Discussion/Conclusion in the Software meeting

- My message: It’s doable and takes 5-6 weeks, which is much shorter than my initial estimation of 3 months, but we, the INTT group, are busy with the commissioning.
- Short-term goal: Introducing the gap between the INTT half-barrels.
  It means position modification for the silicon sensors, etc., does not need to be done right now because misalignment correction probably includes the modification.
- (INTT group has to make an analysis node about the survey studies) (the statement may not be made)
- Joseph tries to add half-barrel volume so that position modification for half-barrels can be made easily.
- Hao-Ren (MIT, MVTX) is interested in the survey geometry implementation to the simulation.

sPHENIX Software and Simulations Meeting, Feb/06/2024

Status of INTT for Geant4 Simulation

Genki Nukazuka (RBRC)

INTT Geometry: Implementation

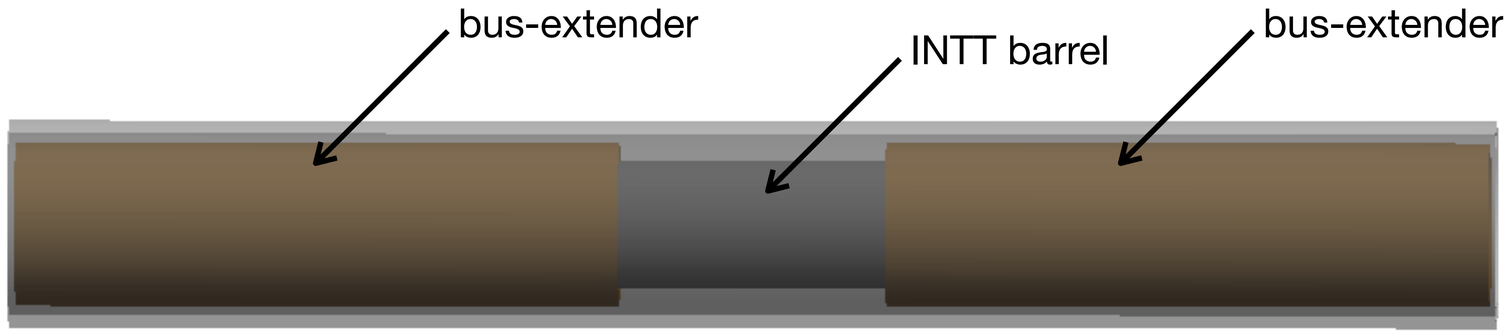
Person in charge:

- Takahiro Todoroki (RBRC, ?—Mar/2020)
- Genki Nukazuka (RIKEN/RBRC, Apr/202—current)

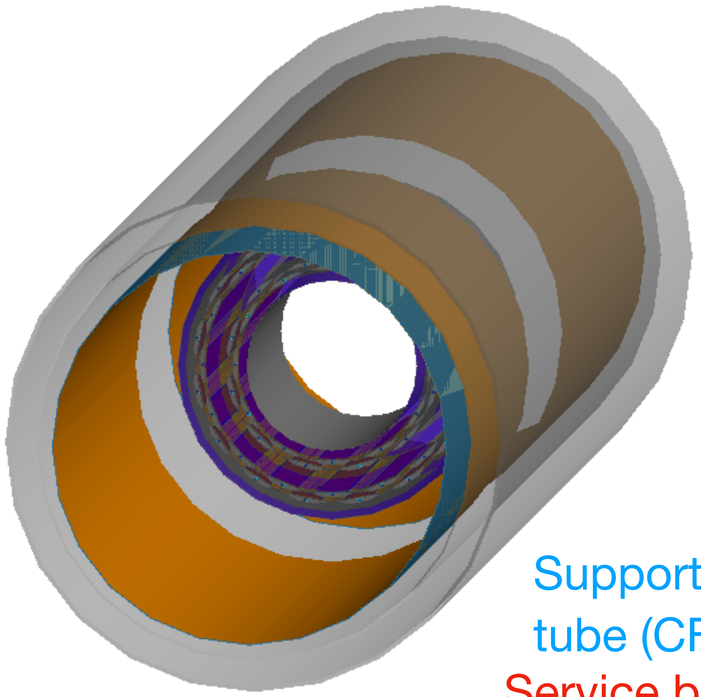
Presentations at the Software&Simulation meeting

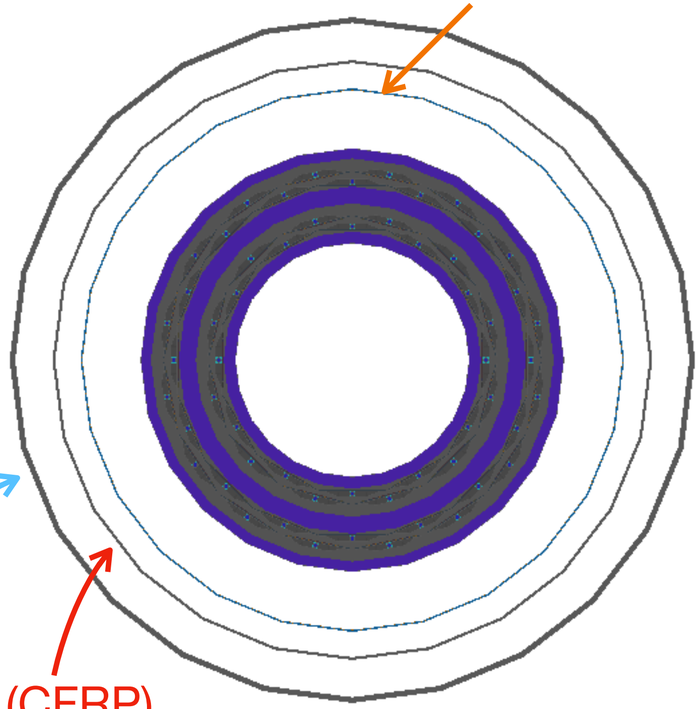
- Jul/07/2020: ϕ offset
- Aug/04/2020: Major updates on the INTT ladder, Bus extender implementation
- Sep/27/2020: ϕ offset
- Feb/08/2021: New end ring (at the tracking software meeting)
- Jun/29/2021: Status report
- Oct/26/2021: Status report
- Nov/02/2021: Calibration software developments
- Nov/16/2021: The inner&outer CFRP skins
- Nov/30/2021: The service barrel and the support tube, Bus extender modification
- Dec/14/2021: Status report

Current INTT Geometry

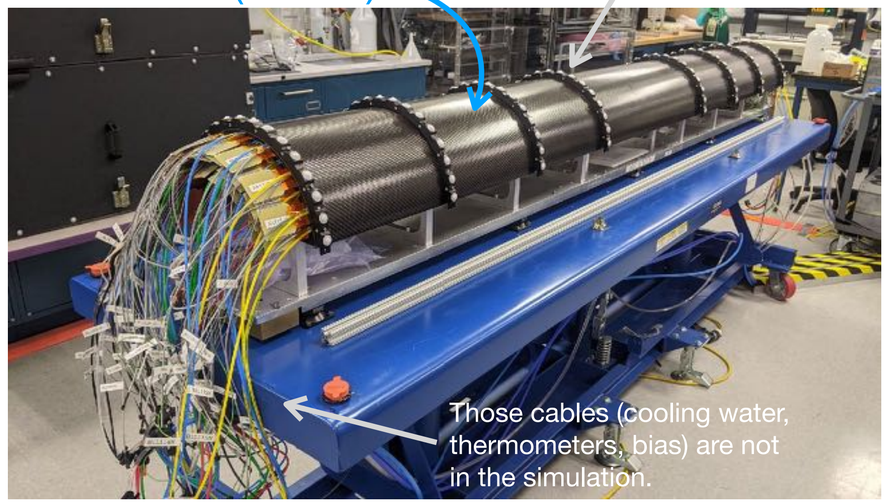


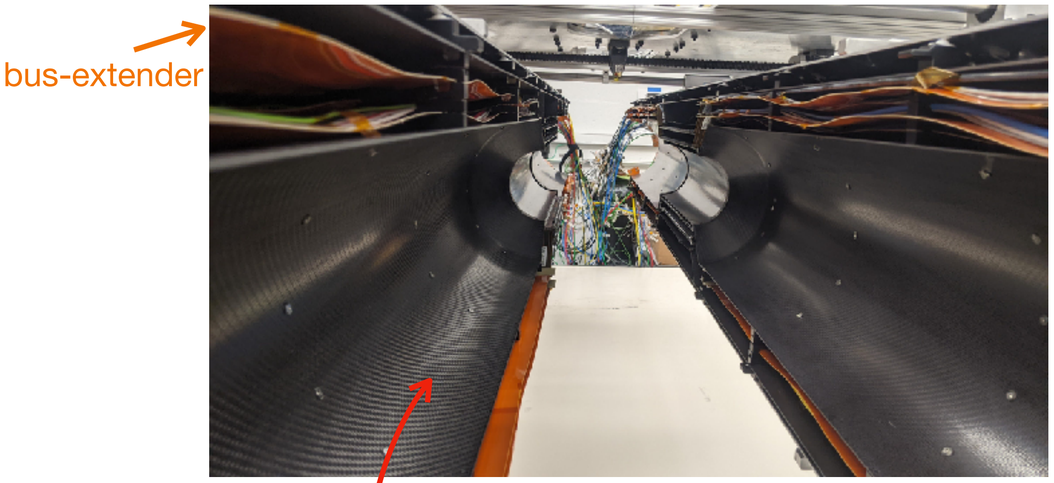
Side view of the INTT model





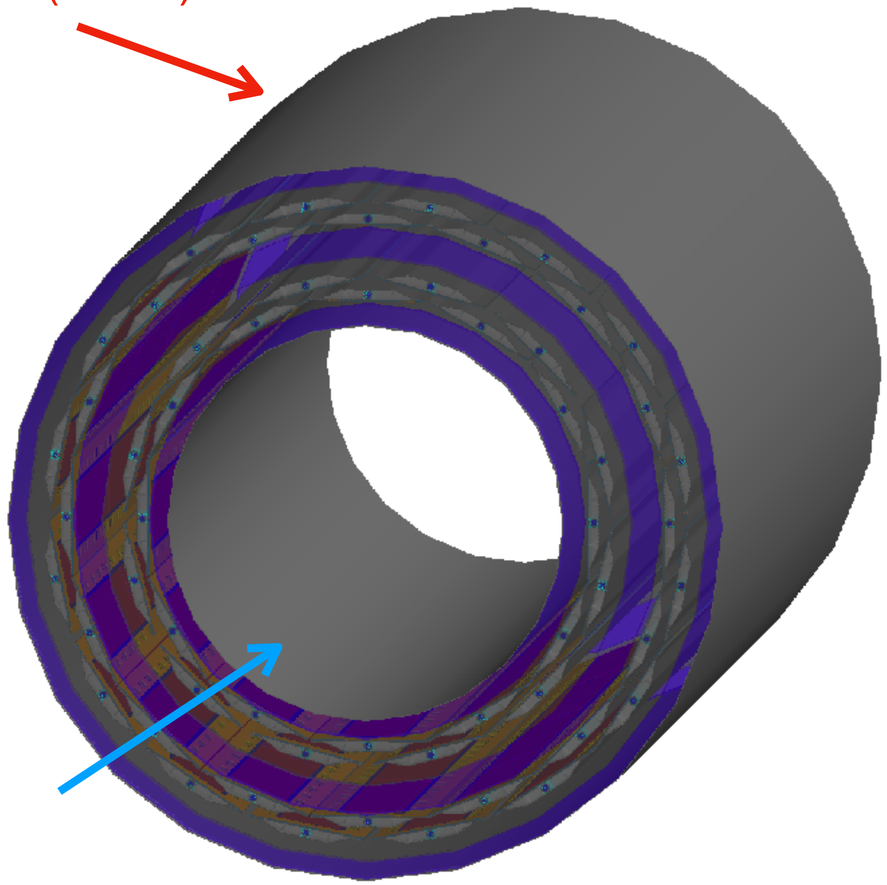
Cross-section



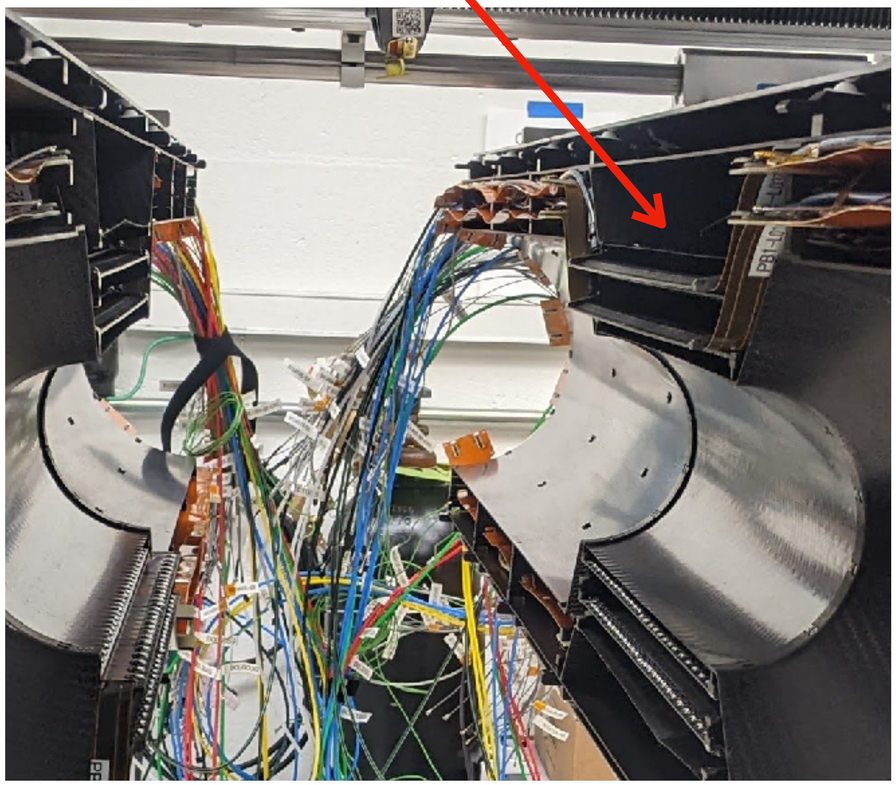


Current INTT Geometry

Outer skin (CFRP)



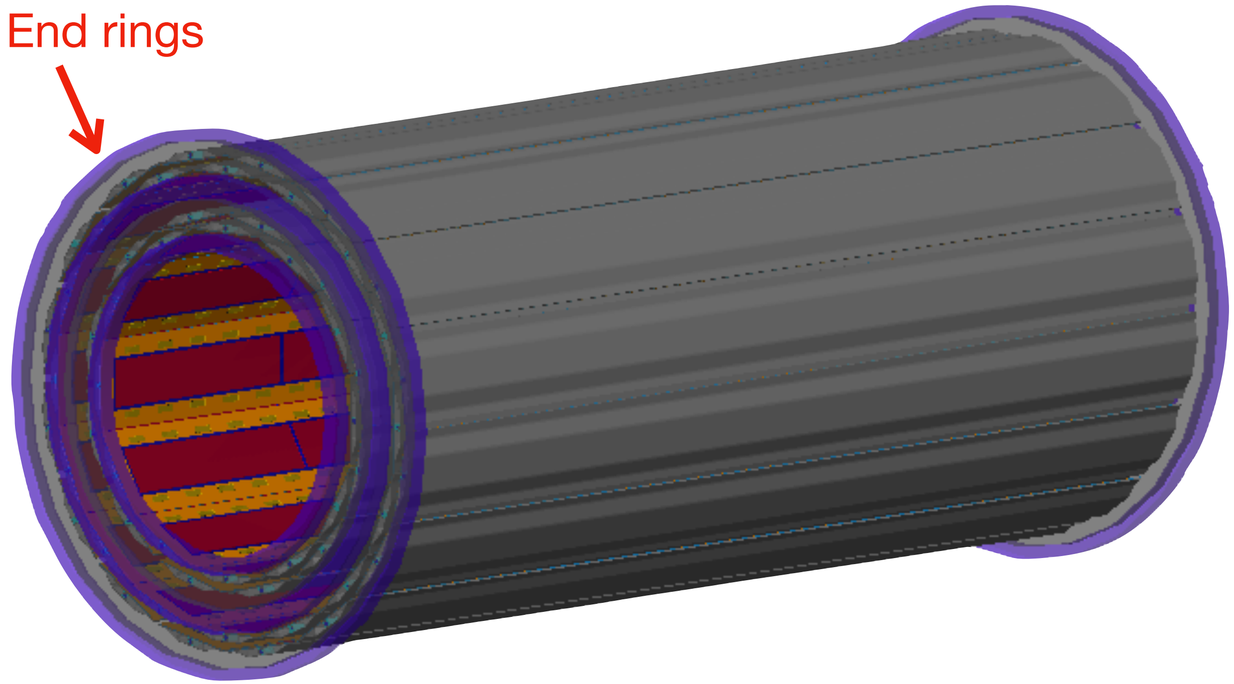
Outer skin (CFRP)



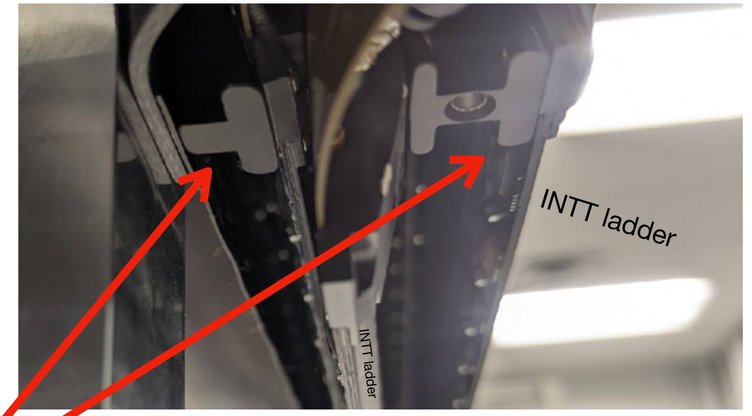
Inner skin (CFRP)

INTT ladders covered by Outer&Inner skins

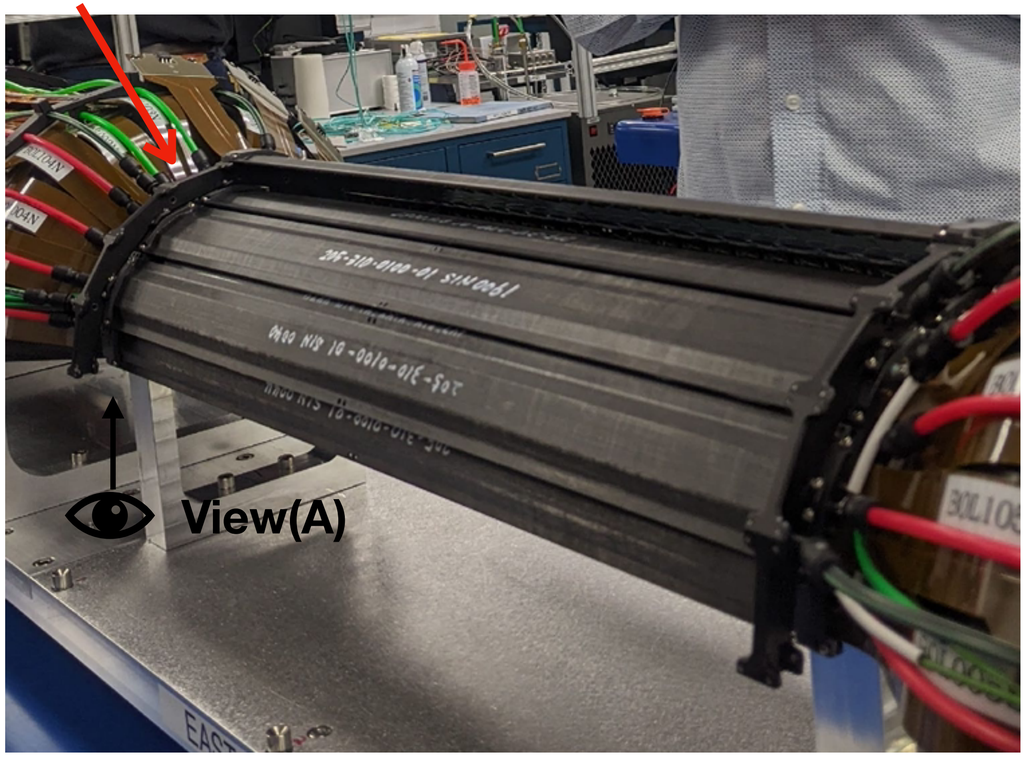
Current INTT Geometry



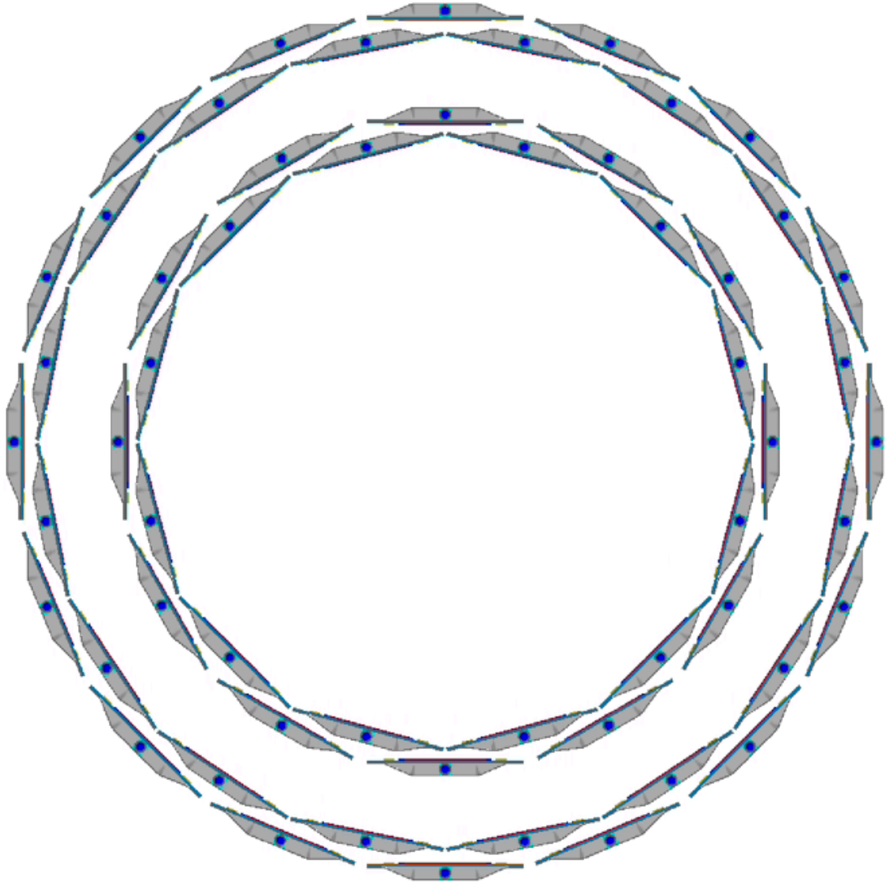
INTT ladders and the end-rings



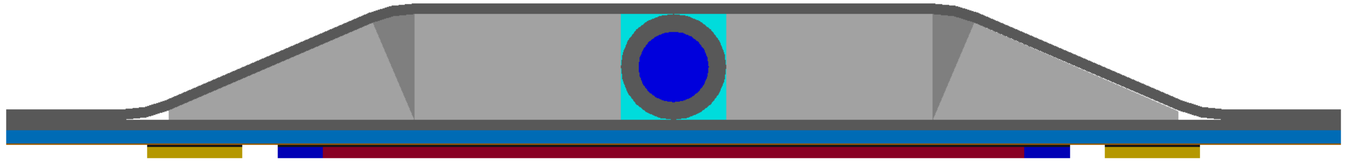
View from (A)



Current INTT Geometry



Cross-section of the INTT ladders



Cross-section of an INTT ladder

The geometry codes

Geometry description:

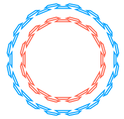
coresoftware/simulation/g4simulation/g4intt/PHG4InttDecector.cc & .hh

Parameters for the geometry:

coresoftware/simulation/g4simulation/g4intt/PHG4InttSubsystem.cc & .hh

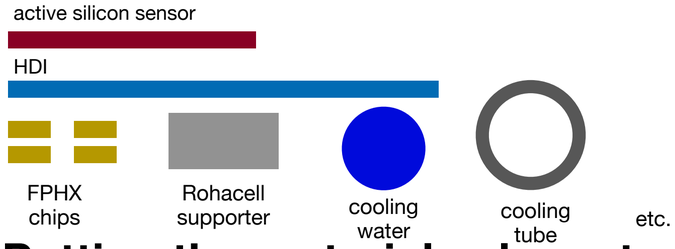
The size of materials is hard-coded.

The geometry codes: How the geometry is constructed

for(loop over INTT inner/outer barrels ){

  for(loop over the inner/outer layers ){

1. Making volumes of the silicon sensors, FPHX chips, HID, etc.

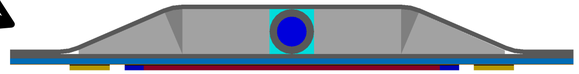


etc.

piece of codes, for example

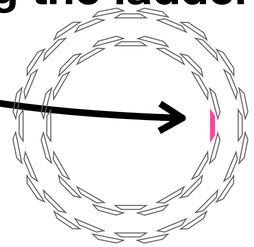
```
192         // Create Si-sensor active volume
193         const double siactive_x = strip_x;
194         const double siactive_y = strip_y * nstrips_phi_sensor;
195         const double siactive_z = strip_z * nstrips_z_sensor;
196         G4VSolid *siactive_box = new G4Box((boost::format("siactive_box_%d_%d") % inttlayer % itype).str(), siactive_x / 2, siactive_y / 2., siactive_z / 2.);
197         G4LogicalVolume *siactive_volume = new G4LogicalVolume(siactive_box, GetDetectorMaterial("G4_Si"),
198                                                                boost::str(boost::format("siactive_volume_%d_%d") % inttlayer % itype).c_str(), 0, 0, 0);
199         if ((n_IsActiveMap.find(inttlayer))->second > 0)
200         {
201           m_ActiveLogVols.insert(siactive_volume);
202         }
203         m_DisplayAction->AddVolume(siactive_volume, "SiActive");
204         // We do not subdivide the sensor in G4. We will assign hits to strips in the stepping action, using the geometry object
```

2. Putting the material volume to a ladder volume



```
922         // Carbon stave
923         double TVstave_y = 0.0;
924         const double TVstave_x = ladder_x / 2. - stave_x / 2.;
925         new G4PVPlacement(0, G4ThreeVector(TVstave_x, TVstave_y, 0.0), stave_volume, (boost::format("stave_%d_%d") % inttlayer % itype).str(),
926                           ladder_volume, false, 0, OverlapCheck());
927         new G4PVPlacement(0, G4ThreeVector(TVstave_x, TVstave_y, 0.0), staveext_volume, (boost::format("staveext_%d_%s") % inttlayer % itype).str(),
928                           ladderext_volume, false, 0, OverlapCheck());
```

3. Putting the ladder volume at the requested ϕ and z



```
1023        // these describe the center of the ladder volume, placing it so that the center of the sensor is at phi = dphi * icopy, and at the correct radius
1024        const double posx = radius * cos(phi - p);
1025        const double posy = radius * sin(phi - p);
1026        const double fRotate = p + (phi - p) + offsetrot;  // rotate in its own frame to make sensor perp to radial vector (p), then additionally rotate to account for ladder phi
1027        G4RotationMatrix ladderrotation;
1028        ladderrotation.rotateZ(fRotate);
1029
1030        // this placement version rotates the ladder in its own frame by fRotate, then translates the center to posx, posy, +/- m_PosZ
1031        auto pointer_negz = new G4PVPlacement(G4Transform3D(ladderrotation, G4ThreeVector(posx, posy, -m_PosZ[inttlayer][itype])), ladder_volume,
1032                                              (boost::format("ladder_%d_%d_%d_negz") % inttlayer % itype % icopy).str(), trackerenvelope, false, 0, OverlapCheck());
1033        auto pointer_posz = new G4PVPlacement(G4Transform3D(ladderrotation, G4ThreeVector(posx, posy, +m_PosZ[inttlayer][itype])), ladder_volume,
1034                                              (boost::format("ladder_%d_%d_%d_posz") % inttlayer % itype % icopy).str(), trackerenvelope, false, 0, OverlapCheck());
```

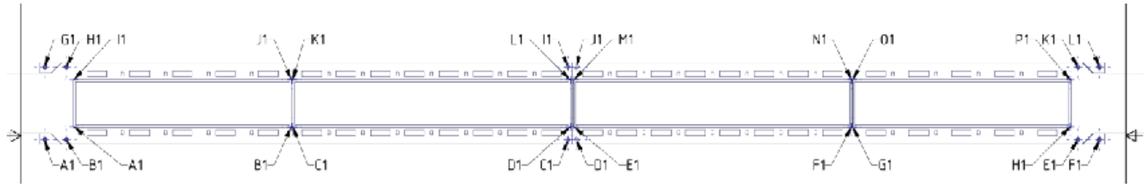
  }

}

- Making volumes for the support structures, etc
- Putting these volumes in the requested position

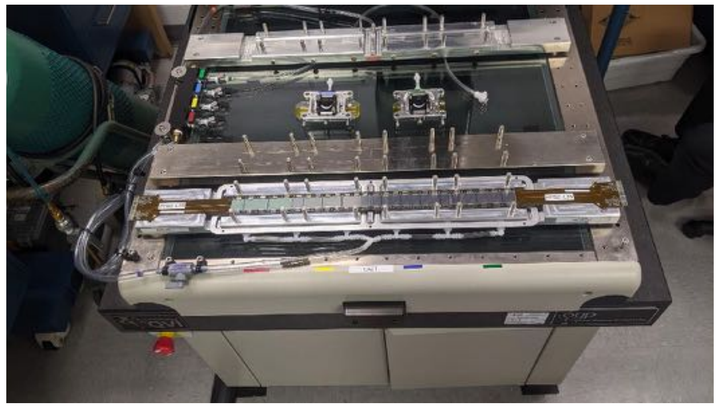
[Survey Information in GitHub]

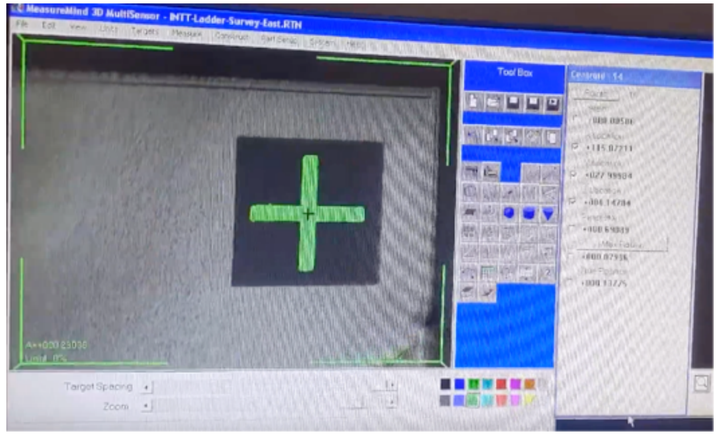
Survey information



B0L000.txt
B0L001.txt
B0L002.txt
B0L003.txt
B0L004.txt
B0L005.txt
B0L006.txt
B0L007.txt
B0L008.txt
B0L009.txt
B0L010.txt
B0L011.txt
B0L100.txt
B0L101.txt
B0L102.txt
B0L103.txt
B0L104.txt
B0L105.txt
B0L106.txt
B0L107.txt
B0L108.txt
B0L109.txt
B0L110.txt
B0L111.txt
B1L000.txt

```
Machine Serial Number: SVL6252331                                    Page:    1
================================================================================
Routine Name                                        Run #       Date & Time
================================================================================
INTT-Ladder-Survey-East.RTN                                 16 Tue Oct 12 10:44:47 2021
================================================================================
================================================================================
Feature      Unit   Nominal     Actual      Tolerances      Deviation   Exceeded
================================================================================

Step 10 - Sensor A - Cross 1
X Location     mm +013.56485 +013.48043                      -000.08442
Y Location     mm +005.99526 +005.96057                      -000.03469
Z Location     mm +000.15466 +000.12212                      -000.03254

Step 12 - Sensor A - Cross 2
X Location     mm +115.06485 +115.00061                      -000.06424
Y Location     mm +005.99526 +005.97479                      -000.02047
Z Location     mm +000.15466 +000.15226                      -000.00240

Step 14 - Sensor A - Cross 3
X Location     mm +115.06485 +114.99841                      -000.06644
Y Location     mm +027.99526 +027.97667                      -000.01859
Z Location     mm +000.15466 +000.15482                      +000.00016

Step 16 - Sensor A - Cross 4
X Location     mm +013.56485 +013.47224                      -000.09261
Y Location     mm +027.99526 +027.95392                      -000.04134
Z Location     mm +000.15466 +000.18816                      +000.03350

Step 18 - Sensor B - Cross 1
X Location     mm +115.76485 +115.65347                      -000.11138
Y Location     mm +005.99526 +005.98515                      -000.01011
Z Location     mm +000.15466 +000.13773                      -000.01693

Step 20 - Sensor B - Cross 2
X Location     mm +245.26485 +245.16880                      -000.09605
Y Location     mm +005.99526 +005.99698                      +000.00172
Z Location     mm +000.15466 +000.08713                      -000.06753

Step 22 - Sensor B - Cross 3
X Location     mm +245.26485 +245.16490                      -000.09995
Y Location     mm +027.99526 +028.00287                      +000.00761
Z Location     mm +000.15466 +000.15920                      +000.00454
```





The position of the points on a ladder was measured.
→ Relative position of the silicon sensors in the ladder.

[Survey Information in GitHub]

Survey information

Another survey gives information on the relative position of a ladder in the INTT half-barrel.

Survey Information in GitHub

Survey information

I heard another survey after installing the INTT barrel to IR. But I don’t know the details. We, the INTT group, have to make an analysis node to summarize all surveys in 2023.

[Survey Information in GitHub]

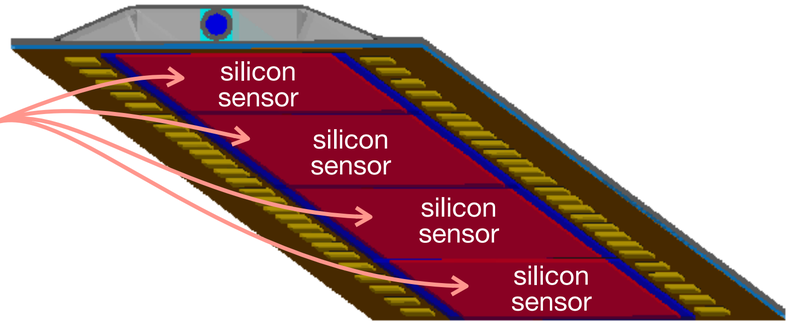
Survey information

INTT / general_codes / josephb / codes / intt_alignment / dat / **EAST_INTT.txt**

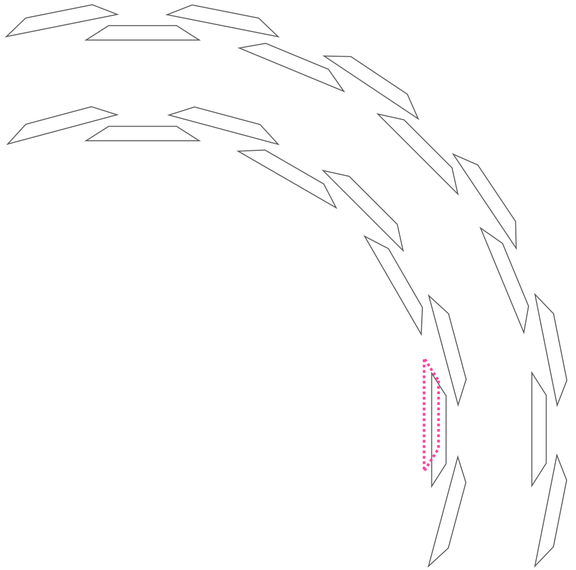
josephbertaux Forgot to add newly created source files

Code | Blame | Executable File · 169 lines (169 loc) · 8.05 KB

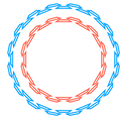
```
1    B0L000_1,  -37.974169,  250.668296,  -71.573027
2    B0L000_2,  -37.282322,  -241.260395,  -71.427629
3    B0L000_3,  -4.482564,  -241.190330,  -80.209207
4    B0L000_4,  -5.199084,  250.709747,  -80.615233
5    B0L001_1,  -67.245138,  250.529745,  -44.187139
6    B0L001_2,  -66.968005,  -241.322534,  -44.381619
7    B0L001_3,  -42.906502,  -241.220291,  -68.320521
8    B0L001_4,  -43.329242,  250.691310,  -68.375938
9    B0L002_1,  -78.818323,  250.818327,  -6.247263
10   B0L002_2,  -78.814317,  -241.218110,  -6.057371
11   B0L002_3,  -69.969479,  -241.157616,  -38.878599
12   B0L002_4,  -70.057721,  250.858538,  -38.988666
13   B0L003_1,  -70.007444,  250.686542,  32.993500
14   B0L003_2,  -70.011697,  -241.385747,  33.180529
15   B0L003_3,  -78.700003,  -241.337139,  0.346792
16   B0L003_4,  -78.874531,  250.685367,  0.291958
17   B0L004_1,  -43.609830,  250.791793,  62.335049
18   B0L004_2,  -43.259587,  -241.103793,  62.470601
```



Joseph made conversion parameters for each silicon sensor using all survey information. We can apply it to make the survey geometry from the ideal geometry (correct?).

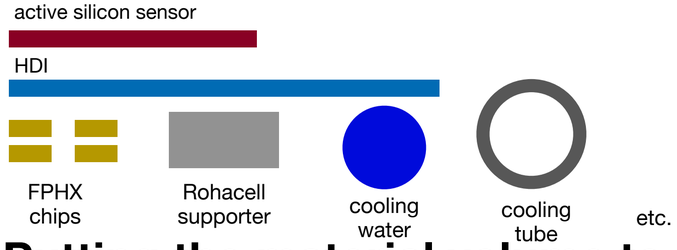


How can we import modification by the survey to the ideal geometry?

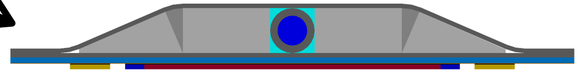
for(loop over INTT inner/outer barrels  **){**

for(loop over the inner/outer layers  **){**

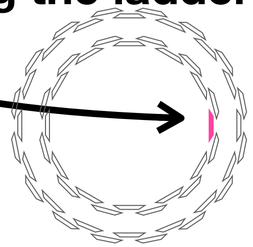
1. Making volumes of the silicon sensors, FPHX chips, HID, etc.



2. Putting the material volume to a ladder volume



3. Putting the ladder volume at the requested ϕ and z



}

}

- Making volumes for the support structures, etc

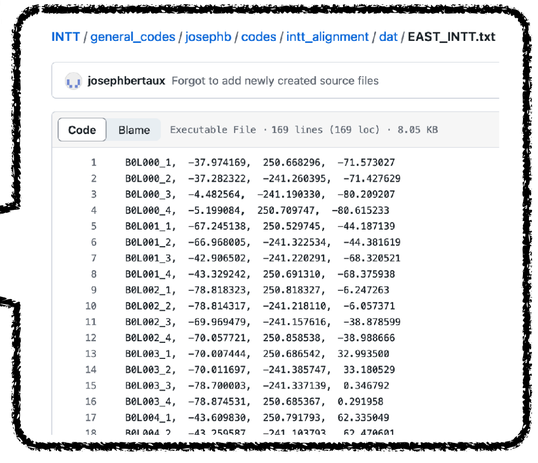
- Putting these volumes in the requested position

The survey modification should be at step 3.

I guess (assuming the person is not me)

- Understanding existing codes: 1 week
- Understanding/Testing the modification: 1—2 weeks
- Implementation of the modification to the geometry: 2 weeks
- Checking the survey geomery: ? (How can we do it?)
- Code review/Pull request: 1 week

→ 5—6 weeks + ? are needed for this topic.


INTT / general_codes / josephb / codes / intt_alignment / dat / EAST_INTT.txt

josephbertaux Forgot to add newly created source files

Code Blame Executable File · 169 lines (169 loc) · 8.05 KB

```
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7   B0L001_3,  -42.906502,  -241.220291,  -68.320521
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9   B0L002_1,  -78.818323,  250.818327,  -6.247263
10  B0L002_2,  -78.814317,  -241.218110,  -6.057371
11  B0L002_3,  -69.969479,  -241.157616,  -38.878599
12  B0L002_4,  -70.057721,  250.858538,  -38.988666
13  B0L003_1,  -70.007444,  250.686542,  32.993500
14  B0L003_2,  -70.011697,  -241.385747,  33.180529
15  B0L003_3,  -78.700003,  -241.337139,  0.346792
16  B0L003_4,  -78.874531,  250.685367,  0.291958
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18  B0L004_2,  -43.259587,  -241.103793,  62.470601
```
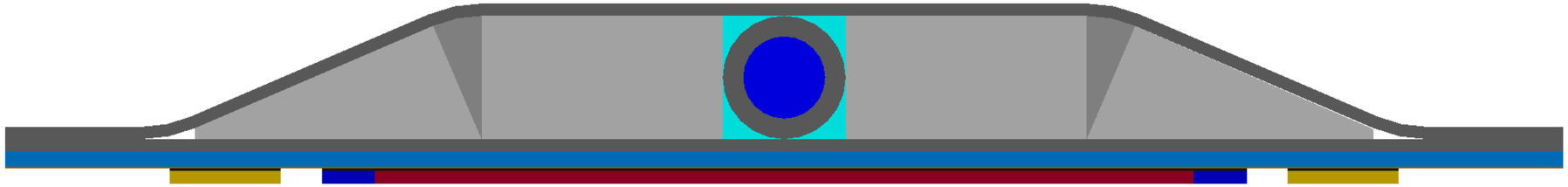

Survey modification

Summary



- Most of the materials for INTT had been implemented.
- Joseph worked on the position modification of the silicon sensors using the survey information.
- We need to make sure that we have all the survey information.
- It is possible to introduce the survey geometry into the sPHENIX Geant4 simulation, though it takes time.
- INTT group is now busy with ROC reinstallation, ladder tests, and commissioning. We (at least those at BNL) should focus on it.