

4D detector workshop

Sensors for the next tracking detector

Luise Poley



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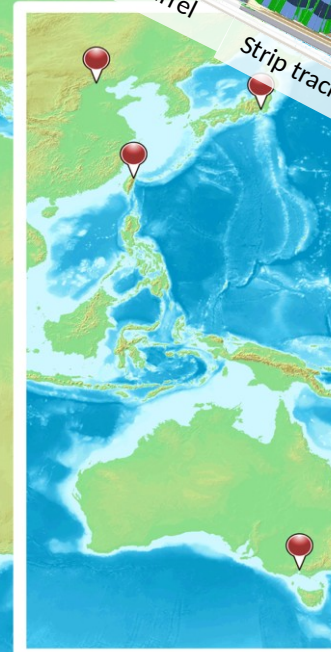
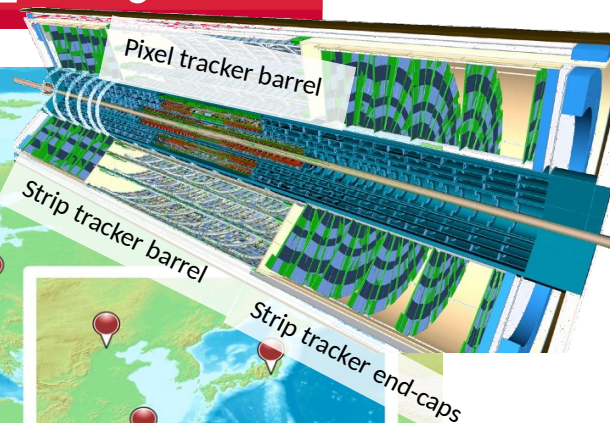
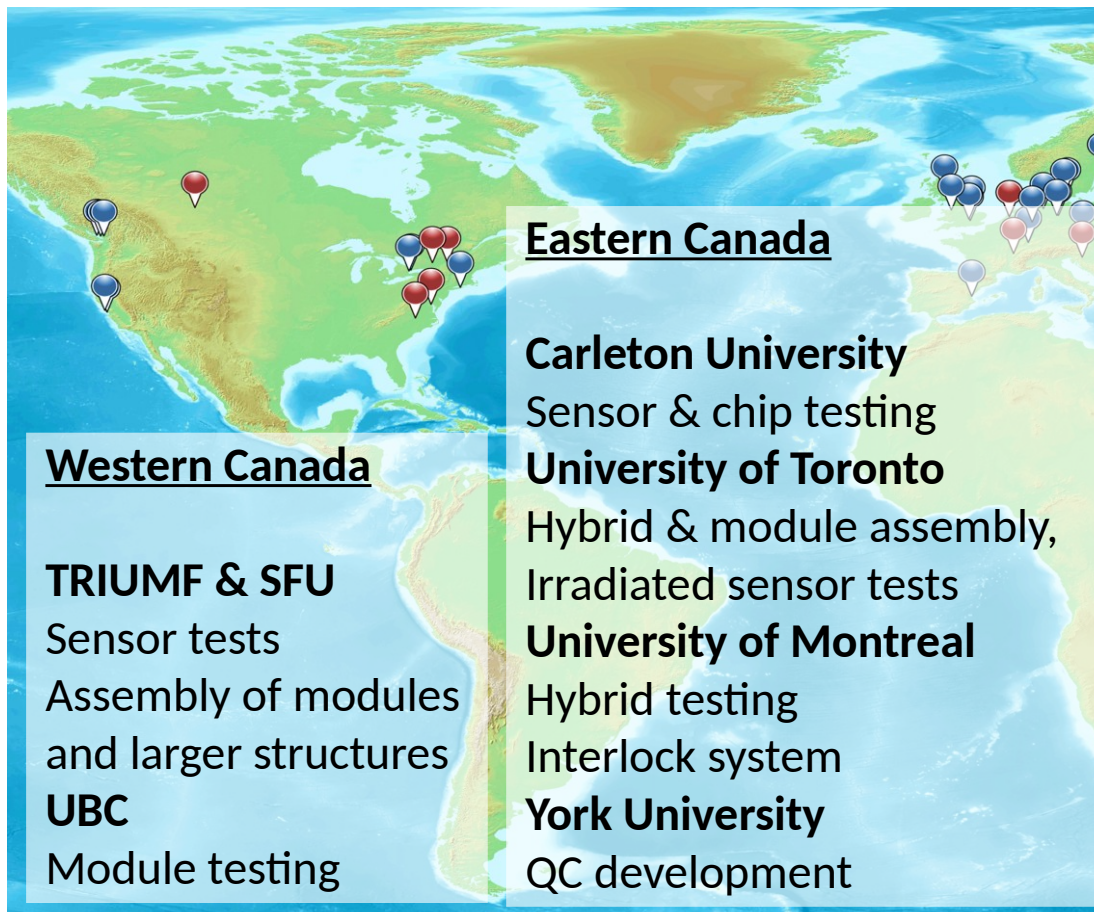


Canada: a major ATLAS ITk player



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Leadership roles in ITk strip tracker

Bernd Stelzer
Activity coordinator
Module loading

Thomas Koffas
Ressource coordinator
For ITk strip tracker

Luise Poley
Activity coordinator
for global hybrid/module assembly

QC for 50% of all end-cap sensors, QC for majority of readout chips, assembly+tests of 50% of all end-cap hybrids, assembly+tests of 25% of end-cap modules and 25% of integrated end-cap structures

Side note: assembly



One of the major ITk efforts in Vancouver is the assembly and testing of larger structures (and all the infrastructure needed to do it)

- Cleanrooms with dry air and vacuum system
- Assembly/loading system (gantry)
- Coordinate measurement machine
- Wire bonders
- Optical inspection systems
- Cold test system



Plan to be involved in the assembly of the next tracking detector as well, but not the focus of today

Current efforts in Vancouver



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Fully equipped cleanrooms for quality control for silicon strip sensors for ATLAS ITk (about 2000 sensors total)

- High resolution imaging
- Shape measurements
- High-volume tests in parallel:
 - Bulk capacitance
 - Leakage current
 - Leakage current stability
- Electrical tests per strip

In parallel: development of setups for further characterisation and defect analysis (for Itk sensors)

- Defect curing with UV light
- Defect detection
- Laser test setup
- Measurements in X-ray beam (AREA-X)

Towards the next tracking detector

Plan to participate in sensor testing effort as well: R&D, prototype testing, maybe production testing

Manufacturing experience



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Production sensors

ATLAS07 sensors:

- + great electrical performance
- mechanically out of spec (too bent)

ATLAS07 sensors:

- + improved bow
- early breakdowns

Lengthy investigations to identify cause: humidity

Assembly flow adjustment:
Everything to be kept dry
Process adjustments

Prototype sensors

Produced by CNM for module prototypes

- early breakdowns
- + replacements made

- occasional problems of individual sensors

+ experiments with new geometries and techniques

+ short turnaround between sensors and module assembly

Sensors for Market Survey

Designed by ITk member in cooperation with experienced company

- early versions showed early breakdowns

+ very close collaboration between project and company

Designer now at SFU!

Local manufacturing capabilities



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Significant advantages to being able to produce our own devices
Several steps are somewhat covered already

- Design: local expertise in Vancouver
- Simulation: being built up at TRIUMF
- Fabrication: devices for most steps existing at 4DLabs (SFU)
 - Successful production of 2-layer 6" devices, using lithography for top layer metallisation
 - Option to get ion implanter (if demand justifies maintenance cost)
 - Option to cooperate with other facilities (looking into Molecular Foundry at LBNL, prior collaborations)
 - Option to try and cooperate with existing partners
- Work needed to actually start fabrication
- Local experience to in debugging fabrication processes
- Option to pool resources to build up more demand?

Going forward



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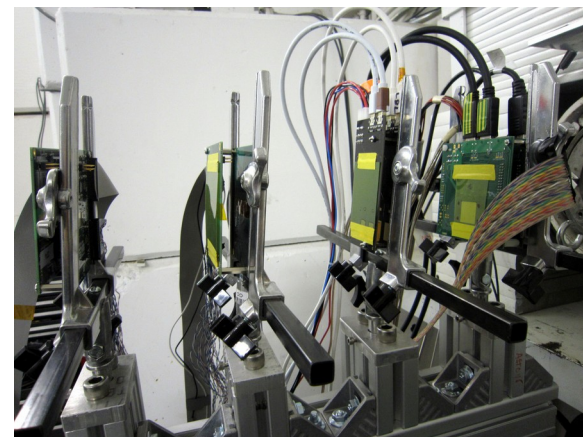
Aim to participate in building the next tracking detector and contribute

- Existing assembly/testing infrastructure
- Access to the TRIUMF irradiation facility
- Experience in beam test experiments (CLS, DLS, electron beam tests)

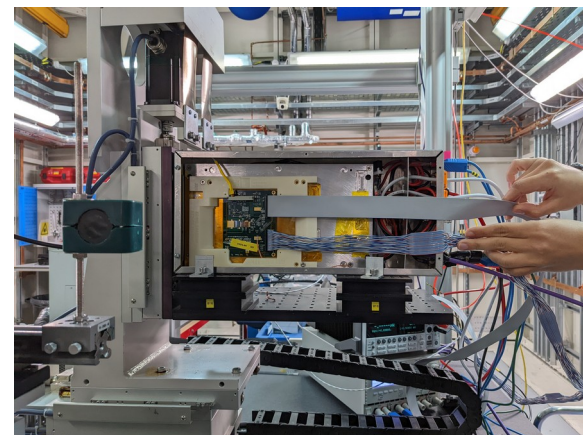
Aim to investigate options to produce our own devices

Build on existing infrastructure: CMC, 4Dlabs, ...

Ideally: find collaborators interested in manufacturing devices in Canada to establish a whole fabrication chain



Tests at TRIUMF PIF facility, December 2020



Diamond Light Source, May 2022