



2021 run: The beamline

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JLAB

HPS collaboration meeting,
SLAC, June 23-25, 2021



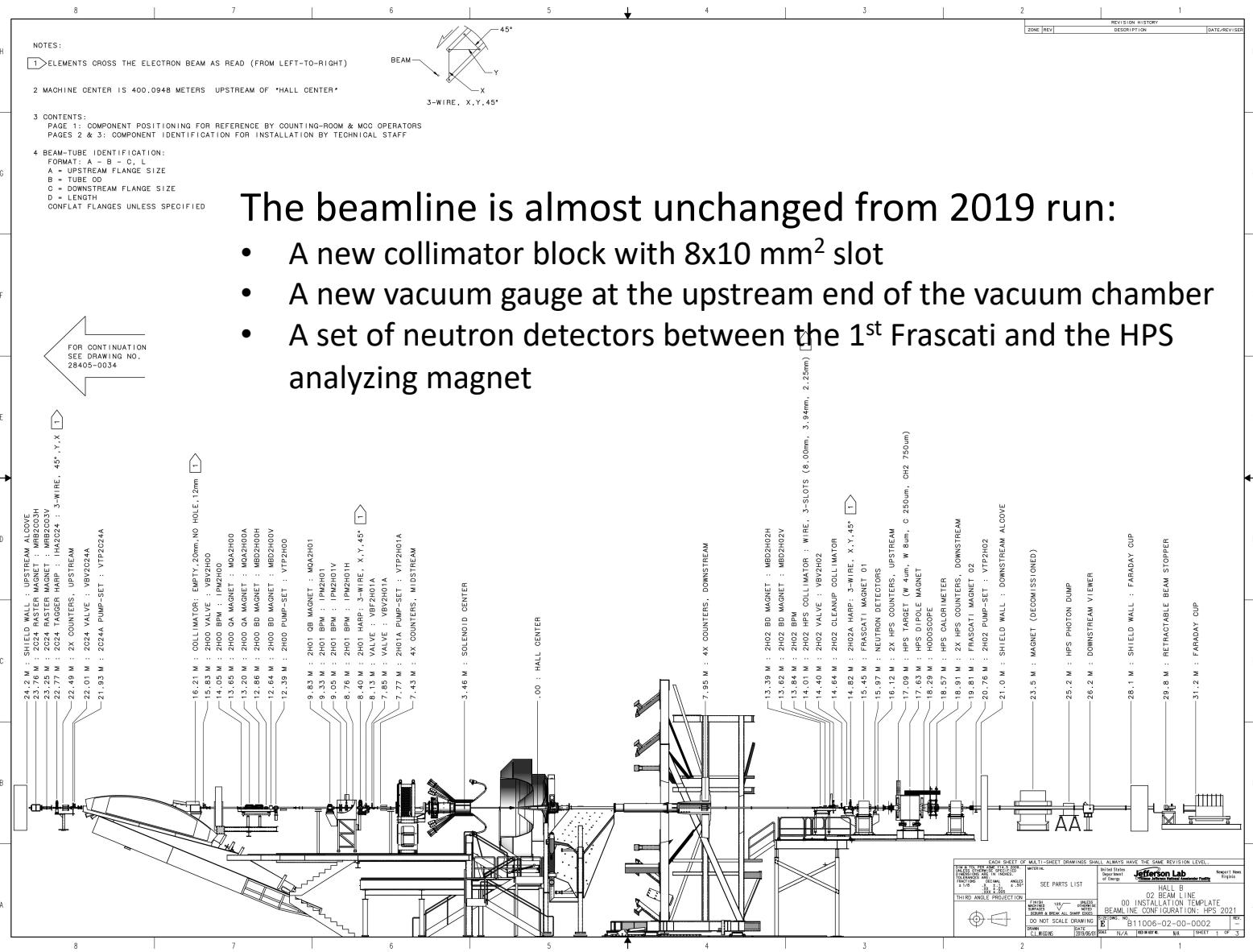
Run schedule – HPS 2021

15	08/22/21	Sunday	1.82	Restore	INSTALL			Run_Group I	3.7/200/-/500
16	08/23/21	Monday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
17	08/24/21	Tuesday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
18	08/25/21	Wednesday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
19	08/26/21	Thursday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
20	08/27/21	Friday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
21	08/28/21	Saturday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
22	08/29/21	Sunday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
23	08/30/21	Monday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
24	08/31/21	Tuesday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
25	09/01/21	Wednesday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
26	09/02/21	Thursday	1.82	Physics	INSTALL			Run_Group I	3.7/200/-/500
27	09/03/21	Friday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
28	09/04/21	Saturday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
29	09/05/21	Sunday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
30	09/06/21	Monday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
31	09/07/21	Tuesday	1.82	Physics	PASS CHANGE			Run_Group I	3.7/200/-/500
32	09/08/21	Wednesday	1.82	Physics	E12-09-019	3.74/40/-/500		Run_Group I	3.7/200/-/500
33	09/09/21	Thursday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
34	09/10/21	Friday	1.82	Physics	PASS CHANGE			Run_Group I	3.7/200/-/500
35	09/11/21	Saturday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
36	09/12/21	Sunday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
37	09/13/21	Monday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
38	09/14/21	Tuesday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
39	09/15/21	Wednesday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
40	09/16/21	Thursday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
41	09/17/21	Friday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
42	09/18/21	Saturday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
43	09/19/21	Sunday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
44	09/20/21	Monday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
45	09/21/21	Tuesday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
46	09/22/21	Wednesday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
47	09/23/21	Thursday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
48	09/24/21	Friday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
49	09/25/21	Saturday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
50	09/26/21	Sunday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
51	09/27/21	Monday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
52	09/28/21	Tuesday	1.82	Physics	E12-17-004	5.56/40/p/500		Run_Group I	3.7/200/-/500
53	09/29/21	Wednesday	1.82	Physics	E12-17-004	5.56/40/p/500		Run_Group I	3.7/200/-/500
54	09/30/21	Thursday	1.82	Physics	E12-17-004	5.56/40/p/500		Run_Group I	3.7/200/-/500
55	10/01/21	Friday	1.82	Physics	E12-17-004	5.56/40/p/500		Run_Group I	3.7/200/-/500
56	10/02/21	Saturday	1.82	Physics	E12-17-004	5.56/40/p/500		Run_Group I	3.7/200/-/500
57	10/03/21	Sunday	1.82	Physics	E12-17-004	5.56/40/p/500		Run_Group I	3.7/200/-/500
58	10/04/21	Monday	1.82	Physics	E12-17-004	5.56/40/p/500		Run_Group I	3.7/200/-/500
59	10/05/21	Tuesday	1.82	Physics	E12-20-008	5.56/40/-/500		Run_Group I	3.7/200/-/500
60	10/06/21	Wednesday	1.82	Physics	E12-20-008	5.56/40/-/500		Run_Group I	3.7/200/-/500
61	10/07/21	Thursday	1.82	Physics	E12-20-008	5.56/40/-/500		Run_Group I	3.7/200/-/500
62	10/08/21	Friday	1.82	Physics	E12-20-008	5.56/40/-/500		Run_Group I	3.7/200/-/500
63	10/09/21	Saturday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
64	10/10/21	Sunday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
65	10/11/21	Monday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
66	10/12/21	Tuesday	1.82	Physics	E12-09-019	Reconfigure		Run_Group I	3.7/200/-/500
67	10/13/21	Wednesday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
68	10/14/21	Thursday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
69	10/15/21	Friday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
70	10/16/21	Saturday	1.82	Physics	E12-09-019	5.56/40/-/500		Run_Group I	3.7/200/-/500
71	10/17/21	Sunday		Reconfigure				Install Run Group M	

Most likely will not happen

Experiment is scheduled for 55 days, starting on August 23
Machine setup – 1.8 GeV/pass, beam energy for HPS – 3.7

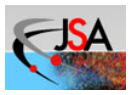
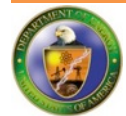




The beamline is almost unchanged from 2019 run:

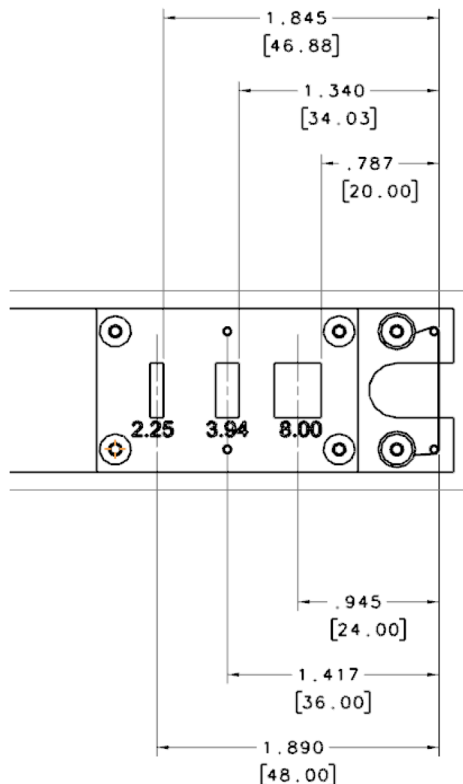
- A new collimator block with 8x10 mm² slot
- A new vacuum gauge at the upstream end of the vacuum chamber
- A set of neutron detectors between the 1st Frascati and the HPS analyzing magnet

JEFFERSON LAB
 00 BEAM LINE
 02 INSTALLATION TEMPLATE
 BEAMLINE CONFIGURATION: HPS 2021
 811006-02-00-0002
 SHEET 1 OF 3



SVT protection collimator

A new block, but unfortunately with wrong hole, 3.94 mm instead of 2.82 mm! My mistake, did not so until day before yesterday, *darn it!*



The block is mounted on the ladder, and has been fiducialized to the girder centerline, EPICS parameters for the motor are set.

Must decide what to do – there is still time to redo it. A new block will not need a fiducialization if we can mount is from bottom of the girder.

2.25 mm and 2.82 mm for 2019 production
Overall ~7% difference in the trigger rate

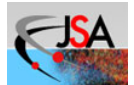
No target

<https://logbooks.jlab.org/entry/3710740> 2.25 mm – Singles-3 t/b =8/7
<https://logbooks.jlab.org/entry/3710736> 2.82 mm – Singles-3 t/b =5/3

Target 8 um

<https://logbooks.jlab.org/entry/3707879> 2.82 mm 150 nA, t/b= 3514/3640
<https://logbooks.jlab.org/entry/3707900> 2.25 mm 200 nA, t/b= 5002/5187

→ 3750/3890 (corr.)




Expected beam parameters for 2021 run

- A document describing the HPS run and the requested beam parameters is ready, has been submitted to Michael Tiefenback. Have to distribute to OPS team.
- Will work with OPS to have HPS beam delivery procedure re-established

Parameter	Requirement	Comments
Energy (GeV)	3.74	May run with 1.92 GeV (1-pass) beam for calibration
$\delta p/p$	$\sim 2 \times 10^{-4}$	
Current (nA)	≤ 300	The production running with 20 μm W-target will use ~ 120 nA
σ_{xy} (μm)	< 30	As measured by 2H02A wire harp
Position stability (μm)	< 30	On 2H02 and 2H00 ($> 30\text{nA}$) BPMs with feedback
Divergence (μrad)	< 100	
Beam Halo ($> \pm 5\sigma$)	$< 10^{-5}$	As measured by 2H02A wire harp
Long term current stability	$< 5 \%$	For > 30 nA, integrated over minutes
Short term beam intensity stability (60 Hz harmonics)	$< 10\%$	of the total power, measured with SLM and halo rates
Bunch charge fluctuations	$< 10 \%$	Measured with DAQ

RSAD draft is with Rad. Control group, request 300 nA on 8 μm W target





FSD
Beam PMTs
ECal Rates
BPMs
Motors
Vacuum
Magnets

Orbit Locks	Running
Counts	Upstream: 411, Midstream: 1976, Downstream: 261, HPS Up: 6783, HPS Down: 242351
Threshold	Upstream: 5000, Midstream: 50000, Downstream: 30000, HPS Up: 35000, HPS Down: 550000
Dwell Time (ms)	Upstream: 5.00000, Midstream: 5.00000, Downstream: 5.00000, HPS Up: 5.00000, HPS Down: 5.00000
Masked / Tripped	

07/21/2019 15:37:19
Beam Permit 1
Pass 5

RATES	Upstream: 223, Left: 205, Right: 205	Tagger: Top: 3, 164, Right: 1, Bottom: 1	Downstream: 30, 12, 45, 124	HPS-L: 257, HPS-R: 6636	Hodo: 1828548, 2868961	HPS-T: 198294, 132666, 99206, 134429, 215777	HPS-SC: 175621, 118028, 93125, 128257, 38297
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Beam Availability	Available
DAQ Status	Not In Use
Beam Type	Electron
Beam Destination	Faraday Cup
BSY Energy (MeV)	4556.656
Max RMS (%)	6.5508
Bunch Frequency	500 MHz

Beamline instrumentation is adequate to support 2021 run

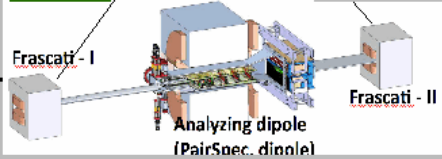
Beam Position Monitors	2C21A: 214.799, 2C24A: 196.434, 2H00: 3.104, 2H01: 1.122, 2H02: -1.490
X Abs Pos (mm)	0.117, 1.196, 5.047, 1.122, 0.590
Y Abs Pos (mm)	0.381, 0.457, 5.047, 9.830, 0.590

TOP SVT	Position (mm): 18.0127, Dist from beam (mm): 0.502, 18.2532
FC Temperatures (F)	Faraday Cup: 74.95, 226.223
BOT SVT	Position (mm): 18.0127, Dist from beam (mm): -0.499
FCup/2C21	1.03
FCup/SLM	593.3559

Moving Devices	Harp 2C21: OUT, Tagger Harp (2C24): OUT, Hall-B Collimator: OUT, Harp 2H01A: OUT, Torus, HPS Collimator: OUT, Harp 2H02A: OUT, HPS target: OUT, Beam Viewer: OUT, Beam blocker: OUT
BB Temperatures (F)	87.68, 90.95

Beamline Vacuum	2C21: 1.167e-07, 2C21A: 3.865e-07, 2C24: 3.426e-06, 2H00: 6.869e-06, 2H01: 5.985e-06, 2H02: 1.036e-05, 2H03: 8.61e-06
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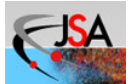
Magnet Settings	2C21H: 1000, 2C21V: 4500, 2C22H: 637, 2C23V: 4387, Tagger: 0.4 A, -0.0 T, MQA2H00: 66305, MQA2H00A: -65912, 2H00H: 270, 2H00V: -2877, MQB2H01: 0
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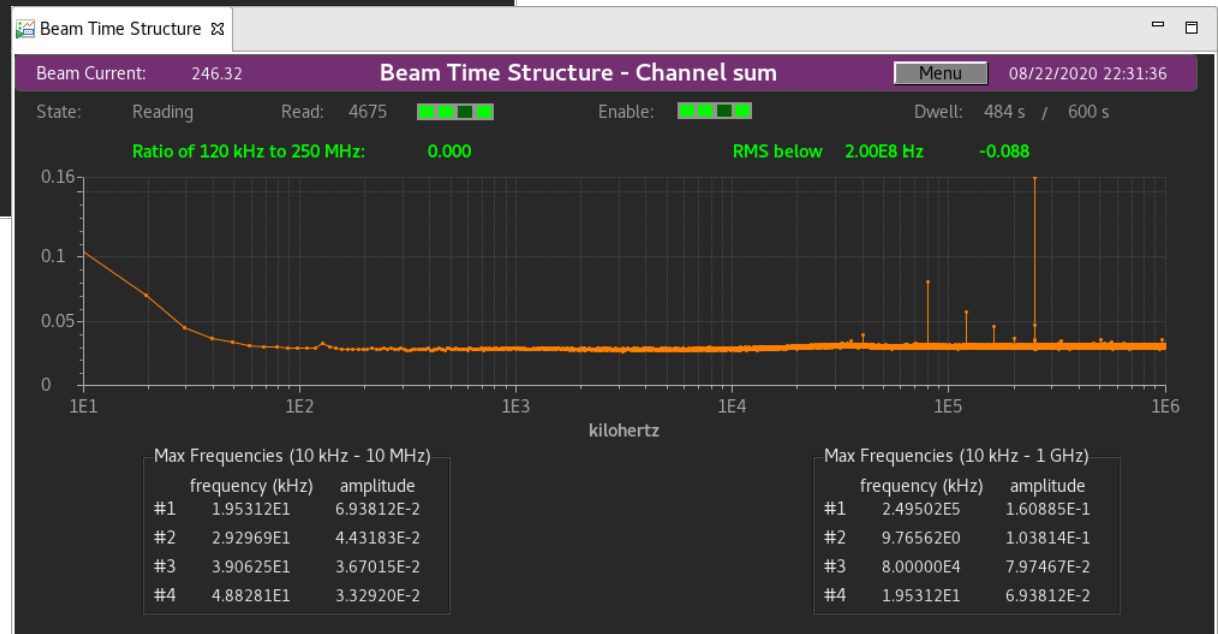
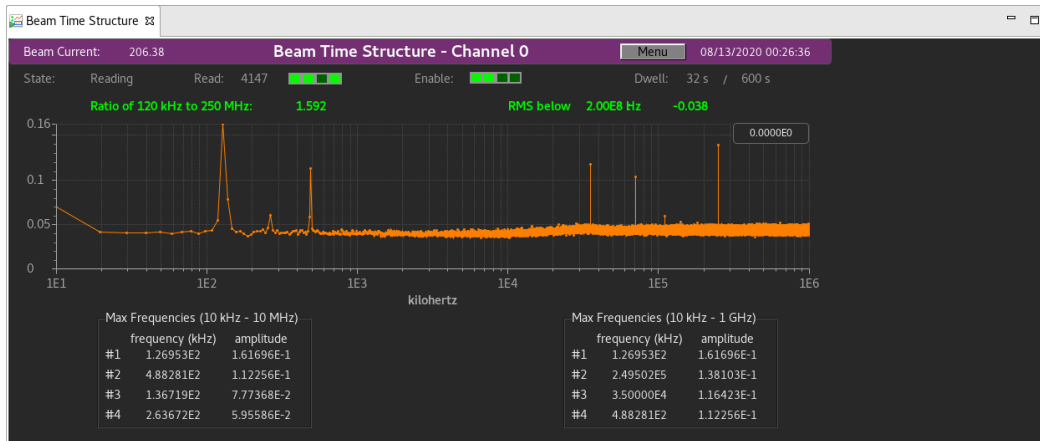
3105.82 A (DAC readback)
3106.00 A
-10918.0 G
1610 A
-9684.0 G
Main Power On
Positive Polarity

To make a log entry right click:
Menu Execute -> Make Log Entry

Scaler Setup

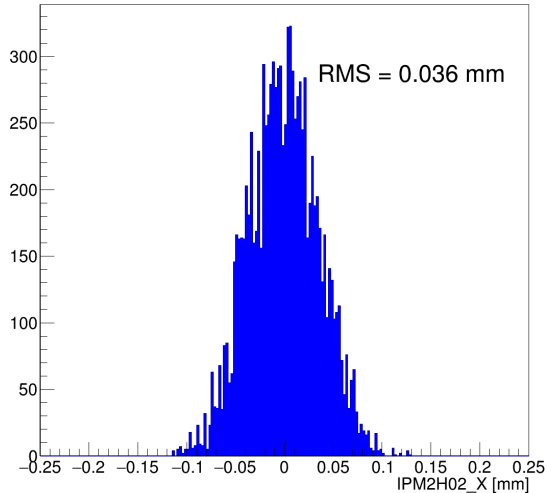


New EPICS app to monitor bunch charge

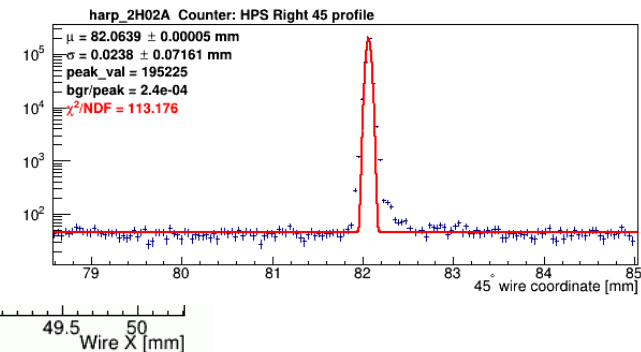
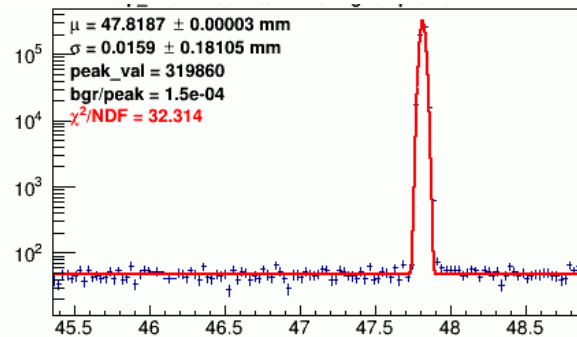
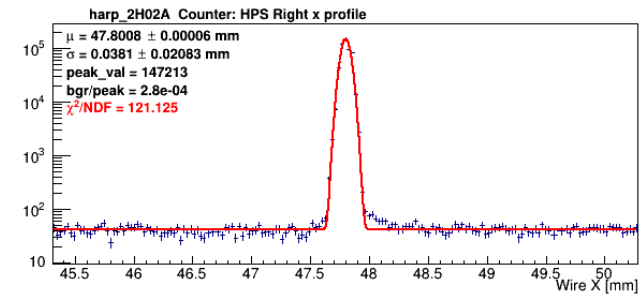
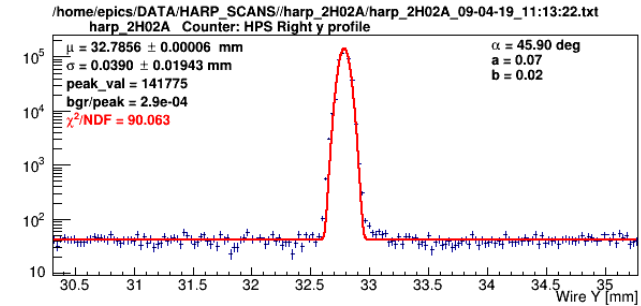
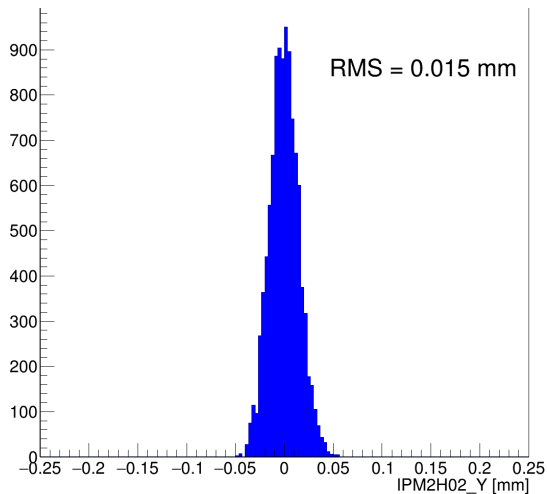


Beamline performance during 2019 run

Beam position stability



Should expect similar performance in 2021.
The biggest issue in 2019 was machine setup and beam tuning to Hall-B - there is no parity experiments this time.



R. Paremuzyan

S. Stepanyan, HPS Collaboration meeting,
SLAC, June 23-25 2021



Summary

- The schedule is very tight, two months before run starts
- Almost no changes to the beamline, but it will be the last to be ready.
- The existing beamline instrumentation is adequate to support the run
- The machine performance is unknown after the ongoing repairs, we must have all the protections in place on day 1
- One of the biggest issues in 2019 was the beam tune to FC going through the SVT collimator. A new collimator block, with larger slot ($8 \times 10 \text{ mm}^2$) has been installed and fiducialized. This should mitigate the issue of the initial tuning.
- Ad hoc “neutron shield” between the 1st frascati and the analyzing magnet installed during the 2019 run seems did not help. A few neutron detectors will be installed in the same place to monitor the neutron flux at the beginning of run and decide on the shield later

