Beam/Accelerator 2025 Run
Hall C Collaboration Meeting Talk

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13 January 2025

Summary

- Goals
- Injector status
- Schedule status
- RF status
- Conclusions

Goals

- Scheduled goal: 900 kW at 1060 MeV/linac through the summer
- Stretch goal: Demonstrate 1100 kW by increasing current to Hall C fourth pass while A is at fifth pass. Ops has to sustain 1100 kW before Physics will push for intermediate heat exchanger upgrade to allow perhaps 1500 kW total.
- Hall C RSAD should be written for 56+ uA at passes 3/4/5 and 80 uA empty target to allow stretch.

Injector

- Injector is essentially new
- Rebuilt 200 kV source
- Rebuilt focusing solenoids
- Degrader installed. LDRD to simulate large emittance positron beam.
- Several weeks of commissioning and testing planned in parallel with linac RF/SRF work
- Three days of dedicated MOLLER tests planned.

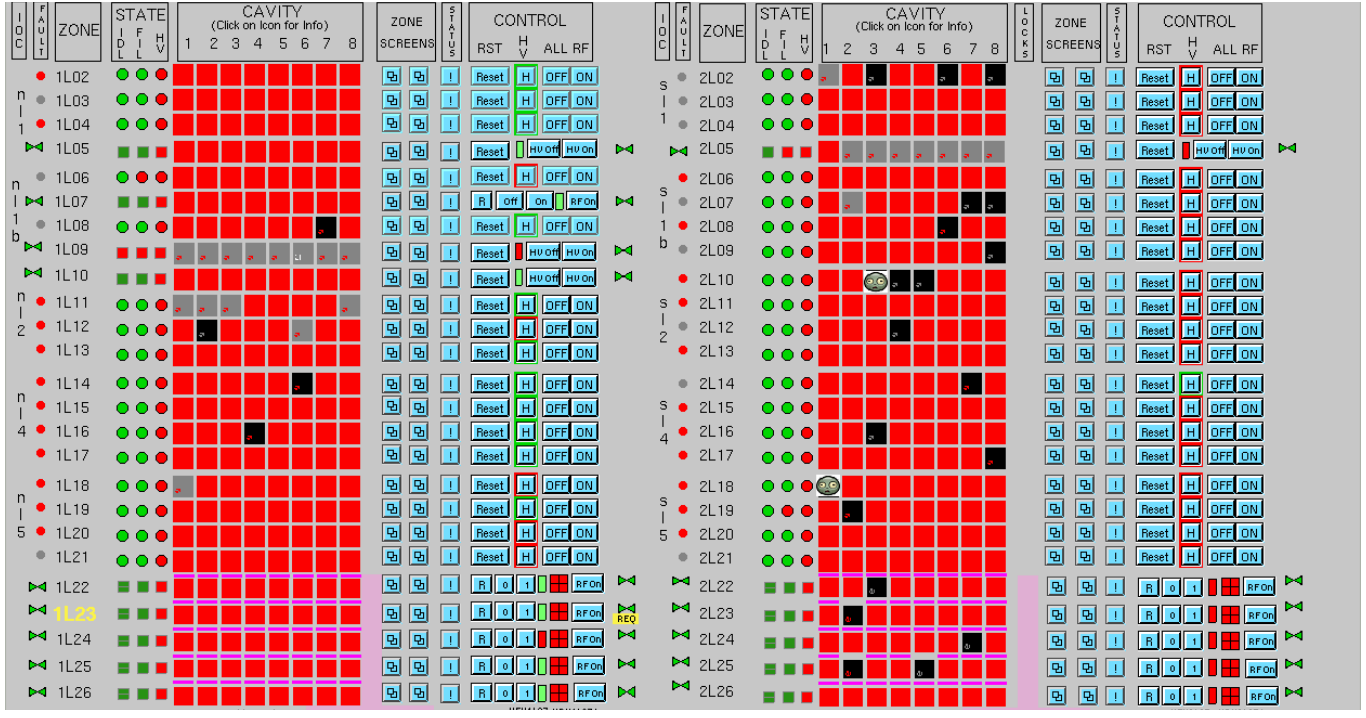
Schedule Status

- Critical path is through SRF commissioning and RF recovery of 30+ other cavities.
- Personnel with transferable skills are being brought in from other groups to get back on track.
- Three refurbished modules need to be commissioned: 1L22, 2L05, 1L09
- Present schedule has 1L09 commissioning ending 13 February.
- Useful CEBAF recovery start will depend on the other 30+ cavities.
- Accelerator Division is working with ES&H to ensure 24-7 on-call support.

RF Status

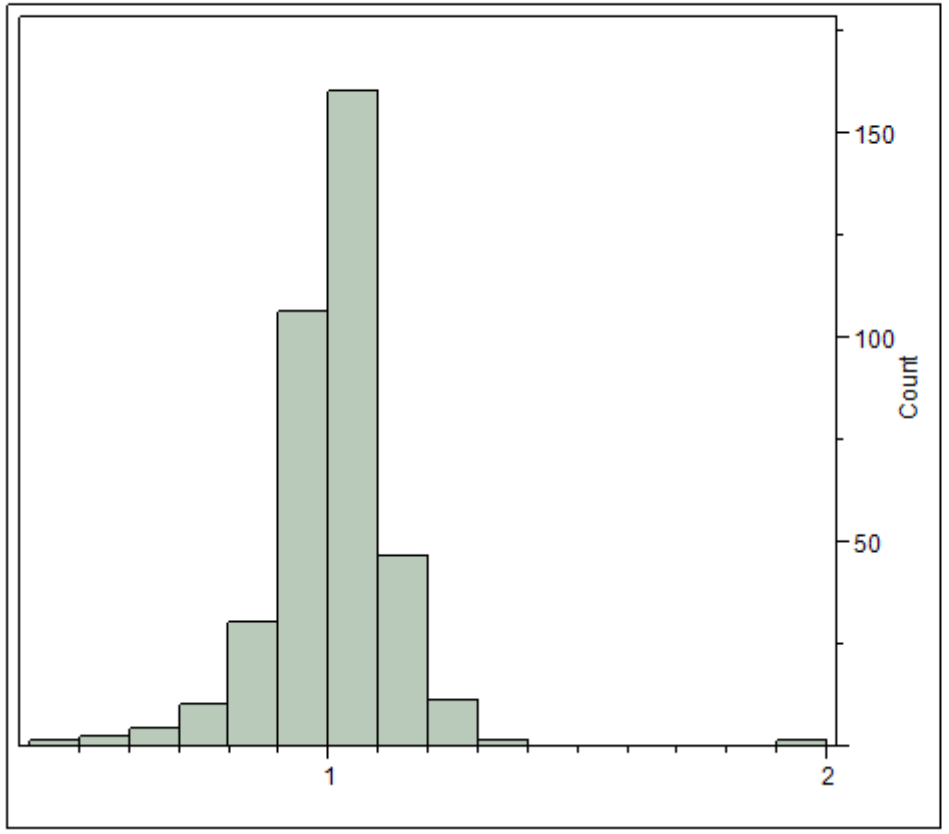
- We need 397 functional linac cavities at the start of the run to reach the energy and beam power goals assuming usual degradation during the run. Three can't be used without CM rebuild.
- Gradient calibration and microphonics data taken last run were put into CED in June. LEM was changed in case the microphonics adjustments impede delivery – aka I can allow more C100/C75 energy gain and faults via two fudge factors. If calibration is an issue, back-out would be slower.

RF Captain 9 January



All cavities in grey or black need to be recovered, plus 1L22 and less 1L12-2

Gradient calibration multipliers



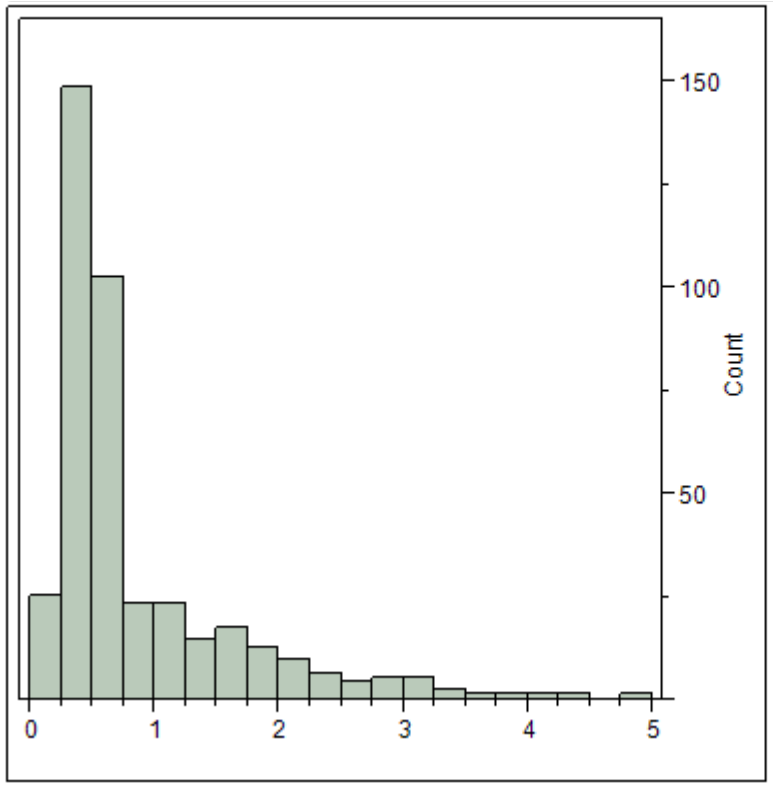
Moments	
Mean	1.0059973
Std Dev	0.1230022
Std Err Mean	0.0063774
Upper 95% Mean	1.0185376
Lower 95% Mean	0.993457
N	372

Beam-based energy gain divided by nominal energy gain.

Data taken by phase shifts of each cavity using following arc as a magnetic spectrometer.

Goal: tighter linac optics via more appropriate quadrupole settings.

Microphonics adjustment ratio



Quantiles

100.0%	maximum	4.877
99.5%		4.41079
97.5%		3.10097
90.0%		1.8926
75.0%	quartile	1
50.0%	median	0.535
25.0%	quartile	0.413
10.0%		0.2906
2.5%		0.1982
0.5%		0.13616
0.0%	minimum	0.079

CED values used in lem to allocate power to microphonics had not been adjusted in my memory, perhaps not since original installation.
Data taken via EPICS and with dedicated system by Tom Powers were used to derive new values. These are the ratios new/old. C25/50 cavities generally lower, C75/C100 generally higher.

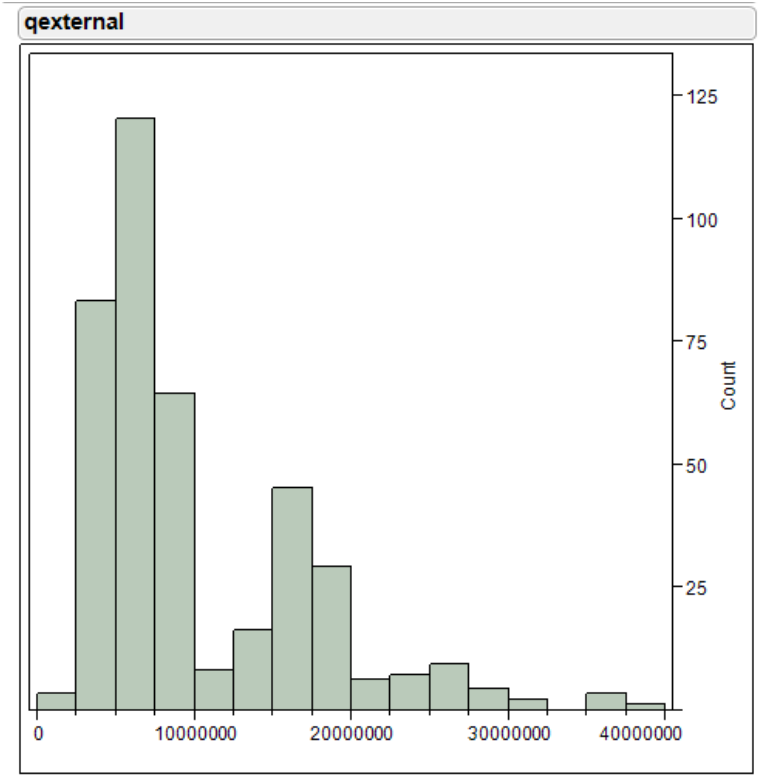
Early recovery sequence – mostly Owl shifts

1) Ops brings functional cavities which will not interfere with SRF commissioning into RF.
2) Ops determines new operational limits for cavities which were cycled to 300 K en passant
3) Ops makes a first cut at adjusting cavities for neutron dose.
4) Ops puts beam through the the NL to 1S01 viewer to phase available cavities. If energy is high enough for arc one shunt supplies to function, repeat for SL at 2S01.
5) Repeat 2, 3 after phasing. Repeat 1-4 as RF/SRF turn over more cavities to Ops.

After all cavities are turned over

- Run *phaser* to get all cavities closer to crest than one can manually.
- Run *lem*. If energy fudge factors required to get beam around arcs at scheduled energy are small, decide whether to repeat beam-based calibration on everything (one day) or just do the refurbished modules (1.5 hours). If C75/C100 gradients are lower than desirable for fault rate, adjust microphonics fudge factors and re-lem until comfortable.

Beam Power Constraints



Coupling of power from the klystron to the cavity and beam is determined by Qexternal. Power ~ V^2/Qext +I^2*Qext +microphonics.

For old RF controls, Qext ~8.8E6 best
For new RF controls, Qext ~1.5E7 best
Value constrained by existence of 3-stub tuners (old) or RF window heating (new).

C100/C75 designs assumed 450 μA maximum so higher Qext for higher V. Sub-optimal for Physics.

Optics setup

After all the preliminaries, 4-5 days for main machine and 1-2 shifts for each hall.

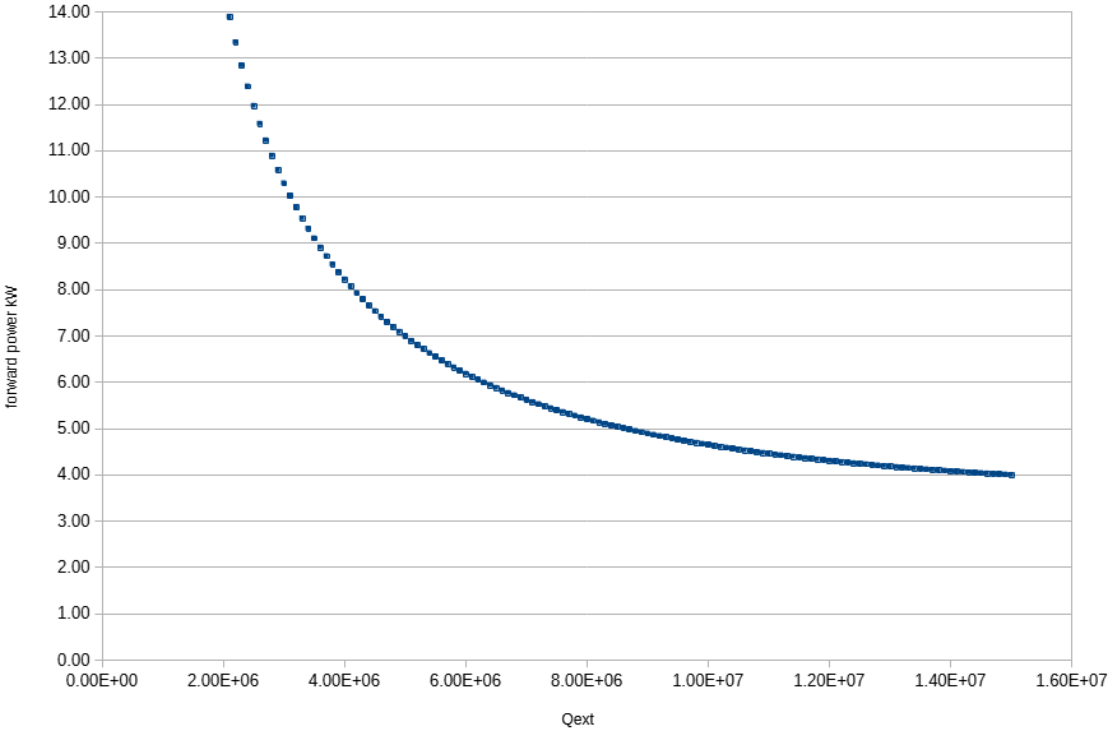
Running high current to an empty target early would help in shaking down RF at full beam power.

Conclusions

- Physics delivery towards the end of February
- We have a long way to go.

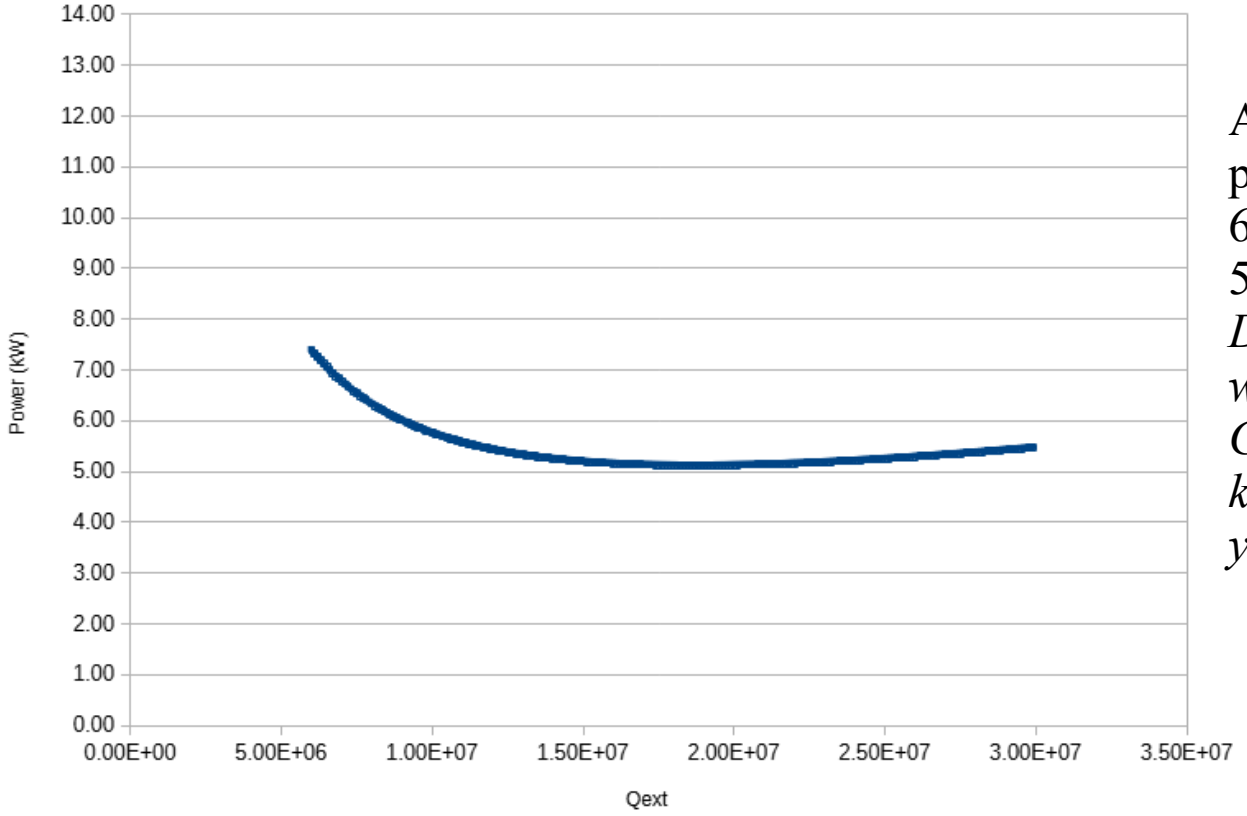
Backup

Power vs Qext, C25/50, 14 MV/m at 500 µA



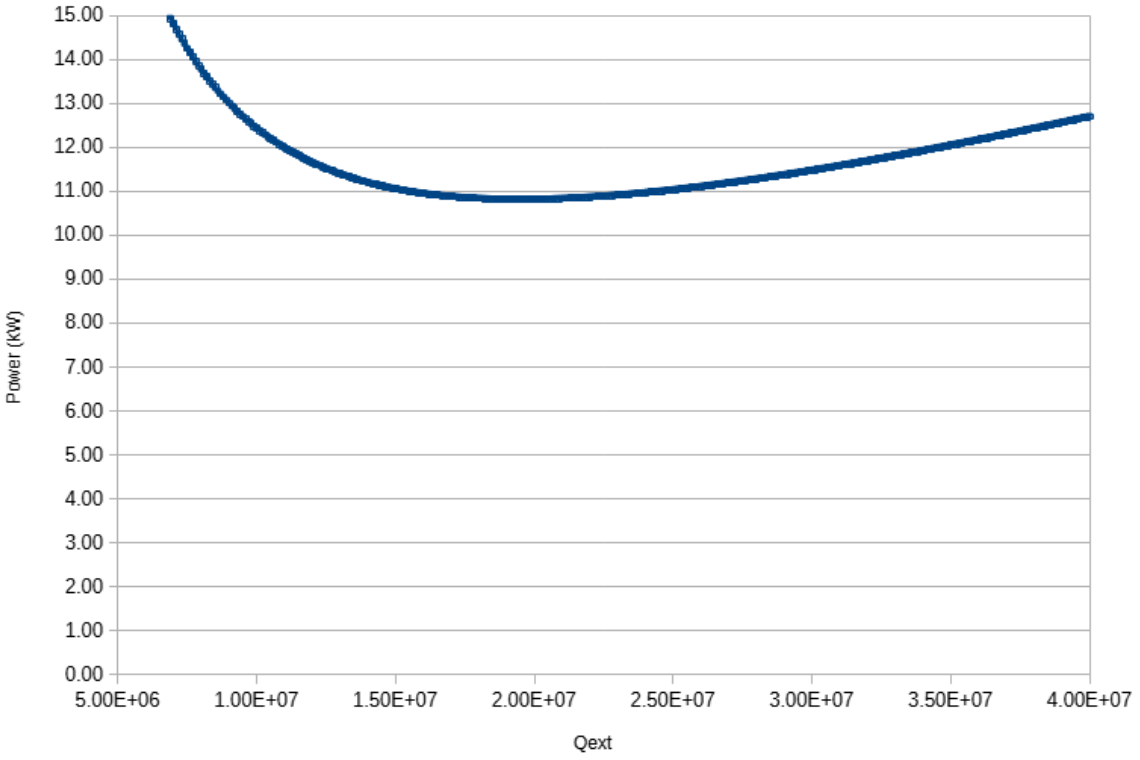
Adapted from spreadsheet provided by C. Giovati
6 kW from klystron
5.2 kW usable at cavity

Power vs Qext, C75, 16 MV/m at 500 µA



Adapted from spreadsheet provided by C. Giovati
6 kW from klystron
5.2 kW usable at cavity
Design goal: 19 MV/m with 8 kW klystrons. Circulators needed to run klystrons at 8 kW are not yet available.

Power vs Qext, C100, 22 MV/m at 500 µA



Adapted from spreadsheet provided by C. Giovati
13 kW from klystron
11.3 kW usable at cavity