# Simulation of Emulsion Cloud Chamber for the FOOT experiment

INFN_Napoli

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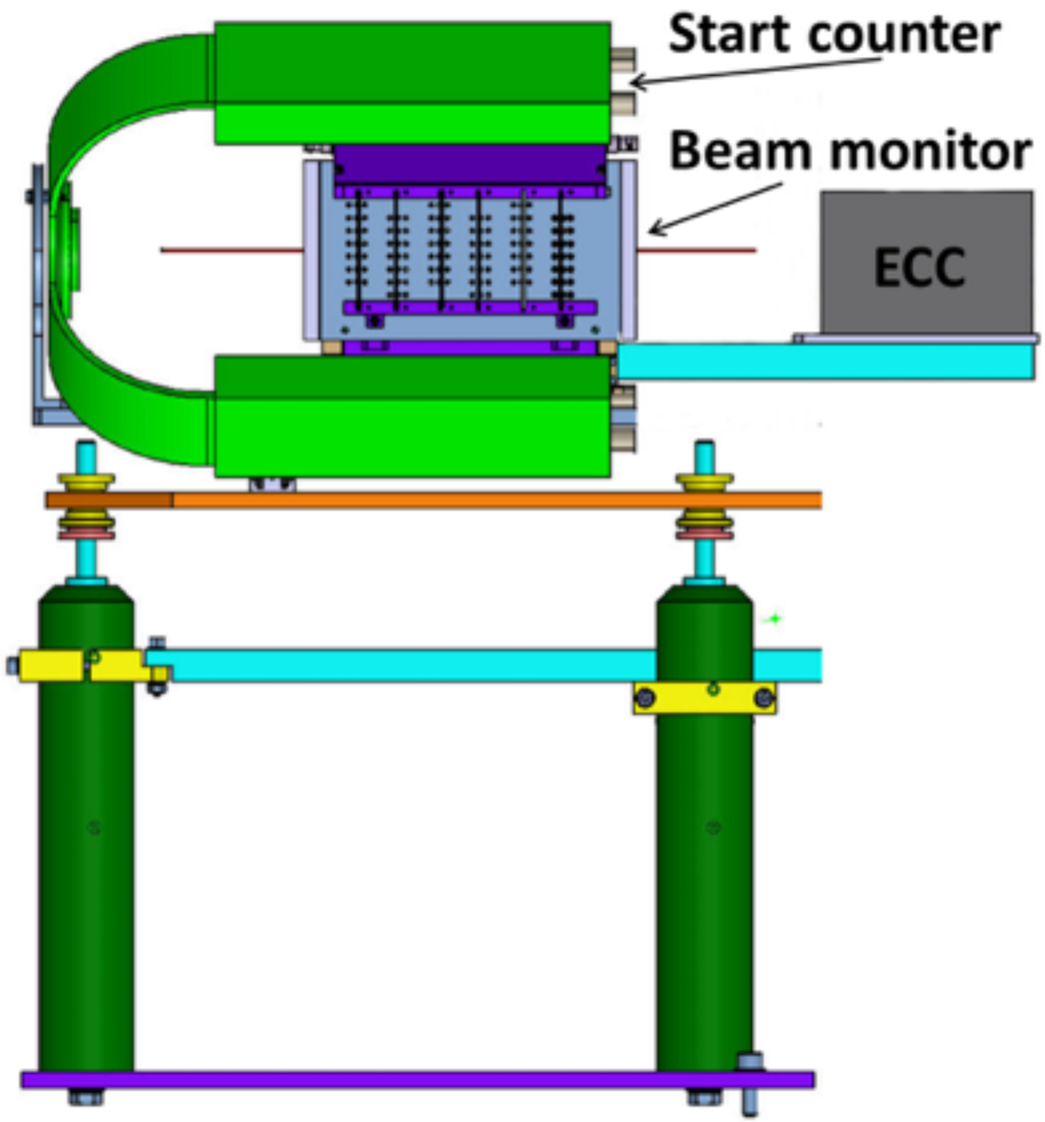
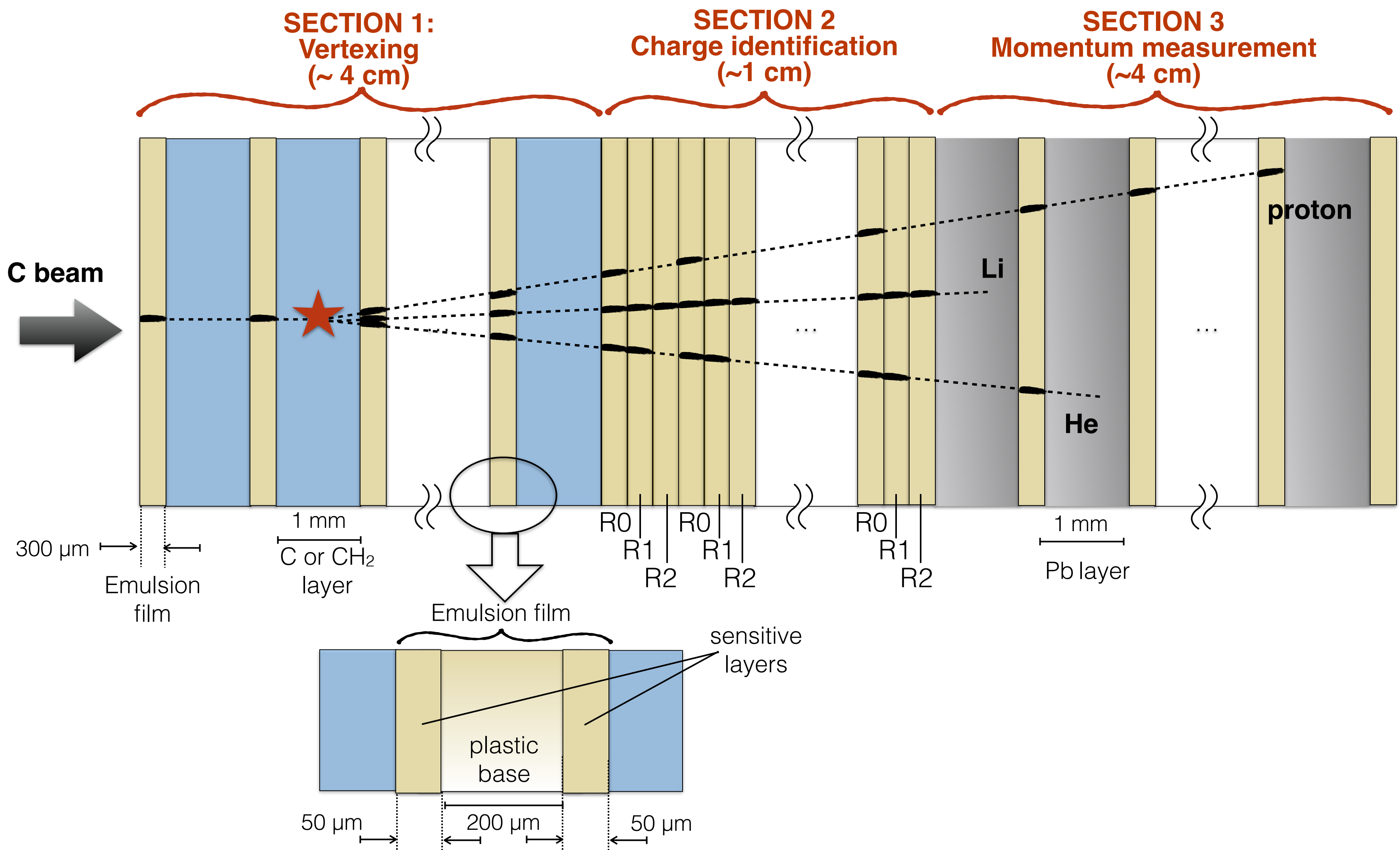
# Outline

- Detector structure
- FLUKA Simulation
- Preliminary results

# ECC setup

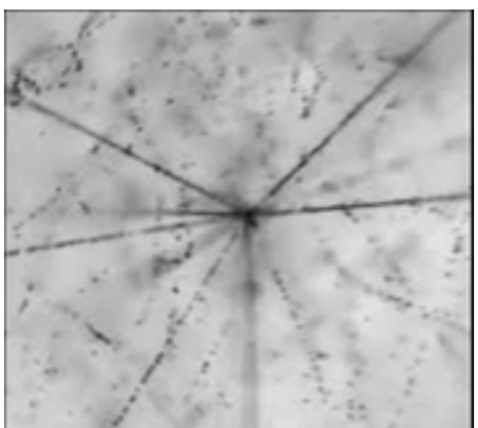


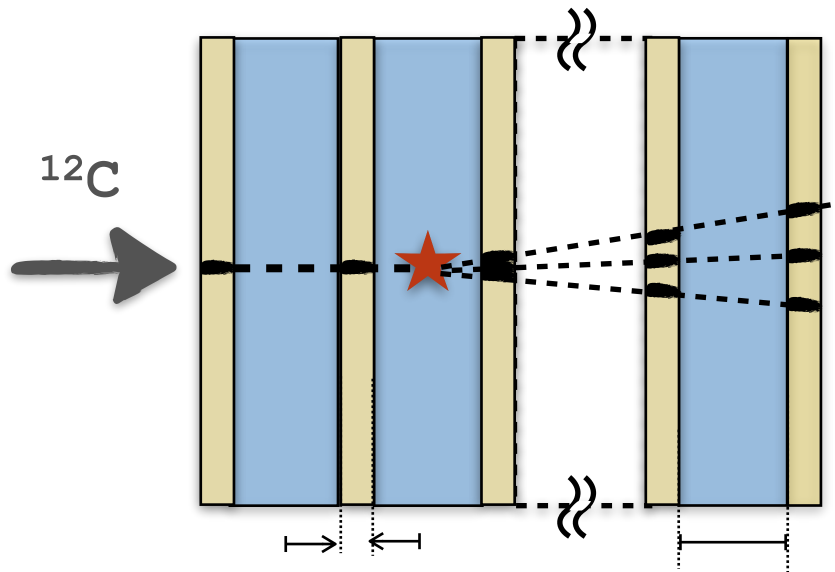
# Detector structure



# Detector structure: section 1

- Alternate target layers of C or $C_2H_4$ and emulsion
- Vertex detector and particle tracking
- Chamber thickness defined by the interaction length to obtain a sufficiently high number of interactions
- Total length ~ 30 cells = 39 mm

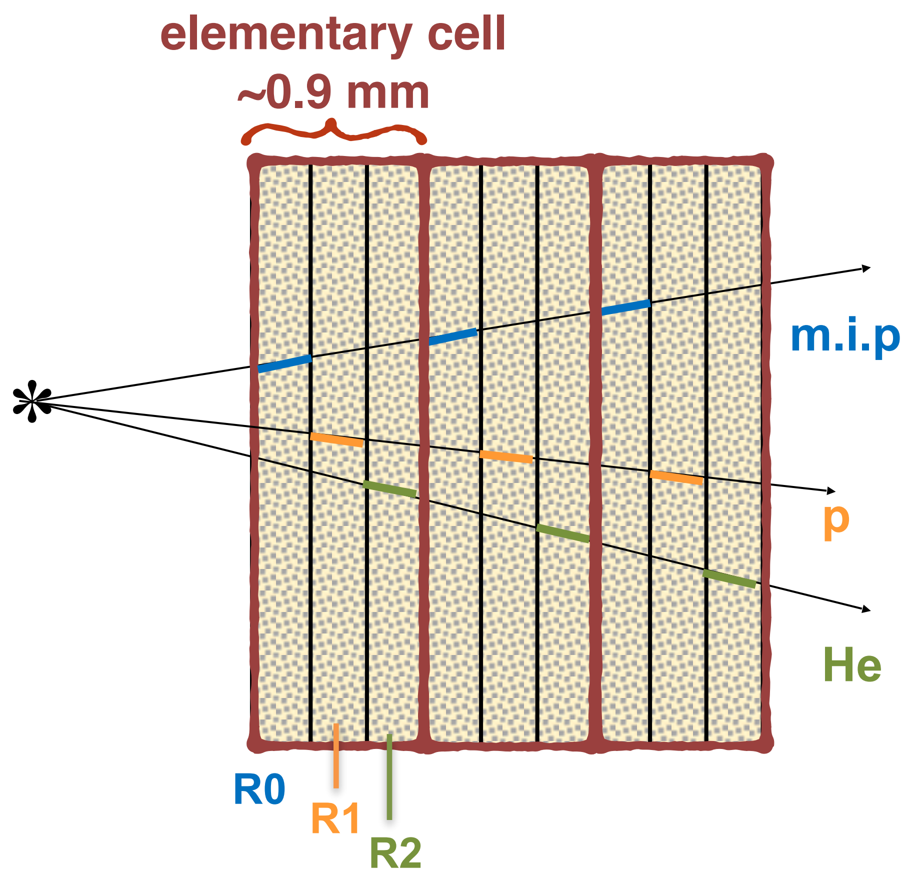




# Detector structure: section 2

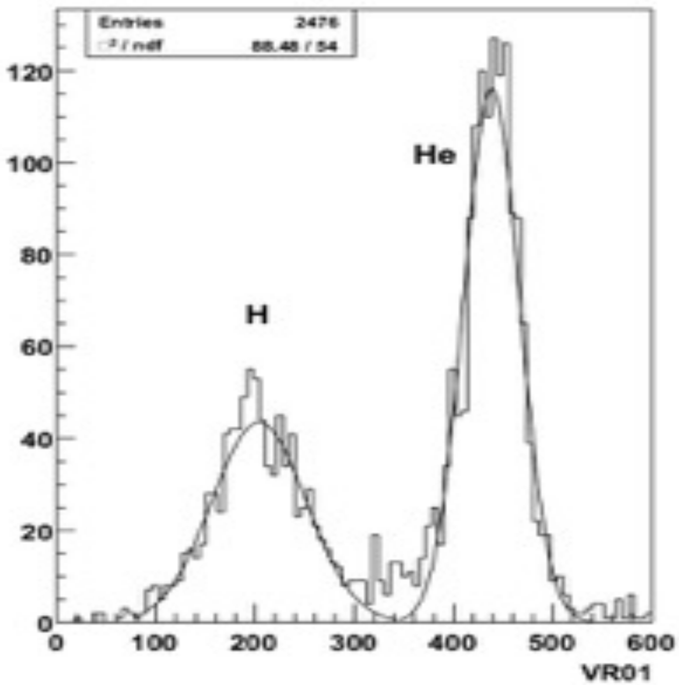
- Charge identification for low Z fragments (H, He, Li)
- Emulsion were differently treated after the exposure and before the chemical treatment according to their position in the elementary cell (0, 1, 2)

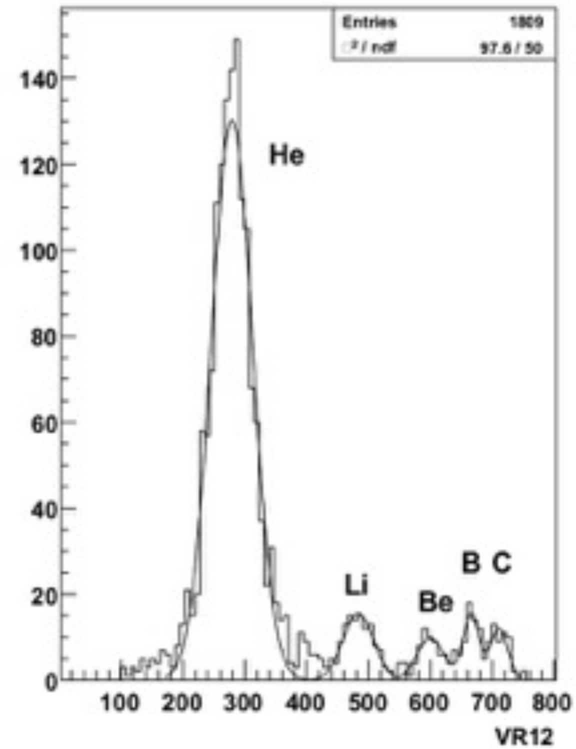
- **R0:**
  - Not refreshed
  - Developed soon after the exposure
  - **Sensitive to m.i.p.**
- **R1:**
  - Appropriate refreshing for protons
  - Insensitive to m.i.p.
  - **Sensitive to protons**
- **R2:**
  - Appropriate refreshing for He
  - **Sensitive to He**



# Detector structure: section 2

## Charge separation



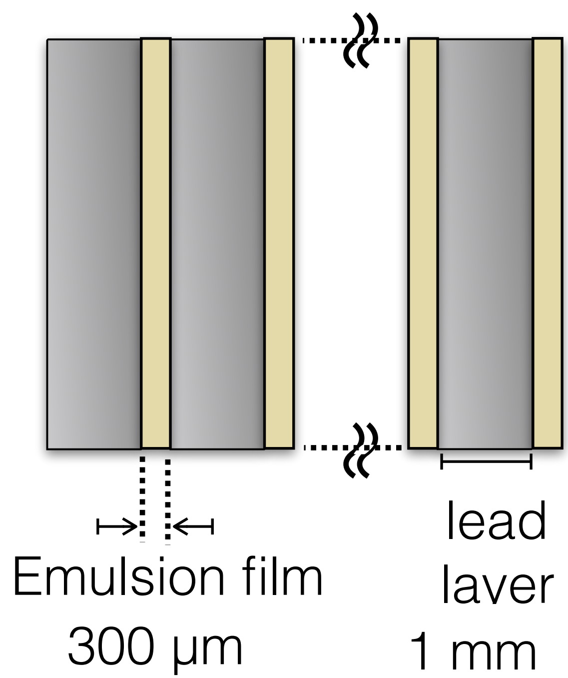

separation capability as function of elementary cells number

| Cells | 3 | 9 | 13 | 20 |
|---|---|---|---|---|
| H-He | 3.3 | 4.5 | 6.5 | |
| He-Li | 2.6 | 3.9 | 4.3 | 5.0 |
| Li-Be | 1.7 | 2.7 | 3.1 | 3.5 |

*JINST 2 (2007) P06004*

# Detector structure: section 3

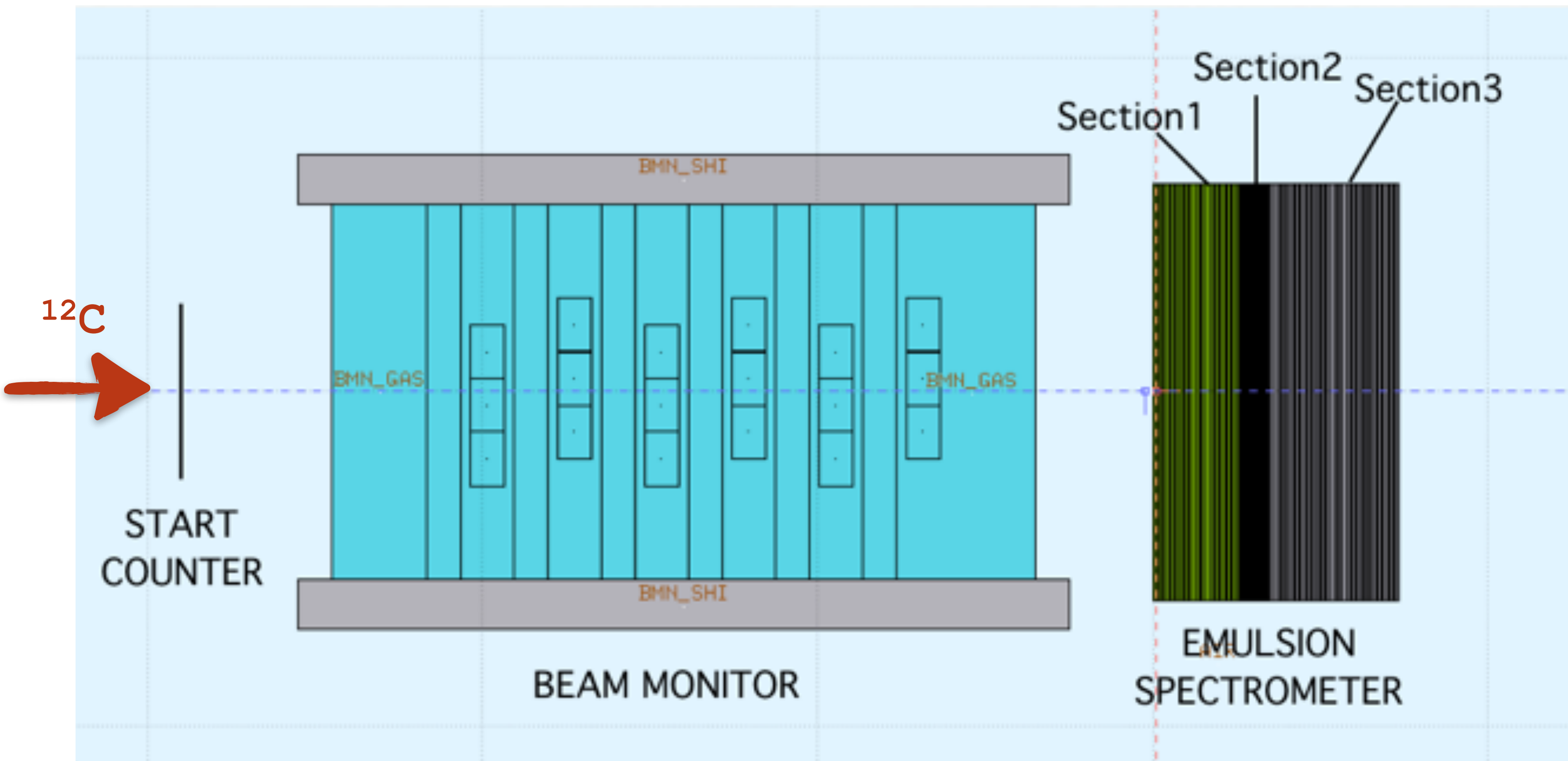
- Emulsion films interleaved with 1mm thick lead plates
- Lead plates from ~10 to ~50 according to the incident beam energy



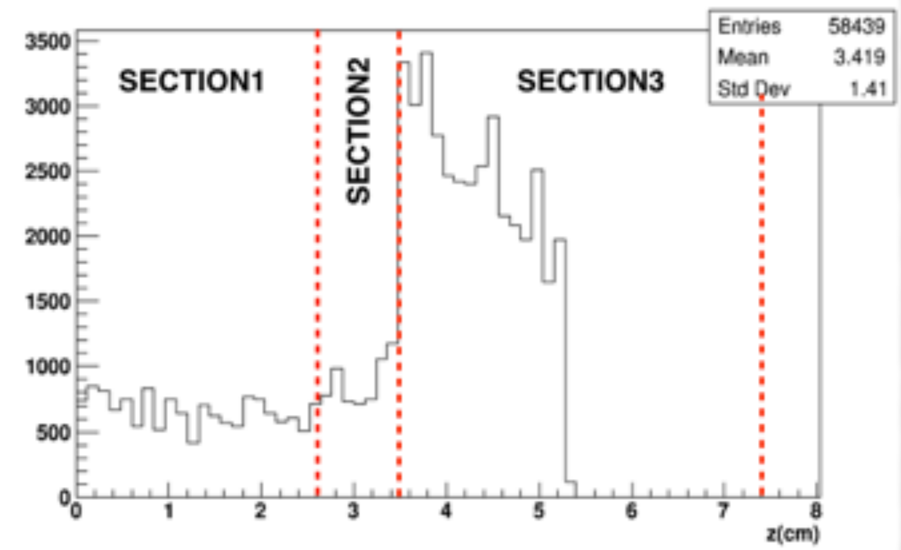
# FLUKA Simulation

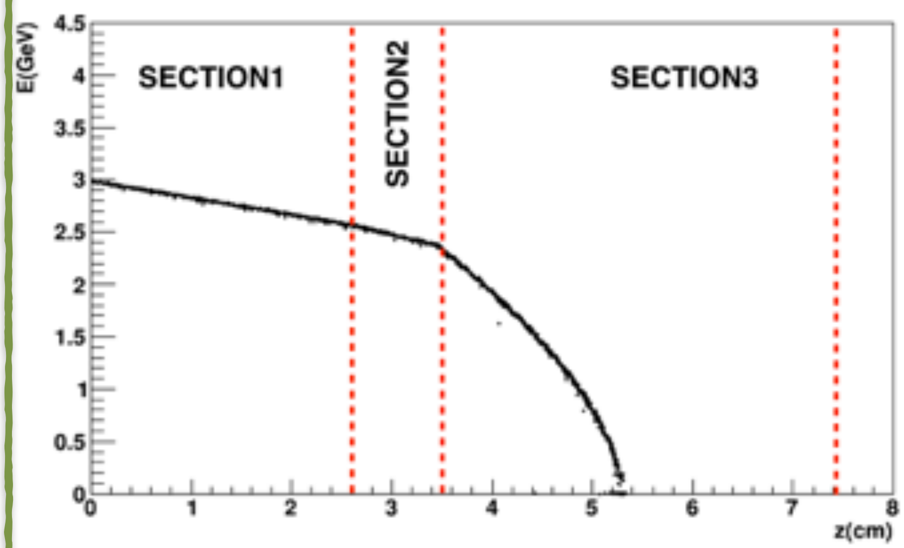
- $^{12}C$ beam (250 MeV/u)
- gaussian shape (FWHM 1 cm)

implemented by Giuseppe and Serena



# Preliminary results




Carbon interaction **vertices position** along the axis

**Final kinetic energy** of the carbon ions inside ECC as function of the depth.

not entering in the ECC: **~1%**

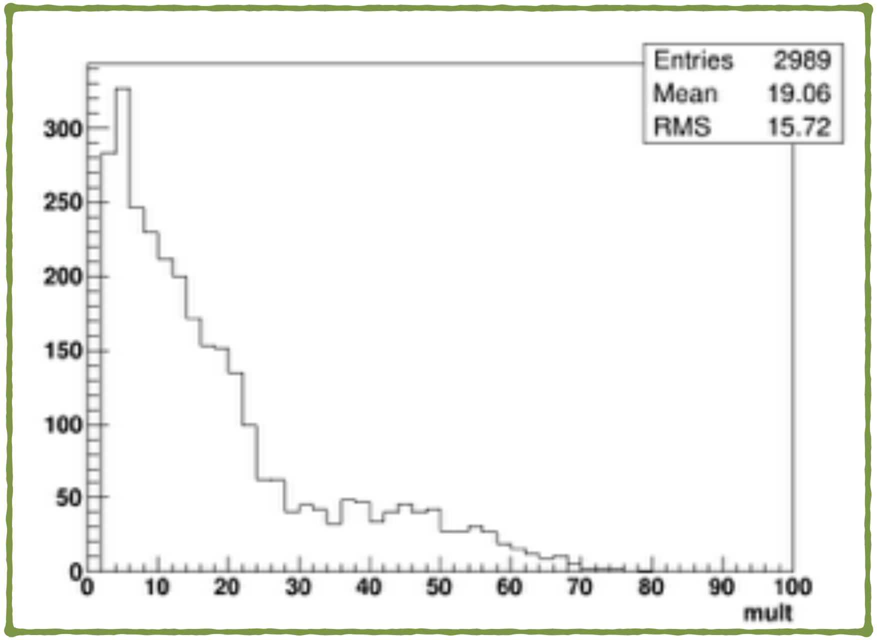
section **1**: **~13%**

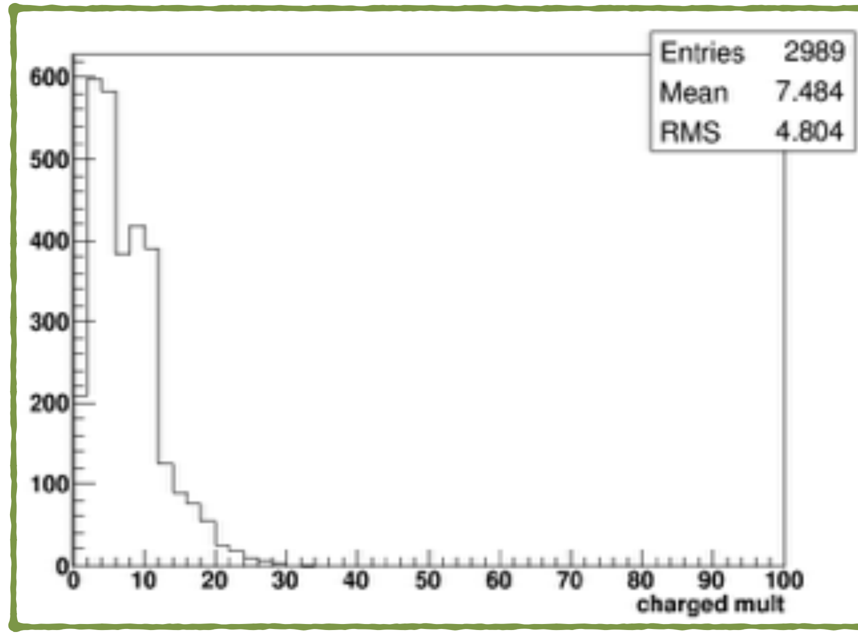
section **2**: **~4%**

section **3**: **~82%**

# Preliminary results

multiplicity

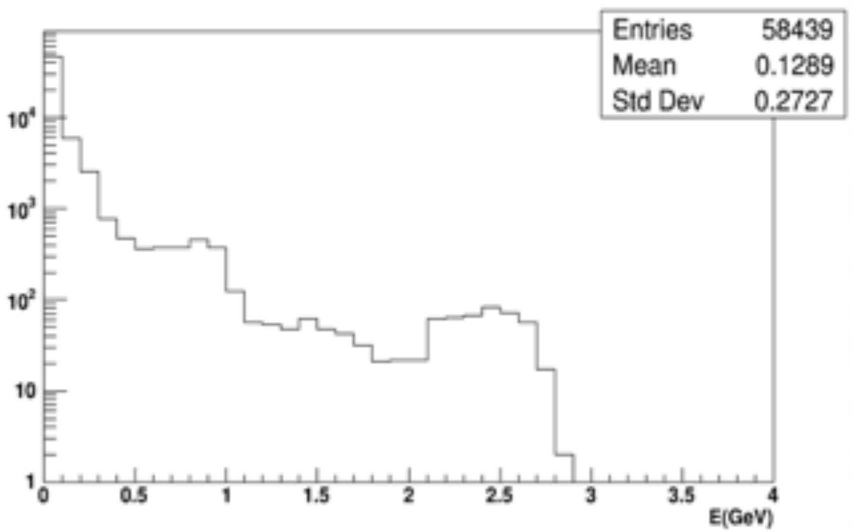


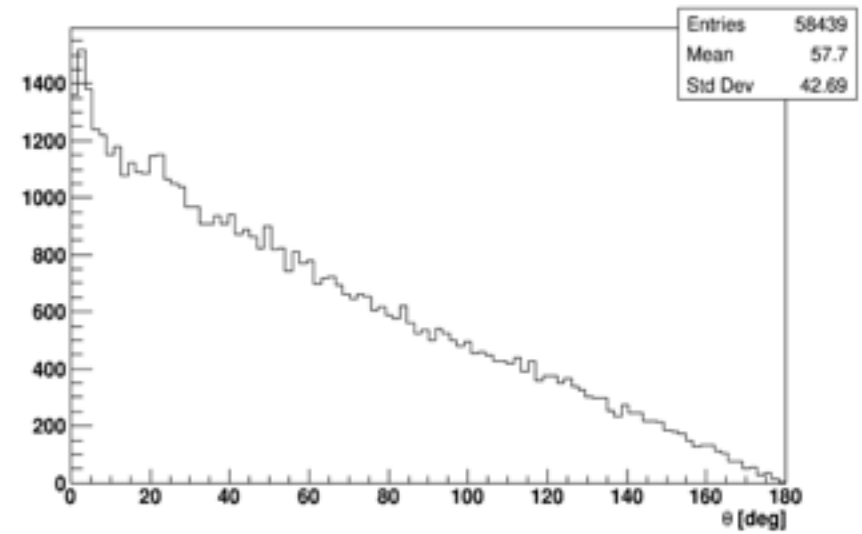




all fragments

e+, e- and
neutrals excluded

# Preliminary results




Kinetic energy distribution of fragments.

Angular distribution of fragments.

**Protons accounts ~87% of total fragments amounts**

# Future

Optimization of the three different sections in terms of passive material choose and total length

# Back up slides

# 2. Section 2: how many elementary cells for charge separation?

The standard deviation for the separation of pair of nuclei, as function of number of elementary cells, is reported in the table.

- 1 cell = 0.9 mm length
- E.g., to obtain a 3$\sigma$ He-Li separation, 9 cells are necessary, (total thickness ~8.1 mm)

| Cells | 3 | 9 | 13 | 20 |
|---|---|---|---|---|
| H-He | 3.3 | 4.5 | 6.5 | |
| He-Li | 2.6 | 3.9 | 4.3 | 5.0 |
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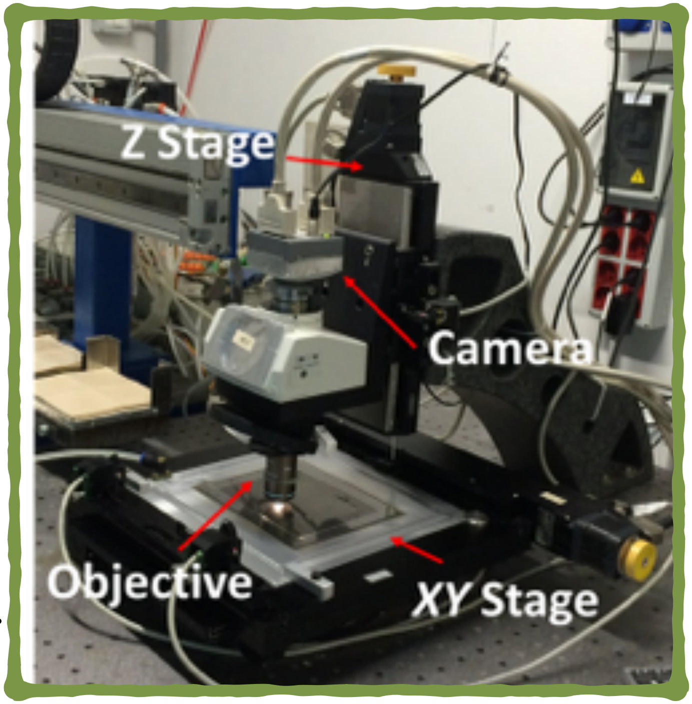
# Scanning system

**Scanning system characteristics:**

- **track reconstruction:** up to 72° (evaluated with respect a direction orthogonal to the emulsion plane)
- **speed:** increased from 40 $cm^2/h$ up to 190 $cm^2/h$
- software LASSO **Continuos Motion** mode





- *A. Alexandrov el al. "A new generation scanning system for the high- speed analysis of nuclear emulsions" JINST 11 (2016) 6002*
- *A. Alexandrov el al. "The continuos motion technique for the new generation scanning system" submitted to JINST (2017)*