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Detector R&D Resources

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Neutrino Detector R&D Workshop

21 January 2016

Introduction

- Fermilab has many technical capabilities that have been optimized for the development and construction of detectors for HEP
- Our facilities are available to qualified researchers in the HEP community
  - The work may be your own initiative
  - You may work in collaboration with an approved lab effort
    - In this case there may be financial support for the technical work
- The goal of this talk is to provide an overview of our current facilities and to inform you on how to access them
  - Testbeam and liquid argon (PAB) facilities excluded since they have been discussed in other talks

Overview

- Facilities:
  - Silicon Detector
  - Precision Metrology
  - Rapid Prototyping and Special Materials
  - Scintillator Detector Development
  - Thin-Film
  - Liquid Argon Test Facility
  - ASIC Development Facility
- Engineering
  - Mechanical (including cryo)
  - Electrical
  - Alignment and metrology

Scintillator Detector Development Facility

- Manager: Anna Pla-Dalmau
- Hosts NICADD extruder for large-scale production of detector scintillator pieces
  - Prototyping runs come first
  - Developing a die requires time and money
- Equipped for for preparation of scintillator paddles
  - Cutting, polishing, etc.

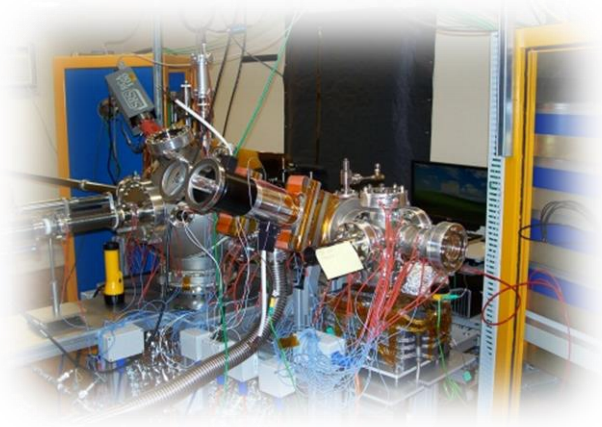
Scintillator Detector Development

- Chemical and analytical labs are maintained for R&D on scintillator materials
  - Extensive work on NOvA liquid scintillator

- Large stock of “pre-owned” scintillator paddles/bars and phototubes
  - Contact: Anatoly Ronzhin
- Legacy wire chamber winding facility with unique detector fabrication capabilities also maintained

Thin Film Facility

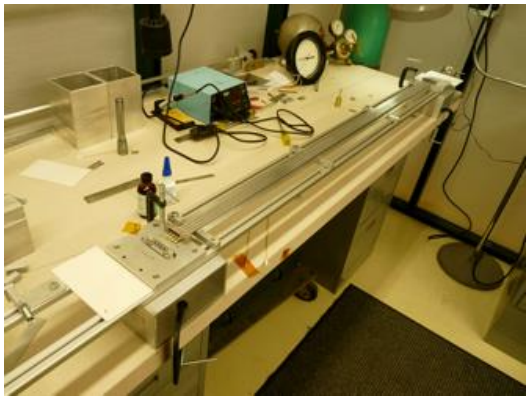
- Provides for application of evaporated and sputtered thin coatings on detector components
- Also specializes in optical fiber and plastic connector polishing and plastic fiber splicing
- Special furnace that provides heat treatment of metals in a vacuum



- Manager: Eileen Hahn

Rapid Prototyping & Special Materials Facility

- Focuses on fabrication and assembly of complex detector elements
- Low-Z carbon fiber production facility
- Houses large, specialized machines adapted for fabrication of detector elements using special materials
- Large clean rooms for detector assembly
- Manager: Dave Butler



Rapid Prototyping & Special Materials

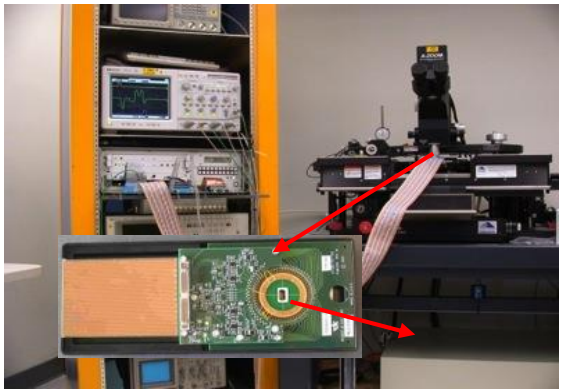
- Examples of prior work
  - Research & Development
    - COUPP Bubble Chamber Assembly
  - Project Work
    - Mu2e Straw Tracker
    - CMS Phase 1 Pixel Detector Frames
    - CMS Phase 1 Endcap Muon Panels
  - Work for Others
    - JLAB SVT Modules
    - NIU Proton CT Fabrication

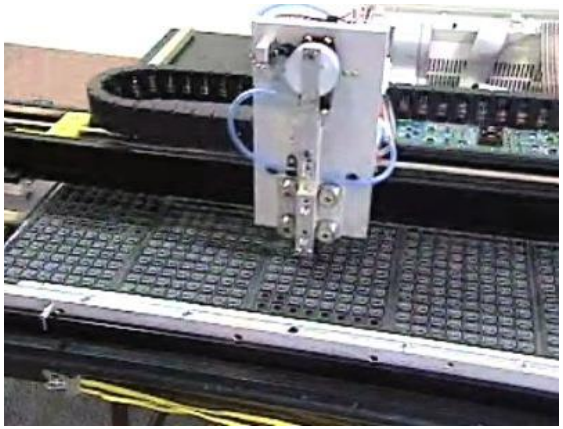
ASIC Development Facility

- Contributes to leading-edge technologies for the design of custom integrated circuits and sensors
- Special attention to designs that are radiation tolerant and that can operate in low temperature environments
  - Currently working on COLDATA chip for DUNE
- Unique contributions to the development of vertically integrated (3D) chip designs, with a focus towards sophisticated on-detector processing of pixel data and large volume data processing for triggering
- Leader: Gregory Deptuch

ASIC Development Facility Infrastructure

- Fabrication
  - Wire Bonding
  - Robotic Tester
  - Wafer Probing
- Testing
  - Printed Circuit Board Design
  - Field Programmable Gate Array (FPGA) Design
  - Cold Vacuum Chamber
  - Sensor Characterization
  - Mobile ASIC Test Setup





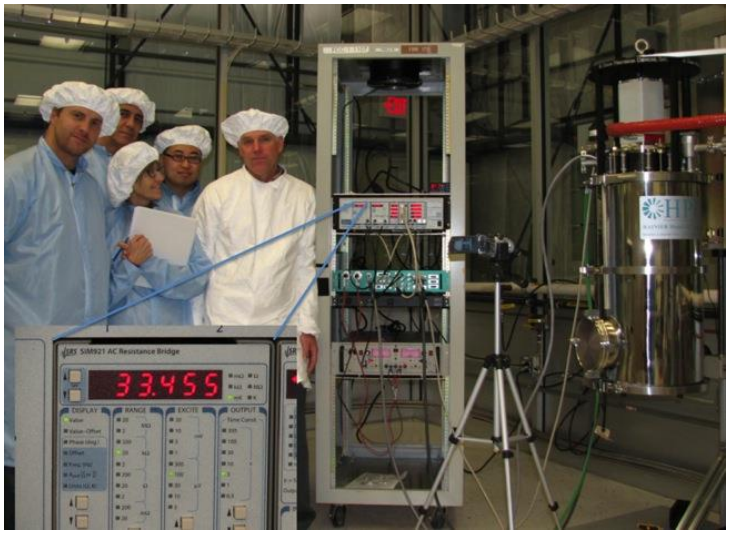
Silicon Detector Facility

- Long history at the forefront of detector R&D including the development of silicon tracking detectors for CDF, D0, and CMS as well as the development of the DES camera
- Facility infrastructure includes equipment for the production of silicon devices (e.g. clean rooms, high-precision measuring devices, and wire-bonding machines) as well as that required for the testing and QA performed on these devices
- Facilities are continually being upgraded to support development and production of the next-generation versions of these devices
- Leader: Gino Bolla

Silicon Detector Facility Infrastructure

Clean Rooms

Wire Bonding Machines

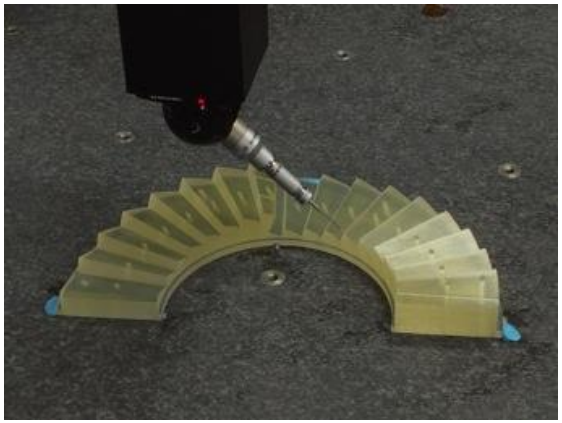


Cryogenic Test Stand

Large Area Assembly Spaces

Precision Metrology Facility

- Closely associated with Silicon Detector Facility
- Provides infrastructure needed for performing high-precision measurements associated with assembly of small-scale detector elements
  - Coordinate measuring machines (CMMs)
  - New CMM for 2m scale devices
- Manager: Mike Roman



Other Particle Physics Division Technical Resources

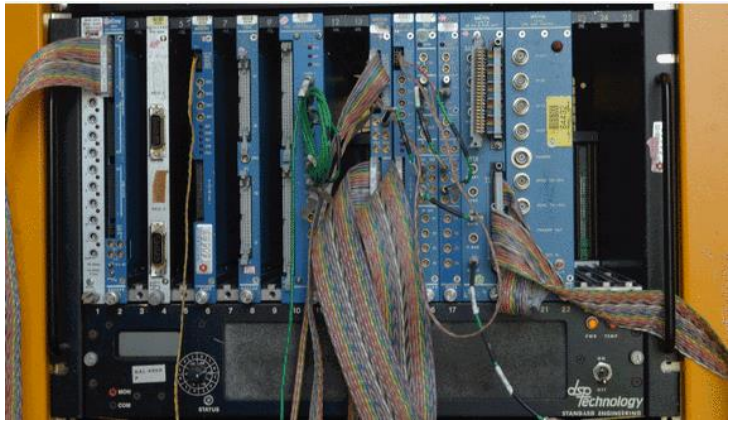
- Assembly and lab space
- Technicians for assembly, rigging, etc.
- Detector Operations and Development Department
  - Home for all of the above, test beam and PAB
  - Head: Rick Ford

Engineering

- Electrical
  - Department Head: Marcus Larwill
  - Front-end, DAQ, grounding/shielding, power distribution
- Mechanical
  - Department Head: Russ Rucinski
  - Cryo
  - Design of structures, fixtures, etc.
- Alignment and Metrology
  - Department Head: Horst Friedsam
  - Surveying, etc. (unusual for R&D)

PREP Electronics Pool

- Computing Sector equipment lending service
- Provides equipment for experiments and test stands
  - High voltage power supplies and distribution
  - NIM
    - Analog signal processing, trigger logic
  - Camac
    - ADC, TDC, logic
    - USB based control modules
  - VME
    - Crates, CPUs, limited other modules (ADCs, etc.)
  - High-current low-voltage supplies
  - Test equipment



PREP

- Website http://prep.fnal.gov
  - Full catalog including inventory
  - Request form
- Counter located in Feynman Computing Center
  - 1st floor east side
  - M-F 9:30-11:30, 12:30-3:00
  - Pick-up, return, exchange equipment
- Offsite use also possible
  - See web site for rules
  - Typically a few days to process initial request
- Questions, comments, etc.: prep@fnal.gov
- Manager: Lorenzo Uplegger

Radioactive Sources

- Special training required
  - Radiological Worker
  - Radioactive Sources
- Contact Kathy Graden in ESH&Q Section to find out what sources are available or how to bring a source from your institution to Fermilab

Access to Resources

- First steps:
  - Talk to group leaders and facility managers
    - Make sure they have the people and equipment available to accommodate your needs
  - Talk to R&D coordinator
    - Brian Rebel for Neutrino Division
- Complete a Technical Scope of Work (TSW)
  - MS Word document
    - Working on online form
  - This is what we used to call an MOU
    - DOE won't let us say "MOU" anymore (uh-oh)
  - Outlines work that will be done and resources that are required
  - Ensures that management is aware of commitments
  - Provides information on necessary safety requirements and reviews

Writing a TSW

- Use a graded approach
  - Shorter document for brief activities and/or limited resources
  - Longer for more involved activities
    - Example: ANNIE
- Template and instructions online
  - http://ppd.fnal.gov/tsw_template.html
- Two parts
  - List of researchers and their activities
  - List of needed resources
    - Space, equipment, labor from technical groups
  - These are generally distinct
- Assistance available from Division Safety Officers
  - Eric McHugh (PPD) and Angela Aparicio (ND)

Completing the TSW

- Review by relevant parties
  - Safety officer to ensure that proper safeguards are in place
    - Help identify hazards
    - Requirements for training, personal protective equipment, etc.
    - Plan for ORC (see next slide)
  - Division management
    - Ensure that resources are available and can be provided to the effort as described
  - R&D Liasons
    - Verify that goals are achievable and resources are well-matched
- Refinement
  - For more complex efforts, may need to iterate on document prior to approval
- Never really complete
  - As requirements and conditions change, TSW may require update

Operational Readiness Clearance (ORC)

- A review is required before equipment can be operated unattended
- Division Safety Officers (DSOs) and facility managers will help you with this process
- TSW provides a list of hazards that may need review
  - Others may become apparent only after design or assembly
    - Example: general electrical safety
- Subject-matter experts will review design and construction
  - May require modification to apparatus
  - While parts are under review, may operate others with pORC (partial ORC)
- Division approval required

Paying for work

- If you are collaborating on a Fermilab R&D effort or construction project, you may be able to get Fermilab to pay for work
- You can pay with outside funds for work done by Fermilab staff by setting up a Strategic Partnership Project (SPP)
  - Formerly known as a Work for Others agreement
  - Defines scope of work and cost
  - Not difficult to establish
- Small jobs, answers to quick questions can be handled without a charge-back account
- Never any charge for use of floor or bench space, use of equipment, training, test beam

Conclusion

- Fermilab maintains a world-class collection of facilities for detector R&D
- The unique capabilities of these facilities are available to the entire HEP community
- We are eager to assist users in achieving their R&D goals
  - Questions or concerns: jdl@fnal.gov
- Our facilities are evolving
  - Please let us know your needs so we can meet them