

Data Analysis

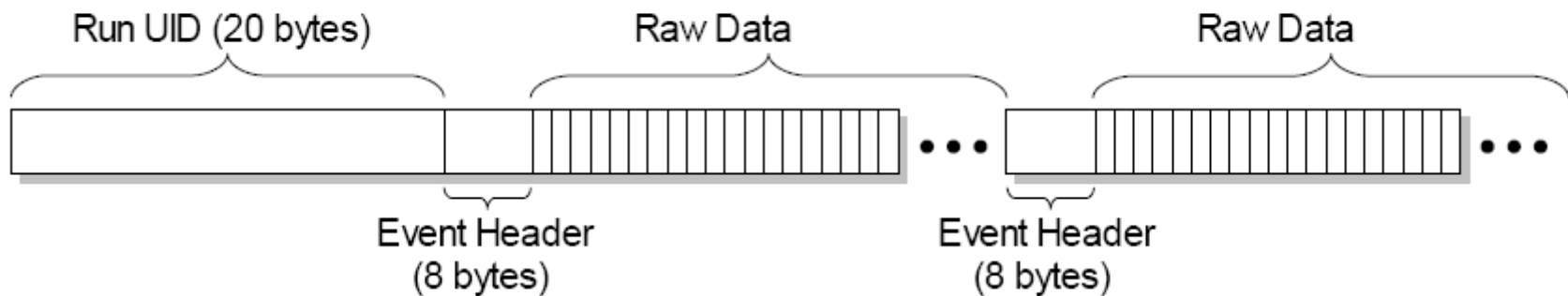
For **AT-TPC** Test Chamber

Hongwei WANG

Read data from the binary file

1 Data format:

The following drawing summarizes the data file format:



2 Byte swap:

WARNING: All binary numbers are in “Big Endian format”, also called the “network byte order” meaning that *the most significant bytes come first*. On Intel platforms, the numbers are in “Little Endian” format so that when you read a Big Endian 4-byte integer from the data file, *you have to swap the bytes*. This is done using the `ntohl()` and `ntohs()` standard functions respectively for 32-bit and 16-bit integers (The meaning of the function names are ‘network to host long’ and ‘network to host short’). To use these functions you have to include `<arpa/inet.h>` on Linux/Unix platforms and `<winsock2.h>` on Windows.

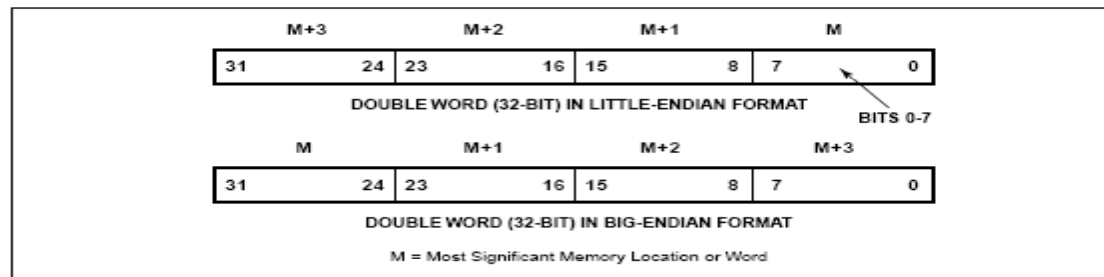


Figure 1. Big Endian vs. Little Endian Memory Formatting

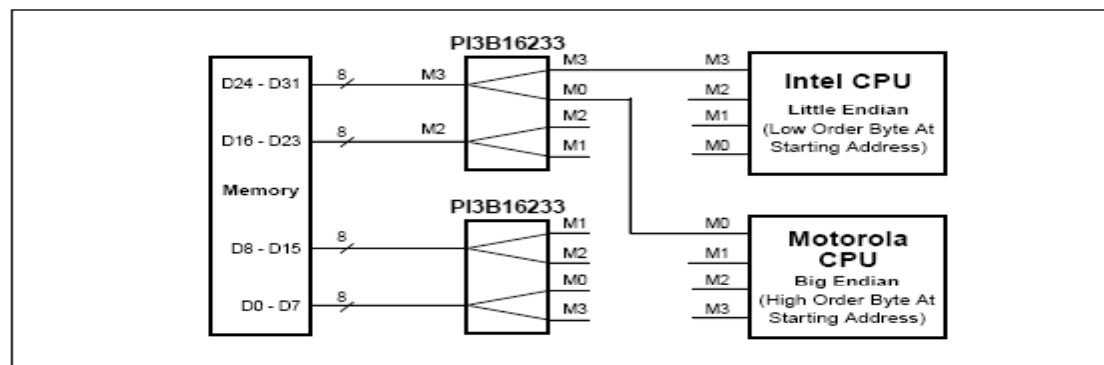


Figure 2. Converting Between Big Endian and Little Endian

3 Unsigned integer: (4 byte), in Fortran, no such data type, the last bit(15) is sign bits .

We solved these problems by use **the ishifc, ibits** and **mvbits** intrinsic functions in Visual Fortran 6.5.

But we also find they have different definition in **gfortran (gcc)** and **Visual Fortran**, especially for **open . ?**

Event Num

Raw data

ASCII Format

Pad Num

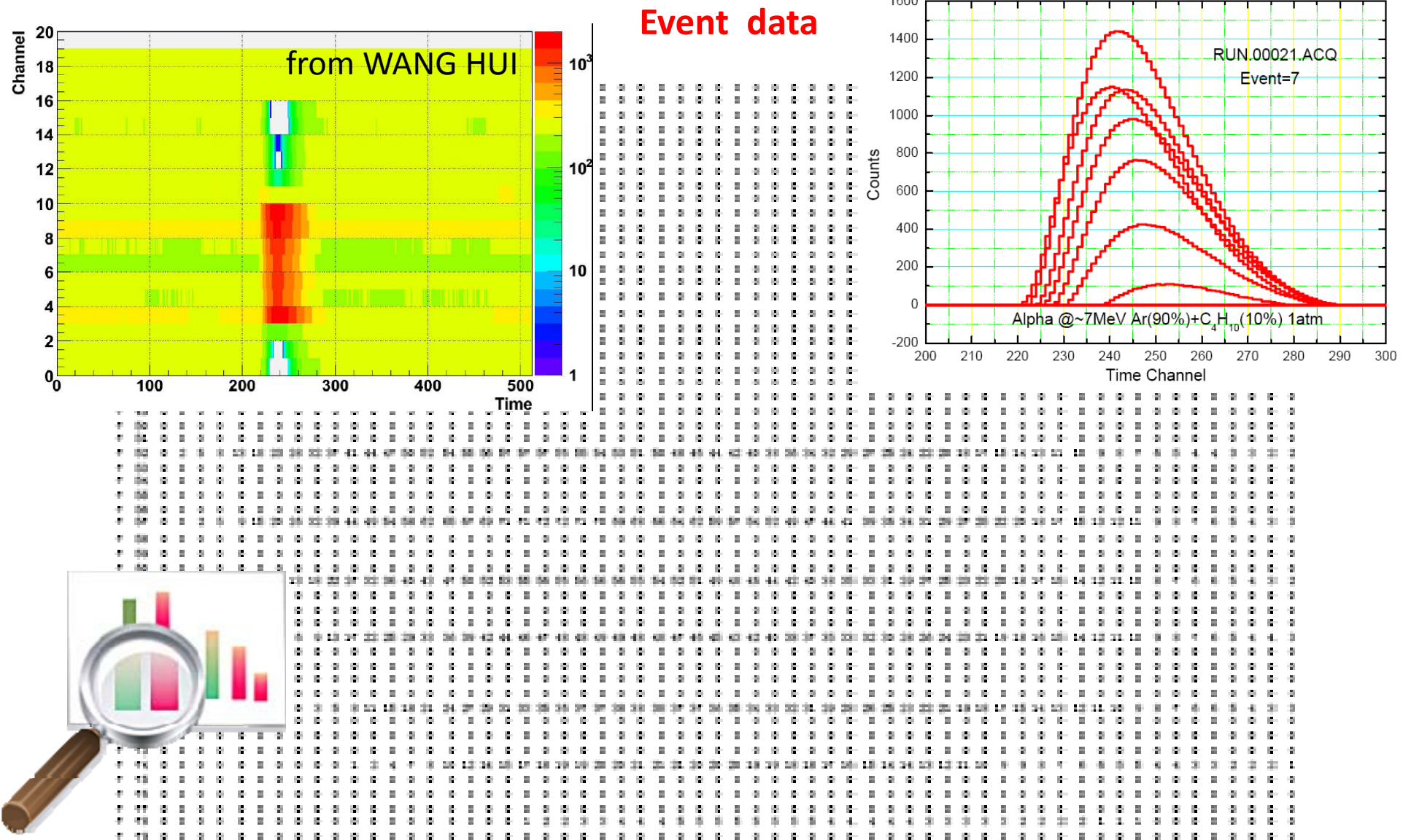


Time channel 1-512

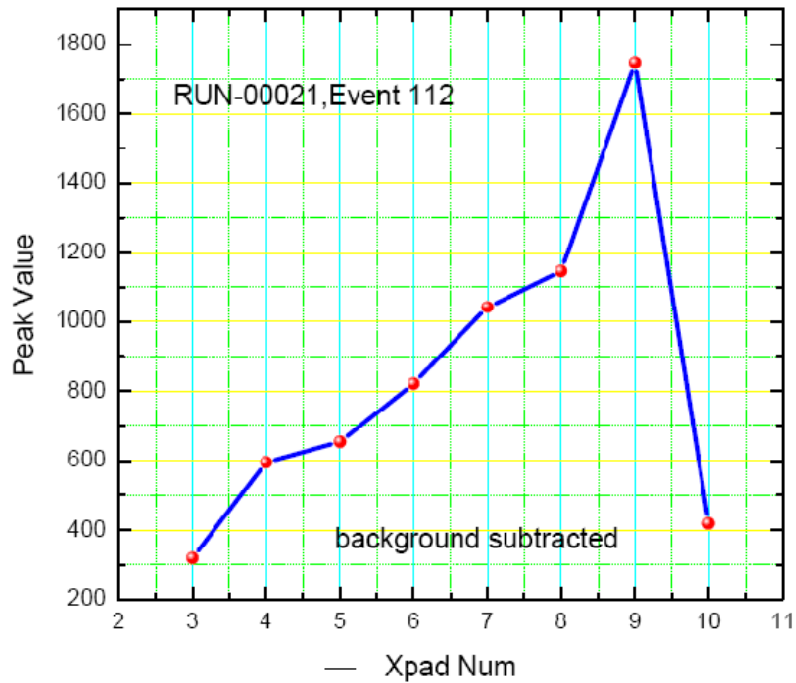
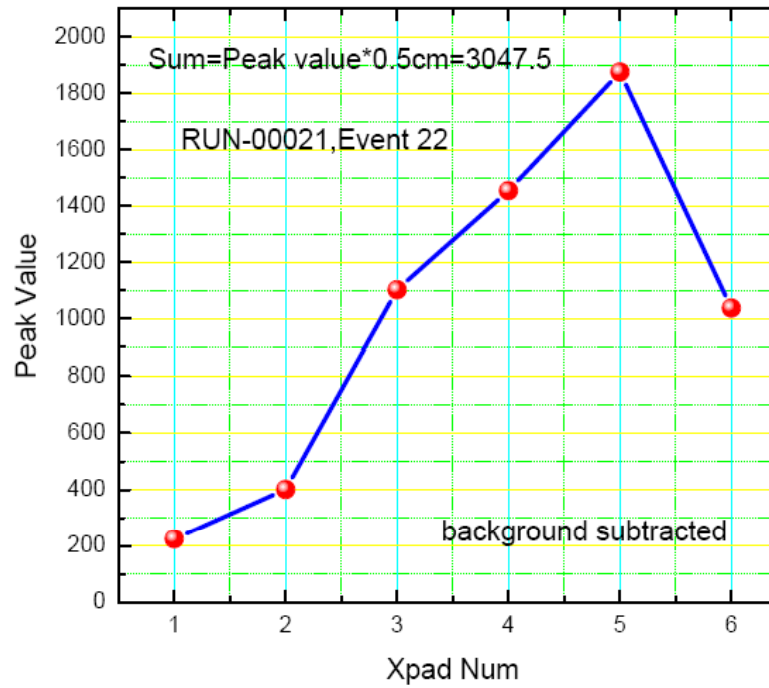
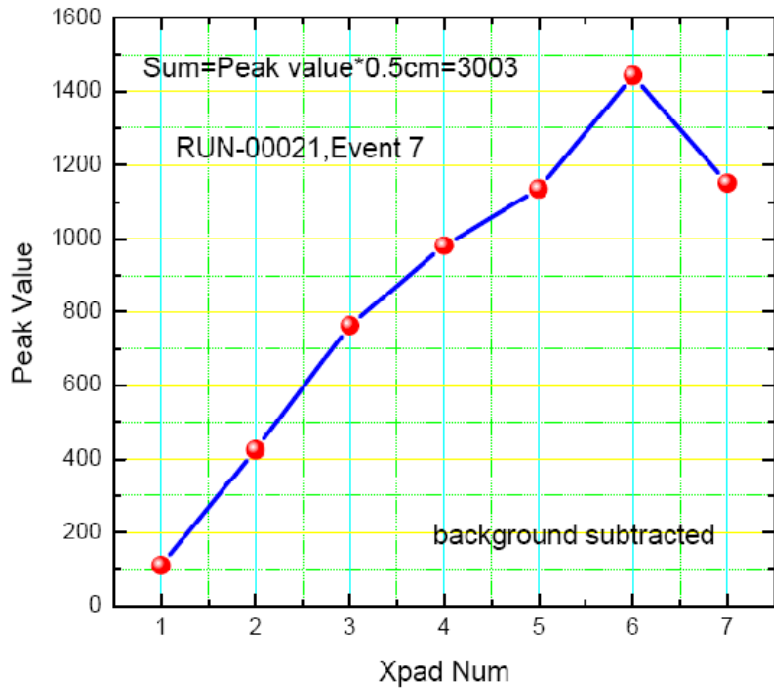
1	1	152	134	128	128	125	113	99	112	125	132	149	155	149	133	131	133
1	2	269	267	264	266	264	264	263	262	260	260	259	260	264	260	262	264
1	3	306	287	275	270	266	258	250	257	275	284	300	309	298	280	272	277
1	4	280	269	260	259	253	241	224	233	253	263	276	279	274	259	254	253
1	5	138	134	147	129	94	83	104	138	160	159	142	136	116	91	86	112
1	6	287	289	290	292	293	297	288	287	289	287	286	284	286	280	278	273
1	7	292	288	295	270	234	222	244	282	313	305	285	284	262	235	233	265
1	8	276	274	280	261	220	198	222	261	287	284	264	263	241	217	215	238
1	9	107	106	121	140	142	130	121	109	123	152	178	185	185	169	122	85
1	10	264	262	262	259	261	262	259	259	257	261	266	268	273	278	279	287
1	11	267	253	262	283	299	288	276	266	280	311	319	323	320	311	266	240
1	12	232	219	240	263	279	261	247	236	249	276	300	307	305	295	250	218
1	13	260	272	294	287	255	256	277	288	281	265	254	254	266	276	280	280
1	14	273	273	271	269	274	275	274	275	278	275	278	276	277	280	276	280
1	15	321	341	365	354	326	330	353	362	352	332	312	316	334	346	348	347
1	16	193	196	219	208	179	186	209	221	222	208	189	191	219	232	233	222

Pad Number 1-79

Background
spectrum



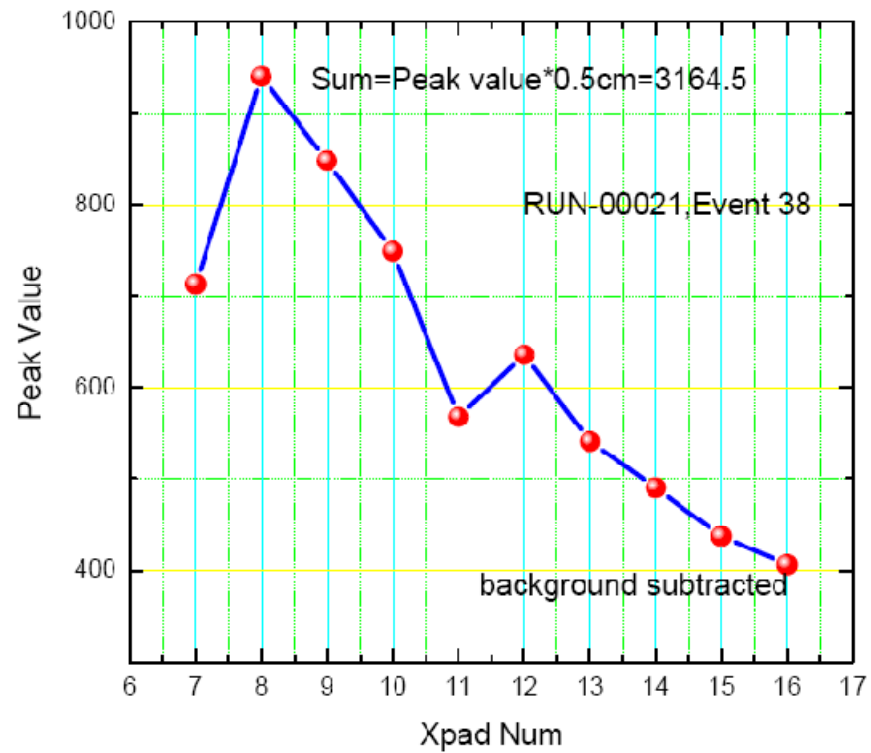
After background subtracted, we can see the event data, here we only show the time scale 220 -280 channel. Then we will look for the maximum value of each pad in time channel, and get such figures.



Bragg Curve

They are **good Events** we defined

We call this maximum value as Qi



They are **bad Events** we defined, and it also include some events have one and two pad triggered.

CHI2 Definition

definition:

$$\chi^2 = \sum \frac{(Q_i - T_i \times Norm)^2}{\sigma^2}$$

$$Norm = \frac{\sum_{\max-1}^{\max+2} Q_i}{\sum_{\max-1}^{\max+2} T_i}$$

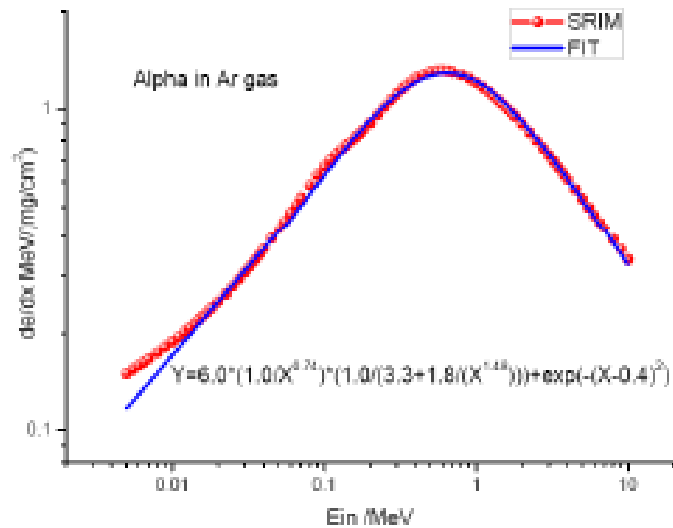
$$\sigma = N - \bar{N} \quad (N : \text{background data}, \bar{N} : \text{Average Value})$$

We only use last three or four point for calculation .

Because other point have a very lower energy loss,

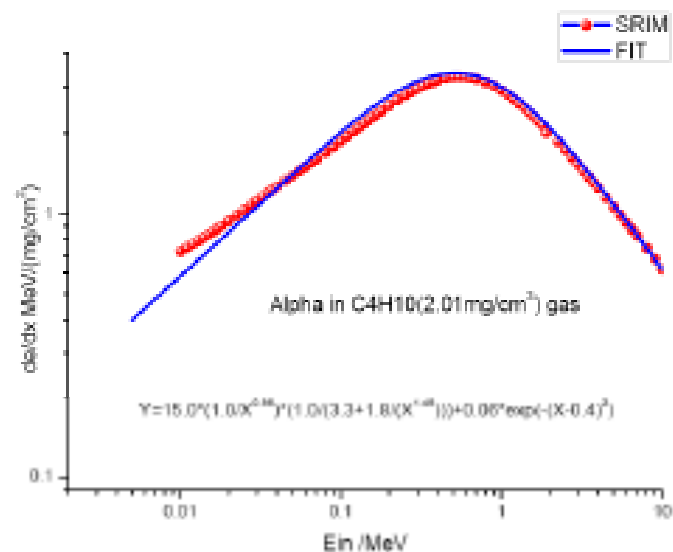
So these data point have much large fluctuation

Theoretical calculation stopping power de/dx curve



Stopping power calculation by SRIM
In Ar(90%) and Isobutene(C₄H₁₀,10%)
gas.

Analytical formula be used in our
analysis program.

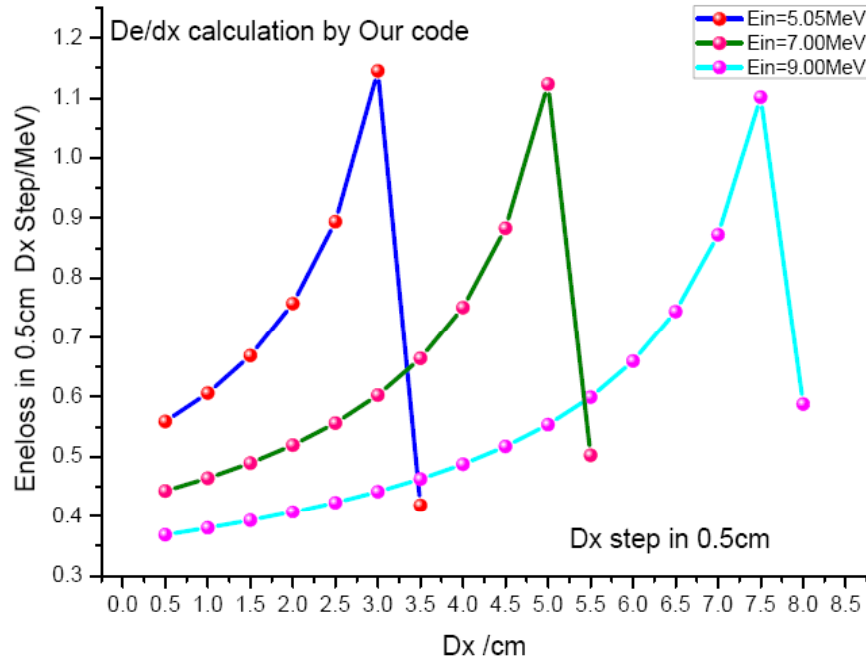


Ar : Density= Gas pressure*40*90%/22400

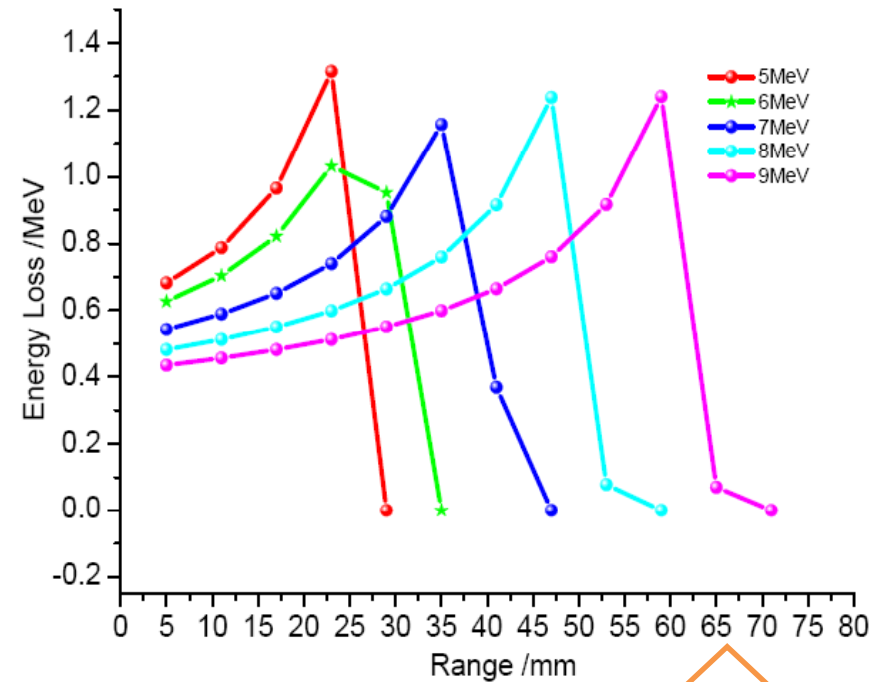
C₄H₁₀ : Density= Gas pressure*40*10%/22400

Energy loss in Dx=0.5 cm step (pad size)

Total Energy be verified from 5 MeV to 9 MeV



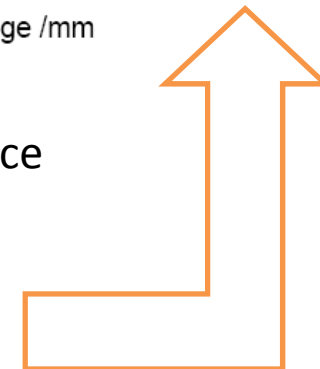
Theoretical Bragg curve



We call this value as T_i

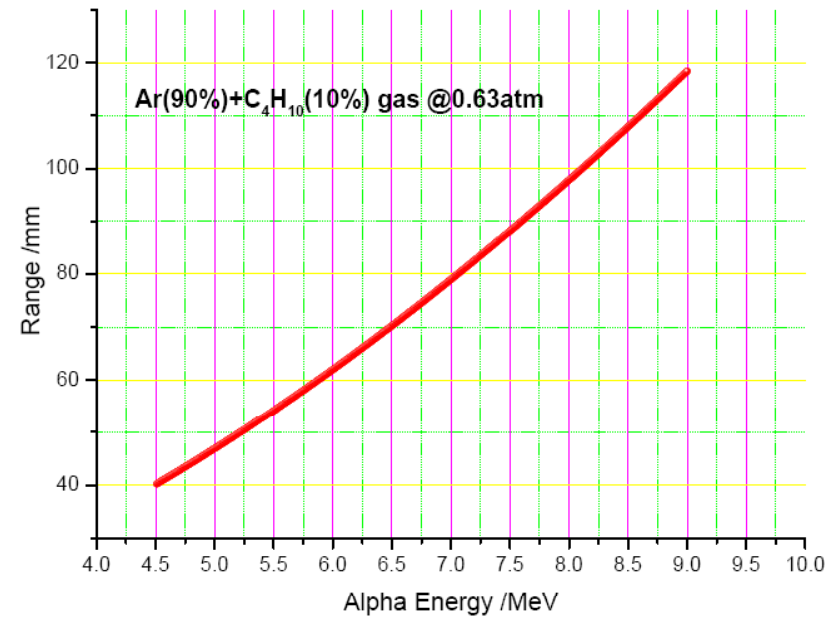
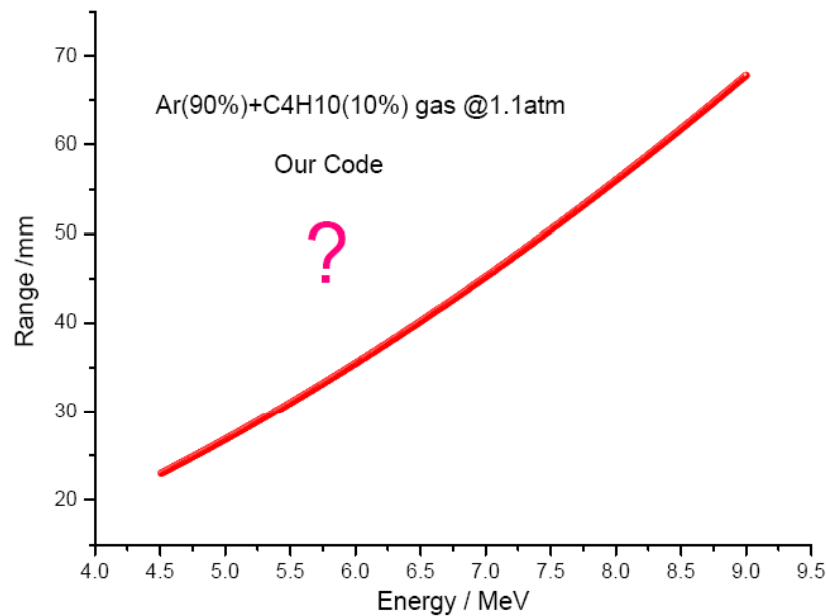
Here, We think about the 1.0 cm distance between Alpha source and Collimator

Then 0.5 cm Pad size and 0.1 cm Gap between Pad



We Compare these Theoretical Value with Exp data by pad num

Energy - Range Curve calculation by our program

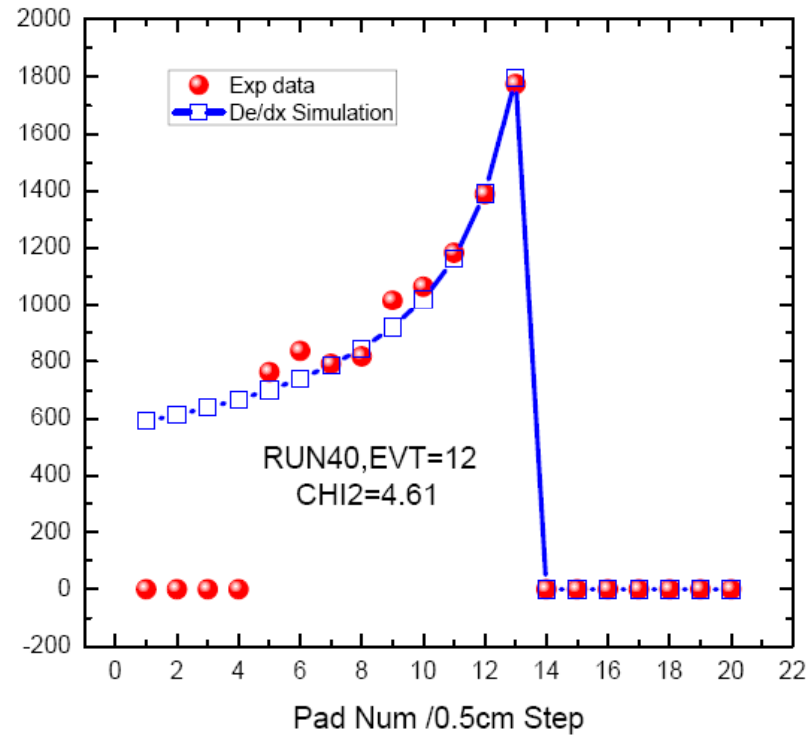
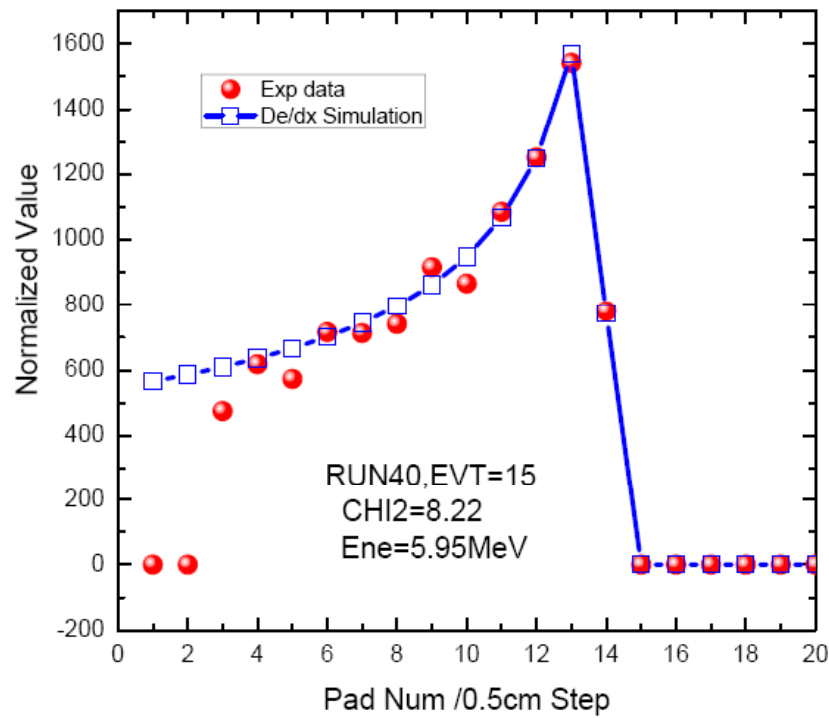


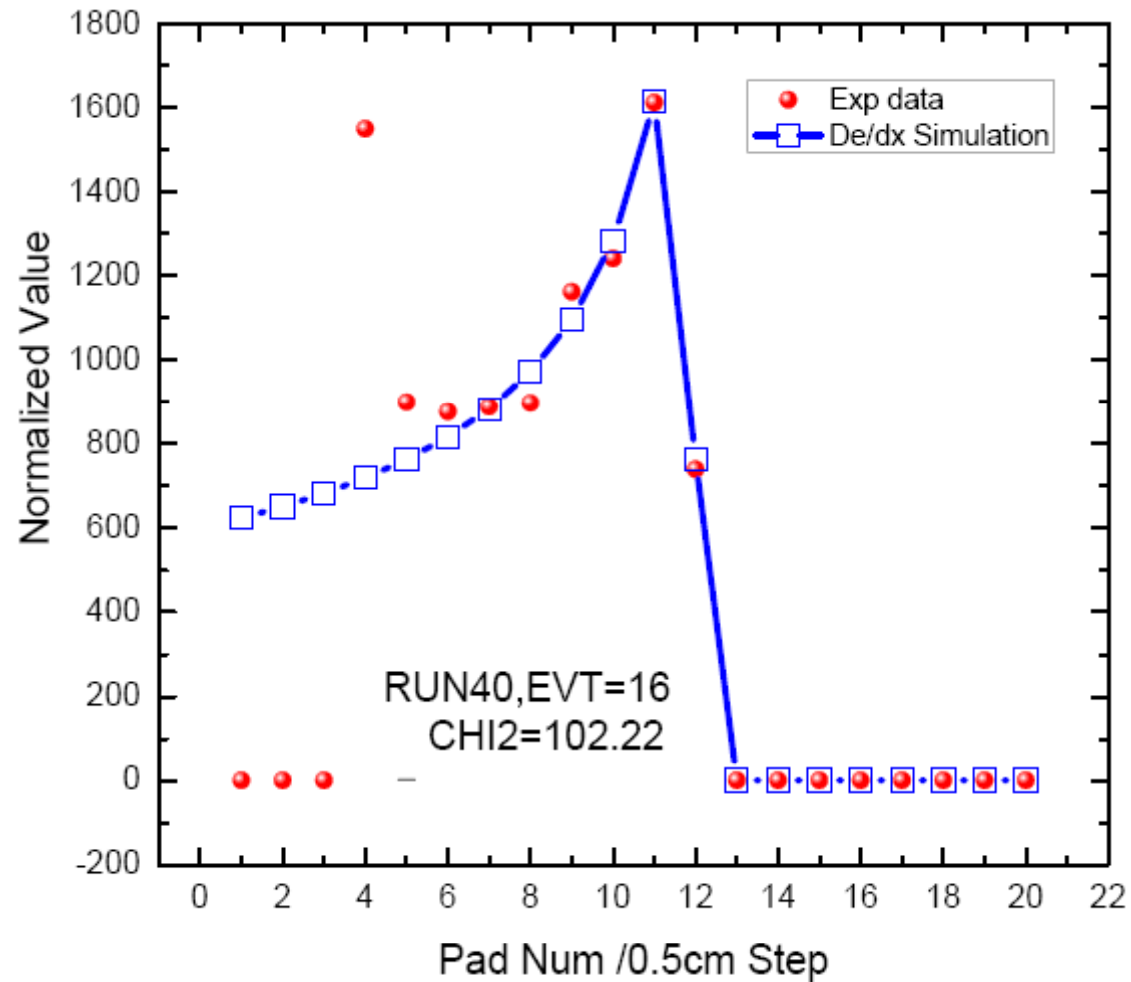
Alpha standard source

228Th: **5.520** (100%), **5.789**(100%),**6.208**(36%),**6.404**(100%),**6.906**(100%), and **8.955**(64%)

241Am: **5.389**(1.3%), **5.443**(12.8%), **5.486**(85.2%) **5.513**(0.12%), **5.545**(0.35%)

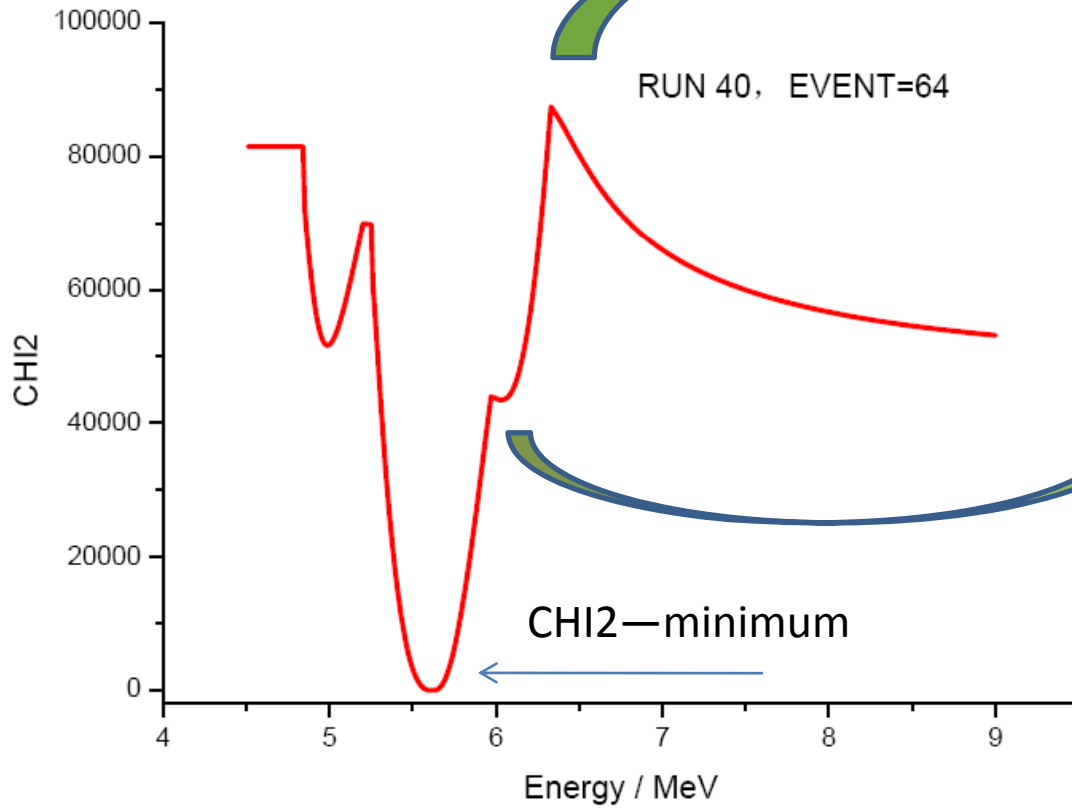
Compare with the Exp data(after normalized)





So you will see if we calculate other tail point, the CHI2 will be a more large value

CHI² Distribution



10.80	0.4055	5.810	2				
16.60	0.4357	5.810	3	22.40	0.4088	6.540	4
22.40	0.4743	5.810	4	28.20	0.4397	6.540	5
28.20	0.5260	5.810	5	34.00	0.4796	6.540	6
34.00	0.5802	5.810	6	39.80	0.5333	6.540	7
39.80	0.7199	5.810	7	45.60	0.6112	6.540	8
45.60	0.9393	5.810	8	51.40	0.7394	6.540	9
0.00	0.0000	5.810	9	57.20	0.9431	6.540	10
0.00	0.0000	5.810	10	0.00	0.0000	6.540	11
				0.00	0.0000	6.540	12

5.00	0.3806	5.820	1	5.00	0.3452	6.550	1
10.80	0.4049	5.820	2	10.80	0.3626	6.550	2
16.60	0.4349	5.820	3	16.60	0.3832	6.550	3
22.40	0.4732	5.820	4	22.40	0.4080	6.550	4
28.20	0.5245	5.820	5	28.20	0.4388	6.550	5
34.00	0.5979	5.820	6	34.00	0.4783	6.550	6
39.80	0.7161	5.820	7	39.80	0.5316	6.550	7
45.60	0.9326	5.820	8	45.60	0.6086	6.550	8
51.40	0.0437	5.820	9	51.40	0.7348	6.550	9
0.00	0.0000	5.820	10	57.20	0.9636	6.550	10
				0.00	0.0000	6.550	11
				0.00	0.0000	6.550	12

5.00	0.3800	5.830	1	5.00	0.3447	6.560	1
10.80	0.4042	5.830	2	10.80	0.3621	6.560	2
16.60	0.4340	5.830	3	16.60	0.3826	6.560	3
22.40	0.4721	5.830	4	22.40	0.4073	6.560	4
28.20	0.5230	5.830	5	28.20	0.4379	6.560	5
34.00	0.5957	5.830	6	34.00	0.4771	6.560	6
39.80	0.7122	5.830	7	39.80	0.5299	6.560	7
45.60	0.9260	5.830	8	45.60	0.6061	6.560	8
51.40	0.0640	5.830	9	51.40	0.7303	6.560	9
0.00	0.0000	5.830	10	57.20	0.9565	6.560	10
				0.00	0.0000	6.560	11
				0.00	0.0000	6.560	12

Energy loss in pad

We search for minimum CHI2 value for possible Alpha Energy

Good Event Selection

Total trigged pad num ≥ 3

Brag peak pad ≥ 5

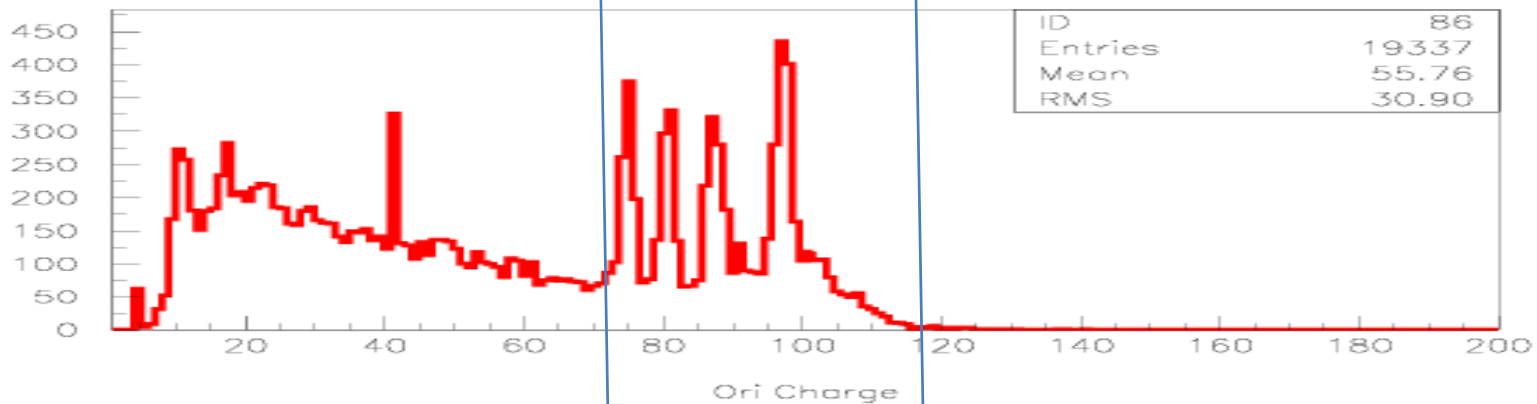
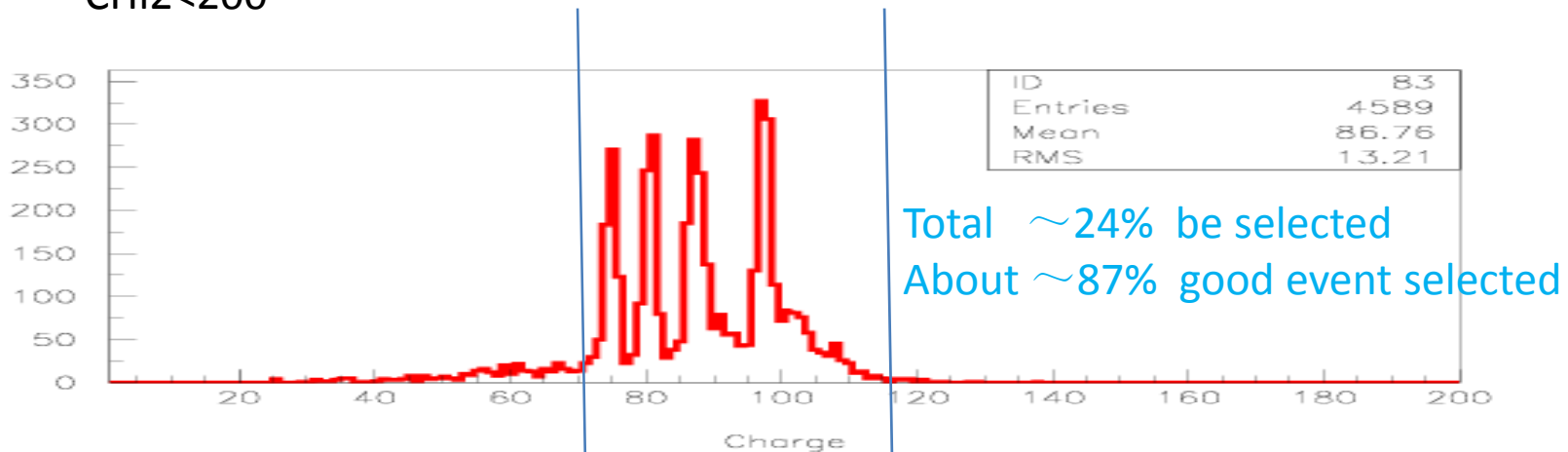
Pad(max) ≥ 900

Pad(max+3)=0

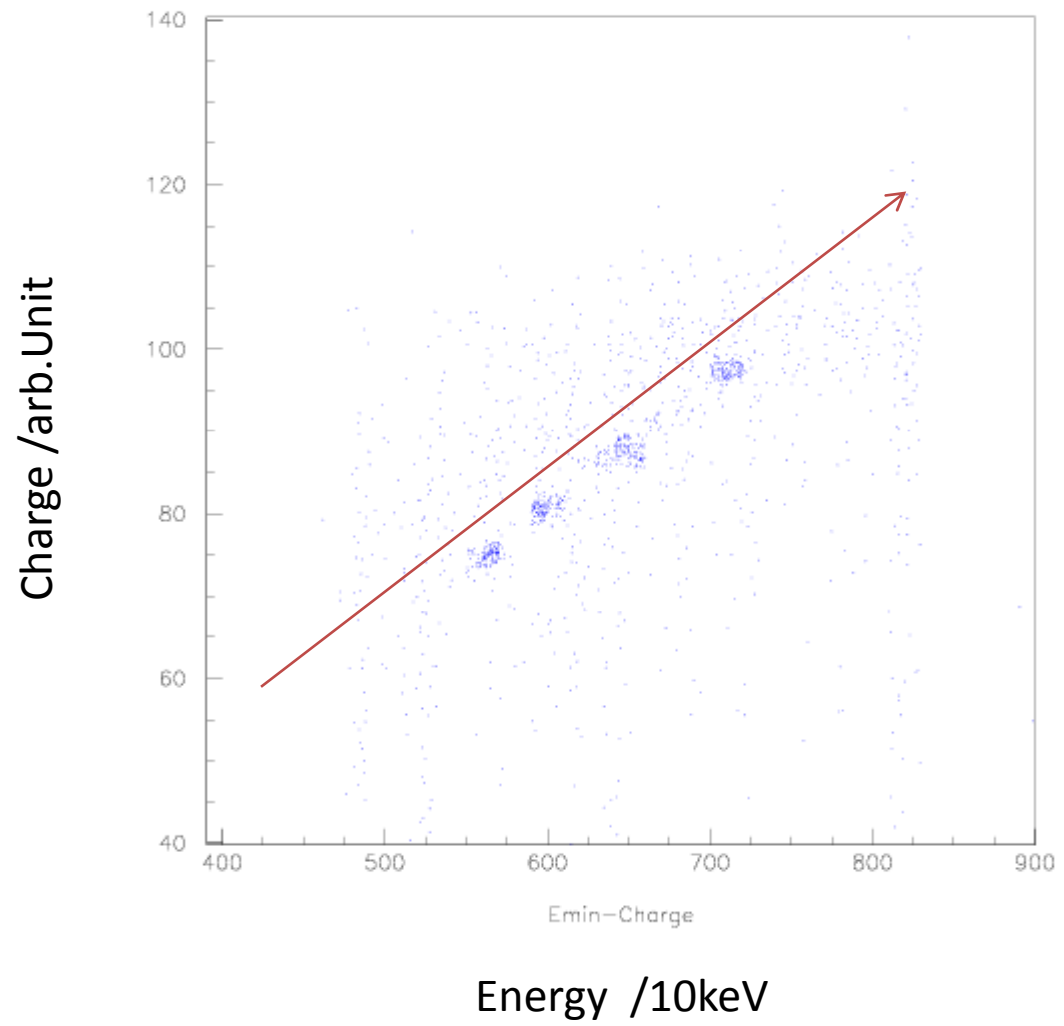
CHI2<200



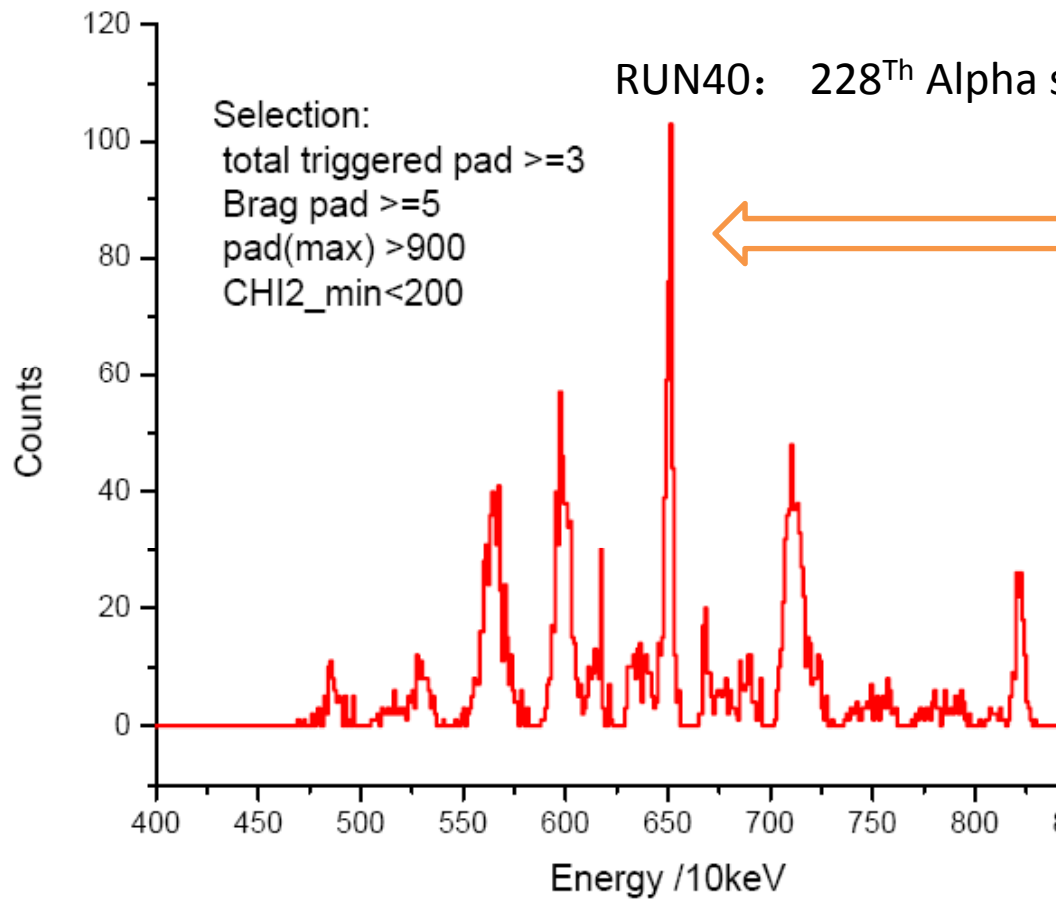
Low gas
Pressure



RUN 40



Charge to Energy Transform



Sharp peak ?

still not solve
this problems

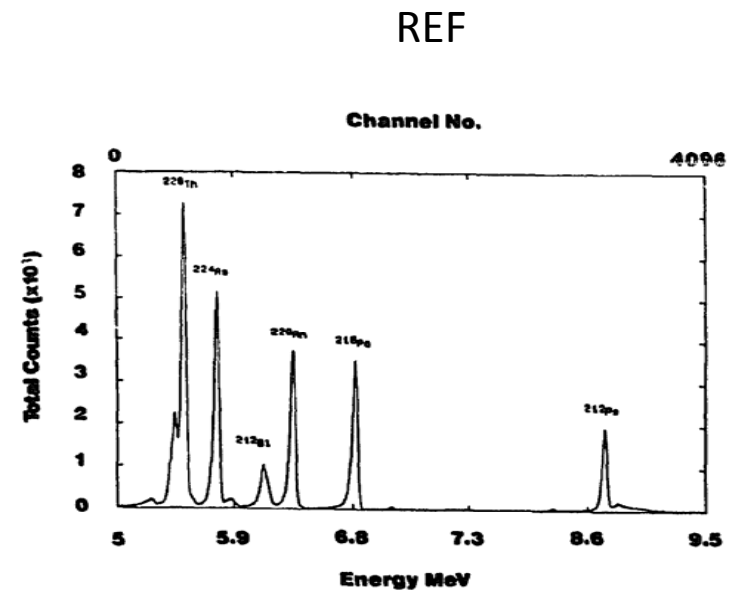
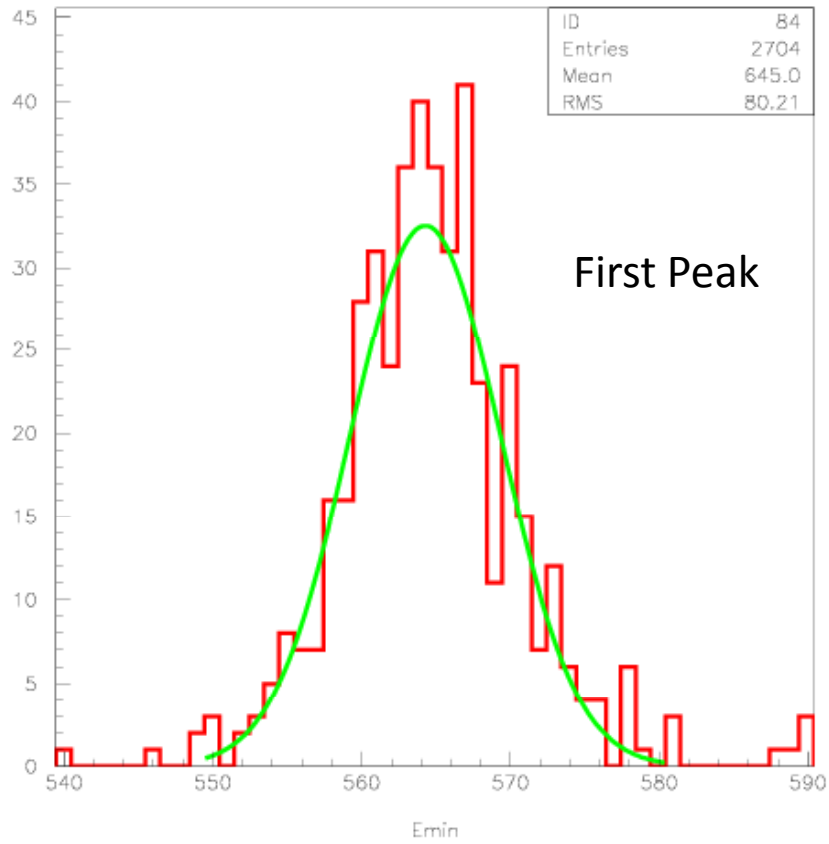
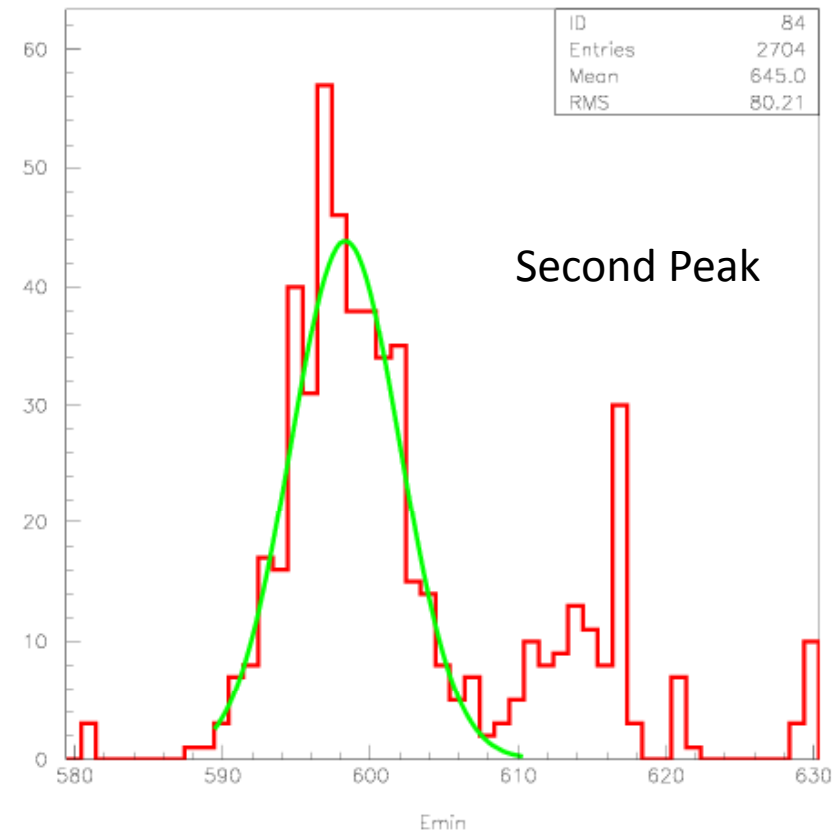


Fig. 2. Spectrum recorded using an ion-implanted Si detector of ^{228}Th and daughter activity.



Sigma=50.85

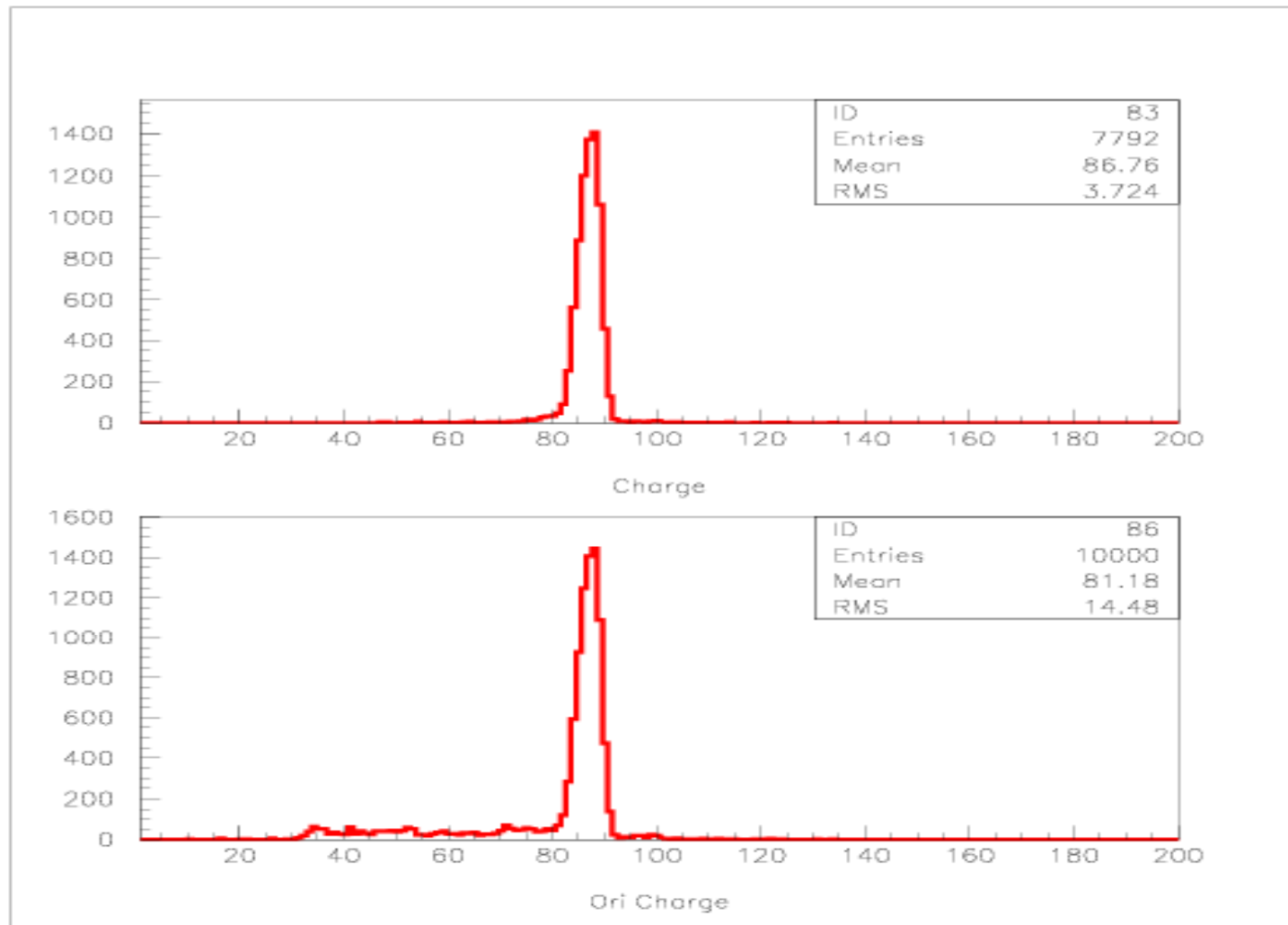


Sigma=37.09

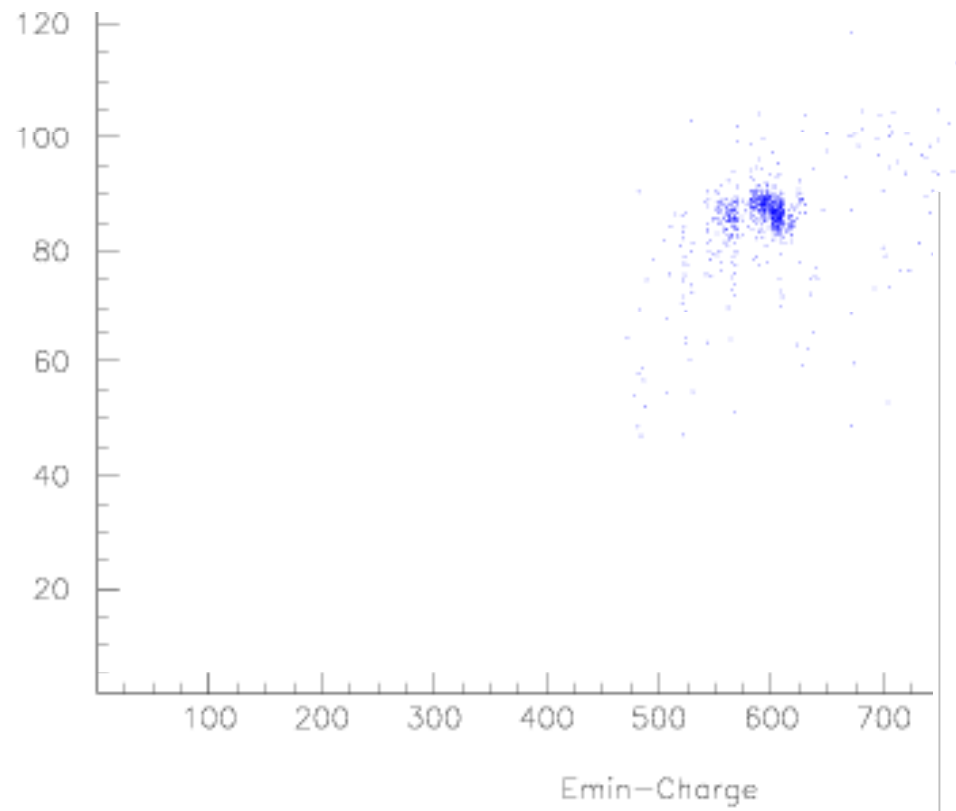
So FMHW $\sim 70 - 150$ keV

RUN47: 241Am Alpha Source

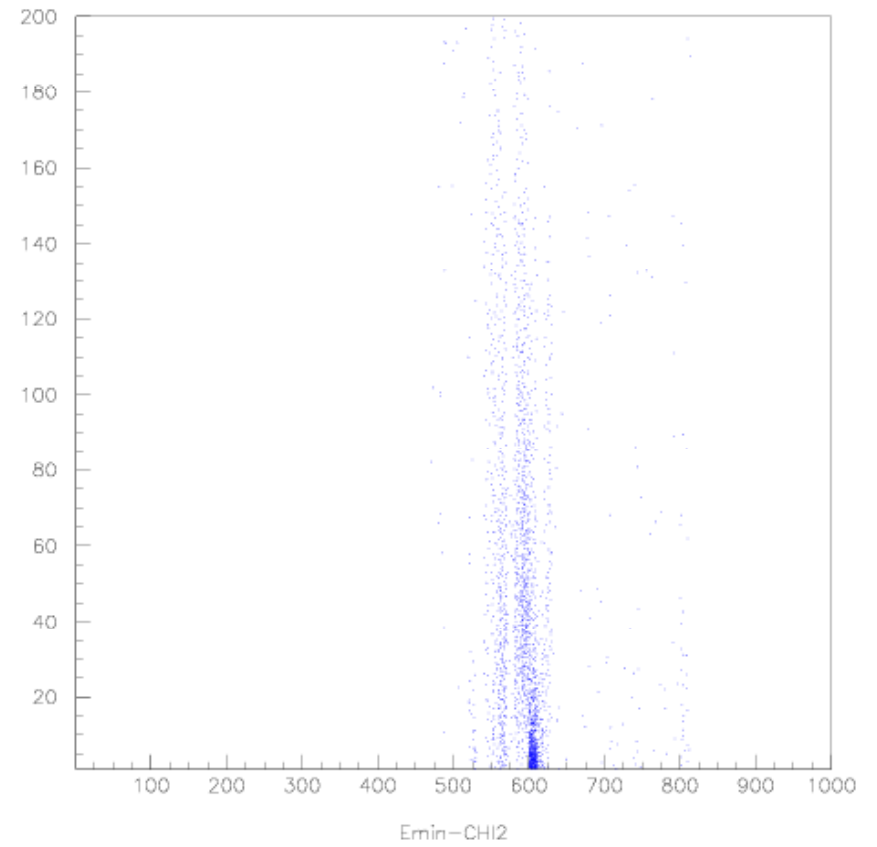
~ 77% be selected



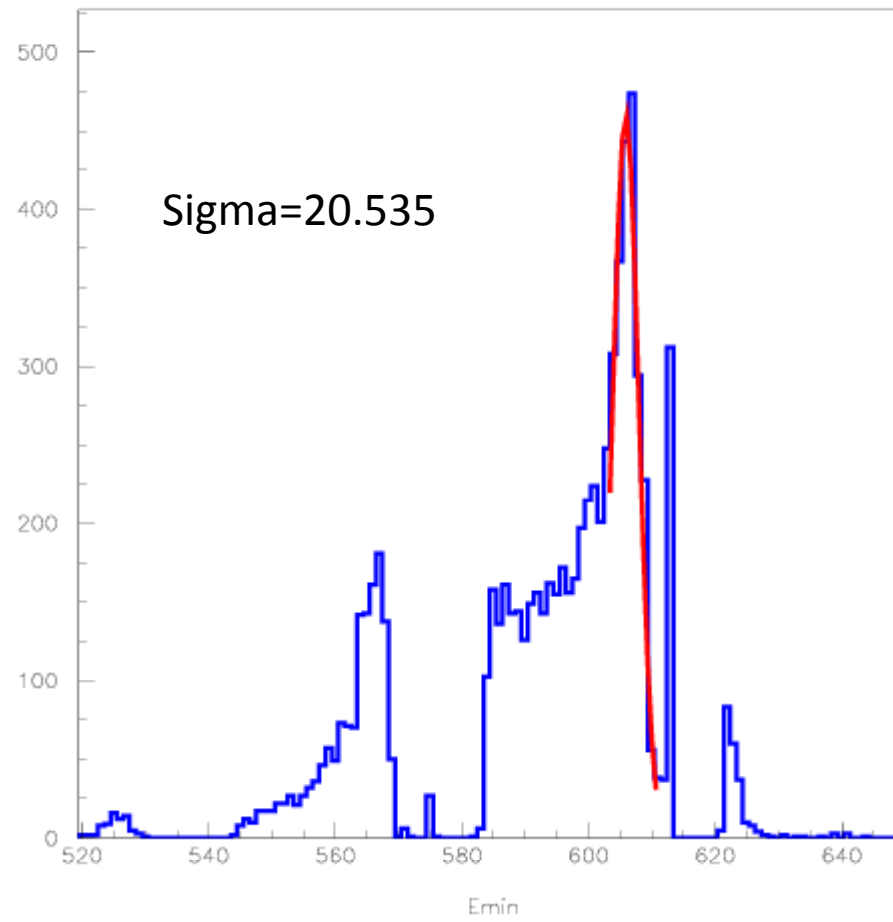
RUN 47



Energy-Charge spectrum

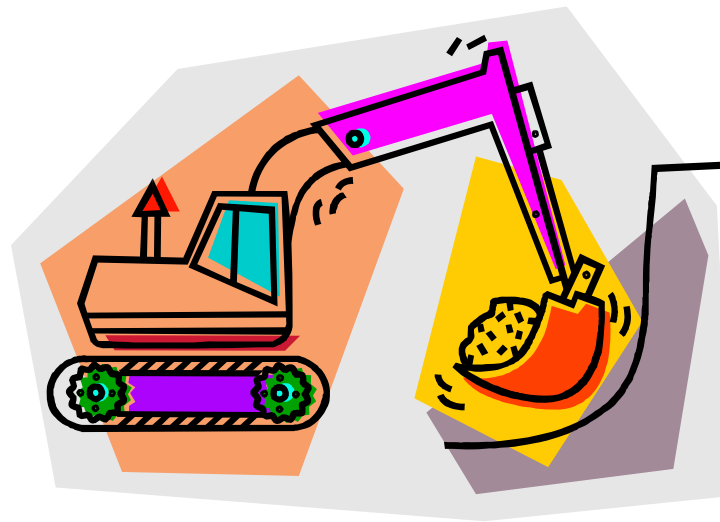


Energy-CHI2 spectrum



So FWHM \sim 50 keV

Thanks for your attention



More work need to do