SiDet: The Little Lab That Could

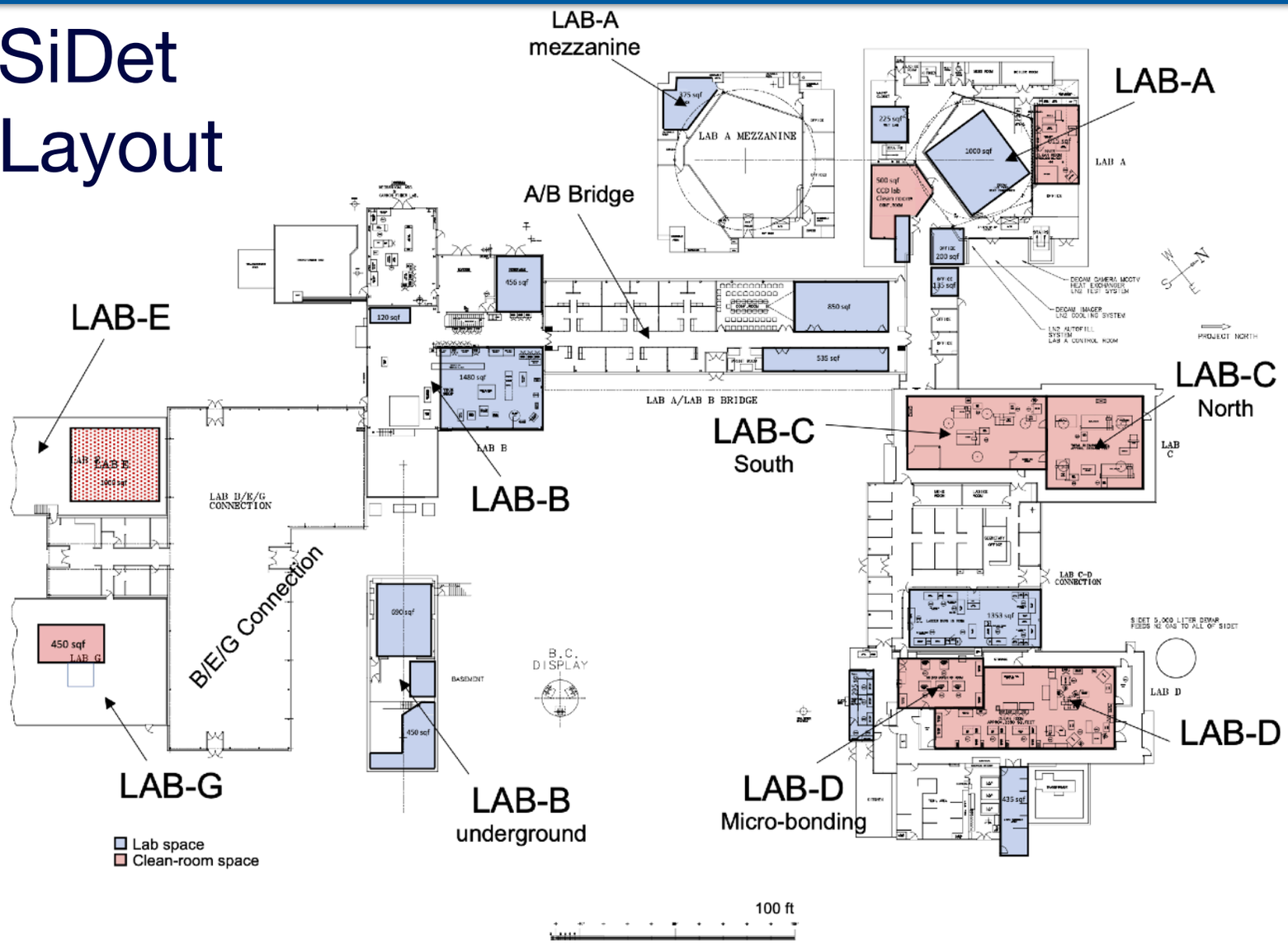
Doug Berry
Fermi National Accelerator Laboratory

CPAD 2026: Instrumentation and Detector R&D Workshop
October 21st, 2026

Silicon Detector Facility

- SiDet hosts over 8000 ft² (750 m²) of cleanrooms (ISO 7)
  - Clean areas for detector testing and storage
- Features sensor packaging, wire bonding, micro assembly, probe testing capabilities
- Large-scale detector assembly area
- Precision metrology for centimeter to meter scale detectors
- CO_2 and cryogenic cooling for silicon and quantum devices
-

SiDet Layout



Cleanroom and Lab Space

5-Star Rating in Google MAPS!





Only 50¢!!!

Review summary

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5.0
★★★★★
6 reviews

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Reviews

Sort

David W. Miller
Local Guide · 442 reviews · 4,076 photos

★★★★★ 4 years ago

Amazing technical resource for all things silicon detector technology related

1 Share

Chris Stoughton
Local Guide · 123 reviews · 1,026 photos

★★★★★ 7 years ago

Best coffee at fermilab. Good parking, too

SiDet Experiments

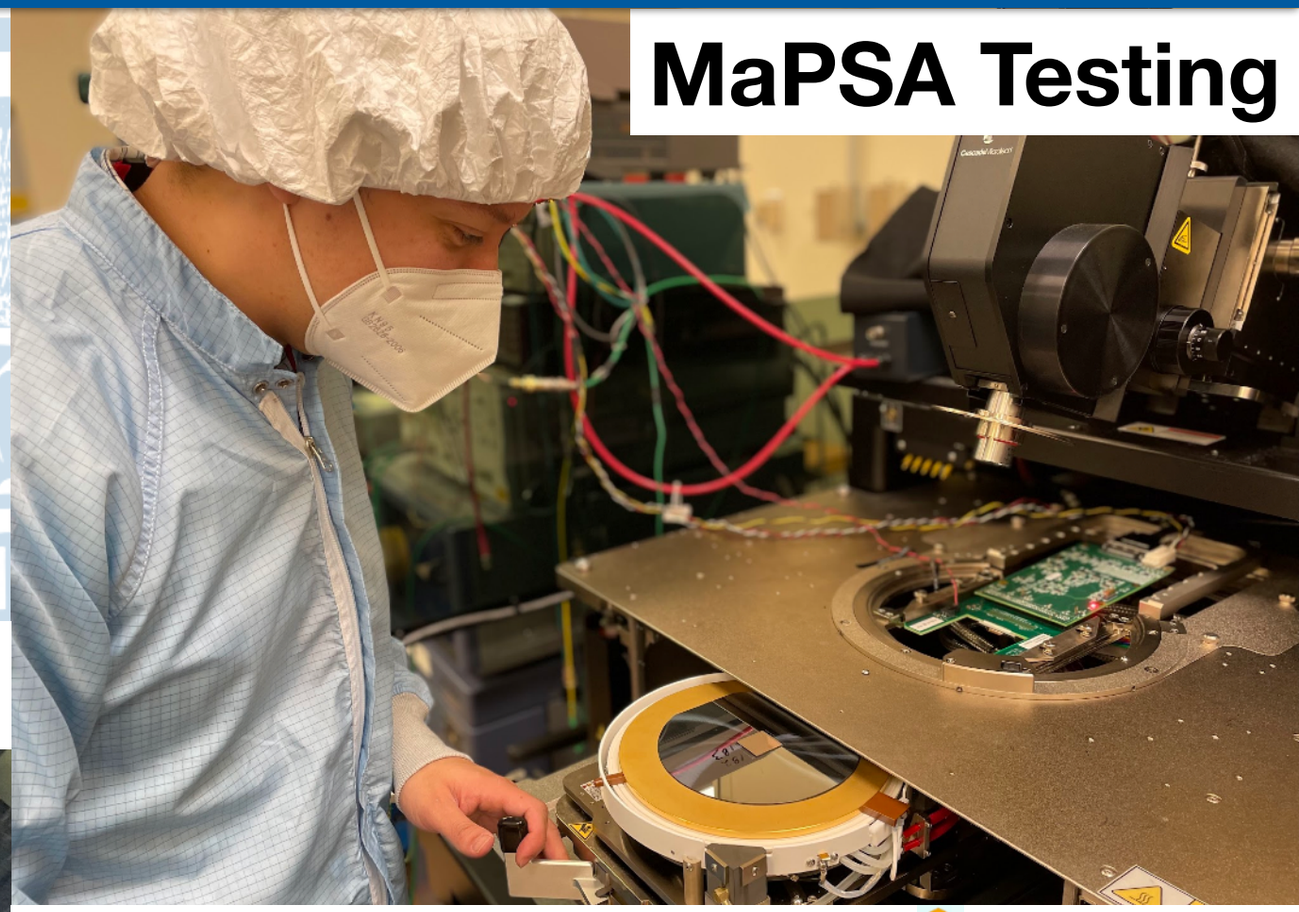
- The Silicon Detector Facility is located at the end of the beam line at FNAL
- Nearly 30 years of experience in silicon detector testing and fabrication
- Currently supports the construction and operation of several experiments
- CMS — Outer Tracker, High Granularity Calorimeter, and Endcap Timing Layer for the HL-LHC Upgrade
  - μ2e — Calorimeter
  - ADMX — Axion Dark Matter Experiment
  - Power rack assembly and testing for PIP-II
  - Mechanical assembly support for PICO



Outer Tracker (OT)

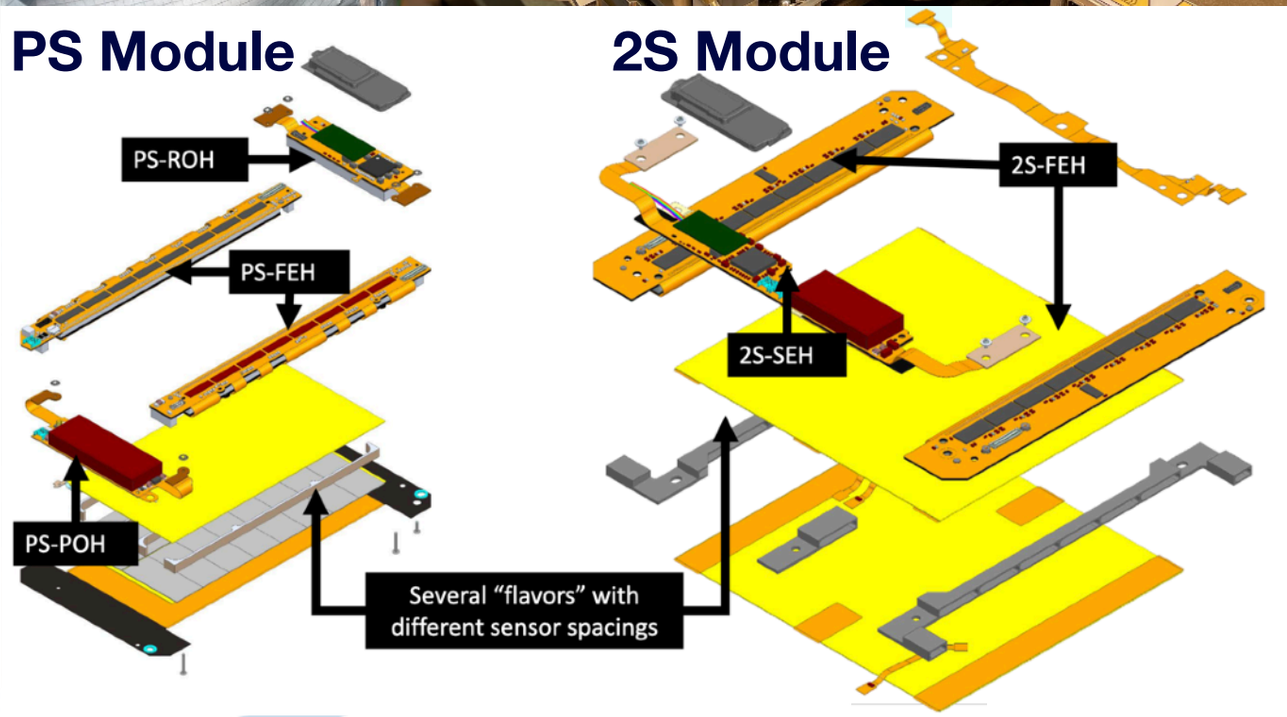
- Three key aspects of the upgrade are being performed at SiDet
  - Macro Pixel Sub-Assembly (MaPSA) Test Station
    - One of five semiautomated MaPSA testing sites
  - Module Assembly
    - 2S and PS module assembly site
  - Flat Barrel Assembly

MaPSA Testing



Flat TBPS Integration

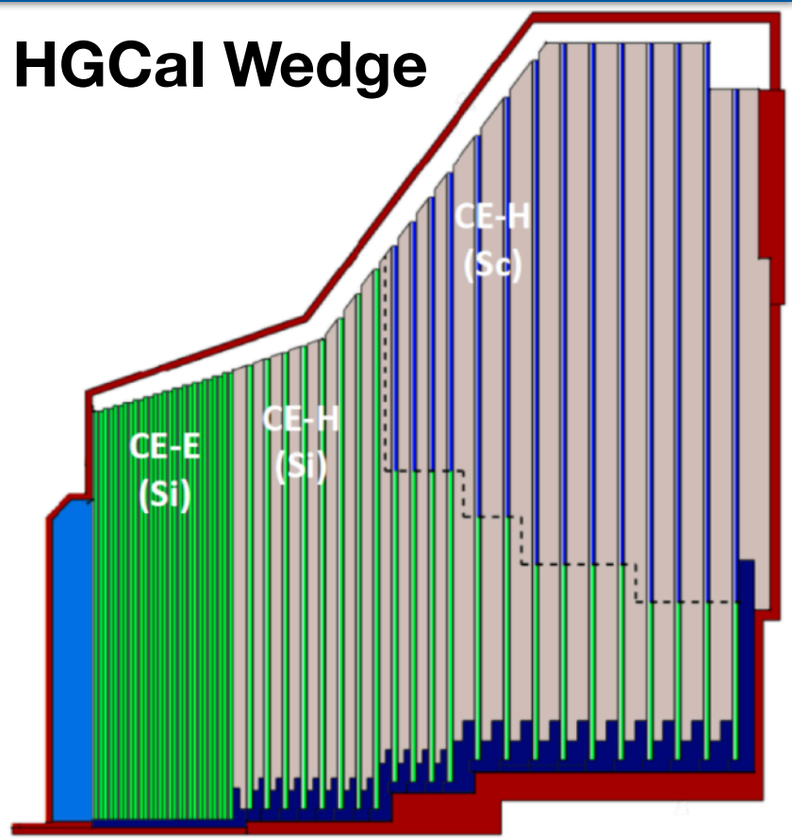




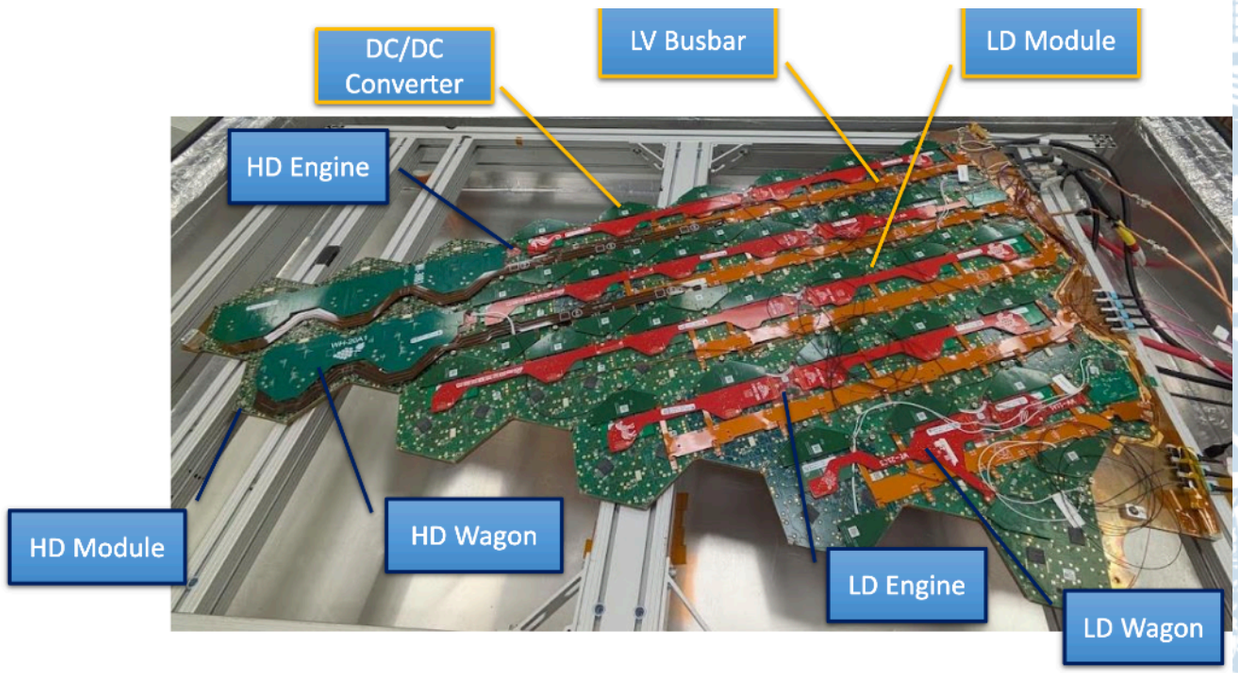
High Granularity Calorimeter (HGCal)

- The HGCal will be the largest silicon detector ever built
  - 620 m² of active silicon sensor area
  - Unique sampling calorimeter that measures jet energy using silicon wafer sized modules
- SiDet will host HGCal cassette assembly, metrology, and cold testing

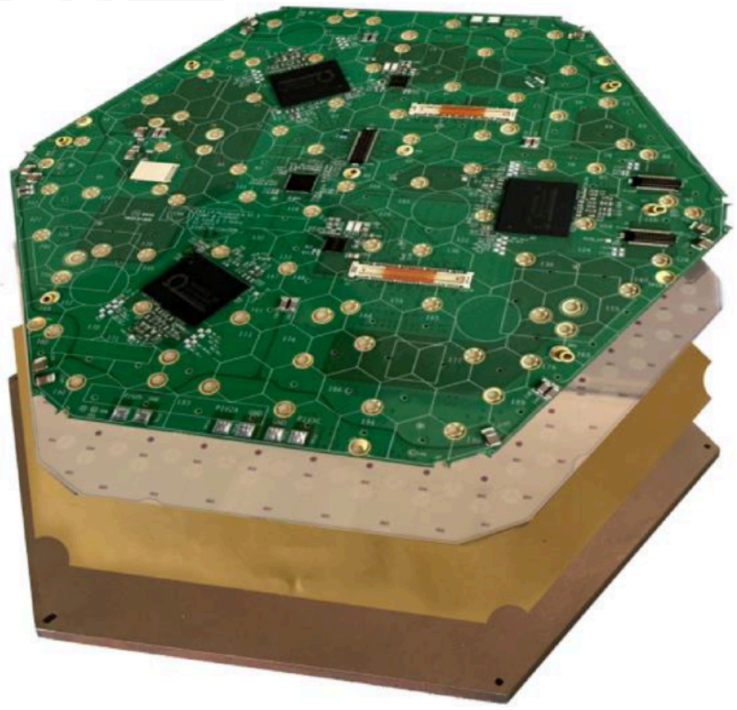
HGCal Wedge



HGCal Fully Assembled Cassette

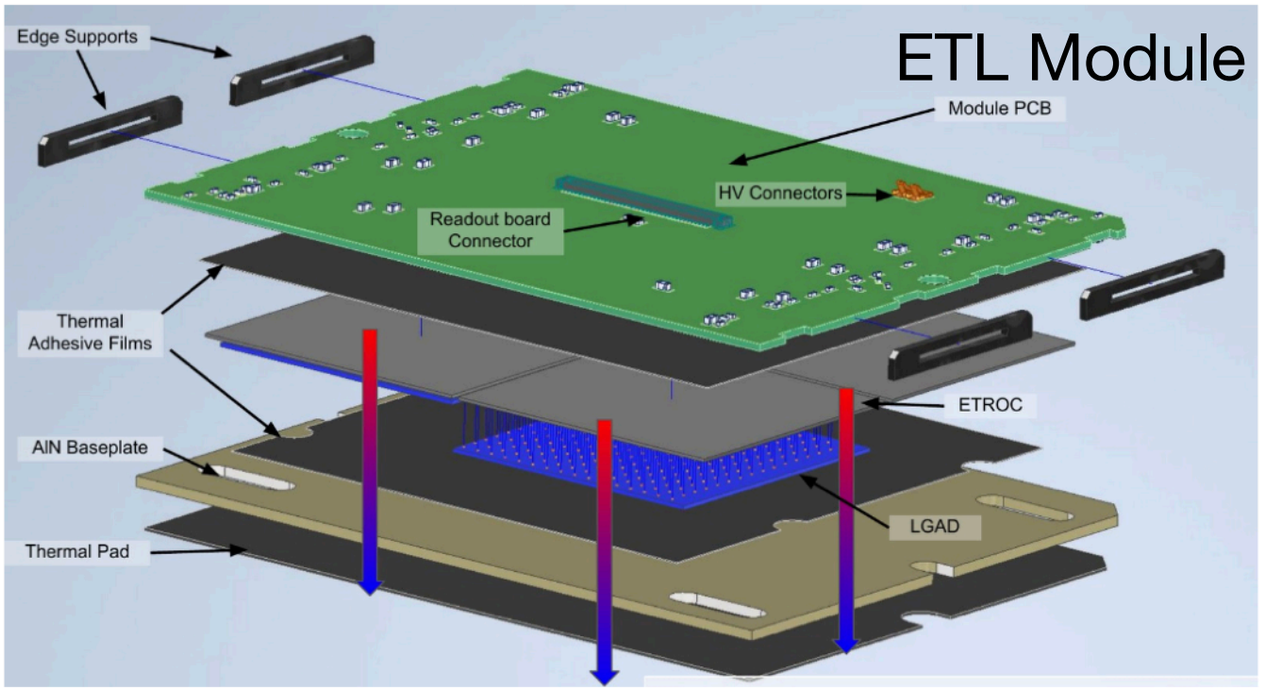


HGCal Module



Endcap Timing Layer (ETL)

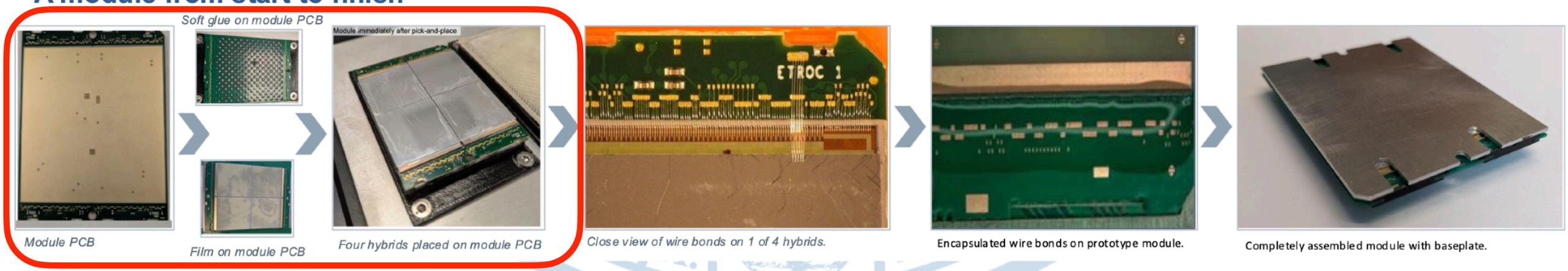
- Modules for the Endcap Timing Layer are being built using an automated gantry in Lab D
  - First use of LGADs in CMS
  - The first half of the assembly sequence can be performed on the gantry



ETL Module Assembly



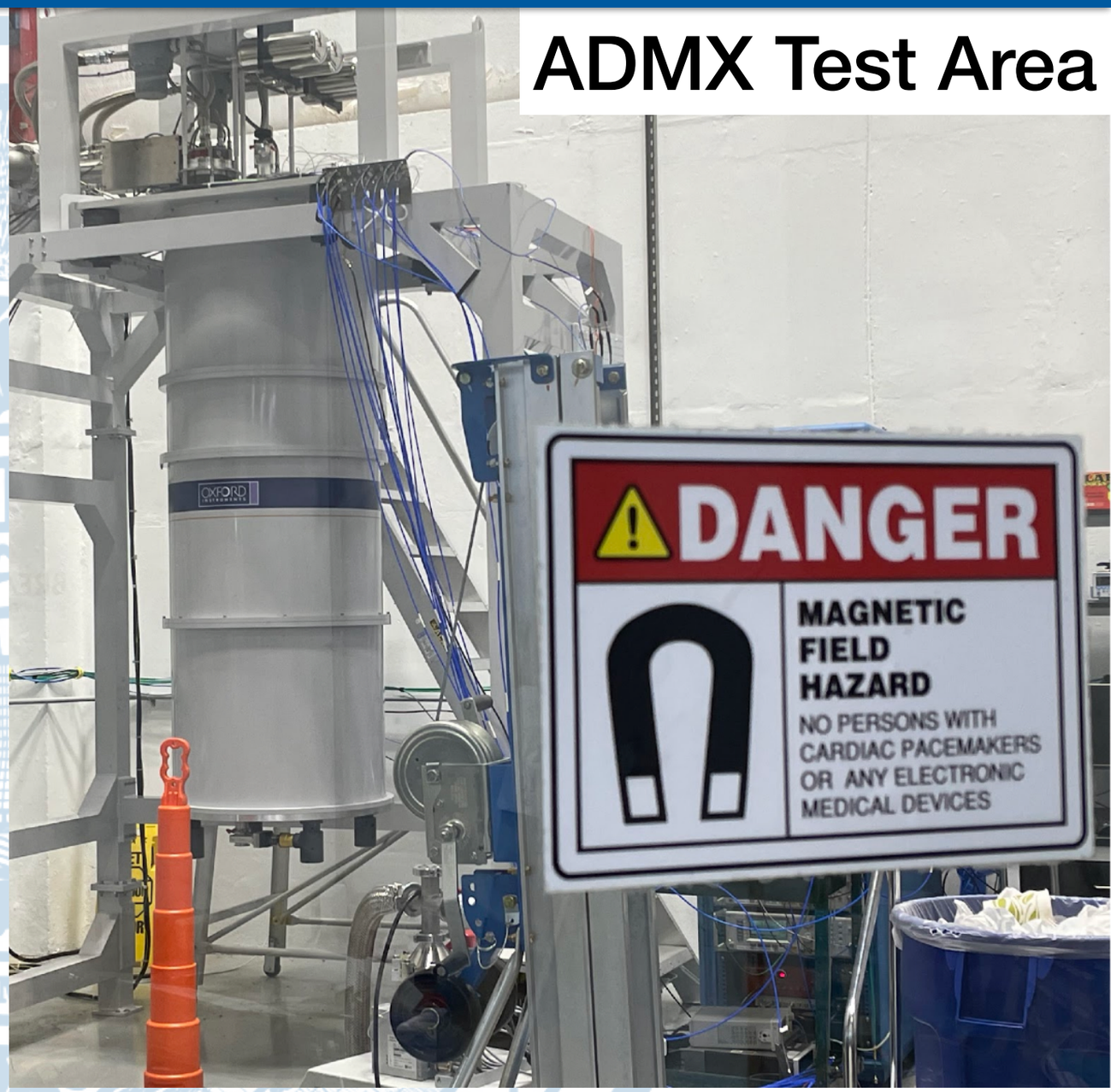
A module from start to finish



On Gantry

Axion Dark Matter eXperiment (ADMX)

- Search for Axion dark matter
  - Bonus benefit of solving the strong CP problem
- ADMX cryogenic test facility for detector development and characterization
- SiDet contributed to the testing of microwave resonant cavities and detector assemblies



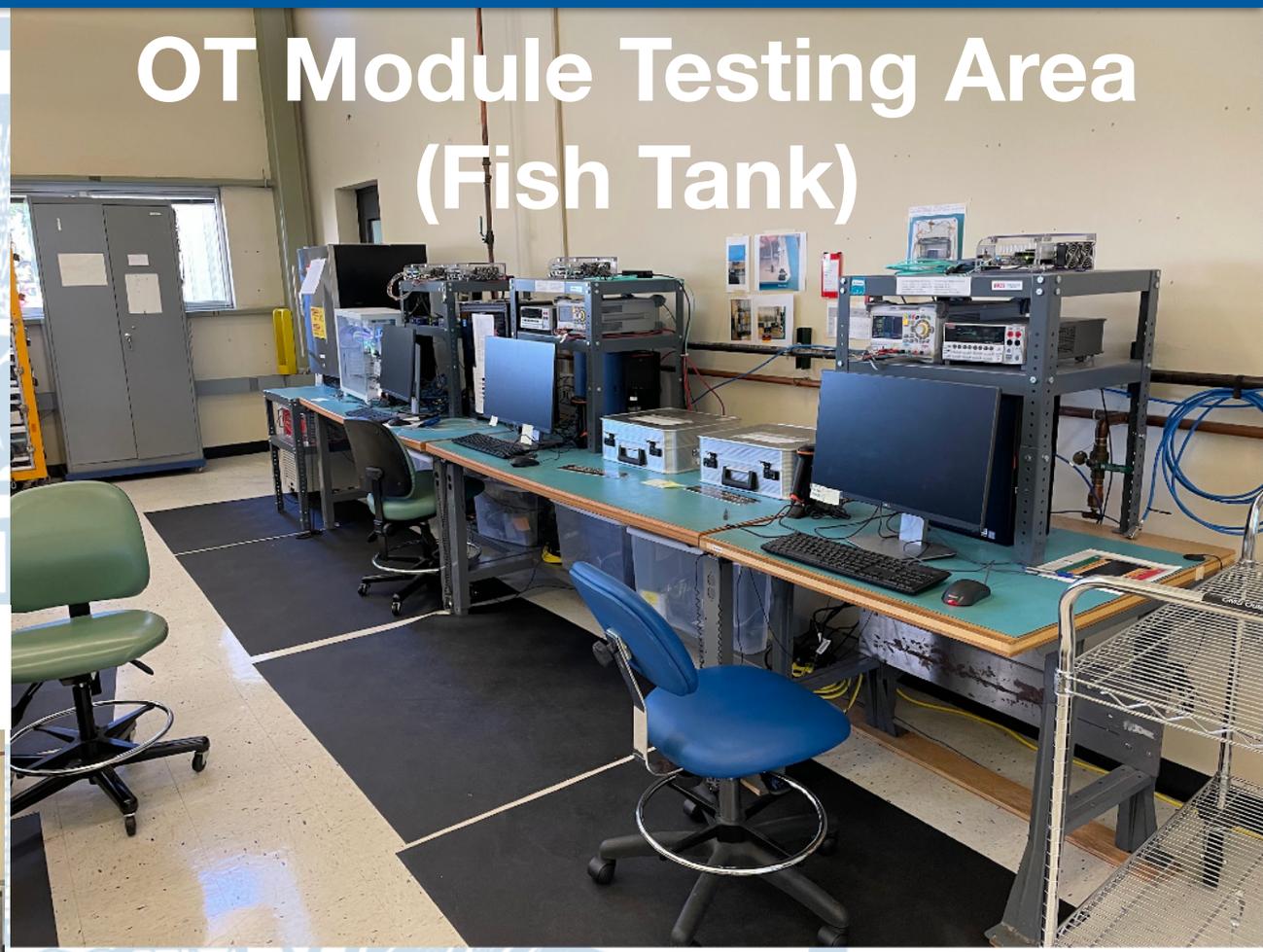
General Laboratory Areas

- SiDet hosts several device testing areas
  - Clean spaces for testing and debugging detectors

Dry Storage



OT Module Testing Area (Fish Tank)



- Equipped with microscopes, HV and LV power supplies, soldering equipment
- Burn-in module testing boxes
- Have a passthrough to the micro bonding laboratory

Laboratory D Cleanroom

- Lab D has the largest number of available services
- Two micro assembly stations
- Two automated assembly stations
  - One for ETL and another for OT PS module assembly
- Automated gluing and encapsulation
- Semiautomated probe station
  - Currently used for MaPSA probe testing
  - Can also perform 8” wafer testing
- Another manual probe station
- Large dry storage area
- Attached directly to the micro bonding lab

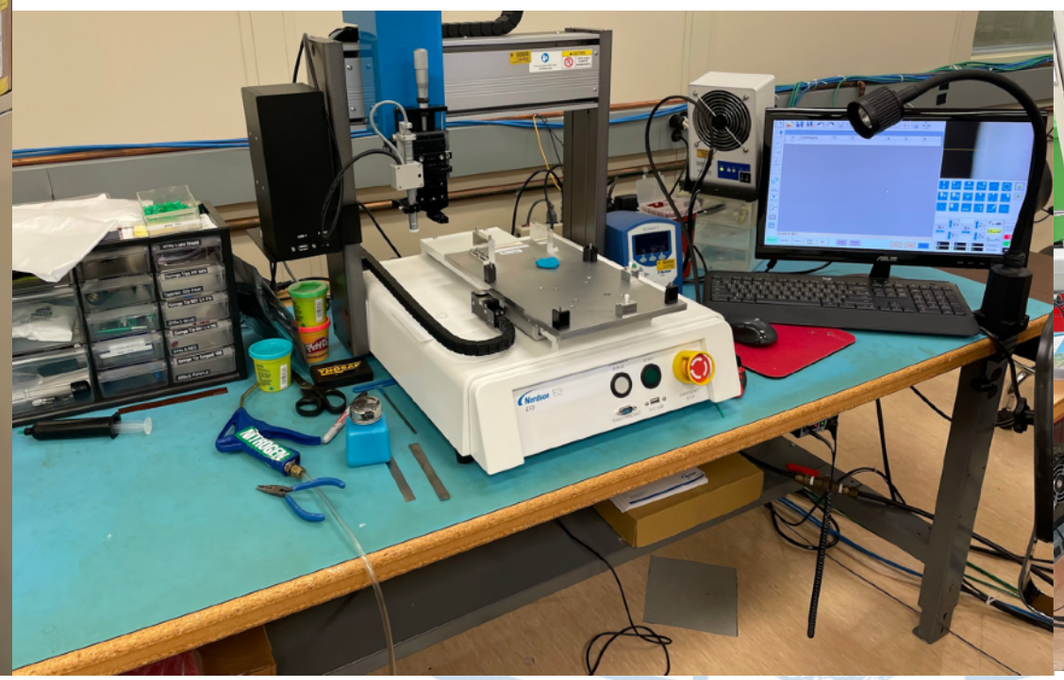
Micro Assembly Station



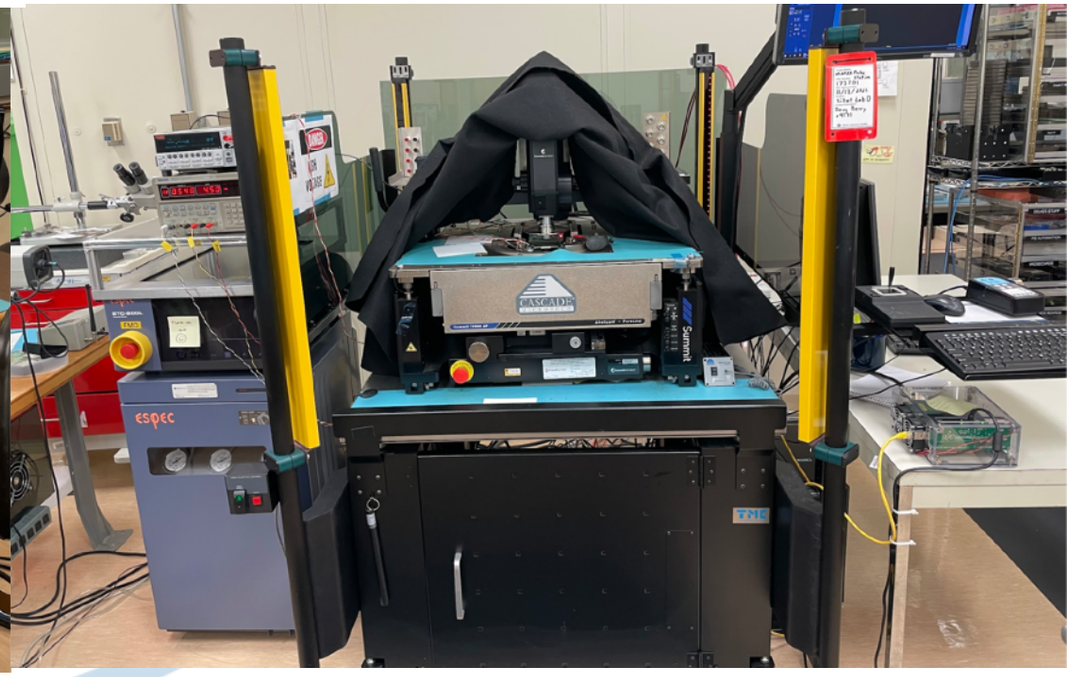
Dry Storage



Encapsulation Station



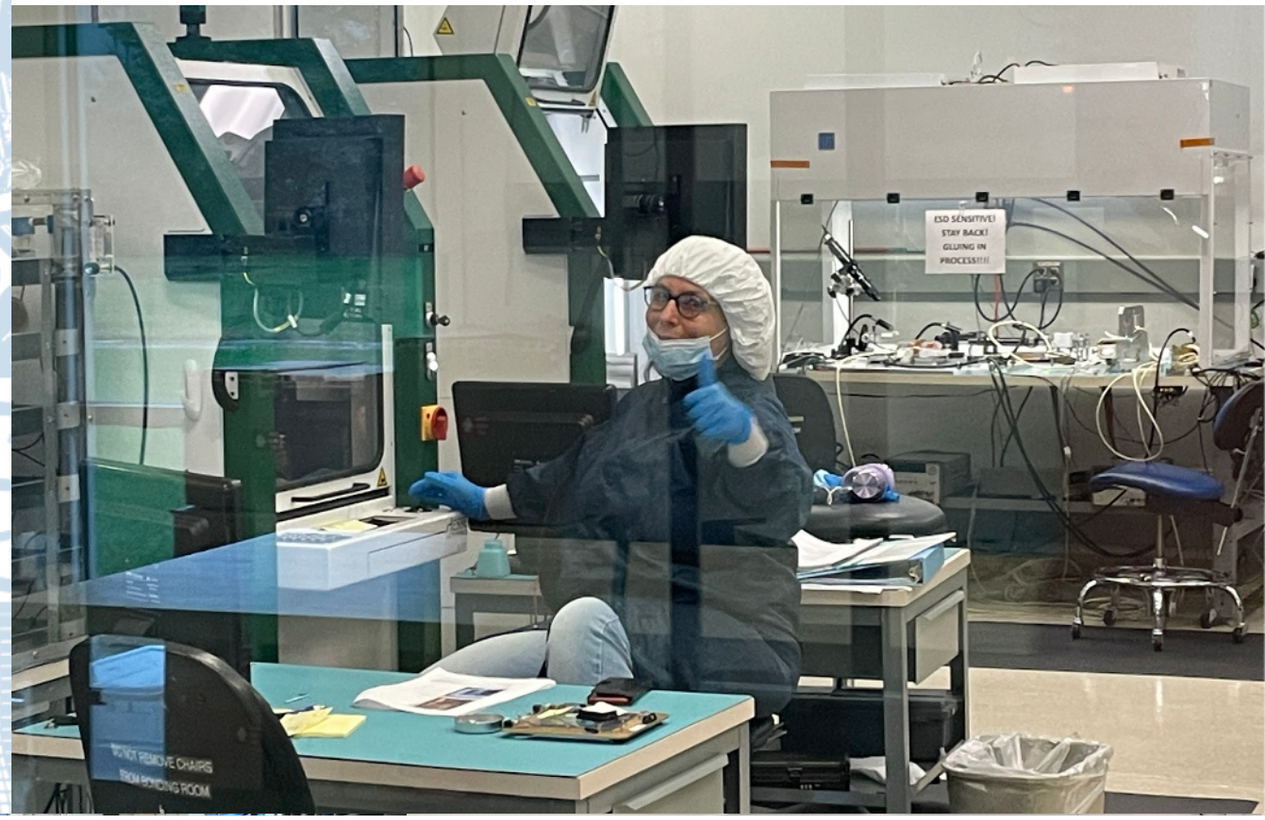
MaPSA Probe Station



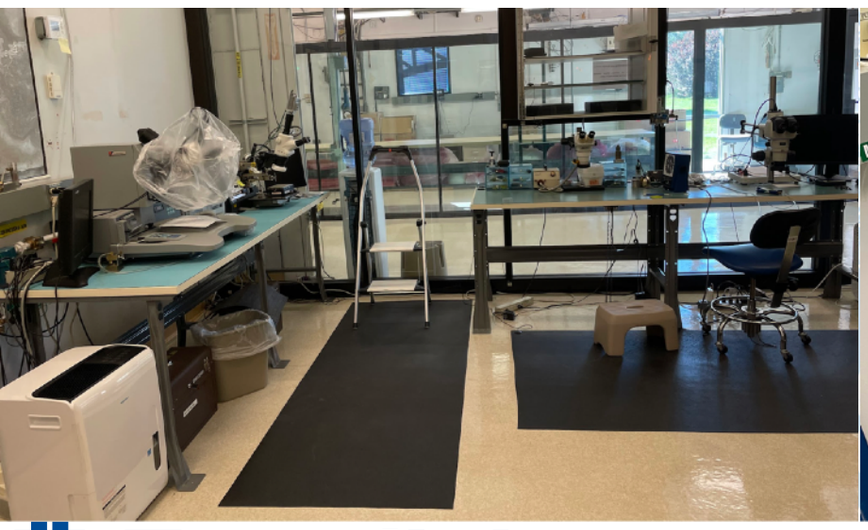
Micro Bonding Lab

- The wirebonding lab hosts two automated microbonders
  - Hesse BJ820 micro bonders
- Device debug and rework stations with microscopes
- Small vacuum oven

Wire Bonding Station



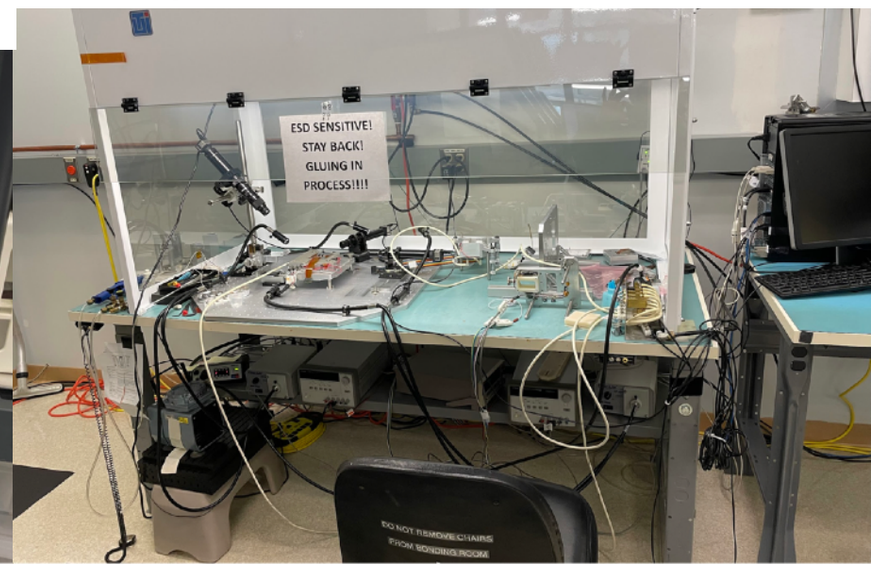
Inspection Area



Vacuum Oven



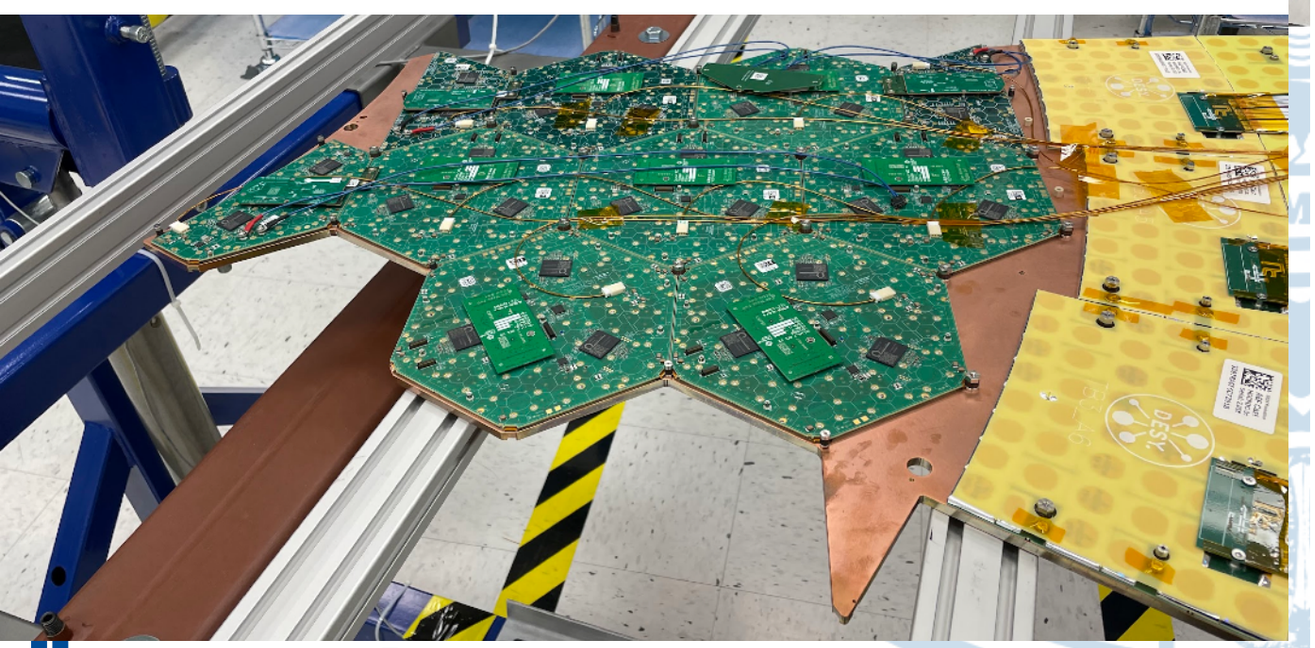
Gluing and Encapsulation Station



Lab C North Cleanroom

- Large cassette assembly area
  - Integration of HGCal silicon modules, front ends, and cooling plates into a 30° sector of HGCal
- Two separate assembly stations
  - Two stations for the cassette assembly chain
  - Two additional debug stations for rework
- Each assembly station is equipped with a full suite of HV, LV, and DAQ systems
- Two cold rooms for testing up to 20 cassettes in parallel
  - Two-week burn-in testing sequence

HGCal Cassette



HGCal Cassette Assembly Stations

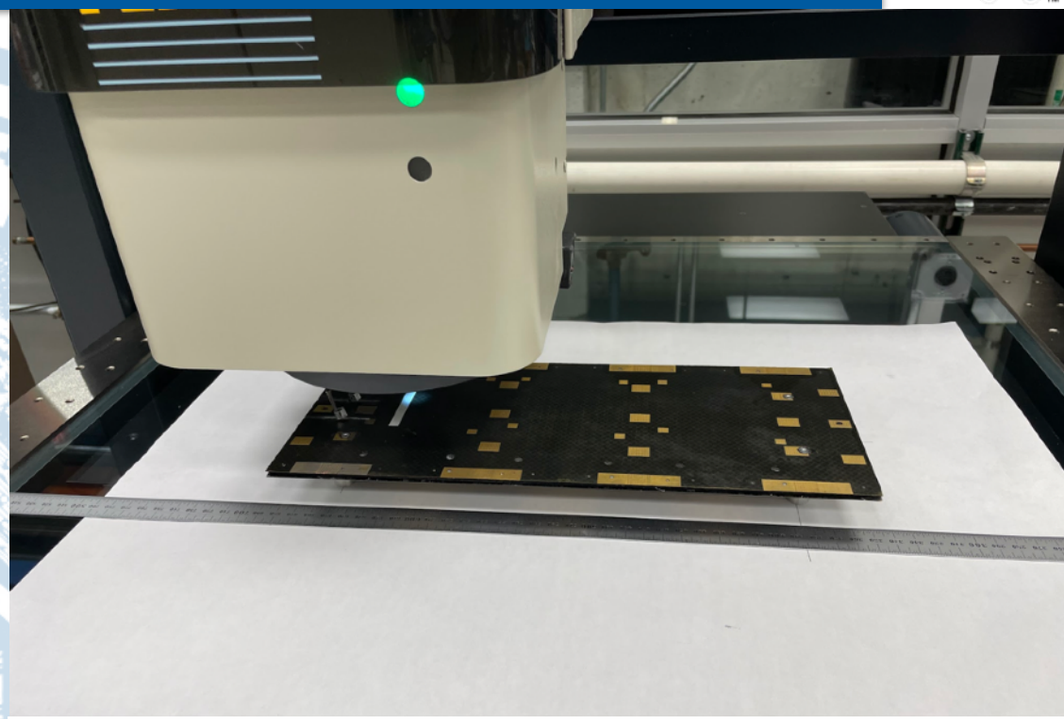


HGCal Cold Boxes



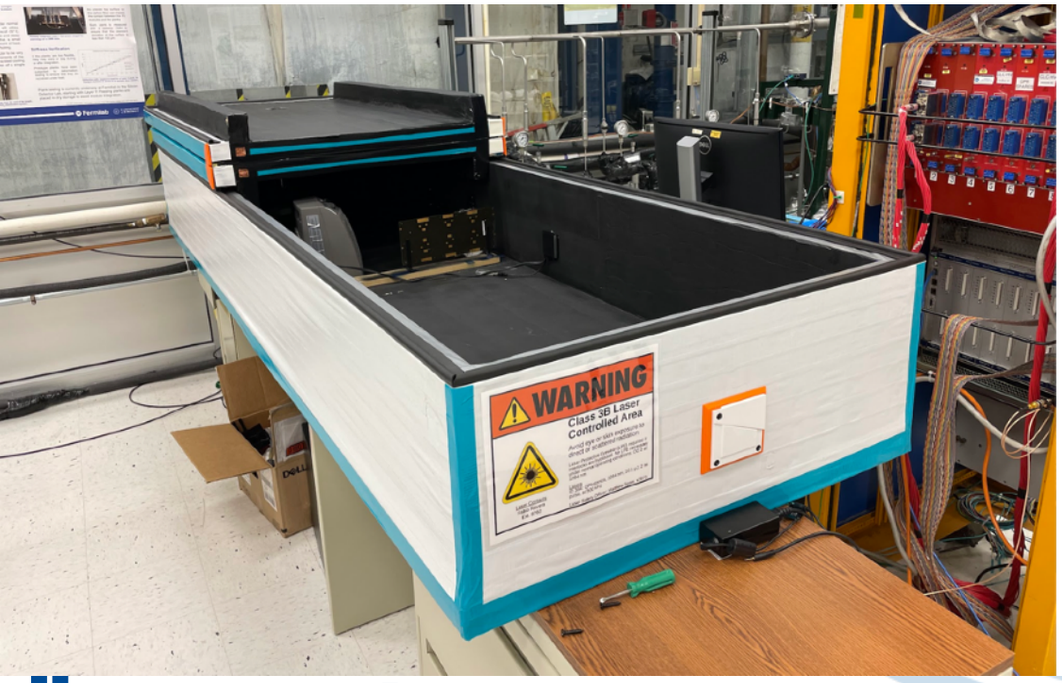
Lab C South Cleanroom

- Integration area for the Flat TBPS
- Large CMM for Flat TBPS Layer assembly
  - Regular CMM also available
- Cold testing boxes for both mechanical and integration testing
- CO_2 distribution manifolds for both the OT and HGCal
- 240-channel HV and 72-channel LV power supplies
- ATCA (pending) and µTCA DAQ systems
- Large vacuum oven

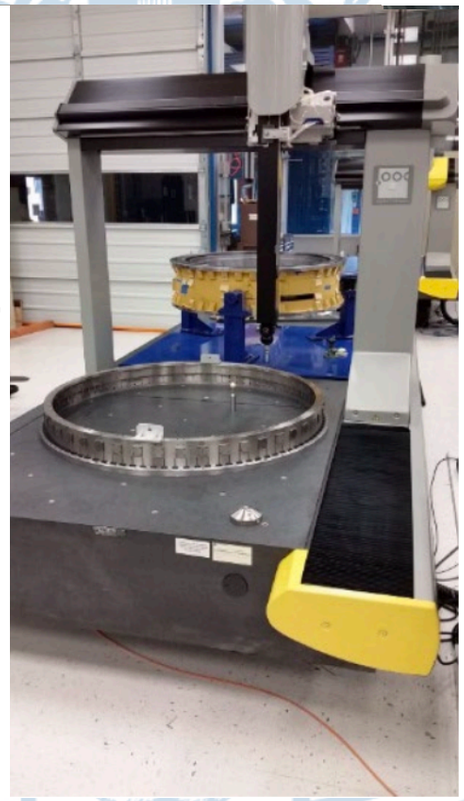


Bare TBPS Plank on OGP Flash 625 CMM

TBPS Cold Box (Mech.)



Brown & Sharp CMM

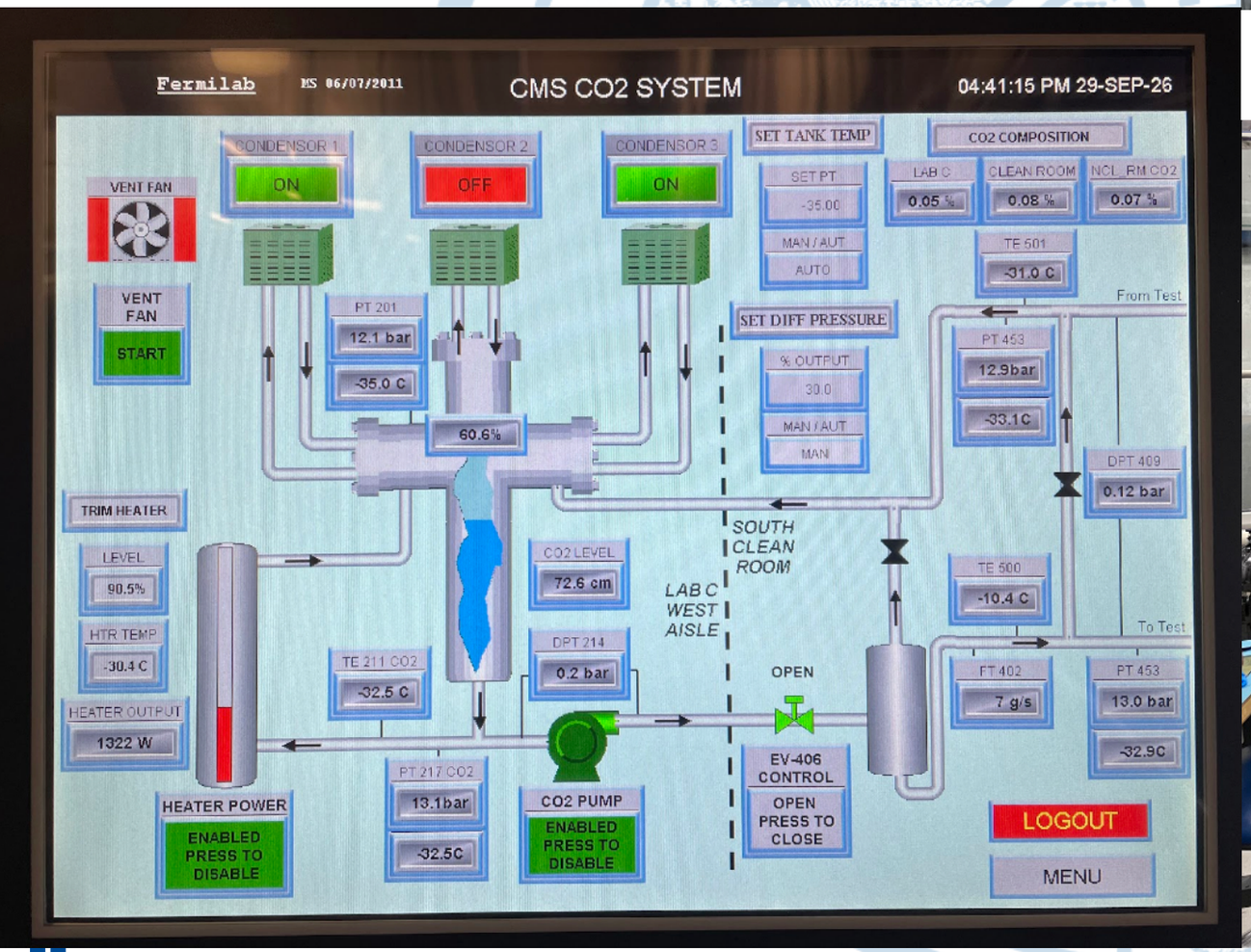


TBPS Integration Test Stand

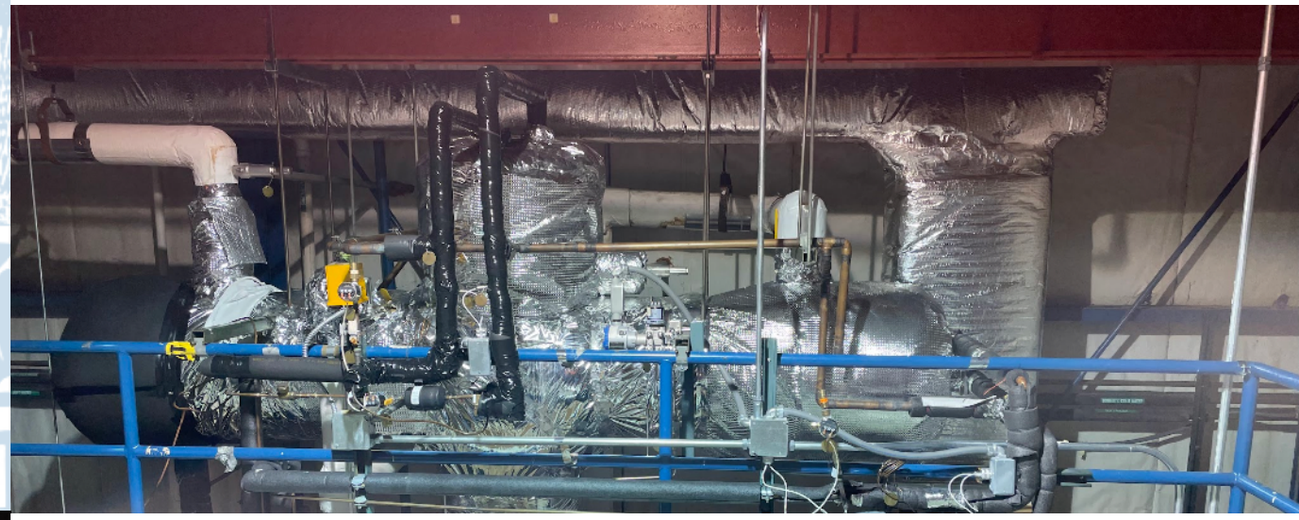


CO_2 Plant

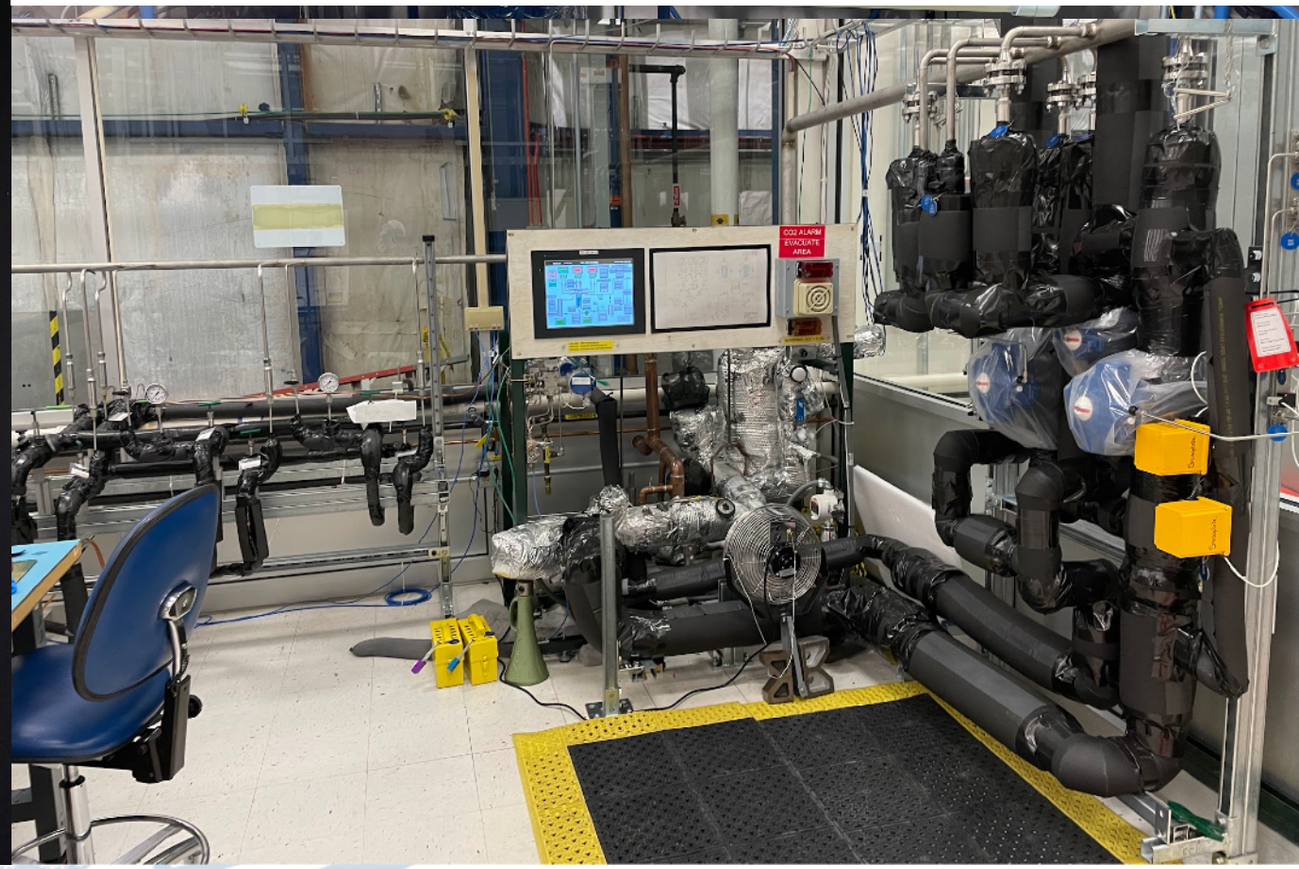
- Lab C features a 300 L dual phase CO_2 cooling plant
- Over 10 kW of cooling capacity
- Currently running 4 cold boxes
  - One OT integration cold box
  - Another OT mechanical cold box
  - Two large HGCal cold boxes



CO_2 Plant Reservoir and Heat Exchangers



CO_2 OT and HGCal Manifold & HMI



Lab B Assembly Area

- Lab B hosts a large detector assembly area
  - In addition to the detector and cryogenic services for ADMX
- Currently building and testing the power system for PIP-II
- Mechanical assembly for PICO

PIP-II Power Racks



PICO Mechanical Assembly



Lab A Assembly Area

- Lab A also features a large detector assembly area
- Currently fabricating the calorimeter for μ2e
  - Cleanroom for wrapping the CsI
- Mezzanine available for additional experiments

μ2e Calorimetry Lab



DCAM Mechanical Support



Crystal Lab

- Currently being used for thermal testing HGCal Components
- Thermal chamber available for both thermal cycling and cold testing

Test Equity 140 Thermal Chamber



Crystal Lab



Services

- SiDet also has several basic services
  - Dry air and nitrogen for detector storage
  - Forklifts and pallet jacks
  - Heavy lift cranes and a rigging team
  - Laboratory-wide vacuum system
  - Standard, three-phase, and 480 V power
    - Not available in all locations
- Various wildlife, including turtles, snakes, and birds

Crane in Lab C



Nitrogen Gas Source



Snapping Turtle



Grass Spider



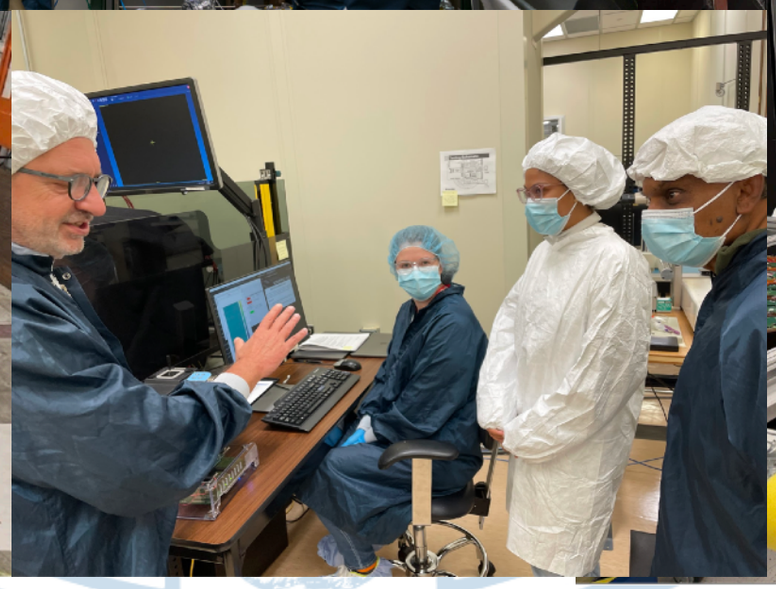
The People

- One of SiDet's greatest strengths is its skilled team of scientists, engineers, technicians, postdocs, and students









FNAL Site Access

- The site access process at Fermilab has improved over the last few years
  - The process is streamlined for US citizens
  - The process takes longer for non-US citizens
    - Typically takes around 45 days
      - Submit your request as early as possible
- Most applicants should request Affiliate status
  - Request User status if you need to use the test beam
  - Business Visitor status may be appropriate for short visits that do not involve hands-on work
- Access can be requested at: https://get-connected.fnal.gov/users-affiliates-access/
  - A different process applies if you already have a computing account or require both computing and site access
  - Track your access request at https://fermi.servicenowservices.com/access_request_status.do

Request Number:	
Access Request:	Onsite access request
Requested For:	
Request Date:	2026-06-17 15:31:42 CST
Current Step:	Complete
Date Entered to Step:	2026-07-22 10:52:12 CST
Time in current step (days):	N/A
Request Duration:	34 Days 19 Hours 20 Minutes
Point of Contact Name:	Doug Berry

Affiliation(s)	Aff. approval	Exp. control	FNAP
Future Collider Physics and Detectors (primary)	Completed	Completed	Completed

The following table lists all of the workflow steps for the entered Site Access Request. The highlighted row is where the request is in the current process. Depending upon a variety of factors (citizenship, the subject of the work being performed, institutional agreements, etc.) the time to complete this approval may vary. If you have questions about any of the steps in the table, please contact the owner of that step at the email provided.

Step#	Step	Average Duration	Description	Progress	Actual Duration
1	Initial Review	<2 day	Validating the submitted data.	Completed	17 Seconds
2	Point of Contact Approval	<1 day	Waiting for point of contact approval. If you have any queries, please contact your Fermilab Point of Contact.	Completed	4 Days 23 Hours 28 Minutes
3	Affiliation Approval	<1 day	Waiting for affiliation approval. For support please contact Campus Access at campusaccess@fnal.gov.	Completed	17 Hours 29 Minutes
4.1	Foreign National Access Program	<60 business days	Waiting for Foreign National Access Program approval. *Most tickets are processed within 7-14 days but it can take up to 45 days when additional subject matter expert (SME) approvals are required, and up to 60 days if indices checks are required for the visit. For more information visit our FNAP webpage at https://get-connected.fnal.gov/foreign-national-access-program/. For support, please contact fnap-request@fnal.gov.	Completed	28 Days 23 Hours 39 Minutes
4.2	Export Control	<3 day	Export Control Subprocess. Email ExportControl@fnal.gov with questions.	Completed	14 Seconds
4.3	FGAD review	<14 days	Foreign Government Affiliation Disclosure Review	Completed	12 Seconds
4.4	Agreements and Institution Manager Review	<7 days	Validating the agreements for the home institution. Most tickets are processed within 2 days but it can take longer if new agreements are needed. For support, please contact Campus Access at campusaccess@fnal.gov.	Completed	1 Minute
4.5	Pending FermiWorks	<5 business days	FermiWorks Documentation Review: Fermi staff confirms the data entered and obtains necessary approvals before submiting their task. For support, please contact campusaccess@fnal.gov.	Completed	17 Seconds
5	Pending Indico	<1 day	Waiting for the Indico registration approval.	Completed	1 Minute
6	Invitation Process	<1/2 day	The invitation letter is issued. If you have not received the letter, please contact Campus Access at campusaccess@fnal.gov.	Completed	2 Hours 39 Minutes
7	Complete	0	Your request has been successfully completed.	Current	

Contacts

- Have a detector R&D project, large or small, that could benefit from SiDet's expertise or facilities? We'd love to hear from you!

General
Steve Nahn
Rick Ford

Silicon Tracking
Nicola Bacchetta
Petra Merkel
Doug Berry

Silicon Calorimetry
Harry Cheung
Joe Pastika

Silicon Timing
Artur Apresyan