simulation update

Radiation Effect

acceptance & yields

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Last time

Issue: the elastic radiation tail

⟶ simulation compared with the Mo and Tai formula

⟶ ΔE dependence?

Include Two parts:

$$\delta = \frac{-\alpha}{\pi}\left(\tfrac{28}{9}-\tfrac{13}{6}\ln\left(\frac{-q^2}{m^2}\right)+\left(\ln\frac{-q^2}{m^2}-1+2Z\ln\eta\right)\left(2\ln\frac{E_1}{\Delta E}-3\ln\eta\right)-\Phi\left(\frac{E_3-E_1}{E_3}\right)-Z^2\ln\frac{E_4}{M}\right.$$

$$+Z^2\ln\frac{M}{\eta\Delta E}\left(\frac{1}{\beta_4}\ln\frac{1+\beta_4}{1-\beta_4}-2\right)+\frac{Z^2}{\beta_4}\left\{\tfrac{1}{2}\ln\frac{1+\beta_4}{1-\beta_4}\ln\frac{E_4+M}{2M}-\Phi\left[-\left(\frac{E_4-M}{E_4+M}\right)^{1/2}\left(\frac{1+\beta_4}{1-\beta_4}\right)^{1/2}\right]\right\}$$

$$+Z\left[\Phi\left(-\frac{M-E_3}{E_1}\right)-\Phi\left(\frac{M(M-E_3)}{2E_3E_4-ME_1}\right)+\Phi\left(\frac{2E_3(M-E_3)}{2E_3E_4-ME_1}\right)+\ln\left|\frac{2E_3E_4-ME_1}{E_1(M-2E_3)}\right|\ln\left(\frac{M}{2E_3}\right)\right]$$

$$-Z\left[\Phi\left(-\frac{E_4-E_3}{E_3}\right)-\Phi\left(\frac{M(E_4-E_3)}{2E_1E_4-ME_3}\right)+\Phi\left(\frac{2E_1(E_4-E_3)}{2E_1E_4-ME_3}\right)+\ln\left|\frac{2E_1E_4-ME_3}{E_3(M-2E_1)}\right|\ln\left(\frac{M}{2E_1}\right)\right]$$

$$-Z\left[\Phi\left(-\frac{M-E_1}{E_1}\right)-\Phi\left(\frac{M-E_1}{E_1}\right)+\Phi\left(\frac{2(M-E_1)}{M}\right)+\ln\left|\frac{M}{2E_1-M}\right|\ln\left(\frac{M}{2E_1}\right)\right]$$

$$\left.+Z\left[\Phi\left(-\frac{M-E_3}{E_3}\right)-\Phi\left(\frac{M-E_3}{E_3}\right)+\Phi\left(\frac{2(M-E_3)}{M}\right)+\ln\left|\frac{M}{2E_3-M}\right|\ln\left(\frac{M}{2E_3}\right)\right]\right)$$

$$-\frac{\alpha}{\pi}\left(-\Phi\left(\frac{E_1-E_3}{E_1}\right)+\frac{Z^2}{\beta_4}\left\{\Phi\left[\left(\frac{E_4-M}{E_4+M}\right)^{1/2}\left(\frac{1-\beta_4}{1+\beta_4}\right)^{1/2}\right]-\Phi\left[\left(\frac{E_4-M}{E_4+M}\right)^{1/2}\right]+\Phi\left[-\left(\frac{E_4-M}{E_4+M}\right)^{1/2}\right]\right\}\right).$$

$$\delta_t = -\{[b_w t_{iw}+\tfrac{1}{2}bT]\ln(E_1/\eta^2\Delta E)$$

$$+[b_w t_{fw}+\tfrac{1}{2}bT]\ln(E_3/\Delta E)\}$$

Elastic Raidiation

Include Two parts:

Vacuum + vertex

Internal Bremsstrahlung

$$\delta = \frac{-\alpha}{\pi}\left(\frac{28}{9} - \frac{13}{6} \ln\left(\frac{-q^2}{m^2}\right) + \left(\ln\frac{-q^2}{m^2} - 1 + 2Z\ln\eta\right)\left(2\ln\frac{E_1}{\Delta E} - 3\ln\eta\right) - \Phi\left(\frac{E_3 - E_1}{E_3}\right) - Z^2\ln\frac{E_4}{M}\right.$$

$$+ Z^2\ln\frac{M}{\eta\Delta E}\left(\frac{1}{\beta_4}\ln\frac{1+\beta_4}{1-\beta_4} - 2\right) + \frac{Z^2}{\beta_4}\left\{\frac{1}{2}\ln\frac{1+\beta_4}{1-\beta_4}\ln\frac{E_4+M}{2M} - \Phi\left[-\left(\frac{E_4-M}{E_4+M}\right)^{1/2}\left(\frac{1+\beta_4}{1-\beta_4}\right)^{1/2}\right]\right\}$$

$$+ Z\left[\Phi\left(-\frac{M-E_3}{E_1}\right) - \Phi\left(\frac{M(M-E_3)}{2E_3E_4 - ME_1}\right) + \Phi\left(\frac{2E_3(M-E_3)}{2E_3E_4 - ME_1}\right) + \ln\left|\frac{2E_3E_4 - ME_1}{E_1(M-2E_3)}\right| \ln\left(\frac{M}{2E_3}\right)\right]$$

$$- Z\left[\Phi\left(-\frac{E_4-E_3}{E_3}\right) - \Phi\left(\frac{M(E_4-E_3)}{2E_1E_4 - ME_3}\right) + \Phi\left(\frac{2E_1(E_4-E_3)}{2E_1E_4 - ME_3}\right) + \ln\left|\frac{2E_1E_4 - ME_3}{E_3(M-2E_1)}\right| \ln\left(\frac{M}{2E_1}\right)\right]$$

$$- Z\left[\Phi\left(-\frac{M-E_1}{E_1}\right) - \Phi\left(\frac{M-E_1}{E_1}\right) + \Phi\left(\frac{2(M-E_1)}{M}\right) + \ln\left|\frac{M}{2E_1 - M}\right| \ln\left(\frac{M}{2E_1}\right)\right]$$

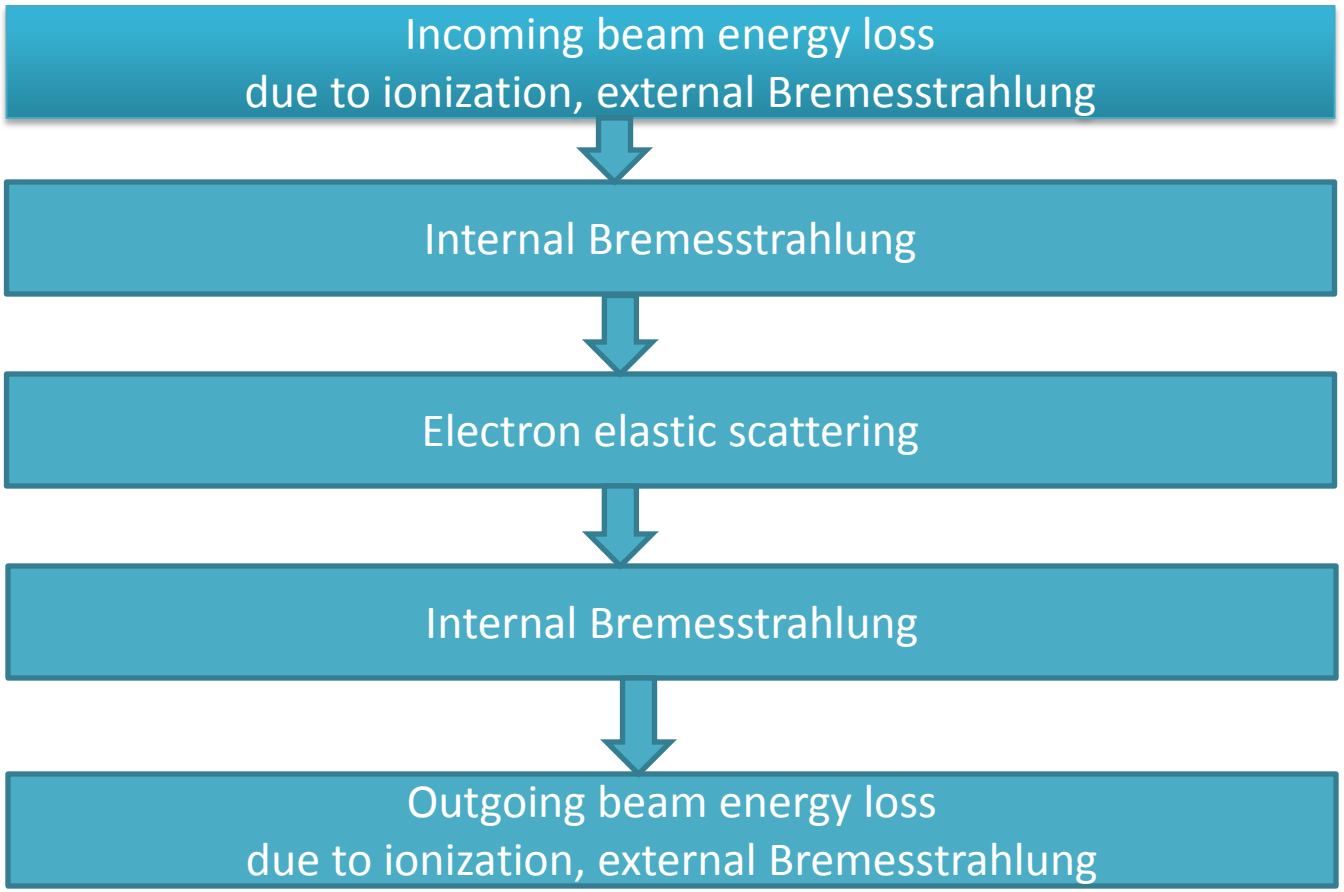
$$\left. + Z\left[\Phi\left(-\frac{M-E_3}{E_3}\right) - \Phi\left(\frac{M-E_3}{E_3}\right) + \Phi\left(\frac{2(M-E_3)}{M}\right) + \ln\left|\frac{M}{2E_3 - M}\right| \ln\left(\frac{M}{2E_3}\right)\right]\right)$$

$$- \frac{\alpha}{\pi}\left(-\Phi\left(\frac{E_1-E_3}{E_1}\right) + \frac{Z^2}{\beta_4}\left\{\Phi\left[\left(\frac{E_4-M}{E_4+M}\right)^{1/2}\left(\frac{1-\beta_4}{1+\beta_4}\right)^{1/2}\right] - \Phi\left[\left(\frac{E_4-M}{E_4+M}\right)^{1/2}\right] + \Phi\left[-\left(\frac{E_4-M}{E_4+M}\right)^{1/2}\right]\right\}\right).$$

Straggling effect (External Bremsstrahlung)

$$\delta_t = -\{[b_w t_{iw} + \tfrac{1}{2}bT]\ln(E_1/\eta^2\Delta E) + [b_w t_{fw} + \tfrac{1}{2}bT]\ln(E_3/\Delta E)\}$$

Elastic Radiation Simulation

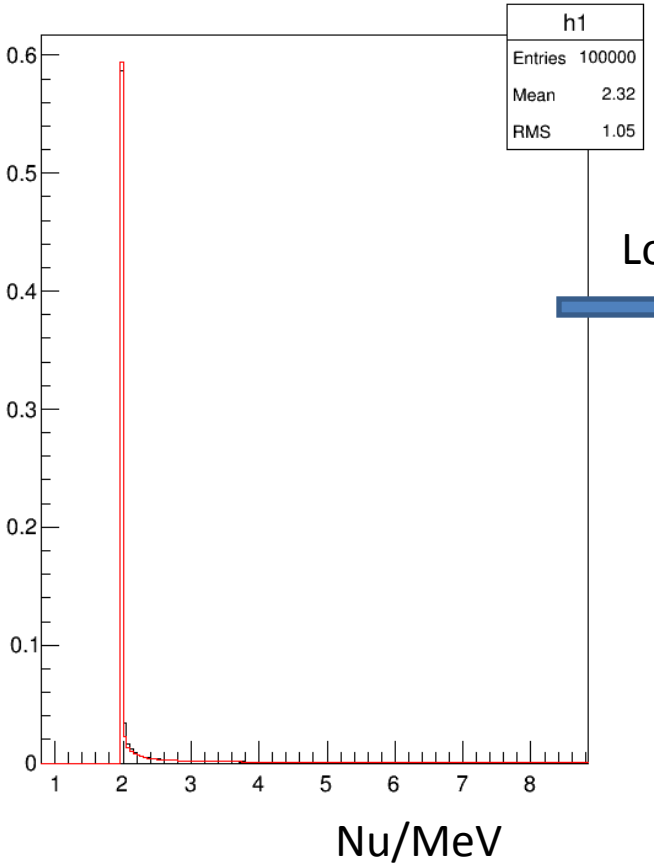


After check bugs…

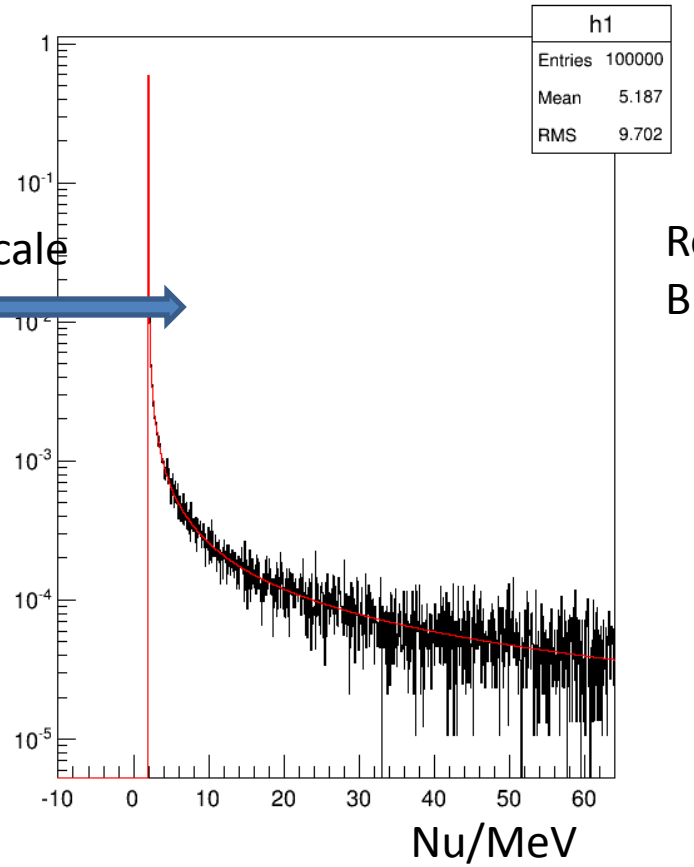
Elastic Raidiation Simulation

Simulated dp distribution versus Mo and Tai formula (do differtiation)

Dp distribution: Only Vacuum + vertex correction + internal Bremsstrahlung



Log scale

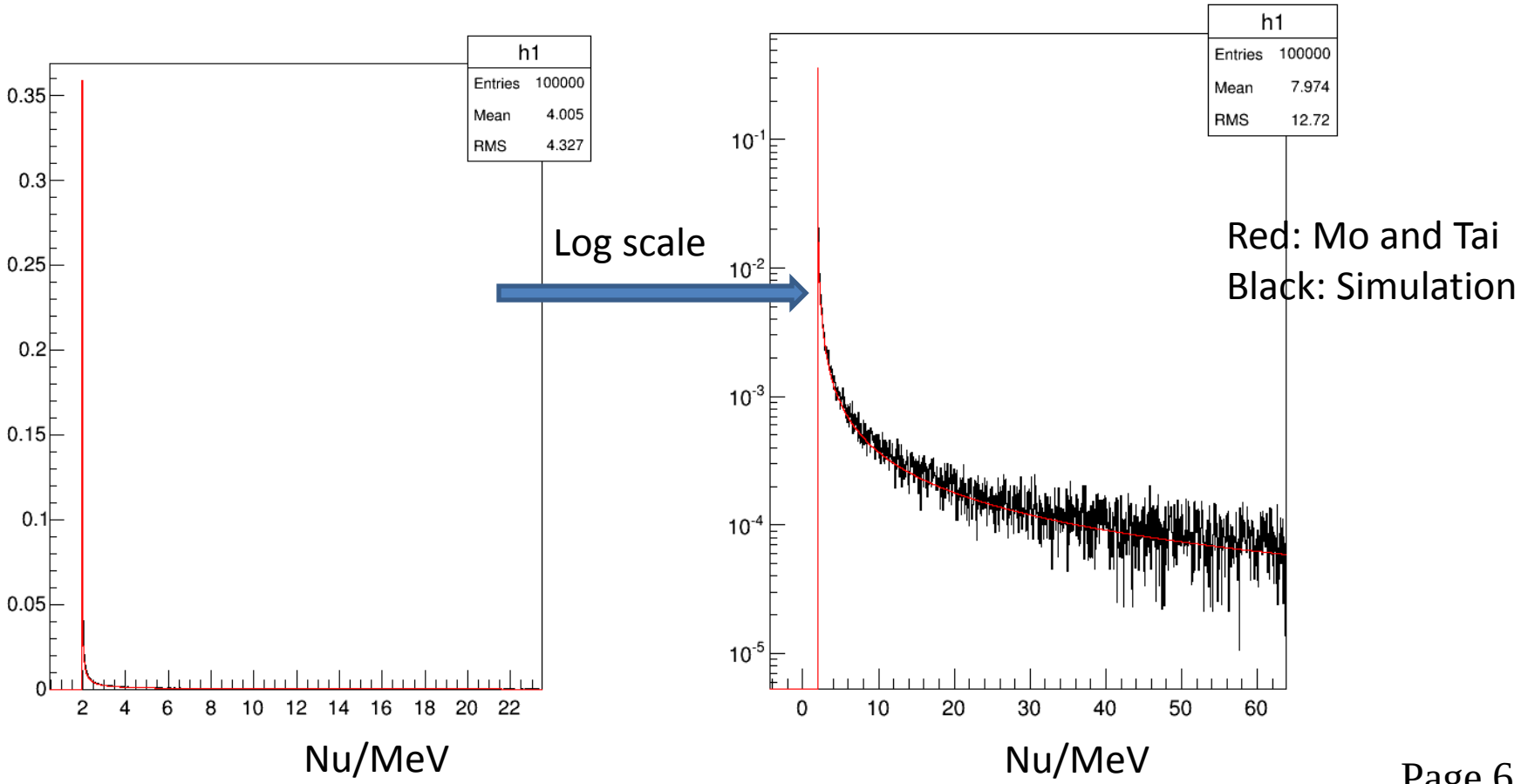


Red: Mo and Tai
Black: Simulation

Elastic Raidiation Simulation

Simulated dp distribution versus Mo and Tai formula (do differtiation)

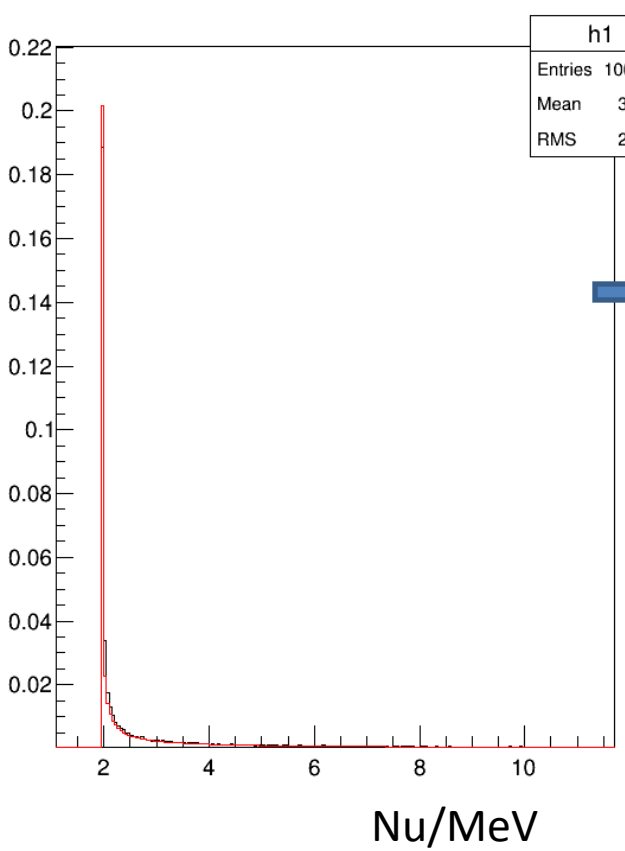
Dp distribution: Only Vacuum + vertex correction + external Bremsstrahlung



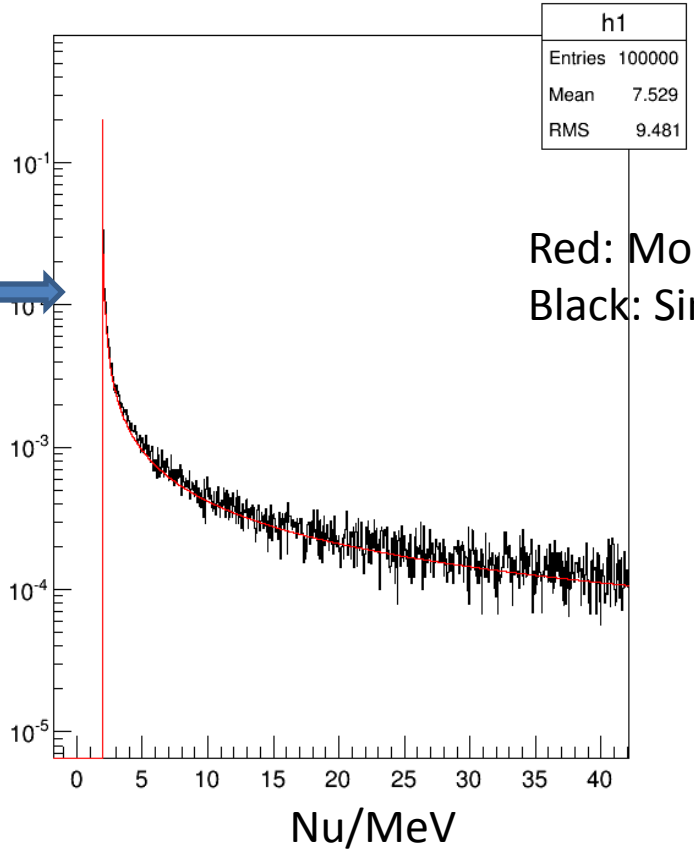
Elastic Raidiation Simulation

Simulated dp distribution versus Mo and Tai formula (do differtiation)

Dp distribution: Vacuum + vertex correction + external + internal



Log scale

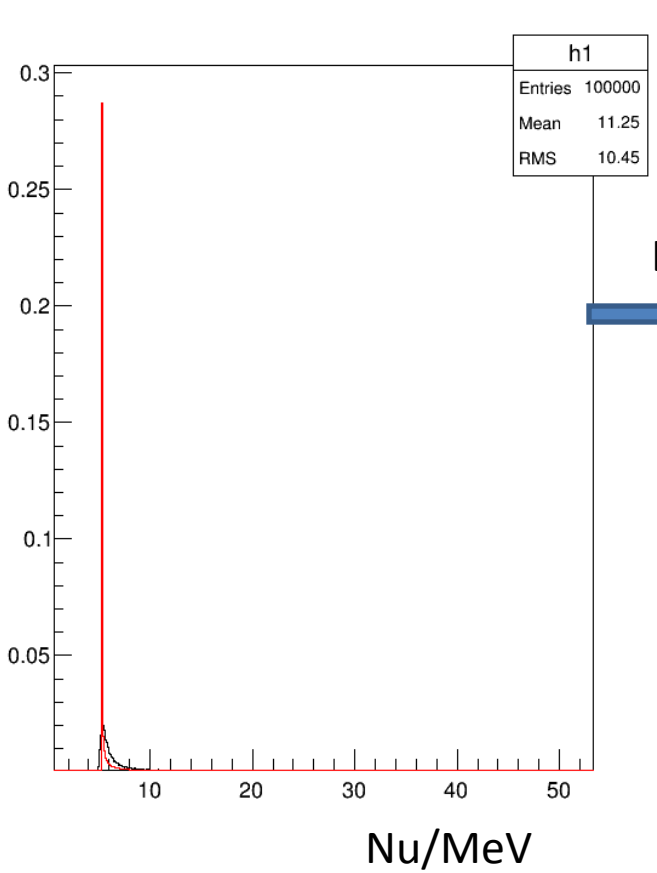


Red: Mo and Tai
Black: Simulation

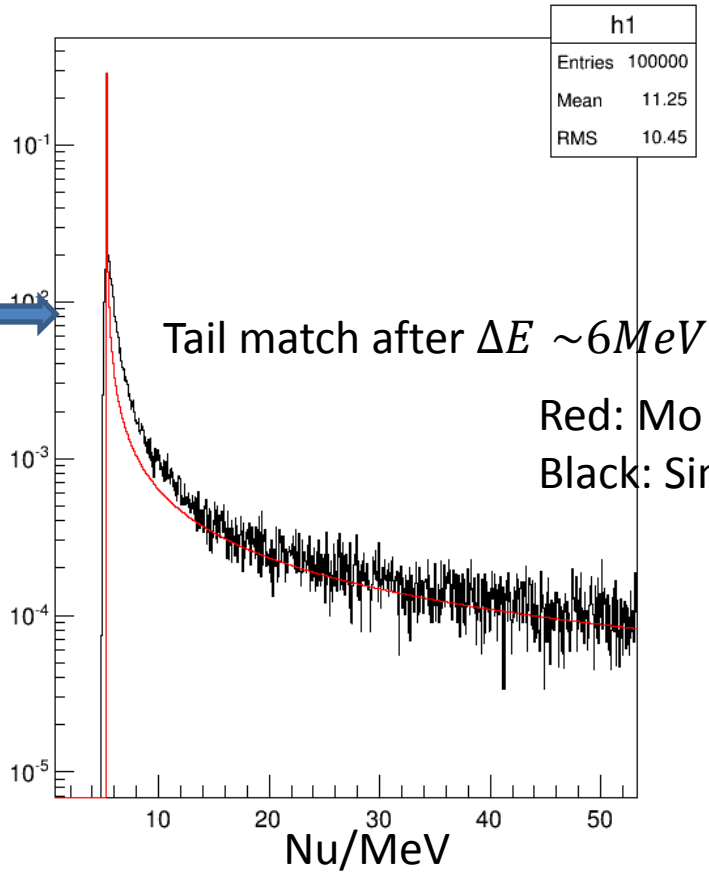
Elastic Raidiation Simulation

If add ionization:

Dp distribution: Vacuum + vertex correction + external + internal + ionization



Log scale



Tail match after $\Delta E \sim 6MeV$

Red: Mo and Tai

Black: Simulation

Acceptance & yields

1. Choose point beam in simulation:

Ten point beam in bpm (x, y):

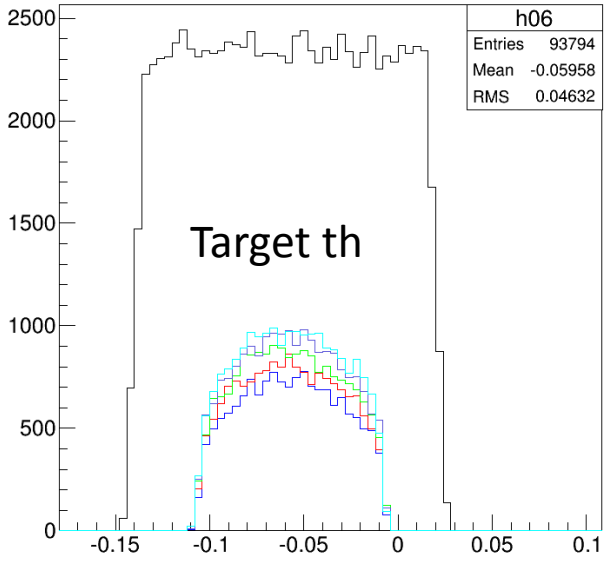
Along bpm x: (-10, 0), (-5, 0), (0, 0), (5, 0), (10, 0)
along bpm y: (0, -10), (0, -5), (0, 0), (0, 5), (0, 10)

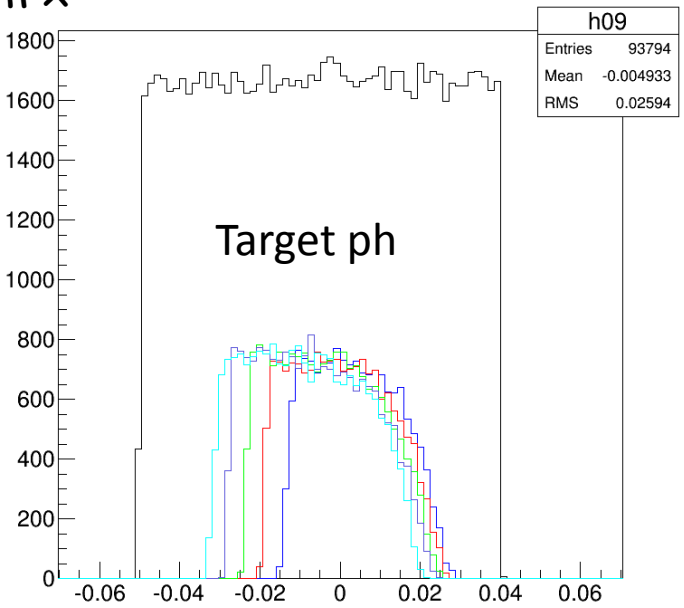
2. Full Angle cover simulation,
larger than accptance (just geometry cut in snake yet)

3. To see the acceptance & yields
Beam energy 2.2GeV, 2.5T, transverse, HRS momentum 1.76GeV

Acceptance & yields

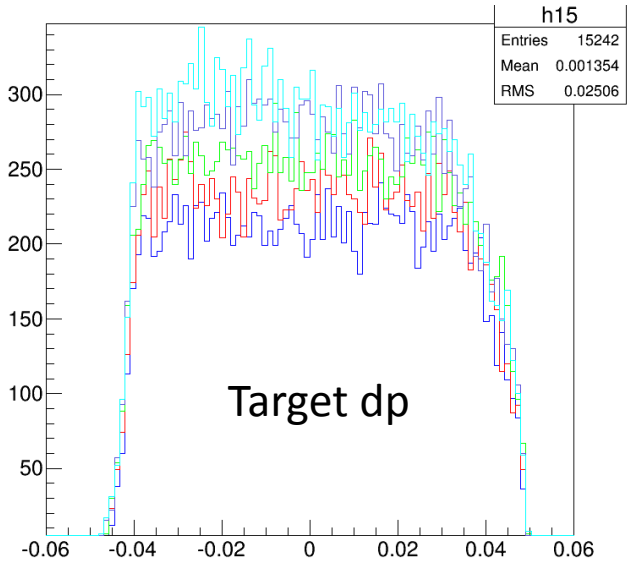
point beam in simulation: Along bpm x

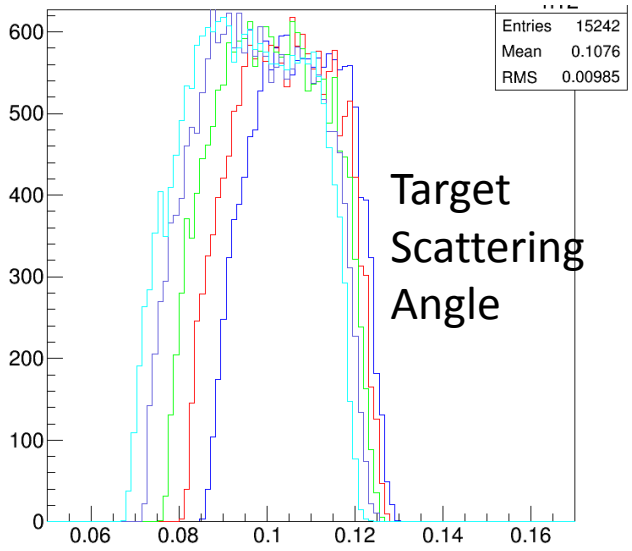




(-10, 0): Blue
(-5, 0):Red
(0, 0):Green
(5, 0): Light blue
(10, 0): Cyan

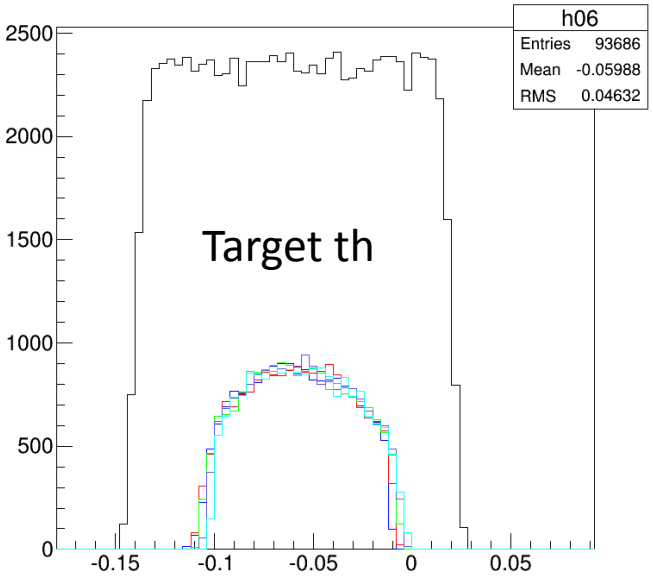
Angle unit: Rad

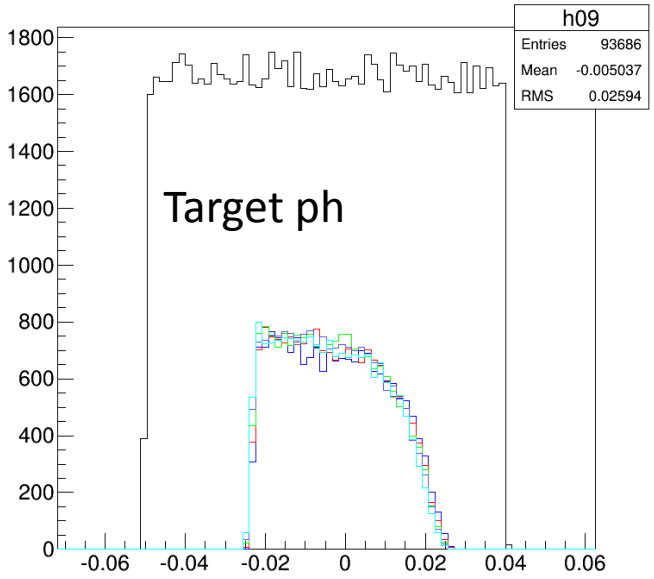




Acceptance & yields

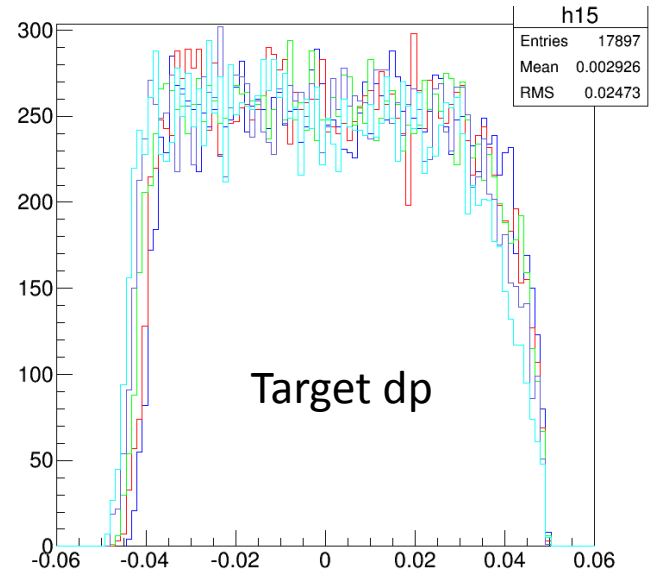
point beam in simulation: Along bpm y

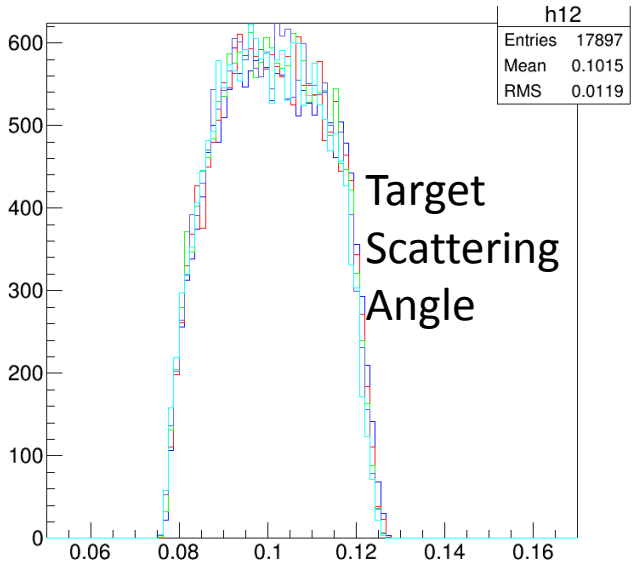




(0, -10): Blue
(0, -5):Red
(0, 0):Green
(0, 5): Light blue
(0, 10): Cyan

Angle unit: Rad





Acceptance & yields

Along x: bpm(x, y)/mm	(-10, 0)	(-5, 0)	(0, 0)	(5, 0)	(10, 0)
Acceptance Ratio (not weighted xs)	0.83	0.91	1.00	1.08	1.25
Yields Ratio (weighted xs)	0.65	0.83	1.00	1.28	1.48

Along y: bpm(x, y)/mm	(0, -10)	(0, -5)	(0, 0)	(0, 5)	(0, 10)
Acceptance Ratio (not weighted xs)	0.97	0.99	1.00	1.00	0.98
Yields Ratio (weighted xs)	1.01	1.05	1.00	1.02	1.04

Summary

Any suggestion?