

Mechanical Engineering at Fermilab

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Summer Student Lecture Series
June 21, 2011



Fermilab

Einstein Once Said.....

- **"Scientists investigate that which already is;
Engineers create that which has never been."**
- Albert Einstein, Physicist.

Outline

- Introduction
- What is Engineering?
- What is Mechanical Engineering?
- What is Fermilab?
- Where/How are Mechanical Engineers Used at Fermilab
- Summary
- Closing Thought

What is Engineering?

- **Engineering** is the discipline, art, skill and profession of acquiring and applying scientific, mathematical, economic, social, and practical knowledge, in order to design and build structures, machines, devices, systems, materials and processes that safely realize improvements to the lives of people.
- Engineering is the art of solving problems!
- **Turning Ideas Into Reality!**

What is Mechanical Engineering

- Is a branch/discipline of engineering
- Applies the principles of physics and material science for analysis, design, manufacturing and maintenance of mechanical systems
- Involves the production and usage of heat and mechanical power for the design, production, and operation of machine, tools, and structures
- is one of the oldest and broadest engineering disciplines
- Uses core concepts and principles including mechanics, kinematics, thermodynamics, materials sciences, structural analysis, heat transfer, fluid mechanics, and computer aided design, and product life-cycle principles

What is Fermilab

- Mission - Fermi National Accelerator Laboratory advances the understanding of the fundamental nature of matter and energy by providing leadership and resources for qualified researchers to conduct basic research at the frontiers of high energy physics and related disciplines.
- This mission has led to many scientific discoveries and technological innovations.

The Mechanical Engineers and Their Fermilab Footprint

- Where at Fermilab are they used?
- How are they used?



The Different Departments at Fermilab

- First you need a lesson on the [Fermilab Organization](#)
- Focus on
 - Accelerator Division
 - Particle Physics Division
 - Technical Division
 - Facilities Engineering Services Section
- These areas support the Fermilab organization.
- The Mechanical Engineering discipline supports all projects and initiatives in these areas.

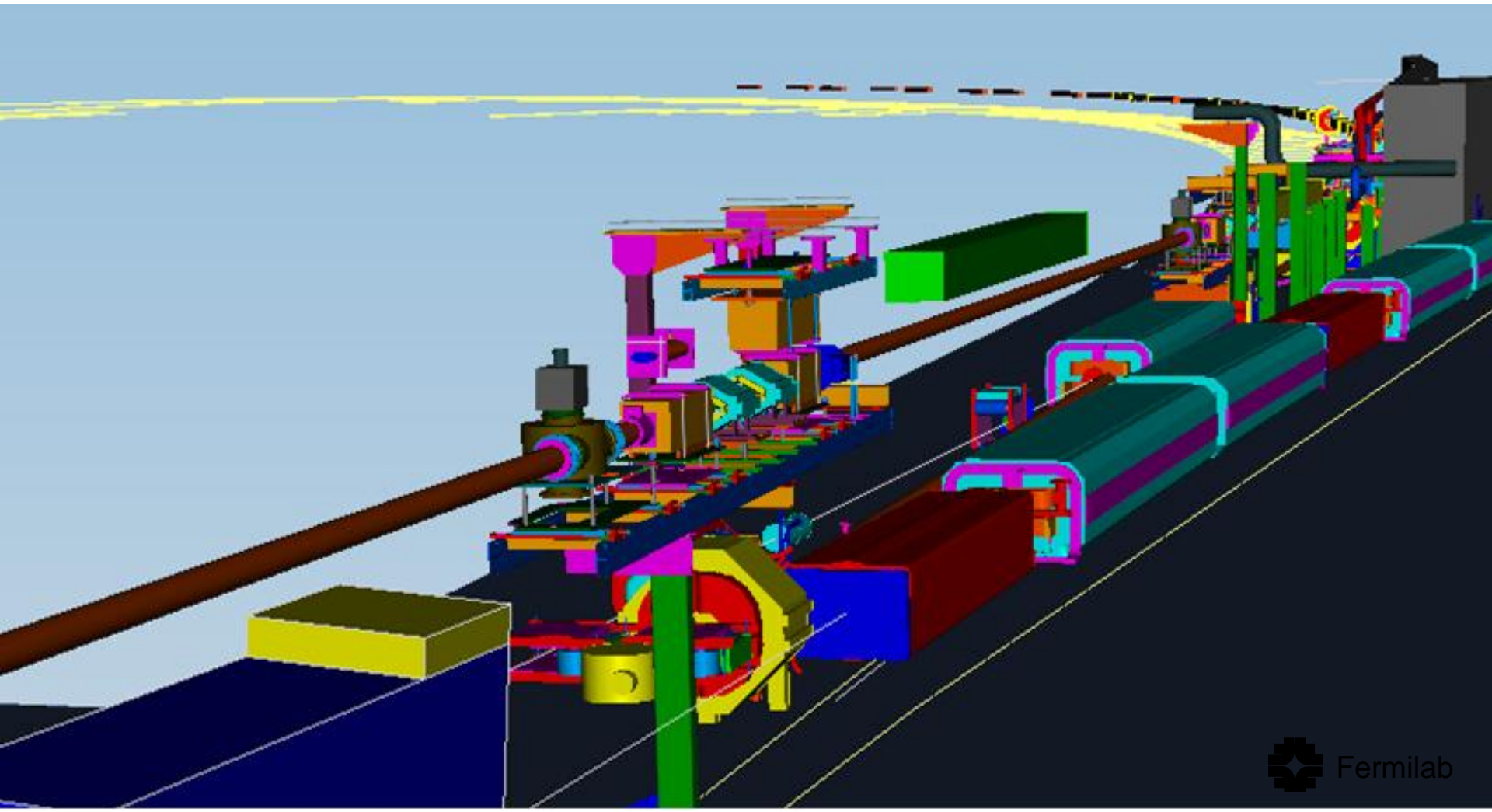
How are Mechanical Engineers Used at Fermilab?

Accelerator Technologies
Abort Systems
Compressed Gas
Computer Aided Design (CAD)
Cryogenics
Finite Element Analysis (FEA)
Fluid Temperature Control
Systems
Instrumentation
Magnet Design
Project Engineering and
Management

Superconducting Radio
Frequency (SRF)
2D, 3D, and Solid Modeling
Support Stands
Target and Horns
Vacuum
Vibrations

Just to name a few !!!!!

Mechanical Systems



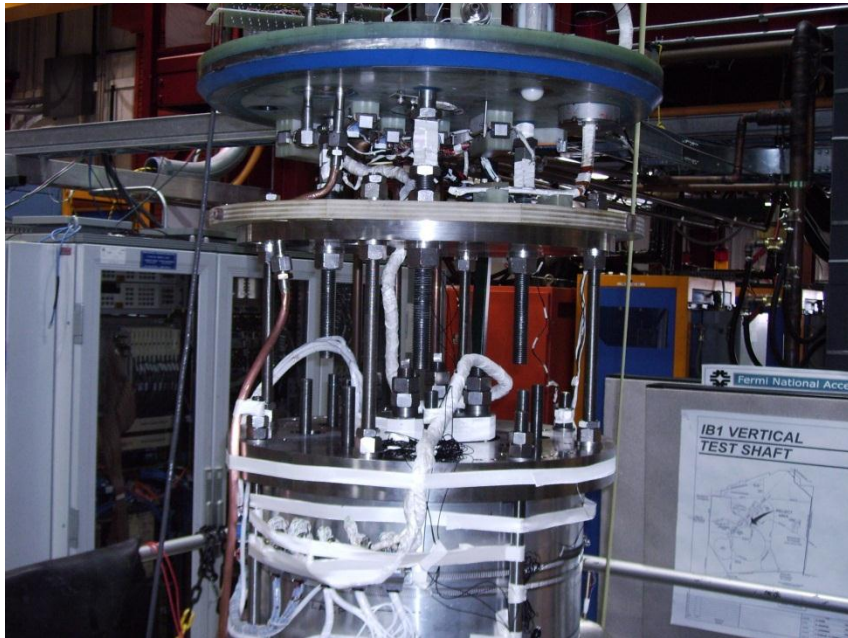
Magnet Suspension System



The Fixture for tilting the Magnet was provided by LBNL (collaborator)



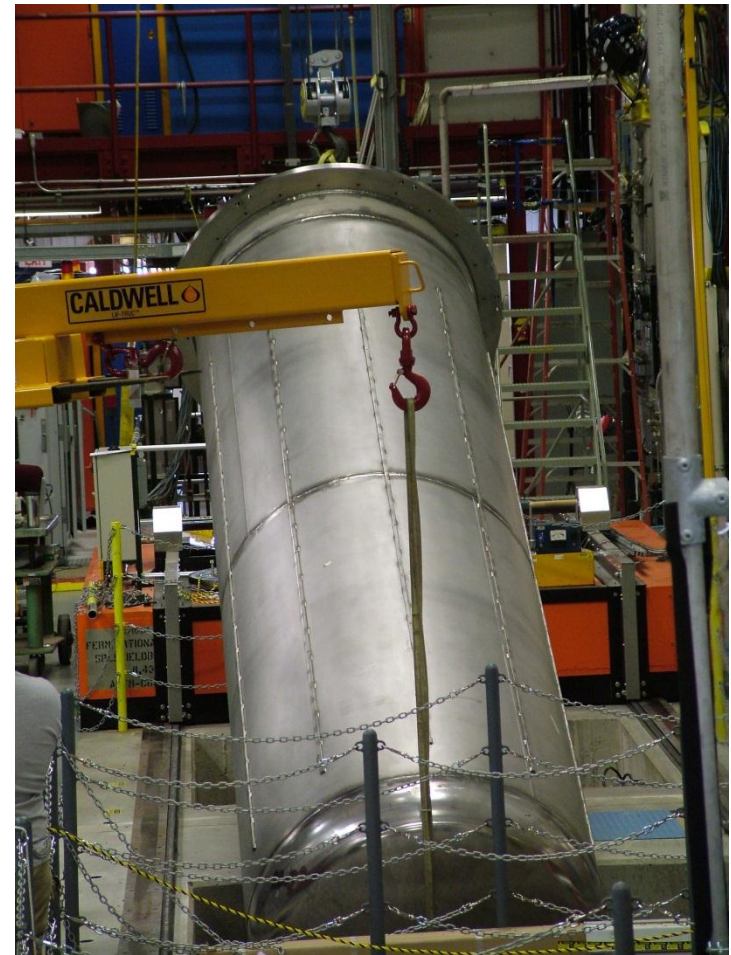
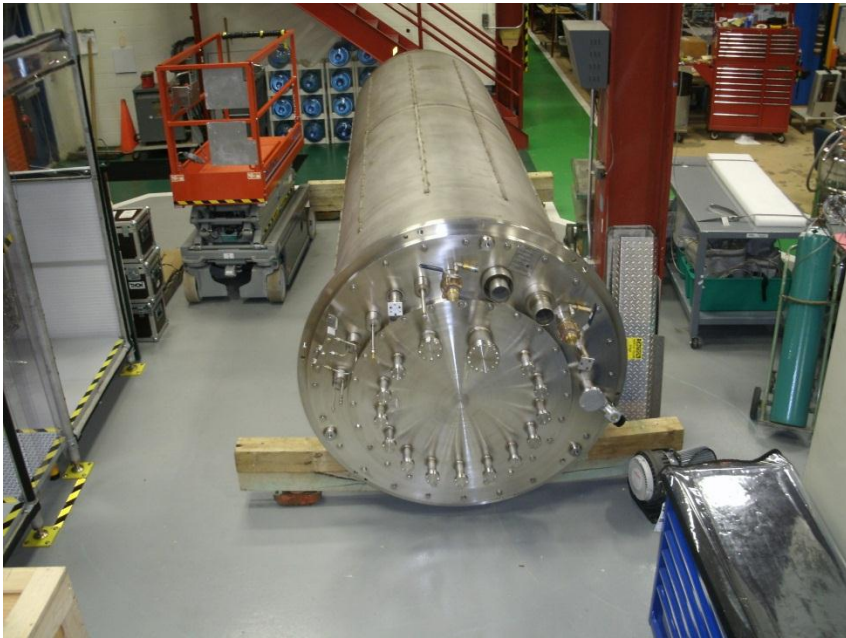
Magnet Suspension System



Vacuum Pumps



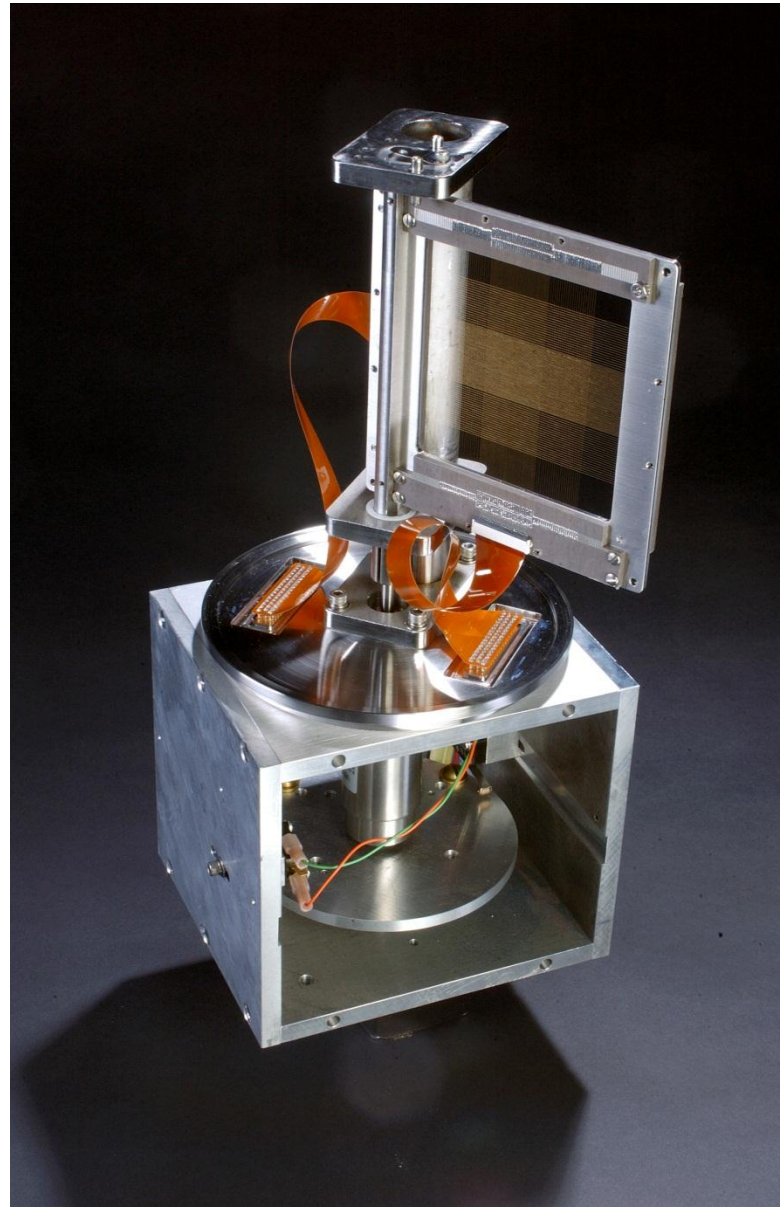
Cryostat for SRF Multiple SRF Cavity Testing



Helium Purifiers



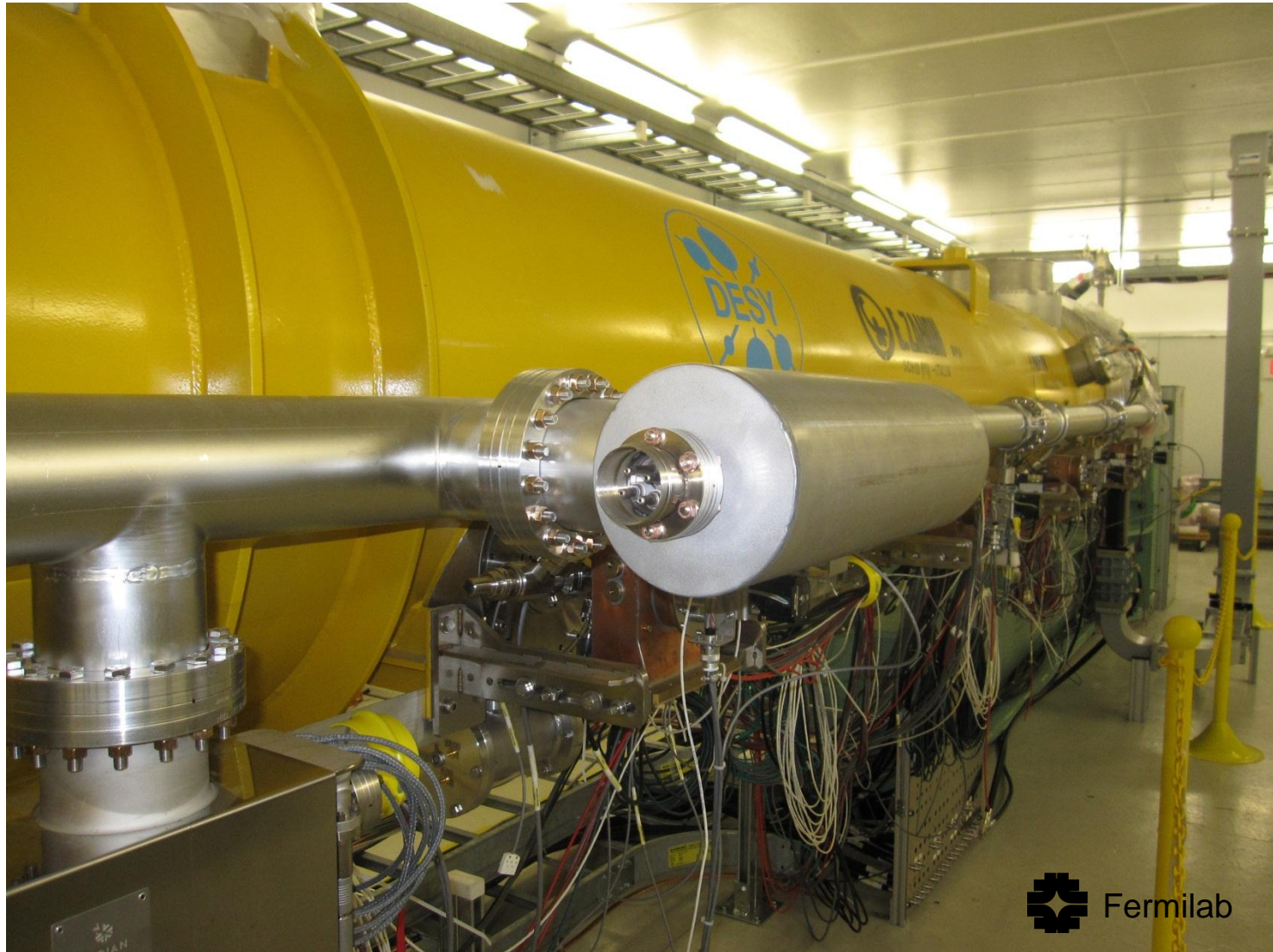
Beam Diagnostics/Instrumentation

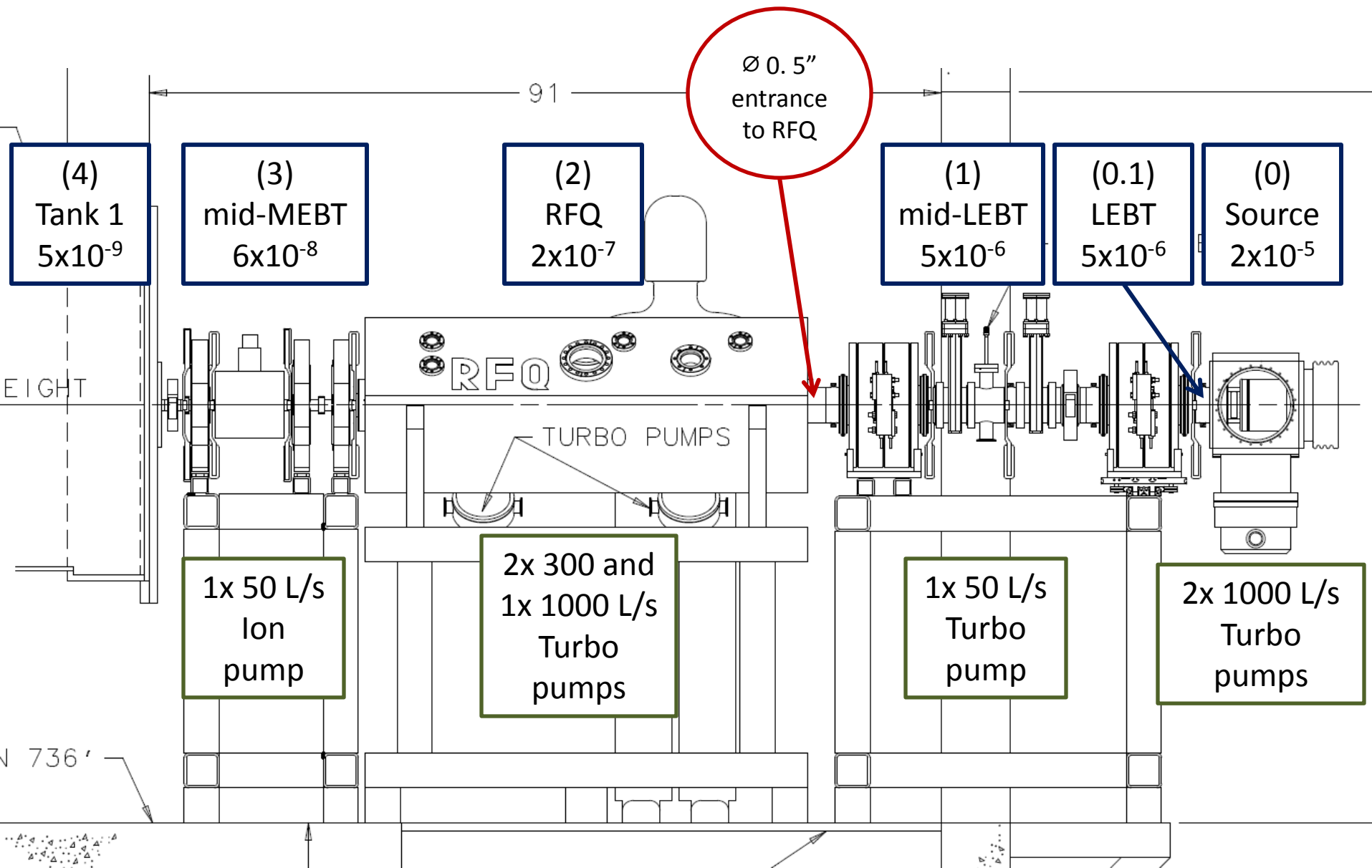


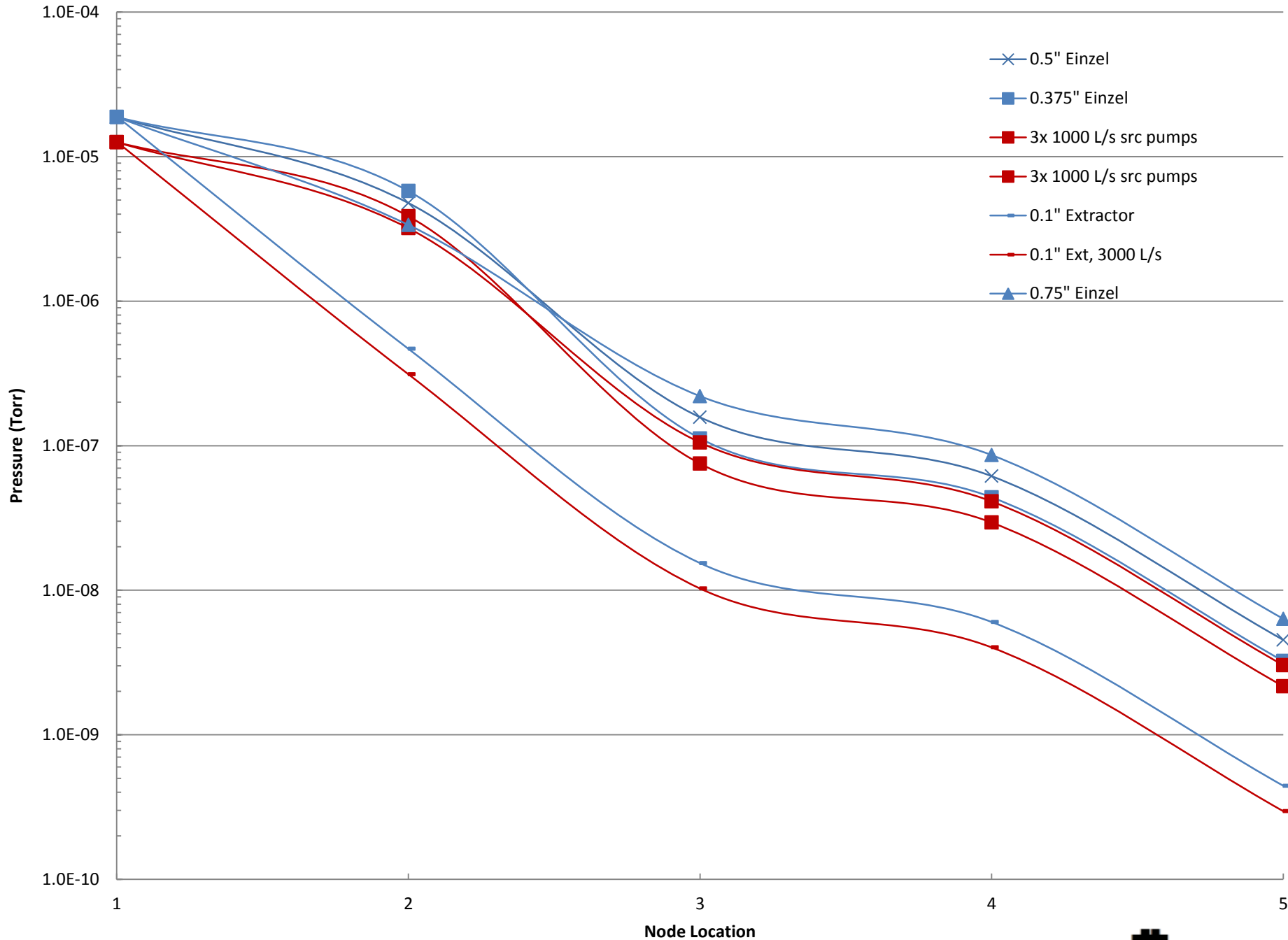
Beam Diagnostics/Instrumentation (continued)



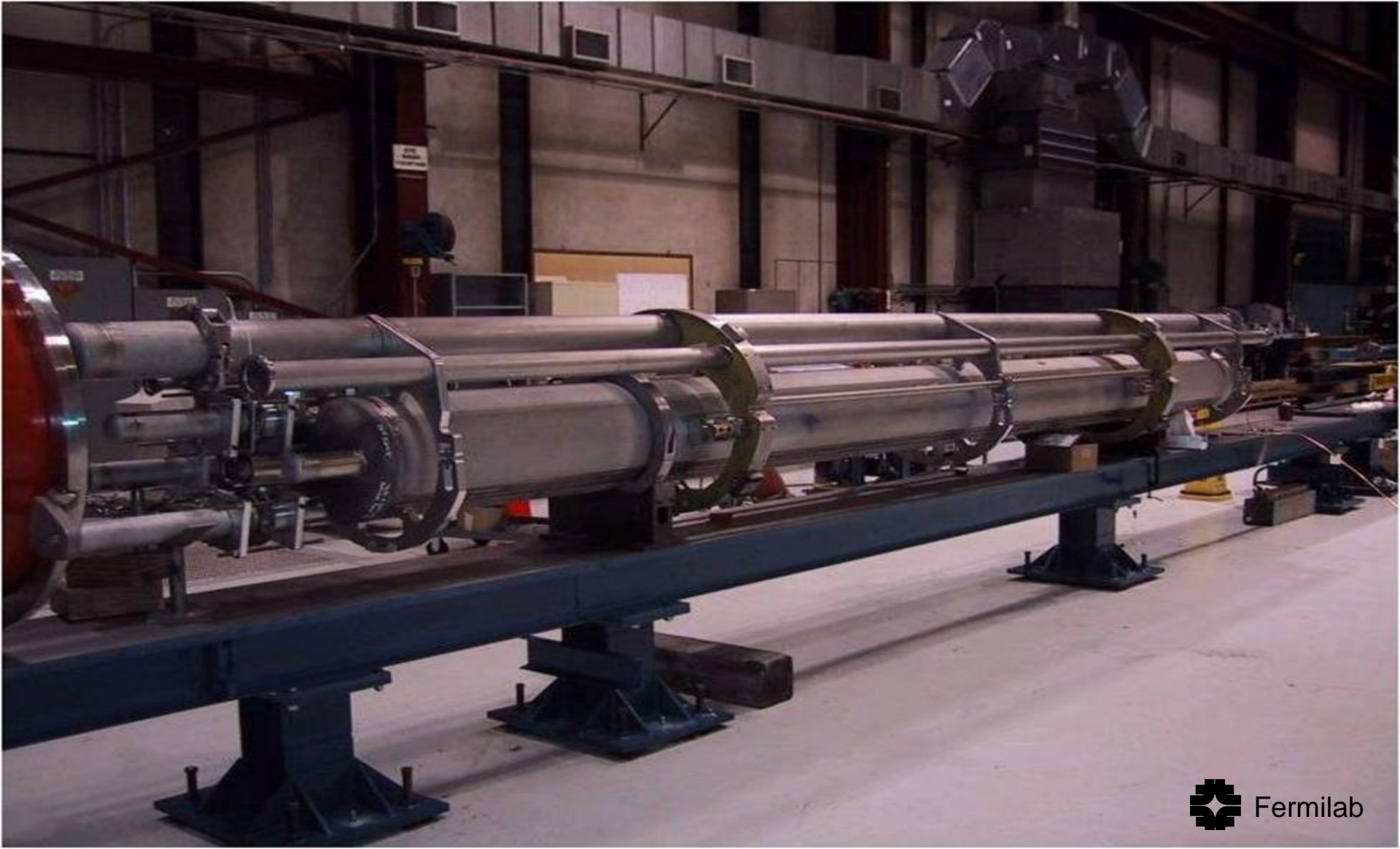
Vacuum Systems Engineering



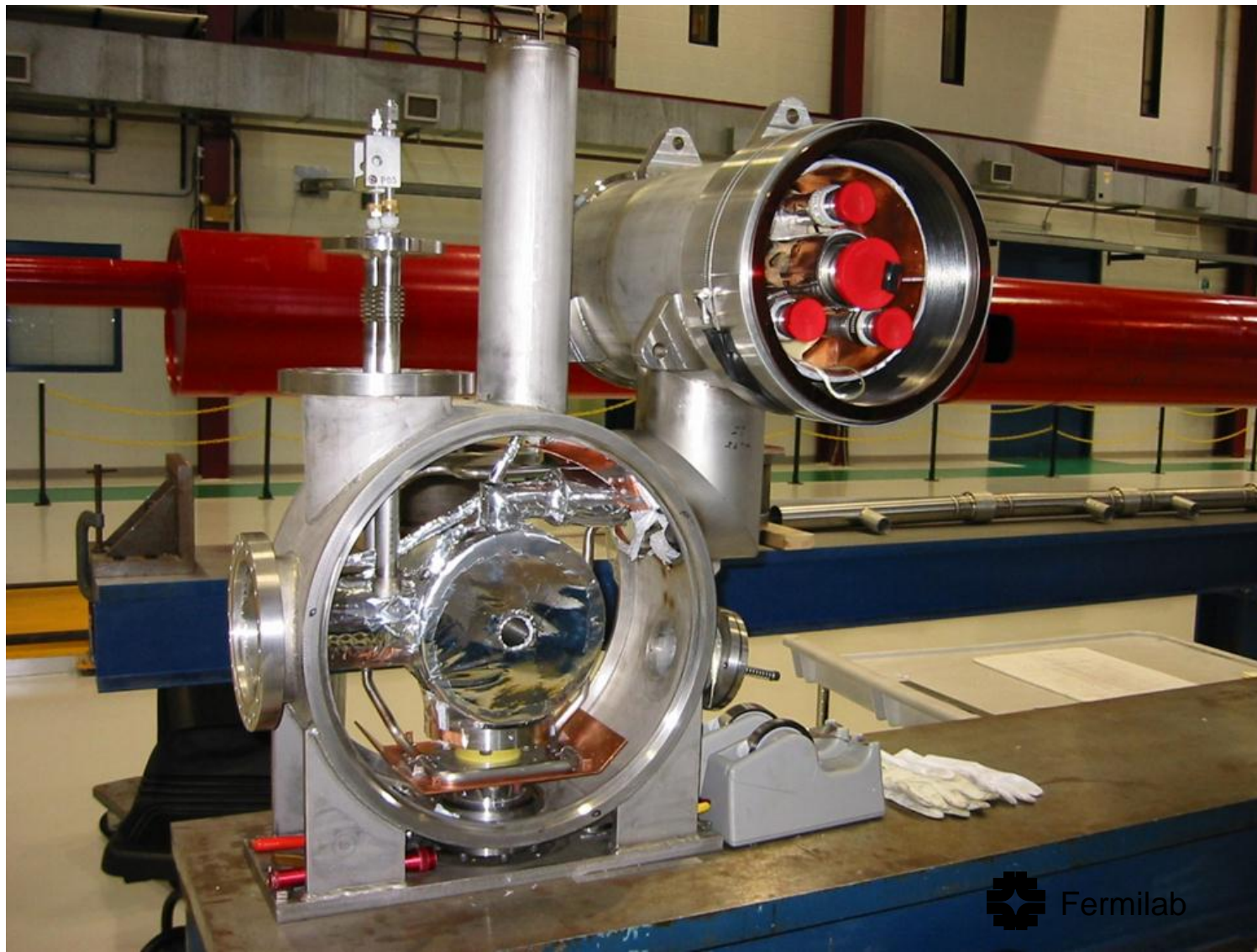




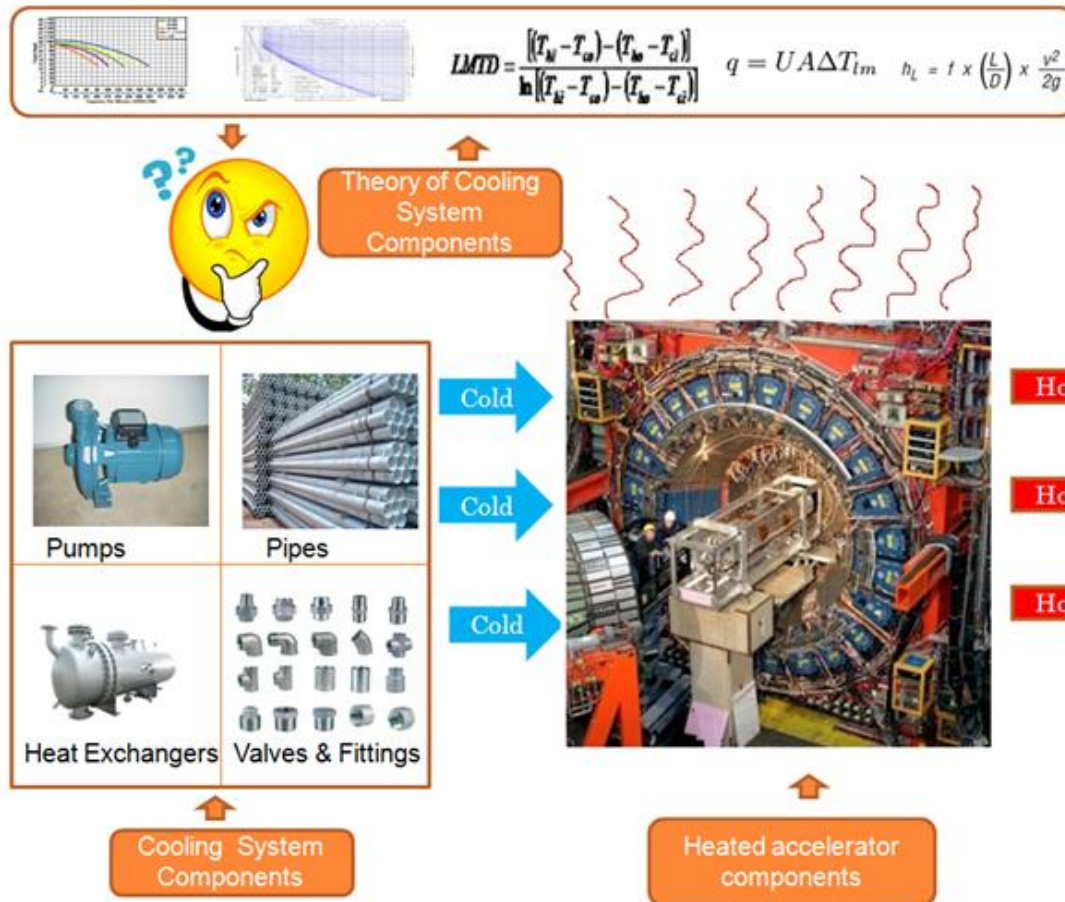
Magnet Design Engineering



Magnet Design Engineering (continued)



Fluids Engineering



Fluids Engineering



Fluids Engineering (continued)



Fluids Engineering (continued)



Cryogenic Systems Engineering (continued)



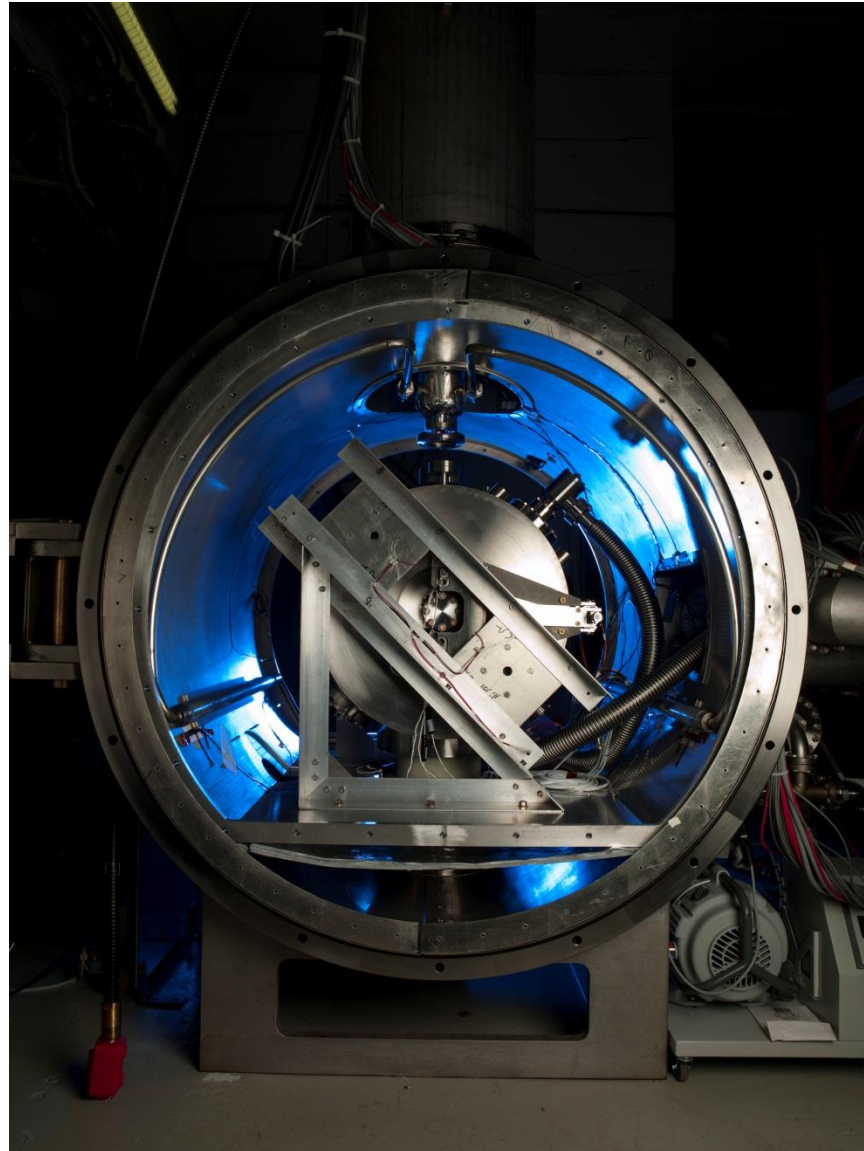
Cryogenic Systems Engineering (continued)



Cryogenic Systems Engineering (continued)

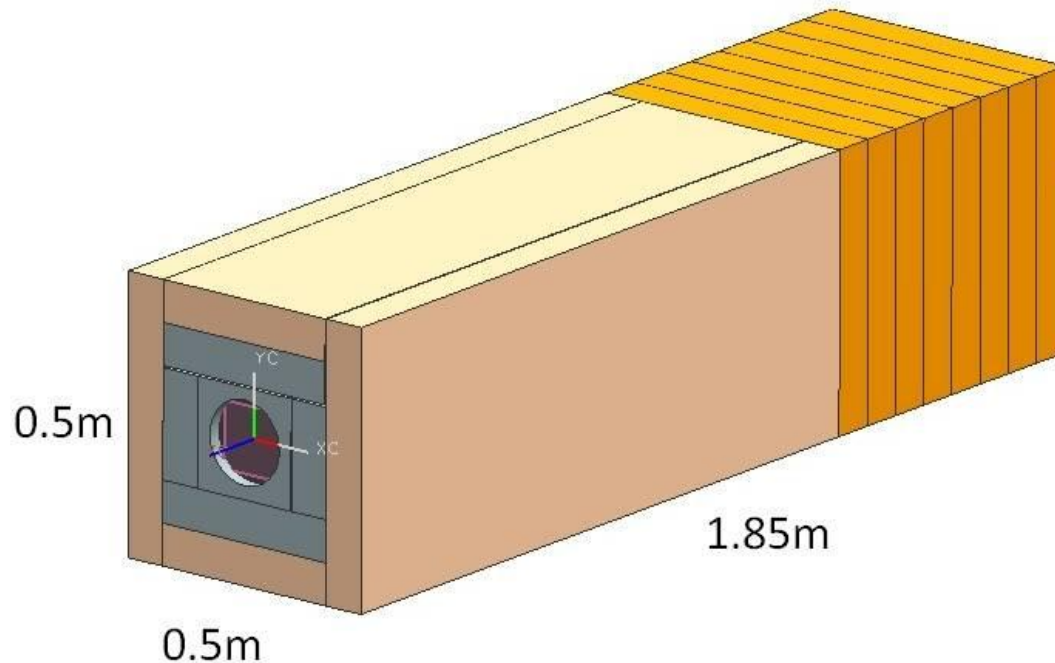


Cryogenics Systems Engineering

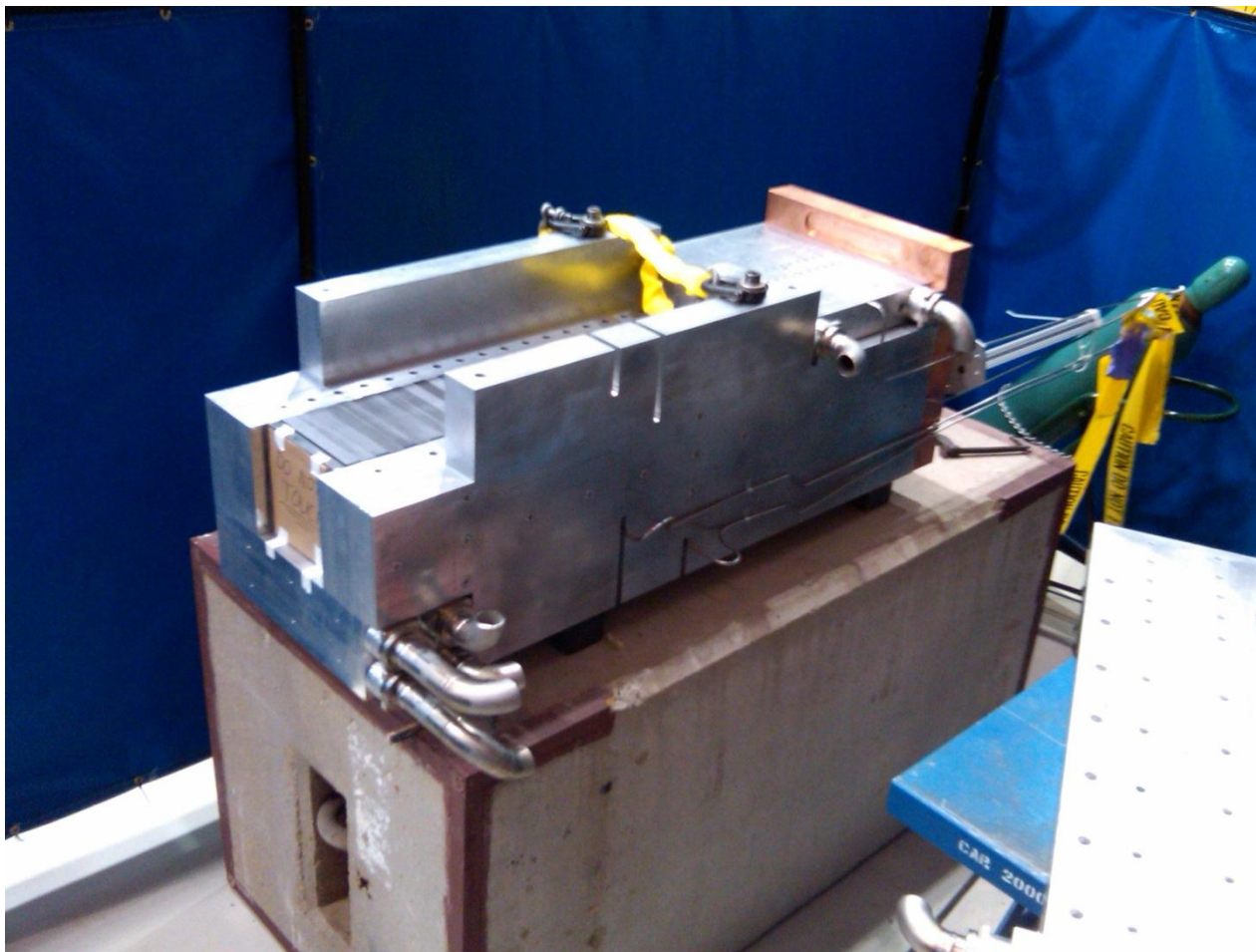


Mechanical Systems – Beam Dump

Absorber Core Configuration



Mechanical Systems – Beam Dump (continued)

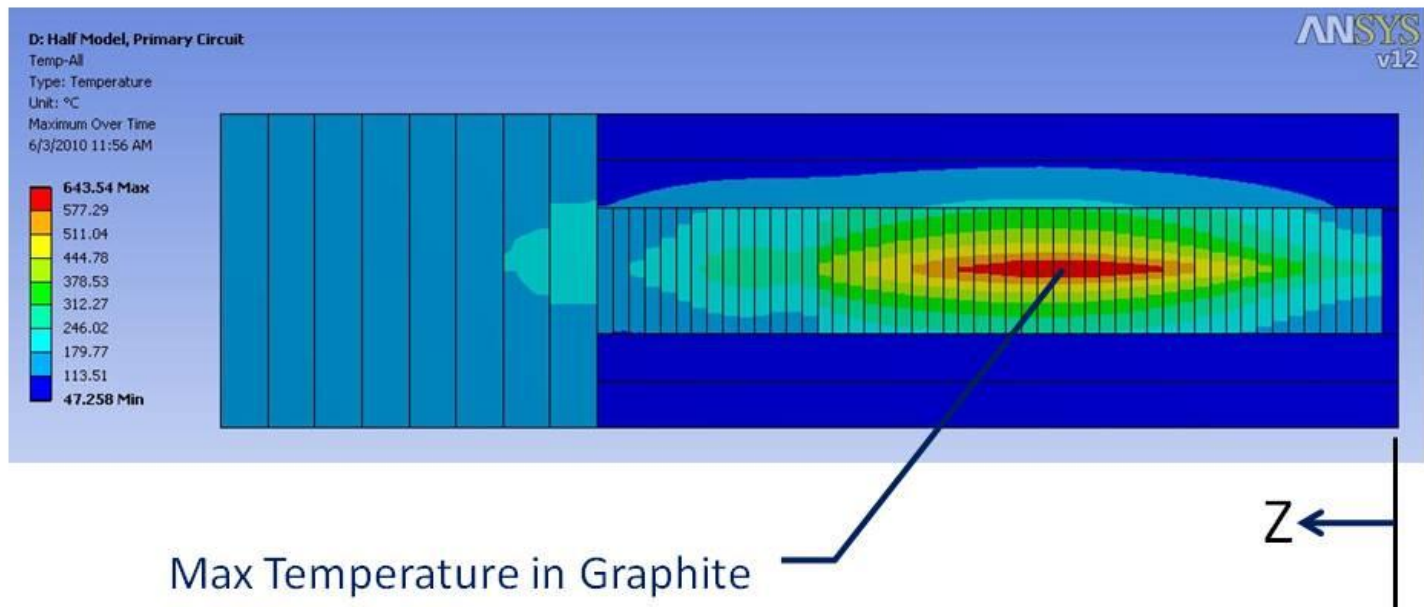


Mechanical Systems – Beam Dump (continued)

System Model Steady State

Centered Beam @BOL

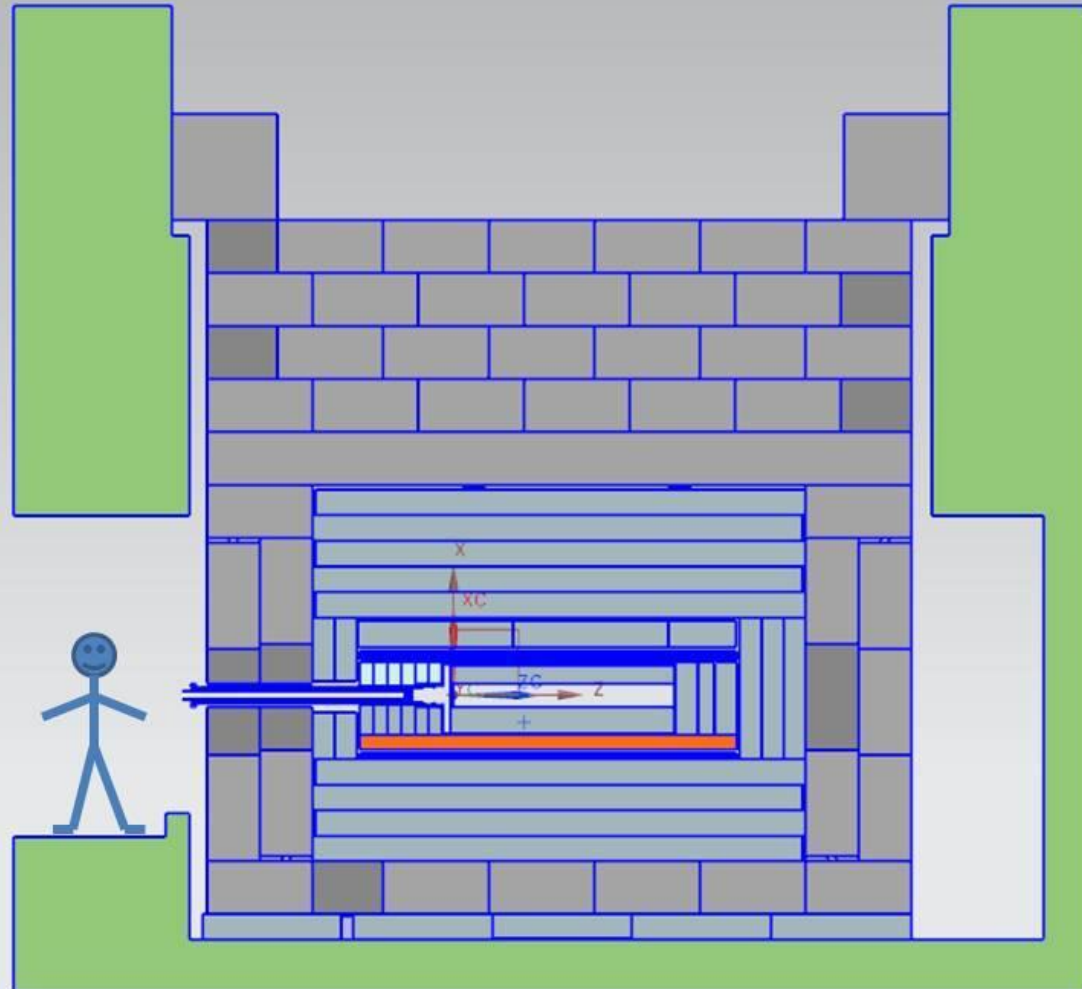
Maximum temperature in graphite and system



Max Temperature in Graphite
643°C @ Z=.482m

Mechanical Systems – Beam Dump (continued)

NML Beam Dump, Elevation Cross Section



Project Engineering



Project Engineering (continued)



Facilities Engineering



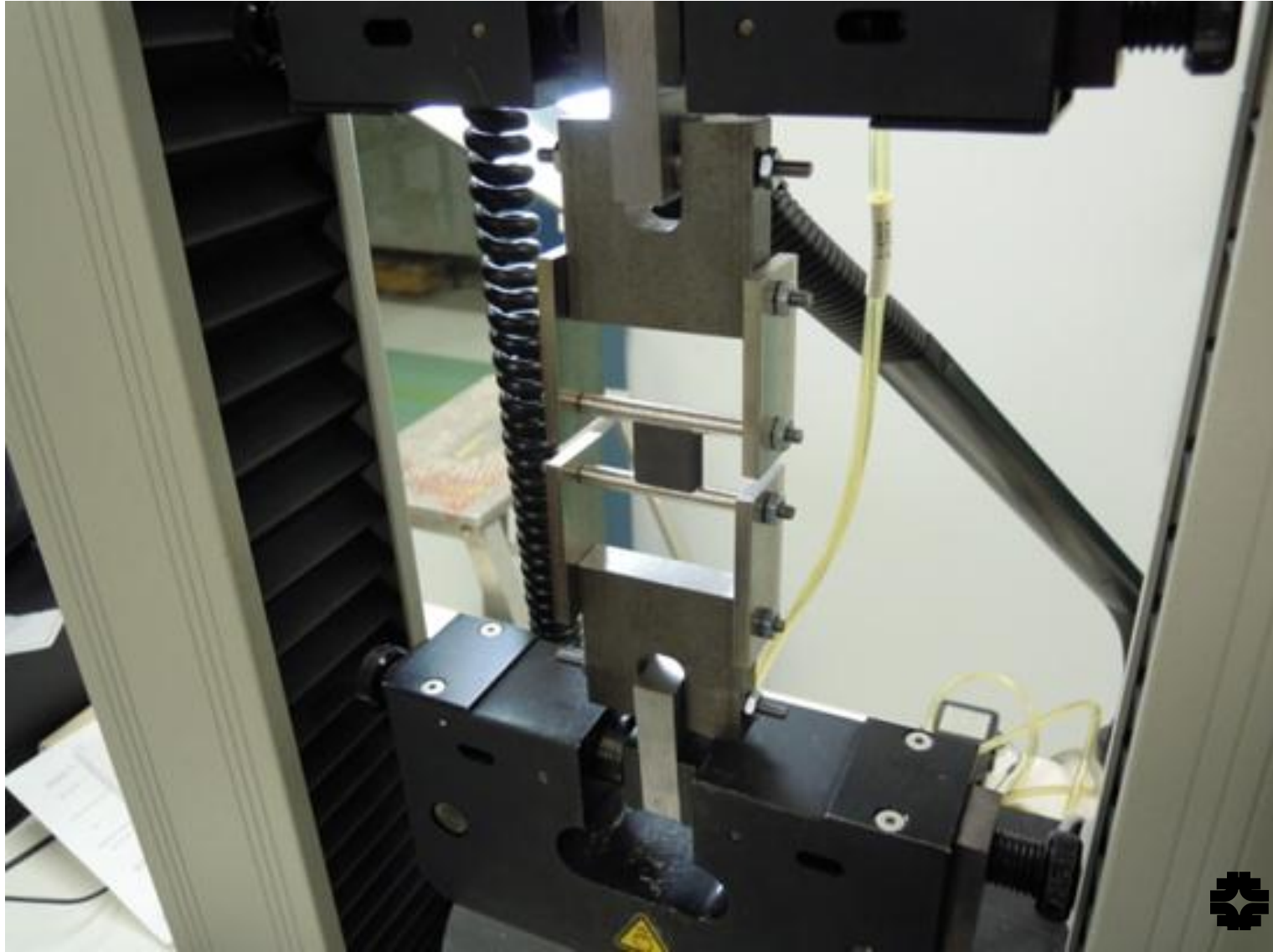
Facilities Engineering (continued)



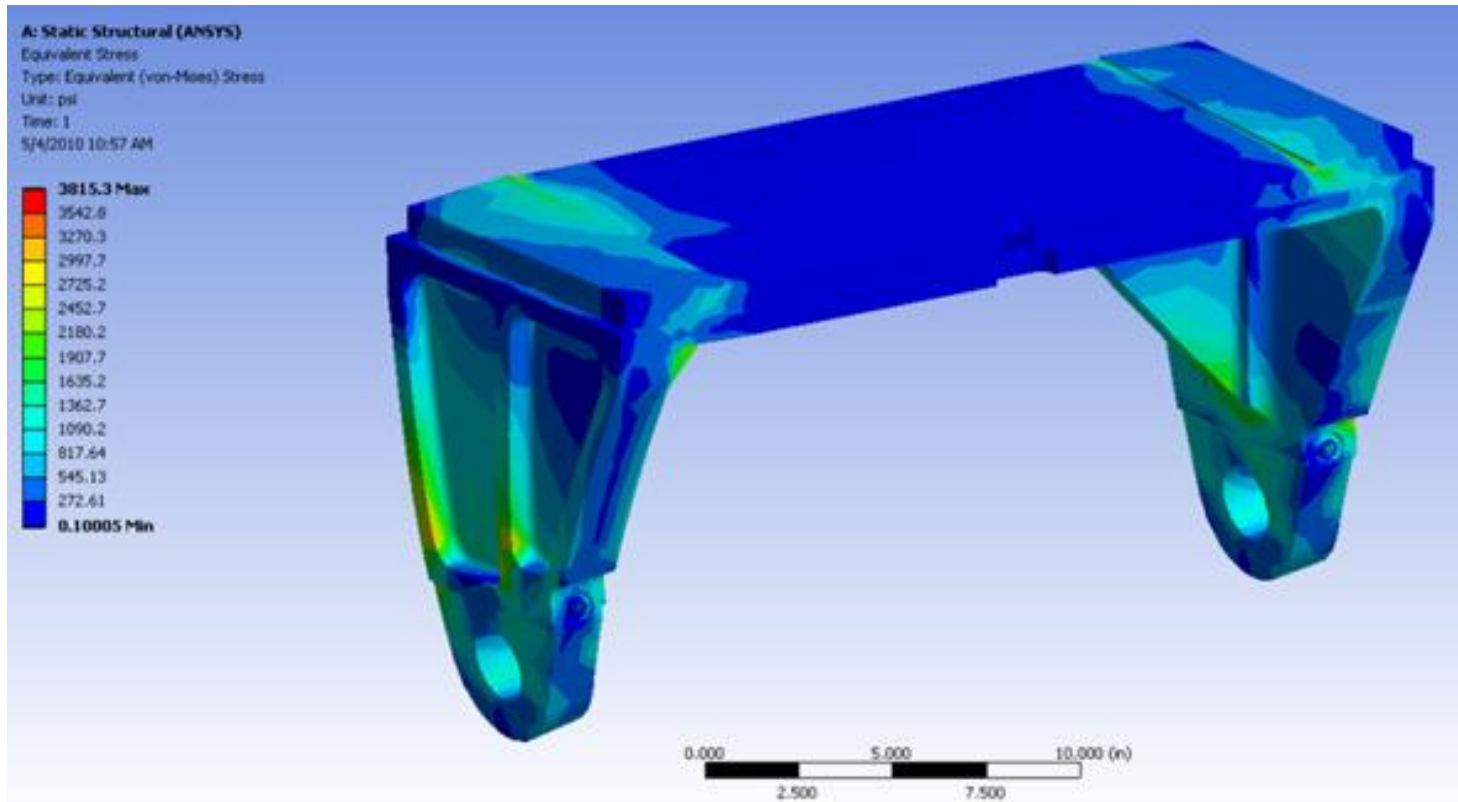
Mechanical Design – NUMI Horn



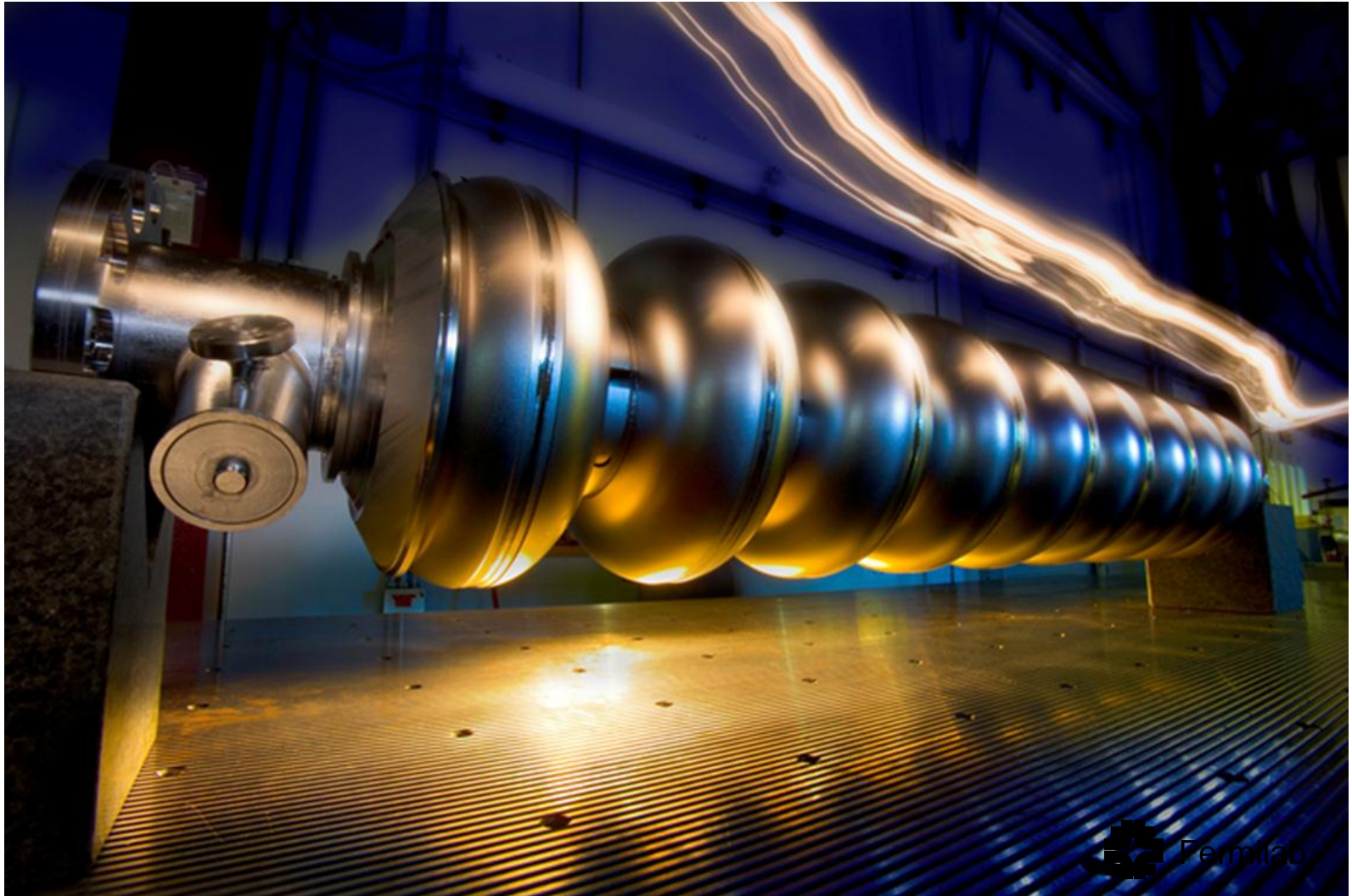
Mechanical Design – NUMI Horn (continued)



Mechanical Design – NUMI Horn (continued)



Superconducting RF Cavity Fabrication and Processing



Superconducting RF Cavity Fabrication and Processing (continued)



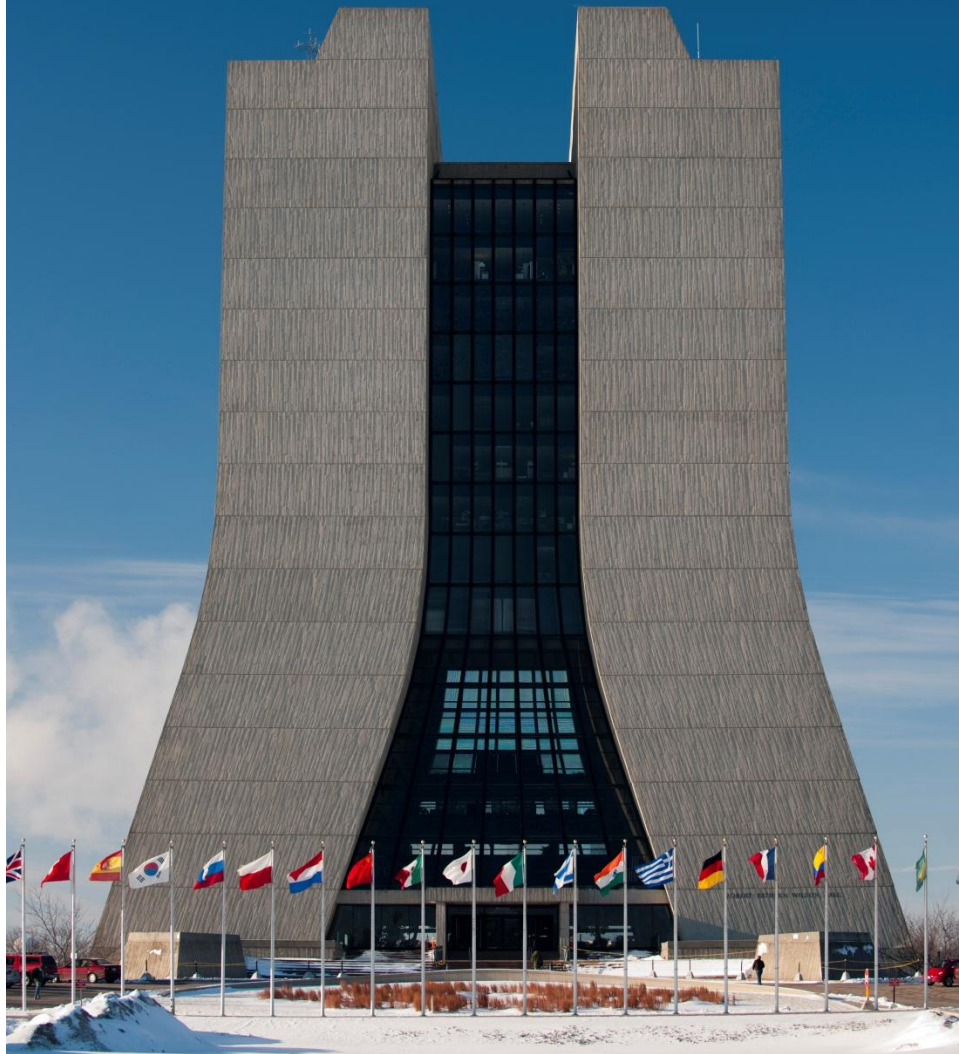
FNAL HPR Tool with 1.3 GHz 9-cell

Summary

- Mechanical Engineers play a very important role at Fermilab.
- They are needed to help Physicists solve very complex physics problems.
- Without Mechanical Engineering, Fermilab would not be able to achieve its mission.

One Closing Note

The Osgood File Transcript



References and Acknowledgment

- Abhishek Deshpande, Mechanical Engineer, AD/Mechanical Support Department
- Albert Einstein, Physicist
- Alex Martinez, Mechanical Engineer, AD/Cryogenics Department
- Allan Rowe, Mechanical Engineer, TD/Superconductivity & RF Development Department
- Arkadiy Klebanar, Mechanical Engineer, AD/Cryogenics Department
- Ben Vosmek, Mechanical Engineer, AD/Mechanical Support Department
- Bradly Verdant, Mechanical Engineer, AD/Mechanical Support Department
- Charles Osgood, The Osgood File, CBS Radio Network
- Cory Crowley, Mechanical Engineer, AD/Mechanical Support Department
- Cosmore Sylvester, Mechanical Engineer, TD/Test & Instrumentation Department
- Curtis Baffes, Mechanical Engineer, AD/Mechanical Support Department
- Dave Pushka, Mechanical Engineer, PPD/Mechanical Department
- Emil Huedem, Mechanical Engineer, FESS/Engineering Department
- <http://old.systemi.net/gallery/Physics/>
- <http://projectx.fnal.gov/>
- <http://filetraffic.eu/s/mechanical%20engineering%20description>
- <http://www.dedham-ma.gov/index.cfm?pid=12646>
- Jerry Leibfritz, Mechanical Engineer, AD/Mechanical Support Department
- Karl Williams, Mechanical Engineer, AD/Mechanical Support Department
- Kevin Duel, Mechanical Engineer, AD/Mechanical Support Department
- Kurt Krempetz, Mechanical Engineer, PPD/Mechanical Department
- Lucy Nobrega, Mechanical Engineer, AD/Mechanical Support Department
- Marty Murphy, Photographer, AD/Operations Department
- Matt Slabaugh, Mechanical Engineer, AD/Mechanical Support Department
- Mike White, Mechanical Engineer, AD/Cryogenics Department
- Reidar Hahn, Photographer, Office Of Communication/Visual Media Services
- Tom Page, Mechanical Engineer, TD/Superconductivity & RF Development Department
- www.fnal.gov
- www.wikipedia.com

Thank You

