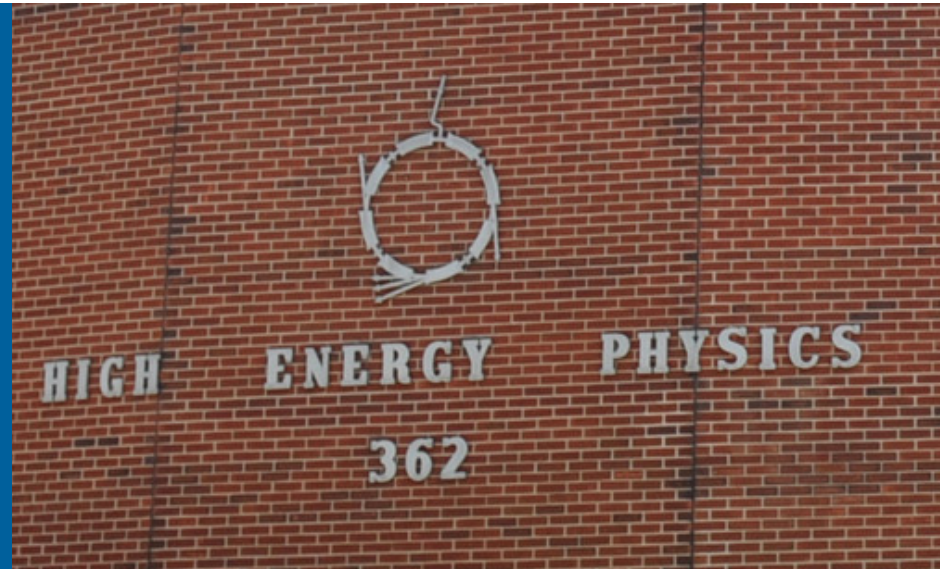


INDEPENDENT SAFETY REVIEW

HIGH ENERGY PHYSICS



MARCEL DEMARTEAU

Argonne High Energy Physics Division

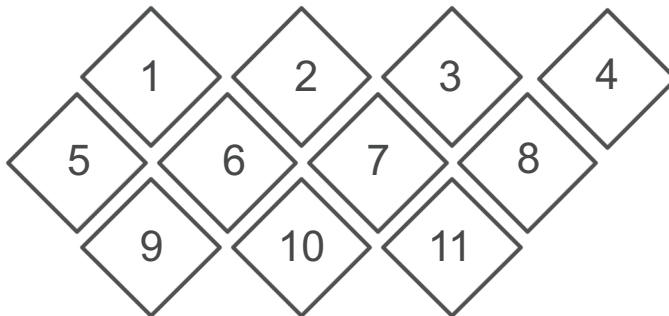
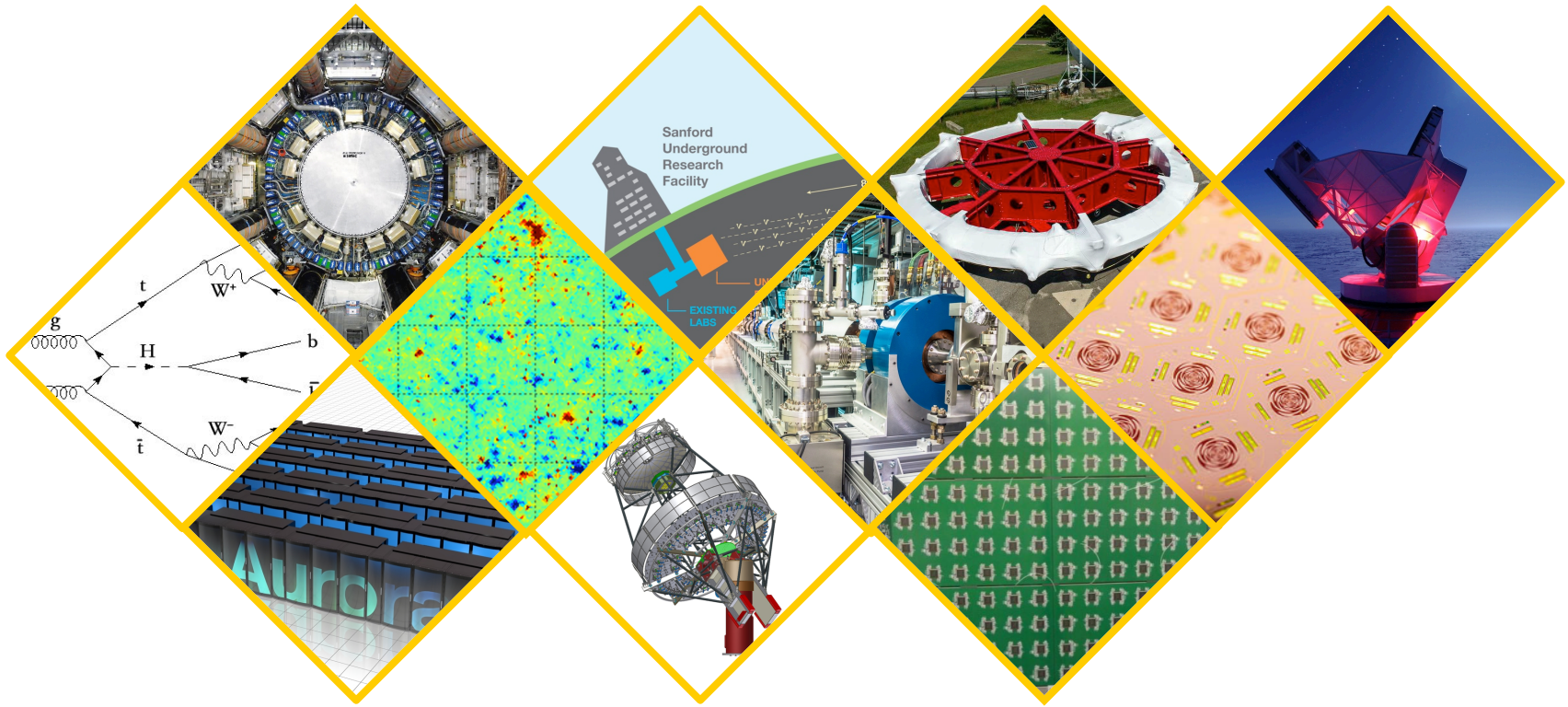
24 September, 2018
Argonne

OUTLINE

- HEP Division
 - Research Focus Areas
 - Organization Chart
- Types of Work in the Division, Core capabilities
 - Electronics Engineering
 - Mechanical Design and Assembly
 - Building infrastructure
 - Argonne Wakefield Accelerator
 - Magnet Facility
- Protocol
- Summary



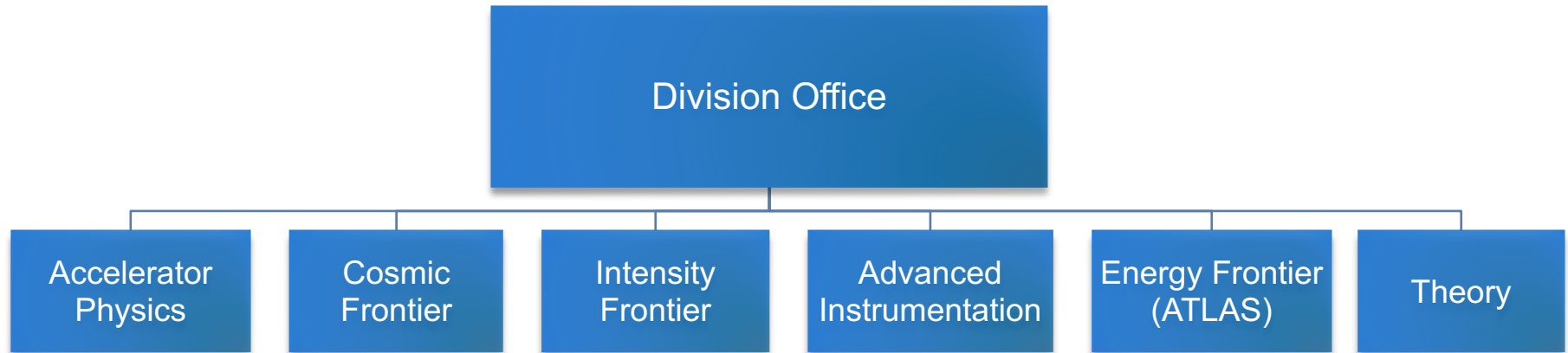
ARGONNE HEP DIVISION



- | | |
|---------------------|----------------------------|
| 1. Energy Frontier | 6. Computational Cosmology |
| 2. Neutrino Program | 7. Accelerator R&D |
| 3. Muon Program | 8. Instrumentation |
| 4. Cosmic Frontier | 9. Computational HEP |
| 5. Particle Theory | 10. Mechanical Support |
| | 11. Electronics Support |

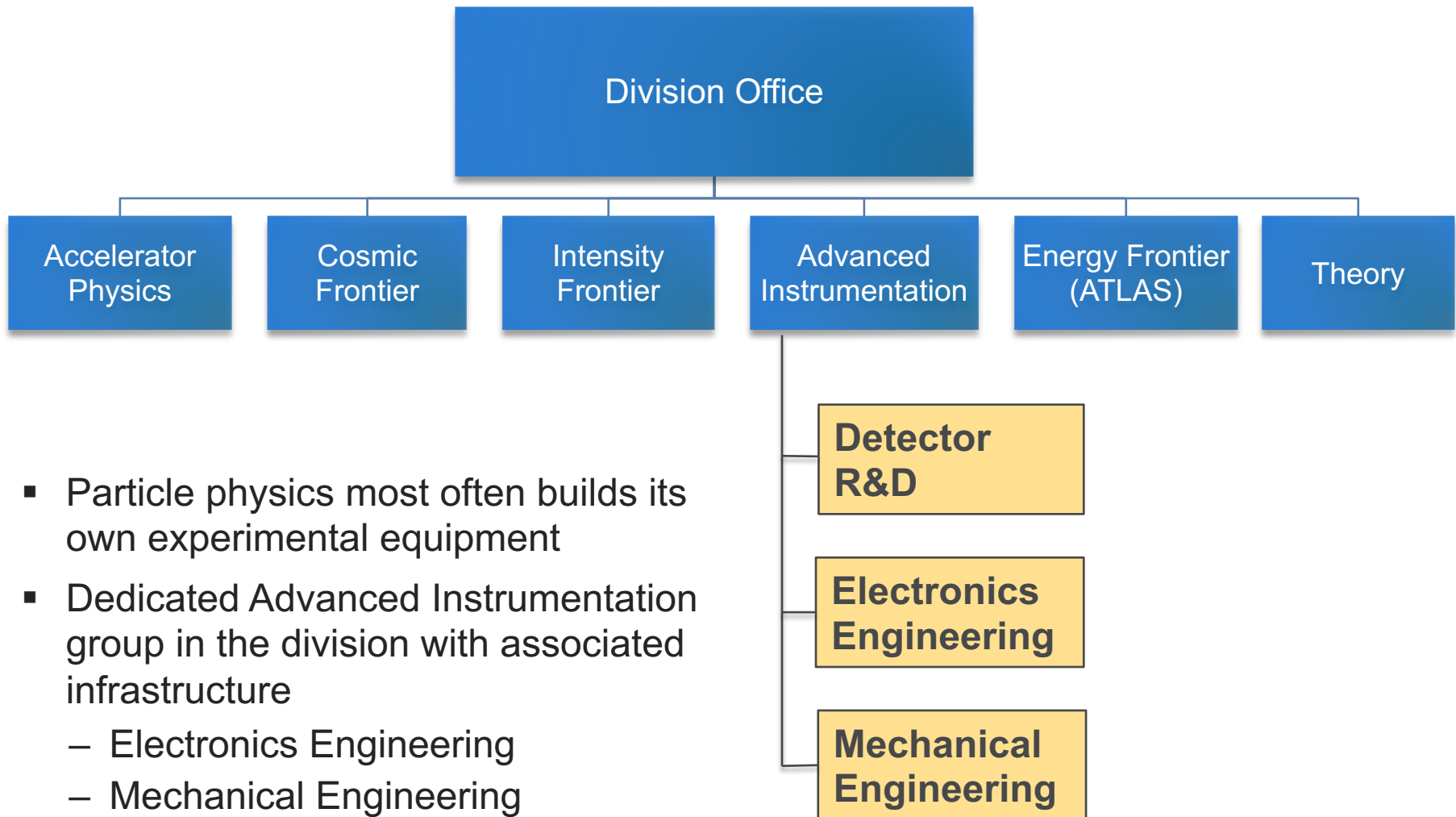
ORGANIZATION

Research Thrusts



ORGANIZATION

Research Thrusts



RESEARCH PROJECTS

Collaborating Experiments

- **ATLAS at the Energy Frontier:**
 - Broad experimental program in detector development and physics analysis
 - Close link with Theory and Advanced Scientific Computing
- **Experimental Cosmology: SPT-3G, CMB-S4**
 - Study of the Cosmic Microwave Background radiation and development of the sensors and readout.
- **Computational Cosmology, Advanced Scientific Computing and Theory**
 - Broad cosmic frontier program that enables and supports a wide range of future surveys (DES, DESI, LSST, CMB-S4, WFIRST). Develop synthetic sky catalogs and advanced statistical tool to unravel the underlying physics from the surveys.
- **Instrumentation and AWA:**
 - AWA as research program and user facility to study advanced acceleration techniques and beam dynamics
 - Detector development to remove technological barriers
- **Muon Program: g-2 and Mu2e experiment**
 - Broad experimental precision physics program; Observations (or lack thereof) need theoretical underpinning.
- **Neutrino Program: NOvA, protoDUNE and DUNE**
 - Studies of CP-violation in the neutrino sector and enable LAr technology

ELECTRONICS ENGINEERING

Core Capabilities

▪ High Speed Digital Design

- Data Acquisition
- Trigger Processors
- Computer Interfaces
- High-Speed Communications
- Design with Programmable Logic (FPGAs)
- VHDL Programming Language (Firmware)

▪ Front-End Design

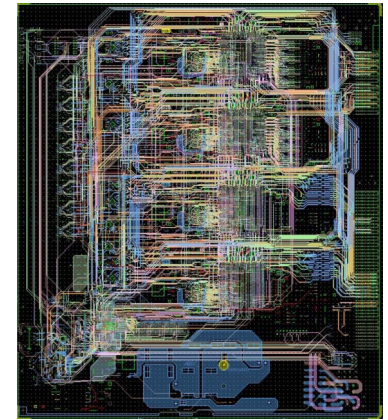
- Charge Amplifier, Preamplifiers
- Digitizers, Discriminators
- Development & Implementation of custom Integrated Circuits
- HV Power Supply, Switching Power Supply

▪ Printed Circuit Board Design

- Charge Amplifier, Preamplifiers
- Digitizers, Discriminators
- Development & Implementation of custom Integrated Circuits
- HV Power Supply, Switching Power Supply

▪ Fabrication and Assembly

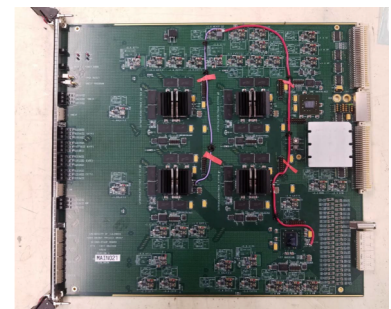
<http://www.anl.gov/hep/capabilities/electronics-design-and-fabrication>



Layout of the FLIC
18-Layer ATCA Board



SSP Boards for DUNE



Modified Second Stage
Board for Track Trigger

MECHANICAL ENGINEERING

Core Capabilities

- **Mechanical Design**

- Accelerator components, UHV, Clean Room, High Precision Positioning, Remote handling, Mechanisms, Machine Design, Automation

- **Analysis,**

- FEA -Thermal Stress, Structural , Heat Transfer
- CFD – Fluids (emphasis on conventional engineering problems)

- **CAD**

- Drafting, Animation, Presentation
- Design support (following through to shops)

- **Facility support**

- Equipment installation

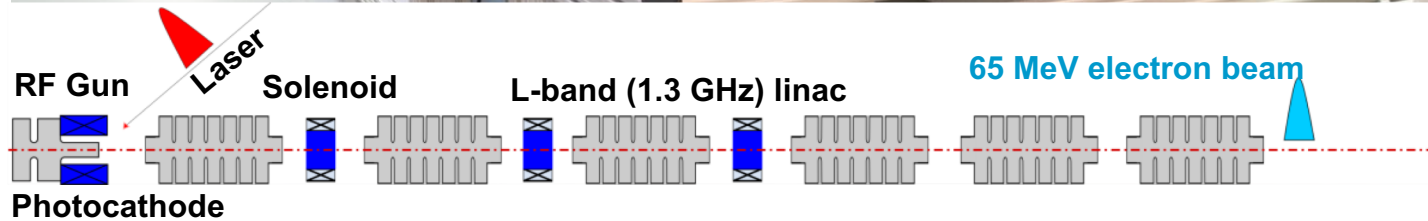
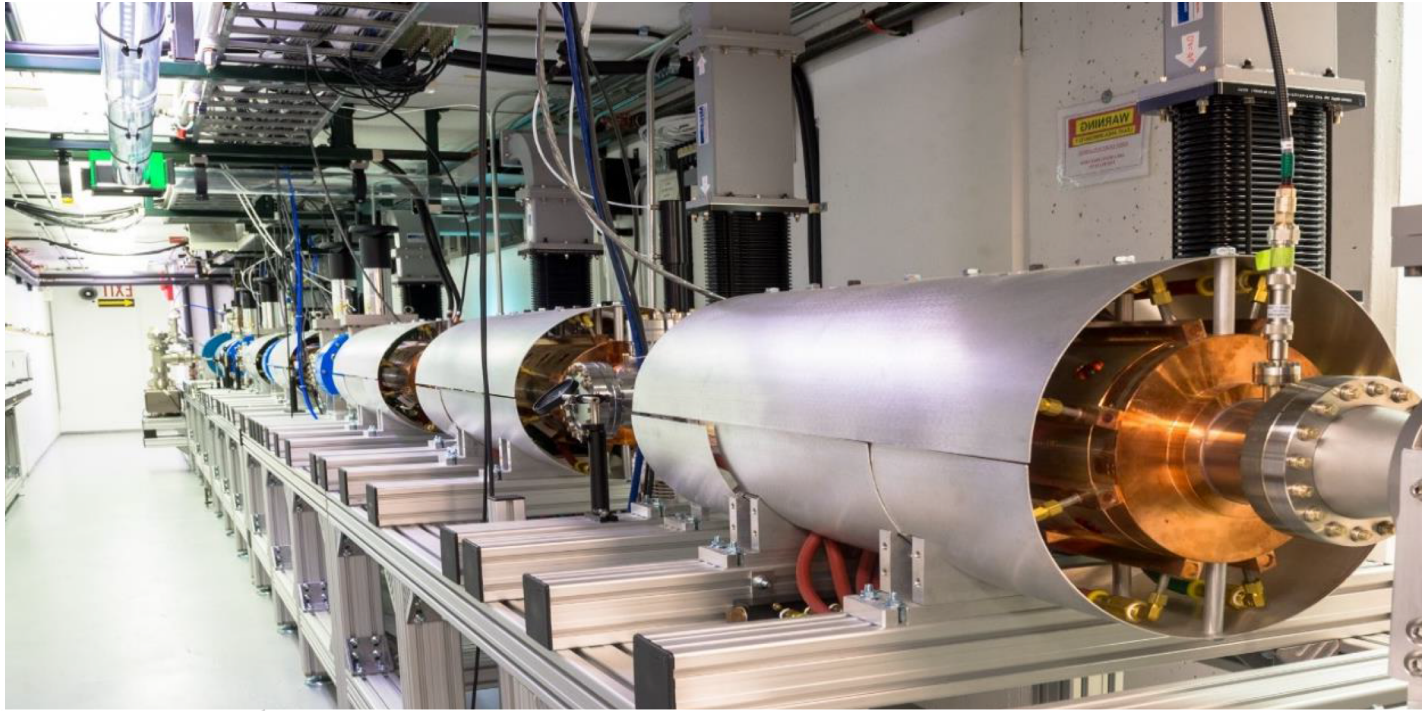


12m telescope structure at DESY



Structural design Schwarzschild-Couder CTA Telescope

ARGONNE WAKE FIELD ACCELERATOR



Single (sub)bunch charge: q_b	5 nC	10 nC
Bunch RMS length: σ_z (mm)	0.50	0.60
Form factor at 91 GHz: $F(\sigma_z)$	0.60	0.37
RMS beam size: σ_x (mm)	0.2	0.35

INFRASTRUCTURE

Building 366

- 22,000 square foot High-bay area with shop and crane access
- Key engineering contributions to:
 - ATLAS TileCal, MINOS, CHOOZ2, DES, NOvA, JUNO, Veritas, CTA, ...
 - Supports engineering projects for the lab as a whole.



NOvA Construction



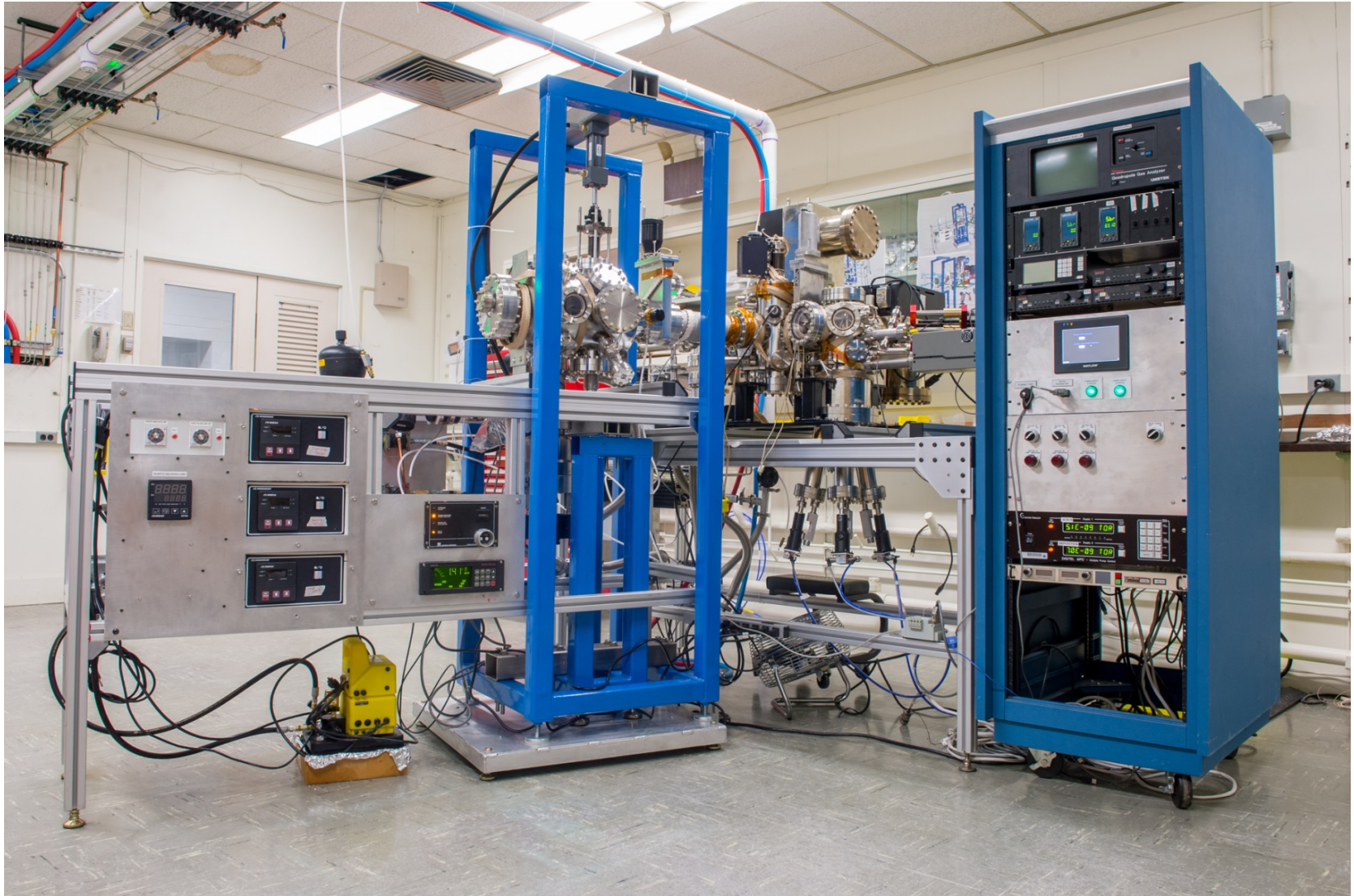
Cathode Plane Array Assembly in Building 366



Mu2e Cosmic Ray Veto Shield

INFRASTRUCTURE

Production Facility for photodetectors



INFRASTRUCTURE

4 Tesla Magnet Facility



HAZARDS

Diversity of Work and Protocol

- Each group faces a different set of hazards
 - Electronics: electric shock, HV
 - Mechanical: general mechanical hazards
 - Magnet: Magnetic fields, cryogenic systems
 - Cosmology: cryogenic systems
 - AWA: RF power, HV, radiation
 - Detector R&D: solvents, temperature, laser
- The HEP division has integrated Work Planning and Control, ESH, and Rad Protection programs, that allow efficient and safe operation for all operations in the division.
- Safety program very much a dialogue to establish work process control documentation
- DD has monthly impromptu “Observation Conversations” with staff to address general safety climate and areas for improvement



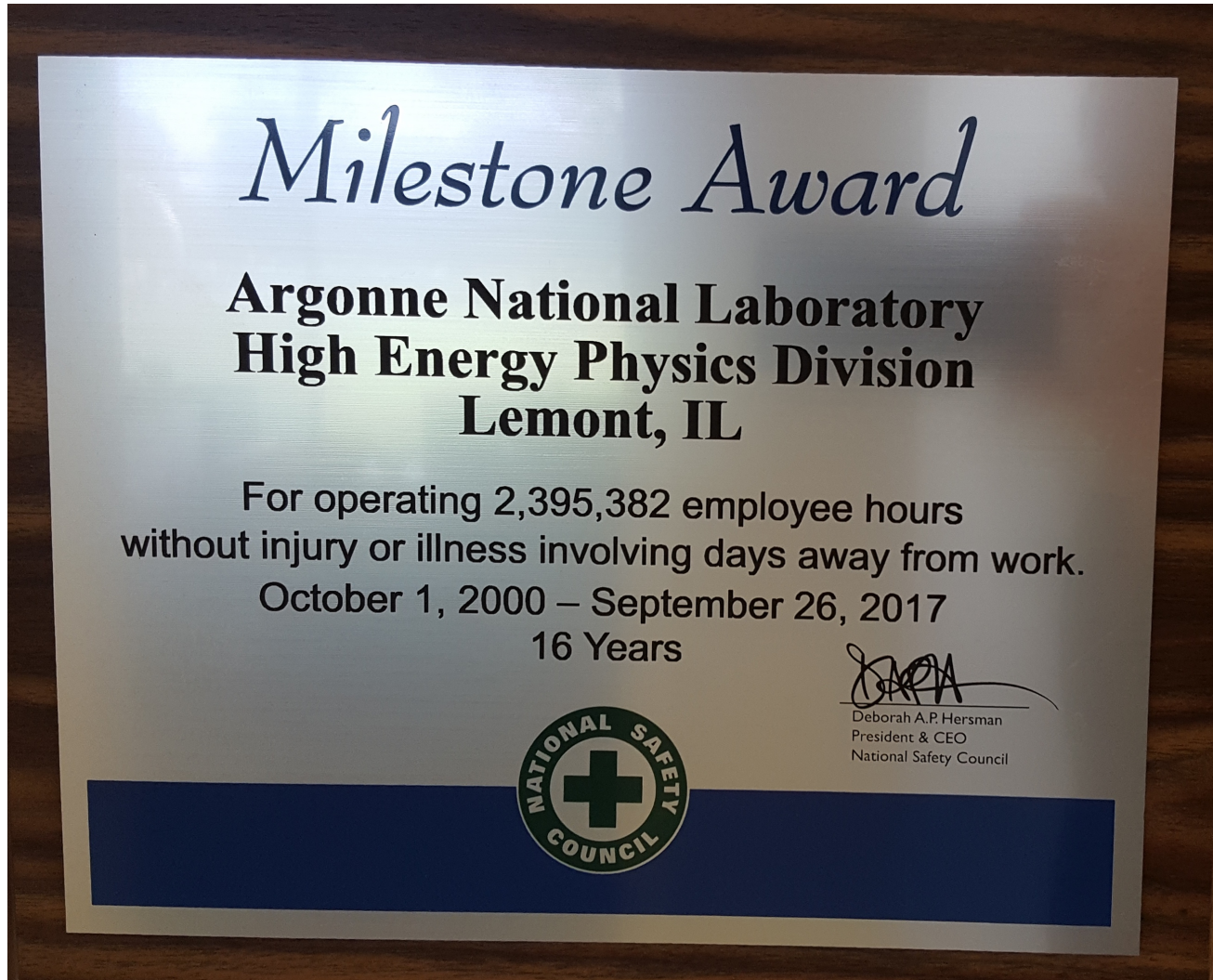
ALL HEP ACTIVITIES CAPTURED

Work Control Documents

- The Division has a local WCD that describes the details how the Division implements Work Planning and Control (WPC)
- All activities are then captured in a suite of Work Control Documents
 - WCD 46245 covers Daily Operations in Building 366
 - WCD 27979 covers the Daily Operations of the AWA Accelerators
 - WCD documents for all other operations
- Creation of WCDs are a team effort led by the person in charge and including all people involved; SME experts sought as needed
- WCDs submitted for approval: Person in Charge, SME and DD
- Work authorization is an independent separate step. Work is authorized by the Person in Charge and the DD.
- For non-standard operations – such as exchanging a klystron – additional level of oversight required

HISTORY

Our Track Record



SUMMARY

Safety in the High Energy Division

- The HEP division has a unique set of programs within the laboratory ranging from advanced electronics equipment to large scale detector for collider experiments
- **HEP has a very good safety track record and we are very well aware that there is no room for complacency with regards to safety**
- Our experienced and talented staff is dedicated to maintaining and enhancing our performance in a safe manner
- The division has a systematic approach for work planning, hazard identification, review and authorization of tasks, and safe execution.
- The division is fully committed to ISM and we are looking forward to engaging in a constructive dialogue with the committee