SRC study at Mainz
A(e,e'p_{rec})n

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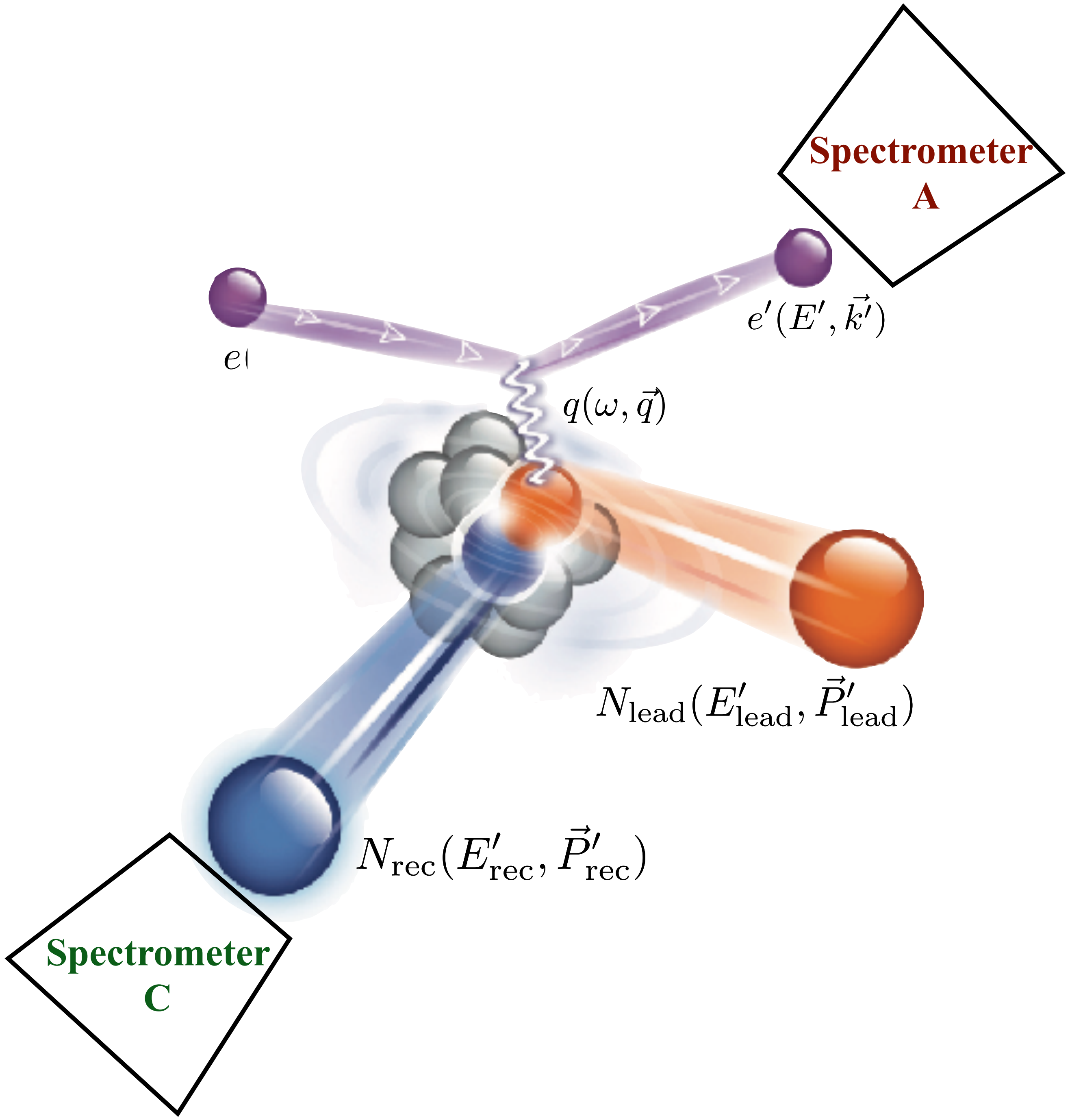
Mainz Test Beam - 2 weeks away

- expected schedule
- latest updates
- radiative correction
- next steps



Schedule

	Mo 19/6	Tu 20/6	We 21/6	Th 22/6	Fr 23/6	Sa 24/6	Su 25/6
					Beam Time		
Axel							
Israel Y							
Israel M							
Eli							
Igor							
Adi							

Shift Schedule

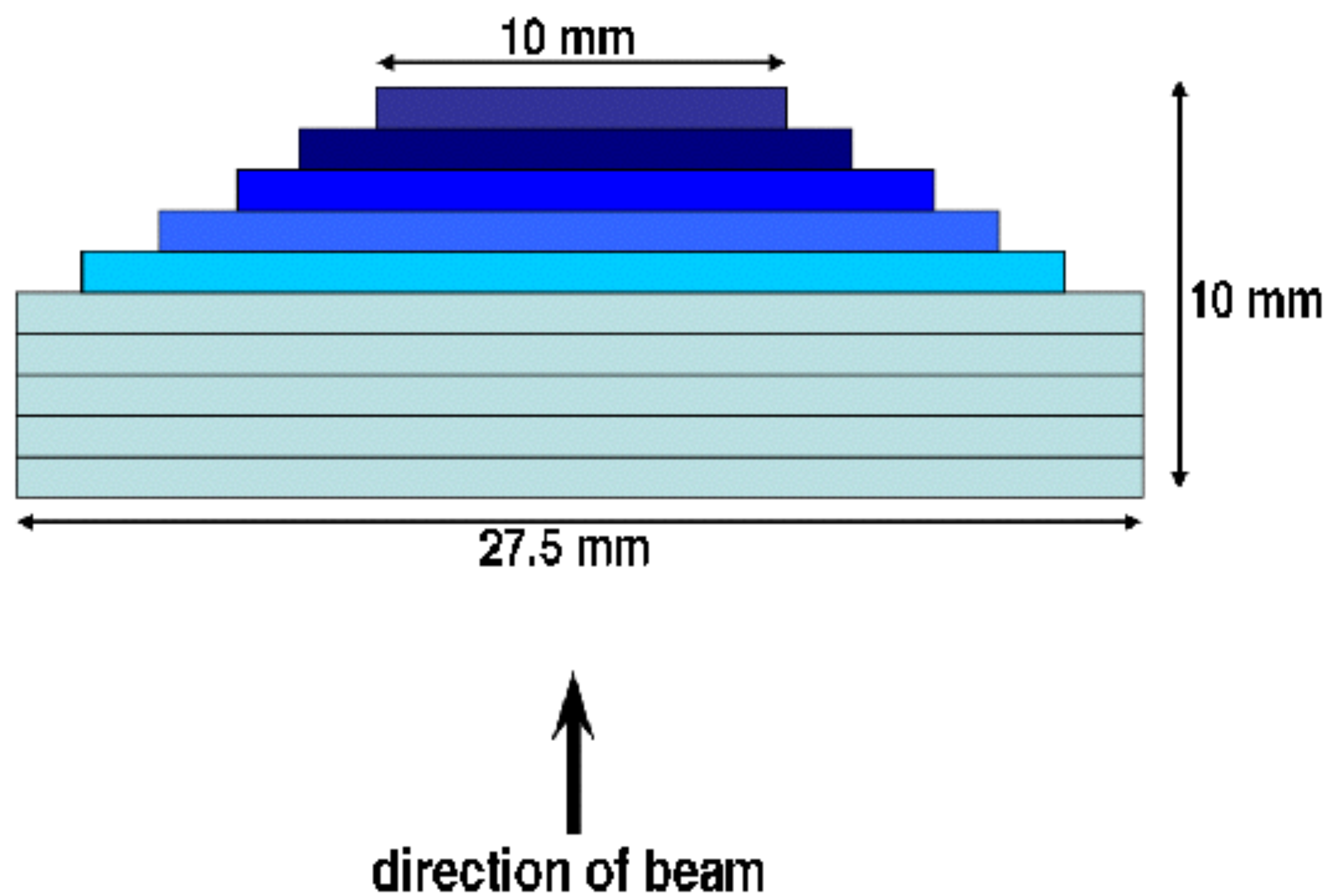
	Th 22/6	Fr 23/6	Sa 24/6	Su 25/6	Mo 26/6
00:00-08:00		Adi	Israel Y	Axel	?
06:00-14:00	Igor	Israel Y	Axel	Eli	
12:00-20:00	Israel Y	Eli	Eli	Adi	
18:00-02:00	Israel M	Israel M	Adi	Israel M	

Latest Updates

- The last run was cut short due to vacuum problem
  - The O-ring seals were damaged by radiation (thick target, high current, small energy)
  - The seals will be exchanged on Monday (19/6) and should not affect our run
- Silicon target has not been checked

Latest Updates

The thick carbon target is constructed as follows



we cannot aim for a 5 mm target,

but the outgoing electron and proton will cross a shorter path inside the target.

Mainz beam time
radiation effects

SimC was used to simulate our kinematics with and without radiation correction - thank you Rey

Target	depth [mm]	kept after radiative correction 20 muA	kept after radiative correction 60 muA	events per day	events per day after radiateve correction
holy ^{12}C	0.2?	92%		10	9
Si	2	69%	68%	105	71
Si	5	44%		264	116

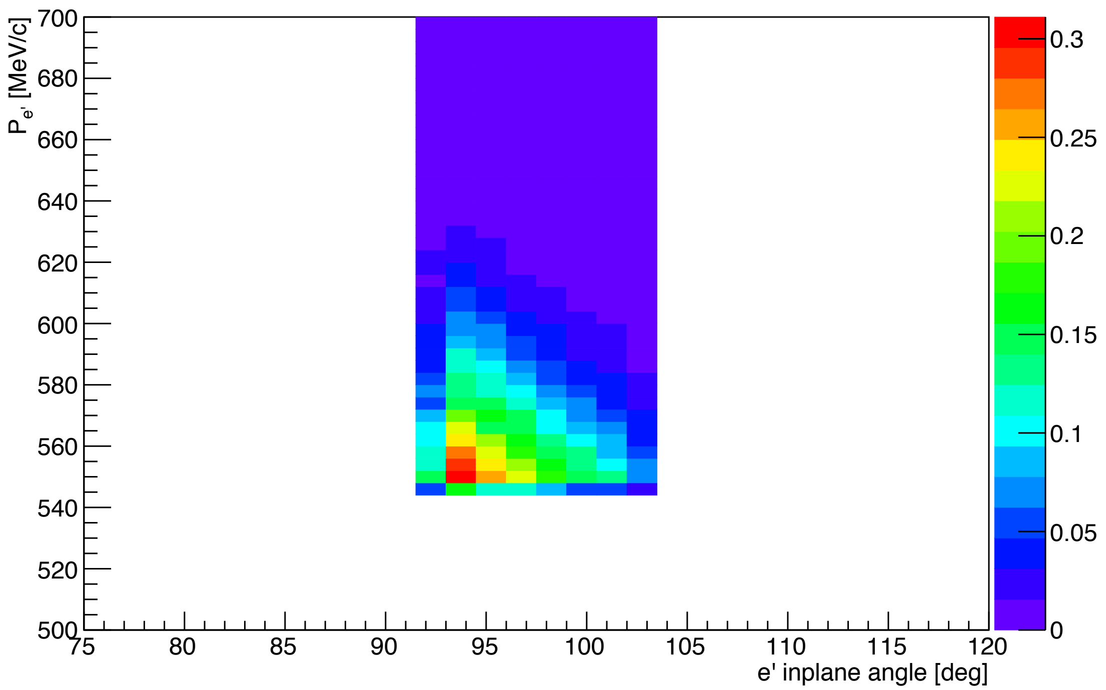
Next steps

- Online analysis environment - Adi + David + Israel Y
- Include expected signature for SRC - Adi
- Change kinematic range of spectrometers to account for radiative effects - Adi

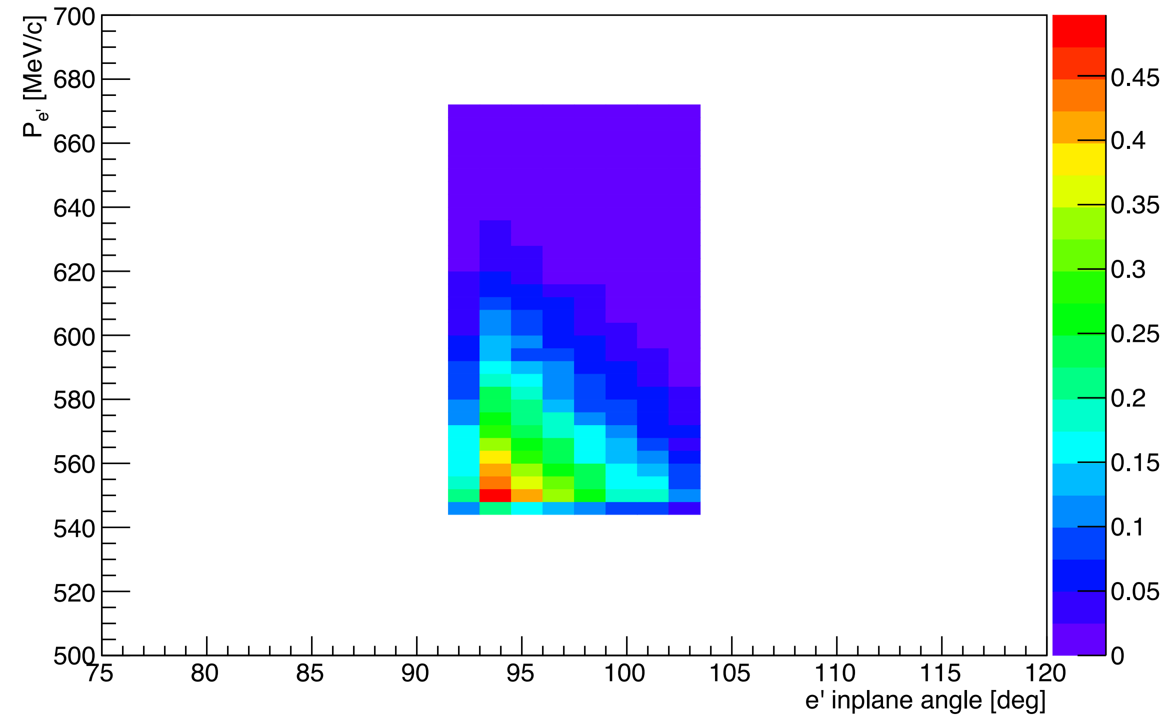
BACKUP

Mainz beam time
radiation effects

with radiative correction



without

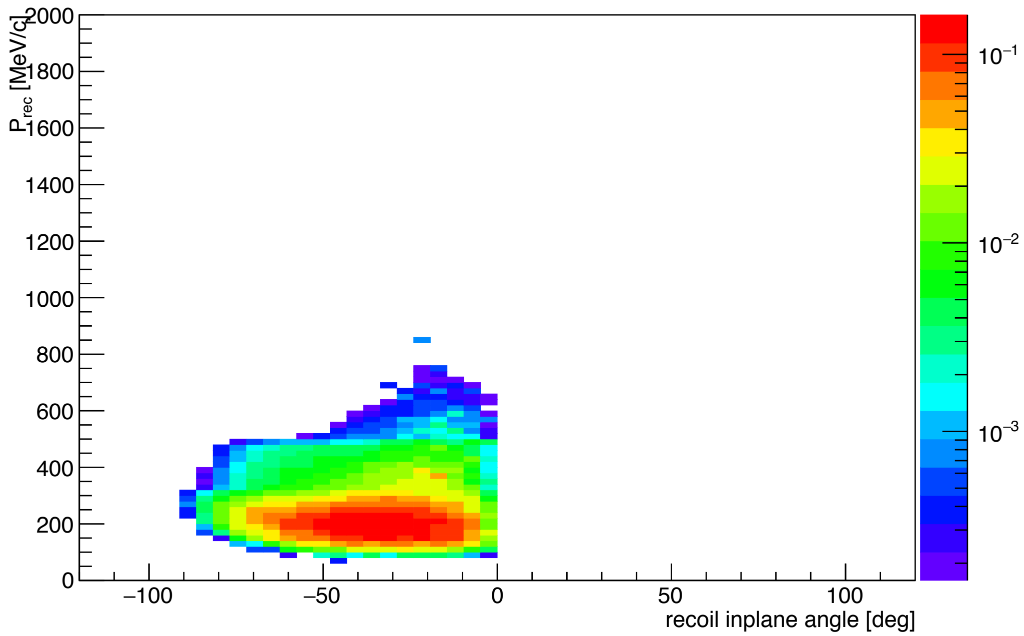


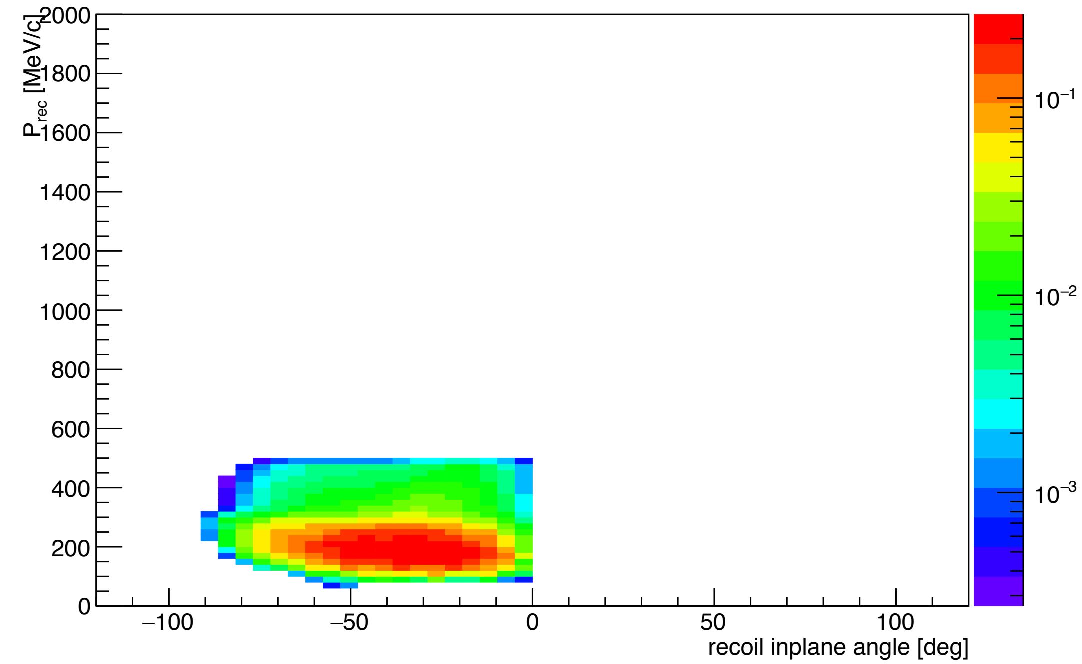
before cuts

Mainz beam time
radiation effects

with radiative correction

without





before cuts

Best kinematic setup

option		1	2
E	**[GeV]**	1.1	1.1
Q2	**[GeV²]**	-1.5	
E'	**[MeV]**	600	560
$\theta_{e'}$	**[º]**	97.8	102.5
P'$_{rec}$	**[MeV/c]**	400	400
θ_{rec}	**[º]**	-53.1	-58.9
P'$_{lead}$	**[MeV/c]**	980	1035
θ_{lead}	**[º]**	-16.2	-11.3
x		1.59	1.48
$\theta_{q,rec}$	**[º]**	20-35	29-41

Electron path
Target ladder

The ladder depth is 4 mm

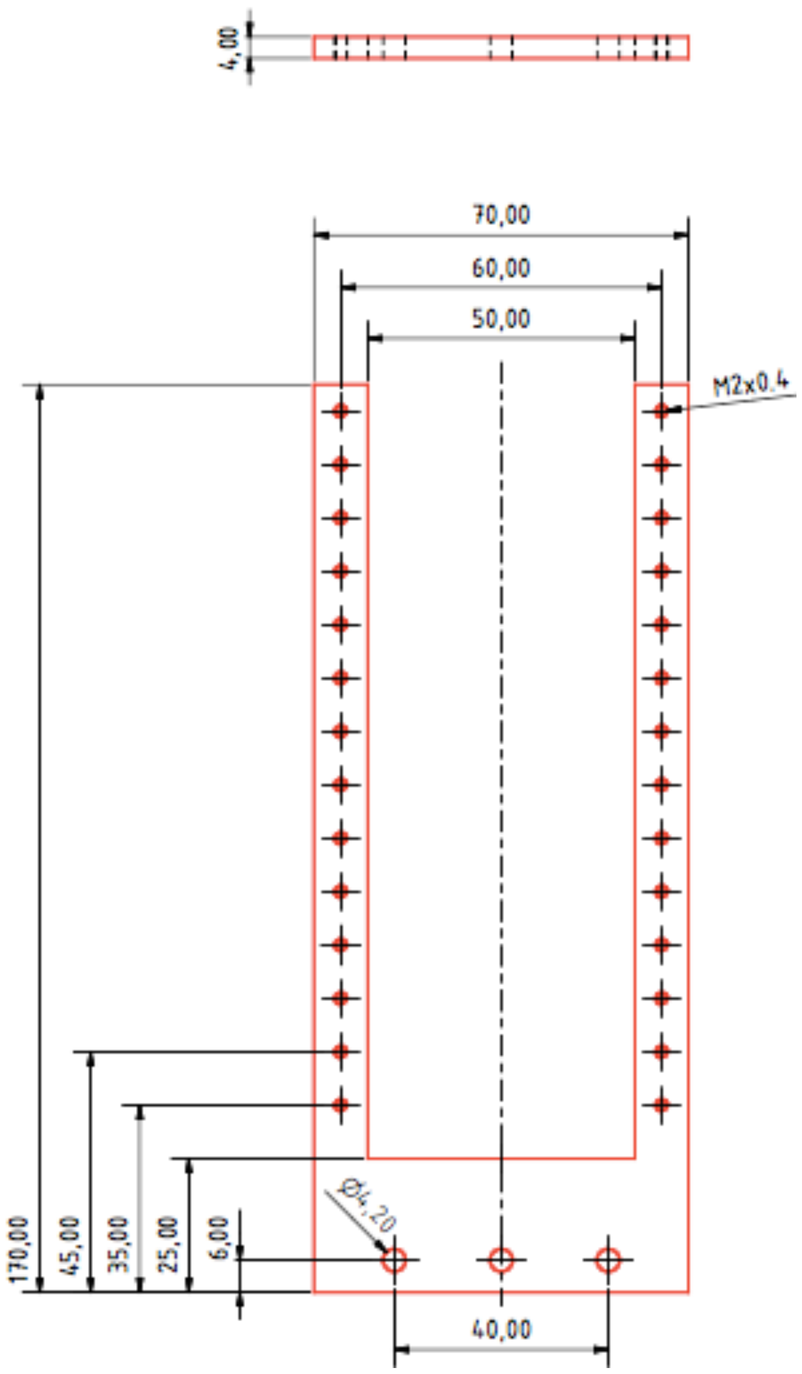
Each frame depth is 4 mm

the target sits between the ladder and the frame

and so:

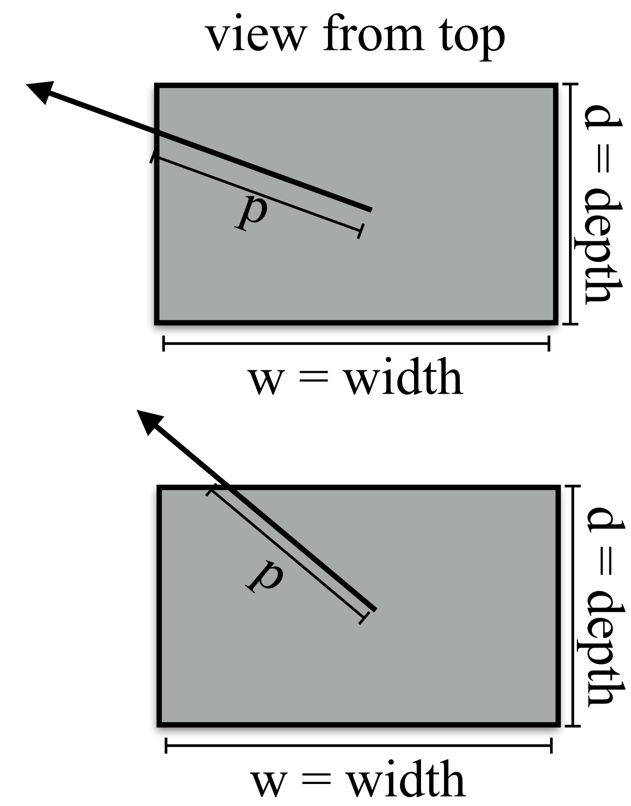
To avoid hitting the target ladder we should limit the electron scattering angle and all spectrometer acceptance range around it to be outside the range [83.48,96.52]

atan (4/35) = 6.52 degrees



Electron path

$$p = \frac{w/2}{cos(\theta)}$$



in case:

$$\frac{w}{2} tan(\theta) > \frac{d}{2}$$

$$p = \frac{d/2}{sin(\theta)}$$

Rate Estimation

For each kinematic setup, the rate was calculated using MCEEP for a deutron target and a current of 10 muA.

To estimate the number of events per day for a different target we took:

$$\mathrm{rate} \times 60 \times 60 \times 20 \times 4.8 \times 0.5 \times \left(\frac{\frac{\rho_{\mathrm{C}} \times \mathrm{A(C)} \times \mathrm{N_A}}{\mathrm{m_A(C)}}}{\frac{\rho_{\mathrm{D}} \times \mathrm{A(D)} \times \mathrm{N_A}}{\mathrm{m_A(D)}}} \right) \times \frac{\mathrm{depth_C}}{\mathrm{depth_D}}$$

20: effective number of hours per day

4.8: a2

0.5: transparency factor

last, we multiply by an additional factor of 2 (hopefully bigger) for the current

Mainz beam time
Target

Target	depth [mm]	density [g/cm^3]	width [mm]	luminosity [muA g/cm^2] with 20 muA	Electron radiation lengths	events per day
^{12}C	10	2.25	20 changing hight:27.5-10	45	0.054	480
holy ^{12}C	0.2?	2.25?	20	0.9		10
AlO	-	-	-	-		
AlO ||	0.5?	3.95	3 times 0.5	1.84	0.011	43
AlO =	0.5?	3.95	10	1.84	0.016	43
Si	2	2.3	10	9.2	0.049	105
Si	5	2.3	10	23	0.054	264

Mainz beam time

single rates

For the chosen kinematic:

- spectrometer A for electron :

  at a previous experiment setup with 13 muA on ~3 mm thick ^{12}C target the spectrometer reached 60 KHz for electron scattering angle of 50^o

Target	thick [mm]	expected single rate [Khz]
^{12}C	10	37
holy ^{12}C	0.2?	0.75
AlO ||	0.5?	0.64
Alo =	0.5?	0.64
Si	2	2.5
Si	5	6.4

Mainz beam time
single rates

For the chosen kinematic:

- spectrometer C for proton is expected to get to the limit
  at a previous experiment setup with 13 muA on ~3 mm thick ^{12}C
  target the spectrometer reached max rate of 100 KHz at 38^{o}

Target	thick [mm]	maximal current for 38
^{12}C	10	3.9
holy ^{12}C	0.2?	195
AlO ||	0.5?	230
Alo =	0.5?	230
Si	2	57
Si	5	23

Mott scaling gives a factor of 0.002 to the rate which allows all target to have current of 60 muA

Mainz beam time

Random Coincidence

SpecA single rate x SpecC single rate x time window

for thin Si target:

2.5 KHz x 100KHz x 10 nsec = 2.5 Hz

2 orders of magnitude below DAQ limitation

This background will be cut off the analysis using PID

Mainz beam time
Target

Target	depth [mm]	density [g/cm^3]	width [mm]	Electron passing [mm] option1	Electron passing [mm] option2	Electron radiation lengths option1	proton passing [mm] option1	proton passing [mm] option2	luminosity [muA g/cm^2] with 20	events per day option1	events per day option2
^{12}C	10	2.25	20 changing hight:	10.1	10.24	0.053	8.32	9.68	20*2.25 = 45	580	480
holy ^{12}C			20						20*0.045 = 0.9	12	10
AlO						-					
AlO vertical	0.5?	3.95	3 times 0.5	0.757	0.768	0.011	0.41	0.48	20*0.092 = 1.84	52	43
Alo horizontal	0.5?	3.95	10	1.84	1.155	0.026	0.41	0.48	20*0.092 = 1.84	52	43
Si	2	2.3	10	5.04	4.6	0.053	1.66	1.93	20*0.46 = 9.2	127	105
Si	5	2.3	10	5.04	5.12	0.053	4.16	4.84	20*1.15 = 23	319	264

Mainz beam time

single rates

For the chosen kinematic:

- spectrometer A for electron : single rate 5 Hz (simulated)
- spectrometer C for proton is expected to get to the limit

at a previous experiment setup with 13 muA on ~3 mm thick ^{12}C target the spectrometer reached max rate of 100 KHz at 38^{o}

Target	thick [mm]	maximal current for 38
^{12}C	10	3.9
holy ^{12}C	0.2?	195
AlO ||	0.5?	230
Alo =	0.5?	230
Si	2	57
Si	5	23

Mott scaling gives a factor of 0.002 to the rate which allows all target to have current of 60 muA

Mainz beam time
Expected Background

w.r.t to our signal at the chosen kinematics:

- MCEEP test for the chosen kinematic setup leading proton to the recoil detector acceptance gives : 0.4 %

Mainz beam time
Expected Background

w.r.t to 4.8 10^{-4} of our events:

- MCEEP test for the chosen kinematic setup leading proton to the recoil detector acceptance gives 2.1 10^{-6} Hz : 0.4 %
- real random : SpecA single rate x SpecC single rate x time window 5 Hz x x 10 nsec = 5 10^{-5} Hz :