

C-C400 Cave A measurment

Abstract

Parallel to FIRST beamtime at GSI in Cave C the usual biophysics dE/E setup was used to measure in Cave A with 400 MeV/u carbon on 5mm carbon target. The reason was, that it might be useful later and the setup was ready to run due to a beamtime before us. So this is just a short report what I can offer as results if somebody wants to use them and what I plan on doing with it.

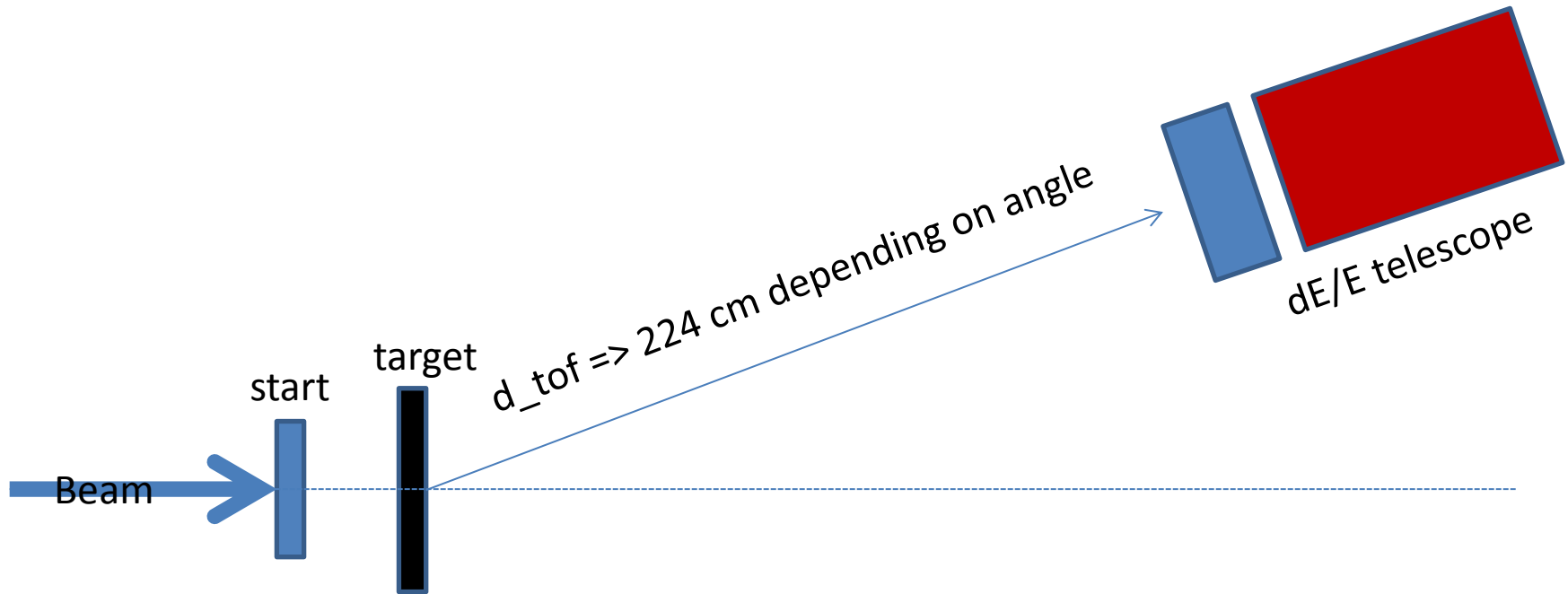
Note:

Setup was optimized for different target, so the results for the carbon target are not as good as they could have been.

Measurement description

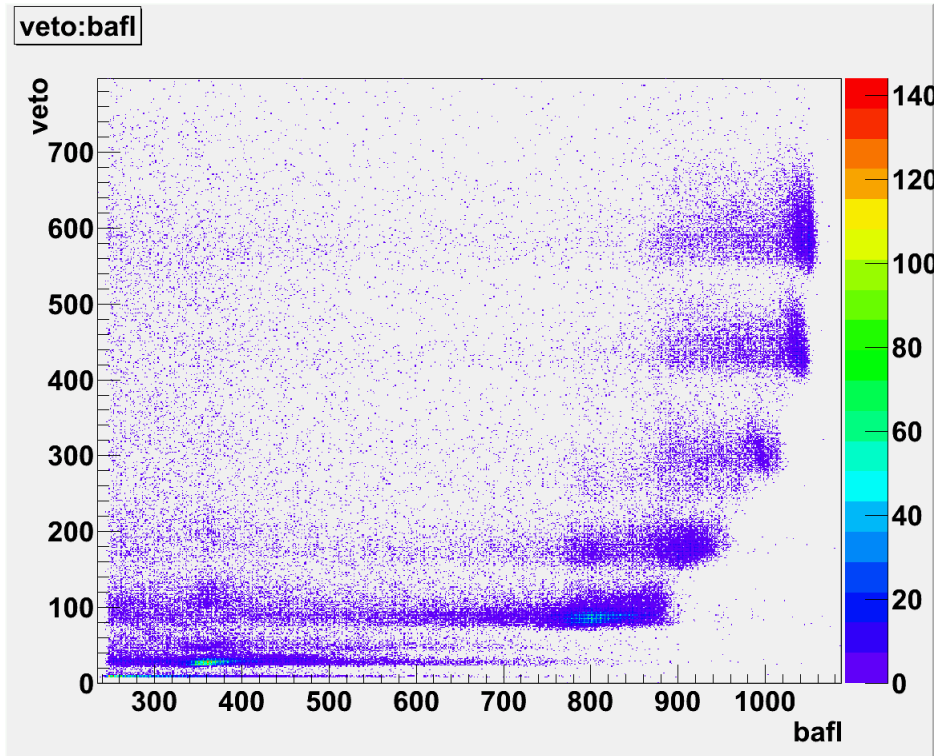
- Setup
 - 100*100*2mm BC400 start scintillator
 - hexagonal 9mm BC400 veto scintillator
 - hexagonal 140mm BaF_2 scintillator
- DAQ: Camac, MBS $\rightarrow \approx 500$ Hz max rate
- Trigger: BaF_2
- Techniques:
 - dE/E
 - inverse time-of-flight
- \rightarrow Yield of different charges + energie spectra

Measurment schematic



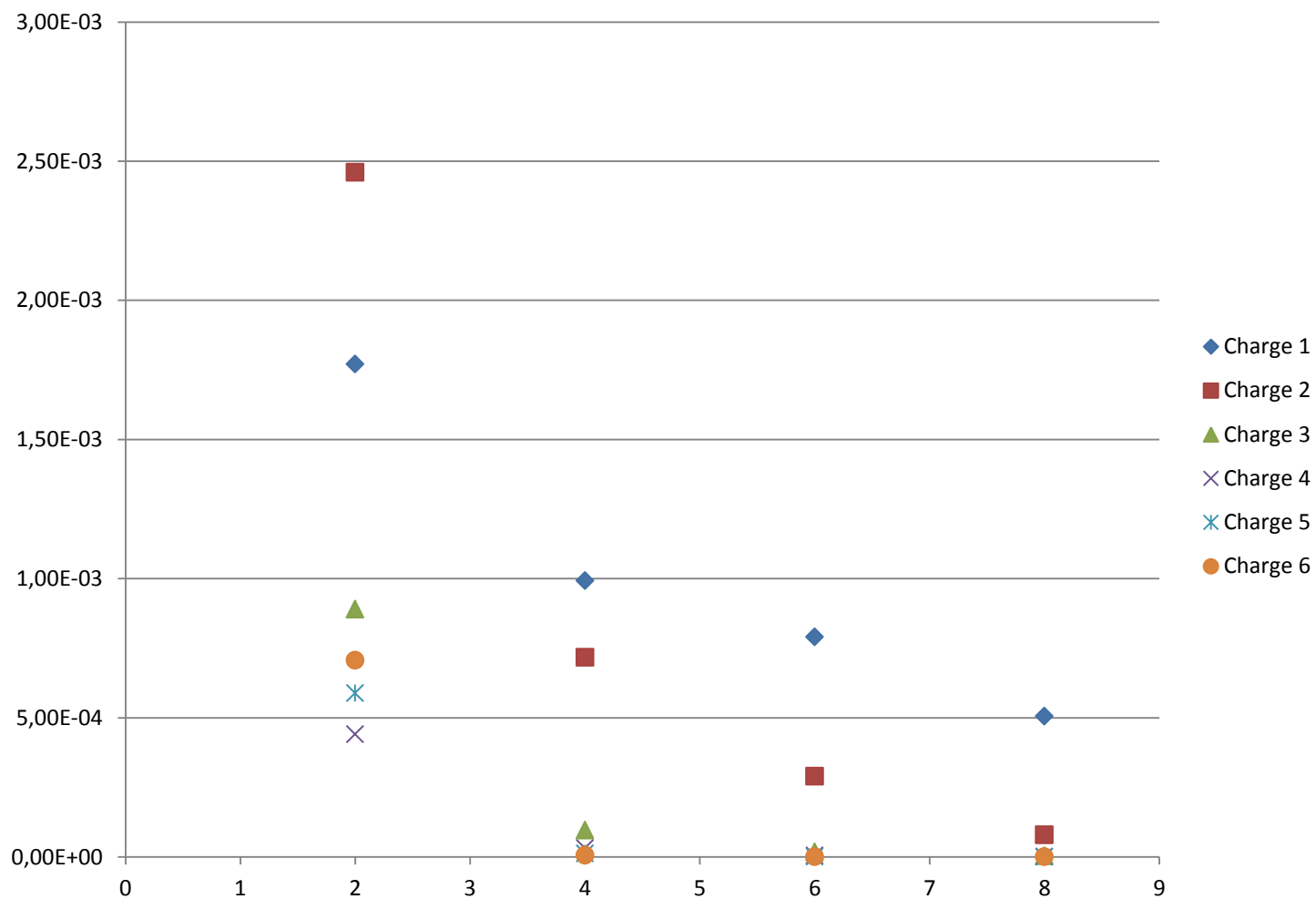
- target: 5mm carbon ($1,84 \text{ g/cm}^2$)
- angles measured:
 - 0,2,4,6,8 checked and usable
 - 15,20 not checked yet
- tof calibration done in beam 0 deg no target

Analysis



- 150k – 200k usefull events per file
- charge id based on dE/E
 - typical events id'ed: > 95%
- typical time resolution $\approx \pm 500$ ps
 - with walk correction applied
- no neutron spectra due to irradiation of the optical stand in Cave A -> charged particles are okay

Yields



Yields (comparison PHITS)

| Yield [msr ⁻¹ source ⁻¹] | angle [deg] | | | | | | |
|---|-------------|----------|----------|----------|----------|----------|----------|
| charge | experiment | 1 | 2 | 3 | 4 | 5 | 6 |
| | 0 | x | x | x | x | x | x |
| cave a | 2 | 1,77E-03 | 2,46E-03 | 8,90E-04 | 4,40E-04 | 5,88E-04 | 7,06E-04 |
| | 4 | 9,92E-04 | 7,17E-04 | 9,55E-05 | 3,11E-05 | 1,20E-05 | 5,37E-06 |
| | 6 | 7,90E-04 | 2,90E-04 | 1,77E-05 | 5,08E-06 | 5,87E-07 | 0,00E+00 |
| | 8 | 5,05E-04 | 7,93E-05 | 3,75E-06 | 2,80E-07 | 0,00E+00 | 0,00E+00 |

| Yield [msr ⁻¹ source ⁻¹] | angle [deg] | | | | | | |
|---|-------------|----------|----------|----------|----------|----------|----------|
| charge | phits | 1 | 2 | 3 | 4 | 5 | 6 |
| | 0 | 1,30E-01 | 3,23E-02 | 2,40E-03 | 1,58E-03 | 3,02E-03 | 7,23E-01 |
| | 2 | 3,03E-03 | 2,38E-03 | 1,95E-04 | 1,18E-04 | 2,35E-04 | 1,26E-03 |
| | 4 | 1,44E-03 | 7,46E-04 | 4,53E-05 | 2,11E-05 | 1,13E-05 | 7,14E-06 |
| | 6 | 7,95E-04 | 1,56E-04 | 2,72E-06 | 9,07E-07 | 3,78E-08 | 7,56E-08 |
| | 8 | 4,74E-04 | 2,48E-05 | 1,25E-07 | 0,00E+00 | 0,00E+00 | 0,00E+00 |

Note:

- mean measurement error $\approx 2\%$
- leading-Z analysis can lead to underestimation of lower charges especially for small angles
- PHITS simulation with simplified

Differential cross section

| cross section [sr ⁻¹ source ⁻¹ barn] | angle [deg] | | | | | | |
|--|-------------|----------|----------|----------|----------|----------|----------|
| charge | experiment | 1 | 2 | 3 | 4 | 5 | 6 |
| | 0 | x | x | x | x | x | 8,35E+03 |
| cave a | 2 | 1,92E+01 | 2,67E+01 | 9,65E+00 | 4,77E+00 | 6,37E+00 | 7,65E+00 |
| | 4 | 1,08E+01 | 7,77E+00 | 1,04E+00 | 3,37E-01 | 1,30E-01 | 5,82E-02 |
| | 6 | 8,56E+00 | 3,14E+00 | 1,92E-01 | 5,51E-02 | 6,36E-03 | 0,00E+00 |
| | 8 | 5,47E+00 | 8,60E-01 | 4,06E-02 | 3,04E-03 | 0,00E+00 | 0,00E+00 |

| cross section [sr ⁻¹ source ⁻¹ barn] | angle [deg] | | | | | | |
|--|-------------|----------|----------|----------|----------|----------|----------|
| charge | experiment | 1 | 2 | 3 | 4 | 5 | 6 |
| | 5 | 7,63E+00 | 4,22E+00 | 2,20E-01 | 5,40E-02 | 0,00E+00 | 0,00E+00 |
| zeitlin 2008 et al | 10 | 4,17E+00 | 6,10E-01 | 1,10E-02 | 3,00E-03 | 0,00E+00 | 0,00E+00 |

Note:

- Zeitlin et al. 400 MeV/u carbon on 5mm carbon target with density 2 g/cm²

Status

- Analysis of 0,2,4,6,8
 - finished for Yields finished
 - for Energy have to still do the walk correction
- comparison with monte carlo
 - PHITS done
 - Geant4 is running for all angles
 - FLUKA simulations ?

What to do with it?

- get a feeling how good the estimates of monte carlo are with our target – beam combination?
- comparison possible by putting solid angle constraints on the FIRST setup using the VTX?
- other ideas?