Understanding implantation of ^{168}Dy

- How many and in which layers do the ions stop
- What is the correlation eff. with FRS

Example of number of counts for various parameters in the implant branch of AIDA

Fully stripped 168Dy
File 168Dy_new_0015_0001.lmd (79 sec of data)

Note: ~ 60% of x implant events have no correlated y strip (within the event separated by a gap > 4 µs)

	Fired x strips	Fired y strips	Fired x missing y	Fired y missing x	Frs total hits	Frs hits gated 168Dy	Frs gate 168Dy and aida x OR y	Frs gate 168Dy and aida x AND y
AIDA 1	116408	65299	**66987**	**26247**	69330	18523	15976 (86%)	6789 (42%)
AIDA 2	73646	73964	**44604**	**50504**	69330	18523	526	97

Example of number of counts for various parameters in the implant branch of AIDA

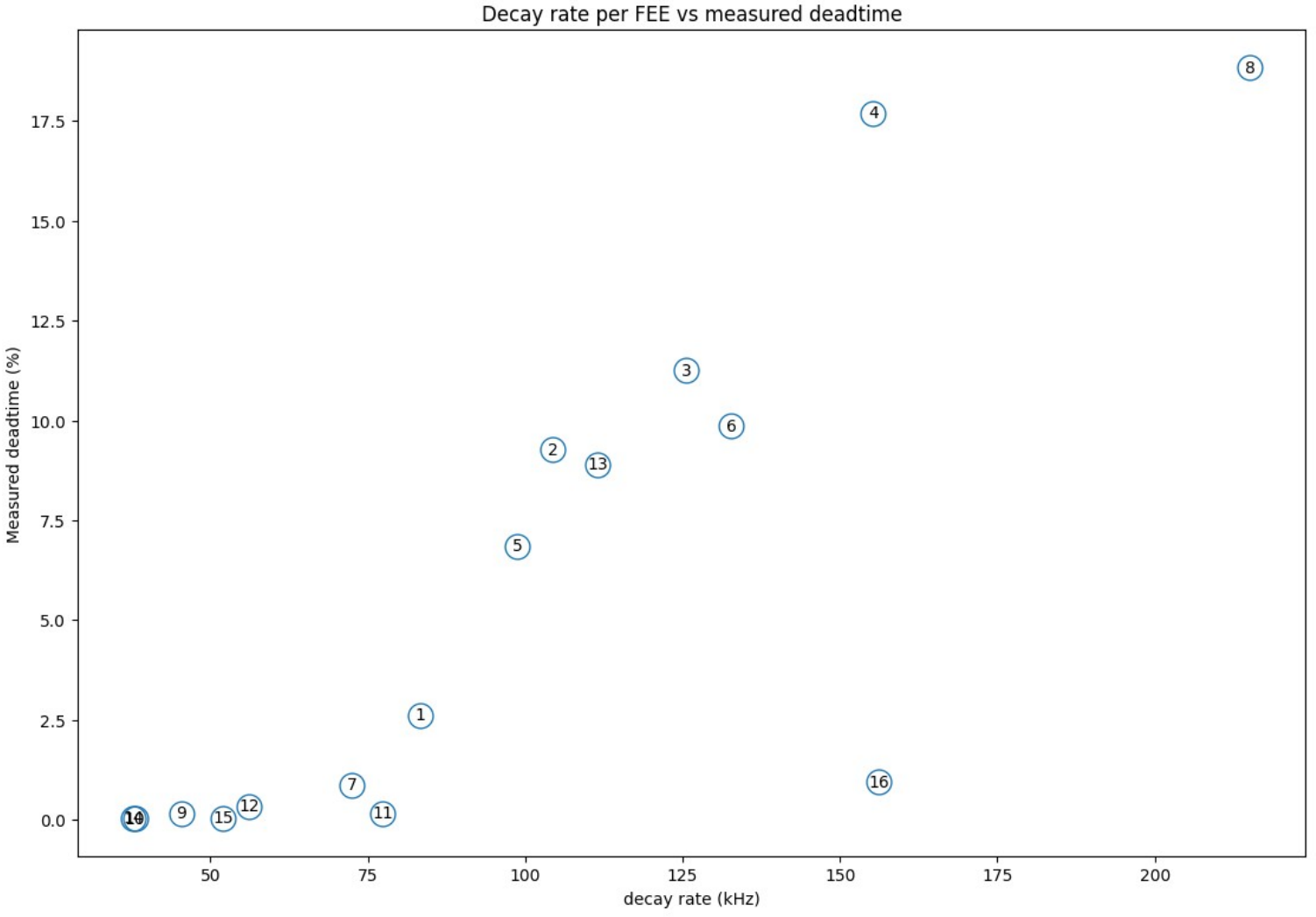
Charge changing (q = 1 from S1-S2) “168Dy_q1”

	Fired x strips	Fired y strips	Fired x missing y	Fired y missing x	Frs total hits	Frs hits gated 168Dy	Frs gate 168Dy and aida
AIDA1	116408	65299	**66987**	**26247**	69330	3433	3551
AIDA2	73646	73964	**44604**	**50504**	69330	3433	3312

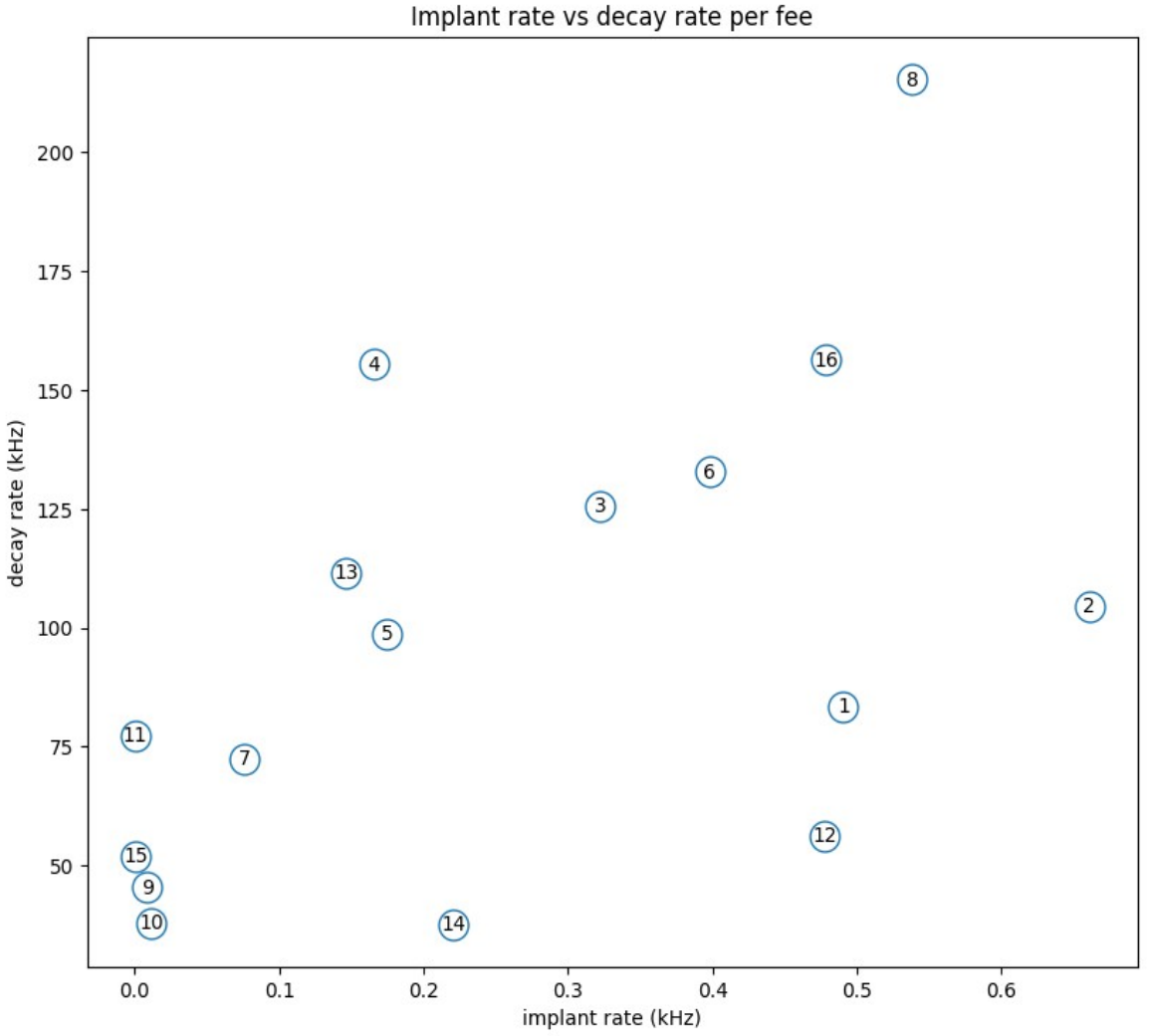
Rates is everything the detector sees, no gates.
Deadtime measured from the AIDA DAQ

Fee	Implant (kHz)	Decay (kHz)	Deadtime (%)
1	0.488745	83.1077	2.61409
2	0.658509	104.067	9.26471
3	0.322316	125.592	11.2551
4	0.165722	155.277	17.7
5	0.174367	98.7079	6.85052
6	0.397785	132.711	9.85792
7	0.0759367	72.432	0.872992
8	0.538468	215.112	18.8345
9	0.00848101	45.3914	0.157141
10	0.0112025	38.0471	0.0268567
11	0.000278481	77.3744	0.158834
12	0.47738	56.2	0.334359
13	0.146329	111.531	8.90589
14	0.220215	37.7324	0.0485554
15	0.000493671	52.0198	0.037864
16	0.478266	156.177	0.952003

Clear correlation between deadtime and decay rate



Weak if any correlation between implant and decay rates

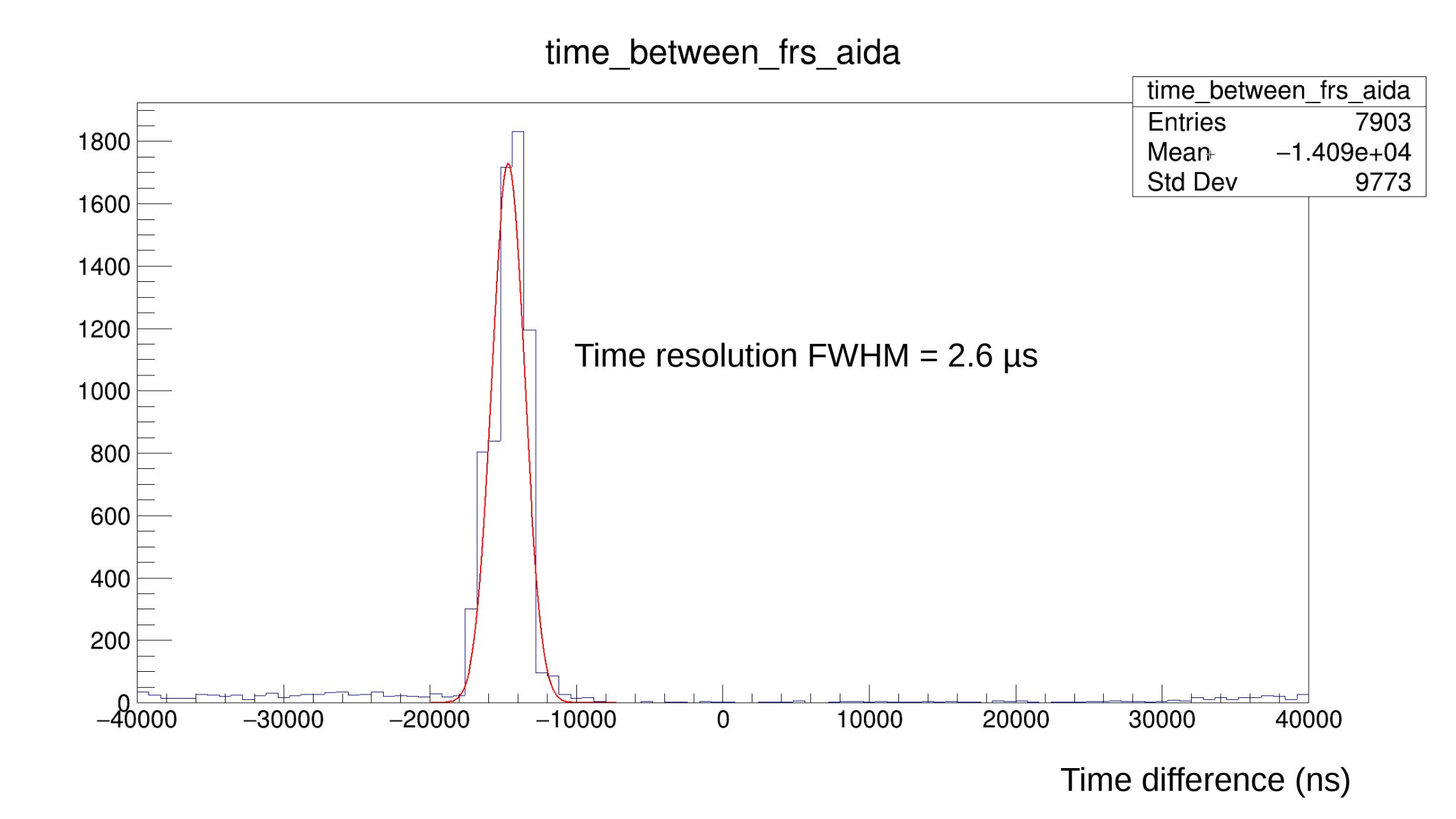


Deadtime

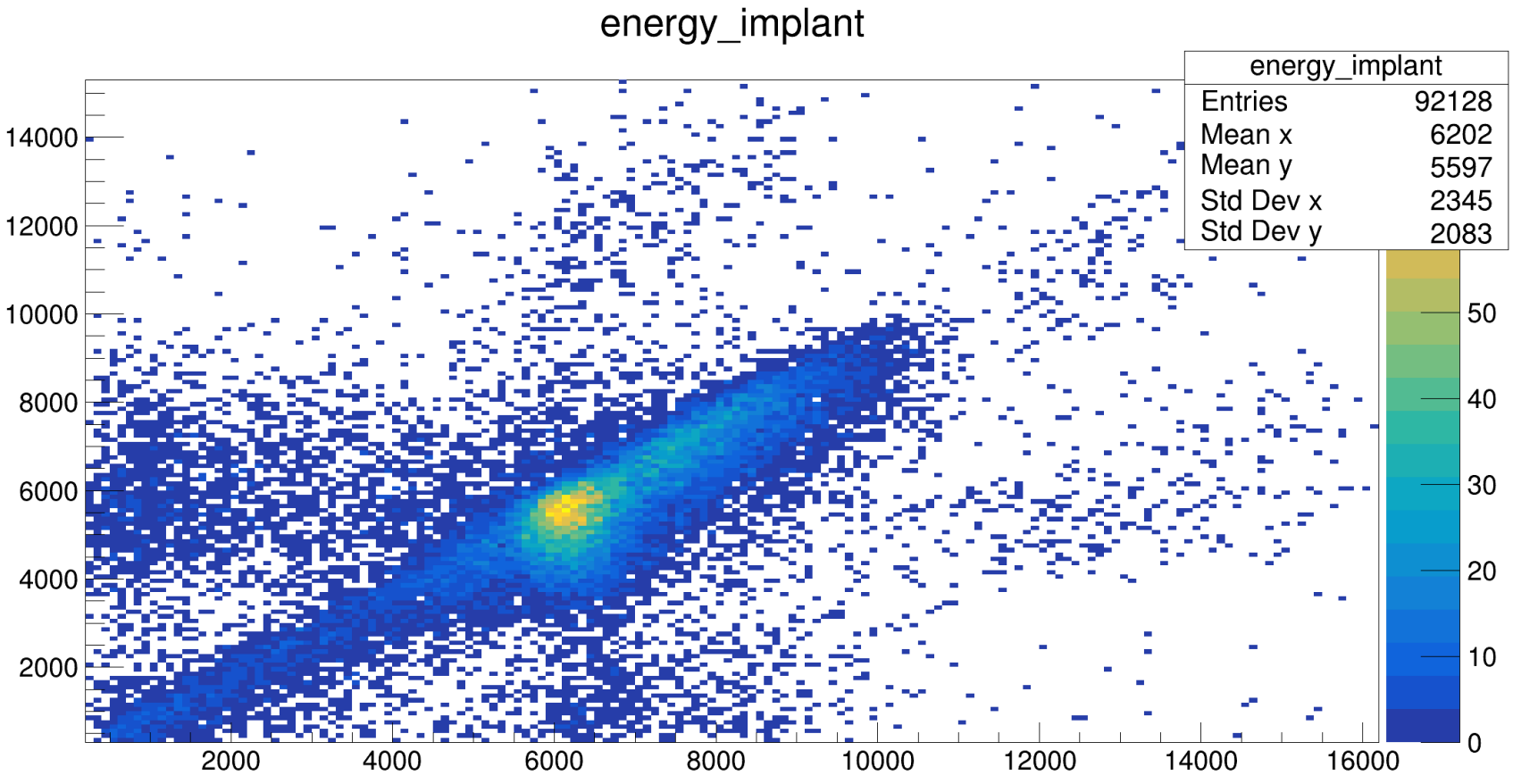
Assuming 20 % deadtime for x and y strips are uncorrelated and random in time, then the livetime for a coincidence is

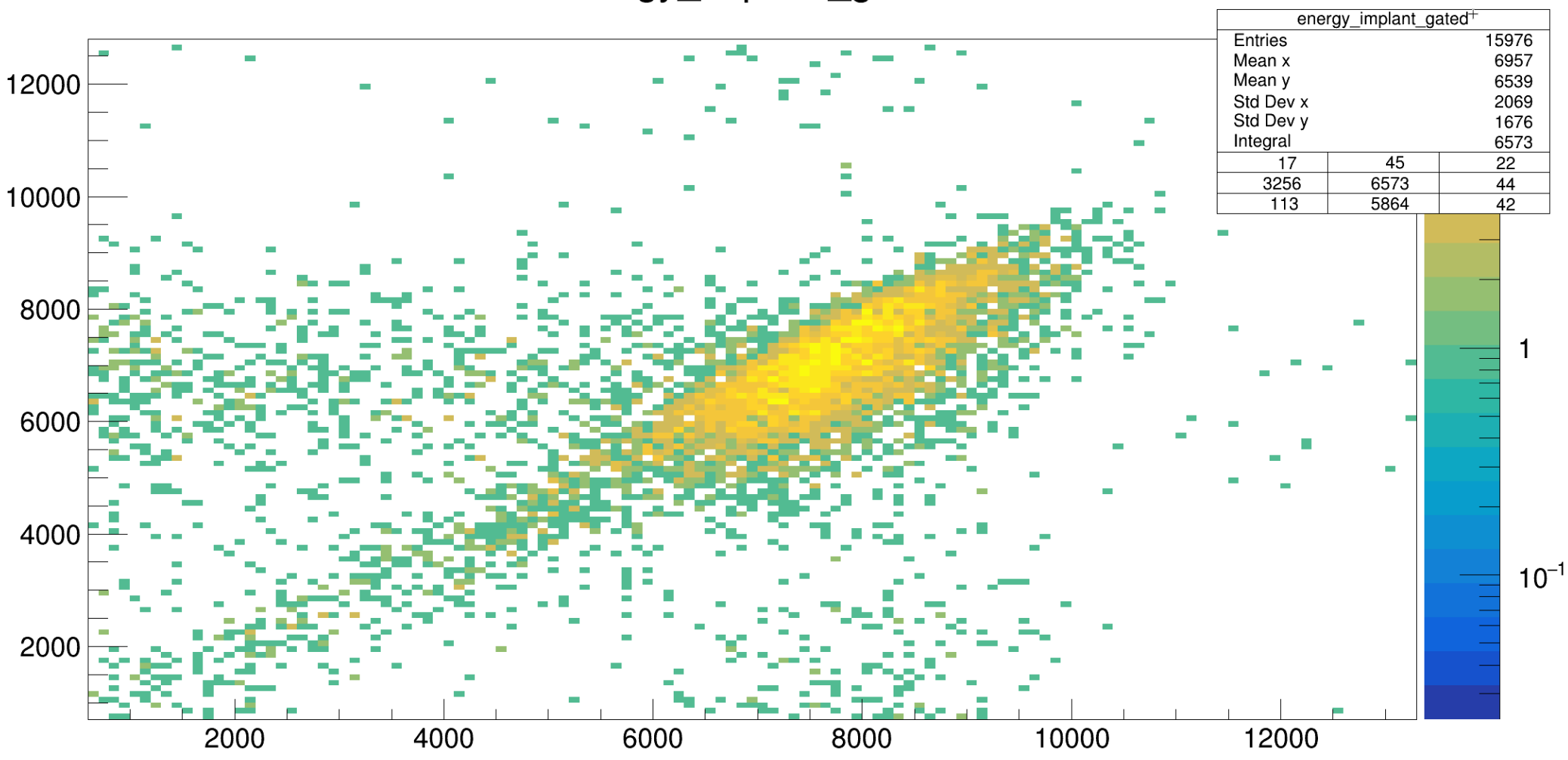
= (1-0.2)*(1-0.2) = 64 %

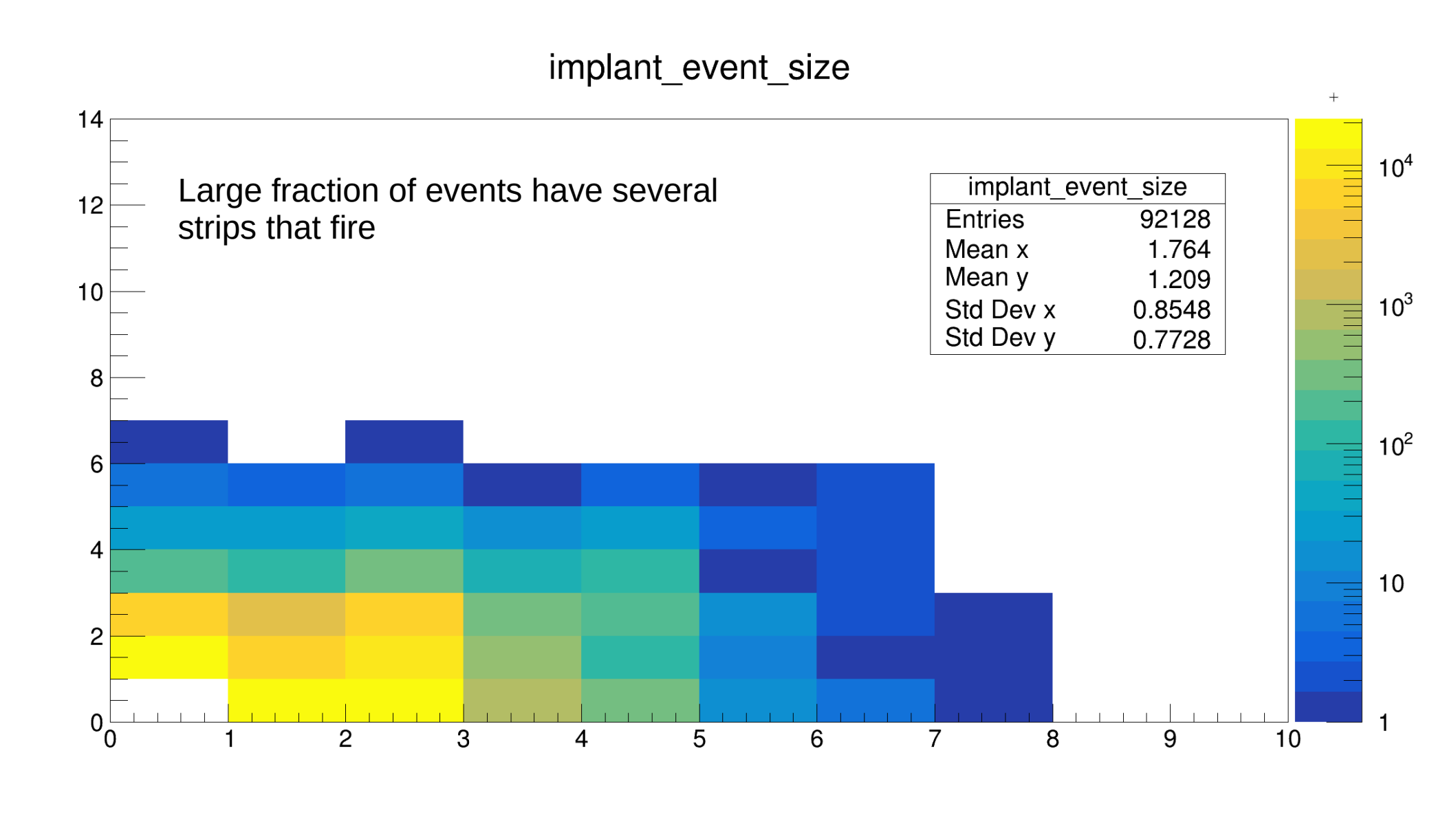
For the case of ^{168}Dy – there is a reduction from 18523 FRS hits to 15976 (86%) in x or y – reducing further to 6789 (36 %) when requiring coincidence, which implies that the deadtime is indeed correlated in time with implantation.

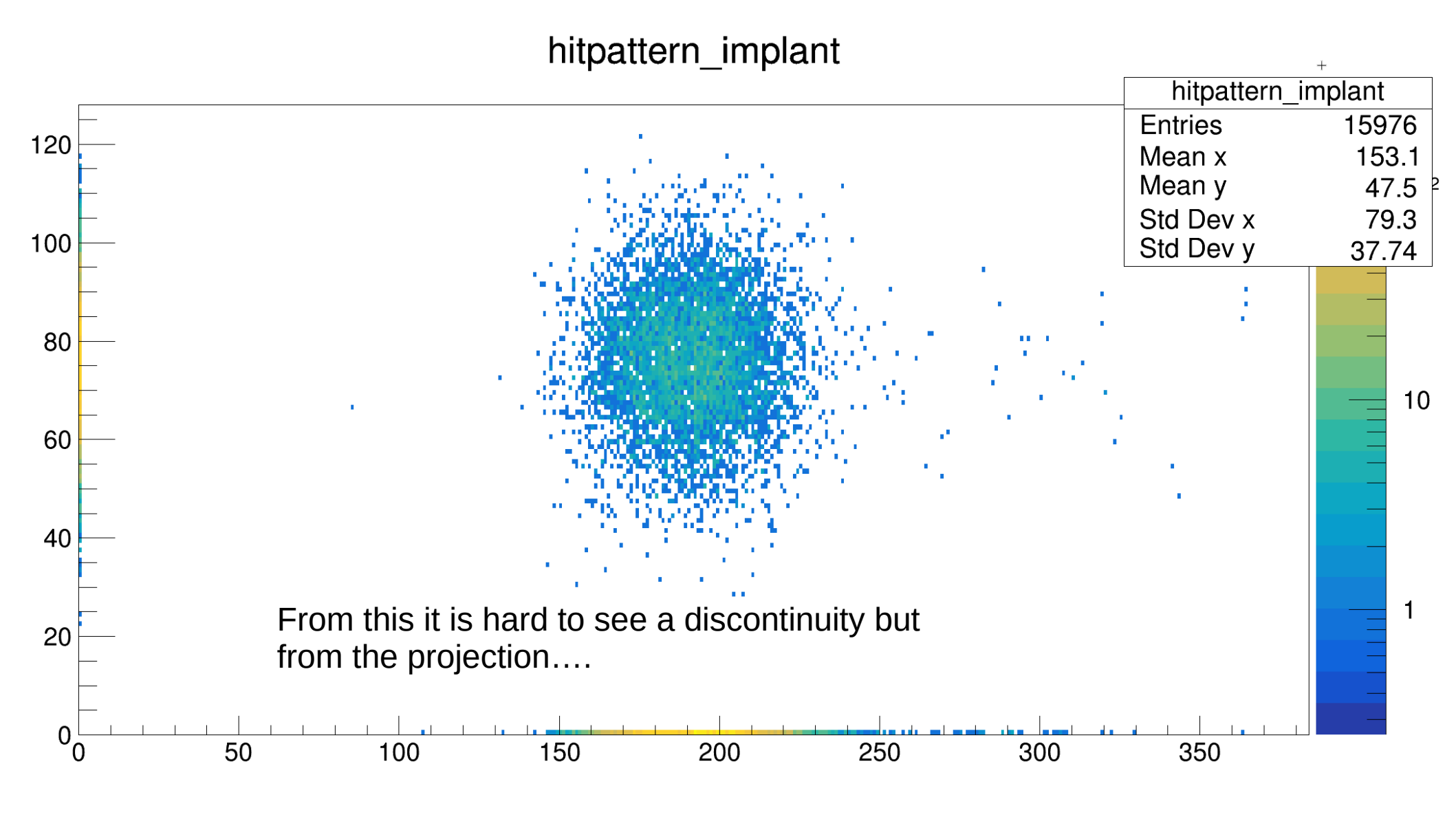

time_between_frs_aida
time_between_frs_aida
Entries 7903
Mean −1.409e+04
Std Dev 9773
Time resolution FWHM = 2.6 µs
1800
1600
1400
1200
1000
800
600
400
200
0
−40000
−30000
−20000
−10000
0
10000
20000
30000
40000
Time difference (ns)

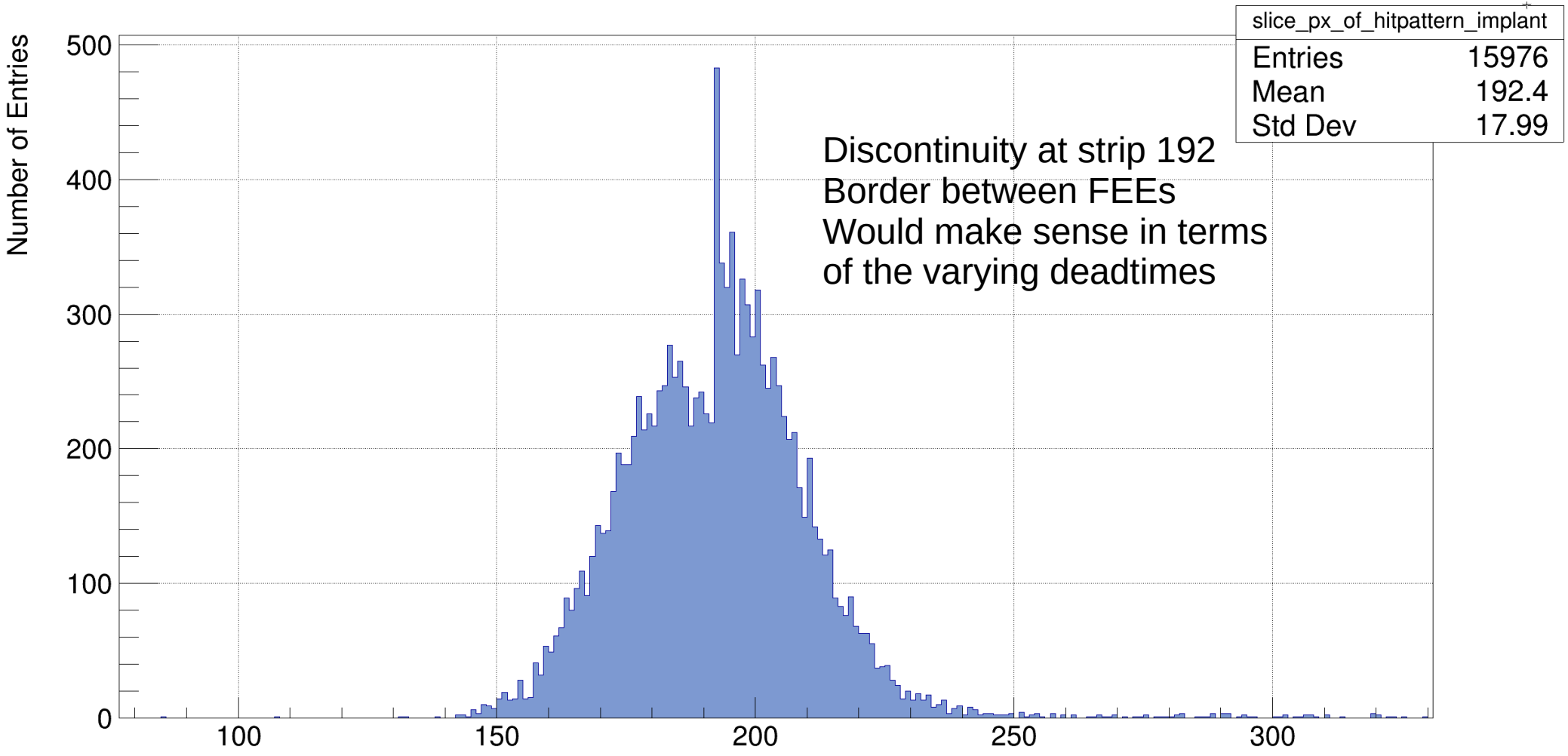
Ex vs Ey no FRS gate



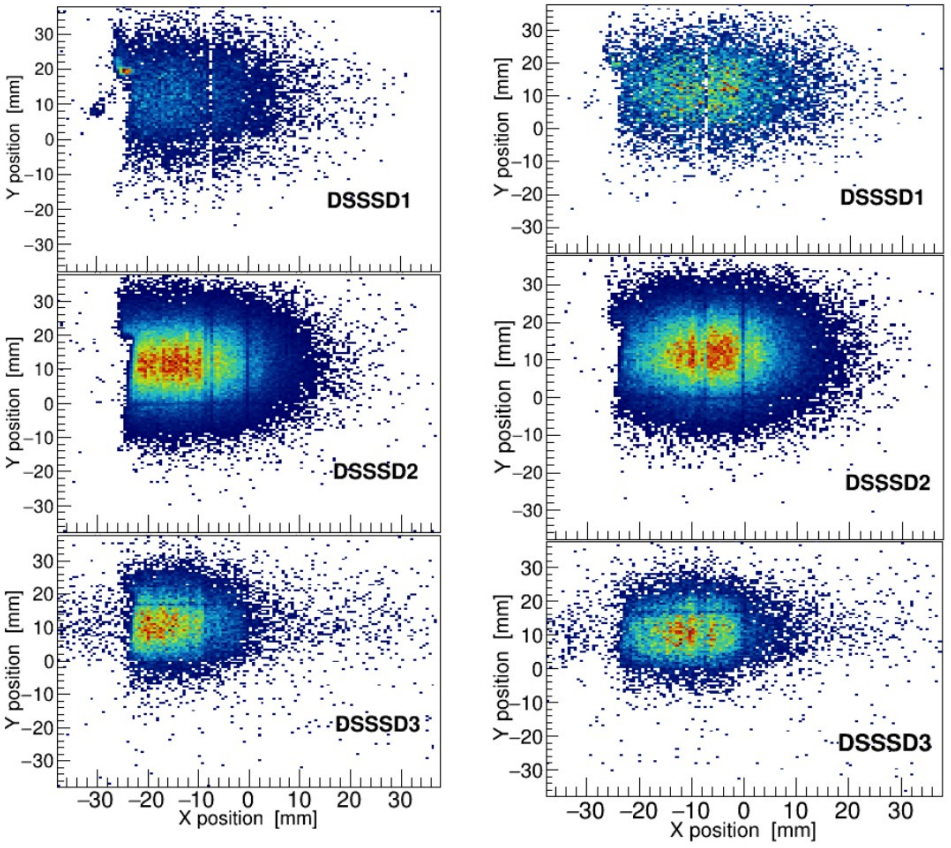

Gated on ^{168}Dy
energy_implant_gated
energy_implant_gated
Entries 15976
Mean x 6957
Mean y 6539
Std Dev x 2069
Std Dev y 1676
Integral 6573
17 45 22
3256 6573 44
113 5864 42
12000
10000
8000
6000
4000
2000
2000
4000
6000
8000
10000
12000
1
10^{-1}


implant_event_size
Large fraction of events have several strips that fire
implant_event_size
Entries 92128
Mean x 1.764
Mean y 1.209
Std Dev x 0.8548
Std Dev y 0.7728
0 1 2 3 4 5 6 7 8 9 10
0 2 4 6 8 10 12 14
1 10 10^2 10^3 10^4

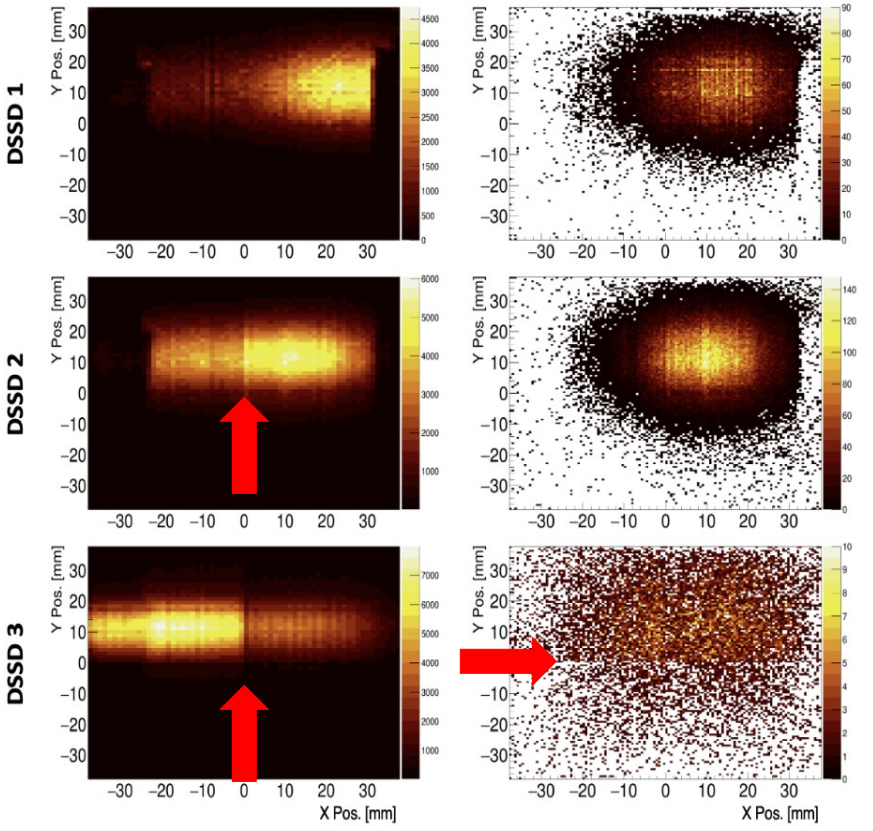

hitpattern_implant
hitpattern_implant
Entries 15976
Mean x 153.1
Mean y 47.5
Std Dev x 79.3
Std Dev y 37.74
From this it is hard to see a discontinuity but from the projection….
0
20
40
60
80
100
120
0
50
100
150
200
250
300
350
1
10


slice_px_of_hitpattern_implant
Entries 15976
Mean 192.4
Std Dev 17.99
Discontinuity at strip 192
Border between FEEs
Would make sense in terms
of the varying deadtimes
Number of Entries
0
100
200
300
400
500
100
150
200
250
300

Other implantation profiles S452

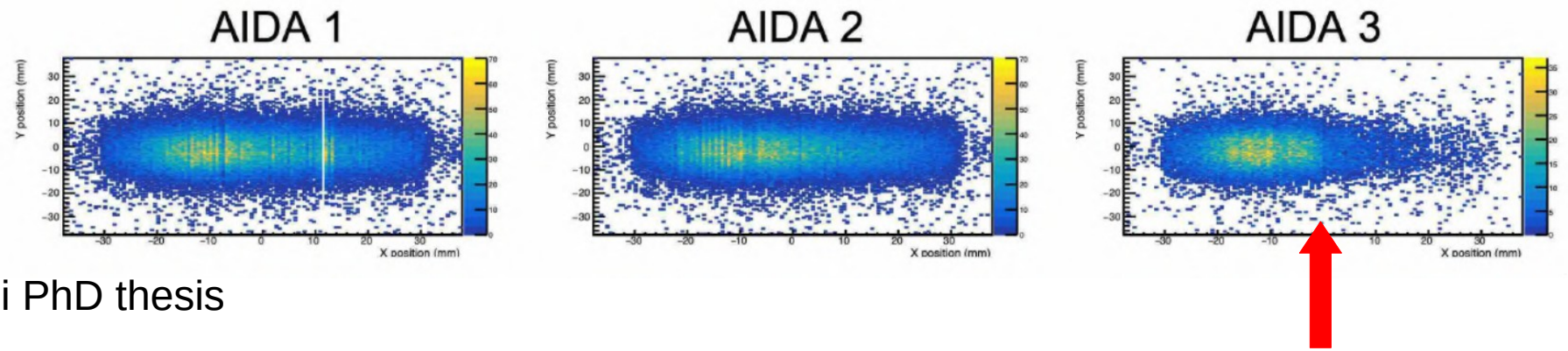


S. Alhomaedhi PhD thesis
^{188,189}Ta

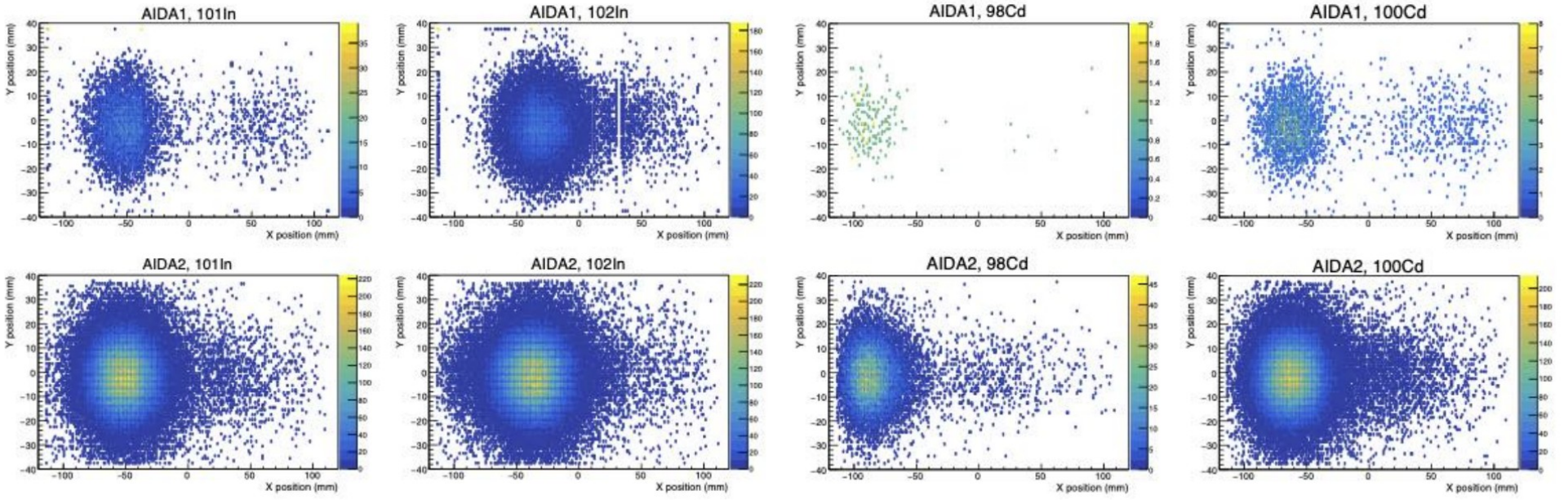


E. Sahin PhD thesis
Left all, right ^{190}W

Po Z=84



M. Polettini PhD thesis



^{100}Sn region. M. Polettini

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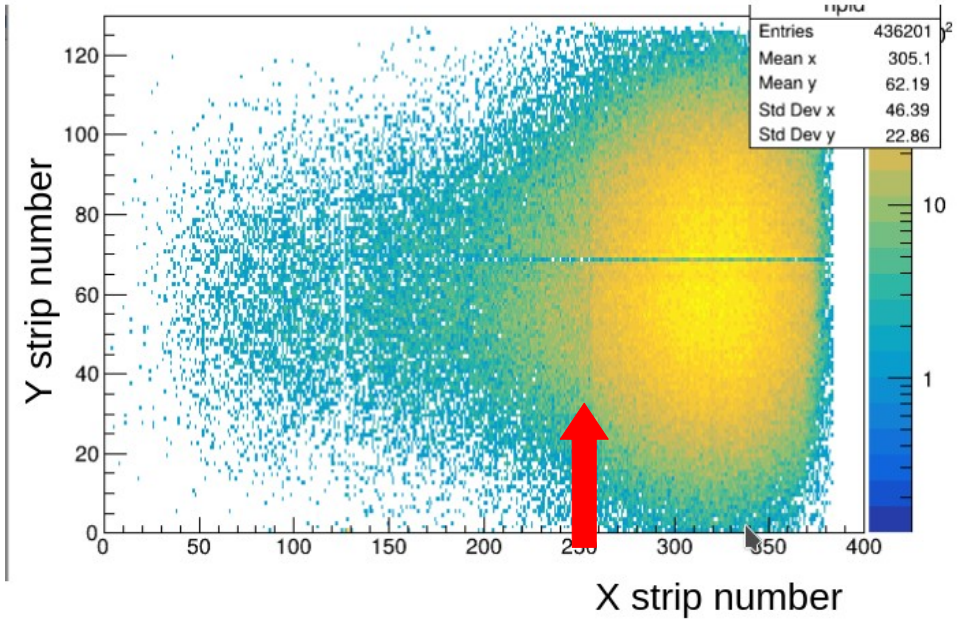
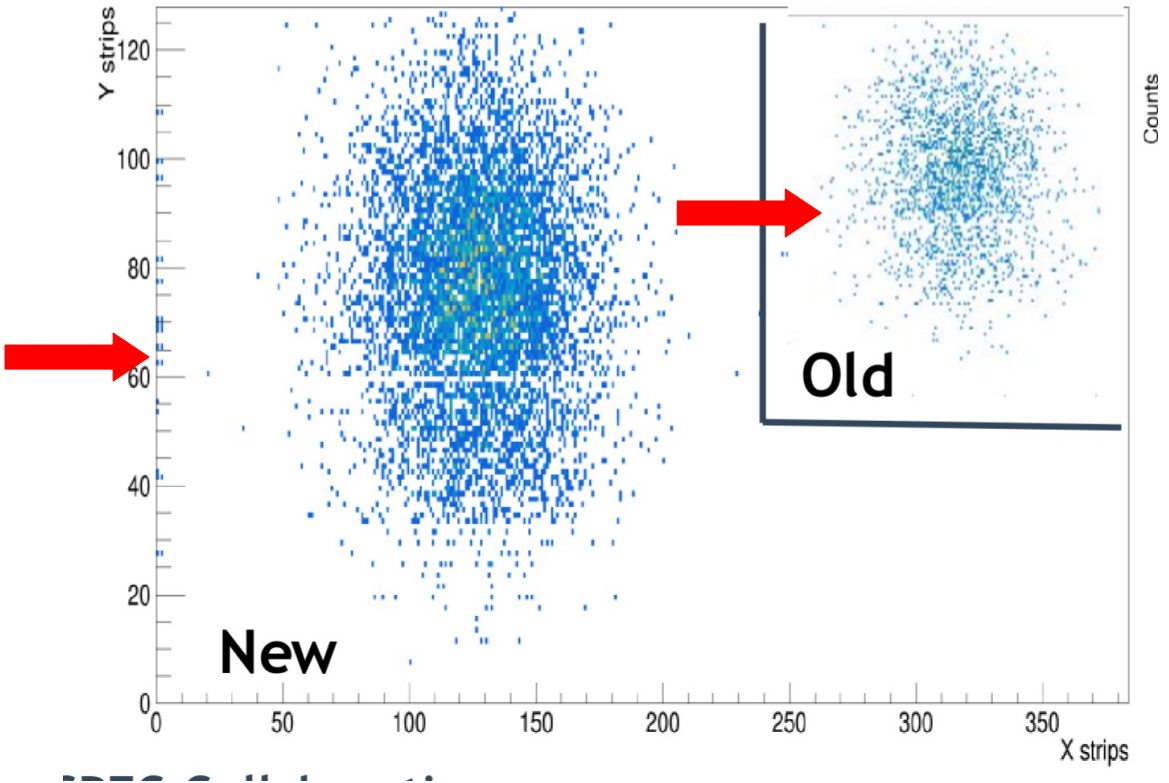
IMPLANTS



A. Morales, shown at NUSTAR week 2025

Discontinuity at strip 256, also a FEE boundary

G302



^{82}Nb looks like > 64 has more counts than < 64

G. Bruni-Campanella shown at nustar week 2025