Absolute cross section Tritium (e,e’p):

Update

How did we extract “raw” absolute cross section?

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Formalism

$$\boxed{\frac{d^6\sigma}{dE'd\Omega_e dP d\Omega_p} = \frac{N_B}{\mathcal{L} * \ \mathcal{E} * V_B * A} * (\mathrm{RC} * \mathrm{LT})}$$

1. Determine NB(Nu, Q2, Pm, Em)

- Bin: 1 bin in Nu and Q2 => NB(Pm, Em)

Selection cuts:

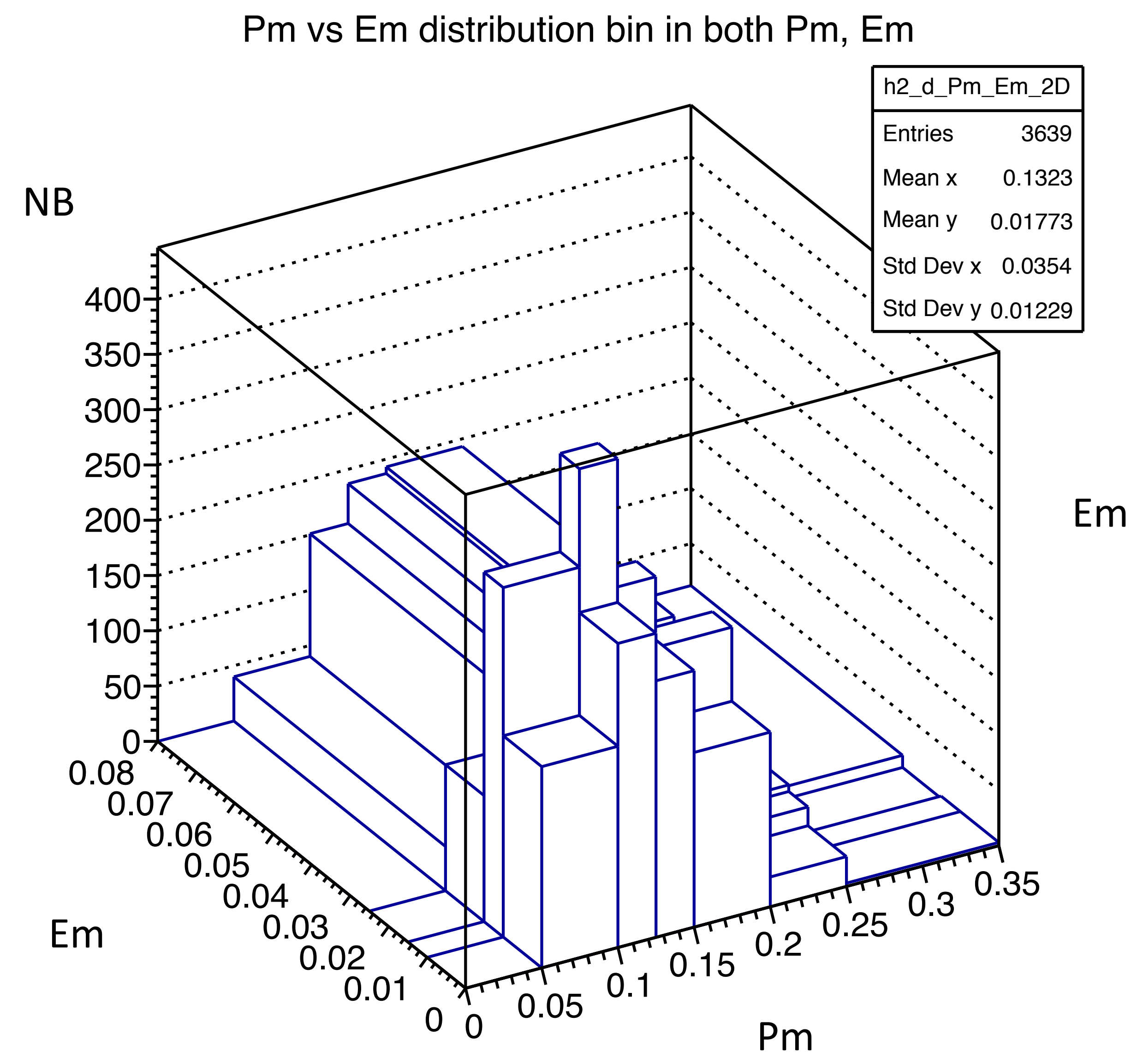
Acceptance cuts:

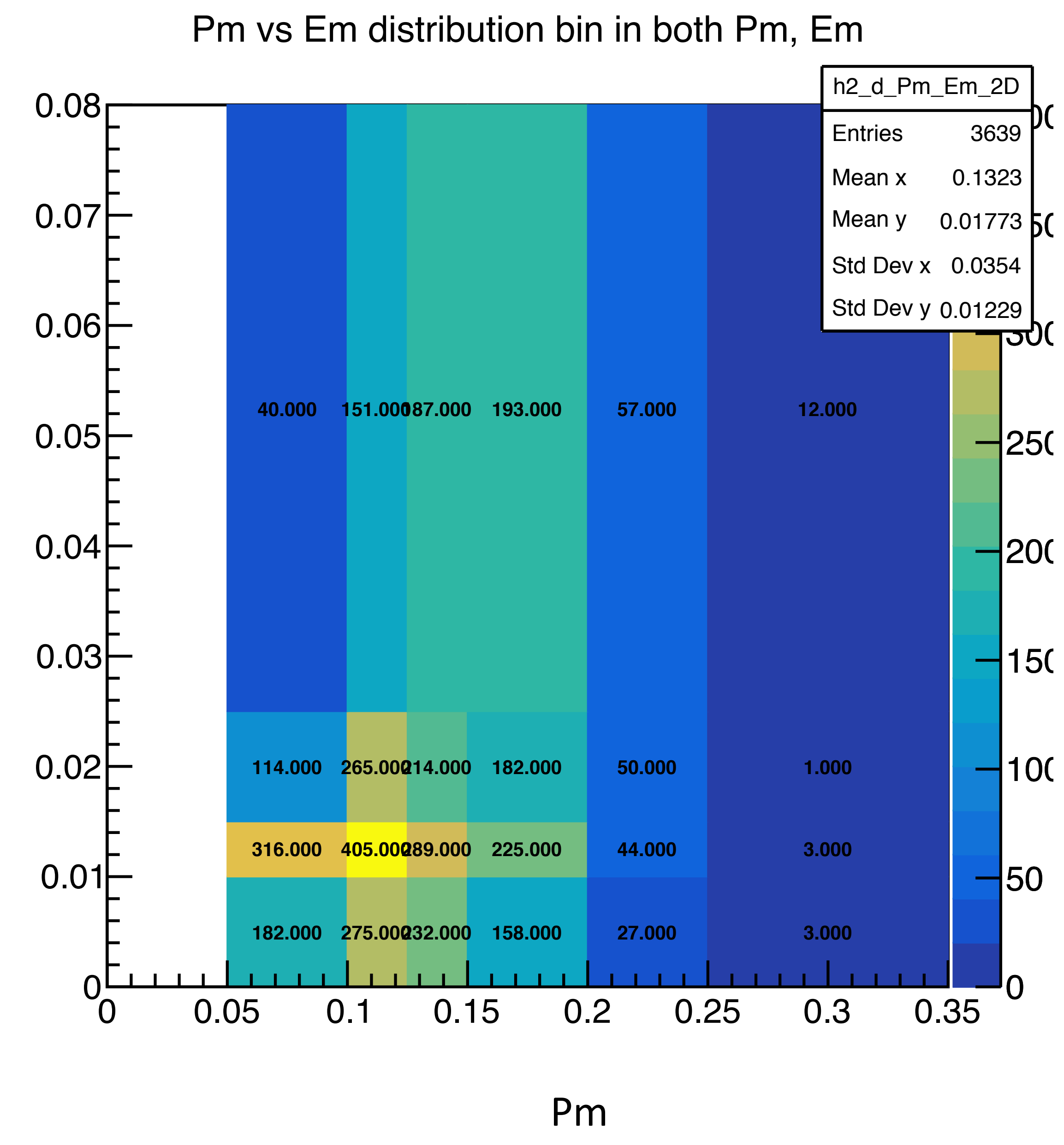
- Dp : +/- 3.0 %
- Xp: +/- 30 mrad
- Yp : +/- 20 mrad
- VZ: +/- 9.5 cm

Other cuts:

- PID:
- Coinc timing
- Tracking
- Th_rq < 37.5
- Xbj > 1.3 (only for slow kin)

NB(Pm, Em) after selection cuts





2. Determine Acceptance

$$A(dE, d\Omega e, dP, d\Omega p) = \frac{N_{acc}^{i}(dE, d\Omega e, dP, d\Omega p)}{N_{gen}^{i}(dE, d\Omega e, dP, d\Omega p)}$$

$$A(\upsilon, Q^2, P_m, E_m) = \frac{N_{acc}^{i}(\upsilon, Q^2, P_m, E_m)}{N_{gen}^{i}(\upsilon, Q^2, P_m, E_m)}$$

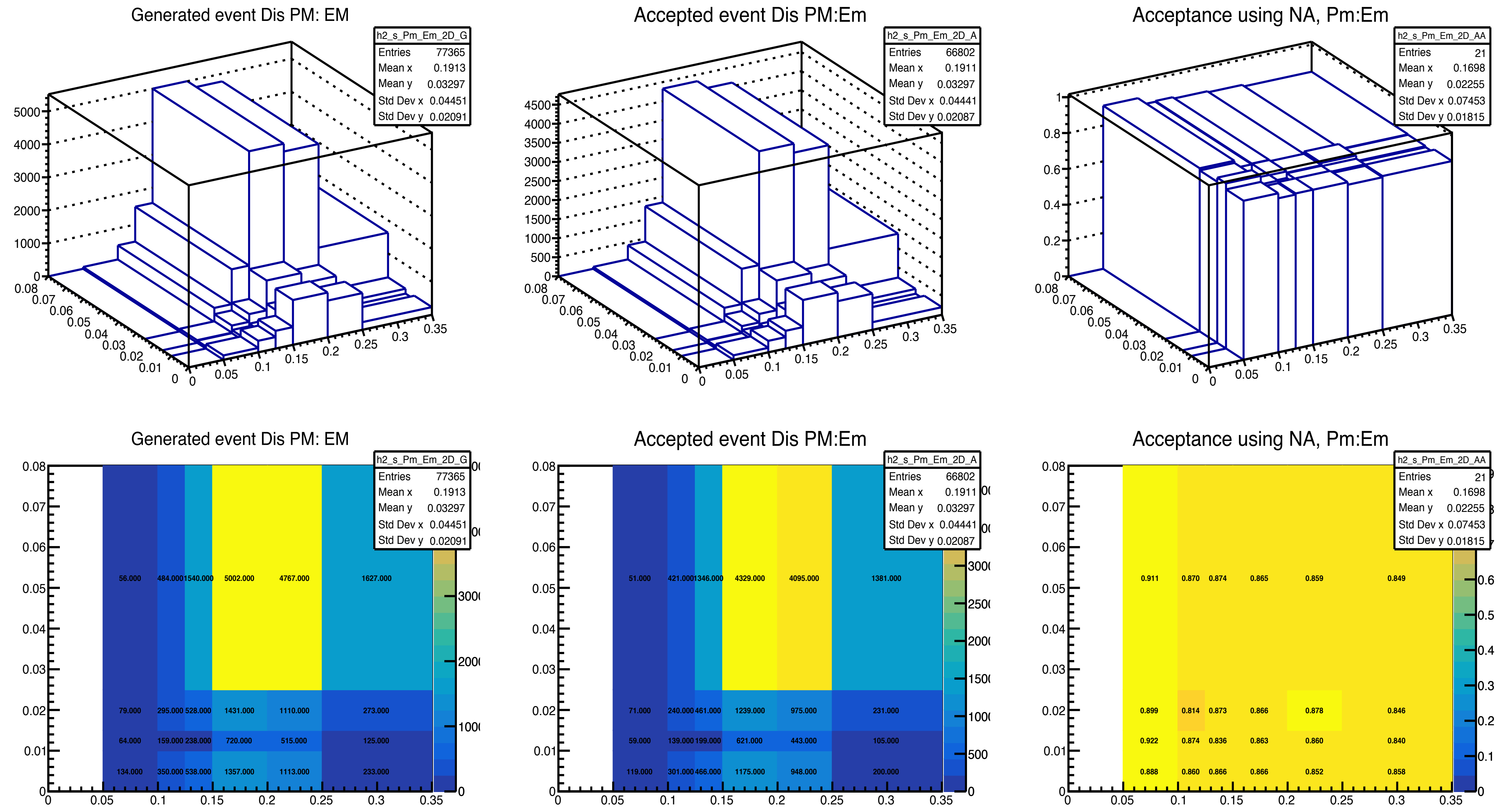
Using SIMC coincident phase space mode:

- Uniformly generate: (dp, xp, yp) for electron and proton arm
- Uniformly generate the vertex Z
- Recording both accepted (pass through spectrometer) and generated event

Total number of generated event: $N_{gen}^{tot}[6D] = N_{gen}^{tot}(\Delta E, \Delta\Omega e, \Delta P, \Delta\Omega p)$

Total generated 6D phase-space: $\Delta PS_{gen}^{tot}[6D] = (\Delta E * \Delta\Omega e * \Delta P * \Delta\Omega p)$

Calculate the acceptance for each bin (Pm, Em)



3. Determine the 6D effective phase-space

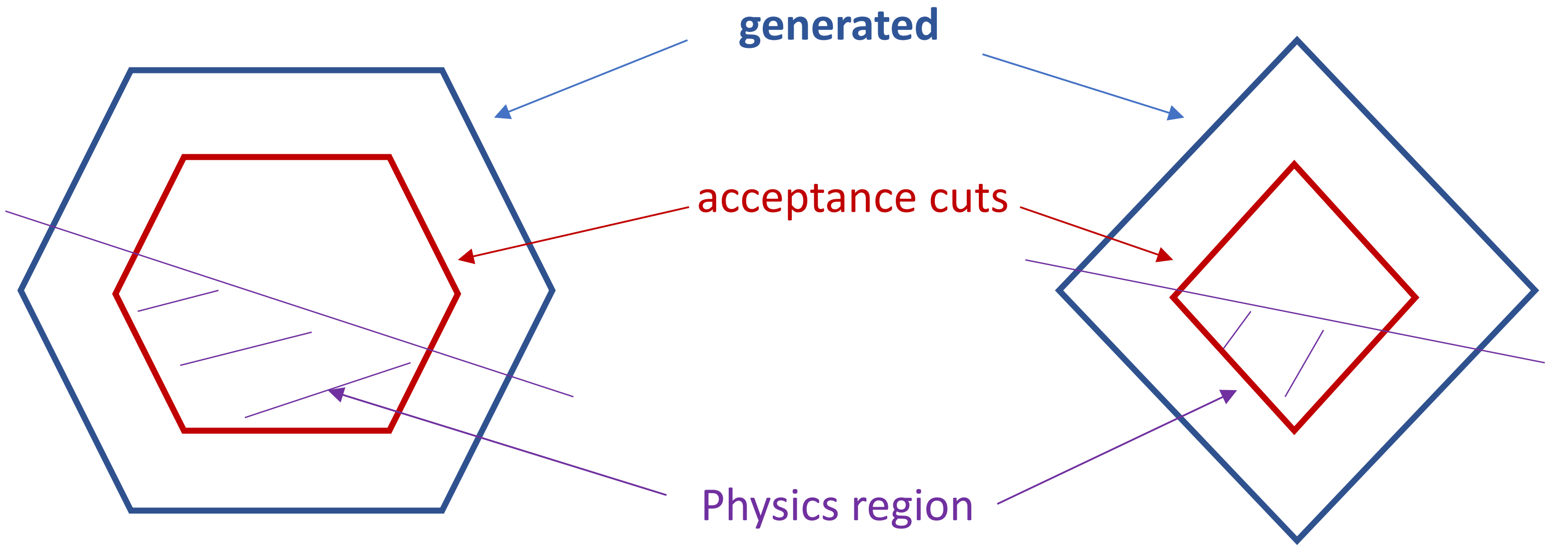
- For each bin (Pm, Em) we obtained NB(Pm, Em) -> What is 6D phase space corresponding to that bin?

$$V_B^{eff}[6D](P_m, E_m) = V_B(P_m, E_m) * A(P_m, E_m)$$

$$V_B^{eff}[6D](P_m, E_m) = \frac{\cancel{N_{gen}(P_m, E_m)}}{N_{gen}^{tot}[6D]} * \Delta PS_{gen}^{tot}[6D] * \frac{N_{acc}(P_m, E_m)}{\cancel{N_{gen}(P_m, E_m)}}$$

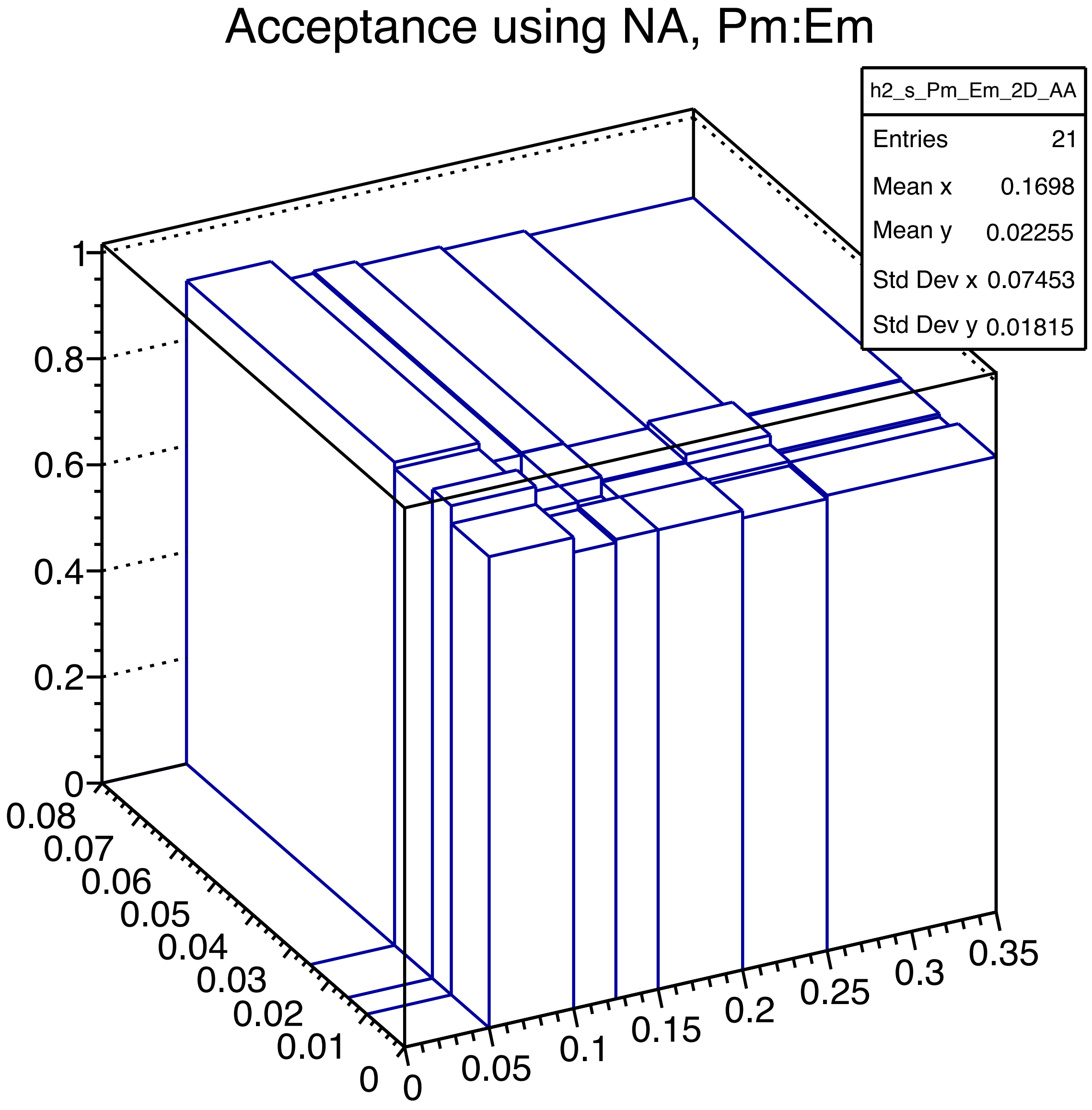
Note: Need to make sure to apply the same acceptance cuts [6D] in the simulation to calculate the effective phase space

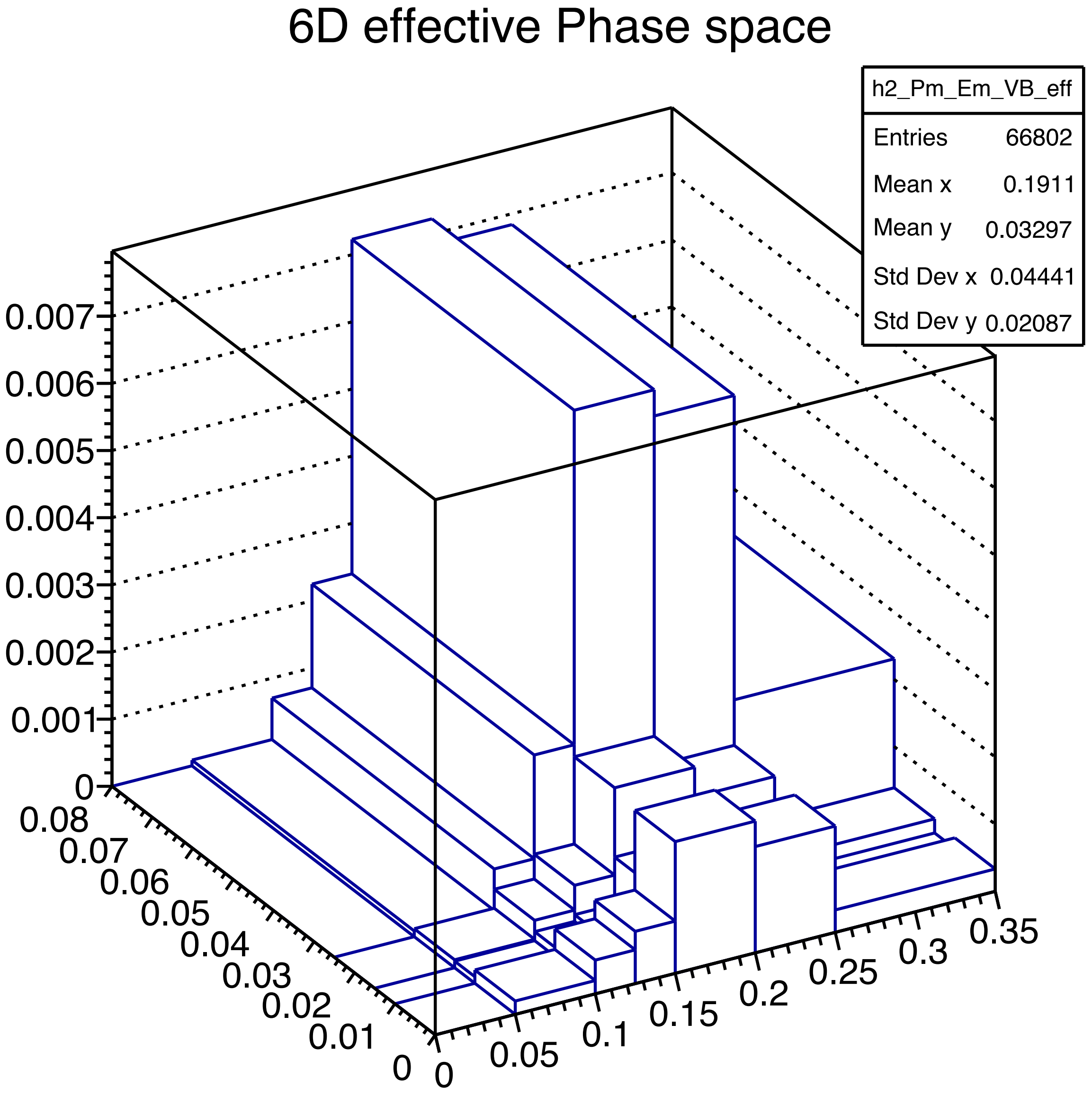
6D phase space



4D space (nu, Q2, Pm, Em)

Acceptance and VB_eff as a function of Pm and Em





4. Determine the integral Luminosity

Target Luminosity $$\mathcal{L}_T = \frac{N_a * \rho * l}{A}$$

Beam luminosity $$\mathcal{L}_B = \frac{Q_{tot}}{q_e}$$

In term of number of electron

Unit : convert to nb

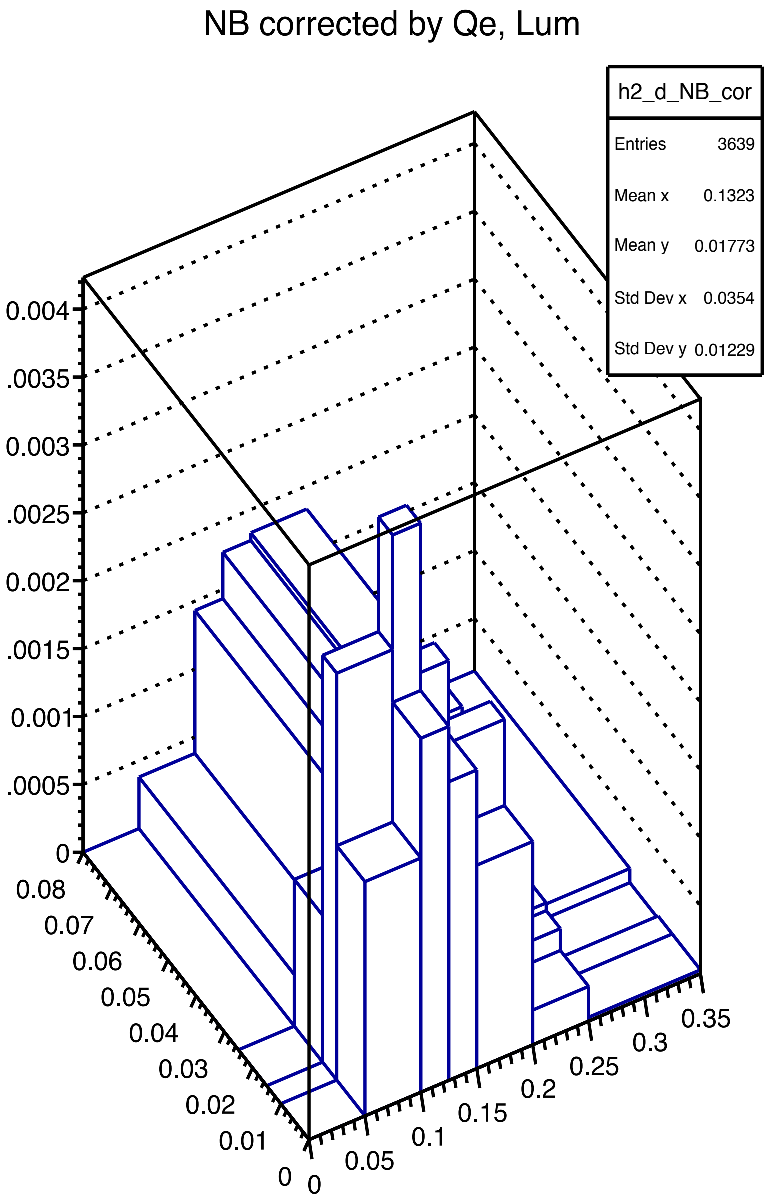
$$\Rightarrow \quad \mathcal{L} = \mathcal{L}_T * \mathcal{L}_B$$

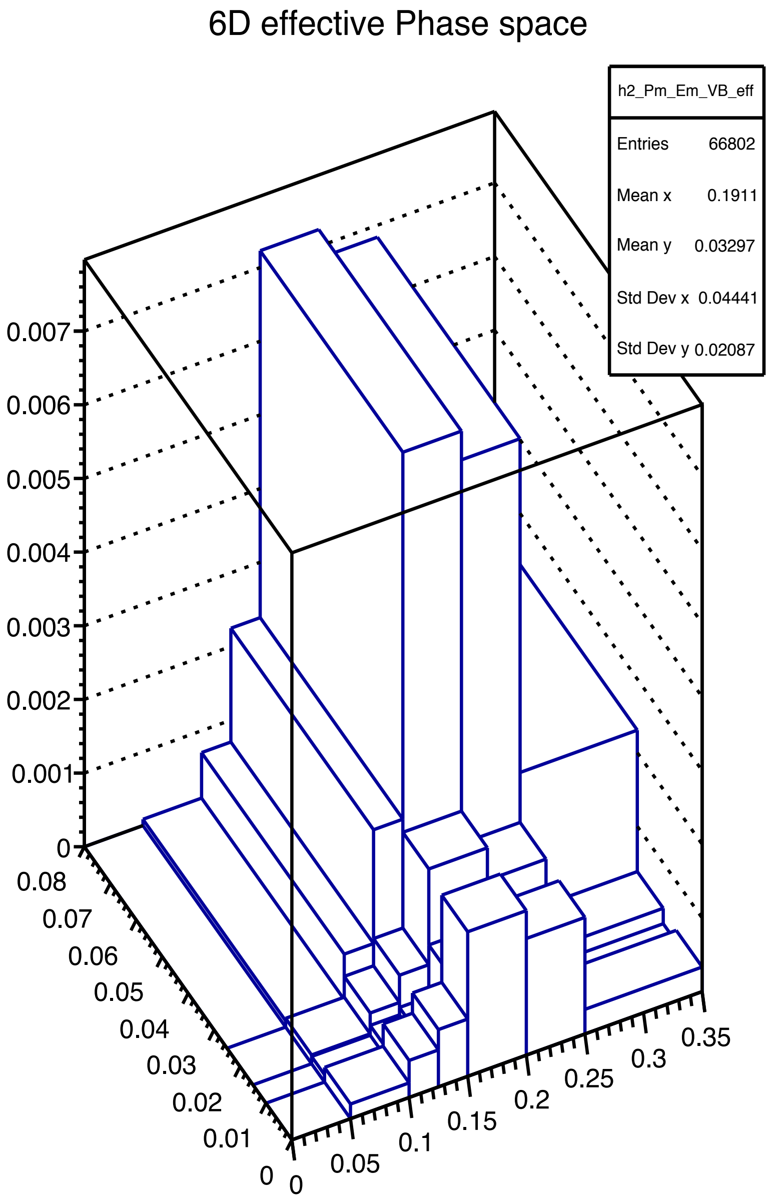
<u>3He and 3H target density</u>

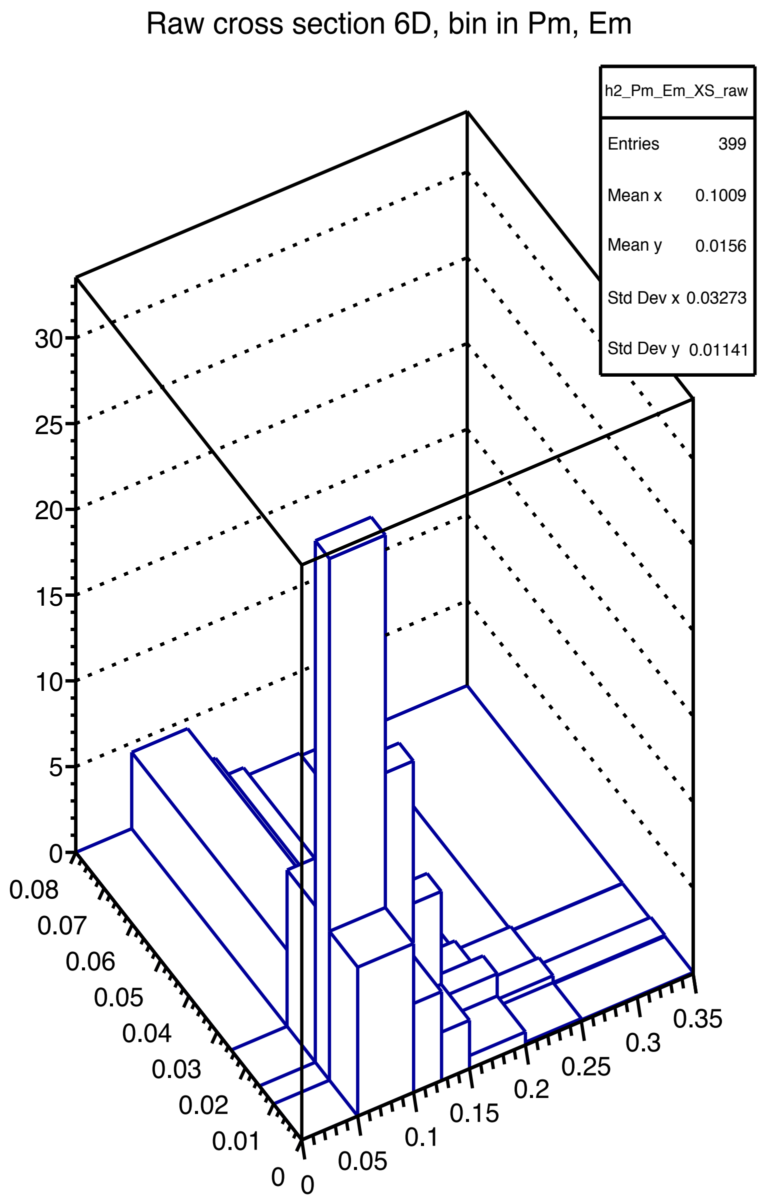
3H: 85.1 g/cm2 $\rightarrow$ $\mathcal{L}_T$ ~ 170 e-13 nb

3He: 53.4 g/cm2 $\rightarrow$ $\mathcal{L}_T$ ~ 107 e-13 nb

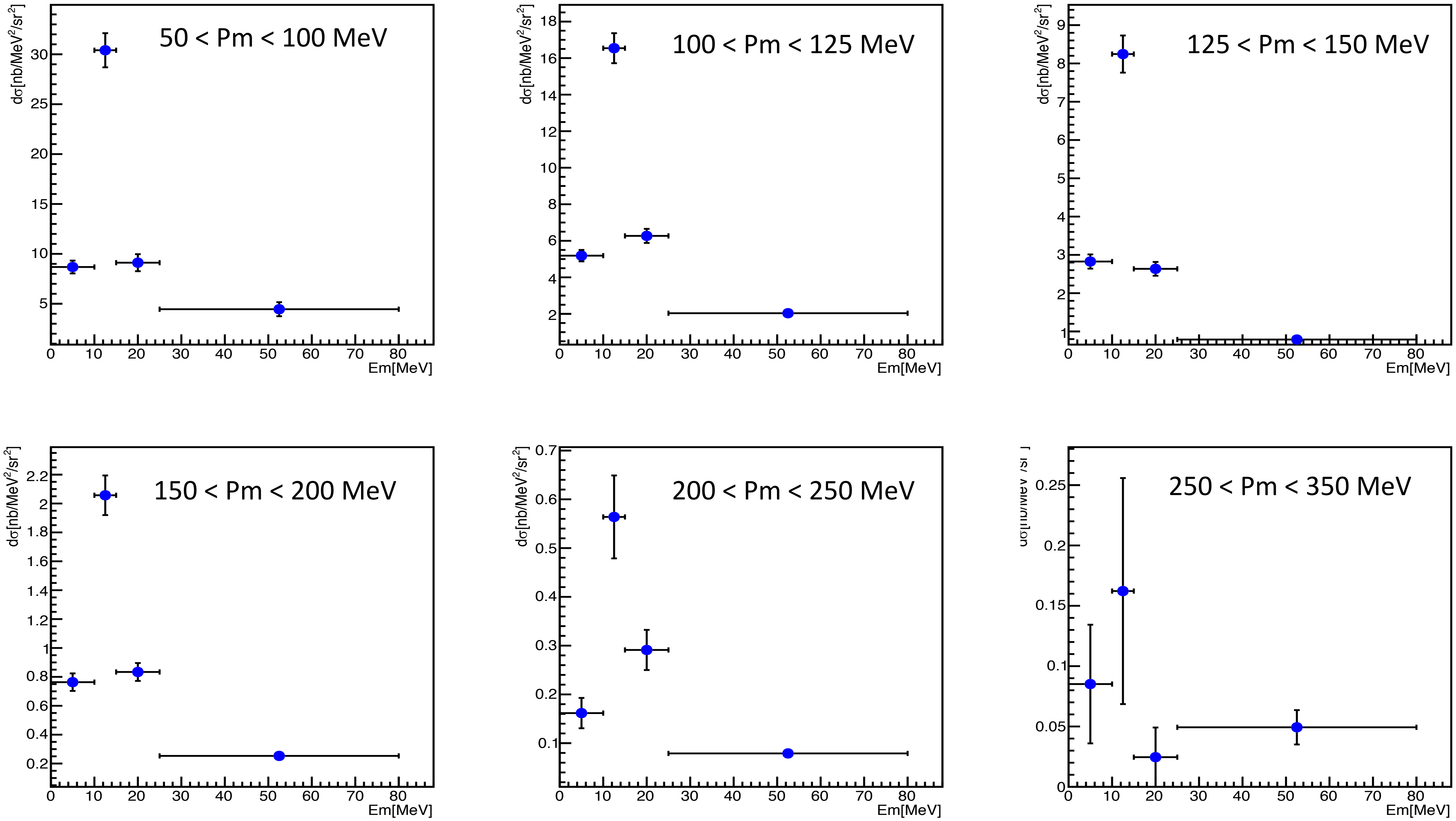
5. Extracted "raw" cross section as function of (Pm, Em)







6. Raw cross section vs Em for each bin of Pm



7. Raw cross section vs Pm, integral over Em.

For each bin Pm:

$$\sigma = \frac{\sum(\sigma_i * w_i)}{\sum w_i}$$

The Stat uncertainty = 1/sqrt(N_{count}^{tot})

N_{count}^{tot} = $\sum N_i$

Where : σ_i is the cross section for bin E_m^i and w_i is the bin width

3H, fast kinematic only