GSI2: ^{16}O (200 MeV) on C2H4

Status of the Analysis

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VIBE meeting, 1st Aprile 2020

GSI_2019: Scanning Progress

Target \ Beam	Oxygen 200 MeV/n	Oxygen 400 MeV/n
Carbon	GSI1	GSI3
Polyethylene	GSI2	GSI4

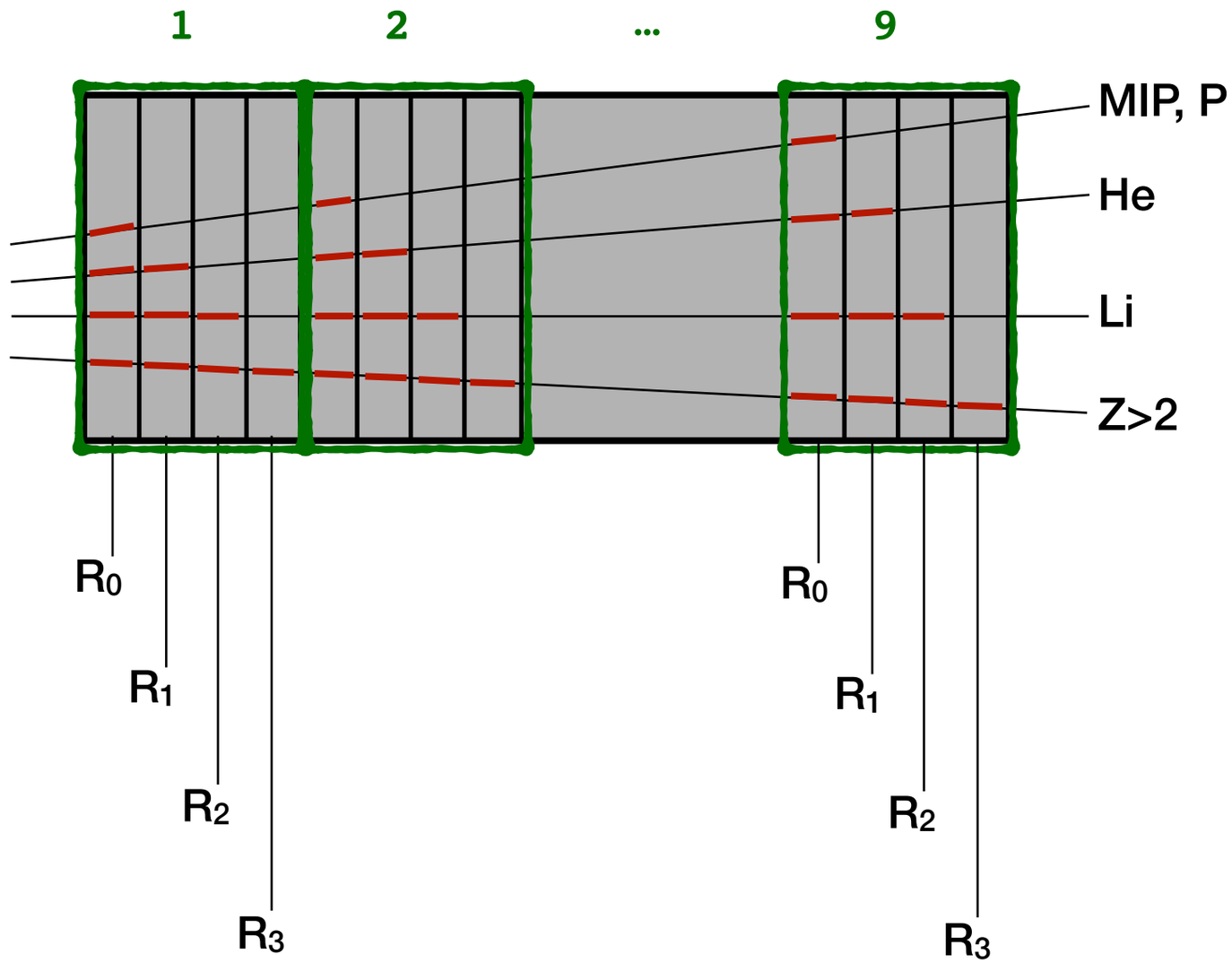
- GSI2: Scanning completed, analysis on-going
- GSI1: Scanning completed, alignment between emulsions completed for S2 and S3
- GSI3: Scanning completed, quality check on-going (½ completed)
- GSI4: Scanning on-going (½ completed)

- On March 16th scanning has been interrupted
- We do not know when it will be possible to restart it

CHARGE IDENTIFICATION IN SECTION 2

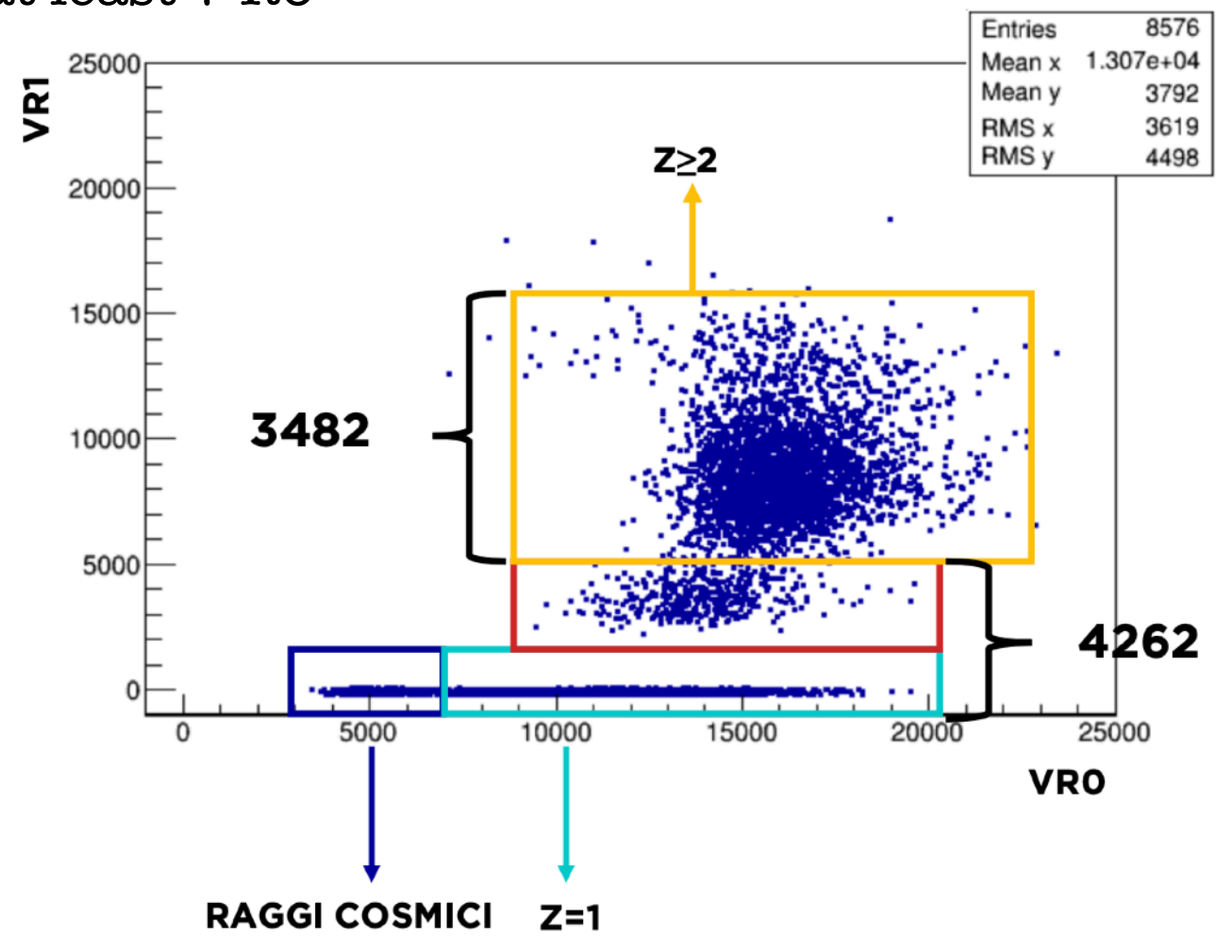
- Emulsions underwent to **different thermal treatments**

- **R0**:
  - Not thermally treated
  - Sensitive to all particles
- **R1** (24 h at T1=**28°C** and RH = 95%):
  - Appropriate temperature for MIP and P
  - Sensitive to Z >1
- **R2** (24 h at **T2=34°C** and RH = 95%):
  - Appropriate temperature for He
  - Sensitive to Z >2
- **R3** (24 h at **T3=36°C** and RH = 95%):
  - Appropriate temperature for Li
  - Sensitive to Z >3



CHARGE MEASUREMENT Z<2

Selection: tracks with at least 7 RO



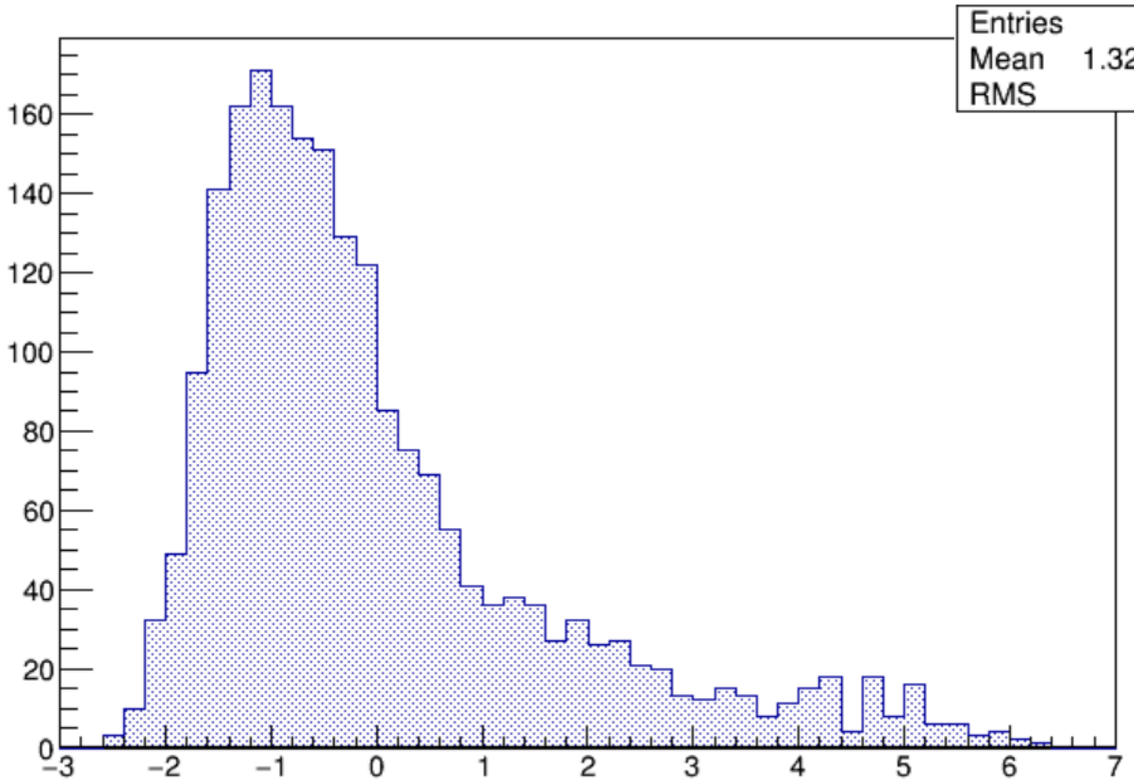
- Z=0: VR1=0 && VR0≤6800
- Z=1 (High energy): VR1=0 && VR0>6800
- Z=1 (Low energy): VR1≠0, VR1 ≤5000
- Z≥2, VR1>5000 —> TPrincipal (see next slide)

TPRINCIPAL TRANSFORMATION

Principal Components Analysis (PCA)

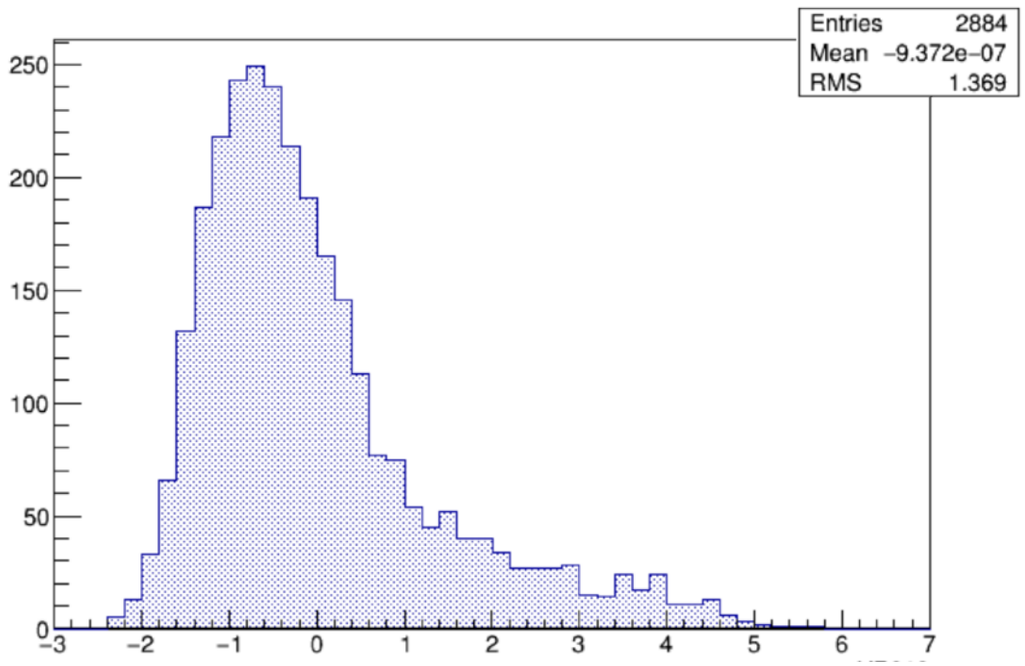
https://root.cern.ch/doc/master/classTPrincipal.html

$VP\_0123=\alpha_{0123}\, VR0_{av}+\beta_{0123}\, VR1_{av}+\gamma_{0123}\, VR2_{av}+\delta_{0123}\, VR3_{av}$



VP_0123

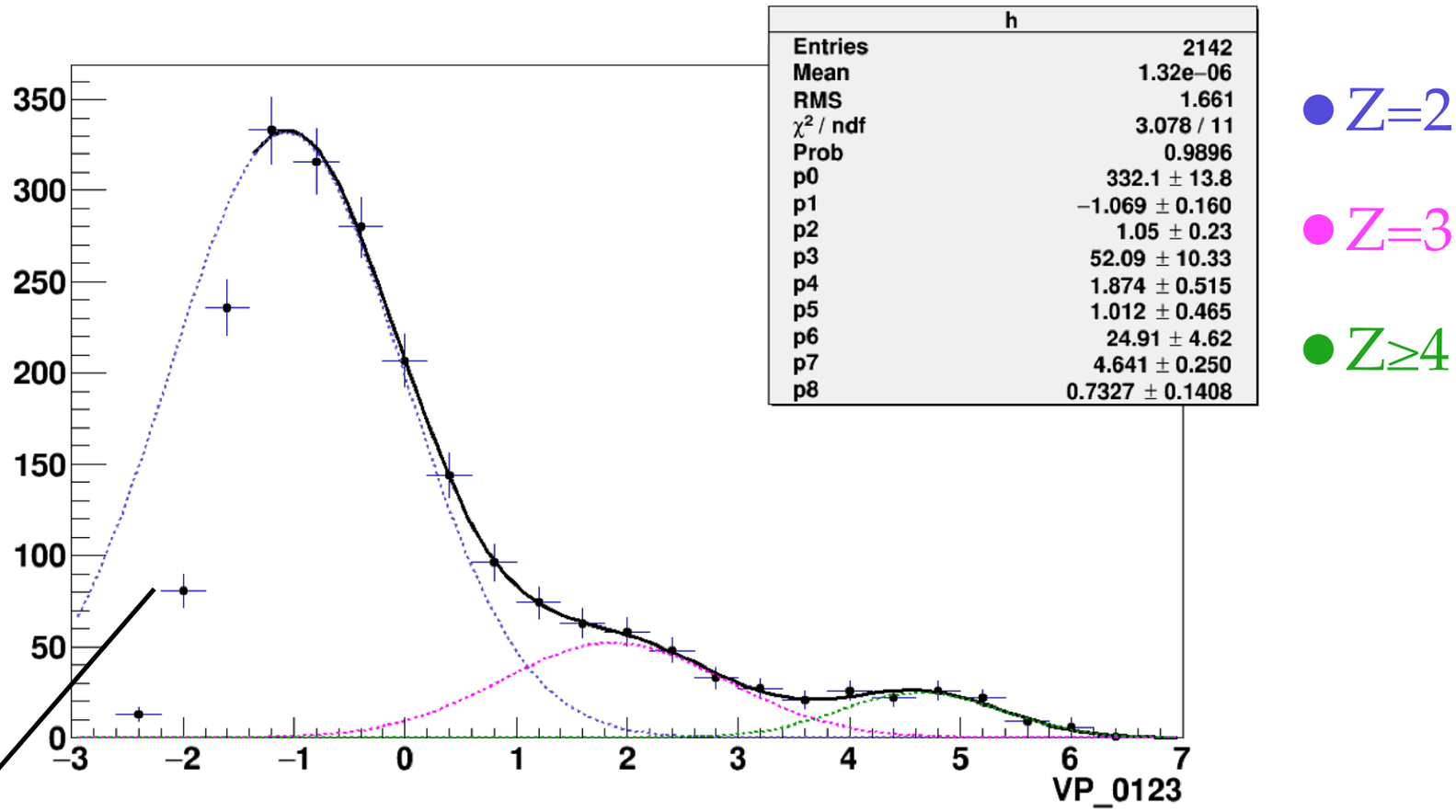
$VP\_012=\alpha_{012}\, VR0_{av}+\beta_{012}\, VR1_{av}+\gamma_{012}\, VR2_{av}$



VP_012

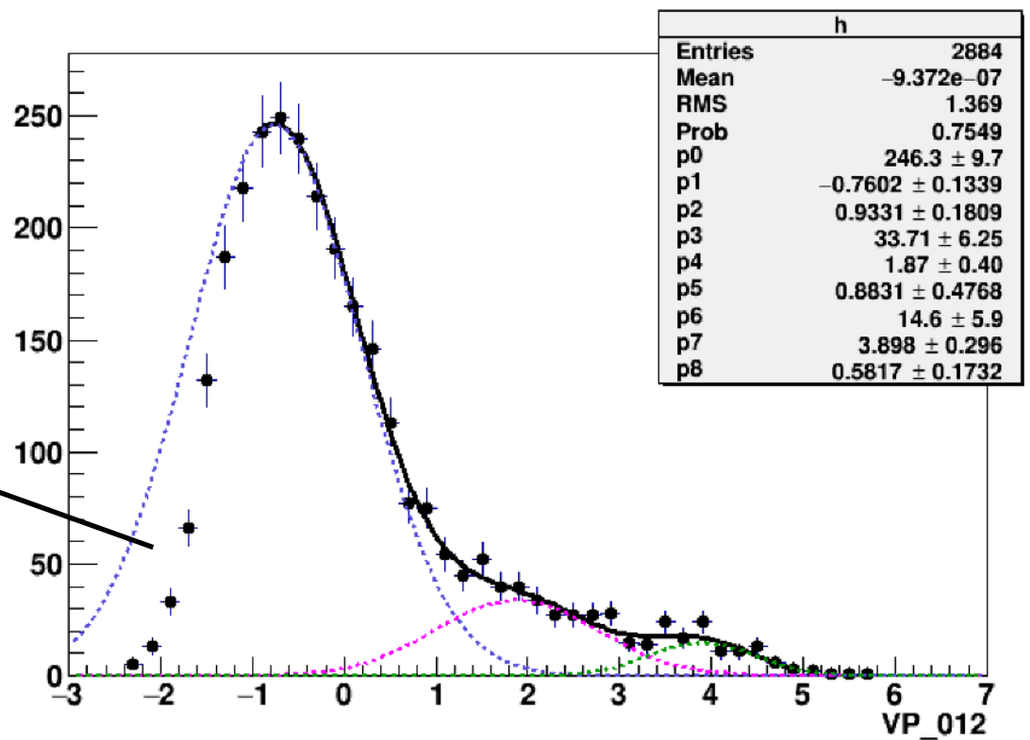
CHARGE ASSIGNMENT Z≥2

Selection: tracks with at least 7 RO



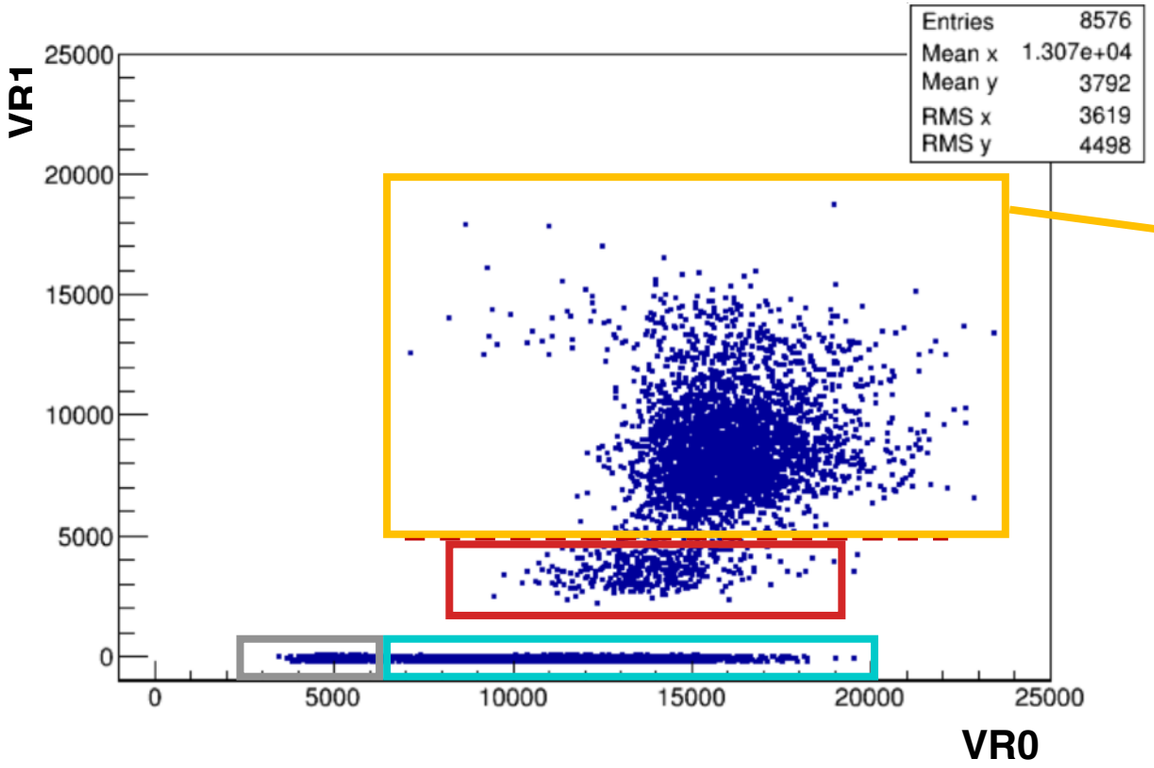
- Z=2
- Z=3
- Z≥4

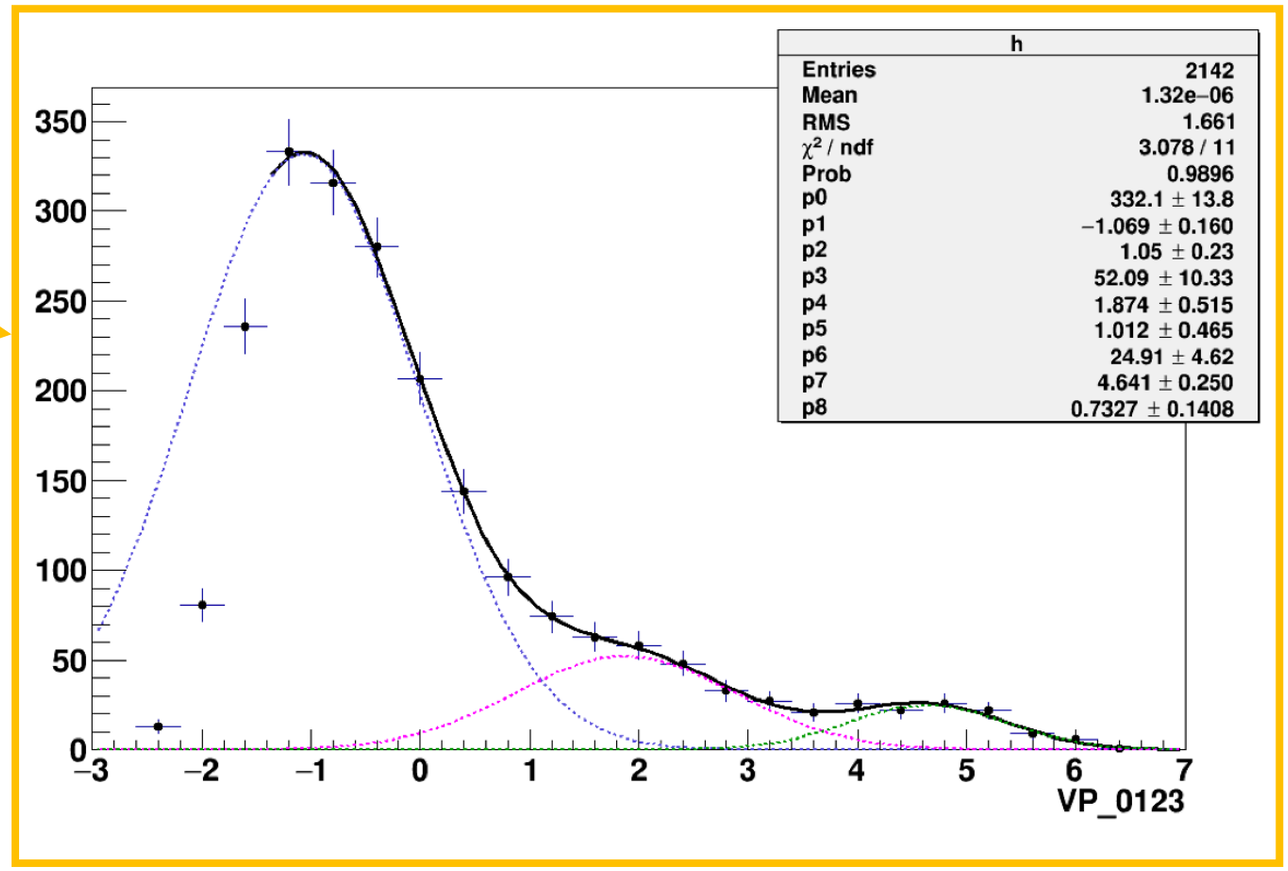
Due to partial cancellation of Z=2 tracks



CHARGE IDENTIFICATION

Selection: tracks with at least 7 RO

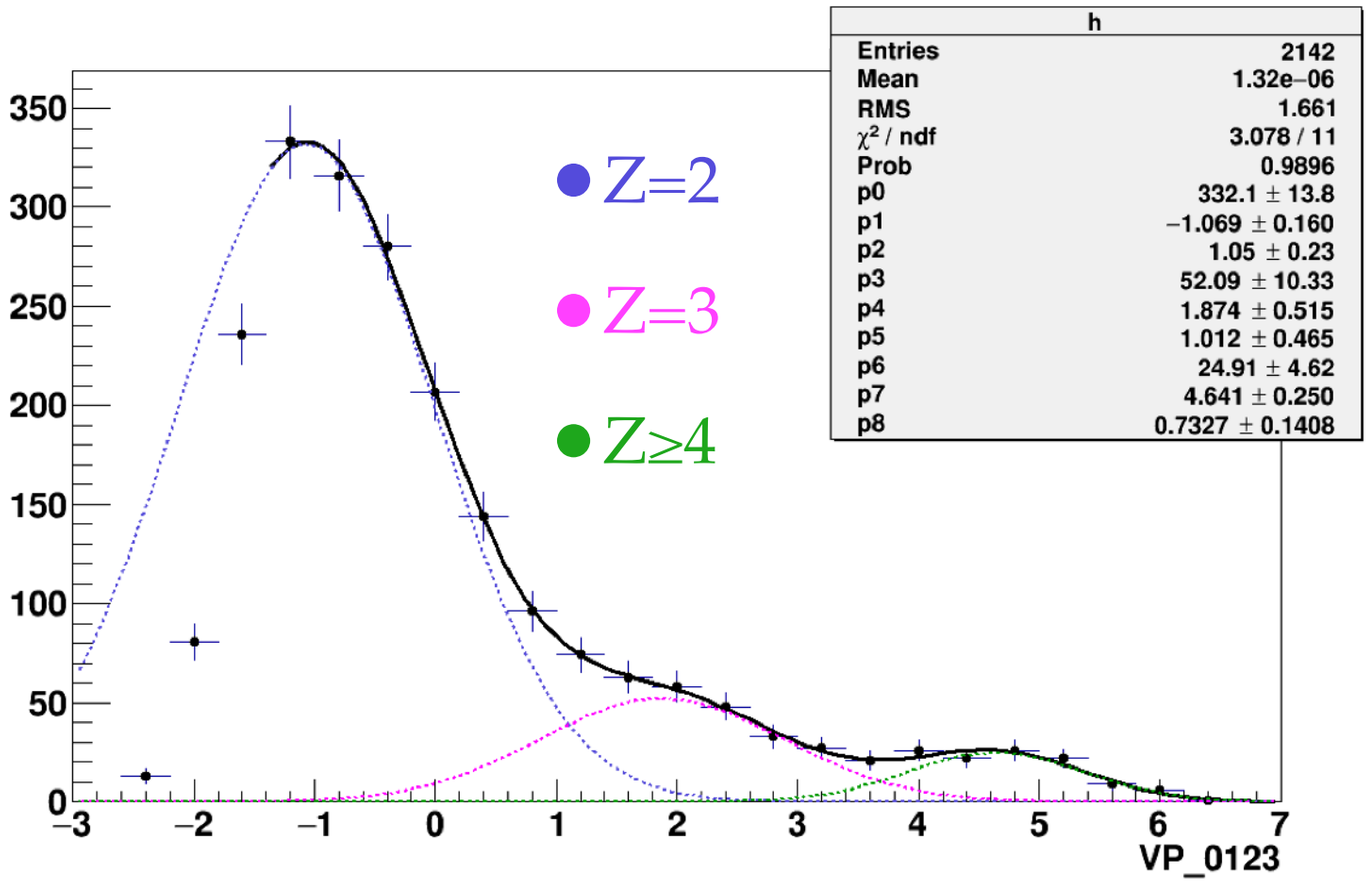




Charge Z	Data	Montecarlo
1 (high Energy)	(55.0 ± 0.6)%	57.0%
1 (low energy)		
2	(38.5 ± 0.5)%	38.2%
3	(5.0 ± 0.2)%	3.3%
≥4	(1.4 ± 0.1)%	1.3%

CHARGE ASSIGNMENT Z≥2

Selection: tracks with at least 7 RO



- Given the value of VP_0123 we assign Z according to the probability provided by the three gaussian distributions

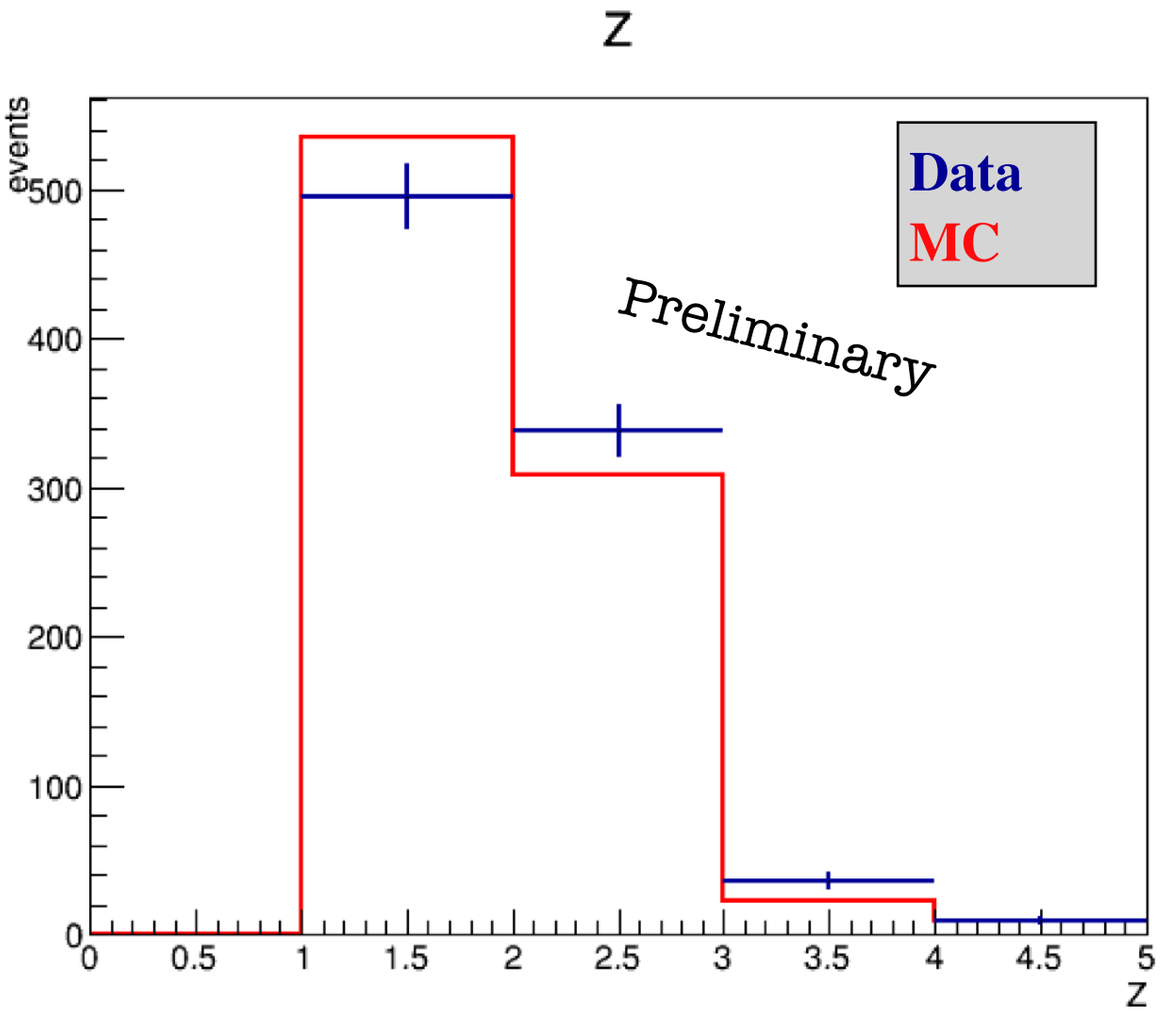
- No bias in the region where signal doesn't agree with the fit (VP_0123 < -1) since the probability of Z=3 and Z≥4 gaussians is negligible

TRACKS ATTACHED TO VERTICES

Z distribution for tracks attached to a “good” vertex.

Only tracks with charge measured/assigned are shown in the plot

Clean sample



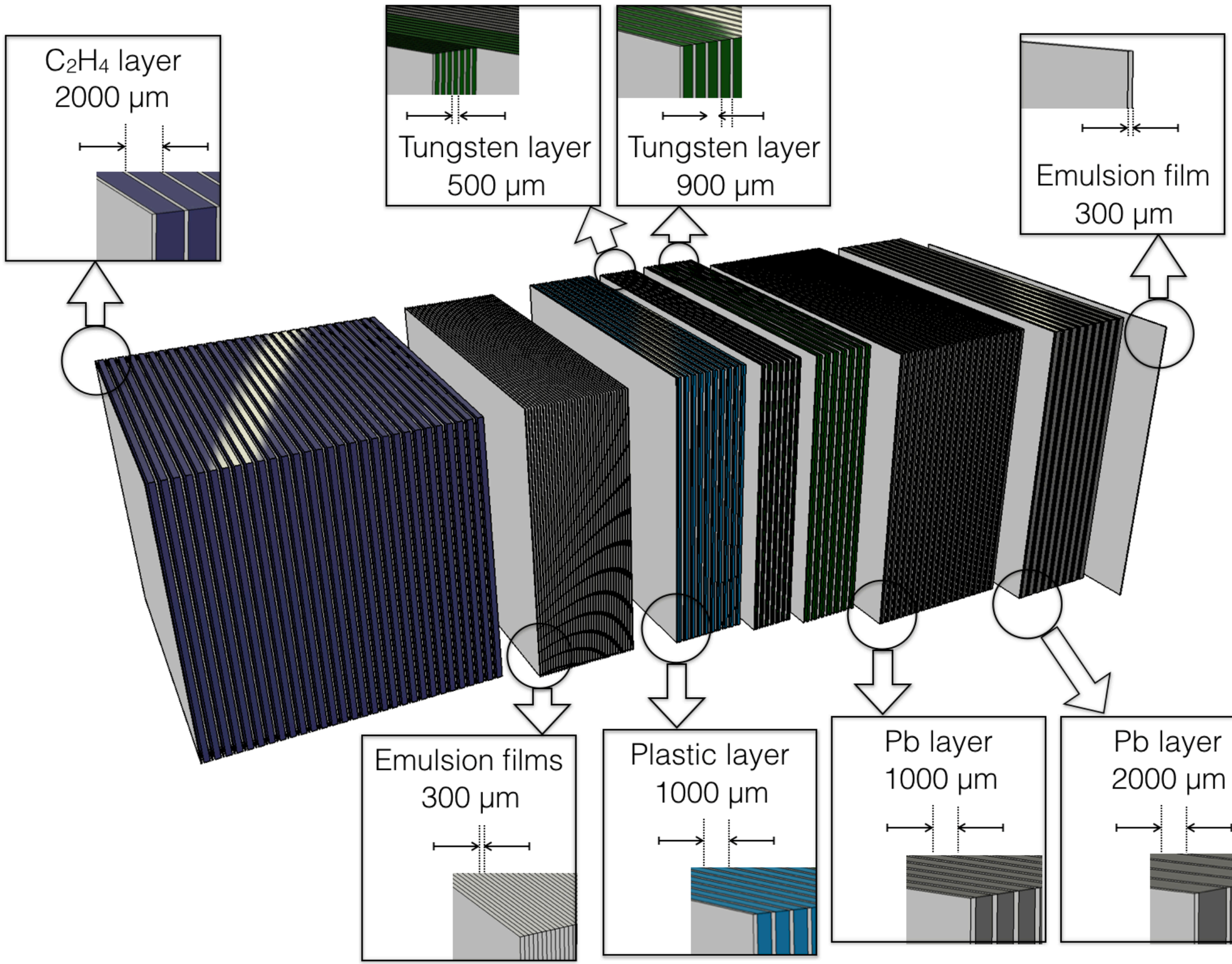
Z	Data	MC
0	0.0%	0.0%
1	56.4%	61.1%
2	38.5%	35.2%
3	4.1%	2.6%
≥4	1.0%	1.0%

Next Steps

- Tag tracks out of present stringent selection
- Include (some) of the refreshing effects in Montecarlo simulation in order to study tracking efficiency in S2
- Evaluate reconstruction efficiency (tracks and vertices)

Back up Slides

Reminder of Detector Structure

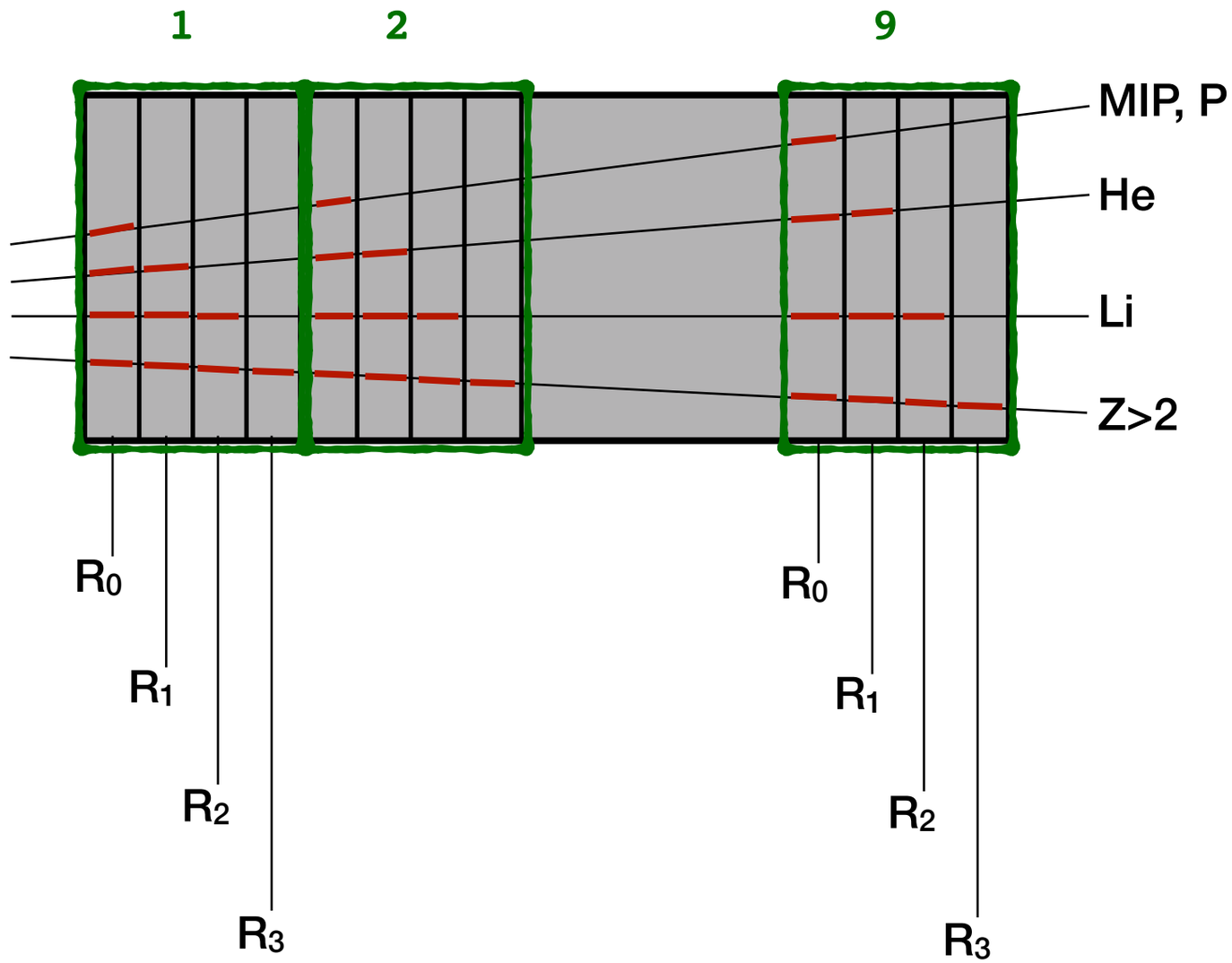


Detector Structure (GSI2 under analysis)

	Oxygen 200 MeV/n
S1	C2H4 (30x2mm) + 30 emu
S2	Emu (36)
S3	Lexan (10x1mm)+10emu
S4	W (7x0.5mm)+7emu
S5	W (7x0.9mm)+7emu
S6	Pb (20x1mm)+20emu
S7	Pb (9x2mm)+10emu

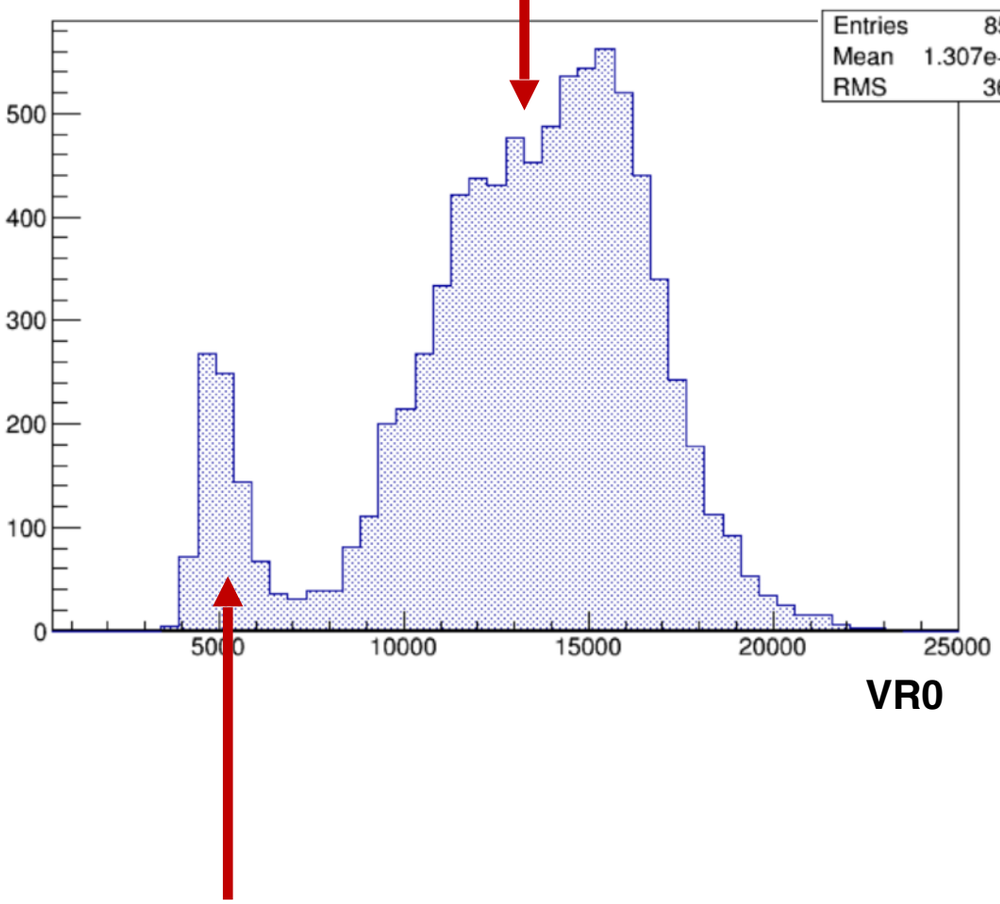
THE EMULSION SPECTROMETER: SECTION 2

- **Charge identification** for low Z fragments (H, He, Li)
- Emulsion will have a **different thermal treatment** according to its position in the elementary cell
  - **R0**:
    - Not thermally treated
    - Sensitive to all particles
  - **R1** (24 h at T1=**28°C** and RH = 95%):
    - Appropriate temperature for MIP and P
    - Sensitive to Z >1
  - **R2** (24 h at **T2=34°C** and RH = 95%):
    - Appropriate temperature for He
    - Sensitive to Z >2
  - **R3** (24 h at **T3=36°C** and RH = 95%):
    - Appropriate temperature for Li
    - Sensitive to Z >3



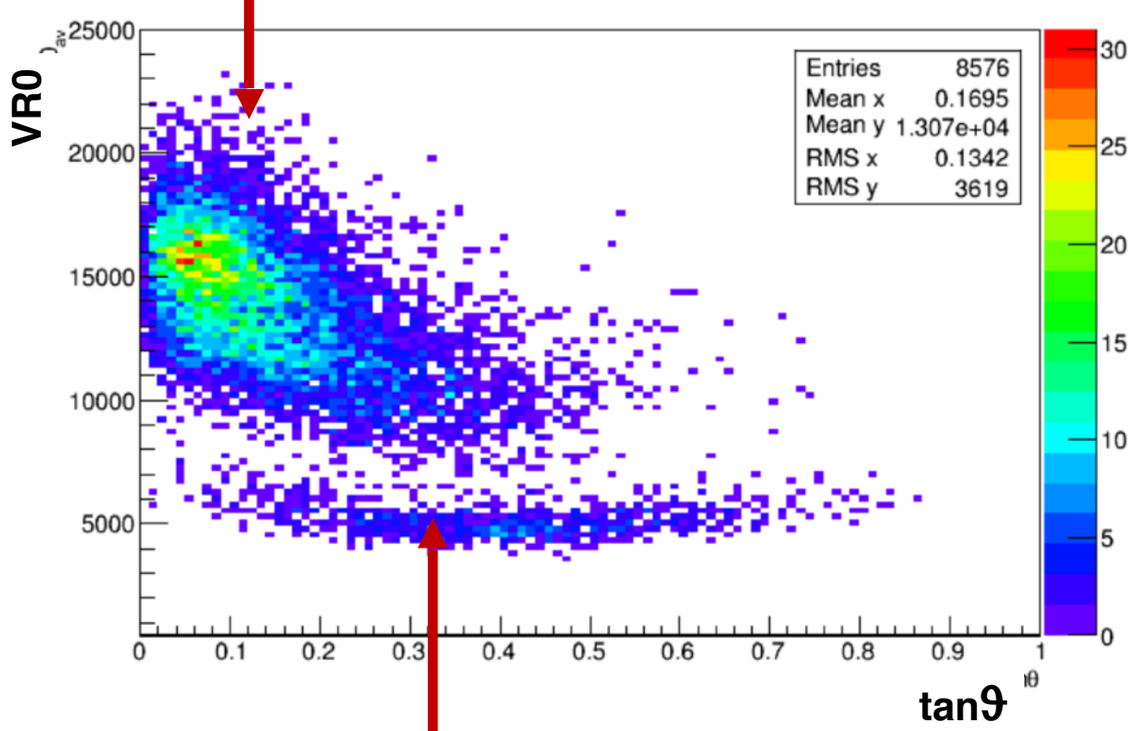
CHARGE IDENTIFICATION

FRAGMENTS



COSMIC RAYS

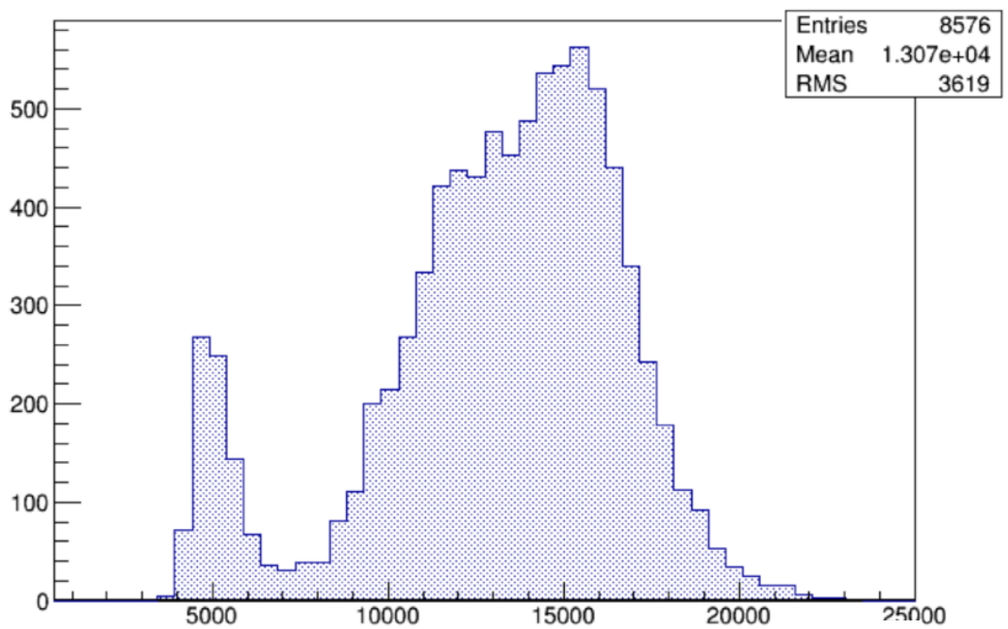
FRAGMENTS



COSMIC RAYS

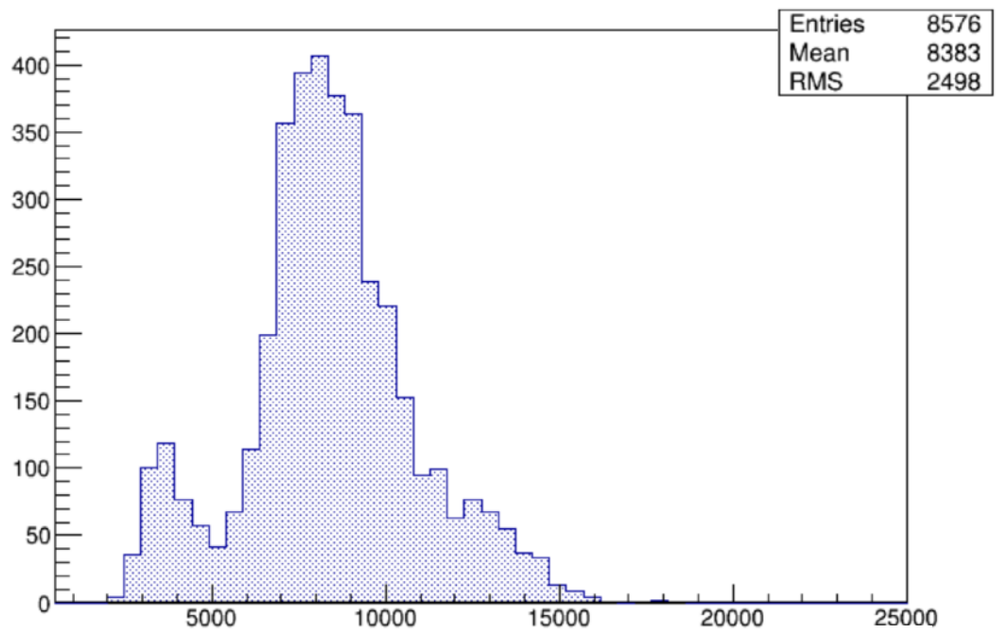
CHARGE IDENTIFICATION

NO THERMAL TREATMENT



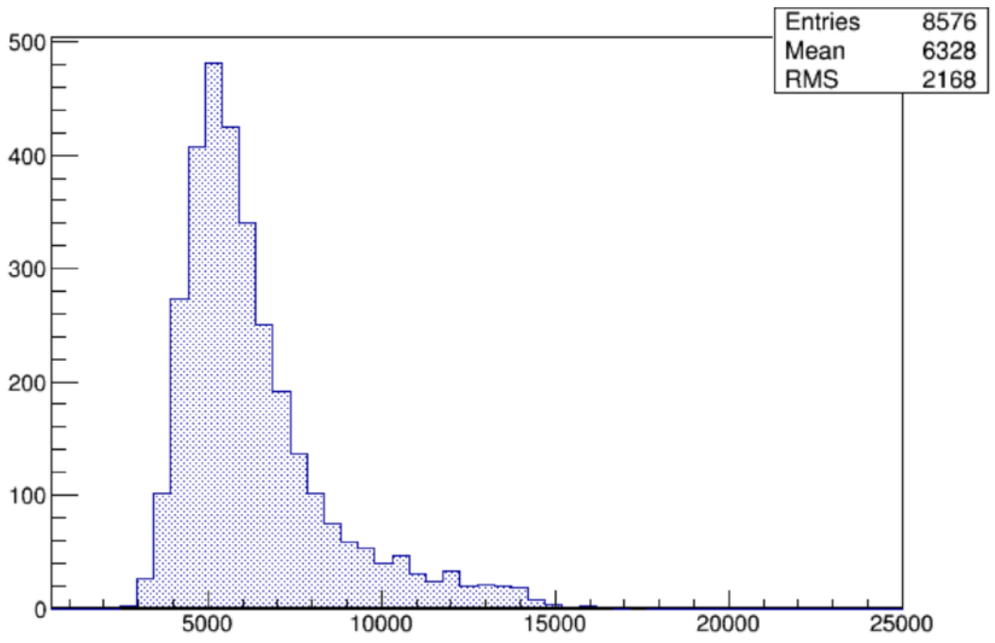
VR0

THERMAL TREATMENT AT 28°C



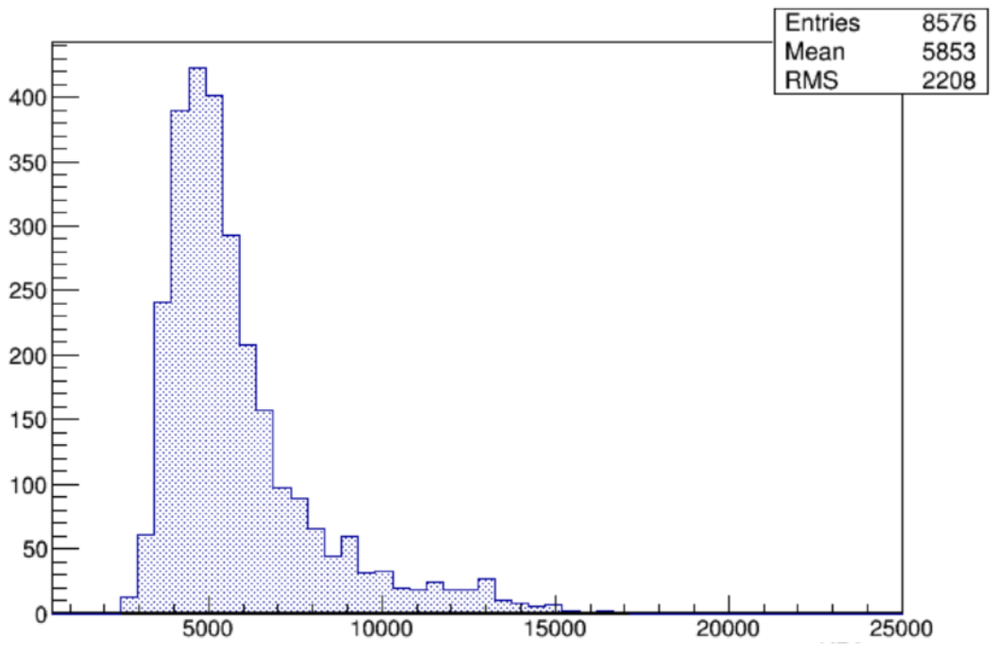
VR1

THERMAL TREATMENT AT 34°C



VR2

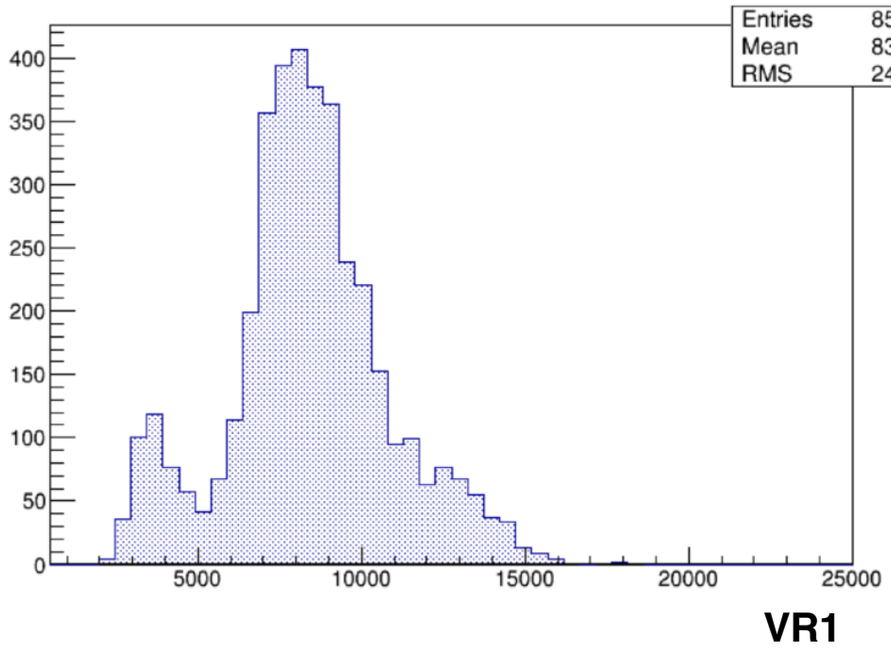
THERMAL TREATMENT AT 36°C

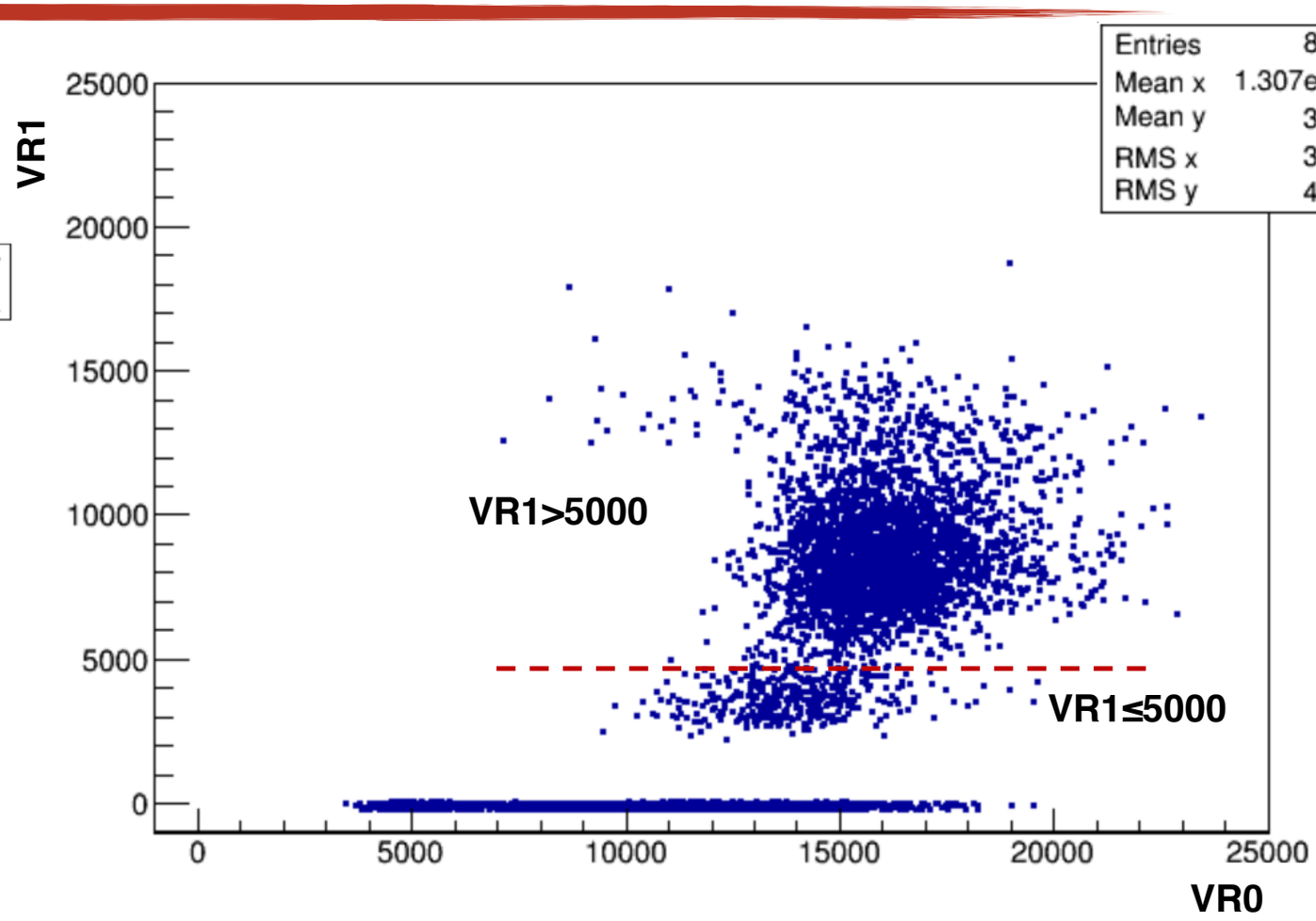


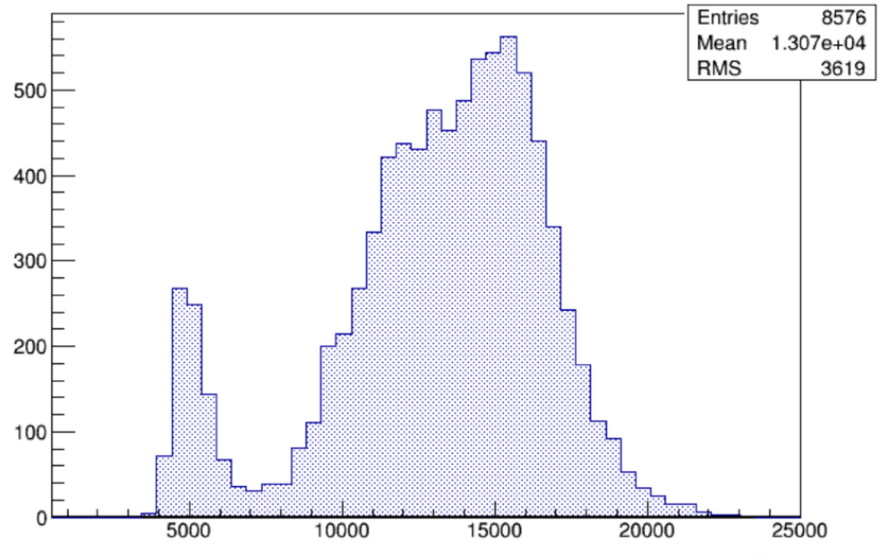
VR3

CHARGE IDENTIFICATION

THERMAL TREATMENT AT 28°C

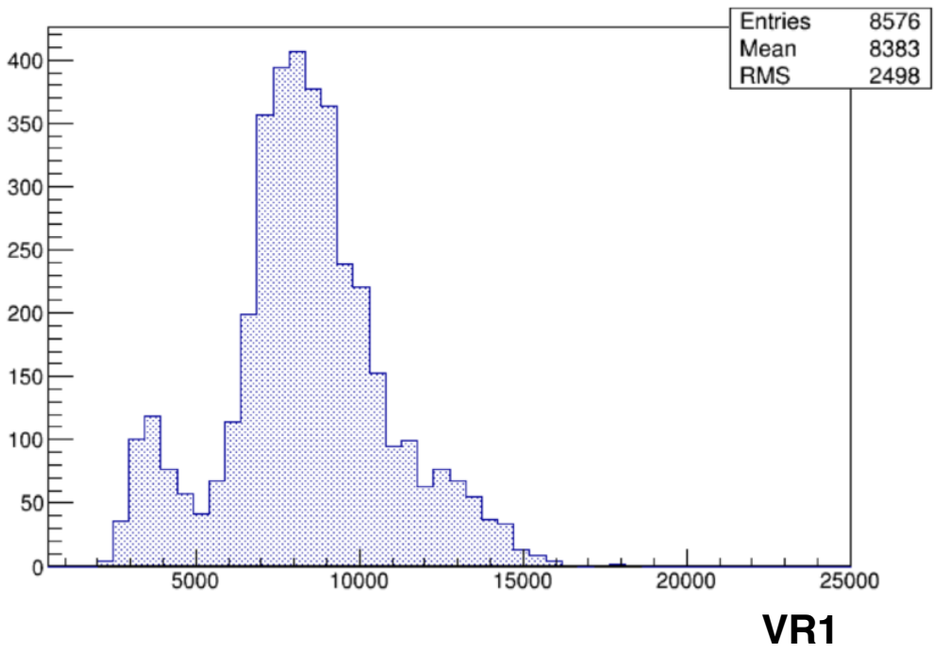




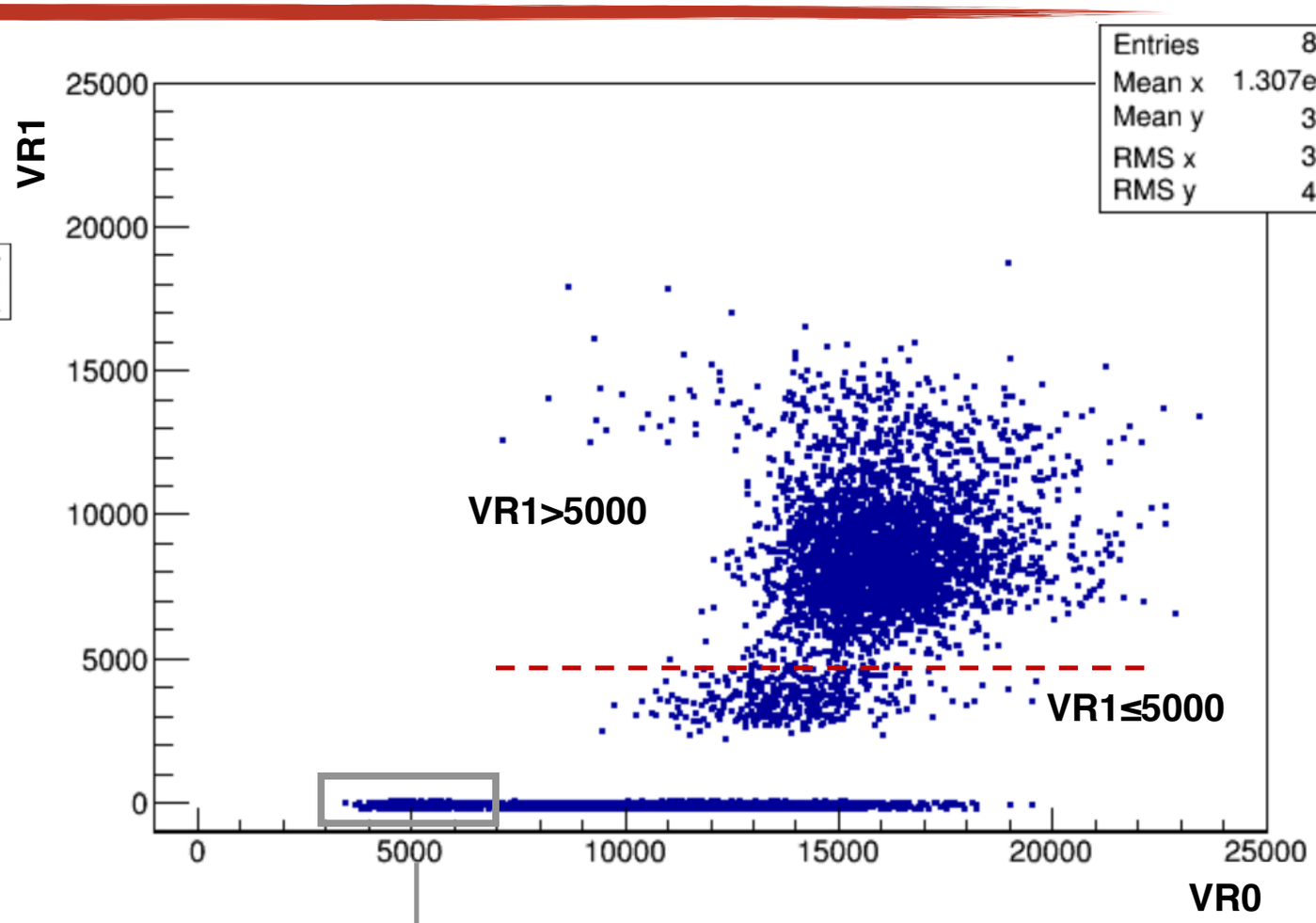


CHARGE IDENTIFICATION

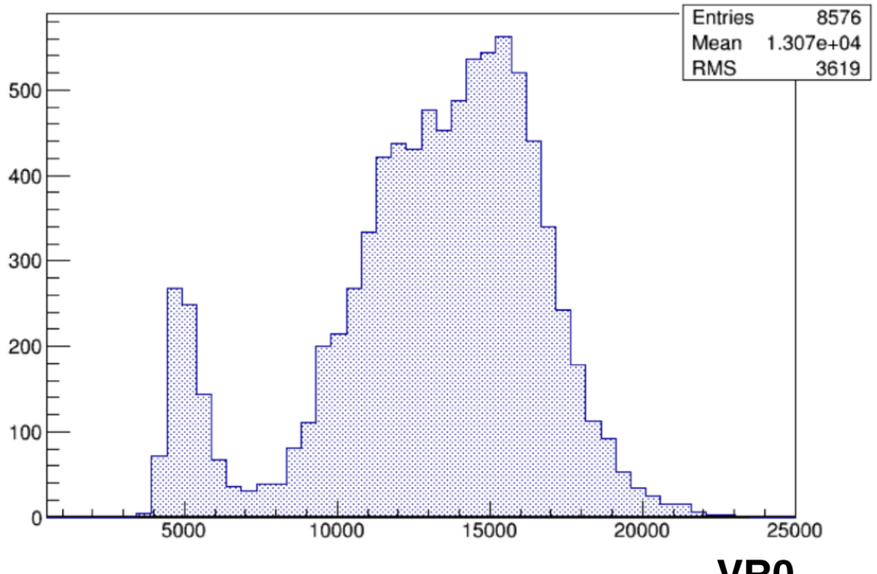
THERMAL TREATMENT AT 28°C



VR1



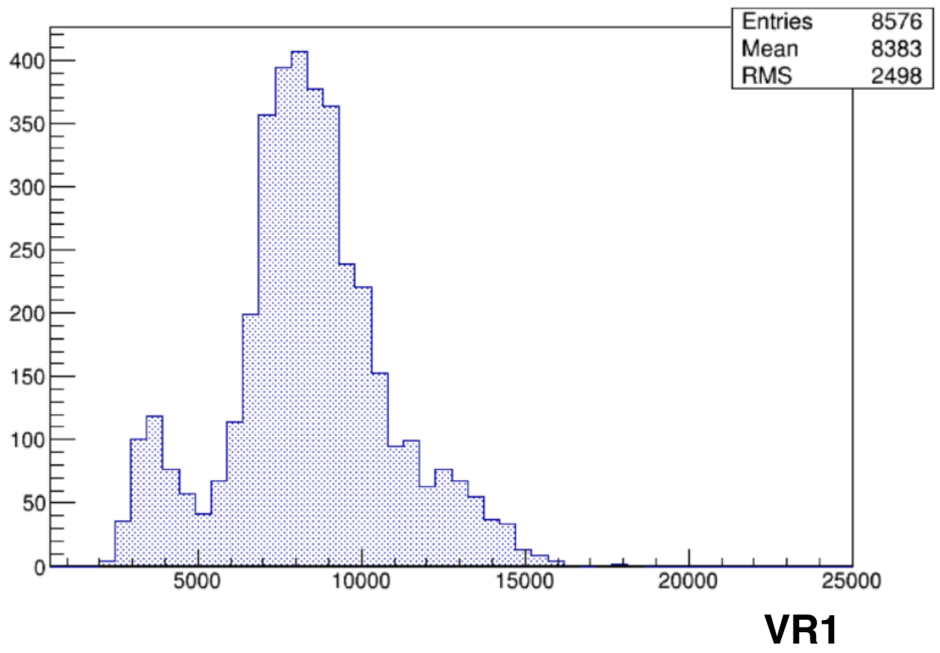
COSMIC RAYS

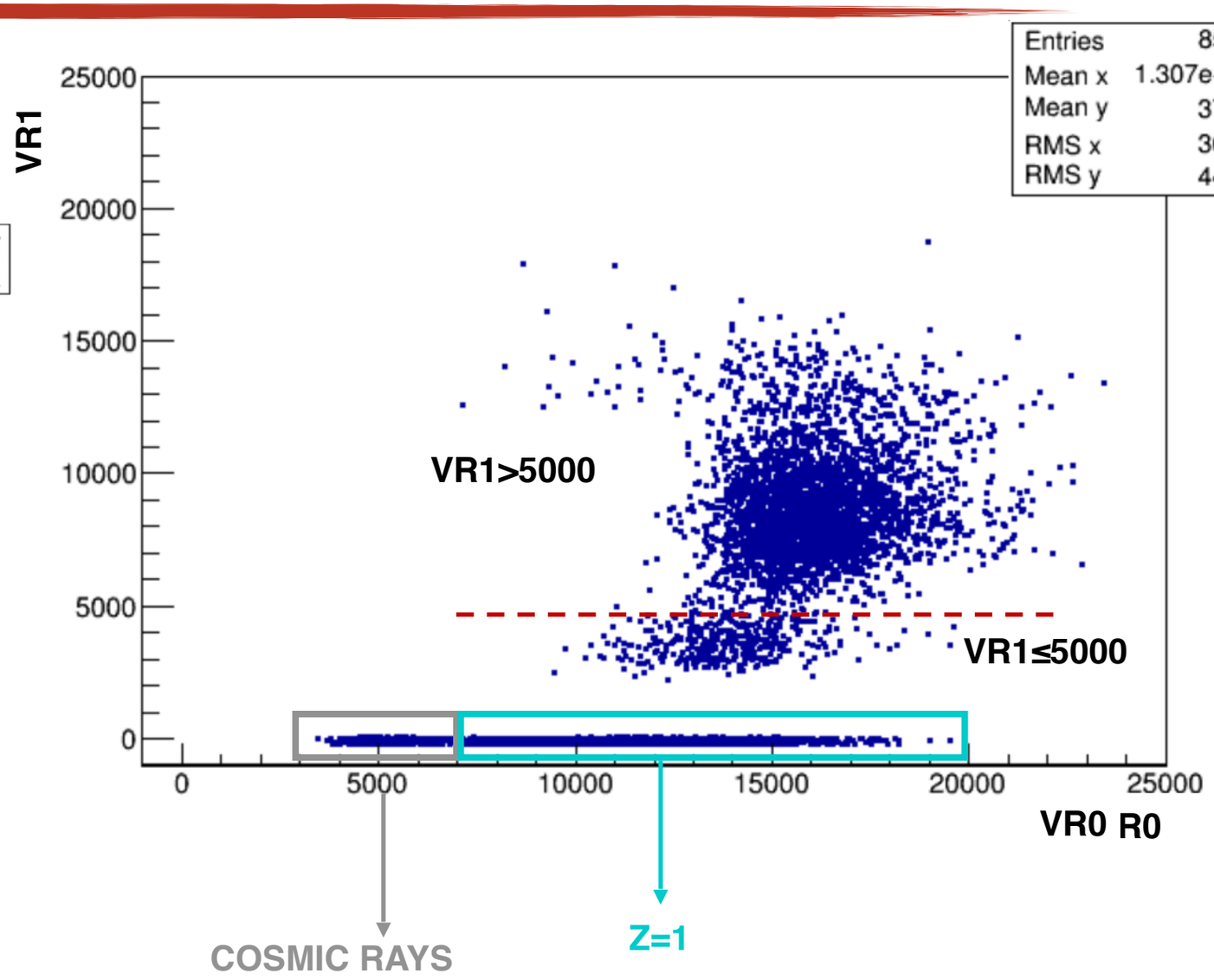


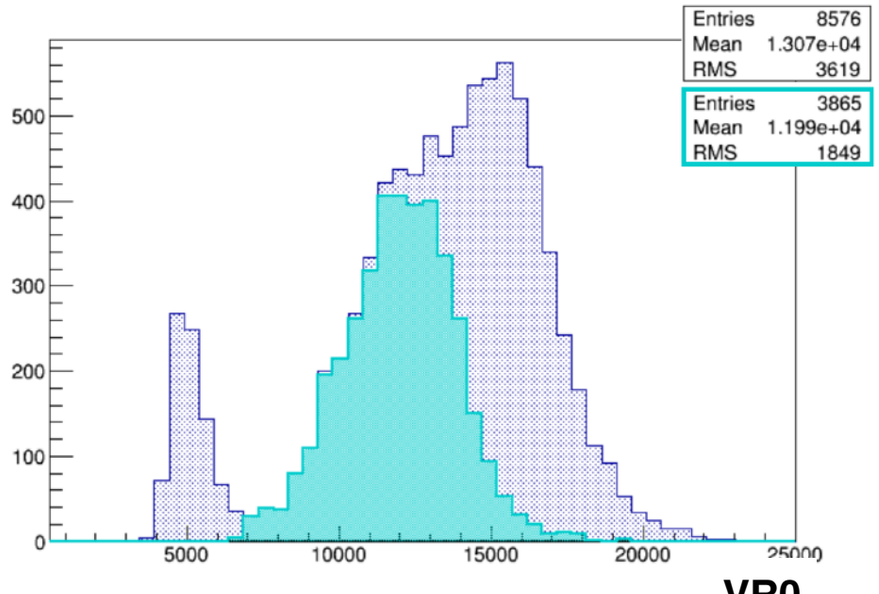
VR0

CHARGE IDENTIFICATION

THERMAL TREATMENT AT 28°C







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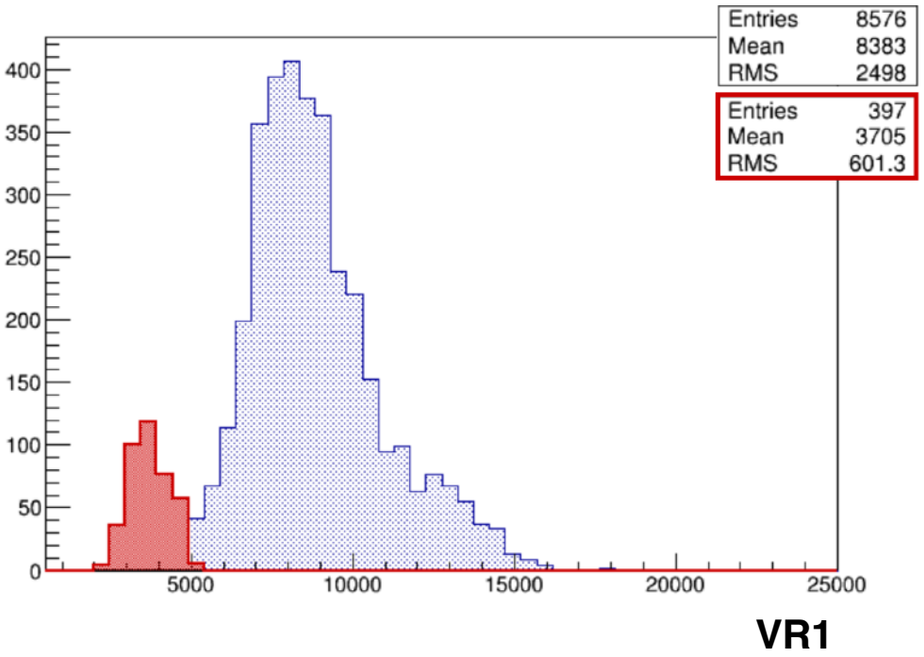

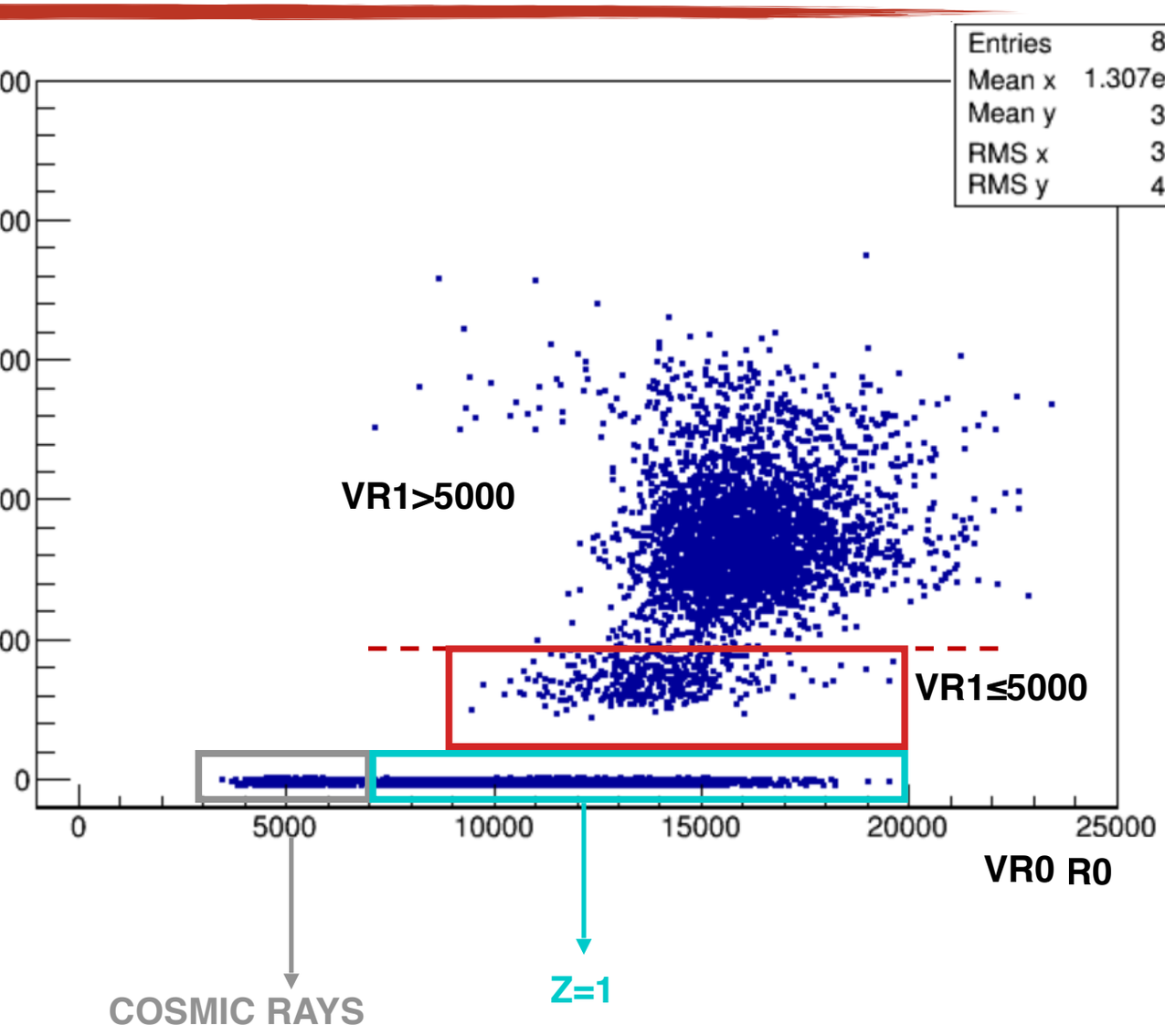

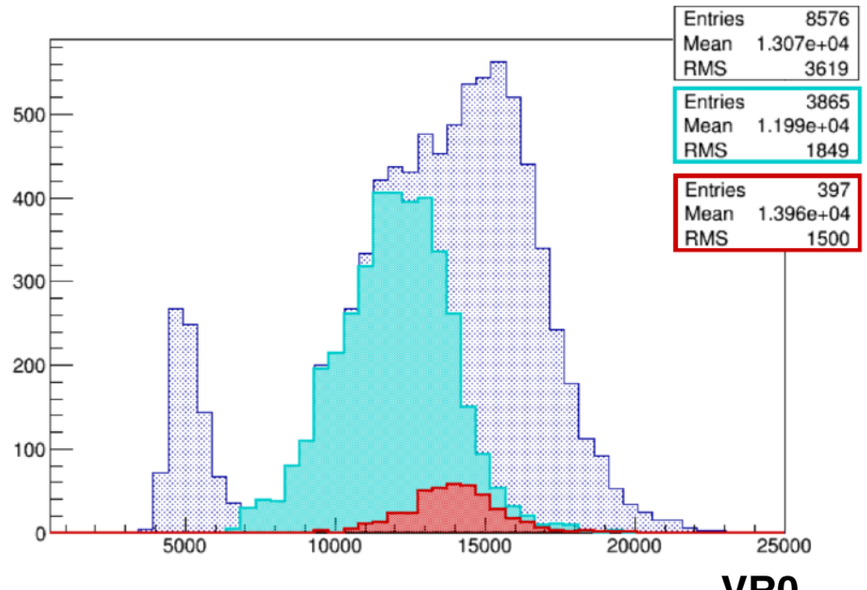

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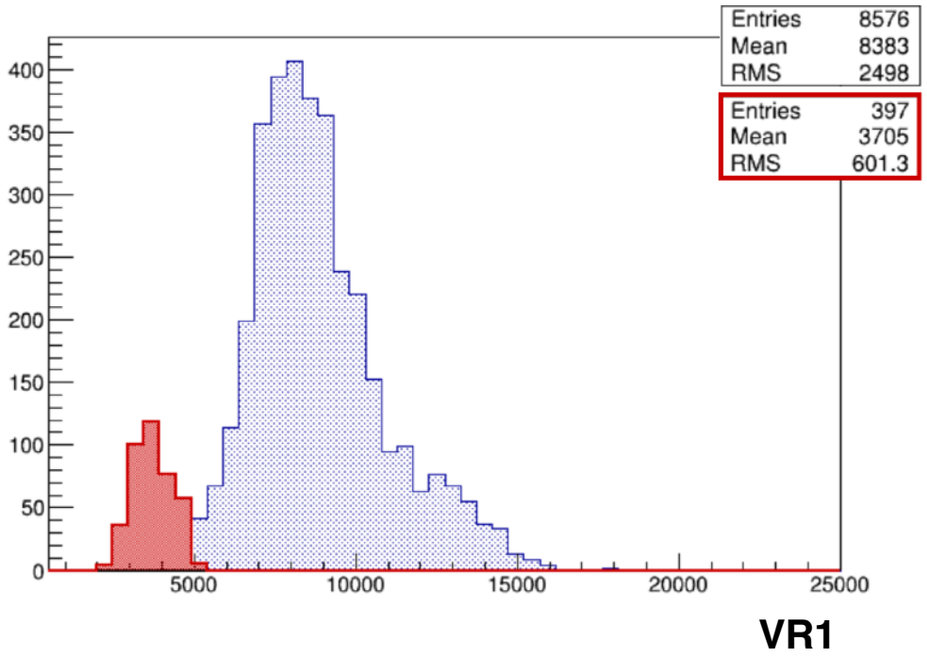
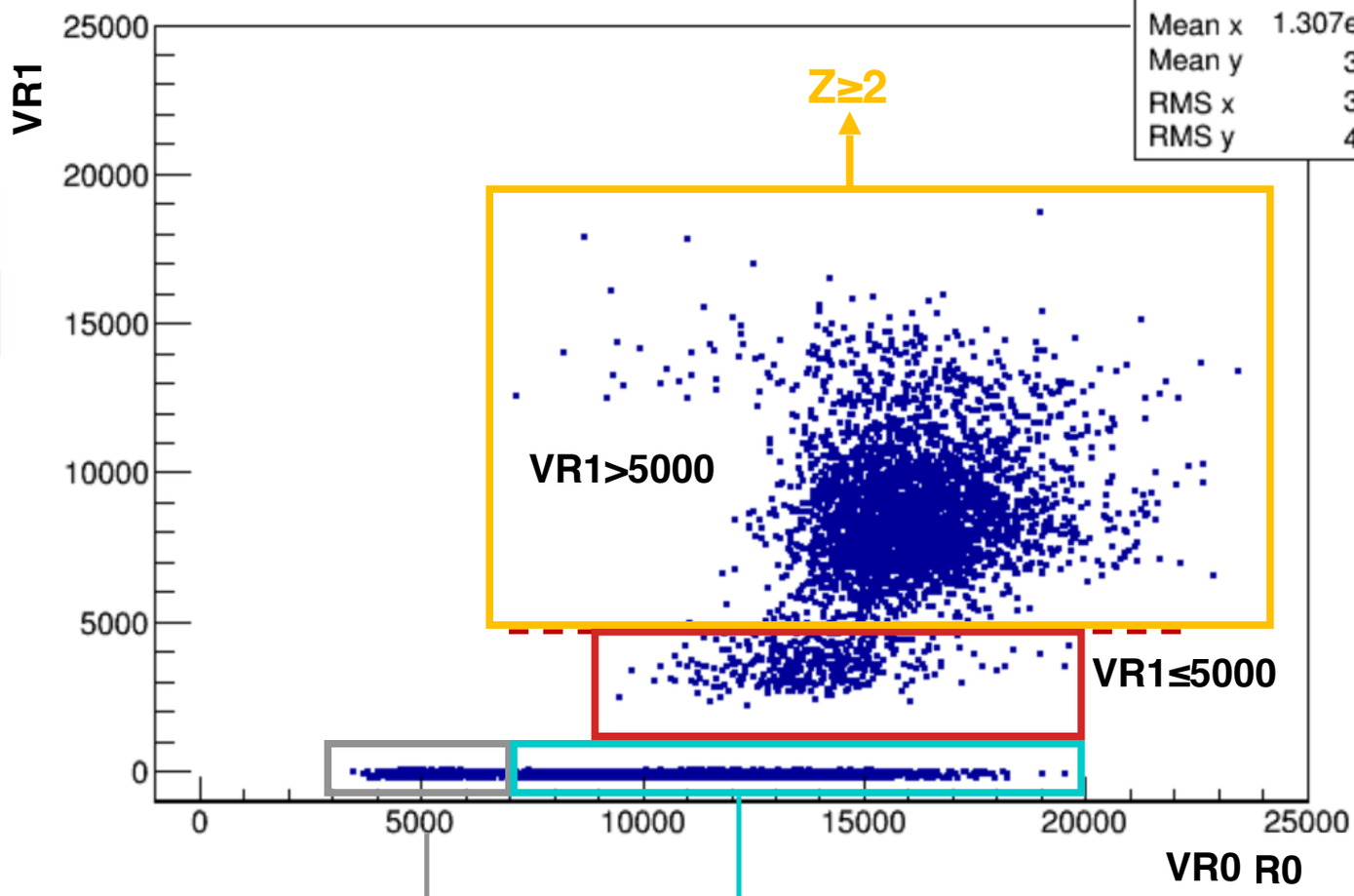
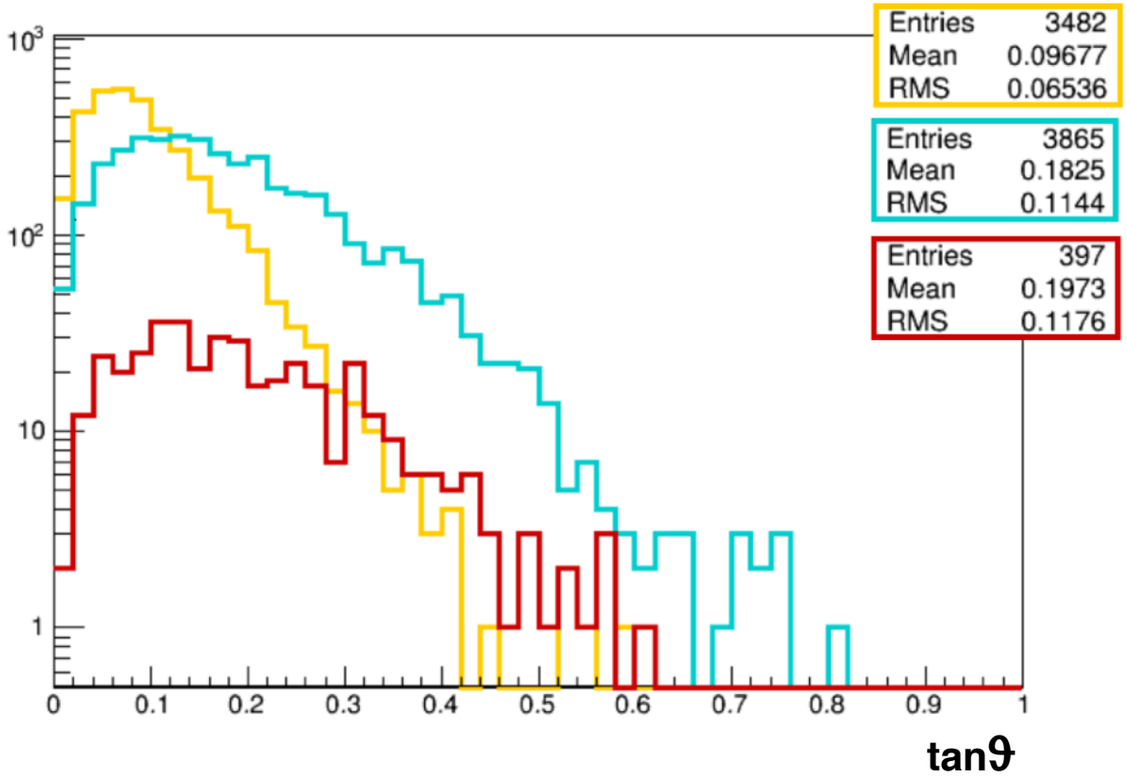
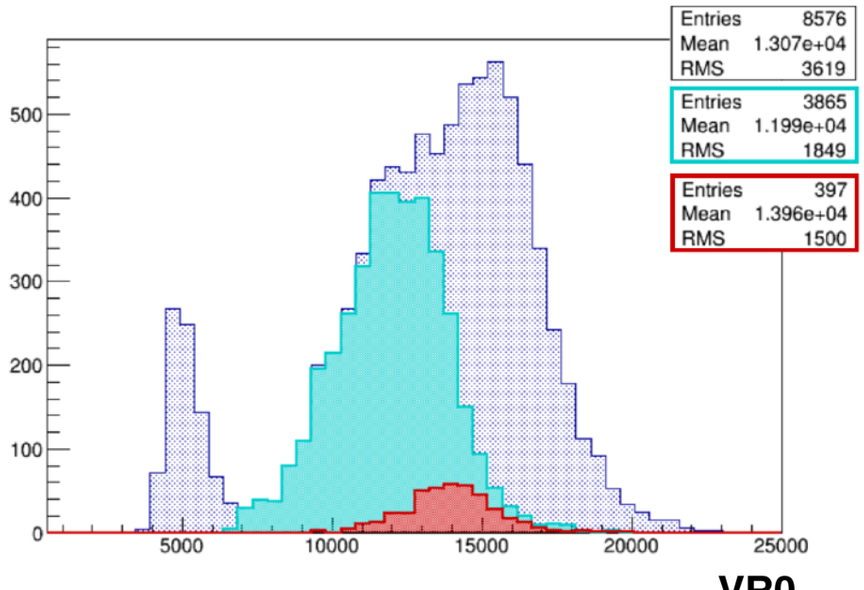




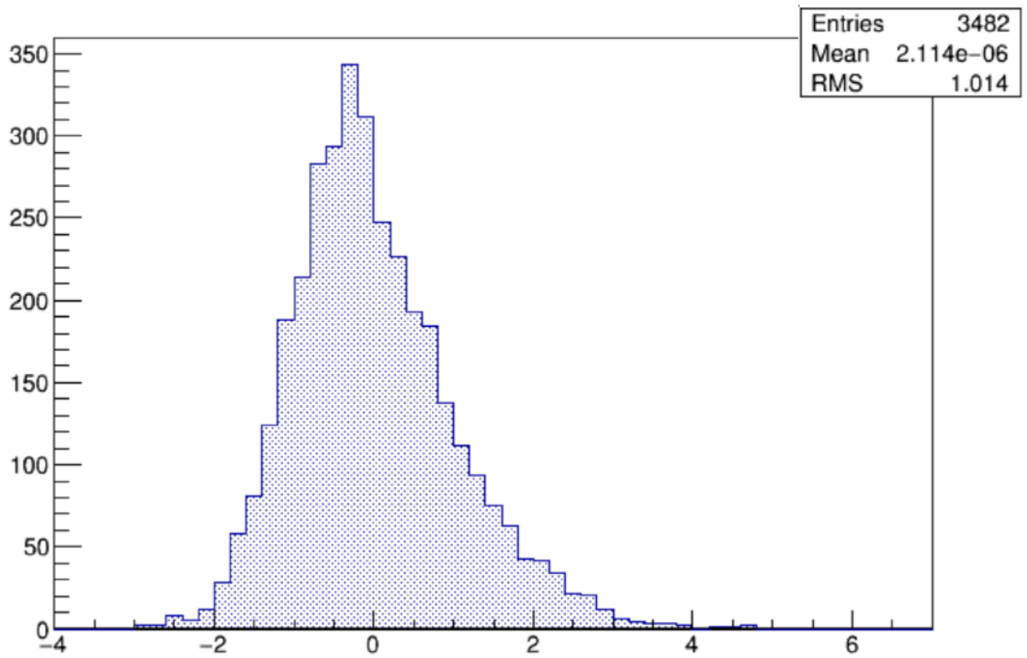




CHARGE IDENTIFICATION

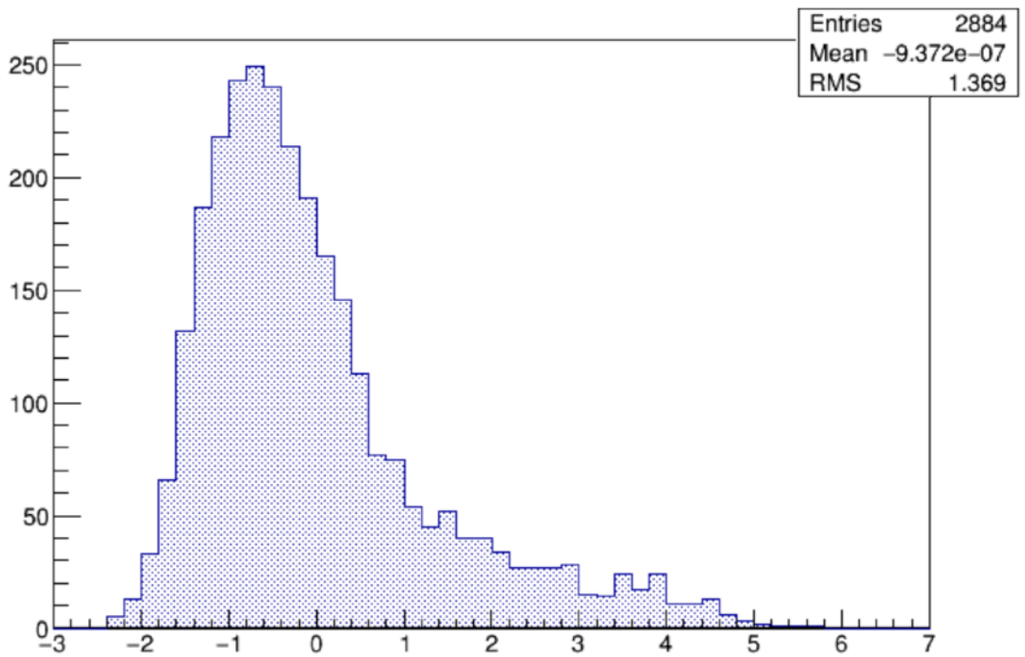
Principal Components Analysis (PCA)
https://root.cern.ch/doc/master/classTPrincipal.html

$VP\_01=\alpha_{01}\, VR0_{av}+\beta_{01}\, VR1_{av}$



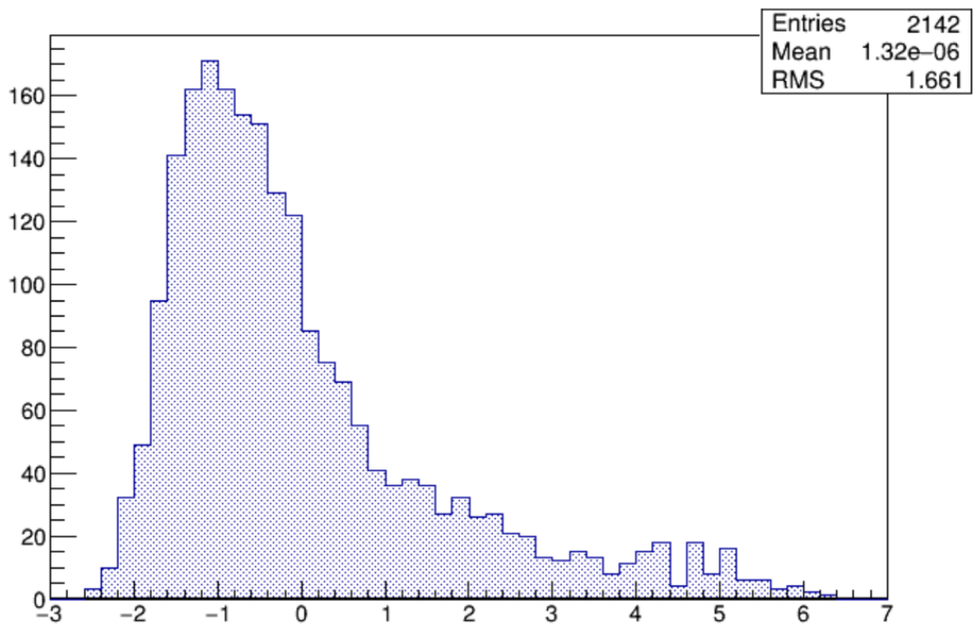
VP_01

$VP\_012=\alpha_{012}\, VR0_{av}+\beta_{012}\, VR1_{av}+\gamma_{012}\, VR2_{av}$



VP_012

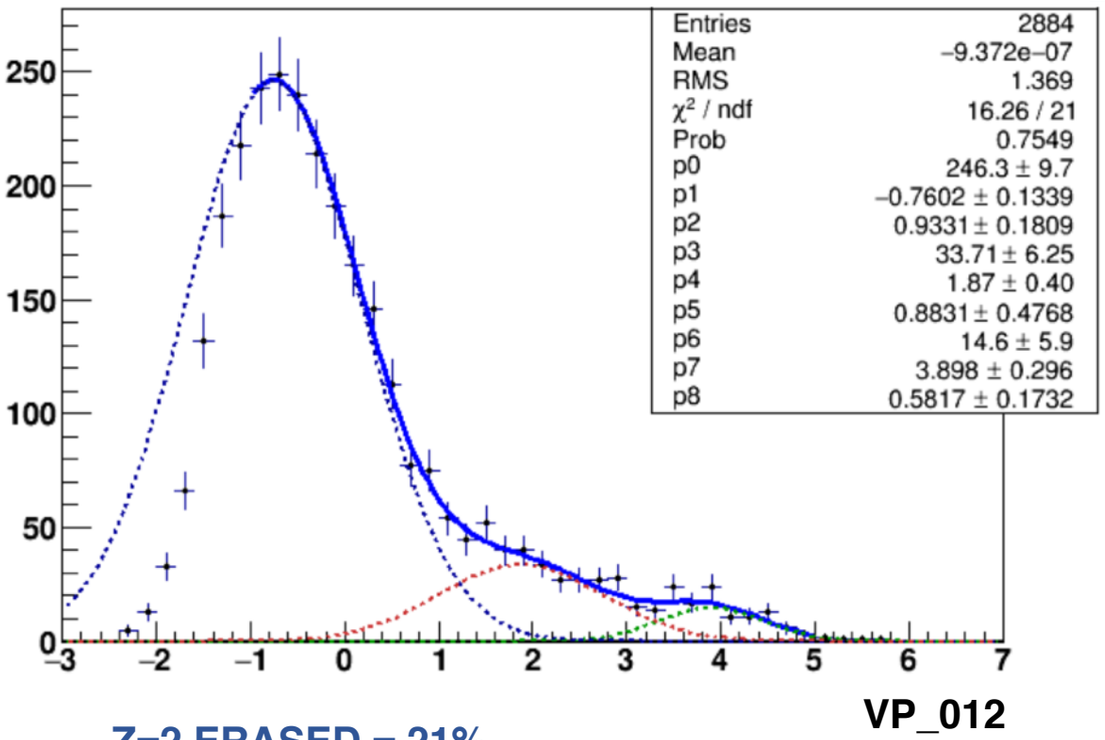
$VP\_0123=\alpha_{0123}\, VR0_{av}+\beta_{0123}\, VR1_{av}+\gamma_{0123}\, VR2_{av}+\delta_{0123}\, VR3_{av}$



VP_013

CHARGE IDENTIFICATION

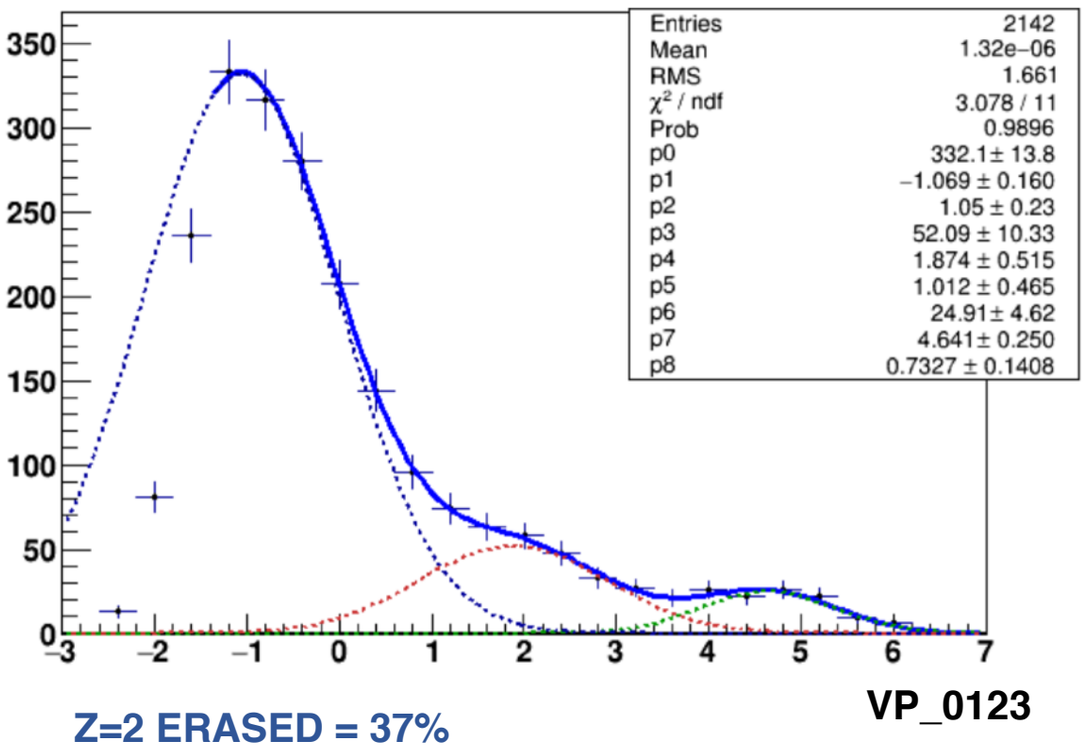
VP_012



Z=2 ERASED = 21%

Function	Amplitude	Mean value (μ)	Standard Deviation (σ)	Integral over total
gaus $z_{=2}$	246.3	-0.7	0.9	85.6%
gaus $z_{=3}$	33.7	1.9	0.9	11.1%
gaus $z_{\geq 4}$	14.6	3.9	0.6	3.2%

VP_0123



Z=2 ERASED = 37%

Function	Amplitude	Mean value (μ)	Standard Deviation (σ)	Integral over total
gaus $z_{=2}$	332.1	-1.1	1.1	82.6%
gaus $z_{=3}$	52.1	1.9	1.0	12.9%
gaus $z_{\geq 4}$	24.9	4.6	0.7	4.6%