Update on the Hall C Monte Carlo simulation for 12 GeV

Mark Jones

Updates to SHMS Single Arm Monte Carlo

- Fitted MC reconstruction optics matrix to improve on the default COSY matrix.
- Updated detector package to include options for
  - Exit window and Ar/Ne Cerenkov .
  - Exit window and helium bag replacing Ar/Ne Cerenkov.
  - Vacuum pipe replacing Ar/Ne Cerenkov.
- Study of reconstruction resolution with various detector configurations.
- Latest release available as a tarball at https://hallcweb.jlab.org/wiki/index.php/SHMS_Single_arm_Monte_Carlo
- SIMC has also been updated with same SHMS code. Can check out latest version from the CVS.

Default Monte Carlo setup

- Target length > 3cm, beer can (diameter = 3.37cm) and wall thickness of 0.005 in
- Need to enter the radiation length of target material in the input file.
- Scattering chamber window is 0.016inches of aluminum
- 15 cm of air between scattering chamber and snout
- SHMS entrance window is 0.020 inches of aluminum
- SHMS exit window is 0.020 inches of aluminum.
- Three options for after the SHMS exit window
  - Argon/Neon Cerenkov. Set the *cer_flag=1* (line 22 in input file). The *vac_flag* (line 23 in input file) is ignored.
  - Helium bag replaces the Argon/Neon Cerenkov. This is the assumed mode of option at low momentum. Set the *cer_flag=0* (line 22 in input file) and set the *vac_flag=0* (line 23 in input file).
  - Vacuum pipe replaces the Argon/Neon Cerenkov. Set the *cer_flag=0* (line 22 in input file) and set the *vac_flag=1* (line 23 in input file).
- SHMS wire chamber resolution is 200 microns
- SHMS collimator is in place and cuts events.
- Events cut if outside area of drift chambers, S1 and S2 scintillators and the calorimeter in *mc_shms_hut.f*.

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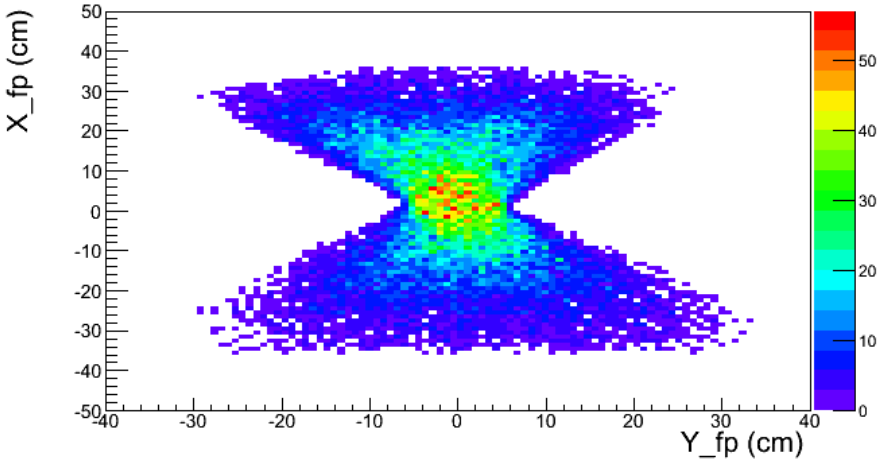
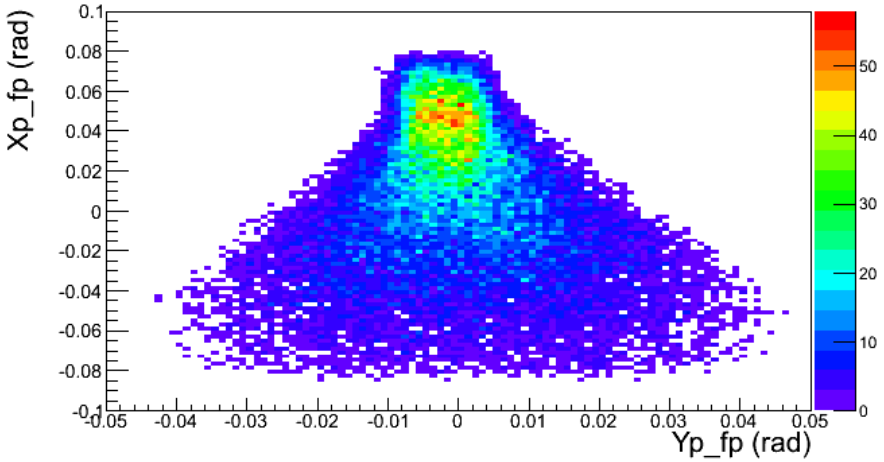
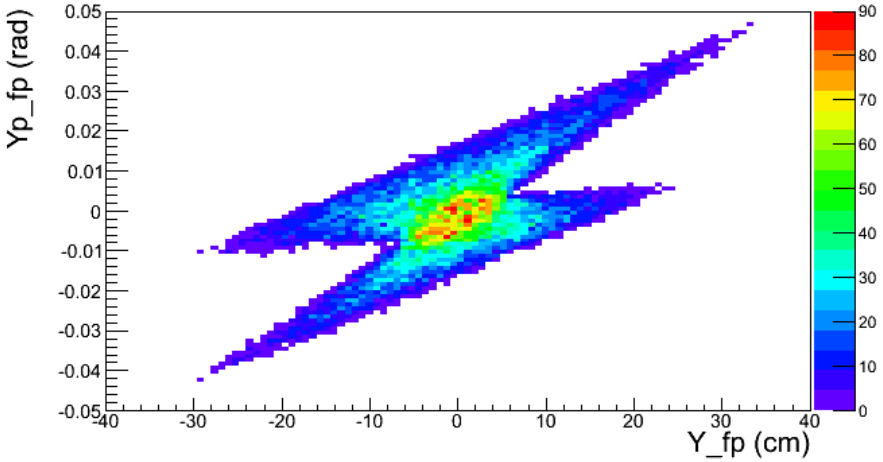
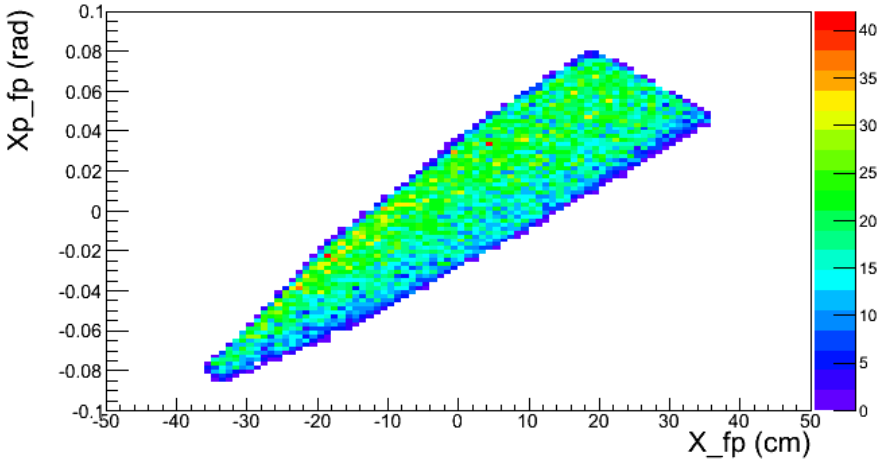
Focal plane distributions

2 GeV electrons from 20cm LH2 target at 20 deg.



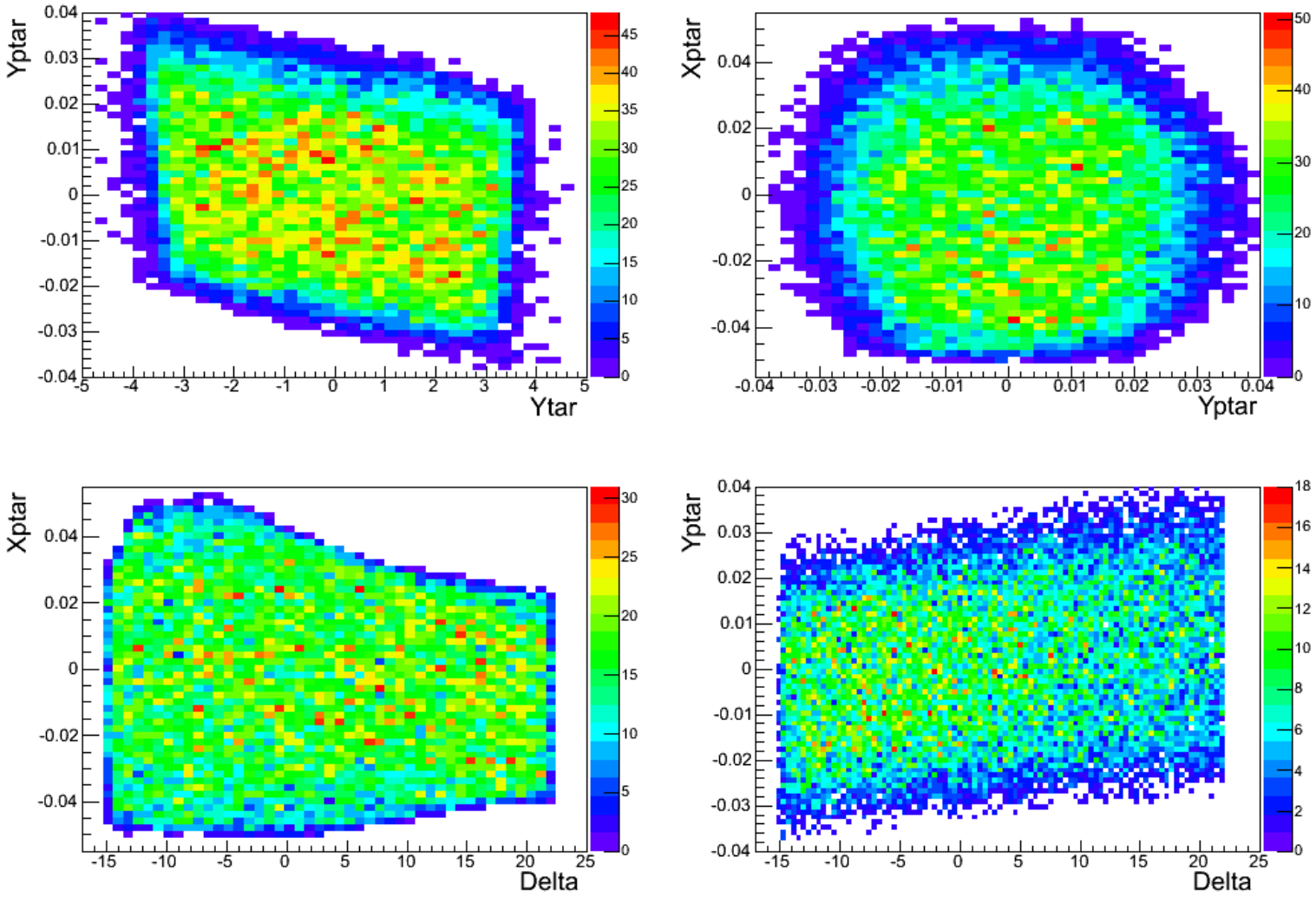




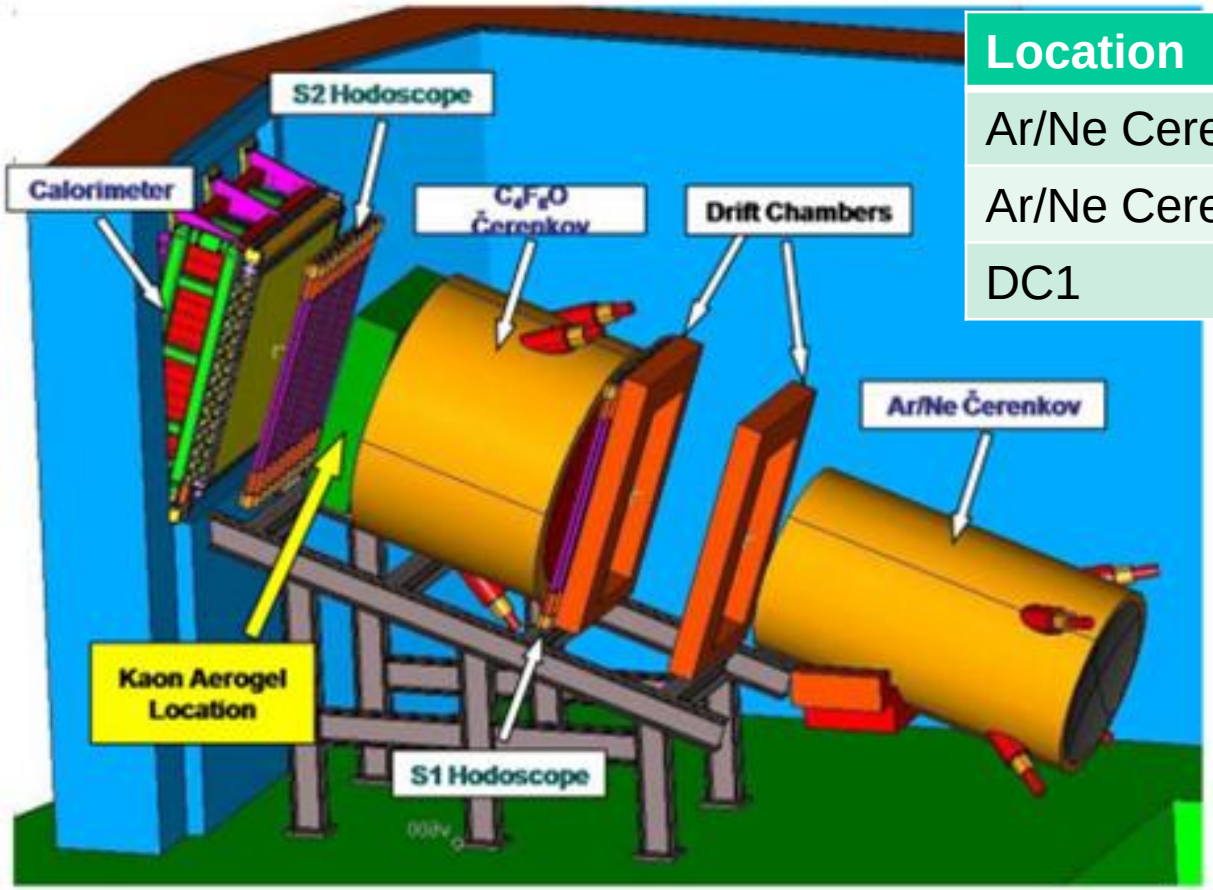


Target distributions

2 GeV electrons from 20cm LH2 target at 20 deg.



SHMS detector package



Location	Z (cm)
Ar/Ne Cerenkov entrance	-291.7
Ar/Ne Cerenkov exit	-61.7
DC1	-40.0

Aluminum exit window with thickness of 0.020 in or 0.6% rad lengths
2 GeV electron
σ_{ms} = 0.41 mr

Study replacing Ar/Ne Cerenkov with vacuum pipe or helium bag. Below 6 GeV Ar/Ne Cerenkov not used.

First Order Optics

SHMS matrix

X'_{tar} (mr) = 0.26 X_{fp} (mm) - 1.38 X'_{fp} (mr)

δ (%) = 0.06 X_{fp} (mm) - 0.0012 X'_{fp} (mr)

Y_{tar} (mm)= -0.61 Y_{fp} (mm) - 0.04 Y'_{fp} (mr)

Y'_{tar} (mr)= 0.27 Y_{fp} (mm) - 1.6 Y'_{fp} (mr)

20mil Al σ_{ms} = 0.41 mr so Z = 291cm expect σ_x = 0.38 mm

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HMS matrix

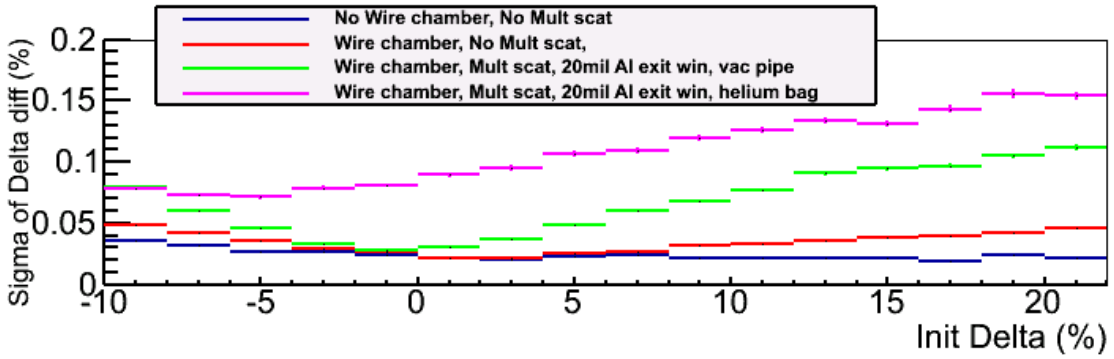
X'_{tar} (mr) = 0.34 X_{fp} (mm) - 3.15 X'_{fp} (mr)

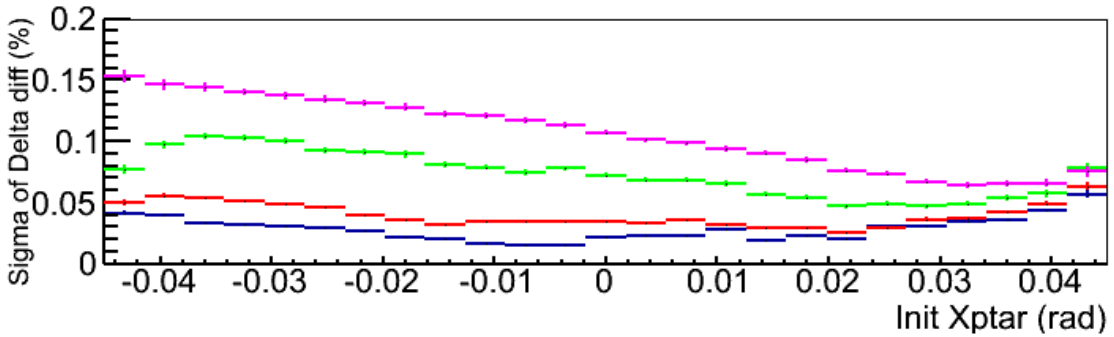
δ (%) = 0.026 X_{fp} (mm) - 0.009 X'_{fp} (mr)

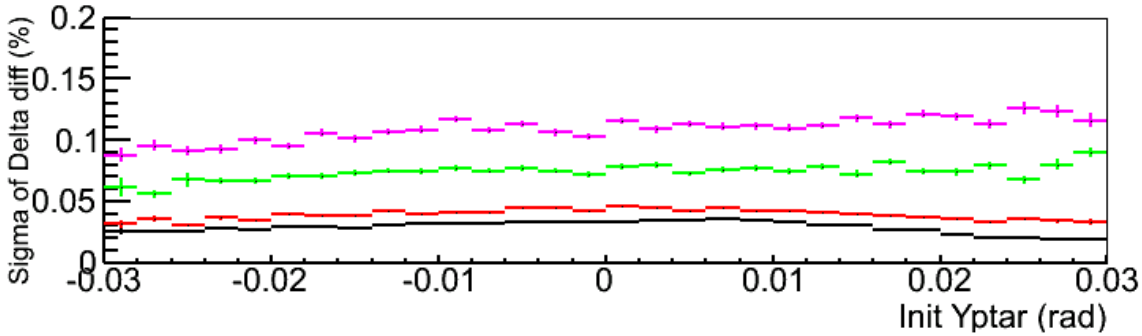
Y_{tar} (mm)= -0.38 Y_{fp} (mm) - 0.086 Y'_{fp} (mr)

Y'_{tar} (mr)= 0.26 Y_{fp} (mm) - 2.1 Y'_{fp} (mr)

Delta resolution





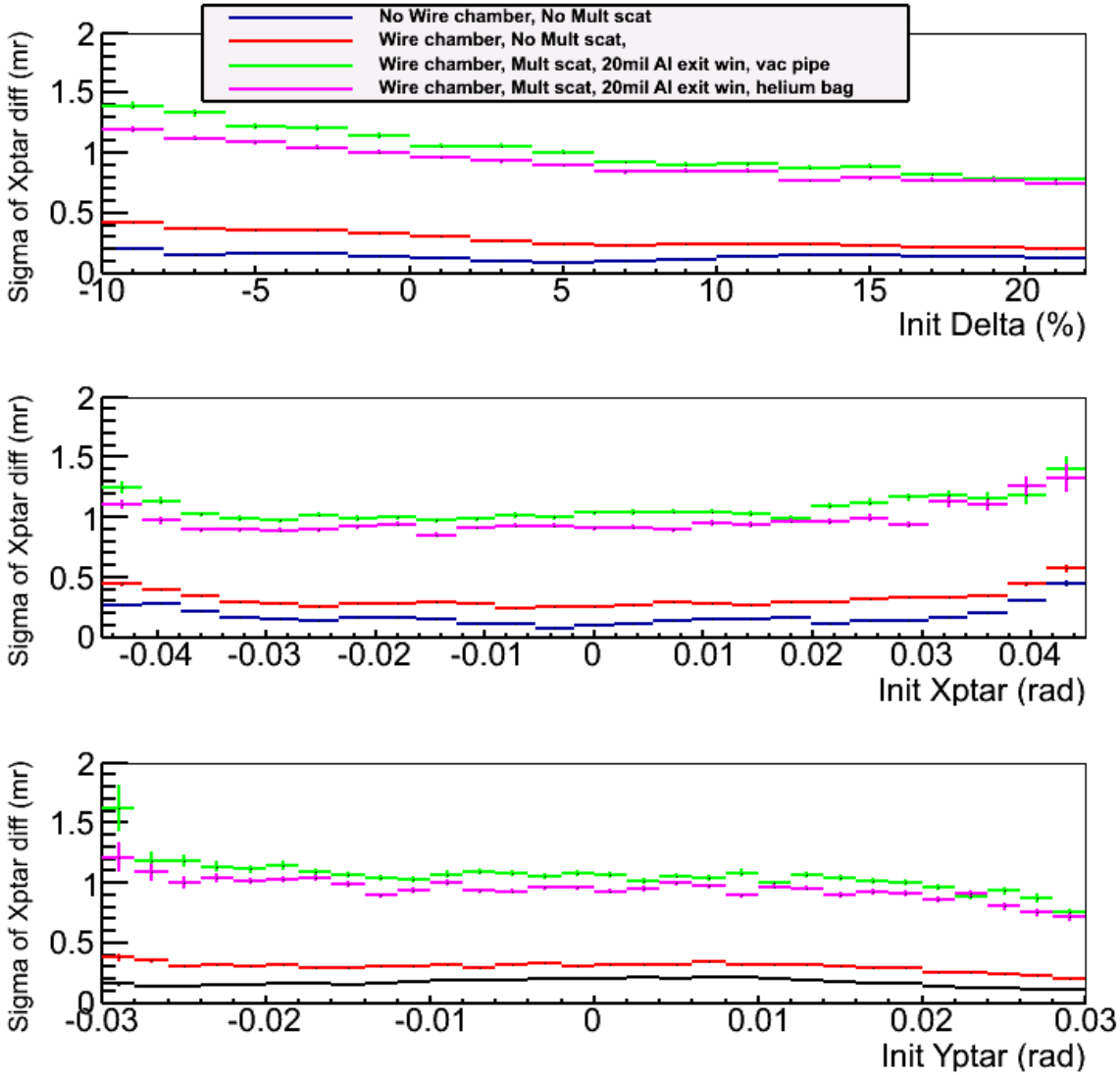


$\text{Delta} = (p-p_c)/p_c$

<u>Conditions</u>

- 2 GeV electrons
- 20cm LH2 target
- SHMS at 20 deg

X’ target resolution (vertical angle)



Conditions

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- 20cm LH2 target
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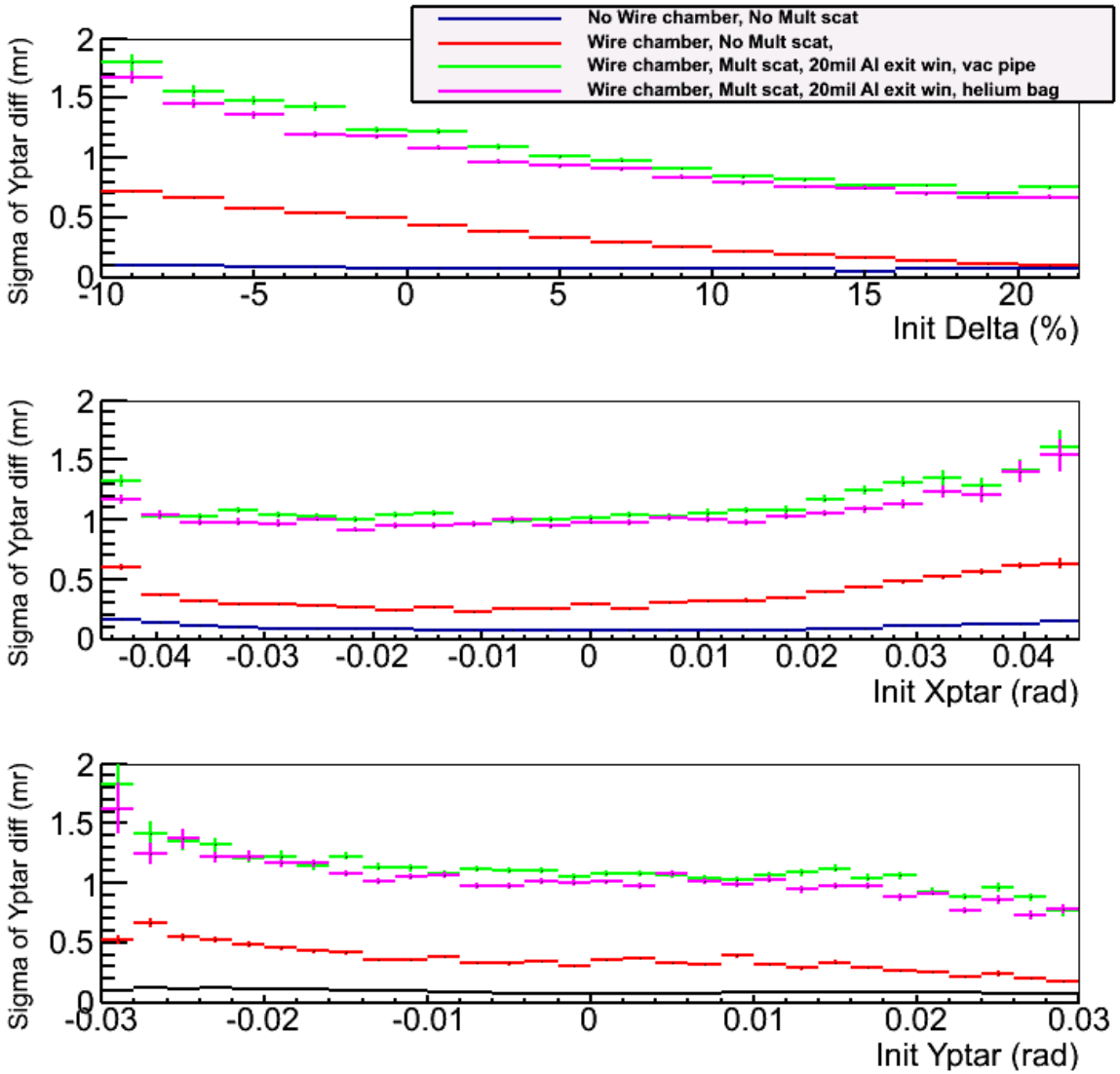
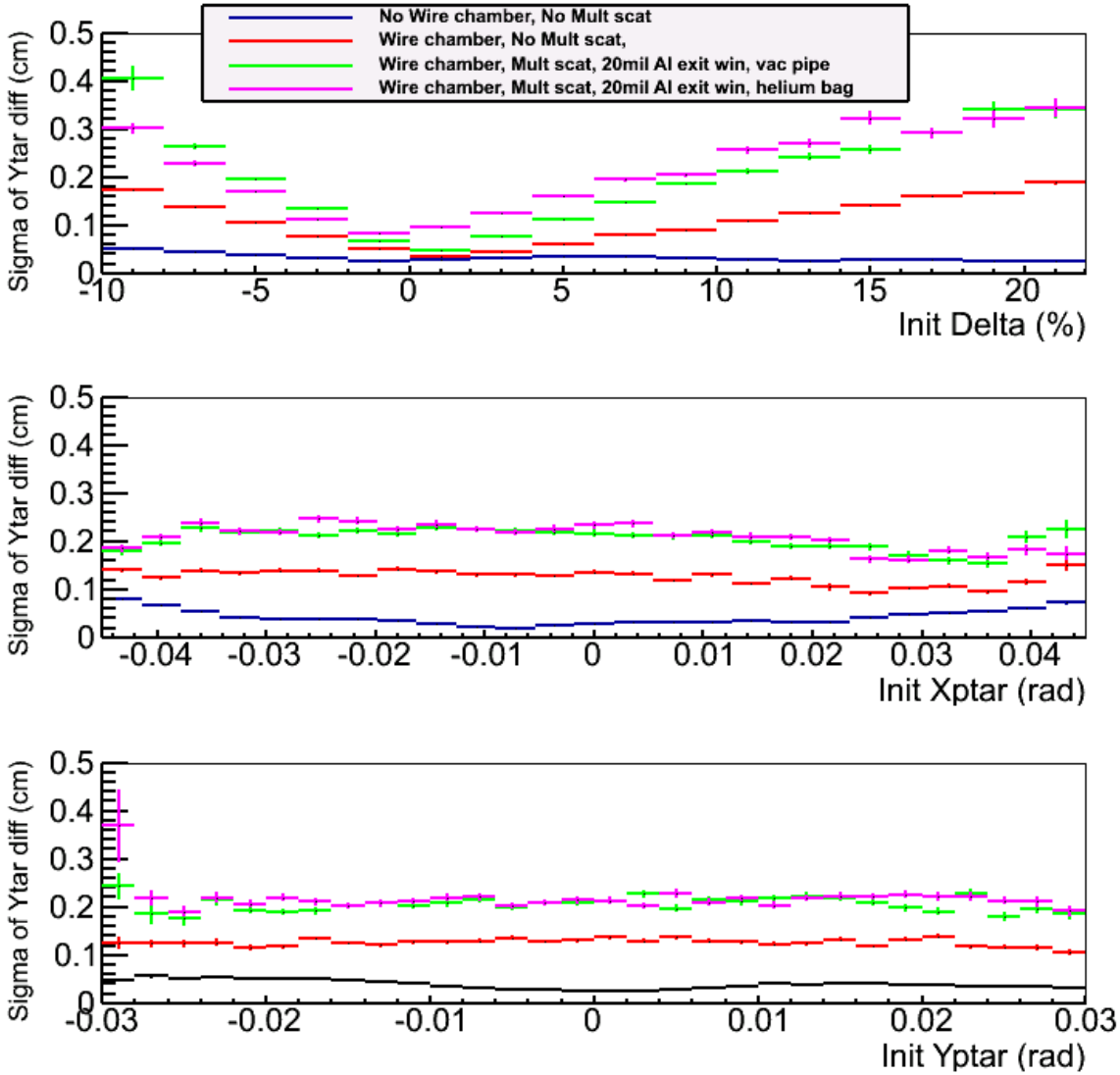
Y' target resolution (horizontal angle)



Conditions

- 2 GeV electrons
- 20cm LH2 target
- SHMS at 20 deg

Y target resolution (horizontal position)



Conditions

- 2 GeV electrons
- 20cm LH2 target
- SHMS at 20 deg

Summary table of resolutions

2 GeV electrons from 20cm LH2 target at 20 deg.

Conditions	Ave σ X'_{tar} (mr)	Ave σ Y'_{tar} (mr)	Ave σ δ (%)	Average σ Y_{tar} (cm)
No WC resolution No multiple scat	0.17	0.09	0.03	0.04
WC resolution No multiple scat	0.30	0.35	0.04	0.10
WC resolution Multiple scat Vacuum pipe	1.08	1.12	0.08	0.21
WC resolution Multiple scat Helium bag	0.96	1.05	0.11	0.22

Summary table of resolutions

20cm LH2 target at 20 deg.

Conditions	Ave σ X'_{tar} (mr)	Ave σ Y'_{tar} (mr)	Ave σ δ (%)	Average σ Y_{tar} (cm)
Ar/Ne Cerenkov 2 GeV	1.6	1.4	0.20	0.33
Ar/Ne Cerenkov 6 GeV	0.66	0.69	0.08	0.21
Vacuum pipe 2 GeV	1.08	1.12	0.08	0.21

Conclusion

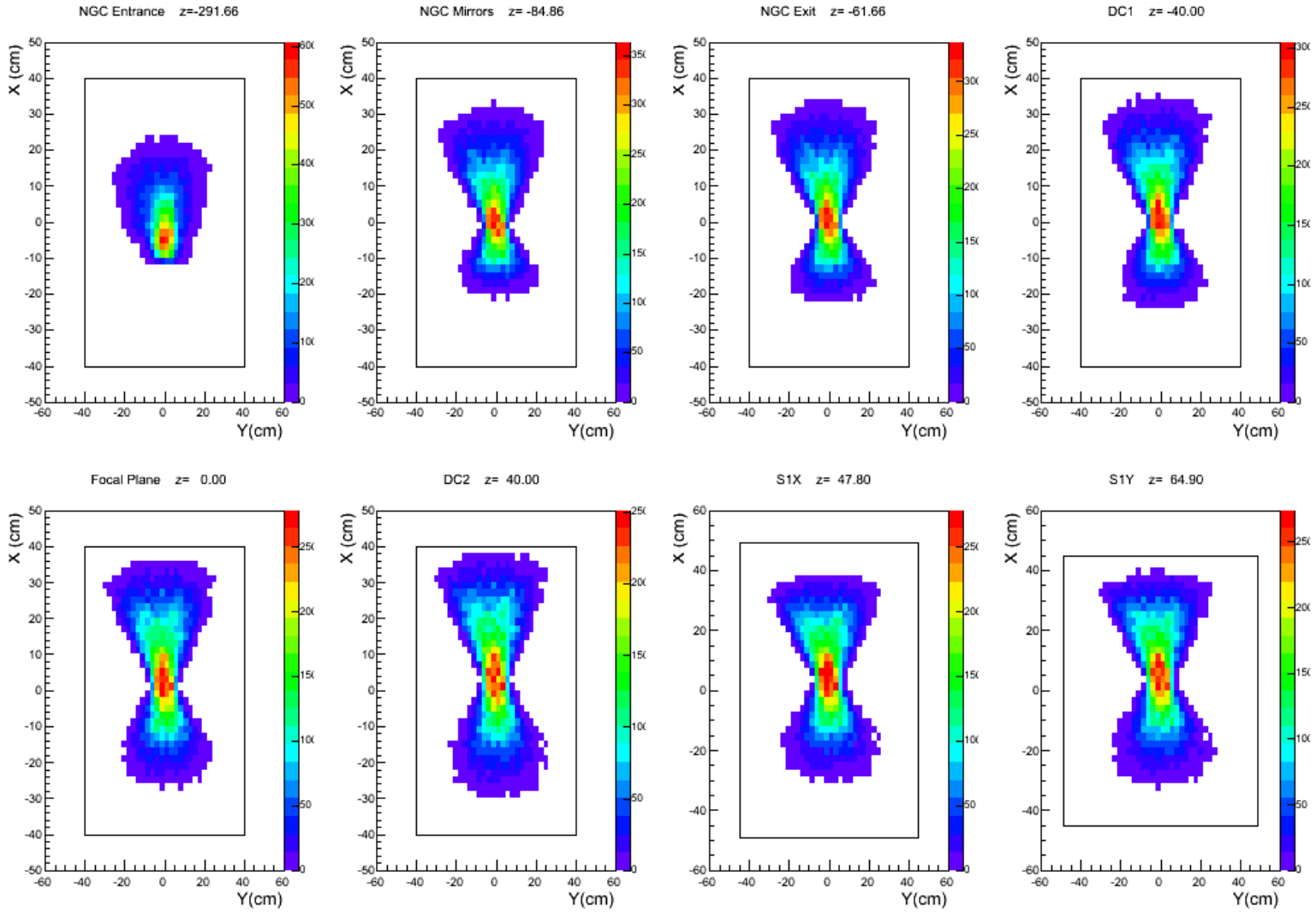
- Can meet the performance specification for resolutions in δ,X'_{tar}, Y'_{tar},Y_{tar}
- Latest release available as a tarball at https://hallcweb.jlab.org/wiki/index.php/SHMS_Single_arm_Monte_Carlo
- SIMC has also been updated with same SHMS code. Can check out latest version from the CVS.
- Need to integrate with the existing HMS single arm package fro inclusive experiments
- Is a workshop or meeting about Monte Carlo in conjunction with next Hall C detector group meeting useful?
- Would like to keep the Hall C MC working group active.

  hallcweb.jlab.org/wiki/index.php/SHMS_MC_Working_Group

Backup Slides

XY Focal plane distributions

2 GeV electrons from 20cm LH2 target at 20 deg. -15% < δ < 22%



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