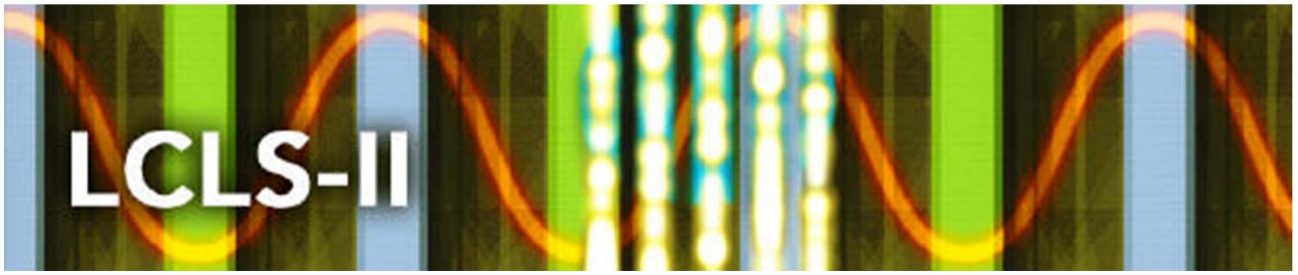


Cryomodule Installation

Kathleen Ratcliffe

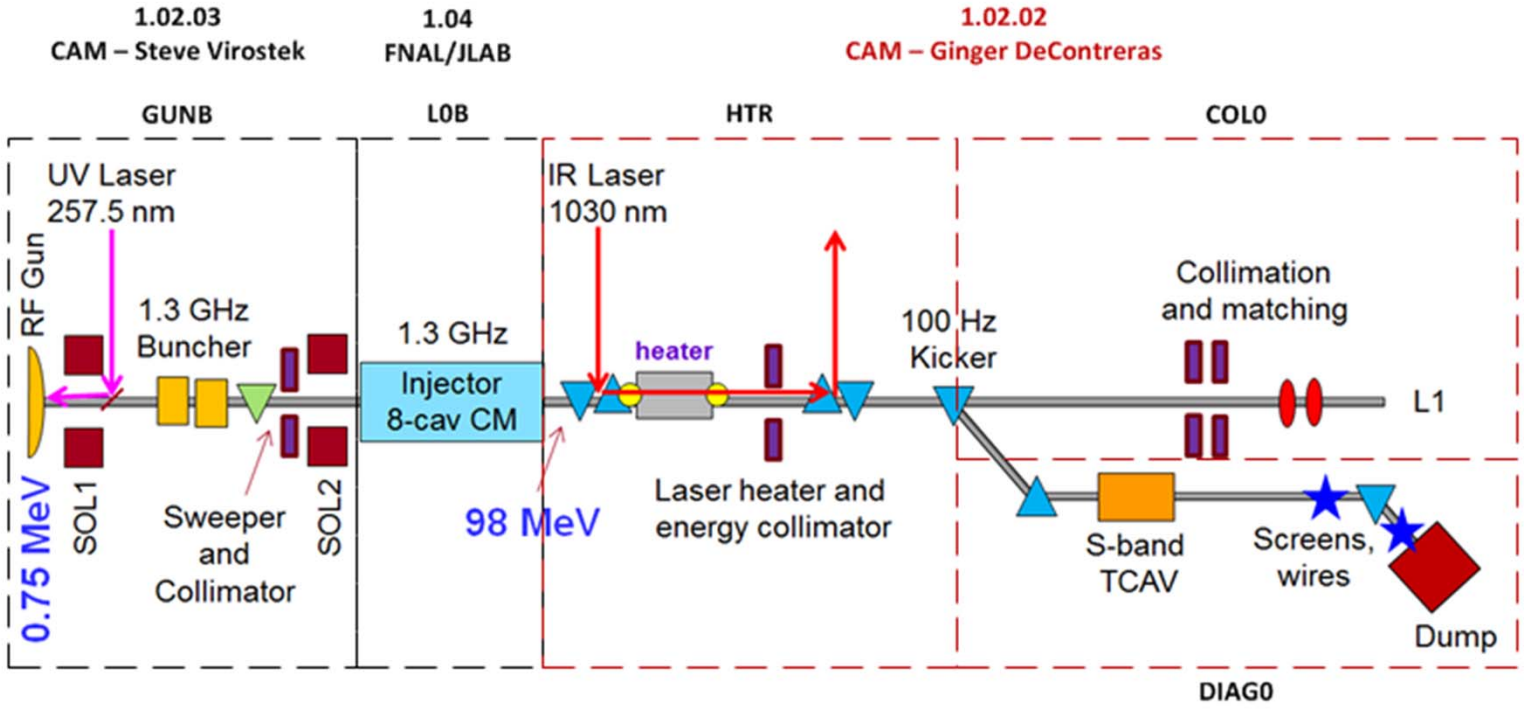
U.S. DEPARTMENT OF ENERGY
Office of Science
Jefferson Lab
Fermilab
BERKELEY LAB
SLAC NATIONAL ACCELERATOR LABORATORY

Outline

- Scope
- Cryomodule Interconnect Overview
- Welding Overview
- HOM Installation Overview
- Cleanroom Variations

Scope 1.02.02 – Injector Systems

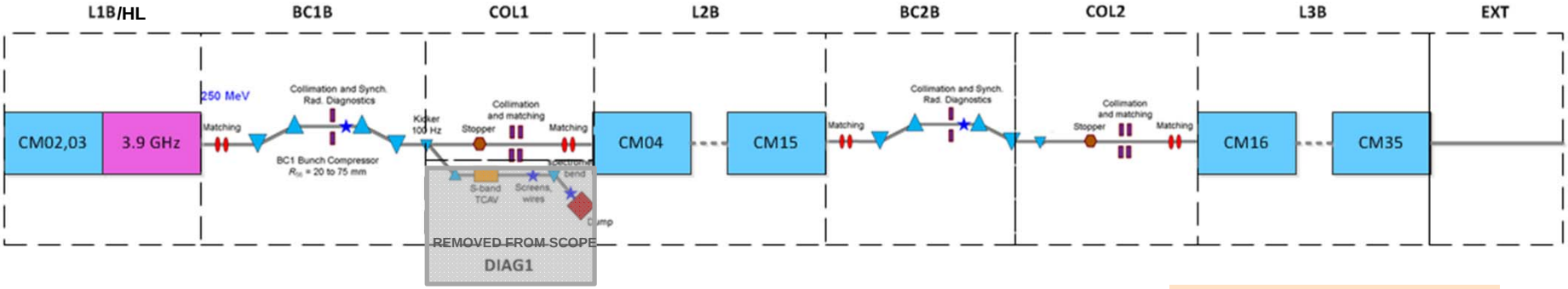
- Installation of all beamline areas
  - Gun, L0B, HTR, COL0 and DIAG0
- Laser Installation
- Installation of gallery racks, plus cables and waveguide to beamline



Slide courtesy of Ginger DeContreras

Scope 1.02.04 Linac Systems

- Linac Systems divided into areas:
  - L1 (two 1.3 GHz cryomodules)
  - HL (two 3.9 GHz cryomodules)
  - BC1/COL1 (collimation and diagnostics)
  - L2 (twelve 1.3 GHz cryomodules)
  - BC2/COL2 (collimation and diagnostics)
  - L3 and Extension (twenty 1.3 GHz cryomodules and connecting beamline)
  - Installation includes Mechanical, RF and Power Conversion for all areas.



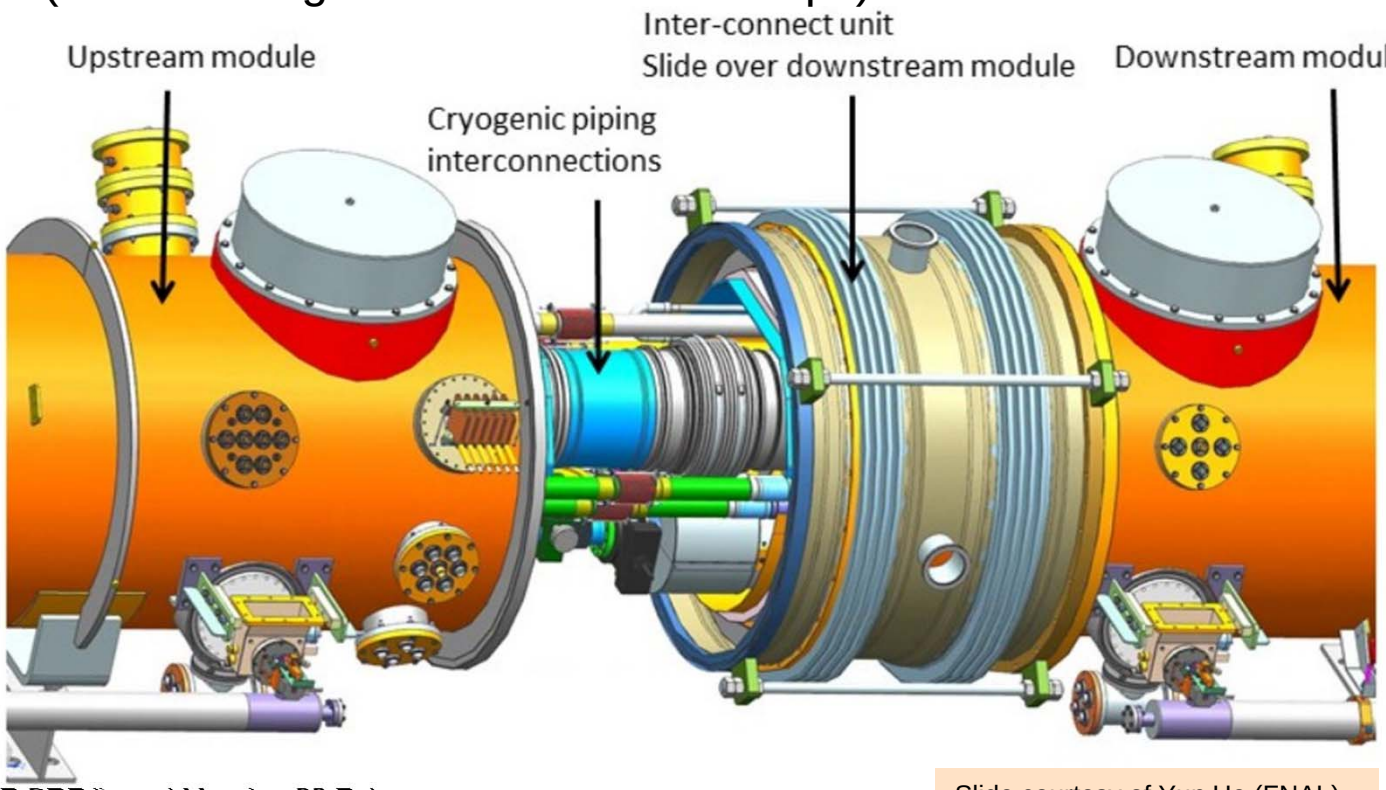
Slide courtesy of Karen Fant

Scope

- CM will be delivered to SLAC Ready for Installation
- SLAC is responsible for the following:
  - Design, procure and install CM supports
  - Design and develop interconnect tooling and fixturing
  - Develop interconnect procedures
  - Develop interconnect travelers
  - Incoming acceptance inspection confirms no change or damage during long transit
    - Checks for vacuum, electrical continuity, alignment and shipping damage
  - Conflat flange removal and prep for welding
  - Install and Checkout Cryomodules
  - Install HOM
  - All other that is necessary for safe and reliable commissioning.
    - Water, Vacuum, Air, Purge Gas, RF Systems
  - Safety Systems
    - Radiation Shielding, BCS, MPS and PPS.

CM Installation/Interconnect Overview

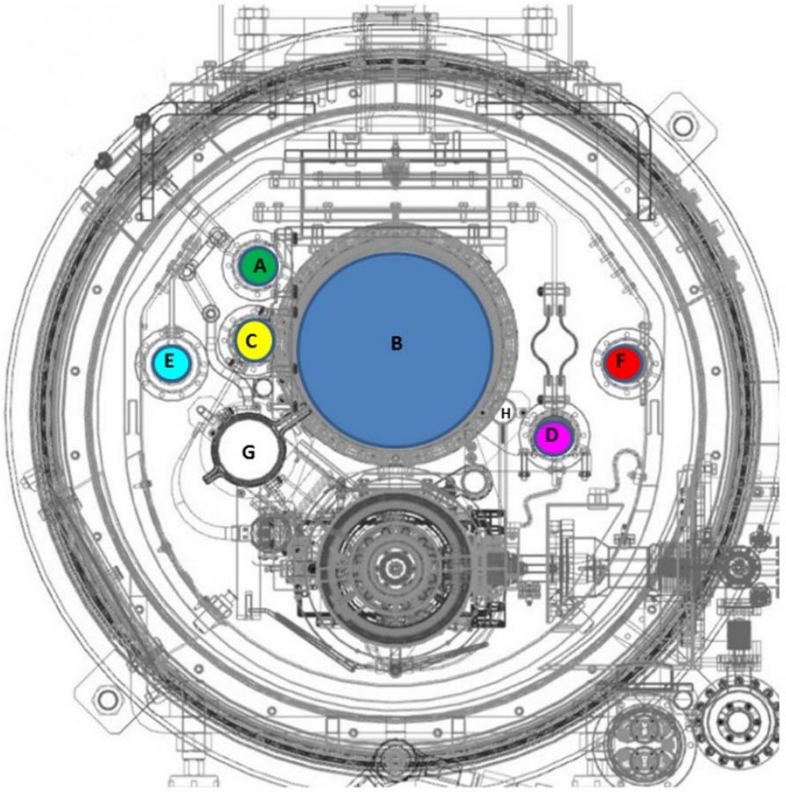
- A bellows interconnect installed between two modules
- Outer shell of the inter-connect unit can slide over the vacuum vessel to allow space for welding of six cryogenic pipes *in-situ*
- Mechanically decouples adjacent CM's and allows for thermal contraction or expansion during thermal cycling
- 33 interconnects are needed for the 37 CM's in the LCLS-II configuration
  - (not including feed-cans and end-caps)

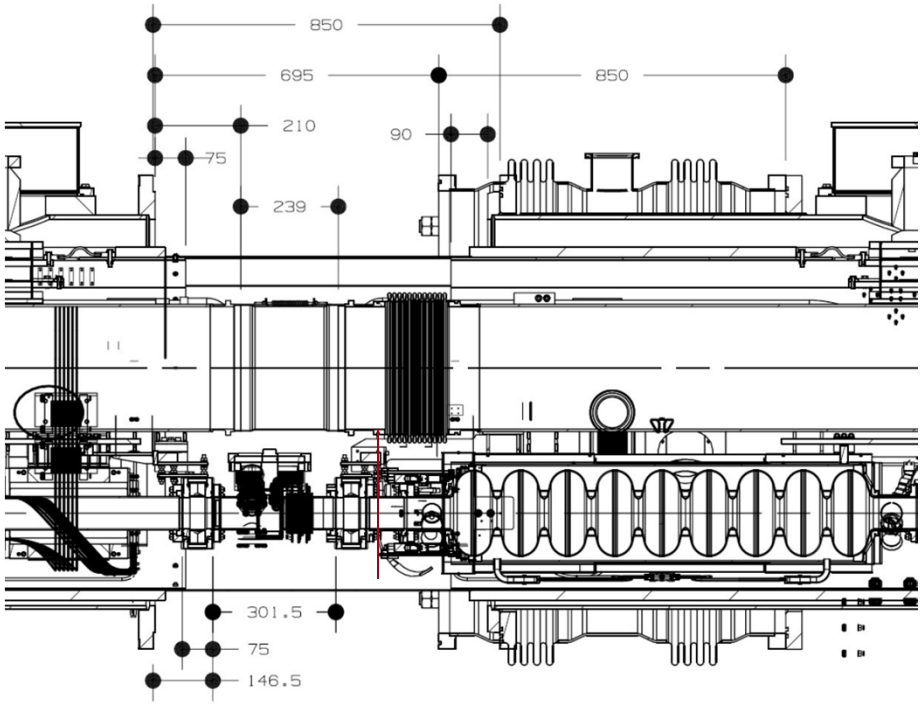


Slide courtesy of Yun He (FNAL)

Interconnect Requirements
-- *In-situ* Welding & Pressure Piping Code Compliance

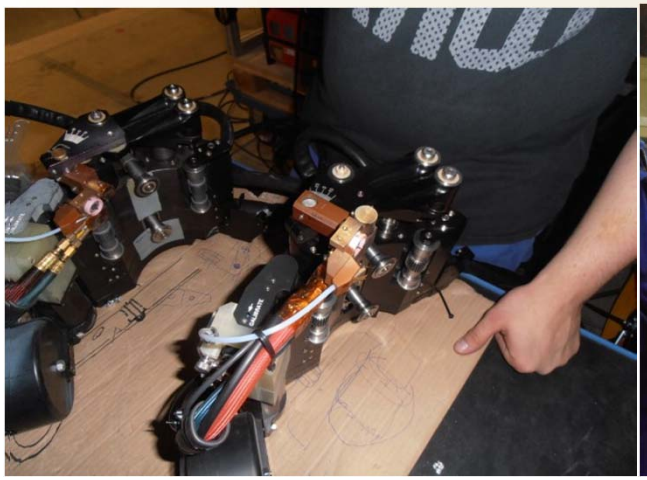
- Space for welding is very tight
- Leak checking
- Pressure testing (or X-ray inspection) for full penetration welding



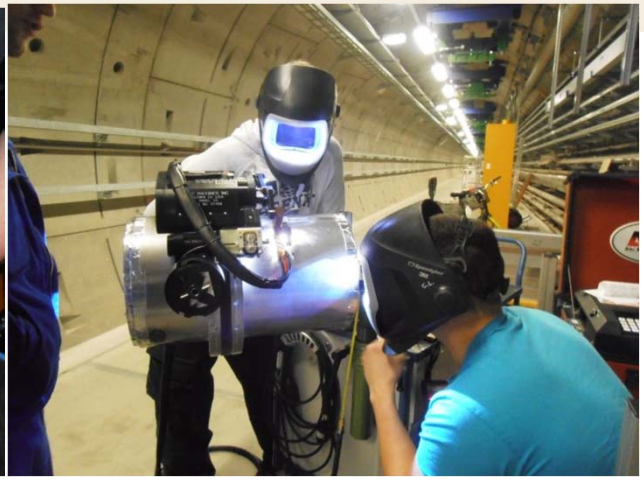


Slide courtesy of Yun He (FNAL)

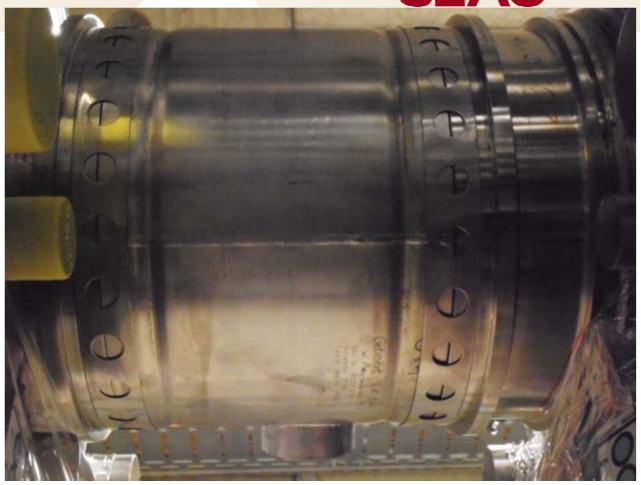
DESY Welding the HGRP



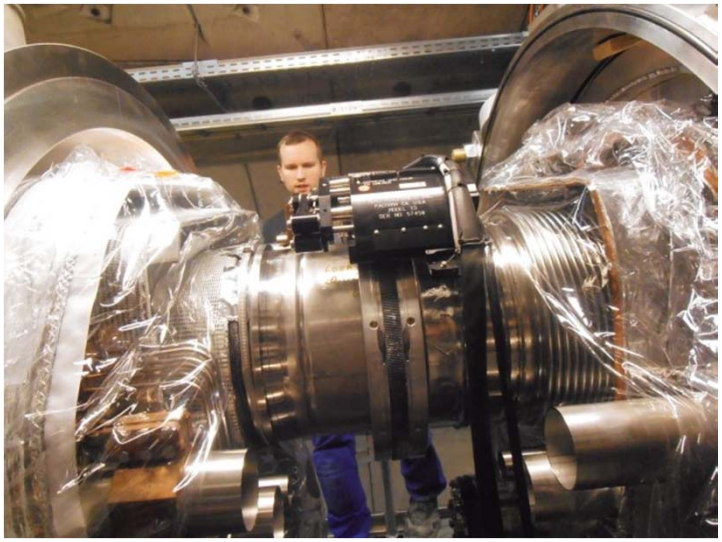
Orbital Track Welder with Custom Head



Qualify the weld



Tack interconnect pipe in place

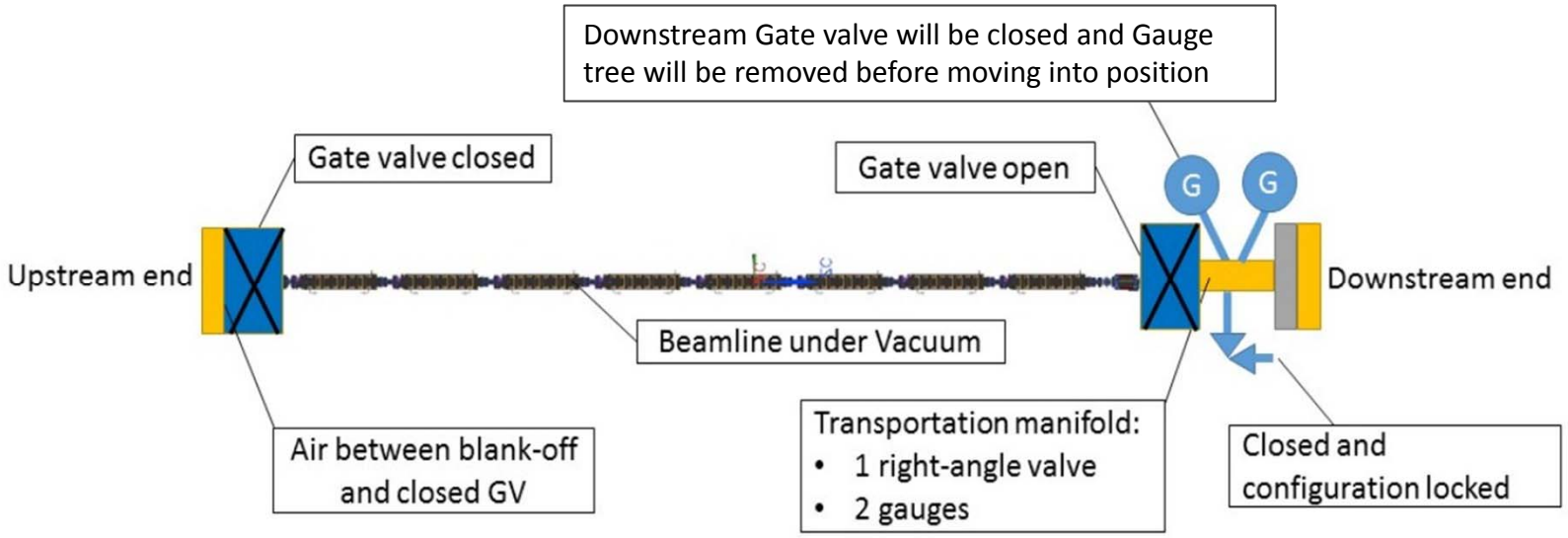


Checking weld set-up

Performing weld-workers on both sides of CM

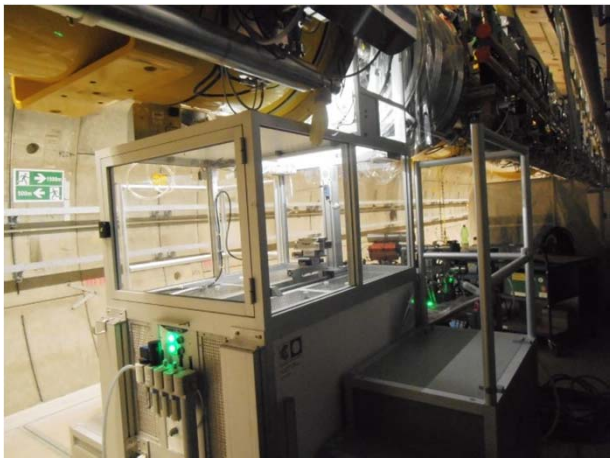
Interconnect Requirements
-- Particle Free UHV for Beamline

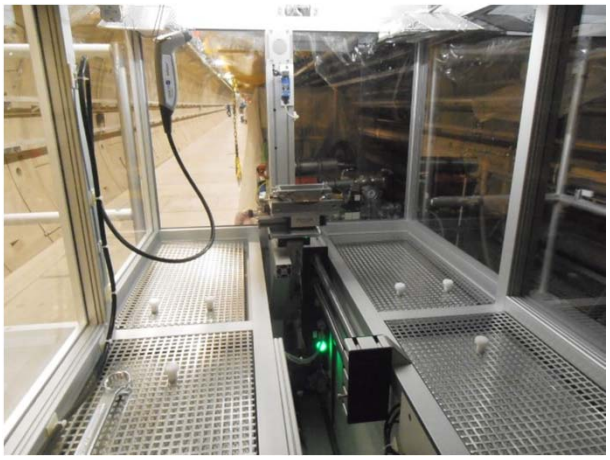
- Beamline vacuum needs to preserve the particle cleanliness of the cavity surfaces
- When making beamline connections between the modules, similar cleaning and assembly procedures as those performed for the cavities in the particle free clean rooms will be applied
- A portable softwall cleanroom (class 10) and strict adherence to the particle free UHV assembly protocols will be applied
- Prior to installation in the Linac string, the beamline vacuum of each module will be under vacuum



Slide courtesy of Yun He (FNAL)

DESY Interconnect Cleanroom

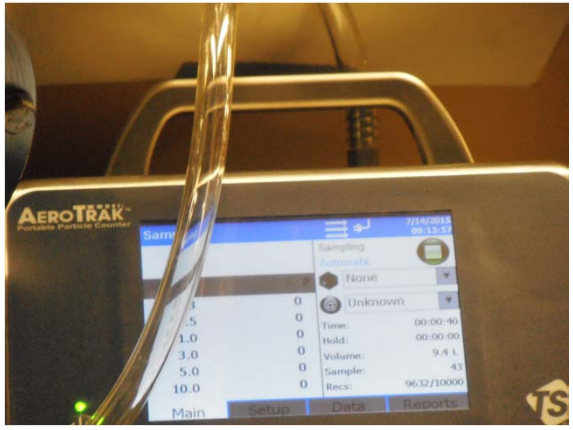




Class 10 Portable Cleanroom

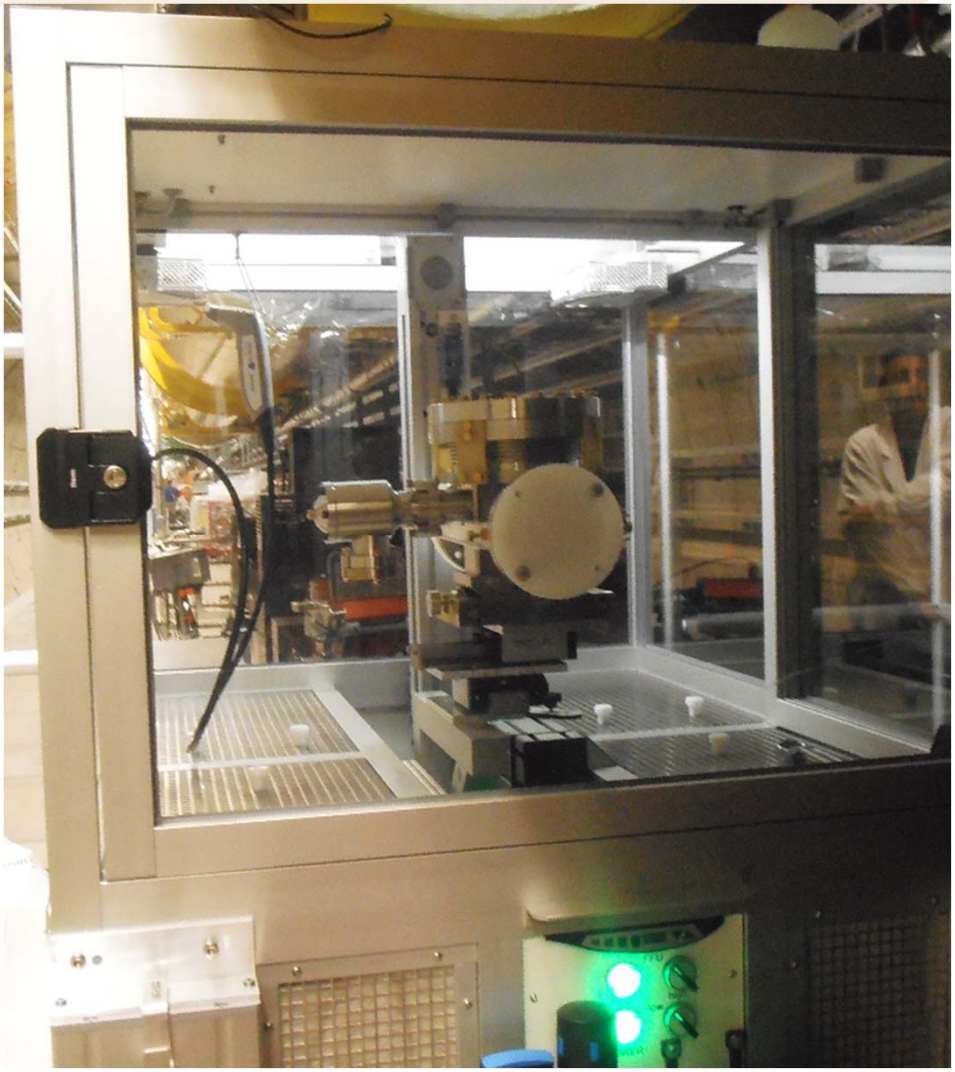
HOM Install Fixture

Donning CR Apparel



Particle Counter

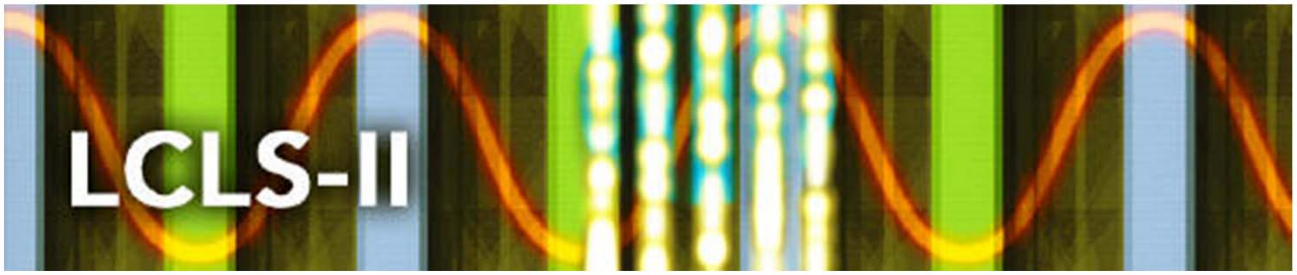
HOM Inside of Portable Cleanroom



Preparing HOM for Beamline Installation in Tunnel Portable Cleanroom

Fermi Lab Cleanroom

Photo courtesy Jerry Leibfritz



End