x>1 and EMC Effect (XEM2) Run Plan

October 14, 2022

1 Initial Non-Production Beam Activities

1.1 Coincidence Hydrogen Elastic Data Taking

- **DAQ:** COIN
- **Trigger** PS6 (SHMS 3/4 + HMS 3/4 COINCIDENCE)
- **electron arm:** SHMS & **proton arm:** HMS
- **Prescale:** PS6=0, PS5=-1, PS3=-1, PS2=-1
- Set target rates of **100 Hz** for **PS1 and PS4**
- **electron arm:** SHMS & **proton arm:** HMS
- We will take coincidence elastic data at 6 different settings. At each setting data will be taken with 10 cm LH2 and Al dummy targets. At the lowest two Q^2 settings, we will also take data with the 48Ca Target to measure the possible hydrogen contamination in 48Ca.
- The goal is **10K elastic coincidences** at each setting.
- **For the first setting (KIN 1 with LH2 target):** the first run should be 15 minutes long. Start the second run immediately after ending the first short run. The first short run will be analyzed while taking the second run.
- Follow Table 1 and take data.

Table 1: Coincidence Hydrogen Elastic Data Taking

Setting	P_{HMS} **(GeV)**	θ_{HMS}	P_{SHMS} **(GeV)**	θ_{SHMS}	**Target**	***I*** **(μA)**	**Est. Time**	**Done ?**
KIN 1	+6.476	19.52°	-4.935	26°	LH2	65	5 hrs	
	+6.476	19.52°	-4.935	26°	dummy	40	40 min	
KIN 2	+5.107	24.89°	-6.286	20°	dummy	40	10 min	
	+5.107	24.89°	-6.286	20°	LH2	65	40 min	
KIN 3	+3.738	31.86°	-7.626	15°	LH2	65	10 min	
	+3.738	31.86°	-7.626	15°	dummy	40	10 min	
KIN 4	+2.289	43.09°	-9.005	10°	dummy	40	10 min	
	+2.289	43.09°	-9.005	10°	LH2	65	10 min	
KIN 5	+2.076	45.36°	-9.2	9.24°	LH2	65	10 min	
	+2.076	45.36°	-9.2	9.24°	dummy	40	10 min	
KIN 6	+1.739	49.49°	-9.502	8°	dummy	40	10 min	
	+1.739	49.49°	-9.502	8°	48Ca	40	10 min	
	+1.739	49.49°	-9.502	8°	LH2	65	10 min	

1.1.1 Coincidence Elastic Data with SHMS Sieve Slit

- HMS Collimator: "Large Collimator"
- SHMS Collimator: "Collimator" or "Centered Sieve"
- **Trigger Settings:** PS2, PS4, PS6

Setting 1 (Same as the last setting)

- **SHMS Momentum and Angle:** -9.502 GeV and 8 deg
- **HMS Momentum and Angle:** +1.739 GeV and 49.49 deg

Table 2: Setting 1

SHMS Coll Setting	**Target**	***I*** **(μA)**	**Est. Time**	**Done ?**
Centered Sieve	LH2	70 uA	10 min	
Centered Sieve	Beryllium	70 uA	10 min	

Setting 2

- **SHMS Momentum and Angle:** -9.026 GeV and 8 deg
- **HMS Momentum and Angle:** +1.739 GeV and 49.49 deg

Table 3: Setting 2

SHMS Coll Setting	**Target**	***I*** **(μA)**	**Est. Time**	**Done ?**
Centered Sieve	Beryllium	70 uA	10 min	
Centered Sieve	LH2	70 uA	10 min	
Collimator	LH2	70 uA	10 min	
Collimator	dummy	40 uA	10 min	

Setting 3

- **SHMS Momentum and Angle:** -8.55 GeV and 8 deg
- **HMS Momentum and Angle:** +1.739 GeV and 49.49 deg

Table 4: Setting 3

SHMS Coll Setting	**Target**	***I*** **(μA)**	**Est. Time**	**Done ?**
Collimator	dummy	40 uA	10 min	
Collimator	LH2	70 uA	10 min	
Centered Sieve	LH2	70 uA	10 min	
Centered Sieve	Beryllium	70 uA	10 min	

- Total estimated time for section 1.1 including the momentum and target changes: **12 hrs** with 100% efficiency.

1.2 Delta Scan with the SHMS

- **DAQ:** COIN
- **Trigger** PS6 (SHMS 3/4 + HMS 3/4 COINCIDENCE)
- **electron arm:** SHMS & **proton arm:** HMS
- **Prescale:** PS6=0, PS5=-1, PS3=-1, PS2=-1
- Set target rates of **100 Hz** for **PS1 and PS4**
- We will take data at 6 different settings. At each setting data will be taken with 10 cm LH2 and Al dummy targets.
- Since this is a delta scan with the SHMS, the central momentum for the SHMS will be kept at -8 GeV for the entire study.
- The goal is **10K elastic coincidences** at each setting.
- Follow Table 5 and take data.

Table 5: Delta Scan with the SHMS

Setting	P_{HMS} **(GeV)**	θ_{HMS}	P_{SHMS} **(GeV)**	θ_{SHMS}	**Target**	I (μA)	**Est. Time**	**Done ?**
KIN 1	+4.18	29.37°	-8.0	16.54°	LH2	65	15 min	
	+4.18	29.37°	-8.0	16.54°	dummy	40	10 min	
KIN 2	+3.77	31.69°	-8.0	15.09°	dummy	40	10 min	
	+3.77	31.69°	-8.0	15.09°	LH2	65	10 min	
KIN 3	+3.35	34.32°	-8.0	13.67°	LH2	65	10 min	
	+3.35	34.32°	-8.0	13.67°	dummy	40	10 min	
KIN 4	+2.94	37.34°	-8.0	12.24°	dummy	40	10 min	
	+2.94	37.34°	-8.0	12.24°	LH2	65	10 min	
KIN 5	+2.51	40.93°	-8.0	10.78°	LH2	65	10 min	
	+2.51	40.93°	-8.0	10.78°	dummy	40	10 min	
KIN 6	+2.08	45.32°	-8.0	9.25°	dummy	40	10 min	
	+2.08	45.32°	-8.0	9.25°	LH2	65	10 min	

- Total estimated time for section 1.2 including the momentum and target changes: **5 hrs** with 100% efficiency.

BEFORE MOVING ON TO THE NEXT SECTION THE DAQ AND EDTM SHOULD BE SET UP FOR THE SINGLE ARM MODE!

1.3 Calibration Data Taking and PID Threshold Checks

- **DAQ:** Single Arm
- At 3 different settings, we will take data with ELREAL trigger on each arm to calibrate the detectors and also with 3/4 trigger on each arm to check the PID trigger thresholds.

1.3.1 Setting 1

- **SHMS Settings:** -4.0 GeV & 20°
- **HMS Settings:** -4.0 GeV & 20°
- **Target:** LH2
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 6 should be set to **-1**.
- Adjust the prescales on **EACH** prescale GUI to keep the rates below 3 kHz.
- The goal number of events is **50K-100K** for each setting.
- **For defocusing: Increase the nominal SHMS Q2 and HMS Q2 currents by +20%.**
- Follow Table 6. Take SHMS and HMS single arm data simultaneously.
- Estimated run times are with 100% efficiency.

Table 6: Calibration/PID Threshold Checks - Setting 1

SHMS/HMS Q2	**HMS PS**		**SHMS PS**		***I***	**Est. Time**	**Done ?**
	PS1	**PS2**	**PS1**	**PS2**	**(μA)**		
+20% defocused Q2	-1	0	-1	0	60	15 min	
nominal Q2	-1	0	-1	0	60	15 min	
nominal Q2	0	-1	0	-1	60	15 min	

1.3.2 Setting 2

- **SHMS Settings:** -3.5 GeV & 25°
- **HMS Settings:** -3.5 GeV & 25°
- **Target:** LH2
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 7 should be set to **-1**.
- Adjust the prescales on **EACH** prescale GUI to keep the rates below 3 kHz.
- The goal number of events is **50K-100K** for each setting.
- **For defocusing: Increase the nominal SHMS Q2 and HMS Q2 currents by +20%.**
- Follow Table 7. Take SHMS and HMS single arm data simultaneously.
- Estimated run times are with 100% efficiency.

Table 7: Calibration/PID Threshold Checks - Setting 2

SHMS/HMS Q2	**HMS PS**		**SHMS PS**		***I***	**Est. Time**	**Done ?**
	PS1	**PS2**	**PS1**	**PS2**	**(μA)**		
+20% defocused Q2	-1	0	-1	0	60	15 min	
nominal Q2	-1	0	-1	0	60	15 min	
nominal Q2	0	-1	0	-1	60	15 min	

1.3.3 Setting 3

- **SHMS Settings:** -2.5 GeV & 35°
- **HMS Settings:** -2.5 GeV & 35°
- **Target:** LH2
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 8 should be set to **-1**.
- Adjust the prescales on **EACH** prescale GUI to keep the rates below 3 kHz.
- The goal number of events is **50K-100K** for each setting.
- **For defocusing: Increase the nominal SHMS Q2 and HMS Q2 currents by +20%.**
- Follow Table 8. Take SHMS and HMS single arm data simultaneously.
- Estimated run times are with 100% efficiency.

Table 8: Calibration/PID Threshold Checks - Setting 3

SHMS/HMS Q2	**HMS PS**		**SHMS PS**		***I***	**Est. Time**	**Done ?**
	PS1	**PS2**	**PS1**	**PS2**	**(μA)**		
+20% defocused Q2	-1	0	-1	0	60	15 min	
nominal Q2	-1	0	-1	0	60	15 min	
nominal Q2	0	-1	0	-1	60	15 min	

1.3.4 Setting 4

- **SHMS Settings:** -1.24 GeV & 35°
- **HMS Settings:** -1.24 GeV & 35°
- **Target:** LH2
- **Trigger**: SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 9 should be set to **-1**.
- Adjust the prescales on **EACH** prescale GUI to keep the rates below 3 kHz.
- The goal number of events is **50K-100K** for each setting.

- Follow Table 9. Take SHMS and HMS single arm data simultaneously.
- Estimated run times are with 100% efficiency.

Table 9: PID Threshold Checks - Setting 4

SHMS/HMS Q2	**HMS PS**		**SHMS PS**		***I***	**Est. Time**	**Done ?**
	PS1	**PS2**	**PS1**	**PS2**	**(μA)**		
nominal Q2	0	-1	0	-1	60	15 min	

- Total estimated time for section 1.3 including the momentum and target changes: **4 hrs**. Estimated run times are with 100% efficiency.

1.4 SHMS Hodoscope Paddle Test

At the 8 degree SHMS settings, we will run with all hodoscopes, and then with four different subsets turned off to check the acceptance. Same for 8.5 with a limited subset.

JRA: No HMS plan for this setting; maybe we can squeeze in some parasitic PID checks or something...

1.4.1 Setting 1

- **DAQ:** Single Arm, SHMS only
- **SHMS Settings:** -9.2 GeV & 8°
- **Target:** LD2 or 12C
- **Trigger**: SHMS PS2 (ELREAL) **OR** SHMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 10 should be set to **-1**.
- Adjust the prescales on **EACH** prescale GUI to keep the rates below 3 kHz.
- Estimated run times are with 100% efficiency.
- (note for experts:) If 3/4 rate (T1) is only slightly (<50%) larger than ELREAL rate (T2), can do PS1=0 for both targets (slightly longer time) and drop the PS2=0
- Follow Table 10

Table 10: SHMS acceptance test with some hodoscopes turned off at 8.0°

Setting	**HV off**		**SHMS PS**		**Target**	***I***	**Est. Time**	**Done ?**
	S1X	S2X	PS1	PS2		(μA)		
1	none	none	-1	0	LD2	60	10 min	
	none	none	-1	0	12C	60	10 min	
	none	none	0	-1	12C	60	10 min	
2	1-7	1-6	0	-1	12C	60	10 min	
	1-7	1-6	-1	0	12C	60	10 min	
	1-7	1-6	-1	0	LD2	60	10 min	
3	1-8	1-6	-1	0	LD2	60	10 min	
	1-8	1-6	-1	0	12C	60	10 min	
	1-8	1-6	0	-1	12C	60	10 min	
4	1-7	1-7	0	-1	12C	60	10 min	
	1-7	1-7	-1	0	12C	60	10 min	
	1-7	1-7	-1	0	LD2	60	10 min	
5	1-8	1-7	-1	0	LD2	60	10 min	
	1-8	1-7	-1	0	12C	60	10 min	
	1-8	1-7	0	-1	12C	60	10 min	
6	1-7	1-8	0	-1	12C	60	10 min	
	1-7	1-8	-1	0	12C	60	10 min	
	1-7	1-8	-1	0	LD2	60	10 min	

1.4.2 Setting 2

- **DAQ:** Single Arm, SHMS only
- **SHMS Settings:** -9.2 GeV & 8.5°
- **Target:** LD2 or 12C
- **Trigger**: SHMS PS2 (ELREAL) **OR** SHMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 11 should be set to **-1**.
- Adjust the prescales on **EACH** prescale GUI to keep the rates below 3 kHz.
- Estimated run times are with 100% efficiency.
- Follow Table 11

Table 11: SHMS acceptance test with some upper hodoscopes turned off at 8.5°

Setting	**HV off**		**SHMS PS**		**Target**	***I***	**Est. Time**	**Done ?**
	S1X	S2X	PS1	PS2		(μA)		
1	none	none	0	-1	12C	60	10 min	
	none	none	-1	0	12C	60	10 min	
	1-5	1-7	-1	0	12C	60	10 min	
	1-5	1-7	0	-1	12C	60	10 min	
	1-6	1-8	0	-1	12C	60	10 min	
	1-6	1-8	-1	0	12C	60	10 min	
	1-7	1-8	-1	0	12C	60	10 min	
	1-7	1-8	0	-1	12C	60	10 min	
2	1-7	1-8	-1	0	LD2	60	10 min	
	1-6	1-8	-1	0	LD2	60	10 min	
	1-5	1-7	-1	0	LD2	60	10 min	
	none	none	-1	0	LD2	60	10 min	

BEFORE MOVING ON TO THE NEXT SECTION TURN ALL OF THE HODOSCOPE HV CHANNELS BACK ON!

2 XEM2 Production Run Plan - Part I

2.1 Q^2 Dependence Studies at 26° - Target Ladder I

- In this section, we will take data with the SHMS and HMS simultaneously in the single arm mode using a subset of targets on the target ladder I.
- While the SHMS and HMS angles will be kept the same, the SHMS and HMS will be configured to several different momentum settings. Please follow the tables below in the order written.

2.1.1 Setting 1

- Set **SHMS momentum** to **-5.42 GeV**.
- Set **HMS momentum** to **-5.42 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 12 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 12. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 12: Q^2 Dependence Studies at 26° - Setting 1

Target	***I*** (μA)	**HMS PS** PS1	PS2	**SHMS PS** PS1	PS2	**Est. Time**	**Target** e^-	**Done ?**
LH2	60	-1	0	-1	0	5.5 hrs	10K	
LD2	60	-1	0	-1	0	2.5 hrs	10K	
Al dummy	40	-1	0	-1	0	1.5 hrs	2.5K	
40Ca	60	-1	0	-1	0	1.5 hrs	5.5K	
40Ca	60	0	-1	0	-1	5 min	-	
12C	60	0	-1	0	-1	5 min	-	
12C	60	-1	0	-1	0	2 hrs	5.5K	

2.1.2 Setting 2

- Set **SHMS momentum** to **-4.767 GeV**.
- Set **HMS momentum** to **-4.767 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 13 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 13. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 13: Q^2 Dependence Studies at 26° - Setting 2

Target	***I*** (μA)	**HMS PS** PS1	PS2	**SHMS PS** PS1	PS2	**Est. Time**	**Target** e^-	**Done ?**
12C	60	0	-1	0	-1	5 min	-	
12C	60	-1	0	-1	0	3.5 hrs	120K	
40Ca	60	-1	0	-1	0	2.5 hrs	120K	
40Ca	60	0	-1	0	-1	5 min	-	
Al dummy	40	-1	0	-1	0	25 min	15K	
LD2	60	-1	0	-1	0	40 min	65K	
LH2	60	-1	0	-1	0	1.5 hrs	65K	

2.1.3 Setting 3

- Set **SHMS momentum** to **-4.19 GeV**.
- Set **HMS momentum** to **-4.19 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 14 should be set to **-1**.

- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 14. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 14: Q^2 Dependence Studies at 26° - Setting 3

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target** e^-	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LH2	60	-1	0	-1	0	2 hrs	550K	
LD2	60	-1	0	-1	0	1 hr	550K	
Al dummy	40	-1	0	-1	0	30 min	130K	
40Ca	60	-1	0	-1	0	2.5 hrs	550K	
40Ca	60	0	-1	0	-1	5 min	-	
12C	60	0	-1	0	-1	5 min	-	
12C	60	-1	0	-1	0	3.5 hrs	550K	

2.1.4 Setting 4

- Set **SHMS momentum** to **-3.69 GeV**.
- Set **HMS momentum** to **-3.69 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 15 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 15. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 15: Q^2 Dependence Studies at 26° - Setting 4

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target** e^-	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
12C	60	-1	0	-1	0	1 hr	400K	
12C	60	0	-1	0	-1	5 min	-	
40Ca	60	0	-1	0	-1	5 min	-	
40Ca	60	-1	0	-1	0	45 min	400K	
Al dummy	40	-1	0	-1	0	10 min	100K	
LD2	60	-1	0	-1	0	20 min	400K	
LH2	60	-1	0	-1	0	30 min	400K	

2.1.5 Setting 5

- Set **SHMS momentum** to **-3.25 GeV**.
- Set **HMS momentum** to **-3.25 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 16 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 16. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 16: Q^2 Dependence Studies at 26° - Setting 5

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target** e^-	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LH2	60	-1	0	-1	0	15 min	250K	
LD2	60	-1	0	-1	0	10 min	250K	
Al dummy	40	-1	0	-1	0	10 min	60K	
40Ca	60	-1	0	-1	0	20 min	250K	
40Ca	60	0	-1	0	-1	5 min	-	
12C	60	0	-1	0	-1	5 min	-	
12C	60	-1	0	-1	0	30 min	250K	

2.1.6 Setting 6

- Set **SHMS momentum** to **-2.86 GeV**.
- Set **HMS momentum** to **-2.86 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 17 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 17. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 17: Q^2 Dependence Studies at 26° - Setting 6

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target** e^-	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
12C	60	-1	0	-1	0	15 min	190K	
12C	60	0	-1	0	-1	5 min	-	
40Ca	60	0	-1	0	-1	5 min	-	
40Ca	60	-1	0	-1	0	10 min	190K	
Al dummy	40	-1	0	-1	0	10 min	40K	
LD2	60	-1	1	-1	1	10 min	190K	
LH2	60	-1	0	-1	0	10 min	190K	

2.1.7 Setting 7

- Set **SHMS momentum** to **-2.52 GeV**.
- Set **HMS momentum** to **-2.52 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 18 should be set to **-1**.

- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 18. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 18: Q^2 Dependence Studies at 26° - Setting 7

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target** e^-	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LH2	60	-1	1	-1	1	10 min	155K	
LD2	60	-1	2	-1	2	10 min		
Al dummy	40	-1	0	-1	0	10 min	40K	
40Ca	60	-1	0	-1	0	10 min	155K	
40Ca	60	1	-1	1	-1	5 min	-	
12C	60	0	-1	0	-1	5 min	-	
12C	60	-1	0	-1	0	10 min	155K	

2.1.8 Setting 8

- Set **SHMS momentum** to **-2.21 GeV**.
- Set **HMS momentum** to **-2.21 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 19 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 19. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 19: Q^2 Dependence Studies at 26° - Setting 8

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target** e^-	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
12C	60	-1	1	-1	1	15 min	135K	
12C	60	1	-1	1	-1	5 min	-	
40Ca	60	2	-1	2	-1	5 min	-	
40Ca	60	-1	2	-1	2	15 min	135K	
Al dummy	40	-1	0	-1	0	10 min	35K	
LD2	60	-1	3	-1	3	10 min	135K	
LH2	60	-1	1	-1	1	10 min	135K	

Setting 9

- Set **SHMS momentum** to **-1.95 GeV**.
- Set **HMS momentum** to **-1.95 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 20 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 20. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Total estimated time for section 2.1 including the momentum and target changes: **41 hrs** with 100% efficiency.

Table 20: Q^2 Dependence Studies at 26° - Setting 9

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target** e^-	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LH2	60	-1	3	-1	3	15 min	120K	
LH2	60	3	-1	3	-1	5 min	-	
LD2	60	4	-1	4	-1	5 min	-	
LD2	60	-1	4	-1	4	10 min	120K	
Al dummy	40	-1	1	-1	1	10 min	30K	
Al dummy	40	1	-1	1	-1	5 min	-	
40Ca	60	3	-1	3	-1	5 min	-	
40Ca	60	-1	3	-1	3	15 min	120K	
12C	60	-1	1	-1	1	10 min	120K	
12C	60	1	-1	1	-1	5 min	-	

2.2 Charge Symmetric Background Studies at 26°- Part I

- BEWARE of the POLARITY CHANGE IN THIS SECTION
- All data in this section will be taken with the **positive** polarity.

2.2.1 Setting 1

- Set **SHMS momentum** to **+2.86 GeV**.
- Set **HMS momentum** to **+2.86 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS3 (ELCLEAN) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 21 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 21. Take data with the SHMS and HMS simultaneously.

Table 21: CSB Studies at 26° - Setting 1

Target	***I***	**HMS PS**			**SHMS PS**			**Est. Time**	Done ?
	(μA)	PS1	PS2	PS3	PS1	PS2	PS3		
12C	60	-1	-1	0	-1	-1	0	10 min	
12C	60	0	-1	-1	0	-1	-1	10 min	
40Ca	60	0	-1	-1	0	-1	-1	10 min	
40Ca	60	-1	-1	0	-1	-1	0	10 min	

2.2.2 Setting 2

- Set **SHMS momentum** to **+2.52 GeV**.
- Set **HMS momentum** to **+2.52 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS3 (ELCLEAN) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 22 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 22. Take data with the SHMS and HMS simultaneously.

Table 22: CSB Studies at 26° - Setting 2

Target	***I***	**HMS PS**			**SHMS PS**			**Est. Time**	Done ?
	(μA)	PS1	PS2	PS3	PS1	PS2	PS3		
40Ca	60	-1	-1	0	-1	-1	0	10 min	
40Ca	60	0	-1	-1	0	-1	-1	10 min	
12C	60	0	-1	-1	0	-1	-1	10 min	
12C	60	-1	-1	0	-1	-1	0	10 min	
Al dummy	40	-1	-1	0	-1	-1	0	10 min	
Al dummy	40	0	-1	-1	0	-1	-1	10 min	
LD2	60	0	-1	-1	0	-1	-1	10 min	
LD2	60	-1	-1	0	-1	-1	0	10 min	
LH2	60	-1	-1	0	-1	-1	0	10 min	
LH2	60	0	-1	-1	0	-1	-1	10 min	

2.2.3 Setting 3

- Set **SHMS momentum** to **+2.21 GeV**.
- Set **HMS momentum** to **+2.21 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS3 (ELCLEAN) **OR** SHMS/HMS PS1 (3/4)

- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 23 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 23. Take data with the SHMS and HMS simultaneously.

Table 23: CSB Studies at 26° - Setting 3

Target	***I***	**HMS PS**			**SHMS PS**			**Est. Time**	Done ?
	(μA)	PS1	PS2	PS3	PS1	PS2	PS3		
40Ca	60	-1	-1	0	-1	-1	0	10 min	
40Ca	60	0	-1	-1	0	-1	-1	10 min	
12C	60	0	-1	-1	0	-1	-1	10 min	
12C	60	-1	-1	0	-1	-1	0	10 min	

2.2.4 Setting 4

- Set **SHMS momentum** to **+1.95 GeV**.
- Set **HMS momentum** to **+1.95 GeV**.
- **SHMS angle: 26°**
- **HMS angle: 26°**
- **Trigger**: SHMS/HMS PS3 (ELCLEAN) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 24 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Follow Table 24. Take data with the SHMS and HMS simultaneously.

- Total estimated time for section 2.2 including the momentum and target changes: **10 hrs**. Estimated run times are with 100% efficiency.

Table 24: CSB Studies at 26° - Setting 4

Target	***I***	**HMS PS**			**SHMS PS**			**Est. Time**	Done ?
	(μA)	PS1	PS2	PS3	PS1	PS2	PS3		
12C	60	-1	-1	0	-1	-1	0	10 min	
12C	60	0	-1	-1	0	-1	-1	10 min	
40Ca	60	0	-1	-1	0	-1	-1	10 min	
40Ca	60	-1	-1	0	-1	-1	0	10 min	
Al dummy	40	-1	-1	0	-1	-1	0	10 min	
Al dummy	40	0	-1	-1	0	-1	-1	10 min	
LD2	60	0	-1	-1	0	-1	-1	10 min	
LD2	60	-1	-1	0	-1	-1	0	10 min	
LH2	60	-1	-1	0	-1	-1	0	10 min	
LH2	60	0	-1	-1	0	-1	-1	10 min	

2.3 Charge Symmetric Background Studies at 20°- Part I

- **BEWARE:** the POLARITY is STILL POSITIVE
- **SHMS S1X (1-7)** and **S2X (1-7)** on BOTH left and right sides are **OFF**

2.3.1 Setting 1

- Turn the **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles **OFF**.
- Set **HMS momentum** to **+3.40 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: +9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS3 (ELCLEAN) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 25 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Take data with the SHMS and HMS simultaneously.

Table 25: CSB Studies at 20° - Setting 1

Target	***I***	**HMS PS**			**SHMS PS**			**Est. Time**	Done ?
	(μA)	PS1	PS2	PS3	PS1	PS2	PS3		
LD2	60	-1	-1	0	-1	-1	0	10 min	
12C	60	-1	-1	0	-1	-1	0	10 min	
12C	60	0	-1	-1	0	-1	-1	10 min	
40Ca	60	0	-1	-1	0	-1	-1	10 min	
40Ca	60	-1	-1	0	-1	-1	0	10 min	

2.3.2 Setting 2

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **+3.04 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: +9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS3 (ELCLEAN) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 26 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Take data with the SHMS and HMS simultaneously.

Table 26: CSB Studies at 20° - Setting 2

Target	***I***	**HMS PS**			**SHMS PS**			**Est. Time**	Done ?
	(μA)	PS1	PS2	PS3	PS1	PS2	PS3		
40Ca	60	-1	-1	0	-1	-1	0	10 min	
40Ca	60	0	-1	-1	0	-1	-1	10 min	
12C	60	0	-1	-1	0	-1	-1	10 min	
12C	60	-1	-1	0	-1	-1	0	10 min	
LD2	60	-1	-1	0	-1	-1	0	10 min	

2.3.3 Setting 3

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **+2.71 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: +9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS3 (ELCLEAN) **OR** SHMS/HMS PS1 (3/4)

- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 27 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Take data with the SHMS and HMS simultaneously.

Table 27: CSB Studies at 20° - Setting3

Target	***I***	**HMS PS**			**SHMS PS**			**Est. Time**	Done ?
	(μA)	PS1	PS2	PS3	PS1	PS2	PS3		
LD2	60	-1	-1	0	-1	-1	0	10 min	
LH2	60	-1	-1	0	-1	-1	0	10 min	
12C	60	0	-1	-1	0	-1	-1	10 min	
12C	60	-1	-1	0	-1	-1	0	10 min	
Ca40	60	-1	-1	0	-1	-1	0	10 min	
Ca40	60	0	-1	-1	0	-1	-1	10 min	

2.3.4 Setting 4

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **+2.421 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: +9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS3 (ELCLEAN) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 28 should be set to **-1**.
- **Prescale values are only estimated; adjust them on both SHMS and HMS Prescale GUIs accordingly to keep the rates below 3 kHz.**
- Take data with the SHMS and HMS simultaneously.

- Total estimated time for section 2.3 including the momentum and target changes: **16.5 hrs**. Estimated run times are with 100% efficiency.

Table 28: CSB Studies at 20° - Setting 4

Target	***I***	**HMS PS**			**SHMS PS**			**Est. Time**	Done ?
	(μA)	PS1	PS2	PS3	PS1	PS2	PS3		
Ca40	60	-1	-1	0	-1	-1	0	10 min	
Ca40	60	0	-1	-1	0	-1	-1	10 min	
Be9	60	0	-1	-1	0	-1	-1	10 min	
Be9	60	-1	-1	0	-1	-1	0	10 min	
Al dummy	40	-1	-1	0	-1	-1	0	10 min	
Al dummy	40	0	-1	-1	0	-1	-1	10 min	
LH2	60	-1	-1	0	-1	-1	0	10 min	
LH2	60	0	-1	-1	0	-1	-1	10 min	
LD2	60	0	-1	-1	0	-1	-1	10 min	
LD2	60	-1	-1	0	-1	-1	0	10 min	
Ca48	60	0	-1	-1	0	-1	-1	10 min	
Ca48	60	-1	-1	0	-1	-1	0	10 min	
C12	60	-1	-1	0	-1	-1	0	10 min	
C12	60	0	-1	-1	0	-1	-1	10 min	
B4C-11	60	0	-1	-1	0	-1	-1	10 min	
B4C-11	60	-1	-1	0	-1	-1	0	10 min	
B4C-10	60	-1	-1	0	-1	-1	0	10 min	
B4C-10	60	0	-1	-1	0	-1	-1	10 min	
Sn (Tin)	40	-1	-1	0	-1	-1	0	10 min	
Sn (Tin)	40	0	-1	-1	0	-1	-1	10 min	
Titanium	40	0	-1	-1	0	-1	-1	10 min	
Titanium	40	-1	-1	0	-1	-1	0	10 min	
54Fe	40	-1	-1	0	-1	-1	0	10 min	
54Fe	40	0	-1	-1	0	-1	-1	10 min	
108Ag	60	0	-1	-1	0	-1	-1	10 min	
108Ag	60	-1	-1	0	-1	-1	0	10 min	
232Thorium	60	-1	-1	0	-1	-1	0	10 min	
232Thorium	60	0	-1	-1	0	-1	-1	10 min	
Ni58	60	0	-1	-1	0	-1	-1	10 min	
Ni58	60	-1	-1	0	-1	-1	0	10 min	
Ni64	60	-1	-1	0	-1	-1	0	10 min	
Ni64	60	0	-1	-1	0	-1	-1	10 min	

2.4 20° EMC and 8° 2N-SRC Running - Target Ladder I

- Before starting, change polarity of spectrometers to "ELECTRON"
- Data will be taken with the SHMS and HMS simultaneously in the single arm mode using several targets on the target ladder I.
- For the entire section of 2.4: **SHMS S1X (1-7)** and **S2X (1-7)** on BOTH left and right sides are **OFF**
- Spectrometer Configurations:
  1. **SHMS angle: 8°**
  2. **SHMS momentum: -9.2 GeV**
  3. **HMS angle: 20°**
- While the above-mentioned SHMS angle, SHMS momentum, and HMS angle will be kept the same, the HMS will be configured to several different momentum settings. Please follow the tables below in the order written.

2.4.1 Setting 1

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-6.6 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 29 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 29. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 29: 20° EMC and 8° 2N-SRC Running - Setting 1

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target e^-**	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LD2	60	-1	0	-1	5	130 min	390K	
LH2	60	-1	0	-1	3	1 hr	120K	
Al dummy	40	-1	0	-1	0	35 min	65K	
9Be	60	-1	0	-1	4	15 min	45K	
40Ca	60	-1	0	-1	3	80 min	180K	
40Ca	60	0	-1	3	-1	5 min	-	
48Ca	40	-1	0	-1	2	2 hrs	180K	
12C	60	-1	0	-1	3	2 hrs	180K	
12C	60	0	-1	3	-1	5 min	-	
B4C-11	60	-1	0	-1	3	1 hr	90K	
B4C-10	60	-1	0	-1	3	45 min	90K	
Sn (Tin)	40	-1	0	-1	2	45 min	45K	
Titanium	40	-1	0	-1	1	1.5 hr	45K	
54Fe	40	-1	0	-1	1	1 hr	45K	
108Ag	60	-1	0	-1	3	30 min	45K	
232Thorium	60	-1	0	-1	2	45 min	45K	
58Ni	60	-1	0	-1	1	1 hr	45K	
64Ni	60	-1	0	-1	1	1 hr	45K	

2.4.2 Setting 2

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-5.878 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 30 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 30. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 30: 20° EMC and 8° 2N-SRC Running - Setting 2

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target e^-**	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
64Ni	60	-1	0	-1	1	75 min	230K	
58Ni	60	-1	0	-1	1	75 min	230K	
232Thorium	60	-1	0	-1	2	1 hr	230K	
108Ag	60	-1	0	-1	3	35 min	230K	
54Fe	40	-1	0	-1	1	70 min	230K	
Titanium	40	-1	0	-1	1	2 hrs	230K	
Sn (Tin)	40	-1	0	-1	2	1 hr	230K	
B4C-10	60	-1	0	-1	3	70 min	460K	
B4C-11	60	-1	0	-1	3	1 hr	460K	
12C	60	-1	0	-1	3	2.5 hrs	920K	
12C	60	0	-1	3	-1	5 min	-	
48Ca	40	-1	0	-1	2	2.5 hrs	920K	
40Ca	60	-1	0	-1	3	1.5 hrs	920K	
40Ca	60	0	-1	3	-1	5 min	-	
9Be	60	-1	0	-1	4	20 min	230K	
Al dummy	40	-1	0	-1	0	35 min	430K	
LH2	60	-1	0	-1	3	25 min	200K	
LD2	60	-1	0	-1	5	130 min	2.6M	

2.4.3 Setting 3

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-5.36 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 31 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 31. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 31: 20° EMC and 8° 2N-SRC Running - Setting 3

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target e^-**	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LD2	60	-1	0	-1	5	10 min	670K	
LH2	60	-1	0	-1	3	20 min	670K	
Al dummy	40	-1	0	-1	0	10 min	110K	
9Be	60	-1	0	-1	4	20 min	670K	
40Ca	60	-1	0	-1	3	1.5 hrs	2.7M	
40Ca	60	0	-1	3	-1	5 min	-	
48Ca	40	-1	0	-1	2	2.5 hrs	2.7M	
12C	60	0	-1	3	-1	5 min	-	
12C	60	-1	0	-1	3	2.5 hrs	2.7M	
B4C-11	60	-1	0	-1	3	1 hr	1.3M	
B4C-10	60	-1	0	-1	3	70 min	1.3M	
Sn (Tin)	40	-1	0	-1	2	1 hr	670K	
Titanium	40	-1	0	-1	1	2 hrs	670K	
54Fe	40	-1	0	-1	1	70 min	670K	
108Ag	60	-1	0	-1	3	35 min	670K	
232Thorium	60	-1	0	-1	2	1 hr	670K	
58Ni	60	-1	0	-1	1	75 min	670K	
64Ni	60	-1	0	-1	1	75 min	670K	

2.4.4 Setting 4

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-4.78 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 32 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 32. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 32: 20° EMC and 8° 2N-SRC Running - Setting 4

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target e^-**	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
64Ni	60	-1	0	-1	1	30 min	550K	
58Ni	60	-1	0	-1	1	30 min	550K	
232Thorium	60	-1	0	-1	2	20 min	550K	
108Ag	60	-1	0	-1	3	15 min	550K	
54Fe	40	-1	0	-1	1	25 min	550K	
Titanium	40	-1	0	-1	1	45 min	550K	
Sn (Tin)	40	-1	0	-1	2	20 min	550K	
B4C-10	60	-1	0	-1	3	25 min	1.1M	
B4C-11	60	-1	0	-1	3	20 min	1.1M	
12C	60	-1	0	-1	3	1 hr	2.2M	
12C	60	0	-1	3	-1	5 min	-	
48Ca	40	-1	0	-1	2	3 hrs	2.2M	
40Ca	60	-1	0	-1	3	2.5 hrs	2.2M	
40Ca	60	0	-1	3	-1	5 min	-	
9Be	60	-1	0	-1	4	10 min	550K	
Al dummy	40	-1	0	-1	0	10 min	92K	
LH2	60	-1	0	-1	3	10 min	550K	
LD2	60	-1	1	-1	5	10 min	550K	

2.4.5 Setting 5

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-4.27 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 33 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 33. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 33: 20° EMC and 8° 2N-SRC Running - Setting 5

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target e^-**	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LD2	60	-1	2	-1	5	10 min	320K	
LH2	60	-1	1	-1	3	10 min	320K	
Al dummy	40	-1	0	-1	0	10 min	53K	
9Be	60	-1	1	-1	4	10 min	320K	
40Ca	60	-1	0	-1	3	20 min	1.2M	
40Ca	60	0	-1	3	-1	5 min	-	
48Ca	40	-1	0	-1	2	25 min	1.2M	
12C	60	-1	0	-1	3	25 min	1.2M	
12C	60	0	-1	3	-1	5 min	-	
B4C-11	60	-1	0	-1	3	10 min	650K	
B4C-10	60	-1	0	-1	3	10 min	650K	
Sn (Tin)	40	-1	0	-1	2	10 min	320K	
Titanium	40	-1	0	-1	1	20 min	320K	
54Fe	40	-1	0	-1	1	15 min	320K	
108Ag	60	-1	0	-1	3	10 min	320K	
232Thorium	60	-1	2	-1	0	10 min	320K	
58Ni	60	-1	0	-1	1	15 min	320K	
64Ni	60	-1	0	-1	1	15 min	320K	

2.4.6 Setting 6

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-3.81 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 34 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 34. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 34: 20° EMC and 8° 2N-SRC Running - Setting 6

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target e^-**	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
64Ni	60	-1	0	-1	1	10 min	220K	
58Ni	60	-1	0	-1	1	10 min	220K	
232Thorium	60	-1	0	-1	2	10 min	220K	
108Ag	60	-1	0	-1	3	10 min	220K	
54Fe	40	-1	0	-1	1	10 min	220K	
Titanium	40	-1	0	-1	1	10 min	220K	
Sn (Tin)	40	-1	0	-1	2	10 min	220K	
B4C-10	60	-1	0	-1	3	10 min	440K	
B4C-11	60	-1	0	-1	3	10 min	440K	
12C	60	-1	0	-1	3	15 min	880K	
12C	60	0	-1	3	-1	5 min	-	
48Ca	40	-1	0	-1	2	15 min	880K	
40Ca	60	-1	0	-1	3	20 min	880K	
40Ca	60	0	-1	3	-1	5 min	-	
9Be	60	-1	1	-1	4	10 min	220K	
Al dummy	40	-1	0	-1	0	10 min	35K	
LH2	60	-1	1	-1	3	10 min	220K	
LD2	60	-1	2	-1	5	10 min	220K	

2.4.7 Setting 7

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-3.40 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 35 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 35. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 35: 20° EMC and 8° 2N-SRC Running - Setting 7

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target e^-**	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LD2	60	-1	3	-1	5	10 min	150K	
LH2	60	-1	2	-1	3	10 min	150K	
Al dummy	40	-1	1	-1	1	10 min	25K	
9Be	60	-1	2	-1	4	10 min	150K	
40Ca	60	-1	0	-1	3	20 min	600K	
40Ca	60	0	-1	3	-1	5 min	-	
48Ca	40	-1	0	-1	2	10 min	600K	
12C	60	-1	0	-1	3	20 min	600K	
12C	60	0	-1	3	-1	5 min	-	
B4C-11	60	-1	1	-1	3	10 min	300K	
B4C-10	60	-1	1	-1	3	10 min	300K	
Sn (Tin)	40	-1	0	-1	2	10 min	150K	
Titanium	40	-1	0	-1	1	10 min	150K	
54Fe	40	-1	0	-1	1	10 min	150K	
108Ag	60	-1	1	-1	3	10 min	150K	
232Thorium	60	-1	0	-1	2	10 min	150K	
58Ni	60	-1	0	-1	1	10 min	150K	
64Ni	60	-1	0	-1	1	10 min	150K	

2.4.8 Setting 8

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-3.04 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 36 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 36. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 36: 20° EMC and 8° 2N-SRC Running - Setting 8

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target e^-**	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
64Ni	60	-1	0	-1	1	10 min	120K	
58Ni	60	-1	0	-1	1	10 min	120K	
232Thorium	60	-1	1	-1	2	10 min	120K	
108Ag	60	-1	1	-1	3	10 min	120K	
54Fe	40	-1	0	-1	1	10 min	120K	
Titanium	40	-1	0	-1	1	10 min	120K	
Sn (Tin)	40	-1	1	-1	2	10 min	120K	
B4C-10	60	-1	2	-1	3	10 min	250K	
B4C-11	60	-1	2	-1	3	10 min	250K	
12C	60	0	-1	3	-1	5 min	-	
12C	60	-1	0	-1	3	15 min	500K	
48Ca	40	-1	1	-1	2	25 min	500K	
40Ca	60	-1	3	-1	3	25 min	500K	
40Ca	60	3	-1	3	-1	5 min	-	
9Be	60	-1	1	-1	4	15 min	500K	
Al dummy	40	-1	1	-1	1	10 min	20K	
LH2	60	-1	3	-1	3	10 min	120K	
LD2	60	-1	0	-1	5	10 min	120K	

2.4.9 Setting 9

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-2.71 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 37 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 37. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 37: 20° EMC and 8° 2N-SRC Running - Setting 9

Target	***I***	**HMS PS**		**SHMS PS**		**Est. Time**	**Target** e^-	**Done ?**
	(μA)	PS1	PS2	PS1	PS2			
LD2	60	-1	4	-1	5	10 min	90K	
LH2	60	-1	4	-1	3	10 min	90K	
Al dummy	40	-1	1	-1	1	10 min	15K	
9Be	60	-1	3	-1	4	10 min	90K	
40Ca	60	-1	3	-1	3	20 min	360K	
40Ca	60	3	-1	3	-1	5 min	-	
48Ca	40	-1	2	-1	2	15 min	360K	
12C	60	-1	2	-1	3	15 min	360K	
12C	60	2	-1	3	-1	5 min	-	
B4C-11	60	-1	3	-1	3	10 min	180K	
B4C-10	60	-1	3	-1	3	10 min	180K	
Sn (Tin)	40	-1	2	-1	2	10 min	90K	
Titanium	40	-1	0	-1	1	10 min	90K	
54Fe	40	-1	1	-1	1	10 min	90K	
108Ag	60	-1	3	-1	3	10 min	90K	
232Thorium	60	-1	2	-1	2	10 min	90K	
58Ni	60	-1	1	-1	1	10 min	90K	
64Ni	60	-1	1	-1	1	10 min	90K	

2.4.10 Setting 10

- Make sure **SHMS S1X (1-7)** and **S2X (1-7)** LEFT and RIGHT hodoscope paddles are **OFF**.
- Set **HMS momentum** to **-2.42 GeV**.
- **SHMS angle: 8°**
- **SHMS momentum: -9.2 GeV**
- **HMS angle: 20°**
- **Trigger**: SHMS/HMS PS2 (ELREAL) **OR** SHMS/HMS PS1 (3/4)
- **Important note on the prescales:** All the other prescales that are NOT specified on each row at the Table 38 should be set to **-1**.
- **NOTE: Prescale values are only estimated, adjust them accordingly to keep the rates below 3 kHz.**
- Follow Table 38. Take data with the SHMS and HMS simultaneously.
- Estimated run times are with 100% efficiency.

Table 38: 20° EMC and 8° 2N-SRC Running - Setting 10

Target	***I*** (μA)	**HMS PS** PS1	PS2	**SHMS PS** PS1	PS2	**Est. Time**	**Target** e^-	**Done ?**
64Ni	60	-1	2	-1	1	10 min	75K	
64Ni	60	2	-1	1	-1	5 min	-	
58Ni	60	2	-1	1	-1	5 min	-	
58Ni	60	-1	2	-1	1	10 min	75K	
232Thorium	60	-1	2	-1	2	10 min	75K	
232Thorium	60	2	-1	2	-1	5 min	-	
108Ag	60	3	-1	3	-1	5 min	-	
108Ag	60	-1	3	-1	3	10 min	75K	
54Fe	40	-1	1	-1	1	10 min	75K	
54Fe	40	1	-1	1	-1	5 min	-	
Titanium	40	1	-1	1	-1	5 min	-	
Titanium	40	-1	1	-1	1	10 min	75K	
Sn (Tin)	40	-1	2	-1	2	10 min	75K	
Sn (Tin)	40	2	-1	2	-1	5 min	-	
B4C-10	60	3	-1	3	-1	5 min	-	
B4C-10	60	-1	3	-1	3	10 min	150K	
B4C-11	60	-1	3	-1	3	10 min	150K	
B4C-11	60	3	-1	3	-1	5 min	-	
12C	60	3	-1	3	-1	5 min	-	
12C	60	-1	3	-1	3	20 min	300K	
48Ca	40	-1	3	-1	2	20 min	300K	
48Ca	40	3	-1	2	-1	5 min	-	
40Ca	60	4	-1	3	-1	5 min	-	
40Ca	60	-1	4	-1	3	25 min	300K	
9Be	60	-1	4	-1	4	10 min	75K	
9Be	60	4	-1	4	-1	5 min	-	
Al dummy	40	2	-1	2	-1	5 min	-	
Al dummy	40	-1	2	-1	2	10 min	12K	
LH2	60	4	-1	3	-1	5 min	-	
LH2	60	-1	4	-1	3	10 min	75K	
LD2	60	-1	5	-1	5	10 min	75K	
LD2	60	5	-1	5	-1	5 min	-	

BEFORE MOVING ON TO THE NEXT SECTION TURN ALL OF THE HODOSCOPE HV CHANNELS BACK ON!

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2.5 Target Boiling Studies - Part I

- This study requires stable high current. It will be postponed if high current beam is unavailable at the moment.
- **DAQ:** Single Arm
- **SHMS/HMS Trigger:** PS2 (ELREAL)/PS2 (ELREAL)
- **SHMS Settings:** -4.0 GeV & 20°
- **HMS Settings:** -4.0 GeV & 20°
- Adjust the prescales (SHMS PS2 and HMS PS2) to keep the rates below 3 kHz. All the other prescales should be set to **-1**.
- The goal number of events is 50K-100K for each target at every current.

2.5.1 Boiling studies - LH2 target

- Move target to LH2 and take one run with **each current setting**.

Table 39: Boiling Studies - LH2 Target

Target	***I*** **(μA)**	**est. time**	**Done ?**
LH2	80 μA	10 min	
LH2	60 μA	10 min	
LH2	40 μA	10 min	
LH2	30 μA	10 min	
LH2	20 μA	10 min	
LH2	10 μA	10 min	

2.5.2 Boiling studies - LD2 target

- Move target to LD2 and take one run with each current setting.

Table 40: Boiling Studies - LD2 Target

Target	***I*** **(μA)**	**est. time**	**Done ?**
LD2	80 μA	10 min	
LD2	60 μA	10 min	
LD2	40 μA	10 min	
LD2	30 μA	10 min	
LD2	20 μA	10 min	
LD2	10 μA	10 min	

2.5.3 Al dummy target data for target wall subtraction

- Move target to Al dummy and take a 10 min run at 40 μA.
- Since this data will be used for the target wall subtraction, no current scan will be performed. We will take data only with 40 μA current.

Table 41: Al dummy target data for target wall subtraction

Target	***I*** **(μA)**	**est. time**	**Done ?**
dummy	40 μA	10 min	
dummy	30 μA	10 min	
dummy	20 μA	10 min	
dummy	10 μA	10 min	

2.5.4 Boiling studies - Beryllium target

- Move target to Beryllium and take one run with each current setting.

Table 42: Boiling Studies - Beryllium Target

Target	***I*** **(μA)**	**est. time**	**Done ?**
Beryllium	70 μA	10 min	
Beryllium	60 μA	10 min	
Beryllium	40 μA	10 min	
Beryllium	30 μA	10 min	
Beryllium	20 μA	10 min	
Beryllium	10 μA	10 min	

2.5.5 Boiling studies - Carbon target

- Move target to Carbon and take one run with each current setting.

Table 43: Boiling Studies - Carbon Target

Target	***I*** **(μA)**	**est. time**	**Done ?**
Carbon	70 μA	10 min	
Carbon	60 μA	10 min	
Carbon	40 μA	10 min	
Carbon	30 μA	10 min	
Carbon	20 μA	10 min	
Carbon	10 μA	10 min	

Total estimated time for section 1.5 including the momentum and target changes: **7 hrs** with 100% efficiency.

2.6 BCM Calibration - Part I

Need a reliable beam delivery of high current 70-80 uA RC needs to coordinate this with the PD.