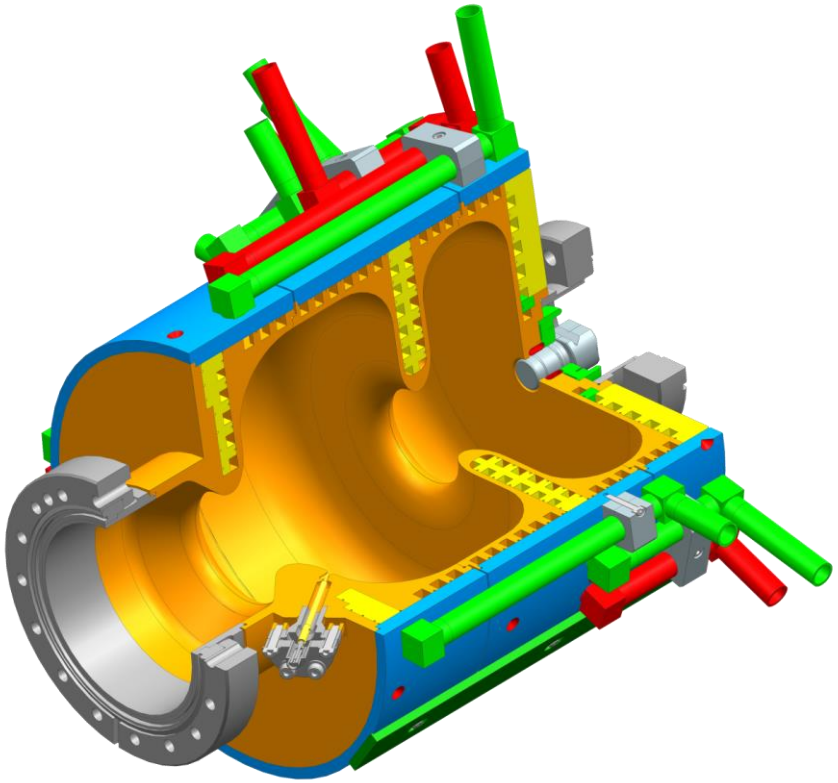
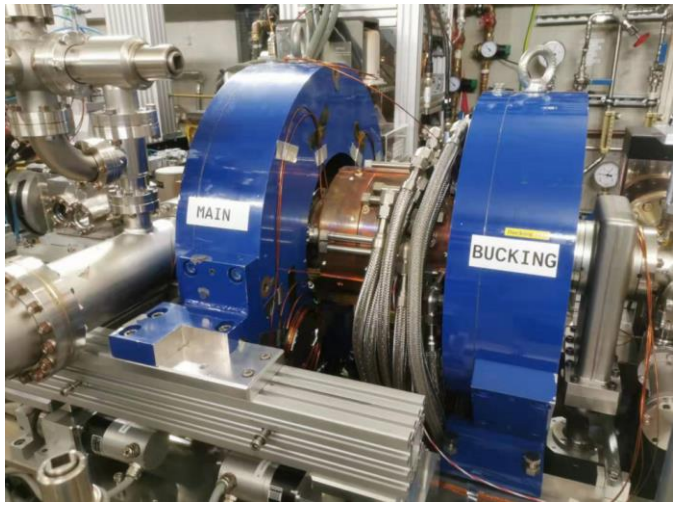
Beam-Based Calibration of Gun5.1 RF power

RF measurement calibration evolution 2021-2023



M. Krasilnikov, S. Zeeshan
PPS, 24.10.2023



HELMHOLTZ

PITZ Photo Injector Test Facility Zeuthen

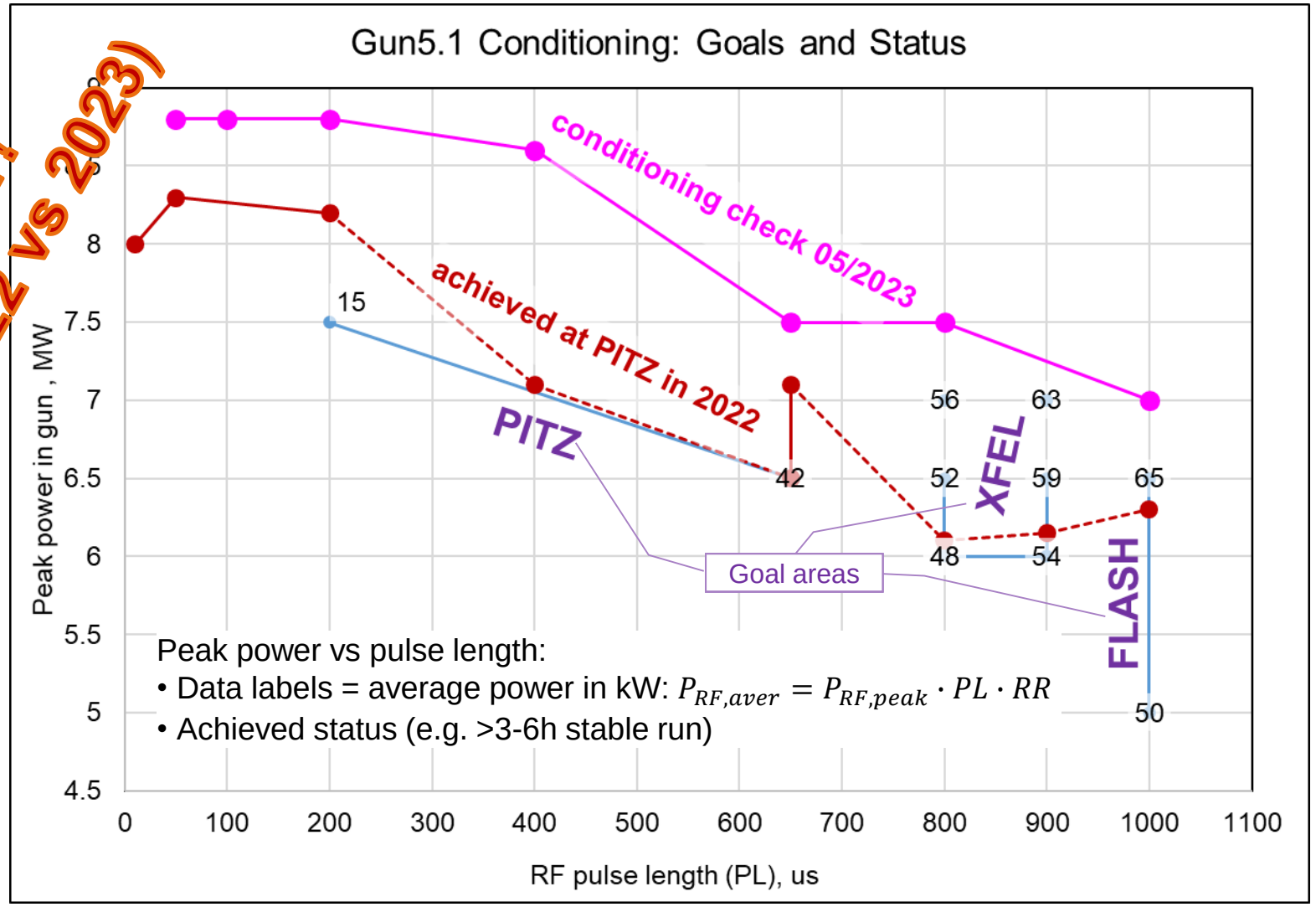
European XFEL

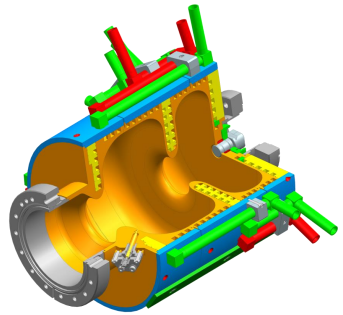
DESY.

Gun5.1 Conditioning Status

Peak power & pulse length

Vertical axis → Ecath?!
Actual to the time (2022 vs 2023)





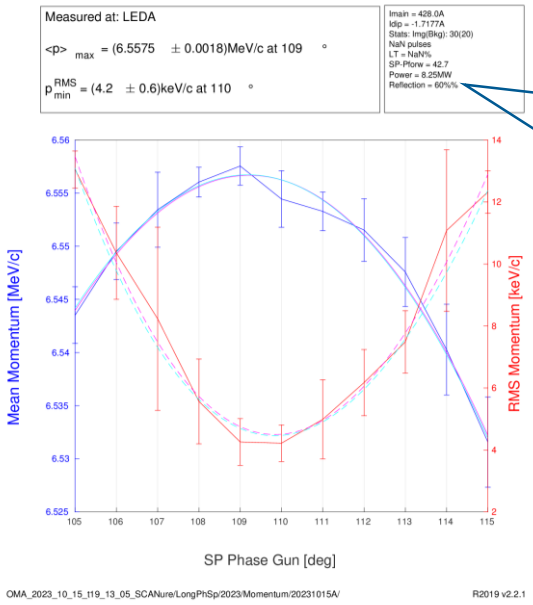
Beam-based calibration of Gun5.1 RF power

Method

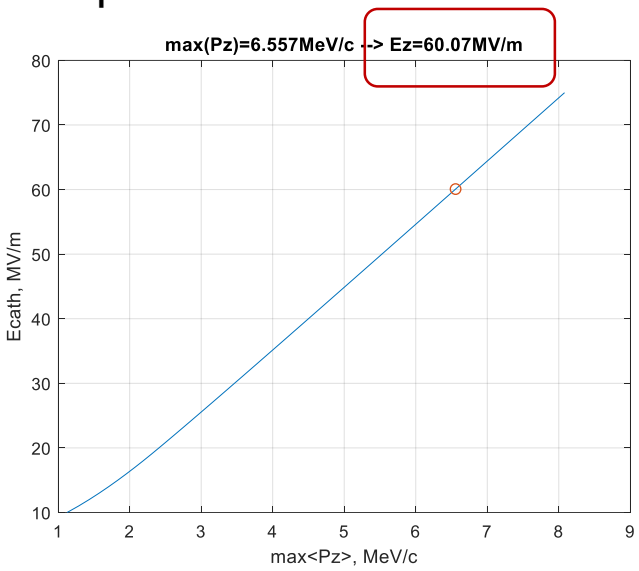
15.10.2023 19:13 M. Krasilnikov, A. Grebinyk

LEDA scan for 60MV/m

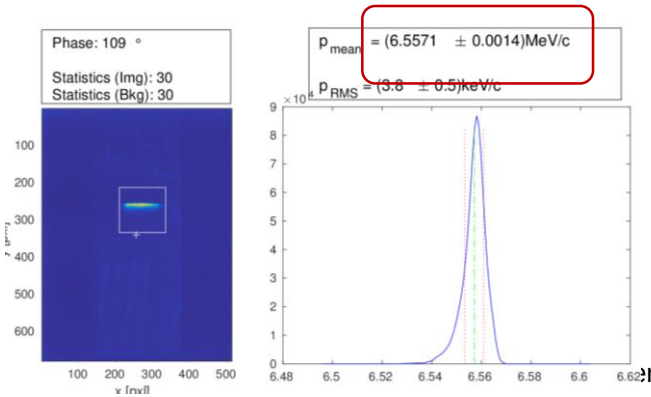
…measure\scripts\Tools\GunGradientFinder\gungradfromoz.m



Imain = 428.0A
Idip = -1.7177A
Stats: Img(Bkg): 30(20)
NaN pulses
LT = NaN%
SP-Pforw = 42.7
Power = 8.25MW
Reflection = 60%%



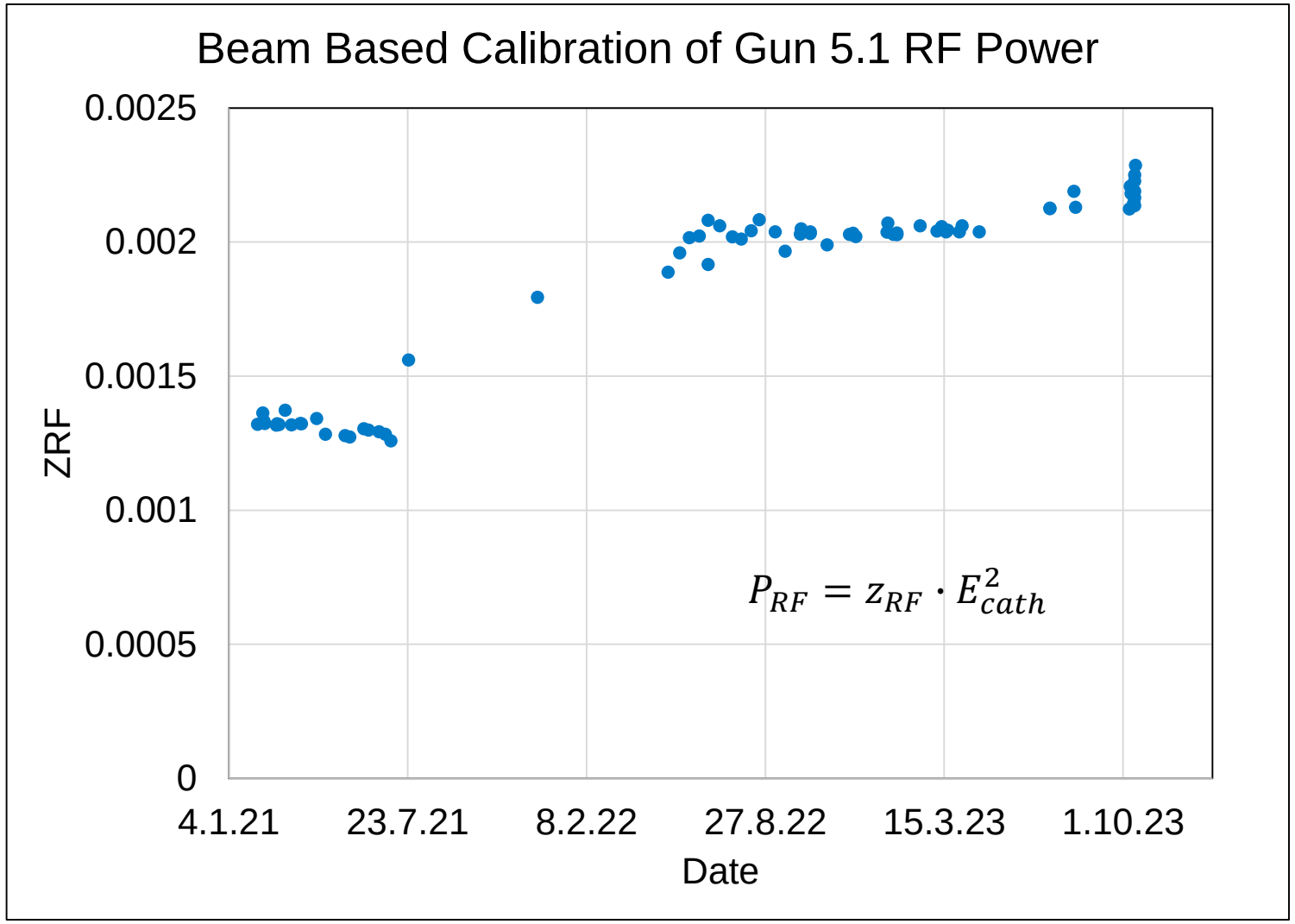
$$P_{RF} = z_{RF} \cdot E_{cath}^2$$



date	time	SP-Pforw	RF Pulse length (optional)	RF power in gun, MW	Reflection %%	<Pz>	PZerr	ZRF	Comment		
15.10.2023	19:13	42.7	200	8.25	60	6.5571	0.0014	0.002286	Modulated beam from Pharos		

Data retrieved from the Logbook

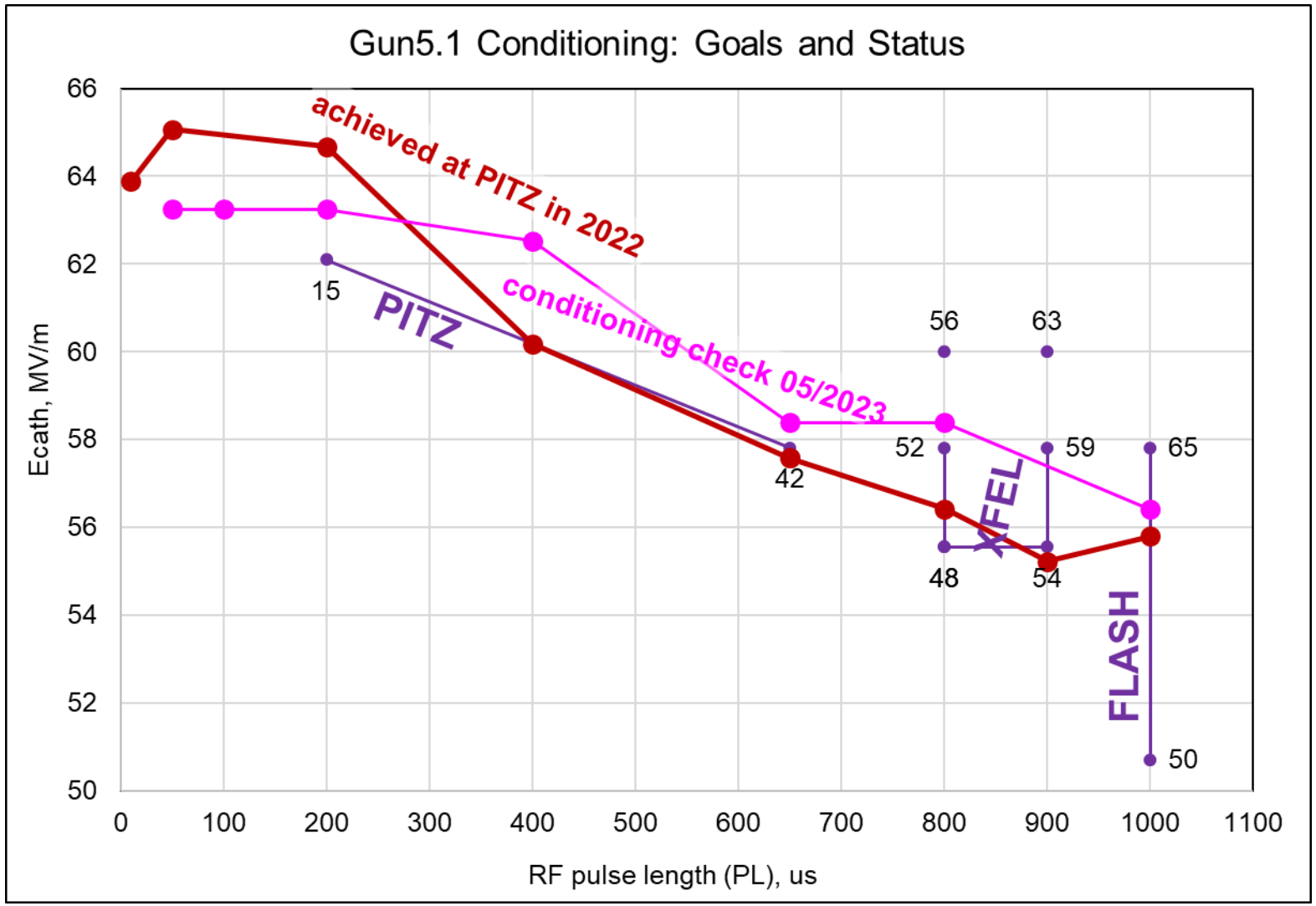
LEDA scans evaluated by Sumaira



Date	Date	time	SP-Pforw	RF Pulse length	RF Power in gun MW	Reflection %%	<Pz>	Pzerr	Ecath	ZRF	Comment
15-Oct-23	15-Oct-23	19:13	42.7	200	8.25	60	6.5571	0.0014	60.07	0.002286329	Modulated beam for Pharos
14-Oct-23	14-Oct-23	22:26	42	200	7.86	56	6.465	0.002	59.1	0.002250337	
14-Oct-23	14-Oct-23	21:54	41	200	7.44	53	6.324	0.003	57.79	0.002227756	
14-Oct-23	14-Oct-23	21:13	35	200	5.27	40	5.4924	0.0016	49.67	0.002136104	
14-Oct-23	14-Oct-23	21:01	39	200	6.63	43	6.069	0.007	55.03	0.002189347	
14-Oct-23	14-Oct-23	8:18	39	200	6.63	38	6.071	0.004	55.32	0.002166453	
13-Oct-23	13-Oct-23	20:28	39	150	6.56	44	6.0696	0.0009	55.31	0.002144354	LEDA for NePAL
13-Oct-23	13-Oct-23	20:19	39		6.57	42	6.0701	0.0007	55.32	0.002146847	LEDA for NePAL
13-Oct-23	13-Oct-23	20:06	39		6.55	38	6.065	0.003	55.26	0.002144962	Pharos
12-Oct-23	12-Oct-23	18:31	40	140	6.98	65	6.1863	0.0016	56.45	0.002190421	no pic and pz peak graph
11-Oct-23	11-Oct-23	19:01	40	150	7.05	64	6.2076	0.0013	56.66	0.002196018	Pharos LEDA Scan
10-Oct-23	10-Oct-23	20:42	39	100	6.67	84	6.068	0.002	55.29	0.002181889	LEDA proj @ MMMG phase Pharos
9-Oct-23	9-Oct-23	21:19	46.2	200	6.79	54	6.084	0.007	55.45	0.002208344	
8-Oct-23	8-Oct-23	8:52	34.4	100	5.04	44	5.394	0.006	48.71	0.002124194	
8/9/2023	8/9/2023	16:13	34.4	130	5.04	47	5.3876	0.0015	48.65	0.002129437	
8/7/2023	8/7/2023	19:22	37.1	140	5.9	85	5.722	0.008	51.91	0.002189525	
7/11/2023	7/11/2023	18:56	42.5	200	6.12	59	5.899	0.004	53.64	0.002127031	
7/11/2023	7/11/2023	17:35	42.5	200	6.14	75	5.911	0.003	53.76	0.002124466	
23.04.2023	4/23/2023	12:08	47.5	225	6.79	40	6.3168	0.0007	57.72	0.002038061	
04.04.2023	4/4/2023	22:28	47.5		6.78	53	6.2787	0.0015	57.35	0.002061403	
01.04.2023	4/1/2023	4:37	47.5		6.77	40	6.3073	0.0011	57.63	0.002038409	
19.03.2023	3/19/2023	23:50	47.5		6.77	23	6.299	0.0005	57.55	0.002044081	
12.03.2023	3/12/2023	22:49	47.5		6.84	65	6.3089	0.0007	57.65	0.002058057	
07.03.2023	3/7/2023	18:12	47.5		6.75	25	6.2937	0.0008	57.5	0.002041588	
17.02.2023	3/17/2023	4:09	47.5		6.74	34	6.295	0.0004	57.51	0.002037854	
16.02.2023	2/16/2023	11:10	47.5		6.76	29	6.2709	0.0007	57.27	0.002061068	
21.01.2023	1/21/2023	2:56	47.5		6.88	53	6.3619	0.0008	58.16	0.002033947	
21.01.2023	1/21/2023	2:41	47.5		6.86	51	6.3613	0.0008	58.16	0.002028034	
17.01.2023	1/17/2023	3:01	47.5		6.86	40	6.3608	0.0007	58.15	0.002028732	
11.01.2023	1/11/2023	11:31	47.5		6.83	49	6.2864	0.0012	57.43	0.002070823	
10.01.2023	1/10/2023	22:15	47.5		6.81	41	6.3269	0.0007	57.82	0.002037	
06.12.2022	12/6/2022	13:25	47.5		6.83	59	6.3592	0.0008	58.14	0.002020555	
03.12.2022	12/3/2022	16:37	47.5		6.78	62	6.3193	0.0006	57.75	0.002032945	LEDA proj at MMMG phase
02.12.2022	12/2/2022	1:18	47.5		6.81	47	6.3397	0.0006	57.95	0.002027871	
29.11.2022	11/29/2022	16:48	47.5		6.71	82	6.295	0.001	57.51	0.002028784	
4.11.2022	11/4/2022	22:51	47.1		6.63	48	6.3168	0.0007	57.72	0.001990036	LEDA scan, now for 50 pC
16.10.2022	10/16/2022	14:21	47.5		6.82	54	6.3295	0.0009	57.85	0.002037875	
16.10.2022	10/16/2022	2:58	47.5		6.79	50	6.3255	0.0006	57.81	0.00203172	LEDA projection at MMMG phase -97deg
06.10.2022	10/6/2022	16:30	47.5		6.8	54	6.3044	0.0009	57.6	0.002049576	
05.10.2022	10/5/2022	17:42	47.5		6.77	41	6.3199	0.0007	57.75	0.002029947	
18.09.2022	9/18/2022	8:36	47		6.51	22	6.2982	0.001	57.54	0.001966261	
07.09.2022	9/7/2022	12:10	47		6.67	52	6.2643	0.0006	57.21	0.002037896	
20.08.2022	8/20/2022	1:10	47.7		6.78	52	6.248	0.0013	57.05	0.00208314	
11.08.2022	8/11/2022	21:07	47		6.56	63	6.2096	0.0004	56.67	0.002042666	
31.07.2022	7/31/2022	8:20	47.6		6.7	52	6.316	0.0008	57.72	0.002011047	
21.07.2022	7/21/2022	12:08	47.6		6.7	61	6.3036	0.0004	57.59	0.002020136	
07.07.2022	7/7/2022	18:58	53		8.58	30	7.0109	0.0007	64.52	0.002061098	
24.06.2022	6/24/2022	23:25	47		6.7	42	6.2159	0.0006	56.74	0.002081115	
14.06.2022	6/14/2022	22:37	47		6.67	40	6.2862	0.0009	57.42	0.002023017	
03.06.2022	6/3/2022	23:43	47		6.74	103	6.3259	0.00005	57.81	0.002016759	
24.05.2022	6/24/2022	2:36	47		6.42	38	6.3328	0.0012	57.88	0.001916364	
10.05.2022	5/10/2022	3:12	47.5	200	6.55	39	6.4375	0.0004	58.9	0.001888038	
23.04.2022	5/23/2022	18:43	49.5		7.14	37	6.5853	0.0008	60.35	0.001960395	
15.12.2021	12/15/2021	12:01	65		7.71	26	7.116	0.004	65.55	0.001794358	Momentum at MMMG phase for SP=65 (7.7MWg) measured in LEDA using 60 (MBI) laser pulses, bunch charge ~0.7pC, still Mo cathode
24.07.2021	7/24/2021	16:49	45		3.4	31	5.185	0.002	46.67	0.001561001	
04.07.2021	7/4/2021	1:17	56.2		4.39	31	6.451	0.004	59.04	0.001259424	LEDA scan with MBI
28.06.2021	6/28/2021	20:52	58.6		4.86	31	6.705	0.0008	61.52	0.001284114	
21.06.2021	6/21/2021	14:37	56.2		4.44	32	6.405	0.003	58.59	0.001293409	
09.06.2021	6/9/2021	8:47	56.2		4.42	29	6.378	0.003	58.32	0.001299533	
04.06.2021	6/4/2021	12:48	50		3.45	30	5.673	0.0008	51.43	0.001304326	LEDA scan, 2pC beam 250kHz at MMMG
19.05.2021	5/19/2021	8:45	56.2		4.36	30	6.398	0.002	58.52	0.001273145	
14.05.2021	5/14/2021	18:43	56.2		4.38	32	6.4	0.003	58.54	0.001278111	
22.04.2021	4/22/2021	20:16	56.2		4.39	32	6.395	0.003	58.49	0.00128322	
12.04.2021	4/12/2021	18:52	60		5.04	28	6.679	0.004	61.27	0.001342563	LEDA Projection at MMMG phase -42deg
26.03.2021	3/26/2021	0:20	59		4.96	27	6.675	0.002	61.23	0.00132298	
25.03.2021	3/25/2021	2:00	56		4.5	27	6.376	0.004	58.3	0.001323962	
15.03.2021	3/15/2021	14:17	60		5.11	26	6.778	0.004	62.24	0.001319112	
08.03.2021	3/8/2021	1:46	60		5.13	28	6.6643	0.0015	61.12	0.001373253	LEDA grab at MMMG=37 deg
01.03.2021	3/1/2021	8:00	55.8		4.39	31	6.312	0.004	57.68	0.001319514	
27.02.2021	2/27/2021	8:11	55.8		4.39	29	6.306	0.002	57.62	0.001322264	
26.02.2021	2/26/2021	12:36	58.5		4.86	28	6.625	0.003	60.74	0.001317306	
13.02.2021	2/13/2021	8:36	56.7		4.511	31	6.384	0.003	58.38	0.001323563	
12.02.2021	2/12/2021	17:57	58.5		4.82	27	6.564	0.003	60.14	0.001332663	
11.02.2021	2/11/2021	11:23	59.3		4.89	28	6.538	0.003	59.89	0.001363328	
05.02.2021	2/5/2021	1:19	57.9		4.54	28	6.408	0.004	58.62	0.001321187	

New plot

Changing mainly 2022-constants



Summary

Summary and Outlook

- Conditioning status should be done using beam-based (maximum mean momentum) RF calibration