Deuteron Quasi-Elastic
Run: 2035

INFORMATION
target: LD2 4 cm
LD2 density: 0.16756 g/cm^3 at T 22 K & p = 30 psi

beam E0 1.16 GeV
current 10.2 uA
L_p0 = 1.055
L_theta0 = 20.5
prescale → ps1=0 ps2=0 **ps3=280** ps4=0 ps5=0 ps6=170 ps7=0 ps8=0
Dead time 14.02%
BCM charges 0.006384 (C)

Quasi-Elastic Identification from D(e,e') invariant mass (W).

Let
M = electron mass
MA = target Mass (input)

f_A = (0_vector , M) → Target At rest
f_Q = f_P0 - f_P1 =(q_vector, omega)
f_A1 = f_A + f_Q
= (q_vector, MA+omega)

The invariant mass^2:
W^2 = A1^2
= MA^2 + 2*MA*omega + omega^2 - |q3m|^2 (*)
= MA^2 + 2*MA*omega -Q^2 (*)
For elastic:
2*MA*omega - Q^2= 0 (**)
which give W^2 = MA^2
But for quasi-elastic W^2 is not at MA^2

In our case, since we are NOT at the elastic scattering from deuteron, so the W2 is not exactly at the M_deutron^2.

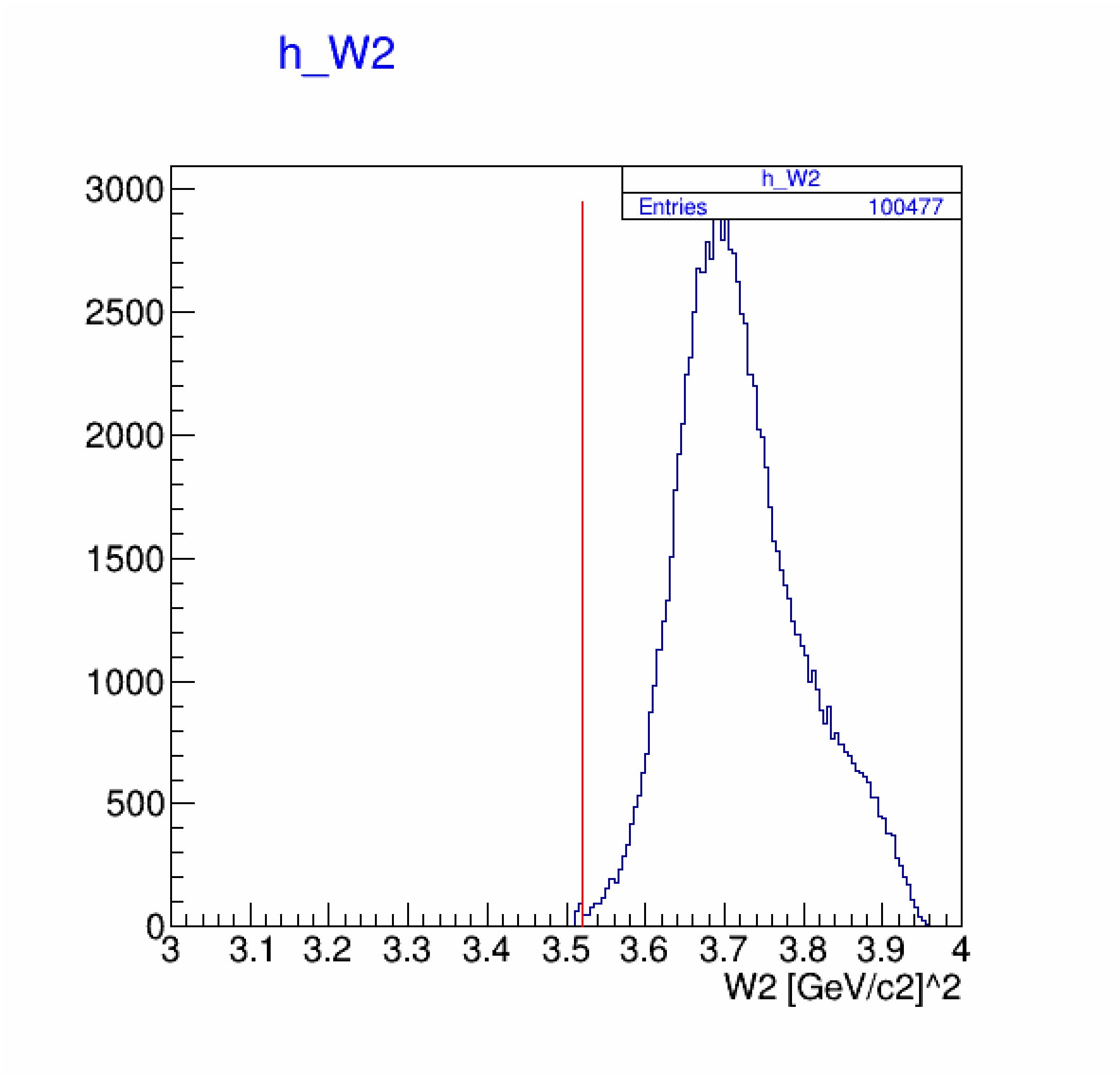

Figure 1.1: Invariant mass ^2 (W2)
redline indicate the deuteron mass^2

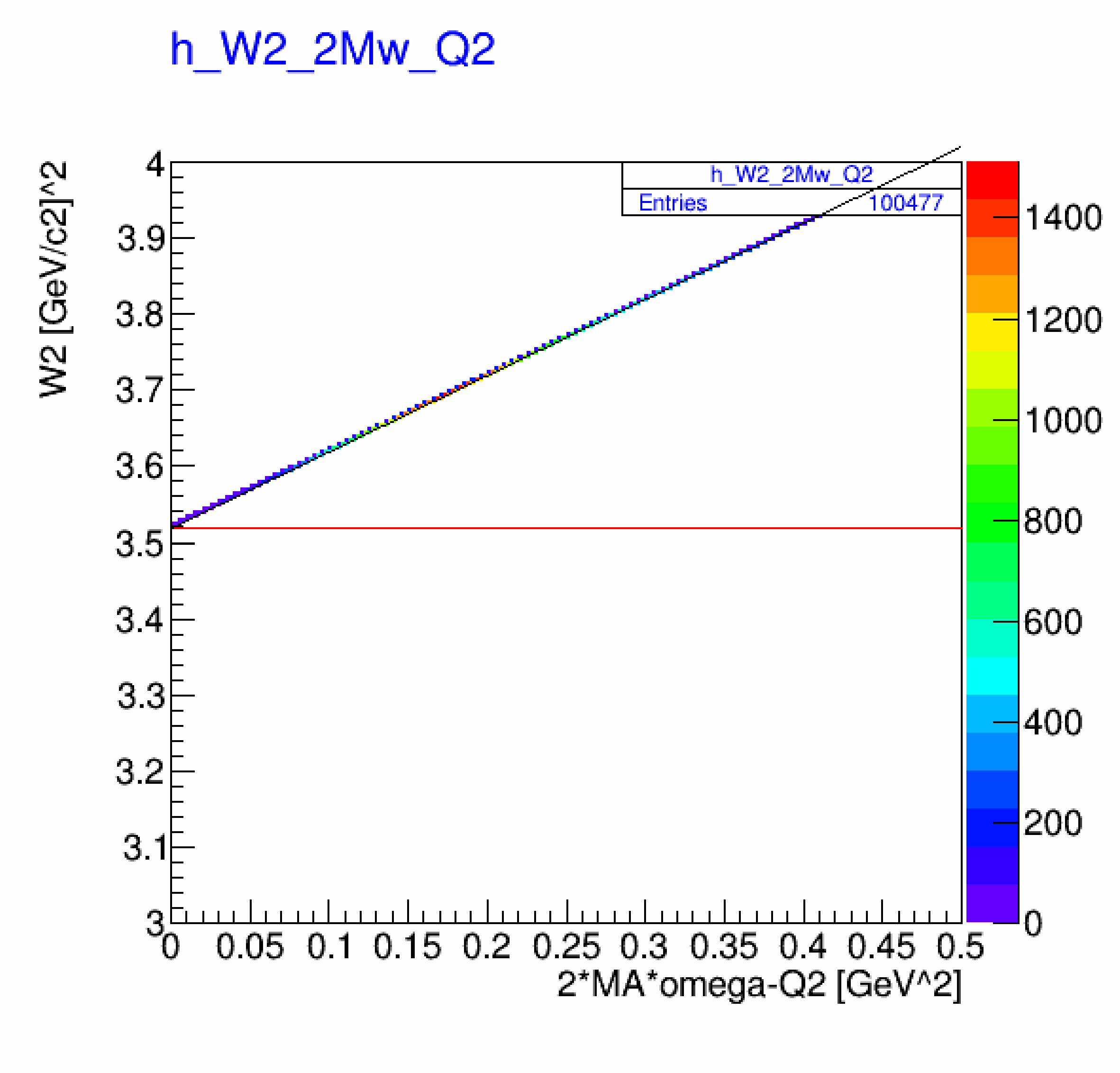

Figure 1.2 invariant mass^2 (W2) vs 2*M*omega-Q^2 (the quantity that would be zero for elastic).

If the target is proton 2*MA*w-Q2 = 2*MA*w*(1-X_bj)

The invariant mass distribution shows that we are not at the elastic scattering from deuteron.

Kinematic coverage in term of Q^2 and |q|

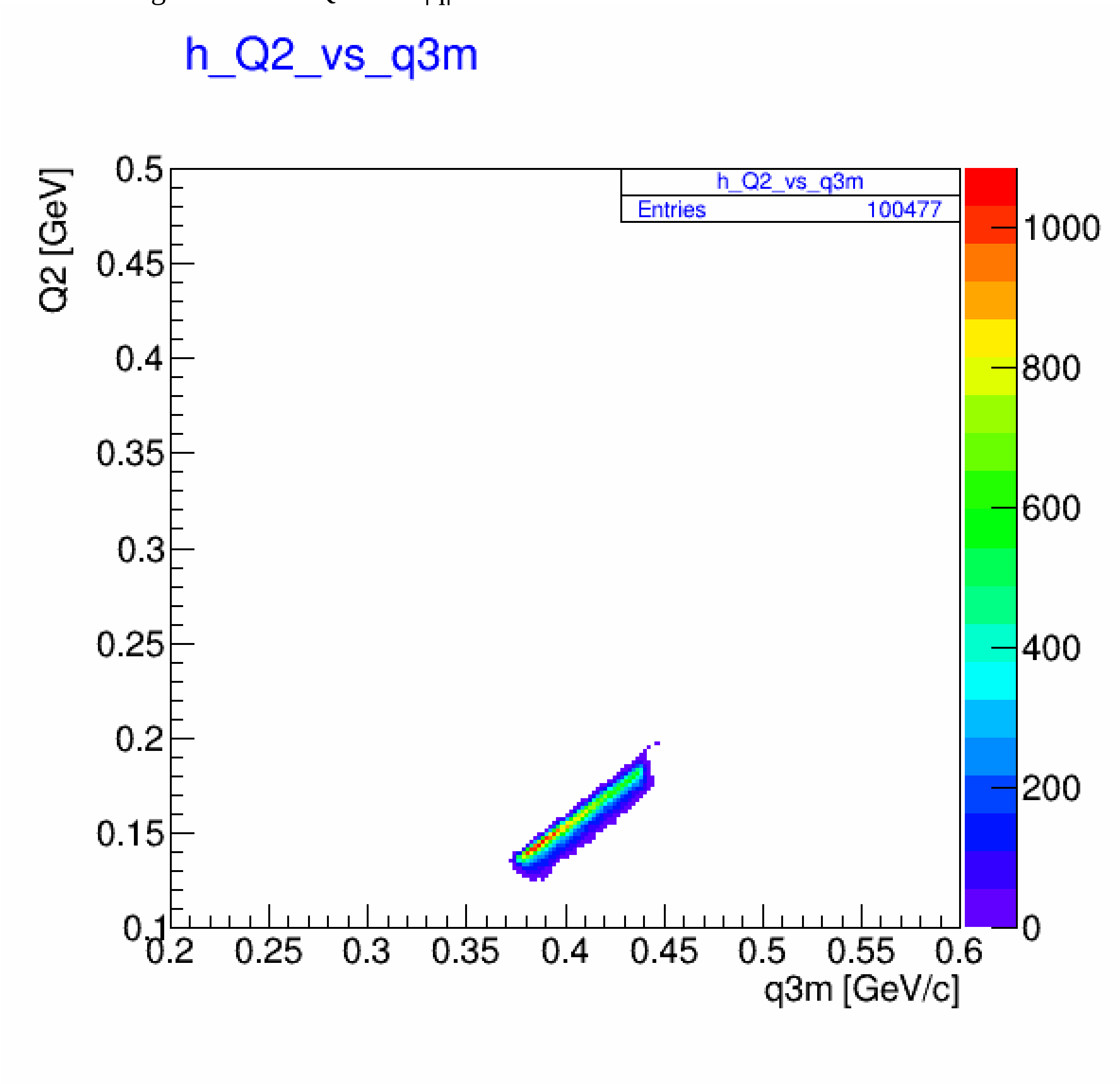

Figure 2 Q2 vs |q|

Data Selection in BigBite

1. has track in BigBite BB.tr.n>=1
2. has hit in either E or dE or both
3. track data match to hit data either fullhit (has both E and dE) or parthit(either E or dE)

4. Using CT to eliminate most of the MIP above CT>-100 ns

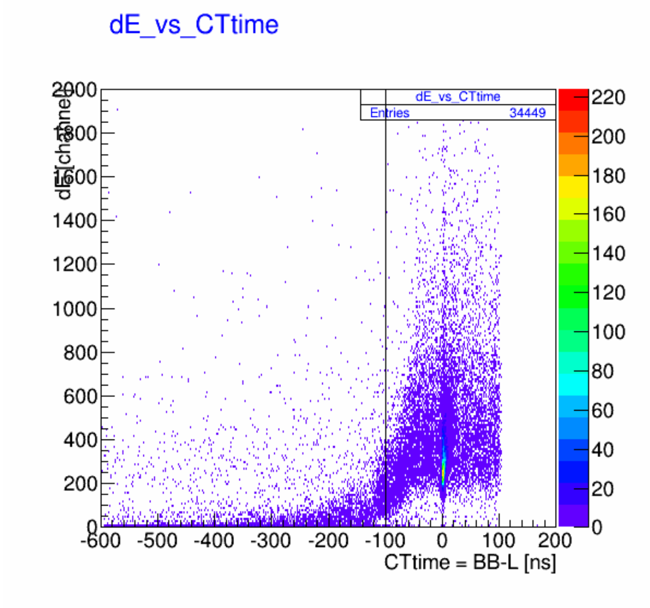

Figure 3.1 E vs CT time

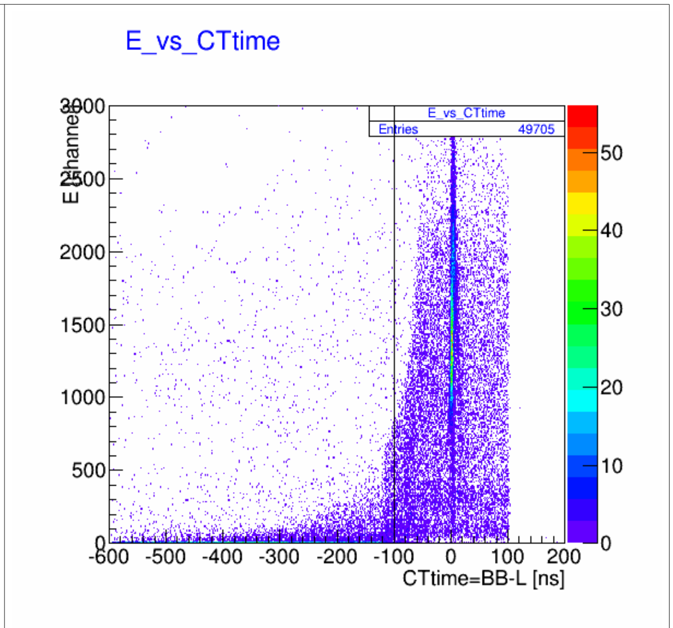

Figure 3.2 dE vs CT time

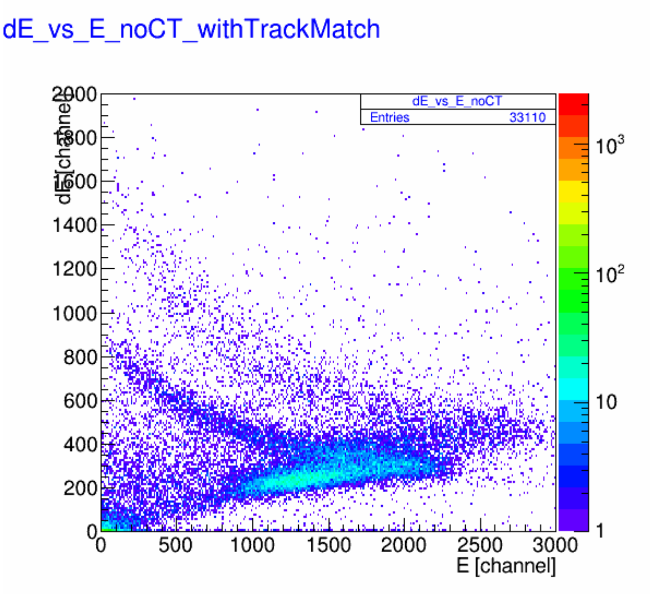

Figure 3.3 dE vs E with NO CT cut

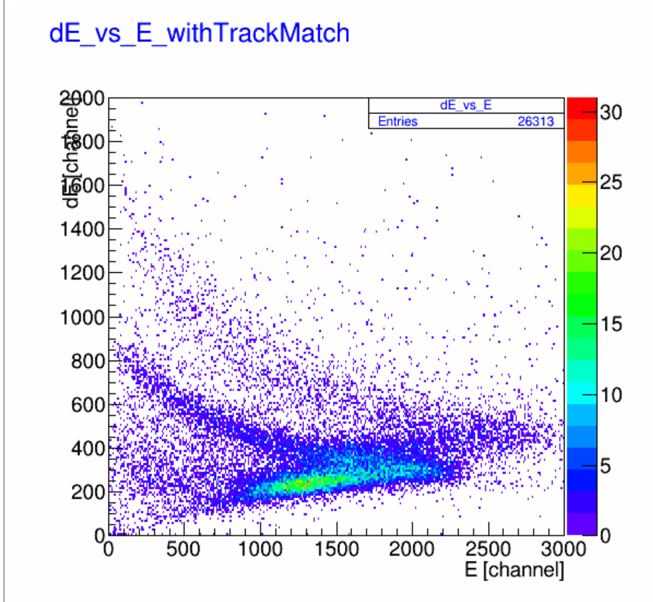

Figure 3.4 dE vs E with minimum CT cut >-100

5. Three option for Proton PID using graphical cut after CT minimum cut

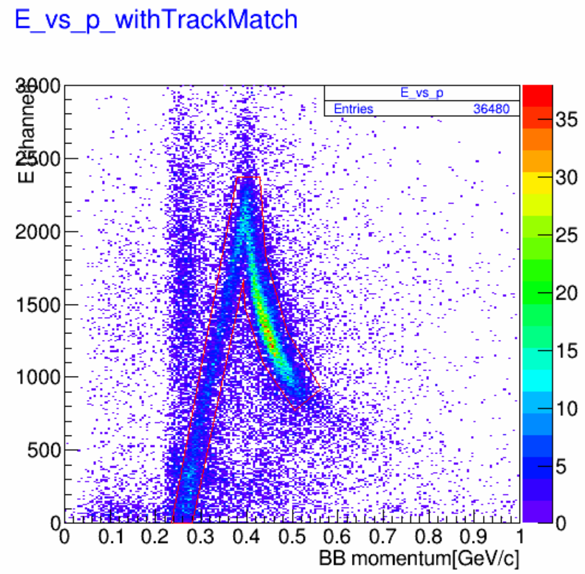

Figure 4.1 E vs BB momentum

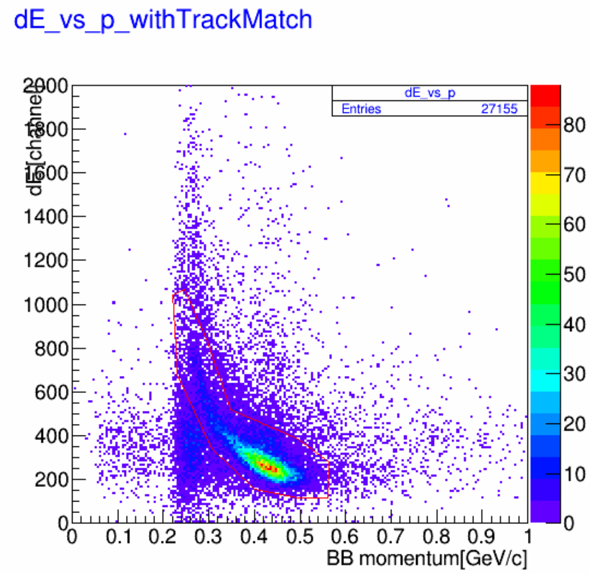

Figure 4.2 dE vs BB momentum

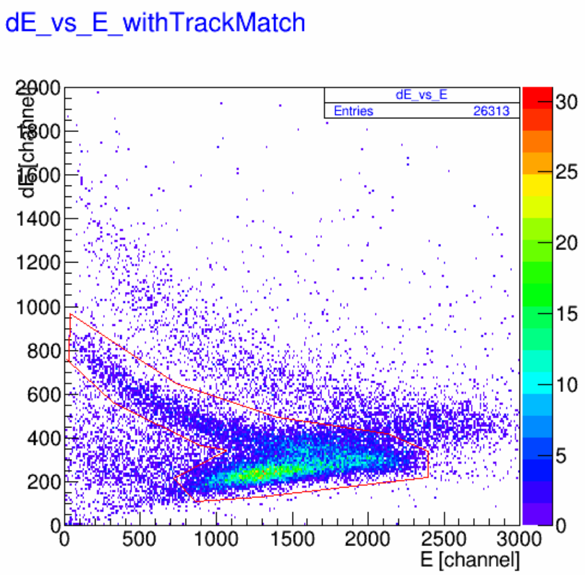

Figure 4.3 dE vs E

Option 1 apply to both fullhit and parthit in E
Option 2 apply to both fullhit and parthit in dE
Option 3 apply to only fullhit data

Physics of D(e,e'p)B

1. p_miss = sqrt(\Sum(q_xi – p_xi)^2)
2. E_recoil = MA + omega – sqrt(p_proton^2 + mp^2)
3. M_miss = sqrt(E_recoil^2 – p_miss^2)

Below data is “NOT using proton PID”, but remove unknown section BB_p <0.3 GeV/c

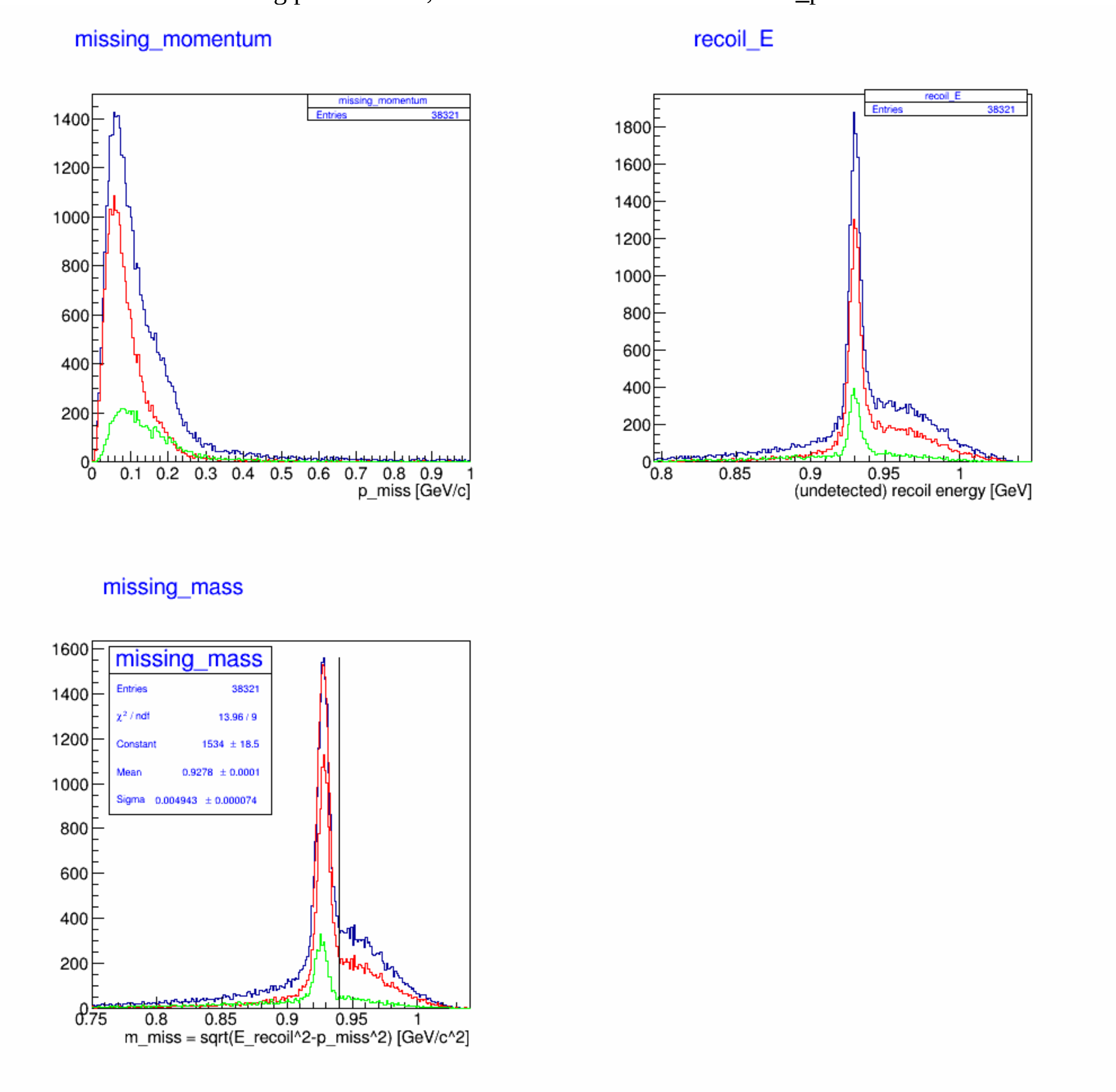

Figure 5.1/.2/.3 missing momentum,recoil_energy, and missing mass respectively. Additional restriction with BB_p>=300 MeV/c
Blue line: all data
red line: for fullhit data
green line: for parthit data in E

The missing mass peak at 0.928 GeV/c^2 which is 0.012 GeV/c^2 lower than the deuteron mass. This might be from the non-corrected momentum reconstruction with energy lose.