(d,p) with extended gas target

basic motivation

- D2   2 electrons

  CD_2 8 electrons

  Factor 4 in energy loss or countrate

- No background from C

- Measure depth in target, where reaction occurs

  Gives beam energy for reaction

  Target might be very thick

- Other reactions, other targets, He

Density of hydrogen 0.090 g/l or 0.090 mg/cm^3.

300 MeV ^{96}Zr loose 144 MeV in 1 mg/cm^2 hydrogen.
Then 300 MeV ^{96}Zr loose 72 MeV in 1 mg/cm^2 deuterium.

400 MeV ^{132}Sn loose 180 MeV in 1 mg/cm^2 hydrogen.
Then 400 MeV ^{132}Sn loose 90 MeV in 1 mg/cm^2 deuterium.

1 mg/cm^2 hydrogen corresponds to 11.1 cm at atm. pressure.

therefore 1 cm correponds to 13 rsp. 16 MeV energy loss for the two beams.

for deuterium the density is twice as high, but talking per length, nothing changes.

Angular straggling in ΔE detector

SRIM calculations give:

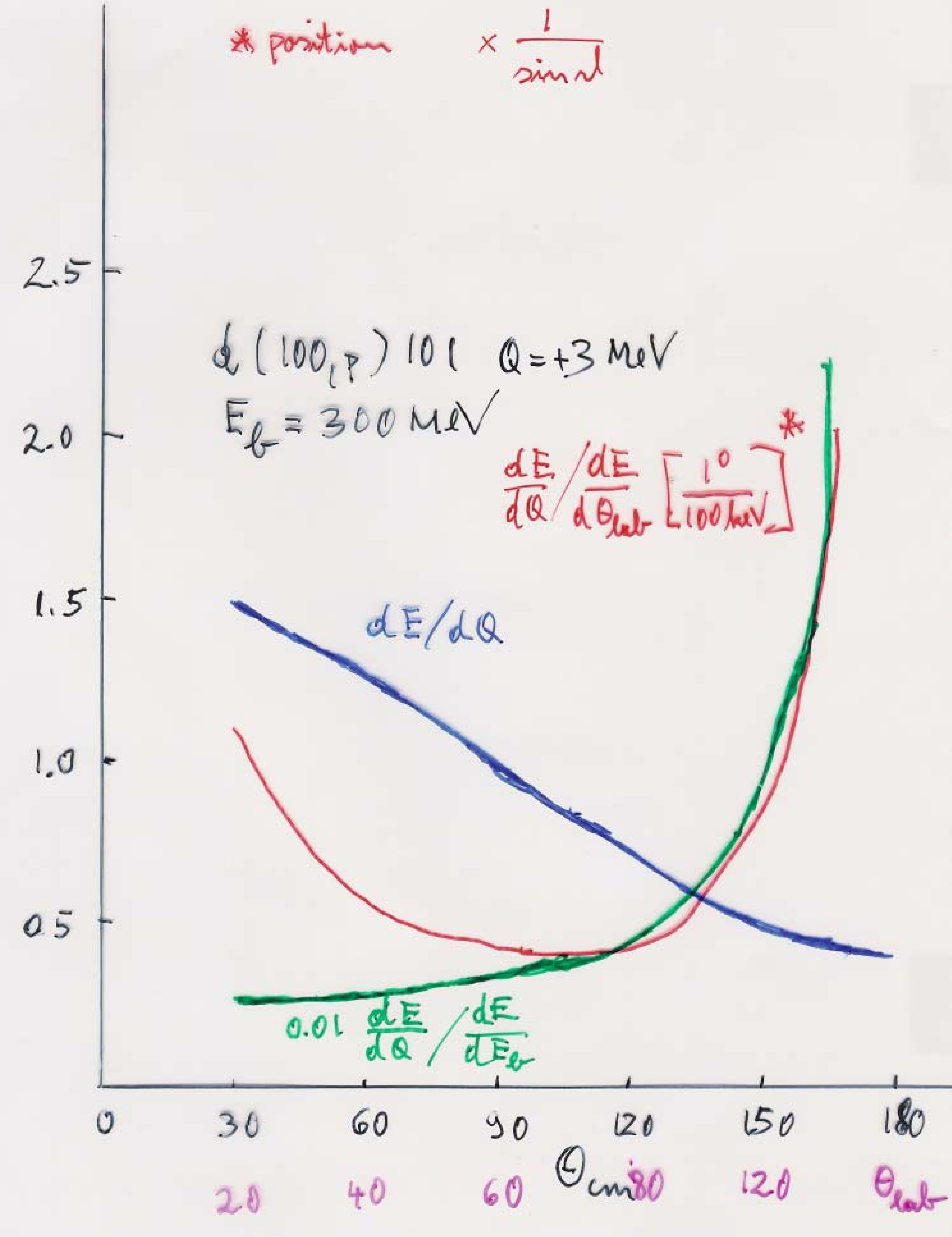
3 MeV protons after 65 mu Si FWHM 110 mrad or 6 deg

5 MeV protons after 70 mu Si FWHM 50 mrad or 3 deg

10 MeV protons after 80 mu Si FWHM 20 mrad or 1 deg

20 MeV protons after 130 mu Si FWHM 20mrad or 1 deg

This is an important contribution, that also limits this approach to forward angles in the lab.



* position × 1/sin α
2.5
2.0
1.5
1.0
0.5
d (100, p) 101 Q = +3 MeV
E_b = 300 MeV
dE/dQ / dE/dθ_lab [1°/100 keV]*
dE/dQ
0.01 dE/dQ / dE/dE_b
0
30
60
90
120
150
180
θ_cm
20
40
60
80
120
θ_lab

Mechanics

- 5 μ Mylar should be ok and easy

  ΔE=100 keV for 3 MeV p

- 65 μ Si is available $\leq$ 1mm resolution

  means 5 cm between detectors

  .1 mm allows smaller size, Si drift detectors?

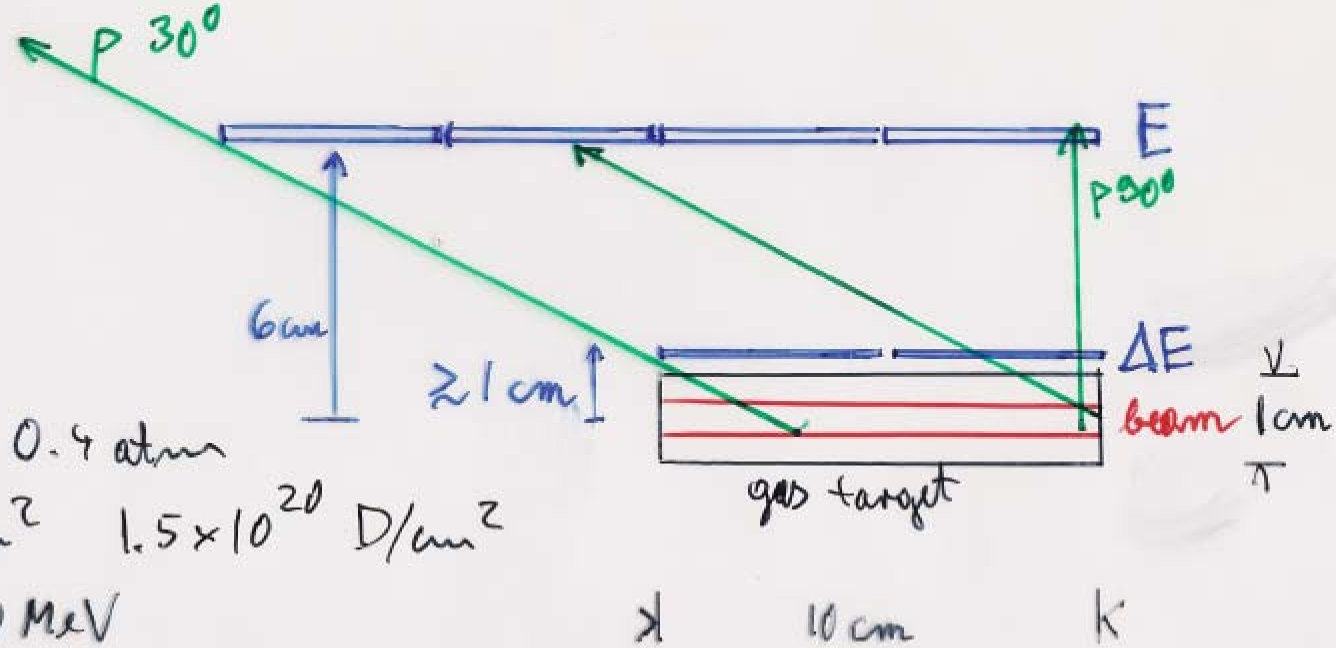
  5 mm resolution in ϕ is sufficient

  ΔE=1.7 MeV at 3 MeV, 2$\times$0.3 MeV at 20 Mev

- at 30 deg 1.035+0.065 mm stop 20 MeV

  At 30 deg most Si needed

- Mechanical arrangement with little dead space



D_2 7.5 cm 0.4 atm

0.5 mg/cm^2 1.5×10^{20} D/cm^2

$\Delta E_e \simeq 40$ MeV

ΔE 65 μ Si 2 × 8 det. × 2 strips 5 mm wide

E $\gtrsim$ 1000 μ Si 4 × 8 det × 10 strips 5 mm wide

Conclusions

- about 200 to 300 keV resolution feasible

  angle and beam energy better defined

- factor 10 detection efficiency over $(CH_2)_n$ target

- angles from $\leq$30 to $\geq$ 100 deg

- might be combined with γ-measurement

- γ- and p-energy might separate isobars

Detection efficiency makes it worthwhile for any "major" program