^{207}Bi source

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A status of activities @ LIP
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Working Group meeting (Zoom - 21st September, 2023)

F. Barao

Data analysis framework

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From RAW data to analysis ROOT trees: 2-step process
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We started using the python decoder (Serhan, Furkan) to read RAW data and convert it to JSON format

After, we developed a JSON reader in C++ to produce ROOT trees (F. Barao)

Alternatively, we also developed a JSON python reader to produce ROOT trees (J. Maneira)

Data analysis framework (cont.)

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From RAW data to analysis ROOT trees: 1-step process in progress
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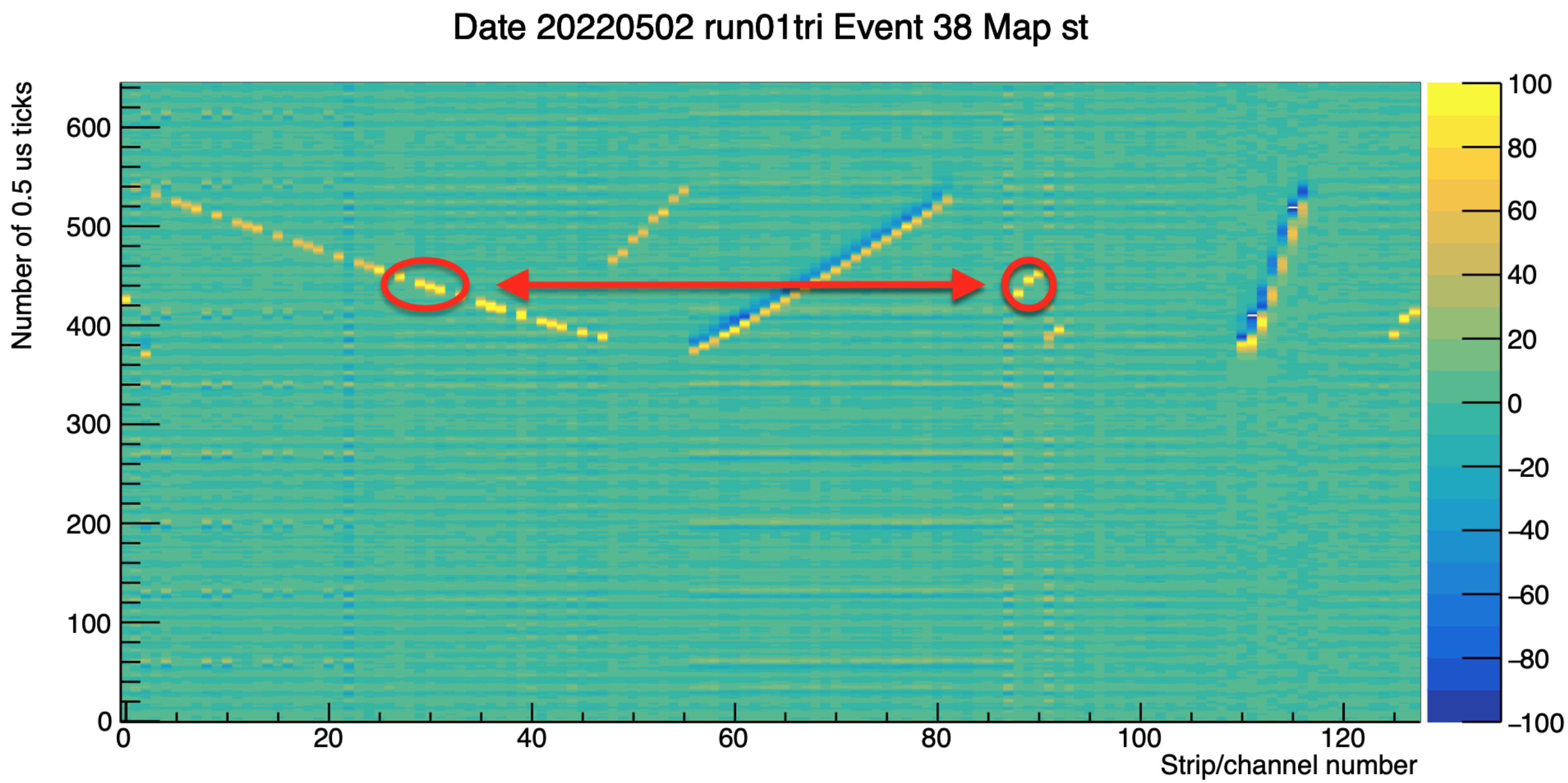
We are working in a C++ code able to read and process the RAW data and create ROOT trees (F. Barao, J. Antunes)

ROOT trees will include raw data information and some processing as: peak-finding, baseline evaluation, statistical mean and sigma channel by channel, channel correlations, ...

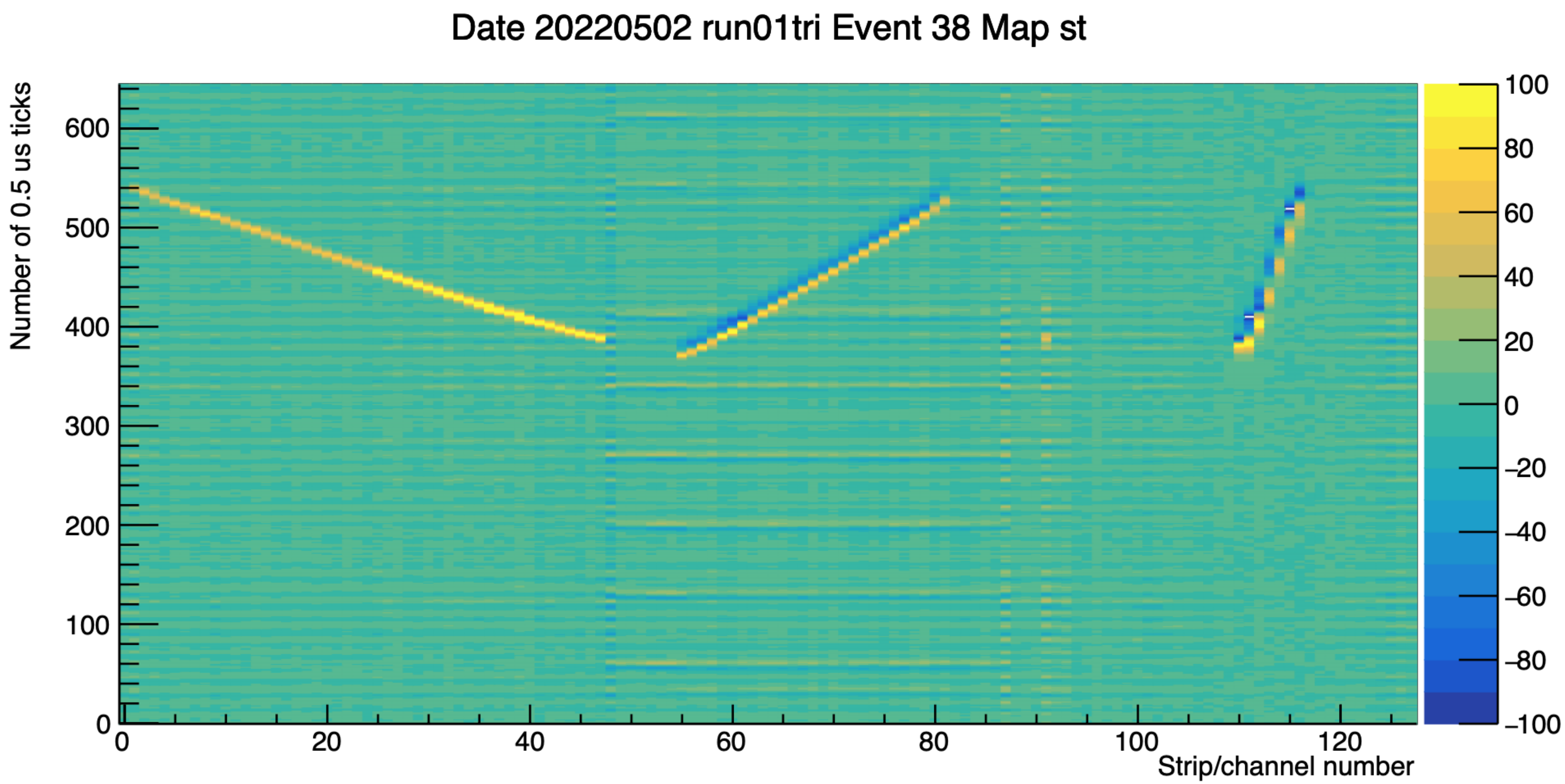
Tuning of readout channels numbering

RAW data (May 2022) python reader contained a channel numbering showing track discontinuities…



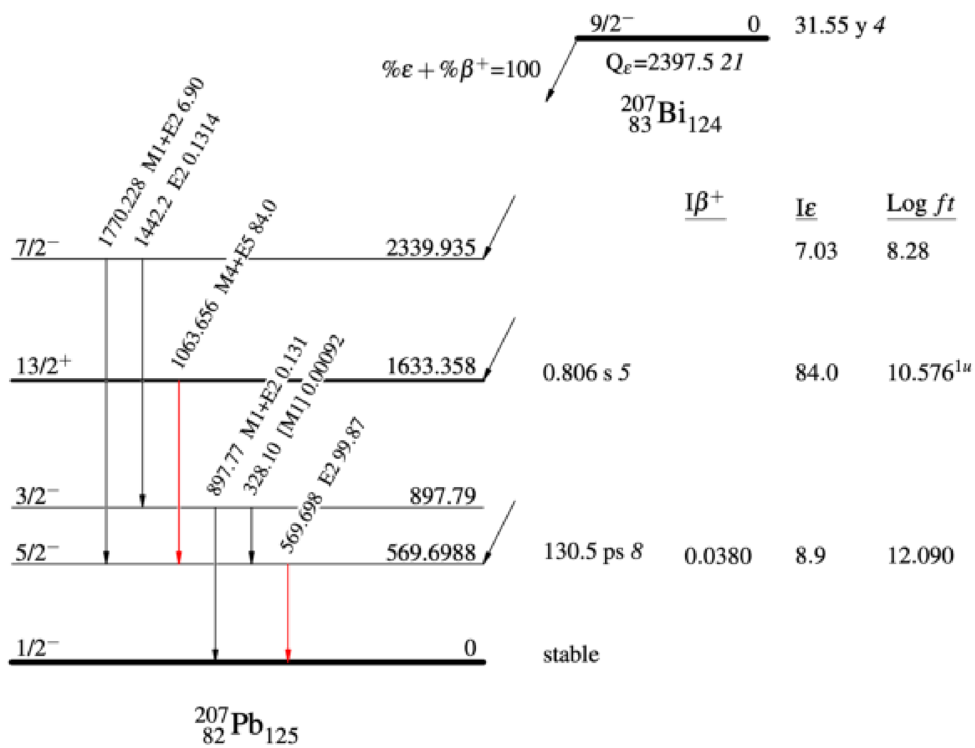
Tuning of readout channels numbering

We (J. Maneira, F. Barao) worked out corrections to channel mapping...



^{207}Bi source: event generator

We (F. Barao + J. Antunes) developped a source event generator, with the implementation of temporal correlations



Time correlated decay chains:

4->1, 1->0

4->2, 2->1, 1->0

4->2, 2->0

3->1, 1->0

1->0

How likely is a K-shell electron from $3 \rightarrow 1$ transition?

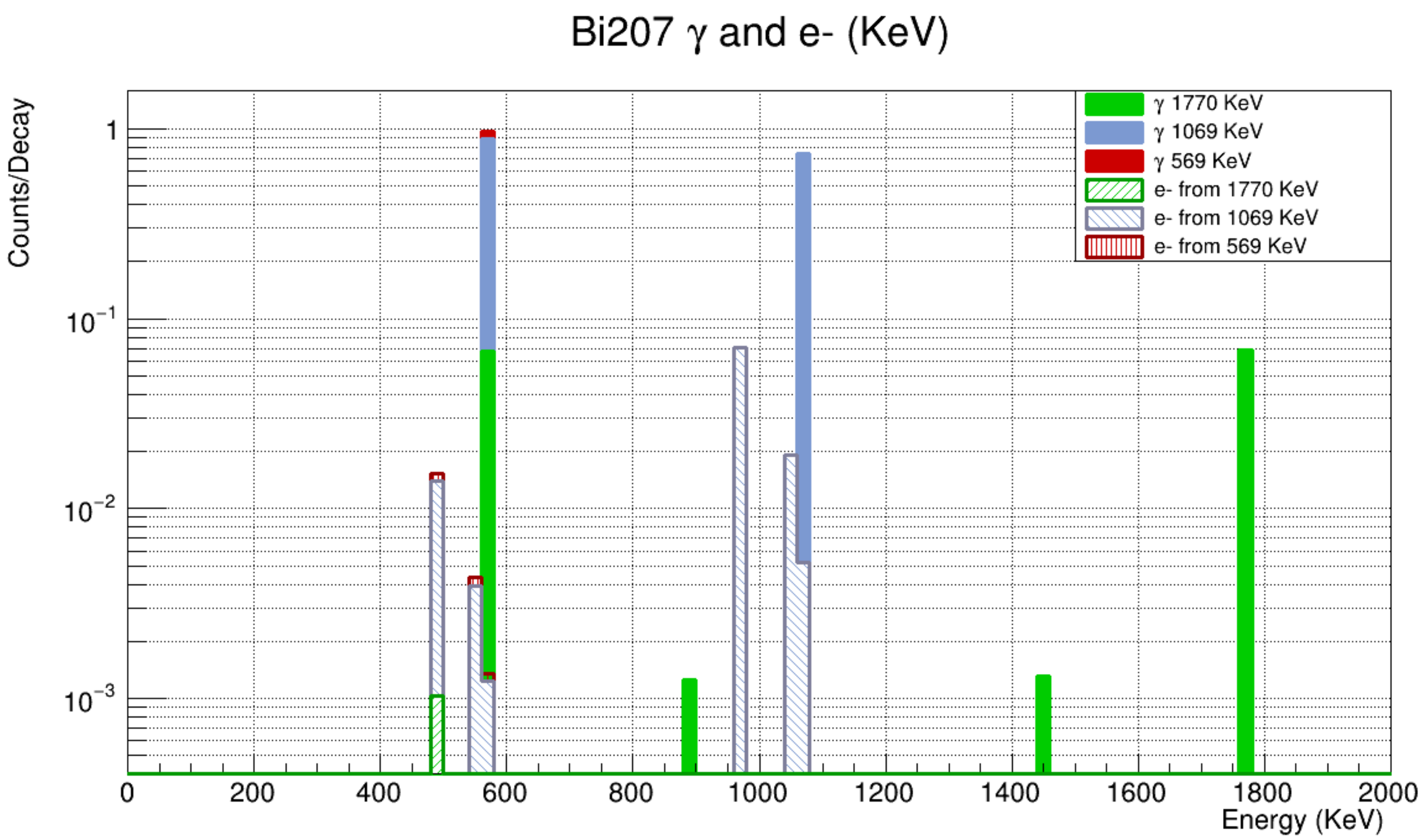
electron kin energy: $T_e = \Delta E_{3\rightarrow 1} - U_{K-shell} = 975.66 KeV$

2.3 Gamma Transitions and Internal Conversion Coefficients

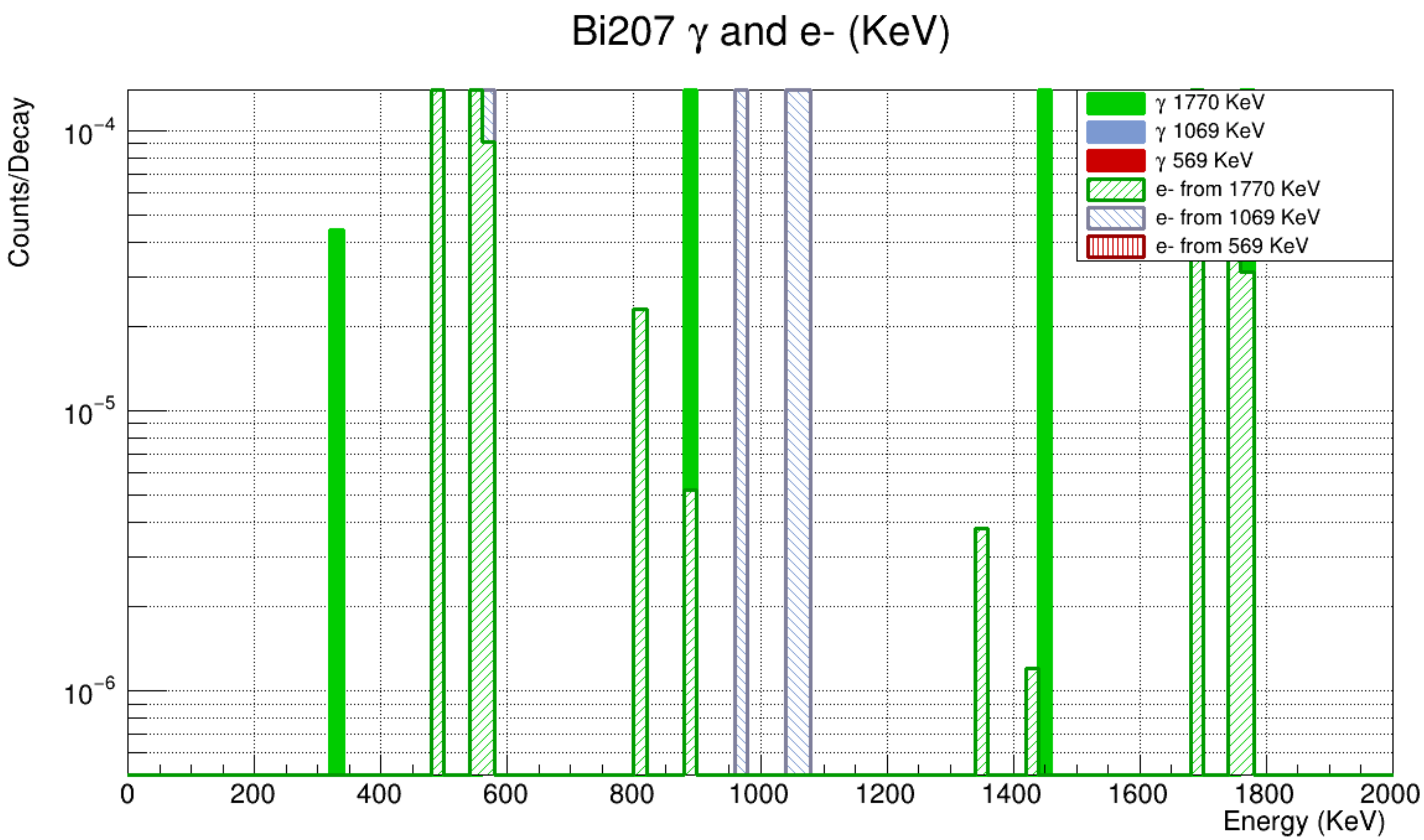
	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-2})	α_L (10^{-2})	α_M (10^{-2})	α_T (10^{-2})
$\gamma_{2,1}$(Pb)	328,11 (10)	0,0044 (35)	[M1]				
$\gamma_{1,0}$(Pb)	569,699 (2)	99,87 (4)	E2	1,583 (23)	0,439 (7)	0,1081 (16)	2,16 (3)
$\gamma_{2,0}$(Pb)	897,8 (1)	0,1313 (48)	M1+8,3%E2	1,82 (8)	0,304 (12)	0,071 (3)	2,22 (9)
$\gamma_{3,1}$(Pb)	1063,659 (3)	84,11 (31)	M4+0,01%E5	9,53 (23)	2,47 (7)	0,591 (33)	12,78 (24)
$\gamma_{4,2}$(Pb)	1442,2 (2)	0,1319 (22)	E2	0,271 (4)	0,0468 (7)	0,01098 (16)	0,337 (5)
$\gamma_{4,1}$(Pb)	1770,236 (9)	6,901 (26)	M1+0,0025%E2	0,342 (5)	0,0556 (8)	0,01292 (19)	0,442 (7)

$$P_e\left(3 \wedge 3 \rightarrow 1 \wedge e_{K-shell}\right) = P(3 \wedge 3 \rightarrow 1) \cdot P(e|3 \rightarrow 1) \cdot P(K-shell|e, 3 \rightarrow 1) \simeq 7.11\%$$

^{207}Bi source: output particles (e, γ)



^{207}Bi source: output particles (e, γ)



^{207}Bi source: event MC simulator

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Aiming to produce a 3D picture of source decays and liquid-argon interaction
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- Data analysis of source events assume energy deposition of γ´s essentially uniform around electron peak position strips
- A detailed simulation of the source events could confirm this and bring additional details
- We started (F.Barao + Summer Internship Physics Degree students), a source event simulation framework.
  Gamma and electron interactions were implemented:
  - γ: photoelectric, Compton and pair-production
  - e: collision losses

Next steps

- Definition of a common data analysis framework
  RAW -> ROOT trees
- Definition of the source positions in protoDUNE
- Towards a source generator + event simulation very detailed? Standalone?
  To be included in LarSoft?