NPS-DVCS: Jan-May 2024

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15 April 2024, updated plan

Abstract

A plan for completing the NPS 2023-2024 by 07:00 on 20 May 2024. Dates for Pb shield removal updated as of 20-Feb. As of 4-Mar, decision made not to remove wings. Adjustments to KinC_x25_4. 3-Pass and 4-Pass accelerator schedule adjustable.

1 Angle Constraints

There are tight constraints on the HMS and SHMS angles that must be respected. These are particularly challenging for the low-x_{Bj} settings. In those cases I have slightly tweaked the NPS calorimeter angle(s) to respect the minimum HMS-SHMS separation requirements.

Requirements

1. HMS minimum angle 12.373 deg. This is due to an interference with the special NPS beam pipe. This is independent of all other constraints
2. NPS-HMS Separation
   (a) Current minimum separation between NPS and HMS is 26 deg. This corresponds to an SHMS to HMS separation $\geq 42.3°$. We may need a new verification / spotting for less than 27 deg.
   (b) Revised date for the wings to come off the Sweep Magnet is 4-March-2024. Then the minimum separation angle is expected to drop to 24.14 deg (SHMS-HMS $\geq 40.44°$. This will need to be re-certified by S. Lassiter.
   (c) Prefer to restore the wings March 11 or 12.
3. NPS Minimum angle constraints
   (a) Current NPS angle requirement is $\gtrsim$ 12.00 deg, but spotters are needed below 12.20°. This is due to the Pb blocks mounted on the back of the Sweep Magnet. This shield can come off anytime, Removal is happening 22-Feb-2024.
   (b) After removal of Pb on Sweep Magnet, the minimum planned angle is 7.4 deg.

2 Remaining 5-Pass Run Plan

Table 1 is a proposed chronological run plan for the remaining 5-pass running.

At 4 m, the calorimeter horizontal acceptance (relative to the geometric midline) is -13 columns and $+15$ column. This is -260 mm and $+300mm$. At 3 m, we expected ± 100 mrad At 4 m, I am tuning the split kinematics to achieve this ± 100 mrad horizontal acceptance. In angular acceptance at 4 m, this means the two calorimeter angle settings that split the statistics are offset from the nominal q-vector direction by -35 mrad $= -2.005°$ and $+25$ mrad $= +1.432°$. These are spatial offsets of -140 mm and $+100$ mm.

Table 1: **Chronological Run Plan for Final 5-Pass NPS Running** 22-Jan to 11-Mar 2024 (07:00). Starting times are assumed $\sim 08:00$. Measured 5-Pass energy is $10,544 \pm 4$ MeV.

Kinematic	Start 2024	x_{Bj}	Q^2 GeV^2	$k_{\rm HMS}$ GeV	$\theta_{\rm HMS}$ deg	$\theta_{\rm NPS}$ deg	$\theta_{\rm SHMS}$ deg	$\theta_{\rm NPS}$ $+\theta_{\rm HMS}$ deg	$D_{\rm Calo}$ m
KinC_x50_2	22-Jan	0.48	3.40						
KinC_x50_3	26-Jan	0.48	4.80						
KinC_x36_5'	29-Jan	0.36	4.00	4.637	16.435	14.000	30.300	30.434	4.00
KinC_x60_3a	1-Feb	0.58	5.10	5.878	16.483	16.713	33.013	33.196	4.00
KinC_x60_3b						20.151	36.451	36.633	
KinC_x60_4a	7-Feb	0.58	6.00	5.038	19.348	14.075	30.375	33.422	4.00
KinC_x60_4b						17.512	33.812	36.860	
	22-Feb	Remove Pb-Shield on Sweep Magnet, Survey NPS to 7.4 deg Replace PMT bases on Columns 24, 25							
KinC_x36_6	23-Feb	0.36	5.00	2.416	26.849	7.400	23.700	34.250	6.00
		Positron runs Monday 26-Feb for $\sim 10\%$ beam charge							
	4-Mar	Certify HMS-SHMS angle							
KinC_x25_4	4-Mar	0.250	3.00	4.149	15.200	11.200	27.500	26.400	4.00
Elastic	10-Mar	1	6.52	+4.310	28.670	15.565	31.865	44.235	9.5
						16.870	33.170		
						18.170	34.470		
	11-Mar	Change to 3-Pass							

3 Spring 2024 3-Pass and 4-Pass Runs

3.1 3-Pass Schedule

We will have 25 days of 3-Pass beam (including pass-change) March 11 to April 5. We will have an additional 15 days of 3-Pass beam May 5–20.

A sequential schedule of 3-Pass running is listed in Table 2. The kinematics are sorted in order of decreasing calorimeter angle to maximally preserve the calorimeter. An alternate schedule, with all 3-pass running in one block is presented in Table 3.

Some scheduling details:

1. From April 2 – May 6, we will have 90% of the cathode polarization if we run at 4-Pass or 95% of the cathode polarization if we ran at 3-Pass. This is the result of the Hall-A 2-Pass run.

2. From May 7-10 we must run at 4-Pass (Hall A will be at 3-Pass), and will receive somewhere from 50% to 70% of the cathode polarization.

3. For KinC_x60_1, the revised charge goal is 16 Coul, to match the statistics acquired in the 5-Pass KinC_x60_3 run.

4. For KinC_x60_1, if we run with the Calo at 4.0 m, the π^0 acceptance will be $\sim 10\%$ lower than the acceptance of KinC_x50_0 at 3.0 m

Table 2: Chronological Run Plan for 3-Pass NPS Running. Starting times are assumed $\sim 08:00$. Expected 3-Pass energy is 6397 MeV. All calorimeter distances are 4.00 m. Days are **Calendar** days, assuming 50% efficiency. Calendar Days include equal statistics on LH_2 and LD_2, with deuterium running at half the beam current as hydrogen.

Kinematic	Start 2024	x_{Bj}	Q^2 GeV^2	$k_{\rm HMS}$ GeV	$\theta_{\rm HMS}$ deg	$\theta_{\rm NPS}$ deg	$\theta_{\rm SHMS}$ deg	$\theta_{\rm NPS}+\theta_{\rm HMS}$ deg	Days
Elastic	11-Mar	3-Pass Elastic. Calorimeter at 9.5 m							
KinC_x50_0a	12-Mar	0.48	3.40	2.638	25.940	14.400	30.700	40.340	9.0
KinC_x50_0b						17.610	33.910	43.550	
KinC_x50_0	π/e ratio ≈ 2. Positron running not needed?								0
KinC_x60_1a	21-Mar	0.58	5.10	1.719	39.81	12.240	28.540	52.05	16
KinC_x60_1b						14.000	30.300	53.81	
KinC_x60_1	π/e ratio ≈ 11. Positron runs 0.25 C/target/(a,b)								0.6
	5-Apr	Schedule break for 4-pass							
KinC_x60_1	5-May	0.58	5.10	1.719	39.81	12.24	28.54	52.05	8
KinC_x36_1	13-May	0.36	3.00	1.956	28.341	11.235	27.535	39.576	3
	π/e ratio ≈ 16. Positron run 0.17 C/target								
KinC_x25_1	16-May	0.24	2.10	1.734	25.129	8.675	24.975	33.804	3
	π/e ratio ≈ 260. Positron running required								

Table 3: Alternate Run Plan for 3-Pass NPS Running. 4-pass running postponed to May.

Kinematic	Start 2024	x_{Bj}	Q^2 GeV^2	$k_{\rm HMS}$ GeV	$\theta_{\rm HMS}$ deg	$\theta_{\rm NPS}$ deg	$\theta_{\rm SHMS}$ deg	$\theta_{\rm NPS}+\theta_{\rm HMS}$ deg	Days
Elastic	11-Mar	3-Pass Elastic. Calorimeter at 9.5 m							
KinC_x50_0a	12-Mar	0.48	3.40	2.638	25.940	14.000	30.700	40.340	9.0
KinC_x50_0b						17.610	33.910	43.550	
KinC_x50_0	18-20 March, Calo at 3.0 m								1.5
KinC_x60_1	23-Mar	0.58	5.10	1.719	39.81	14.400	30.700	54.21	22
	π/e ratio ≈ 11. Positron runs 0.25 C/target/(a,b)								0.6
KinC_x36_1	14-Apr	0.36	3.00	1.956	28.341	11.235	27.535	39.576	3
	π/e ratio ≈ 16. Positron run 0.17 C/target								
KinC_x25_1	19-Apr	0.24	2.10	1.734	25.129	8.675	24.975	33.804	3
	π/e ratio ≈ 260. Positron running required								
Elastic	22-Apr	3-Pass Elastic Calibration							
	23-Apr	Change to 4-Pass							

3.2 4-Pass Schedule

We will have 21 days of 4-Pass beam (including pass-change) April 5–29. April 29 to May 5 we can potentially have either 3- or 4-pass beam, but neither will be polarized more than $\sim 50\%$.

Table 4: **Chronological Run Plan for Final 4-Pass NPS Running**. Starting times are assumed $\sim 08:00$. Measured 4-Pass energy is $8,477 \pm 4$ MeV. All calorimeter distances are 4.00 m. Days are **Calendar** days, assuming 50% efficiency. Calendar Days include equal statistics on LH_2 and LD_2, with deuterium running at half the beam current as hydrogen.

Kinematic	Start 2024	x_{Bj}	Q^2 GeV^2	$k_{\rm HMS}$ GeV	$\theta_{\rm HMS}$ deg	$\theta_{\rm NPS}$ deg	$\theta_{\rm SHMS}$ deg	$\theta_{\rm NPS}+\theta_{\rm HMS}$ deg	Days
KinC_x36_2a	6-Apr	0.36	3.00	4.042	17.010	12.360	28.660	29.370	2
KinC_x36_2b						15.795	32.095	32.805	
KinC_x36_4	8-Apr	0.36	4.00	2.562	24.775	9.890	26.190	34.665	6
KinC_x60_2a	14-Apr	0.58	5.10	3.805	22.925	14.575	30.875	37.500	6
KinC_x60_2b						18.015	34.315	40.940	
KinC_x25_2	20-Apr	0.24	2.10	3.820	14.625	11.395	27.695	26.020	4
KinC_x25_3	24-Apr	0.25	2.98	2.131	23.695	7.395	23.695	30.820	4
	Positron running for KinC_x25_2 & _3 could be Apr 29-30								
	29-Apr	Elastic Calibration (no polarization)							6

Table 5: **Revised Run Plan for Final 4-Pass NPS Running**. Starting times are assumed $\sim 08:00$. Measured 4-Pass energy is 8477 ± 4 MeV. Calorimeter distances TBD, 4.00 or 3.50 m. Days are **Calendar** days, assuming 50% efficiency. Calendar Days include equal statistics on LH_2 and LD_2, with deuterium running at half the beam current as hydrogen. KinC_x36_2 was completed in Dec. Minimum SHMS angle for remote rotation is 27.50 deg.

Kinematic	Start 2024	x_{Bj}	Q^2 GeV^2	$k_{\rm HMS}$ GeV	$\theta_{\rm HMS}$ deg	$\theta_{\rm NPS}$ deg	$\theta_{\rm SHMS}$ deg	$\theta_{\rm NPS}+\theta_{\rm HMS}$ deg	Days
Elastic	23-Apr	4-Pass Elastic Calibration							1
KinC_x36_4	24-Apr	0.36	4.00	2.562	24.775	9.890	26.190	34.665	6
KinC_x60_2a	1-May	0.58	5.10	3.805	22.925	14.575	30.875	37.500	6
KinC_x60_2b						18.015	34.315	40.940	
Hall A	6-10 May	Hall A at 3-pass, pol.$\sim 50\%$ Positron running for KinC_x25_2 & _3							
KinC_x25_2	10-May	0.24	2.10	3.820	14.625	11.395	27.695	26.020	4
KinC_x25_3	14-May	0.25	2.98	2.131	23.695	7.395	23.695	30.820	4
	18-May	Elastic Calibration							1