KaonLTMeeting

February 15th, 2024

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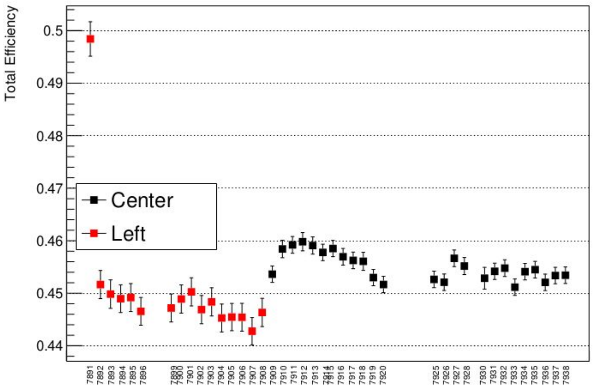
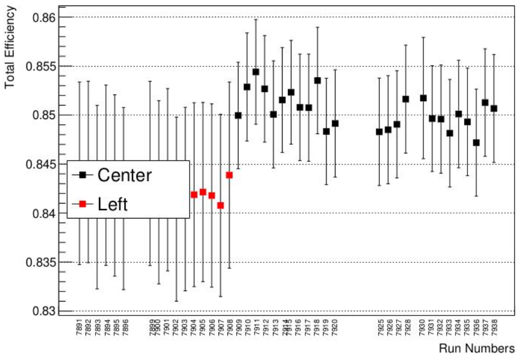
Overview

1. **Updated efficiencies**
2. **Fixed issue with average ratio**
3. **Properly Calculated Statistical Uncertainties**
4. **SIMC Aerogel/HGCer geometric cuts**
5. **Particle Subtraction Script**
6. **Beginning Unsep-xsect Systematic Studies**
7. **Continued issues with generating new parameterization**

1) Updated efficiencies

- Efficiencies were there, just needed to fix HMS Cerenkov+Calorimeter efficiencies
  - Were being calculated run-by-run
  - Can't do this because of contamination
  - Need "golden singles run" to determine contamination-free efficiency
  - See Ali's previous slides on the topic





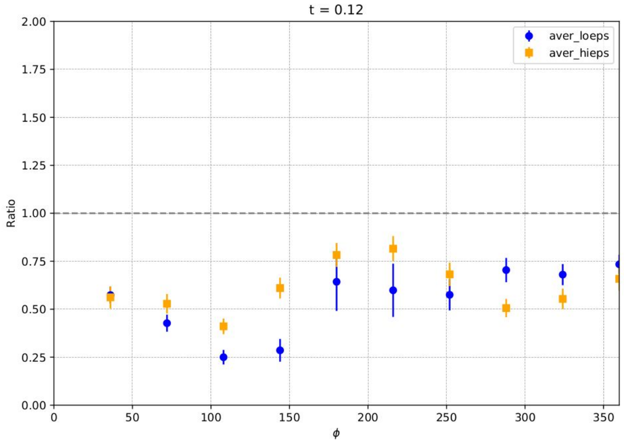
Q^2=2.115
Low eps

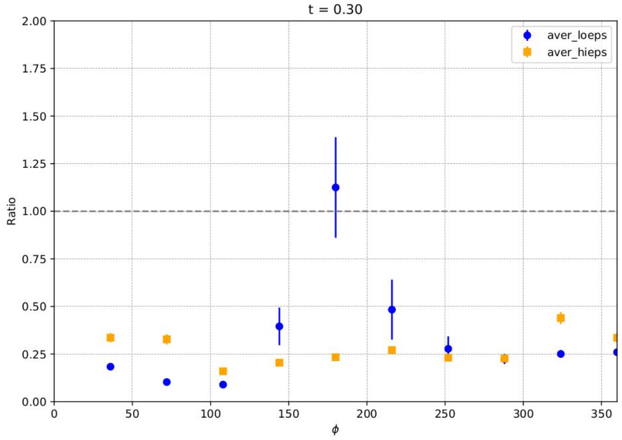
```
##############
# HARD CODED #
##############

# Find HMS Cherenkov efficiency and error based off golden singles run (6603) without contamination
# See https://redmine.jlab.org/attachments/download/1758/KaonLT_Meeting_Feb_23.pdf for more info
hcer_eff = 0.9730
hcer_eff_error = 0.0006

# Find HMS Calorimeter efficiency and error based off golden run ( ) without contamination
# See https://redmine.jlab.org/attachments/download/1758/KaonLT_Meeting_Feb_23.pdf for more info
hcal_eff = 0.9961
hcal_eff_error = 0.0005

##############
##############
##############
```

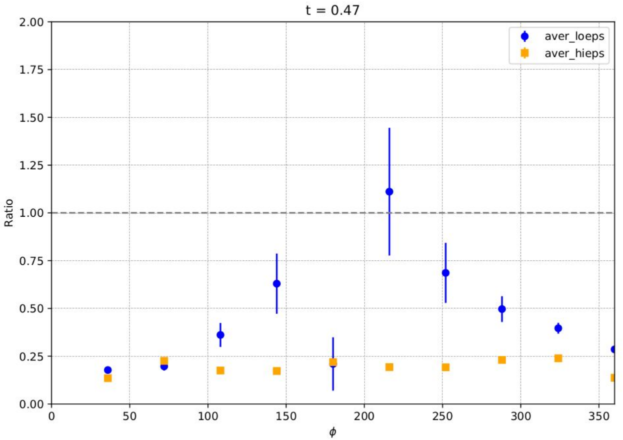
2) Fixed issue with average ratio

Q^2=2.115

- Bug in the code was over-writing ratio values with just the ones calculated by the center setting
- Re-introduced average_ratio.f script to properly find average ratio per bin



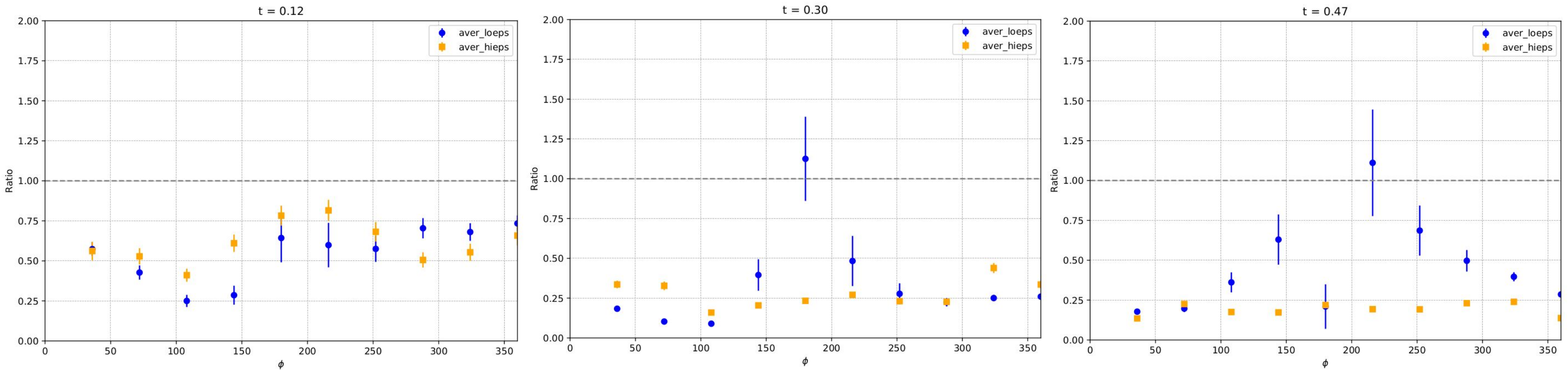




3) Properly Calculated Statistical Uncertainties

Q^2=2.115

- Ali and I went through and properly implemented statistical uncertainties (double-checked with Garth on Monday)
- Q2=2.115, □R_bin~(5-10%)
  - □Y_data_bin~□Y_simc_bin
  - 500k simc events
  - Something seems off…

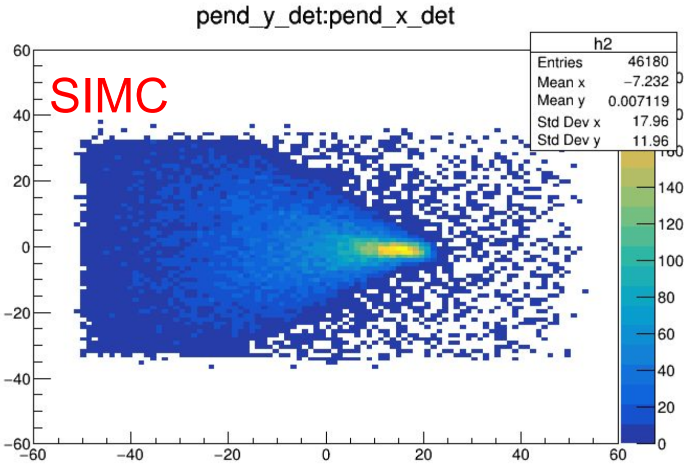


4) SIMC Aerogel/HGCer geometric cuts

Q^2=3.0
W=3.14

- Introduced aerogel tray and HGCer hole geometric cuts into simc
- Aerogel tray applied in recon_hcana while HGCer hole is applied in lt_analysis
  - Done this way to stay consistent with how it is done in data

```
/**********************
 **** SHMS AEROGEL ****
 **********************/
paero_z_det = 231.0; // Front? of SHMS aerogel (units of cm), see PARAM/SHMS/AERO/KaonLT_PARAM/paero_geom.param
paero_x_det = ssxfp + paero_z_det*ssxpfp;
paero_y_det = ssyfp + paero_z_det*ssypfp;

if (
    (InSIMCFilename.Contains("Q4p4W2p74")) || // High and low epsilon
    (InSIMCFilename.Contains("Q3p0W3p14")) || // High and low epsilon
    (InSIMCFilename.Contains("Q5p5W3p02"))    // High and low epsilon
    ){

  // SHMS Aero Geom for n = 1.011 (DEF-files/PRODUCTION/KaonLT_DEF/Paero_1p011/Offline_Physics_Coin_Cuts.def)
  // shmsAeroxposAll    P.aero.xAtAero > -45 && P.aero.xAtAero < 45
  // shmsAeroyposAll          P.aero.yAtAero > -30 && P.aero.yAtAero < 30
  paero_tray_cut = (paero_x_det > -45.0) & (paero_x_det < 45.0) & (paero_y_det > -30) & (paero_y_det < 30);

}else{

  // SHMS Aero Geom for n = All except 1.011 (see DEF-files/PRODUCTION/KaonLT_DEF/Offline_Physics_Coin_Cuts.def)
  // shmsAeroxposAll    P.aero.xAtAero > -55 && P.aero.xAtAero < 55
  // shmsAeroyposAll          P.aero.yAtAero > -50 && P.aero.yAtAero < 50
  paero_tray_cut = (paero_x_det > -55.0) & (paero_x_det < 55.0) & (paero_y_det > -50) & (paero_y_det < 50);

}

/**********************
 **** SHMS HGCer ****
 **********************/
// HGCer Hole cut is now defined in lt_analysis script to be consistent with data procedure.
// These variables are used to apply such cut.
phgcer_z_det = 156.27; // Front? of SHMS HGcer (units of cm), see PARAM/SHMS/HGCER/KaonLT_PARAM/phgcer_geom.param
phgcer_x_det = ssxfp + phgcer_z_det*ssxpfp;
phgcer_y_det = ssyfp + phgcer_z_det*ssypfp;
```



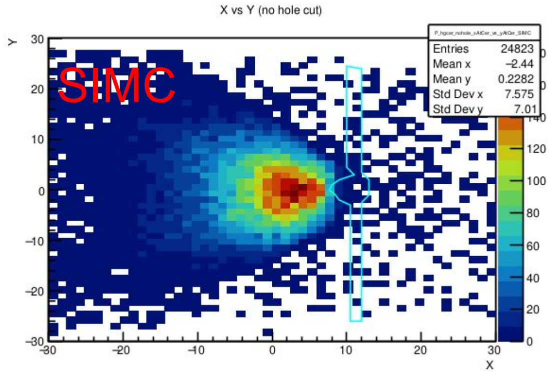
4) SIMC Aerogel/HGCer geometric cuts

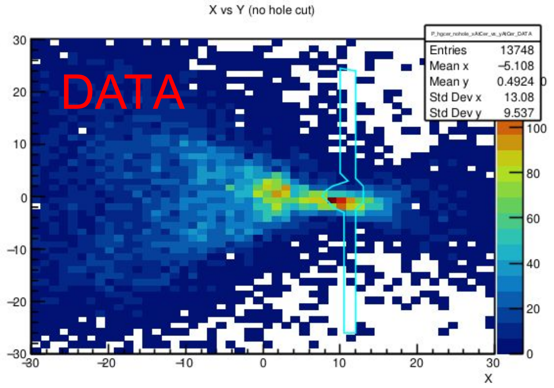
Q^2=3.0
W=3.14

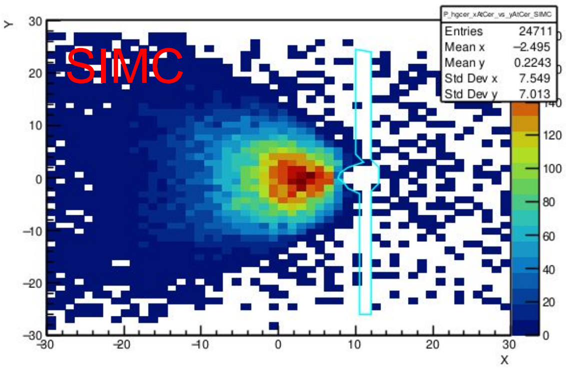
- Introduced aerogel tray and HGCer hole geometric cuts into simc
- Aerogel tray applied in recon_hcana while HGCer hole is applied in lt_analysis
  - Done this way to stay consistent with how it is done in data

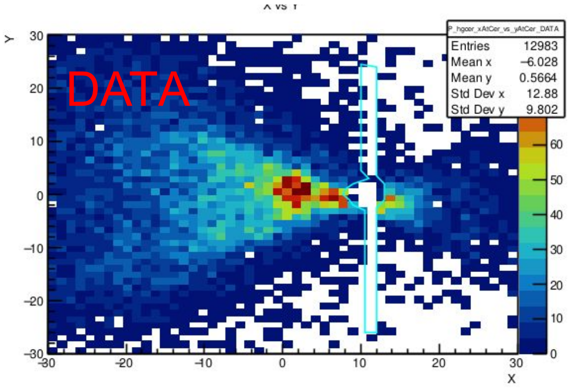
```
##############################################################
# Define HGCer hole cut for KaonLT 2018-19
if ParticleType == "kaon":
    from hgcer_hole import apply_HGCer_hole_cut
    hgcer_cutg = apply_HGCer_hole_cut(Q2, W, EPSSET)
```

```
def apply_HGCer_hole_cut(Q2, W, EPSSET, simc=False):

    # Defined HGCer Geometric cuts
    cutg = TCutG("cutg",21)
    cutg.SetVarX("P_hgcer_xAtCer")
    cutg.SetVarY("P_hgcer_yAtCer")
    cutg.SetPoint(0, 2+10, -25-1)
    cutg.SetPoint(1, 2+10, -2-1)
    cutg.SetPoint(2, 2+10, -1.5-1)
    cutg.SetPoint(3, 3+10, 0-1)
    cutg.SetPoint(4, 3+10, 1-1)
    cutg.SetPoint(5, 3+10, 2.3-1)
    cutg.SetPoint(6, 3+10, 3.0-1)
    cutg.SetPoint(7, 2+10, 4.5-1)
    cutg.SetPoint(8, 2+10, 5-1)
    cutg.SetPoint(9, 2+10, 25-1)
    cutg.SetPoint(10, 0+10, 25.5-1)
    cutg.SetPoint(11, 0+10, 5.5-1)
    cutg.SetPoint(12, 1+10, 4-1)
    cutg.SetPoint(13, -1+10, 3-1)
    cutg.SetPoint(14, -2+10, 2-1)
    cutg.SetPoint(15, -2.3+10, 1-1)
    cutg.SetPoint(16, -1.5+10, 0-1)
    cutg.SetPoint(17, -1+10, -1-1)
    cutg.SetPoint(18, 0.5+10, -2-1)
    cutg.SetPoint(19, 0.5+10, -25-1)
    cutg.SetPoint(20, 2+10, -25-1)
```





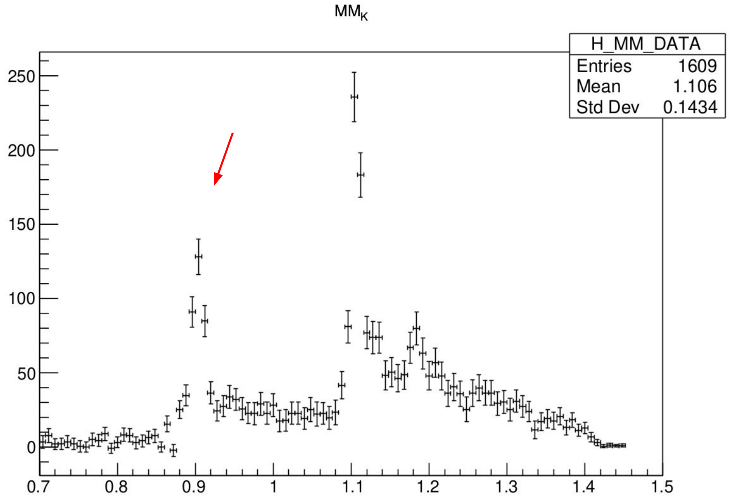




5) Particle Subtraction Script

Q^2=2.115
High eps
Right

- Stream-lined my particle subtraction part of the script a bit
  - I tore it out originally because it was hard coded and used pion data rather than simc
- I need to give Ali my updated recon_hcana script so he can send me some pion samples




```python
# Pion subtraction by scaling simc to peak size
if ParticleType == "kaon":
    from particle_subtraction import particle_subtraction
    SubtractedParticle = "pion"
    H_MM_SUB_SIMC  = TH1D("H_MM_SUB_SIMC","MM_{}".format(SubtractedParticle), 100, 0.7, 1.5)
    particle_subtraction(H_MM_SUB_SIMC, hgcer_cutg, inpDict, phi_setting, SubtractedParticle, scale_factor=1e-3)
    #H_MM_DATA.Add(H_MM_SUB_SIMC,-1)
    histDict["H_MM_SUB_SIMC"] =  H_MM_SUB_SIMC
```

6) Beginning Unsep-xsect Systematic Studies

- Concentrating on pt-to-pt (dsig_random) first
  - Vary cuts/kinematics in SIMC and see how xsects changes
- □acceptance
  - Vary acceptance cuts
- □PID
  - Compare high and low eps hole cut
- □tracking
  - Ali's studies comparing tracking methods
  - Compare to previous tracking (e.g. Carlos Yero's thesis)
- □kinematics
  - Vary angle, momentum, energy
- □MC
  - Vary model
- □radiative
  - SIMC with and without radiative flag

Source	pt-to-pt	t-correlated	scale
Acceptance	0.4	0.4	1.0
PID		0.4	0.5
Coincidence Blocking		0.2	
Tracking efficiency	0.1	0.1	1.5
Charge		0.2	0.5
Target thickness		0.2	0.8
Kinematics	0.4	1.0	
Kaon Absorption		0.5	0.5
Kaon Decay		1.0	3.0
Radiative Corrections	0.1	0.4	2.0
Monte Carlo Model	0.2	1.0	0.5
Total	0.6	2.0	4.2

(TH p199) $d\sigma = \sqrt{d\sigma_{stat}^2 + d\sigma_{random}^2}$

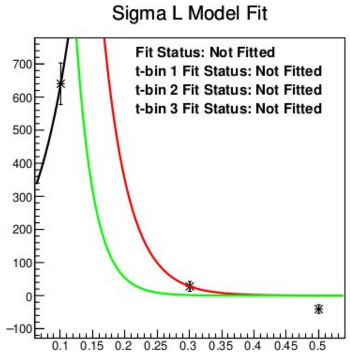
↳ QE

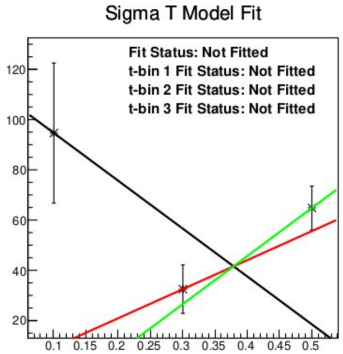
↳ systematic (pt-to-pt)

Previous slides

7) Continued issues with generating new parameterization

- Unsep xsect fits are starting to look good
- But the script to generate improved parameterization generates insane fits
- Likely a change to the model is needed
  - In particular, sigT will need adjustments





Q^2=2.115