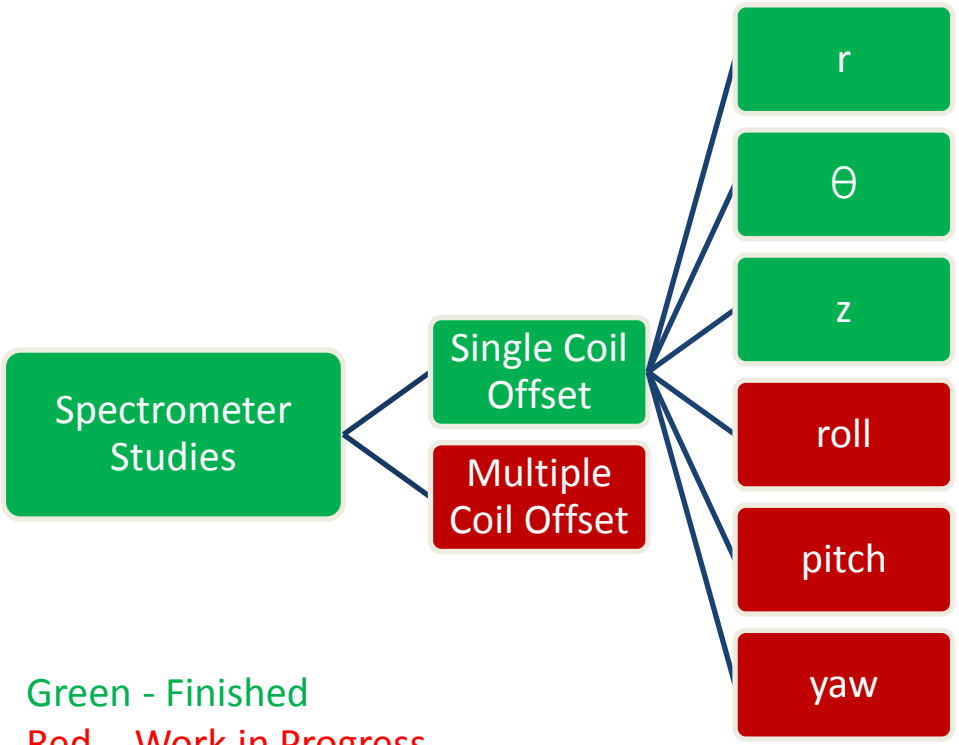
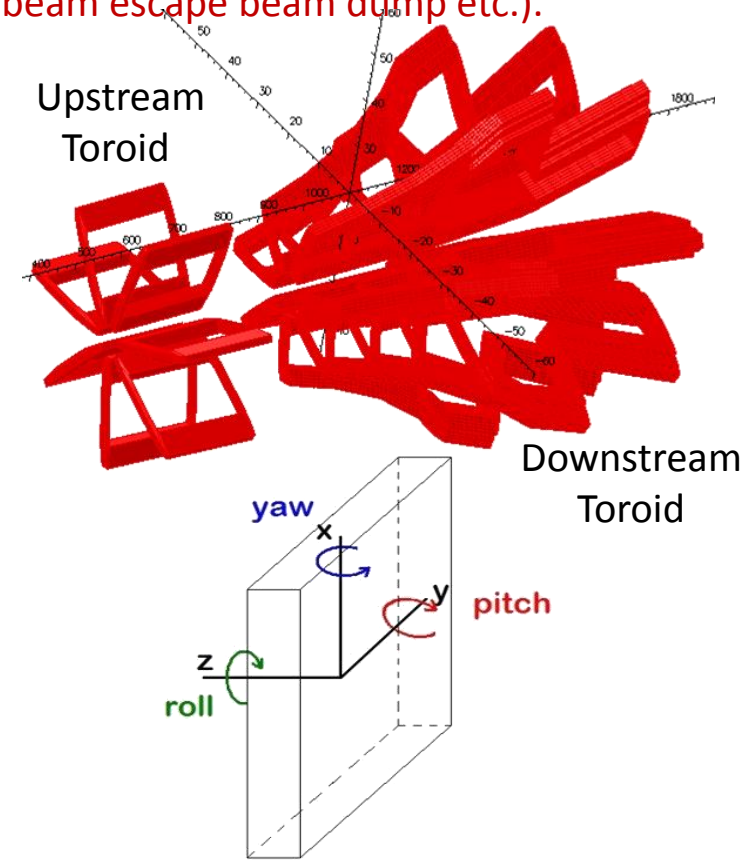
Spectrometer Update
28 May 2018

Introduction

- Sensitivity Studies
  - Use allowed uncertainty in **rate, asymmetry, θ_{lab} and θ_{com}** to estimate how much spectrometer coils can deviate from their default position.
- Beam Steering Studies
  - Effect of coil movement on beam inside beam pipe (power deposited on coils, distortion of beam profile inside beam line, does beam escape beam dump etc.).



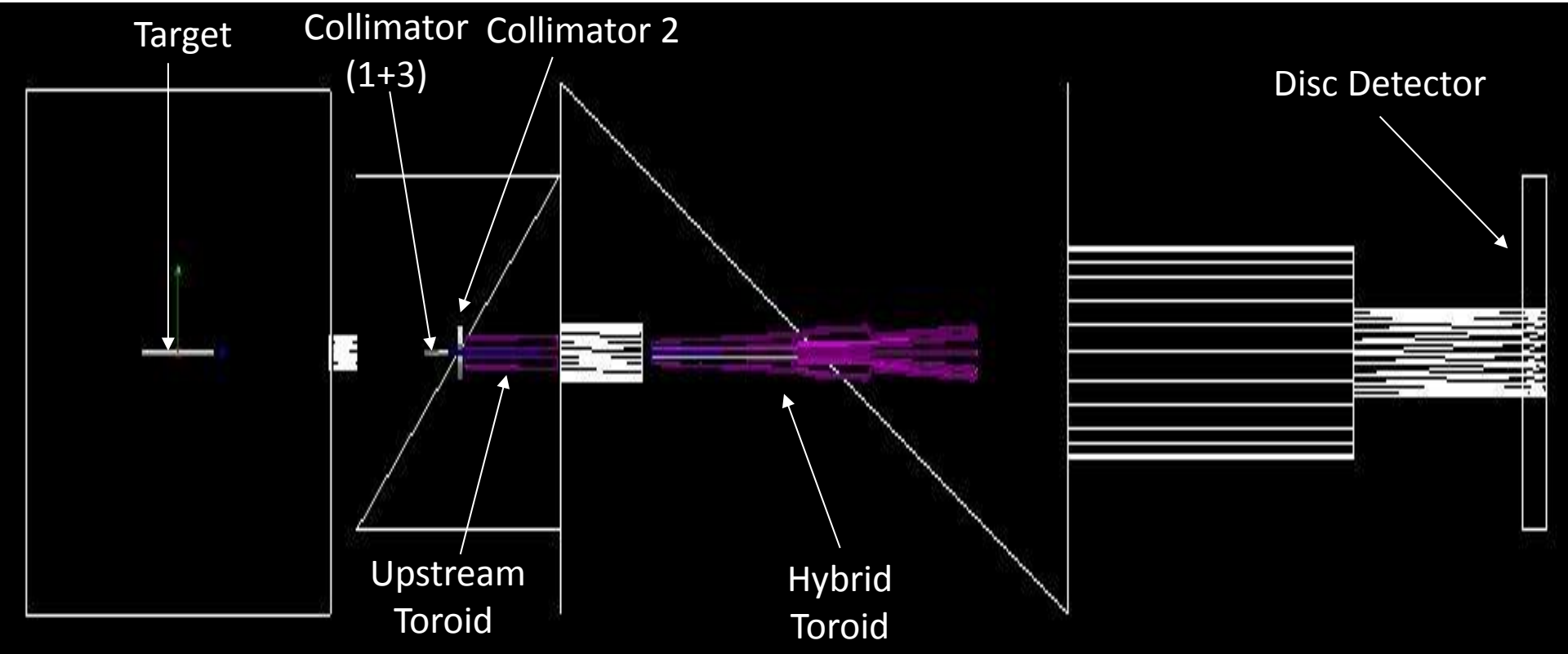
Green - Finished
Red - Work in Progress



Single Coil Sensitivity Studies

Geometry and Simulation Settings

- For each Toroid, 6 different offsets with 11 different offset values (2x6x11=132 unique magnetic field configurations).
- 10 million events for each configuration.
- Stripped all shielding and downstream collimators from geometry_dose.

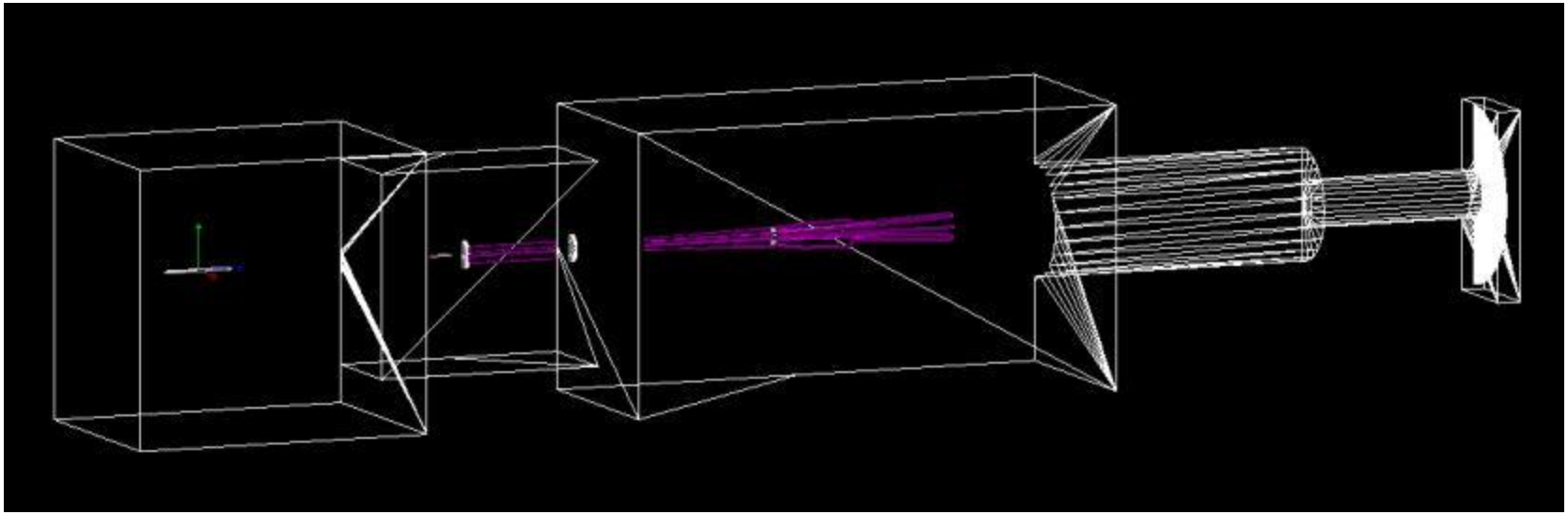


Limitations

- The geometry_dose folder in remoll-1.1.7 showed volume overlap and duplicate material warnings.
- 10 million events took far too long to process in the farm.

Change of Approach

- Run Position Sensitivity Studies with reduced statistics (1 million or less events) with latest merged collimator geometry with shielding stripped off.



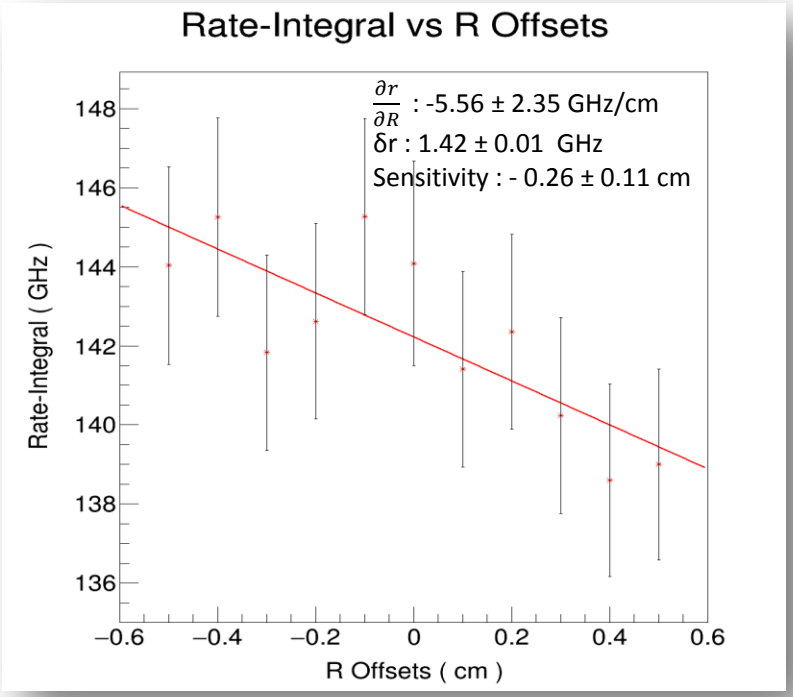
- Run Beam Steering Studies with reduced statistics.
- Run Position Sensitivity Studies with higher statistics if necessary.

Limitations

- With remoll-2.0.0:
  - Output file format different. Need to update analysis scripts.
  - Merged geometry shows lots of validation warnings. Simulation closes with error saying Target Volume not defined.
- With remoll-1.1.7:
  - Merged geometry shows small number of validation warnings.
  - Only got it to work with geant4.9.6p03 so far.

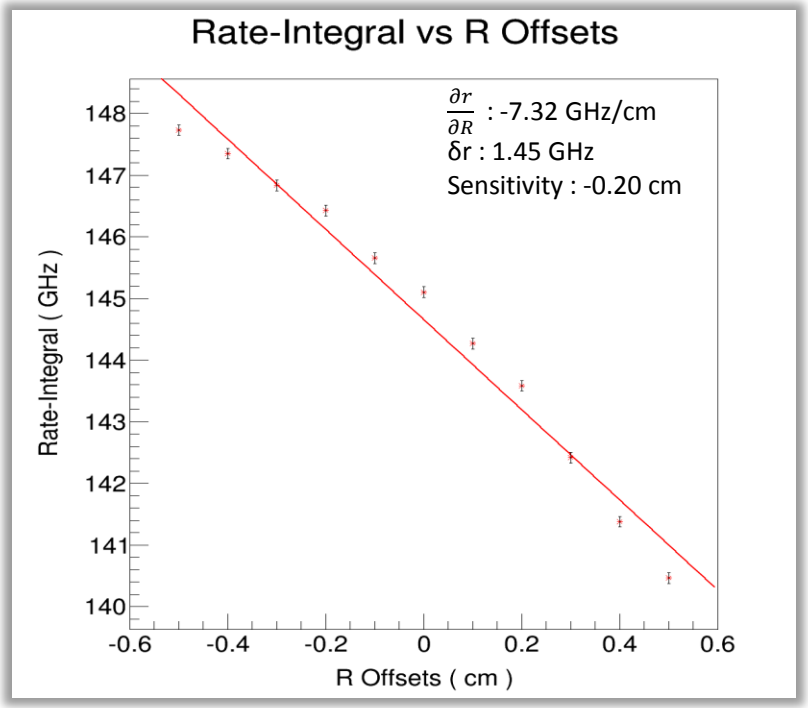
```
FCN=3.20528 FROM MIGRAD    STATUS=CONVERGED      39 CALLS          40 TOTAL
                     EDM=2.21383e-21    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                                   STEP         FIRST
 NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
  1  Slope       -5.56163e+00   2.35177e+00   2.35449e-03   2.82920e-11
  2  Intercept    1.42223e+02   7.48222e-01   7.49088e-04  -2.96420e-13
```

Results



- Geant 4.9.6.p03
- remoll-v1.1.7
- Merged Geometry-v2.2.0 (stripped all shielding)
- 10000 events
- Root 5.34
- S= 0.01*b/m,

$$dS = S\sqrt{\left(\frac{db}{b}\right)^2 + \left(\frac{dm}{m}\right)^2}$$



- Geant 4.10.00.p03
- remoll-v1.0.0
- Dose Geometry-v1.0.0 (stripped all shielding+dsCol)
- 10 million events
- Root 5.34
- S= 0.01*b/m, assume b and m to be constant

Observations

- Merged geometry takes much longer to run compared to the Sculpt even when stripped off all complexities.
- Tested Configurations:
  - Sculpt+Geant4.10+remoll-1.1.7 (Works fast)
  - Sculpt+Geant4.10+remoll-2.0.0 (Works fast)
  - Merged+Geant4.10+remoll-1.1.7(Slow)
  - Merged+Geant4.10+remoll-2.0.0(Slow)
  - Merged+Geant4.9+remoll-1.1.7 (Works but Slow)

Going Forward

- Need to settle on a optimized geometry with updated merged collimator definitions. Find out what's causing the lag with merged geometry.
- Stick with remoll-1.1.7 until analysis scripts for remoll-2.0.0 are done.