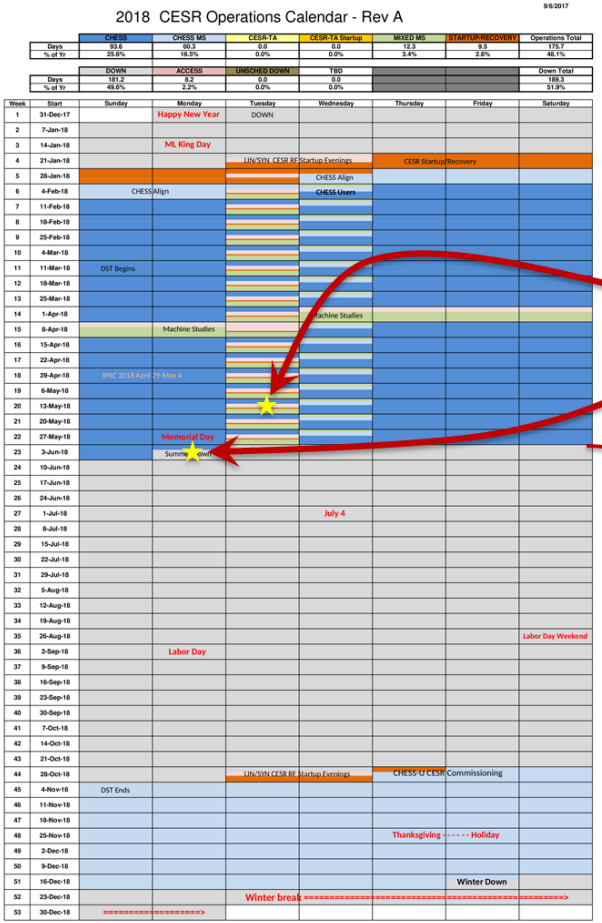
CESR Update

Jim Shanks

On behalf of the CESR Accelerator Group

Two Years Ago…



2018 CESR Operations Calendar - Rev A

9/6/2017

	CHESS	CHESS MS	CESR-TA	CESR-TA Startup	MIXED MS	STARTUP/RECOVERY	Operations Total
Days	93.6	60.3	0.0	0.0	12.3	9.5	175.7
% of Yr	25.6%	16.5%	0.0%	0.0%	3.4%	2.6%	48.1%

	DOWN	ACCESS	UNSCHED DOWN	TBD			Down Total
Days	181.2	8.2	0.0	0.0			189.3
% of Yr	49.6%	2.2%	0.0%	0.0%			51.9%

Week	Start	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	31-Dec-17		Happy New Year	DOWN				
2	7-Jan-18							
3	14-Jan-18		ML King Day					
4	21-Jan-18			LIN/SYN_CESR RE	Startup Evenings	CESR Startup/Recovery		
5	28-Jan-18				CHESS Align			
6	4-Feb-18	CHESS Align			CHESS Users			
7	11-Feb-18							
8	18-Feb-18							
9	25-Feb-18							
10	4-Mar-18							
11	11-Mar-18	DST Begins						
12	18-Mar-18							
13	25-Mar-18							
14	1-Apr-18				Machine Studies			
15	8-Apr-18		Machine Studies					
16	15-Apr-18							
17	22-Apr-18							
18	29-Apr-18	IPAC 2018 April 29-May 4						
19	6-May-18							
20	13-May-18							
21	20-May-18							
22	27-May-18		Memorial Day					
23	3-Jun-18		Summer Down					
24	10-Jun-18							
25	17-Jun-18							
26	24-Jun-18							
27	1-Jul-18				July 4			
28	8-Jul-18							
29	15-Jul-18							
30	22-Jul-18							
31	29-Jul-18							
32	5-Aug-18							
33	12-Aug-18							
34	19-Aug-18							
35	26-Aug-18							Labor Day Weekend
36	2-Sep-18		Labor Day					
37	9-Sep-18							
38	16-Sep-18							
39	23-Sep-18							
40	30-Sep-18							
41	7-Oct-18							
42	14-Oct-18							
43	21-Oct-18							
44	28-Oct-18			LIN/SYN_CESR RE	Startup Evenings	CHESS-U CESR	Commissioning	
45	4-Nov-18	DST Ends						
46	11-Nov-18							
47	18-Nov-18							
48	25-Nov-18					Thanksgiving - - - - -	Holiday	
49	2-Dec-18							
50	9-Dec-18							
51	16-Dec-18						Winter Down	
52	23-Dec-18			Winter break	==========	==========	==========	==========
53	30-Dec-18	==========	==========					

THE END IS NEAR!

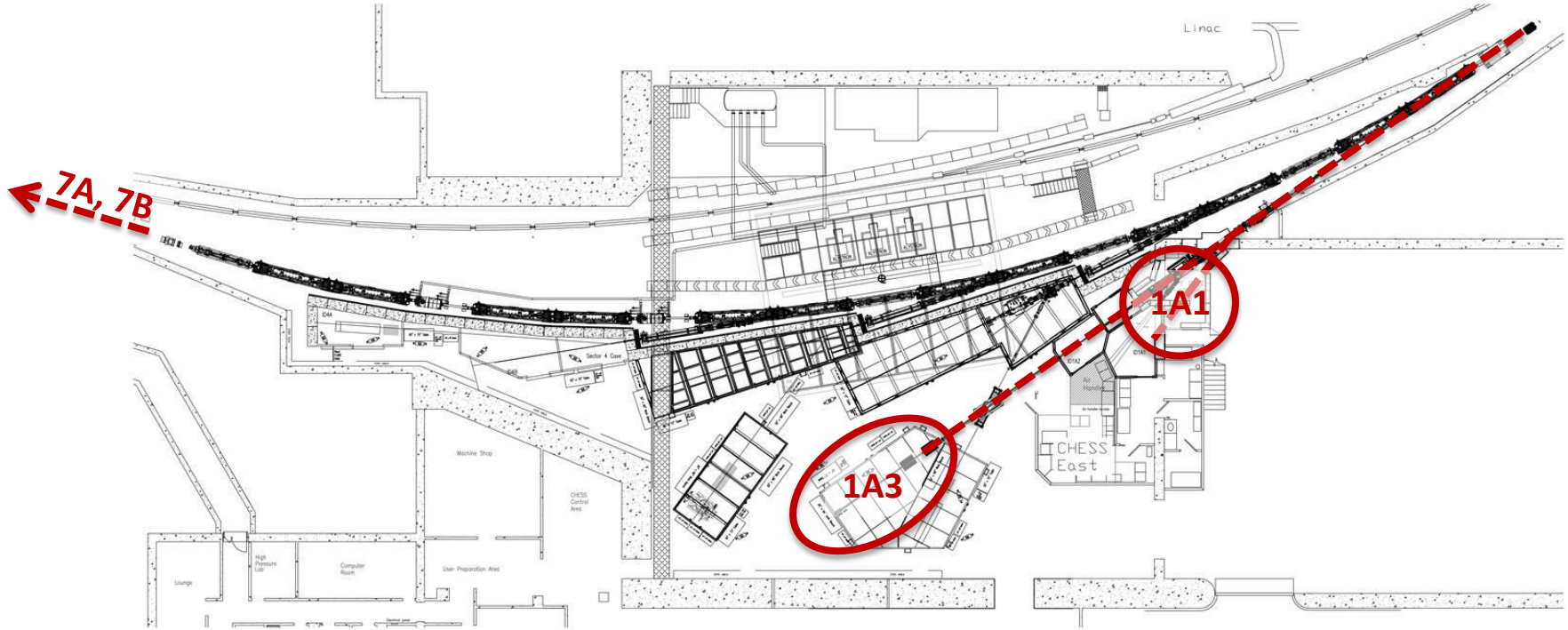
May 15 – YOU ARE HERE

June 4 – End of CHESS as we know it

(Bring a Sledgehammer to Work Day)

CHESS-U Down + Commissioning

One Year Ago...



- **Exactly one year after going dark for the upgrade, we have delivered x-rays to four end stations (Sectors 1+7) plus one front-end (Sector 2A/B), with 50mA+ at 6.0GeV**
- **<u>Tentative plan</u>: Install Sector 3 IDs next Monday, Sector 4 IDs two weeks after that**

November 2019

Serving users at all subscribed end stations!

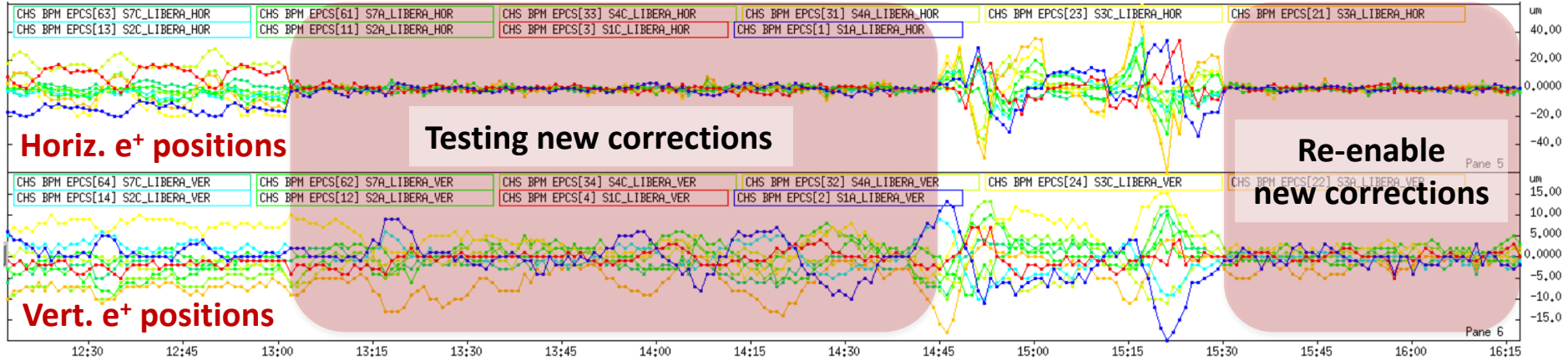
Since Then...

- Routine user operations began in October ‘19
  - Starting at 50mA
  - 75mA in mid-February
  - 100mA in mid-March
- CHESS operations approved up to: **100mA**
  - Need characterization of CHESS optics to proceed to higher current
- Highest-allowed current with L0 occupied: **150mA**
  - Working toward approval for 200mA operations this fall
- Highest current achieved with L0 secured: **200mA**
  - Sustained for several hours before returning to normal operating conditions

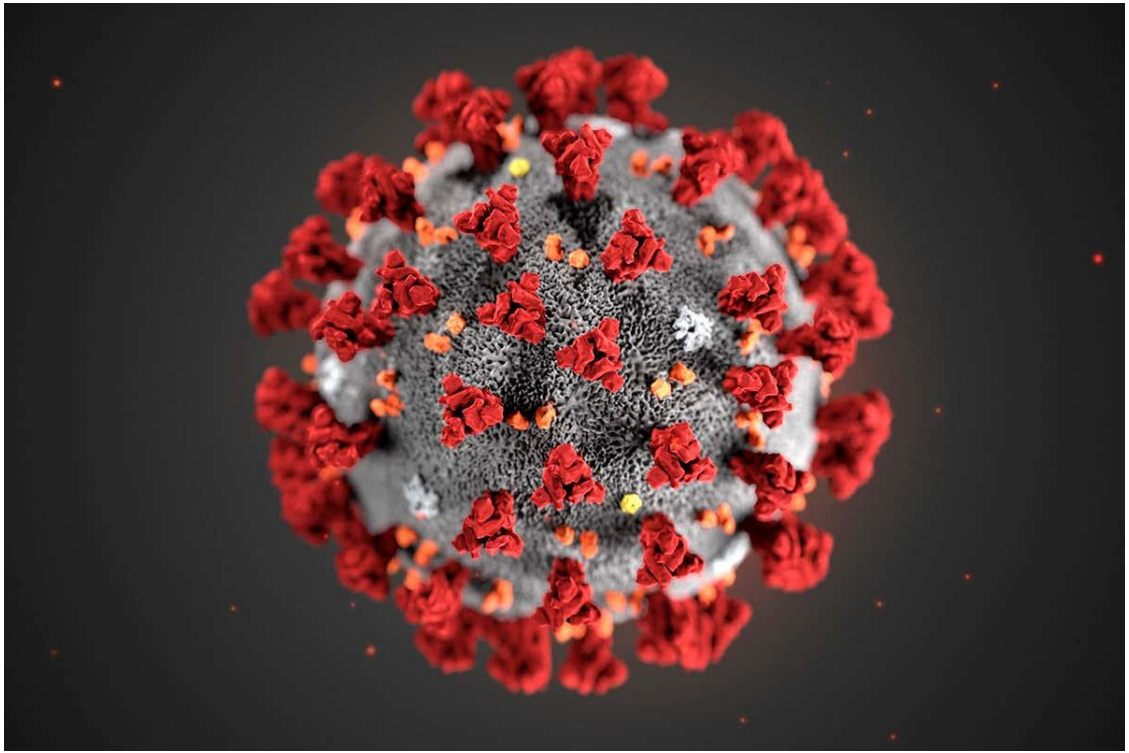
Refinements in the Last Year

- "Model" vs. "as-built" layouts brought into agreement
  - Improved optics corrections
  - Improved reproducibility of conditions
- Updated lattice loaded in January
  - Improved masking from collimators
  - Revised sextupole distribution
- Increased transfer rep rate from synch: 30Hz → 60Hz
  - Faster recovery from beam loss
  - Shorter top-off times
- Improved injection efficiency – up to 60%+ capture from synch

Rapid Position Corrections



- Previously, would correct positions once per topoff (5-10mins)
- Tower de-icing would induce thermal transient in CESR cooling
  - Generated horizontal displacement of positron beam of order ±40μm at CHESS source points
- New correction scheme interleaves H + V corrections every 10 seconds



"[There] is a kind of integrity, if you look on every exit as an entrance somewhere else."

– Rosencrantz and Guildenstern are Dead

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"Always look on the bright side of life."

– Monty Python's Life of Brian

Operations in the Time of CoVID-19

- Rules are changing almost daily...

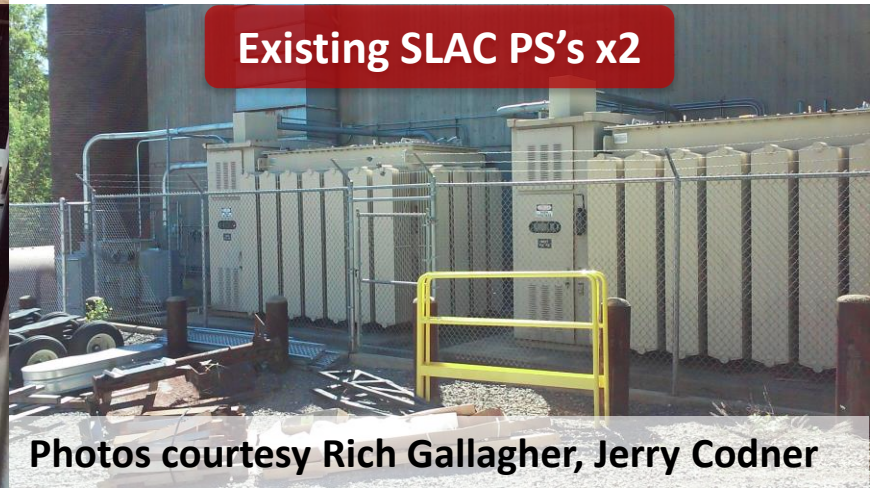
- Cornell has agreed to allow CESR and CHESS to start up for CoVID-19 research on Sector 7B2
  - See after-dinner speaker – Rick Cerione
- Accelerator start-up completed with as much remote operation as possible
  - Surprisingly smooth recovery – beam stored almost immediately
  - Operations-ready conditions demonstrated at 100mA within days of startup
  - Remainder of available time devoted to diagnostics of operational “quirks,” developing future modes of operation, and preparing for reopening other beamlines
- New York’s phased reopening – research for “health and disease, agriculture/food, and national defense” is now allowed by the state
  - Starting up Sectors 1, 3, and 7 as we speak

What's Next?

→ Summer Down Activities

RF Power Supplies

- **Nike-Zeus and Hipotronics** supplies:
  - Both supplies unregulated
  - Footprint is too large for available space
- **SLAC** supplies:
  - Regulated, adjustable, low ripple DC
  - Can be adjusted for maximum klystron DC to RF efficiency
  - 2 SLAC supplies: one for **CESR**, one for **CBETA**
  - **NO SPARE ON SITE**

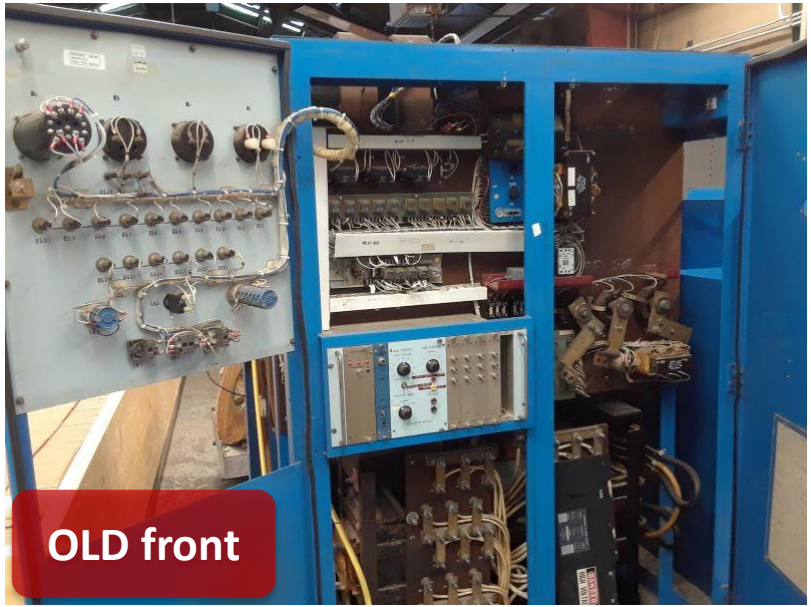


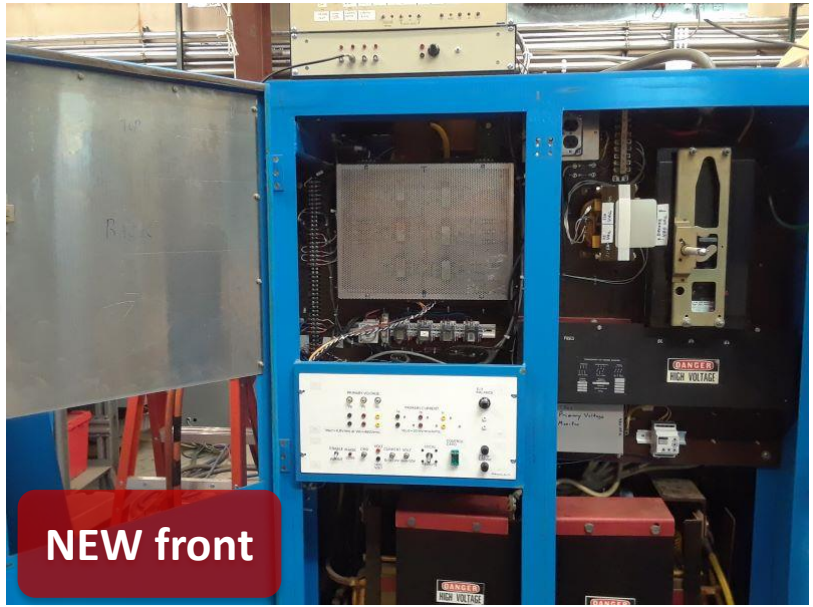
Photos courtesy Rich Gallagher, Jerry Codner

Transformer Pad Work

Photos courtesy Rich Gallagher, Jerry Codner

Spare Dipole Power Supply





- Reliability and obsolescence issues

- Simplified design – fewer boards
- Improved reliability, interlocking
- Repairable with modern components

Slides courtesy Len Hirshman

Fall 2020 Run Plans

The Road to 200mA

- **Summer 2020**
  - Additional cooling on linestops, sliding joints
  - Refinement of shielding between CESR and CHESS
- **Fall 2020**
  - Characterization of CHESS beamlines at higher current (> 125mA)
  - Certification of shielding for 200mA operations
  - Characterization of heat loads in CESR and CHESS at 200mA

Position Corrections

New design is aimed at being more extensible, flexible, and user-friendly

Old software:

- FORTRAN90
- Separate instances run through scripts:
  - Auto: continuously running
  - Manual: run one correction and exit
- No GUI
- All detectors/bumps have the same weight in the Figure of Merit (FoM)

New software:

- Java
- One multithreaded program running as a cluster service, able to run multiple modes
- GUI front-end with live plots
- Ability to assign different weights to each individual element (detector, bump change, steering strength/threshold)

Slide courtesy Laurel Ying

Timing Mode @ CHESS

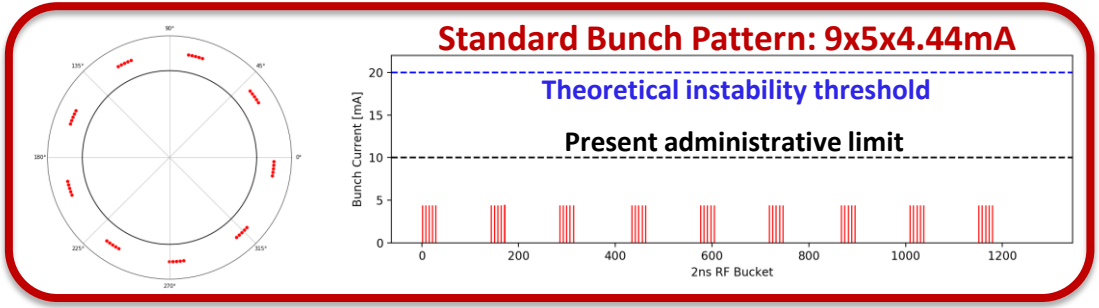
See "Characterizing nanosecond dynamics with X rays Workshop" tomorrow for more details

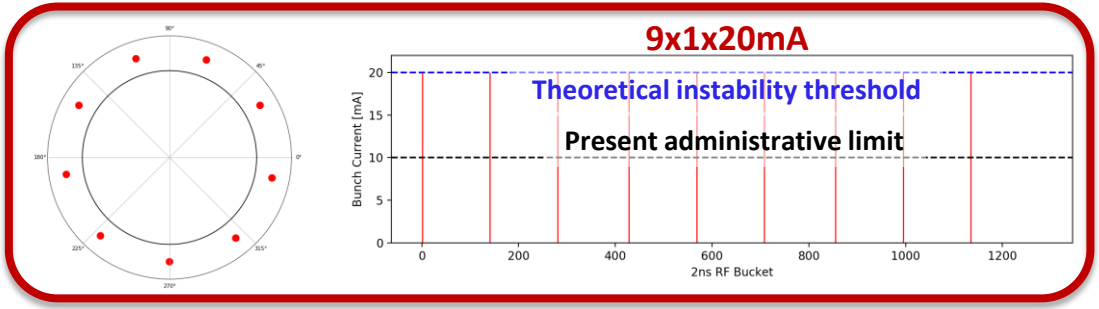
The Short Version:

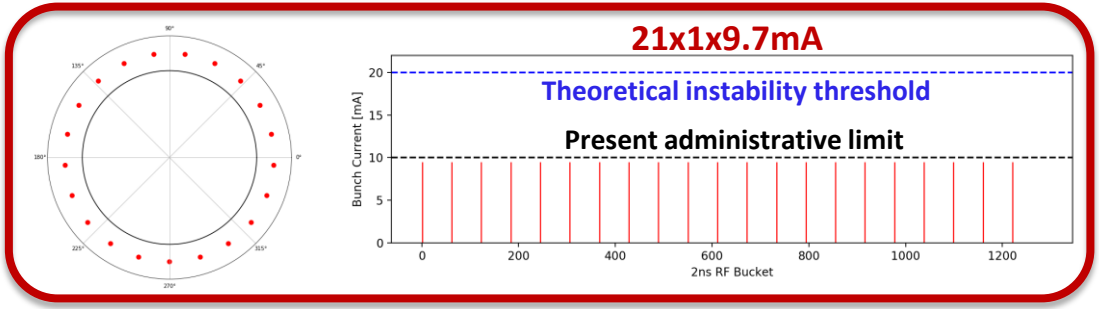
- As other light sources push toward the diffraction limit, they lose the ability to fill to high bunch current
- With CHESS running single-beam, there is potential for increased flexibility in bunch patterns
- What novel experiments might this enable?

Time (EDT)	Session	Presenter
9:00 - 9:15	Introduction	Todd Hufnagel, JHU
9:15 - 9:45	An overview of the development of dynamic experiment capabilities at a synchrotron source	Brian Jensen, LANL
9:45 - 10:15	CESR as a Source for Timing Experiments	Jim Shanks, CHESS
10:15 - 10:45	Detecting photons - What modern detectors can and can't do	Julian Becker, CHESS/DESY
10:45 - 11:00	Break	
11:00 - 11:30	Imaging: Incipient Fracture of Ceramics Under Impact	Brian Schuster, ARL
11:30 - 12:00	Time-resolved x-ray diffraction for exploring strength, phase transitions, and plasticity	Joel Bernier, LLNL
12:00 - 12:30	Ultra-fast EXAFS spectroscopy at the National Ignition Facility	Federica Coppari, LLNL
12:30 - 1:00	Lunch break	
1:00 - 1:30	Probing Dynamic Shock Behavior in Advanced Materials using In-Situ Phase Contrast Imaging	Brittany Branch, Sandia
1:30 - 2:00	Micro-scale ballistic experiments for materials characterization at high strain rates	Debjoy Mallick, ARL
2:00 - 2:30	Timing and Triggering Needs for the Measurement of Energy Release Rate of High Explosives	Laura Smilowitz, LANL
2:30 - 2:45	Break	
2:45 - 3:15	Diagnostic targets for understanding the fragmentation and combustion of reactive materials	Joe Hooper, NPS
3:15 - 3:45	The Role of Defects on Performance	Ellen Cerreta, LANL
3:45 - 4:15	Dynamic compression response of heterogeneous materials	Mukul Kumar, LLNL
4:15 - 4:30	Wrap-up/Path forward	Todd Hufnagel, JHU Brian Schuster, ARL

Timing Mode @ CHESS



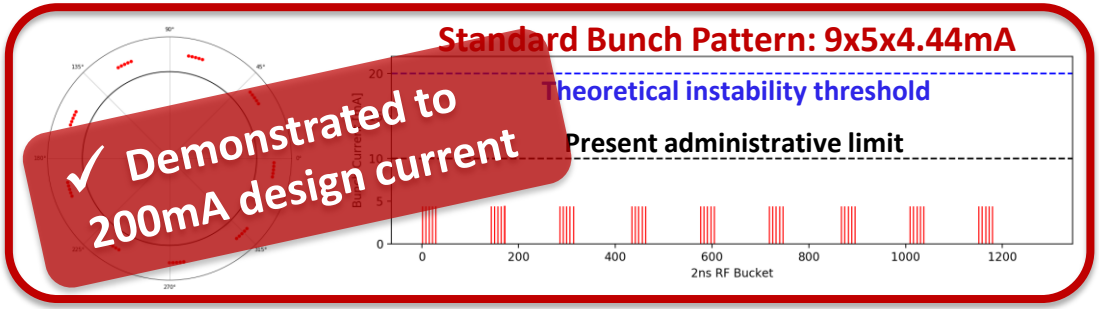


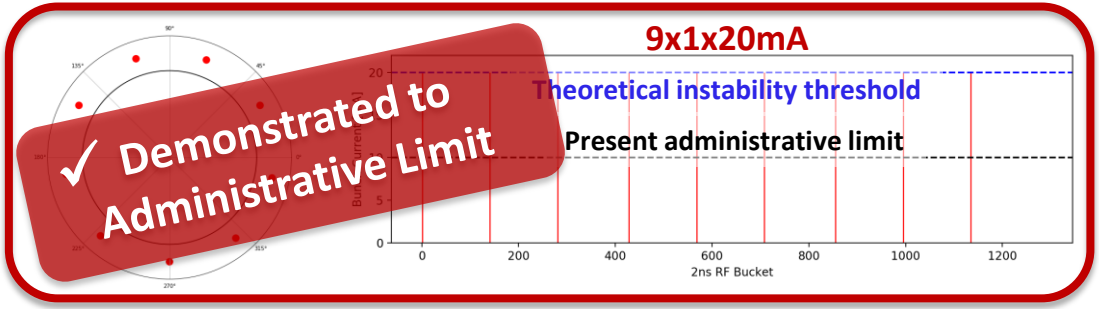


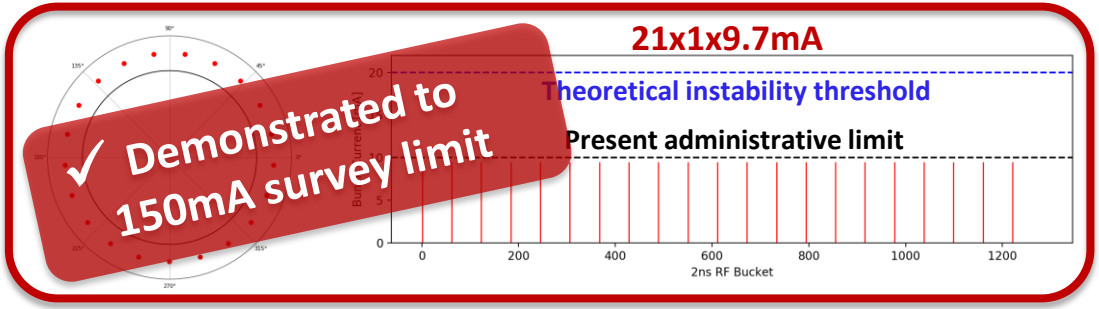
Several bunch patterns under consideration

- Need input from users to identify what patterns are desirable
- Need Machine Studies to identify what patterns are feasible

Timing Mode @ CHESS







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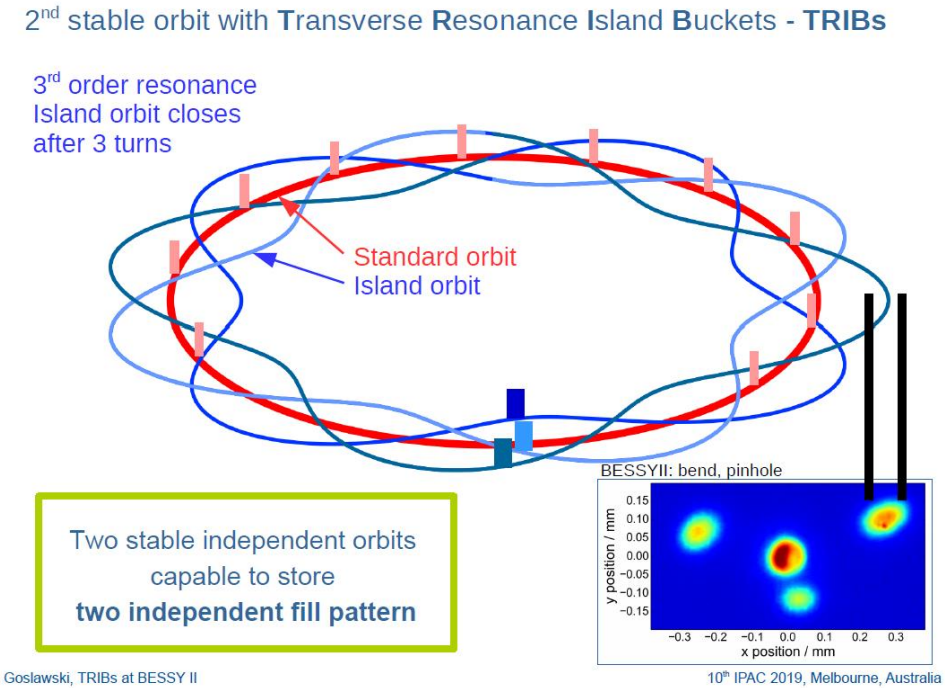
→ Possibility of testing Timing Mode as soon as Fall 2020

TRIBs

- Excite individual bunches onto alternate trajectory
- May enable complementary capabilities for Timing Mode
- Initial feasibility studies for CESR are underway (Suntao Wang)



Summary

- **Present Status:**
  - 100mA operations for CHESS
  - Fast Corrections (10 seconds, vs. 5 minutes) implemented
  - First demonstrations of Timing Mode bunch patterns

- **Coming Soon:**
  - **200mA operations**
  - Installation of spare dipole and RF power supplies
  - Improved corrections program
  - Timing Mode demonstrations