Beam Calculations Status Report

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H4: Updated Layout

Total line length from TVLE up to the end of the last bending magnet : **25.871 m**
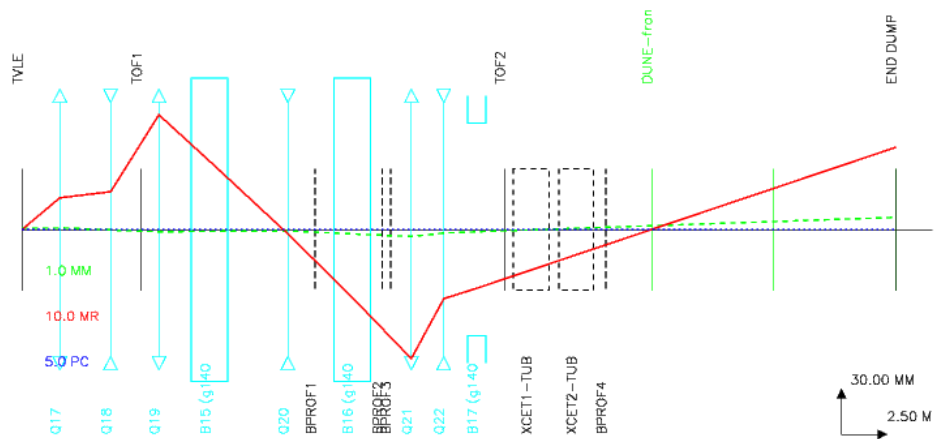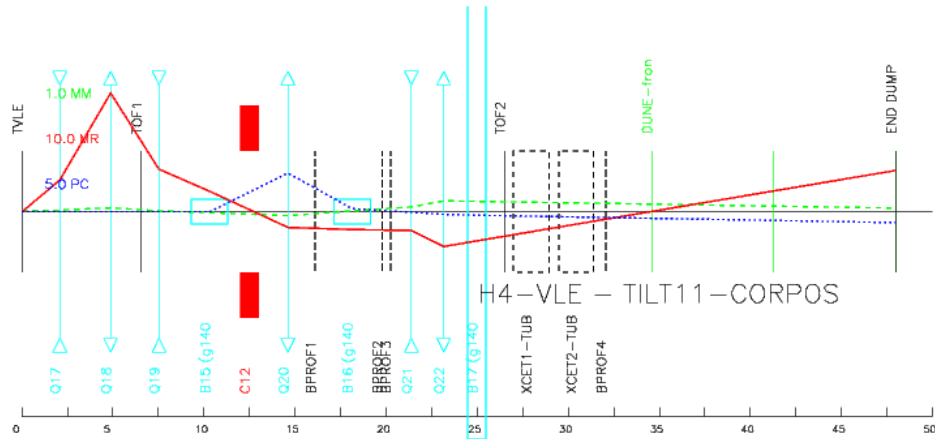Distance between target – experiment : **34.561 m (to be verified soon)**

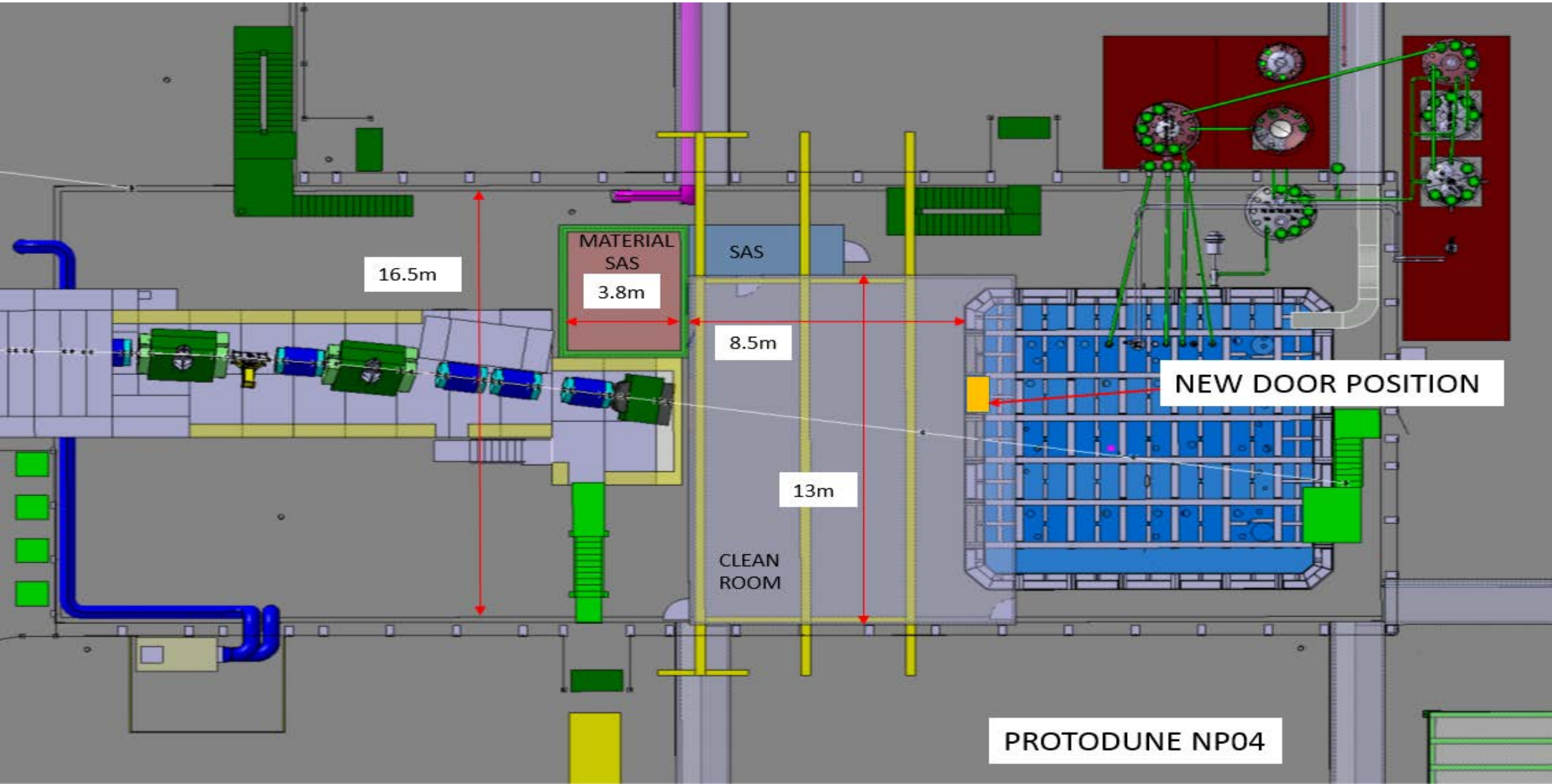To be discussed asap with integration teams :
→ Exact position of the "ProtoDune – SP" experiment wrt to the last bend
→ Angles of interaction of the beam with the detector and 'entry windows'.

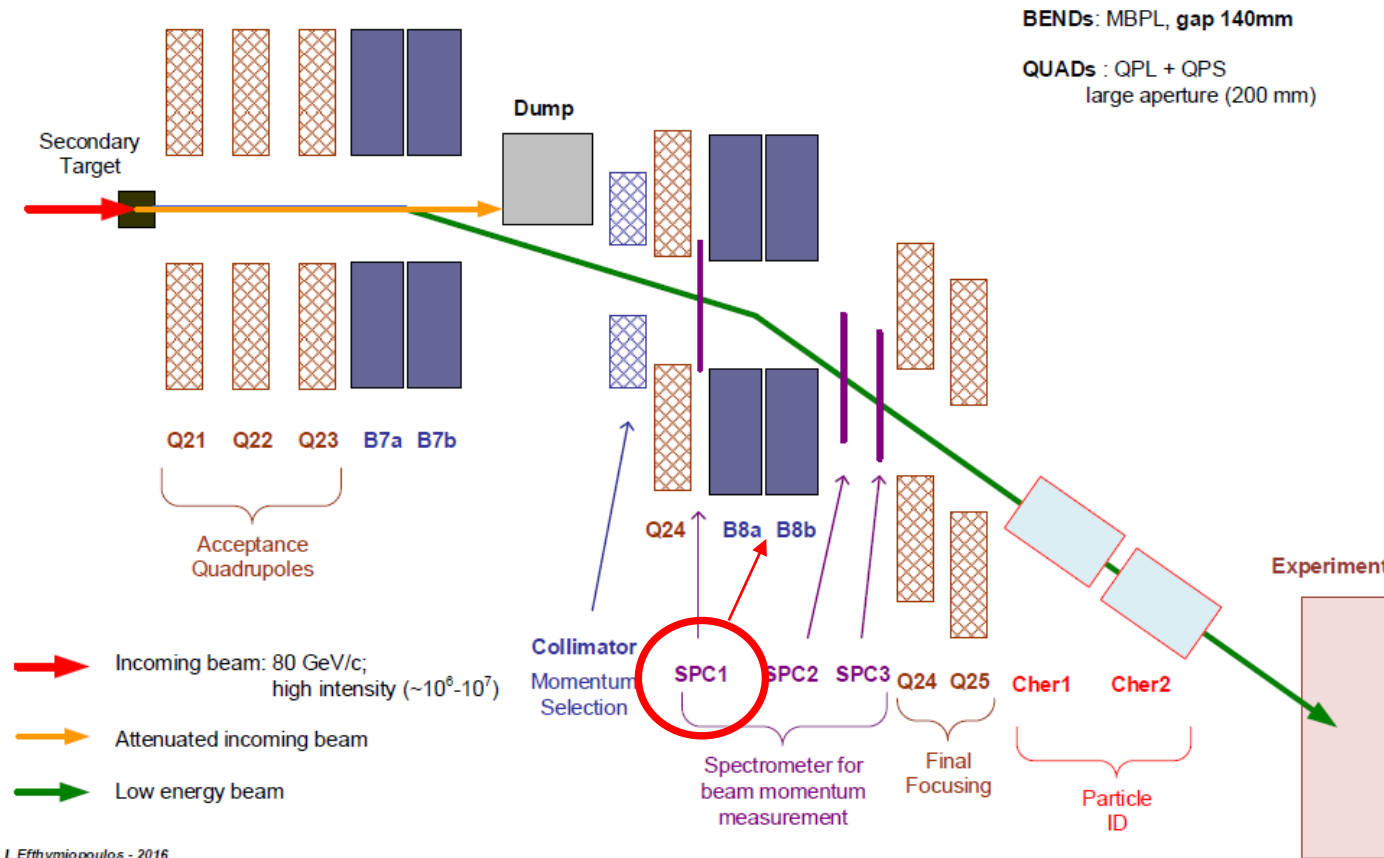TOF counters of dz=10 cm can be placed @ **6.619 & 26.550** m from the target ('TOF1' & 'TOF2')

Integration

H2 beam line – spectrometer positions

EHN1 Extension - H2 VLE Beam
Schematic Layout

BENDs: MBPL, **gap 140mm**

QUADs : QPL + QPS
large aperture (200 mm)

Secondary Target

Dump

Q21   Q22   Q23   B7a   B7b

Acceptance Quadrupoles

Q24   B8a   B8b

Collimator
Momentum Selection

SPC1   SPC2   SPC3   Q24   Q25   Cher1   Cher2   Experiment

Spectrometer for beam momentum measurement

Final Focusing

Particle ID

Incoming beam: 80 GeV/c;
high intensity (~10^6-10^7)

Attenuated incoming beam

Low energy beam

I. Efthymiopoulos - 2016

Spectrometer positions from the B8b **center** :

BPROF1: 2.004 m
BPROF2: 1.718 m
BPROF3: 2.782 m

Assumed nominal energy: **12 GeV**, more energies to follow

Two equivalent geometrical approaches – same results. x1, x3, x4 the position measurements.

- 1. I. Efthymiopoulos, A. Fabich (2005) -

2. N. Charitonidis, Y. Karyotakis (2016)

$$\theta = \cos^{-1} \frac{L_1(L_4 - L_3) + (\frac{x_3 L_4 - x_4 L_3}{L_4 - L_3} - x_1 - L_1 \tan\theta_0)(x_4 - x_3)}{\sqrt{L_1^2 + (\frac{x_3 L_4 - x_4 L_3}{L_4 - L_3} - x_1 - L_1 \tan\theta_0)^2}\sqrt{(L_4 - L_3)^2 + (x_4 - x_3)^2}}$$
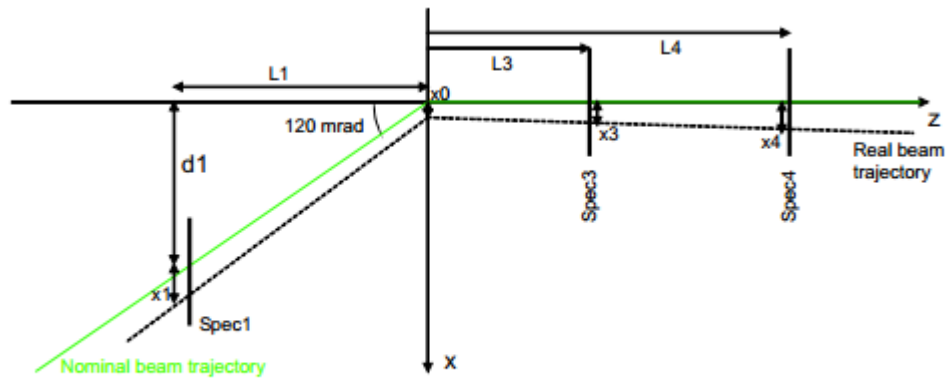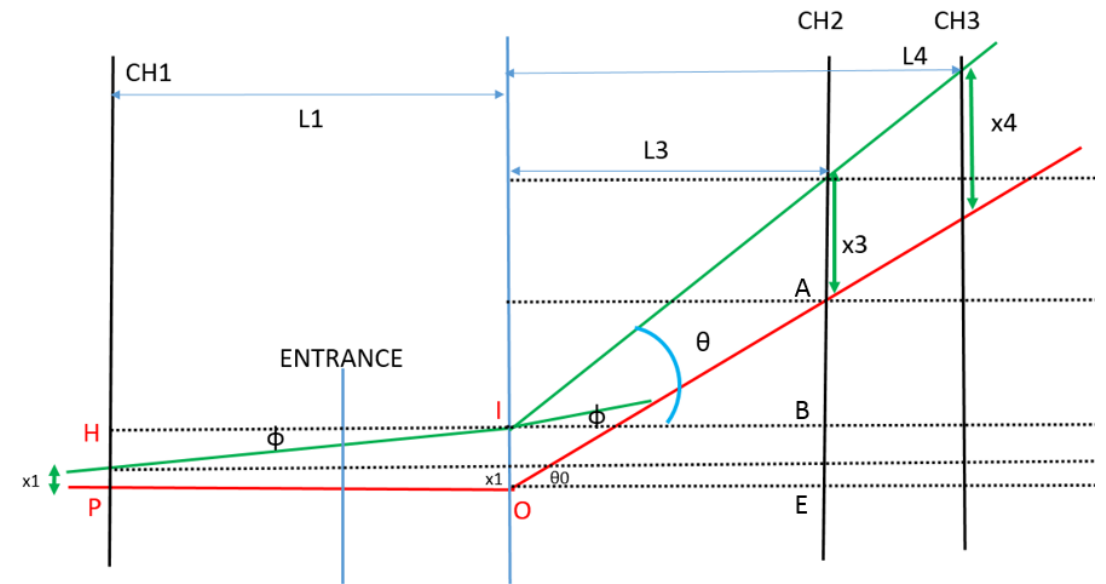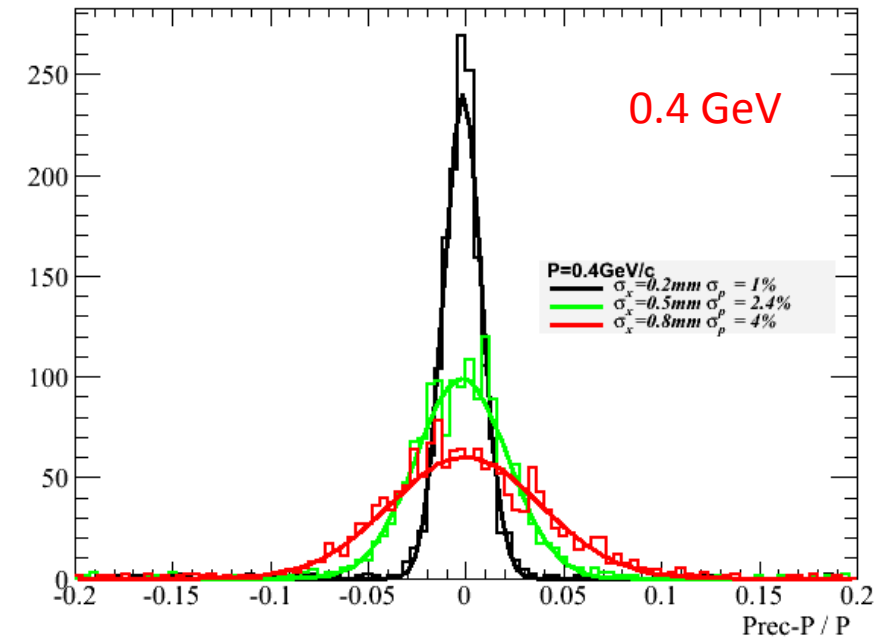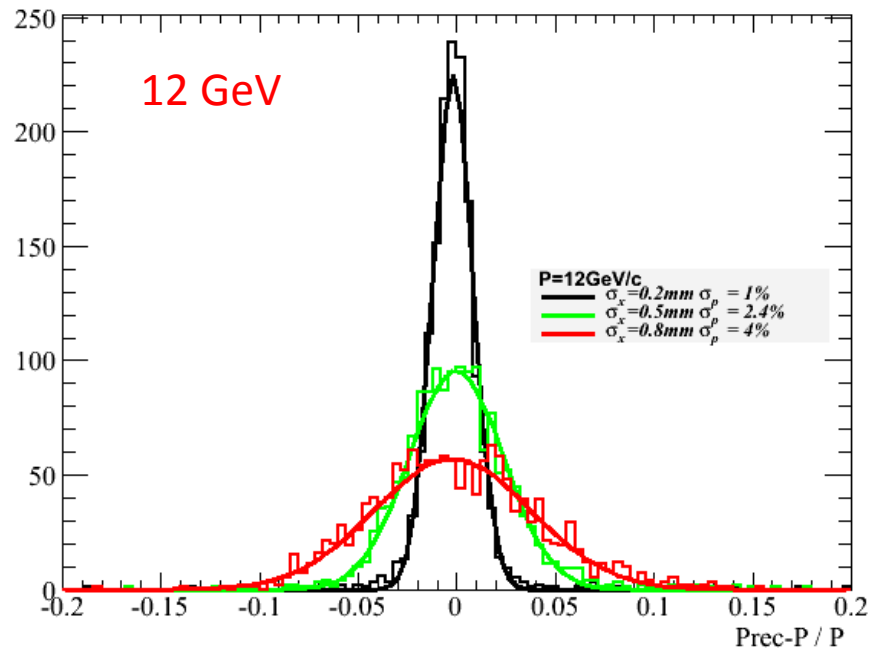
Figure 6: *Geometry of the VLE spectrometer for momentum analysis.*

$$\theta = \text{ArcTan}(\frac{x3 + AB}{L3})$$

Results

Full Simulation from GEANT4. Extracted x1, x3 and x4 used in the reconstruction.

No difference between the different energies since no windows etc are implemented in the simulation
→ Ongoing work

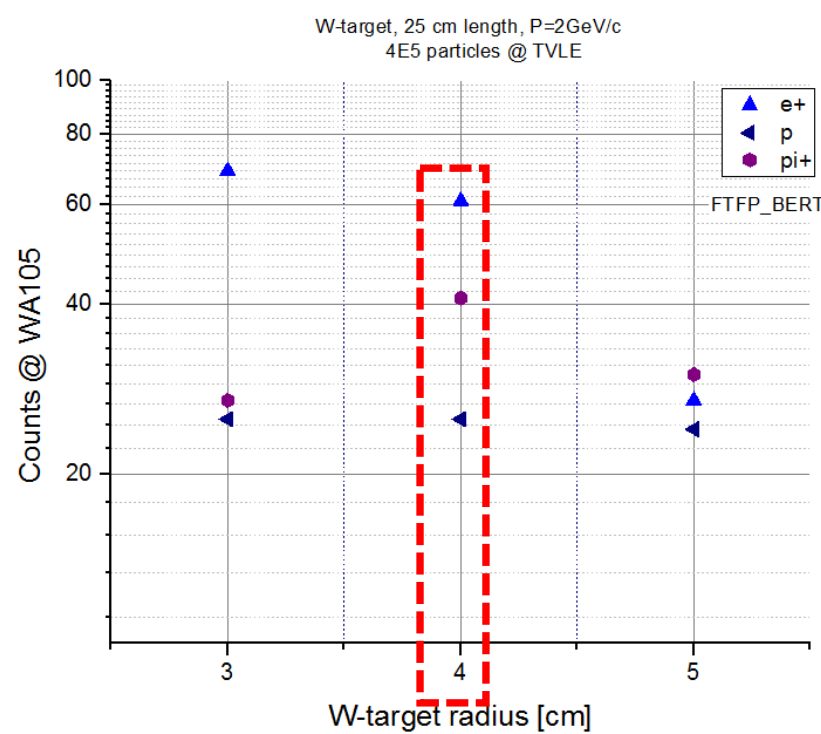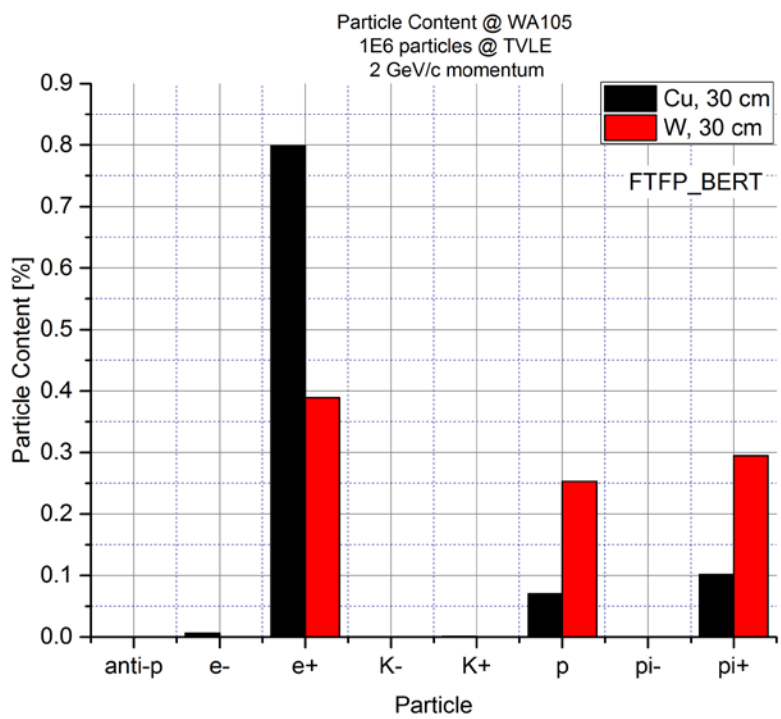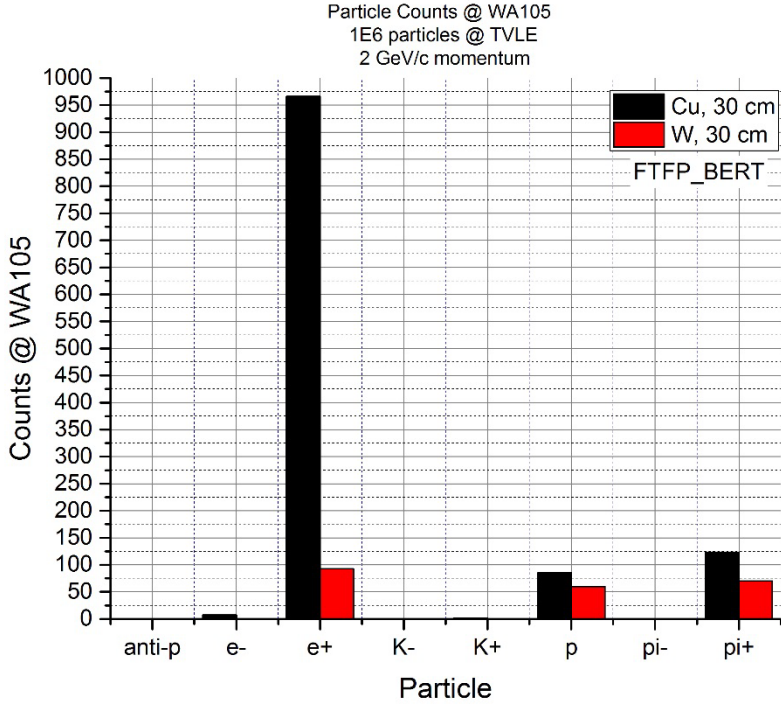# Effect of multiple scattering in low energies (L. Gatignon :)

AT 5 geV/c the vertical spot had an RMS of 7 to 8 mm.....

Lau

The material interacting with the beam must be kept in <u>absolute minimum</u> !!!

Target optimization – W 30 cm, 4 cm radius looks favorable in terms of efficiency for the low energies

The end.

- Thank you !