



Testing the performance of the TRACE detector

Identification of $A \sim 10$ mass ions
at low kinetic energy, by PSA analysis

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Outline

- Scientific motivation
- Experimental setup
- Results of the particles identification analysis

Scientific motivation

- Particle spectroscopy of unbound states in light nuclei

O

N

C

B

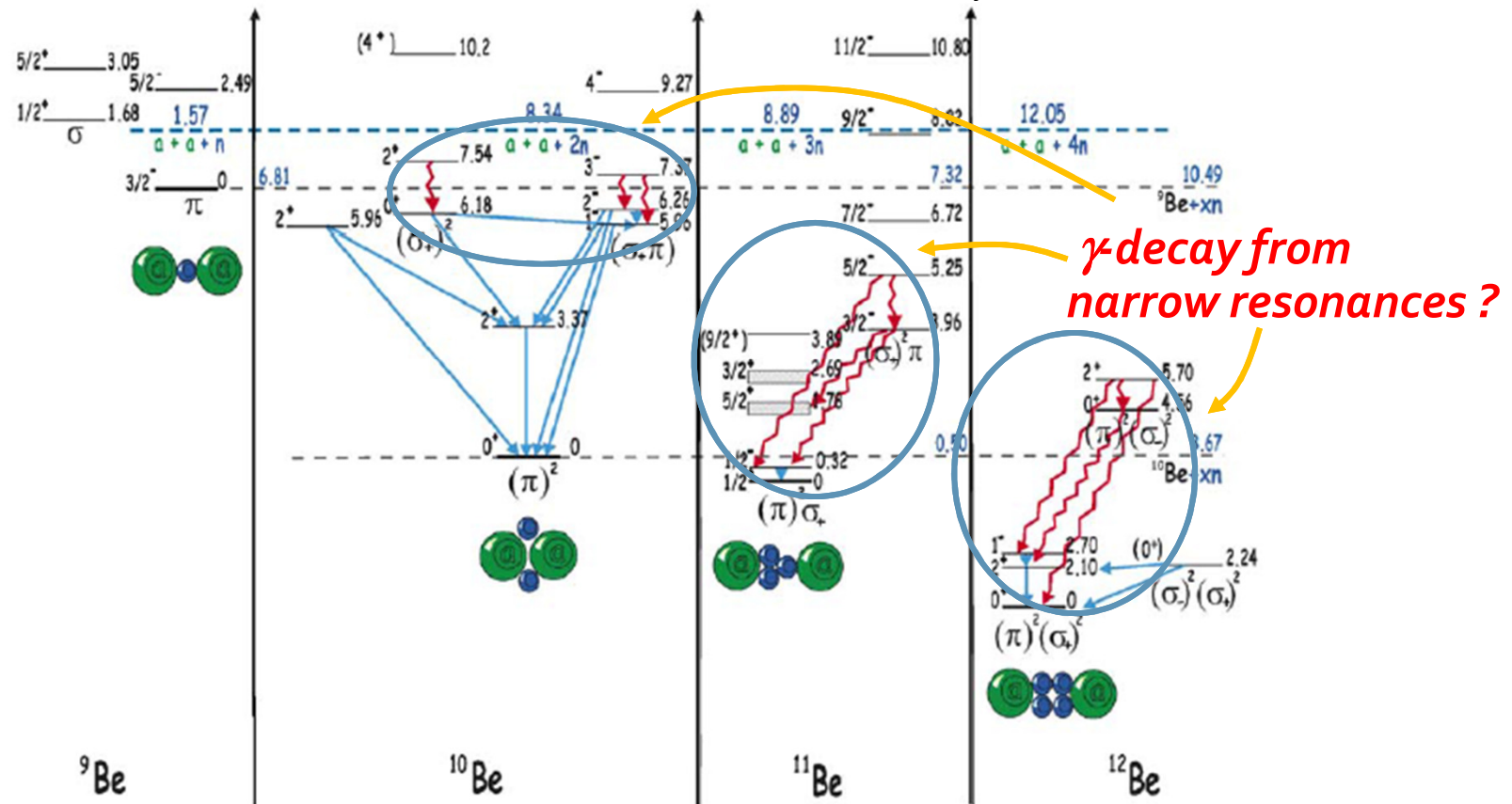
Be

Z		12O 0.40 MeV P	13O 8.58 MS Sp: 100.00% E: 100.00%	14O 70.620 S E: 100.00%	15O 122.24 S E: 100.00%	16O STABLE 99.757%	17O STABLE 0.038%	18O STABLE 0.205%	19O 26.88 S β-: 100.00%
7	10N P: 100.00%	11N 0.83 MeV P: 100.00%	12N 11.000 MS E: 100.00%	13N 9.965 M E: 100.00%	14N STABLE 99.636%	15N STABLE 0.364%	16N 7.13 S β-: 100.00% β-α: 1.2E-3%	17N 4.173 S β-: 100.00% β-n: 95.1%	18N 620 MS β-: 100.00% β-α: 12.20%
6	9C 126.5 MS E: 100.00% Sp: 61.60%	10C 19.308 S E: 100.00%	11C 20.334 M E: 100.00%	12C STABLE 98.93%	13C STABLE 1.07%	14C 5700 Y β-: 100.00%	15C 2.449 S β-: 100.00%	16C 0.747 S β-: 100.00% β-n: 99.00%	17C 193 MS β-: 100.00% β-n: 32.00%
5	8B 770 MS E: 100.00% E: 100.00%	9B 0.54 KeV P: 100.00% 2α: 100.00%	10B STABLE 19.9%	11B STABLE 80.1%	12B 20.20 MS β-: 100.00% B3A: 1.58%	13B 17.33 MS β-: 100.00%	14B 12.5 MS β-: 100.00%	15B 9.93 MS β-: 100.00% β-n: 93.60%	16B <190 PS N
4	7Be 53.24 D E: 100.00%	8Be 5.57 eV α: 100.00%	9Be STABLE 100.0%	10Be 1.387E-6 Y β-: 100.00%	11Be 13.81 S β-: 100.00% β-α: 1.1%	12Be 21.49 MS β-: 100.00% β-n: 100.0%	13Be 2.7E-21 S N	14Be 4.35 MS β-: 100.00% β-n: 81.00%	15Be <200 NS N
	3	4	5	6	7	8	9	10	N

Example of the physics case: neutron-rich Be isotopes

W. von Oertzen et al. / Physics Reports 432 (2006) 43–113

W. von Oertzen, M. Freer, Y. Kanada-En'yo, ...



Example:

$1n$ - $3n$ transfer in the $^{18}\text{O}(10\text{-}20 \text{ MeV/A}) + ^9\text{Be}$ reaction

^{10}Be , ^{11}Be , ^{12}Be products going backward and having very low kinetic energy



Reaction and detection

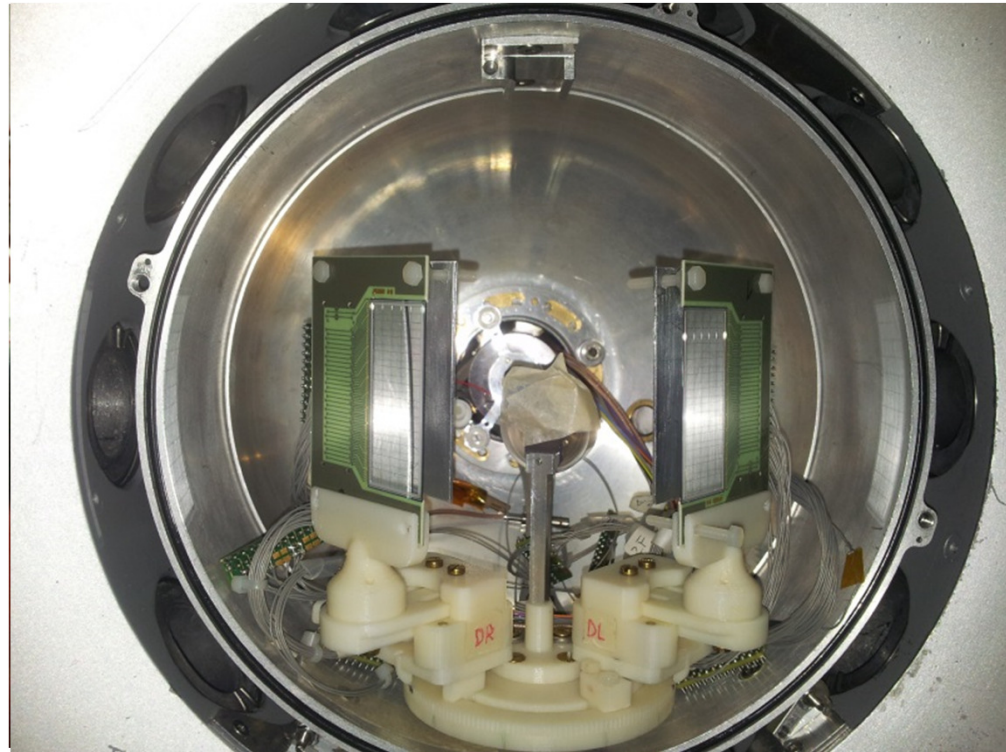
- To produce low energy Li, Be, B, C fragments we used:.

^{37}Cl beam (186 MeV, 1pnA) + ^{12}C target

- The nuclei of interest, target-like products (Li, Be, B, C ...) of mass $A \sim 10$, are scattered at $\sim 40^\circ$ - 60° . The kinetic energy of these products ranges from a few MeV to a few tens of MeV.
- Measurements of the energy, position, mass and charge: Pulse Shape Analysis of the signals from the TRACE detector

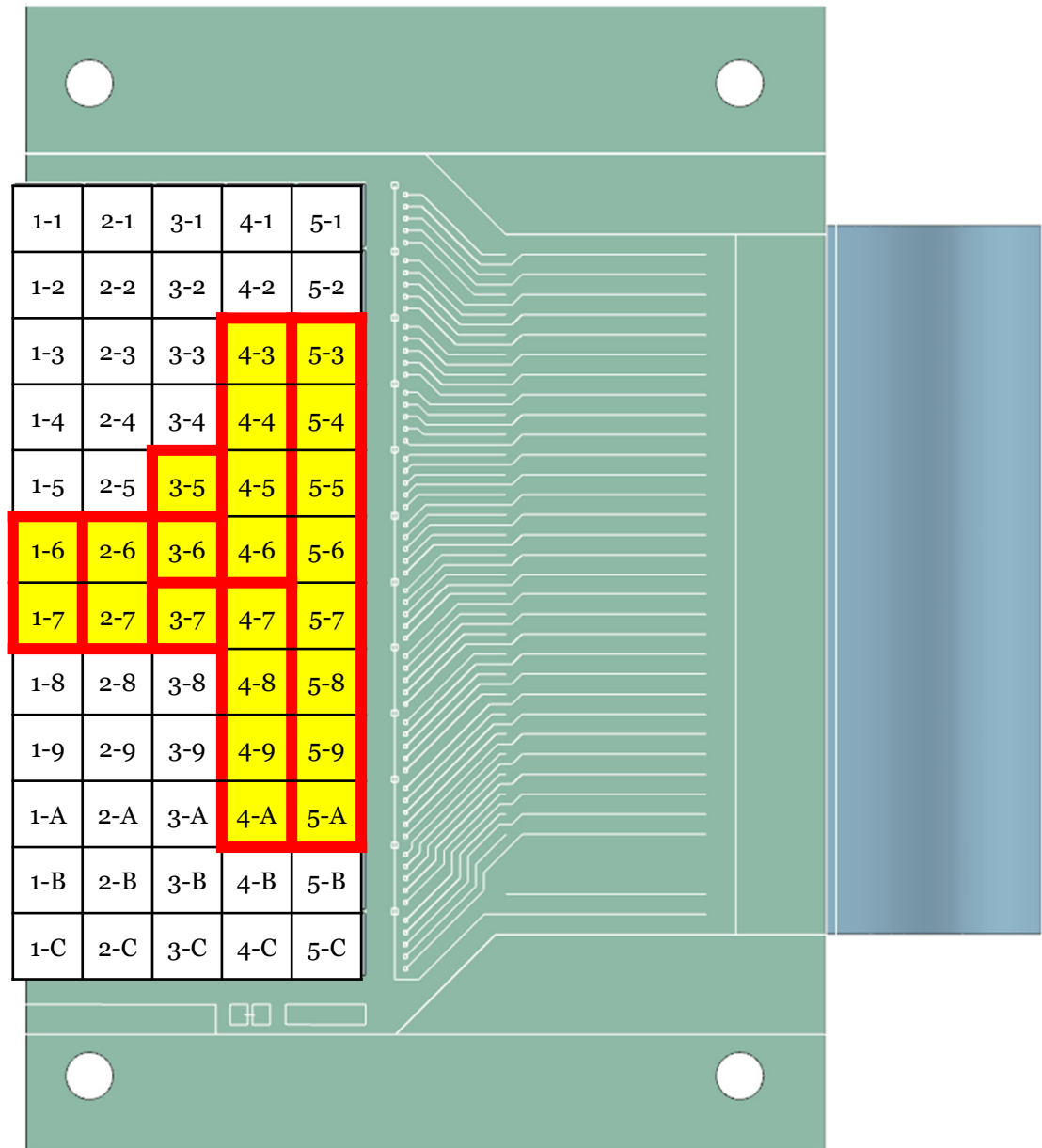
Experimental setup

- TRACE
- GALILEO
- LaBr
- NWall

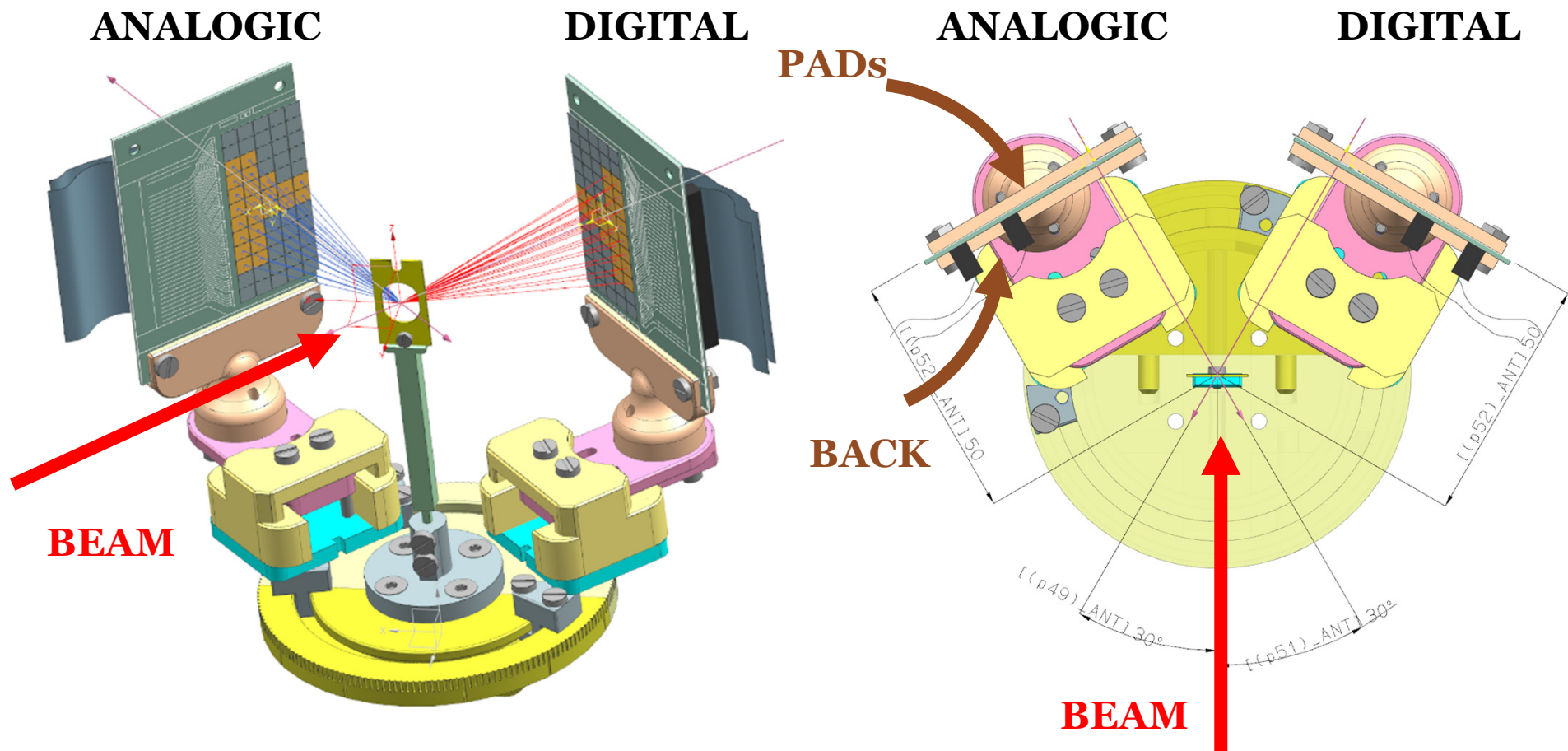


Experimental setup - TRACE

- 8 groups of pads were connected
- The angular range $\sim 30^\circ$ - 50°
- The back was the trigger

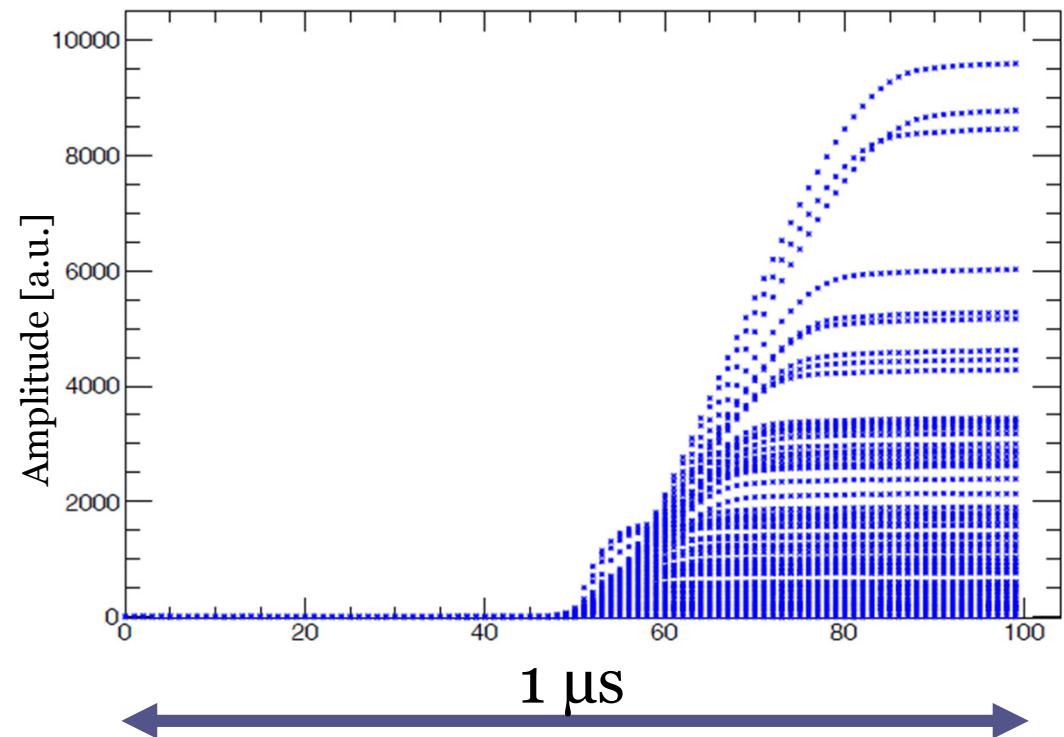


Experimental setup - TRACE

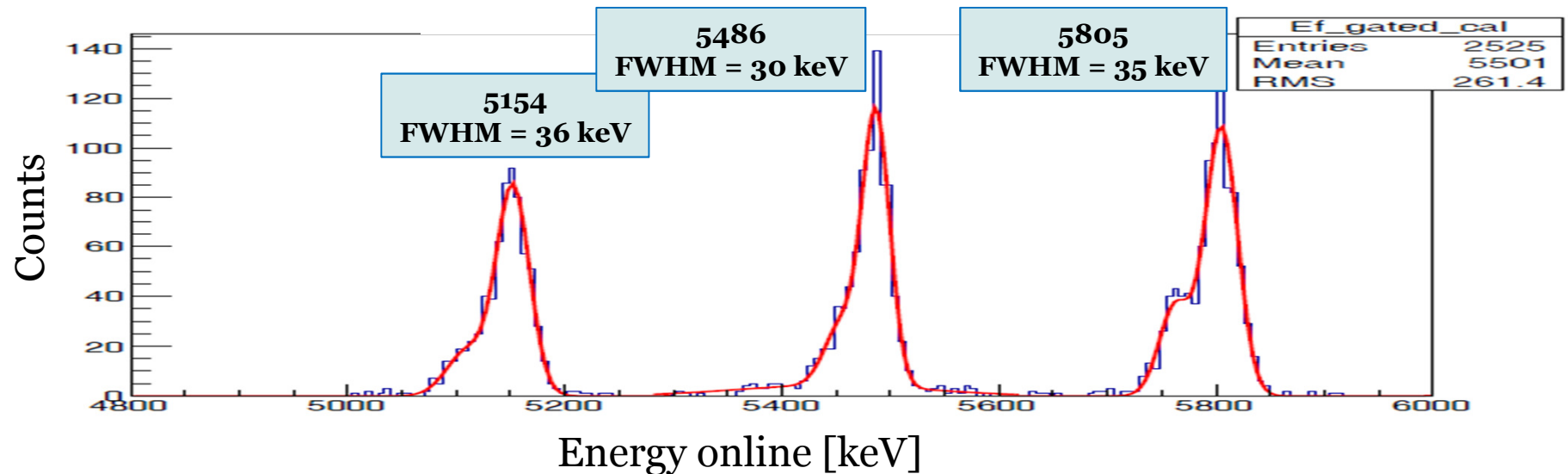
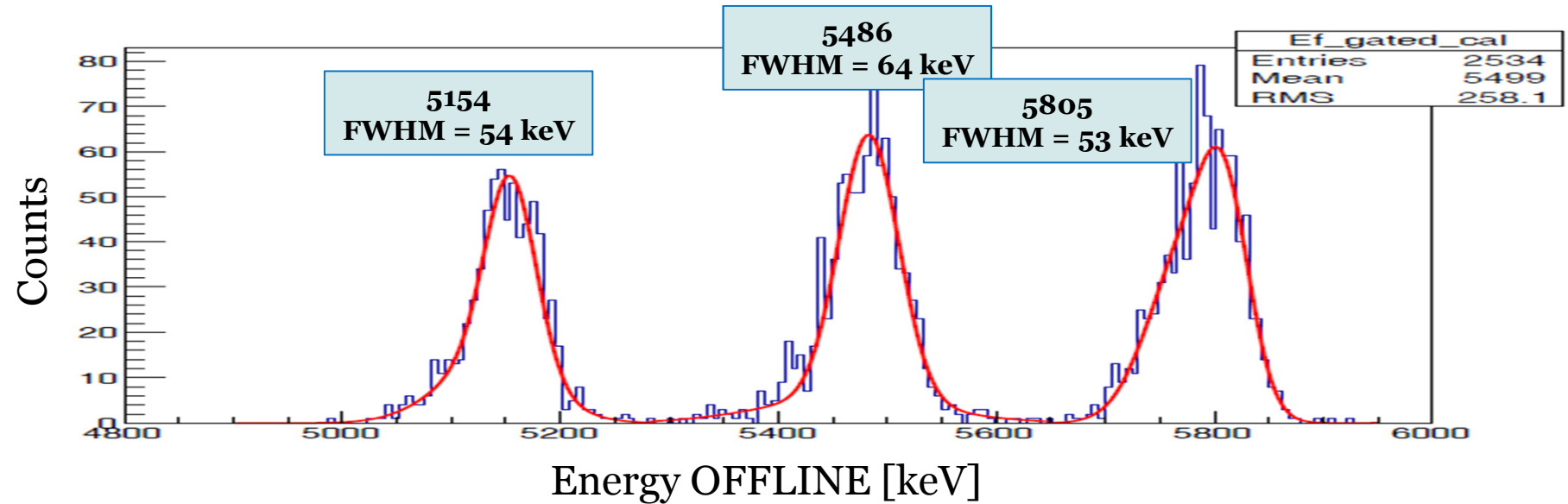


TRACE signals

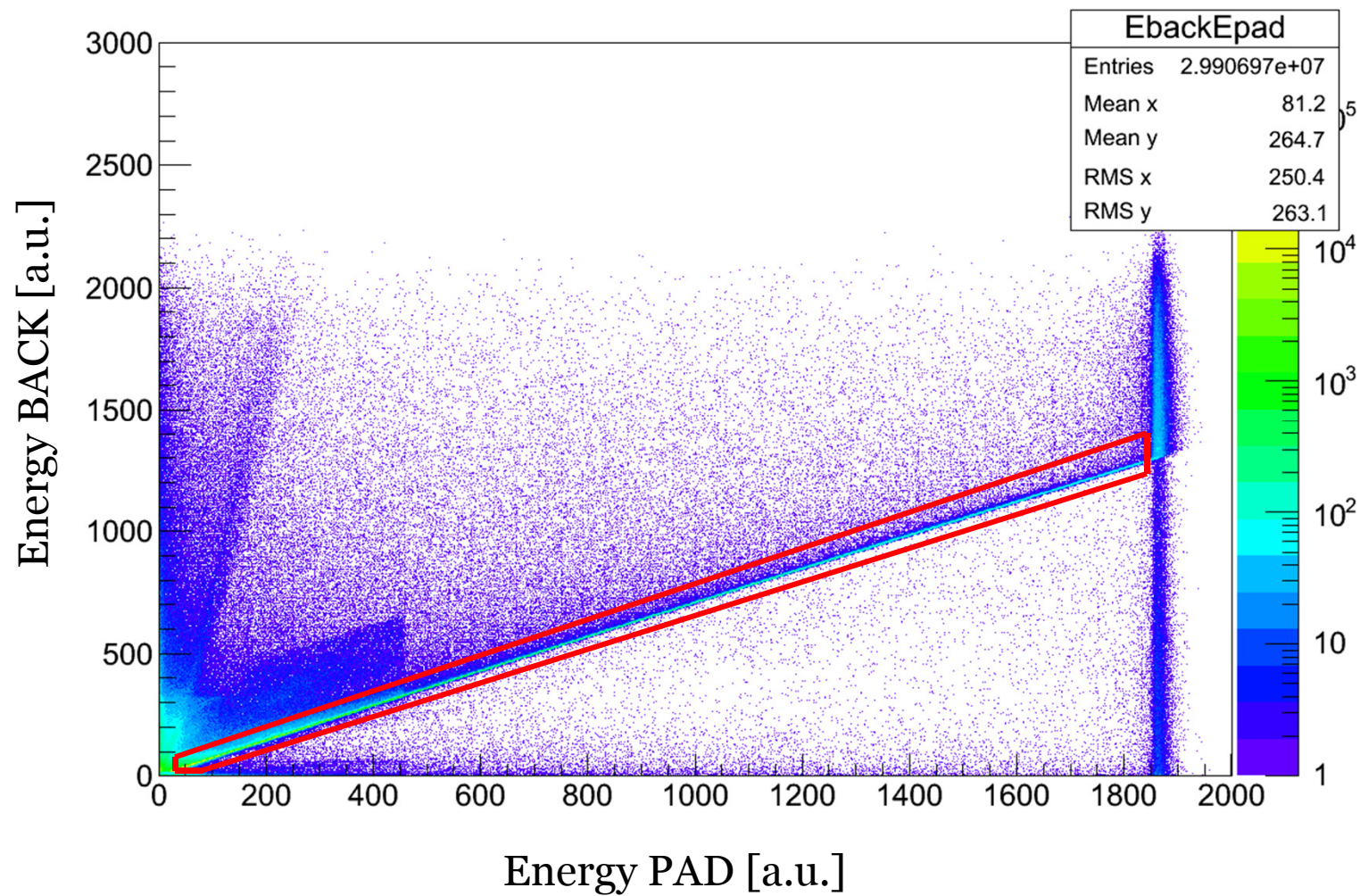
- Signal measurement at every 10 ns
- Energy „BACK” and „PAD”
- I_{max} from the derivative
- Rise time



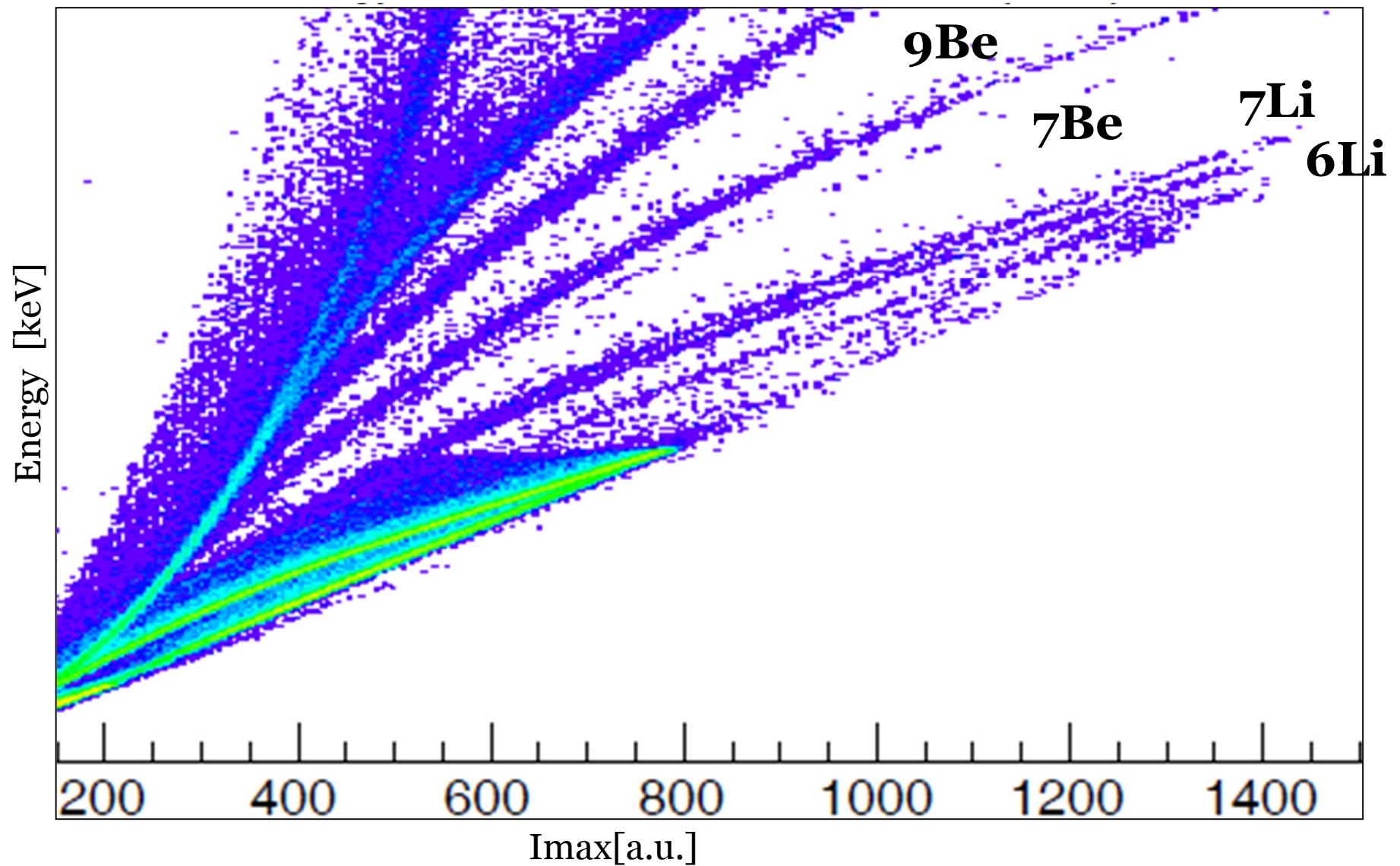
TRACE signals - „online” and „offline” energy resolution



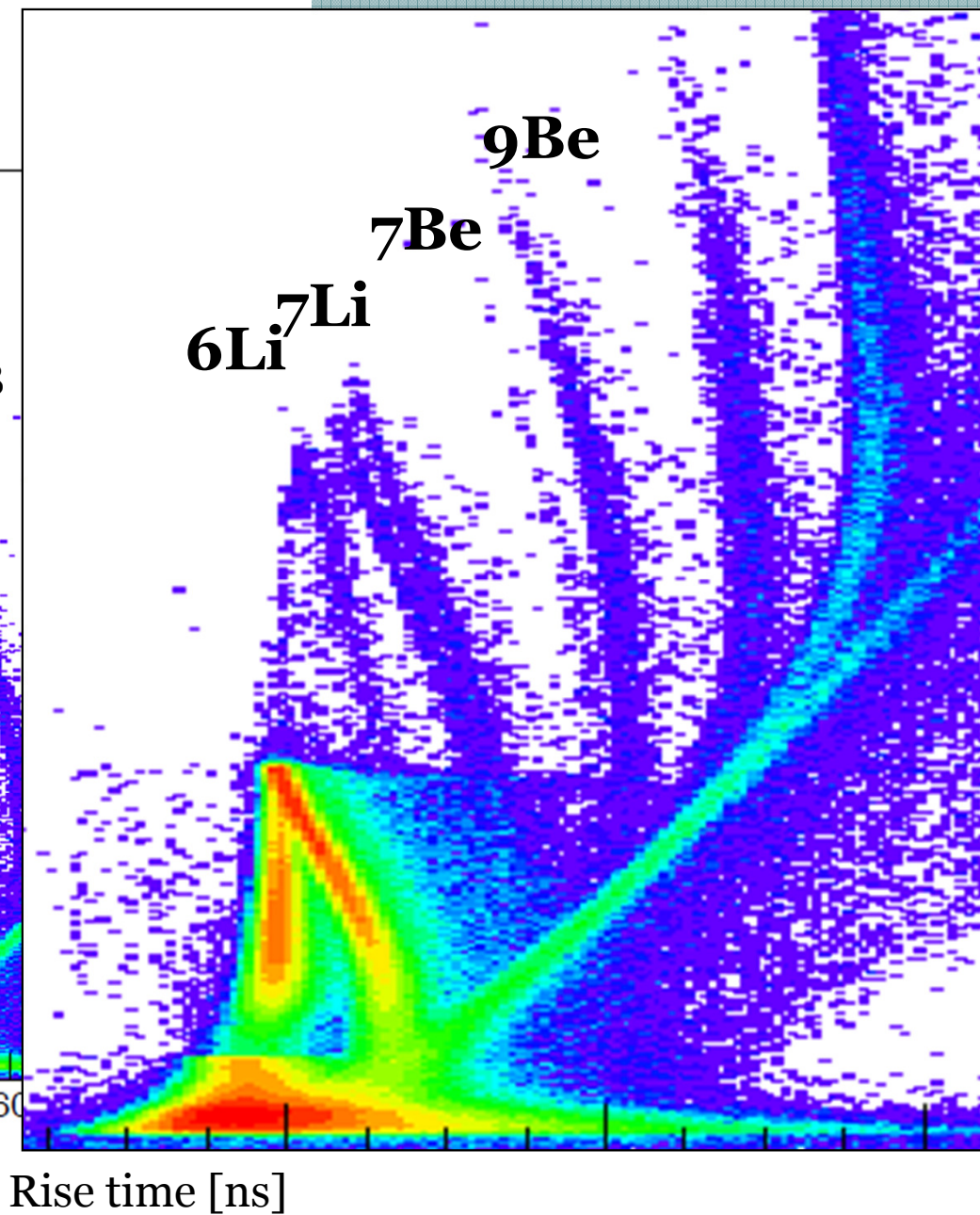
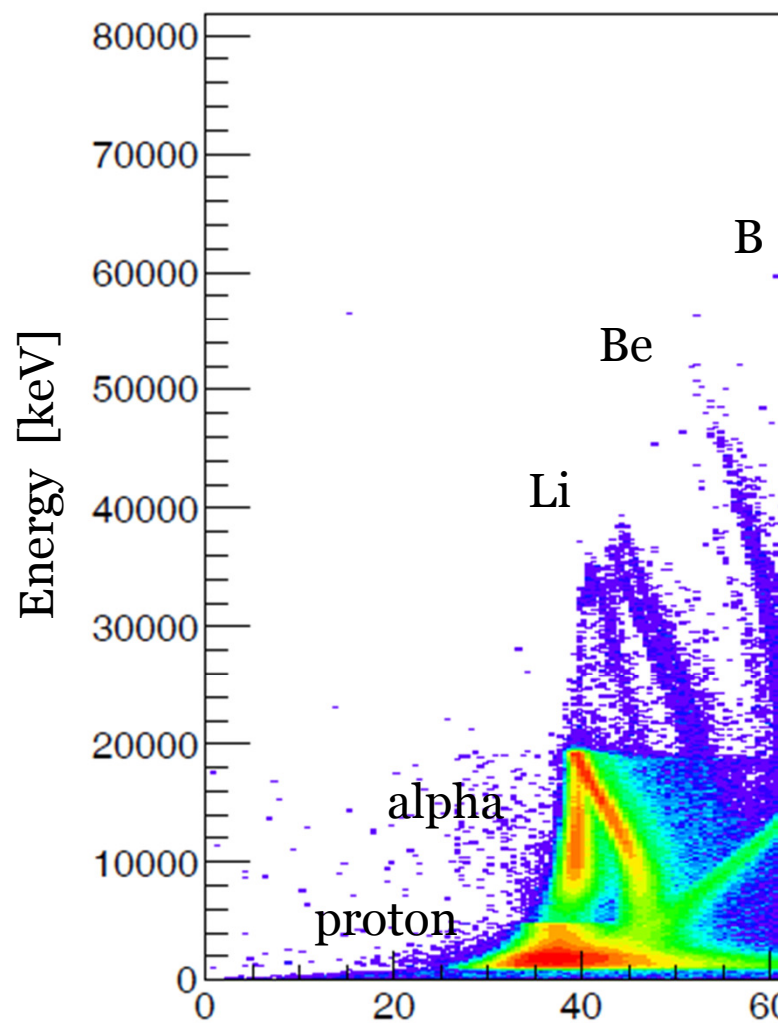
Data analysis



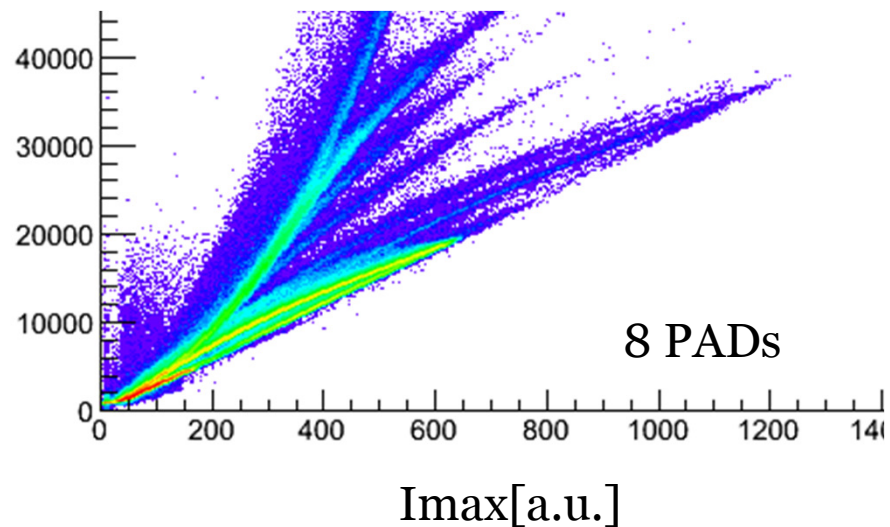
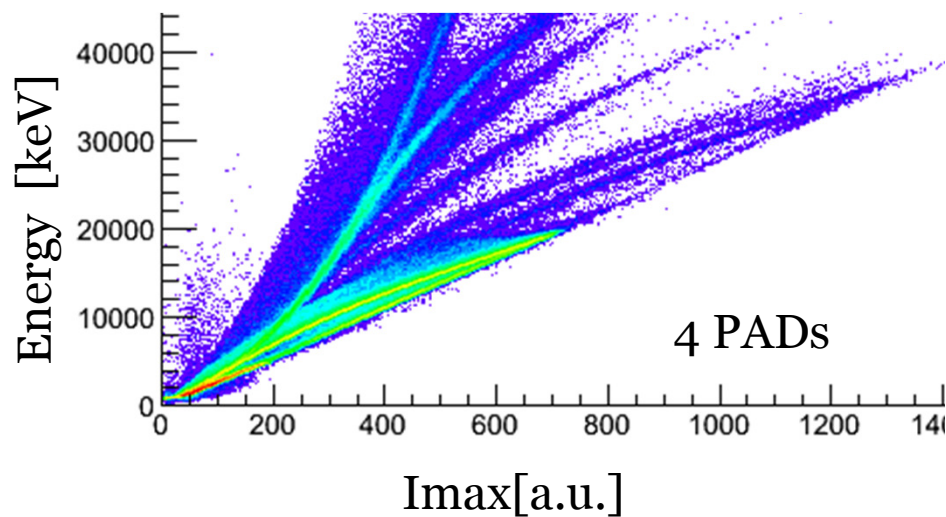
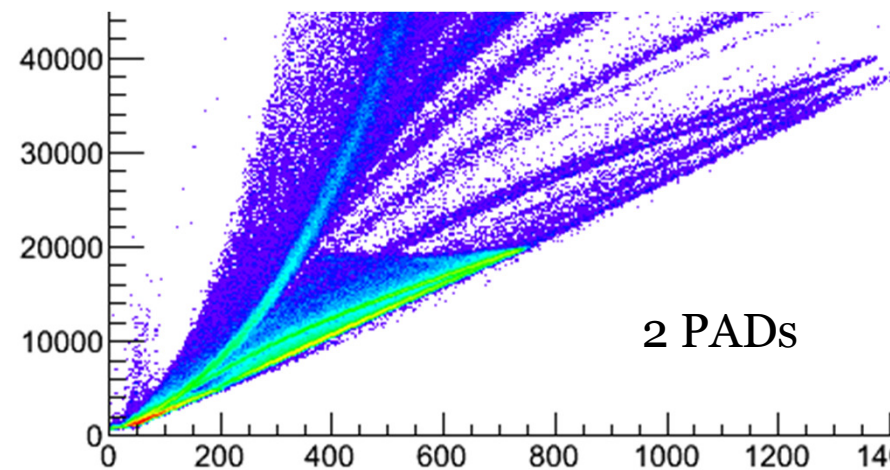
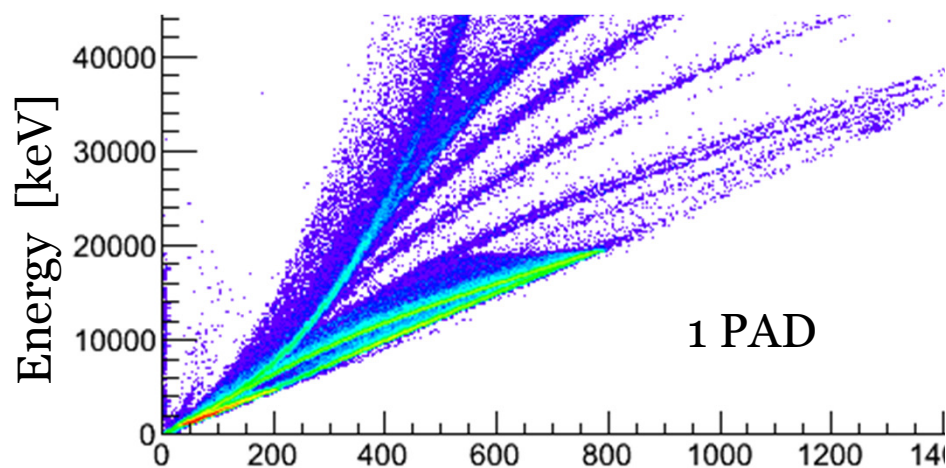
Data analysis



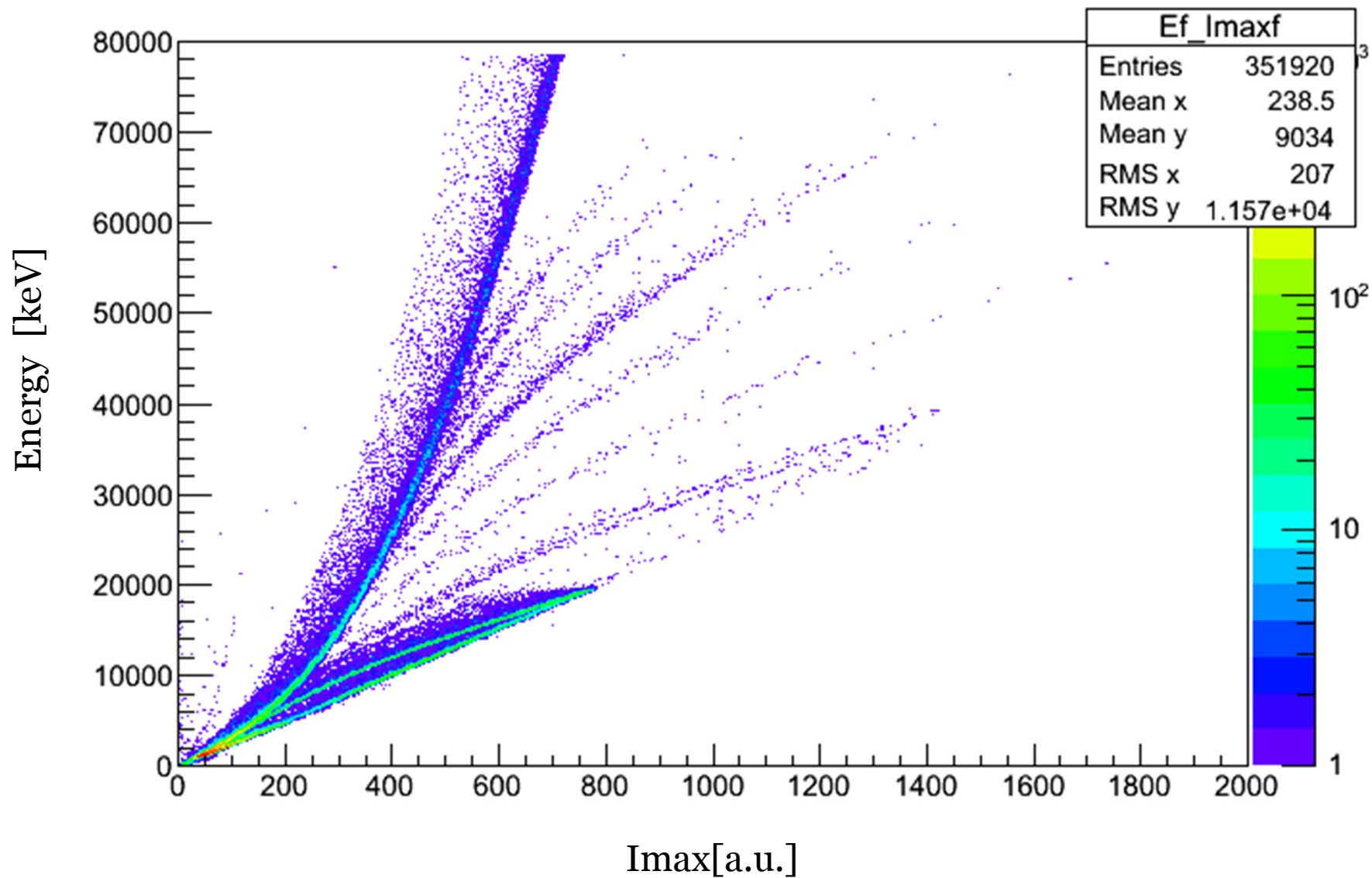
Data analysis



Data analysis



37Cl on 7Li target



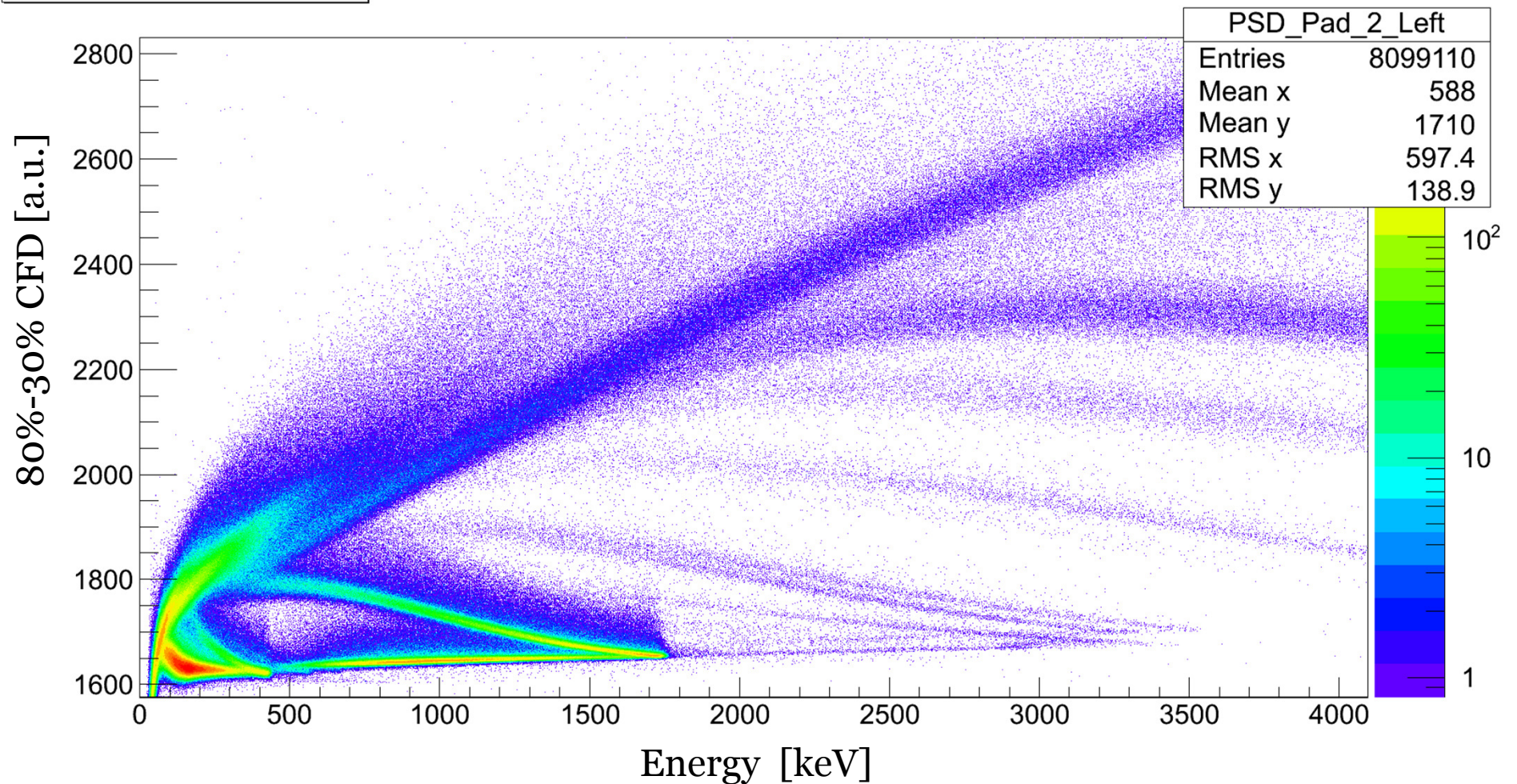


Data analysis - analog acquisition

- Preamplifier signal from a single pad or group of pads were carried to a MegAmp module
- Information about energy
- Information about time: 30% and 80% CFD
- Trigger was the OR of the 80% CFD outputs

Data analysis - analog acquisition

PSD_Pad_2_Left



S. Brambilla, INFN Milano



Summary

- Separation in A and in Z
- Separation in Z down to ~20 MeV for Li and Be isotopes
- Reading from 1 or 2 pads at most

Collaboration

S. Leoni, S. Brambilla, C. Boiano

(INFN Sezione di Milano and Università degli Studi di Milano, Milano, Italy)

B. Fornal, **M. Ciemała**

(Institute of Nuclear Physics, PAN, Krakow, Poland)

D. Mengoni, D. Bazzacco

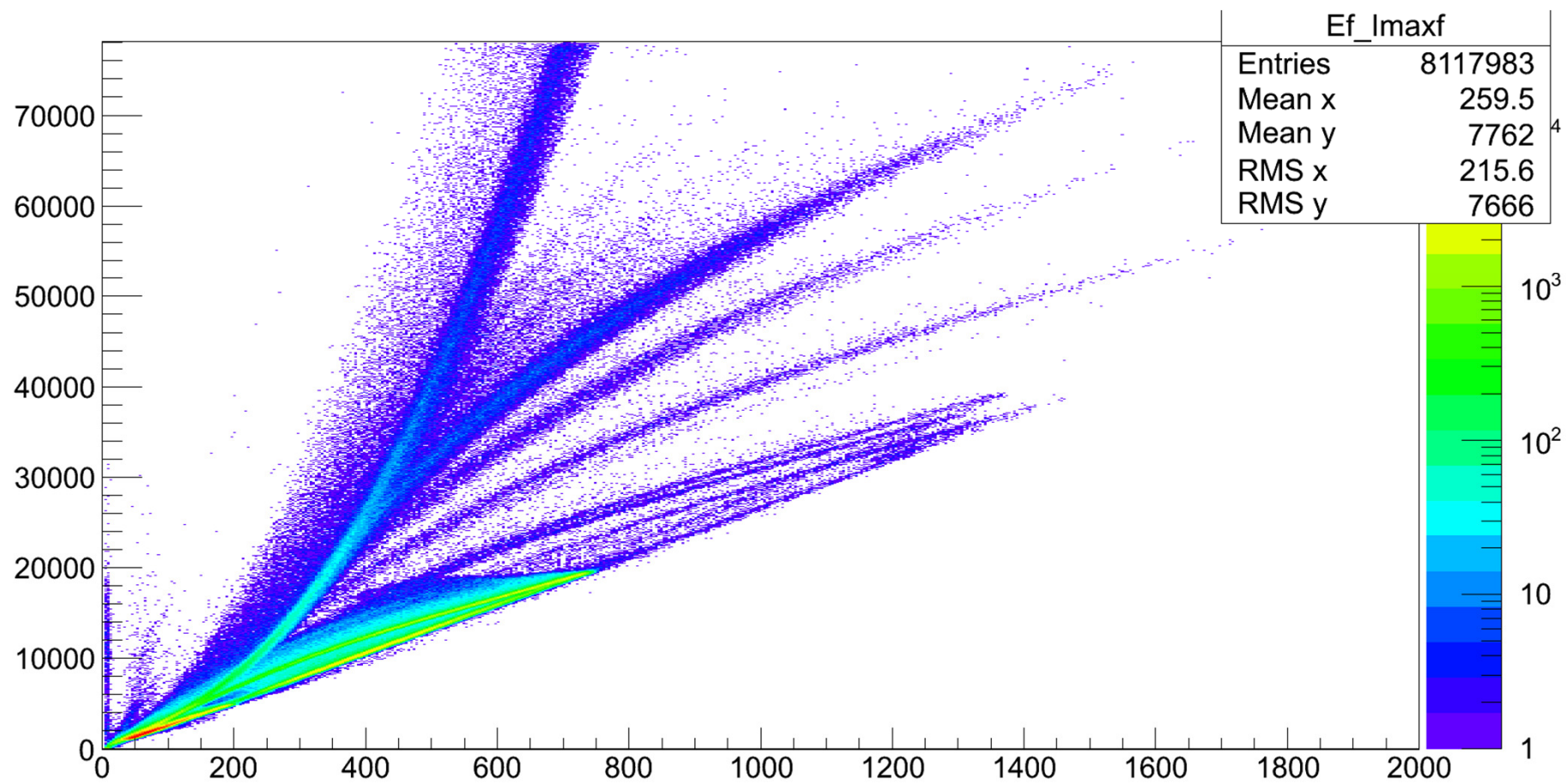
(Dipartimento di Fisica e Astronomia dell'Università and INFN Sezione di Padova, Padova, Italy)

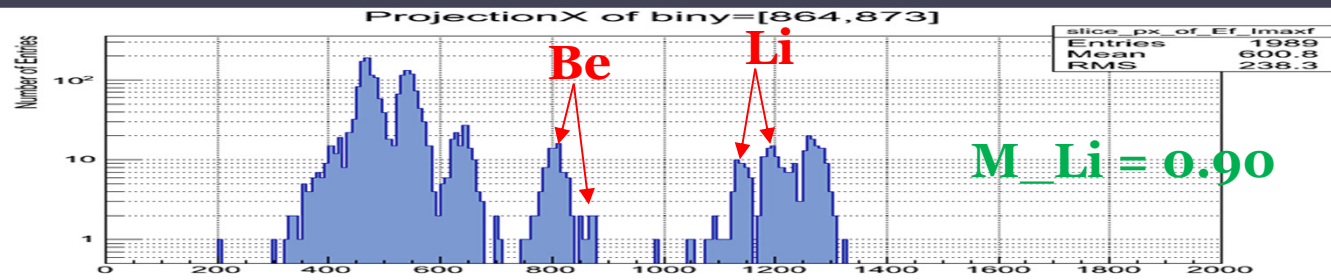
Jose Duenas Diaz

(Universidad de Huelva, Dpto. Ingeniería Eléctrica y Térmica, Huelva, Spain)

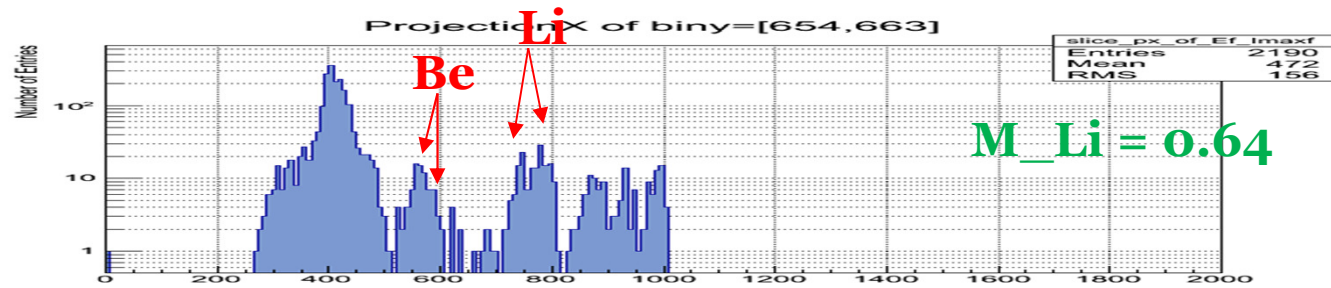
Thank you for your attention!

^{12}C 45V 13h (**2PADs**)

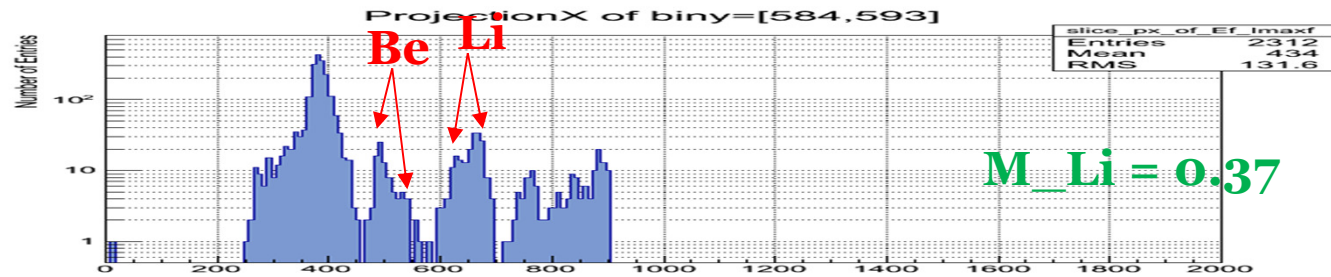




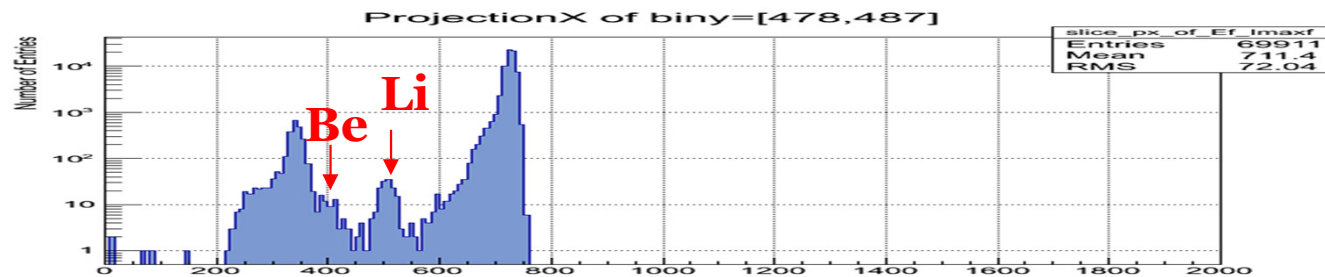
34.52-34.92 MeV



26.12-26.52 MeV



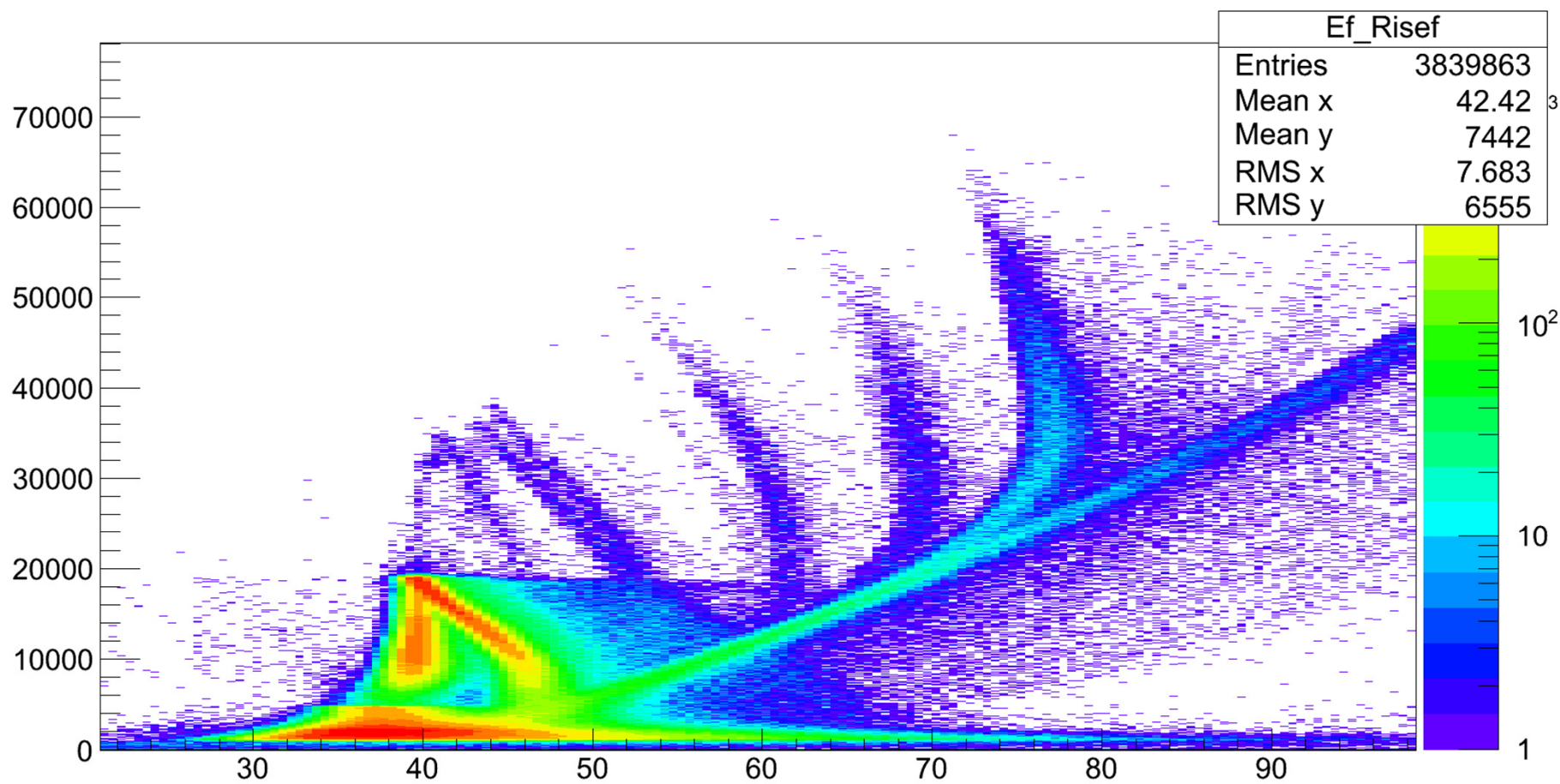
23.32-23.72 MeV

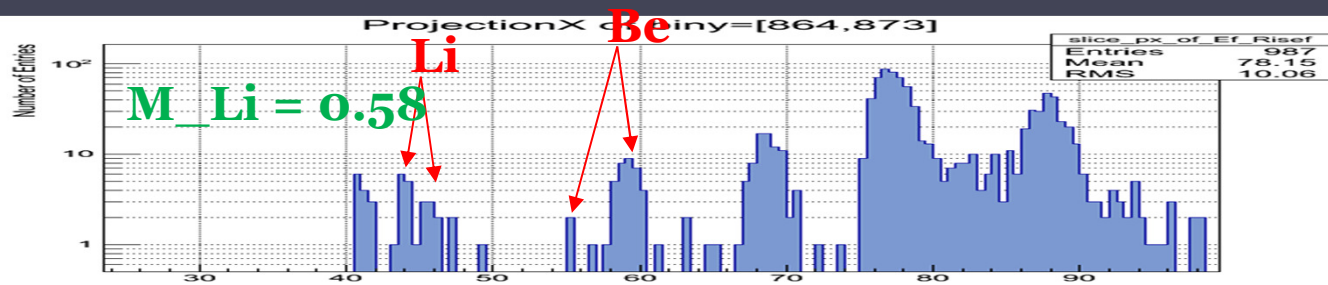


19.08-19.48 MeV

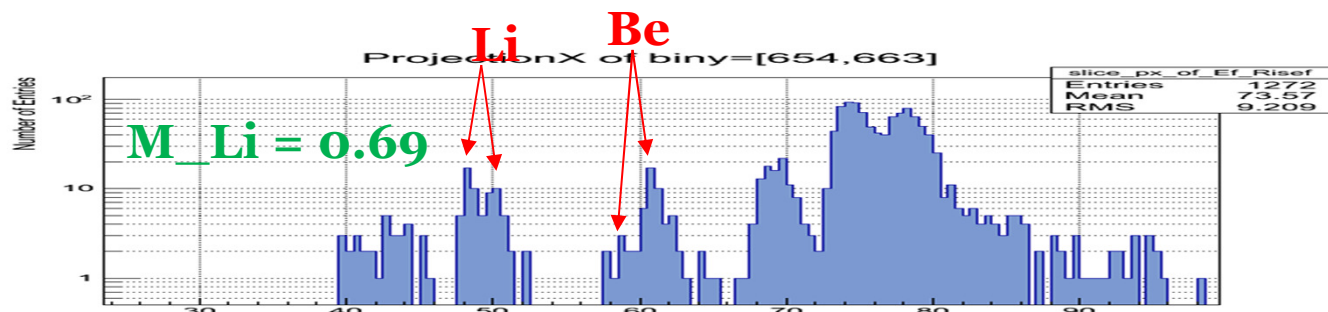
DIGITAL

12C 45V 13h (2PADs)

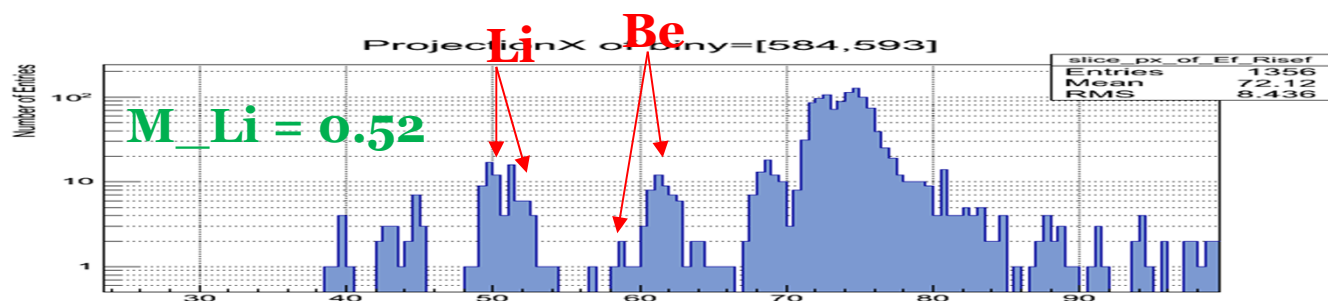




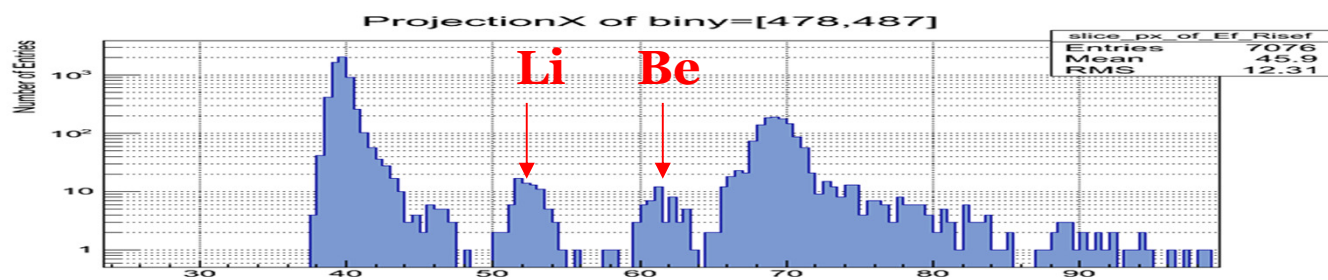
34.52-34.92 MeV



26.12-26.52 MeV



23.32-23.72 MeV

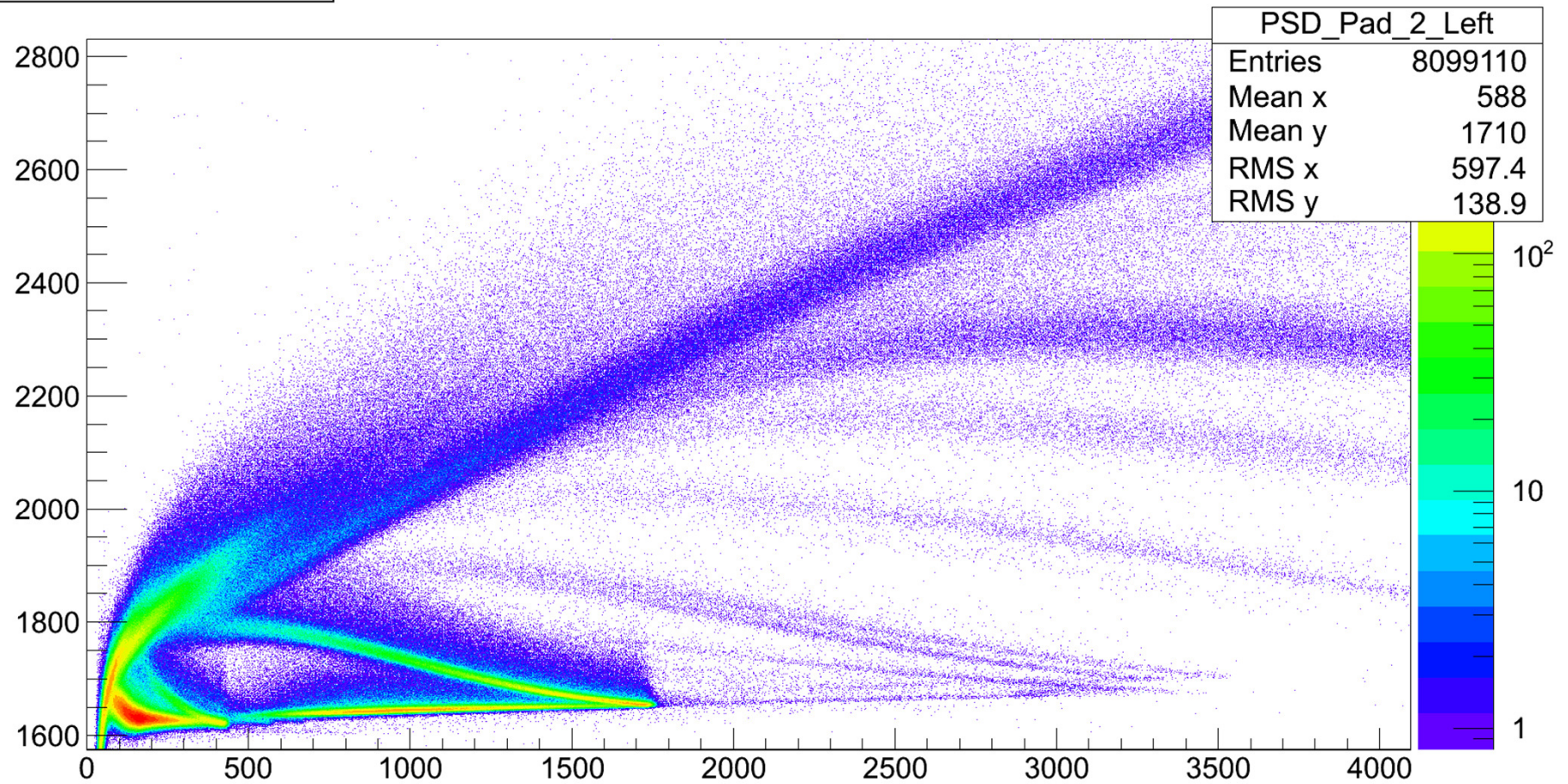


19.08-19.48 MeV

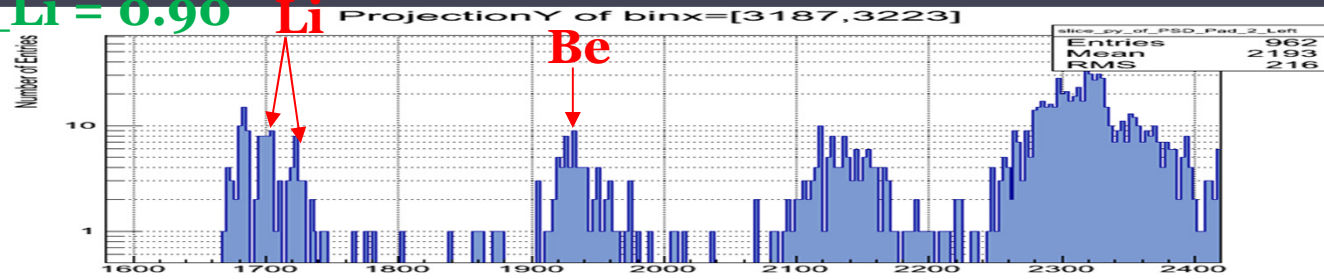
ANALOG

12C 38V 13h (2PADs)

PSD_Pad_2_Left

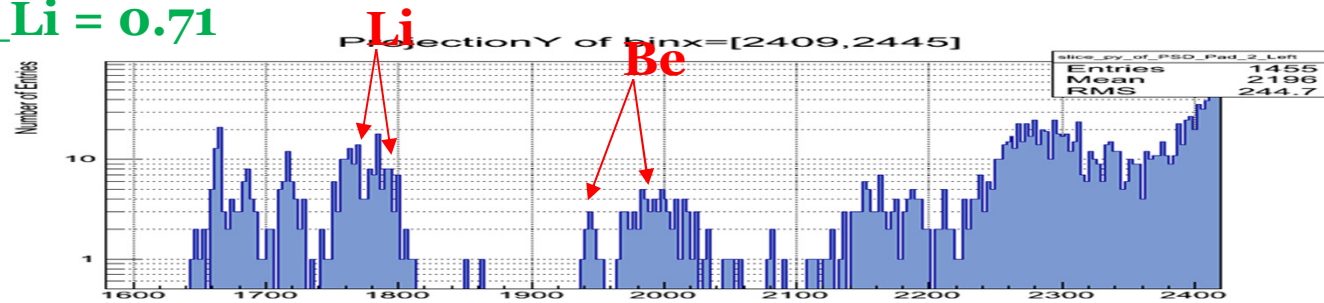


$M_{Li} = 0.90$



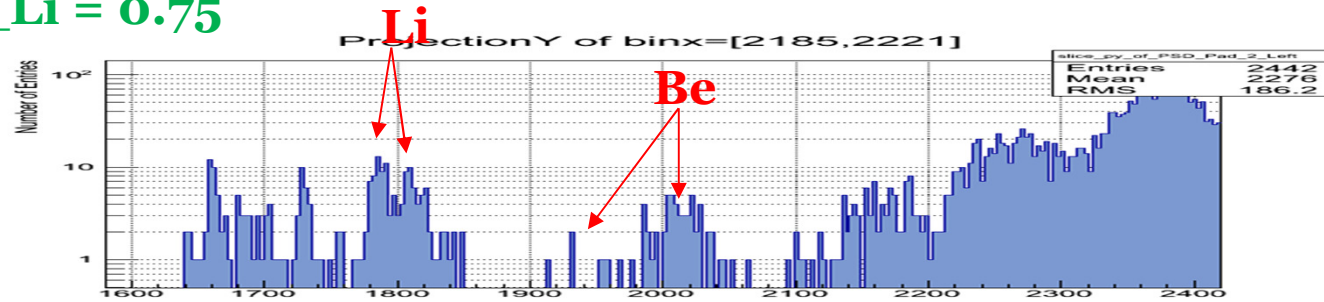
34.52-34.92 MeV

$M_{Li} = 0.71$

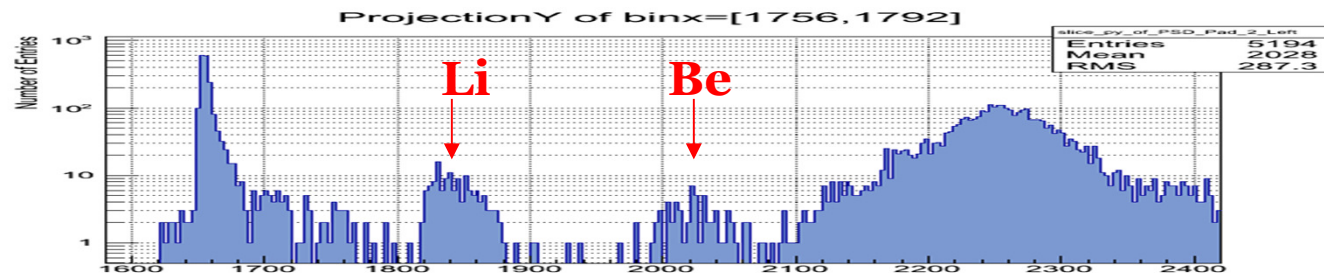


26.12-26.52 MeV

$M_{Li} = 0.75$



23.32-23.72 MeV



19.08-19.48 MeV