

Commissioning Progress and FY24 Beam Parameters



Facility for Advanced
Accelerator Experimental Tests

FACET-II User Meeting 2023

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October 17-19, 2023

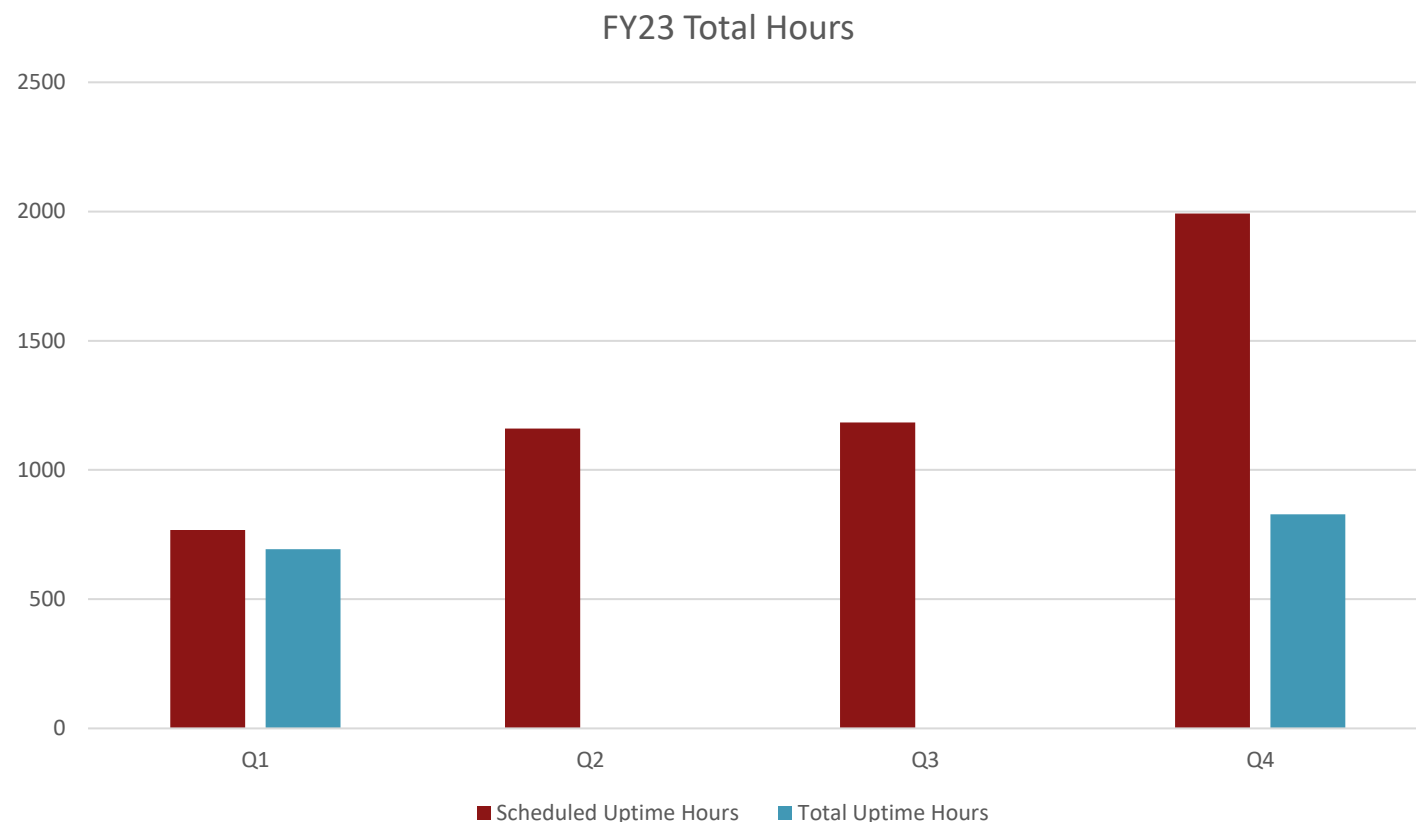
Outline

- FY23 Beam Parameters and Runtime
- Selected Machine Development
- Planned FY24 Run Schedule
- Improvements to Beam Delivery
- Expected FY24 Run Parameters

FY23 Hours

	Q1	Q2	Q3	Q4*
Scheduled Uptime Hours	768	1200	1200	1992
Total Uptime Hours	694	0	0	828
Uptime Percent	90%	0%	0%	42%

- Q1 FY23 90% uptime
- Following incident in December 2022, FACET-II accelerator off until late July 2023
- Significant unscheduled off following recovery due to slow ramp-up of work

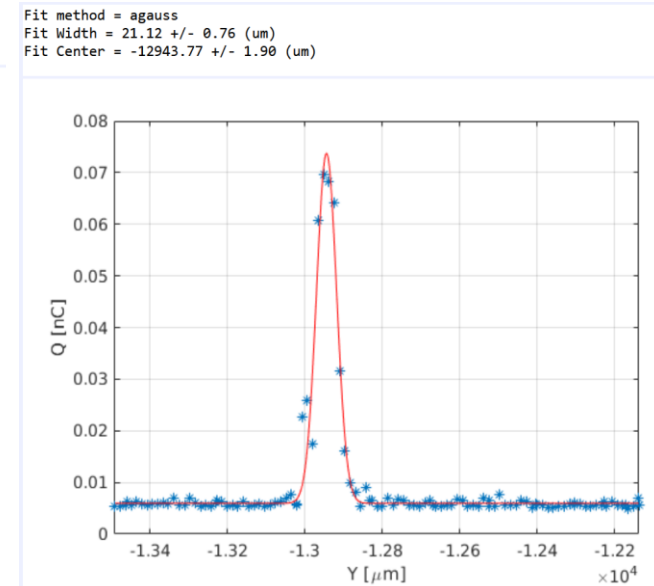
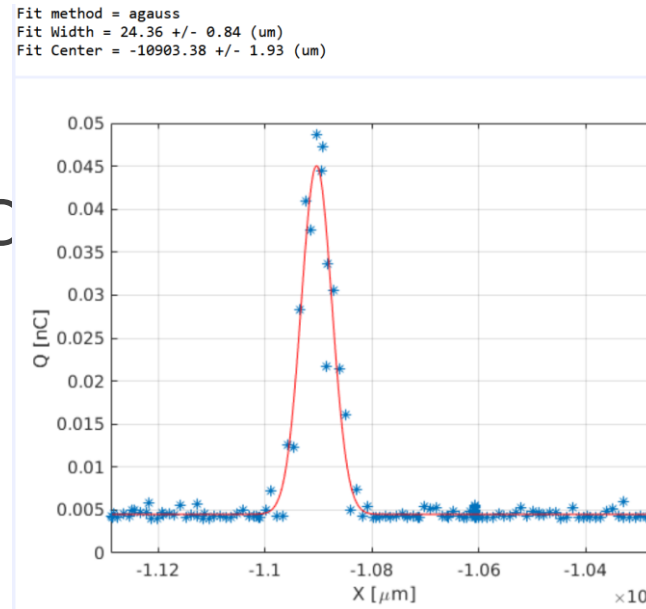


- Nominal Linac energy profile established Oct 10
 - 10GeV S20, 4.5GeV BC14

FY23 Run Hours Statistics

FY23 Parameters

- QE $2.1e-4$
 - Still holding steady
- 3-4 μm emittance in injector at 1nC
 - Very consistent
- 5 μm emittance at L2
 - Reproducible
- 20 μm emittance at L3
 - Linac L3 emittance growth needs addressing following accelerator restart
- 20 μm spot sizes at S20 IP
- 1.1nC typical charge since restart of accelerator
 - Low charge, low energy spread beam to start and shake out all systems



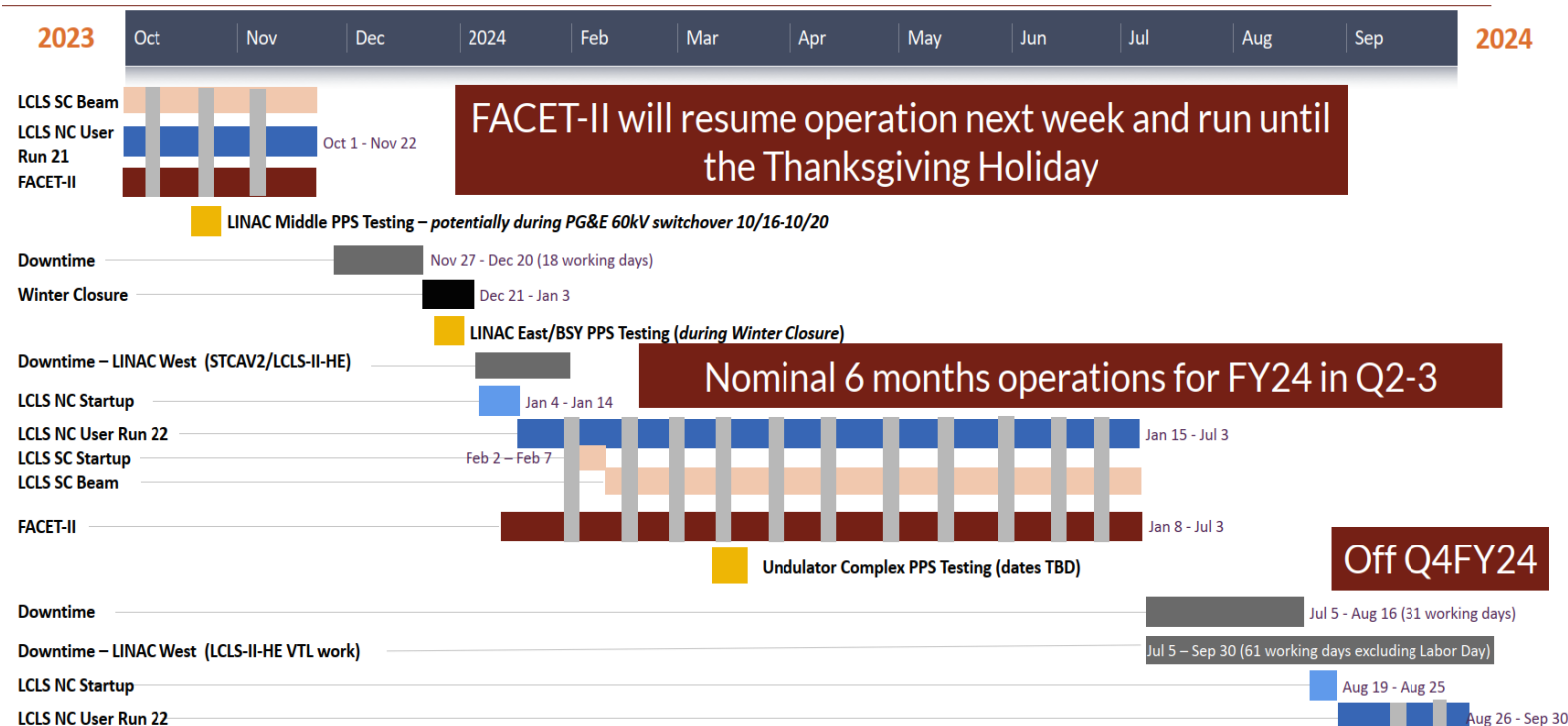
Parameters from the FY23 run

FY24 Runtime Expectations

	Q1	Q2	Q3	Q4
Scheduled Uptime Hours	673	1122	1346	0

- Scheduled uptime hours account for 3-day planned maintenance periods every two weeks and an 85% uptime expectation

Oct 2023/Sept 2024 Accelerator Schedules & Downtimes

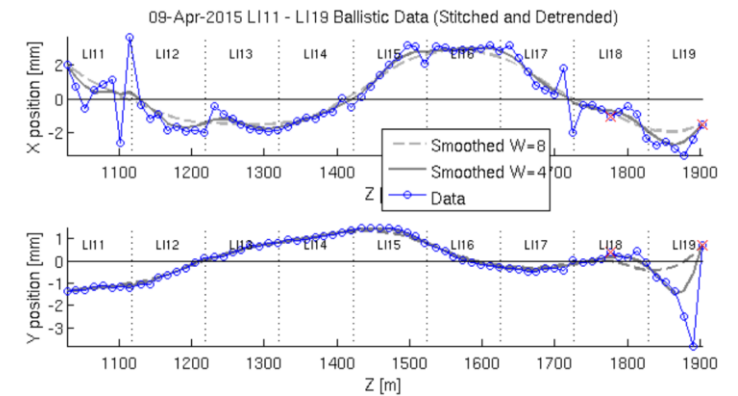


- FACET-II runtime integrated into lab-wide run scheduling

Over 3000 hours of machine uptime planned for FY24

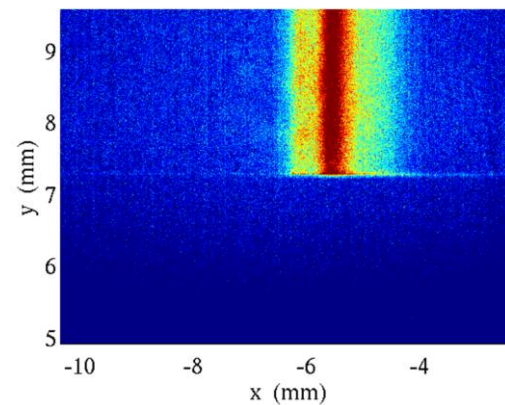
Selected Machine Development

- Ballistic Beam Alignment
 - Smooth discontinuities in linac for better emittance preservation
- S20 IP and Spectrometer Beam Based Alignment
- RF and Magnet Stability
 - Hardware stability contributed to variation in deliverable beam parameters
- 2nC Machine Stability
- Configuration Switching
 - Develop consistent, quick configuration changes between beams with differing compression profiles
- Many High-Level Applications to be developed and updated for reliability



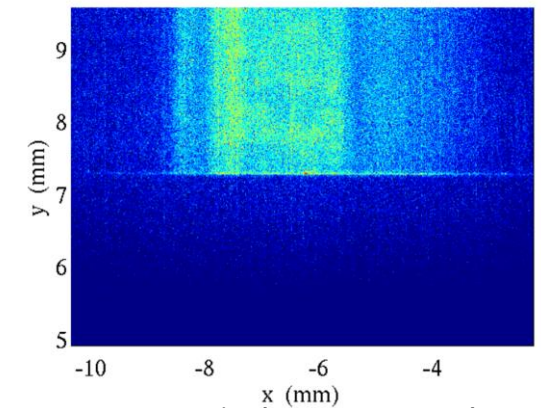
2015 FACET ballistic beam alignment example

Profile Monitor CAMR:LI20:100 20-Aug-2022 12:24:01



Low energy spread

Profile Monitor CAMR:LI20:100 20-Aug-2022 12:26:41



Nominal energy spread

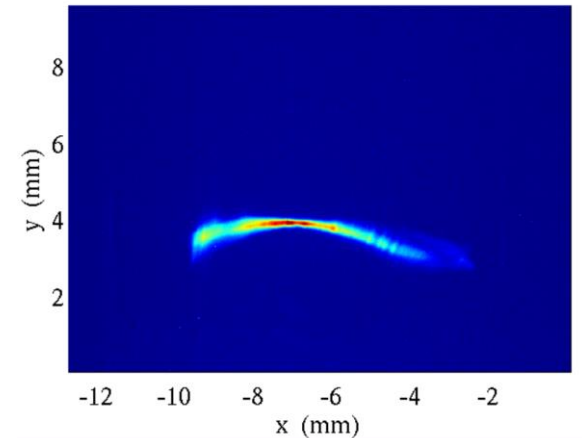
Selected MD's will improve reliability and consistency of beam delivery

Improvements to Beam Delivery

- Laser Heater (see Claudio's talk)
 - Remainder of commissioning following push to 2nC and full compression this Fall
- Two-bunch Commissioning (see Nathan's talk)
 - Will allow for drive and witness bunch through linac rather than collimation with the notch in S20
 - Will also recommission notch-collimator
- L1 LLRF Upgrade (See Carsten's talk)
 - Significantly improve stability of delivered beams

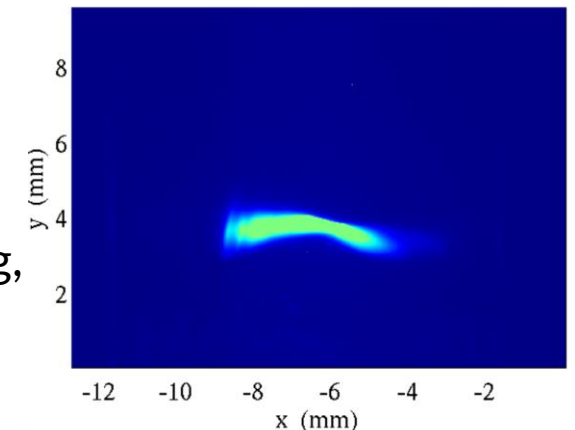
Microbunching observed on beam at SYAG

Profile Monitor CAMR:LI20:100 13-May-2022 13:25:11



Upstream profile monitor inserted: Suppresses micro-bunching, but blows up emittance

Profile Monitor CAMR:LI20:100 13-May-2022 13:26:35



These tasks will improve the capability of beam delivery

Expected FY24 Beam Parameters

- 500pC to 2nC charge
 - MDs to investigate RF and DC magnet stability, tuning techniques for higher charge, configuration switching/development
- 4 μ m gun emittance
 - Gun emittance has been stably reproducible at 4-5 μ m
 - Further improvement expected after spending time developing 10deg Schottky phase configuration
- 8 μ m linac emittance
 - Focus this run will be to maintain the consistency of L3 linac emittance rather than push the minimum size down
- 10 μ m-100 μ m bunch length
 - Focus will be reproducibility and stability
- 9GeV to 11GeV energy
 - Long term project to increase klystron availability in L3

Improvements in stability and capability will enable better, more consistent beam quality

Summary

- Significant downtime after December 2022 incident
- Slow recovery due to Work Planning and Control changes, lab resources
- Machine currently running 1nC at nominal linac energy profile since 10/10
- Following 230kV maintenance and PPS re-certification this week, plan to push to 2nC and recover full compression
- MDs to improve reliable delivery and increased capability will carry on in parallel to user delivery through Thanksgiving, restart in January

Rocky start to FY23 run, but progressing