FOOT EXPERIMENT: SECTION 2

CHARGE IDENTIFICATION BY EMULSION SPECTROMETER

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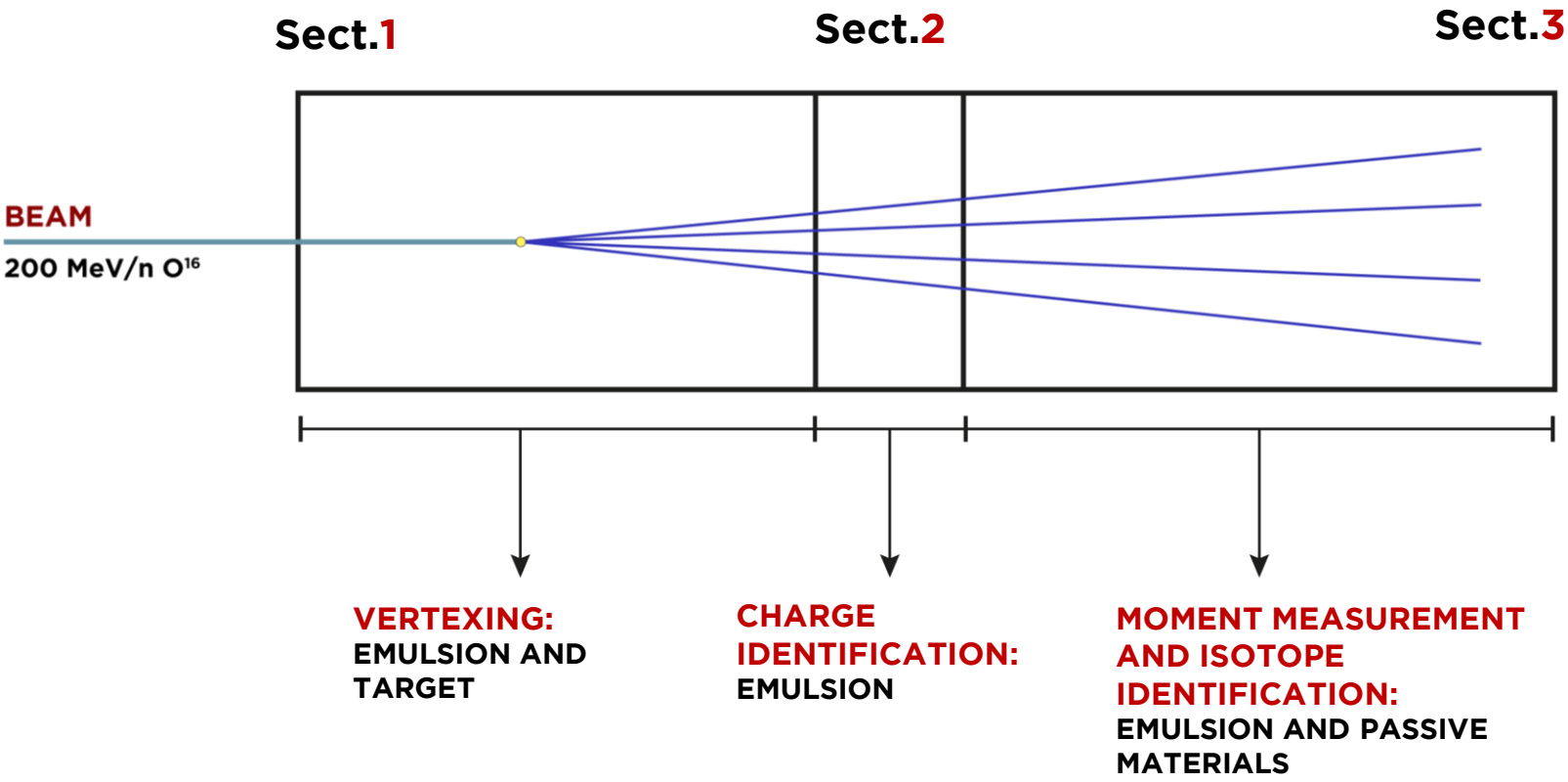
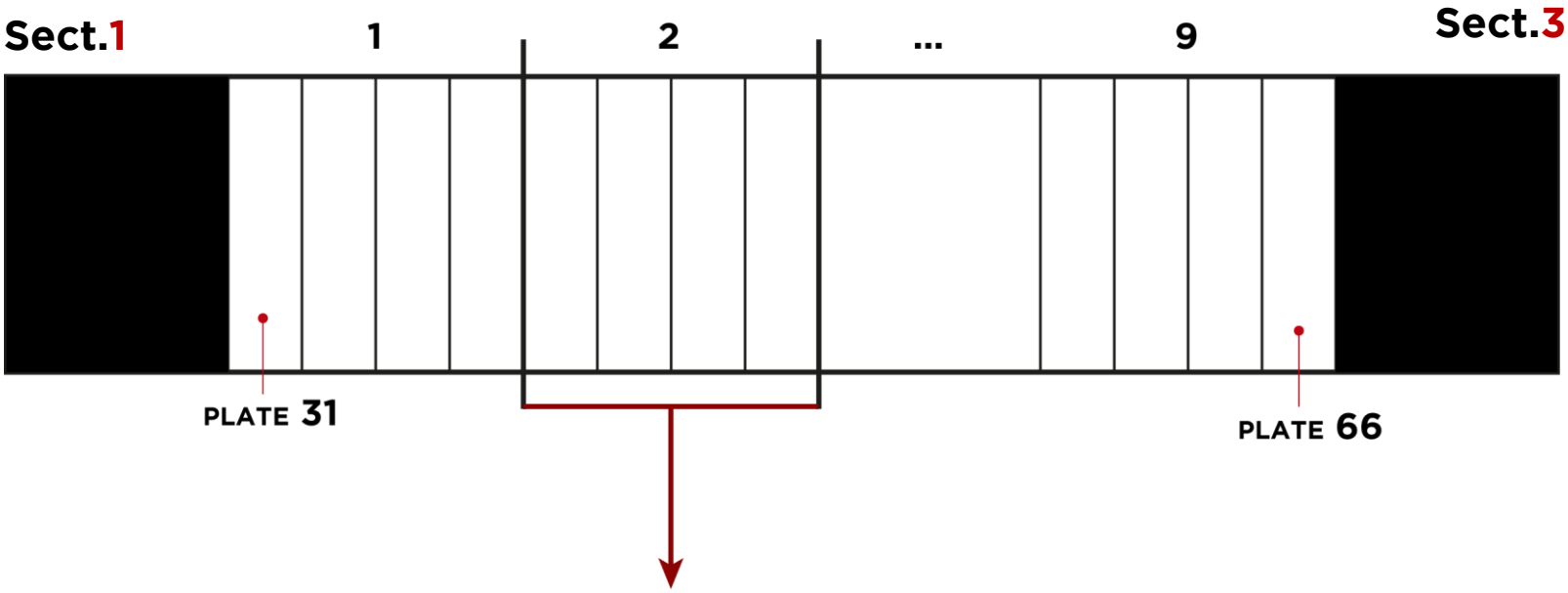
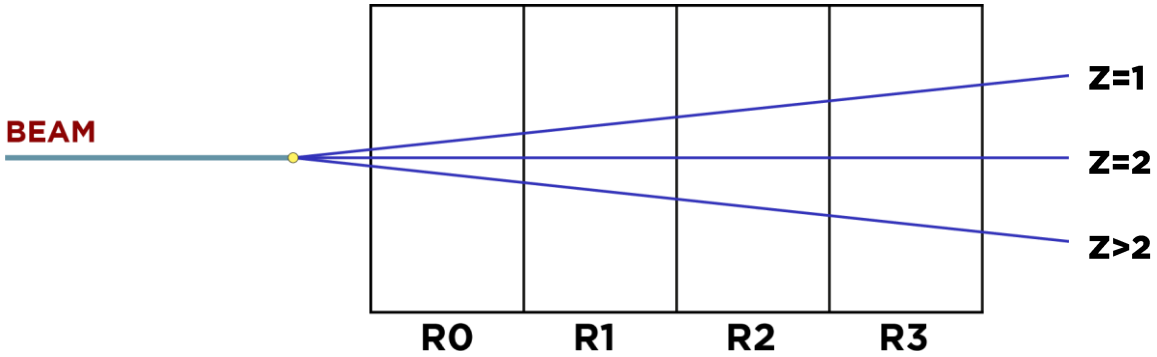
SUMMARY

- Description of the detector
- Thermal Treatment
- Data Analysis
- Charge Identification of Fragments
- Conclusion

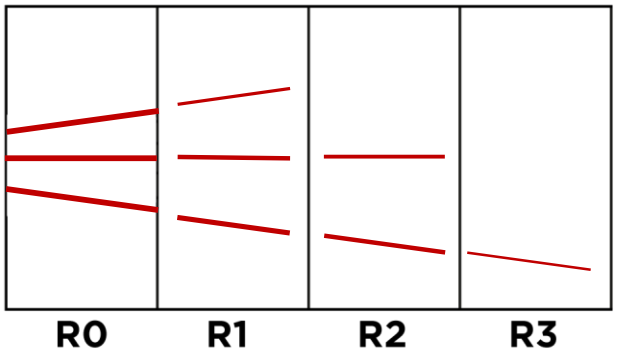


2 FOOT: EMULSION SPECTROMETER





FOOT: EMULSION SPECTROMETER: Section 2

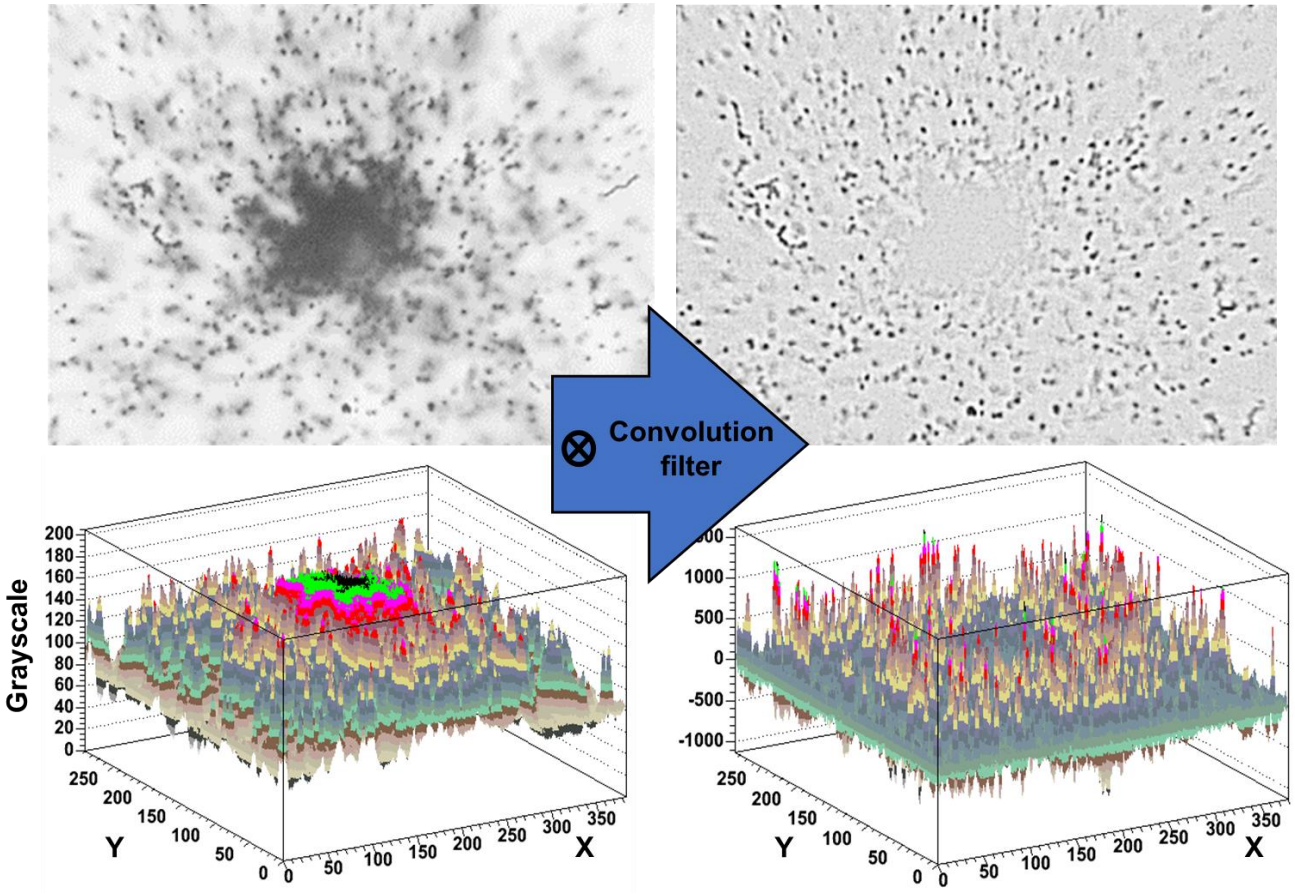


- **R0** IS NOT THERMALLY TREATED;
- **R1** IS THERMALLY TREATED AT 28°C AND 95% RELATIVE HUMIDITY;
- **R2** IS THERMALLY TREATED AT 34°C AND AT 95% RELATIVE HUMIDITY;
- **R3** IS THERMALLY TREATED AT 36°C AND AT 95% RELATIVE HUMIDITY.

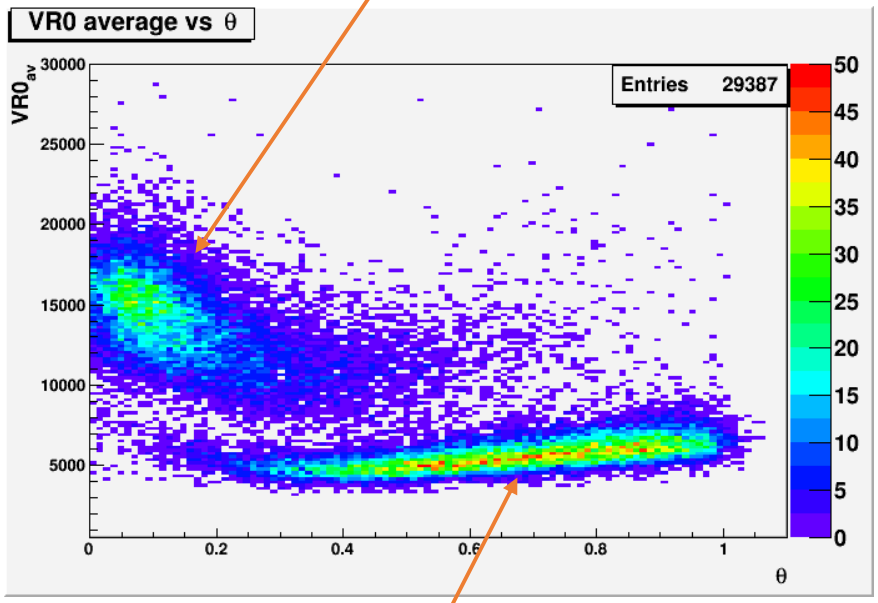
- FOR EACH THERMAL CONDITION, A TRACK IS CHARACTERIZED BY FOUR VOLUME VARIABLES REFERRED TO AS VR0, VR1, VR2 AND VR3.
- FOR EACH TRACK, THE AVERAGE VALUES (VR(n)_AVERAGE; n=0,1,2,3) BY FOUR VARIABLES ARE CALCULATED AND COMPARED.

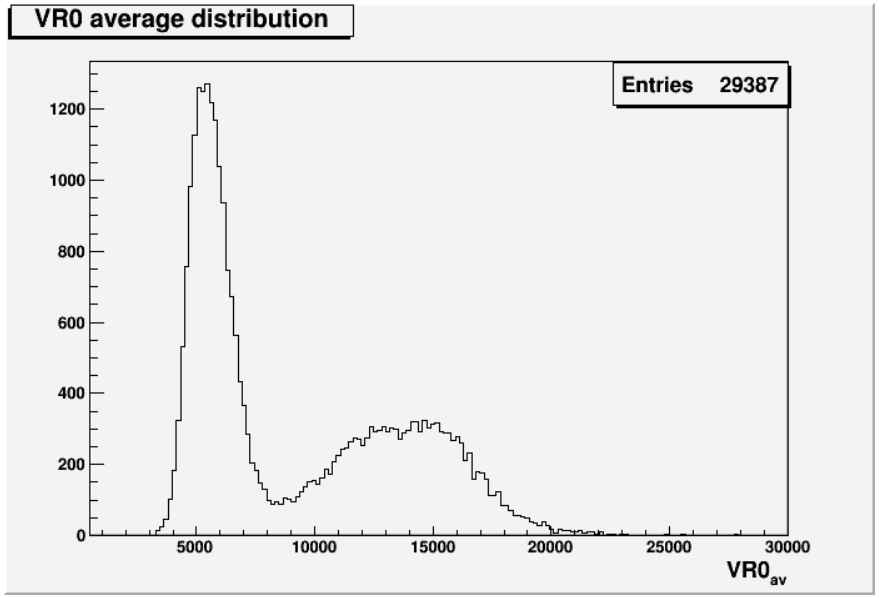
$$VR(n)_{av} = \frac{\sum \text{Volume in R(n)}}{\text{number of R(n) emulsions}}$$

Image processing

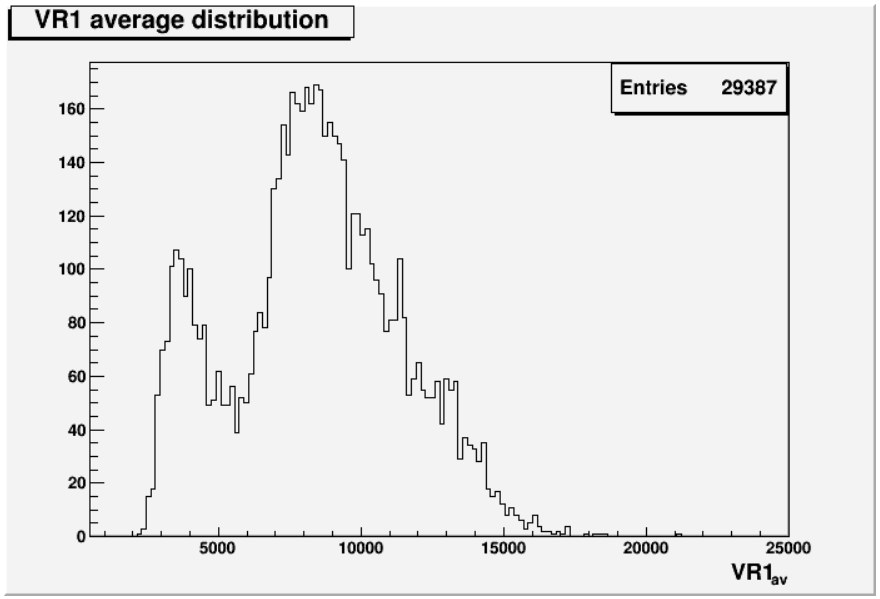


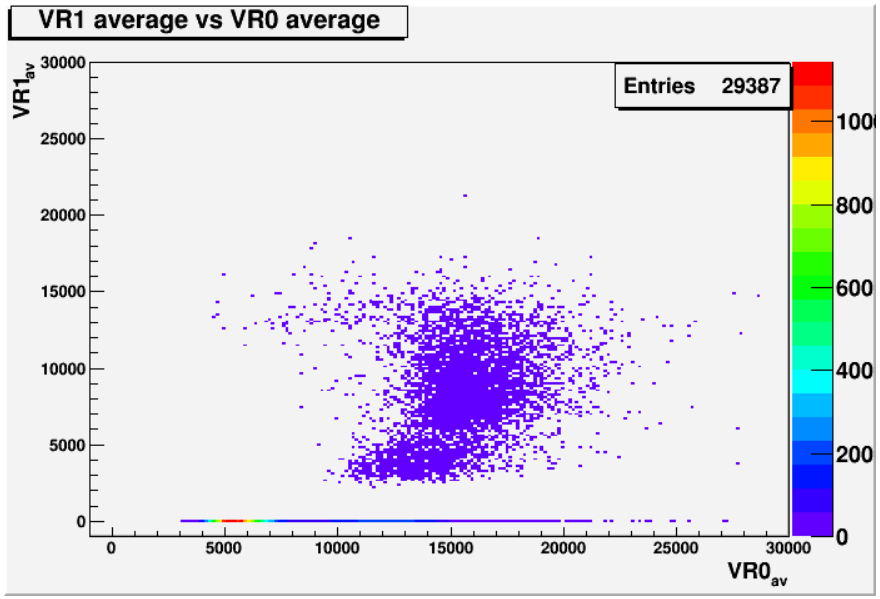
Fragments



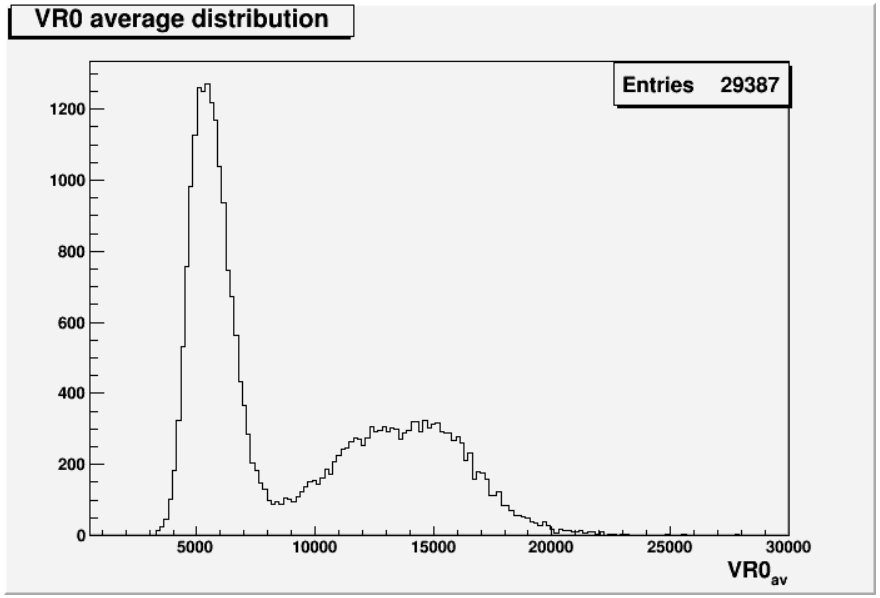


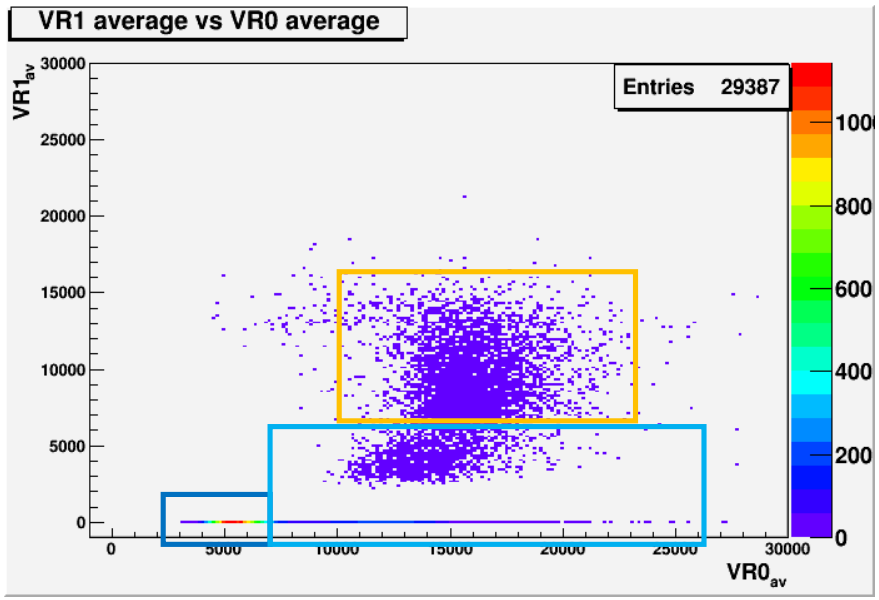
Cosmic rays

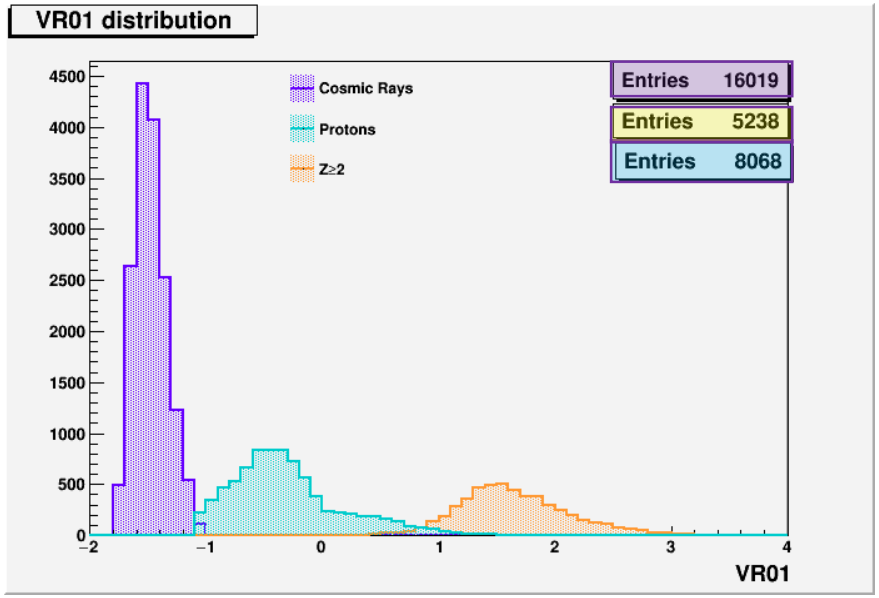




VR1 AND VR0 ARE NOT THE BEST VARIABLES TO PERFORM PARTICLE'S CLASSIFICATION



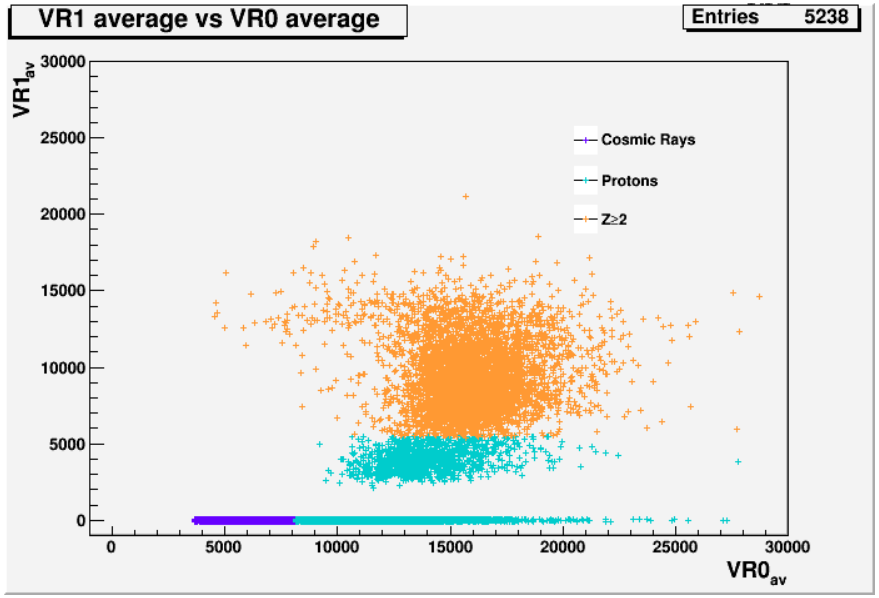


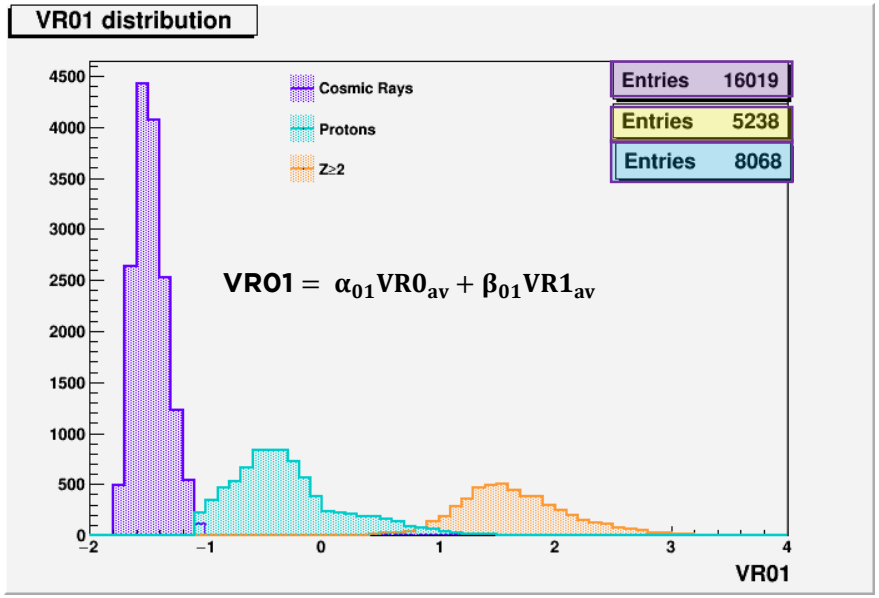


$$VR01 = \alpha_{01} VR0_{av} + \beta_{01} VR1_{av}$$

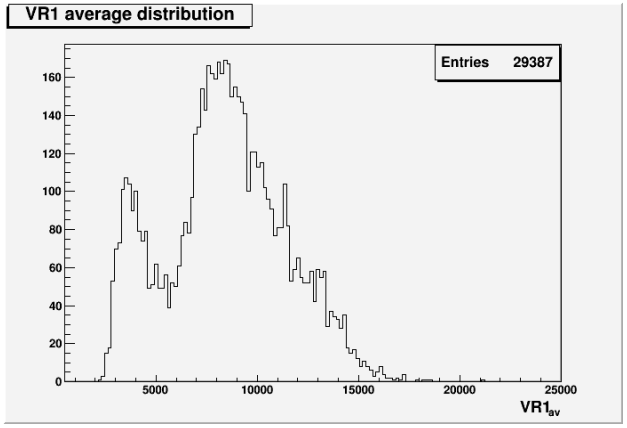
"THE PRINCIPAL COMPONENTS METHOD CONSISTS OF APPLYING A LINEAR TRANSFORMATION TO THE ORIGINAL VARIABLES. THIS TRANSFORMATION IS DESCRIBED BY AN ORTHOGONAL MATRIX AND IS EQUIVALENT TO A ROTATION OF THE ORIGINAL PATTERN SPACE INTO A NEW SET OF COORDINATE VECTORS, WHICH HOPEFULLY PROVIDE EASIER FEATURE IDENTIFICATION AND DIMENSIONALITY REDUCTION."

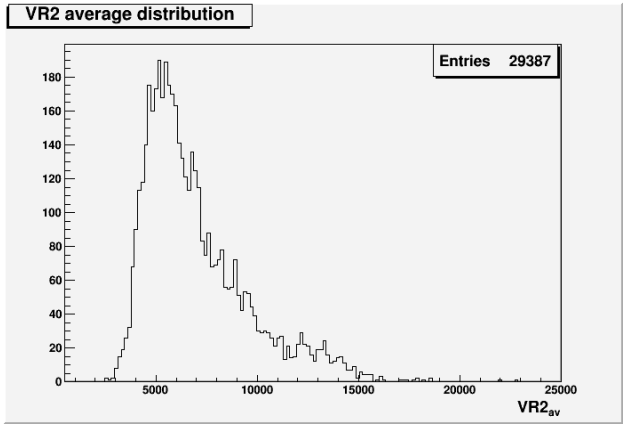
Principal Components Analysis (PCA)
https://root.cern.ch/doc/master/classTPrincipal.html

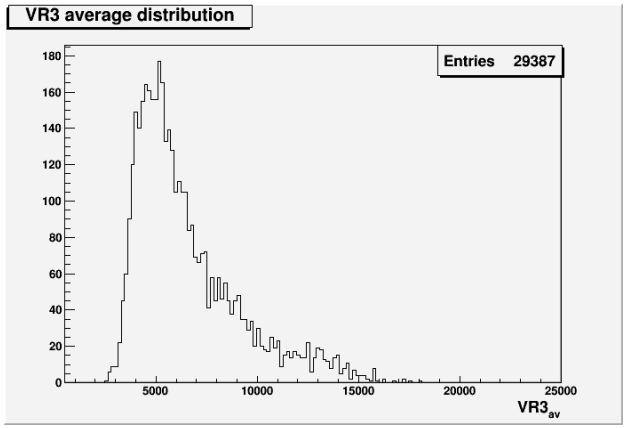


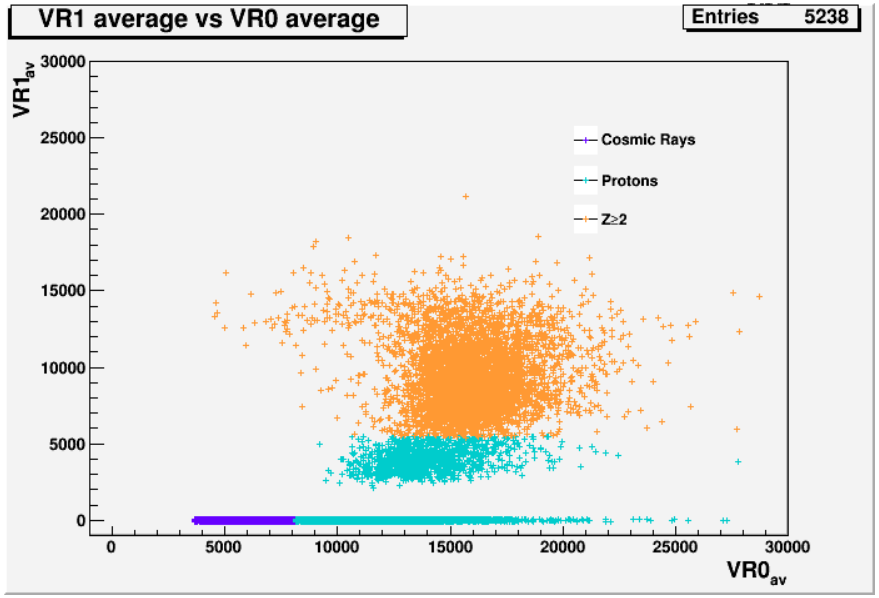


	MC Simulation(%)	Data(%)
Z=1	62,2 +- 0,4	60,5 +- 0,6
Z=2	32,2 +- 0,4	39,5 +- 0,4
Z>2	5,7 +- 0,2	

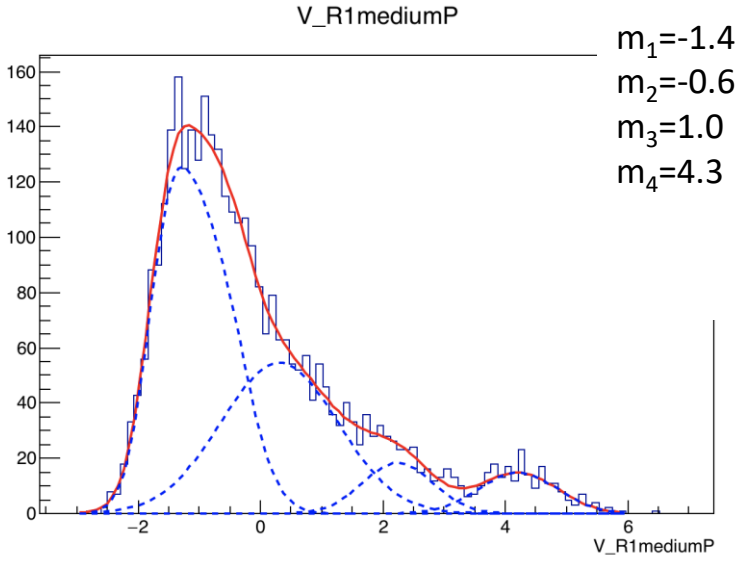








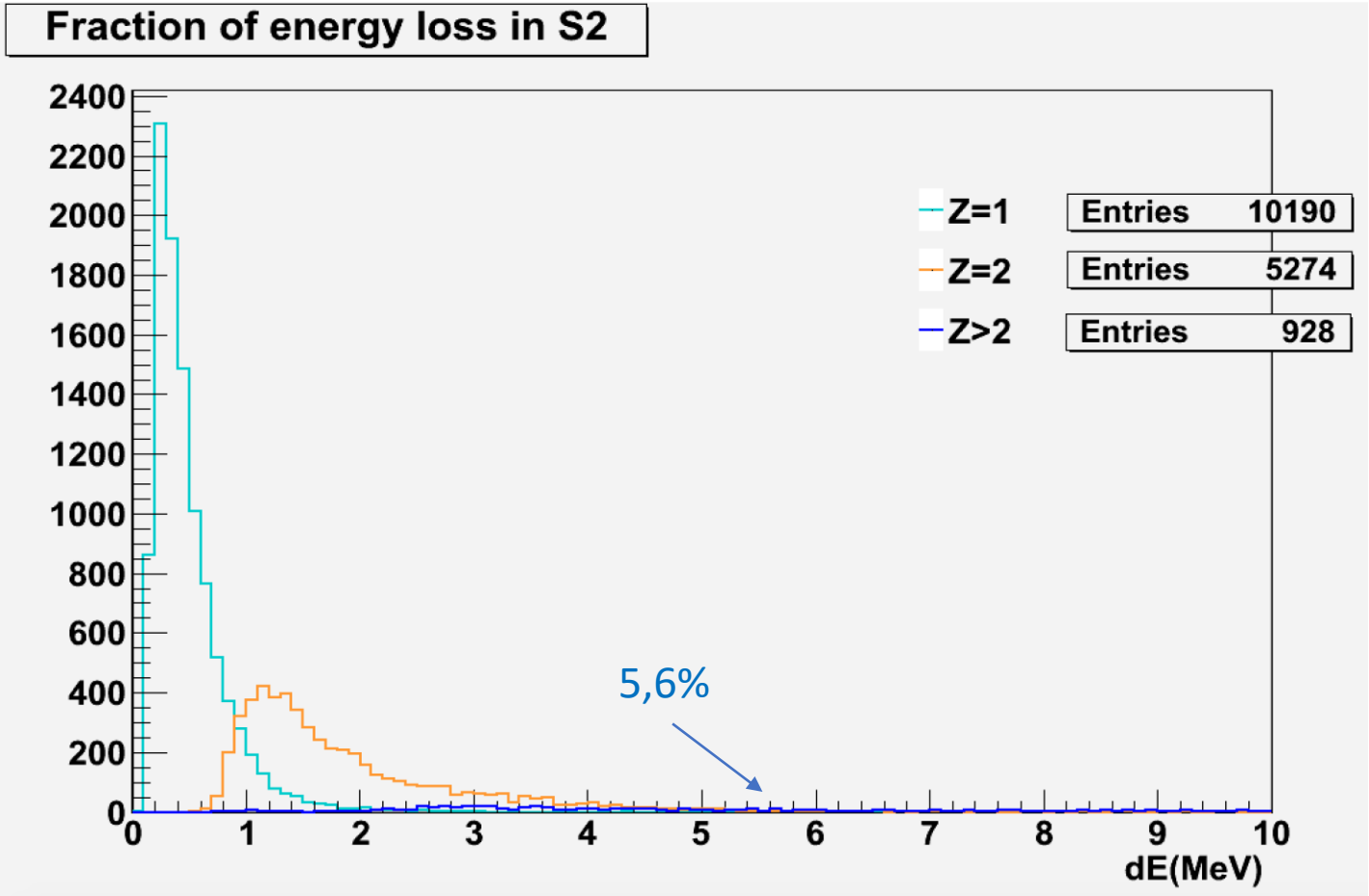
$$\mathbf{VR123} = \alpha_{123}\mathbf{VR1_{av}} + \beta_{123}\mathbf{VR2_{av}} + \gamma_{123}VR3_{av}$$



m_1=-1.4
m_2=-0.6
m_3=1.0
m_4=4.3

FOOT: CHARGE IDENTIFICATION

Fraction of energy loss in one emulsion in section 2 predicted by Montecarlo Simulation



CONCLUSIONS

- The first analysis for charge identification of fragments has been performed.
- Protons has been recognised with high purity

NEXT STEP

- Improve the analysis in order to have a better separation between helium and higher Z fragments by appling machine learning.
- Study of the possibility to identify the charge of short tracks stopping in S1 through their VR0
- Further optimization of the thermal treatment.

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