

Engineering Portfolio

Terrance Schaub | Commissioning • Experimental Systems • Controls & I&C

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TERRANCE SCHAUB

EXPERIMENTAL SYSTEMS ·
COMMISSIONING · I&C

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SELECTED TECHNICAL PORTFOLIO

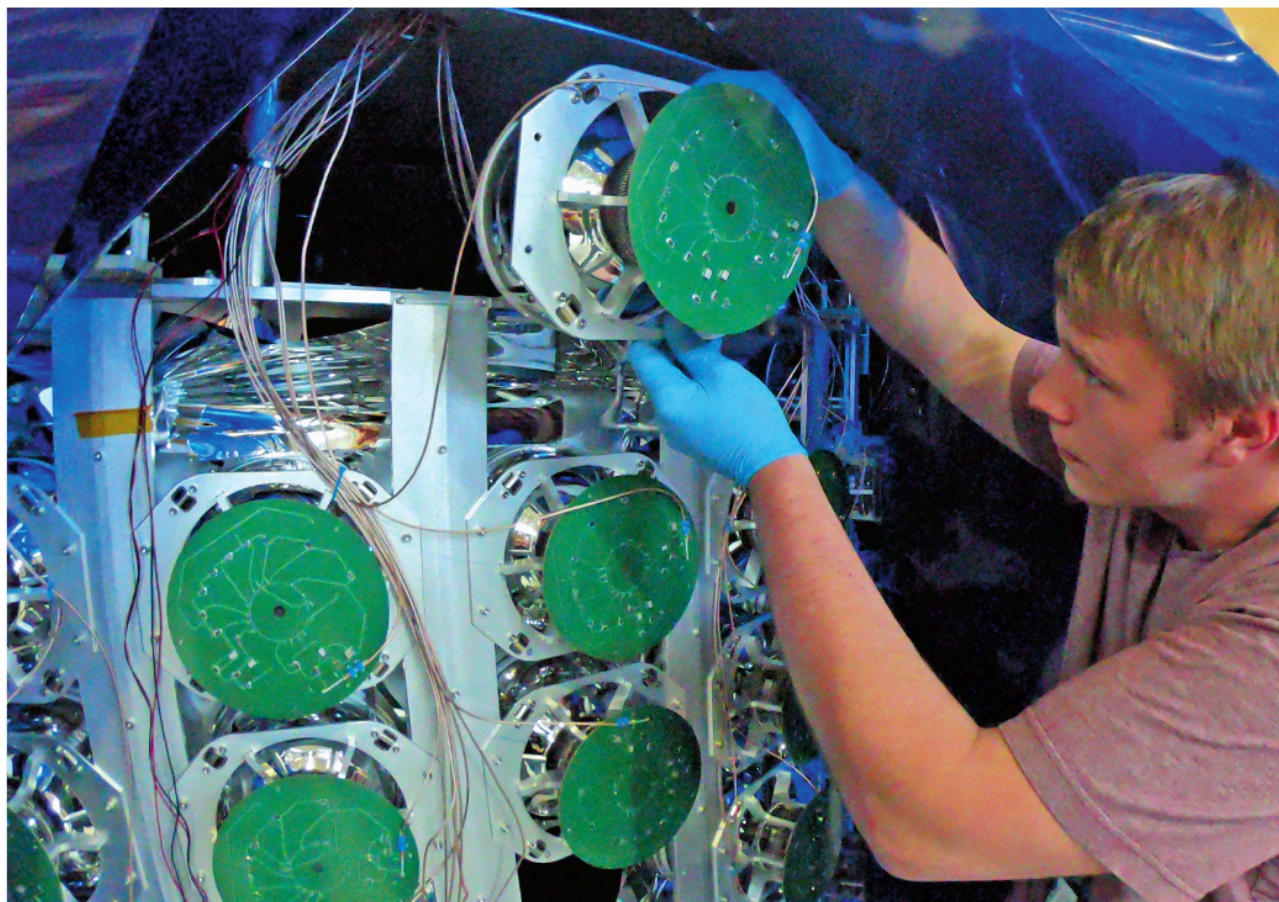
I bring complex experimental systems from hardware to operation.

Hands-on construction, integration, startup, testing, troubleshooting and operations across accelerator-driven nuclear and particle-physics systems at Los Alamos National Laboratory.

[Explore facilities & projects](#)

[Résumé & background](#)

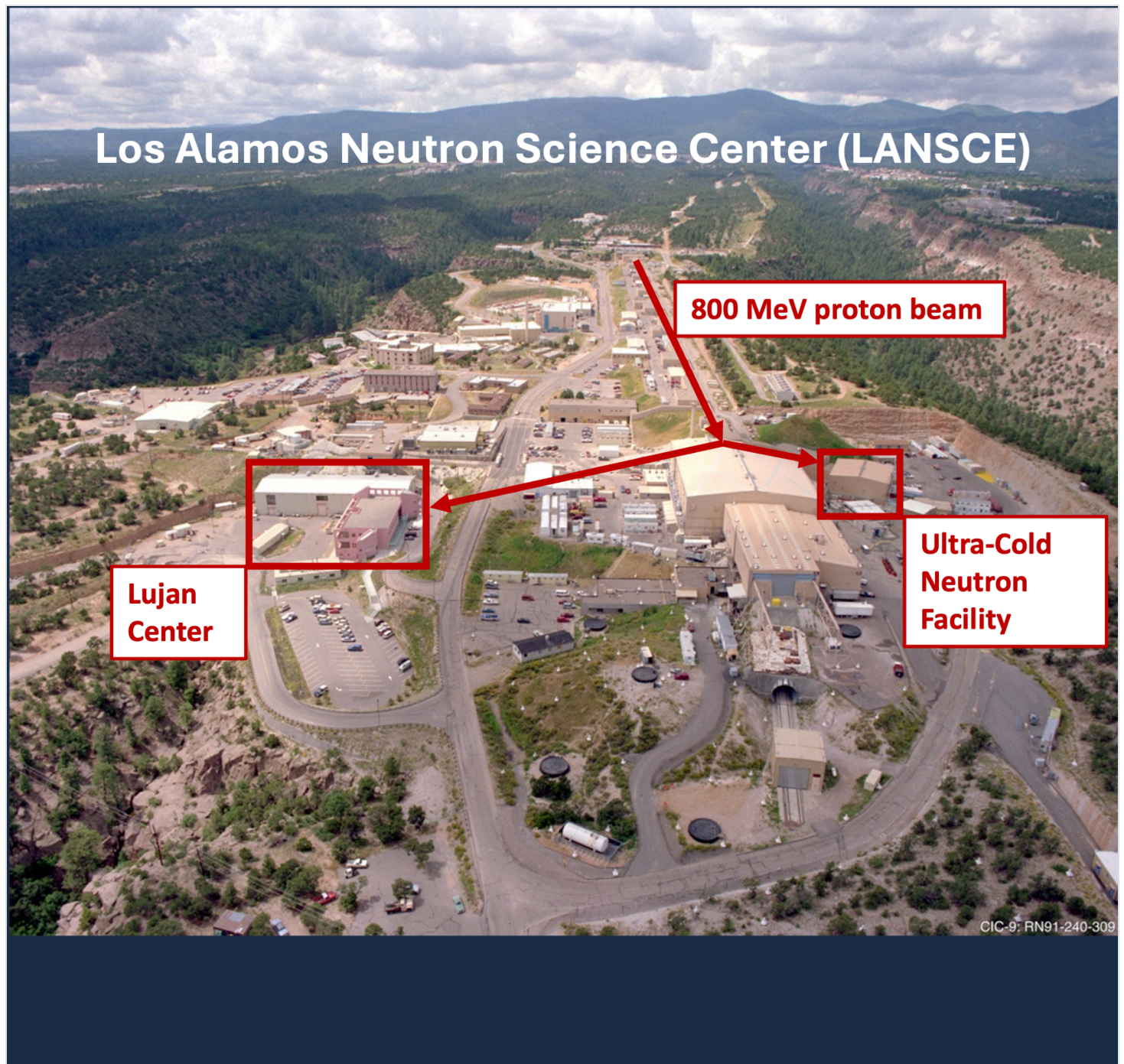
[Portfolio PDF](#)



WHERE THE WORK HAPPENED

Start with LANSCE, then move into the two experimental areas

The portfolio is organized spatially first. The aerial establishes the scale of the LANSCE accelerator complex; directly below it, the Lujan Center and UCN / Area B sections show where the major experiments and systems in this portfolio were located.



FACILITY OVERVIEW

Los Alamos Neutron Science Center — LANSCE

800 MeV proton accelerator complex feeding multiple experimental facilities. My work represented here spans the Lujan Center / CCM program and the UCN experimental facility.

Lujan Center

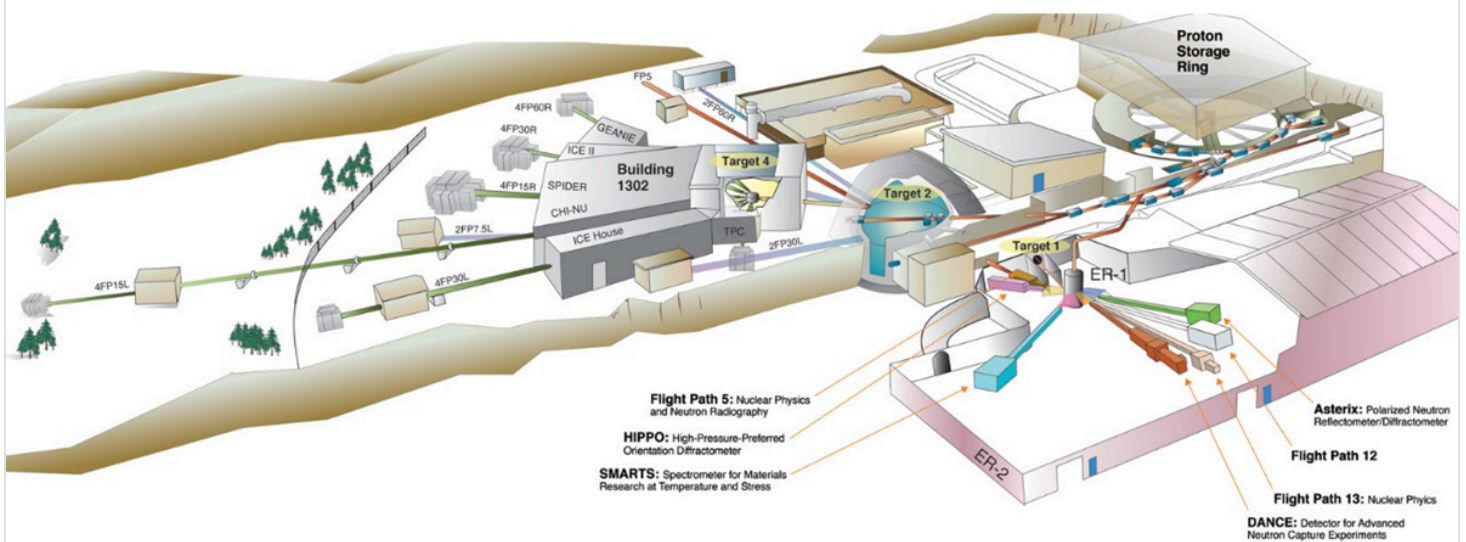
CCM200

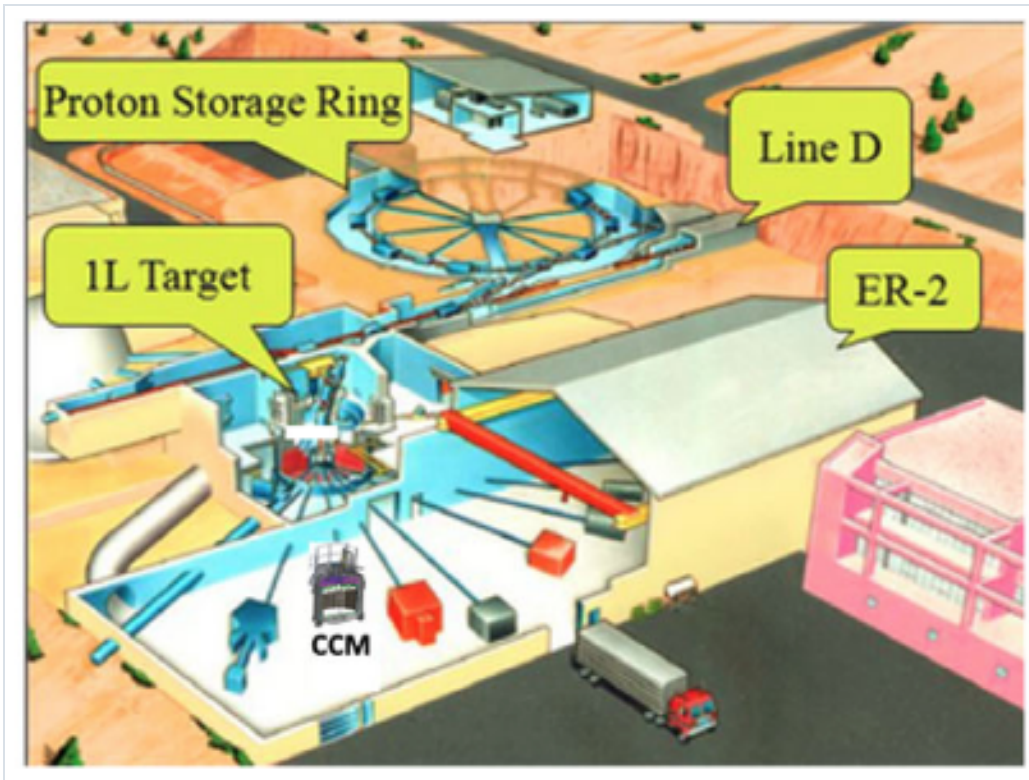
UCN Facility

nEDM

LUJAN CENTER

Lujan Center Experimental Area ER1



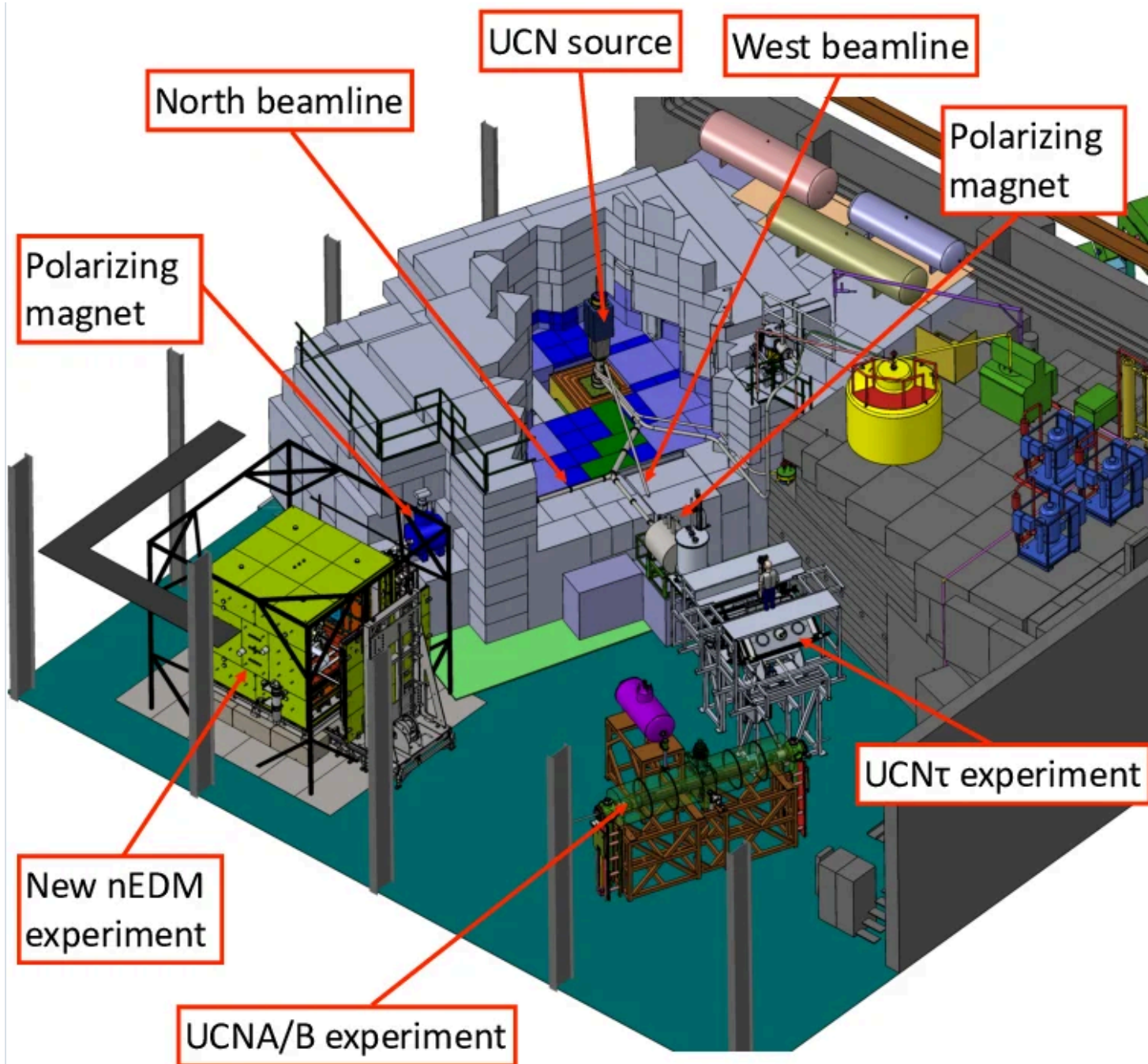


The full-width 3D model establishes the larger Lujan / Target 1 geometry. The overview below places CCM within Experimental Area ER1 relative to Target 1, the Proton Storage Ring, Line D and ER-2.

- Coherent CAPTAIN-Mills / CCM200
- Target 1 / stopped-pion neutrino source
- Neighboring neutron flight paths and instruments

UCN FACILITY / AREA B

UCN Experimental Area



The Area B CAD shows the UCN source, north and west beamlines, polarizing magnets and the major experiments sharing the hall.

- LANL nEDM experiment
- UCN τ experiment
- UCNA / UCNB experimental area
- UCN source, beamlines and supporting vacuum / cryogenic systems

From facility scale down to the hardware

These pages go deeper into what each experiment or facility does, the physics or measurement it supports, and the specific systems I built, integrated, commissioned, operated or supported.



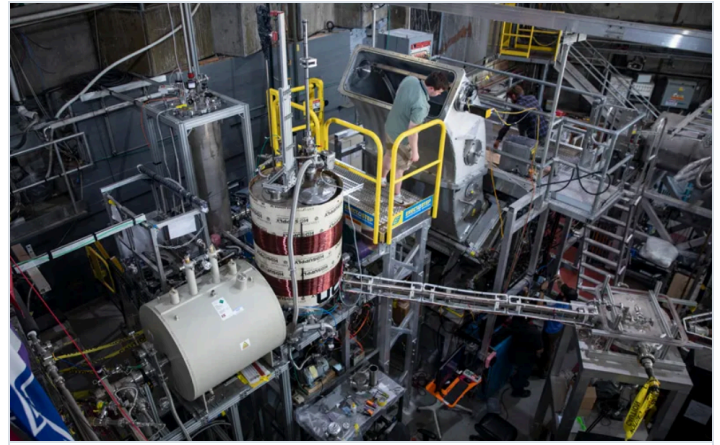
UCN Facility Systems

Beamline, cryogenic, vacuum, gas-distribution, magnet and experimental-support systems across Area B.

Beamline

Cryogenics

Facility interfaces



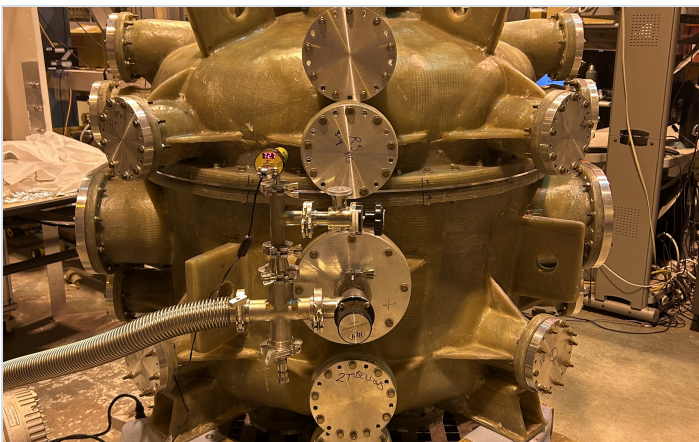
UCN τ

Neutron-lifetime experiment support spanning vacuum operations, rigging, detector integration, diagnostics and commissioning of the UCN τ + elevator / vacuum-extension upgrade.

Vacuum

Commissioning

Rigging



LANL nEDM

Vacuum chamber, hydraulic neutron-valve actuation, instrumentation, controls and system commissioning.



Cavallo Cryo & HV

Cavallo high-voltage multiplier development for nEDM@SNS: cryogenic test infrastructure, instrumentation,

Vacuum

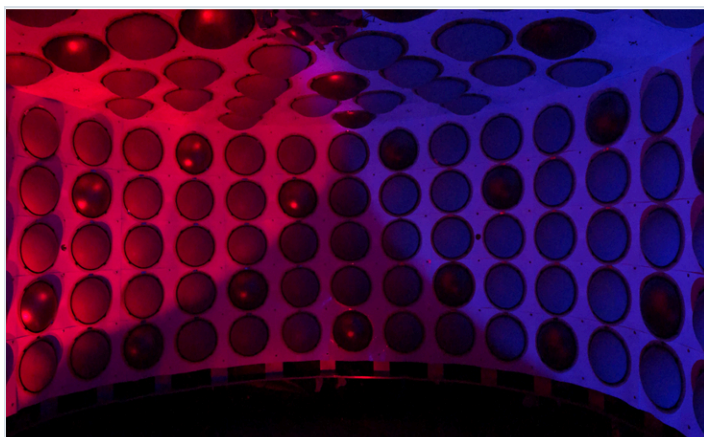
Hydraulics

Controls

integration, diagnostics and full-scale
R&D testing.

Cryogenic

High Voltage

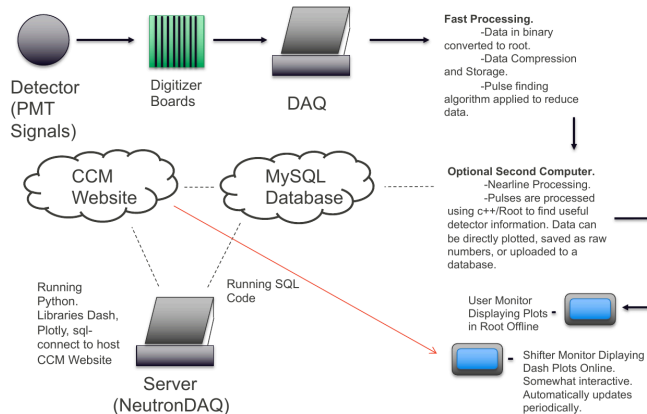


CCM200

Large liquid-argon detector construction,
installation, commissioning, monitoring,
troubleshooting and operations.

Detector construction

DAQ / I&C



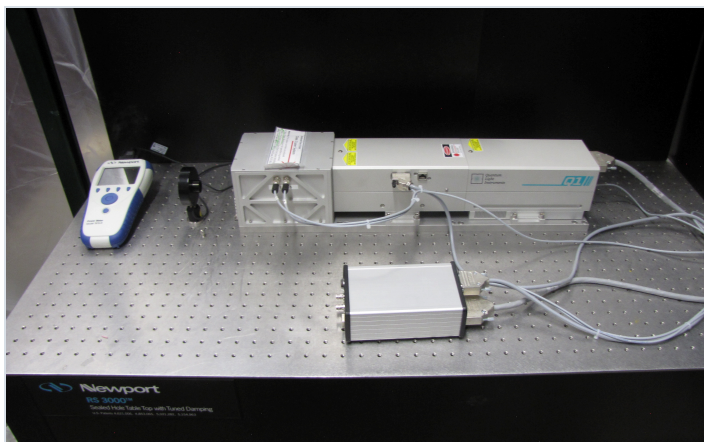
Controls & Instrumentation

Cross-project controls, I/O, DAQ,
HMI/GUI, databases, online monitoring,
serial communications and fault
isolation.

PLC

DAQ

HMI / Monitoring



Additional Experimental R&D

Liquid-argon PMT testing, laser
optimization, interlocks, detector
calibration and component
characterization.

COMMISSIONING APPROACH

From individual hardware to integrated operation

Construction	Integration	Startup	Functional Testing	Operations
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My strongest work has typically been at the interfaces: tracing what was actually installed, understanding how subsystems interact, instrumenting behavior, isolating faults, coordinating changes and proving that the integrated system operates as intended.

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Experimental systems · commissioning ·
instrumentation & controls

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external-use review.

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FACILITY SYSTEMS

Ultracold Neutron Facility Systems

The UCN facility converts high-energy spallation neutrons into ultracold neutrons that can be transported through guides and stored for precision experiments.

[UCN source](#)

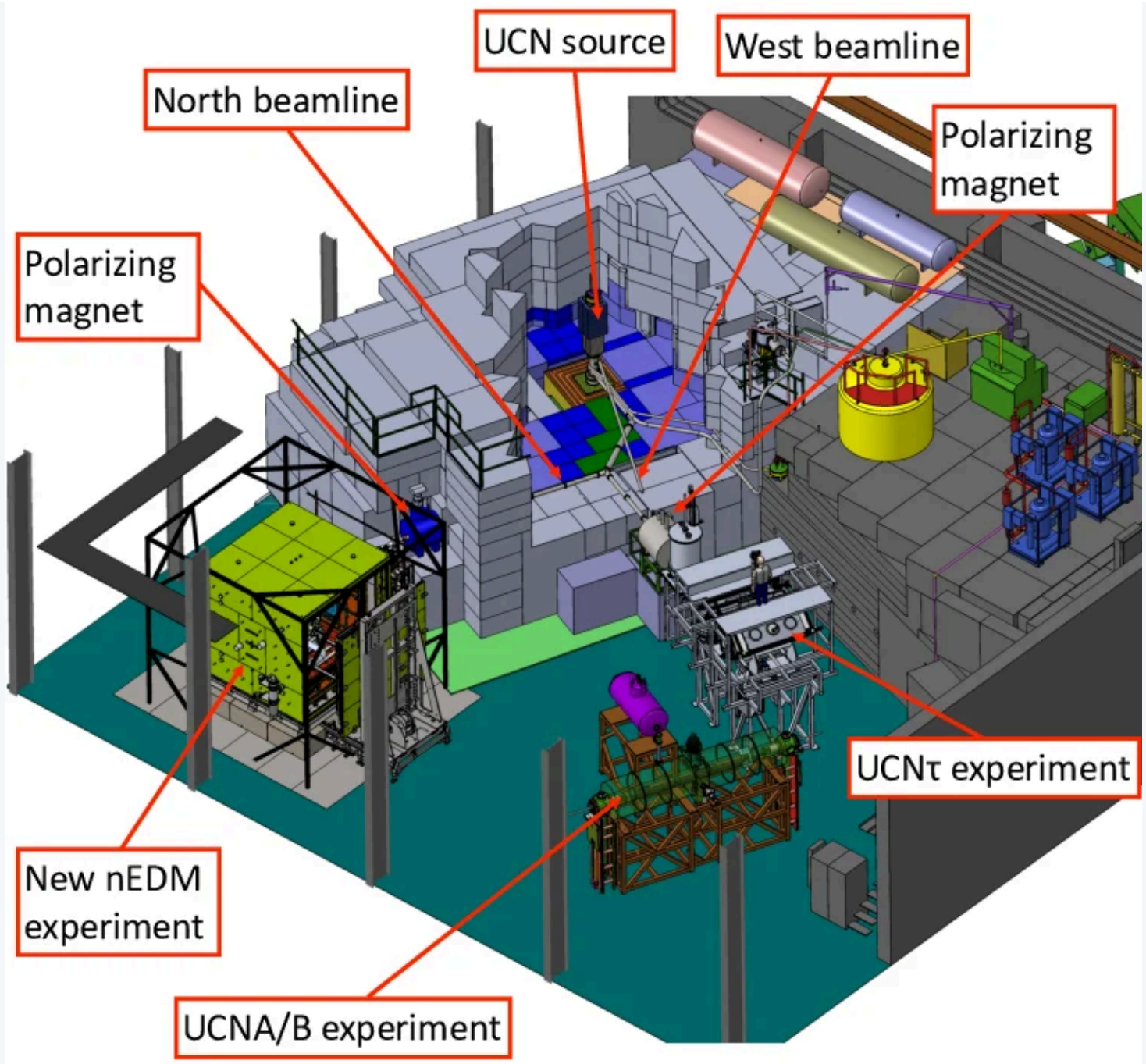
[Beamlines](#)

[Vacuum](#)

[Cryogenics](#)

[Magnets](#)

[Controls](#)

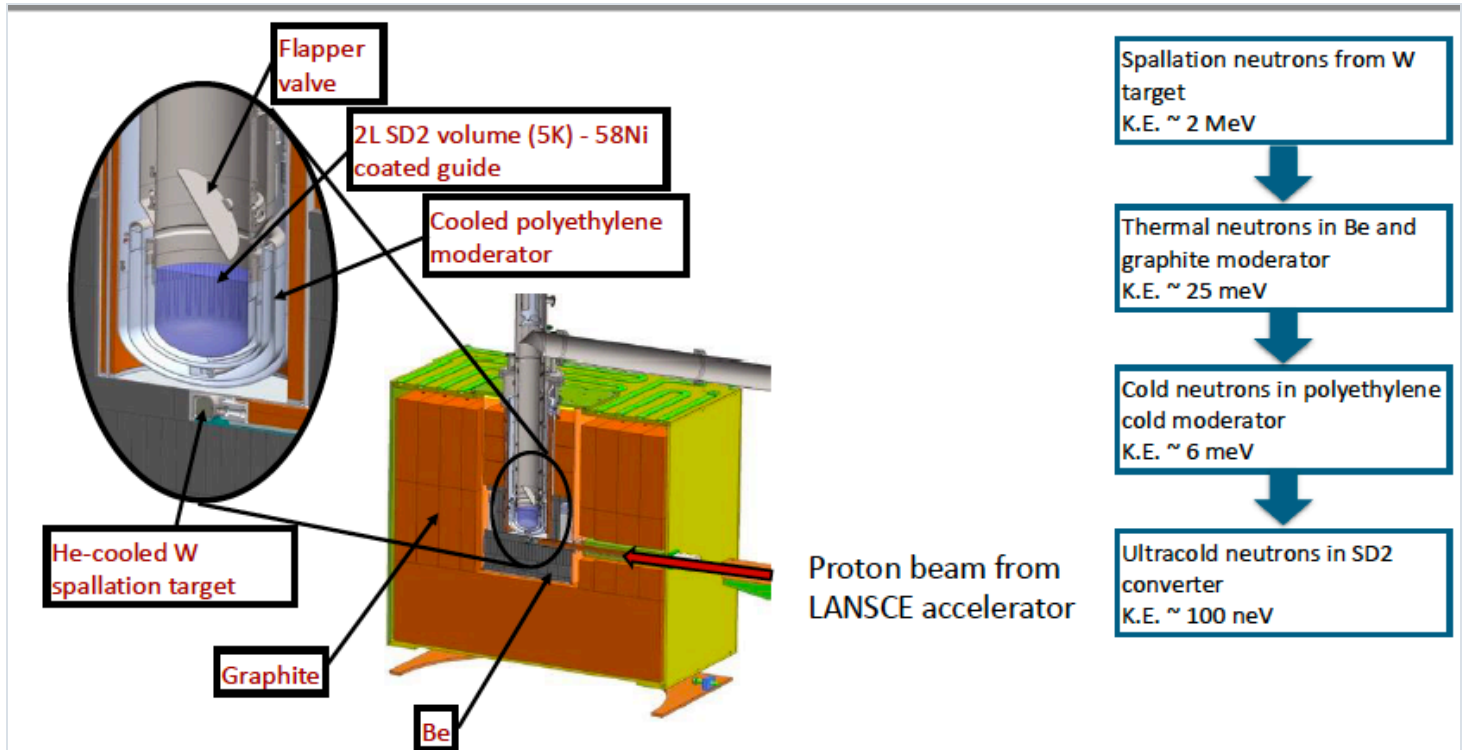


WHAT DOES THE FACILITY DO?

Turning an 800 MeV proton beam into ultracold neutrons

LANSCE protons strike a tungsten spallation target to create energetic neutrons. Successive moderator stages reduce their energy, and a solid-deuterium converter at cryogenic temperature produces the ultracold-neutron population used by experiments in Area B.

Unlike a single experiment, the UCN source and beamline are shared infrastructure: they produce, condition and transport neutrons to experiments such as nEDM, UCN τ and UCNA/B.



UCN production chain from the LANSCE proton beam through tungsten spallation, moderation and the cryogenic solid-deuterium converter.

PRODUCTION CHAIN

From accelerator beam to experiments

800 MeV protons LANSCE accelerator beam
Spallation Tungsten target produces energetic neutrons

Moderation

Be / graphite and polyethylene reduce neutron energy

UCN conversion

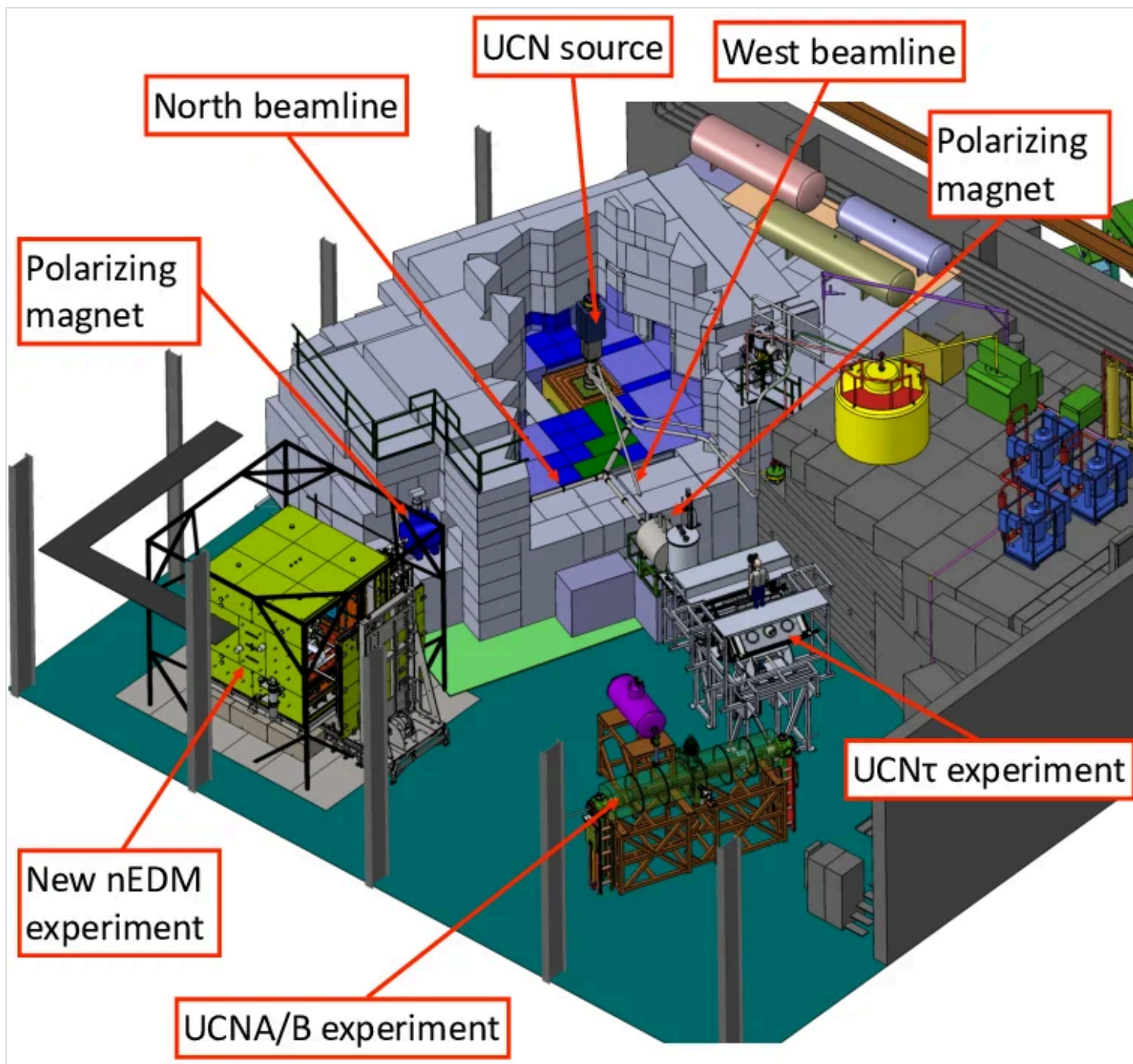
Solid D₂ at cryogenic temperature

Beamlines

UCN transported to Area B experiments

AREA B CONTEXT

One source supporting multiple precision experiments



UCN source, north and west beamlines, polarizing magnets and major experiments.



Experimental-area view for scale and physical context.

MY ROLE

Supporting the systems between the source, facility and experiments

My responsibilities spanned nitrogen and helium distribution, helium-liquefier operation, superconducting-magnet support, vacuum pumping on primary UCN beamlines,

deuterium-gas infrastructure, PLC/HMI controls, beamline pressure and temperature instrumentation, experimental-user integration and general facility hardware support.

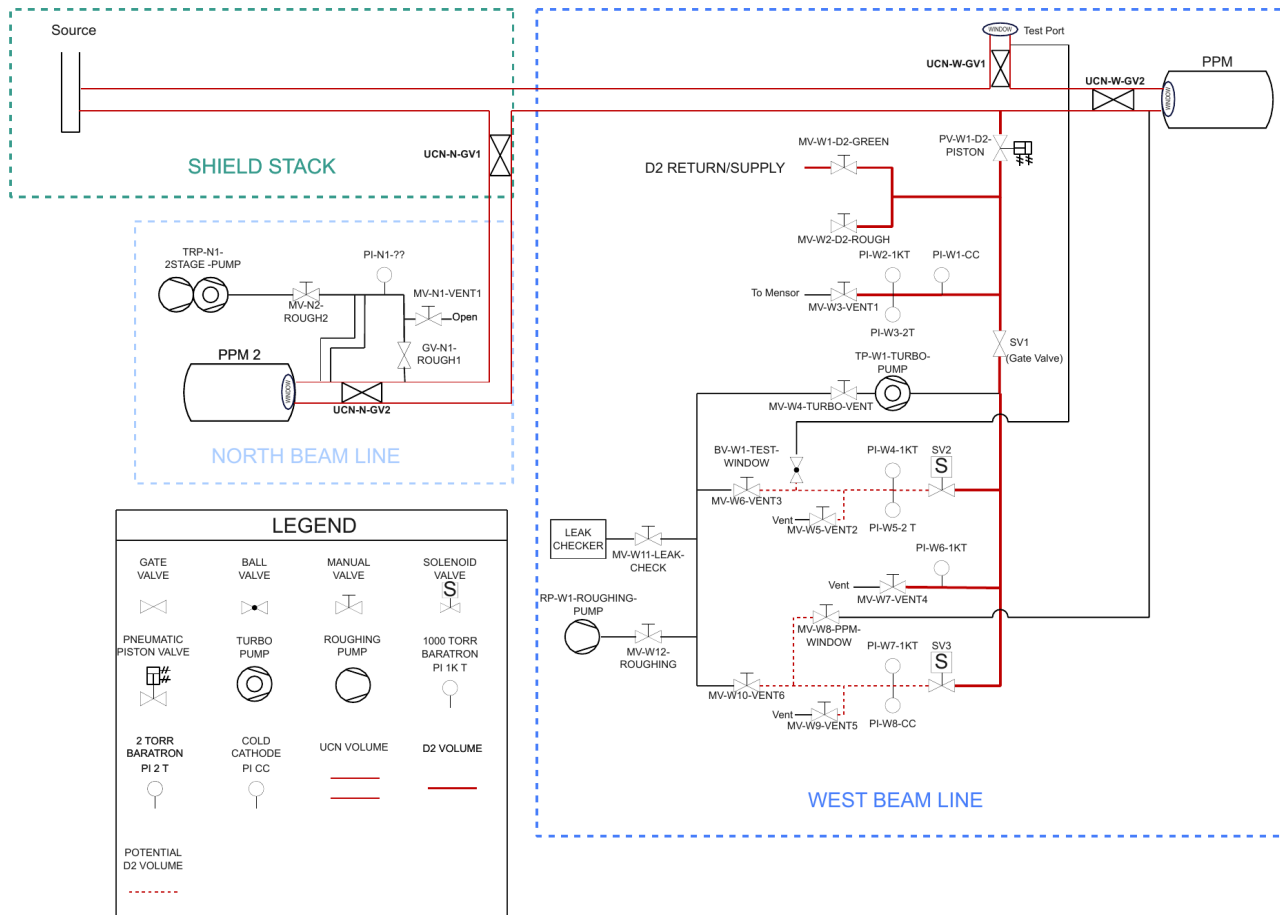
WORKING DOCUMENTATION

Source / polarizing-magnet manifold

I developed this working P&ID in situ to document the as-operated source / PPM manifold for integration, operation and troubleshooting. It captures the source and beamline vacuum volumes, pumping equipment, valves, pressure instrumentation and deuterium interfaces.

Private draft: this working drawing is not represented as an issued engineering drawing and remains subject to external-use review.

SOURCE / PPM MANIFOLD P&ID



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UCN τ — Neutron Lifetime Experiment

Experimental infrastructure, vacuum-system operations, detector installation, beamline readiness, diagnostic development and commissioning support for the magneto-gravitational neutron-lifetime experiment at LANL.

Vacuum

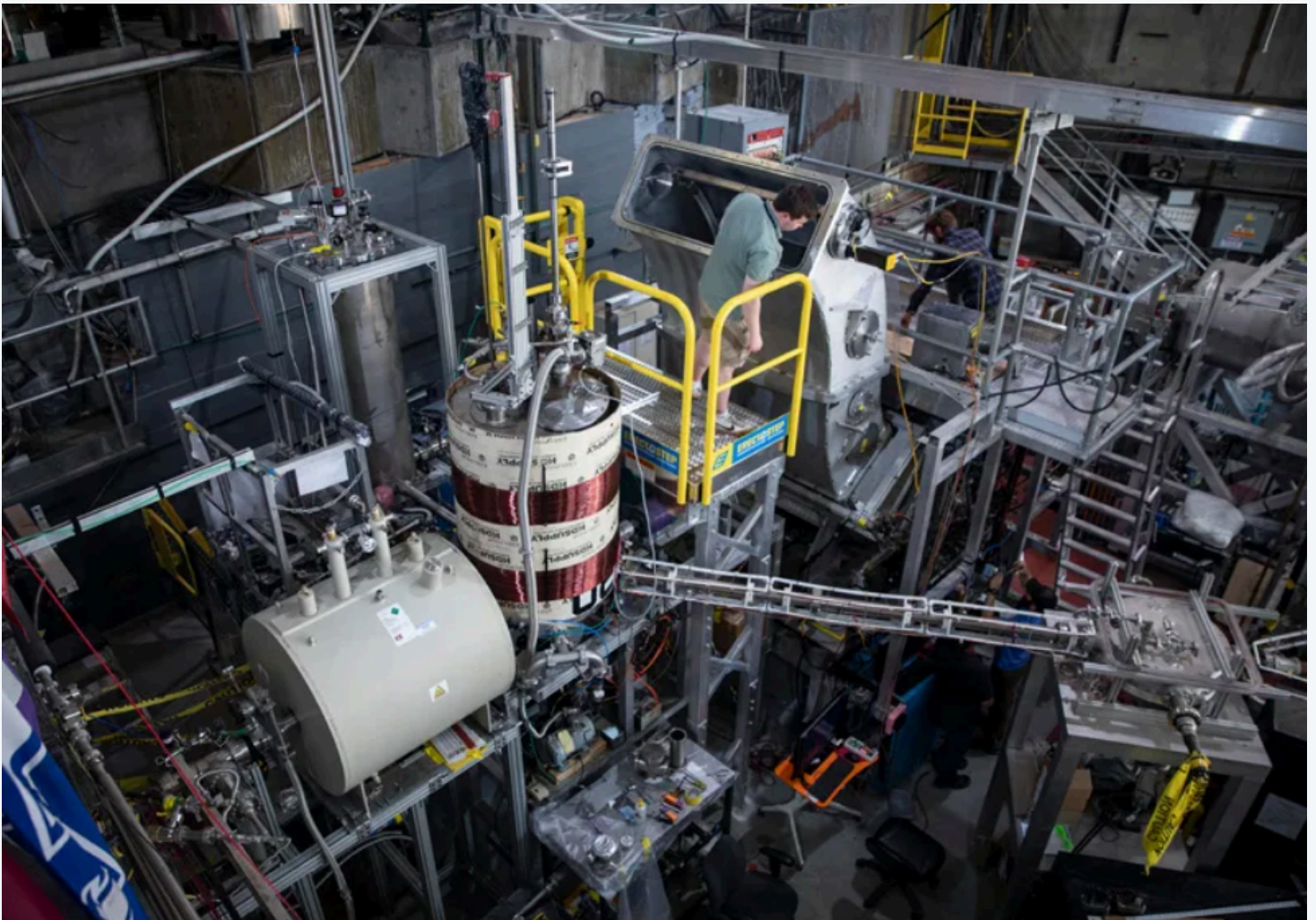
Rigging / Crane

Detector Integration

Utilities

Diagnostics

Commissioning

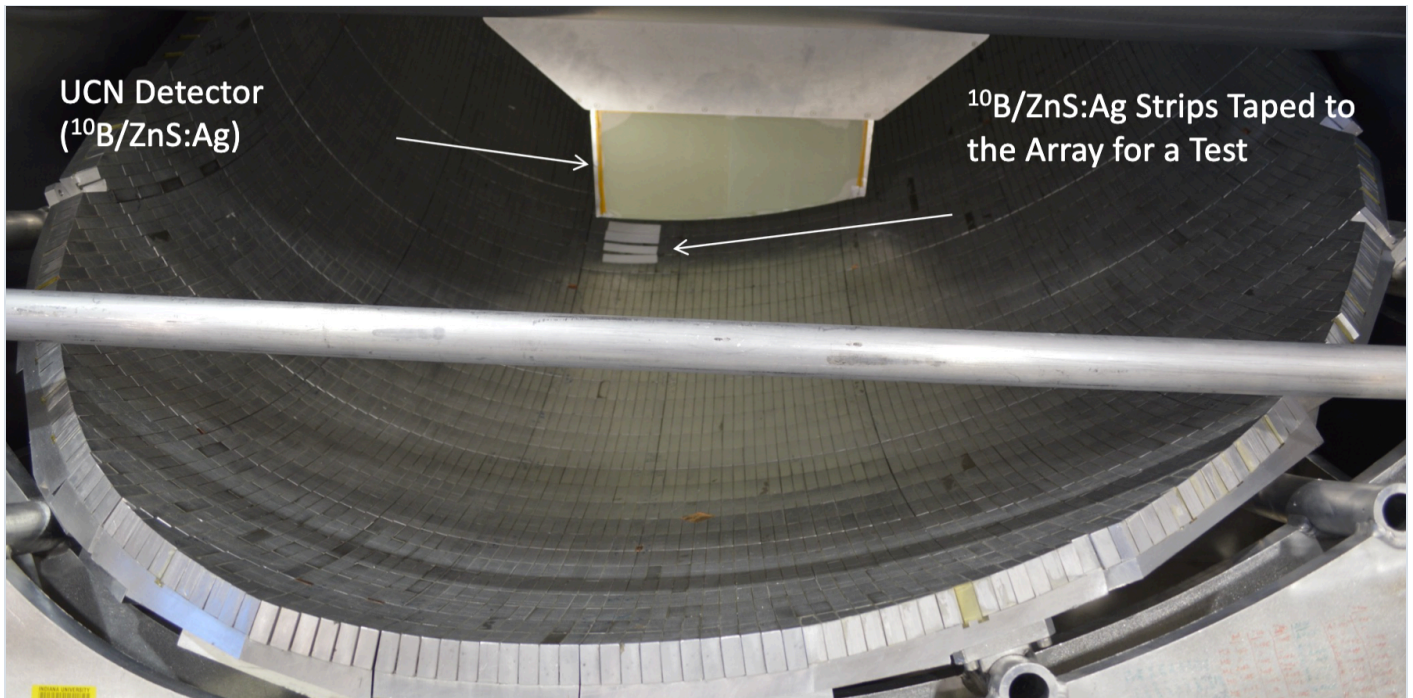


WHAT IS UCNT?

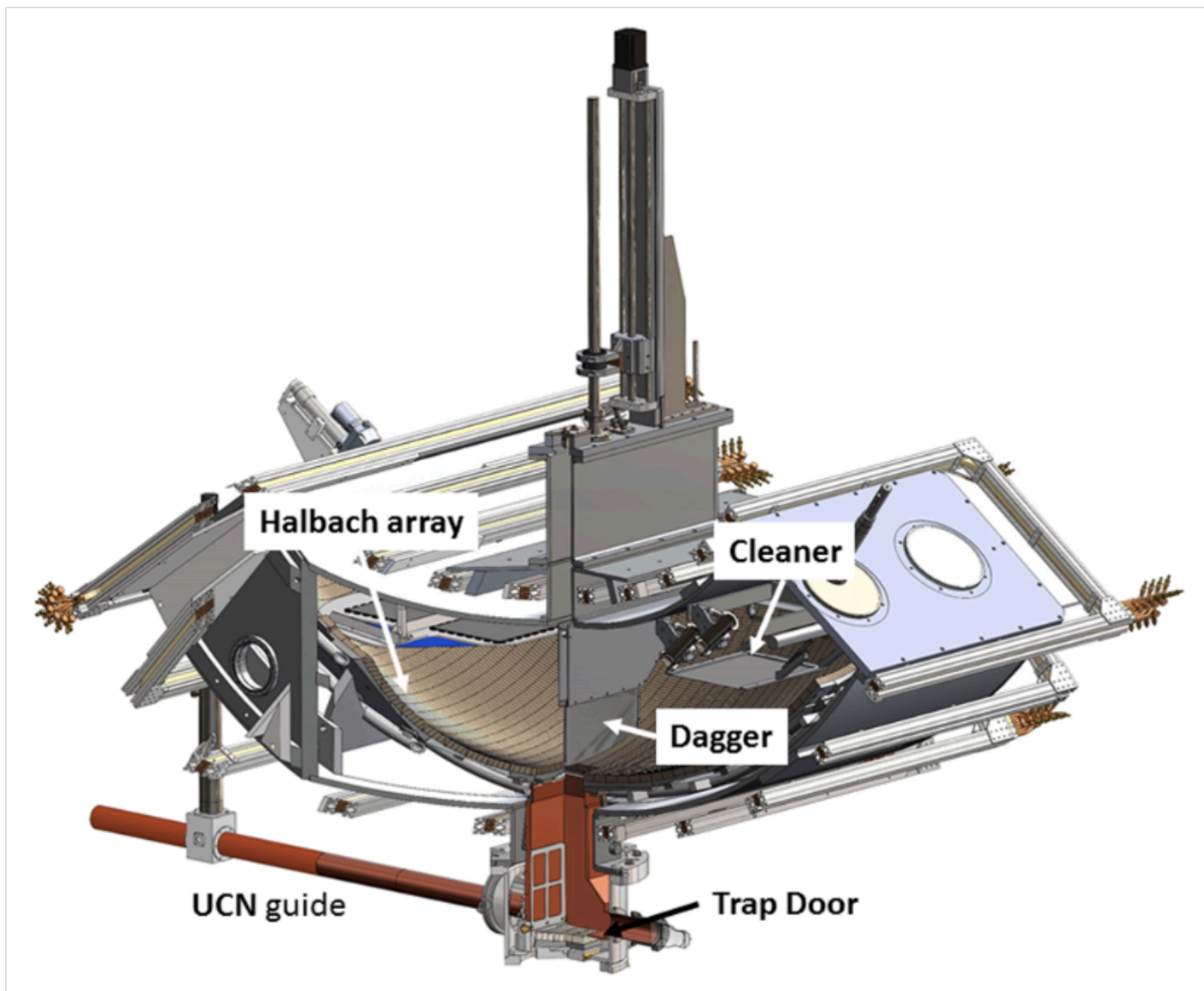
A magneto-gravitational trap for measuring the free-neutron lifetime

UCN τ stores polarized ultracold neutrons in an asymmetric, open-top trap lined with a Halbach array of permanent magnets. The magnetic field repels weak-field-seeking neutrons from the trap surface while gravity confines them vertically, reducing losses from contact with material walls during storage.

After a controlled storage interval, a movable in-situ detector known as the **dagger** is lowered into the trap to count surviving neutrons. Comparing surviving populations after different storage times provides a measurement of the neutron lifetime.



View into the magneto-gravitational trap with a UCN detector positioned above the Halbach array during detector testing.



UCNT storage trap showing the Halbach array, movable dagger detector, cleaner, UCN guide and original trap-door loading geometry.

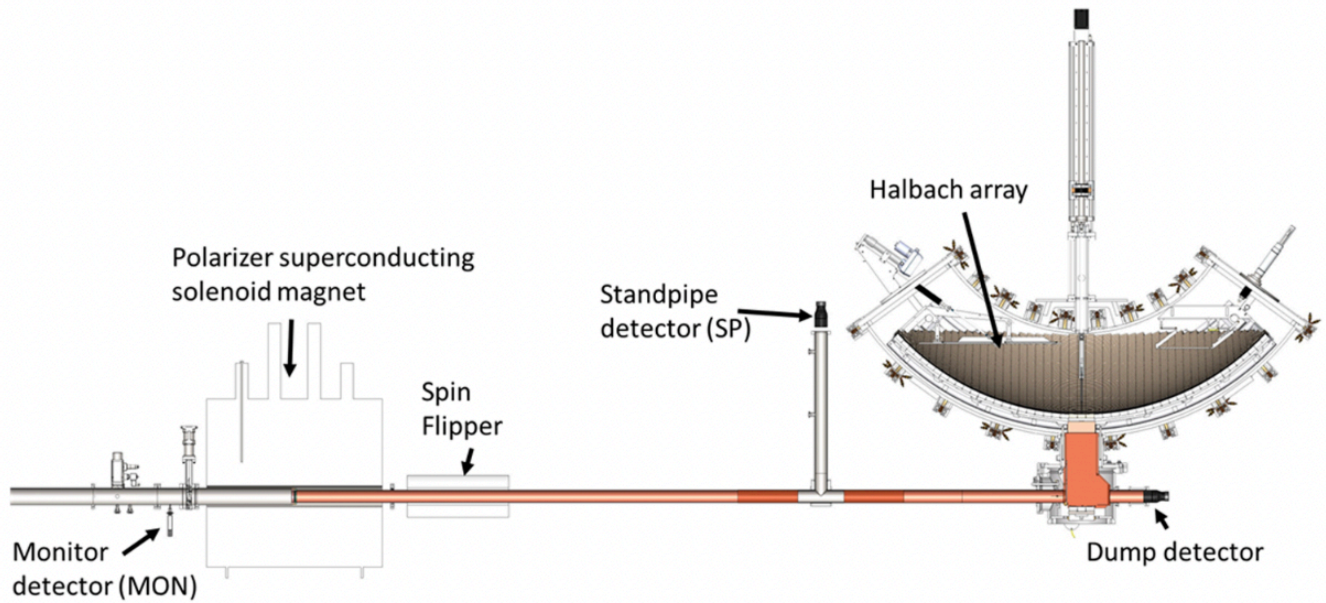
HOW UCNT WORKS

Fill, store, then count the survivors

01

Fill & polarize

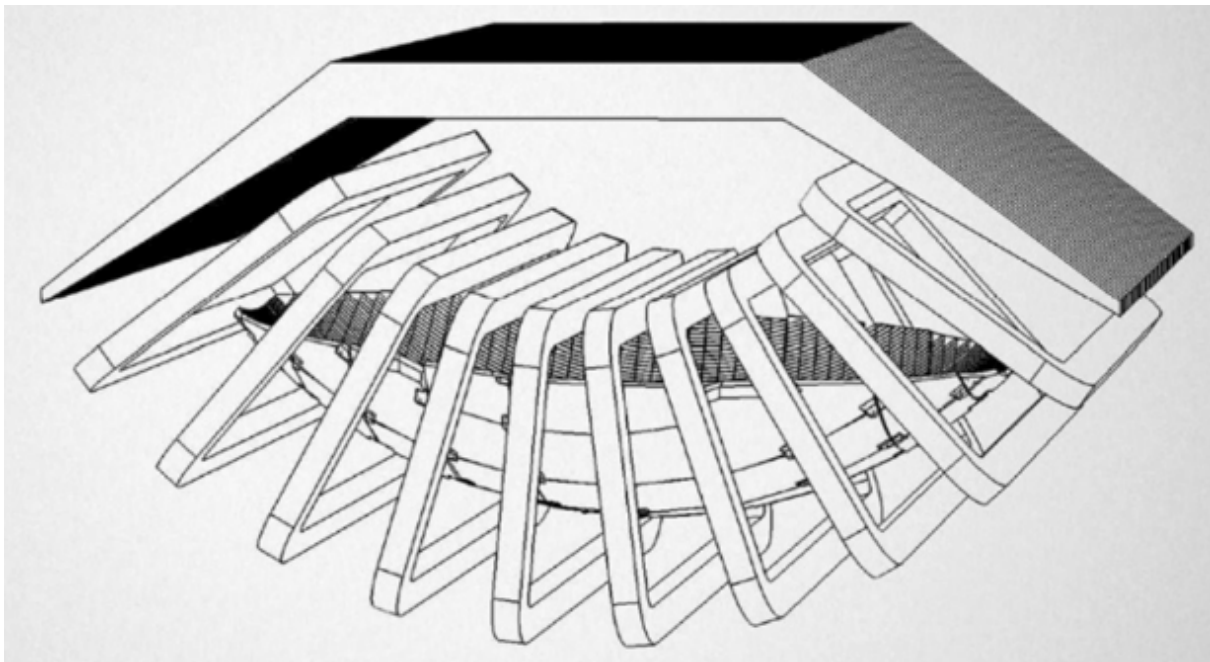
Ultracold neutrons are transported through the beamline, polarized and directed into the storage apparatus. Beamline monitors and detectors provide information about the delivered UCN population.

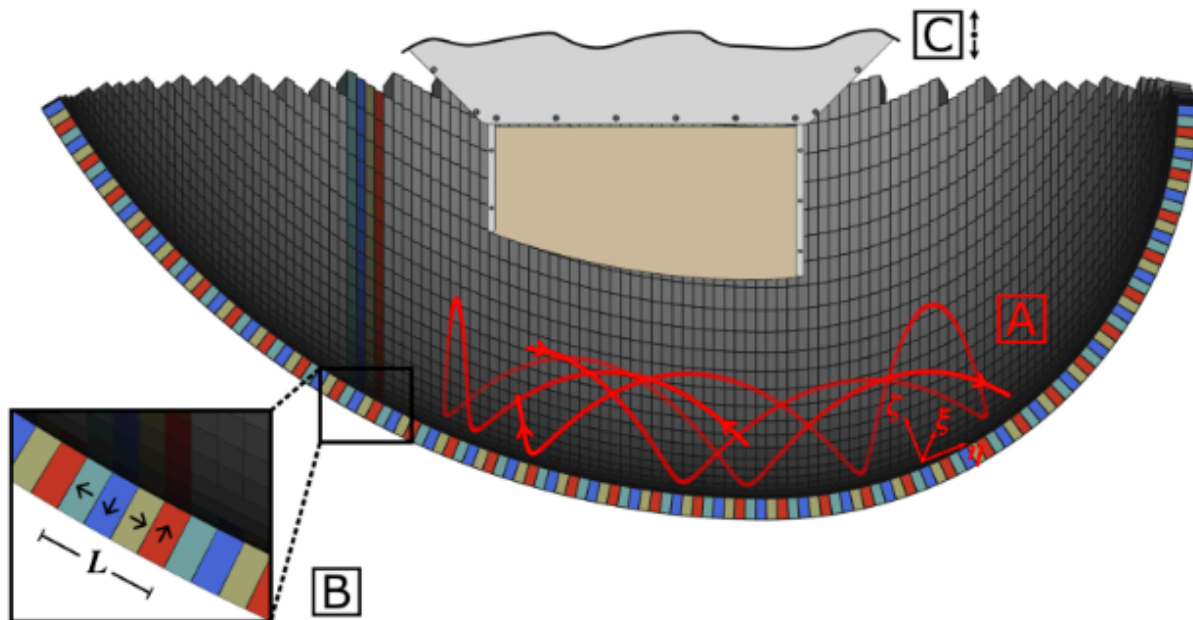


02

Store without material-wall losses

The permanent-magnet Halbach array creates a strong magnetic boundary while gravity closes the trap vertically. The goal is to store UCN while minimizing non-decay losses associated with material bottle walls.

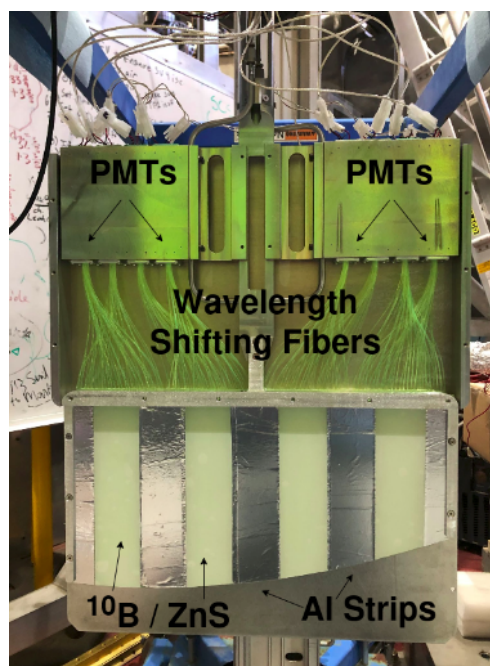




03

Count with the dagger

After the selected storage time, the dagger is lowered into the trap. Neutrons captured in the detector produce scintillation light that is carried through wavelength-shifting fibers to photomultiplier tubes for counting.



MY ROLE

Experimental integration, facility support & commissioning

I supported UCN τ by bringing electrical power, compressed air and gas utilities to the experiment; performing major vacuum-chamber operations and crane lifts; supporting dagger installation and beamline connection readiness; and helping bring new hardware into an operable experimental configuration. I also developed a custom IR-camera diagnostic fixture to investigate vibration during trap motion and helped a student get started with image cleanup and object-identification methods for motion analysis.

BUILD-TO-OPERATIONS PROGRESSION

From facility interfaces to the UCN τ + elevator upgrade

My work centered on the physical interfaces that allowed the experiment and its upgrades to be installed, evacuated, connected, tested and handed over for operation.

STAGE

01

Facility utilities & experiment readiness

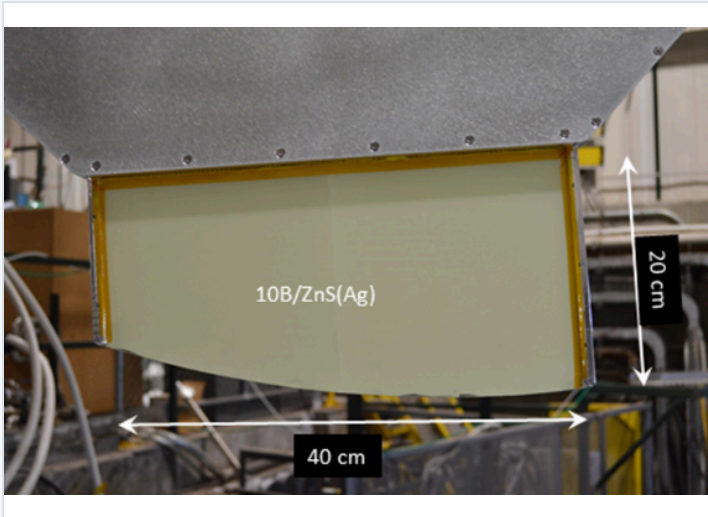
I brought electrical power, compressed air and gas services to the experiment and supported the practical interfaces required to connect UCN τ to the surrounding UCN facility. This included preparing for beamline connection and coordinating the hardware, access and utility needs around experimental work.

STAGE

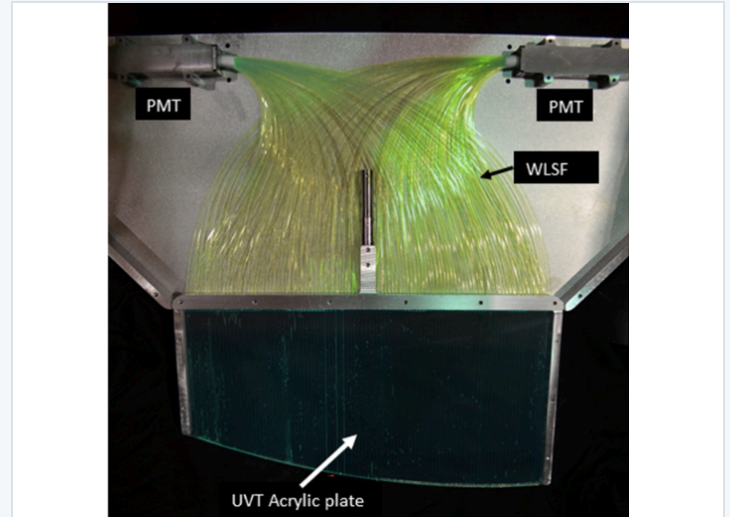
02

Vacuum-chamber operations, rigging & detector installation

I supported major vacuum-chamber operations and crane lifts around the apparatus, including work required to access the trap and install experimental hardware. I also supported installation of the movable dagger detector and readiness for reconnection to the UCN beamline.



Inside the magneto-gravitational trap with the dagger detector positioned above the Halbach array.



Dagger optical readout: wavelength-shifting fibers carry scintillation light to PMTs.

STAGE

03

Custom IR motion diagnostic

To investigate vibration observed during trap motion, I built a custom diagnostic fixture that positioned an infrared camera over an existing ConFlat viewport. The 3D-printed fixture incorporated the camera, IR illumination and heat sinking so the moving hardware could be observed without opening the vacuum system. I also helped a student get started with basic image-cleanup and object-identification approaches for extracting motion from the recorded imagery.

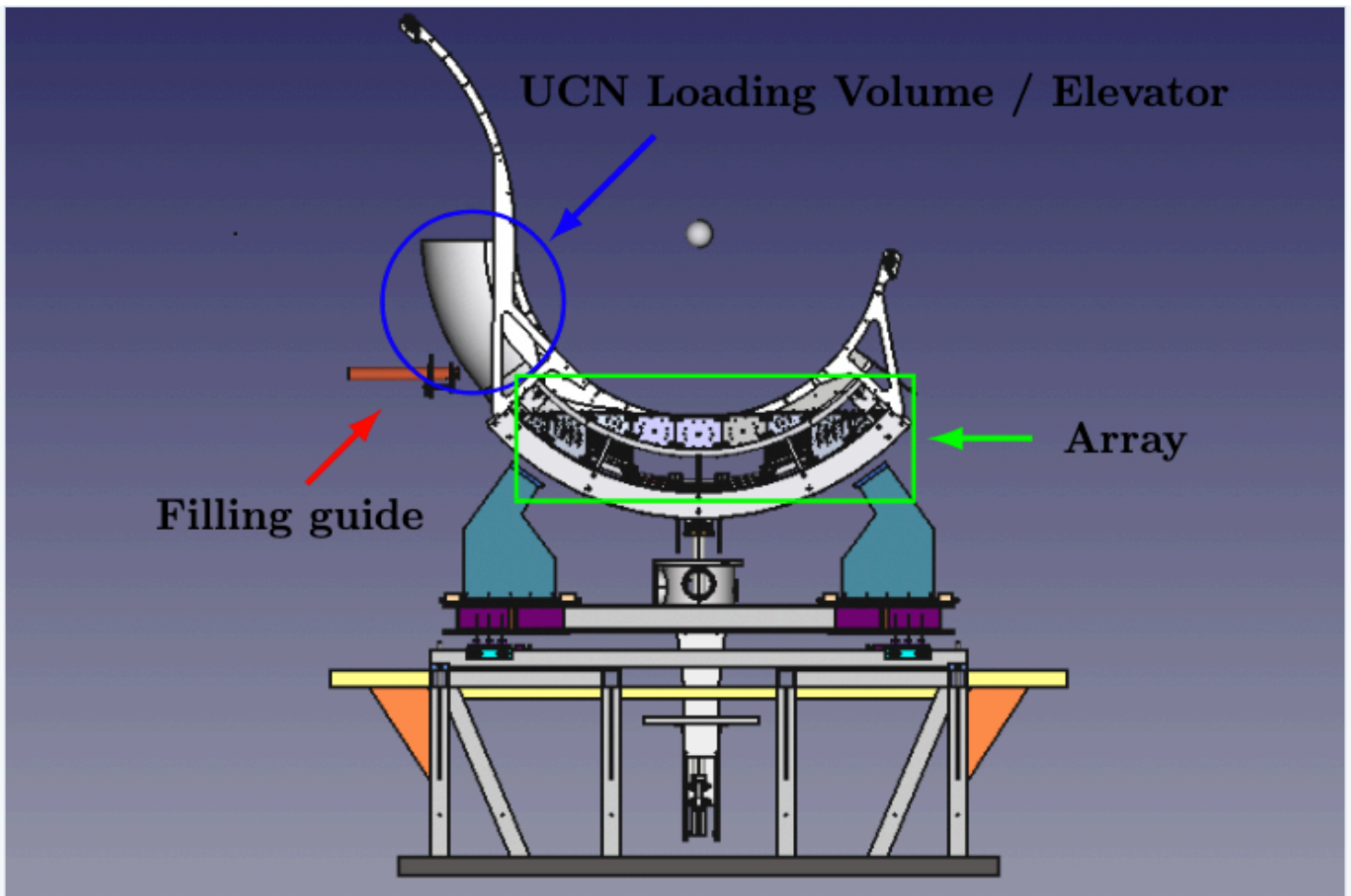
Diagnostic approach: observe the mechanism through an existing vacuum viewport → stabilize camera / illumination geometry → collect motion imagery → clean frames and identify the moving object → use the visual record to support mechanical troubleshooting.

STAGE

04

UCN τ + elevator / vacuum-extension upgrade

The UCN τ + upgrade replaced the original loading approach with a movable UCN loading volume — an “elevator” — intended to improve transfer of ultracold neutrons into the magnetic trap. The upgrade added substantial new vacuum and mechanical hardware above the existing experiment.



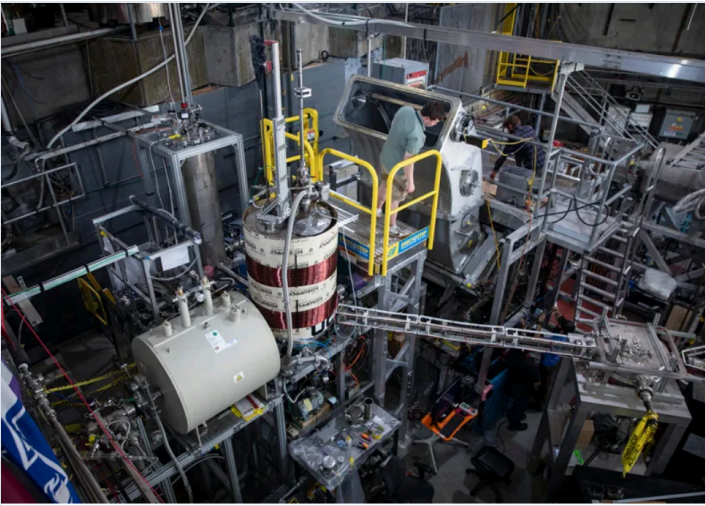
UCNτ+ concept showing the new loading volume / elevator, filling guide and existing Halbach array.

STAGE

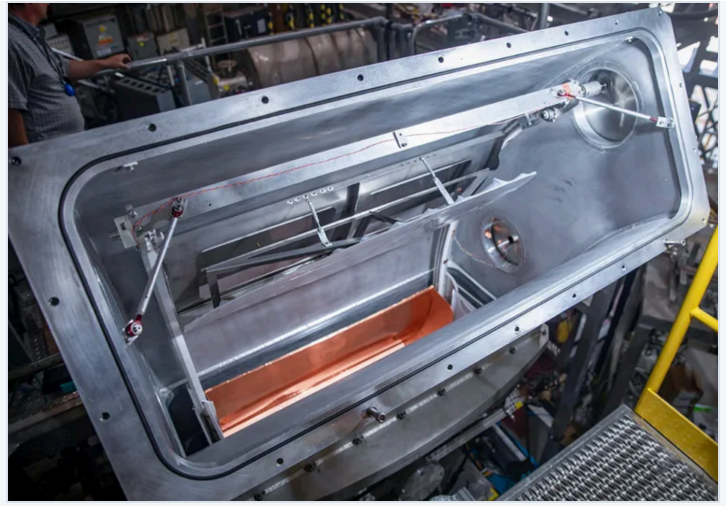
05

Mechanical fitting, craning & commissioning the upgrade

I performed extensive crane operations and fitting work while the UCNτ+ elevator and vacuum extension were installed and commissioned. The work required repeatedly positioning large hardware around the existing apparatus, establishing the new mechanical and vacuum interfaces, and supporting the team as the upgrade moved from installation into functional checkout.



UCN τ^+ installation showing the scale of the elevator / vacuum-extension hardware above the existing experiment.



Inside the open UCN τ^+ vacuum extension during installation and commissioning.

STAGE

06

Operational handoff & experiment support

Across the original apparatus and later upgrade work, my role was to make sure the physical experiment was ready to operate: utilities available, vacuum and mechanical interfaces assembled, major hardware safely moved and installed, detector / beamline connections ready, and commissioning problems worked through with the experiment team.

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EXPERIMENT & COMMISSIONING CASE STUDY

LANL Neutron Electric Dipole Moment Experiment

A precision experiment using stored ultracold neutrons to search for an electric dipole moment of the neutron.

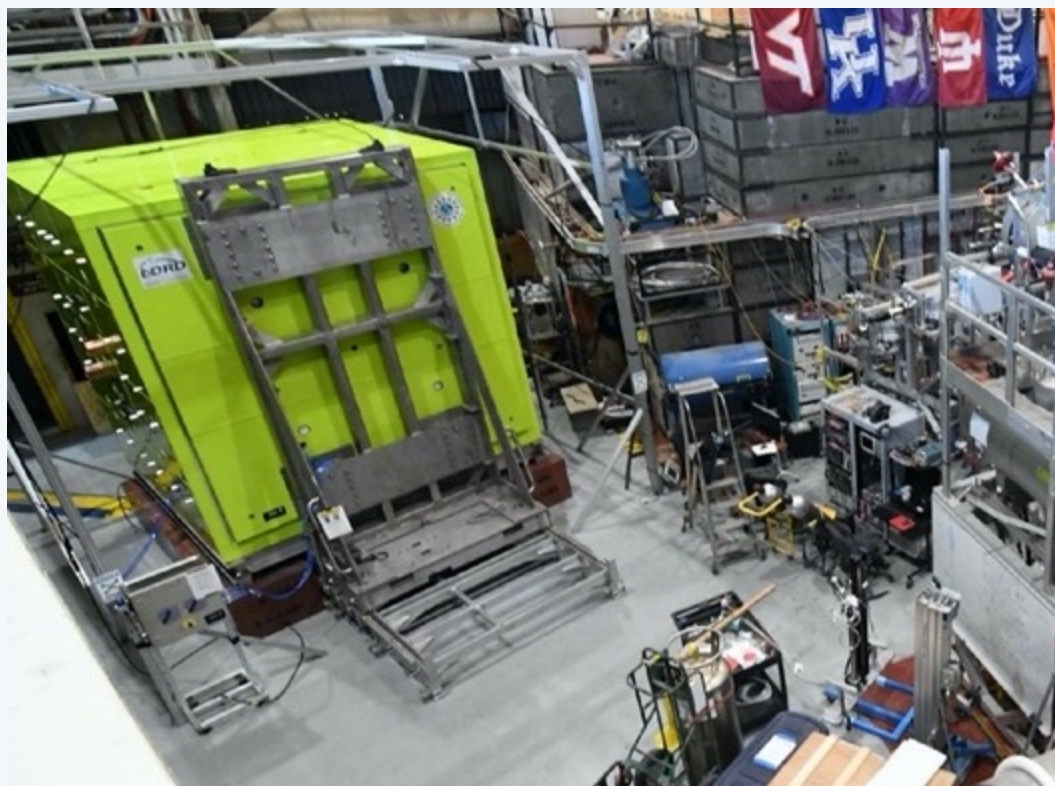
Ultracold neutrons

High vacuum

Hydraulics

Controls

Commissioning



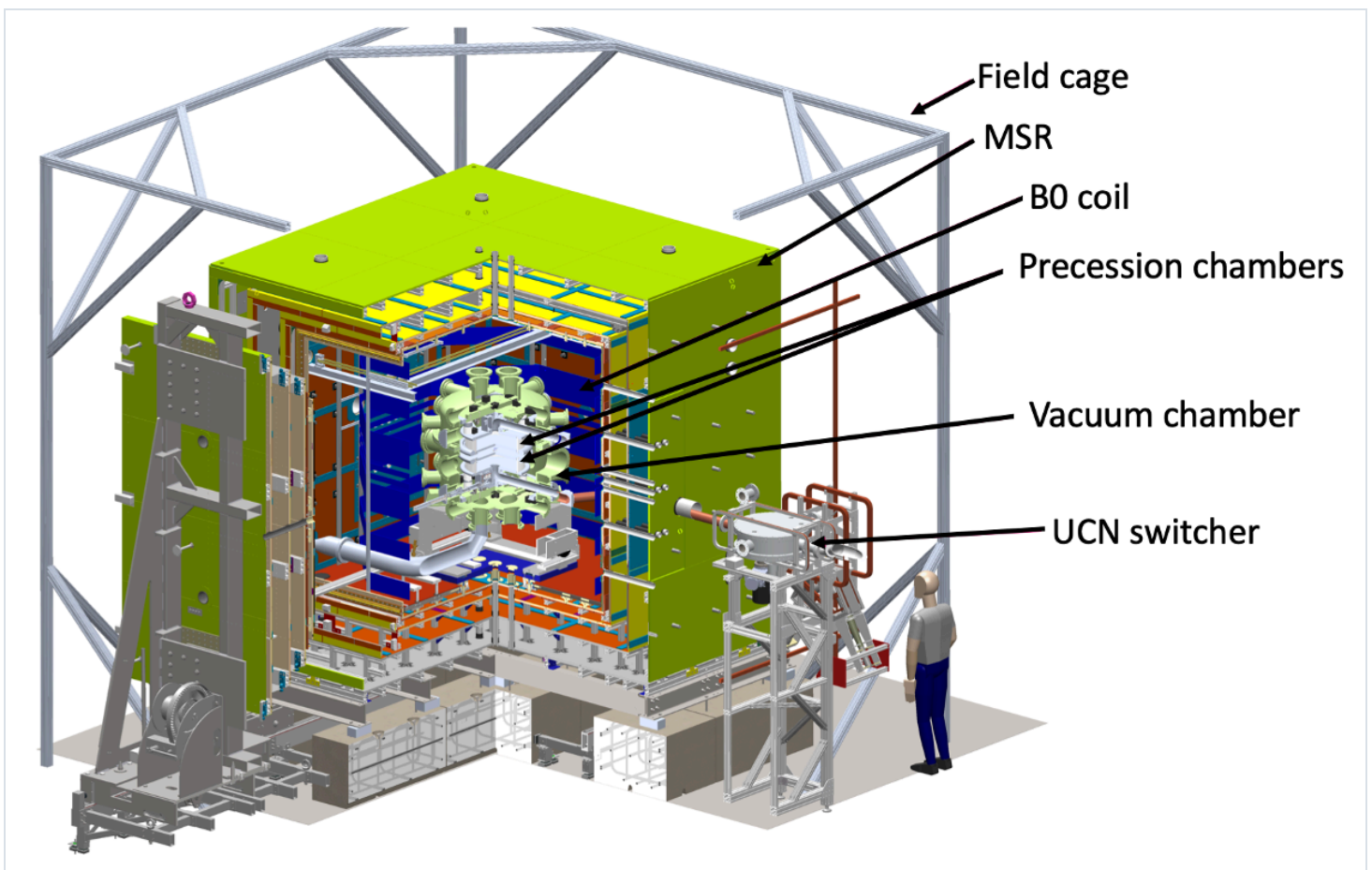
Real experimental-area photograph cropped from released LANL nEDM / Area B imagery. The bright green structure is the magnetically shielded room housing the core nEDM measurement region.

WHAT IS THE EXPERIMENT?

Searching for a tiny electric dipole moment in the neutron

The experiment stores polarized ultracold neutrons in measurement chambers and observes their spin precession in carefully controlled magnetic and electric fields. The measurement searches for an extremely small change in precession associated with reversing the electric field.

A nonzero neutron electric dipole moment would be evidence of physics beyond the Standard Model and is connected to the broader question of why the observable universe contains much more matter than antimatter.



Full apparatus context: field cage, magnetic shielding, B0 coil, precession chambers, vacuum chamber and UCN transport hardware.

HOW NEDM WORKS

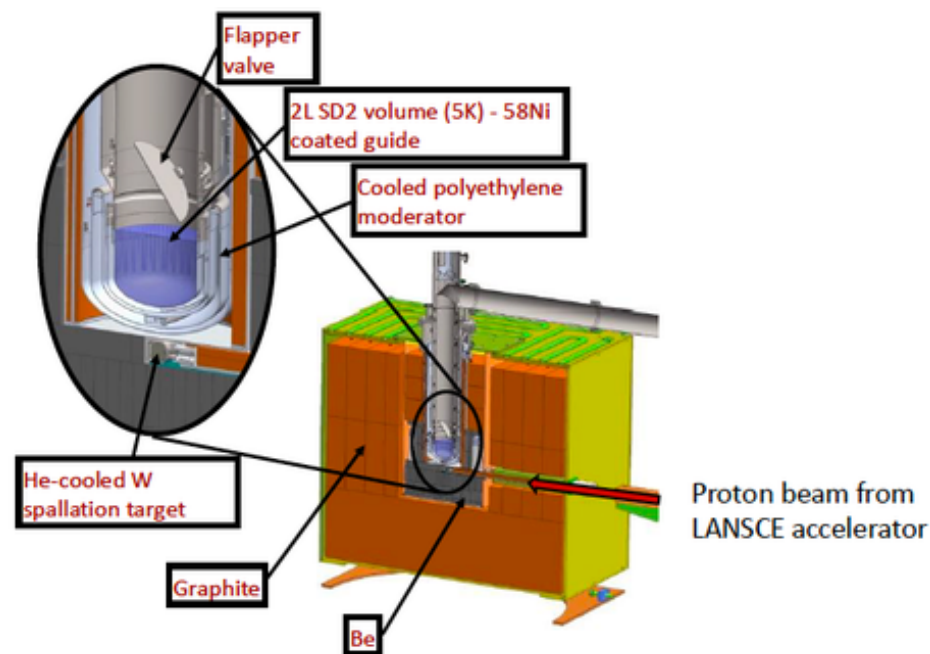
How the LANL nEDM Experiment Works

The experiment searches for a permanent neutron electric dipole moment by measuring an extremely small electric-field-dependent shift in the spin-precession frequency of stored ultracold neutrons.

01

Produce & Polarize UCN

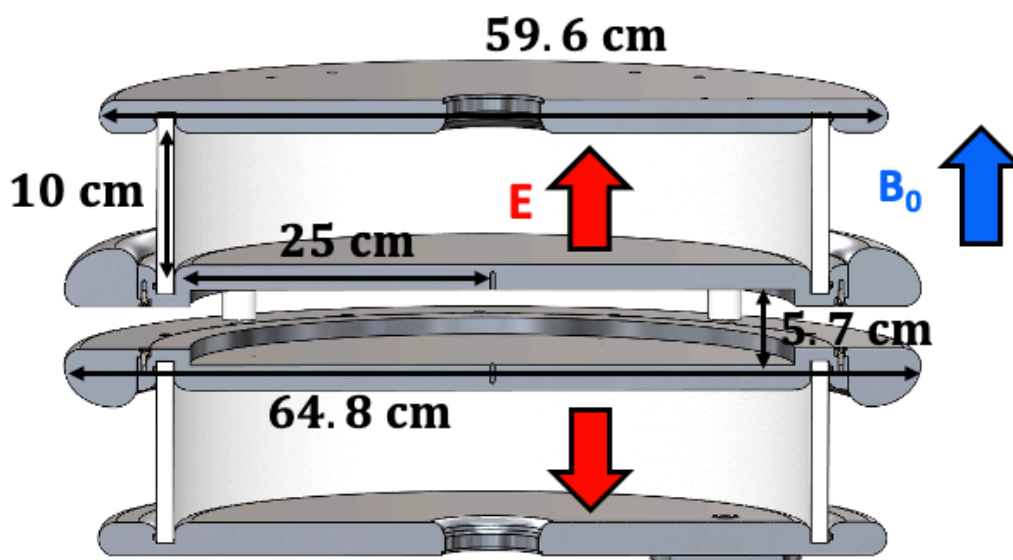
An 800 MeV proton beam produces spallation neutrons in a tungsten target. Moderation and a cryogenic solid-deuterium converter reduce their energy to the ultracold regime. The UCN are transported through guides and polarized before entering the nEDM apparatus.



02

Store & Measure Spin Precession

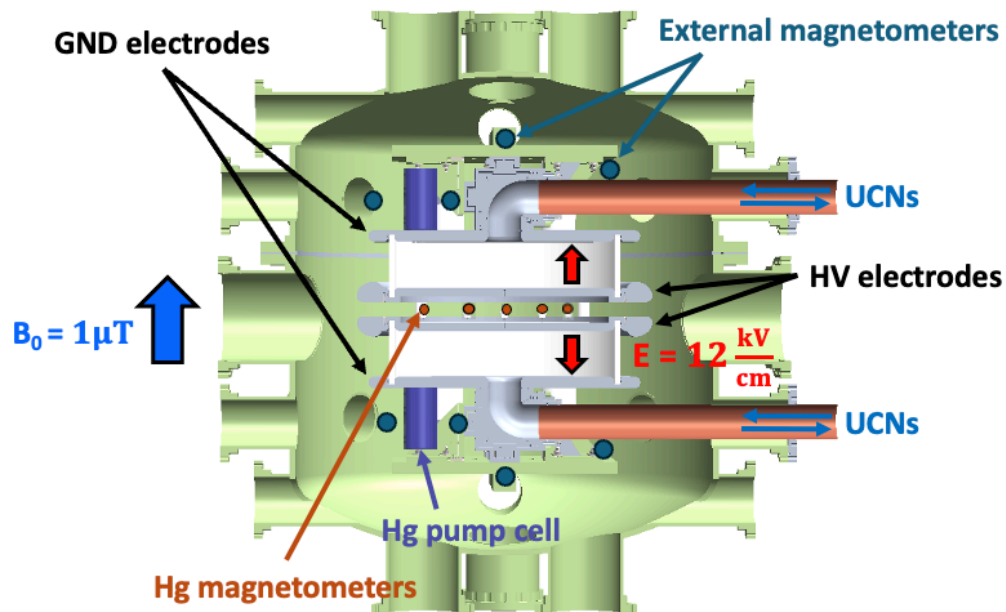
Polarized UCN are stored in two precession chambers inside a precisely controlled magnetic environment. Ramsey's method uses two RF spin rotations separated by a long free-precession period while electric and magnetic fields are applied. A neutron EDM would appear as a small electric-field-correlated change in precession frequency.



03

Compare Fields & Control Systematics

The double-cell geometry and repeated field configurations allow the experiment to compare neutron precession while controlling magnetic-field effects. Mercury-199 co-magnetometry and external magnetometers track the magnetic environment, while screened low-magnetic-signature components reduce gradients near the measurement cells.



MY ROLE

Building and commissioning the hardware that stores and controls the neutrons

My work centered on the main vacuum vessel and neutron-valve system: mechanical construction and integration, vacuum preparation, hydraulic actuation, pressure and position instrumentation, first-generation controls, installation and troubleshooting during commissioning.

BUILD-TO-COMMISSIONING PROGRESSION

From vacuum preparation to an installed neutron-valve system

The sequence below follows the actual development path: initial vacuum conditioning, valve construction and component preparation, magnetic-material

screening, two generations of hydraulic actuation and controls, alignment and integrated vacuum testing, endurance testing, installation and later field repair.

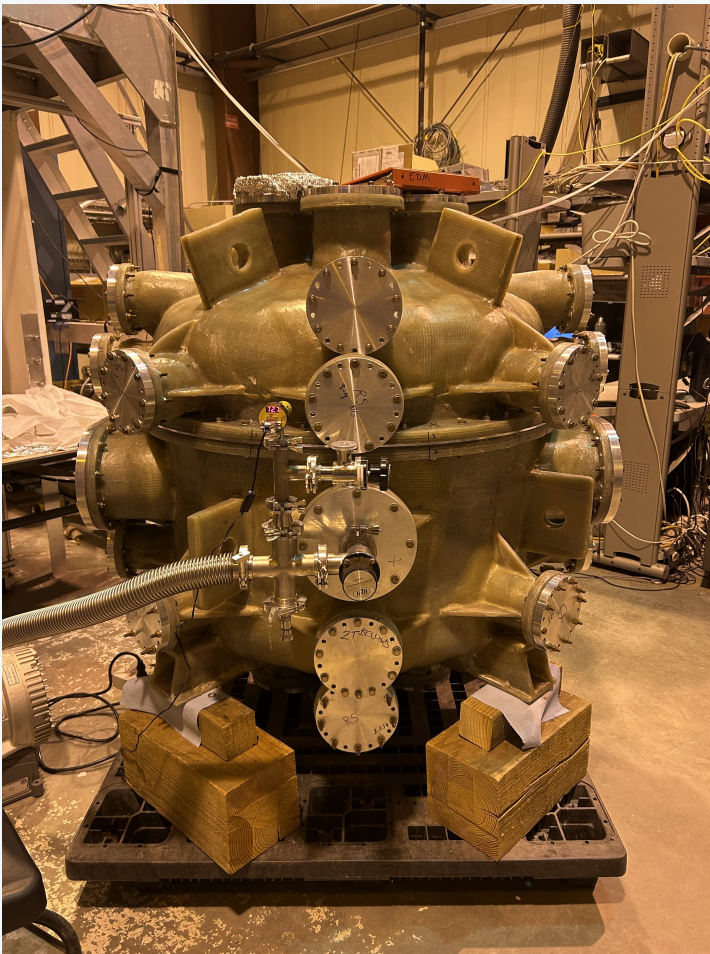
STAGE

01

Initial vacuum preparation & conditioning

The work began with the main G10 components installed in the chamber and an extended vacuum-conditioning period. I rough-pumped the system for several weeks and then transitioned to turbomolecular pumping for several more weeks before the chamber was opened again for valve-system development.

Pump-down included leak checking to identify and resolve leaks rather than relying on pressure alone. This established the vacuum behavior of the large custom vessel and began the long process of reducing outgassing before the more complex mechanical hardware was integrated.



Main chamber during vacuum preparation.



Interior of vacuum chamber.

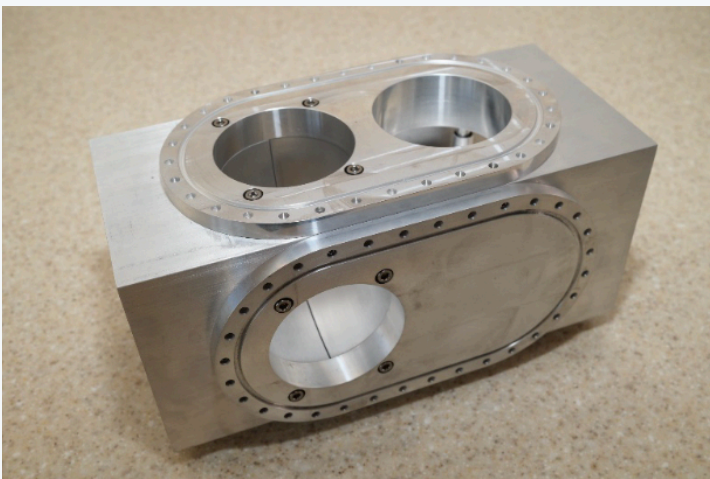
STAGE

Valve construction, cleaning & mechanical development

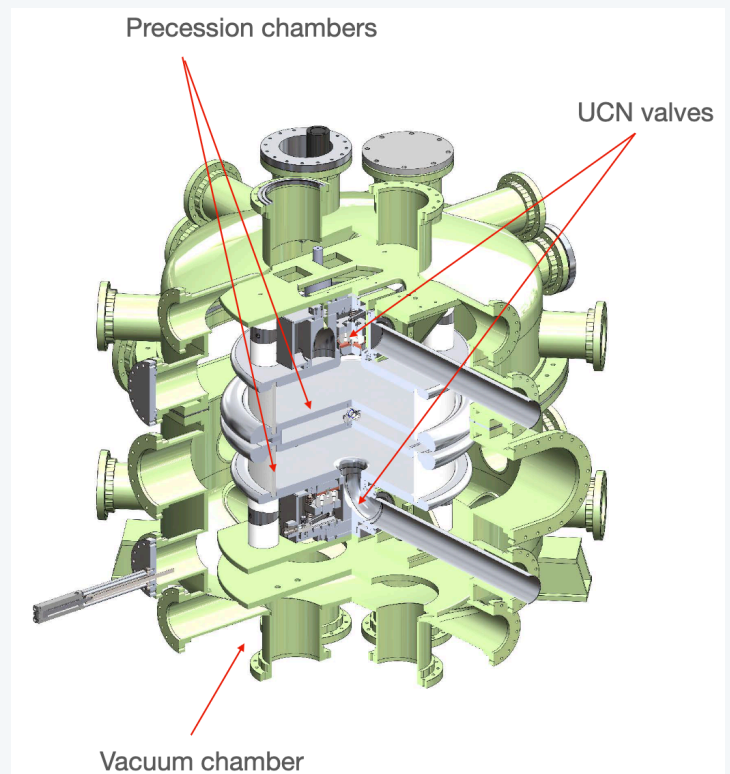
After the initial vacuum conditioning, the chamber was opened for an extended period while I built up and hand-tested the two neutron valves. I first concentrated on getting the bottom valve operating smoothly by hand before adding powered actuation.

Component preparation was continuous throughout this work. Parts were carefully cleaned before installation and often cleaned again after rework or handling. Depending on the material and component, this included non-abrasive cleaning, ultrasonic cleaning, isopropyl alcohol and deionized water. Metal hardware could receive a detergent or Citranox bath, followed by extended oven baking and a final alcohol / deionized-water cleaning before returning to the apparatus.

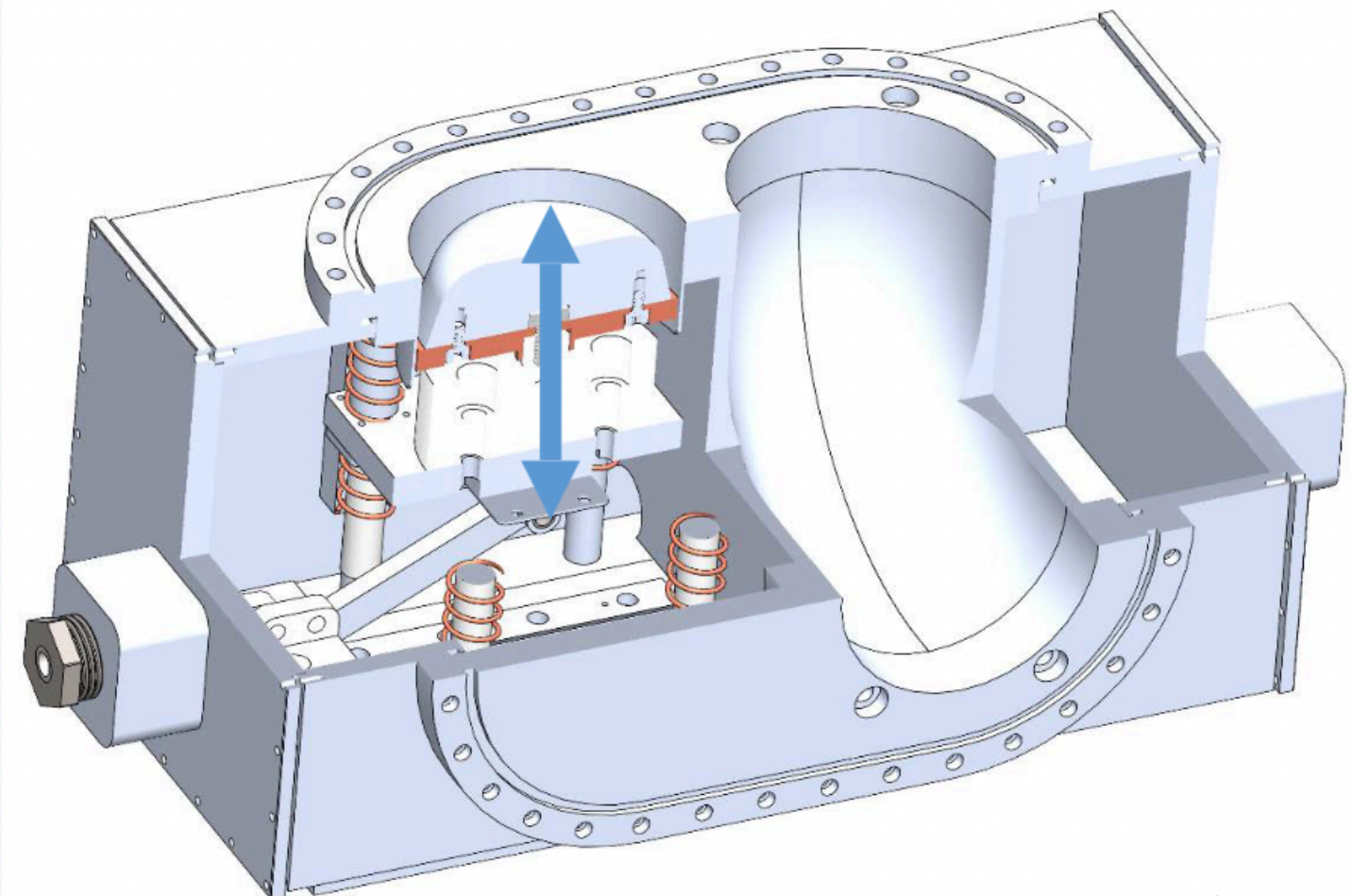
The assembled system required repeated mechanical adjustment. Bringing both the upper and lower cells into alignment while also mating correctly to the neutron beam guides and maintaining the vacuum interfaces became a major part of the development work.



Machined chamber hardware used in the precession-cell assembly.



Central-assembly context showing the two precession chambers, UCN valves and surrounding vacuum chamber.



Cutaway view of the chamber hardware and valve-motion geometry used during mechanical development.

STAGE

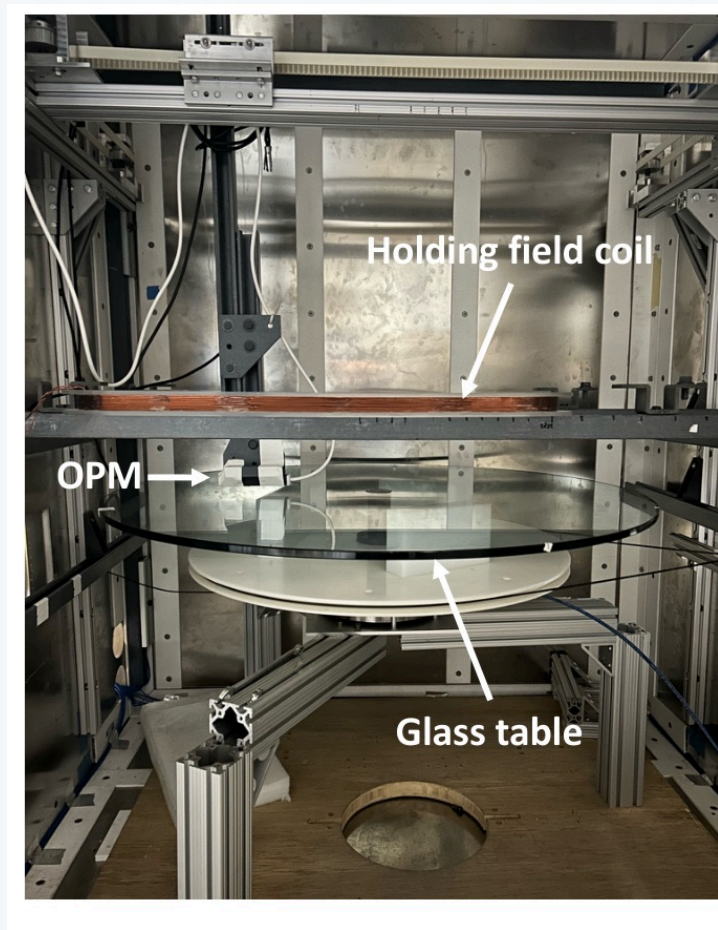
03

Magnetic-material screening before integration

Because the measurement cells had to operate in an extremely controlled magnetic environment, candidate hardware was also screened for magnetic impurities before final integration. The project used a dedicated magnetic-impurity scanner and evaluated more than 100 parts, including valve hardware, guides, sealing components, chamber supports, fasteners, actuators and other pieces used around the central assembly.

My role was on the hardware side rather than the magnetic measurement or analysis. I disassembled the cell hardware, prepared and cleaned parts, delivered components for scanning, helped with mechanical aspects of the scanner / turntable when needed, and later reassembled the apparatus. The physicists performing the measurements and simulations determined the relevant magnetic limits for a component's location.

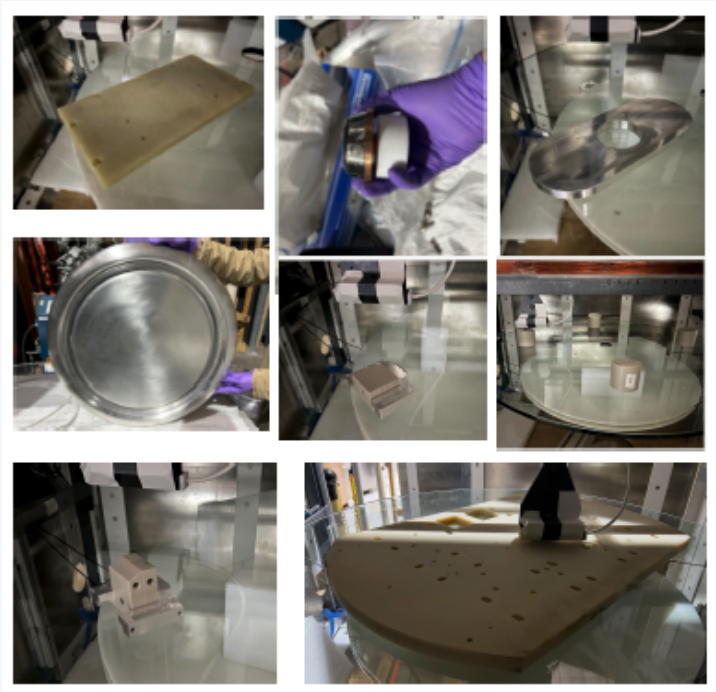
If a component produced an unacceptable result, I was brought into the practical redesign discussion: whether the solution should be a different material, geometry, fabrication route or replacement component. Cleaning could also be repeated when contamination or residue was suspected.



Turntable magnetic-impurity scanner used to evaluate components before integration.



Cleaned HV electrode being prepared for magnetic screening.



Central-assembly components during construction, preparation and fit-up.

04

First hydraulic concept: stepper-driven actuation

The first powered concept used a stepper motor to drive a hydraulic piston. The goal was precise, controlled displacement, and I built a separate DAQ and GUI around this configuration for testing and operation.

Long-duration testing exposed a problem that was not obvious from the concept alone: small hydraulic blowby at the chamber piston accumulated over repeated motion. Over time, the chamber-side piston could drift outside the usable stroke of the stepper-driven piston. Precision at the drive end therefore did not guarantee reliable position authority over long-term operation.

Design iteration: the stepper-based system was useful development hardware even though it was not retained. Testing revealed a cumulative hydraulic behavior that drove the actuation concept toward a continuously available pressure source.

STAGE

05

Revised hydraulic system & new controls

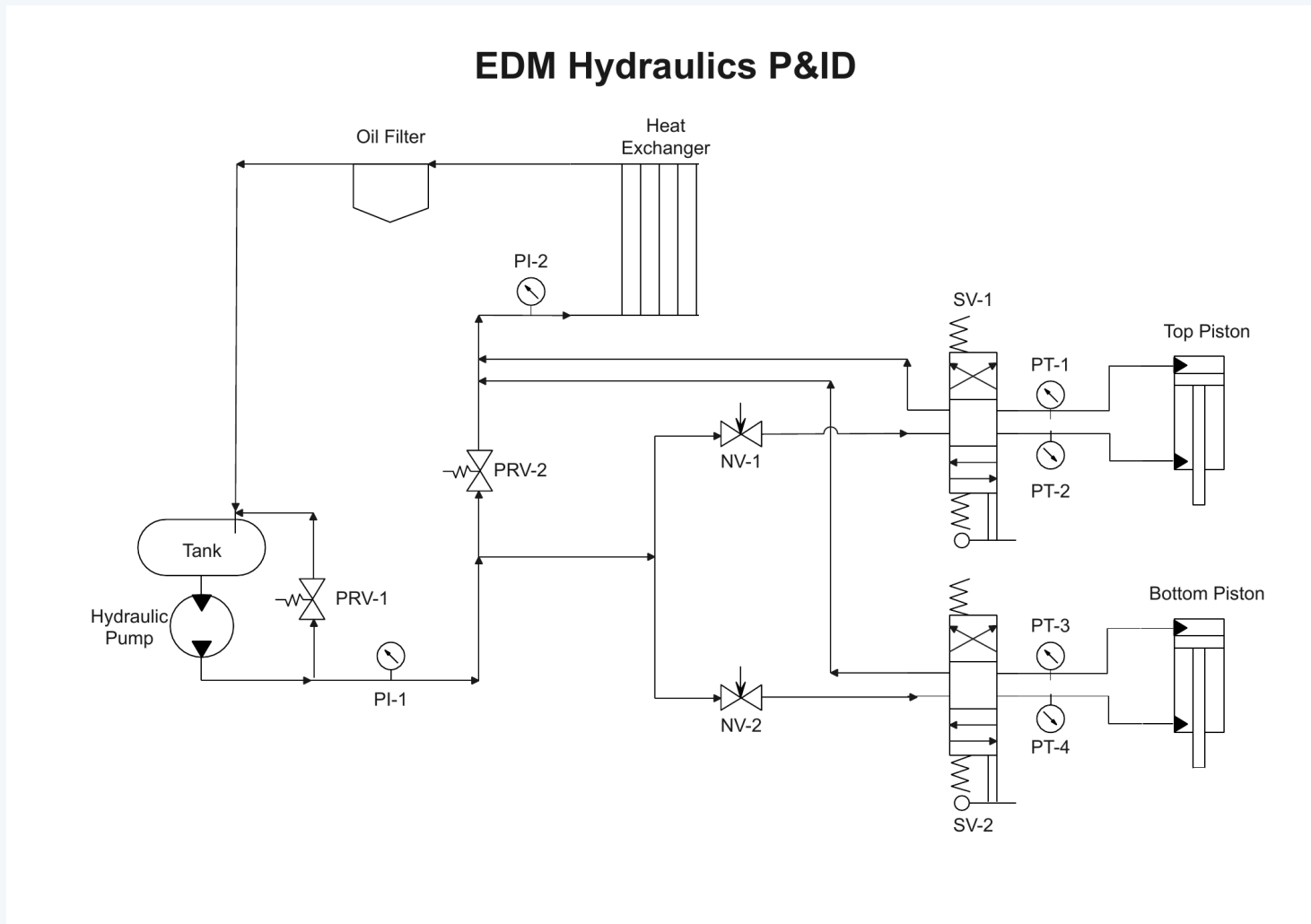
I then built out the revised system around a hydraulic pump so drive pressure would be available whenever valve motion was required. I designed and built a custom electrical interface box that acquired four pressure signals and two valve-position signals, controlled four relays, and connected the hydraulic hardware to a live-view plotting GUI.

The GUI displayed valve position and pressures through each stroke and provided useful troubleshooting messages when a protection condition tripped. Raw position information was also made available for inclusion in the experiment DAQ stream.

I documented the hydraulic system with the working P&ID shown below and developed a bill of materials with vendor data sheets for the hydraulic components. Official pressure-safety calculations were provided by Design Engineering; I reviewed the system from the build and operating side and supported its approval, but I was not the design authority responsible for those calculations. The final operating behavior was tuned experimentally rather than through a detailed analytical model. Needle valves NV-1 and NV-2 were used to control flow to the pistons

while retaining higher available hydraulic pressure. I consulted with the physicists on the desired valve stroke time and tuned the system to achieve a reliable operating stroke.

The system required additional mechanical tuning as the valves were brought into reliable operation. Once the lower cell was operating smoothly, getting the upper and lower assemblies to work together required significant realignment and repeated teardown and rebuild of the apparatus. High voltage was not part of this test configuration; the system did not yet include the HV feedthroughs.



Working hydraulic-system P&ID developed during integration and commissioning. Working system documentation; not an issued engineering drawing.

STAGE

06

Integrated alignment, vacuum & endurance testing

Final mechanical alignment had to satisfy several requirements at once: both valves needed smooth travel, the cells had to mate correctly with the neutron beam guides, and the assembled chamber had to maintain high vacuum. The apparatus was repeatedly adjusted, pumped down and retested.

Vacuum loading produced small shifts in the structure, so support alignment was adjusted after observing the system under vacuum rather than relying only on atmospheric-pressure fit-up. After the final configuration was established, I performed the proof test under vacuum, cycling the valve system thousands of times before installation.

Why the endurance test mattered: the goal was no longer simply to demonstrate that a valve could move. The complete mechanical, hydraulic, vacuum, instrumentation and control system had to continue operating repeatedly in its integrated configuration.

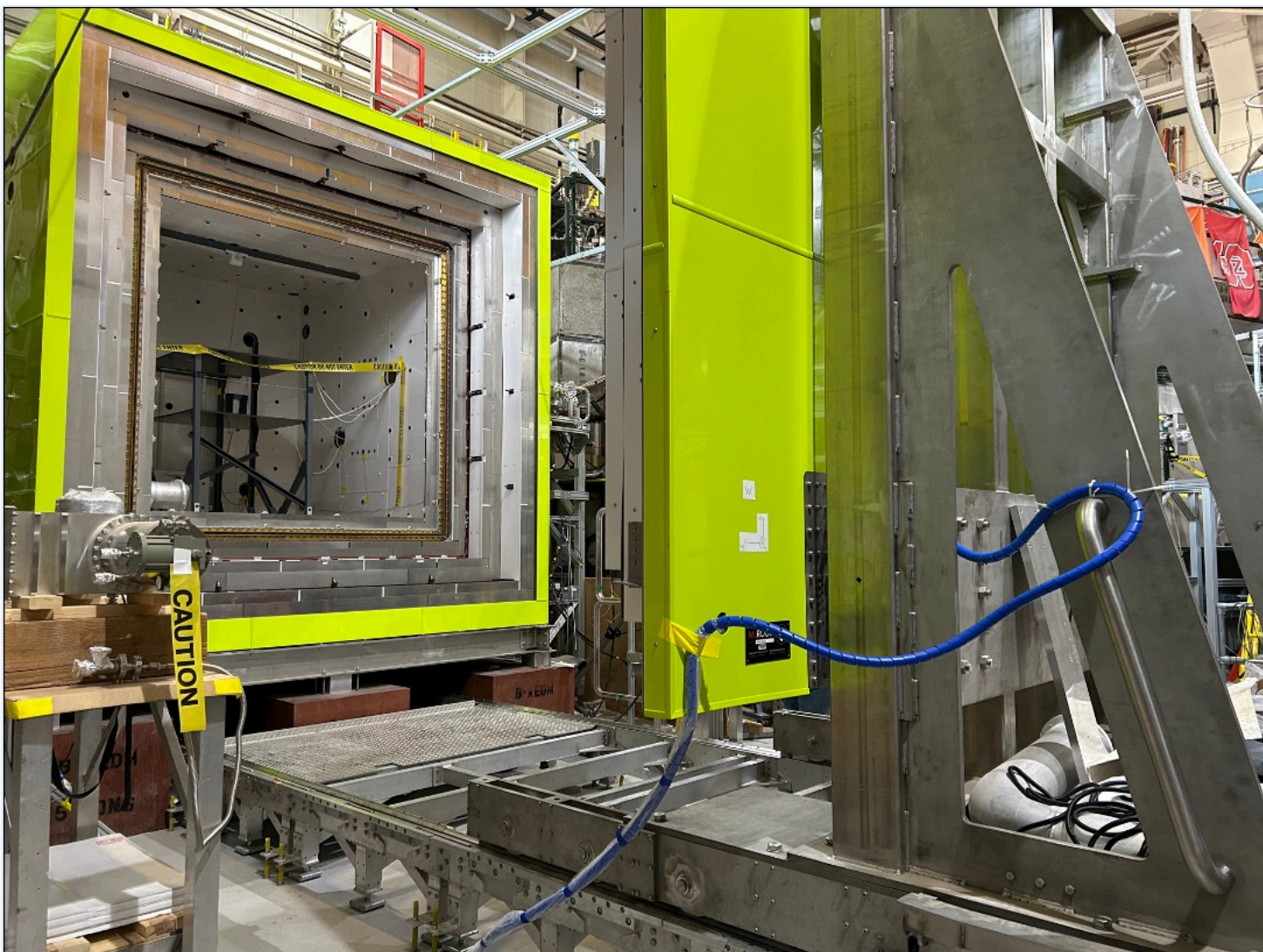
STAGE

07

Magnetic shield room door alignment & troubleshooting

I worked closely with Magnetic Shield Corporation on alignment and maintenance of the large magnetic-shield-room door surrounding the nEDM apparatus. I installed an extended door-track upgrade, cleaned and aligned electrical contact points, and performed resistance and continuity checks across the door interface.

I also troubleshooted a mechanical latching issue in which cam mechanisms were hanging up before full engagement, preventing the door from closing and sealing properly. I iteratively adjusted the door and latching system to support reliable opening, closing, electrical contact and mechanical engagement.



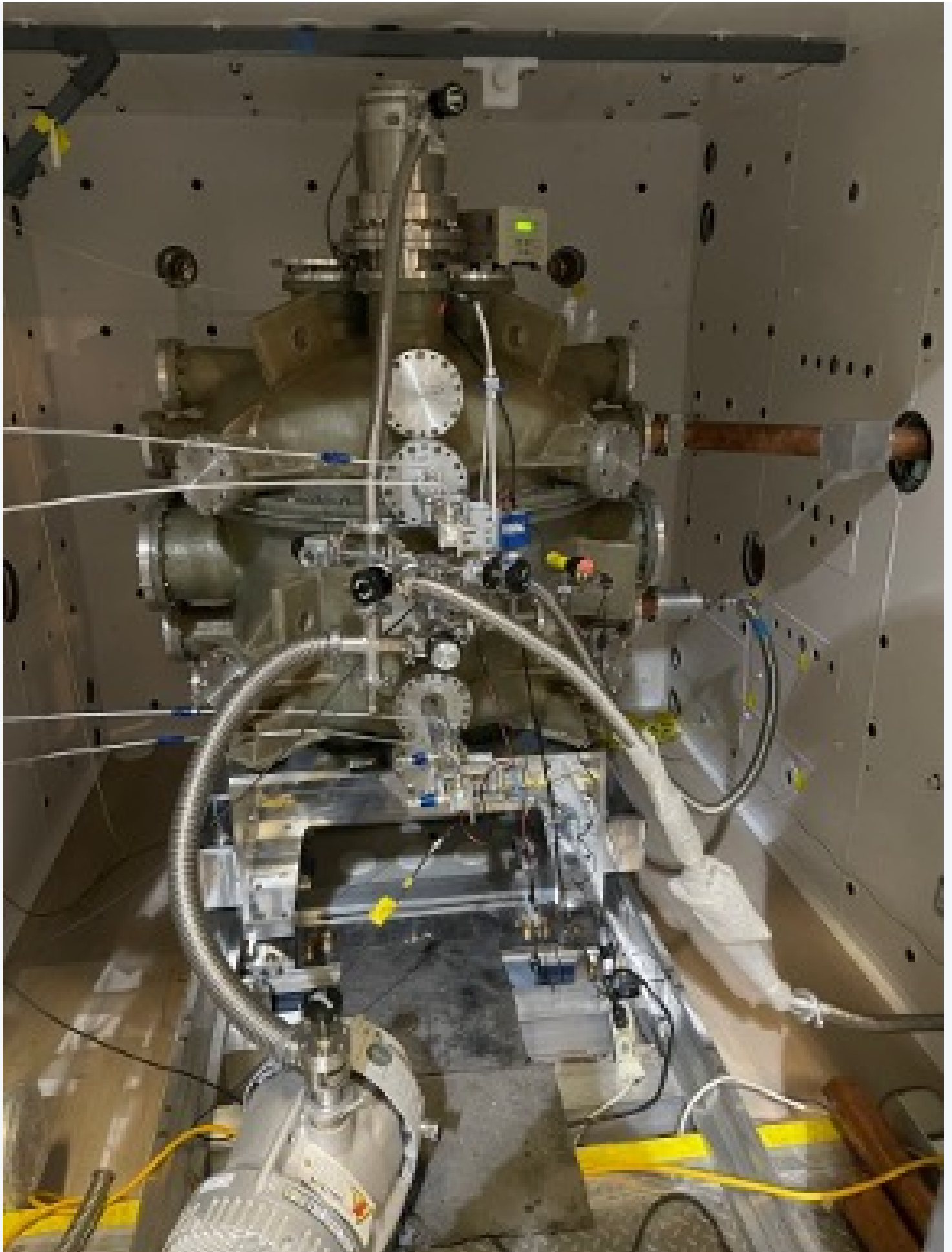
Magnetic shield room door and track system surrounding the nEDM apparatus.

STAGE

08

nEDM installation & coupling to the UCN beamline

Installation required more than lifting the chamber into place. A separate platform was installed at the opening of the nEDM magnetic-shield room, and the chamber was placed on a custom trolley so the assembled vessel could be rolled into position and connected to the neutron beamline.



STAGE

09

Commissioning troubleshooting & field repair

Commissioning included both controls faults and mechanical problems. In one case, a valve repeatedly stopped partway through its travel. Pressure, position and control-state information showed that the system was reaching a protective pressure threshold rather than simply binding mechanically; correcting the threshold and retesting restored continuous motion.

A more difficult problem appeared after the apparatus had already been installed. Loose internal hardware interfered with valve travel. Repair required disconnecting the integrated system, rolling the chamber back out of the magnetic-shield-room opening on the trolley, opening the vessel in the beam area, disassembling the cell hardware, correcting the problem and completely reassembling the chamber.

Lesson carried forward: inaccessible internal hardware needs objective verification before final integration. Once a complex system is installed, a small assembly problem can become a major disassembly, access and reassembly effort.

Project resolution: the assembly was completed in time to take beam. The experiment demonstrated that ultracold neutrons could be captured, stored and dumped using both cells, completing the proof-of-concept objective for this stage of the apparatus.

Terrance Schaub

Experimental systems · commissioning ·
instrumentation & controls

Private draft · LANL-related material remains subject to
external-use review.

TERRANCE SCHAUB

EXPERIMENTAL SYSTEMS ·
COMMISSIONING · I&C

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CRYOGENIC HIGH-VOLTAGE R&D · NEDM@SNS

Cavallo High-Voltage Multiplier

Development of an in-situ electrostatic multiplier intended to generate hundreds of kilovolts inside the cryogenic nEDM@SNS apparatus while avoiding the challenges of a conventional full-voltage cryogenic feedthrough.

Cryogenics

High voltage

Vacuum

Instrumentation

R&D commissioning



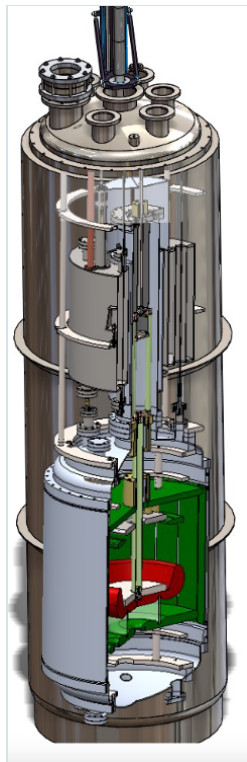
Cavallo high-voltage test hardware during development and integration.

WHAT IS THE PROJECT?

Generating extreme voltage inside a cryogenic experiment

The nEDM@SNS experiment requires several hundred kilovolts on a measurement-cell electrode immersed in approximately 0.4 K liquid helium. Delivering the full voltage through a conventional feedthrough creates difficult thermal, electrical, magnetic-material and physical-size constraints.

The Cavallo multiplier approaches the problem differently: bring a much smaller voltage into the cryogenic region, then repeatedly transfer electrostatically induced charge to an isolated collector electrode. The construction-ready design targets approximately 650 kV from a 50 kV input.



0.4 K

liquid-helium
operating
environment

50 kV

representative
external input

650 kV

cryogenic design
target

Gain ≈ 18

final electrode
geometry

HOW THE CAVALLO MULTIPLIER WORKS

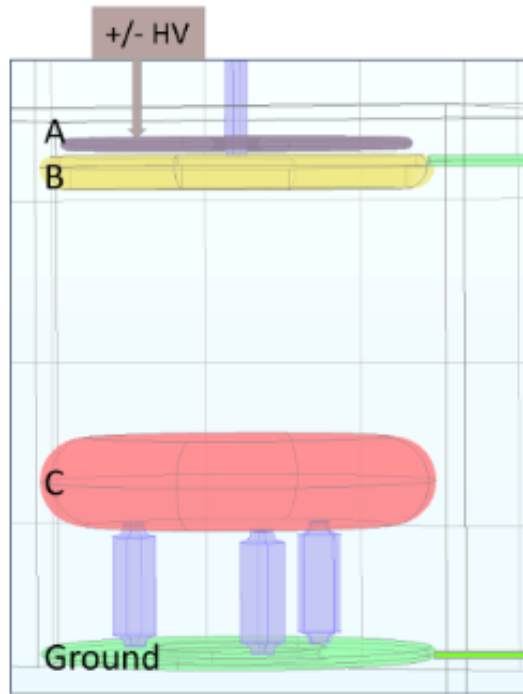
Charge, move, transfer — then repeat

The multiplier builds voltage through repeated mechanical charge-transfer cycles rather than directly feeding the final high voltage into the cryostat.

01

Induce Charge

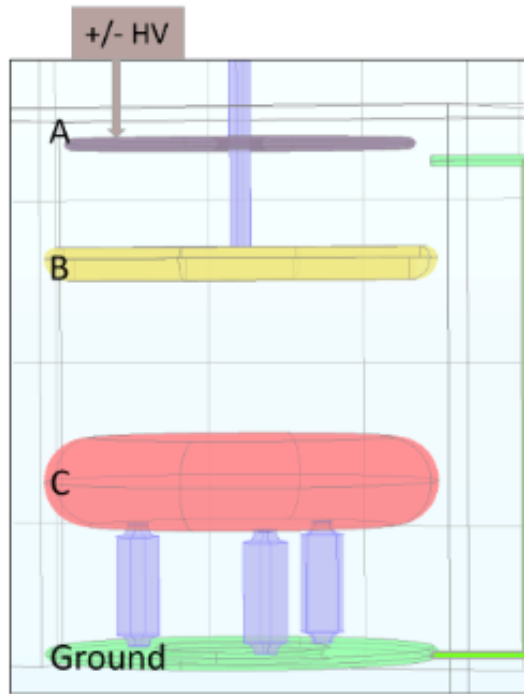
Input electrode A is biased by the external high-voltage supply. Transfer electrode B begins close to A while connected to ground, allowing capacitive induction to load charge onto B.



02

Move the Charge

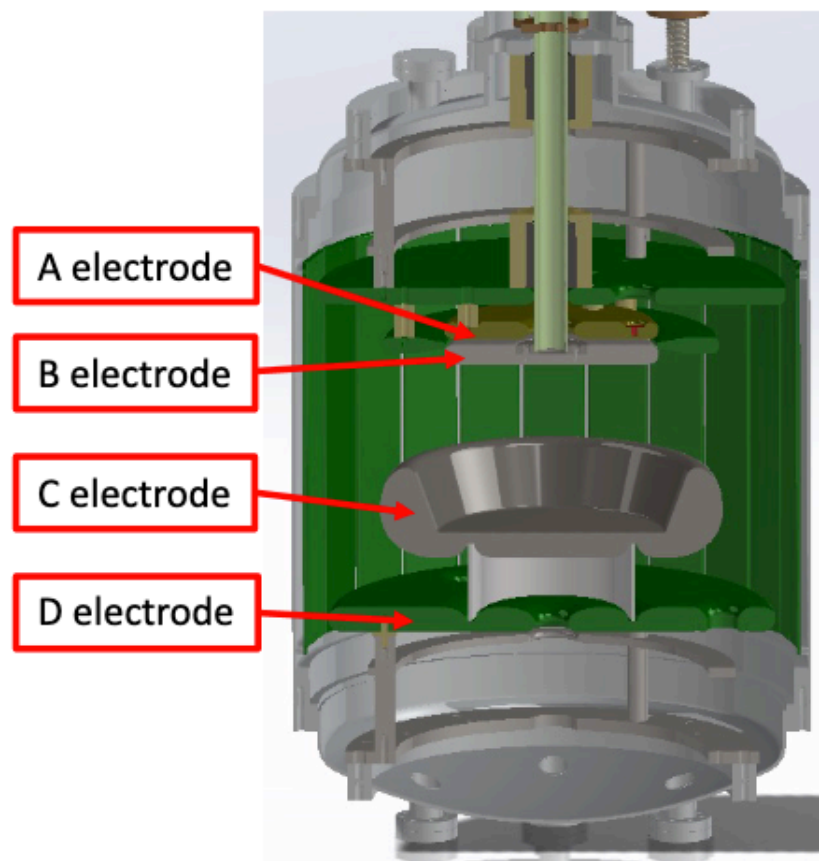
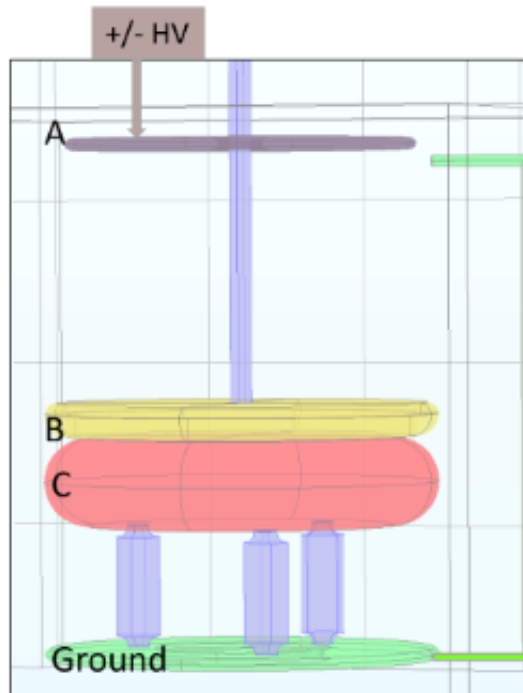
B disconnects from ground while retaining its charge. A mechanical actuator translates the electrode away from A and toward the isolated high-voltage collector C.



03

Transfer & Accumulate

B approaches C and transfers charge to the isolated collector. B then returns to its starting position and the cycle repeats, progressively raising C to a much larger potential.



Released CAD identifying the A, B, C and D electrode geometry inside the full-scale assembly.

Animated electric-field view of the Cavallo charging cycle.

VOLTAGE MEASUREMENT

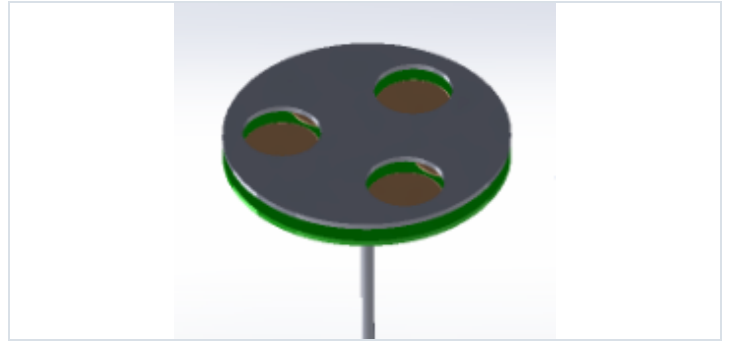
Measuring the collector voltage without a direct HV connection

The collaboration used a custom rotary field mill to infer the high-voltage collector potential without making a direct electrical measurement at hundreds of kilovolts. A grounded rotating shutter periodically exposes a sensing electrode to the electric field, converting the static field into an AC signal that can be calibrated against known collector voltage.

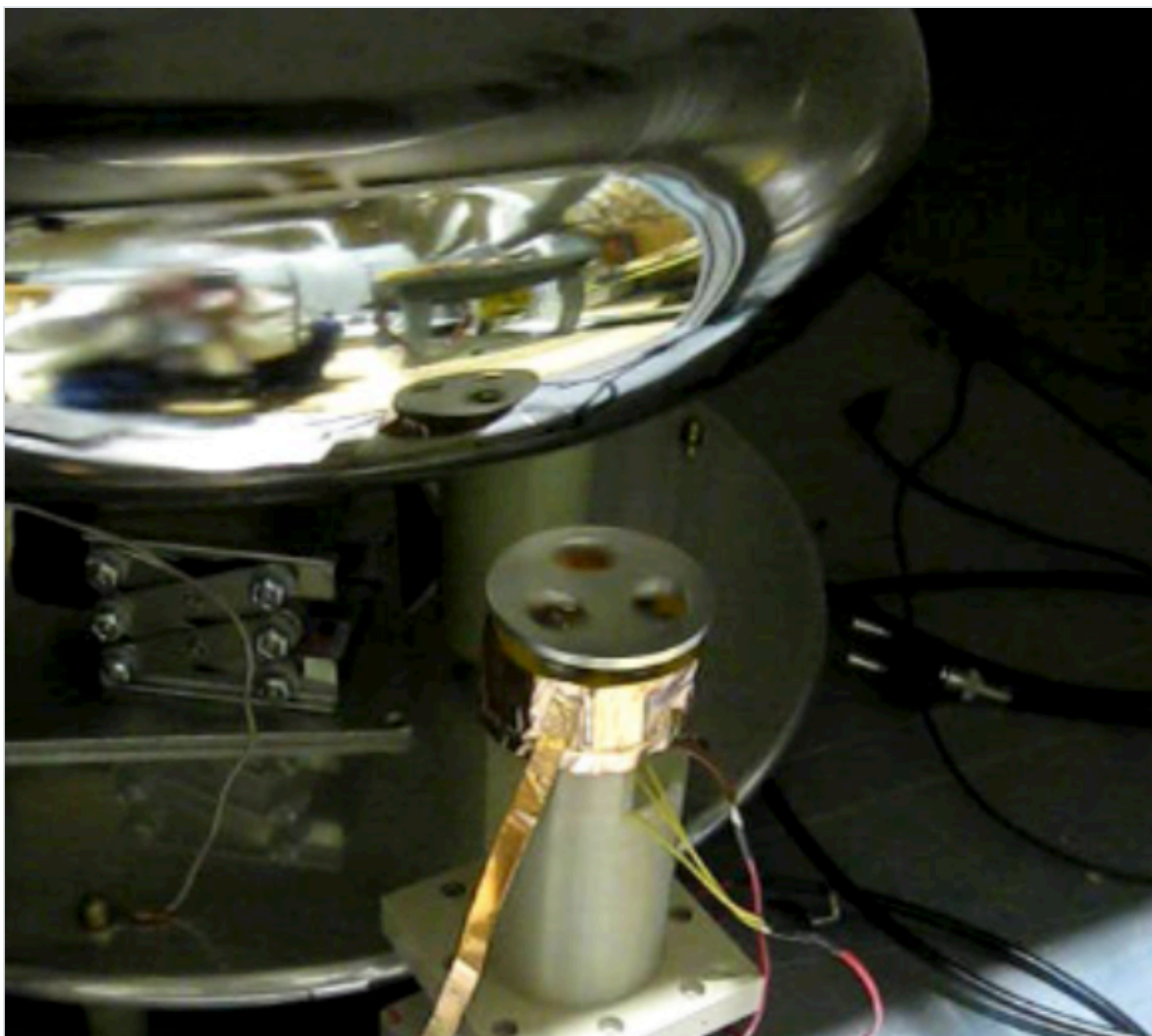
Role distinction: I did not design or develop the field mill. I supported the larger apparatus, vacuum/cryogenic infrastructure and testing environment in which the HV system and its diagnostics operated.



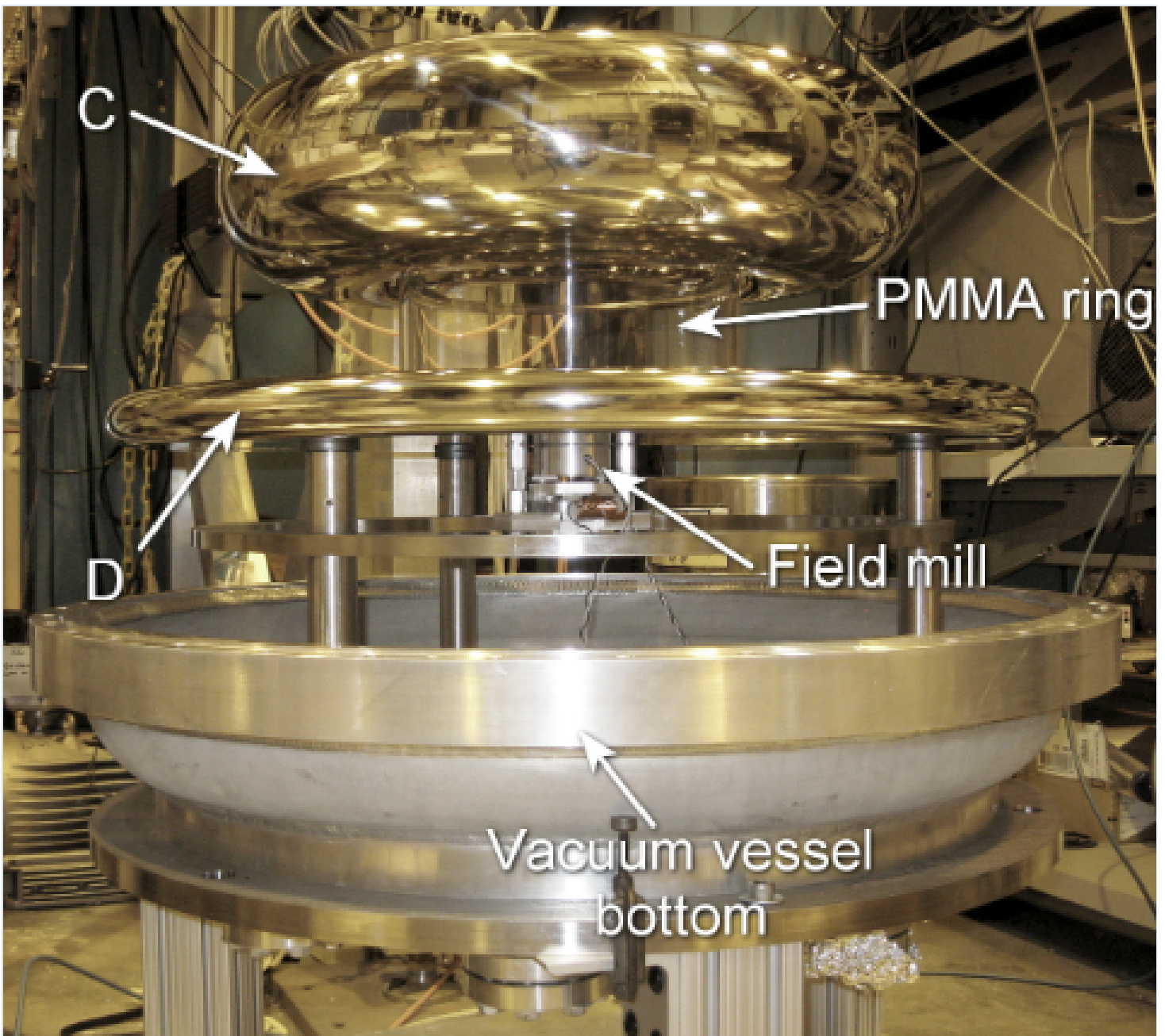
Field-mill hardware.



Rotating-shutter CAD.



Field-mill hardware beneath the high-voltage electrode region.



Collector-voltage measurement geometry showing C, D, the PMMA ring and the field mill beneath the high-voltage electrode region.

MY ROLE

Building, instrumenting and commissioning the cryogenic test apparatus

I built most of the supporting test apparatus around the central Cavallo high-voltage volume: the cryogenic and vacuum infrastructure, plumbing, support hardware, instrumentation, DAQ interfaces, utilities and test setup required to install the central assembly and operate the system.

- Fabricated and installed 316 stainless-steel tubing systems, primarily from 1/8-inch through 1-inch tubing with larger exhaust plumbing.
- Performed tubing bending, fitting and welding, followed by vacuum, leak and cryogenic testing from component through full-system level.
- Plumbed cryogen fill and exhaust systems and later helped rebuild the apparatus from the original liquid-helium configuration to a simplified liquid-nitrogen test configuration.
- Retrofitted cryogenic and vacuum instrumentation/DAQ from the earlier MSHV experiment; tested the integrated DAQ and instrumentation and calibrated a custom liquid-level sensor.
- Integrated roughing and turbo pumping, vacuum gauges, leak checking, temperature and pressure sensing, level measurement and automated fill-valve functions.
- Organized wiring and electronics racks and brought required utilities—including electrical power and compressed air—to the test apparatus.
- Provided crane operations and mechanical handling for installation of the central HV volume into the dewar and connection to cryogenic plumbing and instrumentation.
- Supported component tests with temporary cryogenic setups and built a test platform for electrical testing.
- Acted as the SF₆ gas owner/support contact for room-temperature testing and provided vacuum and leak-checking support for the HV program.
- Worked with the responsible engineer on the LN₂ reconfiguration and formal startup/test procedures; participated in electrical, pressure, cryogenic and industrial-hygiene walkdowns under the governing IWD.

Once the supporting systems were commissioned and operating, I handed the apparatus over for experimental operation while continuing daily checks of cryogenic, vacuum and instrumentation behavior.

From inherited hardware to an operable cryogenic HV test system

My contribution was concentrated on the infrastructure and integration required to make the Cavallo central volume a functioning experiment: fabrication, cryogenics, vacuum, instrumentation, utilities, mechanical handling, work control and operational support.

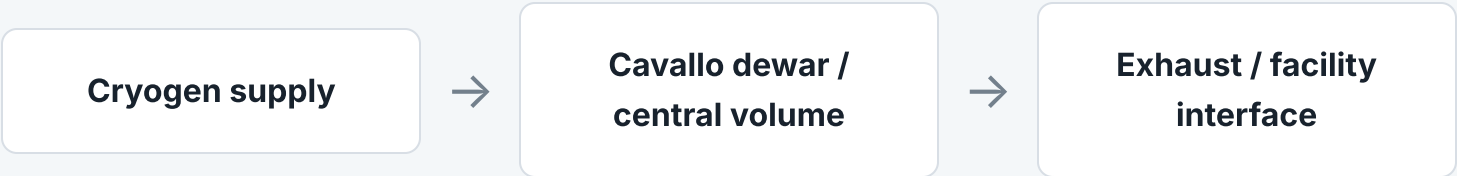
STAGE

01

Fabrication, plumbing & support infrastructure

I fabricated much of the hardware connecting the central Cavallo volume to the surrounding test system. This included extensive 316 stainless-steel tubing work from small instrumentation lines through larger cryogenic/exhaust plumbing, plus support structures and practical installation hardware.

I bent, fitted and welded tubing and verified components with vacuum, leak and cryogenic tests before integrating them into larger subsystems.



STAGE

02

Vacuum, instrumentation & DAQ retrofit

I outfitted the apparatus with the cryogenic and vacuum instrumentation needed for commissioning and operation. The DAQ/instrumentation package was adapted from the earlier MSHV experiment, then tested as an integrated system.

The system included roughing and turbo pumping, leak-checker interfaces, vacuum gauges, temperature and pressure sensors, liquid-level measurement, fill-valve automation and organized electronics/wiring. I calibrated the custom liquid-level sensor and verified the instrumentation and DAQ together before operation.

STAGE

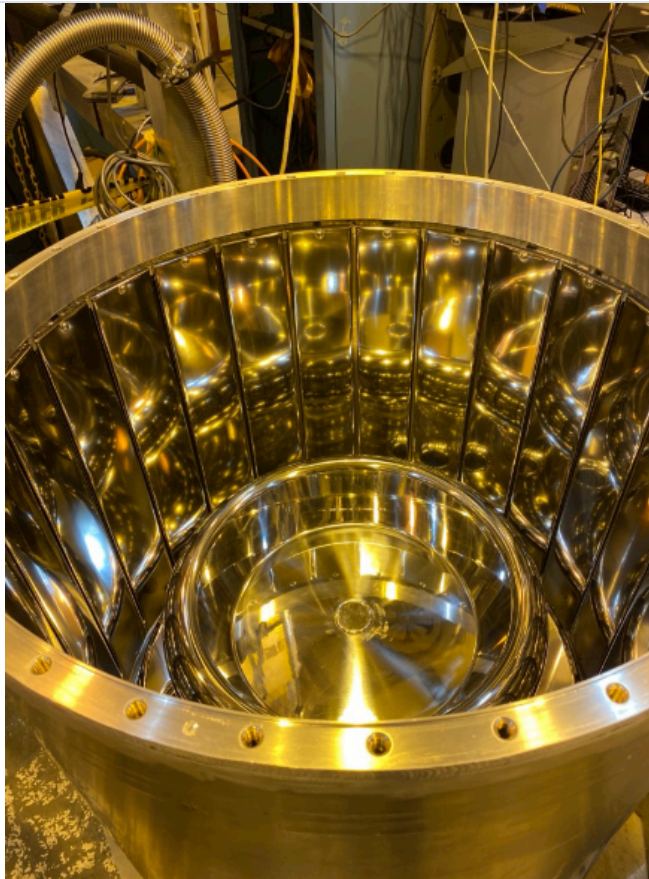
03

Central-volume installation & integrated leak checking

I provided crane and mechanical-handling support to place the HV central volume into the dewar, then connected the cryogenic plumbing and instrumentation to the surrounding system. Leak checking was iterative: individual components, assembled subsystems and finally the complete apparatus were tested as the build progressed.



Central assembly and dewar during integration. I supported the installation and connected the surrounding cryogenic, vacuum and instrumentation systems.



Interior HV region. The central HV design was collaboration hardware; my work focused primarily on the infrastructure that allowed it to be installed, cooled, evacuated, instrumented and tested.

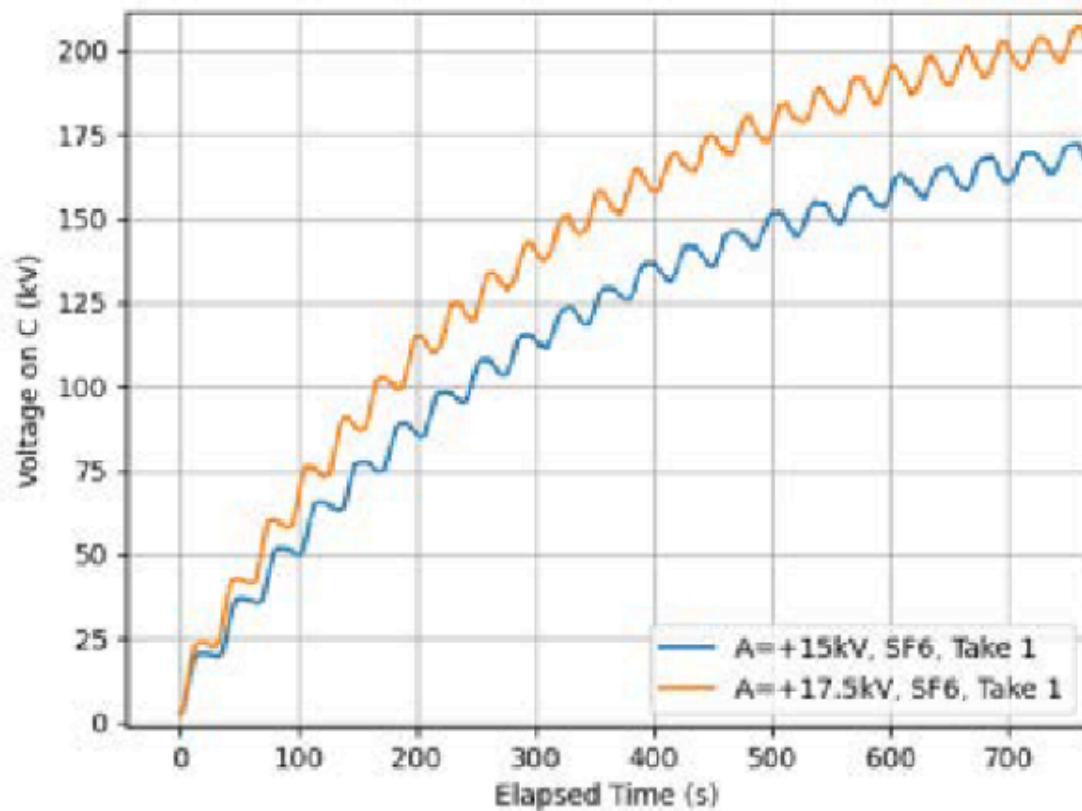
STAGE

04

Room-temperature SF₆ testing support

Before cryogenic operation, the full-scale system was demonstrated at room temperature in SF₆. I served as the SF₆ gas owner/support contact, supplied the gas system and provided vacuum and leak-checking support for the HV tests.

The published full-scale demonstration reached approximately 255 kV from a 25 kV input in about 600 Torr SF₆. I am a coauthor on the 2026 paper reporting this result.



Representative room-temperature charging curves from the Cavallo development program.

25 kV → ~255 kV

Published full-scale room-temperature demonstration in approximately 600 Torr SF₆.

STAGE

05

Reconfiguration from LHe to LN₂ testing

The original apparatus was built for a full liquid-helium test configuration. When program priorities and helium availability changed, the cryogenic test was simplified to liquid nitrogen. I rebuilt internal portions of the dewar and exterior plumbing to the second configuration, working closely with the responsible engineer to install the revised system.

I also worked with engineering on the formal LN₂ startup/test procedures and represented the cryogenic-handling side of the apparatus during electrical, pressure, cryogenic and industrial-hygiene walkdowns under the IWD.

STAGE

06

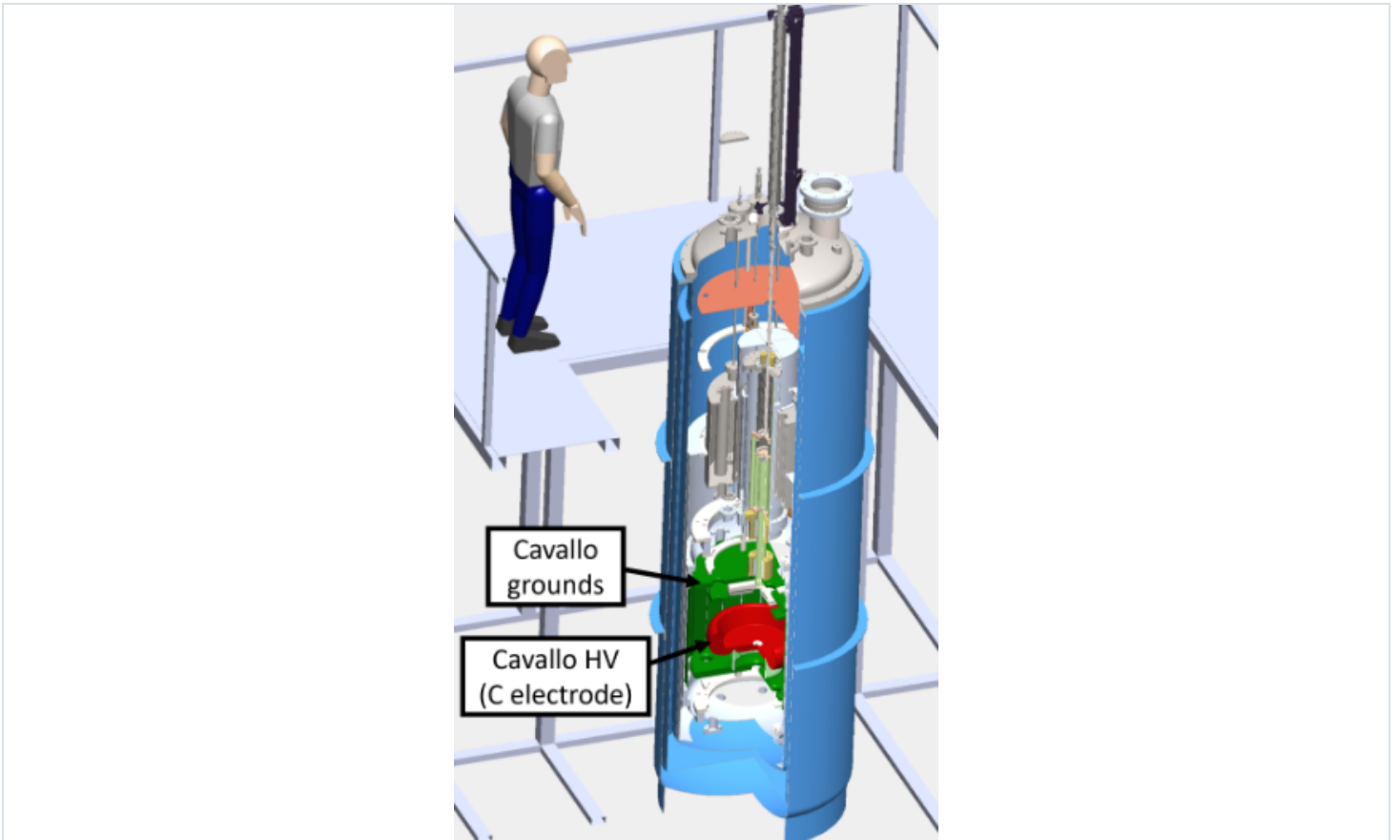
Commissioning, handoff & operational support

The cryogenic plumbing, vacuum systems, instrumentation and supporting infrastructure operated as intended, and I brought the system to the point where the experiment team could run it. I then handed the apparatus over for experimental operation while checking in daily and observing system behavior.

During LN₂ testing, the team encountered difficulty maintaining the stable pressure needed for the measurement because the dewar top and vessel—hardware inherited from two different projects—did not mate perfectly. The program was subsequently curtailed before that configuration produced the intended cryogenic dataset. I would describe that outcome carefully: the supporting systems I owned were commissioned and operational, while the remaining experimental limitation was associated with the inherited vessel interface and the program ended before a further redesign could be completed.

SYSTEM CONTEXT

How the Cavallo test program connected to nEDM@SNS



Released integration CAD showing the Cavallo HV electrode and surrounding grounds in the larger nEDM@SNS cryogenic system.

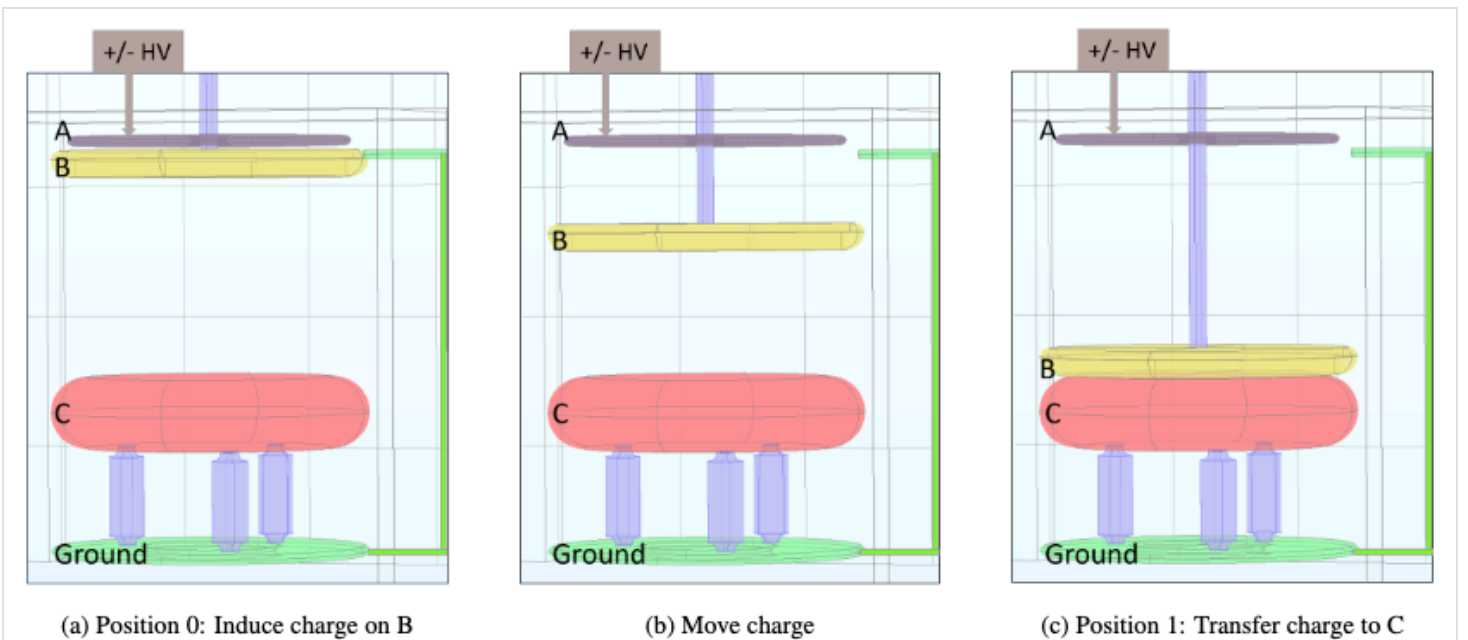


Figure 1: An example of a Cavallo multiplier: The charge is transferred to the B electrode in (a), then physically moved with the B electrode in (b), and transferred to the C electrode in (c). Then the B electrode returns to the position in (a) to recharge and repeat the cycle.

The complete charge-transfer sequence: induce charge on B, mechanically move it, transfer charge to C, and repeat.

Project publications & presentations

255-kV full-scale demonstration

The 2026 paper reports the room-temperature full-scale demonstration and includes me, T. J. Schaub, as a coauthor.

Demonstration of 255-kV high-voltage generation with a Cavallo multiplier system ↗

Cryogenic-test preparation

A 2023 APS/DNP-JPS presentation documents preparation for the cryogenic test of the full-scale multiplier and includes me among the project authors.

APS 2023 session record ↗

Terrance Schaub

Experimental systems · commissioning ·
instrumentation & controls

Private draft · LANL-related material remains subject to
external-use review.

TERRANCE SCHAUB

EXPERIMENTAL SYSTEMS ·
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DETECTOR CASE STUDY

Coherent CAPTAIN-Mills — CCM200

Large liquid-argon scintillation detector construction, integration, commissioning, monitoring, troubleshooting and operations at the Lujan Center.

~10-ton LAr detector

200 PMTs

Construction

Commissioning

DAQ / Monitoring



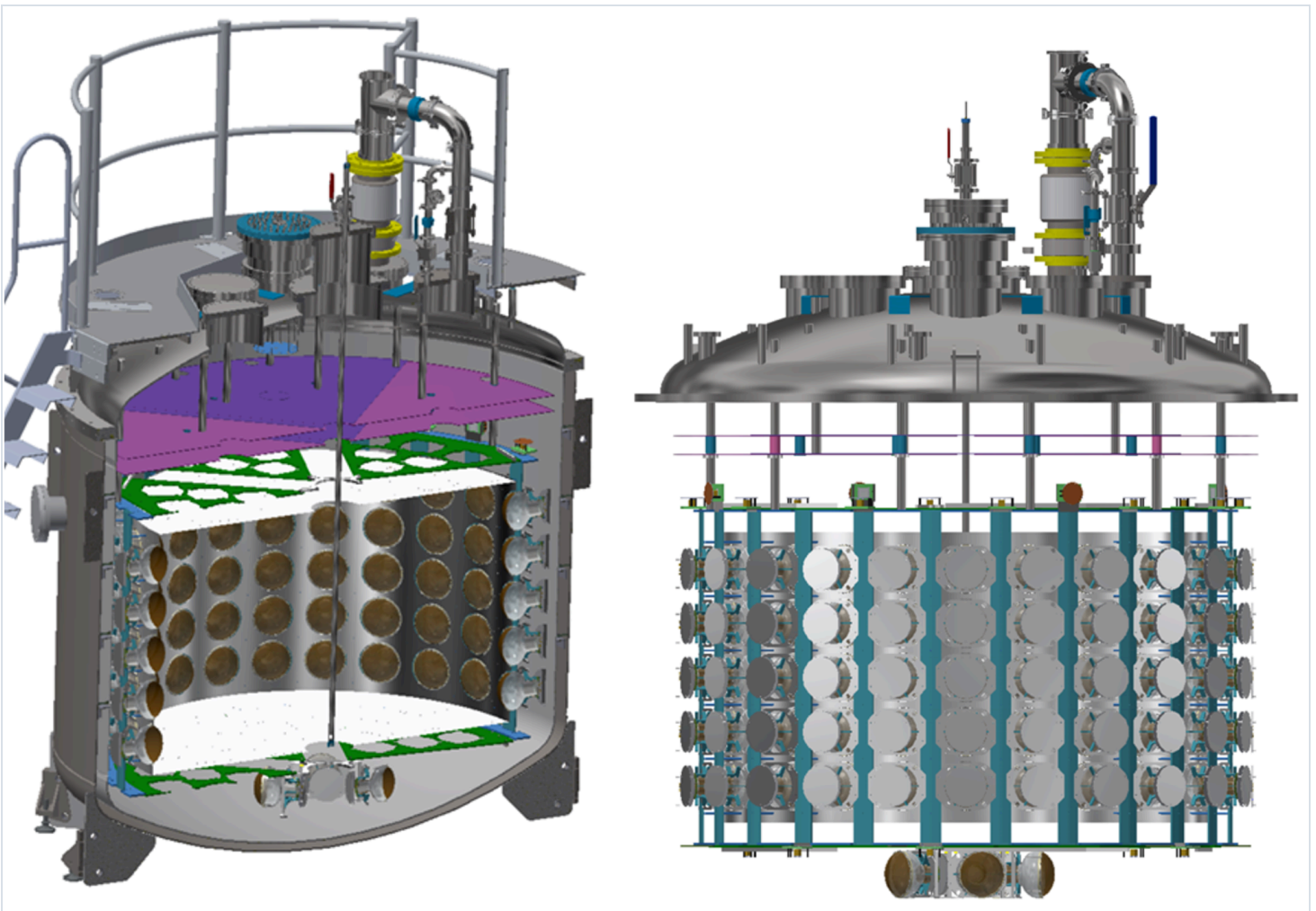
WHAT IS CCM200?

A liquid-argon detector searching for accelerator-produced new physics

Coherent CAPTAIN-Mills (CCM200) is a large liquid-argon scintillation detector located at the Lujan Center at LANSCE. An 800 MeV pulsed proton beam strikes a tungsten target,

producing the stopped-pion neutrino source used by the experiment to search for sterile neutrinos and accelerator-produced sub-GeV dark-matter signals. The detector can be moved to different source-to-detector distances to probe distance-dependent neutrino oscillations.

A 10-ton liquid argon volume is surrounded by 200 8-inch, 9-stage photomultiplier tubes (PMTs). Particle interactions in the argon produce 128 nm scintillation light. Tetraphenyl butadiene (TPB)-coated reflector foils and TPB-coated PMT bulbs wavelength-shift that ultraviolet light into wavelengths the PMTs can detect, allowing the optical response to be digitized by the DAQ and reconstructed as detector events.



CCM200 detector CAD showing the liquid-argon vessel and 200-PMT detector structure.

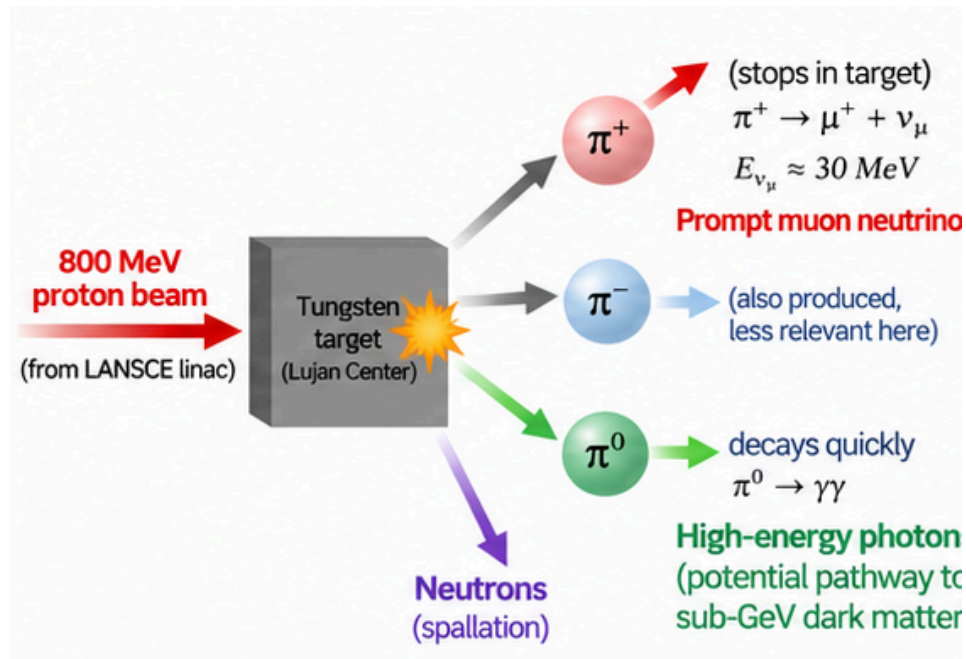
HOW CCM200 WORKS

From the accelerator beam to a measurable signal

01

Accelerator-driven particle source

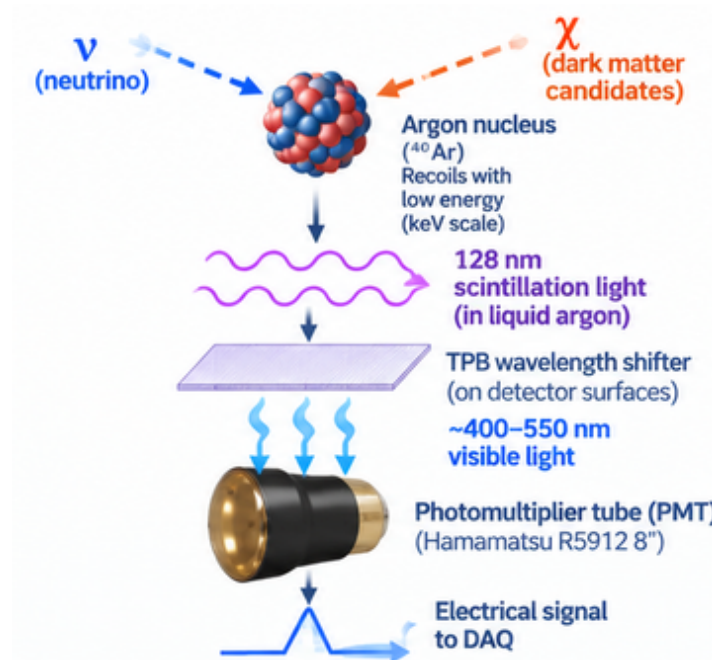
An 800 MeV proton beam from the LANSCE linear accelerator strikes a tungsten target at the Lujan Center. This produces neutrons as well as charged and neutral pions. Charged pions stop and decay, providing a well-characterized source of approximately 30 MeV muon neutrinos. Neutral pions produce high-energy photons, providing a potential pathway to accelerator-produced sub-GeV dark matter.



02

Detection in liquid argon

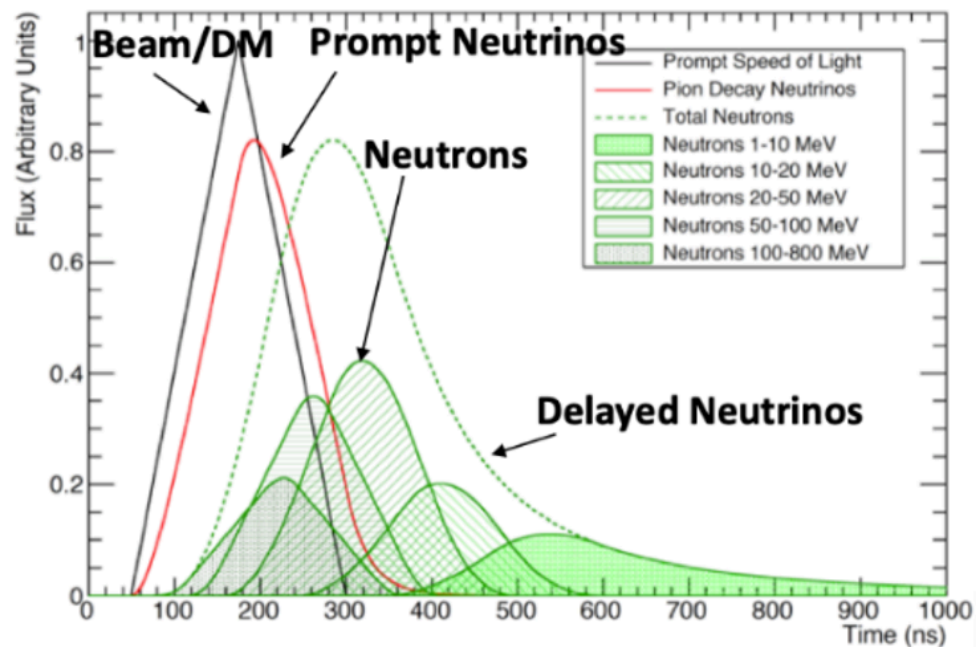
Neutrinos or dark-matter candidates can scatter from argon nuclei in the liquid argon. A recoiling argon nucleus produces 128 nm scintillation light. Tetraphenyl butadiene (TPB) coatings wavelength-shift this light into the visible range, where it is detected by the PMTs and digitized by the DAQ system.



03

Timing and energy separate signals

The time structure of the LANSCE beam helps distinguish prompt neutrino and potential dark-matter signals from beam-related neutron backgrounds. Reconstructed energy, timing and event rate are used with pulse-shape and veto information to separate candidate signal populations from backgrounds.



MY ROLE

Detector construction through commissioning and operations

My work included detector construction and upgrades, PMT hardware, installation, system power-up and testing, commissioning, monitoring / DAQ support, troubleshooting and optimization during operation.

BUILD-TO-OPERATIONS PROGRESSION

From individual PMTs to an operating 200-channel detector

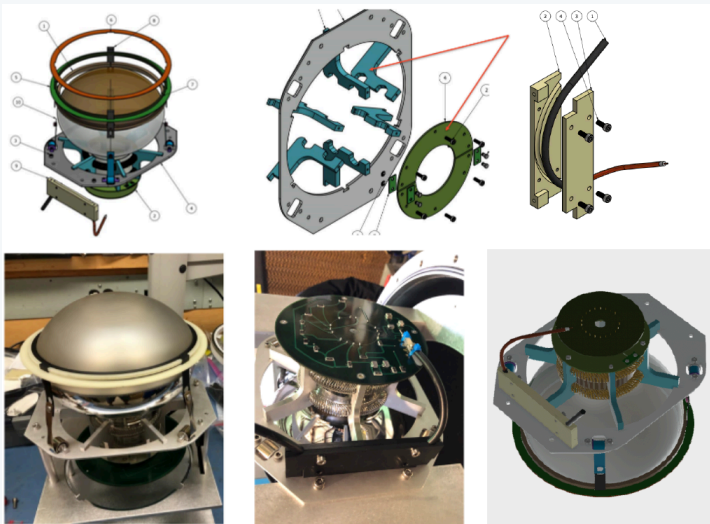
The sequence below follows the work from component construction and liquid-argon testing through detector integration, installation, commissioning, monitoring and whole-detector characterization.

STAGE

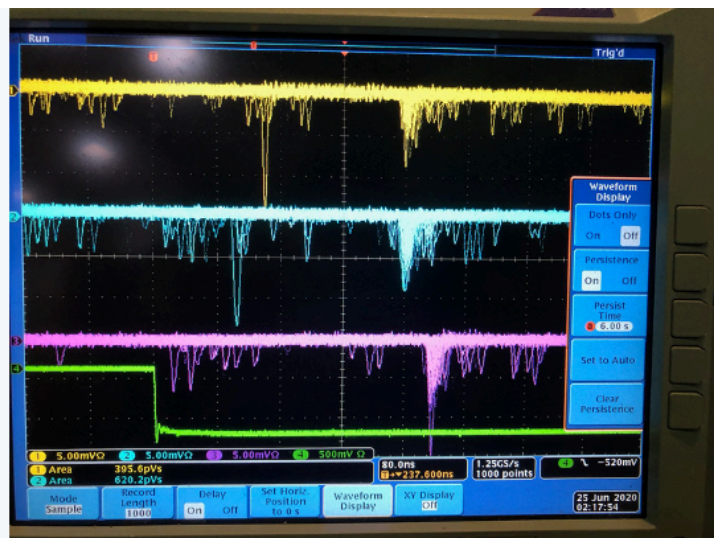
01

PMT construction & bench testing

Individual photomultiplier assemblies were built and checked before detector integration. This included the PMT mechanical support, base / high-voltage hardware, cabling interfaces and direct oscilloscope checks of PMT signal behavior.



PMT mechanical / electrical assembly and support hardware.



Representative oscilloscope response during PMT-level testing.

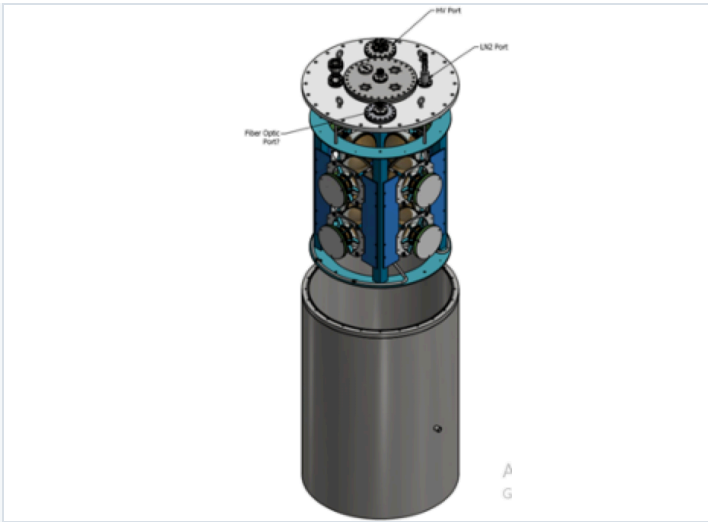
STAGE

02

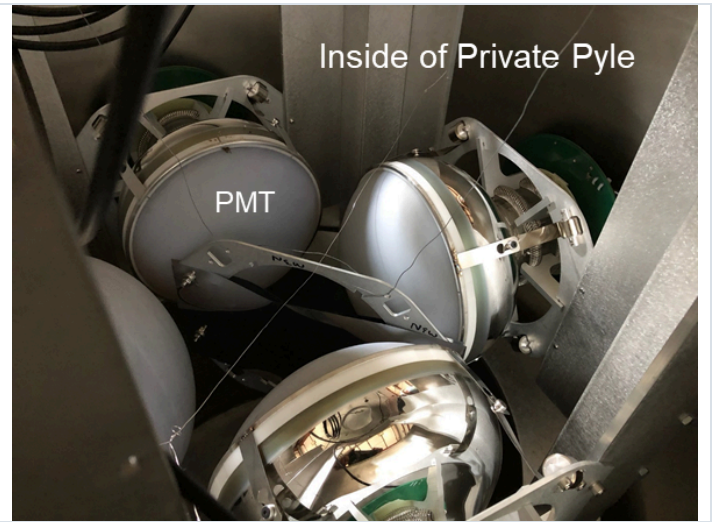
Component-level testing in liquid argon

A smaller vacuum-jacketed liquid-argon cryostat ("Private Pyle") was used to reproduce detector conditions before changes were implemented in CCM. PMTs, high-voltage / cabling components, optical hardware and wavelength-shifting materials could be tested at component scale.

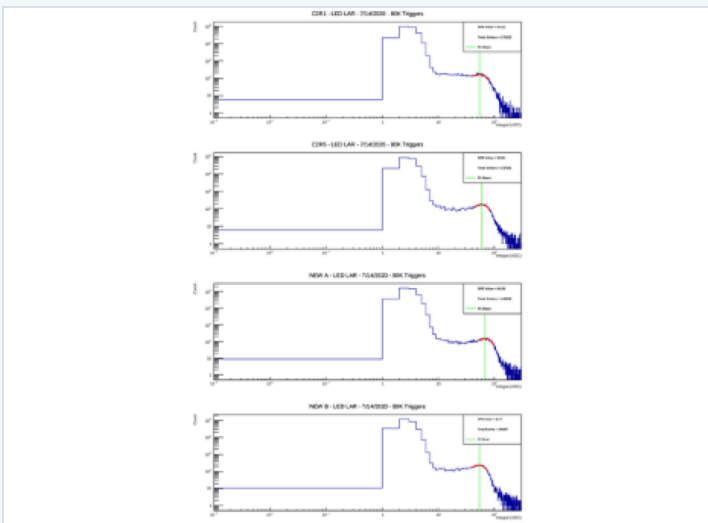
Test sources: ambient background, LED illumination, radioactive calibration sources and a Class 4 laser were used to characterize detector response and compare candidate components / configurations.



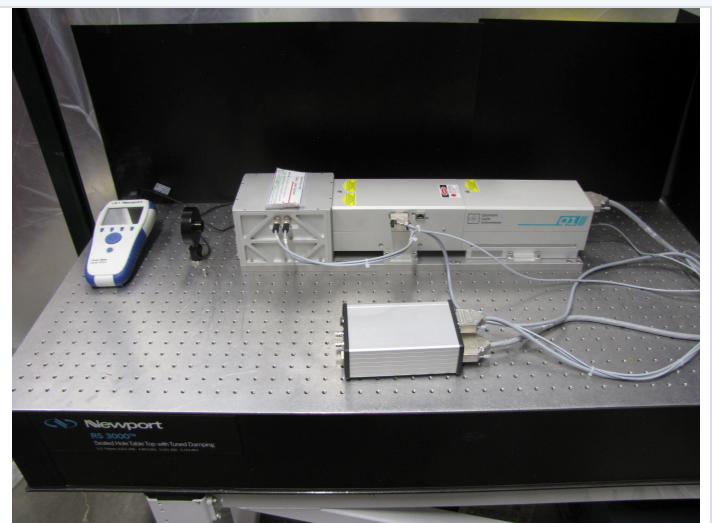
Private Pyle test-cryostat CAD.



PMTs installed inside the test cryostat.



Representative PMT-rate / trigger response plots.



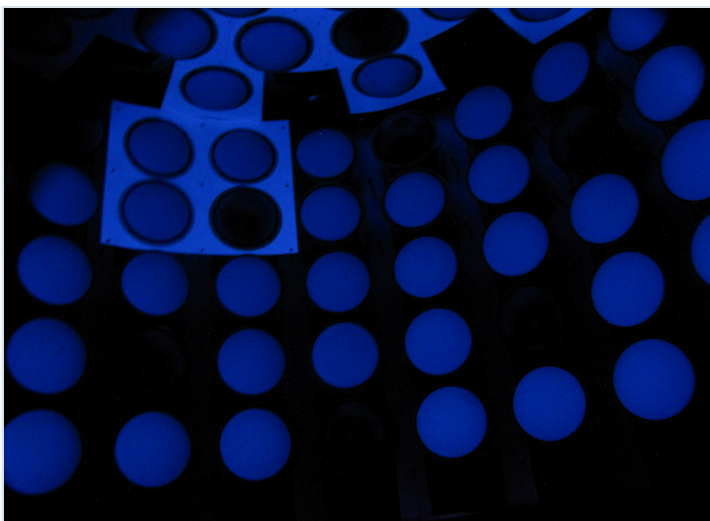
Class 4 laser used for optical characterization and calibration work.

STAGE

03

PMT integration into the detector

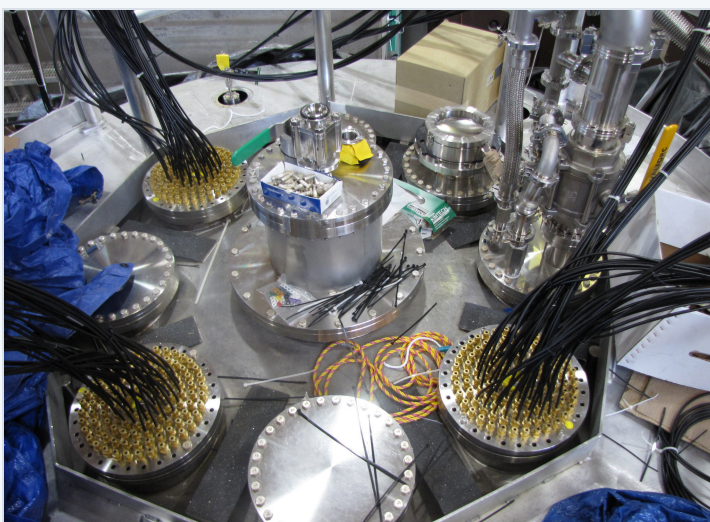
Qualified PMT assemblies were integrated into the detector with their high-voltage / signal cabling and feedthrough infrastructure. Testing then moved from individual assemblies to groups of installed channels so response and detector-level integration problems could be found before final installation.



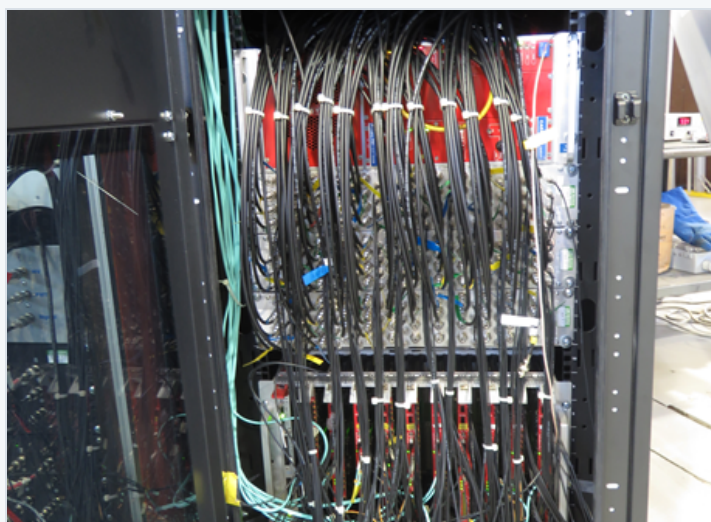
Installed PMT array during detector-level optical / integration work.



Additional detector-integration view during PMT installation / checkout.



PMT cabling and detector-top feedthrough integration.



Detector electronics / cabling infrastructure supporting channel checkout and DAQ integration.

STAGE

04

Detector installation at the Lujan Center

After assembly and subsystem checkout, the completed detector package was lifted and installed into the CCM cryostat / experimental position using a mobile crane that was driven into the experimental building. Installation required coordination across rigging, detector hardware, cabling, cryogenic interfaces and the surrounding experimental area.



CCM detector installation using a mobile crane inside the Lujan Center experimental building.

STAGE

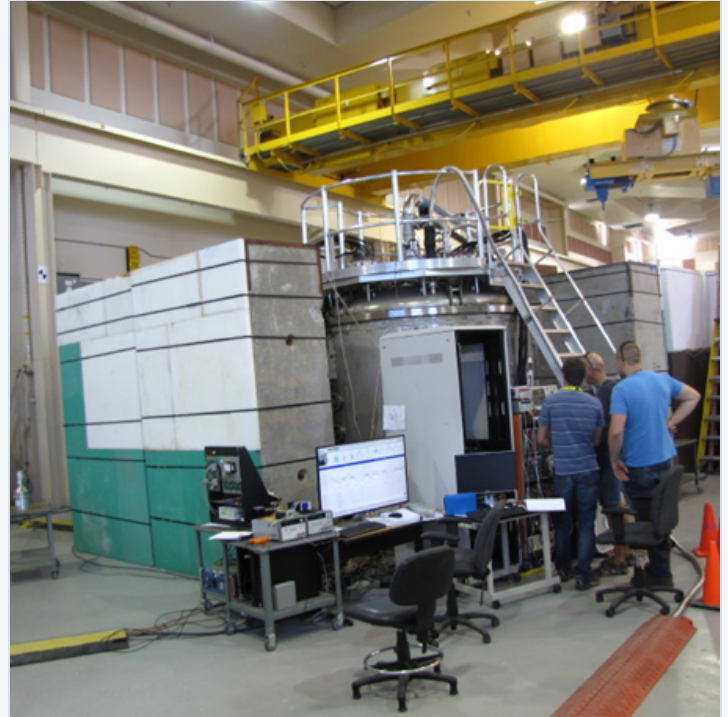
05

Initial detector commissioning in the experimental area

With the detector installed, testing shifted to the complete experimental configuration. The immediate goal was straightforward but important: determine whether the fully assembled detector, DAQ, instrumentation and surrounding experimental systems behaved correctly together after installation.



CCM experimental area and shielding environment.



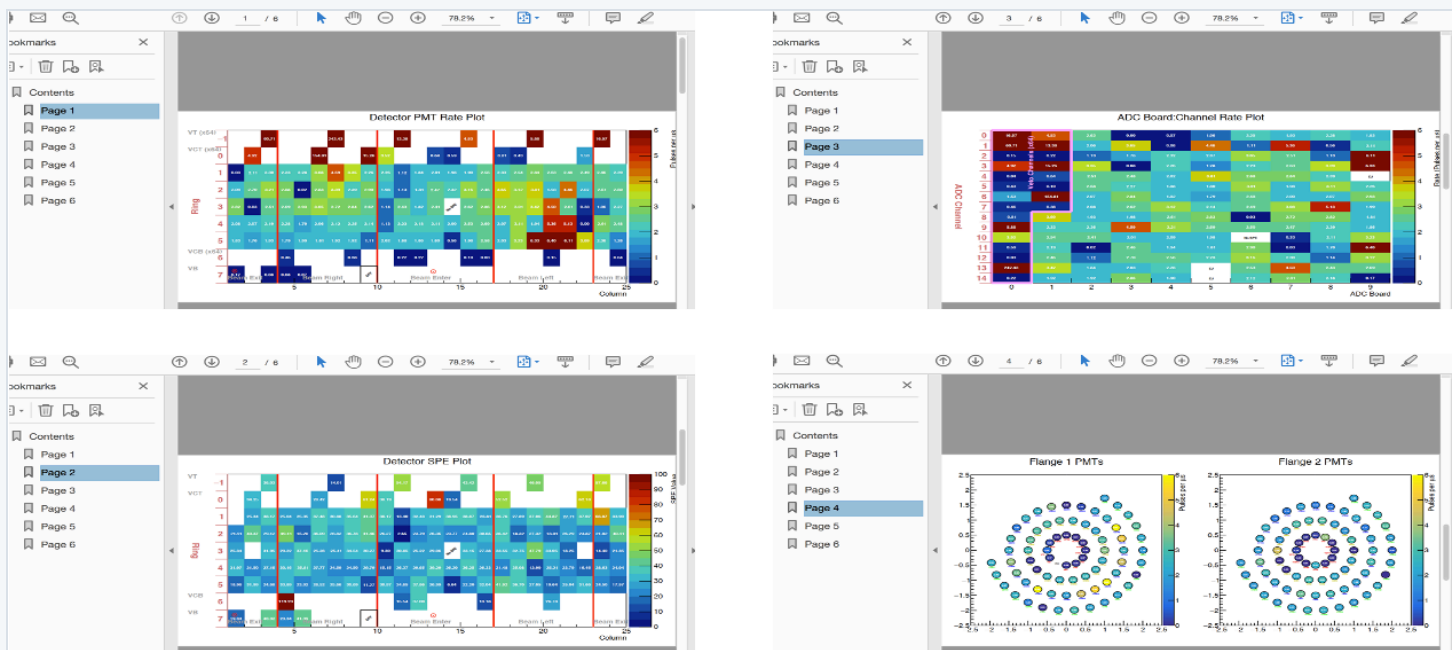
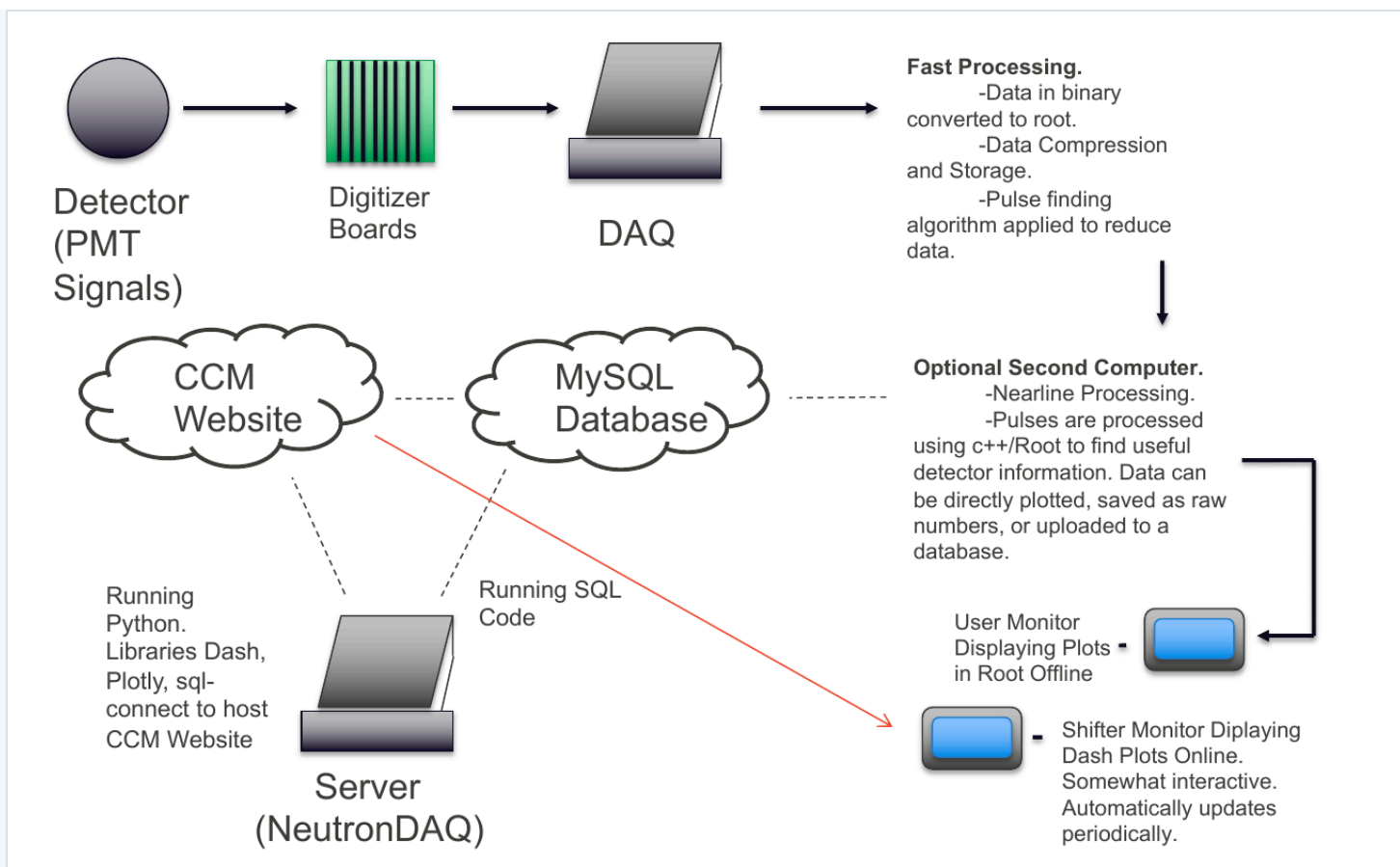
Detector in its installed configuration during early checkout / commissioning.

STAGE

06

Nearline processing for detector troubleshooting

I developed nearline visualization tools so detector behavior could be evaluated at the PMT, detector, ADC-board / channel and flange levels rather than troubleshooting only from raw waveforms. This made channel-to-channel problems and spatial patterns much easier to recognize during commissioning and operations.



Nearline views of detector PMT rates, SPE values, ADC board / channel rates and flange-level PMT behavior.

STAGE

07

Online monitoring for detector operations

Processed detector and environmental information was moved into a MySQL database and exposed through a web interface. This made detector-status information available online to experiment personnel and shift operators rather than limiting it to local analysis tools.



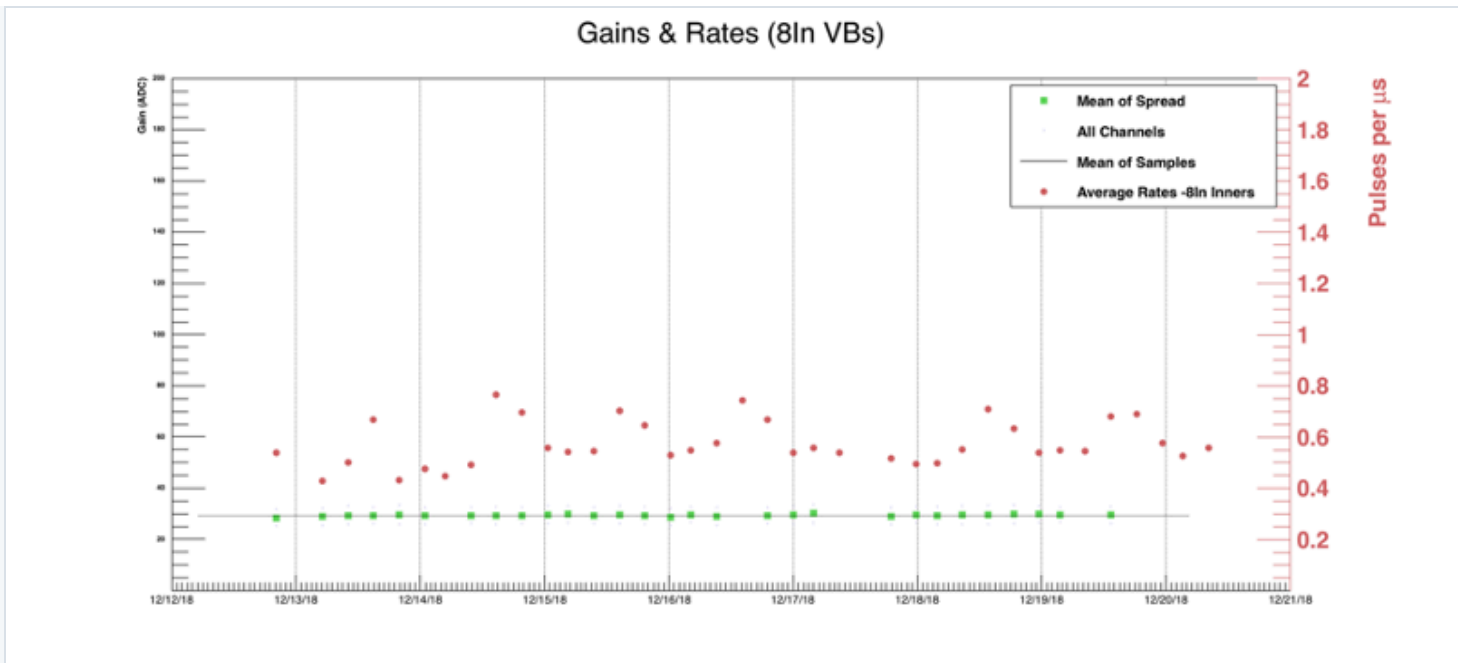
Online detector / environmental monitoring made available through the CCM web interface.

STAGE

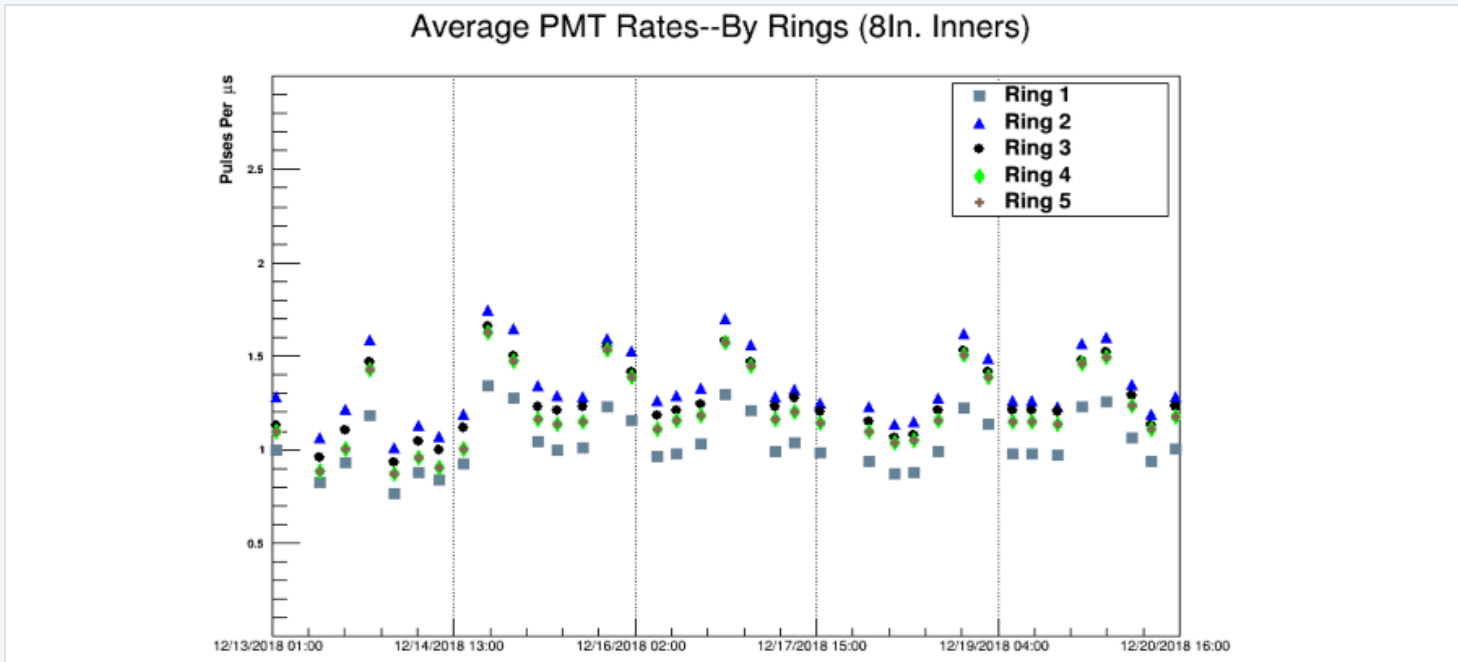
08

Whole-detector characterization & response over time

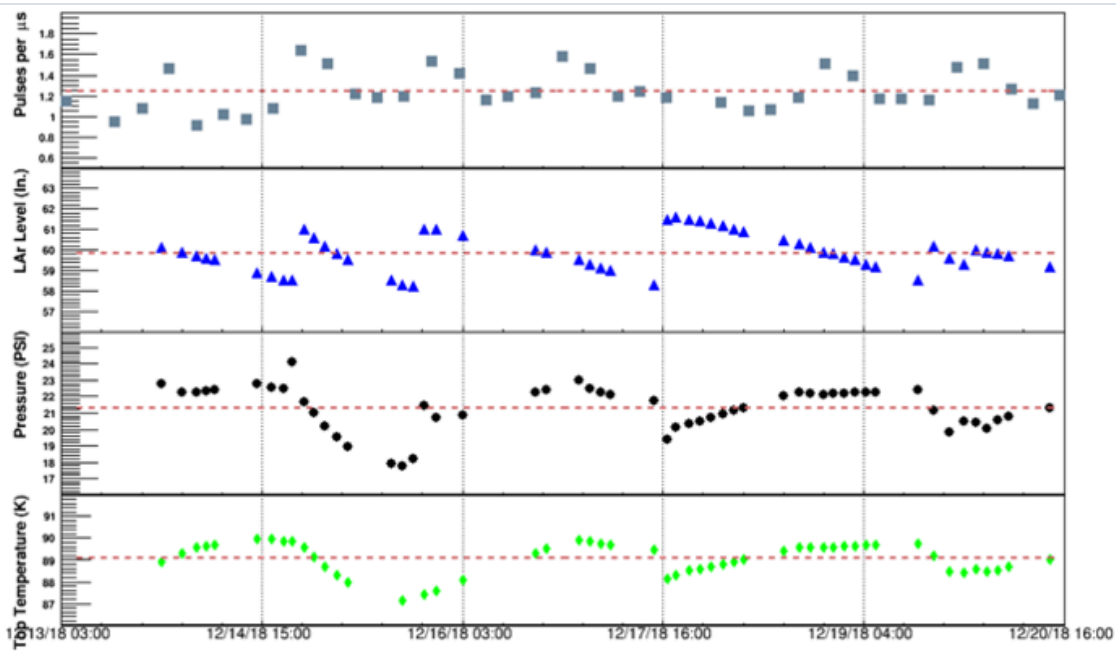
Once individual channels and subsystems were functioning, analysis shifted toward detector-wide behavior over longer periods. Gain and rate stability were evaluated across channels and detector regions, and PMT-rate trends were compared against liquid-argon level, pressure and temperature so changes in detector response could be separated from environmental or operating-condition effects.



Gain / rate stability across detector channels over time.



Average PMT-rate behavior by detector ring over multiple days.



Detector response compared with liquid-argon level, pressure and temperature over time.

COMMISSIONING EXAMPLE

Using monitoring data to trace a detector-wide rate oscillation

During operation, PMT rates showed a repeating daily pattern. Comparing channel behavior and environmental timing pointed toward a light-related effect rather than a detector-wide electronics failure. Physical testing while watching the rates ultimately identified non-opaque fiber-optic through-port caps as the light-entry path. Covering the caps removed the identified leak mechanism.

RECOGNITION

**Coherent Captain Mills Experiment Team — LANL
Large Team Award**

The CCM team was recognized by Los Alamos for rapidly designing and operating a functioning particle-physics experiment using the 800 MeV LANSCE proton beam and the 10-ton liquid-argon detector. Terrance Schaub is listed among the Physics team members in the LANL award publication.

[View LANL award publication →](#)

PUBLISHED FEATURE

Scientific American

2020 · SCIENTIFIC AMERICAN

Hidden Neutrino Particles May Be a Link to the Dark Sector

Feature article on the CCM experiment, including published imagery of my detector work.

[Open article →](#)

Terrance Schaub

Experimental systems · commissioning ·
instrumentation & controls

Private draft · LANL-related material remains subject to
external-use review.

TERRANCE SCHAUB

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CROSS-PROJECT TECHNICAL CAPABILITY

Controls, DAQ & Instrumentation

Systems that make experimental hardware observable, diagnosable, controllable and usable by operators.

PLC / HMI

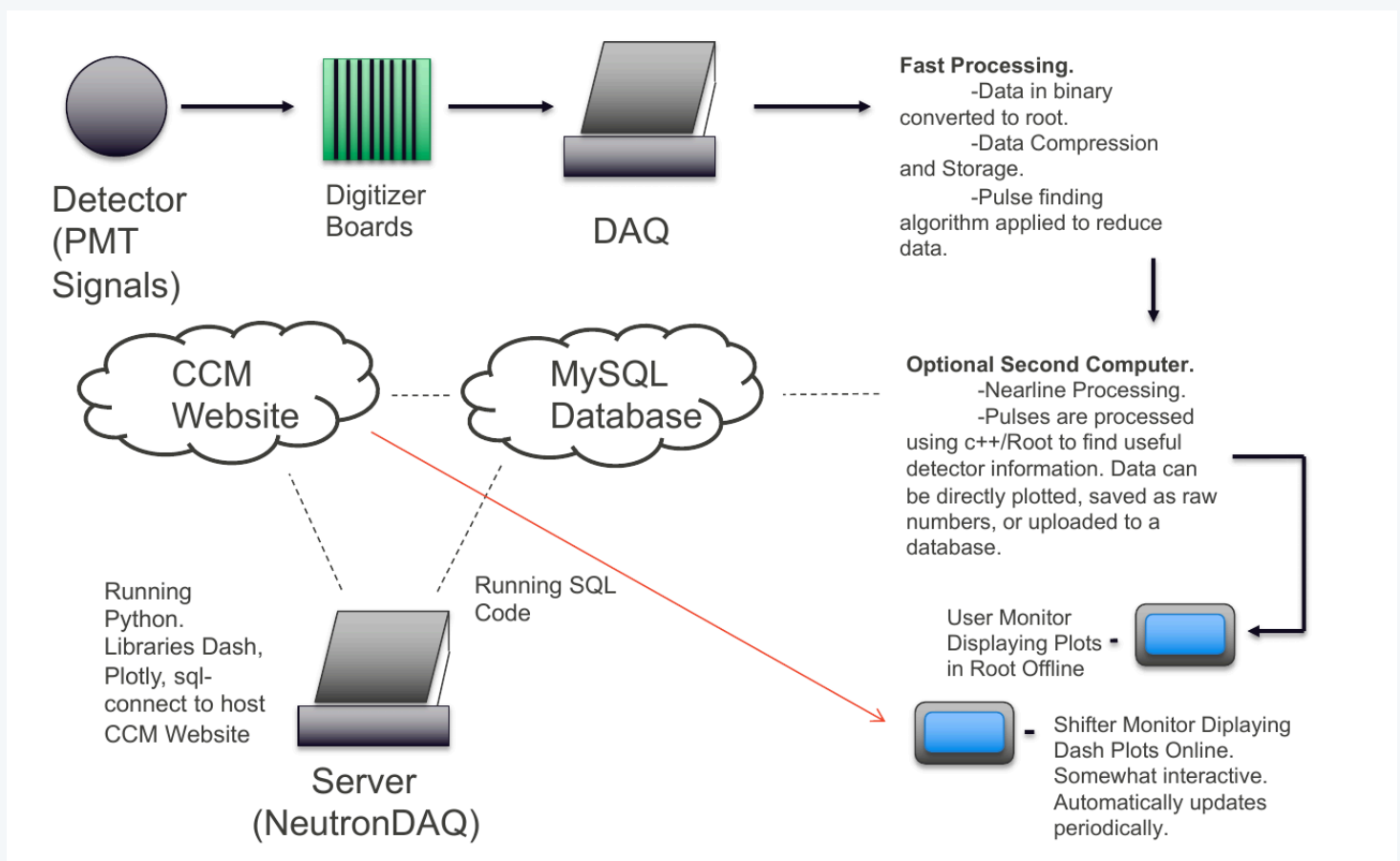
4-20 mA

DAQ

SQL

Python

Interlocks



CCM EXAMPLE

Detector signal → DAQ → database → operator display

The CCM monitoring design I presented used digitizer boards and DAQ for PMT signals, fast/nearline processing, a MySQL database, and a Python Dash/Plotly website for online visualization.

SIGNAL

PMTs & digitizers

Detector waveforms acquired through digitizer boards and DAQ.

PROCESSING

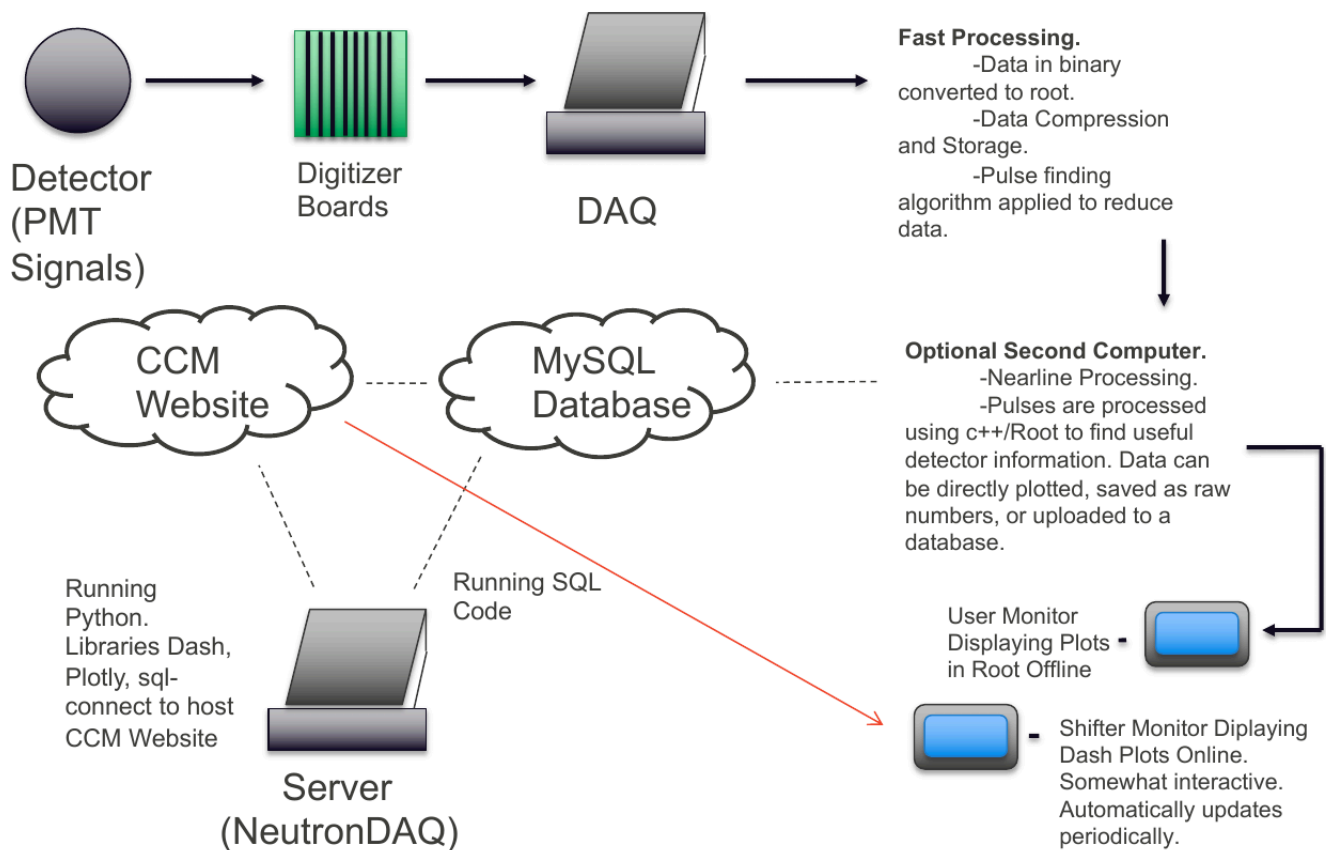
C++ / ROOT + nearline analysis

Pulse finding and derived detector quantities generated from the acquired data.

OPERATIONS

MySQL + Python Dash / Plotly

Selected values stored and presented as online plots for users and shifters.



[Click to inspect the architecture slide full-size.](#)

Cross-project controls work

PLC / HMI

Schneider M340 systems, analog/digital I/O, structured control logic, HMI interfaces, manual/automatic operation, timers and interlocks.

Instrumentation

Pressure, temperature, flow, valve-position and other process measurements; 4–20 mA and 0–10 V signals; scaling and calibration workflows.

Communications

Microcontrollers

RS-232 and Modbus TCP integration, device polling, logging and offline control-network configuration.

Arduino-class systems and SSR/relay interfaces used for experimental prototypes and first-pass controls.

DAQ / Trending

Waveform acquisition, nearline analysis, Python logging, database integration and diagnostic trending.

Commissioning

Using measured system state to verify prerequisites, isolate faults, confirm interlocks and document actual equipment behavior.

LASER / INTERLOCK EXAMPLE

Remote control, optimization and engineered safety

For CCM/SBND laser work, the system supported remote GUI control and external triggering. I also documented and worked with a fully interlocked protective enclosure in which opening the lid interrupted laser operation.

Laser model Q1B-10-FIH-ATTN-1064
Serial #Q118252
Firmware v3.0.3
CPU: 1.82% / RAM: 0.75%

Q1 laser monitoring and control panel

Main	Batch Mode	SH Attenuator	FiH Attenuator	Harmonics	Service	Help
Module type: FiH/SH						
SH temperature: 45.75 °C						
Set SH temperature: Set Save as default						
FH temperature: 50.3 °C						
Set FH temperature: Set Save as default						
FiH temperature: 44.71 °C						
Set FiH temperature: Set Save as default						
On time: 1286:40:22						
STATUS: WARMING UP Start laser Stop laser						
19 Jul 03 19:22:54:9250991] Quantas INFO: LD1 pump current adjusted to 120.00 A [Jul 03 19:22:43:972165] Quantas INFO: LD1 pump current adjusted to 120.60 A [Jul 03 19:22:54:988265] Quantas INFO: LD1 pump current adjusted to 121.14 A [Jul 03 19:23:07:5944] Quantas INFO: LD1 pump current adjusted to 121.67 A						

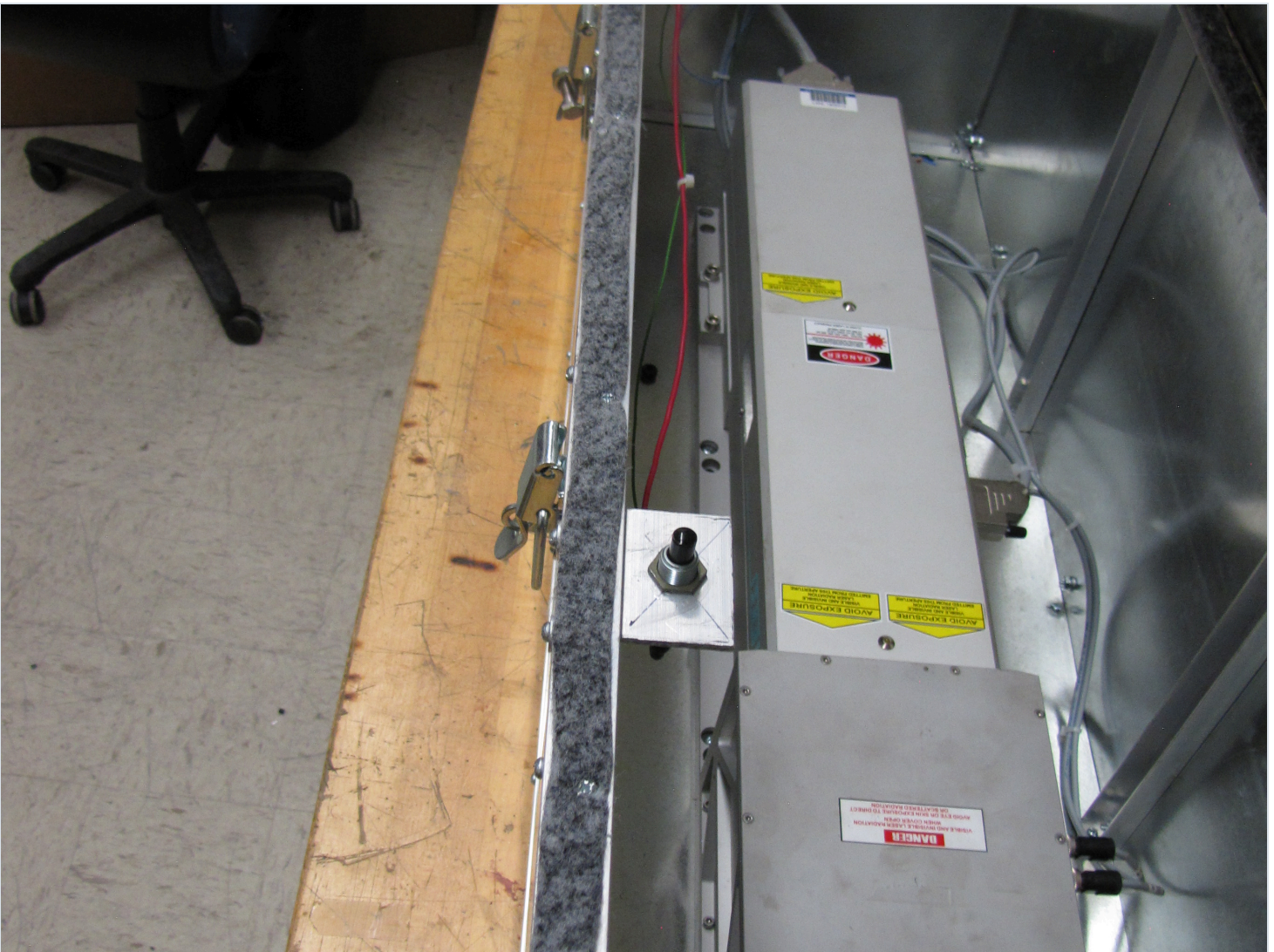
Clear messages

©2017-2018 Quantum Light Instruments Ltd.

Laser monitoring / control GUI.



Protective interlocked laser enclosure.



Enclosure interior / interlock hardware.

Design for diagnosis

I value enough instrumentation and state feedback to distinguish an actual process event from a bad sensor, reconstruct the sequence that produced a failure, and identify the subsystem that should be investigated next.

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TECHNICAL & SAFETY READINESS

Training & Qualifications

Selected technical and safety training completed in support of experimental-system construction, commissioning, and operations at Los Alamos National Laboratory.

- | | |
|-----------------------------|------------------------------------|
| — Primary Beam Access Areas | — Laser Safety — Class 3B & 4 |
| — Radiological Worker II | — General Radiological Worker |
| — Radioactive Sealed Source | — Energized Electrical Work |
| — Electrical Safety | — Advanced Pressure Systems |
| — Pressure & Vacuum Systems | — Cryogenic Person in Charge (PIC) |
| — Cryogen Safety | — Gas Cylinder Safety |
| — Chemical Hazard Safety | — Security |

— **Building-Specific Emergency Response**

— **Forklift Operator**

— **Crane Operator**

— **Designated Purchaser**

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external-use review.

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PUBLICATIONS & TECHNICAL OUTPUT

Selected scientific publications

Peer-reviewed papers, proceedings and public technical work connected to my experimental physics, accelerator, ultracold-neutron and machine-learning projects.

CCM / PARTICLE PHYSICS

Coherent CAPTAIN-Mills

2023 · PHYSICAL REVIEW D

Prospects for detecting axionlike particles at the Coherent CAPTAIN-Mills experiment

What it asks: Could CCM detect axionlike particles (ALPs) produced in the LANSCE beam dump? **Method:** Uses CCM engineering-run backgrounds to project sensitivity to ALPs produced through photon- or electron-coupled processes and detected through gamma-ray-producing interactions or decays in liquid argon. **What makes it different:** Rather than looking for nuclear recoils from dark matter, this study repurposes CCM as a beam-dump detector for ALP signatures and projects the reach of the upgraded CCM200 detector.

Open →

2022 · PHYSICAL REVIEW D

First dark matter search results from Coherent CAPTAIN-Mills

What it asks: Did the 2019 CCM120 engineering run contain a coherent-scattering signal consistent with light dark matter or sterile-neutrino-related physics? **Method:** Analyzes the first 10-ton liquid-argon engineering data taken near the Lujan source and compares the observed event population with expected backgrounds and signal models. **What makes it different:** This is the broader first-results paper: it documents detector operation, the engineering-run analysis and how those lessons drove the transition from CCM120 to the 200-PMT CCM200 detector.

Open →

2022 · PHYSICAL REVIEW LETTERS

First Leptophobic Dark Matter Search from the Coherent-CAPTAIN-Mills Liquid Argon Detector

What it asks: Is there evidence for light dark matter that couples primarily to baryonic matter rather than leptons? **Method:** Searches the 2019 CCM120 data for coherent elastic scattering of accelerator-produced dark-matter candidates from argon nuclei, using the detector's light-based response, beam timing and background model. **What makes it different:** This paper focuses specifically on the leptophobic/baryonic-vector model and converts the null result into exclusion limits for previously unexplored light-dark-matter parameter space.

Open →

2020 · SCIENTIFIC AMERICAN

Hidden Neutrino Particles May Be a Link to the Dark Sector

Public-facing overview: Scientific American explains the motivation behind CCM, the stopped-pion neutrino source and the idea of searching for sterile neutrinos and connections to a possible dark sector. Unlike the research papers on this page, this is a magazine feature rather than an authored technical publication; it provides an accessible picture of the experiment and its scientific goals.

Open →

Ultracold-neutron systems

2026 · PHYSICAL REVIEW C

High-voltage and electrode system for a cryogenic experiment to search for the neutron electric dipole moment

What it asks: Can the cryogenic nEDM concept achieve the very high electric fields needed for a substantially more sensitive neutron electric-dipole-moment measurement?

Method: Develops and experimentally demonstrates high-voltage, electrode and supporting technologies for operation in superfluid helium while meeting heat-load and magnetic-noise constraints. **What makes it different:** This is an enabling-technology paper rather than a physics-result paper; its focus is making a future nEDM measurement at fields up to 75 kV/cm technically possible.

[Open →](#)

2025 · PREPRINT

Detection of ultracold neutrons with powdered scintillator screens

What it asks: Can faster scintillator materials improve ultracold-neutron detection compared with conventional ZnS:Ag screens? **Method:** Fabricates and tests YAP:Ce and LYSO:Ce powdered scintillator screens, comparing decay time, phosphorescence, light response and measured UCN counts with ZnS:Ag. **What makes it different:** This is a detector-development study focused on improving UCN counting performance; YAP:Ce showed the strongest overall performance of the alternatives tested.

[Open →](#)

Study for Alternative Cavity Wall and Inductive Insert Material

What it asks: How can material choices help control longitudinal beam instability in the LANSCE Proton Storage Ring as beam conditions become more demanding? **Method:** Studies alternative cavity-wall and inductive-insert materials in the context of impedance, beam stability and planned shorter, higher-instantaneous-power proton bunches. **What makes it different:** Unlike the detector papers, this is accelerator R&D focused on the machine that creates and conditions the proton beam.

Open →

MACHINE LEARNING / IMAGING

Scientific computing

Unsupervised learning about 4D features of microparticle motion

What it asks: Can unsupervised machine learning discover useful motion features directly from high-speed scientific imagery? **Method:** Applies a deconvolutional neural-network / locally competitive learning approach to synchronized two-camera videos of microparticles produced by exploding wires, learning features related to local velocity and time-dependent 3D motion. **What makes it different:** This work is computational rather than nuclear-detector hardware, using machine learning to extract physical structure from large imaging datasets without hand-labeling every feature.

Open →

This page currently includes the publications and proceedings I have confirmed from public records. It can be expanded as additional records are identified.

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DOCUMENTATION · PROVENANCE · PUBLIC SOURCES

Sources & release information

Public references and LANL unlimited-release (LA-UR) records associated with work shown in this portfolio.

LANSCCE ULTRACOLD NEUTRON FACILITY

UCN Facility Sources

Public overview

Los Alamos National
Laboratory

UCN Experiments — overview of the experiments hosted by the
LANSCCE Ultracold Neutron Facility, including UCN τ

UCN τ / UCN τ +

UCN τ Sources

2022

CERN EP Seminar · Steven
Clayton

Precision Measurements of the Neutron Lifetime with UCN τ —
apparatus, Halbach trap, dagger and experimental imagery

2017

Review of Scientific
Instruments

A New Method for Measuring the Neutron Lifetime Using an In
Situ Neutron Detector — dagger detector construction and
readout

LA-UR-24-29579 2024 / Phys. Rev. C	Measurement of the Free Neutron Lifetime in a Magneto-Gravitational Trap with In Situ Detection — experimental layout and later dagger-detector configuration
LA-UR-25-26458 2025 · Los Alamos National Laboratory	New Measurement of Free Neutron Lifetime Achieves World-Record Precision — UCN τ results, UCN τ + elevator installation imagery and upgrade description
2024 NCSU dissertation	UCN τ + Upgrade — detailed elevator geometry, loading-volume CAD and technical context

NEDM / LOS ALAMOS NEUTRON ELECTRIC DIPOLE MOMENT EXPERIMENT

nEDM Sources

LA-UR-26-27764 2026	Overview of the LANL nEDM Experiment
LA-UR-26-27805 2026	Magnetic Impurity Scanner for the Los Alamos nEDM Experiment
2023 Nuclear Instruments and Methods A	Characterization of the New Ultracold Neutron Beamline at the LANL UCN Facility
Public overview University of Illinois	nEDM Experiments — nEDM@LANL
LA-UR-22-27810 2022	The LANL nEDM Experiment — Takeyasu Ito (apparatus CAD, vacuum chamber, precession chambers and UCN-valve imagery)

2023
nEDM2023 presentation

The Los Alamos National Laboratory nEDM Experiment — Felicity Hills (downloadable presentation material)

CAVALLO / CRYOGENIC HIGH VOLTAGE · NEDM@SNS

Cavallo Sources

LA-UR-26-24570
2026

Demonstration of 255-kV High-Voltage Generation with a Cavallo Multiplier System

2026
arXiv / NIM-A manuscript

Electrode Design for a Cavallo High Voltage Multiplier in a Cryogenic nEDM Experiment

2023
nEDM2023

Cavallo High Voltage Multiplier for the nEDM@SNS Experiment — Steven Clayton

2018
Journal of Instrumentation

Cavallo's Multiplier for in situ Generation of High Voltage

LA-UR-25-31563
2025 / 2026 publication

High Voltage and Electrode System for a Cryogenic Experiment to Search for the Neutron Electric Dipole Moment — LANL accepted manuscript / Physical Review C

2024
Caltech dissertation

Creating the Electric and Magnetic Fields for the nEDM@SNS Experiment — Marie Blatnik (Cavallo apparatus, cryogenic prototype, test apparatus and field-mill development)

CCM / COHERENT CAPTAIN-MILLS

CCM Sources

LA-UR-19-30856 2019	Convincing Search for Sterile Neutrinos at LANL Coherent Captain-Mills (CCM) Experiment
LA-UR-20-29390 2020	Upgrades to the Coherent CAPTAIN Mills Experiment for the Upcoming CCM200 Run
LA-UR-21-24983 2021	First Dark Matter Search Results from Coherent CAPTAIN-Mills
LA-UR-21-28474 2021	Prospects for Detecting Axionlike Particles at the Coherent CAPTAIN-Mills Experiment
LA-UR-22-22687 2022	LANSCCE-PSR Short-Pulse Upgrade for Improved Dark Sector Particle Searches with the Coherent Captain Mills Experiment
LA-UR-25-26474 2025	Measurement of the Liquid Argon Scintillation Pulse Shape Using Differentiable Simulation in the Coherent CAPTAIN-Mills Experiment
2020 University of New Mexico	Searching for Sterile Neutrinos and Accelerator Produced Dark Matter with the Coherent CAPTAIN-Mills (CCM) Detector at the Los Alamos Neutron Science Center
2020 Scientific American	The Darkest Particles / Hidden Neutrino Particles May Be a Link to the Dark Sector

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PROFESSIONAL BACKGROUND

Experimental systems, commissioning & instrumentation

My work has sat at the boundary between physics experiments, engineering hardware, controls, fabrication and facility systems. I am strongest when a complicated physical system needs to be built, integrated, brought online and understood.

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Selected technical scope

- Vacuum and cryogenic systems
- Gas, pneumatic and hydraulic systems
- PLC / HMI and experimental controls
- Instrumentation, calibration and DAQ
- High-voltage and detector systems
- Superconducting magnets and beamline systems
- Rigging, crane/forklift and installation work
- System walkdowns, readiness and work-control processes

Working style

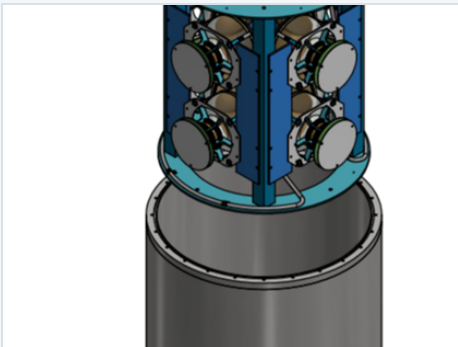
I tend to learn systems from the physical equipment outward: what it has to do, how the hardware is arranged, what the interfaces are, what the instrumentation says, and how the

system actually behaves during startup and operation.

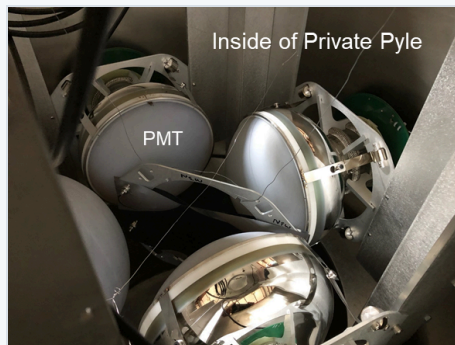
I work well with formal engineering specialists while contributing a field-oriented perspective on constructability, integration, diagnostics, commissioning and maintainability.

ADDITIONAL EXPERIMENTAL SYSTEMS

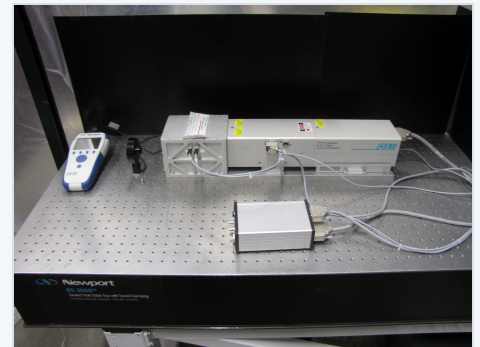
Smaller R&D work that shows end-to-end ownership



400-L LAr test cryostat used for PMT/component testing.



PMT test hardware inside the cryostat.



CCM/SBND laser characterization and optimization work.

Education & selected experience

Los Alamos National Laboratory — Research Technologist / experimental systems work across CCM, UCN and nEDM projects.

St. John's College, Santa Fe — B.A., Great Books curriculum with history of mathematics and science.

University of New Mexico — Graduate coursework in physics, electrical/computer engineering, computation and machine learning.

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