CESR Update

Jim Shanks

On behalf of the CESR Accelerator Group
Two Years Ago...

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
• 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
• Tentative plan: Install Sector 3 IDs next Monday, Sector 4 IDs two weeks after that
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
• 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
“[There] is a kind of integrity, if you look on every exit as an entrance somewhere else.”
– Rosencrantz and Guildenstern are Dead

“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

OLD front

NEW front

• 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
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)
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?

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