

CUSP GEANT4 Mass Model

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CUSP GEANT4 Status

- The gdml mass model has been exported from CAD and imported in the GEANT4 model (last version CUSP_GEANT4_20231013 in progress)
- The Monte carlo simulations works as expected (see <https://github.com/giovixo/g4cusp/tree/main/notebooks>)
- Stay tuned for the scientific results

GEANT4 Mass Model

Geometries are imported
from CAD system and
converted to tessellated solids

```
// First declare a tessellated solid
//
G4TessellatedSolid solidTarget = new G4TessellatedSolid("Solid_name");

// Define the facets which form the solid
//
G4double targetSize = 10*cm ;
G4TriangularFacet *facet1 = new
G4TriangularFacet (G4ThreeVector(-targetSize,-targetSize,      0.0),
                  G4ThreeVector(+targetSize,-targetSize,      0.0),
                  G4ThreeVector(      0.0,      0.0,+targetSize),
                  ABSOLUTE);
G4TriangularFacet *facet2 = new
G4TriangularFacet (G4ThreeVector(+targetSize,-targetSize,      0.0),
                  G4ThreeVector(+targetSize,+targetSize,      0.0),
                  G4ThreeVector(      0.0,      0.0,+targetSize),
                  ABSOLUTE);
G4TriangularFacet *facet3 = new
G4TriangularFacet (G4ThreeVector(+targetSize,+targetSize,      0.0),
                  G4ThreeVector(-targetSize,+targetSize,      0.0),
                  G4ThreeVector(      0.0,      0.0,+targetSize),
                  ABSOLUTE);
G4TriangularFacet *facet4 = new
G4TriangularFacet (G4ThreeVector(-targetSize,+targetSize,      0.0),
                  G4ThreeVector(-targetSize,-targetSize,      0.0),
                  G4ThreeVector(      0.0,      0.0,+targetSize),
                  ABSOLUTE);
G4QuadrangularFacet *facet5 = new
G4QuadrangularFacet (G4ThreeVector(-targetSize,-targetSize,      0.0),
                    G4ThreeVector(-targetSize,+targetSize,      0.0),
                    G4ThreeVector(+targetSize,+targetSize,      0.0),
                    G4ThreeVector(+targetSize,-targetSize,      0.0),
                    ABSOLUTE);

// Now add the facets to the solid
//
solidTarget->AddFacet((G4VFacet*) facet1);
solidTarget->AddFacet((G4VFacet*) facet2);
solidTarget->AddFacet((G4VFacet*) facet3);
solidTarget->AddFacet((G4VFacet*) facet4);
solidTarget->AddFacet((G4VFacet*) facet5);

Finally declare the solid is complete
//
solidTarget->SetSolidClosed(true);
```

CAD exported mass model release (1)

- cusp_payload_GEANT4-worldVOL.gdml
- cusp_payload_GEANT4-worldVOL-structure.xml
- cusp_payload_GEANT4-worldVOL-solids.xml
- define.xml
- + some prescription (see next slide)

gdml mass model release (2)

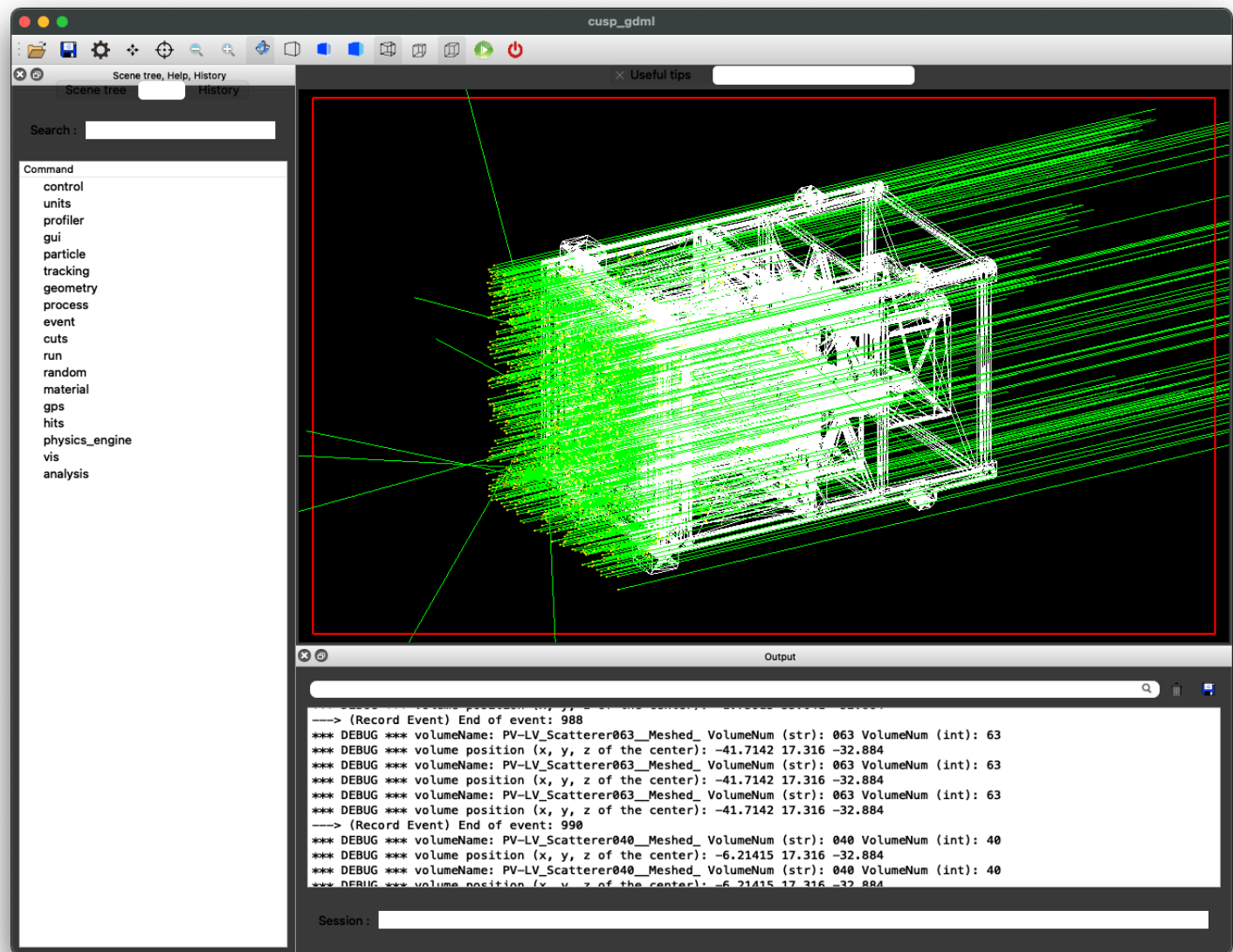
file generated by: Giovanni Lombardi

date: 13/10/2023

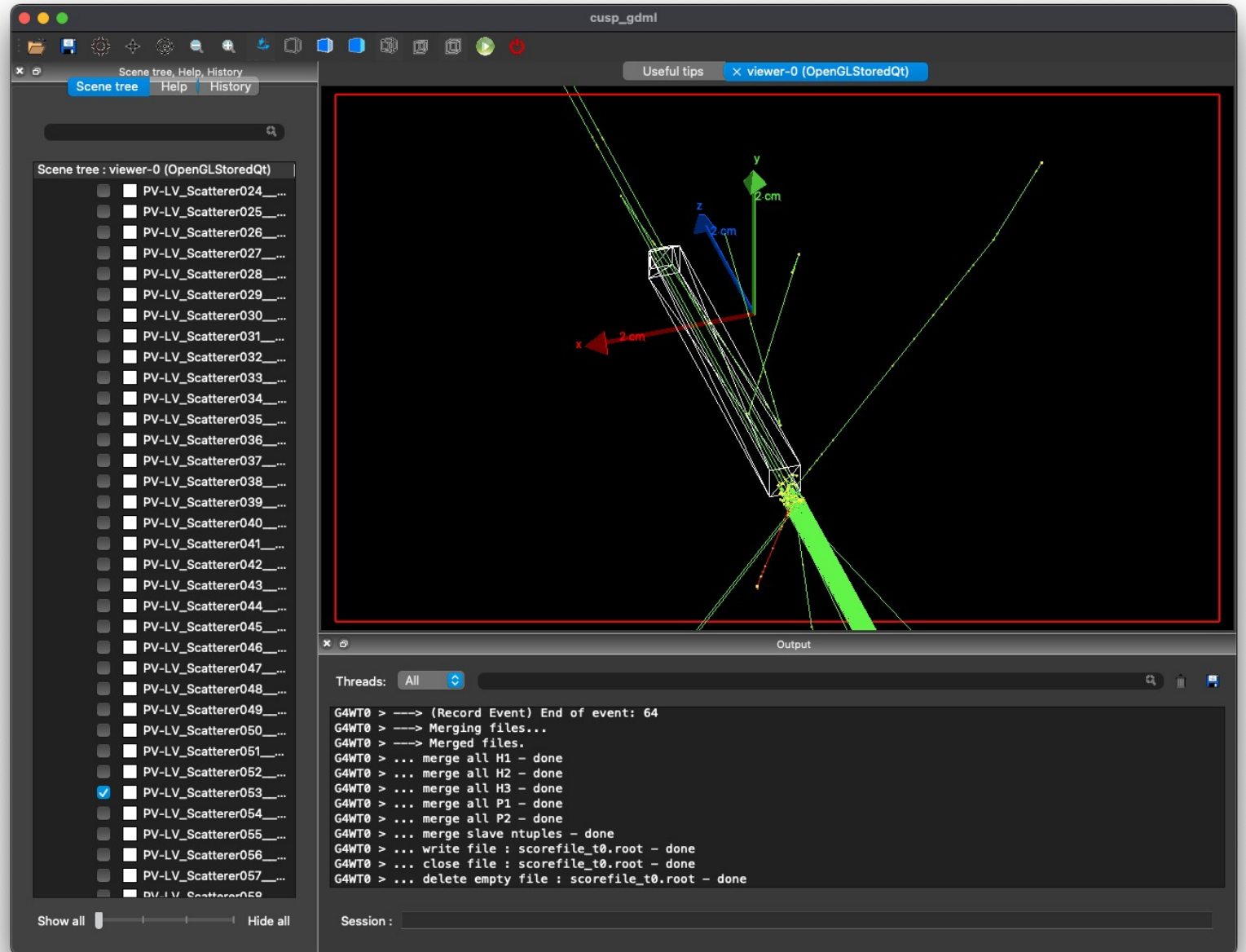
news:

- material in each part of the step file:
 - G4_Galactic: World
 - G4_Al: metallic frame; if_platform_payload; spacer; absorber_filter_al; scatterer_filter_al
 - G4_Glass_Plate: MAPMT
 - G4_Plexiglass: Gyroscope; abs_scatt_frame
 - G4_W: short_side_W_cover; side_W_cover; Absorber_filter_W
 - G4_W: absorber_collimator; scatterer_collimator -> in this case the W is the material but you have to reduce the density of these parts of 90%
 - G4_PolytrifluoroChloroethylene: PCB; apd_sensor_pcb; apd; apd_pcb -> you have to convert that in FR4
 - G4_Plastic_SC_Vinyltoluene: Scatterer_box
 - G4_Ti: Absorber_filter_Ti; scatterer_filter_Ti
 - G4_A-150_TISSUE: Absorber_box -> look the material missing note
- material missing:
- Absorber: custom material "GaGG" is not included in the NIST library, it shall be added manually in the simulator with this properties:
- GaGG: gadolinium-aluminium-gallium, 4 chemical elements Gd3Al2Ga3012.density 6.63 g/c

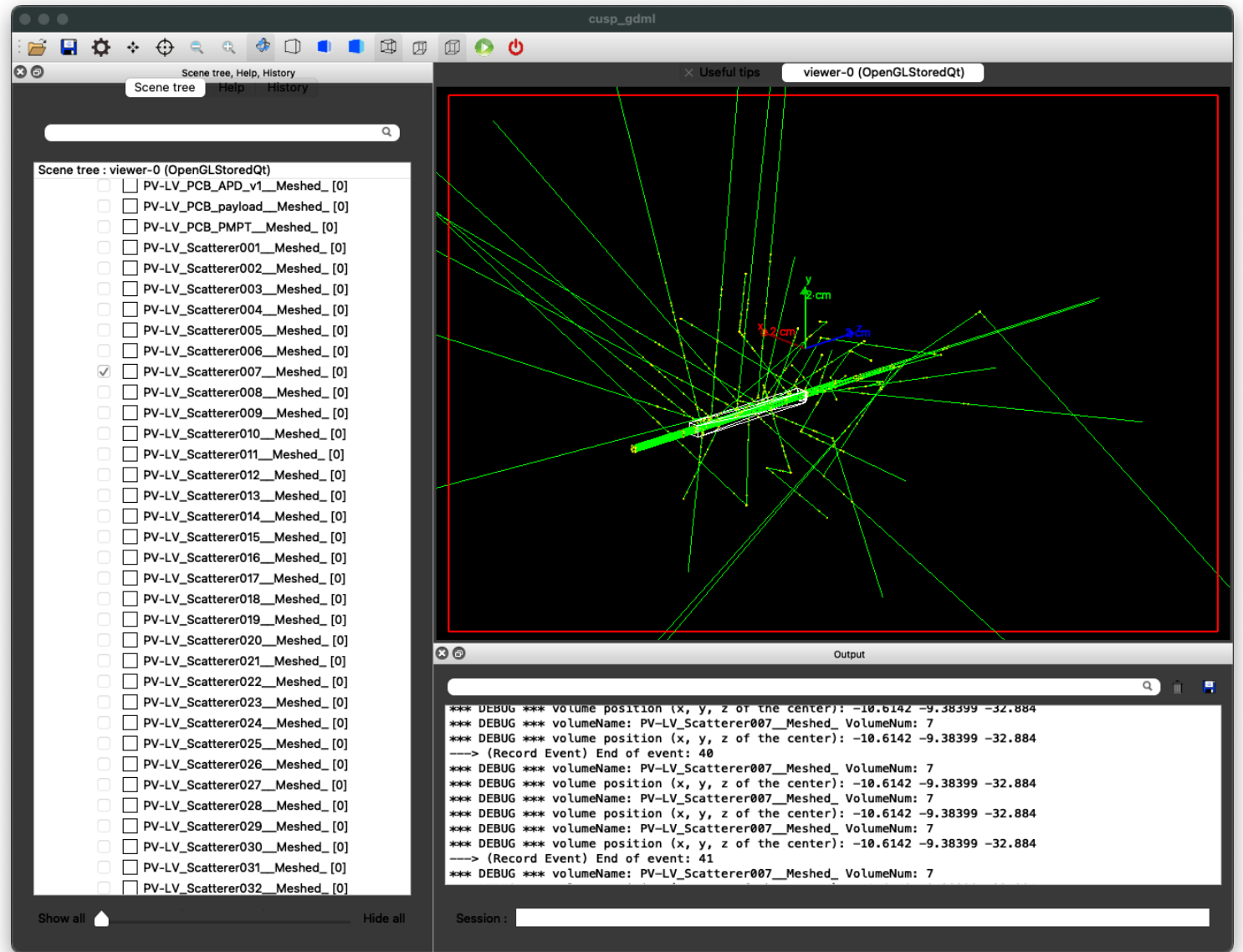
Screenshots (Qt GUI) (1)



Screenshots (2)



Screenshots (3)



gdml Mass Model

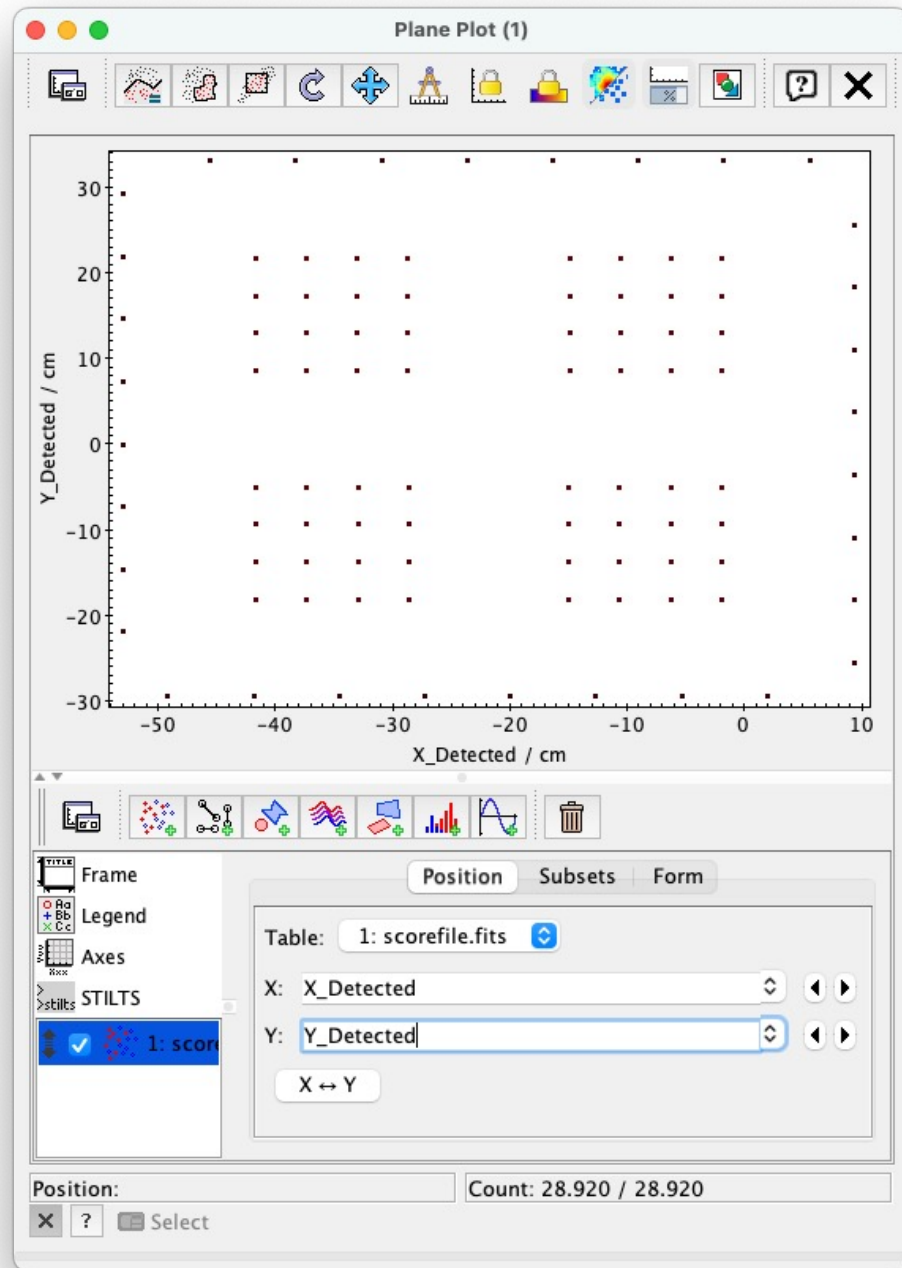
File xxx-structure.xml

```
<volume name="LV_Scatterer_v064__Meshed_">
  <materialref ref="G4_PLASTIC_SC_VINYLTOLUENE"/>
  <solidref ref="Mesh2Tess109"/>
  <auxiliary auxtype="Color" auxvalue="#80808000"/>
</volume>
```

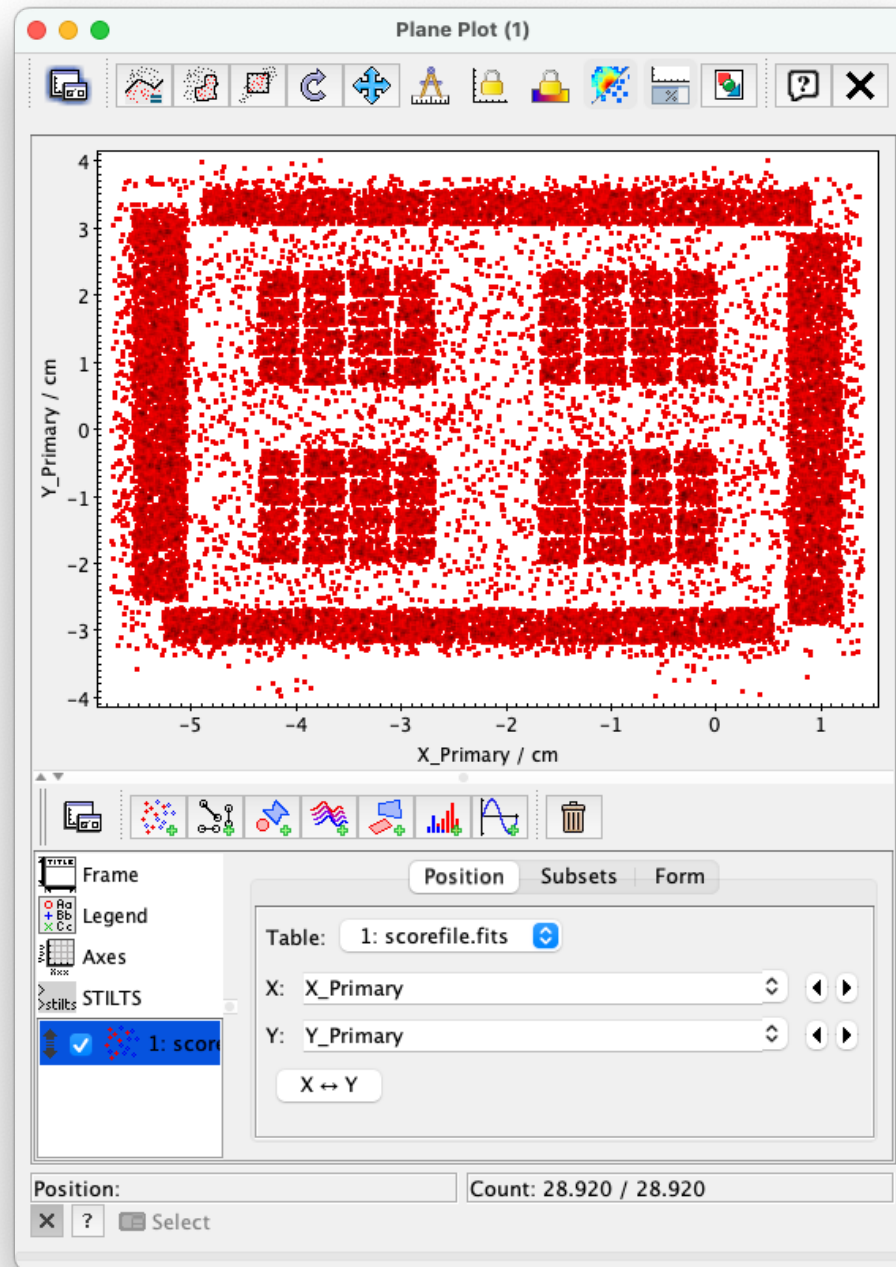
File xxx-solids.xml

```
<tessellated name="Mesh2Tess109">
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_10" vertex2="Mesh2Tess109_6" vertex3="Mesh2Tess109_1"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_1" vertex2="Mesh2Tess109_6" vertex3="Mesh2Tess109_2"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_5" vertex2="Mesh2Tess109_10" vertex3="Mesh2Tess109_9"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_6" vertex2="Mesh2Tess109_10" vertex3="Mesh2Tess109_5"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_11" vertex2="Mesh2Tess109_9" vertex3="Mesh2Tess109_0"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_5" vertex2="Mesh2Tess109_9" vertex3="Mesh2Tess109_11"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_1" vertex2="Mesh2Tess109_2" vertex3="Mesh2Tess109_0"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_0" vertex2="Mesh2Tess109_2" vertex3="Mesh2Tess109_11"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_9" vertex2="Mesh2Tess109_10" vertex3="Mesh2Tess109_1"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_9" vertex2="Mesh2Tess109_1" vertex3="Mesh2Tess109_0"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_6" vertex2="Mesh2Tess109_7" vertex3="Mesh2Tess109_3"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_6" vertex2="Mesh2Tess109_3" vertex3="Mesh2Tess109_2"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_2" vertex2="Mesh2Tess109_3" vertex3="Mesh2Tess109_8"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_2" vertex2="Mesh2Tess109_8" vertex3="Mesh2Tess109_11"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_4" vertex2="Mesh2Tess109_11" vertex3="Mesh2Tess109_8"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_4" vertex2="Mesh2Tess109_5" vertex3="Mesh2Tess109_11"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_7" vertex2="Mesh2Tess109_5" vertex3="Mesh2Tess109_4"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_7" vertex2="Mesh2Tess109_6" vertex3="Mesh2Tess109_5"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_3" vertex2="Mesh2Tess109_4" vertex3="Mesh2Tess109_8"/>
  <triangular type="ABSOLUTE" vertex1="Mesh2Tess109_7" vertex2="Mesh2Tess109_4" vertex3="Mesh2Tess109_3"/>
</tessellated>
```

Screenshots (4)



Screenshots (5)



Scientific validation and results

To do list

- Effective area
- Spurious polarization
- Polarimetry
- Etc...