Accelerator Capabilities and Interest from CLS

June 25th, 2026

E. Nebot del Busto on Behalf of CLS

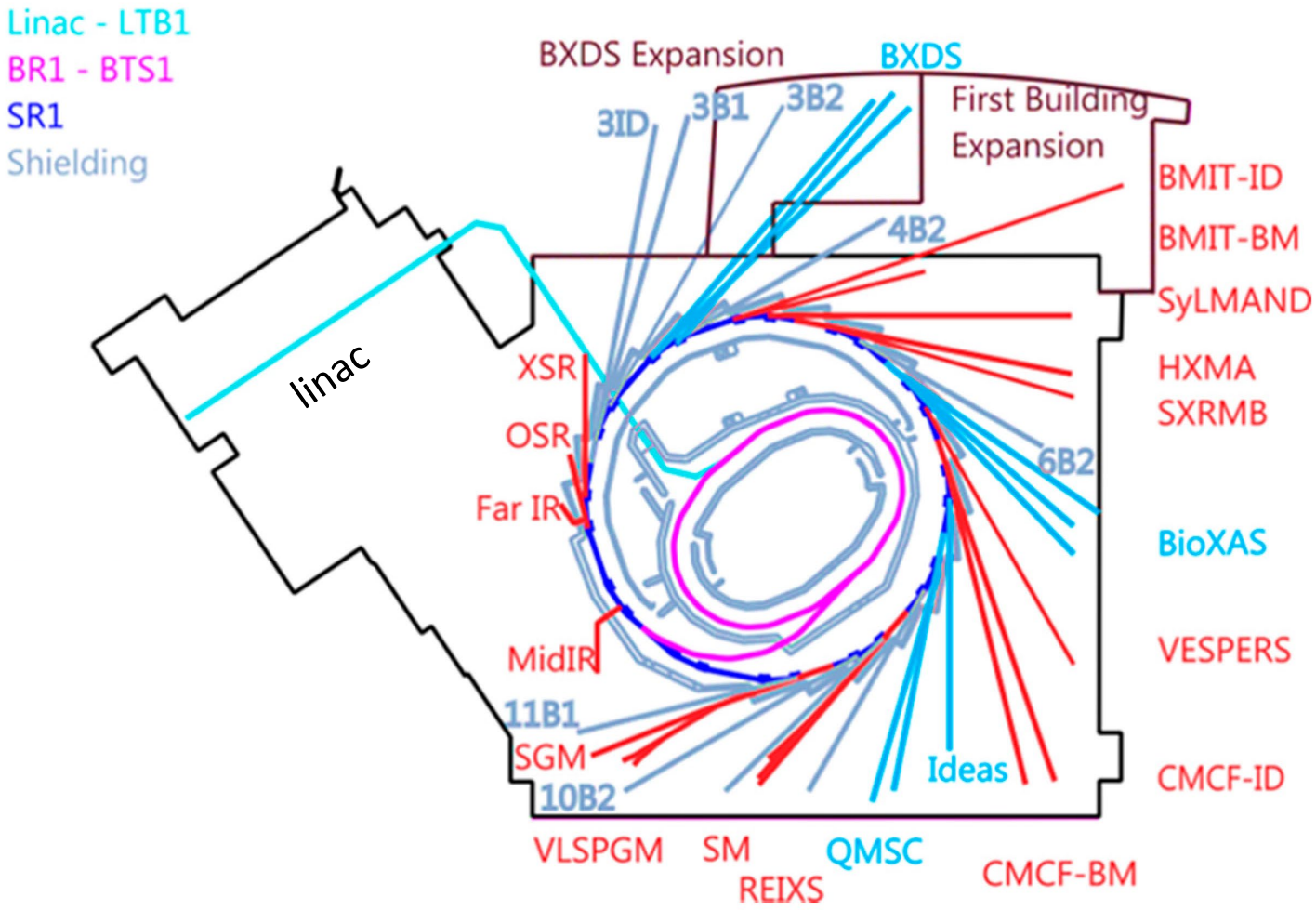
We acknowledge we are on Treaty 6 Territory and the Homeland of the Métis. We pay our respect to the First Nations and Métis ancestors of this place and reaffirm our relationship with one another

Outlook

- A brief introduction to the Canadian Light Source
- The Magnet Mapping Lab
- Neural Networks (NN)
- Beam Instrumentation
- Detector and Instrumentation testing capabilities
- Free Electron Laser: The WaterFEL project

The Canadian Light Source

- NC LINAC + LTB: 153 MeV (target 250 MeV)
- NC Booster Ring: 153 MeV to 2.9 GeV with 1 s cycle
- SRF Storage Ring: 2.9 GeV @ 220 mA in top-up mode
- 22 beam lines available
- First user beam in 2005
- Staff of ~270



Magnet Mapping Lab

- Developed to support the assembly, measurement and tuning of Insertion Devices (IDs)
- Lab capabilities (beyond IDs):
  - Hall probe
  - Flipping coil
  - Vibrating Wire
- 2 experts on Lab operation
- Engineering/Technologist support
  - Survey (laser tracker), transport, …

Magnet Mapping Lab: past, present and future

- Activities:
  - ID performance characterization
  - Assembly and shimming of permanent magnet IDs
  - Fiduzialization and alignment measurement of magnet systems
  - Magnetic field maps
  - Ramping curves for electromagnets
  - Magnetic field quality: multipole components, field roll-off, fringe fields
- CLS expertise has been sought by other international research centers
- In current discussions with major magnet manufacturers

Neural Networks

- Pursuing the understanding, use and implementation of NN and AI methods to improve our beam quality
  - Currently attempting implementation of NN approaches into CLS Fast Orbit Feedback system
  - Contributed with NN driven data analysis of large datasets of KEK-b turn by turn (~400) BPM signals
  - Participated in multiple projects involving neural networks and AI beyond electron beams:
    - X ray behaviour in Tokamak plasma, hemodialysis membrane affinity prediction

Beam Instrumentation

- Beam Loss Monitoring experience
  - Distributed systems
  - Detector development and characterization:
    - Ionization, scintillation and Cherenkov based technologies
  - Prototyping of Electro-Optical read out electronics
  - Management and Handling of critical parameters:
    - Beam Abort Thresholds

Detector and Instrumentation testing capabilities I

- CLS has 22 beamlines with energies ranging from the Far IR to the hard X ray (100 keV) with various degrees of tuneability
  - Access is available through the standard beam time request: Peer reviewed, Purchased, Rapid and Beam Team Accesses

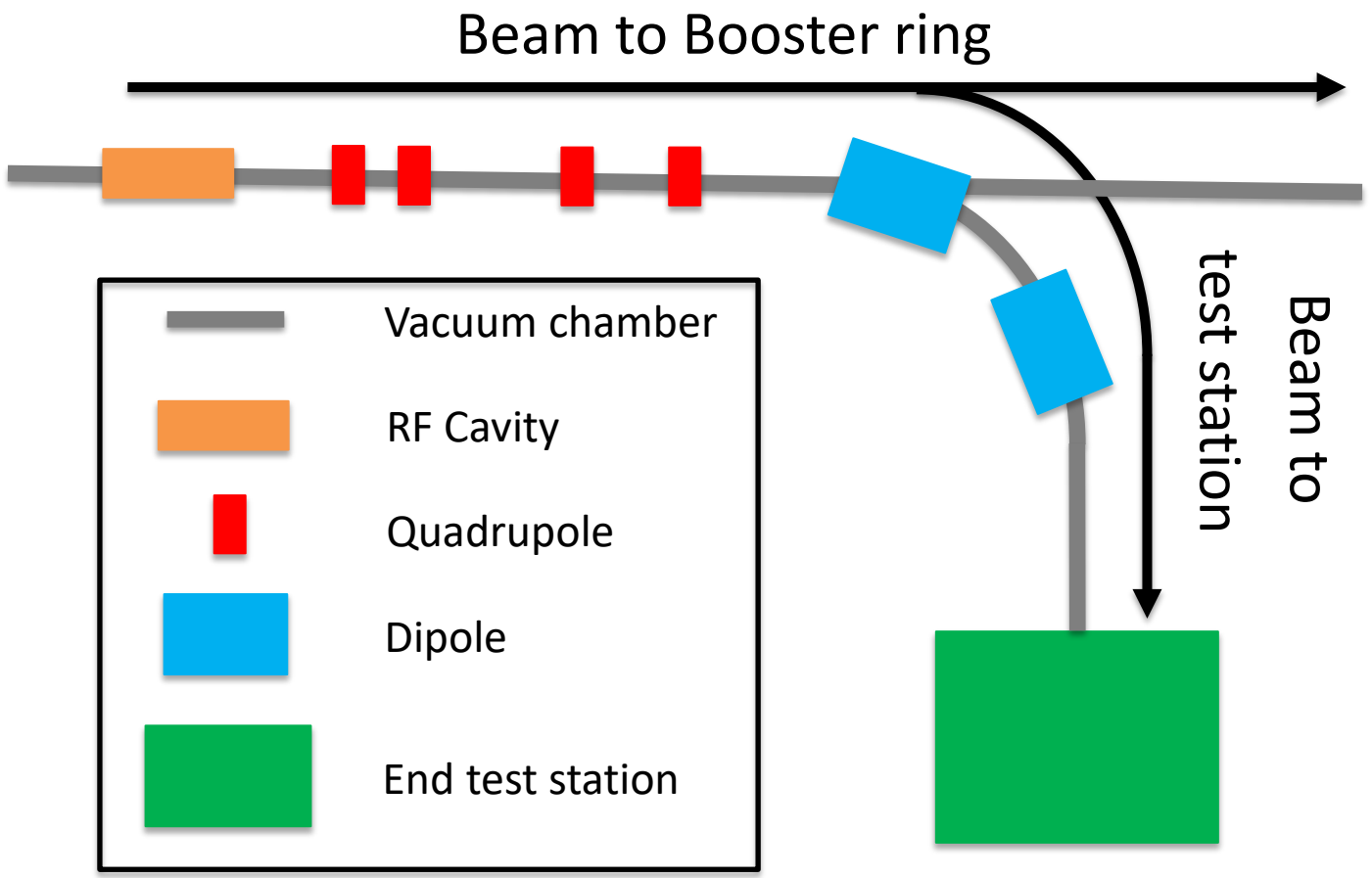
    Applying for Beamtime - Canadian Light Source

- The Accelerators Operations and Development department owns 2 beamlines dedicated to diagnostics
  - OSR → Operates in the visible centered at λ~500 nm
  - XSR → Operates in the 8 – 24 keV with max flux in the low end

Detector and Instrumentation testing capabilities II

- Potential for electron irradiation

Parameter	Value
Pulse rate	1 Hz
Bunch spacing	2 ns
Pulse length	< 140 ns
Bunch charge	< 200 pC
Energy (current)	< 153 MeV
Energy (nominal)	< 250 MeV
Energy Spread	< 0.5 % rms



Canadian Light Source | Centre canadien de rayonnement synchrotron

CLS collaboration: the WaterFEL Project

- CLS involvement started within the last year
  - Beam Dynamic simulations for manufacturer design cross check
    - Leveraging on expertise on General Particle Tracker to develop a twin model for verification of beam parameters (emittance and energy spread)
    - Using CST suite to generate field maps in all RF cavities
  - Electron source design characterization
    - Leaning on exiting simulations of the (very similar) CLS gun to model the waterFEL gun
    - Performing dedicated experiments to benchmark gun simulations

Summary and conclusions

- Involvement topics that could benefit the FCCee project
  - Magnetic measurements, NN, LINAC simulations, BLM development and testing, Instrumentation/detector testing support (light and e-)
- Currently collaborating in multiple topics with colleagues across Canada and Internationally
  - USask, TRIUMF, Max IV, Eli-NP, NSLS-II ,…
- Looking forward to leveraging on our good working relationships and electron beam expertise

Thank you