Nuclear reactions with relativistic radioactive beams (NUC-RIA)

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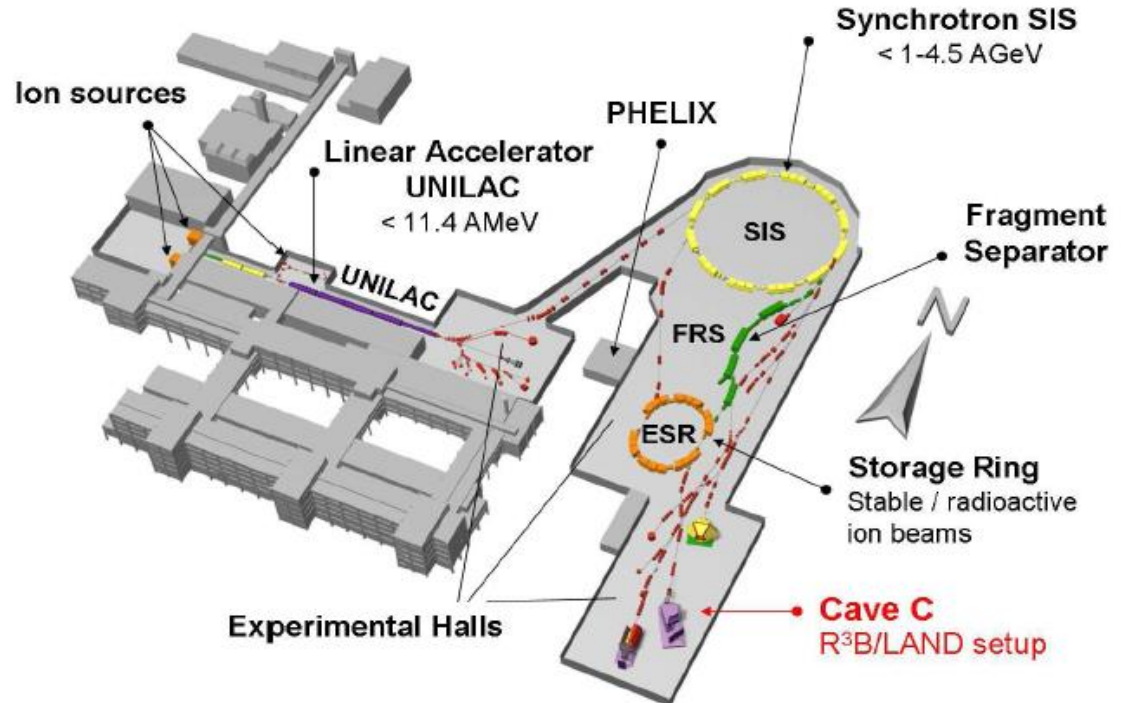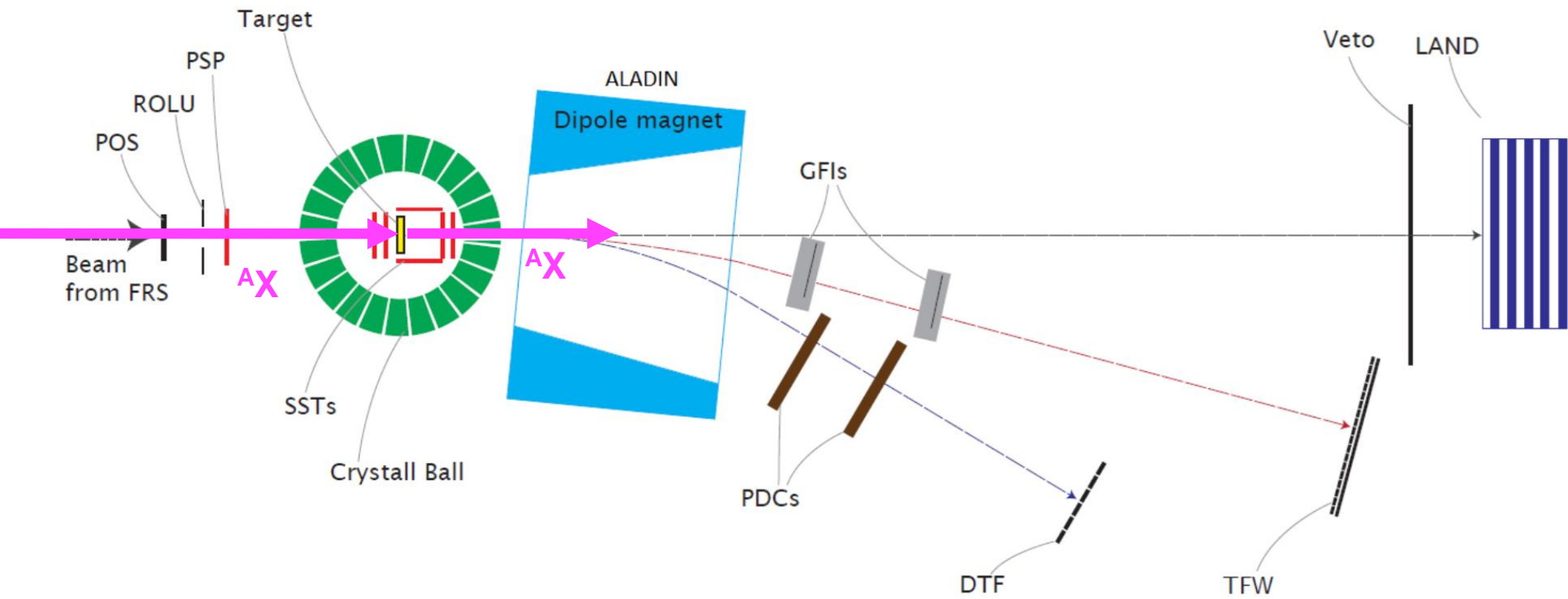
Introduction

- We analysed the data from R^3B, which is located in GSI, a large-scale accelerator facility for heavy ions, in Darmstadt, Germany;

Main Subjects:

- The setup of the whole experiment;

- The tools we used to analyse the data

- The graphs we obtained;

- The conclusions.

POS

ROLU

PSP

Target

Beam from FRS

^{A}X

SSTs

Crystall Ball

ALADIN

Dipole magnet

^{A}X

GFIs

PDCs

DTF

Veto

LAND

TFW

Credits: *"Recent results on (p,pn) knock-out reactions at QFS"*, Galaviz, Daniel

Software tool: root

- Each .root file from the experiment contains a root Tree with a number of events.

- A specific event consists of a set of measured values related to each detector in the whole experimental setup.
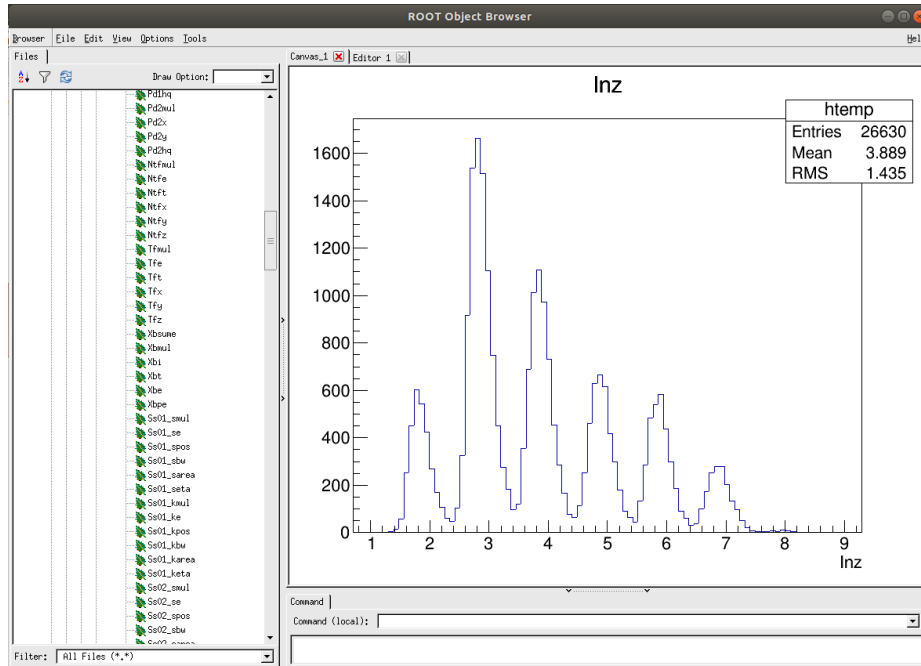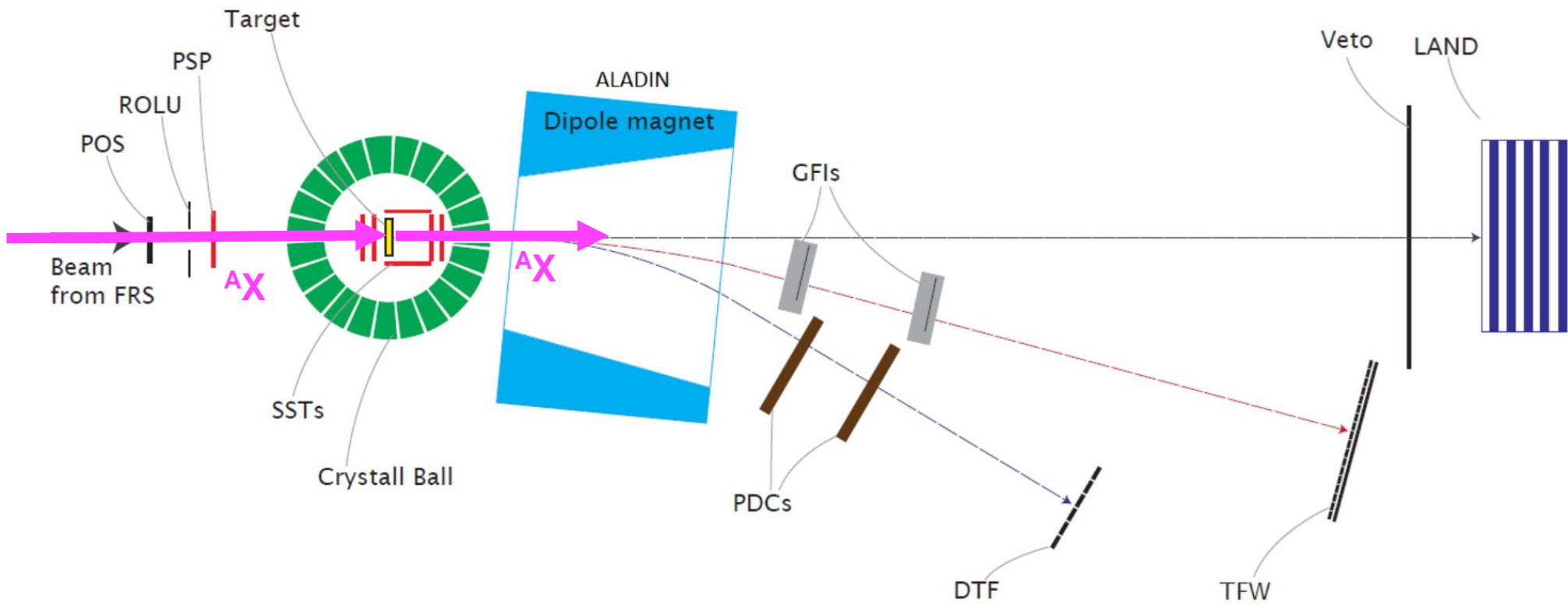
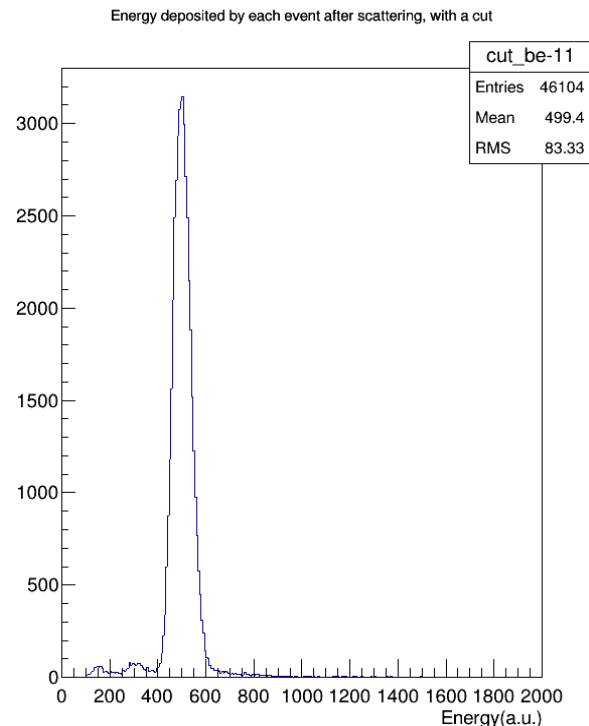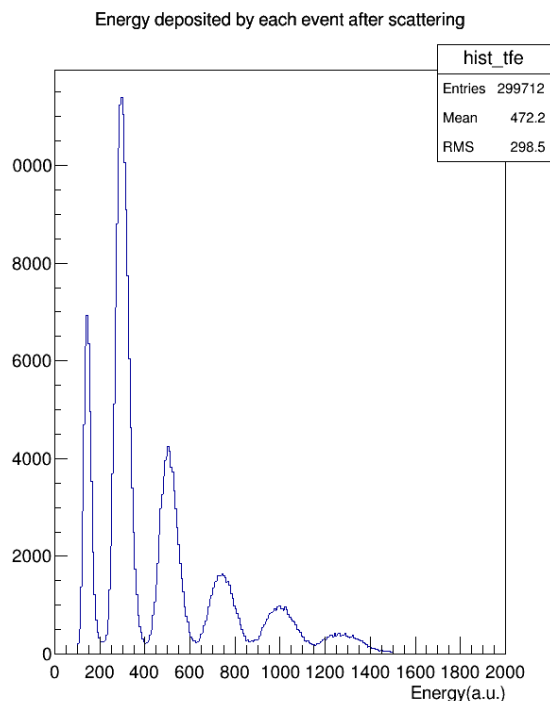Credits: *"Recent results on (p,pn) knock-out reactions at QFS",* Galaviz, Daniel

Cutting histograms in root

- Identifying different elements and isotopes;

- Using cuts to isolate different isotopes;

- A cut filters any selected events, independently of the represented variables, despite the fact that it looks like a simple graphical cut.

- Thus, a chosen cut can then be applied to any histogram of any variable/s.
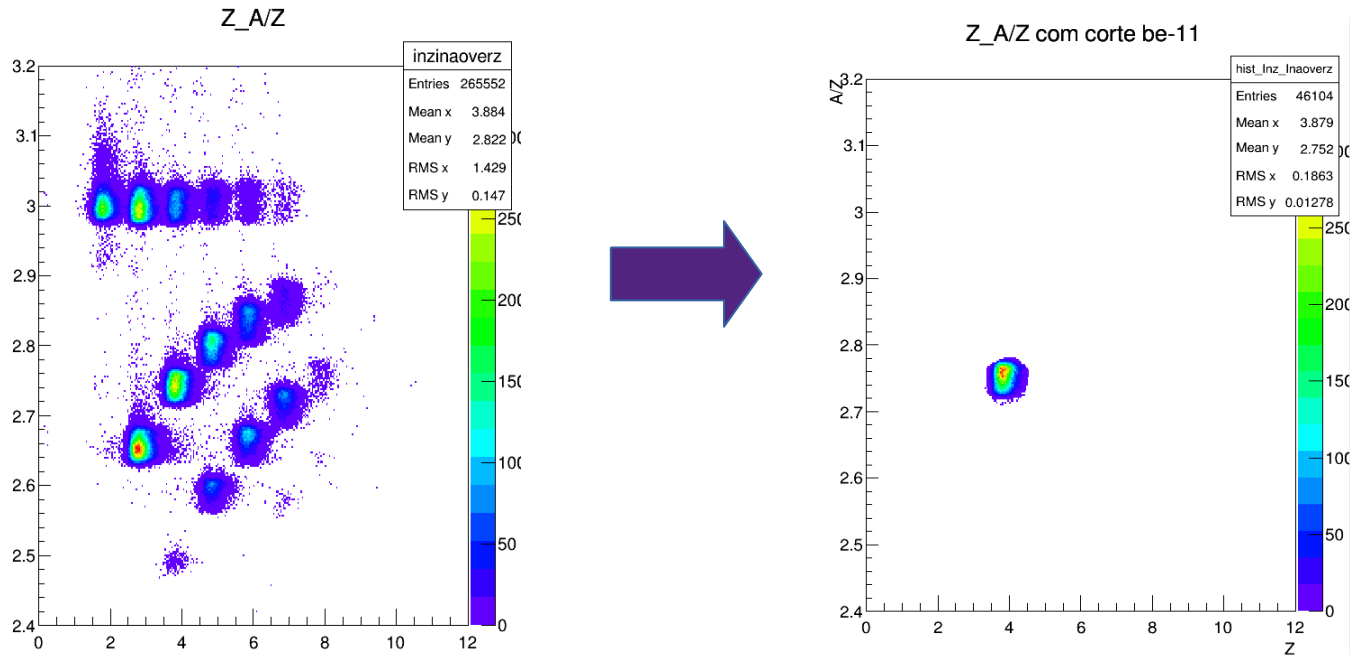
Energy selection

- As the beam travels, it loses and deposits energy in many detectors.

- This deposited energy is measured, and can be used to reconstruct the mass spectrum of the isotopes, providing a way to better clean the signals of each isotope.

Energy deposited by each event after scattering

hist_tfe	
Entries	299712
Mean	472.2
RMS	298.5

Energy deposited by each event after scattering, with a cut

cut_be-11	
Entries	46104
Mean	499.4
RMS	83.33

Angle analysis

- The variables directly measured by the detectors in the experiment only provide Cartesian coordinates for the spatial positions of the isotope beam;
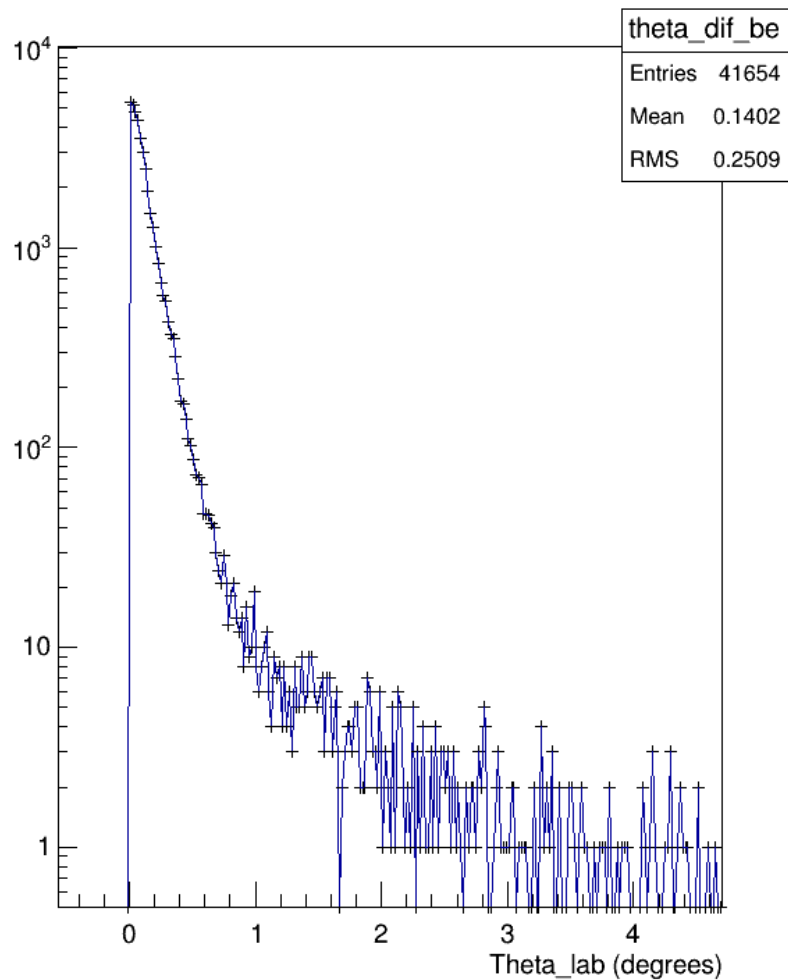
- As such, it is necessary to manipulate the available variables to obtain other useful spatial variables, such as the angles of incidence and deflection of the beam;

11Be on CH2	theta_dif_be	
	Entries	41654
	Mean	0.1402
	RMS	0.2509

11Be on C	theta_dif_be	
	Entries	46067
	Mean	0.1328
	RMS	0.2344

Theta_lab (degrees)

11Be on CH2

theta_dif_be	
Entries	41654
Mean	0.1402
RMS	0.2509

8Li on CH2

theta_dif_li	
Entries	48317
Mean	0.1685
RMS	0.3698

Theta_lab (degrees)

11Be on CH2

theta_dif_be	
Entries	41654
Mean	0.1402
RMS	0.2509

6He on CH2

theta_dif_he	
Entries	27532
Mean	0.3012
RMS	0.6897

Theta_lab (degrees)
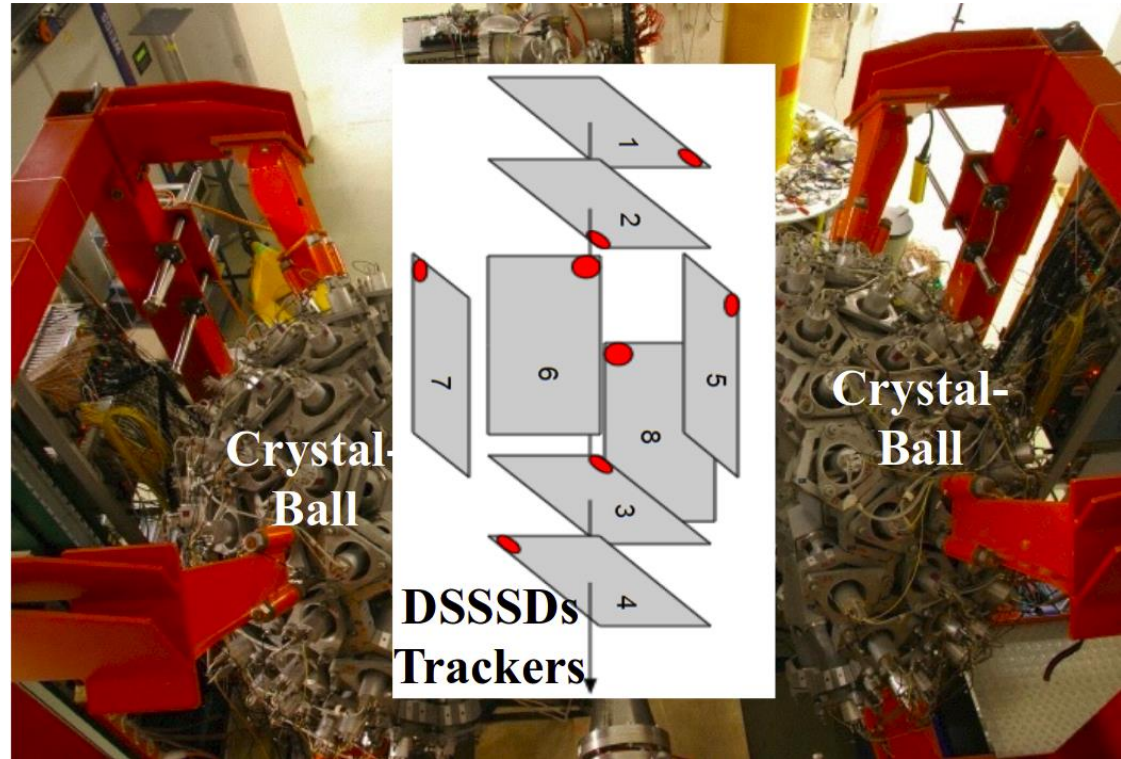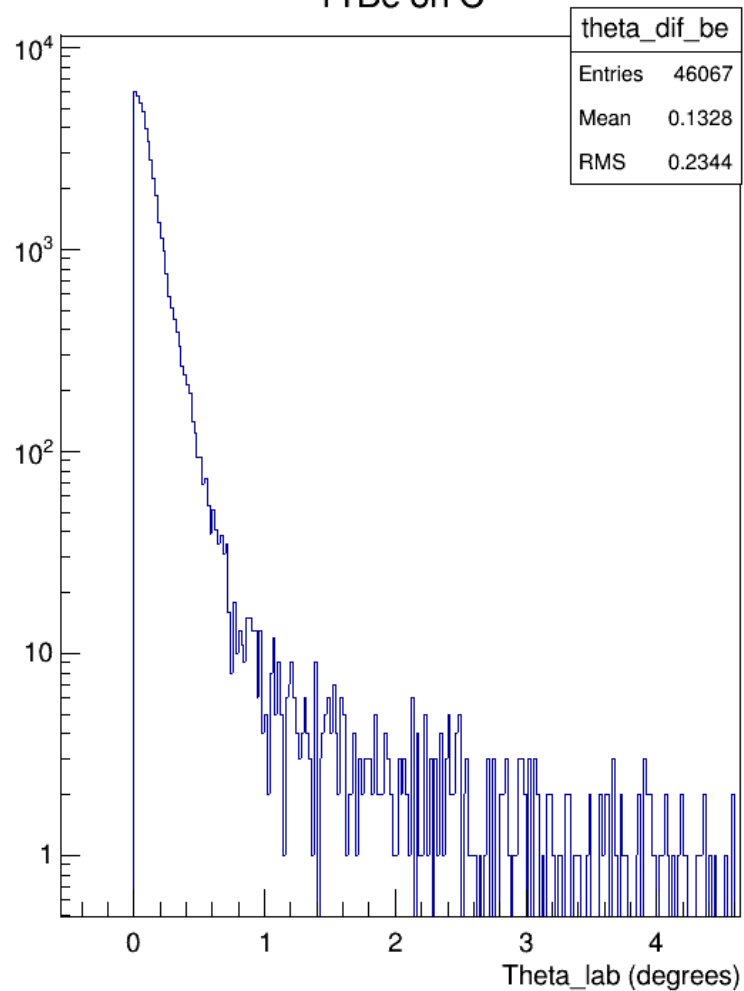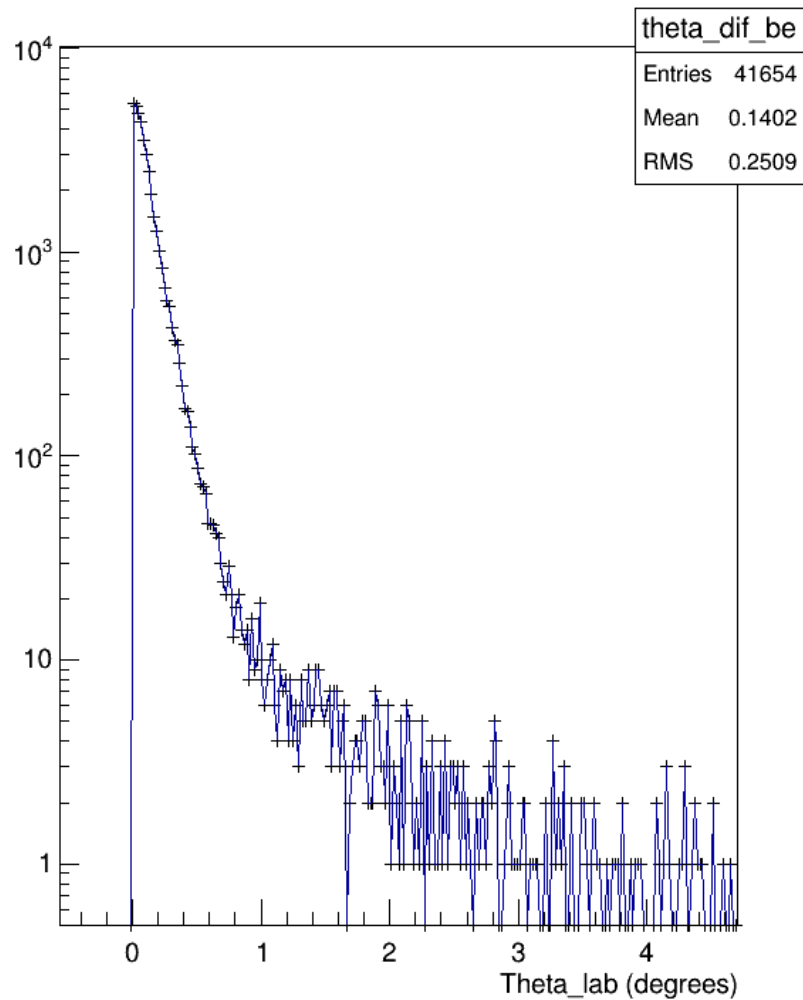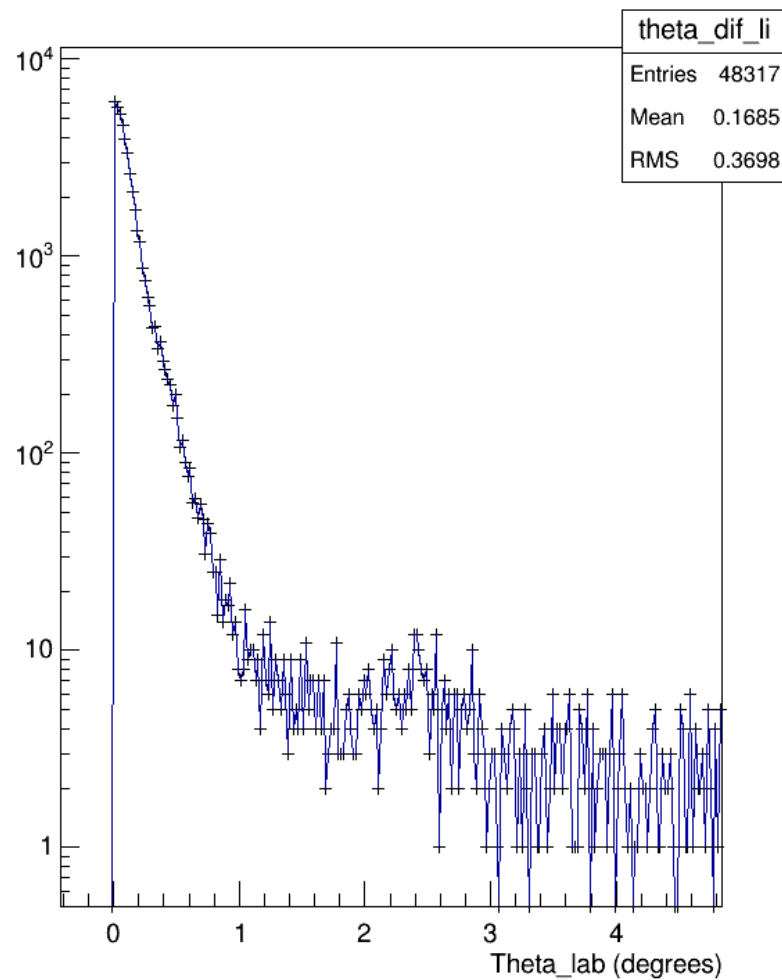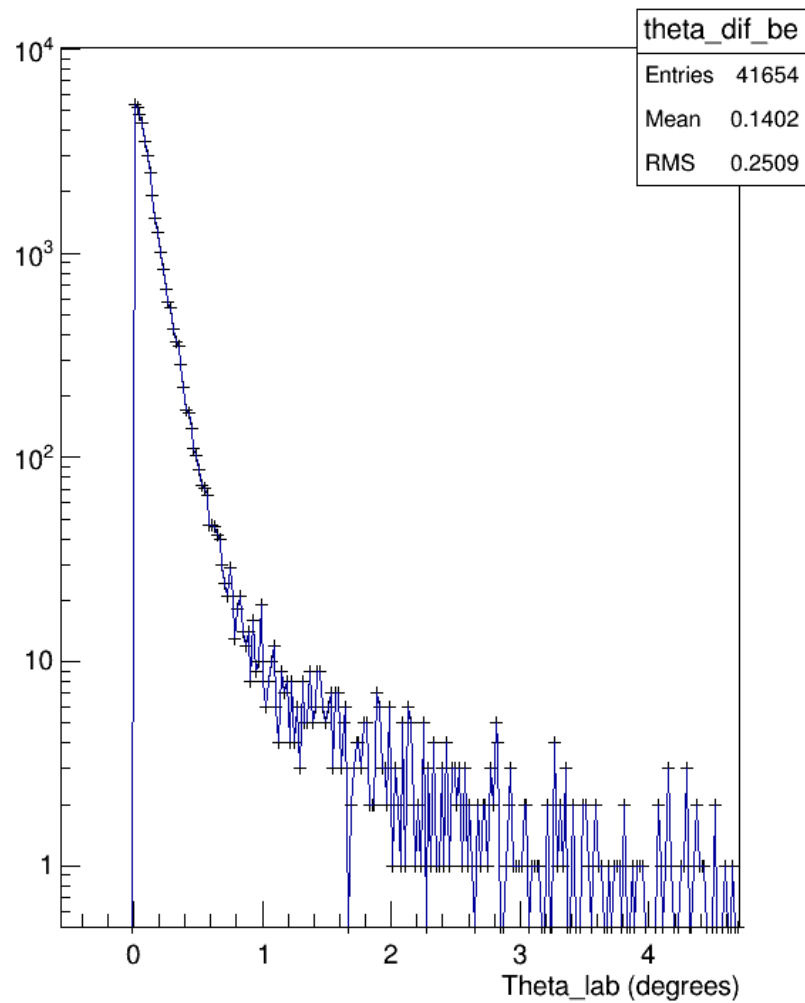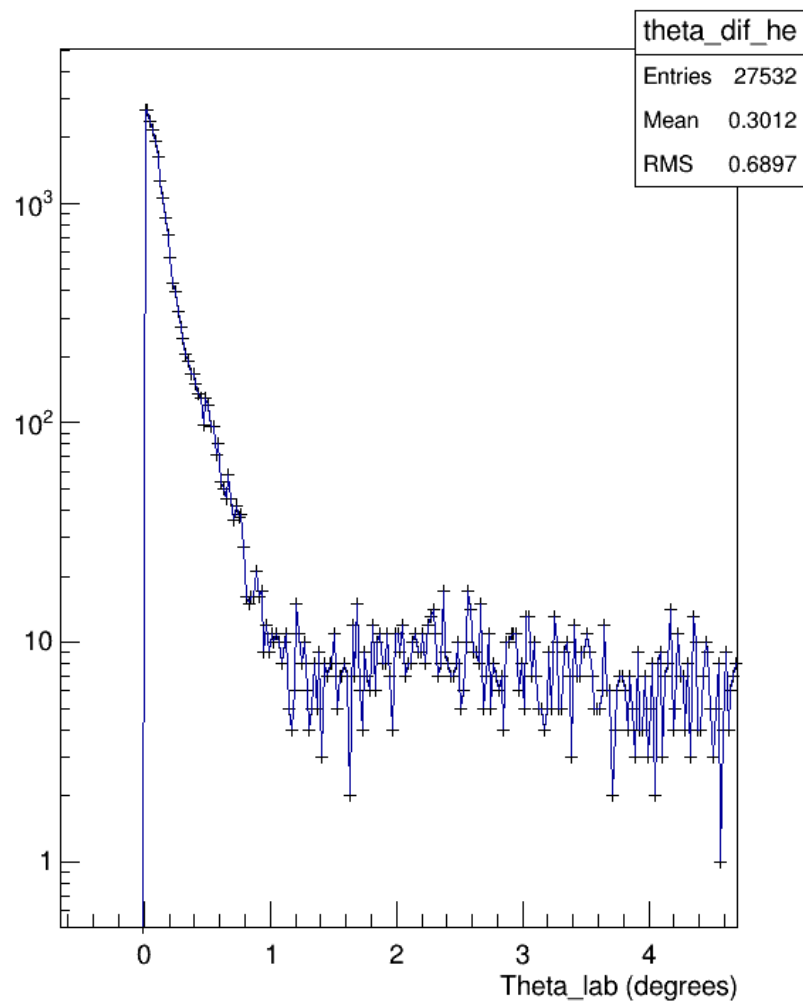
Conclusion

- We learnt how to use root and developed a lot of programming skills (save_cut.root);

- Analyses structure of a large-scale experiment with great number of detectors and variables and how to obtain useful information from it;

- It's still a work in progress.

Positions in the xy-plane in the first sst detector

hist_delta_x_delta_y_inicial	
Entries	72143
Mean x	-1.621
Mean y	-0.4775
RMS x	0.5331
RMS y	0.4817

Left panel:

$\frac{d\sigma}{d\Omega}(\theta)$

Legend: $p(^{11}\mathrm{Be},^{11}\mathrm{Be})p$, $p(^{8}\mathrm{Li},^{8}\mathrm{Li})p$

10^{3}
10
10^{-1}
10^{-3}
10^{-5}
10^{-7}

$0 \quad 30 \quad 60 \quad 90$

$\theta_{\mathrm{c.m.}}(\mathrm{deg.})$

Right panel:

$\frac{d\sigma}{d\Omega}(\theta)$

Legend: $p(^{11}\mathrm{Be},^{11}\mathrm{Be})p$, $p(^{8}\mathrm{Li},^{8}\mathrm{Li})p$

10^{3}
10
10^{-1}
10^{-3}
10^{-5}
10^{-7}

$0 \quad 2 \quad 4 \quad 6$

$\theta_{\mathrm{lab}}(\mathrm{deg.})$