Weekly Updates On nu e Meeting

Fitting Procedures Based on POT Normalization

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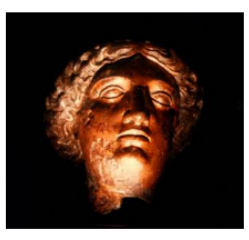


POT Normalization Final Check

Differencial Cross-section -> Total Cross-section

$$\frac{dN(T)}{dT} = Ne \times \int dE_\nu \frac{d\Phi(E_\nu)}{dE_\nu} \frac{d\sigma(T, E_\nu)}{dT}$$

where

$$\frac{d\sigma}{dT} = \frac{2G_\mu^2 m_e}{\pi E_\nu^2}[a^2 E_\nu^2 + b^2 (E_\nu - T)^2 - abm_e T]$$

$$N(E_\nu) = Ne \times \Phi(E_\nu) \times \int \frac{2G_\mu^2 m_e}{\pi E_\nu^2}[a^2 E_\nu^2 + b^2 (E_\nu - T)^2 - abm_e T]dT$$
$$= \frac{2G_\mu^2 m_e}{\pi E_\nu^2} \times E_\nu \times \Phi(E_\nu) \times Ne \left[\left(a^2 + \frac{b^2}{3}\right) - \frac{abme}{2E_\nu}\right]$$

which is consistant with total cross-section formular, please see details:

$$Ne \int \frac{d\Phi(E_\nu)}{dE_\nu} \cdots \Theta\left[a^2 E_\nu^2 + b^2 (E_\nu - T)^2 - ab\, m_e T\right]$$

$$\frac{dN(T)}{dT} = Ne \times \int \Phi(E_\nu) \left[a^2 E_\nu^2 + b^2 (E_\nu - T)^2 - ab\, m_e T\right]$$

$$= \Phi(E_\nu) Ne \int_0^{E_\nu} \left[a^2 E_\nu^2 + b^2 (E_\nu - T)^2 - ab\, m_e T\right] dT$$

$$= \Phi(E_\nu) Ne \left[a^2 E_\nu^2 T \Big|_0^{E_\nu} + b^2 E_\nu^2 T \Big|_0^{E_\nu} - b^2 2E_\nu \frac{T^2}{2} \Big|_0^{E_\nu} + b^2 \frac{T^3}{3} \Big|_0^{E_\nu} - ab\, m_e \frac{T^2}{2} \Big|_0^{E_\nu} \right]$$

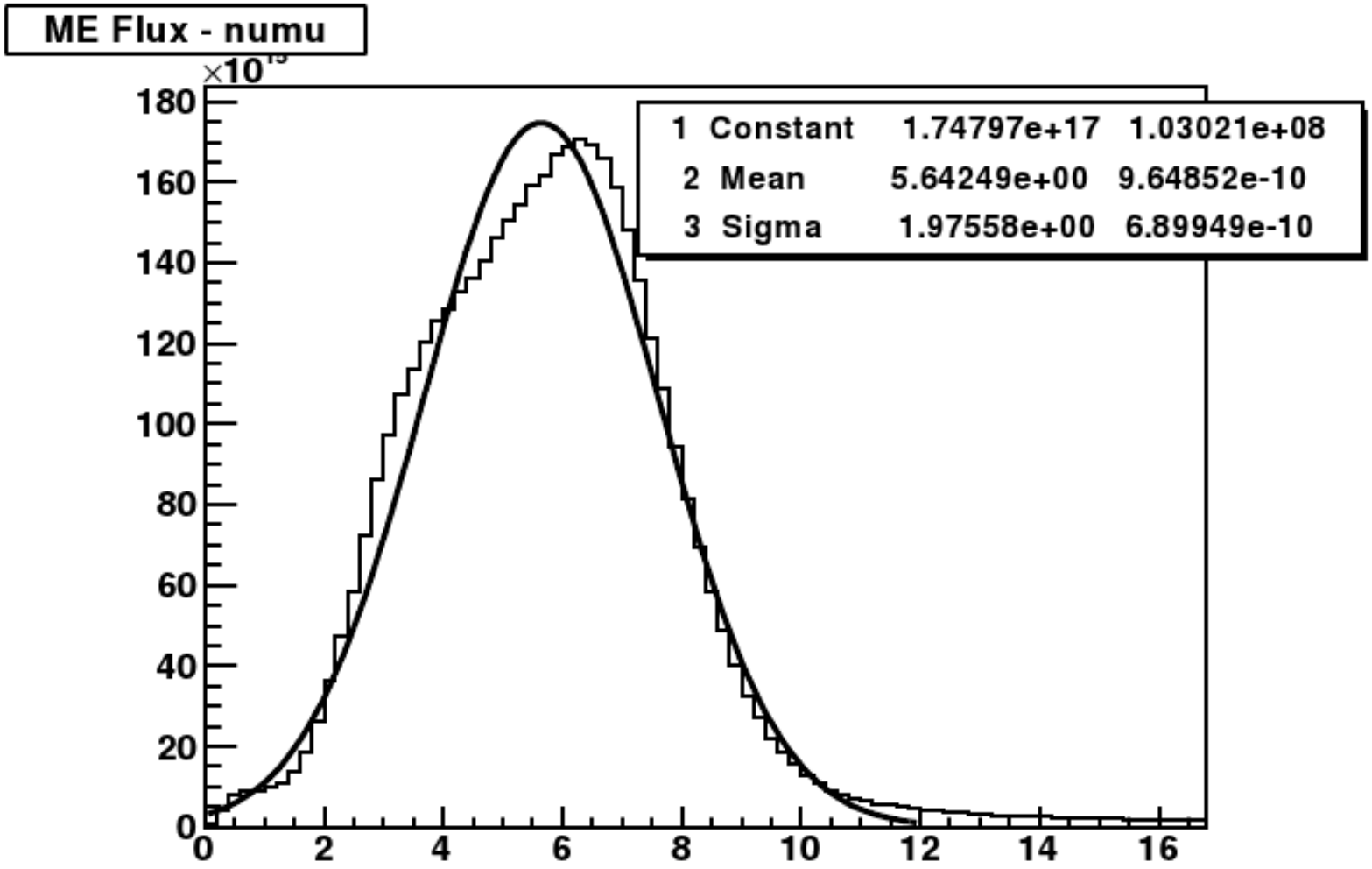
$$= \Phi(E_\nu) Ne \left[E_\nu^2 (a^2 + b^2) T \Big|_0^{E_\nu} - \left(\frac{ab\, m_e}{2} + b^2 E_\nu\right) T^2 \Big|_0^{E_\nu} + b^2 \frac{T^3}{3} \Big|_0^{E_\nu} \right]$$

$$= \Phi(E_\nu) Ne \left\{ (a^2 E_\nu^2 + b^2 E_\nu^2) E_\nu - \frac{ab\, m_e}{2} E_\nu^2 - b^2 E_\nu^3 + \frac{b^2}{3} E_\nu^3 \right.$$

$$\left. a^2 E_\nu^3 + b^2 E_\nu^3 - \frac{ab\, m_e}{2} E_\nu^2 - b^2 E_\nu^3 + \frac{b^2}{3} E_\nu^3 \right.$$

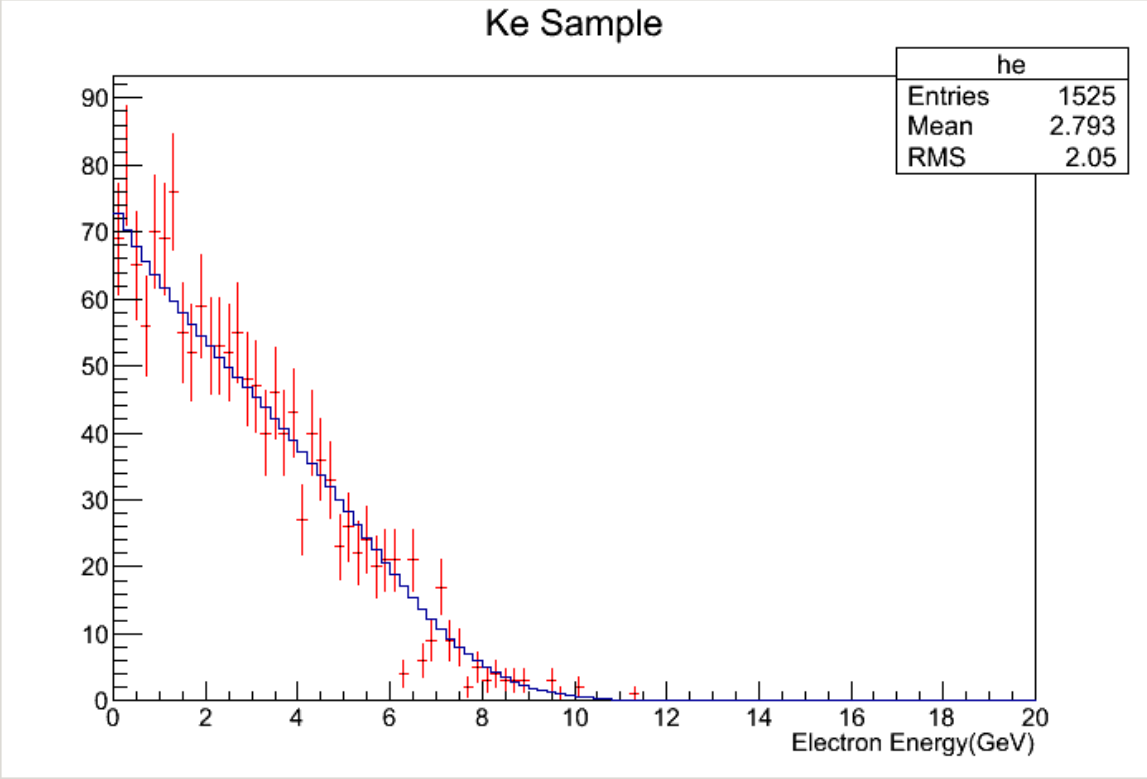
$$\frac{2G_F^2 m_e E_\nu}{\pi} \cdot \Phi(E_\nu) Ne \left[\left(a^2 + \frac{b^2}{3}\right) - \frac{ab\, m_e}{2 E_\nu} \right]$$

Fitting On Single Gaussian Flux



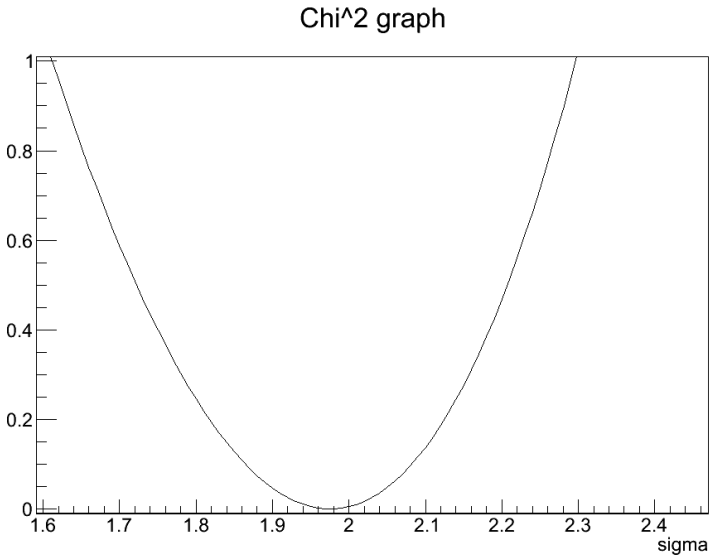
Single Gaussian, 3 parameters. For a certain POT number

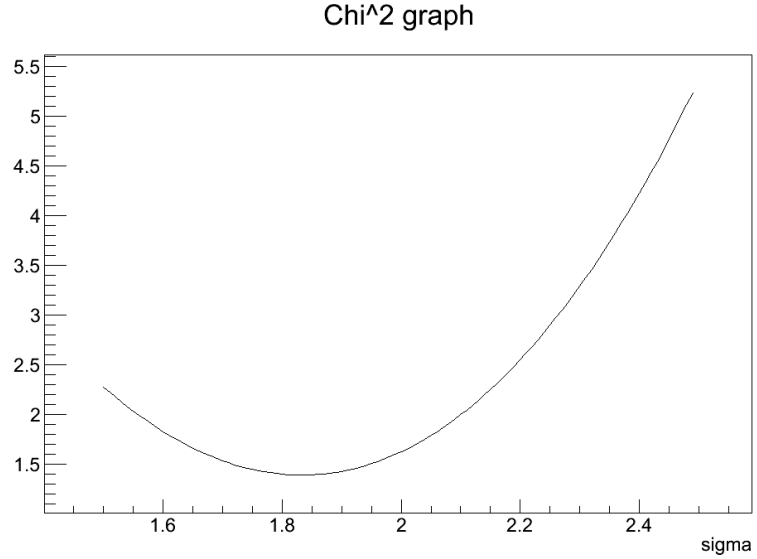
Electron Kinetic Energy Spectrum Sample



- Input Flux into model, get a smooth electron spectrum
- Randomly sample a set of sudo data based on the smooth electron spectrum
- Consider the sudo data as detected electron kinetic energy(true sigma=1.97)

Chi^2 Graphs, Manually Fitting Sigma





Fitting on Smooth Ke histogram, minimum chi^2~0,
Fitted sigma is more close to the true value 1.97

Fitting on 1 set of Gaussian Sampled ke sudo data,
Fitted sigma 1.83 has a bias to the true value 1.97

For Sudo Data, Compare TMinuit and Manual Fitting Sigma

	Fitted Parameter	Error
ManualFitting	1.83	0.32
TMinuitFitting	1.833	0.35

- the Error of ManualFitting is the amount of sigma changes when the chi^2 is changed by 1
- the Error of TMinuitFitting is the fitting error provided by TMinuit in root

Next Fitting

- Fit 9 parameters of the new flux file: MINERvA Document 8253-v1 with triple Gaussian
- Sample a set of sudo data using new numu flux, fix 8 parameters, fit one parameter manually and in TMinuit
- Sample 100 sets of sudo data using new numu flux, fix 8 parameters, fit one parameter in TMinuit for 100 samples, plot the fitted parameter(should be a gaussian distribution), get the Medium(Fitted par) and Sigma(Fitting error).