

# Aerogel Correction 3

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- Not formally an efficiency as the cut applied on the AGC demands no signal
- The aerogel has an “efficiency” in that some good proton events will Cherenkov due to knock-on electrons
- Now calling this the “knock-on correction”
- Using standard efficiency approach,  $\epsilon_{AGC} = N_{did} / N_{should}$
- Use Heep Coin data for clean proton sample

```
Should = abs(CTime.epCoinTime_ROC1)<2  
&& abs(P.kin.secondary.emiss)<0.05  
&& P.kin.secondary.pmiss<0.05  
&& H.cal.etottracknorm>0.8 && H.cer.npeSum>5  
&& P.hgcer.npeSum<0.05
```

```
Did = Should && P.aero.npeSum<4
```



$E_B$	$p_{SHMS}$	$n_{AGC}$
KaonLT Heep Coin		
10.6	4.84	1.011
8.2	4.67	1.011
6.2	3.49	1.011
4.9	2.58	1.030
3.8	2.58	1.030
PionLT Heep Coin		
9.2	5.02	1.011
7.9	5.51	1.011
9.2	6.27	1.011

- Add low  $Q^2$  Heep Coin from KaonLT
  - Add high  $p_{SHMS}$  Heep Coin from PionLT
- Momentum range now brackets physics data
- Different aerogel trays
  - Assume interaction probability  $1 - \epsilon$  scales linearly with density  $\rho \propto n - 1$

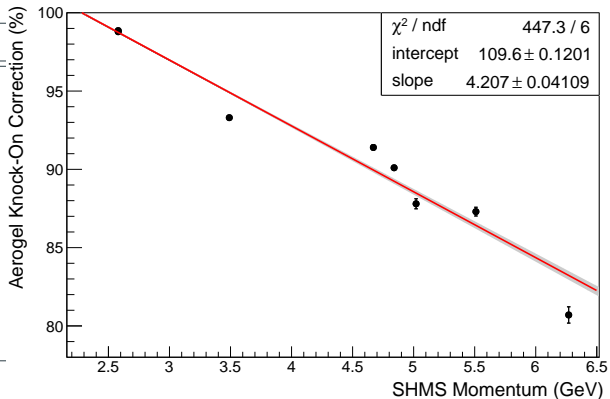
$$\frac{1 - \epsilon_1}{n_1 - 1} = \frac{1 - \epsilon_2}{n_2 - 1}$$



$$\epsilon = \frac{N_{did}}{N_{should}}$$

$$\Delta\epsilon = \epsilon \sqrt{\frac{1}{N_{did}} - \frac{1}{N_{should}}}$$

<i>PSHMS</i>	$\epsilon_{AGC}$
2.58	$98.8 \pm 0.04 \%$
2.58	$98.9 \pm 0.03 \%$
3.49	$93.3 \pm 0.09 \%$
4.67	$91.4 \pm 0.2 \%$
4.84	$90.1 \pm 0.2 \%$
5.02	$87.8 \pm 0.3 \%$
5.51	$87.3 \pm 0.3 \%$
6.27	$80.7 \pm 0.5 \%$

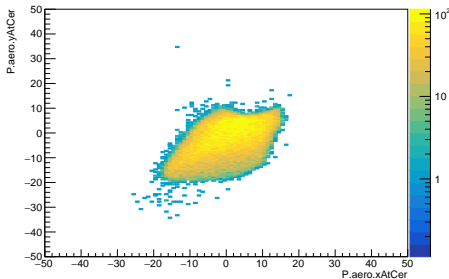


Using binomial errors  $\rightarrow$  visually too small for scatter of points  
 $\rightarrow$  implies source of systematic uncertainty

- Heep Coin does not illuminate the entire AGC tray
- Aerogel surface is not completely uniform
- Investigate SHMS  $\delta$ ,  $xy$  coordinates at aerogel

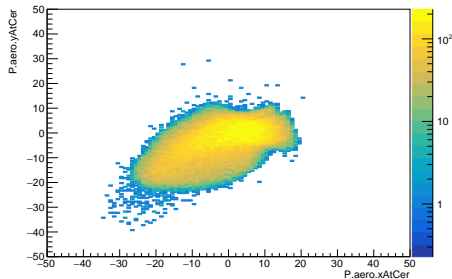
$$p_{SHMS} = 2.58$$

HeepCoin\_3p8\_Autumn18



$$p_{SHMS} = 4.84$$

HeepCoin\_10p6\_Autumn18



# Linear Fit: Ad-Hoc Systematic Uncertainty



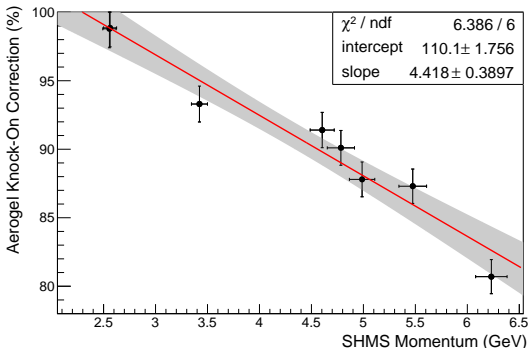
Add a systematic on an ad-hoc basis: % error necessary for  $\chi^2/\text{NDF} \sim 1$

$$\epsilon = \frac{N_{\text{did}}}{N_{\text{should}}} \quad \Delta\epsilon_{\text{STAT}} = \epsilon \sqrt{\frac{1}{N_{\text{did}}} - \frac{1}{N_{\text{should}}}} \quad \Delta\epsilon = \sqrt{\Delta\epsilon_{\text{STAT}}^2 + (0.014\epsilon)^2}$$

$$p_{\text{SHMS}} = p_{\text{CENTRAL}} * \langle \delta_{\text{SHMS}} \rangle$$

$$\Delta p_{\text{SHMS}} = p_{\text{SHMS}} * \text{RMS}(\delta_{\text{SHMS}}) / 100$$

$p_{\text{SHMS}}$ (GeV)	$\epsilon_{\text{AGC}}$
$2.56 \pm 0.06$	$98.8 \pm 1.4 \%$
$2.56 \pm 0.06$	$98.9 \pm 1.4 \%$
$3.42 \pm 0.08$	$93.3 \pm 1.4 \%$
$4.60 \pm 0.11$	$91.4 \pm 1.3 \%$
$4.78 \pm 0.13$	$90.1 \pm 1.3 \%$
$4.99 \pm 0.12$	$87.8 \pm 1.3 \%$
$5.47 \pm 0.13$	$87.3 \pm 1.3 \%$
$6.23 \pm 0.15$	$80.7 \pm 1.2 \%$

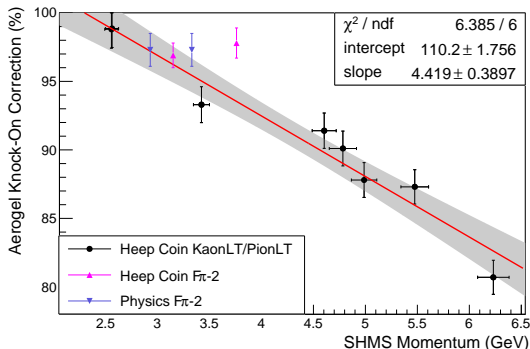


# Compare with $F\pi-2$



- Two Heep Coin settings investigated, average of both efficiency measurements applied to data
- Error estimation seems to assume  $N_{did}$ ,  $N_{should}$  uncorrelated
- Table: exact values from Bill's thesis
- Plot: scaled from  $n=1.03$  (HMS ACD) to  $n=1.011$  (SHMS AGC)

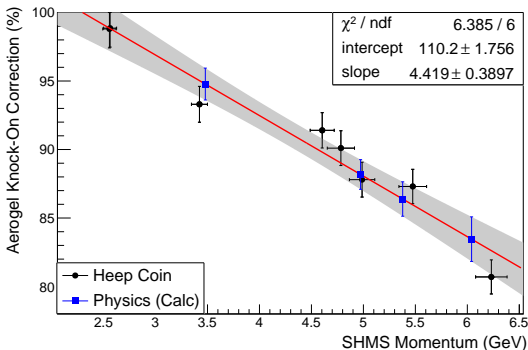
$PHMS$	$\epsilon_{ACD}$
Heep Coin	
3.15	$91.5 \pm 0.9 \%$
3.76	$94.0 \pm 1.1 \%$
Physics	
2.93	$92.7 \pm 1.2 \%$
3.33	$92.7 \pm 1.2 \%$



# Corrections for Data



- Calculated from the linear fit to the Heep Coin results
- Uncertainties from the confidence interval
- Scaled to appropriate index of refraction
- Expect slight modifications if offsets change



$(Q^2, W)$	$p_{SHMS}$	$n_{AGC}$	$\epsilon_{AGC}$ (%)
(3.0, 3.14)	6.04	1.011	83.4 $\pm$ 1.6
(3.0, 2.32)	3.48	1.015	92.8 $\pm$ 1.6
(2.1, 2.95)	4.97	1.015	83.8 $\pm$ 1.6
(4.4, 2.74)	5.38	1.011	86.3 $\pm$ 1.3



Goal: nice results for Hall A/C Collaboration Meeting June 17-18

- Add AGC correction to effective charge calculation\*
- Determine HGC, RF cut corrections
- Verify flat rate-dependence of KaonLT data (boiling + coin blocking)
- Set up binned kinematics for LTSEP framework\*
- Run a few iterations\*
- Make draft slides\*

I will be away the week of June 8-12 → Hall A/C presentation to be (mostly) ready June 5