

Fall 2018

- Goals
 - Figure out all the changes with the ChoozSimulation code
 - Finish the Dilution Refrigerator Geometry transition
- Progress
 - Redownloaded ChoozSimulation
 - Were some errors with download, will try to compare with changes made to ChoozSim over the summer
 - Started moving over my old code and editing the ChoozSimulation code

Week of 5/1/18 - Errors

```

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc: In member function 'void DetectorConstruction::ConstructPit()':
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:188:101: error: 'concrete_offset' was not declared in this scope
    btractionSolid("ChoozPit_ConcreteJacket", Jacket21Tube, Jacket2Tube, 0, concrete_of
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc: In member function 'void DetectorConstruction::ConstructPbSheilding(G4double, G4double, G4double)':
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:238:2: error: 'fDRheight1' was not declared in this scope
    fDRheight1 = 1287*mm;
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:239:78: error: 'fDRheight' was not declared in this scope
    ieldTube = new G4Tubs("Polyshield", zeroradius, outerRadius_shield, fDRheight/2
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc: At global scope:
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:225:91: warning: unused parameter 'topthickness' [-Wunused-parameter]
    ion::ConstructPbSheilding(G4double innerR, G4double outerR, G4double topthickness
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc: In member function 'void DetectorConstruction::ConstructPolySheilding(G4double, G4double, G4double)':
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:266:2: error: 'fDRheight' was not declared in this scope
    fDRheight= 1279*mm;
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:267:2: error: 'fDRheight1' was not declared in this scope
    fDRheight1 = 1289*mm;
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc: At global scope:
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:254:93: warning: unused parameter 'topthickness' [-Wunused-parameter]
    n::ConstructPolySheilding(G4double innerR, G4double outerR, G4double topthickness

```

```

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:282:5
4: error: no 'void DetectorConstruction::ConstructSupportiveCasing()' member fun
ction declared in class 'DetectorConstruction'
    void DetectorConstruction::ConstructSupportiveCasing()
        ^

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc: In m
ember function 'void DetectorConstruction::ConstructDespereaux()':
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:302:2
5: warning: declaration of 'vec_fifty' shadows a member of 'DetectorConstructio
' [-Wshadow]
    G4ThreeVector vec_fifty(0*mm,0*mm,403.15*mm);
        ^

In file included from /afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/Detecto
rConstruction.cc:2:0:
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/include/DetectorConstruction.hh:1
01:37: note: shadowed declaration is here
        G4ThreeVector          vec_fifty;
        ^

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:314:2
: error: expected ';' before 'innerRadius50KC'
    innerRadius50KC =167.5*mm
    ^

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:320:8
: error: 'class DetectorConstruction' has no member named 'G4SubtractionSolid'
    this->G4SubtractionSolid*hollowCylinder50K = new G4SubtractionSolid("HollowCyl
    ^

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:320:2
7: error: 'hollowCylinder50K' was not declared in this scope
    this->G4SubtractionSolid*hollowCylinder50K = new G4SubtractionSolid("HollowCyl
    ^

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:322:1
11: error: 'FLogicWorld' was not declared in this scope
    cement(0, vec_fifty, hollowCylinder50KLog, "Hollow 50 K Cylinder", FLogicWorld
        ^

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:332:2
4: warning: declaration of 'vec_four' shadows a member of 'DetectorConstruction'
[-Wshadow]
    G4ThreeVector vec_four(0*mm,0*mm,259.1*mm);
        ^

```

```

In file included from /afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/Detecto
rConstruction.cc:2:0:
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/include/DetectorConstruction.hh:1
03:37: note: shadowed declaration is here
        G4ThreeVector          vec_four;
                                ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:335:9
8: error: 'newG4LogicalVolume' was not declared in this scope
    newG4LogicalVolume(plateTube, fMaterialCu, "4 K Plate", fLogicWorld, false, 0);
                                ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:345:2
: error: expected ';' before 'innerRadius4KC'
    innerRadius4KC =149*mm
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:350:8
8: error: 'hz4KCinner' was not declared in this scope
    beInner = new G4Tubs("4KCylinderinner", zeroradius, innerRadius4KC, hz4KCinner/
                                ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:351:8
: error: 'class DetectorConstruction' has no member named 'G4SubtractionSolid'
    this->G4SubtractionSolid*hollowCylinder4K = new G4SubtractionSolid("HollowCyli
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:351:2
7: error: 'hollowCylinder4K' was not declared in this scope
    this->G4SubtractionSolid*hollowCylinder4K = new G4SubtractionSolid("HollowCyli
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:364:2
3: warning: declaration of 'vec_one' shadows a member of 'DetectorConstruction'
[-Wshadow]
    G4ThreeVector vec_one(0*mm,0*mm,128.1*mm);
                                ^
In file included from /afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/Detecto
rConstruction.cc:2:0:
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/include/DetectorConstruction.hh:1
05:37: note: shadowed declaration is here
        G4ThreeVector          vec_one;
                                ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:377:2
: error: expected ';' before 'innerRadius1KC'
    innerRadius1KC =129.5*mm
    ^

```



```

/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:383:8
: error: 'class DetectorConstruction' has no member named 'G4SubtractionSolid'
  this->G4SubtractionSolid*hollowCylinder1K = new G4SubtractionSolid("HollowCyli
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:383:2
7: error: 'hollowCylinder1K' was not declared in this scope
  this->G4SubtractionSolid*hollowCylinder1K = new G4SubtractionSolid("HollowCyli
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:395:2
7: warning: declaration of 'vec_hundred' shadows a member of 'DetectorConstructi
on' [-Wshadow]
  G4ThreeVector vec_hundred(0*mm,0*mm,144.1*mm);
    ^
In file included from /afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/Detecto
rConstruction.cc:2:0:
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/include/DetectorConstruction.hh:1
07:37: note: shadowed declaration is here
      G4ThreeVector          vec_hundred;
    ^
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/DetectorConstruction.cc:410:2
7: warning: declaration of 'vec_fifteen' shadows a member of 'DetectorConstructi
on' [-Wshadow]
  G4ThreeVector vec_fifteen(0*mm,0*mm,72.9*mm);
    ^
In file included from /afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/src/Detecto
rConstruction.cc:2:0:
/afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/include/DetectorConstruction.hh:1
08:37: note: shadowed declaration is here
      G4ThreeVector          vec_fifteen;
    ^
make[2]: *** [CMakeFiles/RicochetChoozSim.dir/src/DetectorConstruction.cc.o] Err
or 1
make[1]: *** [CMakeFiles/RicochetChoozSim.dir/all] Error 2
make: *** [all] Error 2

```

Week of 4/24/18

- Spoken with Oliver about Geometry

```
/run/initialize

/gun/energy 15 GeV
/gun/particle neutron
/gun/position 0.0 0.0 .41 m
/gun/number 100
/gun/direction 0 1 0

#/gps/particle neutron
#/gps/ene/type Mono
#/gps/ene/mono 100 MeV
#/gps/pos/type Plane
#/gps/pos/shape Rectangle
#/gps/pos/rot1 0 0 1
#/gps/pos/rot2 1 0 0
#/gps/pos/halfx 1 m
#/gps/pos/halfy 1 m
#/gps/pos/centre 0.0 -.05 .41 m
#/gps/direction 0 1 0

/control/verbose 0
/run/verbose 0
/event/verbose 0
/tracking/verbose 0

/ricochetchoozsim/generator/SetNeutronSource true
/ricochetchoozsim/generator/setsourceradius 4.25 m
/ricochetchoozsim/generator/setsourceheight 8.4 m
/ricochetchoozsim/generator/setneutronsourcespectrum fast_neutron_spectrum.txt

/run/beamOn 100
```

Week of 4/17/18

- Following documentation from https://ecolephysique.sciencesconf.org/data/program/G4_LIO_w2_generator_physicslist.pdf

```
/run/initialize

/gun/energy 15 GeV
/gun/particle neutron
/gun/position 0 -.05 .41 m
/gun/number 100
/gun/direction 0 1 0

/gps/particle neutron
/gps/ene/type Mono
/gps/ene/mono 100 MeV
/gps/pos/type Plane
/gps/pos/shape Rectangle
/gps/pos/rot1 0 0 1
/gps/pos/rot2 1 0 0
/gps/pos/halfx 1 m
/gps/pos/halfy 1 m
/gps/pos/centre 0 -.05 .41 m
/gps/direction 0 1 0

/control/verbose 0
/run/verbose 0
/event/verbose 0
/tracking/verbose 0

/ricochetchoozsim/generator/SetNeutronSource true
/ricochetchoozsim/generator/setsourceradius 4.25 m
/ricochetchoozsim/generator/setsourceheight 8.4 m
/ricochetchoozsim/generator/setneutronsourcespectrum fast_neutron_spectrum.txt

/run/beamOn 100
```

GPSPPrimaryGeneratorAction.cc

```
#include "G4Event.hh"
#include "G4GeneralParticleSource.hh"

#include "GPSPPrimaryGeneratorAction.hh"

GPSPPrimaryGeneratorAction::GPSPPrimaryGeneratorAction()
{
    m_particleGun = new G4GeneralParticleSource();
}

GPSPPrimaryGeneratorAction::~GPSPPrimaryGeneratorAction()
{
    delete m_particleGun;
}

void GPSPPrimaryGeneratorAction::GeneratePrimaries(G4Event* anEvent)
{
    m_particleGun->GeneratePrimaryVertex(anEvent);
}
```


Error Received

```
[branson3@login04 ChoozSimulation]$ ./RicochetChoozSimulation_build/RicochetChoozSim /afs/hep.wisc.edu/ddm/Ricochet/ChoozSimulation/fast_neutrons_gun.mac
```

```
*****
Geant4 version Name: geant4-10-01-patch-02 [MT]    (19-June-2015)
                  Copyright : Geant4 Collaboration
                  Reference  : NIM A 506 (2003), 250-303
                  WWW       : http://cern.ch/geant4
*****
```

```
***** COMMAND NOT FOUND </gps/particle neutron> *****
```

```
***** Batch is interrupted!! *****
```

```
*** Break *** segmentation violation
```

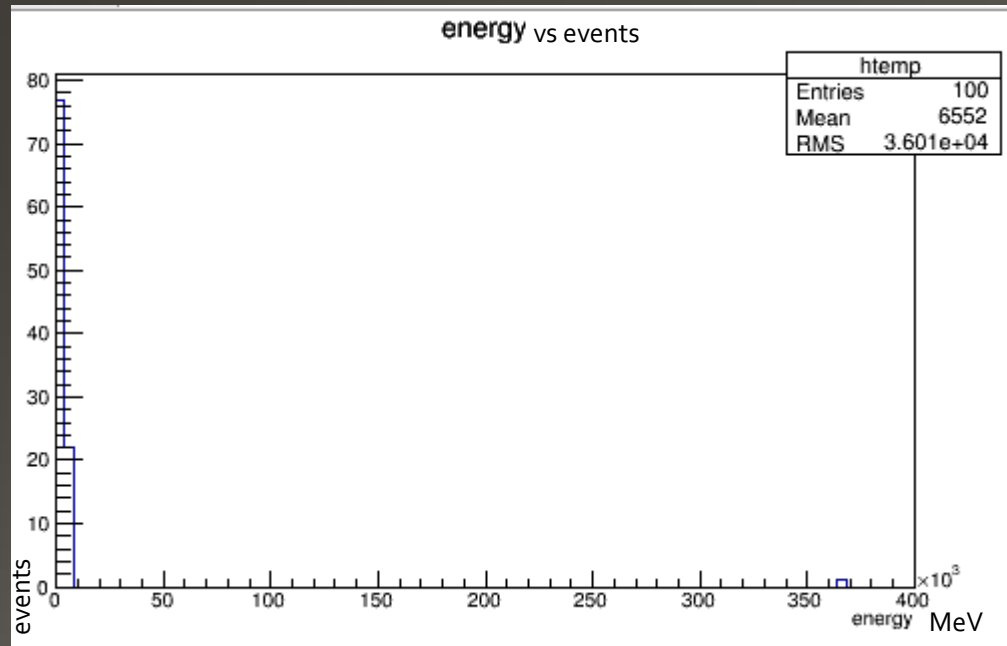
```
=====  
There was a crash.
```

```
This is the entire stack trace of all threads:
```

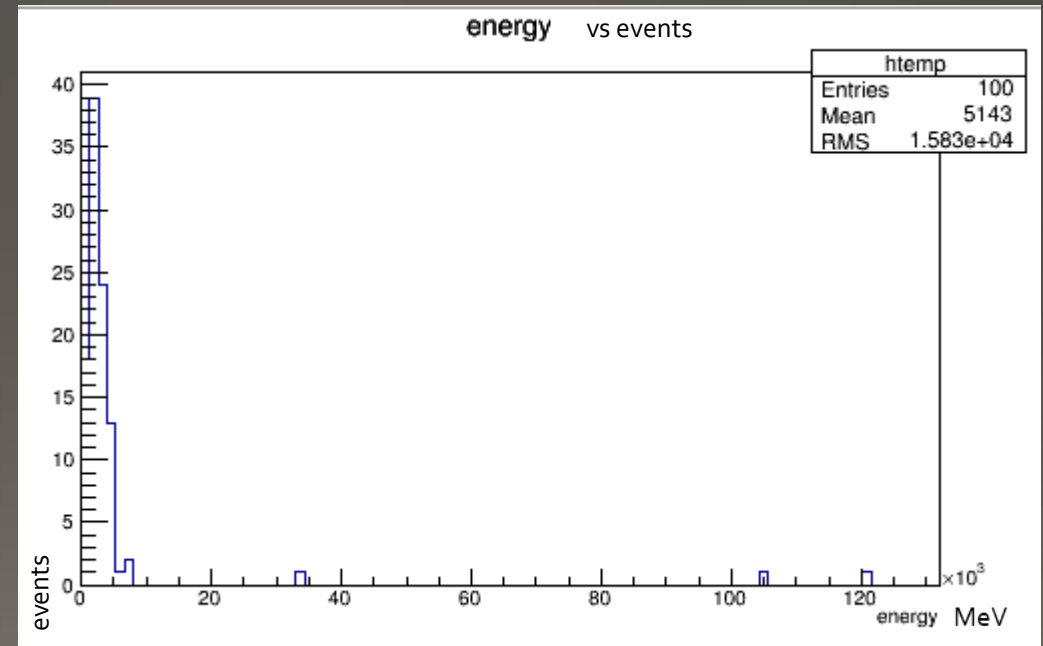
```
=====  
#0 0x0000000329aeac82e in waitpid () from /lib64/libc.so.6  
#1 0x0000000329ae3e479 in do_system () from /lib64/libc.so.6  
#2 0x000007f7bab0271b9 in TUnixSystem::StackTrace() () from /afs/hep.wisc.edu/ddm/Ricochet/root_v6.06.08_build/root_v6.06.08/lib/root/libCore.so  
#3 0x000007f7bab02920c in TUnixSystem::DispatchSignals(ESignals) () from /afs/hep.wisc.edu/ddm/Ricochet/root_v6.06.08_build/root_v6.06.08/lib/root/libCore.so  
#4 <signal handler called>  
#5 0x000007f7ba90ca8e0 in G4NeutronHPInelastic::~~G4NeutronHPInelastic() () from /afs/hep.wisc.edu/ddm/Ricochet/geant4.10.01.p02/lib64/libG4processes.so  
#6 0x000007f7ba90cb2d9 in G4NeutronHPInelastic::~~G4NeutronHPInelastic() () from /afs/hep.wisc.edu/ddm/Ricochet/geant4.10.01.p02/lib64/libG4processes.so  
#7 0x000007f7ba905fbf9 in G4HadronicInteractionRegistry::Clean() () from /afs/hep.wisc.edu/ddm/Ricochet/geant4.10.01.p02/lib64/libG4processes.so  
#8 0x000007f7ba8d55e41 in G4HadronicProcessStore::~~G4HadronicProcessStore() () from /afs/hep.wisc.edu/ddm/Ricochet/geant4.10.01.p02/lib64/libG4processes.so  
#9 0x000007f7ba8d5748d in G4ThreadLocalSingleton<G4HadronicProcessStore>::~~G4ThreadLocalSingleton() () from /afs/hep.wisc.edu/ddm/Ricochet/geant4.10.01.p02/lib64/libG4processes.so  
#10 0x0000000329ae35992 in exit () from /lib64/libc.so.6  
#11 0x0000000329aeled24 in __libc_start_main () from /lib64/libc.so.6  
#12 0x000000000004229c9 in _start ()  
=====
```

Week of 4/10/2018

- Working on getting interactions in the crystal
- Correct misunderstanding of Geant4 geometries



ChoozSimulation with Alex's geometry



ChoozSimulation with my geometry

Week of 3/13/18

- ChoozSimulation
 - Got it working
 - Using Xming, root crashes when using TBrowser()
 - Will download tool Carolyn uses
- Geometry
 - Finished the geometry file, sent off to Kim, Carolyn, Oliver to look over
 - Check using Oliver's visualization tools

Last Semester

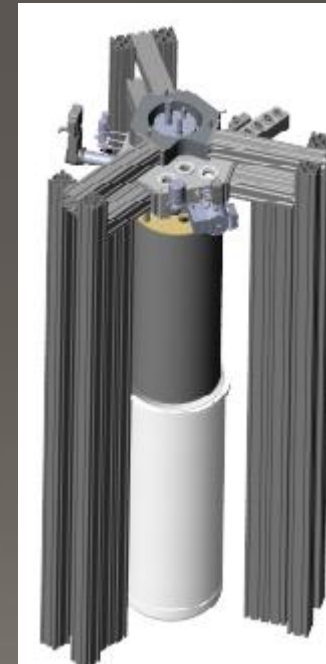
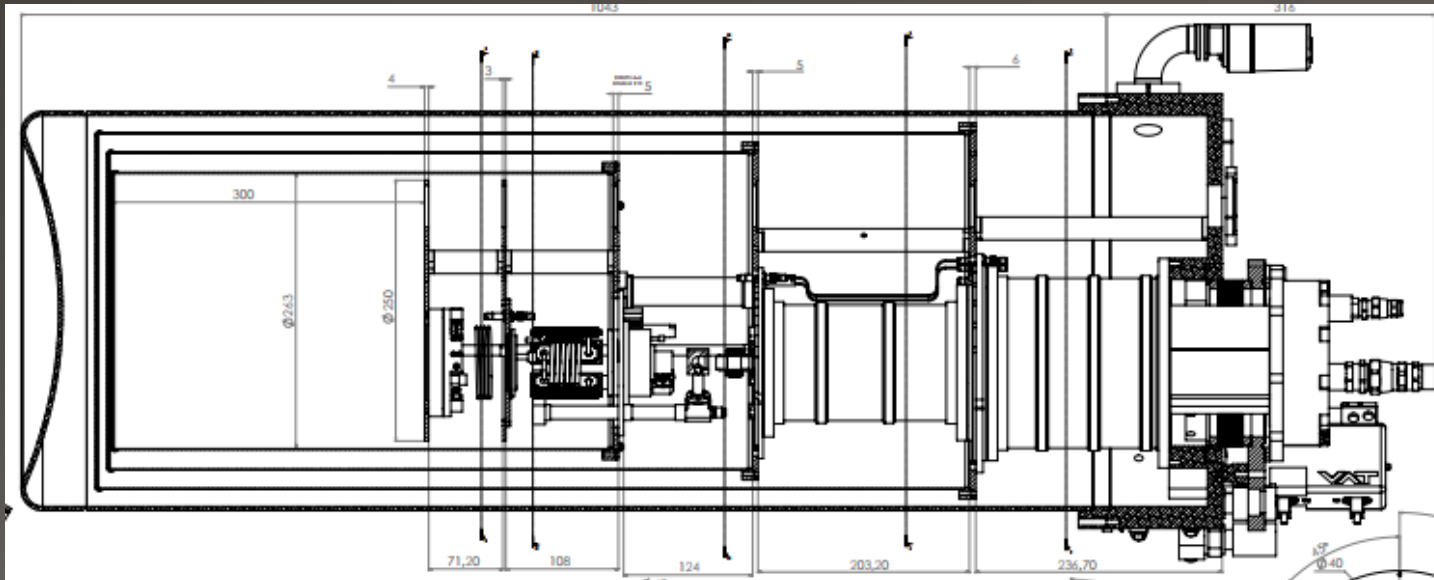
- ADR -> Dilution Refrigerator
 - Created a proposal for a new geometry for a dilution refrigerator
- ChoozSimulation
 - Install geant, root, ChoozSimulation
- Poster
 - Presented at the Women in Physics conference at Iowa State over break

Week of 11/15/2017

- ChoozSimulation
 - Ran into problem with change in login while it was running
 - Was able to get past the problem
 - “Exceeded Disk Quota” at make install
 - We need more space before we can install more
 - Still need to install.... (once we have space)
 - Geant
 - ChoozSim?

ADR -> Dilution Refrigerator

- Relative Geometry is giving me trouble
- Meeting with Oliver to go through and better understand
- Sizes are very different it seems (ADR about 34 cm by 30 cm where Dilution refrigerator is 2.2615 m by 1.15 m)

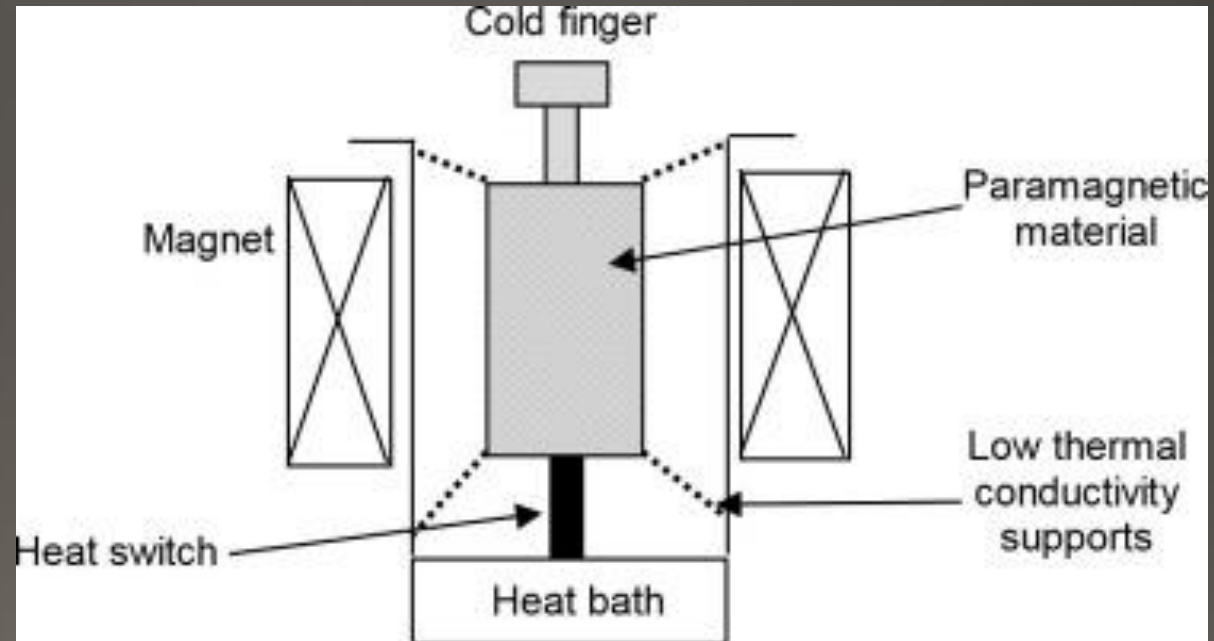


Week of 11/1/2017

- ChoozSimulation
 - After many meetings...
 - It works
 - There would be a histogram for proof if I could login in to the right place

Refrigerators

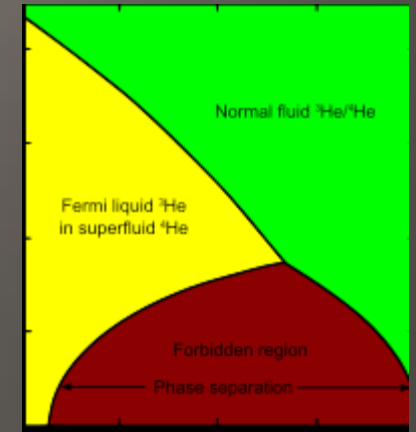
- ADR (Adiabatic Demagnetization Refrigerator)
 - Magnetic moment aligns with magnetic field
 - Strength of magnetic field \sim strength of alignment
 - Lowering the field slowly to cool
 - Control temp using control of the magnetic field strength



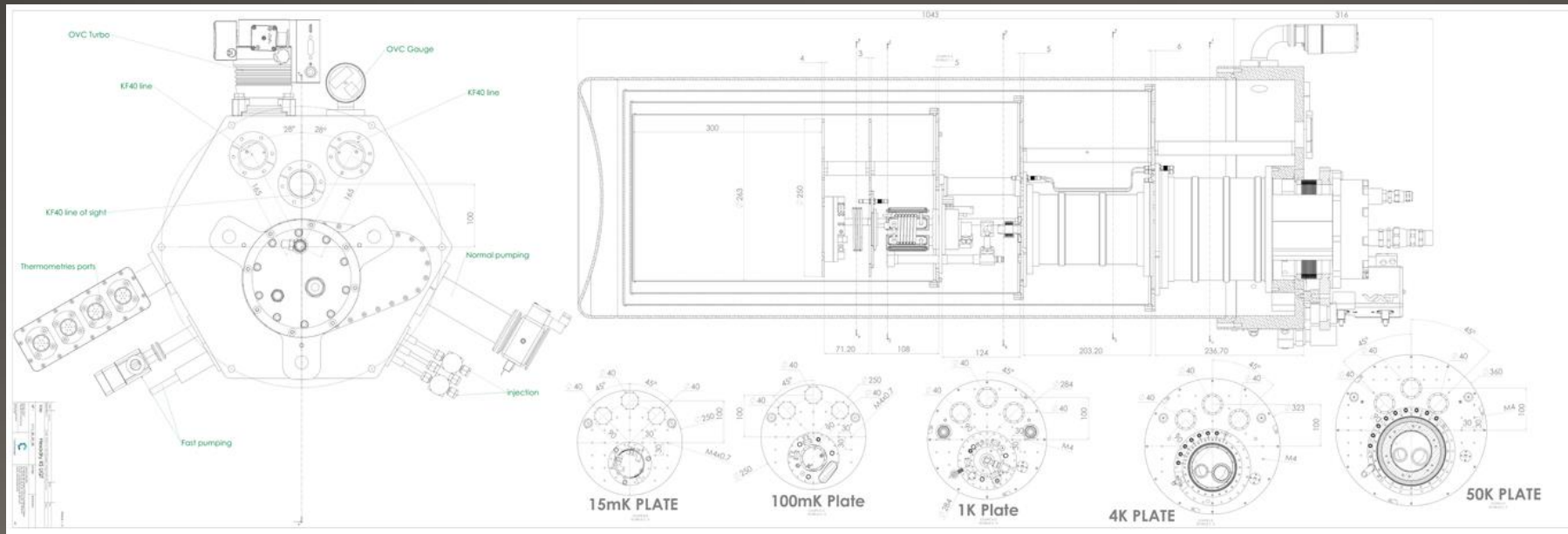
Refrigerators

- Dilution Refrigerator
 - .87 Kelvin, He^4 goes to He^3
 - First gets sent through a cooling section surrounded by liquid nitrogen
 - Through each chamber, pressure goes down, lowering the temperature
 - Can go very low (.002 K usually)

Temperature(K)



He^3 concentration (%)



Week of 10/18/2017

- ChoozSimulation
 - Meeting with Dan Bradley tomorrow
 - Recompile ChoozSim
- Geometry files
 - Learning about ADR and Dilution Refrigerators
 - Drawing the Geometry to better visualize a transition

Week of 10/3/17

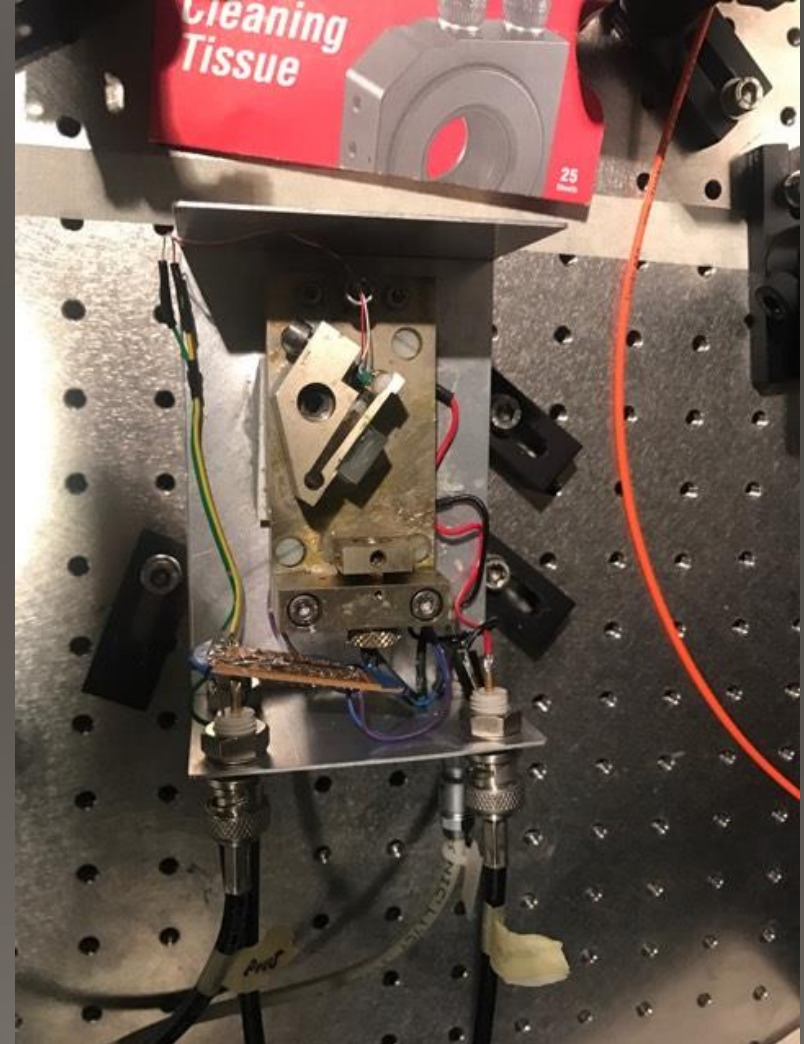
- Gone last week
- RicochetChoozSim
 - Info from Carolyn
 - Get a segmentation fault
 - Learn about debugging program

Semester Goals Fall 2017

- Get ChoozSimulation working on our computers
- Replace the ADR with a dilution refrigerator in the geometry
- Run the backgrounds with the new geometry
- Run backgrounds finding an exponential rise at the threshold

Summer in Denmark

- Aarhus University
- Ion trapping
- Lasers
- Calculations for MgH^+



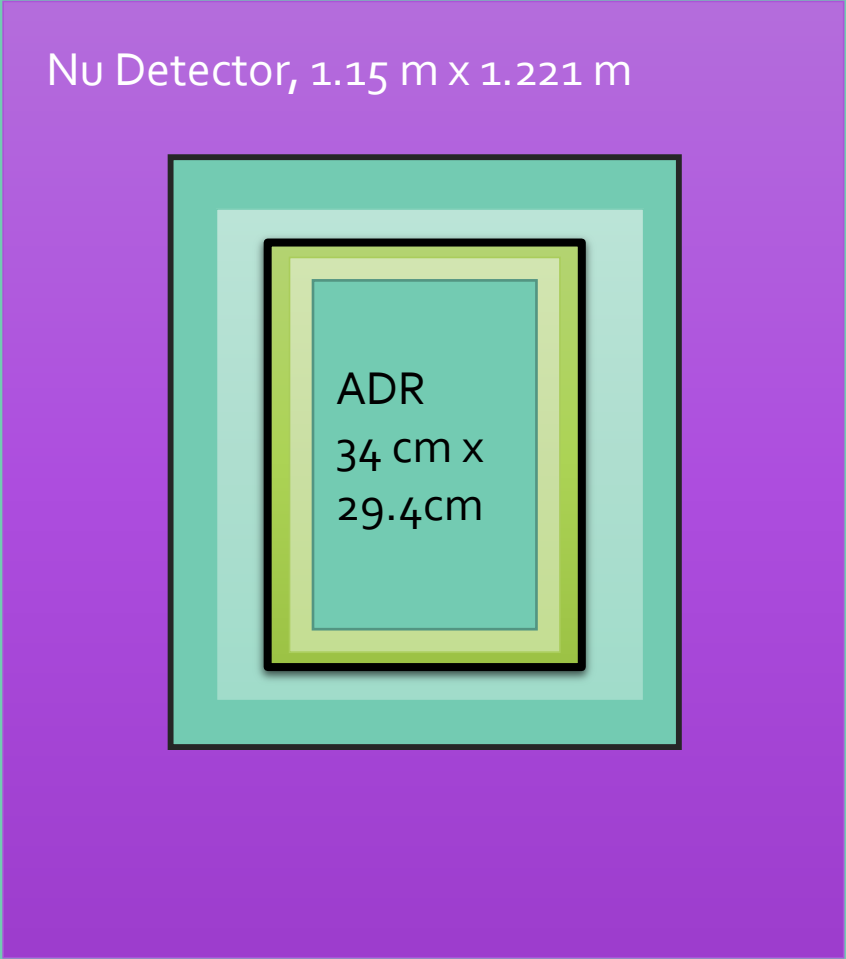
Replacing the ADR

Outer
Detector, [1
m, 4.25 m] x
[3.2 m, 4.2 m]

Pb and
Polyethylene, 4
cm and 10cm

Nu Detector, 1.15 m x 1.221 m

ADR
34 cm x
29.4cm

A diagram showing concentric rectangular layers representing shielding. The innermost layer is a light blue rectangle labeled 'ADR 34 cm x 29.4cm'. This is surrounded by a thin yellow border, then a thin light blue border, then a thick purple border, and finally a thick teal border. The teal border is labeled 'Outer Detector, [1 m, 4.25 m] x [3.2 m, 4.2 m]'. The purple border is labeled 'Nu Detector, 1.15 m x 1.221 m'. To the left of the diagram, text indicates 'Pb and Polyethylene, 4 cm and 10cm'.

Overall Project

I am working with Ricochet and will be doing simulations of the neutron background being received in the detector.

Week of 5/23

- Trouble with the unzipped ChoozSimulation
- Try to get git clone working with github.mit.edu to acquire the
- Getting help with our github.mit.edu problems
 - Talking to Alex and trying to figure out why it wasn't working
 - Lead to creating ssh keys that did not work
 - Call MIT help desk
 - So far they have been unable to help
 - Alex was able to get the github working on our computers, but through a vncserver, not through a ssh pipe

Spring Semester 2017

Started:

- We have moved closer to being able to do simulations in our new directories with our new code and the new information that comes with that.
- Over the summer Carolyn and Kim will move on, I will work with them for about 3 more weeks.

Learned:

- About linux and more about these simulations
- About Ricochet, what it is doing and some of the parts that go into building it.

Week of 5/2

Goals:

- Create an environment so that I can move forward with installing the ChoozSimulation code
- Get the installation finished off with hopefully no more problems.

Completed:

- Made an env.sh that seems to work and has brought me to the next part of the install of ChoozSimulation code.
- The testCfneutrons.mac works in the new (ratcage-040317) directory

Week of 4/25

Goals:

- Install the ChoozSimulation code into the new directory and build it
- Have the testCfneutrons.mac run in the old directory and new directory to make sure everything is working

Completed:

- The MATERIALS.ratdb is now as it should be and working
- Downloaded the ChoozSimulation after having trouble transferring it from github to the server

Week of 4/18

Goals:

- Install ChoozSimulation code into the new Ricochet directory and try and build it
- Fix typos in MATERIALS.ratdb

Completed:

- Transfer from old SPECTRUM.ratdb and adding additional elements to ELEMENTS.ratdb from old directory (ratcage) to new directory (ratcage-040317)

Week of 4/11

Goals:

- Transfer old spectrum, needed materials and elements over from old rat folder into the new rat folder, where the simulations will be done from now on.