UMassAmherst
The Commonwealth's Flagship Campus

Interest in the CEPC Vertex Prototype

Rafael Coelho Lopes de Sa

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HEP Group at UMass Amherst

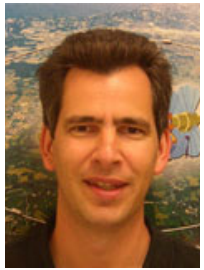
- Faculty


Ben Brau


Rafael Coelho Lopes de Sa


Carlo Dallapiccola


Verena Martinez Outschoorn


Stephane Willocq

- Scientists


Thiago Paiva (Elec Engineer)


Tiago Ramos (Mech Engineer)


Ed Moyse (Comp Sci)

- 4 postdocs (Roger Caminal, Attillio Picazio, Nora Pettersson, Roberto Di Nardo)
- 12 graduate students
- Several undergraduate students

Relevant Expertise (Si Trackers)

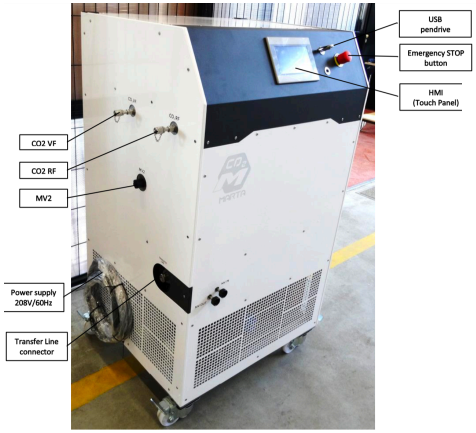
- CMS Phase I Forward Pixel (Rafael Lopes de Sa and Verena Martinez)
  - Structural design, CO_2 cooling design and testing, prototype machining and assembly, module testing
- CMS Phase II Tracker Outer Barrel (Rafael Lopes de Sa)
  - CO_2 cooling design and testing, structural design, shielding and grounding, carbon composite production and machining
- ATLAS ITk Pixel Inner System (Rafael Lopes de Sa and Tiago Ramos)
  - CO_2 cooling design and testing, local support structure testing, production QA/QC
- ATLAS ITk Strips (Ben Brau and Carlo Dallapiccola)
  - Bus tape automated testing, production QA/QC, module testing
- CMS Phase II Tracker Electronics (Thiago Paiva)
  - Track Trigger ATCA board development
- ATLAS ITk (Nora Pettersson and Ed Moyse)
  - Layout design and optimization, track reconstruction algorithm and code development.
- CDF Run2 Silicon Tracker (Ben Brau)
  - In situ studies of sensor depletion (aging studies)

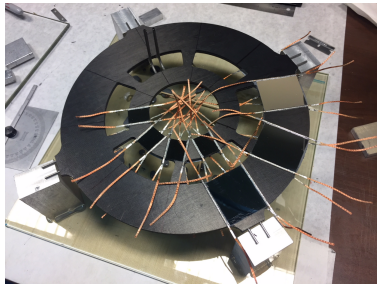
Research Infrastructure

- 3 dedicated facilities
  - Physical Sciences Building
  - IALS Core Facilities
  - Lederle Graduate Tower
- Physical Sciences Building
  - [HEP] wet and dry assembly areas
  - [HEP] electronics assembly
  - [HEP] clean room (from class 10,000 to class 100 hoods)
  - [HEP] **tracker mechanics laboratory**
- Lederle Graduate Tower
  - [HEP] **electronics assembly**
  - Machine shop
- IALS Core Facilities
  - **Digital Design and Fabrication**
  - Semiconductor Device Fabrication
  - **Mechanical Device Characterization**

*** Facilities marked with [HEP] are exclusive to experimental particle and nuclear physics.**

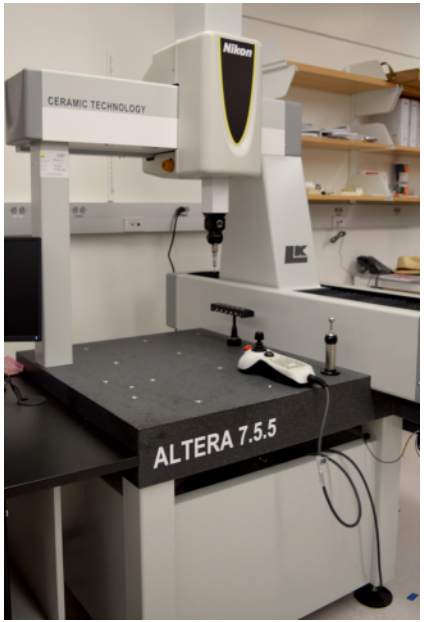
PSB Tracker Mechanics Lab





- Highlights
  - CO_2 cooling plant with PACL cycle as used in ATLAS, CMS, and LHCb silicon detectors
  - Large thermal chamber (1.22m x 1.22m x 1.22m) with precise temperature control (-40oC to +210oC) and humidity control (GN_2 and CDA)
- Current activities
  - Thermofluidic demonstrator for ATLAS ITk Pixels
  - Thermal Properties measurement for ATLAS ITk Pixels
  - High pressure tests for ATLAS ITk Pixel CO_2 manifold
  - ATLAS ITk Strips bus tape metrology (based on the Oxford automated system)

IALS Mechanical Device Fabrication and Characterization

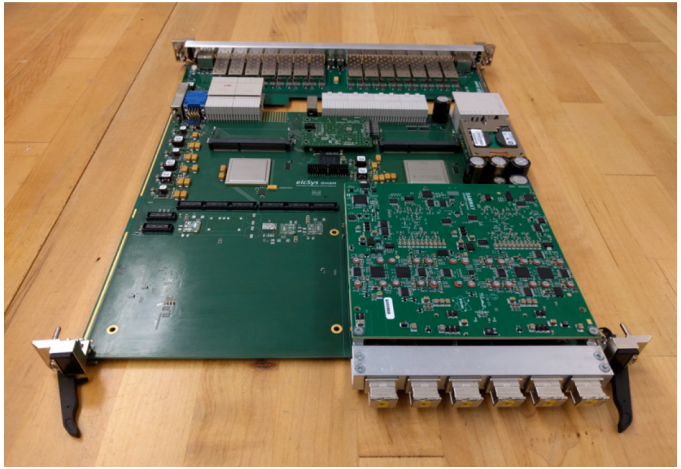


- Highlights (characterization)
  - Nikon Altera CMM Machine (5 axis, 1µm precision)
  - 3D scanner measurement (not as precise as the CMM machine, but fast)
  - Several other equipment for mechanical characterization
- Highlights (fabrication)
  - Plastic 3D printers
  - Metal 3D printers
  - Rapid laser cutting for complex geometries

Very advanced prototyping capabilities

LGRT Electronics Laboratory

- Highlights
  - ESD-safe Clean Assembly Area
  - Design, building, and testing of Printed Circuit Boards
  - Surface mounted component and IC reworking stations
  - ATCA development and testing stations (communication standard used in ATLAS, CMS, and LHCb)
  - Firmware development and simulation
- Current activities
  - ATLAS Muon NSW Trigger Board
  - ATLAS Muon L0MDT (Phase 2) Trigger Board



Lederle Graduate Tower has other laboratories and machine shops serving several HEP experiments (ATLAS, LZ, EXO, JLAB, g-2, DarkSide, ...).
Several years of experience in particle and nuclear physics.

Bonus! UMass Radiation Laboratory

- Highlights
  - Neutron irradiation facility
  - May be used to study the effects of atomic displacement damage on semiconductors and other materials like epoxy resins

- We (HEP group) haven't used this resource yet, but we are interested in exploring its potential for radiation qualification of structural components.

Capabilities

- UMass Amherst has a large set of resources for prototype development
  - Out-of-Autoclave carbon composites production
  - CO_2 cooling design and characterization
  - Geometrical characterization via CMM and imaging methods
  - Advanced temperature and humidity environment control for detector testing
  - Advanced 3D printing for prototypes and mechanical characterization
  - Experienced machine shop serving large-scale experiments
  - Semiconductor device fabrication (ebeam evaporator, wafer metallization, film deposition, ion milling, plasma etching system, …)
  - Advanced PCB and circuit assembly, reworking, and testing capabilities
  - ATCA data communication development and testing

Interest in the CEPC Vertex Prototype Project

- Mechanical production: Out-of-Autoclave carbon fiber structure production
  - Relevant Experience: CMS Phase 2 Outer Tracker
- Mechanical design: structural, cooling, grounding, …
  - Relevant Experience: CMS Phase 1 Pixel, CMS Phase 2 Outer Tracker, ATLAS ITk Pixel and Strips
- Mechanical characterization: glue thermal and radiation qualification, thermal performance for supports and modules, …
  - Relevant Experience : CMS Phase 1 Pixel, CMS Phase 2 Outer Tracker, ATLAS ITk Pixel
- Mechanical prototyping: 3D printing and machining of pixel support structures
  - Relevant Experience: CMS Phase 1 Pixel, CMS Phase 2 Outer Tracker
- Mechanical testing: module and large-scale structure testing in controlled environment
  - Relevant Experience: CMS Phase 1 Pixel, ATLAS ITk Pixel and Strips

- **People directly involved:** Rafael Lopes de Sa (faculty) and Tiago Ramos (engineer).

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