

# Weekly Updates On nu e Meeting

## Flux Parameters Fitting & Error Band & Flux High Energy Tail Fitting

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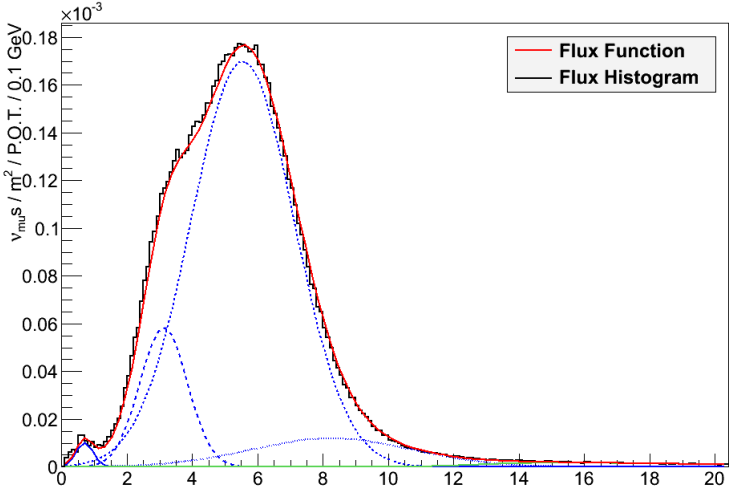
Hampton University

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# Flux Function with Components

## Flux Histogram and Flux Function



## 5 Pars Fitting

Fitting range (0-20 GeV on the Ke Genie data), which is respect to the main part of the flux ( Gaus 1 and Gaus 2), fix the tail( Gaus 3 and Landau).

New and old Fitted result, difference in the fitting code:

- ▶ Use true values as start parameter
- ▶ Use smaller step sizes especially for pars with big error, a2 and s2 (step sizes are 0.05% of the true values, others are 0.1%)
- ▶ remove all the bounds
- ▶ increase minimization steps: `arglist[0] = 20000` → 30000

Fitted Values : old/new

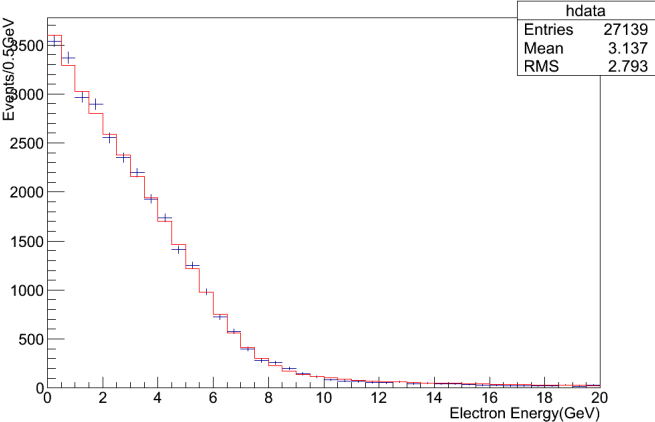
Par	p0(a1)	p1(m1)	p2(s1)	p3(a2)
True	1.70e-4	5.53672	1.58104	5.84246e-5
Fitted	1.751e-4/1.718e-4	5.303/5.418	1.631/1.573	2.961e-5/4.040e-5
Error	0.876e-4/0.046e-4	0.722/0.148	0.645/0.046	7.109e-5/0.921e-5
Par	p4(m2)	p5(s2)	p6(a3)	p7(m3)
True	3.11705e+00	7.28272e-1	1.20244e-05	8.25820e+00
Fitted	fixed	8.087e-1/9.913e-1	fixed	fixed
Error	-	6.679e-1/3.486e-1	-	-
Par	p8(s3)	p9(L1)	p10(L2)	p11(L3)
True	2.46943e+00	9.70000e-06	1.60000e+01	2.18393e+00
Par	a0	m0	s0	
Value	1.01635e-5	6.96276e-1	2.65576e-1	

red numbers – parameters need to be fitted

blue numbers – fixed parameters

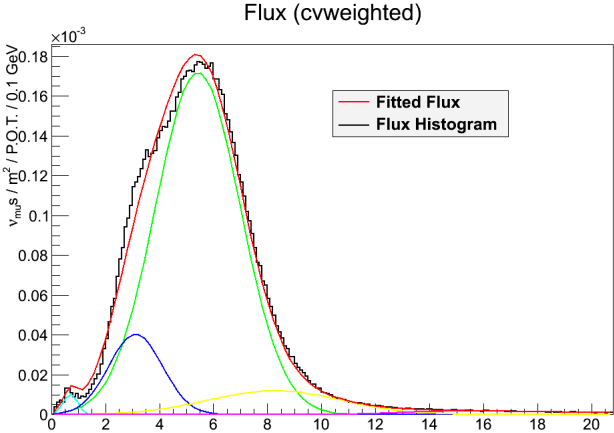
# Ke Fitting Plot and Chi-Squared

5 Pars Fitting



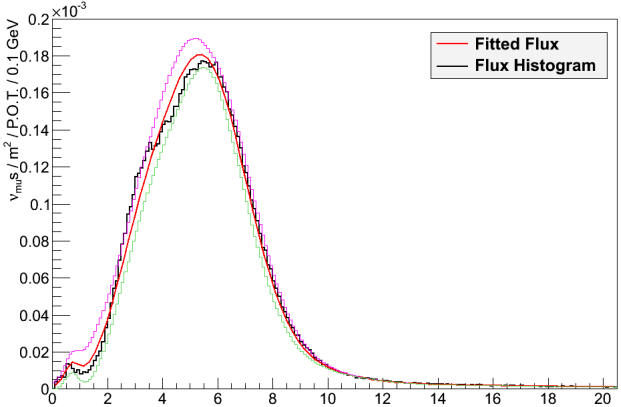
$$\chi^2 = 2.3058$$

# Flux Result Plot with Components

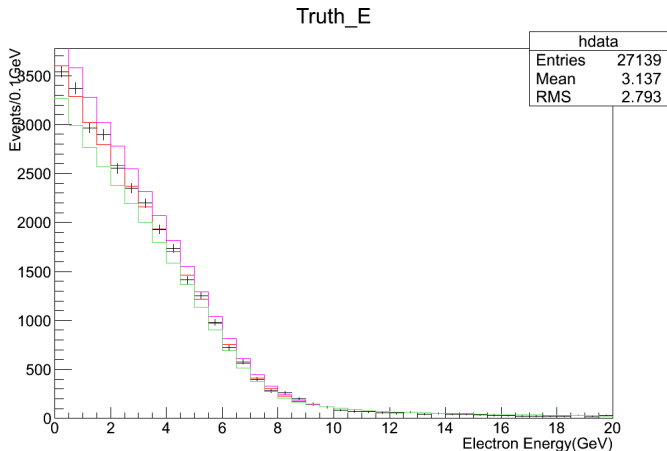


# Flux Result Error Band

with error band "up" and "down"  
Flux (cvweighted)



# Fitted Ke and Chi<sup>2</sup> check



higher limit ke & Genie data:  $\chi^2=6.49$

lower limit ke & Genie data:  $\chi^2=6.94$

Fitted ke & Genie data:  $\chi^2=2.032$

$\chi^2$  change is not 1



## High Energy Tail Normalization

Use the tail(20-50 GeV) of the electron energy data to constrain the flux high energy tail(20-50 GeV).

In the prediction(flux histogram):

take the ratio flux->Integral(20,50)/Ke data -> Integral(20,50)

$$R = \frac{\text{FluxHistIntegral}(20 - 50 \text{ GeV})}{\text{KePredictionIntegral}(20 - 50 \text{ GeV})} = \frac{8.0147e - 6}{326}$$

In the ke fitting code, 20-50 tail integral of the ke data should be equal to the fitted ke:

$$R = \frac{\text{FluxFunctionIntegral}(20 - 50 \text{ GeV})}{\text{KeDataIntegral}(20 - 50 \text{ GeV})} = \frac{\text{FluxFunctionIntegral}(20 - 50 \text{ GeV})}{322}$$

## Fitting the Scaling Par of the tail

p6 is the parameter got fitted.

Par	p0(a1)	p1(m1)	p2(s1)	p3(a2)
True	1.70e-04	5.53672e+00	1.58104e+00	5.84246e-05
Fitted	1.718e-4	5.418	1.573	4.040e-5
Error	0.046e-4	0.148	0.046	0.921e-5
Par	p4(m2)	p5(s2)	p6(a3)	p7(m3)
True	3.11705e+00	7.28272e-01	1.20244e-05	8.25820e+00
Fitted	fixed	9.913e-1	1.182e-05	fixed
Error	-	3.486e-1	?	-
Par	p8(s3)	p9(L1)	p10(L2)	p11(L3)
True	2.46943e+00	$\frac{9.70000e-06}{p6} \times p6$	1.60000e+01	2.18393e+00
Fitted	fixed	combined with p6	fixed	fixed
Error	-	-	-	-
Par	a0	m0	s0	
Value	1.01635e-5	6.96276e-1	2.65576e-1	

# New Fitting Error Matrix

## 5 Pars Fitting Covirence Matrix

$2.16397e-11$	$-1.1914e-07$	$-3.95438e-08$	$-5.42644e-12$	$-2.71982e-07$
$-1.1914e-07$	0.0219322	$-0.00064736$	$2.51874e-07$	$-0.0129567$
$-3.95438e-08$	$-0.00064736$	0.00208096	$-3.67598e-08$	0.00313972
$-5.42644e-12$	$2.51874e-07$	$-3.67598e-08$	$8.48998e-11$	$2.71836e-08$
$-2.71982e-07$	$-0.0129567$	0.00313972	$2.71836e-08$	0.121527

# 5 Pars Fitting Screen Message

```
File Edit View Search Terminal Help
chi^2=2.03059
Warning ln <Tfile::Append>: Replacing existing TH1: hepx (Potential memory leak).
chi^2=2.03058
MIGRAD MINIMIZATION HAS CONVERGED.
FCN=2.03058 FROM MIGRAD STATUS=CONVERGED 258 CALLS 259 TOTAL
EDM=3.30436e-05 STRATEGY= 1 ERROR MATRIX UNCERTAINTY 100.0 per cent

EXT PARAMETER
NO. NAME VALUE ERROR STEP FIRST
SIZE DERIVATIVE
1 a1 1.71840e-04 4.65185e-06 1.26700e-08 4.35780e+02
2 m1 5.41840e+00 1.48095e-01 6.56296e-05 -4.41899e-03
3 s1 1.57300e+00 4.56175e-02 7.90711e-05 -1.87693e-01
4 a2 4.04029e-05 9.21411e-06 1.92982e-08 3.54076e+02
5 s2 9.91322e-01 3.48607e-01 7.12163e-04 8.92693e-03

EXTERNAL ERROR MATRIX. NDIM= 25 NPAR= 5 ERR DEF=1
2.164e-11 -1.191e-07 -3.954e-08 -5.426e-12 -2.720e-07
-1.191e-07 2.193e-02 -6.474e-04 2.519e-07 -1.296e-02
-3.954e-08 -6.474e-04 2.081e-03 -3.676e-08 3.140e-03
-5.426e-12 2.519e-07 -3.676e-08 8.490e-11 2.718e-08
-2.720e-07 -1.296e-02 3.140e-03 2.718e-08 1.215e-01

PARAMETER CORRELATION COEFFICIENTS
NO. GLOBAL 1 2 3 4 5
1 0.33929 1.000 -0.173 -0.186 -0.127 -0.168
2 0.37483 -0.173 1.000 -0.096 0.185 -0.251
3 0.28235 -0.186 -0.096 1.000 -0.087 0.197
4 0.23288 -0.127 0.185 -0.087 1.000 0.008
5 0.35890 -0.168 -0.251 0.197 0.008 1.000

par: 0.00017184, par error: 4.65185e-06
par: 5.4184, par error: 0.148095
par: 1.573, par error: 0.0456175
par: 4.04029e-05, par error: 9.21411e-06
par: 0.991322, par error: 0.348607
2.16397e-11 -1.1914e-07 -3.95438e-08 -5.42644e-12 -2.71982e-07
-1.1914e-07 0.0219322 -0.00064736 2.51874e-07 -0.0129567
-3.95438e-08 -0.00064736 0.00208096 -3.67598e-08 0.00313972
-5.42644e-12 2.51874e-07 -3.67598e-08 8.48998e-11 2.71836e-08
-2.71982e-07 -0.0129567 0.00313972 2.71836e-08 0.121527
root [3] .q
[wenting@mlnervagpvm03 GGLflux]$
```