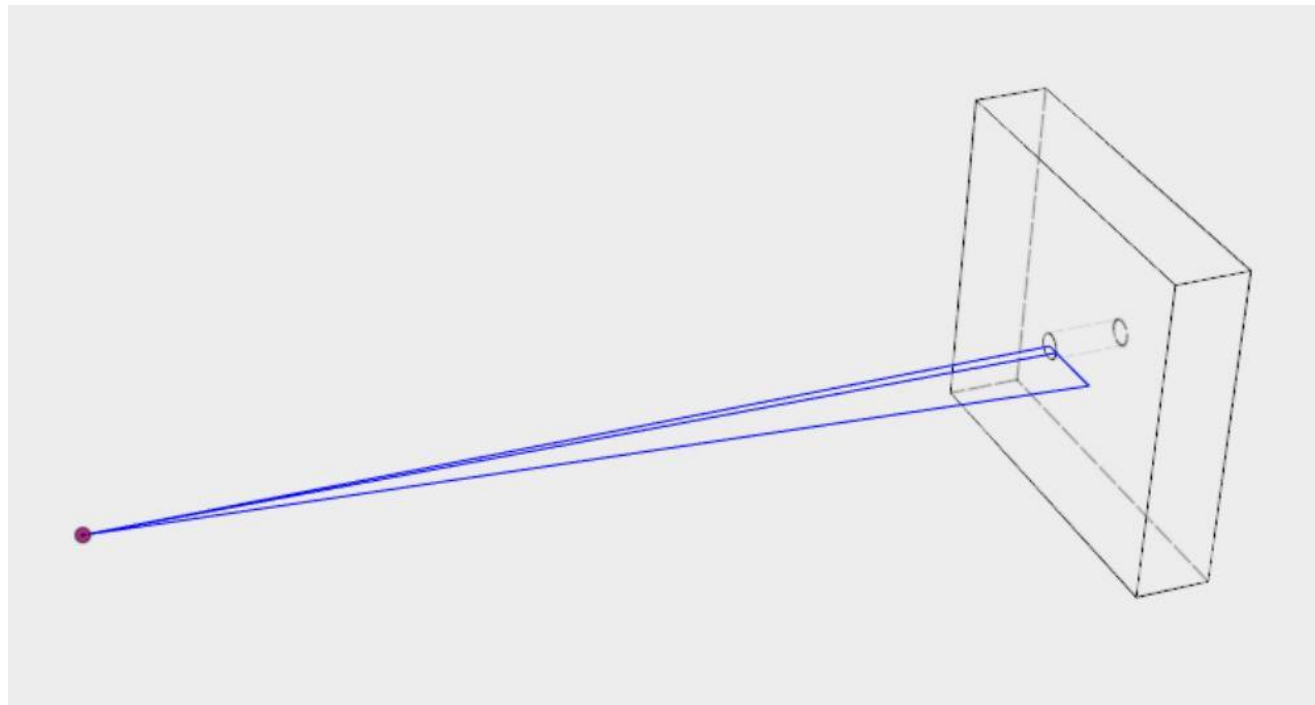# MWPC Simulation

❖ Using TOF for angular cuts rejects too many events
❖ Problem incorporating noise into simulation
❖ Preliminary simulation results
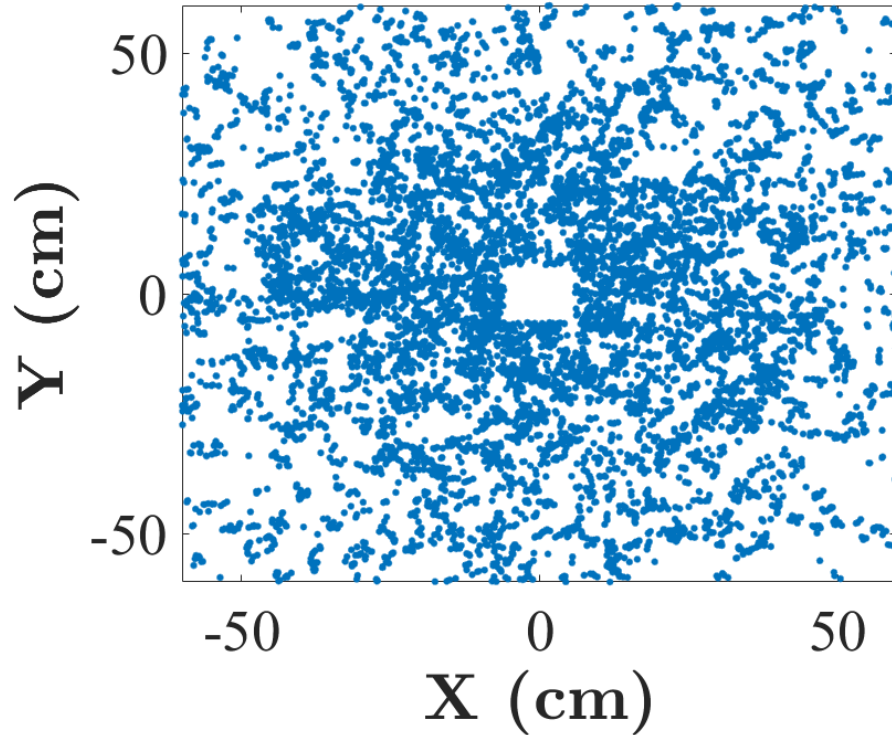❖ Proposed next steps

# Using TOF for Angular Cuts

Idea: Use hits on the Time of Flight as way of putting angular cuts on events in simulation.

To do this, specify an inner radius and an outer radius corresponding to desired angular cuts. If an event produces any hits inside of inner radius or outside of outer radius, reject entire event.
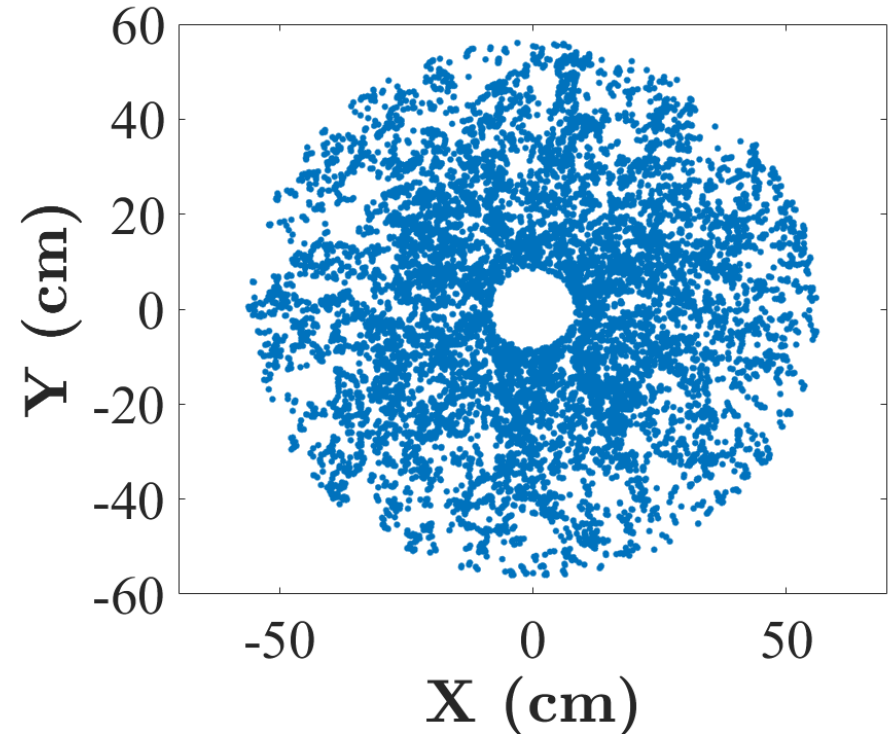
# Using TOF for Angular Cuts



Implementation in code seems to have been successful?

# Using TOF for Angular Cuts

In simulation, too many pion events are rejected:

~ 90% of pion events are rejected relative to the amount when no TOF cuts are implemented, while ~ 18% of muon events are rejected
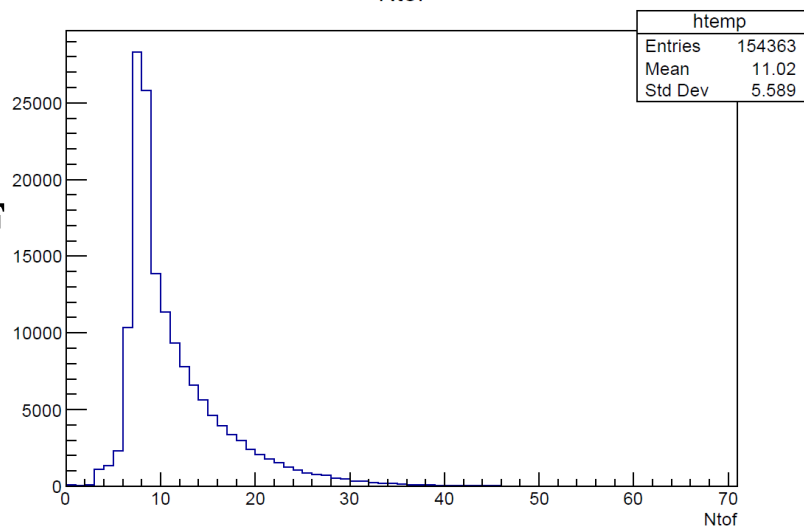
Possible explanations – code was written wrong, pions shower more in TOF and produce more hits farther away from actual event, etc.

Possible solution – use a different method of cutting angles?

See next slide for plots showing number of TOF hits for muons and pions, with and without TOF cuts in simulation. Note number of events per plot in top right corner
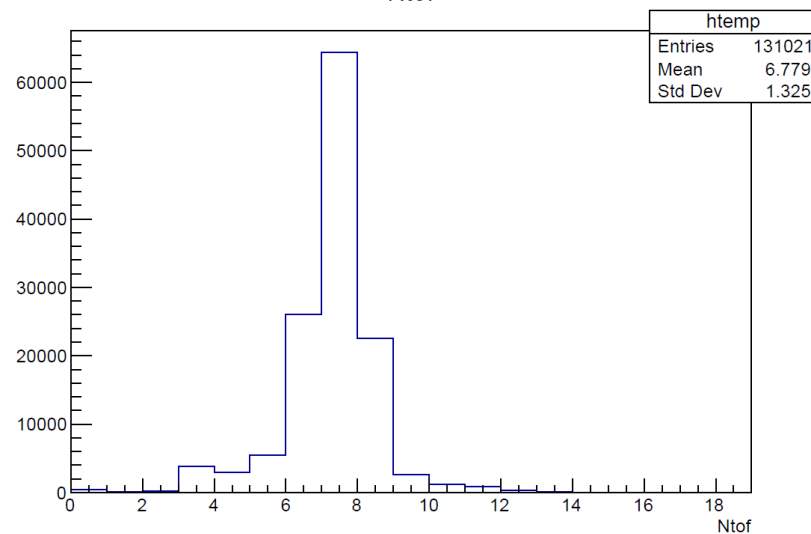
Pions — Muons

No TOF Cuts / With TOF Cuts

**Pions — No TOF Cuts** (Ntof)

htemp
Entries 154363
Mean 11.02
Std Dev 5.589

**Muons — No TOF Cuts** (Ntof)

htemp
Entries 131021
Mean 6.779
Std Dev 1.325

**Pions — With TOF Cuts** (Ntof)

htemp
Entries 14631
Mean 7.121
Std Dev 1.63

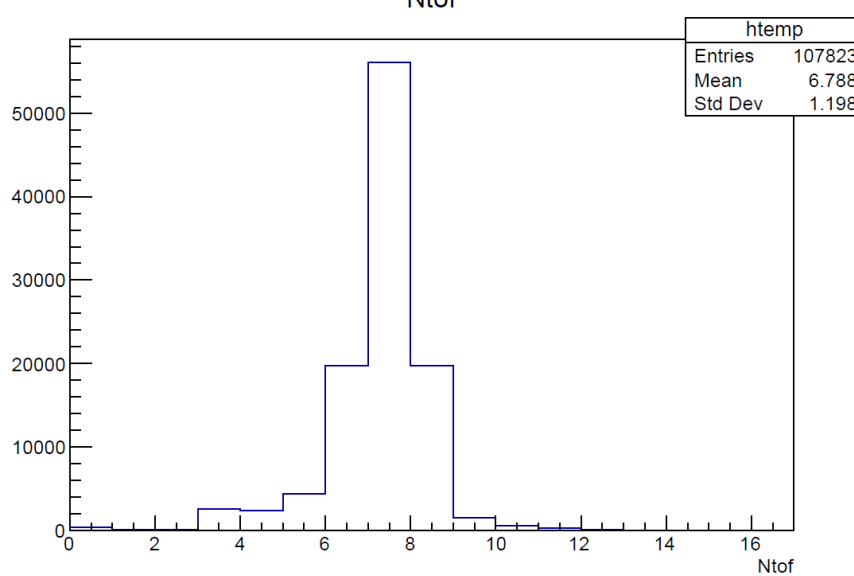**Muons — With TOF Cuts** (Ntof)

htemp
Entries 107823
Mean 6.788
Std Dev 1.198
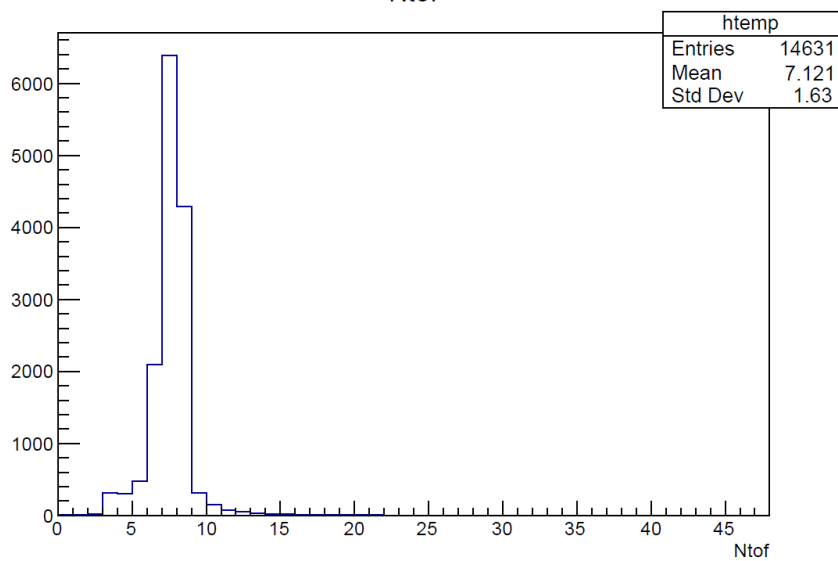
# Incorporating Noise into Simulation

❖      Noise currently is added to simulation by adding beam accidentals to input event files

❖      In order for this to be effective, need physical lead target included in simulation geometry

❖      Hoping for guidance from JLab (David, Ilya) on doing this

# Simulation Results

Tested two geometries:
2 detectors with 140 cm of iron between them
8 detectors with 20 cm of iron between each detector

The following plots show background rejection vs. signal acceptance for the two geometries when varying numbers of MWPCs are included in the MVA, and also compares the two geometries (third plot)
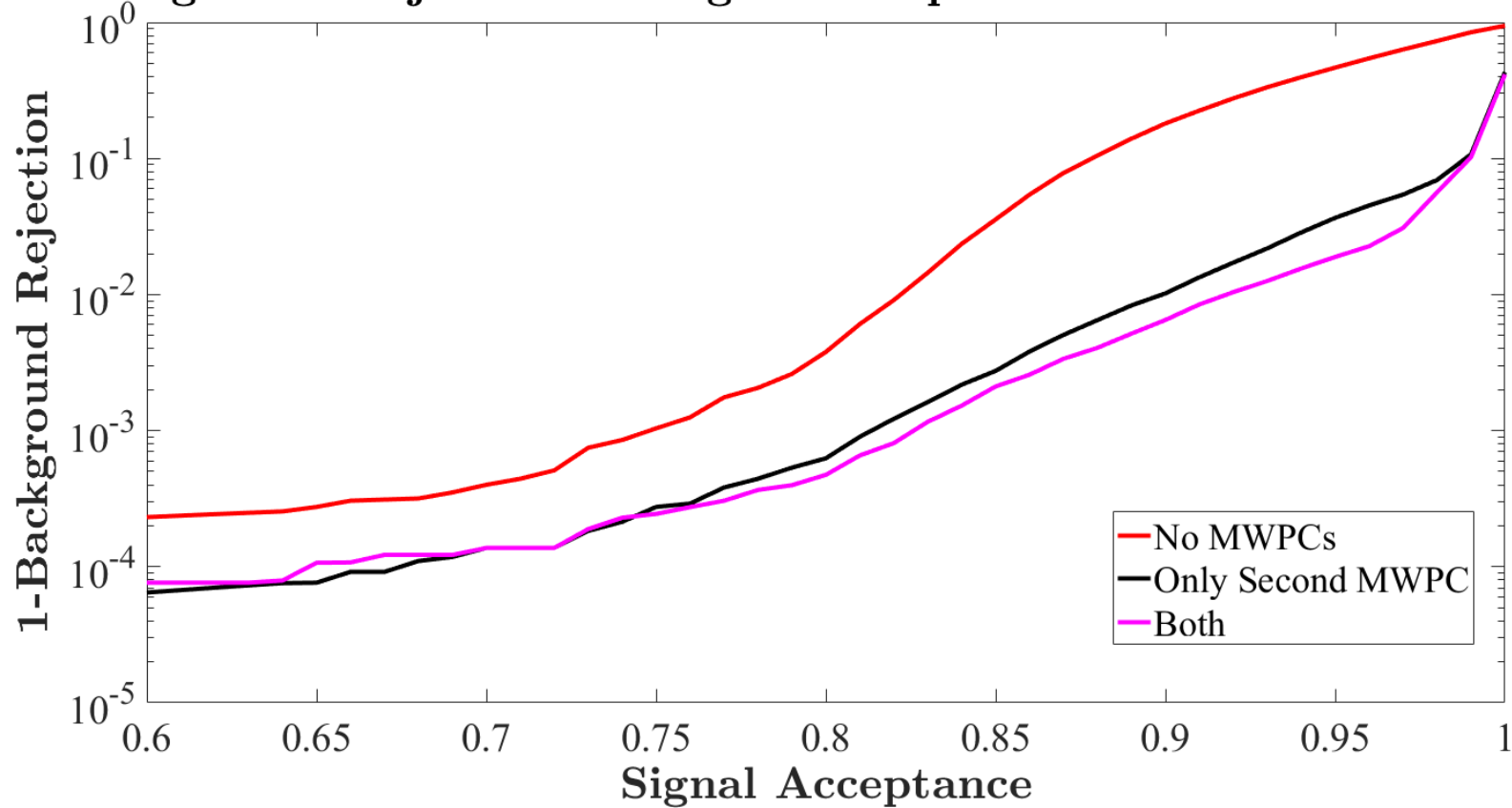
1-Background Rejection vs. Signal Acceptance for 8 MWPC Geometry
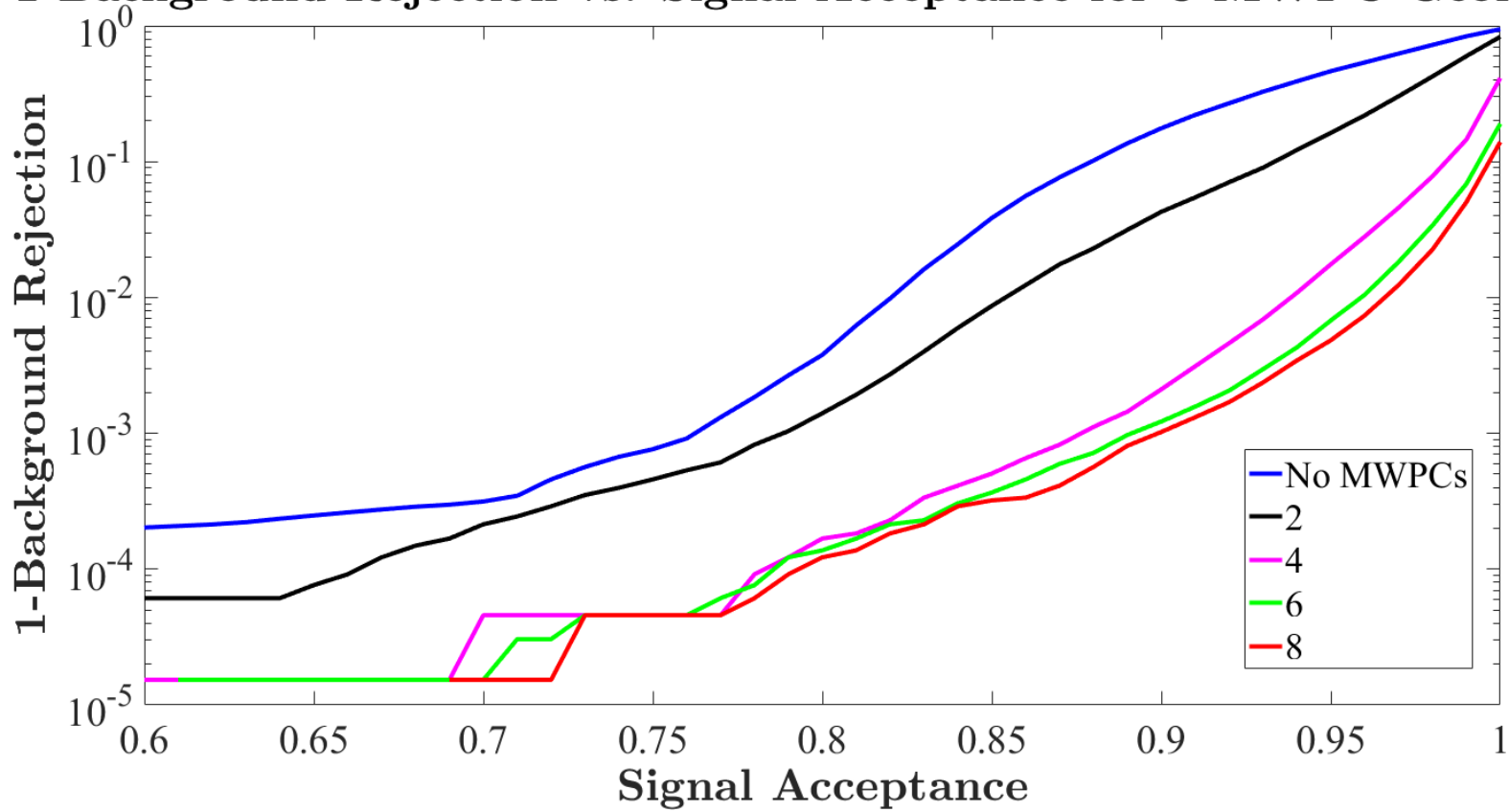
8 MWPCs is best – agrees with result from last summer

1-Background Rejection vs. Signal Acceptance for 2 MWPC Geometry

Compare purple and black curves – is the first MWPC (infront of all iron) necessary?

1-Background Rejection vs. Signal Acceptance Comparing Geometries

Signal Acceptance

1-Background Rejection

— 2 MWPCs, 140 cm Iron Total
— 2 MWPCs, 20 cm Iron Total
— 8 MWPCs, 140 cm Iron Total
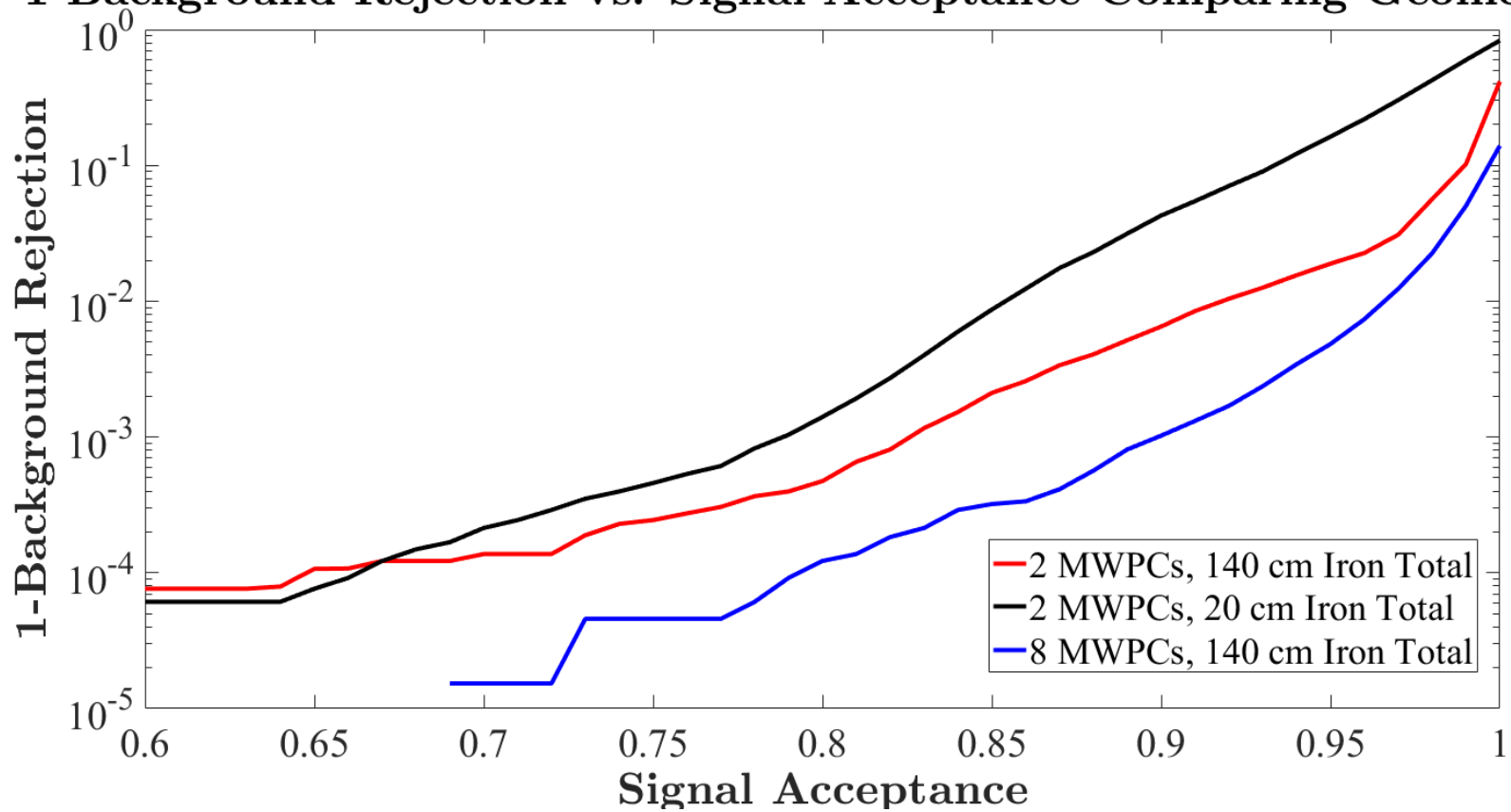
Tenative conclusions based off last plot:

- More Iron is better (compare red and black curves)
- More detectors are better (red and blue curves)

Caveats: These simulation runs did NOT have any noise and did NOT have any angular cuts

# Additional Simulation Information

The MVA outputs importance of variables. Its not exactly clear what these mean, maybe David has an idea, but I include them in the tables below.

| Ranking input variables (method unspecific) |
| --- |
| 1 : Nfmwpc8 : 7.633e-01 |
| 2 : Nfmwpc7 : 7.615e-01 |
| 3 : Nfmwpc6 : 7.521e-01 |
| 4 : Nfmwpc5 : 7.308e-01 |
| 5 : Nfmwpc4 : 6.780e-01 |
| 6 : Nfcal_hits : 6.767e-01 |
| 7 : Nfmwpc : 6.327e-01 |
| 8 : Nfcal_clusters : 6.172e-01 |
| 9 : Nfmwpc3 : 5.742e-01 |
| 10 : Efcal_clusters : 5.689e-01 |
| 11 : Nfmwpc2 : 4.142e-01 |
| 12 : Ntof : 3.498e-01 |
| --- 13 : Nfmwpc1 : 2.504e-01 |
| --- 14 : Ntracks : 1.031e-02 |

| Ranking input variables (method specific)...--- BDT |
| --- |
| 1 : Nfcal_hits : 1.470e-01 |
| 2 : Nfmwpc8 : 8.129e-02 |
| -3 : Ntof : 7.915e-02 |
| -4 : Nfmwpc : 7.715e-02 |
| 5 : Nfmwpc3 : 7.458e-02 |
| 6 : Nfmwpc2 : 7.154e-02 |
| 7 : Efcal_clusters : 7.131e-02 |
| 8 : Nfmwpc5 : 7.058e-02 |
| 9 : Nfmwpc4 : 6.865e-02 |
| 10 : Nfmwpc1 : 6.703e-02 |
| 11 : Nfcal_clusters : 5.856e-02 |
| 12 : Nfmwpc6 : 5.469e-02 |
| 13 : Nfmwpc7 : 4.780e-02 |
| 14 : Ntracks : 3.071e-02 |

# MVA also outputs input variable separation plots. Not clear if these are helpful.
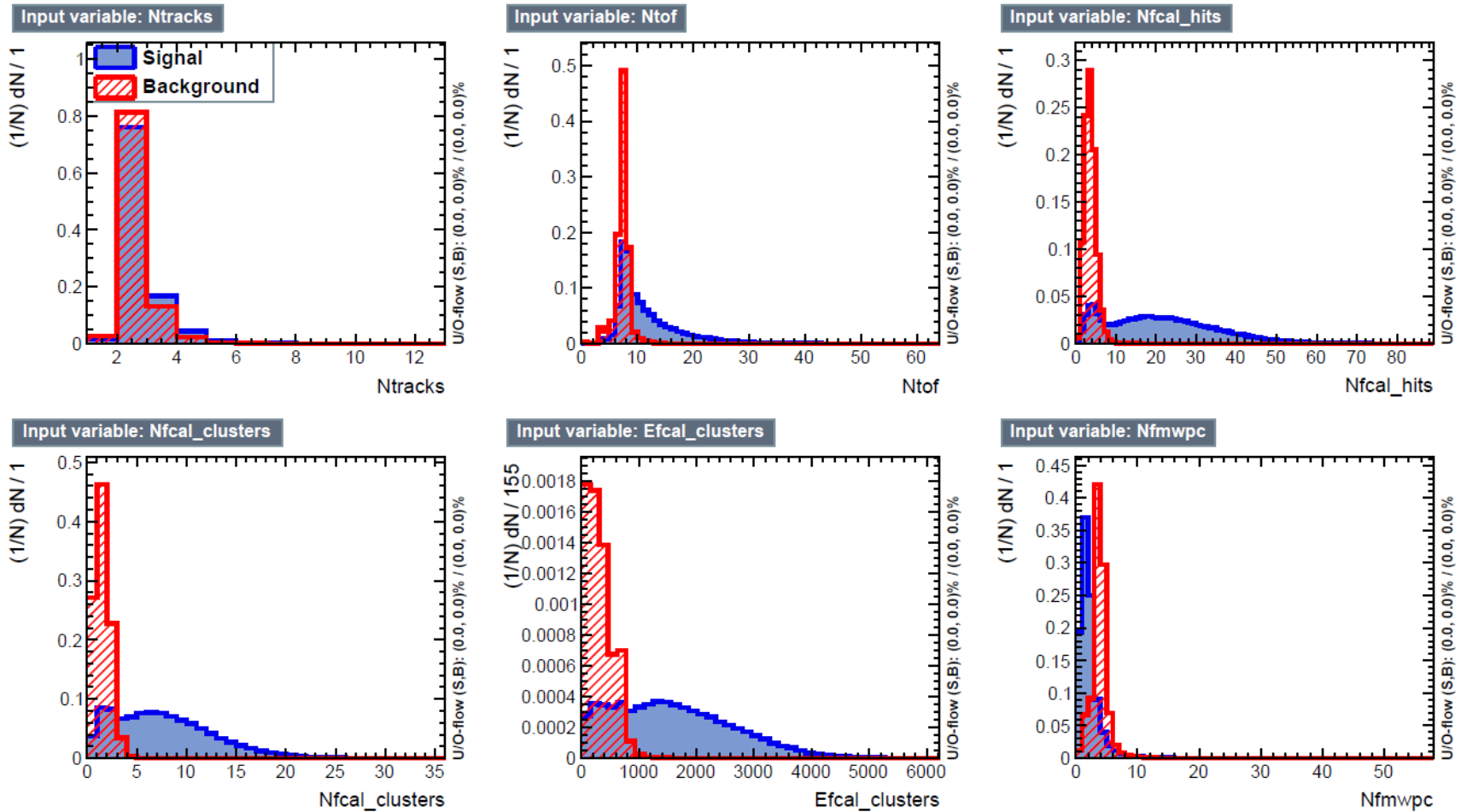
# Proposed next steps

❖     Bobby gone for next 1.5 weeks, available through email
❖     Could run simulation if enough familiarity with programs, else wait for JLab or Bobby
❖     Nick/Andrew could write up .xml files for desired simulation geometries (7 geometries from Prof. Miskimen and 1 from David – next page shows these for reference)

MWPC    140 cm iron    MWPC

Integrated Num. charged particles

message 3     message 2     May 29, 2017 DL
git revision #2a0d897
message 1

message 4

Integrated Num. charged particles

Z-lab (cm)