BB efficiency

I'm trying to determine the BigBite efficiency for detecting protons during the production. As already been presented, the efficiency of E plane scintillators is approximately 100% and momentum independent (of course when proton momentum is above punch through point in dE plane) and the efficiency of the dE plane is going down very sharply for the large momentum. The drop off the efficiency of the later is easily understood due to the small thickness of the bars with combination with the threshold. So the efficiency is totally determined by the MWDC.
I'm trying to perform a simplest method to determine the efficiency by comparing the number of events detected by E plane and number of events detected in the E plane with the requirement of tracking. We want to use this method during the production period.

In order to estimate the number of events I draw the TOF peak based on the E plane (I use the BB.tp.e.hit_tof variable) and count the Net number of events under the peak. In the next step I count the number of protons in the same region with additional cut BB.tr.n>0, require track. The numbers presented in the table 1.
In addition I used two cut on the position along the scintillator bar, 1) pos<0.2 and 2) pos<0.4, while the second case take all the data (random check with pos<0.1 give consistent results). Position distribution shown on fig 1:

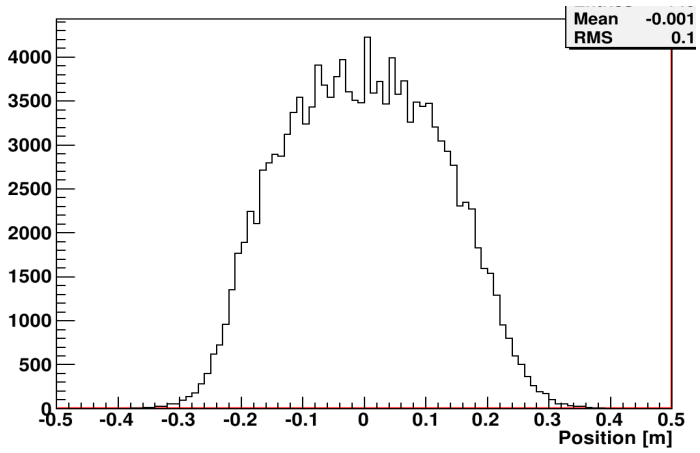

Fig 1: Position distribution along scintillator bar

During this test I can't use any cut for PID except the energy deposit in the E plane. The PID based on the momentum can't be used because it calculated based on MWDC and dE/E can't be used due to the very small efficiency of dE at large momenta.
Before I estimated the efficiency I verified that distributions with the MWDC doesn't drop at some point. On fig 2, position (scintillator based) vs in plane angle based on MWDC.

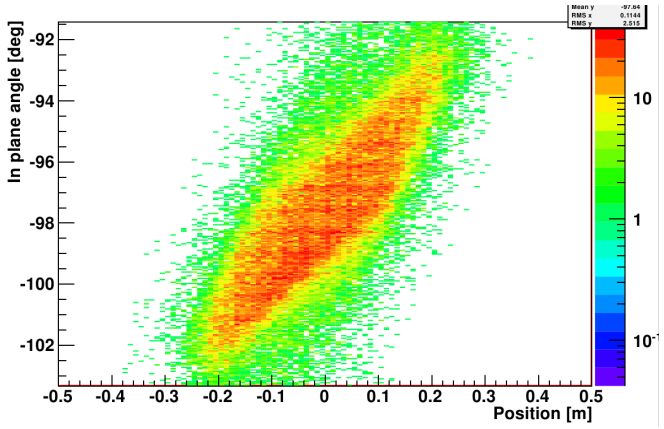

Fig 2: In plane angle vs position. Example from run 3121

On fig 3 corrected TOF vs in plane angle:

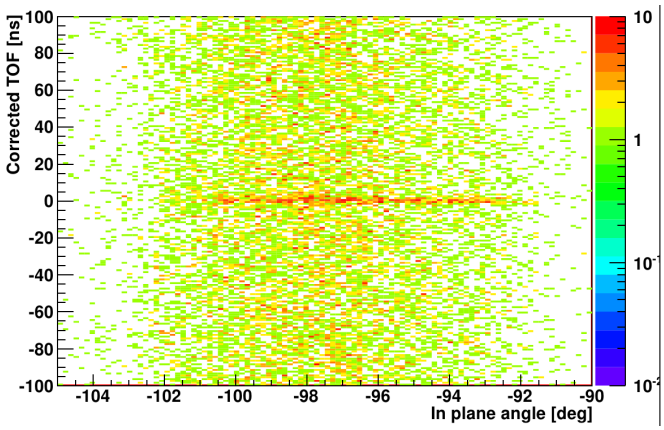

Fig 3: Corrected TOF vs in plane angle. Example from run 3121

I took different runs from production, the runs that I used listed in the table 1:

	Runs number*	**#e,e'p_r****		**#e,e'p_r with track>0**		**Efficiency for cut on pos<0.2**		**Efficiency for cut on pos<0.4**	
		Pos<0.2	Pos<0.4	Pos<0.2	Pos<0.4	Eff	Error***	Eff	Error
1	3030, 3032	1986	2232	1539	1711	77	1	79	1
2	3040, 3043, 3044	2573	3054	2103	2427	82	1	79	1
3	3051, 3052, 3053	3624	3990	2512	2789	69	1	70	1
4	3062, 3063, 3064	2751	2996	2280	2551	83	1	85	1
5	3081, 3082, 3083	3150	3384	2554	2681	81	1	79	1
6	3090, 3091, 3092	2491	2778	1938	2187	78	1	79	1
7	3100, 3103, 3105	2544	2683	1880	2053	74	1	77	1
8	3111, 3112	1942	2224	1501	1760	77	1	79	1

9	3120. 3121	2037	2104	1765	1899	87	1	90	1
10	3130, 3135	2253	2475	1964	2145	87	1	87	1
11	3141, 3142	2324	2600	1812	2051	78	1	79	1
12	3190, 3191	2188	2537	1701	1997	78	1	79	1
13	3200, 3201	2313	2658	1631	1911	71	1	72	1
14	3222, 3223	2023	2454	1360	1715	67	1	70	1
15	3240, 3241	2781	3032	2161	2366	78	1	78	1
16	3260, 3261	2227	2464	1679	1888	75	1	77	1
17	3289, 3281	1736	2045	1302	1547	75	1	76	1
18	3299, 3300	1923	2278	1370	1650	71	1	72	1
19	3320, 3321	2547	2885	1981	2283	78	1	79	1
20	3350, 3351	2604	2998	1812	2072	70	1	69	1
21	3360, 3361	2088	2342	1629	1849	78	1	79	1
22	3380, 3381	2351	2655	1869	2182	79	1	82	1
23	3400, 3401	1909	2198	1519	1801	80	1	82	1
24	3421, 3422	2344	2689	1876	2171	80	1	81	1

* the runs number that I chained in order to increase statistics
** number of events under the peak after background subtraction, see text.
*** Error determined based on the inefficiency.

The summary of the table 1 is shown on Fig 4:

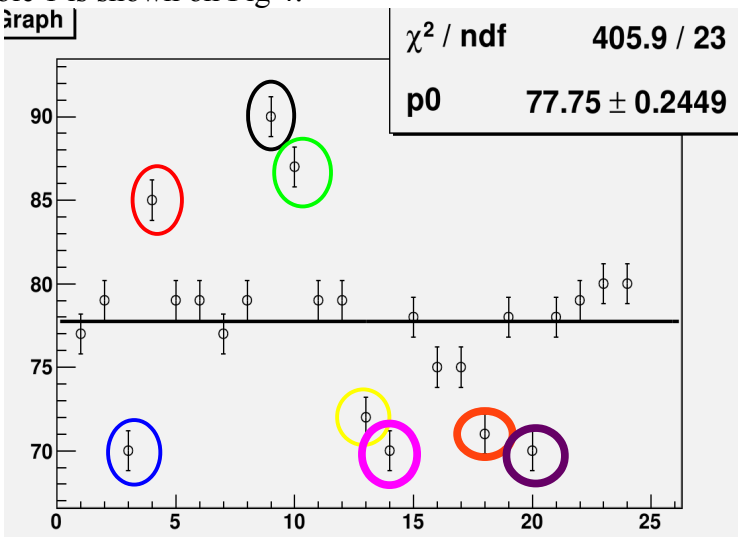

Fig 4: efficiency vs runs (number is based on the table)

BigBite efficiency during the production using the triple 81 ± 8.9% for 625 MeV/c kinematics and 74±9.4 % for 750 MeV/c.
If we average these two measurements we get **77.5 ± 6.5%.**

Problem:
Why we have such big fluctuation in the efficiency when the background normalized per charge is roughly the same during the runs?

Appendix:

Background normalized to charge for the runs from the table shown on Fig A1:

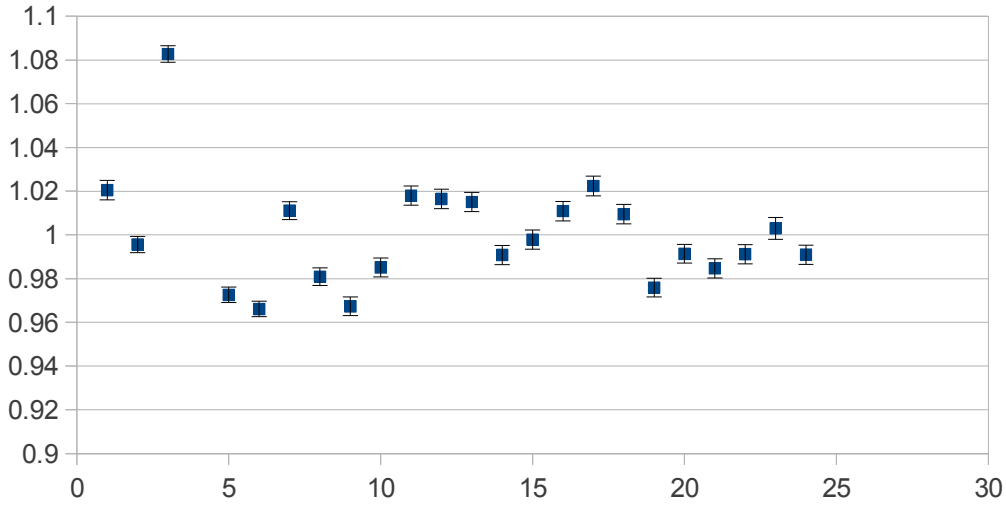

Fig A1: Background level normalized to charge.

Third point is strongly deviate from the average (much higher background) and it correlated to low efficiency. It's also correlated with the point on fig A2.

stability of the background during the production (triple coincidence case):
fig A2 – A3, show the background level normalized to charge for 625 and 750 MeV/c

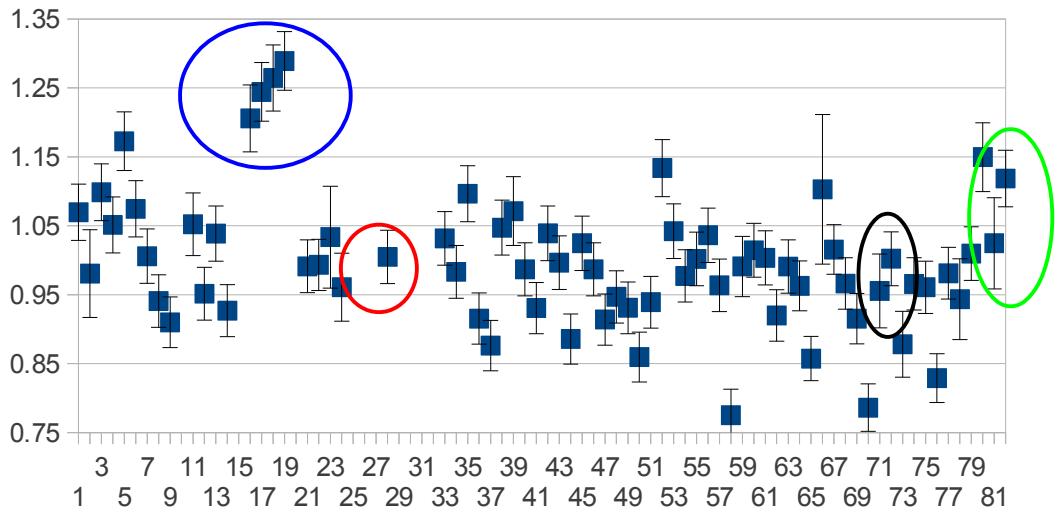

Fig A2: 625 MeV/c

Four points in the graph above, numbered: 16 – 19 , deviate from unity and these point correlated to the point number 3 on figure 4 (or the table). So, here we see that for larger background we have lower efficiency.

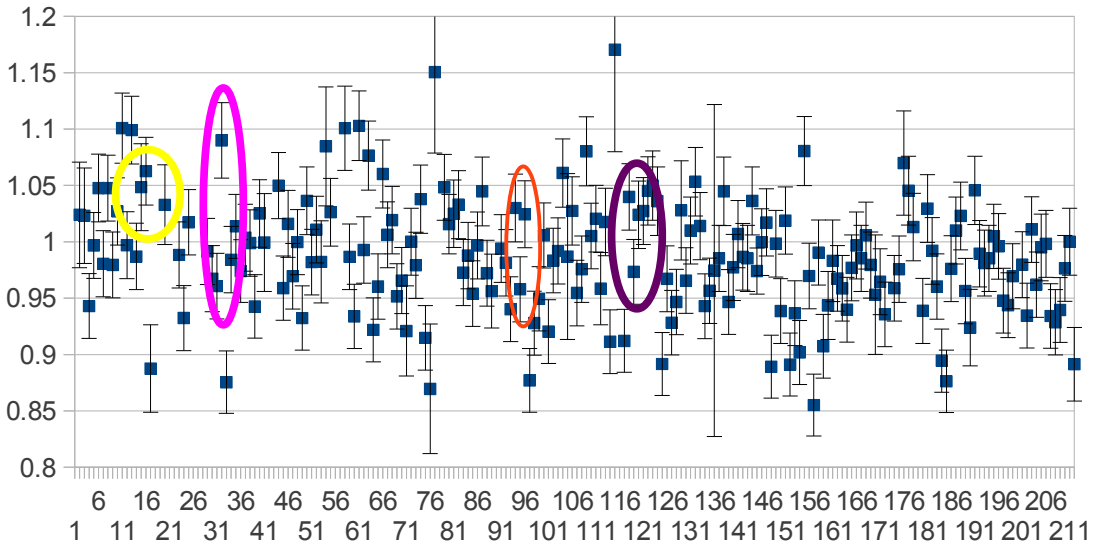

Fig A3: 750 MeV/c