Inclusive Ratio.

Cut_1: T3 no edtm |L_theta|<=0.06 && |L_phi|<=0.03

Cut_2: electron PID: with (prl_sum_E/p)>=0.7 && single track in LHRS

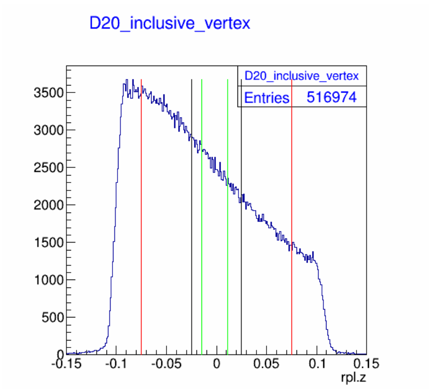
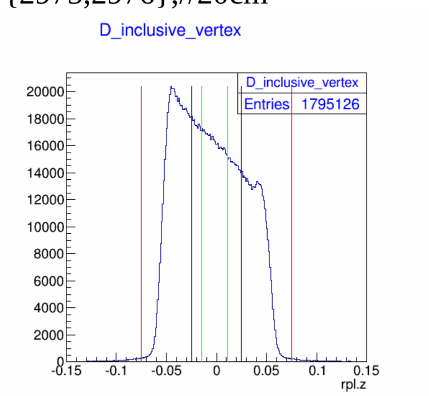
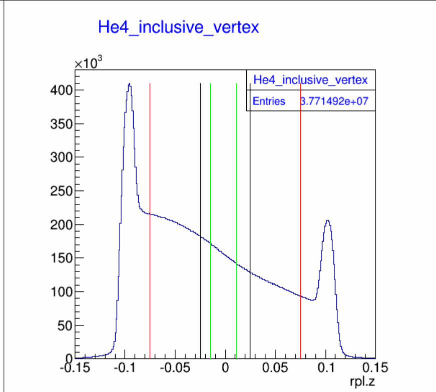
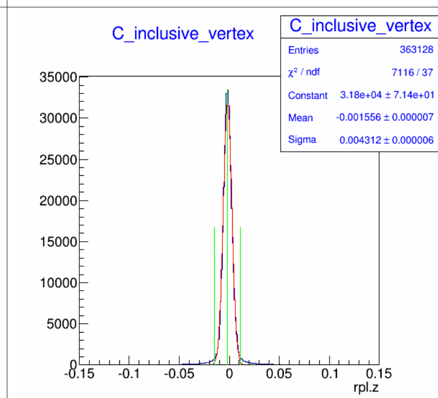
Cut_3: End-cap (vertex) cut:
- D-20cm: at |rpl.z|<=7.5 cm
- D-10cm: at |rpl.z|<=2.5 cm
- He-20cm: at |rpl.z|<=7.5 cm
- C-slated: at |rpl.z+0.16|<=1.30 cm (3*sigma fit)

Table 1:

Comparing targets	End-cap (vertex) cut & vertex data selection
D-20cm & He-20cm	at |rpl.z|<=7.5 cm (red-line)
D-10cm & He-20cm	at |rpl.z|<=2.5 cm (black-line)
(He || D)& C-slated	at |rpl.z+0.16|<=1.30 cm (green-line)

Table 2:

D2	He4	C12

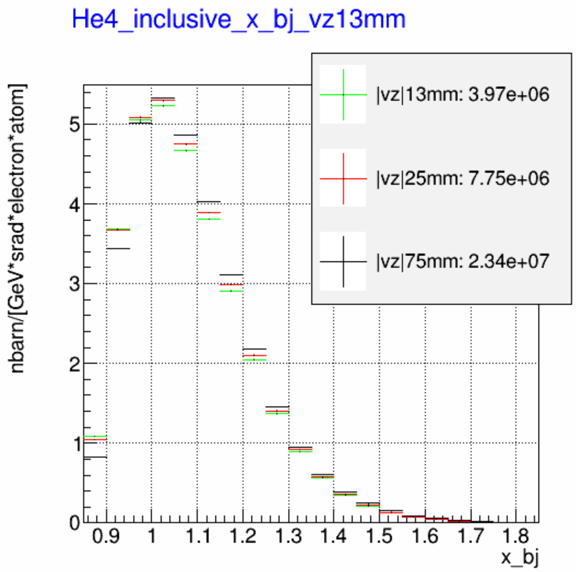

V1:
int runlist_D20[2] = {2975,2976};//20cm

V2:
int runlist_D10[8] = {3171,3172,3173,3174,3175,3176,3177,3178};//10cm
	
	V3:
	All kin 12 data
		
		V4:
		runlist_C[] = {2977,2979,2981}
		
		the target is 0.25mm(??) thick with 20 degree slated.
		The area-density = 0.0419+/-0.0005 g/cm^2
		if 90 degree to the beam.
		But with slated angle, we have to modify the area-density (where the beam seen) with 0.0419/sin(20)

Now we can calculate cross section with the following parameters.
Table 3:

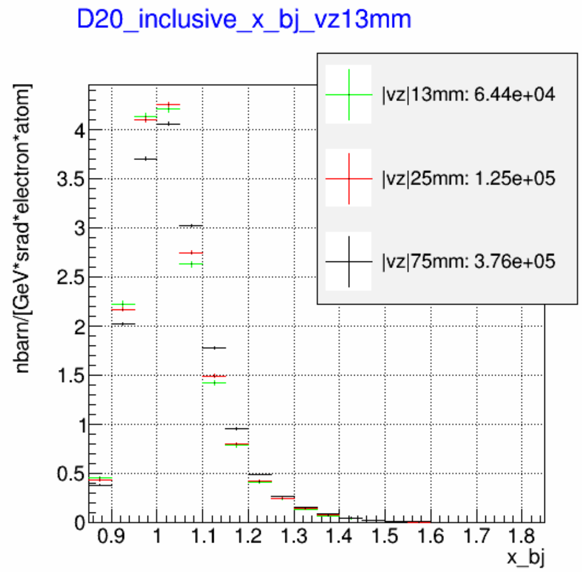
		Ld2 (10cm) (3171-78)	He4 Kin12	C12 (2977,2979,2981)	Ld2 (20cm) (2975-6)
parameter	**unit**	**value**	**value**	**value**	**value**
Target Density	g/cm^3	0.168	0.034	0.0419 g/cm^2	0.168
Target Length	cm	5	15	*add: 1/sin(20 deg)	15
(Target Density)*(target Length)	g/cm^2	0.838	0.508	0.123	2.513
N_A	atom/mol	6.020E+23	6.020E+23	6.020E+23	6.020E+23
A_z	g/mol	2	4	12	2
(Target Density)(target Length)*N_A/A_z*	*(g/cm^3)*(cm) *(atom/mol)*(mol/g) =atom/cm^2*	*2.52E+23*	*7.64E+22*	*6.15E+21*	*7.57E+23*
Total Charge	C	3.89E-02	2.27E+00	1.55E-01	6.50E-03
Electron charge	C/electron	1.60E-19	1.60E-19	1.60E-19	1.60E-19
N_electron = (Total Charge)/(electron charge)	*(C)/(C/electron) =electron*	*2.43E+17*	*1.42E+19*	*9.68E+17*	*4.06E+16*
N_electron_target_area_number_density = [(Total Charge)/(electron Charge)] *[(Target Density)*(target Length)*N_A/A_z]	**electron*atom*cm^-2**	**6.13E+40**	**1.09E+42**	**5.95E+39**	**3.07E+40**
dE_electron	GeV	0.31	0.31	0.31	3.100E-01
sin(L_angle)		0.347	0.347	0.347	0.347
L_theta	rad	0.12	0.12	0.12	0.12
L_phi	rad	0.06	0.06	0.06	0.06
dE_e*d2_omega_e = dE_electron*sin(L_angle)*L_theta*L_phi	**GeV*srad**	7.744E-04	7.744E-04	7.744E-04	7.744E-04
Factor = (dE_e*d2_omega_e)^-1* (N_electron_target_area_number_density)^-1	**Cm^2 -------------------------------------- [GeV*srad*electron*atom]**	2.106E-38	1.190E-39	2.172E-37	4.201E-38
[1 Barn = 1e-24 cm^2]	**barn -------------------------------------- [GeV*srad*electron*atom]**	2.106E-14	1.190E-15	2.172E-13	4.201E-14
[1 nBarn = 1e-33 cm^2]	**nbarn -------------------------------------- [GeV*srad*electron*atom]**	**2.106E-05**	**1.190E-06**	**2.172E-04**	**4.201E-05**
	cross section = factor *N_pass_cut				

Correction Factor		Ld2 (10cm) (3171-78)	He4 Kin12	C12 (2977,2979,2981)	Ld2 (20cm) (2975-6)
dead time		**5.0%**	**15.0%**	**6.5%**	**7.0%**
L single track efficiency		99.4%	99.5%	99.8%	99.4%
total correction factor		**1.06E+00**	**1.18E+00**	**1.07E+00**	**1.08E+00**

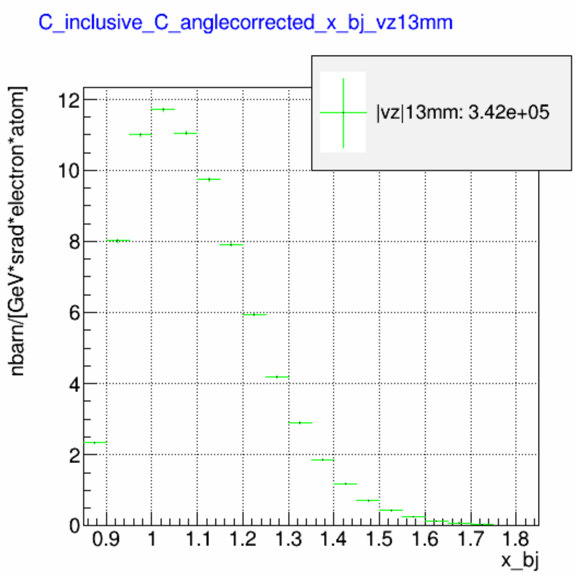
Table 4.: The Inclusive cross section in x_bj distribution for He4, C and D. (With Correction Factor)



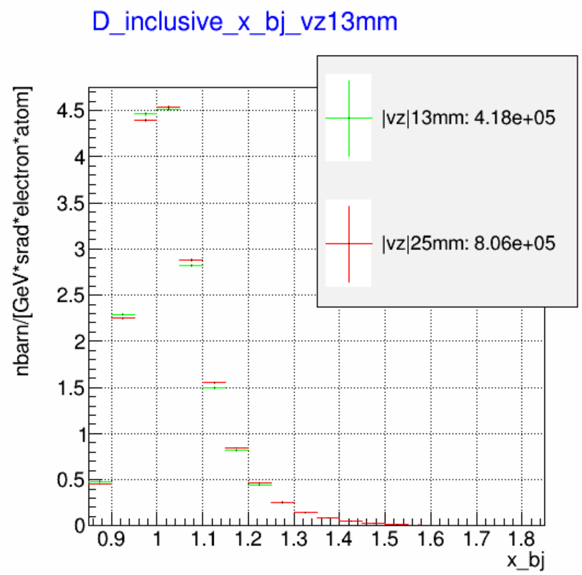
X1*:
Inclusive Cross Section for He4



X2*:
Inclusive Cross Section for D (20-cm size)



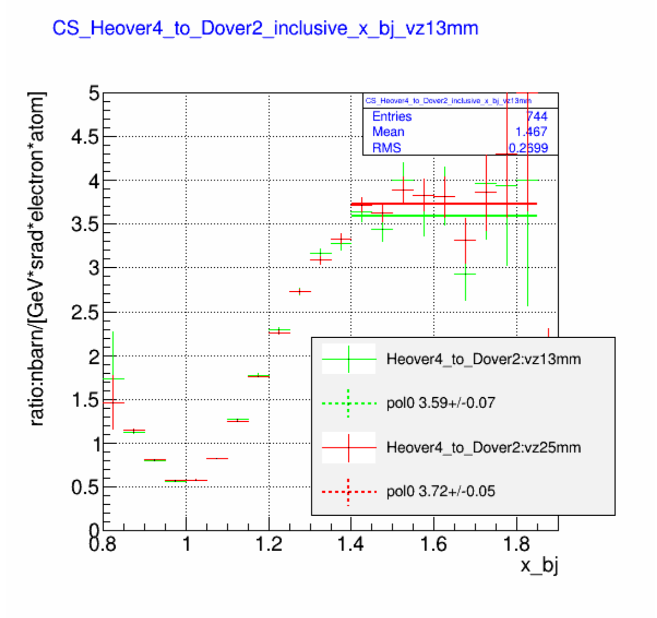
X3*:
Inclusive Cross Section for C



X4*:
Inclusive Cross Section for D (10-cm size)

Consider the difference in the cross section for 20-cm and 10-cm Deuteron X2* & X4*. This can be cause by other factor which have to be further investigate. Maybe the density are quite difference in those two difference time? Maybe the boiling effect are differ for different length target?

Table 5: Inclusive Cross section ratio for C12, He, D (with correction factor)



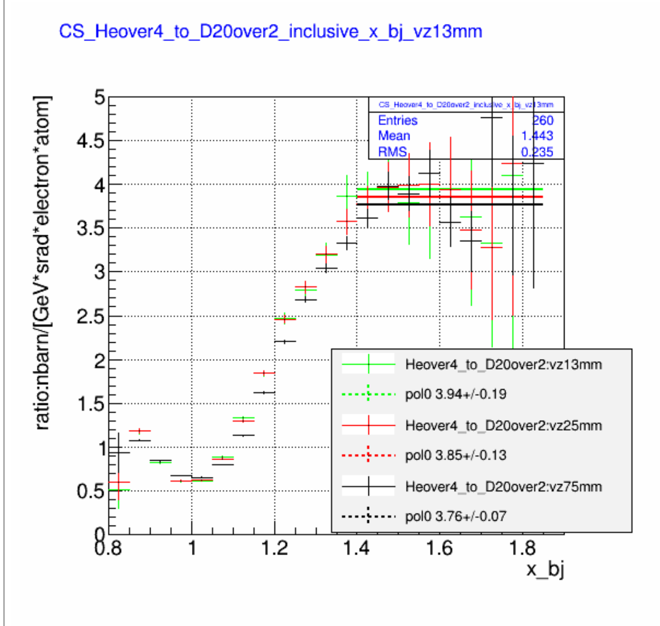
R1*:He/4 to D/2 (10cm-length)

give a2 pol0 3.59+/-0.07(fit only)

pol0 3.72+/-0.05

compare to a2(He) at 3.60*

{N. Fomin et al, physi. Rev. Lett 108, 092502(2012)} with Q2 = 2.7-6.4



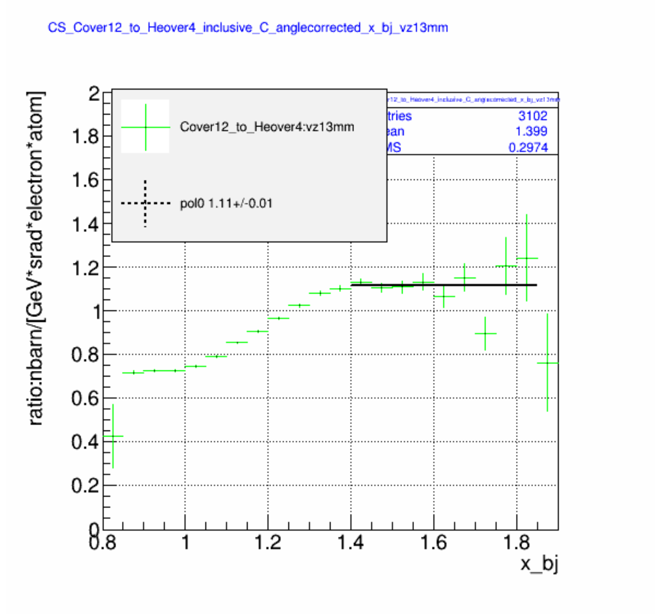
R2*:He/4 to D/2 (20cm-length)

give a2 pol0 3.94+/-0.19

pol0 3.85+/-0.13

pol0 3.76+/-0.07

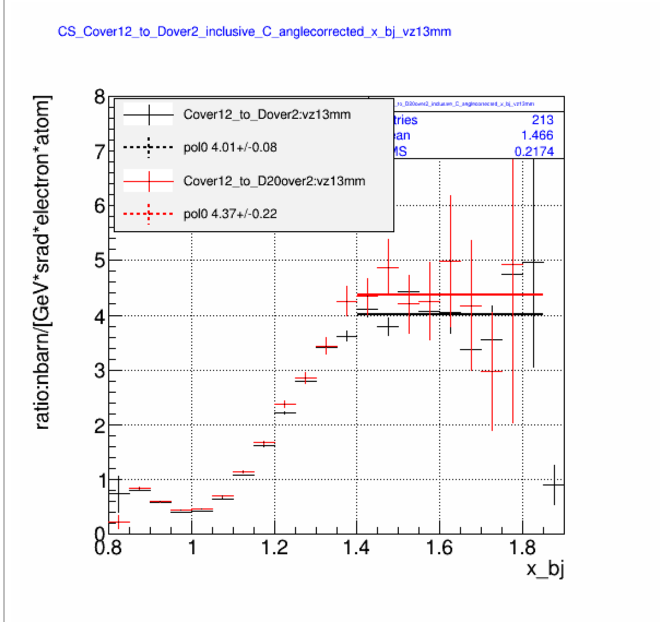
compare to a2(He) at 3.60*



R3*:

C/12 to He/4

give flat region at pol0 1.11+/-0.01



R4*:

C/12 to D/2

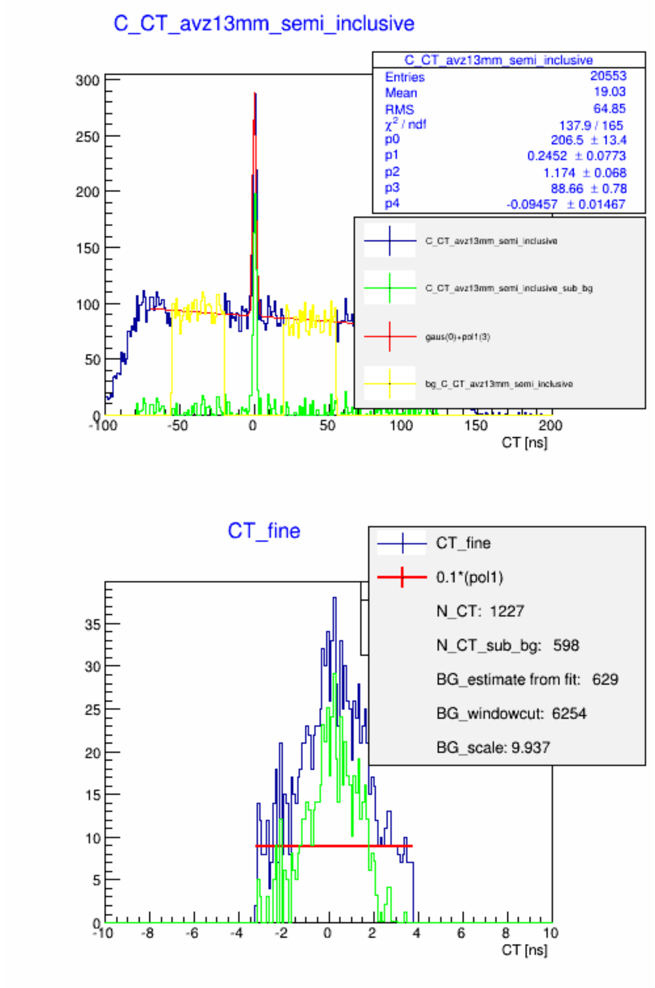
give a2 pol0 4.01+/-0.08

pol0 4.37+/-0.22

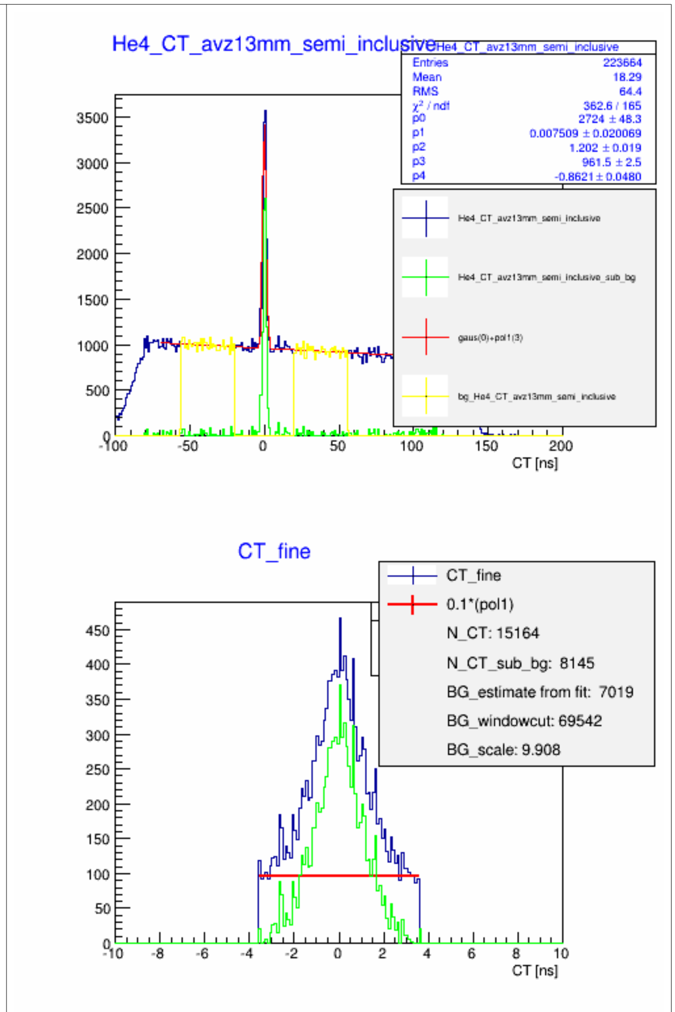
compare to a2(C) at 4.75*

Semi-inclusive:D , He, C

1. C to He



A1: carbon CT with {mean,sigma} = {0.25,1.17} ns



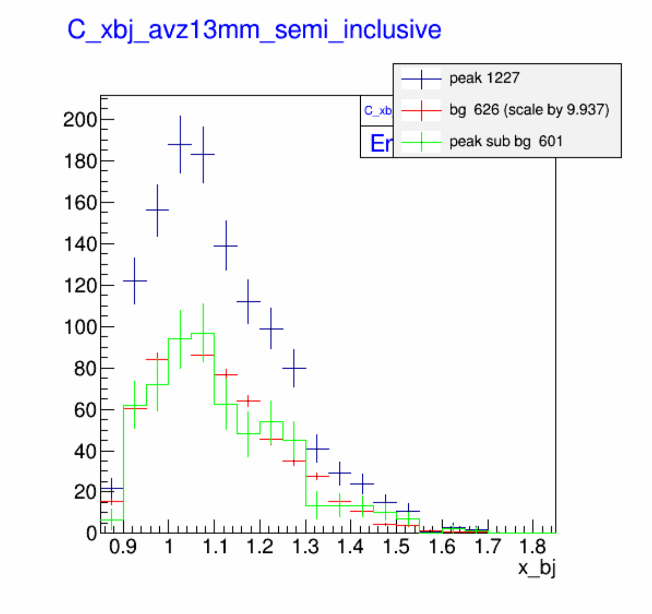
A2: He CT with {mean,sigma} = {0.01,1.20} ns

*[cut:L.electron_id==1&& abs(exL.th)<=0.06&&abs(exL.ph)<=0.03 &&abs(exL.p-3.6)<=0.155 && abs(rpl.z-0.0016)<=0.0130 && BB.tr.n==1 && BB.proton_id[0]==1 &&abs(rpl.z-BB.tr.tg_y[0]*1.12+0.007)<=0.06 && abs(BB.tr.tg_th[0]-0.1)<=0.350 &&abs(BB.tr.tg_ph[0])<=0.080]*

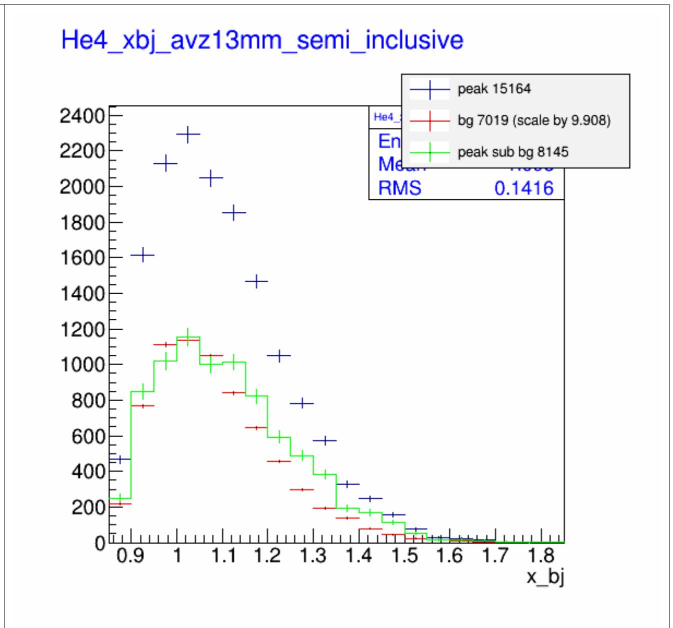
The cut in CT is 3*sigma which cover 99.7% correcting for the lost by 0.3%.

But it is also with 2*sigma which cover 95.45% and correcting for the lost by 4.55%.

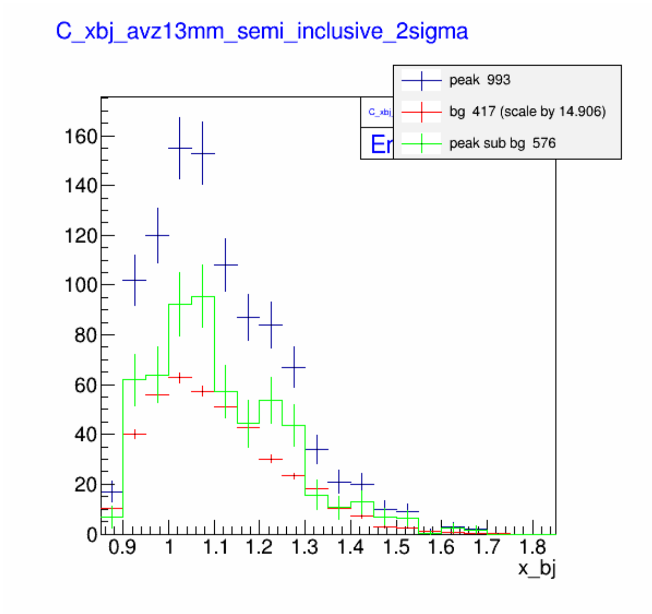
But the background by 1/3.



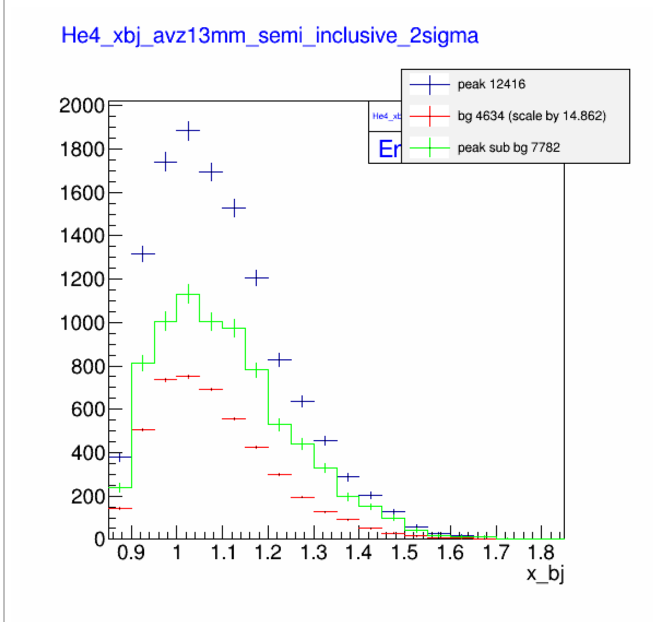
A3.1: Carbon: x_bj with 3*sigma cut in CT



A4.1: He: x_bj with 3*sigma cut in CT



A3.2: Carbon: x_bj with 2*sigma cut in CT



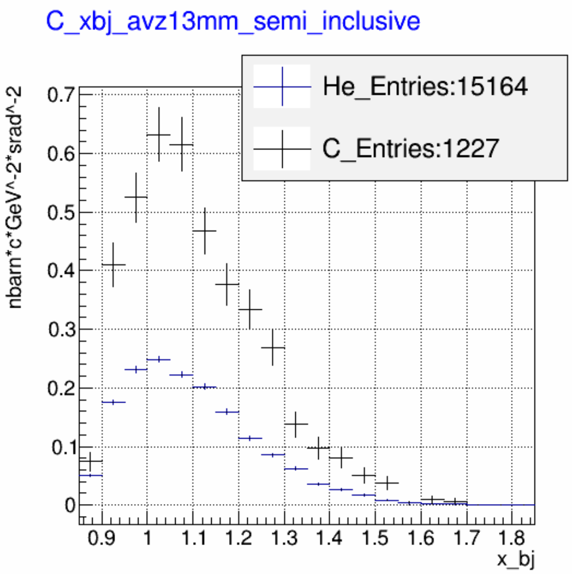
A4.2: He: x_bj with 2*sigma cut in CT

Cross section factors:

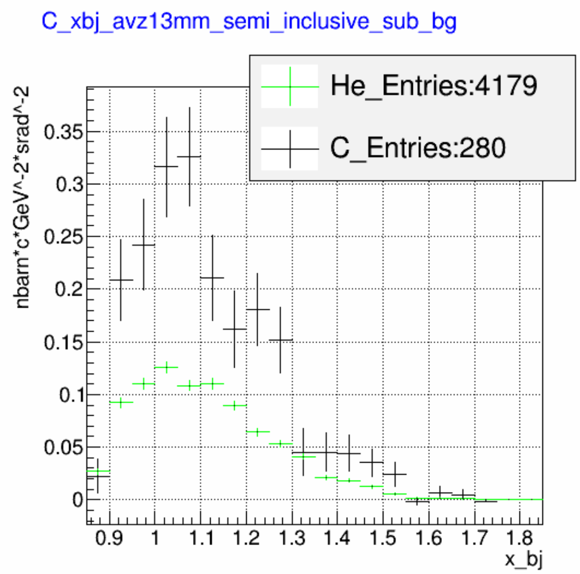
		He4 Kin12	C12 (2977,2979,2981)
parameter	**unit**	**value**	**value**
Target Density	g/cm^3	0.034	0.0419 g/cm^2
Target Length	cm	2.6	*add: 1/sin(20 deg)
(Target Density)*(target Length)	g/cm^2	0.088	0.123
N_A	atom/mol	6.020E+23	6.020E+23
A_z	g/mol	4	12
(Target Density)(target Length)*N_A/A_z*	*(g/cm^3)*(cm) *(atom/mol)*(mol/g) =atom/cm^2*	*1.32E+22*	*6.15E+21*
Total Charge	C	2.27E+00	1.55E-01
Electron charge	C/electron	1.60E-19	1.60E-19
N_electron = (Total Charge)/(electron charge)	*(C)/(C/electron) =electron*	*1.42E+19*	*9.68E+17*
N_electron_target_area_number_density = [(Total Charge)/(electron Charge)] *[(Target Density)*(target Length)*N_A/A_z]	**electron*atom*cm^-2**	**1.88E+41**	**5.95E+39**
dE_electron	GeV	0.31	0.31
sin(L_angle)		0.347	0.347
L_theta	rad	0.12	0.12
L_phi	rad	0.06	0.06
dE_e*d2_omega_e = dE_electron*sin(L_angle)*L_theta*L_phi	**GeV*srad**	7.74E-04	7.74E-04
dp_proton	GeV/c	0.60	0.60
sin(BB_angle)		0.99	0.99
BB_theta	rad	**0.70**	**0.70**
BB_phi	rad	**0.16**	**0.16**
dp_pro*d2_omega_p = dp_proton*sin(BB_angle)*BB_theta*BB_phi	**GeV/c*srad**	6.67E-02	6.67E-02
dE_e*d2_omega_e*dp_pro*d2_omega_p = dE_electron*sin(L_angle)*L_theta*L_phi* dp_proton*sin(BB_angle)*BB_theta*BB_phi	**GeV^2*c^-1*srad^2**	5.16E-05	5.16E-05
Factor = 1./(dE_e*d2_omega_e*dp_pro*d2_omega_p) /(N_electron_target_area_number_density)	**cm^2*c ------------------------- GeV^2*srad^2**	**1.03E-37**	**3.26E-36**
Factor [Barn = 1e-24 cm^2]	**Barn*c ------------------------- GeV^2*srad^2**	1.03E-13	3.26E-12
[nbarn = 1e-33 cm^2]	**Nbarn*c ------------------------- GeV^2*srad^2**	**1.03E-04**	**3.26E-03**

correction factor		He4 Kin12	C12 (2977,2979,2981)
dead time		15.0%	6.5%
L single track efficiency		99.5%	99.8%
BB track efficiency		79.0%	79.0%
BB single track efficiency		89.5%	82.9%
total correction factor		1.67	1.64

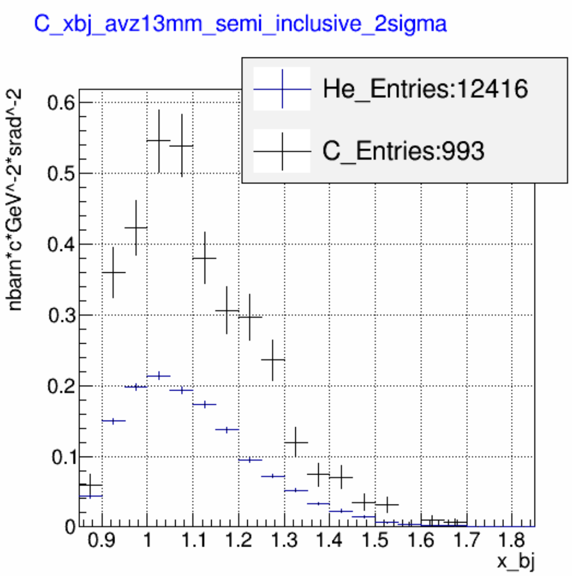
The cross section in x_bj distribution.



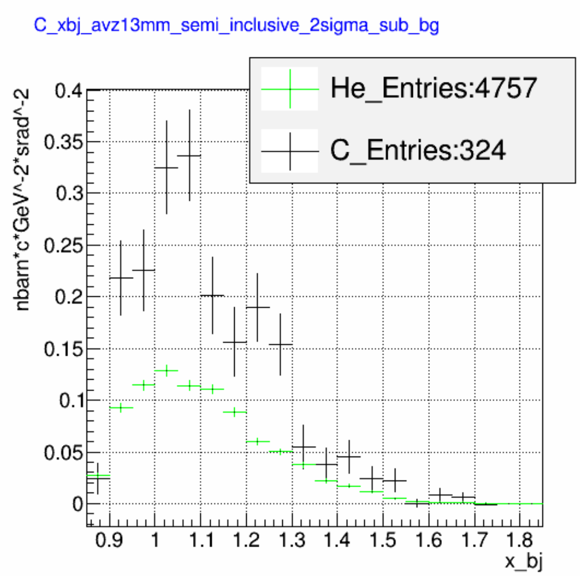
A5.1 cross section within CT no background subtracion.
black: Carbon cross section (3*sigma CT)
blue: He cross section (3*sigma CT)



A5.2 cross section within CT **WITH** background subtracion.
black: Carbon cross section (3*sigma CT)
green: He cross section (3*sigma CT)

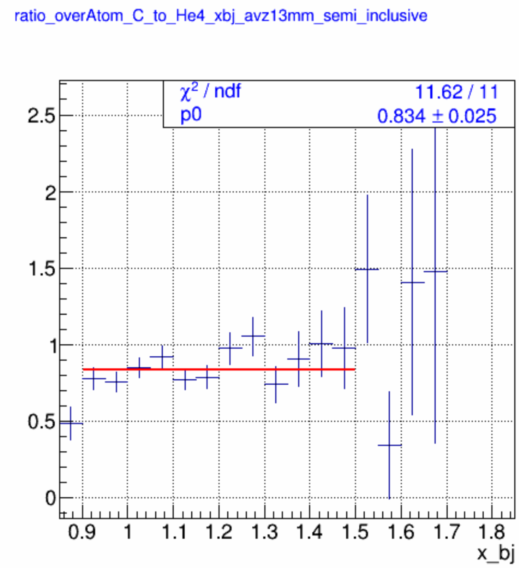


A5.3 cross section within CT no background subtracion.
black: Carbon cross section (2*sigma CT)
blue: He cross section (2*sigma CT)
correction for 4.45% data lost

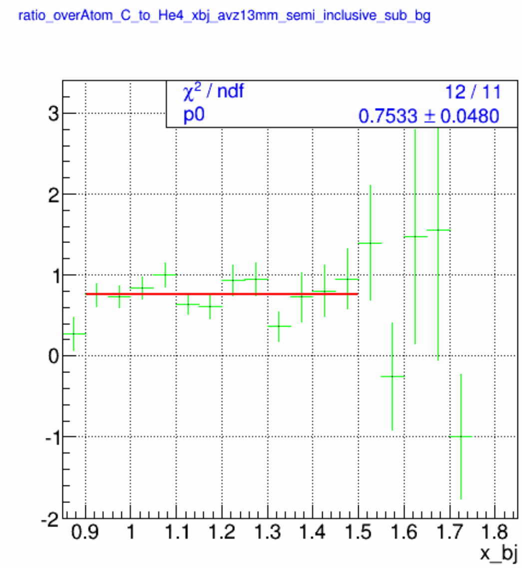


A.5.4 cross section within CT **WITH** background subtracion.
black: Carbon cross section (2*sigma CT)
green: He cross section (2*sigma CT)
correction for 4.45% data lost

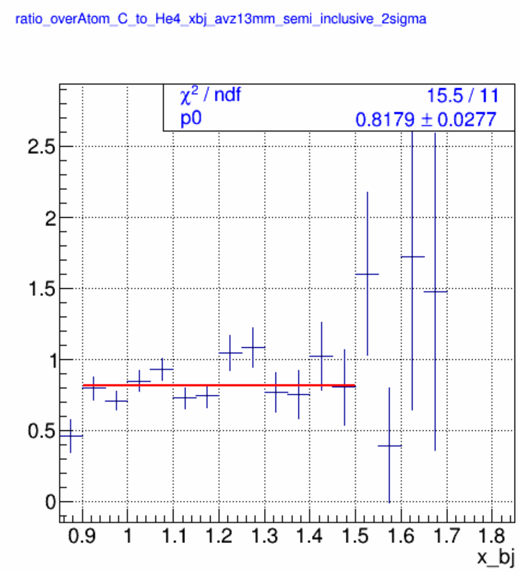
Now the cross section ratio of C/12 to He/4



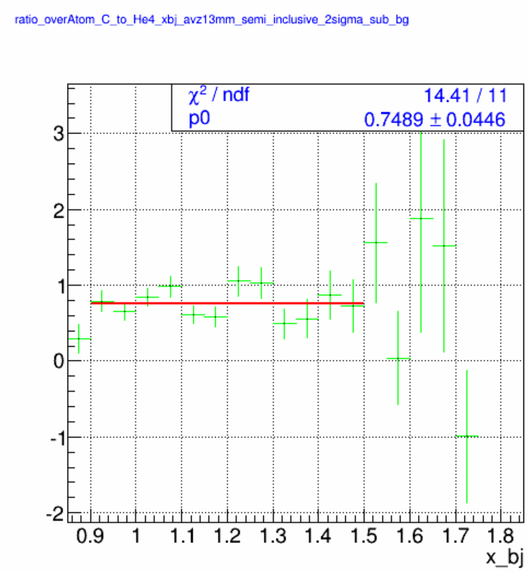
A6.1: The cross section ratio of C/12 to He/4 **without** background subtraction.
9.834+/- 0.025



A6.2: The cross section ratio of C/12 to He/4 **with** background subtraction.
0.753+/- 0.048



A6.3: The cross section ratio of C/12 to He/4 **without** background subtraction. (from 2*sigma and 4.45% correction)
0.8179+/-0.028



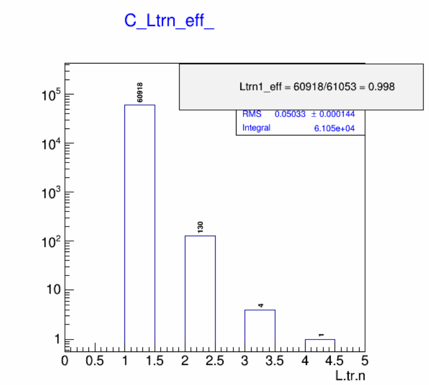
A6.4: The cross section ratio of C/12 to He/4 **with** background subtraction.(from 2*sigma and 4.45% correction)
0.749+/- 0.045

The flat region can be seen in range from x_bj = {0.9, 1.5} with the value of {9.834+/- 0.025, 0.8179+/-0.028} without bg subtracted,{ 0.753+/- 0.048, 0.749+/- 0.045} with bg subtracted.

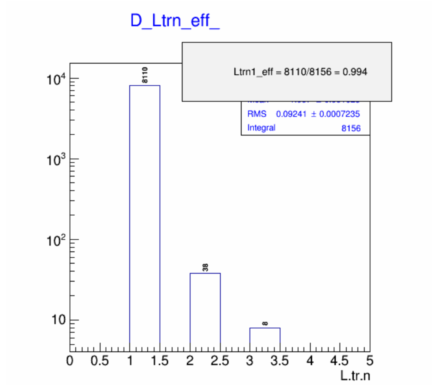
Correction Factors detail.

1. Ltrn single track efficiency

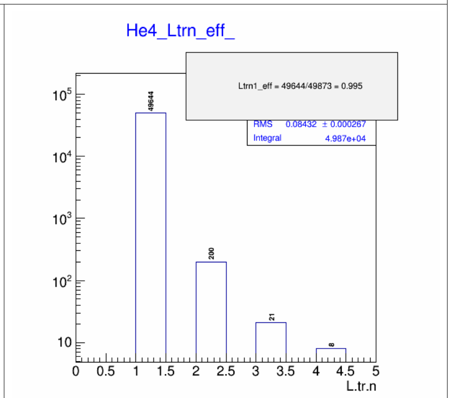
DBB.evtypebits&(1<<3) && DBB.edtpl==0 && DBB.l1a[0]>=120 && DBB.l1a[0]<=570 && (L.prl1.e+L.prl2.e)/(1000*exL.p)>=0.7 && abs(exL.th)<=0.06&&abs(exL.ph)<=0.03 &&abs(exL.p-3.6)<=0.155 && abs(rpl.z-0.0016)<=0.0130



C: 99.8%



D(20-cm): 99.4%



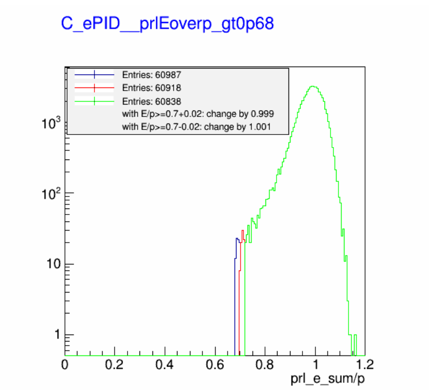
He: 99.5%
(sample set)

2. ePID efficiency

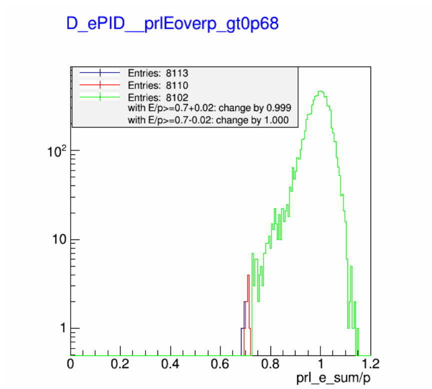
DBB.evtypebits&(1<<3) && DBB.edtpl==0 && DBB.l1a[0]>=120 && DBB.l1a[0]<=570 && L.tr.n==1 && abs(exL.th)<=0.06&&abs(exL.ph)<=0.03 &&abs(exL.p-3.6)<=0.155 && abs(rpl.z-0.0016)<=0.0130

the selection for ePID is with Esum/p>=0.7

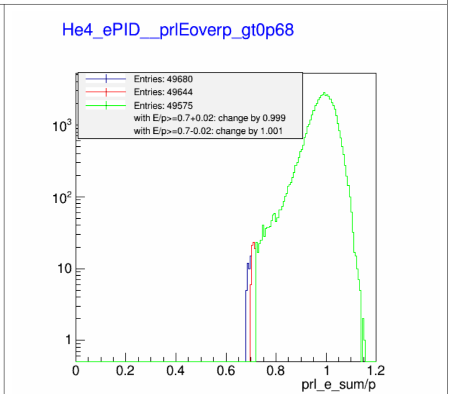
with && (L.prl1.e+L.prl2.e)/(1000*exL.p)>=0.7+/-0.02



Esum/p>=0.7+0.2 to 0.7
change by 0.1%
Esum/p>=0.7-0.2 to 0.7
change by 0.1%



Esum/p>=0.7+0.2 to 0.7
change by 0.1%
Esum/p>=0.7-0.2 to 0.7
change by< 0.1%



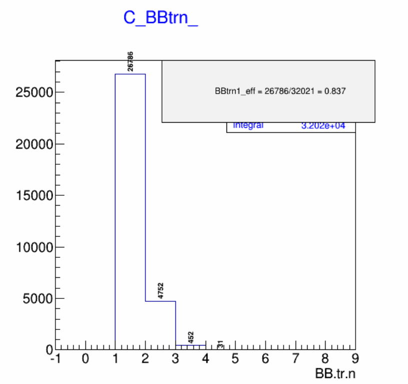
Esum/p>=0.7+0.2 to 0.7
change by 0.1%
Esum/p>=0.7-0.2 to 0.7
change by< 0.1%

L.electron_id = L.tr.n==1 && prl_Esum/p>=0.7

3. BB track efficiency: 79% average over all range of momentum from Hydrogen Elastic

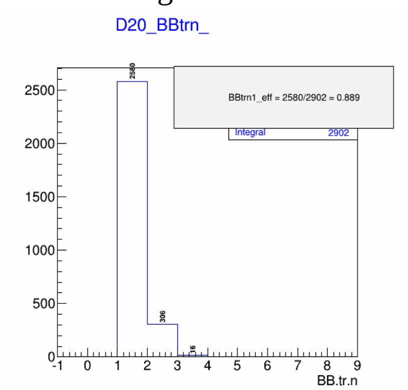
4. dead time		
6.5%	N/A	15%

4. BB_single_track_eff
L.electron_id==1 && abs(exL.th)<=0.06&&abs(exL.ph)<=0.03 &&abs(exL.p-3.6)<=0.155 && abs(rpl.z-0.0016)<=0.0130 && BB.proton_id[]==1

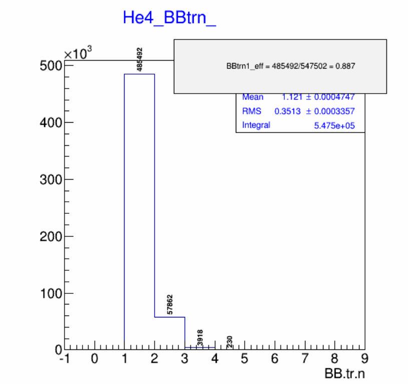


If choose single track in BB
: Eff = 83.7%

If choose single track in BB

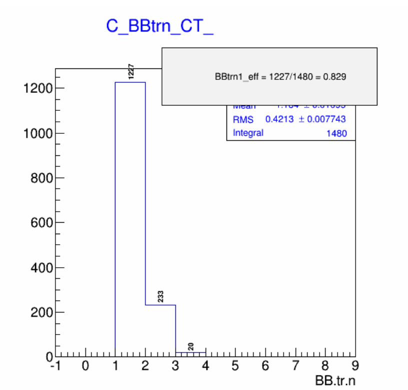


: Eff = 88.9%

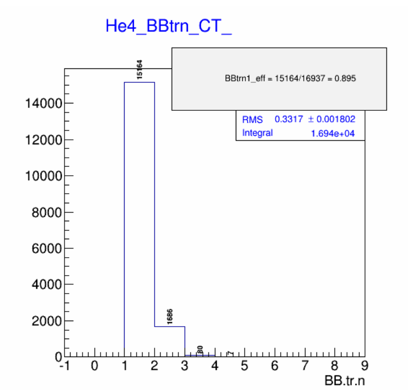


If choose single track in BB
: Eff = 88.7%

4.2 BB_single_track_eff in all Cut Coincidence time
L.electron_id==1 && abs(exL.th)<=0.06&&abs(exL.ph)<=0.03 &&abs(exL.p-3.6)<=0.155 && abs(rpl.z-0.0016)<=0.0130 && BB.tr.n>0 && BB.proton_id[]==1
&&abs(rpl.z-BB.tr.tg_y[]*1.12+0.007)<=0.06 && abs(BB.tr.tg_th[]-0.1)<=0.350
&&abs(BB.tr.tg_ph[])<=0.080 && abs(Kin.Cttime_pathcorr[]-mean)<=3*sigma



Not enough entries within CT cut
N/A



abs(Kin.CTtime_pathcorr[]-0.25) <=3.52 If choose single track in BB : Eff = 82.9%		abs(Kin.CTtime_pathcorr[]-0.01) <=3.61 If choose single track in BB : Eff = 89.5%