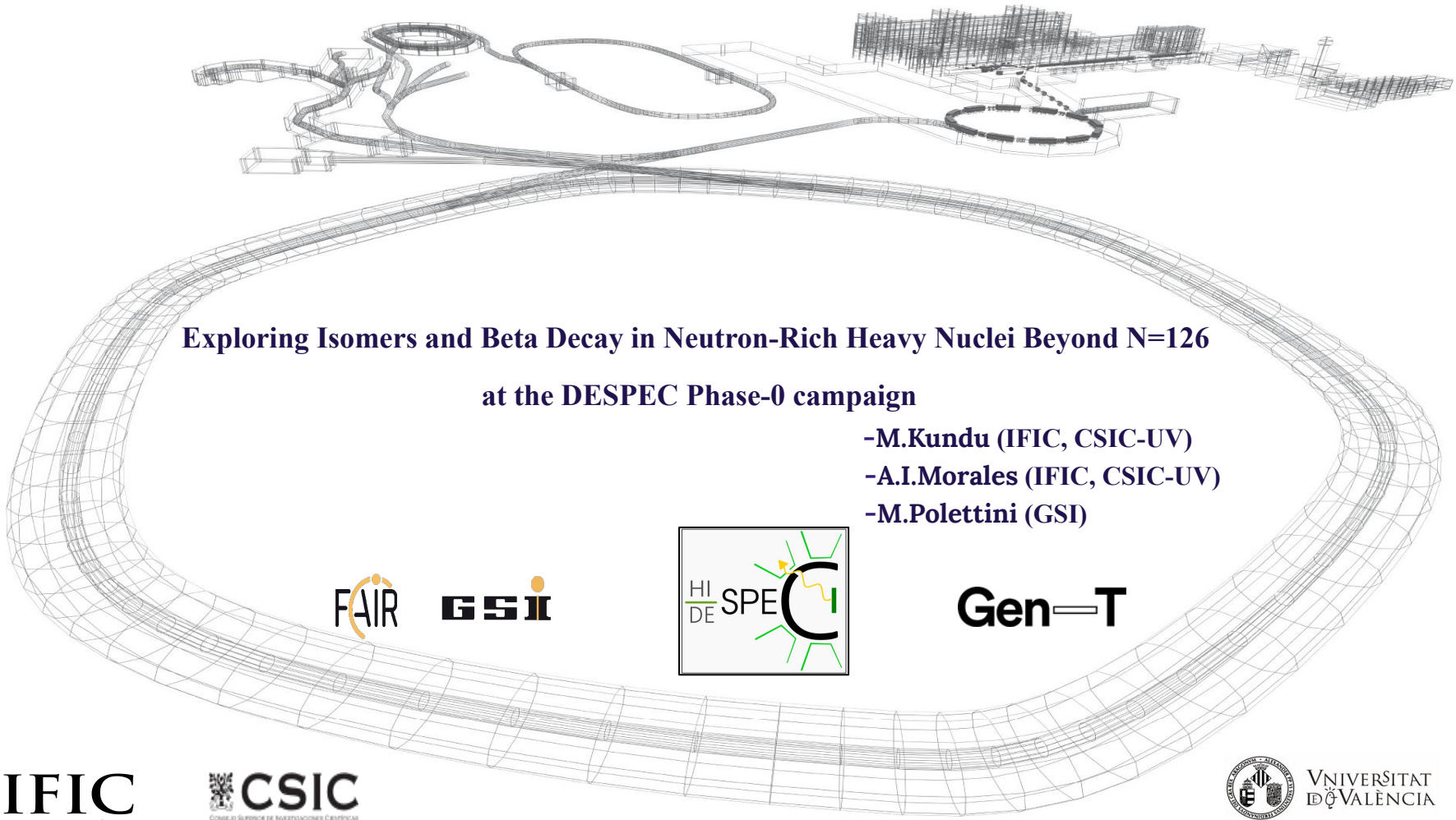

Exploring Isomers and Beta Decay in Neutron-Rich Heavy Nuclei Beyond N=126

at the DESPEC Phase-0 campaign

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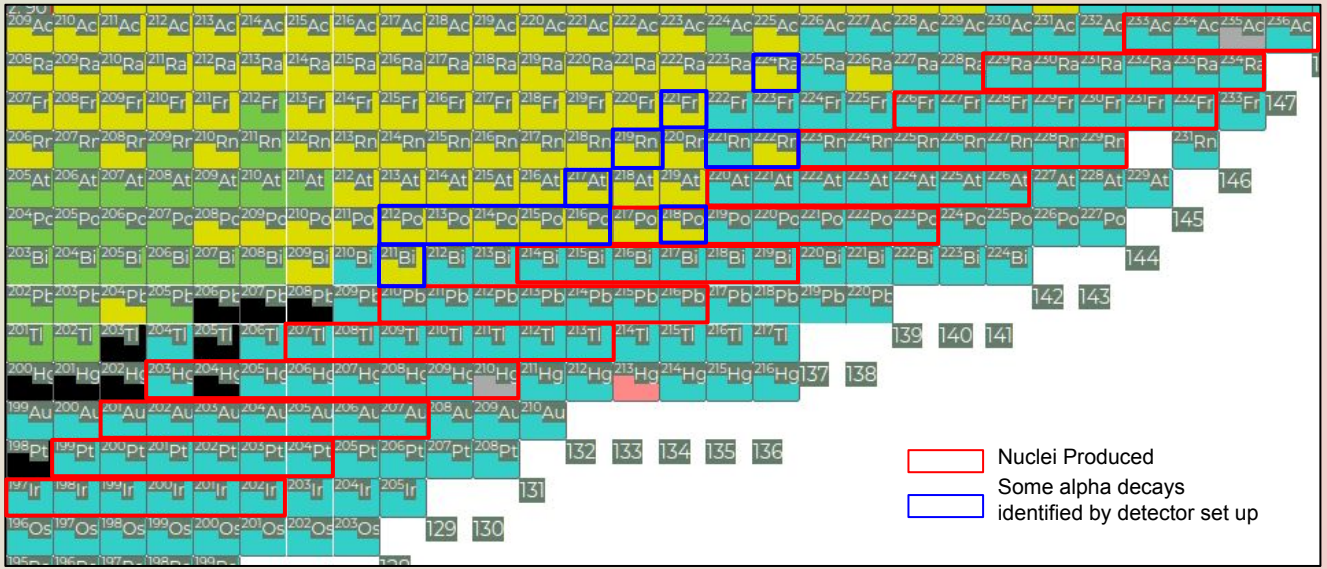
IFIC INSTITUT DE FÍSICA CORPUSCULAR CSIC CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS VNIVERSITAT DE VALÈNCIA

Scope of our experiment

- Investigation of the scarcely explored N = 126 shell closure region
- All the neutron nuclei beyond Bi are formed by rapid neutron capture process
- Benchmark nuclear structure models around doubly magic ^{208}Pb



Region of interest

Motivation

- To search for new isomers
- To measure beta decay half lives of Pt and Au nuclei
- To build decay schemes
- To measure reduced transition probabilities

Experimental setup

- A beam of ^{238}U at 1 GeV/nucleon is collided with a ^{9}Be target to produce the nuclei by fragmentation reactions.
- The nuclei are passed through FRS to separate and identify them using **Bρ-ΔE-Bρ** technique .
- The nuclei are implanted in AIDA located inside the detector setup

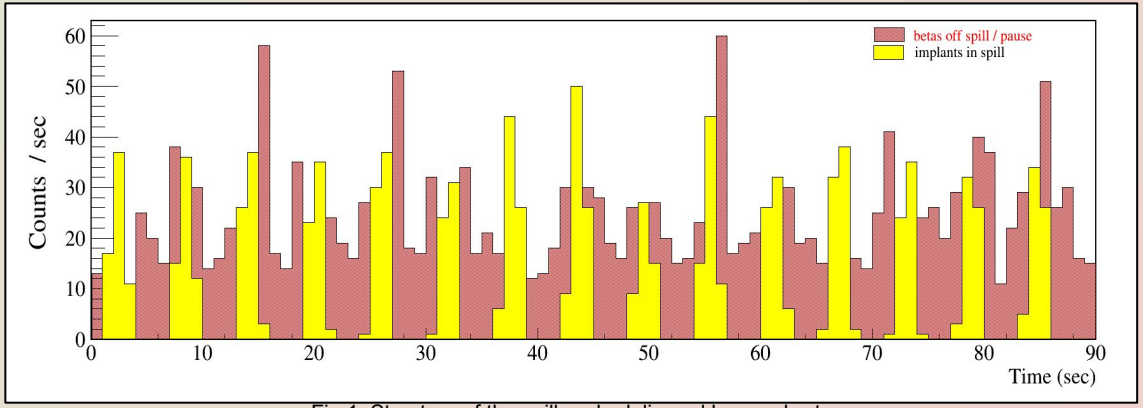


Fig 1: Structure of the spill cycle delivered by synchroton

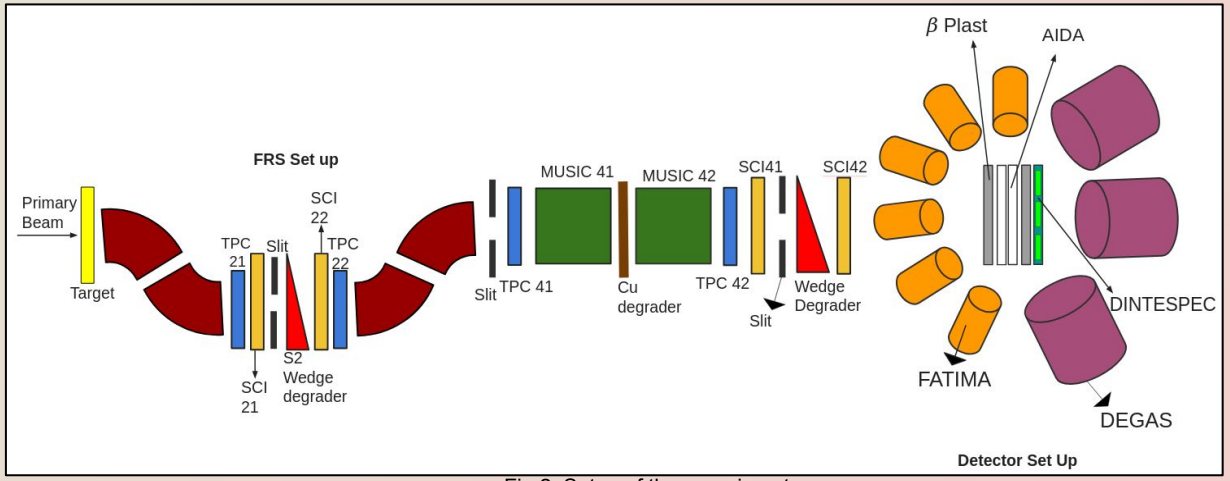


Fig 2: Setup of the experiment

Initial Particle Identification:

- The fragments produced in the reaction suffer a loss of energy according to their charge states in the intermediate degrader in FRS
- The fully stripped nuclei are selected for isotopical separation of the produced nuclei in a two-dimensional Particle Identification (PID) matrix Z vs A/Q

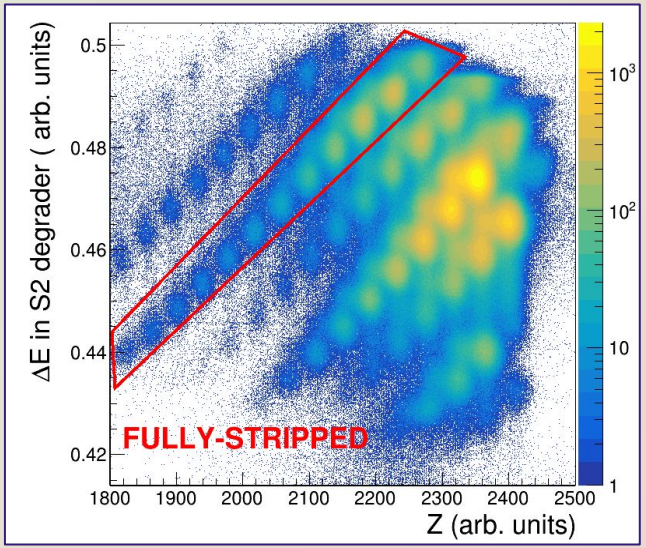


Fig 1: Energy loss in degrader according to charge states

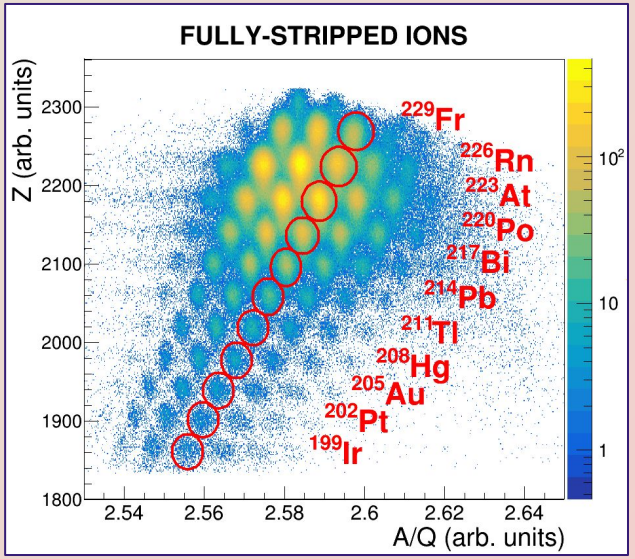
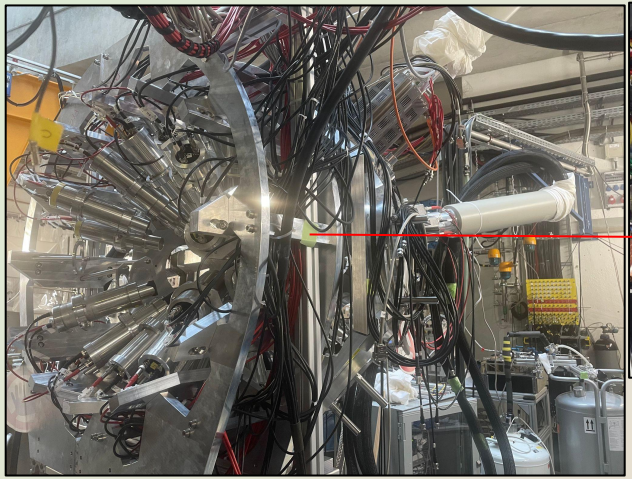
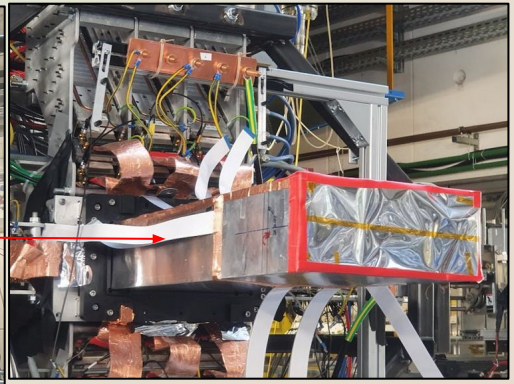


Fig 2: Initial Particle Identification

Detector Set Up





SNOUT

Fig 1: DESPEC detectors

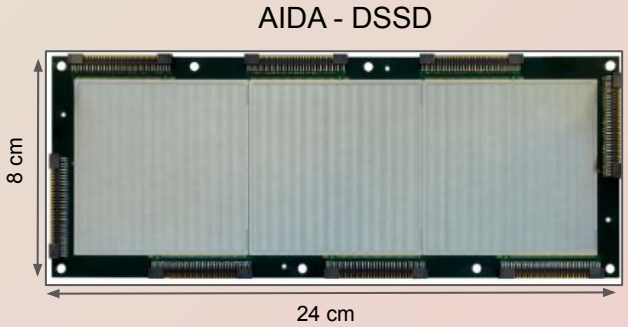


Fig 2: AIDA-DSSD layer

- Heavy nuclei implanted in **DSSSDs** sandwiched between β Plastic scintillators mounted in a SNOUT
- Ɣ decay spectroscopy and life time measurements are performed with the hybrid FATIMA + DEGAS ɣ array, consisting of 36 LaBr3 and 27 HPGe crystals

- Highly pixelated Double Sided Silicon Strip Detector
- Consist of a DSSD of 24 x 8 cm², 384 x strips, 128 y strips
- The pixelation helps to determine position of implants and decays
- Thickness of the Si detector is 1mm

Preliminary results obtained from analysis with AIDA
Study of α decay

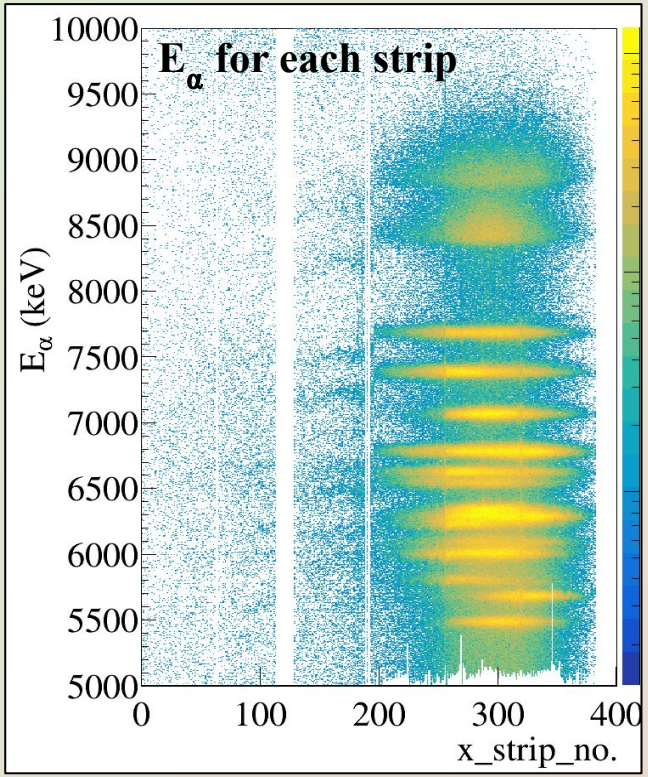


Fig 1: Energy of α detected according to strips

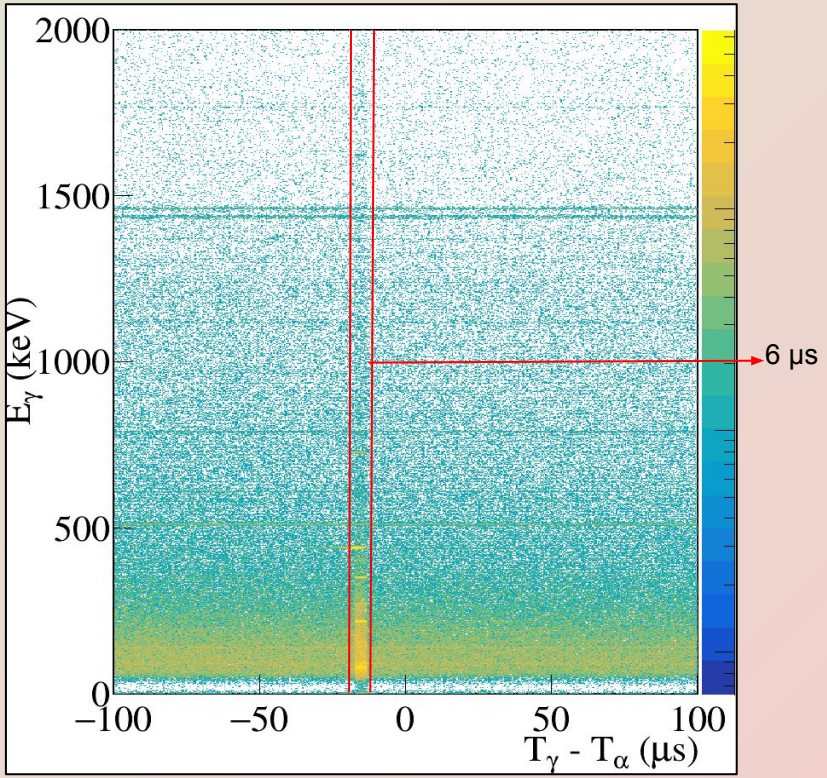
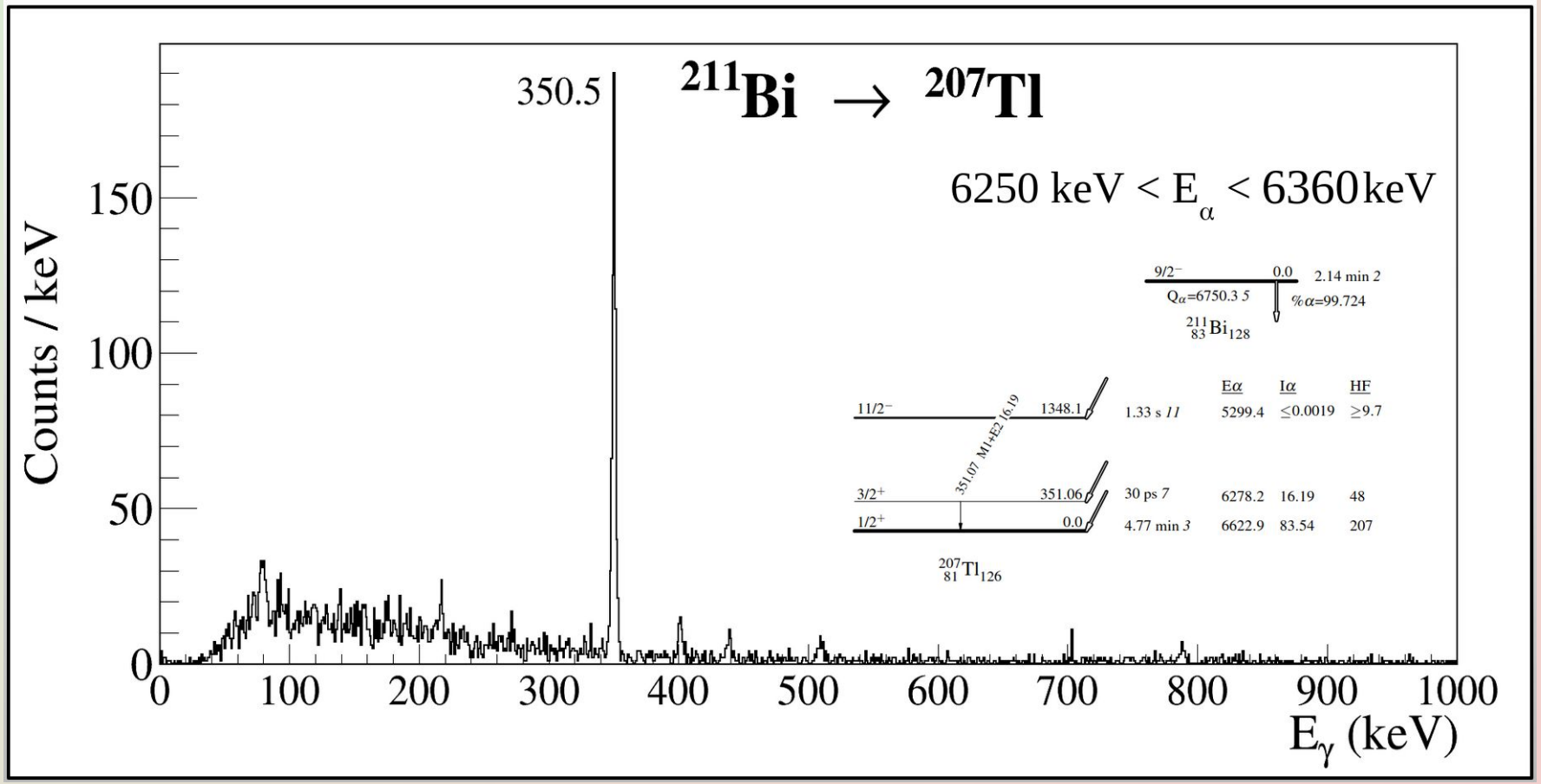


Fig 2: Time coincidence for correlation of γ with α decay

Conditions:

- Only x strips > 196 are considered
- No clustering
- Removal of noisy strips
- Only 1 layer of AIDA is considered

- Only particles out of spill
- β like particles 5 MeV < E_β < 20 MeV considered .
- Multiplicity for AIDA = 1
- Multiplicity for DEGAS = 1



γ information obtained from DEGAS for the selected region of α energy

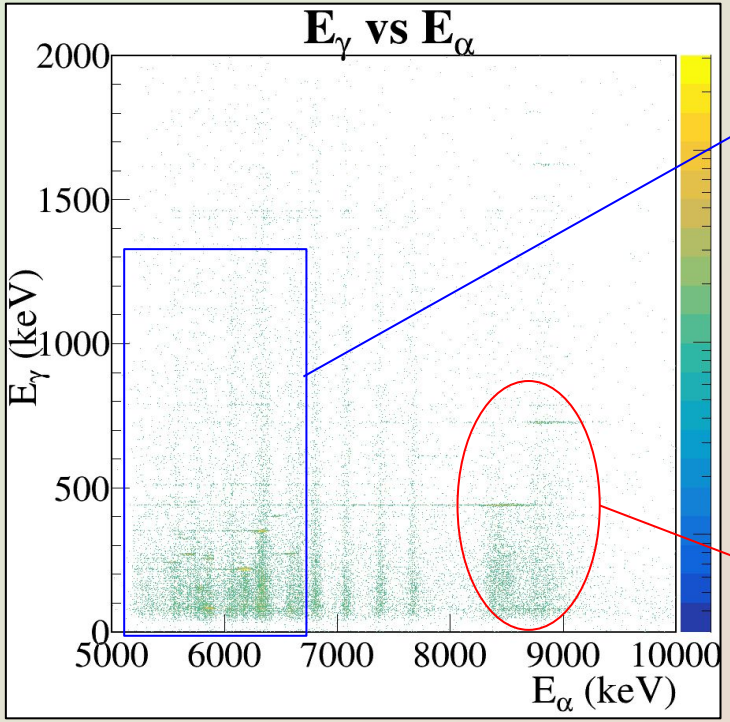
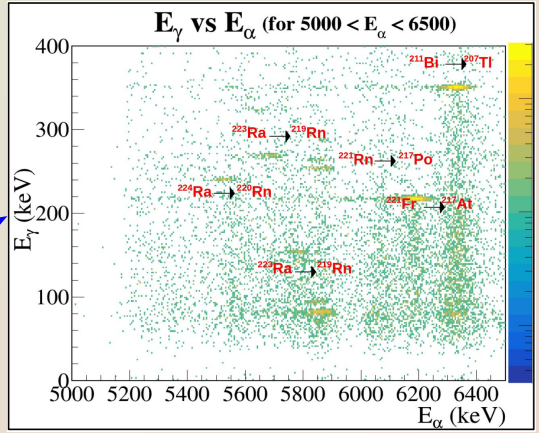
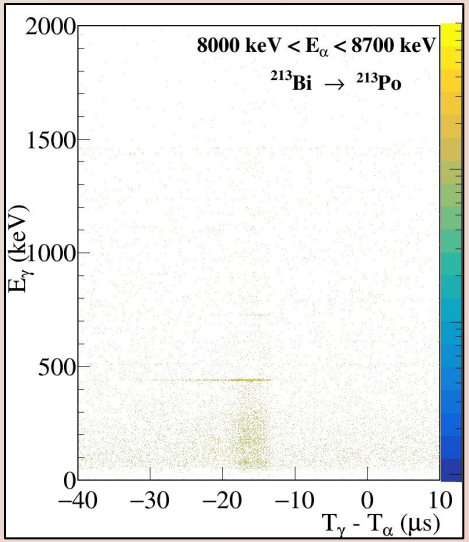


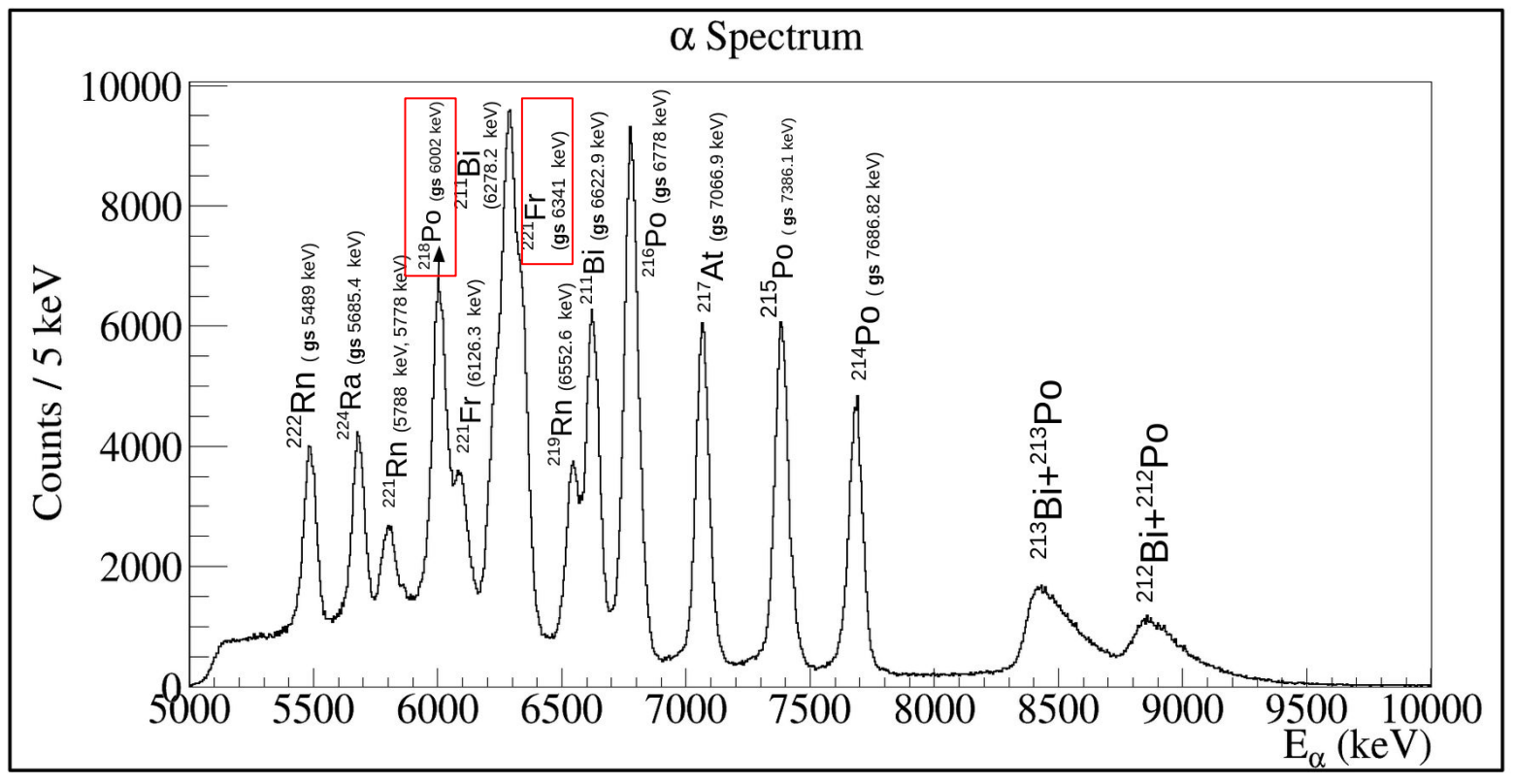
Fig 1: ɣ energy detected in DEGAS correlated to the α energies observed in AIDA within a prompt time coincidence window





- γ rays are clearly observed using the conditions discussed before.

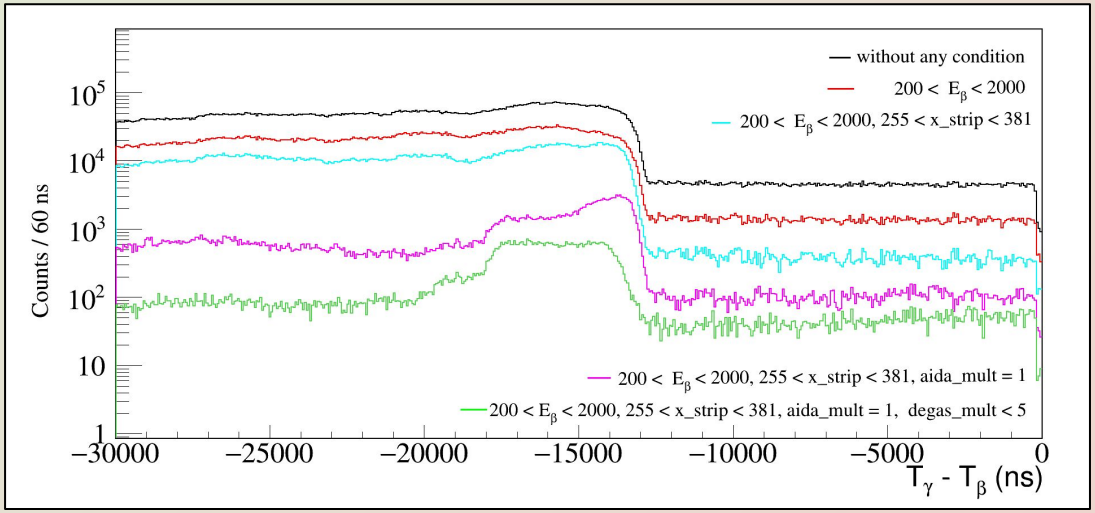
- Prompt time coincidence: **6 μs**
  Half life of ^{213}**Po** : **3.706 μs**
- **β decay** of ^{213}**Bi** to ^{213}**Po** is observed.
- Tail confirms the γ decay follows the **β decay** from ^{213}**Bi**



α Spectra observed in our experiment

Preliminary results obtained from analysis with AIDA
Study of β - γ correlation

γ – β correlation study



Conditions :

- Only x strips > 196 are considered
- No clustering
- Removal of noisy strips
- Multiplicity = 1
- 1 AIDA layer is considered
- Only β particles out of spill
- β like particles 0 keV < E_β < 2000 keV considered

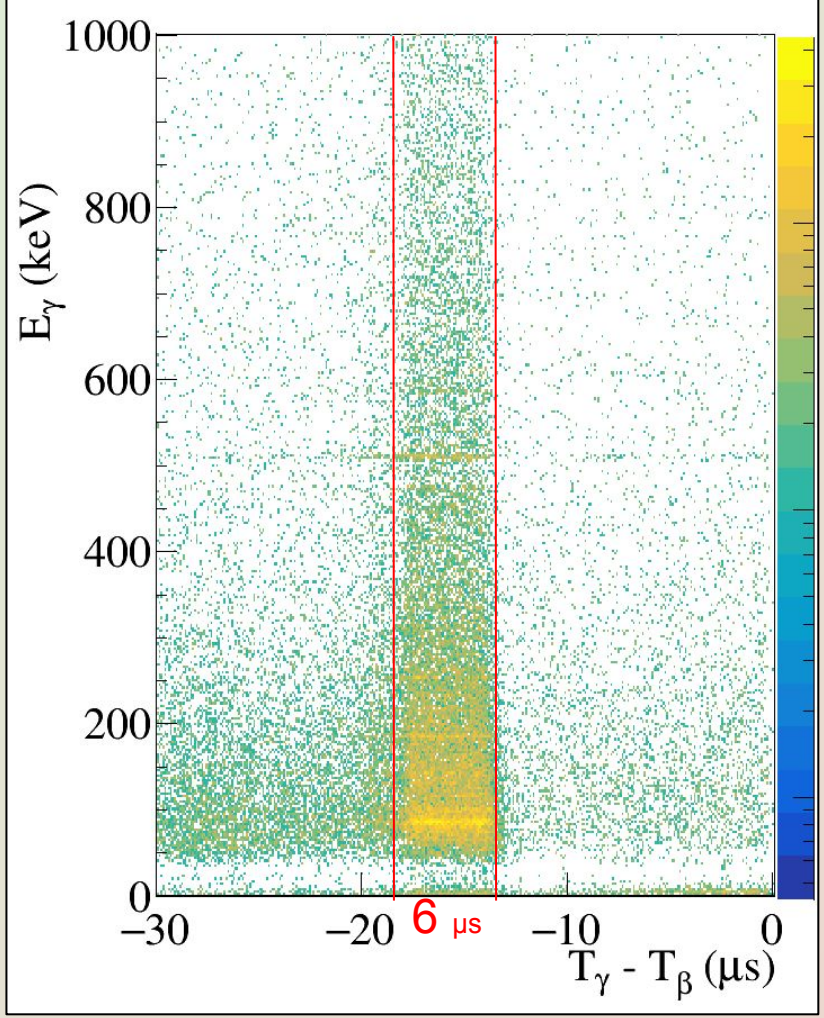


Fig : Time coincidence for correlation of ɣ with β decay

γ rays are observed in coincidence with β particles with conditions:

- Multiplicity for AIDA = 1
- Multiplicity for DEGAS < 5

γ spectrum corresponding to $\beta - \gamma$ correlation.

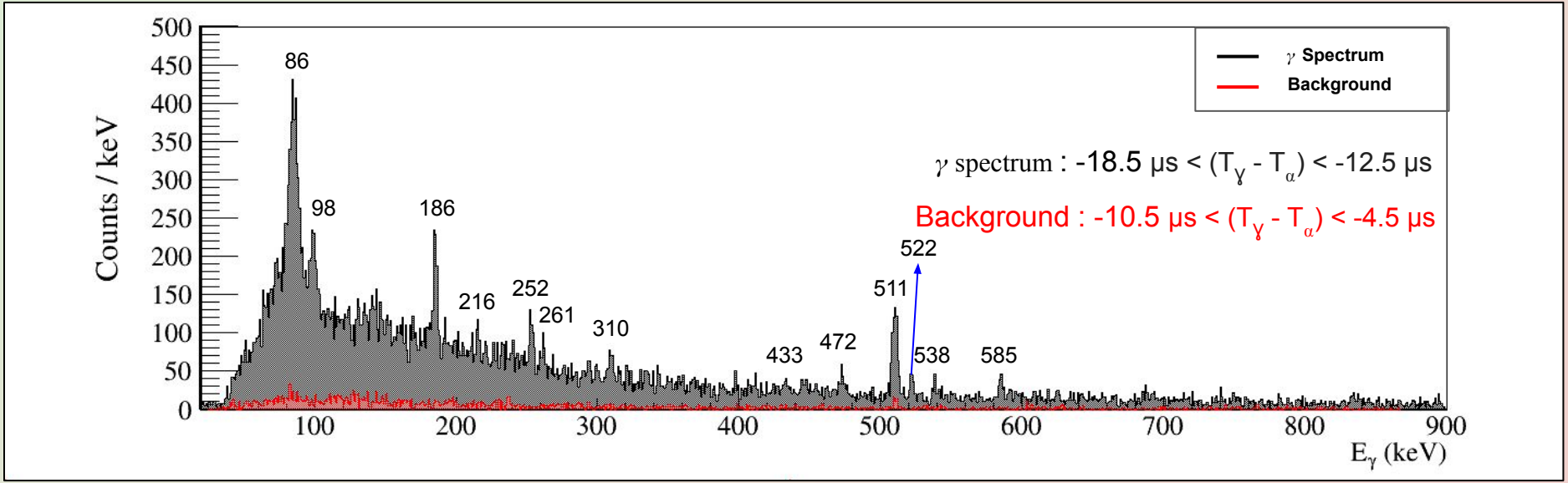
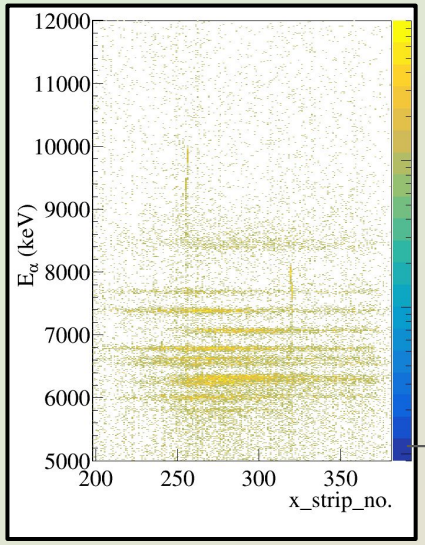


Fig : ɣ spectra obtained after correlating ɣ observed in DEGAS with β decay in AIDA

Conditions used:

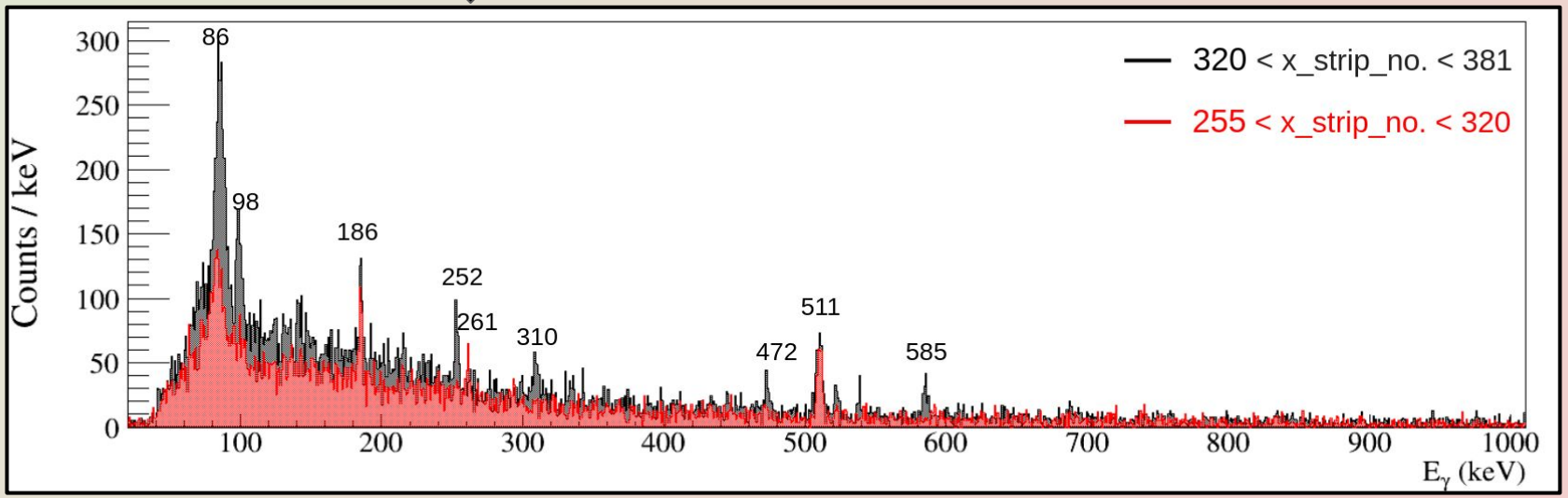
- 200 keV < E_β < 2000 keV
- 255 < x strip no. < 381
- Multiplicity of AIDA = 1
- Multiplicity of DEGAS < 5



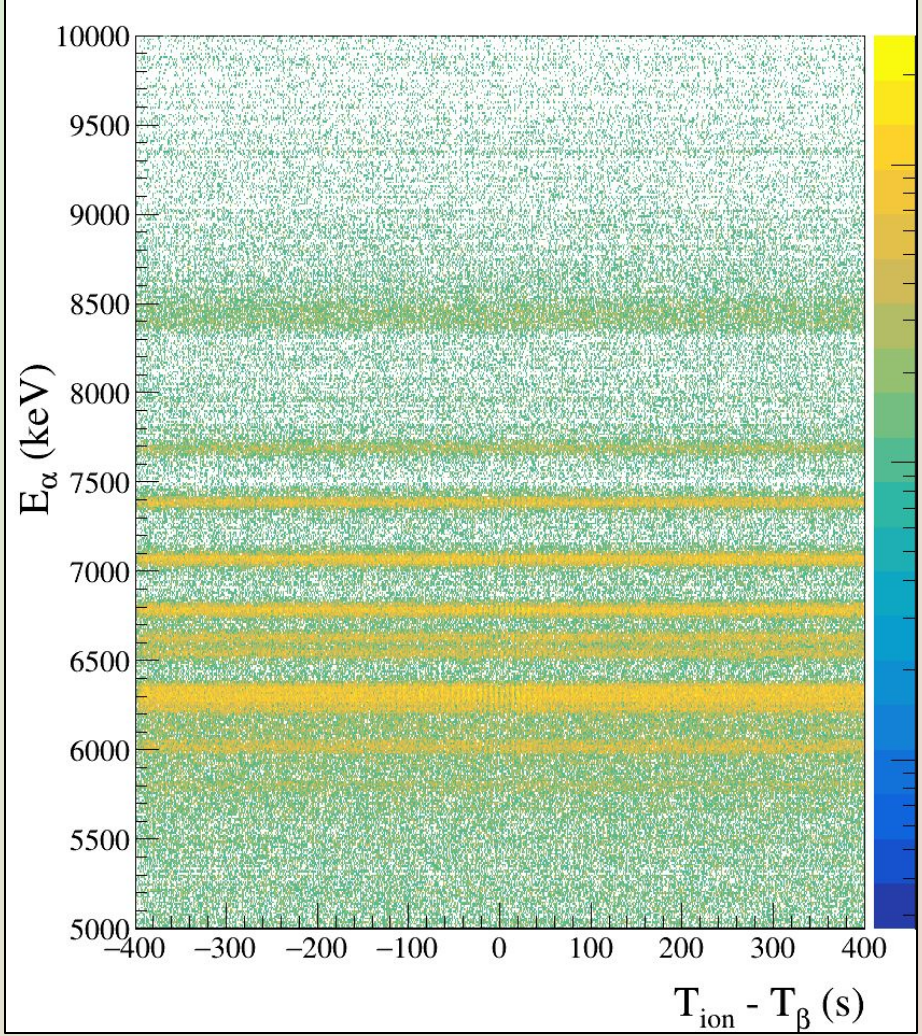
γ spectra corresponding to β - γ correlation

Conditions used:

- 200 kev < E_β < 2000 keV
- -18.5 µs < (T_γ - T_α) < -12.5 µs
- Multiplicity of AIDA = 1
- Multiplicity of DEGAS < 5



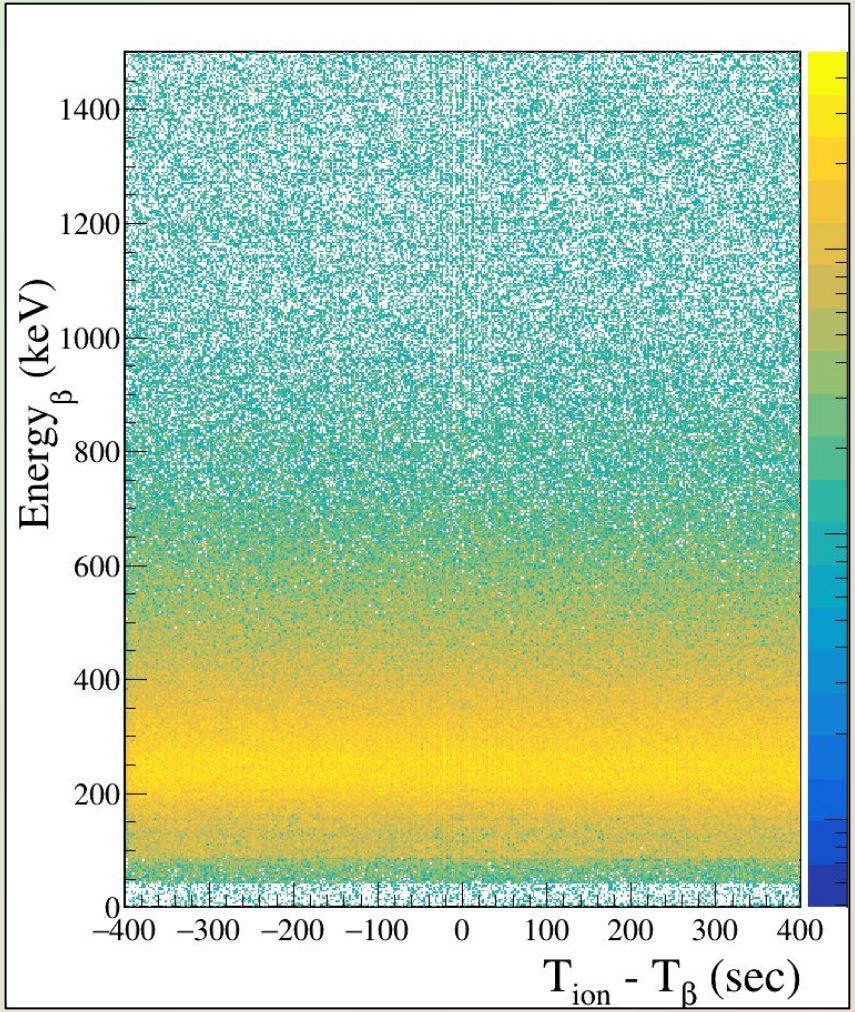
Preliminary results obtained from analysis with AIDA
Study of ion-β decay correlation



α energy range in a ion - β correlation time window ranging from -400 s to 400 s

Conditions :

- Only x strips > 196 are considered
- No clustering
- Removal of noisy strips
- Multiplicity = 1
- 1 AIDA layer is considered
- Only β particles out of spill
- 5000 keV < E_α < 10000 keV are only considered.
- Ions implanted in 1st layer of AIDA are only considered
- Only β particles detected within the same strip as the ion are considered for correlation.



β decay in a ion - β correlation time window ranging from -400 s to 400 s

Conditions :

- Only x strips > 196 are considered
- No clustering
- Removal of noisy strips
- Multiplicity = 1
- 1 AIDA layer is considered
- Only β particles out of spill
- β like particles 0 keV < E_β < 1500 keV considered
- Ions implanted in 1st layer of AIDA are only considered
- Only β particles detected within the same strip as the ion are considered for correlation.

Summary and Future Plans

- Experimental data obtained from AIDA for first 3 hrs of the experiment have been correlated with the information obtained from DEGAS
- Extend our analysis on ion-β correlation
  - Implement the y strips incase of high noise
  - Implement the FRS information and correlate with information obtained from AIDA

Collaboration:

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Timo	Dickel
Emma	Haettner
Christoph	Scheidenberger
Christine	Hornung
Tom	Davinson
Kathrin	Wimmer
Sultan	Alhomaidhi
Helena	Albers
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Calum	Jones
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Sara	Pigliapoco
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Zhong	Liu
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Robert	Page
Dan	Judson
Magda	Satrazani
Betool	Alayed
Muneerah	Alaqeel
Dennis	Bittner
Gopal	Mukherjee
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Davide	Genna
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Volker	Werner
Usama	Ahmed
Martin	von Tresckow
Aikaterini	Zyriliou
Margarita	Efstathiou
Rinku	Prajapat
Suraj Kumar	Singh


Thank you

Study of beta - signals in AIDA

Conditions :

- Only x strips > 196 are considered
- No clustering
- Removal of noisy strips
- Multiplicity = 1
- DSSD0 (upstream AIDA layer)
- Spill scaler built with implantations of AIDA
- Only □ particles out of spill
- □ like particles 0 MeV < E_β < 20 MeV considered
- Files used correspond to first 3hrs of experiment with 1.5 g/cm^2 S4 degrader .