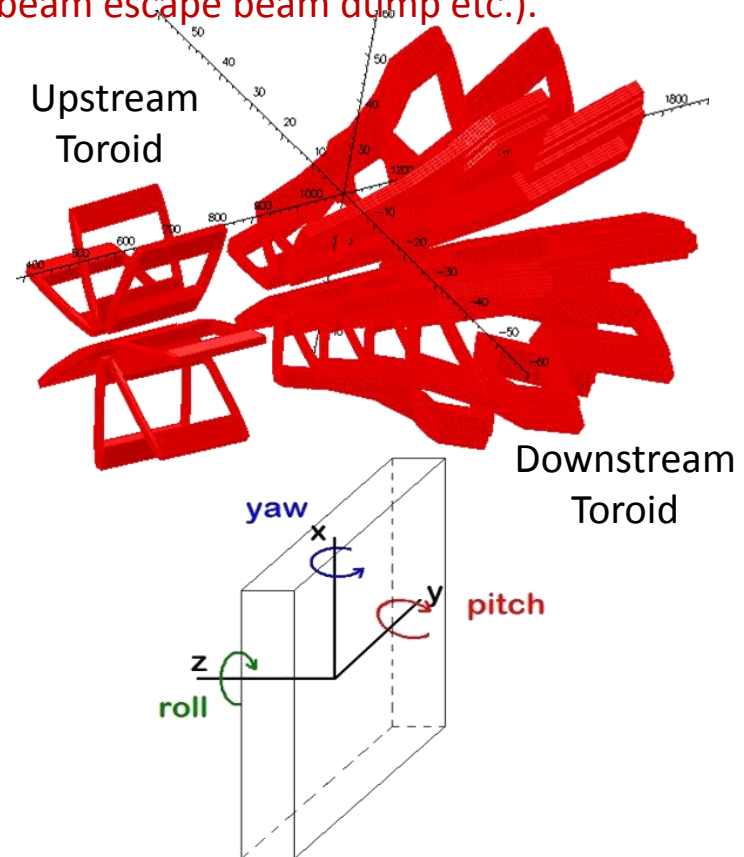
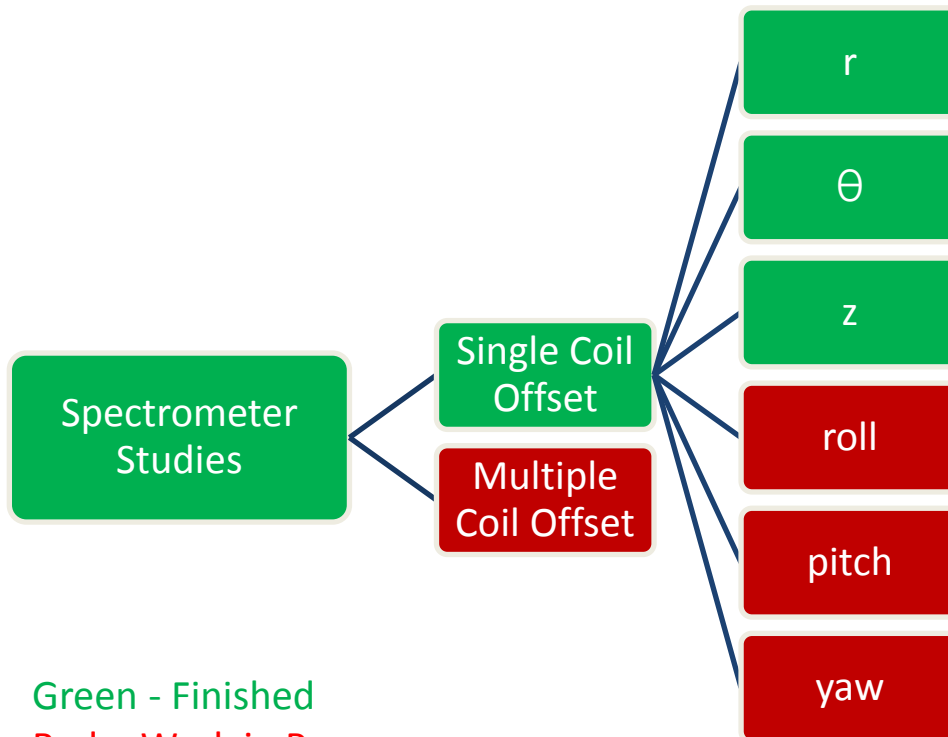


# Spectrometer Update

## 28 May 2018

# Introduction

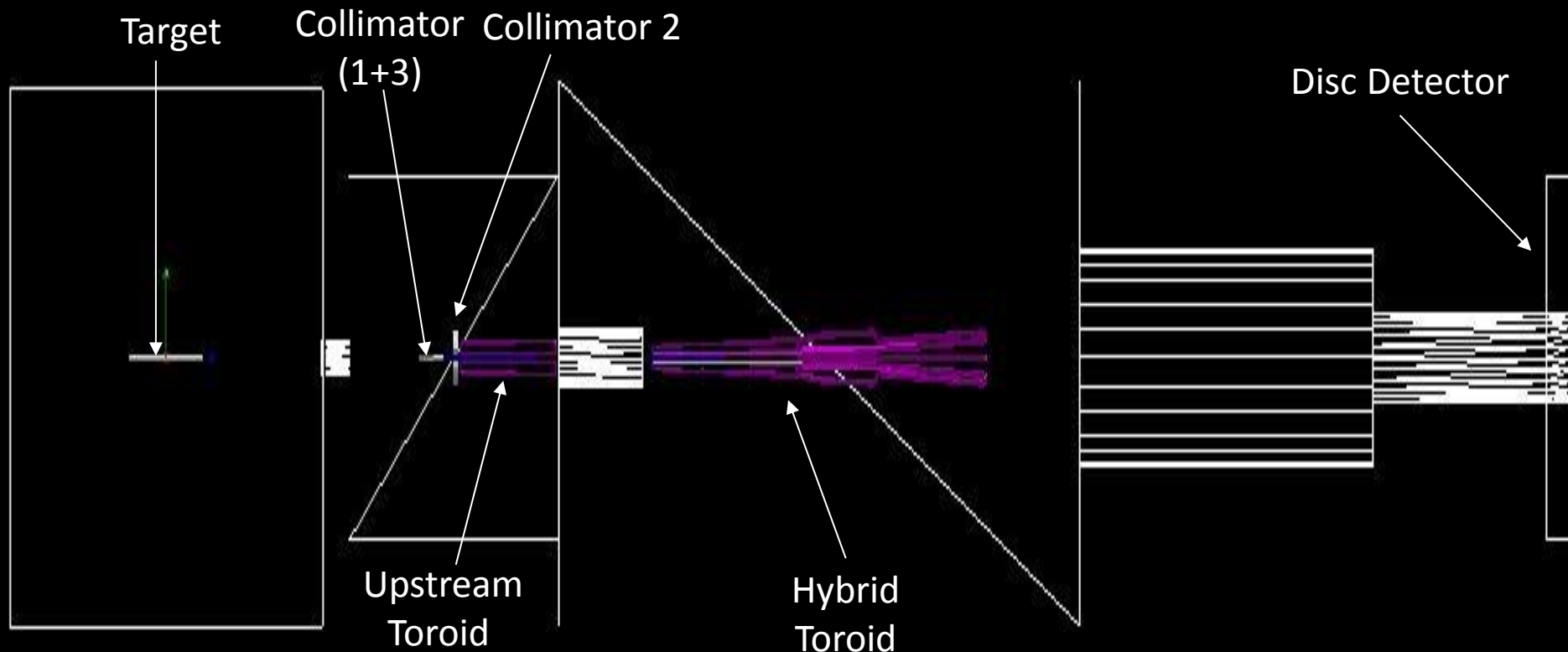
- Sensitivity Studies
  - Use allowed uncertainty in **rate, asymmetry,  $\theta_{lab}$  and  $\theta_{com}$**  to estimate how much spectrometer coils can deviate from their default position.
- Beam Steering Studies
  - Effect of coil movement on beam inside beam pipe (power deposited on coils, distortion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



# Single Coil Sensitivity Studies

## Geometry and Simulation Settings

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

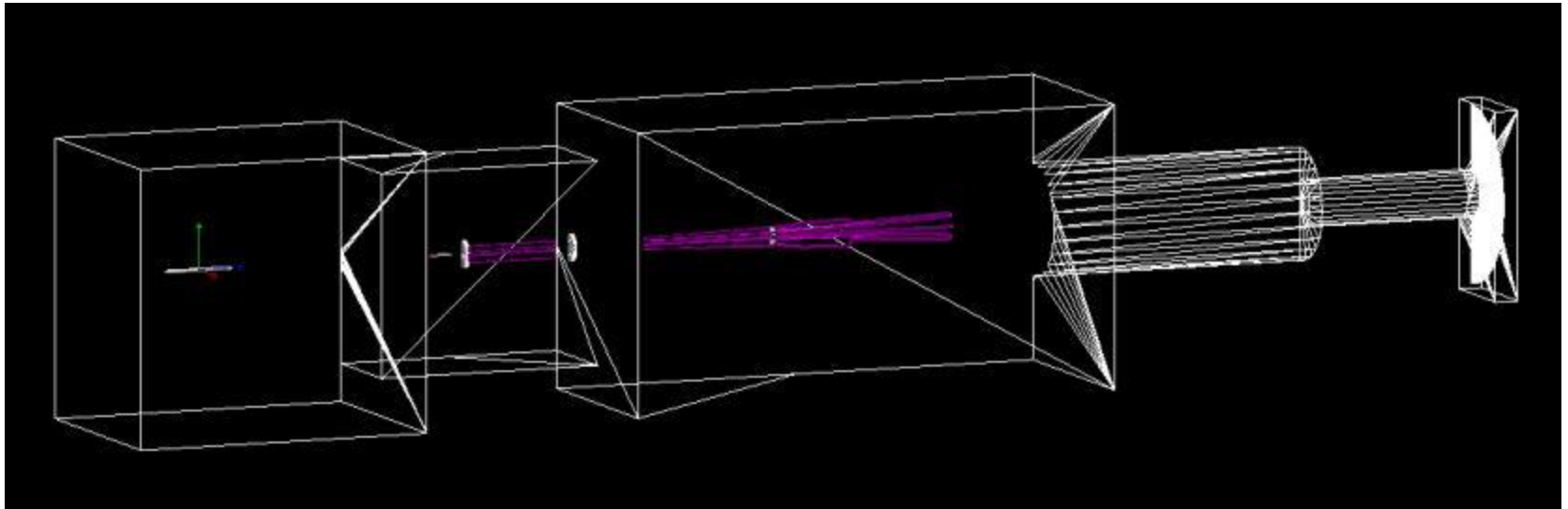


# Limitations

- 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.

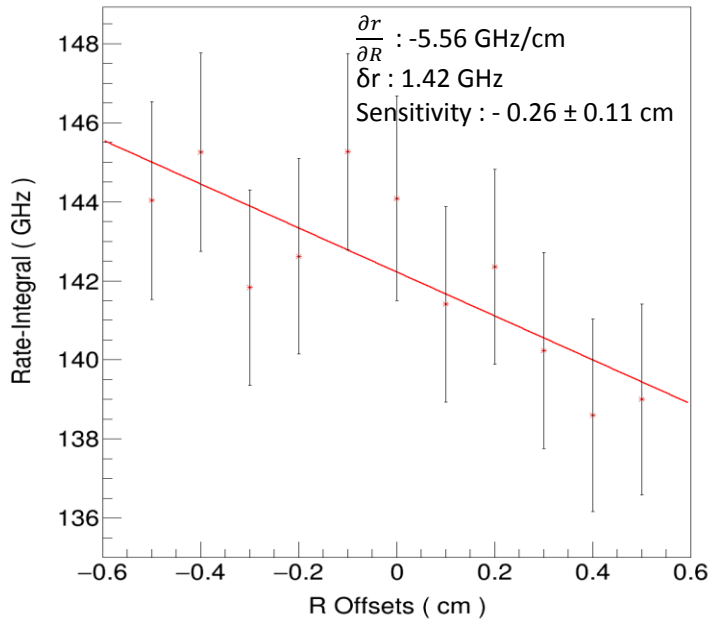
```

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

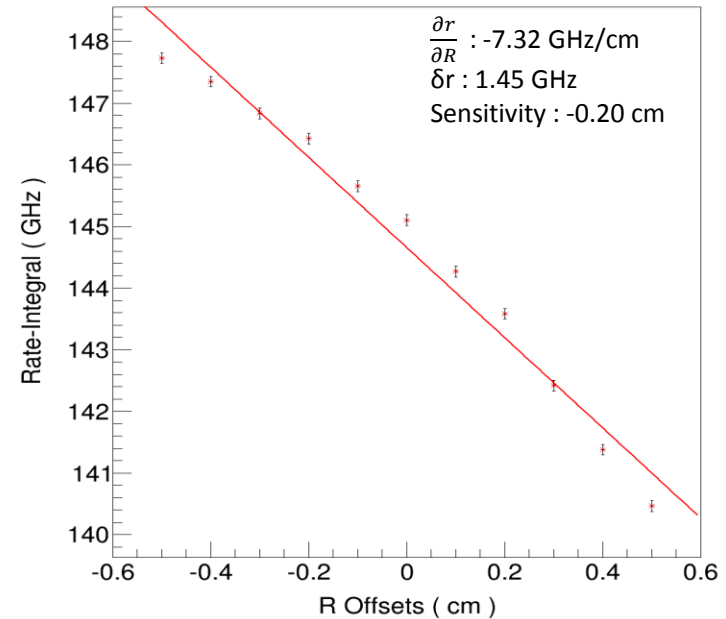
```

# Results

Rate-Integral vs R Offsets



Rate-Integral vs R Offsets



- 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.