

Problem in Cryostat construction ...and possible solution

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What's The Problem

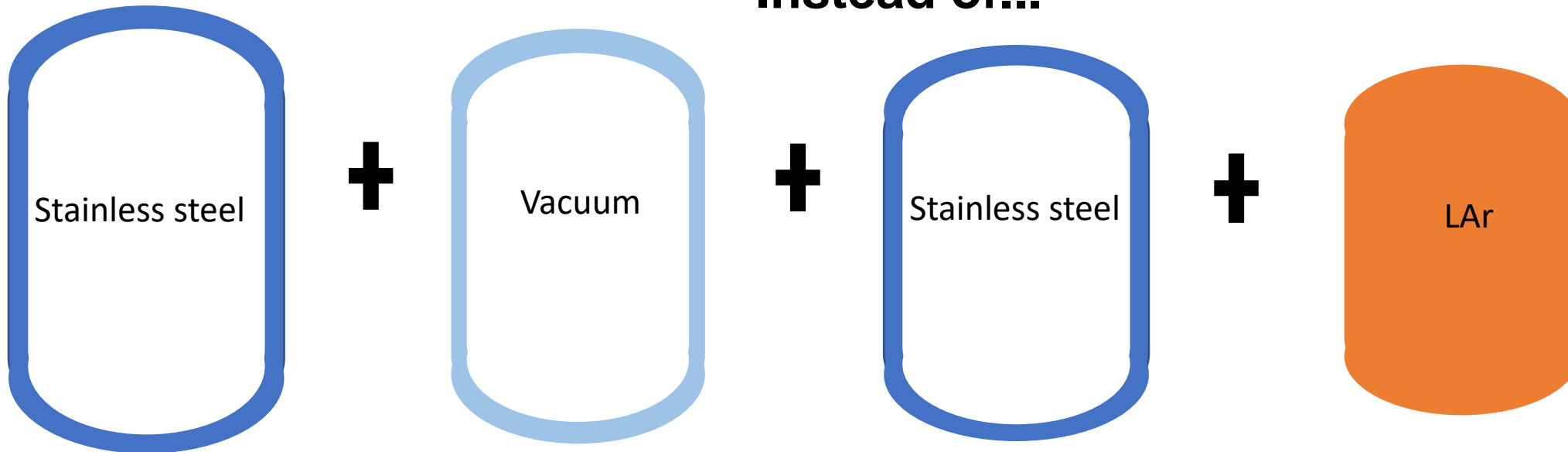
```
Routine:src/DSRunAction.cc(83):*** AUTOSEED OFF ***
Routine:src/DSRunAction.cc(84):*****
Routine:src/DSRunAction.cc(100):Random seed: 0
Routine:src/DSRunAction.cc(112):Initialized Binary File: _v1.fil
Developer:src/DSGeneratorG4Gun.cc(72):geantino Energy: 1 MeV; Position: (0,0,0) cm; Direction: (0,0,1)
geantino 0 E: 1000 keV; Edep: 0 LiquidArgon GridSteel (0,0,54.595) step 545950 ID: 1 Parent ID: 0 gtime: 1.82109 Transportation
geantino 0 E: 1000 keV; Edep: 0 GridSteel GaseousArgon (0,0,54.605) step 100 ID: 1 Parent ID: 0 gtime: 1.82143 Transportation
geantino 0 E: 1000 keV; Edep: 0 GaseousArgon TPB (0,0,56.105) step 15000 ID: 1 Parent ID: 0 gtime: 1.87146 Transportation
geantino 0 E: 1000 keV; Edep: 0 TPB Acrylic (0,0,56.115) step 100 ID: 1 Parent ID: 0 gtime: 1.87179 Transportation
geantino 0 E: 1000 keV; Edep: 0 Acrylic VetoLiquidArgon1 (0,0,61.115) step 50000 ID: 1 Parent ID: 0 gtime: 2.03858 Transportation
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon1 MetalSilicon (0,0,71.115) step 100000 ID: 1 Parent ID: 0 gtime: 2.37214 Transportation
geantino 0 E: 1000 keV; Edep: 0 MetalSilicon MetalSilicon (0,0,71.15) step 350 ID: 1 Parent ID: 0 gtime: 2.37331 Transportation
geantino 0 E: 1000 keV; Edep: 0 MetalSilicon Arlon (0,0,71.185) step 350 ID: 1 Parent ID: 0 gtime: 2.37448 Transportation
geantino 0 E: 1000 keV; Edep: 0 Arlon VetoLiquidArgon1 (0,0,71.235) step 500 ID: 1 Parent ID: 0 gtime: 2.37614 Transportation
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon1 Arlon (0,0,71.735) step 5000 ID: 1 Parent ID: 0 gtime: 2.39282 Transportation
geantino 0 E: 1000 keV; Edep: 0 Arlon MetalTitanium (0,0,71.835) step 1000 ID: 1 Parent ID: 0 gtime: 2.39616 Transportation
geantino 0 E: 1000 keV; Edep: 0 MetalTitanium VetoLiquidArgon2 (0,0,72.835) step 10000 ID: 1 Parent ID: 0 gtime: 2.42951 Transportation
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon2 StainlessSteel (0,0,100) step 271650 ID: 1 Parent ID: 0 gtime: 3.33564 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel VetoLiquidArgon2 (0,0,100) step 0 ID: 1 Parent ID: 0 gtime: 3.33564 Transportation
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon2 StainlessSteel (0,0,100) step 0 ID: 1 Parent ID: 0 gtime: 3.33564 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel VetoLiquidArgon2 (0,0,100) step 0 ID: 1 Parent ID: 0 gtime: 3.33564 Transportation
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geantino 0 E: 1000 keV; Edep: 0 StainlessSteel VetoLiquidArgon2 (0,0,100) step 0 ID: 1 Parent ID: 0 gtime: 3.33564 Transportation
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon2 StainlessSteel (0,0,100) step 0 ID: 1 Parent ID: 0 gtime: 3.33564 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel VetoLiquidArgon2 (0,0,100) step 0 ID: 1 Parent ID: 0 gtime: 3.33564 Transportation
----- WWW ----- G4Exception-START ----- WWW -----
*** G4Exception : GeomNav1002
    issued by : G4Navigator::ComputeStep()
Track stuck or not moving.
    Track stuck, not moving for 10 steps
    in volume -Cryostat_VetoBuffer- at point (0,0,1000)
    direction: (0,0,1).
    Potential geometry or navigation problem !
    Trying pushing it of 1e-07 mm ...Potential overlap in geometry!

*** This is just a warning message. ***
----- WWW ----- G4Exception-END ----- WWW -----
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon2 StainlessSteel (0,0,100) step 0.0001 ID: 1 Parent ID: 0 gtime: 3.33564 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel Vacuum (0,0,198) step 980000 ID: 1 Parent ID: 0 gtime: 6.60457 Transportation
geantino 0 E: 1000 keV; Edep: 0 Vacuum StainlessSteel (0,0,199) step 10000 ID: 1 Parent ID: 0 gtime: 6.63793 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel Water (0,0,200) step 10000 ID: 1 Parent ID: 0 gtime: 6.67128 Transportation
geantino 0 E: 1000 keV; Edep: 0 Water StainlessSteel (0,0,450) step 2.5e+06 ID: 1 Parent ID: 0 gtime: 15.0104 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel Air (0,0,452) step 20000 ID: 1 Parent ID: 0 gtime: 15.0771 Transportation
Routine:src/DSEventAction.cc(134):>>> Event 0; NPE = 0; CPUtime/event = 0 s
Trace:src/DSEventAction.cc(142): Starting Position: (0,0,0) cm
Trace:src/DSEventAction.cc(143): Energy : 1000 keV
```

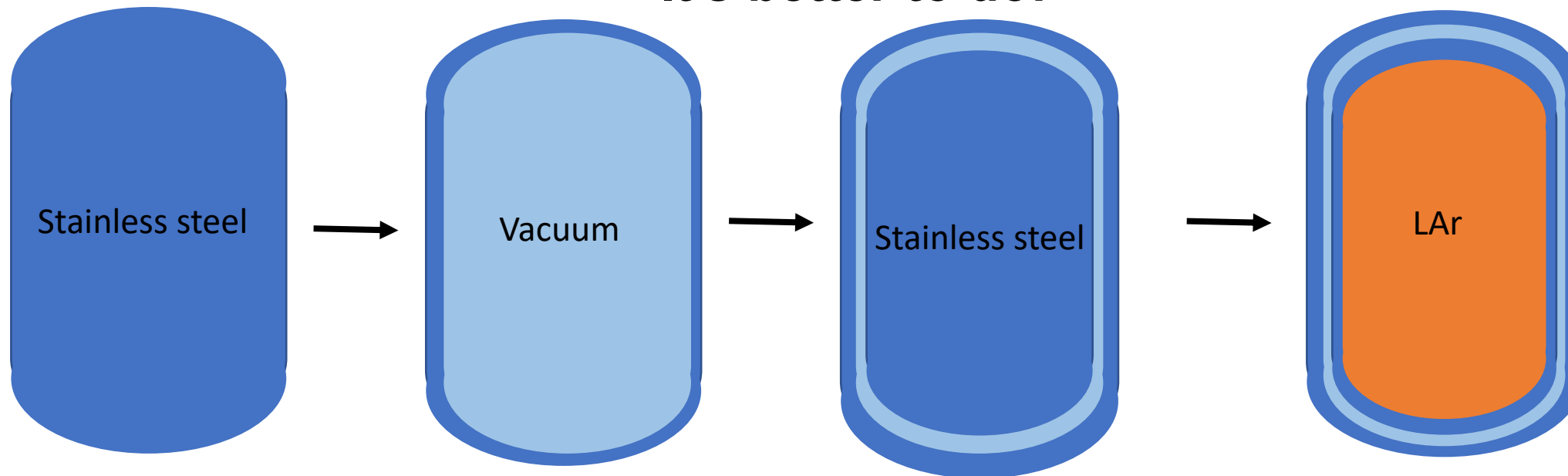
We shoot a geantino from (0,0,0) upward and downward

- The geantino is stuck at the interface between Veto LAr and the Stainless Steel
- The Stainless Steel seems to be 98 cm thick!

Instead of...



It's better to do:



Geant4 Implementation (in DSDetectorLowMass.cc)

```
//-----  
//                               Cryostat Mother                               //  
//-----
```

//Outer Cryostat

```
G4Tubs* outer_cryostat_body = new G4Tubs("outer_cryostat_body", 0, cryoOuter_OuterR, cryostat_Height*0.5, 0, 360*deg);  
G4Sphere* outer_cryostat_cap = new G4Sphere("outer_cryostat_cap", 0, cryoOuter_OuterR, 0*deg, 360*deg,0*deg, 90*deg );  
G4UnionSolid* outer_cryostatWithCap = new G4UnionSolid("outer_cryostatWithCap", outer_cryostat_body, outer_cryostat_cap, 0, topCap_pos);  
G4UnionSolid* outer_cryostatWithCaps = new G4UnionSolid("outer_cryostatWithCaps", outer_cryostatWithCap, outer_cryostat_cap, rotate_X_180, bottomCap_pos);  
  
G4LogicalVolume* outer_CryostatLV = new G4LogicalVolume(outer_cryostatWithCaps,StainlessSteel, "outer_CryostatLV");  
G4PVPlacement* outer_Cryostat = new G4PVPlacement(0, origin, "outer_Cryostat", outer_CryostatLV, myMotherVolume, false, 0, myCheckOverlap);
```

//Vacuum

```
G4Tubs* vacuum_body = new G4Tubs("vacuum_body", 0, cryoOuter_InnerR, cryostat_Height*0.5, 0, 360*deg);  
G4Sphere* vacuum_cap = new G4Sphere("vacuum_cap", 0, cryoOuter_InnerR, 0*deg, 360*deg,0*deg, 90*deg);  
G4UnionSolid* VacuumWithCap = new G4UnionSolid("VacuumWithCap", vacuum_body, vacuum_cap, 0, topCap_pos);  
G4UnionSolid* VacuumWithCaps = new G4UnionSolid("VacuumWithCaps", VacuumWithCap, vacuum_cap, rotate_X_180, bottomCap_pos);  
  
G4LogicalVolume* VacuumLV = new G4LogicalVolume(VacuumWithCaps, Vacuum, "VacuumLV");  
G4PVPlacement* VacuumPV = new G4PVPlacement(0, origin, "VacuumPV", VacuumLV, outer_Cryostat, false, 0, myCheckOverlap);
```

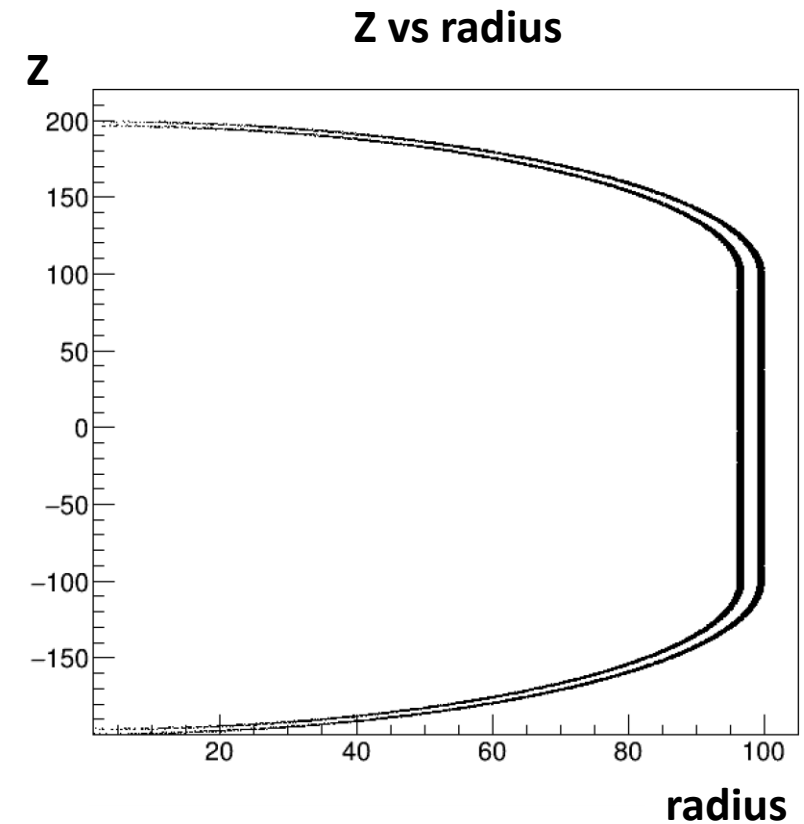
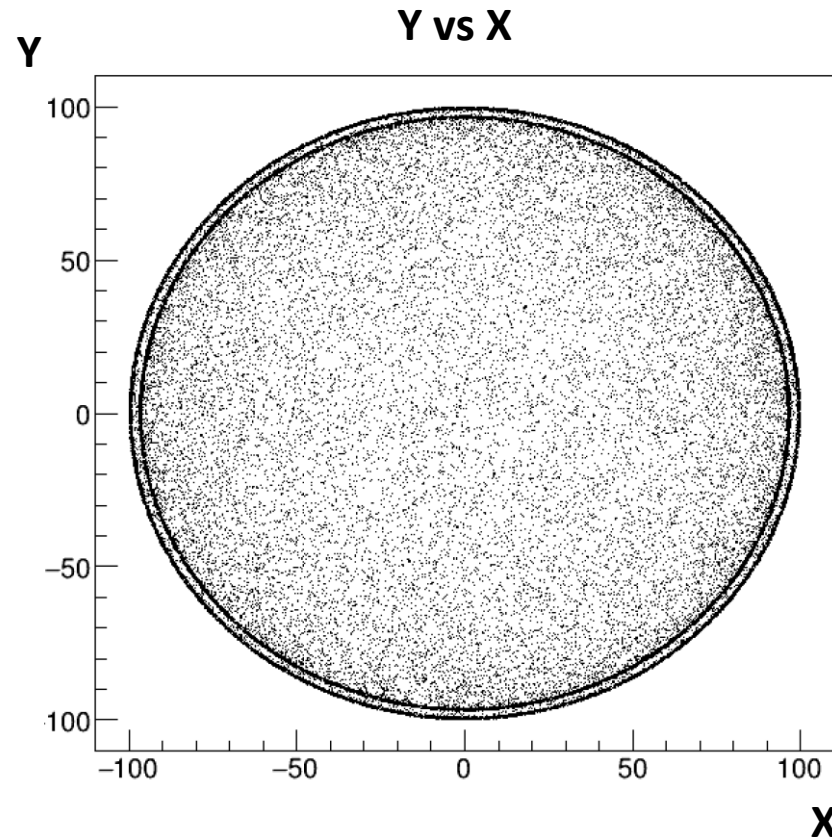
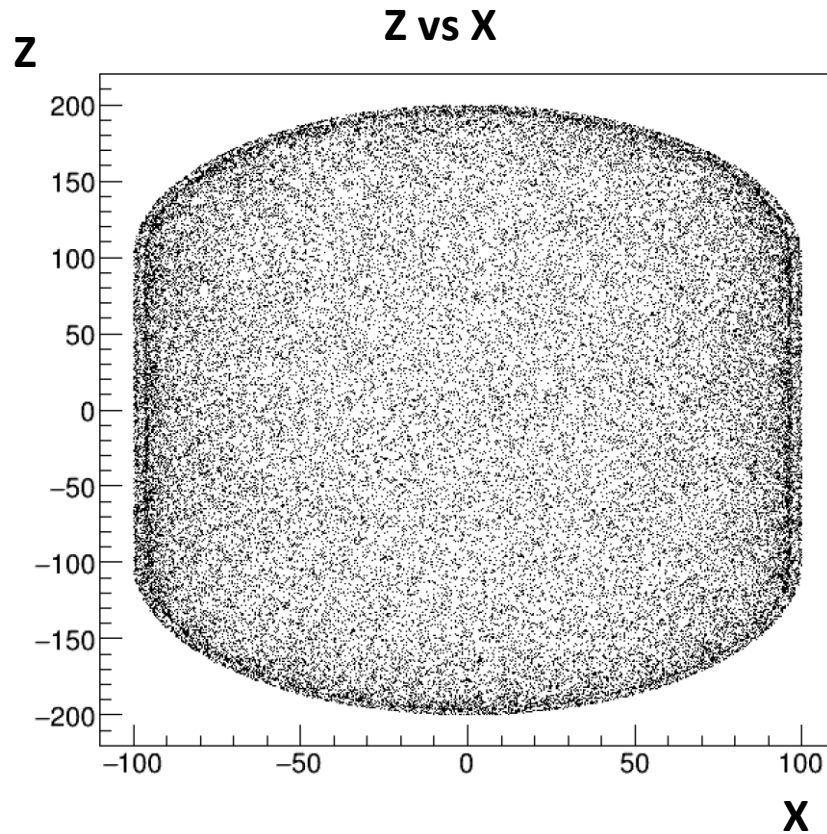
//Inner Cryostat

```
G4Tubs* inner_cryostat_body = new G4Tubs("inner_cryostat_body", 0, cryoInner_OuterR, cryostat_Height*0.5, 0, 360*deg);  
G4Sphere* inner_cryostat_cap = new G4Sphere("cryostat_cap", 0, cryoInner_OuterR, 0*deg, 360*deg,0*deg, 90*deg);  
G4UnionSolid* inner_cryostatWithCap = new G4UnionSolid("inner_cryostatWithCap", inner_cryostat_body, inner_cryostat_cap, 0, topCap_pos);  
G4UnionSolid* inner_cryostatWithCaps = new G4UnionSolid("inner_cryostatWithCaps", inner_cryostatWithCap, inner_cryostat_cap, rotate_X_180, bottomCap_pos);  
  
G4LogicalVolume* inner_CryostatLV = new G4LogicalVolume(inner_cryostatWithCaps,StainlessSteel, "inner_CryostatLV");  
G4PVPlacement* inner_Cryostat = new G4PVPlacement(0, origin, "inner_Cryostat", inner_CryostatLV, VacuumPV, false, 0, myCheckOverlap);
```


Validation

To look at the shape of the cryostat we shoot a good statistics of geantinos from the Stainless Steel and look at the distribution of their coordinates

```
cryostatWalls_thickness = 1. cm  
outerCryostat_outerRadius = 100. cm  
cryostatVacuum_thickness = 2. cm  
cryostat_height = 200. cm
```



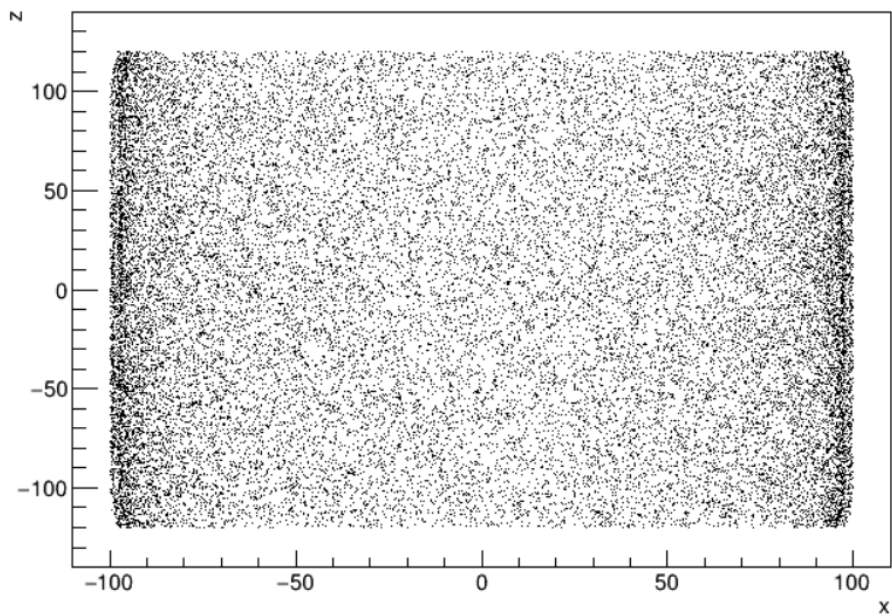
Validation

- The geantino is no more stuck at the interface between Veto LAr and the Stainless Steel
- The thickness of Stainless Steel is now correctly 1 cm

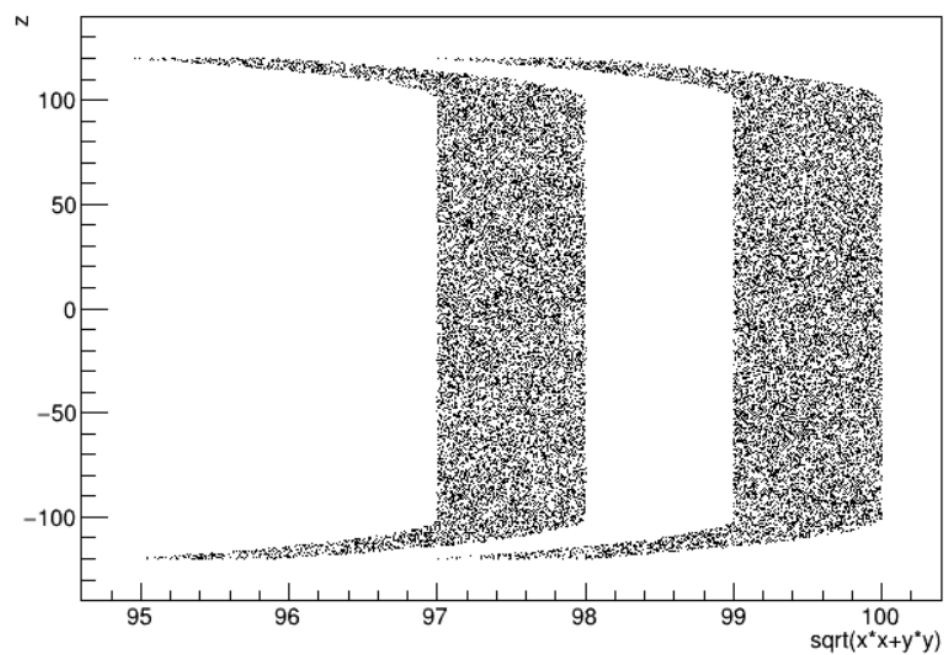
```
Develop:src/DSTGeneratorG4Gun.cc(72):geantino Energy: 1 MeV; Position: (0.0001,0,0) cm; Direction: (0,0,1)
geantino 0 E: 1000 keV; Edep: 0 LiquidArgon GridSteel (0.0001,0,54.595) step 545950 ID: 1 Parent ID: 0 gtime: 1.82109 Transportation
geantino 0 E: 1000 keV; Edep: 0 GridSteel GaseousArgon (0.0001,0,54.605) step 100 ID: 1 Parent ID: 0 gtime: 1.82143 Transportation
geantino 0 E: 1000 keV; Edep: 0 GaseousArgon TPB (0.0001,0,56.105) step 15000 ID: 1 Parent ID: 0 gtime: 1.87146 Transportation
geantino 0 E: 1000 keV; Edep: 0 TPB Acrylic (0.0001,0,56.115) step 100 ID: 1 Parent ID: 0 gtime: 1.87179 Transportation
geantino 0 E: 1000 keV; Edep: 0 Acrylic VetoLiquidArgon1 (0.0001,0,61.115) step 50000 ID: 1 Parent ID: 0 gtime: 2.03858 Transportation
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon1 MetalSilicon (0.0001,0,71.115) step 100000 ID: 1 Parent ID: 0 gtime: 2.37214 Transportation
geantino 0 E: 1000 keV; Edep: 0 MetalSilicon MetalSilicon (0.0001,0,71.15) step 350 ID: 1 Parent ID: 0 gtime: 2.37331 Transportation
geantino 0 E: 1000 keV; Edep: 0 MetalSilicon Arlon (0.0001,0,71.185) step 350 ID: 1 Parent ID: 0 gtime: 2.37448 Transportation
geantino 0 E: 1000 keV; Edep: 0 Arlon VetoLiquidArgon1 (0.0001,0,71.235) step 500 ID: 1 Parent ID: 0 gtime: 2.37614 Transportation
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon1 Arlon (0.0001,0,71.735) step 5000 ID: 1 Parent ID: 0 gtime: 2.39282 Transportation
geantino 0 E: 1000 keV; Edep: 0 Arlon MetalTitanium (0.0001,0,71.835) step 1000 ID: 1 Parent ID: 0 gtime: 2.39616 Transportation
geantino 0 E: 1000 keV; Edep: 0 MetalTitanium VetoLiquidArgon2 (0.0001,0,72.835) step 10000 ID: 1 Parent ID: 0 gtime: 2.42951 Transportation
geantino 0 E: 1000 keV; Edep: 0 VetoLiquidArgon2 StainlessSteel (0.0001,0,196) step 1.23165e+06 ID: 1 Parent ID: 0 gtime: 6.53786 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel Vacuum (0.0001,0,197) step 10000 ID: 1 Parent ID: 0 gtime: 6.57121 Transportation
geantino 0 E: 1000 keV; Edep: 0 Vacuum StainlessSteel (0.0001,0,199) step 20000 ID: 1 Parent ID: 0 gtime: 6.63793 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel Water (0.0001,0,200) step 10000 ID: 1 Parent ID: 0 gtime: 6.67128 Transportation
geantino 0 E: 1000 keV; Edep: 0 Water StainlessSteel (0.0001,0,450) step 2.5e+06 ID: 1 Parent ID: 0 gtime: 15.0104 Transportation
geantino 0 E: 1000 keV; Edep: 0 StainlessSteel Air (0.0001,0,452) step 20000 ID: 1 Parent ID: 0 gtime: 15.0771 Transportation
```

BACKUP SLIDES

z:x



z:sqrt(x*x+y*y)



y:x

