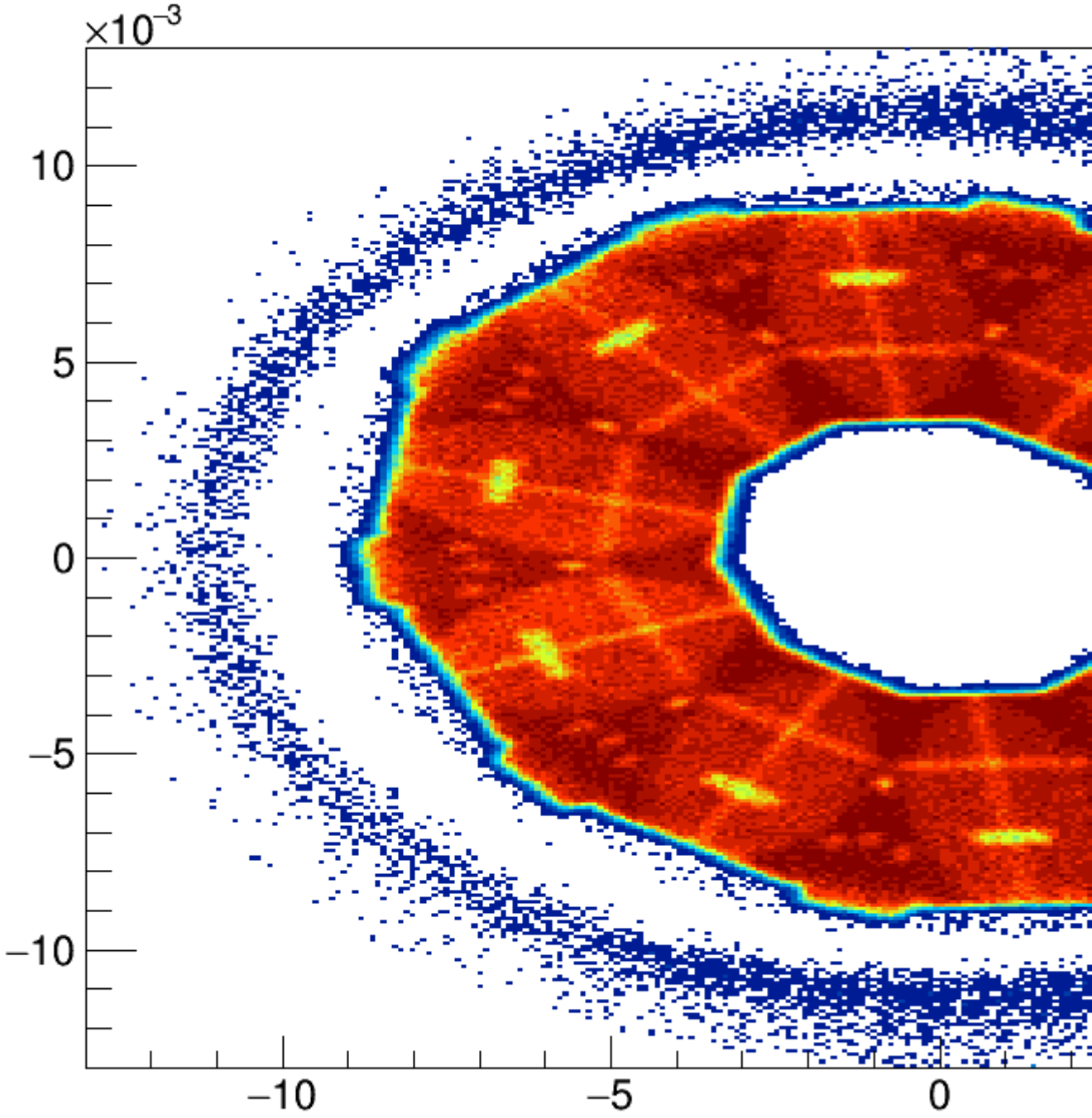
Either we are not using the composite shapes correctly in our code or ROOT seems to have a bug there.... Did anyone ever experience similar problems. I guess we were also lucky seeing this after all, as the material budget has to be just enough to actually slow down the particles enough so they are not seen in the last layers of the tracking detector anymore.

Best regards,

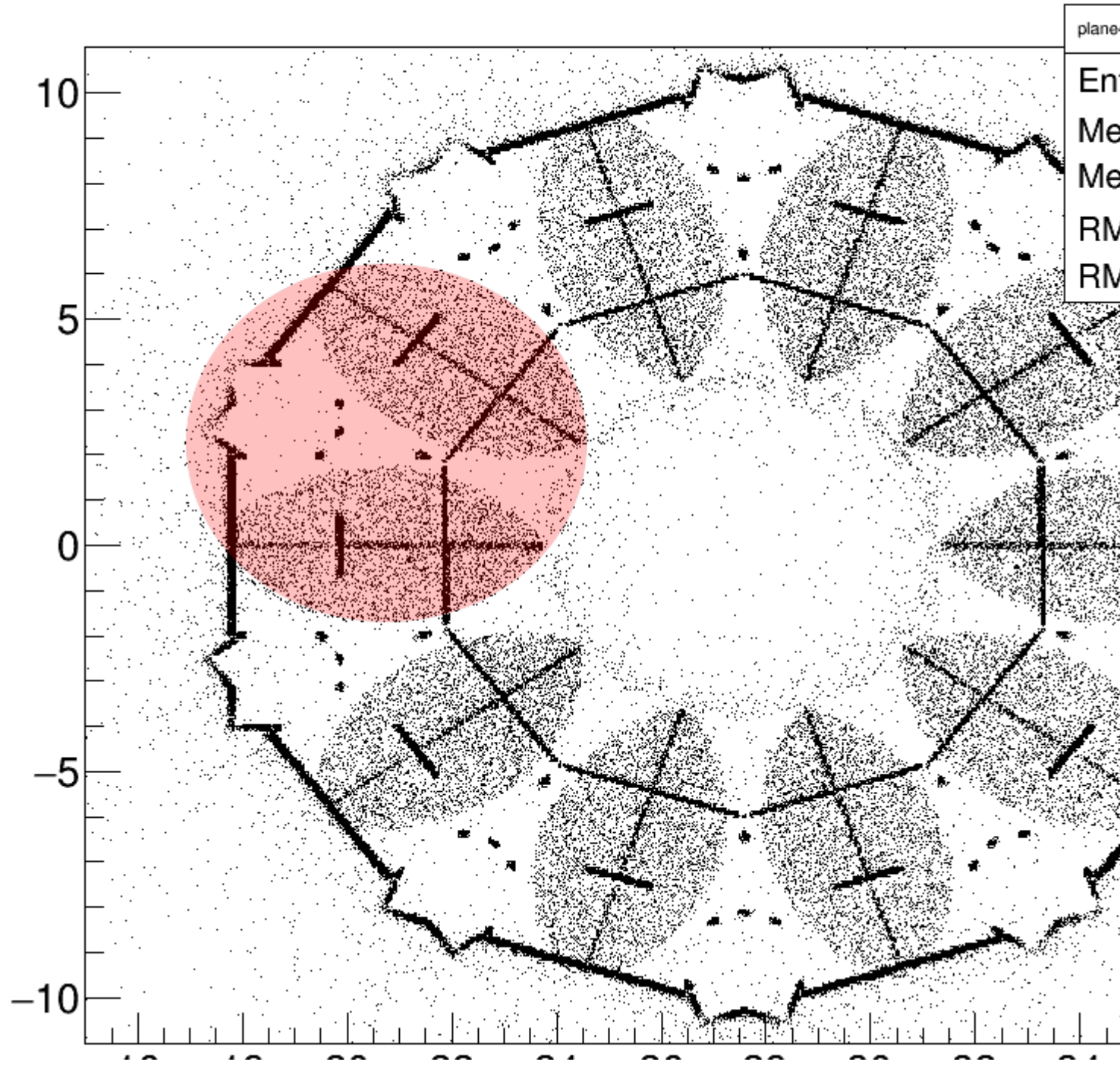
Stefan

File Attachments

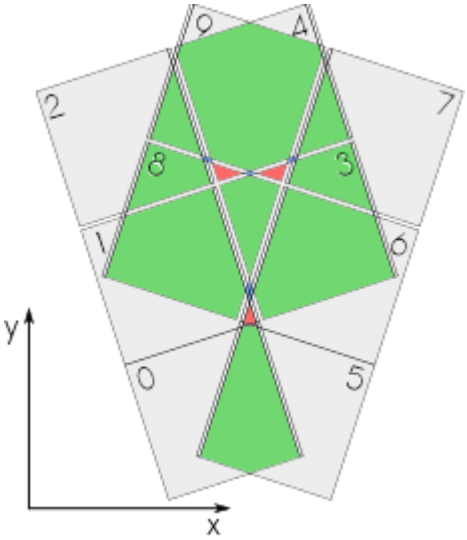
1) acc2d.png, downloaded 1664 times



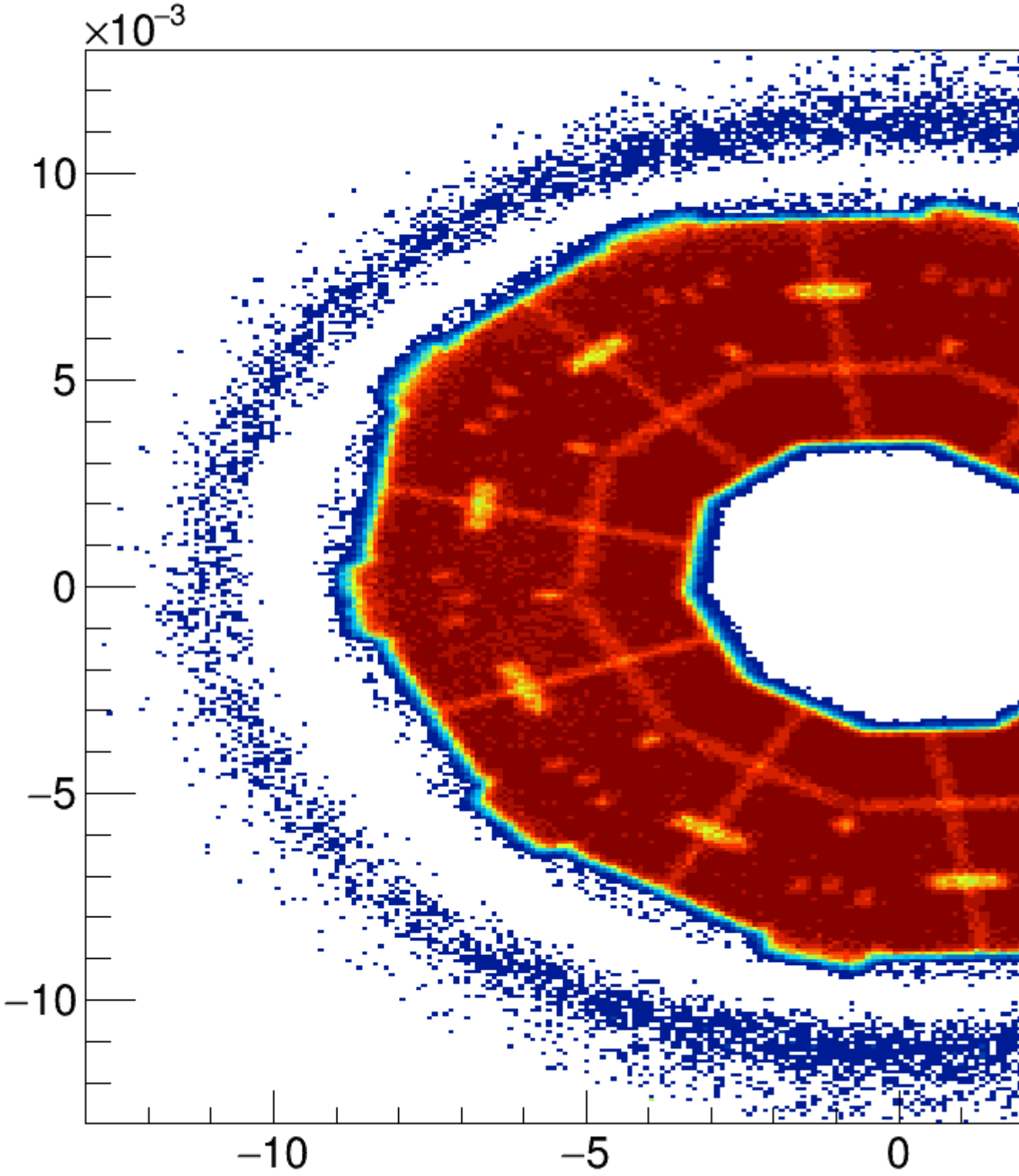
2) circle.png, downloaded 1638 times



3) sensor-overlap-new.png, downloaded 1589 times



4) acc2d.png, downloaded 1591 times



Subject: Re: Geometry Problems
Posted by StefanoSpataro on Wed, 20 Apr 2016 11:54:07 GMT

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Dear Stefan,
last September I reported you several geometry warnings which were coming from the luminosity monitor, making the simulation crash sometimes in my Mac. Is this problem you found connected to these issues?

Subject: Re: Geometry Problems
Posted by Stefan Pflueger on Wed, 20 Apr 2016 12:04:15 GMT
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Hi Stefano,

I checked the forum and my emails but I could not find the problem you are referring to. Do you have any link for me? It could be that that there is some relation to what you mentioned, but I don't know the exact warnings you are referring to so kind of difficult to tell. Since I only changed the way the diamond support structure is created and it looks completely identical at the end I would assume there should be no connection... But in case ppl are using the CompositeShape to construct parts of their geometry I strongly suggest to check if their similar effects as we have observed them. Our angular resolution at 1.5 GeV is now twice as good as before! The effect was dramatic.

Subject: Re: Geometry Problems
Posted by StefanoSpataro on Wed, 20 Apr 2016 12:08:38 GMT
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StefanoSpataro wrote on 14 September 2015 16:42
Dear all,
after a long delay I put the QA macros inside macro/qa/lmd. I reduced the number of events to 1000 since it is too slow and in some computer it took more than 6 minutes for 2000.
In reality, I noticed that sometimes the sim macro is crashing and I have not understood why. In particular in my MAC I was not able to run the macros, it crash at event 0. When I am able to run, there are several geant4 errors from the geometry:

```
-------- WWWW ------- G4Exception-START -------- WWWW -------
*** G4Exception : GeomNav1002
      issued by : G4PropagatorInField::ComputeStep()
Particle is stuck; it will be killed.
  Zero progress for 51 attempted steps.
  Proposed Step is 1.99896e-05 but Step Taken is 1.99896e-05
 in volume lmd_vol_cvd_disc
*** This is just a warning message. ***
-------- WWWW -------- G4Exception-END --------- WWWW -------


-------- WWWW ------- G4Exception-START -------- WWWW -------
*** G4Exception : GeomNav1002
      issued by : G4PropagatorInField::ComputeStep()
```

Particle is stuck; it will be killed.
  Zero progress for 51 attempted steps.
  Proposed Step is 1.74027e-05 but Step Taken is 1.74027e-05
 in volume lmd_vol_vac
*** This is just a warning message. ***

Then maybe the geometry has internal problems. Doing a CheckFullGeometry I found the following:

```
========================================================================
STAGE 2: Global overlap/extrusion checking within 10 microns
========================================================================
Info in <TGeoNodeMatrix::CheckOverlaps>: Checking overlaps for cave and daughters within 0.001
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_ref_sys with 2 daughters but not voxelized
Check overlaps:      [==========] 1589 [100.00 %]
Info in <TGeoNodeMatrix::CheckOverlaps>: Number of illegal overlaps/extrusions : 12
```

and

```
========================================================================
STAGE 3: Propagating 1000000 tracks starting from vertex
 and conting number of boundary crossings...
========================================================================
Error in trying to cross boundary of SupportCylinderov831_2 00:00:00
Error in trying to cross boundary of SupportCylinderov831_2 00:00:00
Error in trying to cross boundary of SupportCylinderov831_2 00:00:00
Error in trying to cross boundary of SupportCylinderov831_1 00:00:00
Error in trying to cross boundary of SupportCylinderov831_2 00:00:00
Error in trying to cross boundary of SupportCylinderov831_1 00:00:01
Error in trying to cross boundary of SupportCylinderov831_1 00:00:01
Error in trying to cross boundary of SupportCylinderov831_2
```

...

I don't know if you have ever seen such problems.

Moreover, I noticed that the reco macro in my Mac is failing, since it seems the trafo_matrices_lmd.dat path is hardcoded, and if you change the path of the macro then you have the crash. If it has to be used in the common framework this should become more general, i.e. parameters should be loaded inside some ParameterClass by the standard Ascii file.

To summarize, the lmd qa macros are on the dashboard, but they can fail and the output is not well stable.

Regards

Stefano

Subject: Re: Geometry Problems
Posted by Stefan Pflueger on Wed, 20 Apr 2016 13:39:20 GMT
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Hi,

thx! Ok that looks indeed like these problems could be connected. Crash means the whole simulation is aborted, right? If so I never experienced this in my simulations... The errors seem like they could be coming from the strange geometry we had before. lmd_vol_cvd_disc is exactly the volume that was troublesome... would be interesting to see if these messages disappear now. I did a CheckFullGeometry() now and the only bad things I got is these warnings:

Quote:
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_vac with 9 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_ref_sys with 2 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_half with 4 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_plane with 6 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_module with 3 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_side with 3 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_die with 6 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_die with 4 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_side with 3 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_die with 6 daughters but not voxelized
Warning in <TGeoChecker::CheckOverlaps>: Volume lmd_vol_die with 4 daughters but not voxelized

Im not sure how bad this is... what does the voxelized mean? At least the diamond support seems not to be part in it. Everything else looks clean. I just had a thought, maybe our mistake was setting the cut shape thicknesses to 1. in the old geometries. That is kind of unnecessary and could introduce some problems...

Subject: Re: Geometry Problems
Posted by StefanoSpataro on Thu, 28 Apr 2016 11:58:49 GMT
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When you have a volume with daughters, the modeler creates for each volume some optimization structures called voxels (see Voxelization) to minimize the penalty having too many daughters in your tracking performance. I.e. in a structure where you have many

daughters, such as a pixel layer, or a chambers with thousands of wires, to find in which volume the point (x,y,z) is located (you have to imagine a loop into all the daughter volumes).

If I remember correctly, the warning appears when the bounding box of an assembly is smaller than the inside volumes. In any case, the warning reflects some anomaly in the geometry, virtual or non virtual overlaps of clashes. Have you tried to take a look into such volumes, to understand what could be the possible reason? Which lmd geometry are you checking?

Subject: Re: Geometry Problems
Posted by Stefan Pflueger on Thu, 28 Apr 2016 13:34:38 GMT
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Hi,

no I did not check the volumes in detail... Is that a critical issue? My simulations work fine and the results now look much better. I'm using the Lumi_Detector geometry file in the trunk geometry folder.

Stefan

Subject: Re: Geometry Problems
Posted by StefanoSpataro on Thu, 28 Apr 2016 14:42:09 GMT
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Hi,
I have just tried macro/qa/lmd/sim_LMD.C and in my mac it still crashes at the first event:

Run 0 start.
>>> Event 0

*** Break *** segmentation violation
Generating stack trace...
[invalid usage]: unrecognized option '-d'
Usage: atos [-p pid] [-o executable] [-f file] [-s slide | -l loadAddress] [-arch architecture] [-printHeader] [address ...]
0x000000010e131f97 in _ZNK17TGeoShapeAssembly15DistFromOutsideEPKdS1_idPd + 0x447 from /Users/spataro/fairsoft_mar15p1bis/buildFairSoft/lib/root/libGeom.so
[invalid usage]: unrecognized option '-d'
Usage: atos [-p pid] [-o executable] [-f file] [-s slide | -l loadAddress] [-arch architecture] [-printHeader] [address ...]
0x000000010e131e38 in _ZNK17TGeoShapeAssembly15DistFromOutsideEPKdS1_idPd + 0x2e8 from /Users/spataro/fairsoft_mar15p1bis/buildFairSoft/lib/root/libGeom.so
[invalid usage]: unrecognized option '-d'
Usage: atos [-p pid] [-o executable] [-f file] [-s slide | -l loadAddress] [-arch architecture] [-printHeader] [address ...]
0x000000010e10554c in _ZN13TGeoNavigator24FindNextDaughterBoundaryEPdS0_Rib + 0x8bc from /Users/spataro/fairsoft_mar15p1bis/buildFairSoft/lib/root/libGeom.so
[invalid usage]: unrecognized option '-d'
Usage: atos [-p pid] [-o executable] [-f file] [-s slide | -l loadAddress] [-arch architecture]

[-printHeader] [address ...]
 0x000000010e103a96 in _ZN13TGeoNavigator16FindNextBoundaryEdPKcb + 0x9c6 from /Users/spataro/fairsoft_mar15p1bis/buildFairSoft/lib/root/libGeom.so
[invalid usage]: unrecognized option '-d'
Usage: atos [-p pid] [-o executable] [-f file] [-s slide | -l loadAddress] [-arch architecture] [-printHeader] [address ...]
 0x000000012317d8cd in _ZN16TG4RootNavigator11ComputeStepERKN5CLHEP10Hep3VectorES3_dRd + 0x3dd from /Users/spataro/fairsoft_mar15p1bis/buildFairSoft/lib/libg4root.so

This means there is still something bag in the geoemtry definition, or maybe the file in the qa macro is obsolete.
