

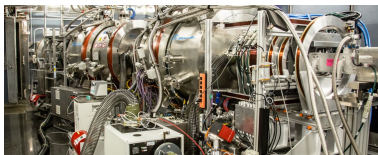
CombLayer: Towards a simple MCNP beamline builder

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- Neutron instrument are dense, complex systems made of many high scattering materials.



- We have traditionally modeled them as simple objects.
- **This is NOT a choice!** – Driven by the effort required to model.

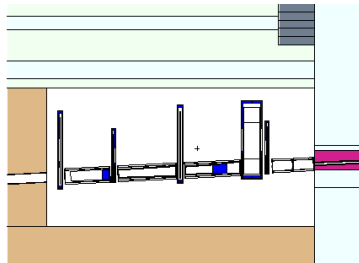
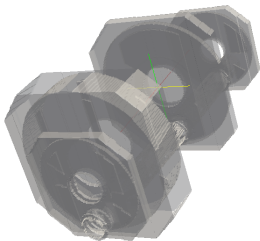
All of the following cause modelling difficult:

- Every volume needs to be described with individual quadratic surfaces.
- Volume needs to be completely described
- Surfaces like torus can only be on an axis
- The code is less readable than assembly code

All of the following *help* to the modeler are incomplete in the geometric algebra space and normally result in runtime penalty.

- Complementary cells
- Universes require full computation of objects within
- Transform cards / Lattice cards
- Macrobodyes
- Boolean invariances

Geometry:

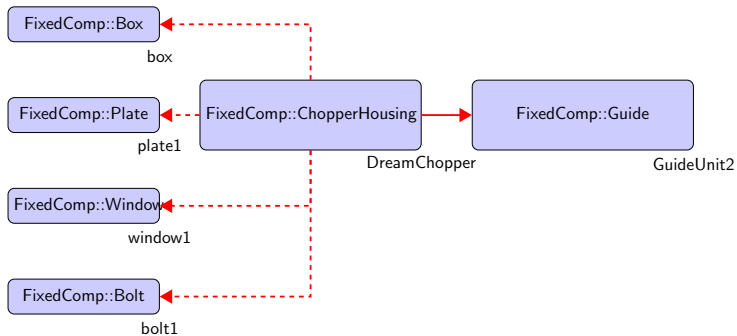


- Build a model out of complex components [like McStas]
- Build complex components without needing to consider anything bigger.
- Have a toolbox of gadgets to help build our complex components

Model:

- Output should be *good to run*
- A system of naming that allows construction without referring to numbers
- Tally/Variance reduction system that can use the CombLayer model

Geometry: Origins/Axis/Common surfaces

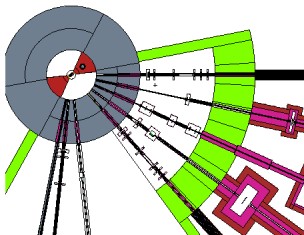
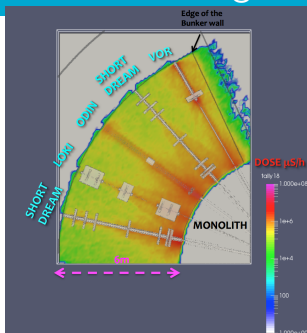


LOCAL origin and axis space

LOCAL surface map

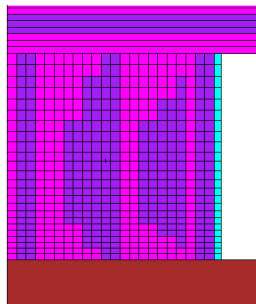
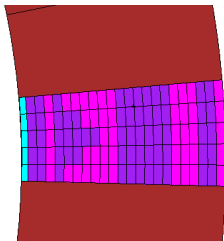
EXPORTS origin and axis space and link points + axes

Multiple Direction linkage



- Linkage **followed** by Rotation/Offset
- Start point - End Point linkage system

Bunker Wall Layout



- Have the ability to make any cell discrete (3D)
- The material for each cell/cells are then read from an XML file
- Division allows cell-bases variance reduction

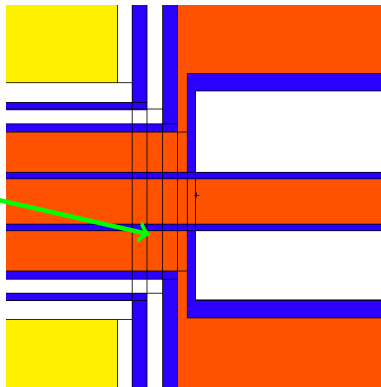
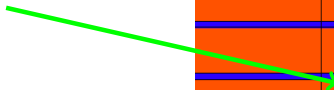
BunkerWall code

```
1 void Bunker::createMainWall(Simulation& System)
2 {
3     ELog::RegMethod RegA("Bunker","createMainWall");
4     size_t AS=activeSegment; // binary system
5     for(size_t i=0;AS && i<nSectors;i++)
6     {
7         const std::string CName="Sector"+StrFunc::makeString(i);
8         if (AS & 1)
9         {
10             const int CN=getCell("frontWall",i);
11             ModelSupport::LayerDivide3D LD3(keyName+"MainWall"+
12                                             StrFunc::makeString(i));
13
14             LD3.setSurfPair(0,SMap.realSurf(bnkIndex+1001+static_cast<int>(i)),
15                           SMap.realSurf(bnkIndex+1002+static_cast<int>(i)));
16
17             LD3.setSurfPair(1,SMap.realSurf(bnkIndex+5),
18                           SMap.realSurf(bnkIndex+6));
19             LD3.setSurfPair(2,SMap.realSurf(bnkIndex+7),
20                           SMap.realSurf(bnkIndex+17));
21             LD3.setFractions(0,segDivide);
22             LD3.setFractions(1,vertFrac);
23             LD3.setFractions(2,wallFrac);
24
25             LD3.setMaterialXML(keyName+"Def.xml","WallMat",keyName+".xml",
26                               ModelSupport::EvalMatString(wallMat));
27             LD3.divideCell(System,CN);
28             removeCell("frontWall",i);
29             addSurfs(CName,LD3.getSurfs());
30             addCells(CName,LD3.getCells());
31         }
32         AS>>=1;
33     }
```

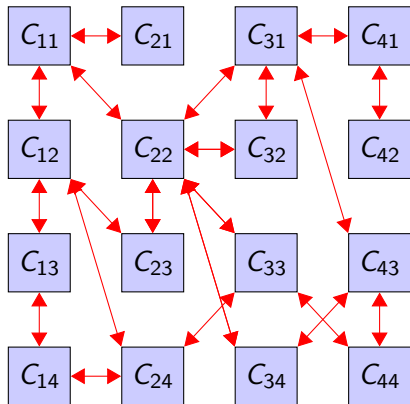
Specialized Link Units: Pipework

- CombLayer allows pipework using object that have links and free points
- Any convex profile is acceptable
- Multi-layer joins done for all object inherited from LayerComp

Multi layer link
joins

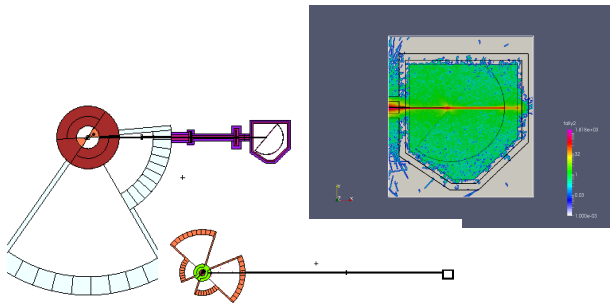


Variance reduction: Semi-Adjoint processing



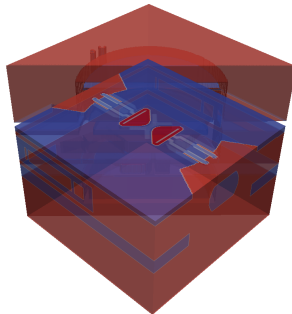
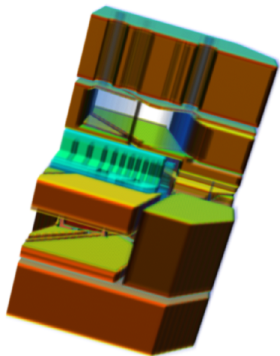
- Create the object connections
- Calculate the attenuation and $1/r^w$ from cell centre to cell centre for each
- Evolve the Markov Chain cell interaction probability
- Use result as w_{ij} component.

Variance reduction: Long beamlines



- Long beamline need to exploit angular biasing
- Auto-determined ext card on a cell/cell level
- Benefits from LD3 splitting

Conclusions



- We have tools to process complex geometries
- In a position to offer fast target to sample calculations
- Code/Build your model at a level away from MCNP

Download <https://github.com/SAnsell/CombLayer>