
SRC study at Mainz

$A(e, e' p_{\text{rec}})n$

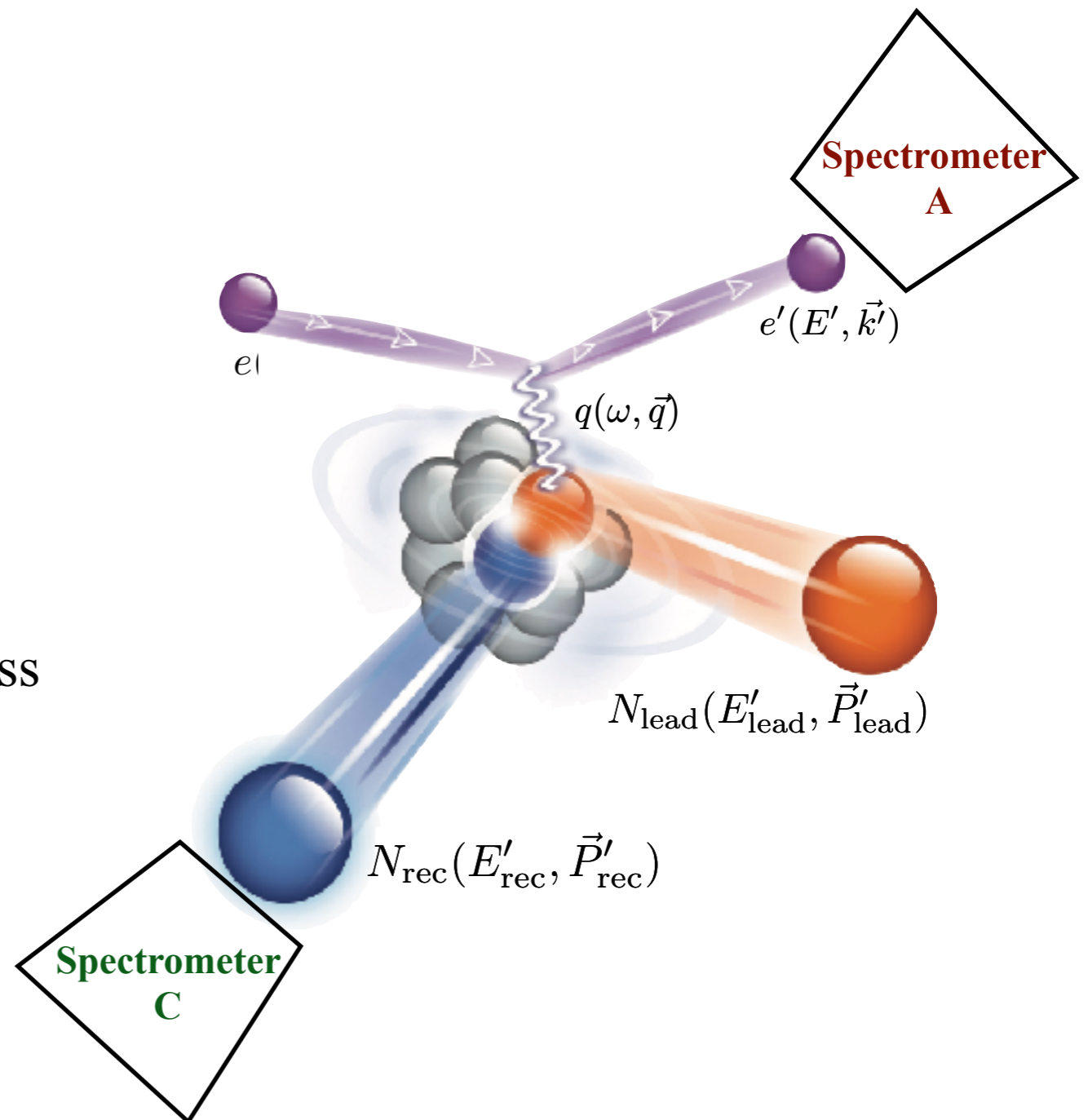
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Mainz Test Beam - A month away

- latest updates
- chosen kinematics
- current rate estimation
- Single rates
- random coincidence
- expected physics background
- radiative corrections - work in progress
- working plan for the next month



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							
Adi							

Latest Updates

- The Cherenkov detectors is now installed also on spectrometer A and ready to be used
- We can use only the installed targets :
 - The carbon targets are either too thin or too thick for our use.
 - The silicon targets were not yet to be used.
 - Hopefully they will be tested at the beginning of June, to check for the maximal current they can hold.
 - above 20 μA we should use wobblers

Best kinematic setup

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

Electron path

Target ladder

The ladder depth is 4 mm

Each frame depth is 4 mm

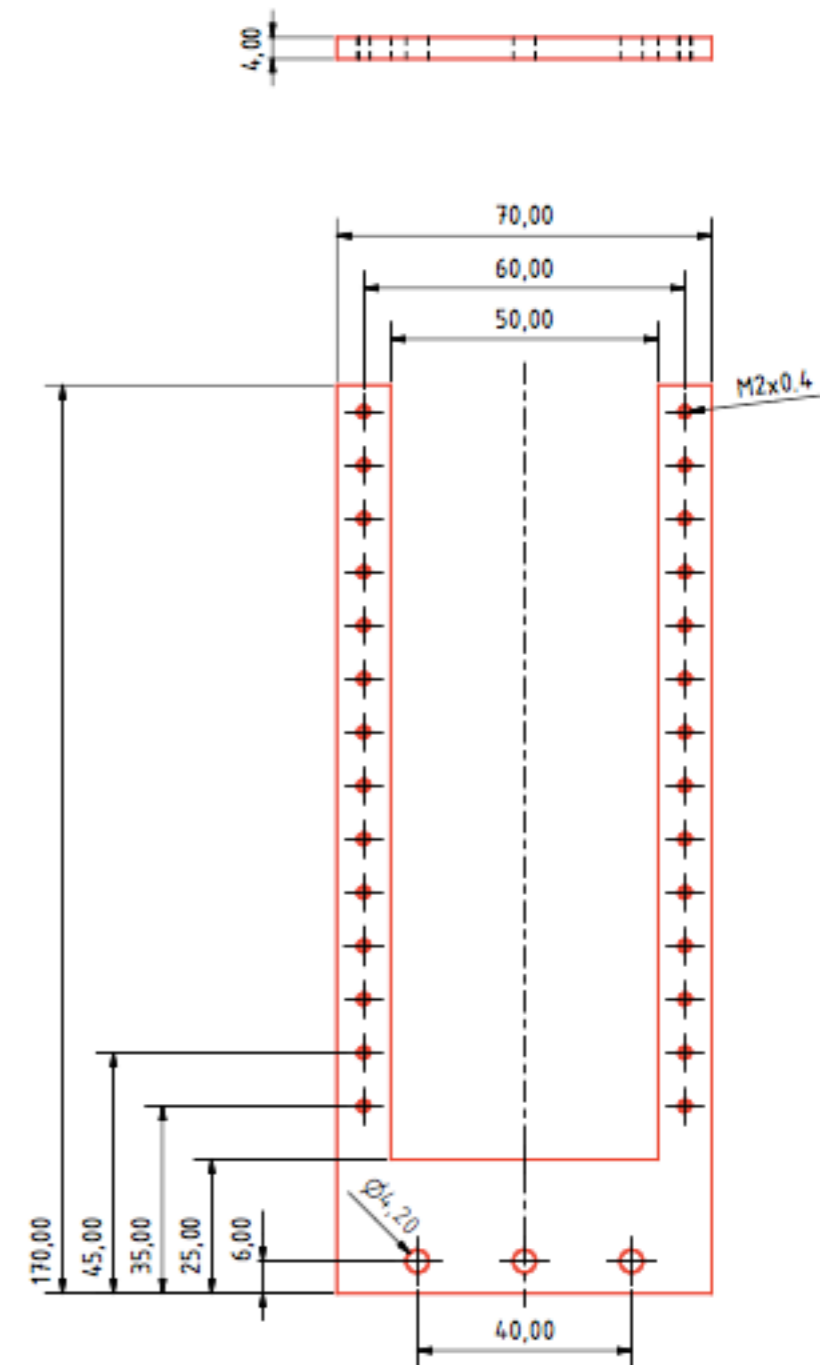
the target sits between the ladder and the frame

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]

$\text{atan}(4/35) = 6.52$ degrees



Rate Estimation

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

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

$$\text{rate} \times 60 \times 60 \times 20 \times 4.8 \times 0.5 \times \left(\frac{\frac{\rho_C \times A(C) \times N_A}{m_A(C)}}{\frac{\rho_D \times A(D) \times N_A}{m_A(D)}} \right) \times \frac{\text{depth}_C}{\text{depth}_D}$$

↑
↑

effective number of hours per day
transparency factor

|
|

a2

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 μA on ~ 3 mm thick ^{12}C target the spectrometer reached 60 KHz for electron scattering angle of 50°

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 μA on ~ 3 mm thick ^{12}C target the spectrometer reached max rate of 100 KHz at 38°

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 μA

Mainz beam time

Random Coincidence

SpecA single rate x SpecC single rate x time window

for thin Si target:

$$2.5 \text{ KHz} \times 100\text{KHz} \times 10 \text{ nsec} = 2.5 \text{ Hz}$$

2 orders of magnitude below DAQ limitation

This background will be cut off the analysis using PID

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

radiation effects

SimC was used to simulate kinematic setup #1 with and without radiation correction for 2 mm thick deuteron target - thank you Rey

Radiative effects have cause **5.55% loss in statistics**
currently checked for our targets.

Next steps

- Decide on run plan - all
- Check radiative corrections - Rey & Adi
- Online analysis environment - Adi

BACKUP

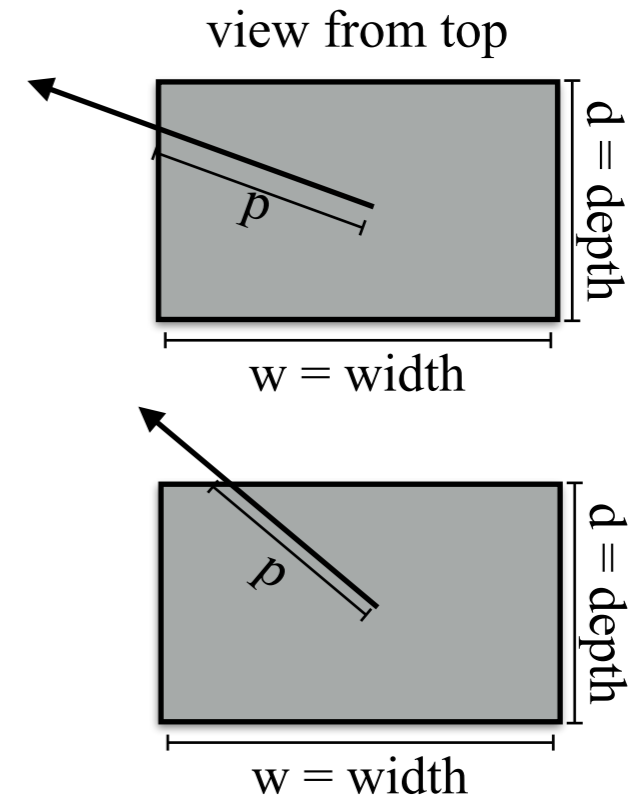
Electron path

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

in case:

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

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



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 [$\mu\text{A g/cm}^2$ 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	$20 \cdot 2.25 = 45$	580	480
holy ¹² C			20						$20 \cdot 0.045 = 0.9$	12	10
AlO						-					
AlO vertical	0.5?	3.95	3 times 0.5	0.757	0.768	0.011	0.41	0.48	$20 \cdot 0.092 = 1.84$	52	43
AlO horizontal	0.5?	3.95	10	1.84	1.155	0.026	0.41	0.48	$20 \cdot 0.092 = 1.84$	52	43
Si	2	2.3	10	5.04	4.6	0.053	1.66	1.93	$20 \cdot 0.46 = 9.2$	127	105
Si	5	2.3	10	5.04	5.12	0.053	4.16	4.84	$20 \cdot 1.15 = 23$	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 μA on ~ 3 mm thick ^{12}C target the spectrometer reached max rate of 100 KHz at 38°

Target	thick [mm]	maximal current for 38
^{12}C	10	3.9
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Mott scaling gives a factor of 0.002 to the rate which allows all target to have current of 60 μA

Mainz beam time

Expected Background

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

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