

# CEBAF Accelerator Status

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# Outline

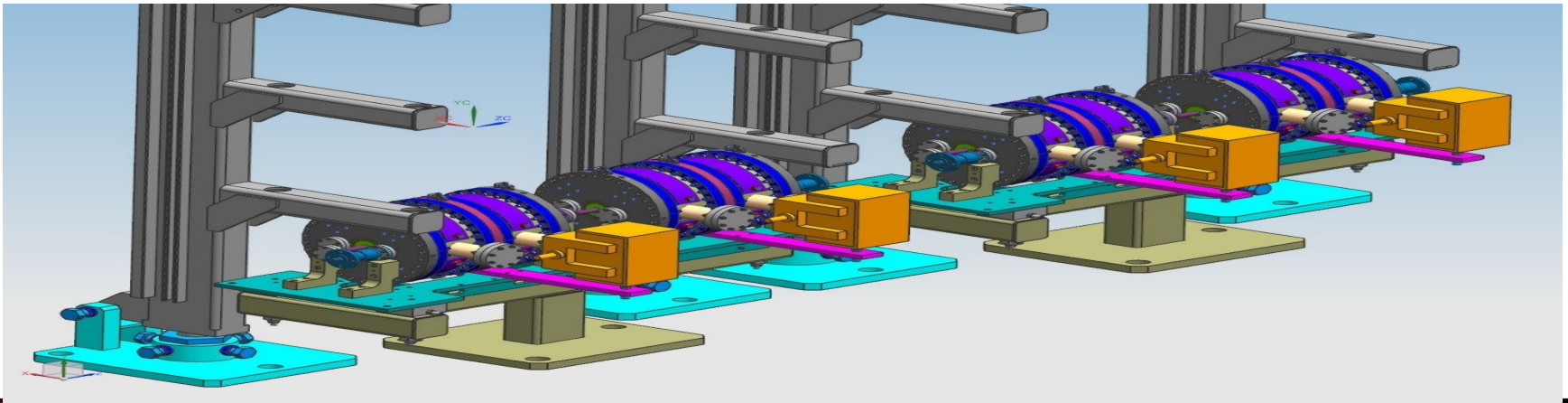
- Accelerator Management Changes
- FY17 Accelerator Operations
  - Fall 2016
  - Spring 2017
- FY18
  - 3+ Hall Operations
- CEBAF Performance Plan
- Summary

# Accelerator Division Leadership

- On April 30 **Andrew Hutton** stepped down as the head Accelerator Division
  - ~10 years as Division Leader
  - Prior to assuming the Division Leadership, Andrew was Director of Accelerator Operations for ~15 years.
    - Commissioning of 4 GeV CEBAF
    - Ramp up to 6 GeV
    - Recovery post-Hurricane Isabel
- **Fulvia Pilat** has assumed the role of *Acting Division leader* until the completion of the search for the new Division leader

# Fall 2016 Accelerator Operations

- Hall A (1,3,4,5 passes, 70  $\mu$ A) & Hall-D 5.5 passes
- Linac Energy: 1050 MeV/linac
- Commission 5th pass separator
  - Validate improvements made over the Summer 2016
    - Compact Geometry (+9%)
    - Increase RF power (+10%)
  - Changes validated!
  - Vacuum leak in one of the cavities immediately following commissioning rained on the parade



# Fall 2016 Accelerator Operations

- Availability Challenges
  - Arc7 Box Supply choke failure
    - Unable to support beam beyond 4th pass, required a change in program.
    - One of 12 new large box power supplies
    - Design flaw in estimating heat generated in choke
    - Klixons install on all chokes
    - Infant mortality issue
  - SRF Warm Poly Window failure
    - Required thermal cycle to repair and clean beamline vacuum (one-week lost time)
    - End-of-life issue
    - Replacing all Poly windows this summer with ceramic
  - South Access Main 1 Feed issues
    - Persistent ground fault, jumpered out

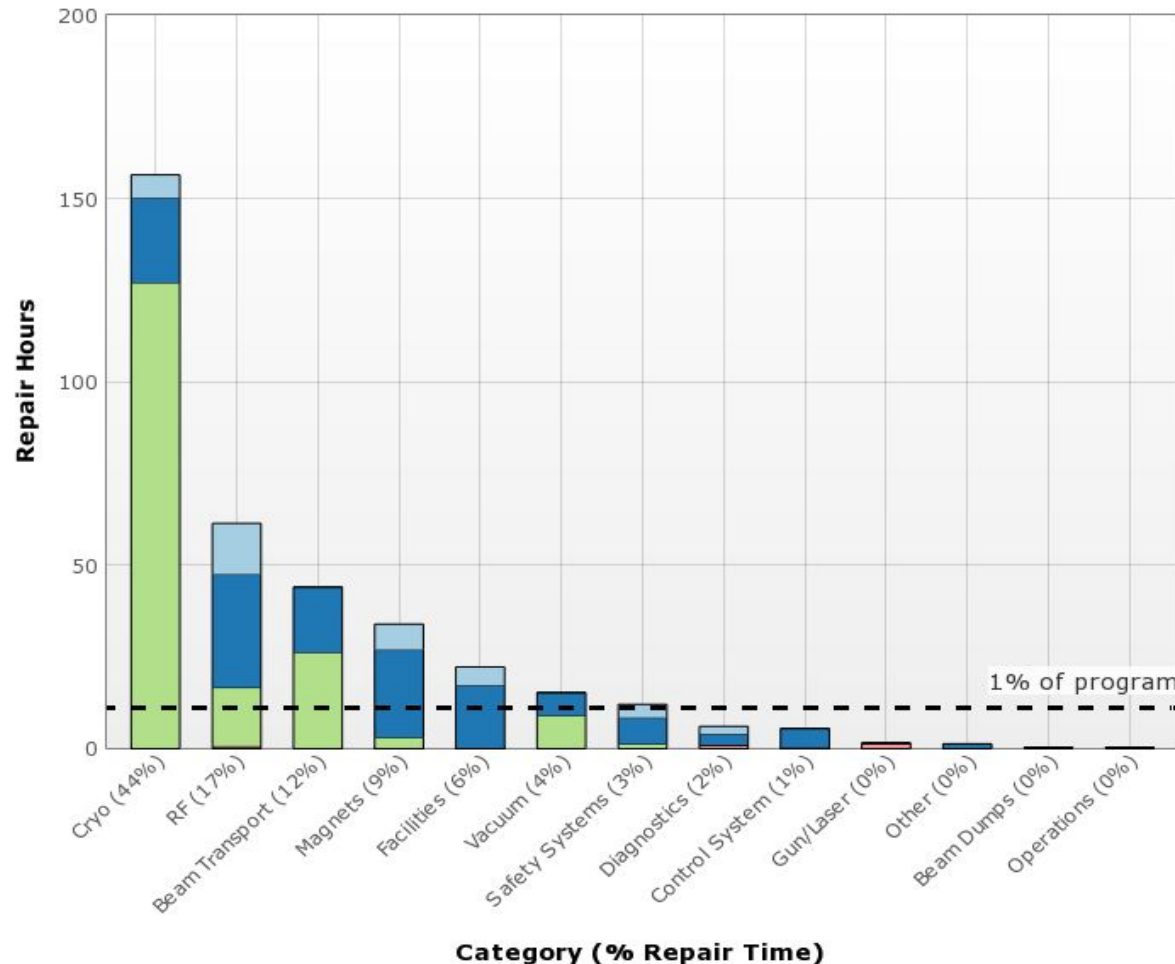
# Spring 2017 Accelerator Operations














- 2+ Hall Operations
  - Hall-D 5.5 passes (first production run of GlueX)
  - Hall-B&C @ 3-pass (KPP)
  - Hall-A 1-pass
- Linac Energy: 1050 MeV/linac
- Commission 5th pass separator (AGAIN, after vacuum repair)
  - All Good!
  - Hall-D received the majority of its beam using 5th pass separator
  - 5th pass separator operated week(s?) without a trip.
- Hall-B and C KPP complete!
  - End of beam related 12 GeV Project activities
- 3-hall operations with two high current halls (A&C) established

# Spring 2017 Availability Challenges

## Accelerator System Repair Report

January 26, 2017 - January 26, 2018



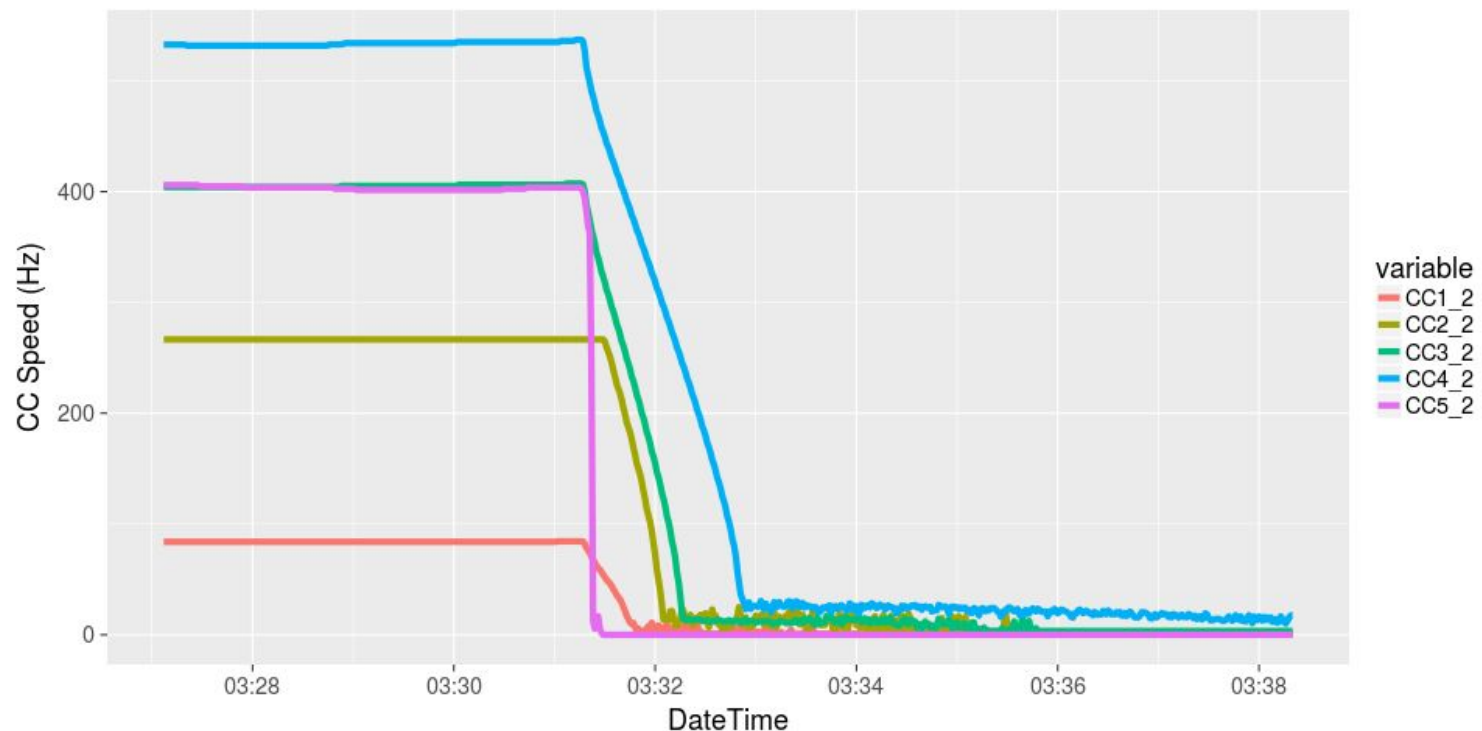
		Prg Hrs	Prg %
	Jan '17	144	14%
	Feb '17	648	62%
	Mar '17	247	23%
	Apr '17	14	1%
	May '17	0	0%
	Jun '17	0	0%
	Jul '17	0	0%
	Aug '17	0	0%
	Sep '17	0	0%
	Oct '17	0	0%
	Nov '17	0	0%
	Dec '17	0	0%
	Jan '18	0	0%
Total:		1,053	

■ Incident Downtime



# Cryogenic Status

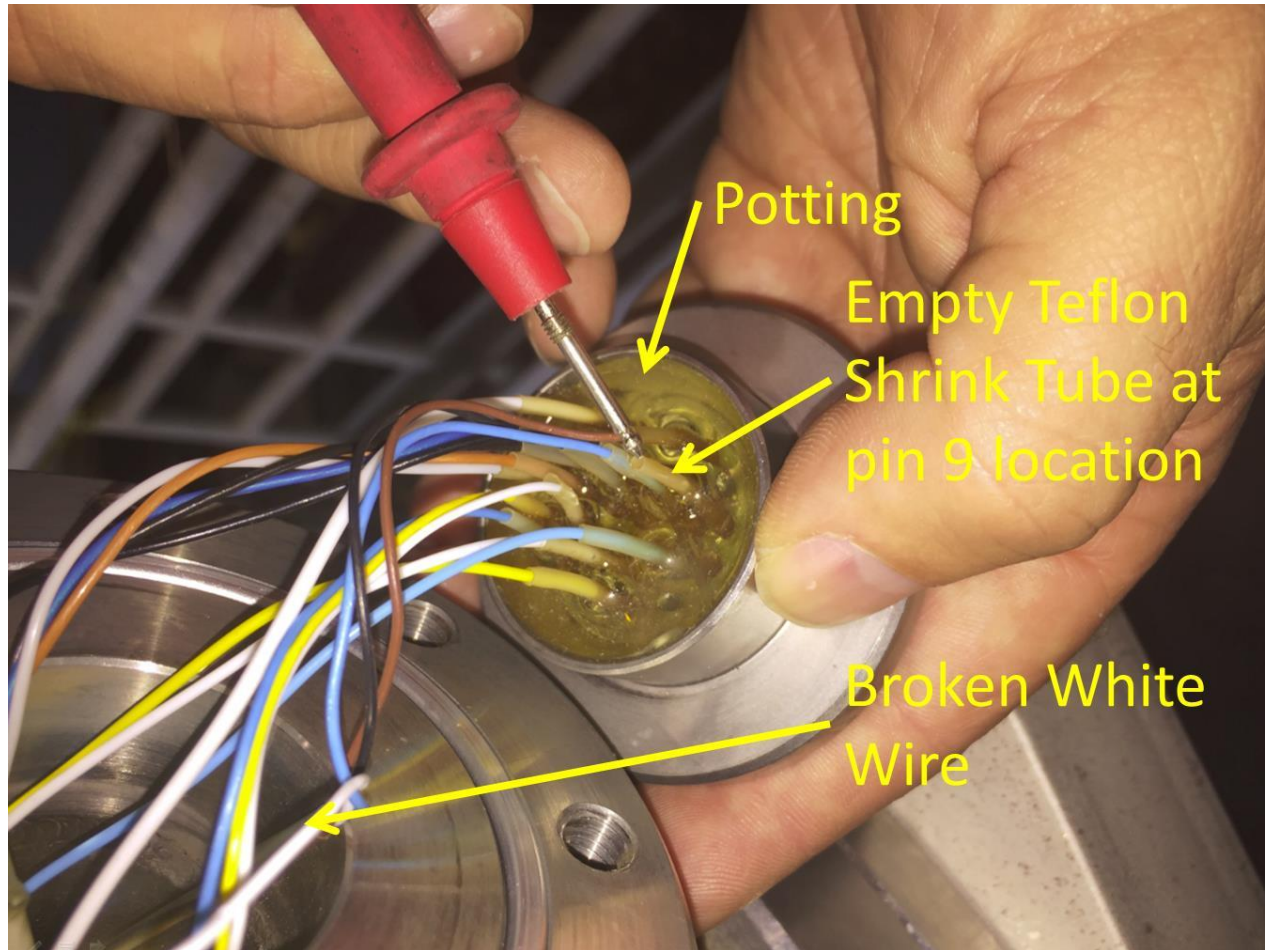
- Spring 2017 run was going well up to March 9th 2017
  - CHL1->SC1 tripped off in the evening
  - Recovered and tripped in the early morning of March 10th
  - Cold Compressor 5 (CC5) inoperable post 2nd trip.





# Cryo: CHL1->SC1->CC5 Update

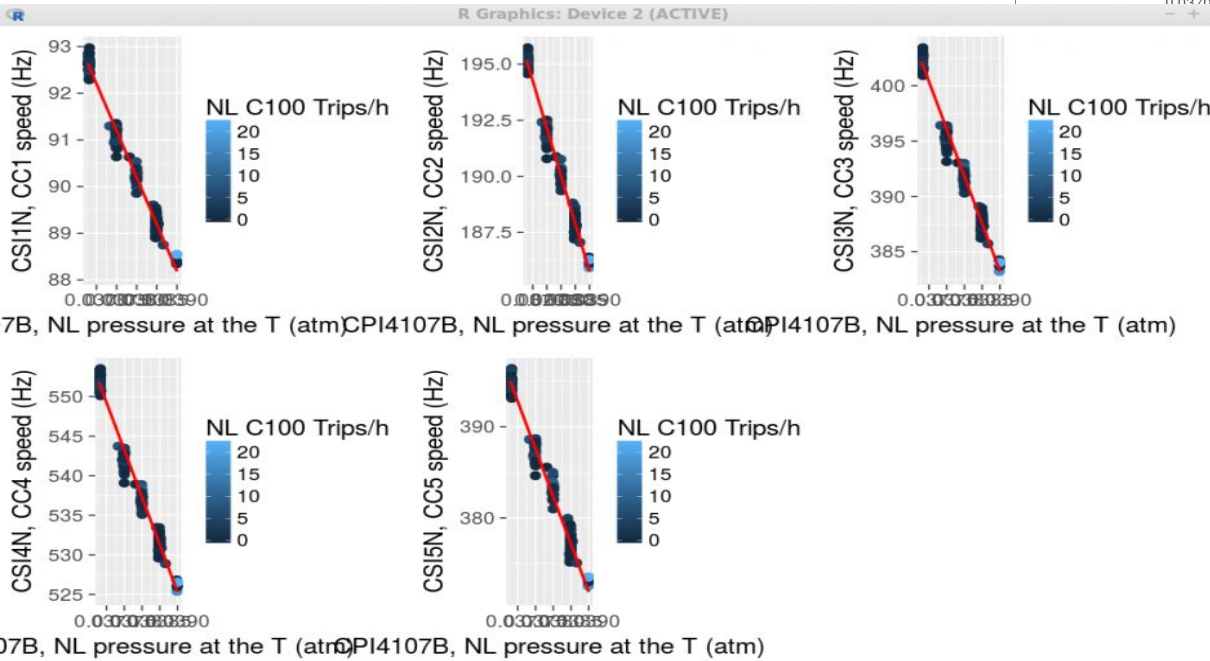
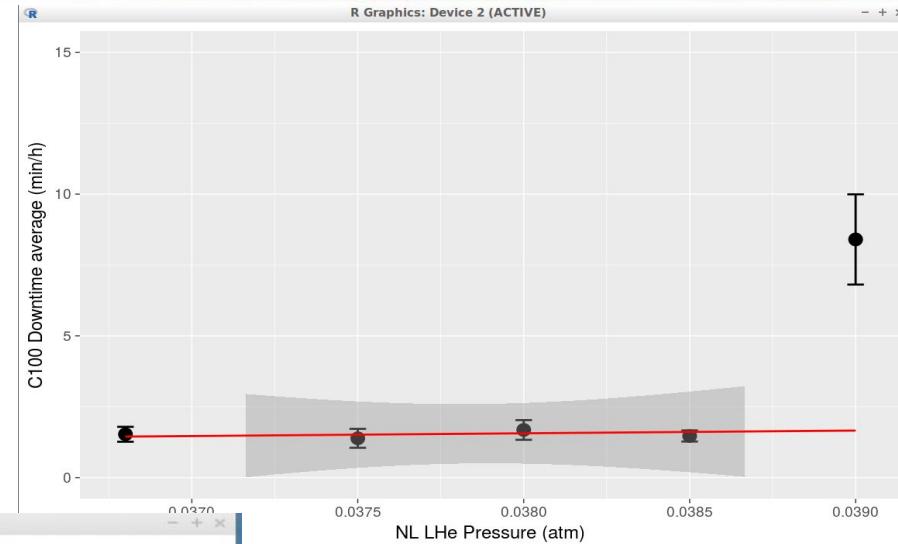
2017-05-02: Broken wire on magnetic bearing connector was found.



# Optimizing 12 GeV Operations: SRF/Cryo

## LHe Pressure:

- Higher operating pressure -> less stress on 2K cold-box compressors
- ~2milli-atm of pressure margin available

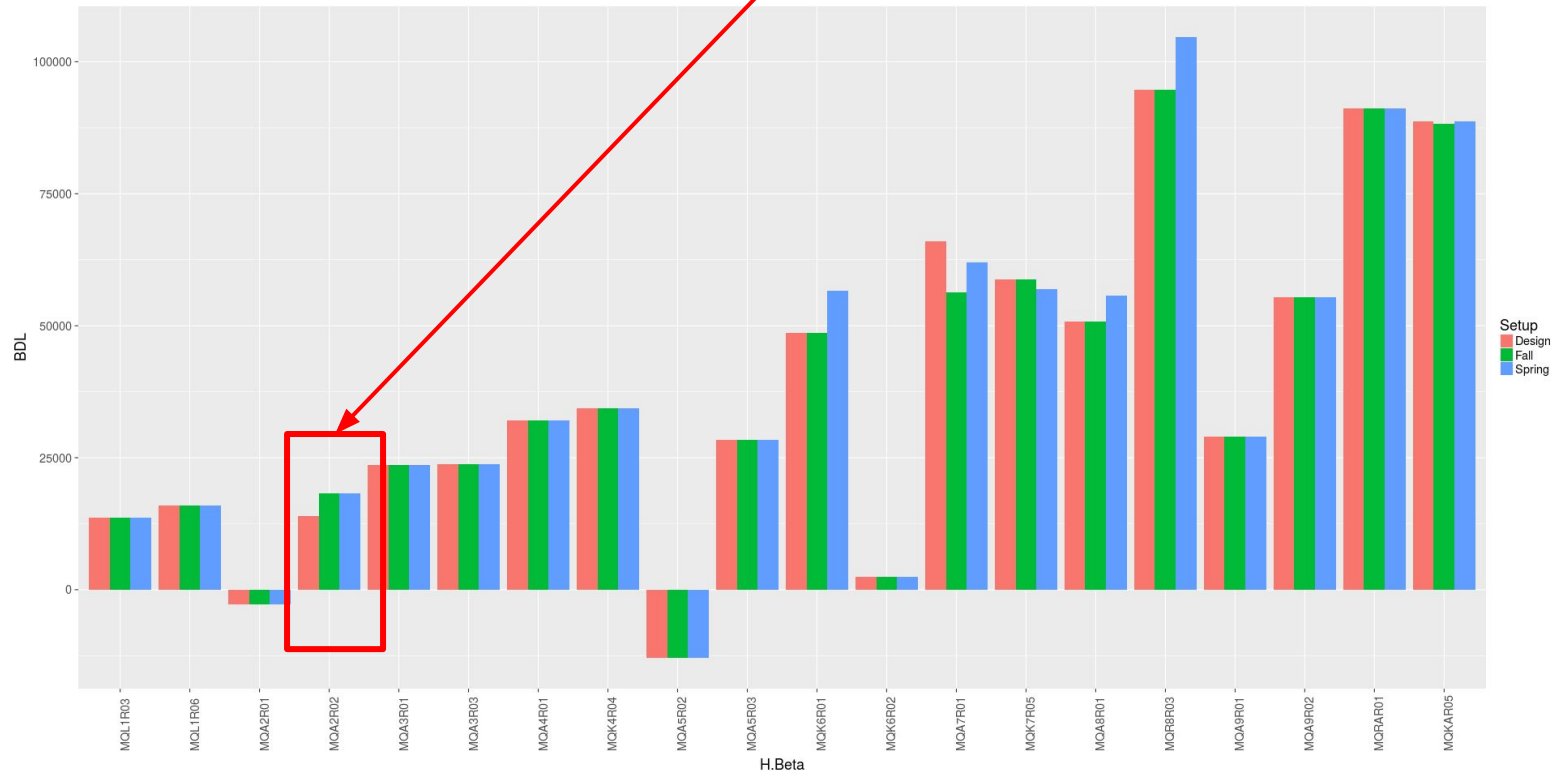


- All CC spin reduced
- CC4:
  - 552 Hz -> 532 Hz

# Optimizing 12 GeV Operations: Optics

## The 2R Optics Anomaly

- Optics matching consistently required **MQA2R02** quadrupole set 30% off design.
- Detective work by Tiefenback identified MQA2R09 quad as problematic
  - Confirmed with magnet coil resistance and pole field measurements



# Optimizing 12 GeV Operations: 4-Hall OPS

- Laser table upgrade completed Summer 2016
- 750 MHz 5th pass separators completed/commissioned Spring 2017
- Laser RF controls completed April 2017
- System is complete!

Channel 3  
Channel 3 2017-03-27 12:39:19

23fps

OIO4

/cs/opshome/edm/pol\_source/pgunFreqDiv.edl

### Laser Frequency Divider

	Laser A	Laser B	Laser C	Laser D
Frequency Readback	500 MHz	250 MHz	500 MHz	250 MHz
Frequency Archived	499	250	499	250
Seed Power	183	23	219	106
Seed Temperature	279	245	282	285
PreAmp Power	474	421	453	422
Scanning Enabled?	Enabled	Enabled	Enabled	Enabled

### Command Console

\$A02	\$A04	\$A02	\$A04
\$A02	\$A04	\$A02	\$A04

# Fall 2017 and beyond

- Cryogenics situation still fluid, but...
  - planning for a 2K operations on two cold-boxes by Sept. until we know that this is not supportable.
- Beam operations resume first week in Oct (start of FY18)
- 3+ hall operation
- Linac Energy: 1050 MeV/linac
- Challenges include:
  - 4-hall operation for the first time
    - Lower availability
  - First time two beam for physics through the same slit
  - First use of the vertical separators for simultaneous 5th pass beam to A, B or C
  - Fully loaded linac currents: May push the old compromised klystrons over the edge



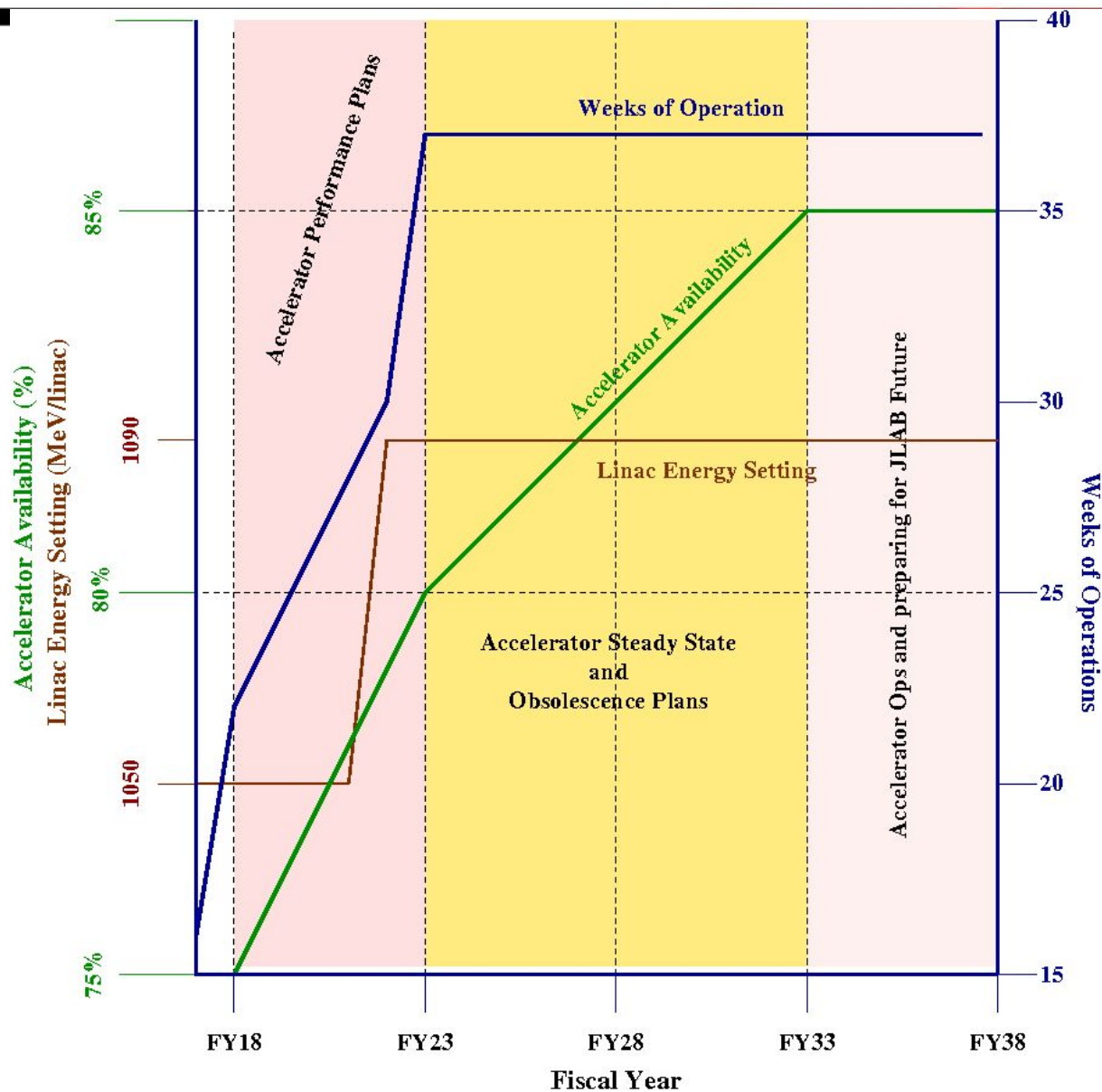
# 4-Hall Operations and Beam Availability

Hall lines contribution to CEBAF Beam Availability.

- High current halls tend to have higher rate of MPS (BLMs, Ion Chambers, BLA) faults
- More invasive beam tuning for the supported halls.
- Expect 10% less Beam Availability for 4-Hall OPS
- In terms of Physics hours, 4-Hall ops out performs 3-Hall operations

	MPS/tuning Impact	Physics-per-week
1-Hall	97	0.97
2-Hall	94	1.88
3-Hall	90	2.7
4-Hall	87	3.5

# CEBAF Performance Plan (Under Development)





# Performance Goals

What	Unit	Goal
Availability	%	> 80
Optimal Weeks	weeks-per-year	37
Beam Tuning Hours	h/week	< 8
Peak Hall Multiplicity	Number of halls	4
12 GeV Program Expected Duration	years	20
Performance Plan Duration	years	5
Linac Design Energy	MeV	1090
Required Linac Energy Margin at start of FY	MeV	> 110
Overall FSD Trip rate	trips/h	< 15
Overall FSD Trip Downtime	min/h	5
RF Trip rate	trips/h	< 10
Beam Loss Trip rate	trips/h	

# Gap Analysis

Performance Metric	Present Gap	Performance Plan	Time scale
Energy Reach	-100 MeV/linac	8 C75 refurbishments	FY18-FY22
Energy Reach	No 6.5 kW klystron spares	20 klystrons/y	FY18-FY22
Energy Reach	Insufficient 13 kW klystron spares	2 klystrons/y	FY18-FY26
Energy Reach: Maintenance	-9 MeV/pass/year	1 C75 every 1.5 years	FY23+
Energy Reach: Maintenance	6.5 kW Klystron consumable	10 klystron/y	FY23+
System Availability	CEBAF Critical Spares	Fund the critical spare list	FY18-FY20
System Availability	CEBAF Consumables	Fund consumables list	
System Availability (Long-term)	CEBAF Obsolescence		
System Availability	Cryogenic 2 K Cold-box	Build new 2 K cold-box	By FY23
Hall Multiplicity	ESR capacity	Build new End-station refrigerator	By FY23
System Availability	Cryogenic Critical Spares	New 2K cold Box	
System Availability	Cryogenic Consumables		
System Availability(Long Term)	Cryogenic Obsolescence		
Optimal Weeks and Hall Multiplicity	Operations and technical Staffing insufficient to support 37 weeks/year	Build up staffing levels	
Beam Tuning	Insufficient Operator group staffing	Build up operator group levels	

# Energy Gap Plan

Date	FY	Estimated Linac Energy Reach	Proposed Linac Energy Setting for FY	Linac Margin	Refurbished cryomodules completed in FY
		(MeV/linac)	(MeV/Linac)	(MeV/linac)	
2016-10-01	FY17	1105	1050	55	C50-13
2017-10-01	FY18	1100	1050	50	C75-1
2018-10-01	FY19	1106	1050	56	C75-2
2019-10-01	FY20	1112	1050	62	C75-3, C75-4
2020-10-01	FY21	1140	1050	90	C75-5, C75-6
<b>2021-10-01</b>	<b>FY22</b>	<b>1168</b>	<b>1090</b>	<b>78</b>	C75-7, C75-8
<b>2022-10-01</b>	<b>FY23</b>	<b>1196</b>	<b>1090</b>	<b>106</b>	C75-9
<b>2023-10-01</b>	<b>FY24</b>	<b>1202</b>	<b>1090</b>	<b>112</b>	-
<b>2024-10-01</b>	<b>FY25</b>	<b>1185</b>	<b>1090</b>	<b>95</b>	C75-10

# Summary

- 12 GeV Experimental program established
  - Hall-A: GMP completed (Hall-A), schedule portion of DVCS completed
  - Hall-B: PRad completed, HPS engineering run
  - Hall-D: First production run Spring 2017
- 12 GeV beam related activities completed
  - Hall-B KPP
  - Hall-C KPP
- Accelerator Operations continues to dial in 12 GeV performance
  - Combined effort with CASA, SRF, Engineering, Facilities
- Availability Challenges Remain
  - New systems issues: Box supplies, magnet buses
  - End-of-life issues: SRF Window failures, SC1 2K cold-box
  - Performance Plan in development
    - Lack of critical spares
    - End-of-life issues and obsolescence