LINAC Upgrade Project at the Canadian Light Source

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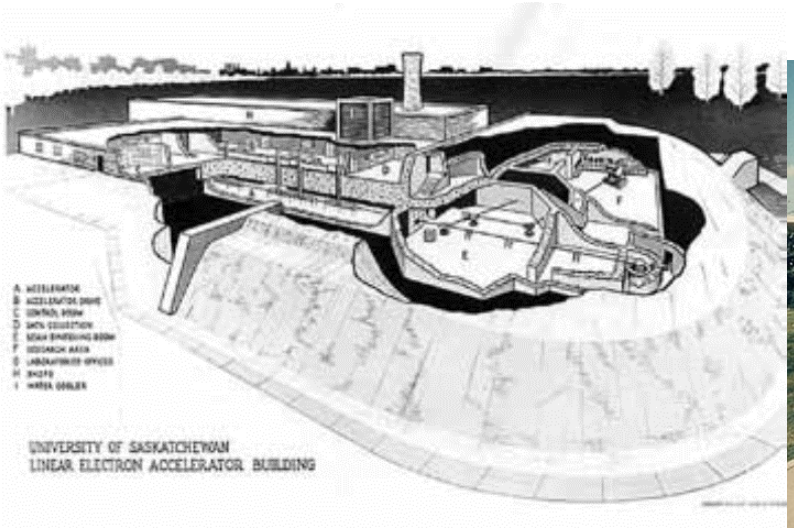
History

Saskatchewan Accelerator Laboratory (SAL)

- 1964 -high energy physics research facility
- 300 MeV LINAC
- ~ 2,000 m^2 footprint
  - Brick and mortar



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Canadian Light Source

- Construction started 1999
  - 2.9 hectare footprint
  - ~ 12,000 m^2 building
  - 5 levels
  - Linac in SAL building
  - Booster/Storage Rings, and Beamlines in ‘new’ section of building

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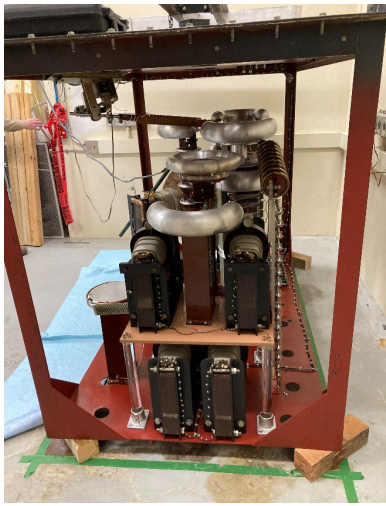
University of Saskatchewan

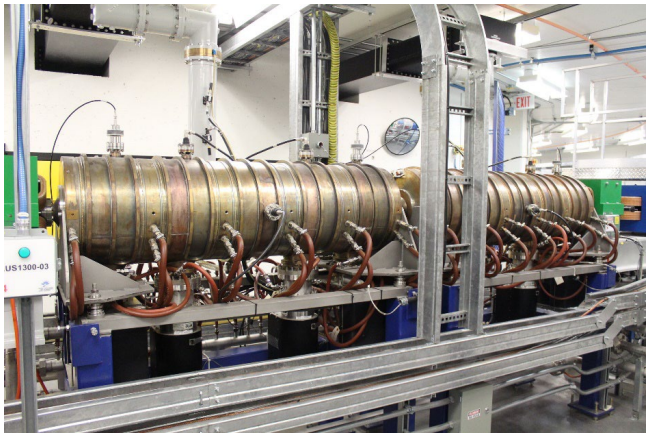
Electron Gun and Linac

- 2 Stories undergound
  - Former SAL
- 250 MeV
- 1Hz
- 6 Section
- 70 or 140 nS pulse
- Energy Compression



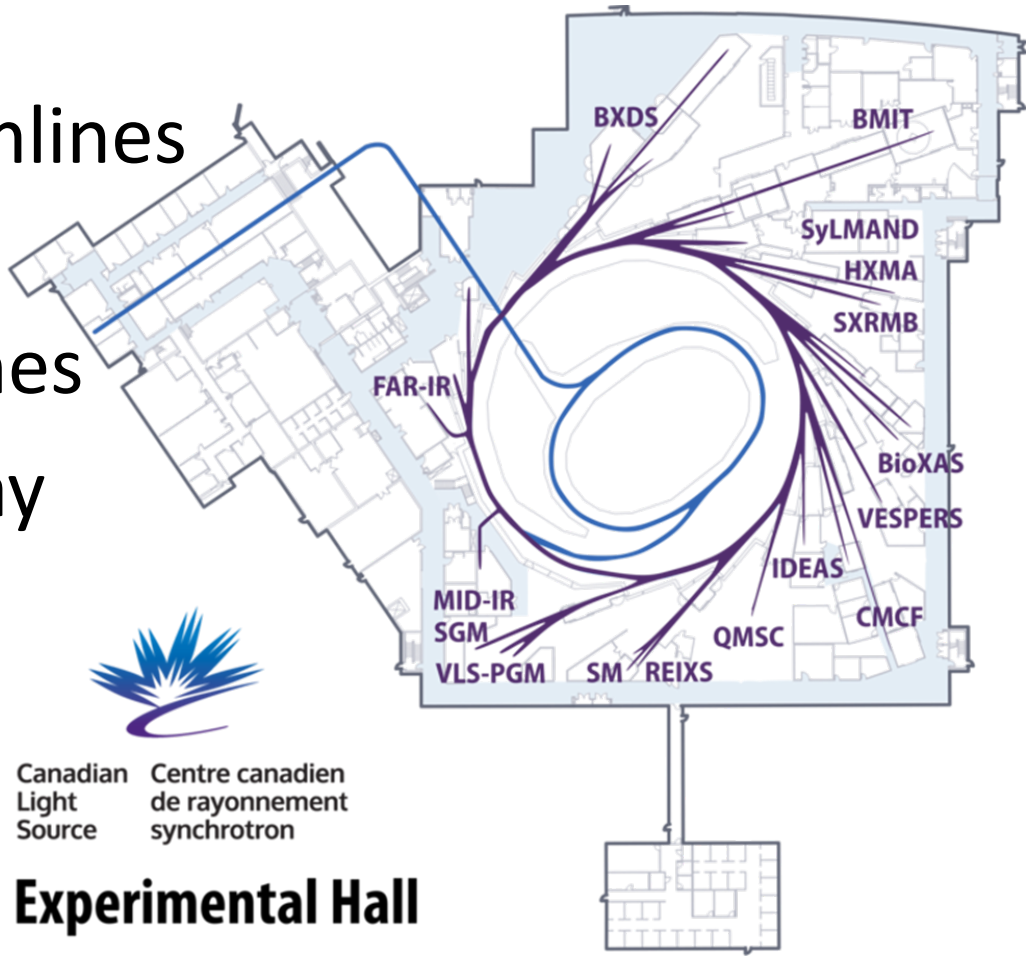
Booster Ring/Storage Ring

- **Booster Ring**
- 250 MeV to 2.9 GeV
- 10 mA design average current
  - 3 to 4 mA normal
- 2 Conventional RF cavities
- **Storage Ring**
- 12 straight sections
  - 9 available for insertion devices
- 170.88 m circumference
- Superconducting RF cavity



Beamlines

- 22 Operational Beamlines
- 2 diagnostic beamlines
- Infrared to Hard X-ray



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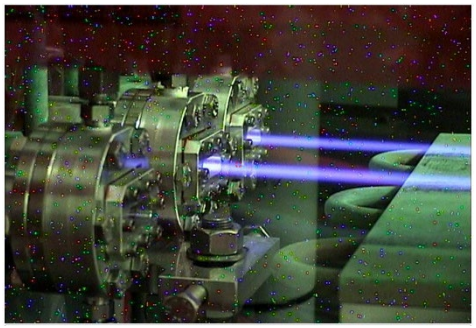
Experimental Hall



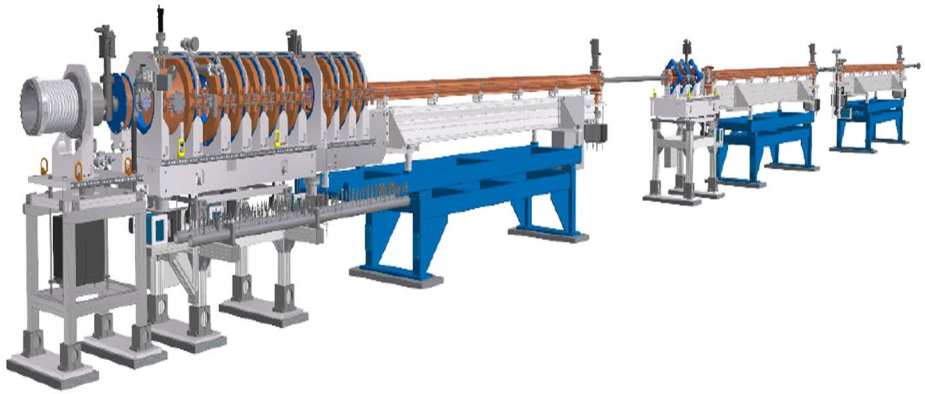
CLS Linac Replacement Project

- Why Change the Linac????
  - Improved Reliability!!
  - Better Beam
  - ‘Like for Like’ Change
- Change = Opportunity
  - What else can we get from the project?
- Project touching many departments
  - Planning and Preparation
  - Dismantling
  - Installation
  - Commissioning/Testing
  - Radiation Protection/Safety input needed

‘Like for Like’ Change

Accelerator Physicists

Shiny New Toy



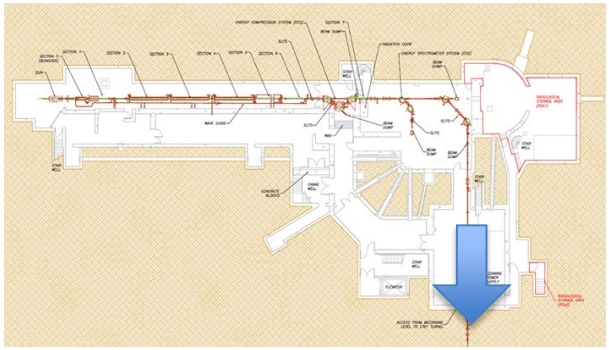
Slide courtesy Darin Street

‘Like For Like’ Change

- 250 MeV Linac
  - Same location
  - 1Hz e^- Pulse
  - Same pulse length
  - Same energy

- Like for like safety?
  - Shielding
  - ACIS (lockup)
  - Fire Protection

LINAC



2 Stories Underground

To Synchroton

Like For Like Change, almost…

- Single Bunch Mode – Increased current
  - Previous 0.24 nC
  - Planned 1.5 nC
  - Improved Single Bunch Mode Operation
- Injector Frequency Change
  - Previous 2856 MHz
  - Planned 3000 MHz
  - Improved Booster Ring Capture Efficiency
- Physically shorter
  - 3 sections from 6 sections
- 10 Hz E-Gun or RF operation
  - But not both!
- Removal of partial concrete wall

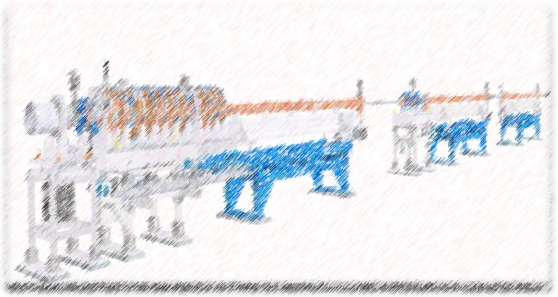
Safety Planning And Preparation

Regulatory

- Documentation: “Like for Like Change”
- New LINAC within Licencing envelope
- No Licencing concerns!

Worker Safety

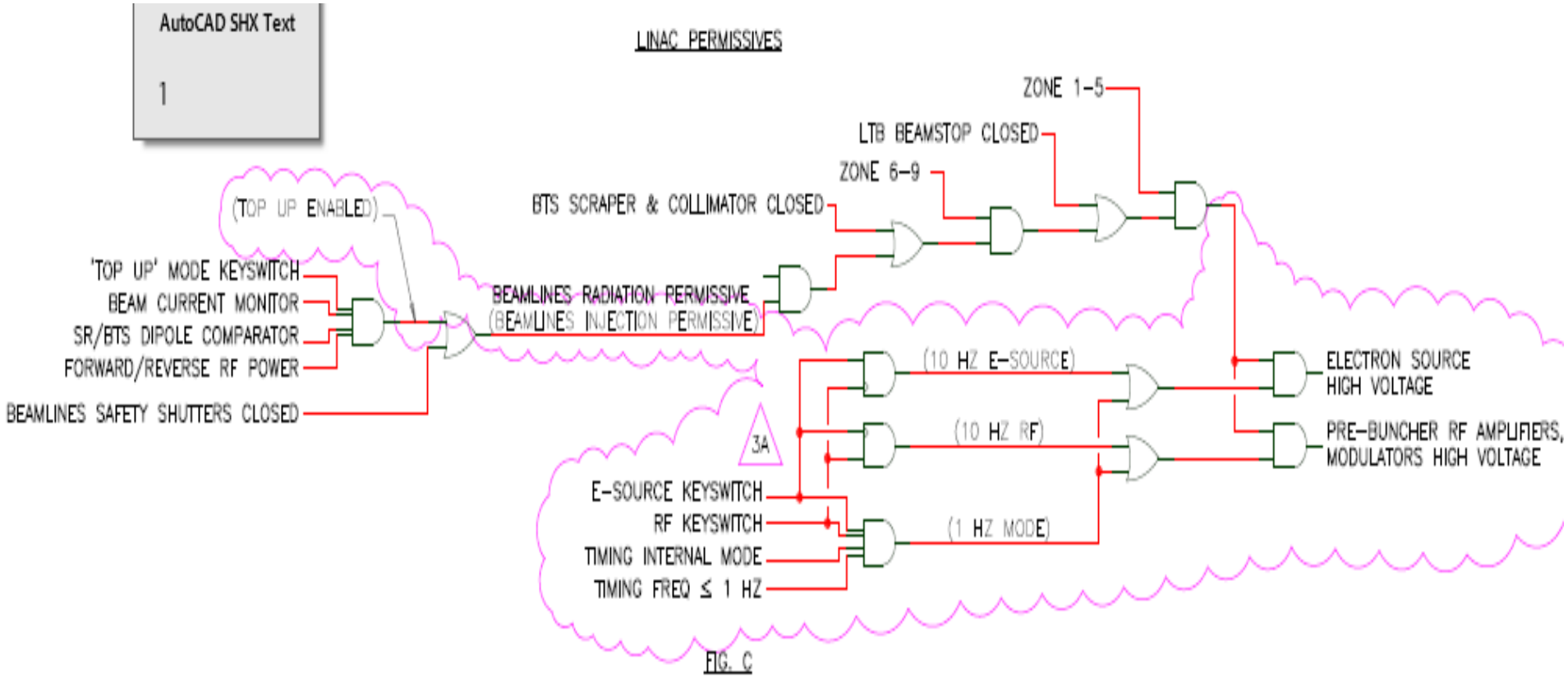
- Hazardous Building Materials Assessment
- Residual radiation surveys
- Dismantling Plan
  - Logistics and storage
- Daily Tool-Box Meetings



Access Control and Interlock System (ACIS)

- **10 Hz E-Gun or RF operation - Not both!**
  - Improve Commissioning
  - Shielding/Occupancy reviews required
- **ACIS modifications to limit 10 Hz Operation**
  - Input signals to ACIS from timing system
  - Egun and RF System Disabled independently

ACIS Interlock Logic Diagram

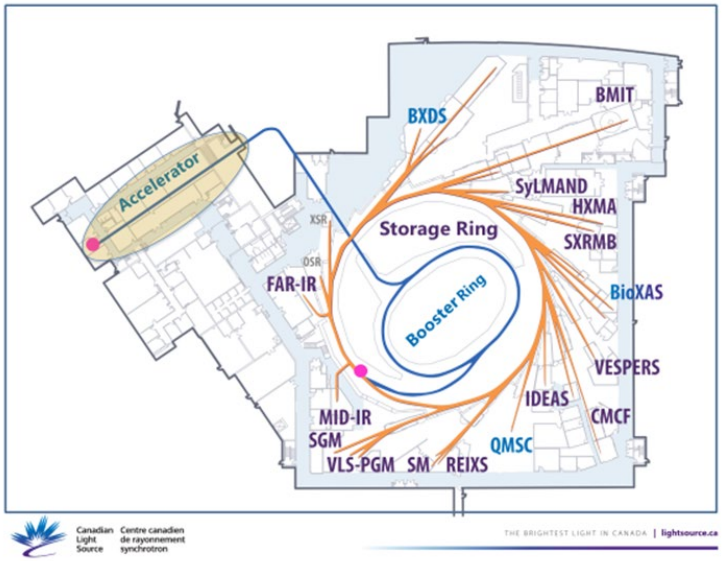


ACIS Zone Changes

- **Concrete Half-Wall removal**
  - Not a shielding wall for CLS
  - Change of egress path
  - Move of one ACIS gate
  - Improvement to overall egress!
- **Concrete block wall removal**
  - Redesign of ACIS zones
  - Reduced congestion, improved access to eqp

Dismantling Plan

- Detailed dismantling plan developed
  - Residual radiation level well understood
    - Max contact dose < 25 µSv/h
    - Strict limits on disposal
  - Logistics and other details
    - Movement and storage
    - Survey records
    - Disposal process



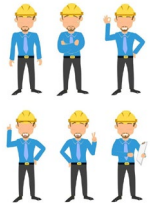
Out with the old linac!

- **Gone in 3 Days!**
  - 2 weeks allotted as contingency
  - Radiation Surveys kept pace
  - Logistics kept pace
  - All due to good preparation!
- **No injuries**
  - No minor injuries, no near misses
- **Compliance**
  - Limits on total occupancy in linac area
  - Hot work permits/requirements
  - Lockout/Tagout (Control of Hazardous Energy)
  - Worker PPE Requirements


Linac Hall After!

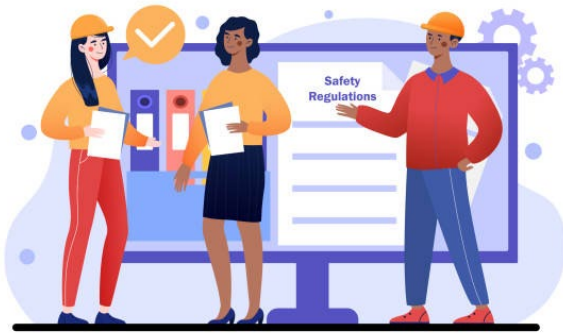
Safety Perfection?

- **Storage Issues**
  - Several storage non-conformances
  - All resolved promptly when raised
  - Reminders in daily meetings
- **Signs and Barriers**
  - Linac removal resulted in partially uncovered sump - poorly marked
- **But no big surprises…**



Communication

- Communication of work, change, and safety concerns through:
  - Daily Tool-Box Meetings
    - 8am, 3:15pm leads + Managers
  - Signs
  - ‘SLACK’ channels
  - Reporting Systems
  - Hallway meetings
    - Reinforced the message!!!




DANGER
HIGH VOLTAGE
UNAUTHORIZED PERSONNEL
KEEP OUT
MEETING ROOM
(STANDING ROOM
ONLY!)

Linac Installation

- **> Two years project planning**
  - Project Management Lead Assigned
  - Large Team Effort (by CLS standards)
  - May 27 –and Commissioning Synchrotron Beam Off
  - Installation complete by Sep 9
    - 1 week behind schedule
  - Still looking promising for Jan 1, 2025 User Beam

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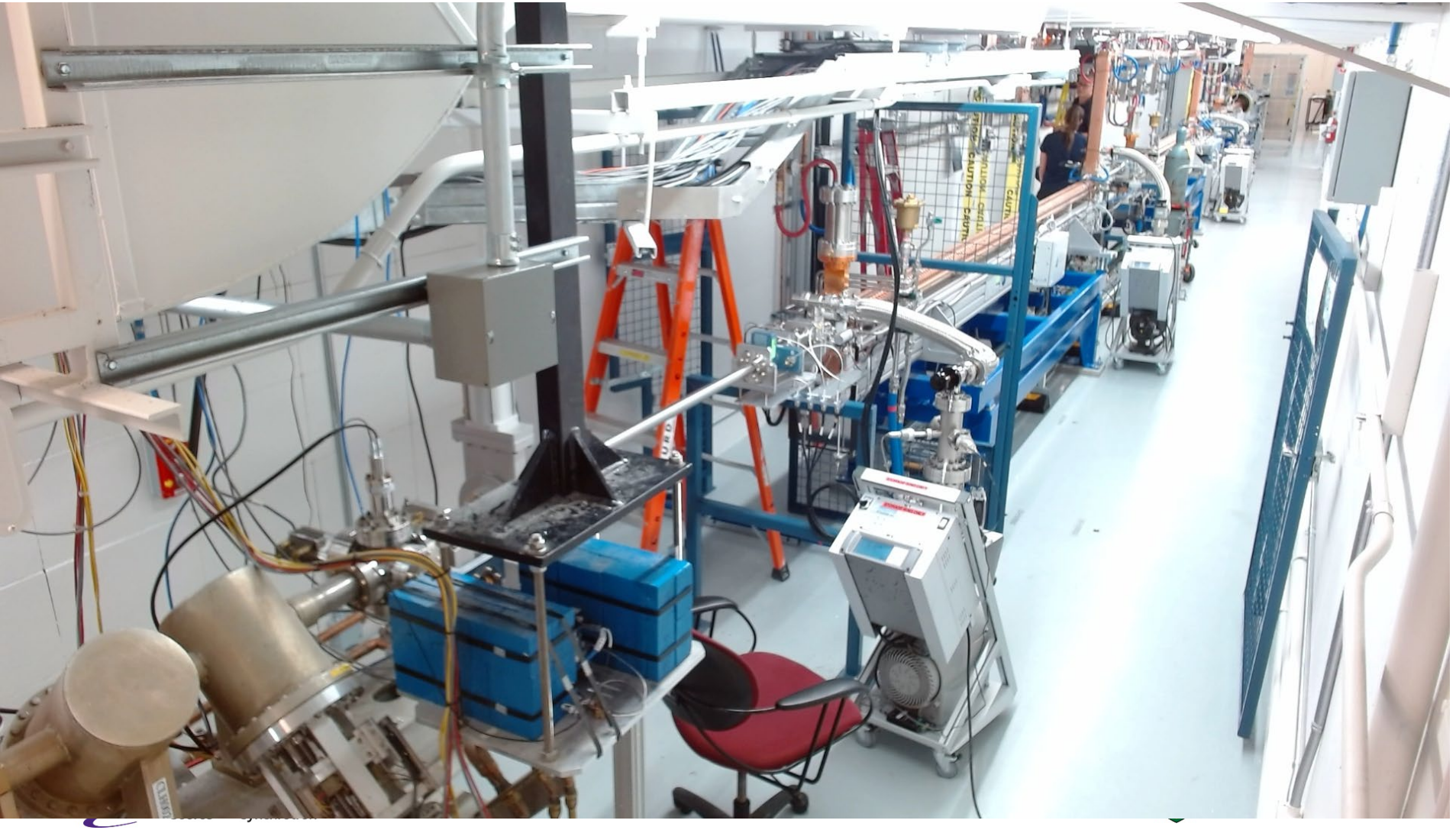
Installation



Commissioning

- September 10 – Dec 31, 2024
  - RF Conditioning
  - Very Slow
  - Issues with components
  - Commissioning not completed

Current Status

- RF Conditioning continuing
  - Still very slow but progressing
  - Problems are understood
- Plan to achieve 180 mA from Linac by Aug 31
- User beam by October 2025?

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Thank-you!