Brookhaven National Laboratory

U.S. DEPARTMENT of ENERGY

Threshold-Based Analysis – Gain Vs Inclination Angle

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HRPPD B-Field Measurements at BNL

@BrookhavenLab

Overview

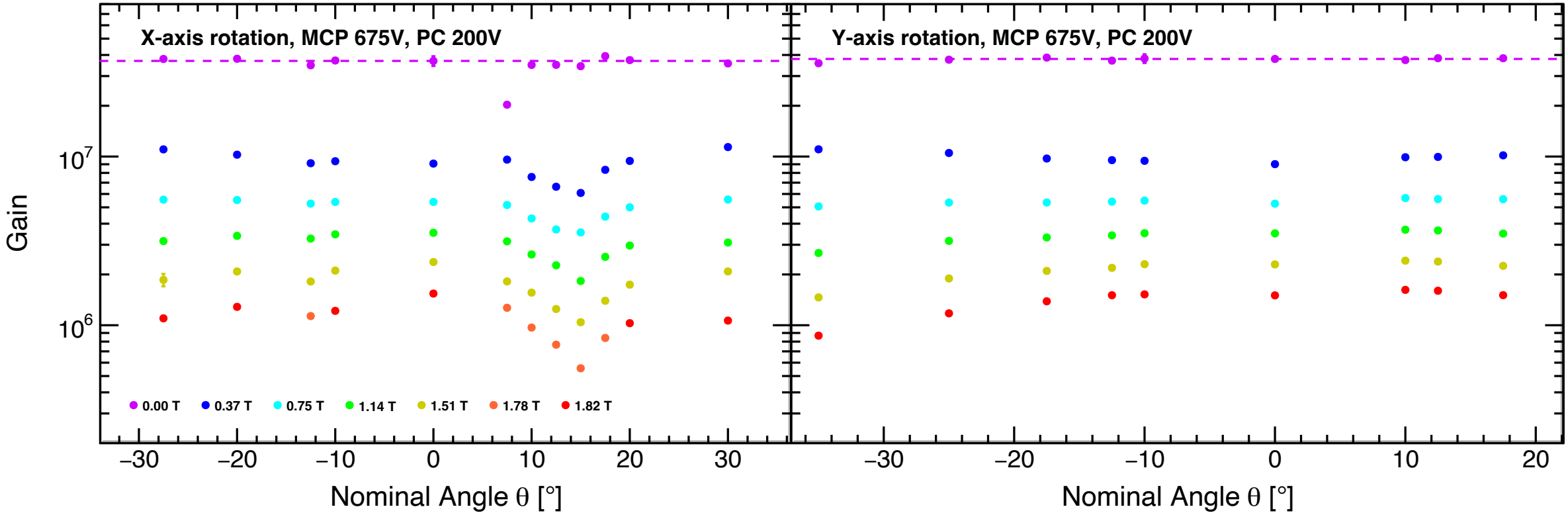
- **126 runs analyzed (selected)** to evaluate Gain vs. Inclination Angle
- **Consistency check** performed: time-window-based vs. threshold-based methods

What's New

- **Additional 15 runs analyzed** to compare 0T data at the beginning and end of runs (when available)
- **Additional 143 runs analyzed** to include in Gain vs. Inclination Angle

Figure 3 – Threshold-Based Analysis

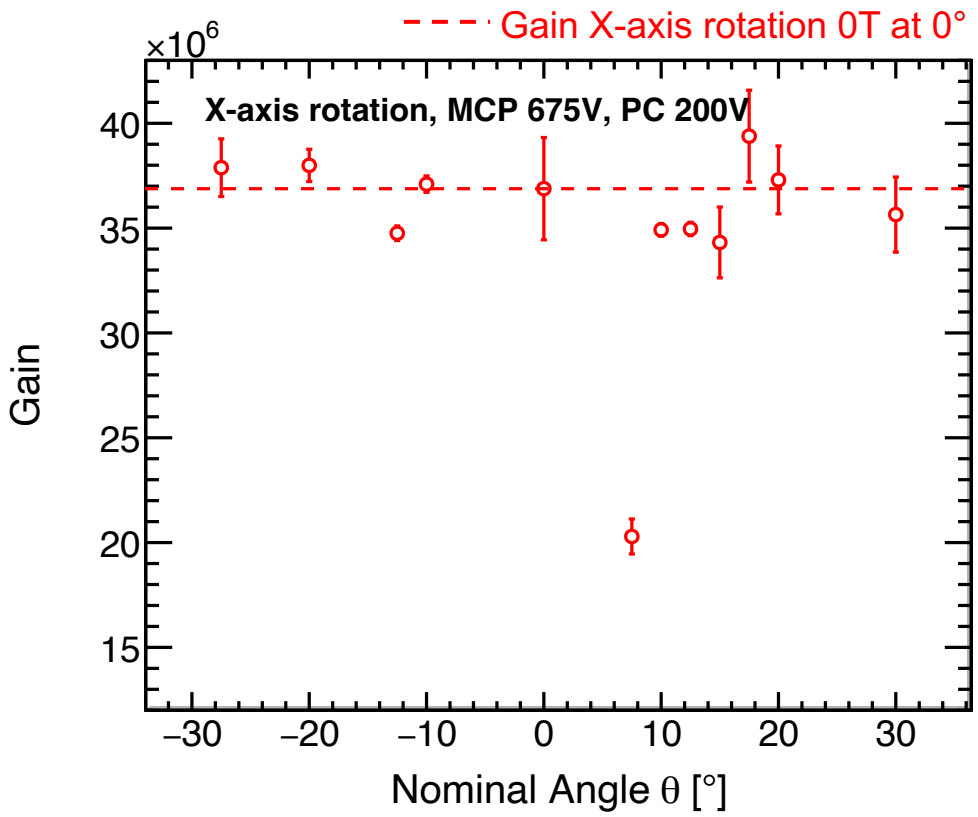
Before normalization using data with 0T at 0°

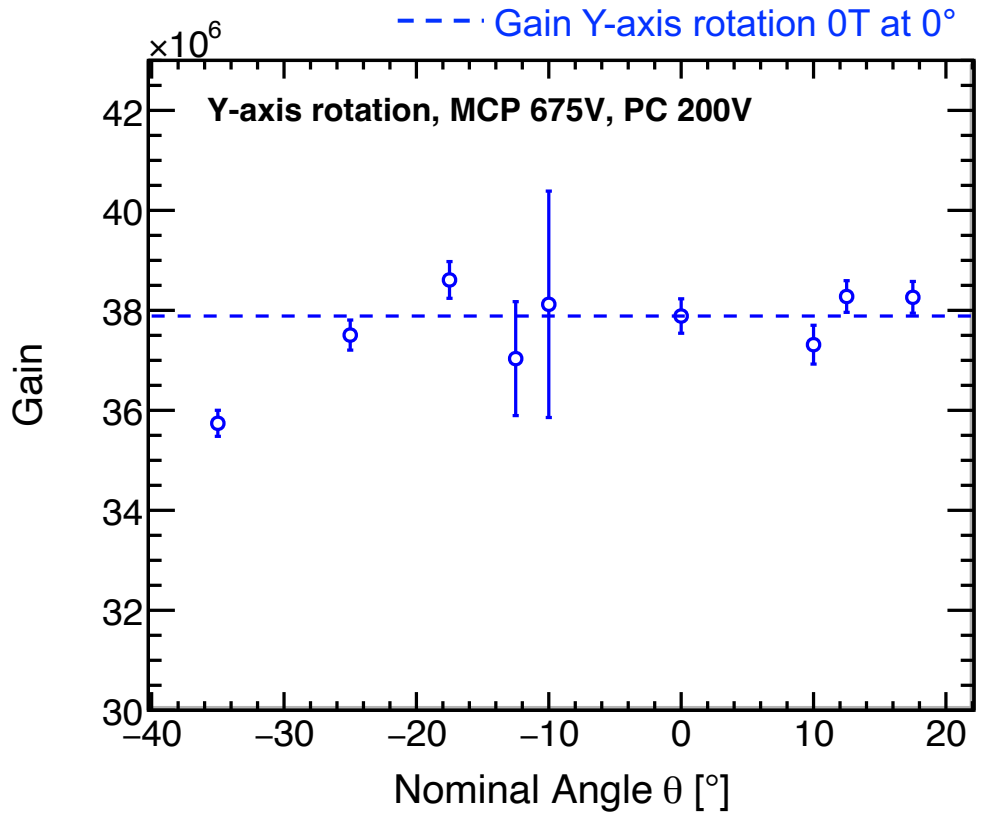


+7.5° (X-axis, 0T): shows lower gain, inconsistent with other 0T data points.
+12.5° (X-axis): dip observed, aligned with MCP plane.

0T Data: Systematic Check

Only beginning of runs

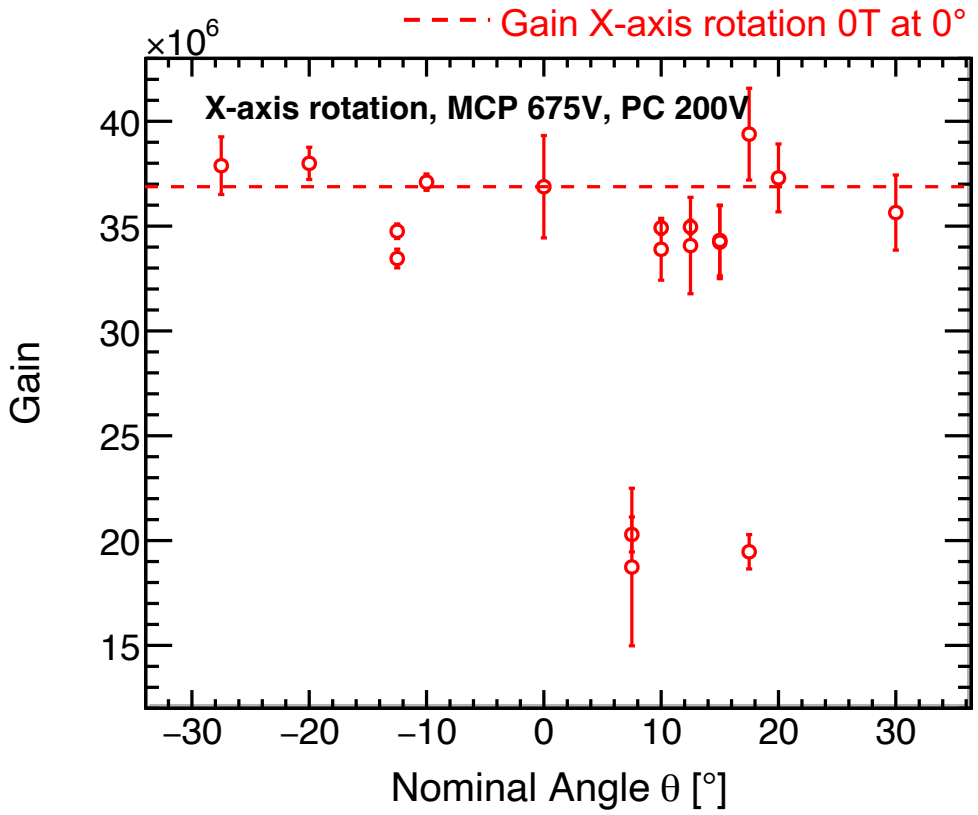


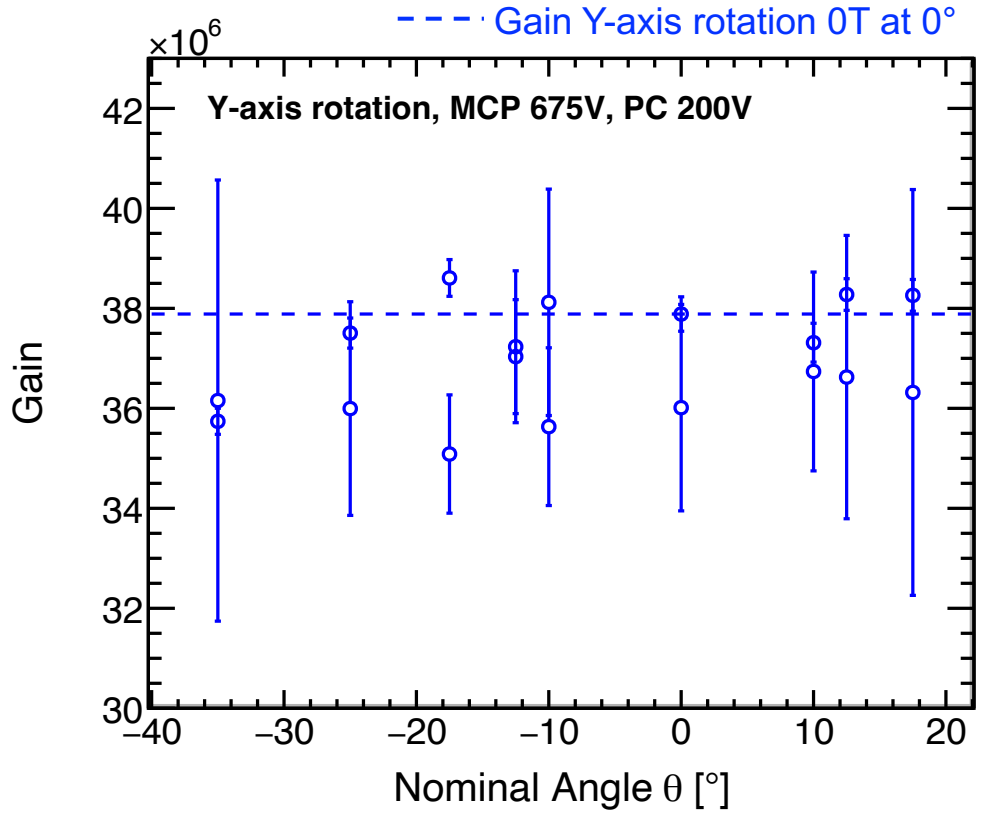


Overall 0T data are consistent within statistical error bars.
At X-axis rotation, **+7.5°** data show **consistently low gain**.

0T Data: Systematic Check

Beginning and end of runs when available

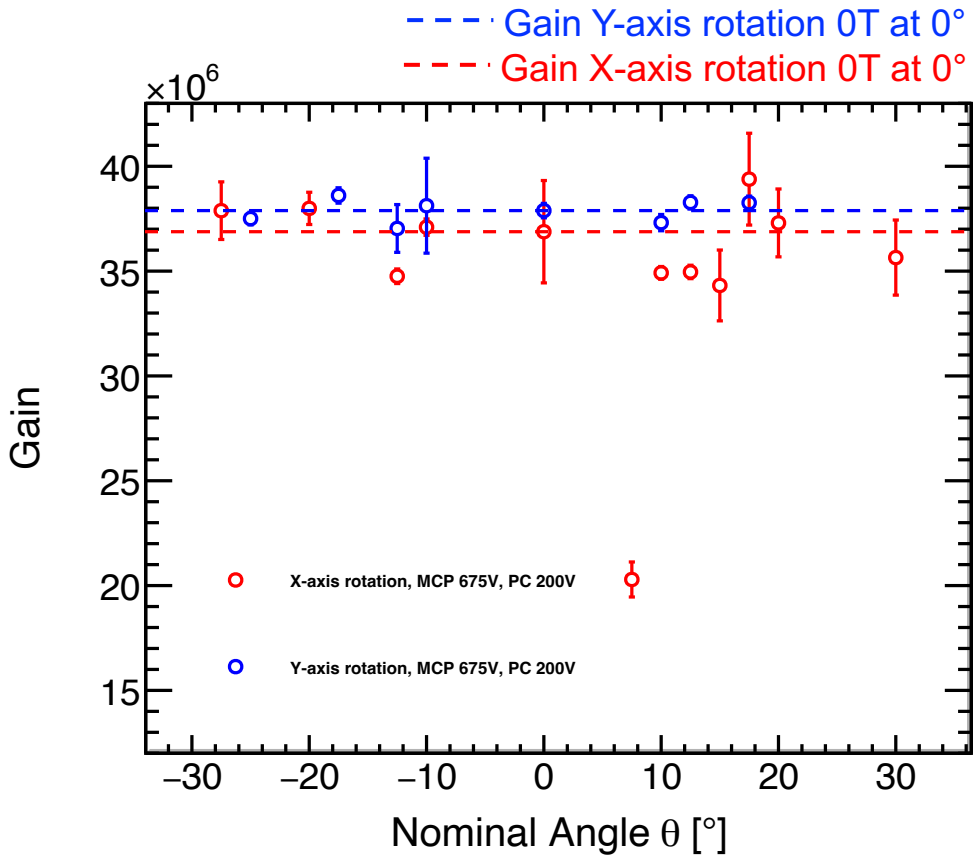




Overall 0T data are consistent within statistical error bars. At X-axis rotation, **+7.5°** data show **consistently low gain** and **+17.5°** data show **large discrepancies at the beginning and end of runs**.

0T Data: Systematic Check

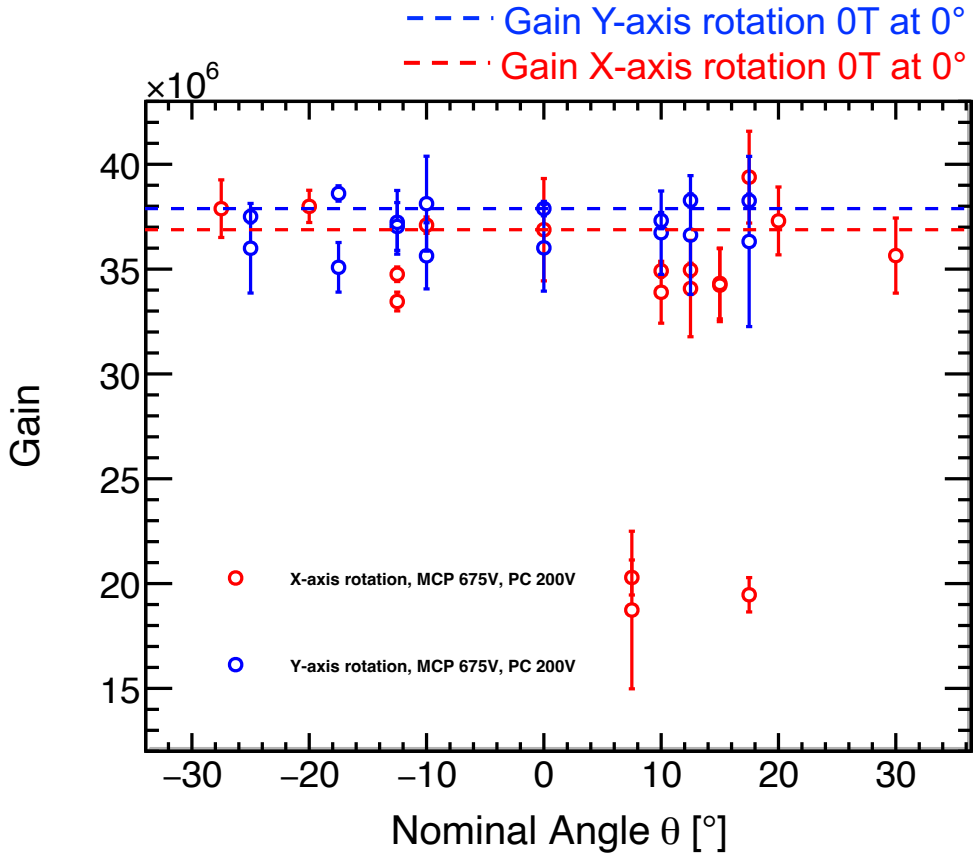
Only beginning of runs



Overall 0T data are consistent within statistical error bars.
At X-axis rotation, **+7.5°** data show **consistently low gain**.

0T Data: Systematic Check

Beginning and end of runs when available



Overall 0T data are consistent within statistical error bars. At X-axis rotation, **+7.5°** data show **consistently low gain** and **+17.5°** data show **large discrepancies at the beginning and end of runs**.

HRPPD B-Field Data Summary

Laser was on sinc yesterday, HRPPD warmed up 15 mins, no-field-flip scan

Iteration	Tilt Axis	Nom. Angle (deg)	Time	Run #	B-Field_Tot (T)	B-Field Bx (T)	laser	HV Setting	Note	Channel Selectior	PDE	q0	q1	q2	q3	q4
	+X	+30	13:37	201526	1.509	0.719	1.6 kHz, **40%**	200-700-200-700-200	ch16&17		6.61	0	525.112	0	523.877	0
	+X	+17.5	13:43	201527	0.002	0.000	1.6 kHz, **40%**		run----0A.sh, Ch 18, 17, 24, 23, 12, 11		9.09	2315.67	696.373	270.364	3013.59	2582.07
	+X	+17.5	13:45	201528	0.001	0.000	1.6 kHz, **40%**		Ch 18, 17, 24, 23, 12, 11, 19		9.85	4028.66	1436.83	653.124	4044.29	4788.56
	+X	+17.5	13:48	201529	0.374	0.100	1.6 kHz, 40%		run--400A.sh, Ch 17, 18	3	7.07	68.4878	764.211	0	766.341	122.223
	+X	+17.5	13:49	201530	0.374	0.100	1.6 kHz, 40%		Ch 17, 18	3	7.41	677.167	1324.07	85.5771	1328.77	700.793
	+X	+17.5	13:51	201531	0.374	0.100	1.6 kHz, 40%		Ch 17, 18	3	7.09	335.188	2051.2	0	2052.5	463.47
	+X	+17.5	13:53	201532	0.751	0.201	1.6 kHz, 40%		Ch 17	1	7.17	420.262	427.517	0	427.97	504.25
	+X	+17.5	13:55	201533	0.752	0.201	1.6 kHz, 40%		Ch 17	1	7.21	116.669	715.816	213.961	715.652	252.428
	+X	+17.5	13:57	201534	0.752	0.201	1.6 kHz, 40%		Ch 17, afterpulses	1	7.42	528.601	1059.83	0	1059.39	521.877
	+X	+17.5	13:58	201535	0.752	0.201	1.6 kHz, 40%		Ch 17, afterpulses	1	7.07	273.062	1399.46	113.805	1405.82	368.04
	+X	+17.5	14:01	201536	1.136	0.304	1.6 kHz, 40%		Ch 17	1	7.05	69.6744	227.169	0	229.257	78.8042
	+X	+17.5	14:02	201537	1.137	0.304	1.6 kHz, 40%		Ch 17	1	7.32	259.648	414.891	108.641	413.302	285.658
	+X	+17.5	14:04	201538	1.137	0.304	1.6 kHz, 40%		Ch 17	1	7.2	44.5304	631.349	42.653	632.66	73.1089
	+X	+17.5		201539	1.137	0.304	1.6 kHz, 40%		Ch 17, afterpulses	1	7.11	856.859	874.58	40.5989	882.326	1069.55
	+X	+17.5	14:08	201540	1.505	0.404	1.6 kHz, 40%				6.09	124.856	108.218	40.6958	121.144	86.3107
	+X	+17.5	14:09	201541	1.508	0.404	1.6 kHz, 40%		Ch 17	1	7.14	73.1459	215.816	41.3107	216.717	70.3219
	+X	+17.5	14:11	201542	1.508	0.405	1.6 kHz, 40%		Ch 17	1	7.34	273.14	371.456	41.8924	370.862	270.741
	+X	+17.5	14:13	201543	1.508	0.405	1.6 kHz, 40%		Ch 17		7.32	453.629	540.958	44.8082	541.597	450.808
	+X	+17.5	14:16	201544	1.775	0.477	1.6 kHz, 40%				5.23	53.0631	65.1447	0	90.0717	65.5387
	+X	+17.5	14:17	201545	1.775	0.477	1.6 kHz, 40%		Ch 17	1	6.76	142.851	122.63	0	130.46	137.971
	+X	+17.5	14:19	201546	1.776	0.477	1.6 kHz, 40%		Ch 17	1	7.1	123.325	245.008	42.121	235.689	130.344
	+X	+17.5	14:20	201547	1.776	0.477	1.6 kHz, 40%		Ch 17	1	7.68	381.319	371.208	0	370.093	238.103
	+X	+17.5	14:24	201548	0.004	0.001	1.6 kHz, 40%		Ch 18, 17, 24, 23, 12, 11		9.12	2312.16	732.096	228.18	3005.92	2530.63
	+X	+17.5	14:26	201549	0.003	0.001	1.6 kHz, 40%		Ch 18, 17, 24, 23, 12, 11		9.08	2485.35	791.806	333.432	3245.78	2802.75
	+X	+7.5	14:31	201550	0.001	0.000	1.6 kHz, 40%		Ch 18, 17, 24, 23, 12, 11		8.85	2216.9	691.946	259.289	2897.11	2466.29
	+X	+7.5	14:32	201551	0.001	0.000	1.6 kHz, 40%		Ch 18, 17, 24, 23, 12, 11, many dark current		8.78	2534.09	815.192	392.921	3342.73	2910.06
	+X	+7.5	14:34	201552	0.373	0.036	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7.44	507.984	666.577	234.268	894.578	542.773
	+X	+7.5	14:36	201553	0.374	0.037	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7.21	855.632	1035.34	523.709	1572.89	900.709
	+X	+7.5	14:37	201554	0.374	0.037	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7.08	1230.15	1477.2	368.306	2358.19	1261.67
	+X	+7.5	14:40	201555	0.751	0.074	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7.29	352.139	406.83	0	528.283	374.148
	+X	+7.5	14:41	201556	0.752	0.074	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7.23	501.216	616.885	578.684	822.597	530.402
	+X	+7.5	14:43	201557	0.752	0.074	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7.38	724.746	845.709	660.614	1196.12	757.217
	+X	+7.5	14:44	201558	0.752	0.074	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.9	885.373	1097.93	0	1570.03	933.814
	+X	+7.5	14:47	201559	1.136	0.112	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.97	204.232	236.238	300.735	308.432	217.102
	+X	+7.5	14:48	201560	1.137	0.112	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7	333.942	374.759	581.662	517.529	348.265
	+X	+7.5	14:50	201561	1.137	0.112	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7.13	456.519	544.658	46.2329	747.826	478.325
	+X	+7.5	14:51	201562	1.137	0.112	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	7.22	580.133	715.626	44.0473	992.348	620.29
	+X	+7.5	14:54	201563	1.507	0.148	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.84	117.806	137.527	0	164.893	149.667
	+X	+7.5	14:56	201564	1.507	0.148	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.58	213.585	238.169	0	303.062	241.261
	+X	+7.5	14:57	201565	1.508	0.149	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.62	288.852	354.645	350.241	449.261	332.42
	+X	+7.5	14:59	201566	1.508	0.149	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.5	356.657	452.376	485.052	584.517	408.764
	+X	+7.5	15:01	201567	1.774	0.175	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	5.36	101.564	102.448	0	118.178	113.468
	+X	+7.5	15:03	201568	1.774	0.175	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.27	156.754	168.539	232.588	297.581	188.51
	+X	+7.5	15:04	201569	1.775	0.175	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.67	224.627	255.557	120.356	321.055	268.71
	+X	+7.5	15:06	201570	1.775	0.175	1.6 kHz, 40%		Ch 17, 18 (both similar amplitude)	3	6.77	326.304	358.586	352.649	448.765	373.8
	+X	+7.5	15:10	201571	0.004	0.000	1.6 kHz, 40%		Ch 18, 17, 24, 23, 12, 11		9.1	2225.33	683.125	245.634	2897.91	2454.87
	+X	+7.5	15:12	201572	0.002	0.000	1.6 kHz, 40%		Ch 18, 17, 24, 23, 12, 11		8.75	2299.36	736.627	344.349	3010.79	2623.89

★ 0T runs
MCP 675 V
PC 200 V

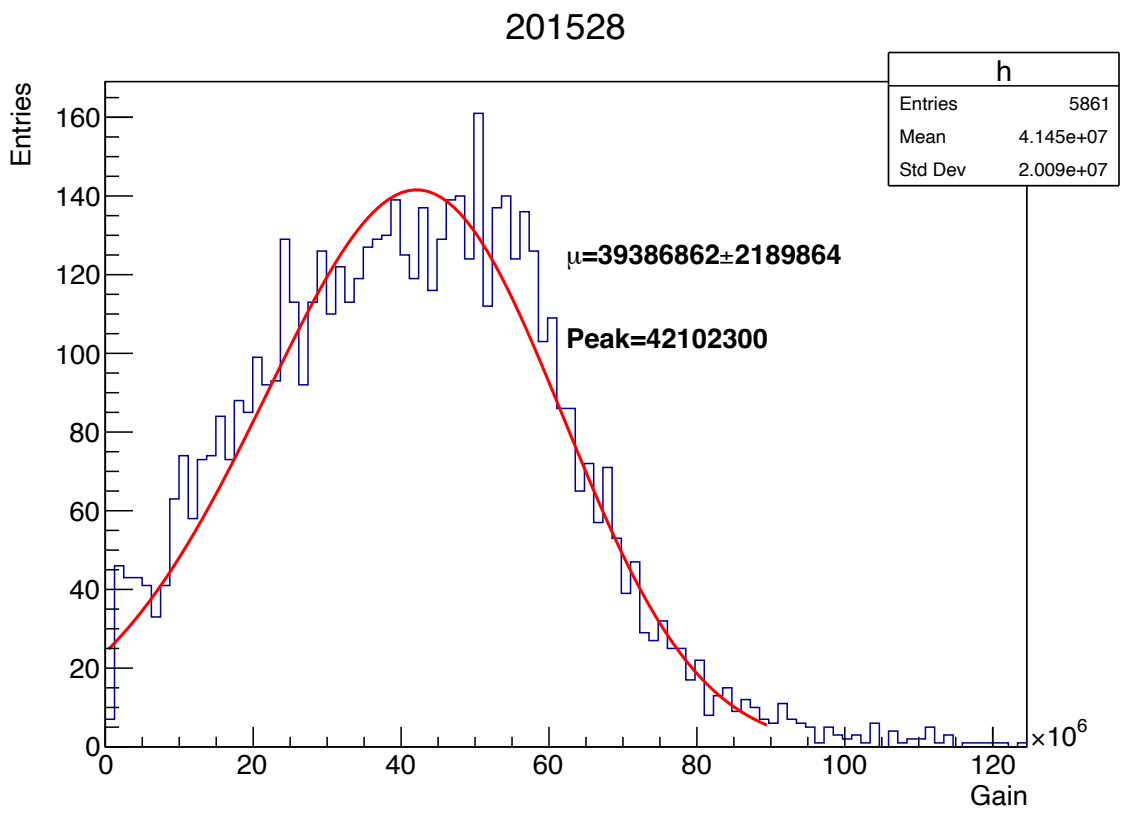
Dec 12, 2025
+17.5°

Dec 12, 2025
+7.5°

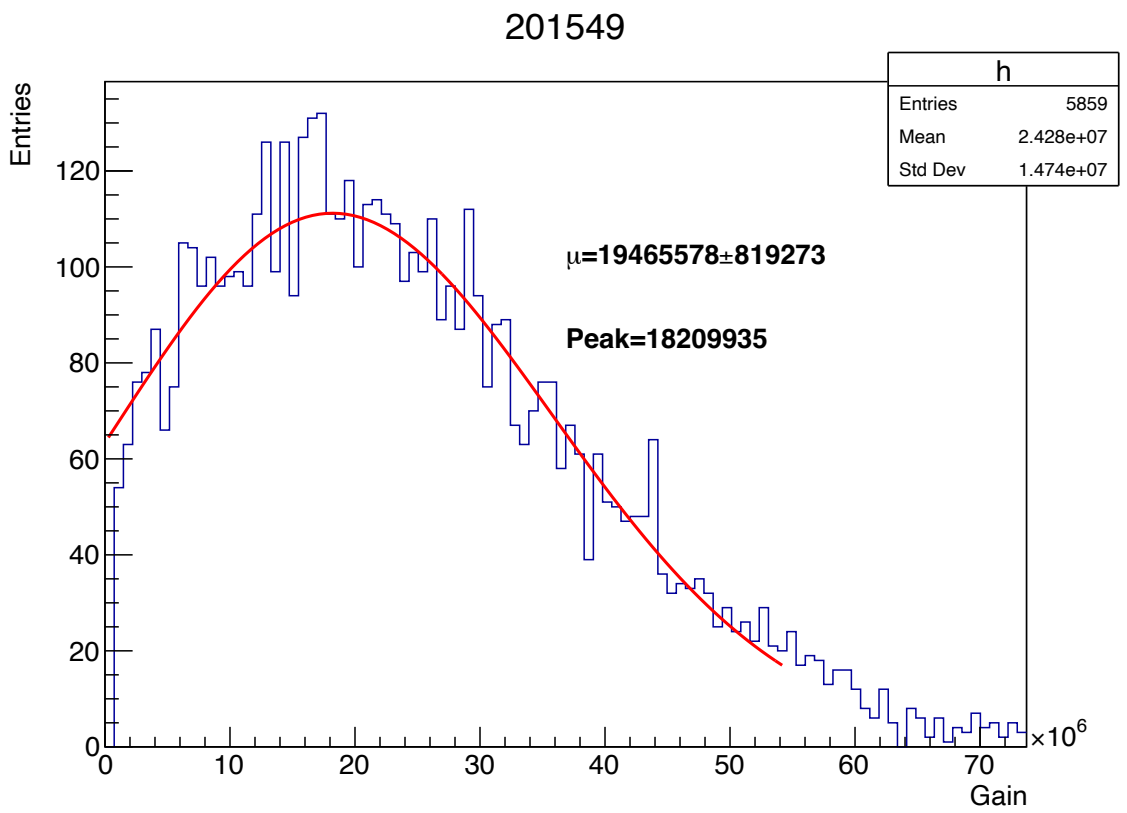
Examples – Gain Distributions

+17.5° (X-axis, 0T)

Beginning of run



End of run

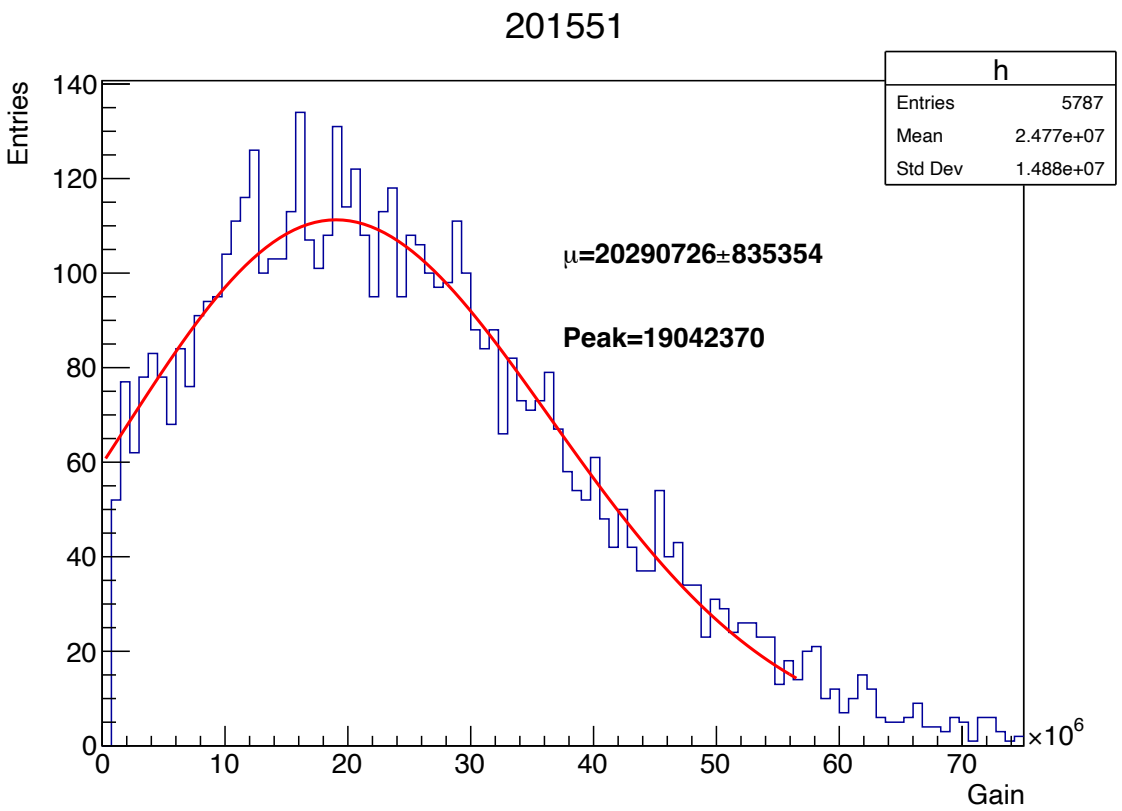


Noticed that shapes are different. By the way, we took +17.5° and then +7.5° measurements in a row (end of run of +17.5° and beginning and end of +7.5° are consistent – next slide)

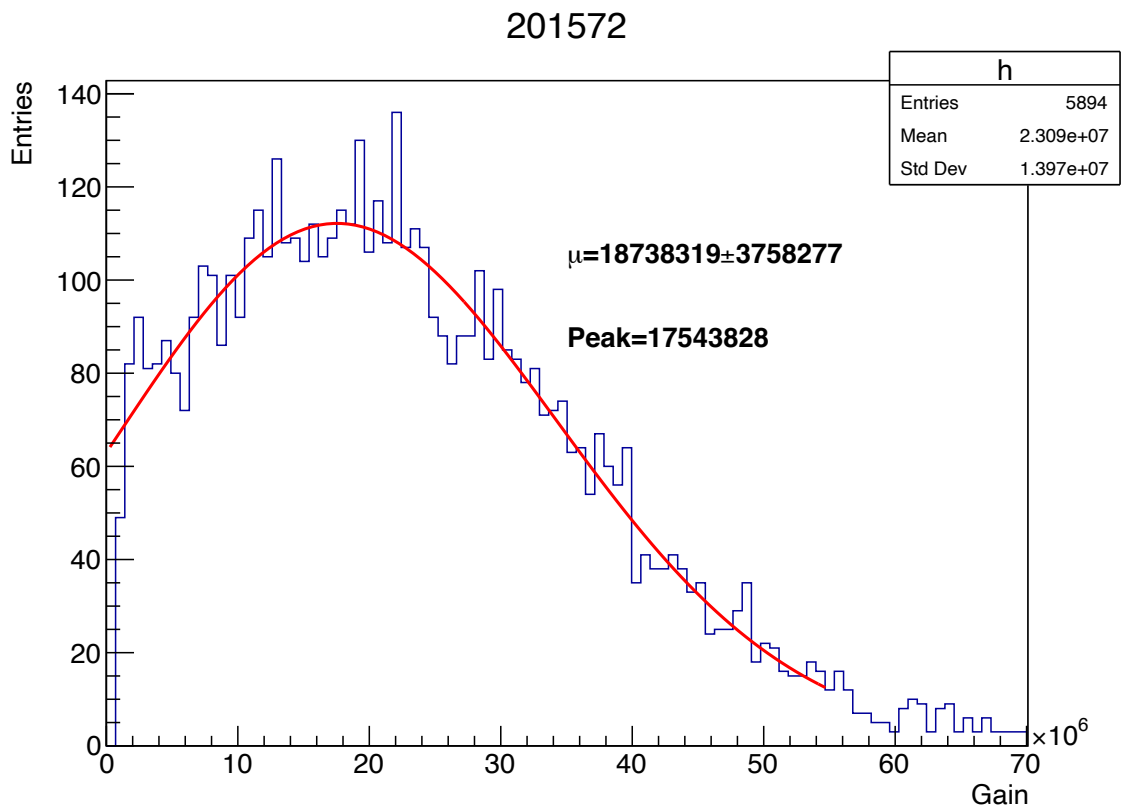
Examples – Gain Distributions

+7.5° (X-axis, 0T)

Beginning of run

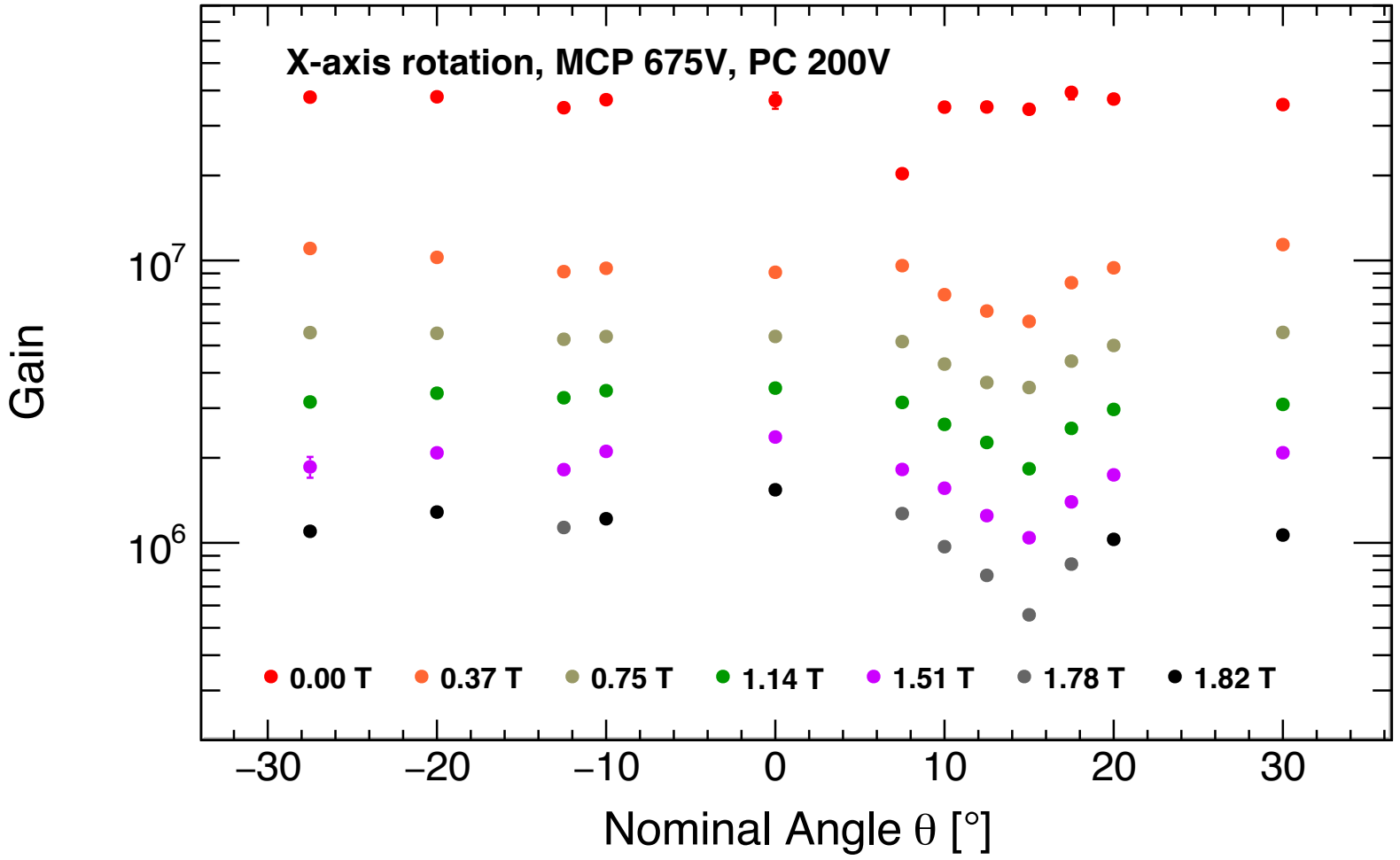


End of run



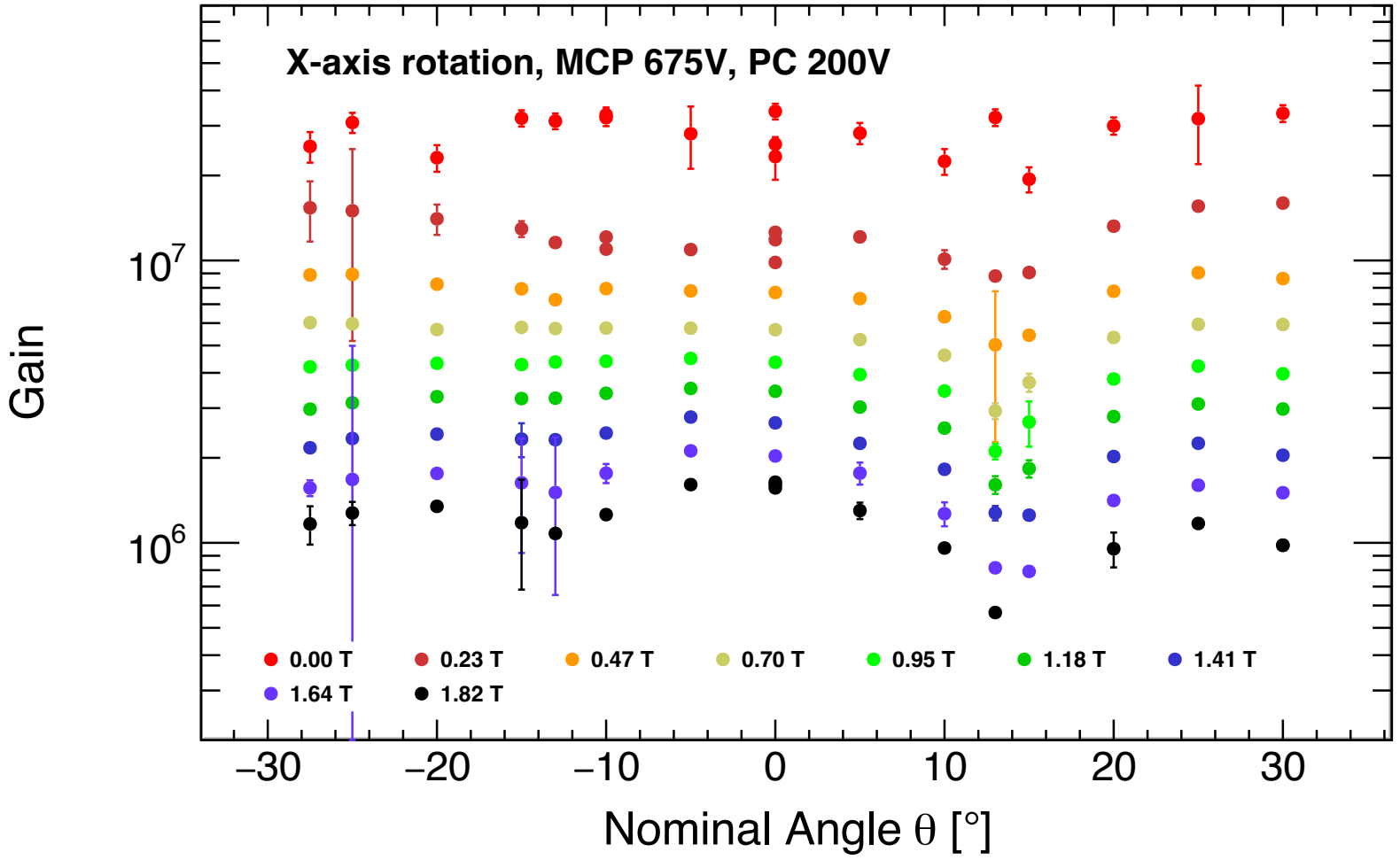
Looks consistent distributions at the beginning and end of runs

Gain VS Inclination Angle (Selected)



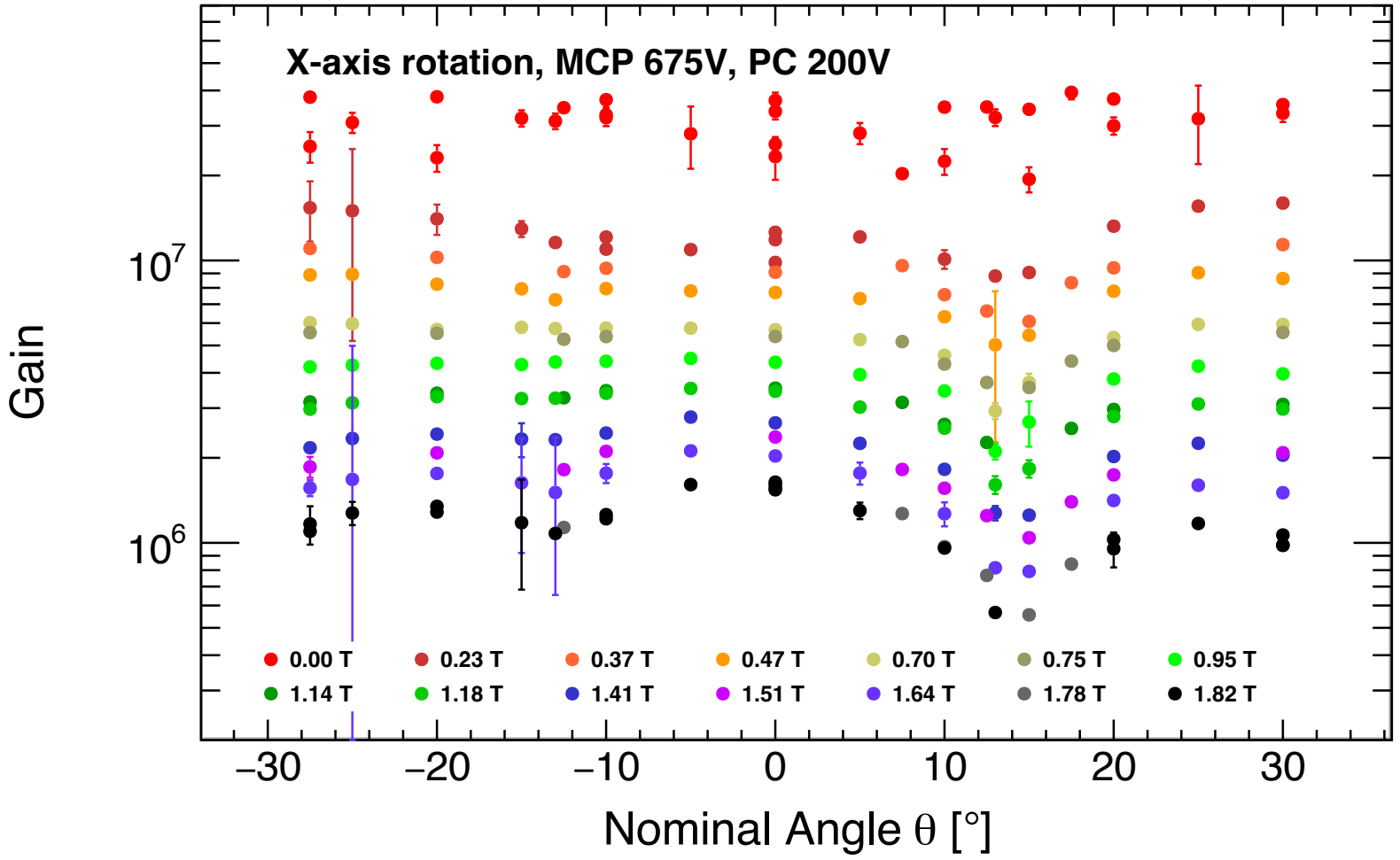
Data 332 – 1551
Taken later stage of data-taking
on
Nov/24/2025
Nov/25/2025
Dec/11/2025
Dec/12/2025

Gain VS Inclination Angle (Additional)



Data 168 – 324
Taken early stage of data-taking
on
Nov/19/2025
Nov/24/2025

Gain VS Inclination Angle (Combined)



Data 168 – 1572
Taken
on
Nov/19/2025
Nov/24/2025
Nov/25/2025
Dec/11/2025
Dec/12/2025

Summary

- Updated Gain vs. Inclination angle with additional data.
- Compared 0T data at the beginning and end of runs for systematic check.
  - Overall 0T data are consistent within statistical error bars.
  - At X-axis rotation, **+7.5°** data show **consistently low gain**
  - **+17.5°** data show **large discrepancies at the beginning and end of runs**.
  - Observations:
    - **+17.5°** Gain distributions are different from the beginning and end of runs.
    - **+17.5°** measurement followed by **+7.5°** measurements.
    - End of **+17.5°** and **beginning and end of +7.5°** measurements are **consistently** low and similar gains.
    - Maybe something happened during **+17.5° measurements?**
- Revisit some data with larger error bar to re-do better fit.
- Need to double-check error bar calculation for normalized Gain vs. Inclination figure using gain at 0T at 0°.

Backup Slides