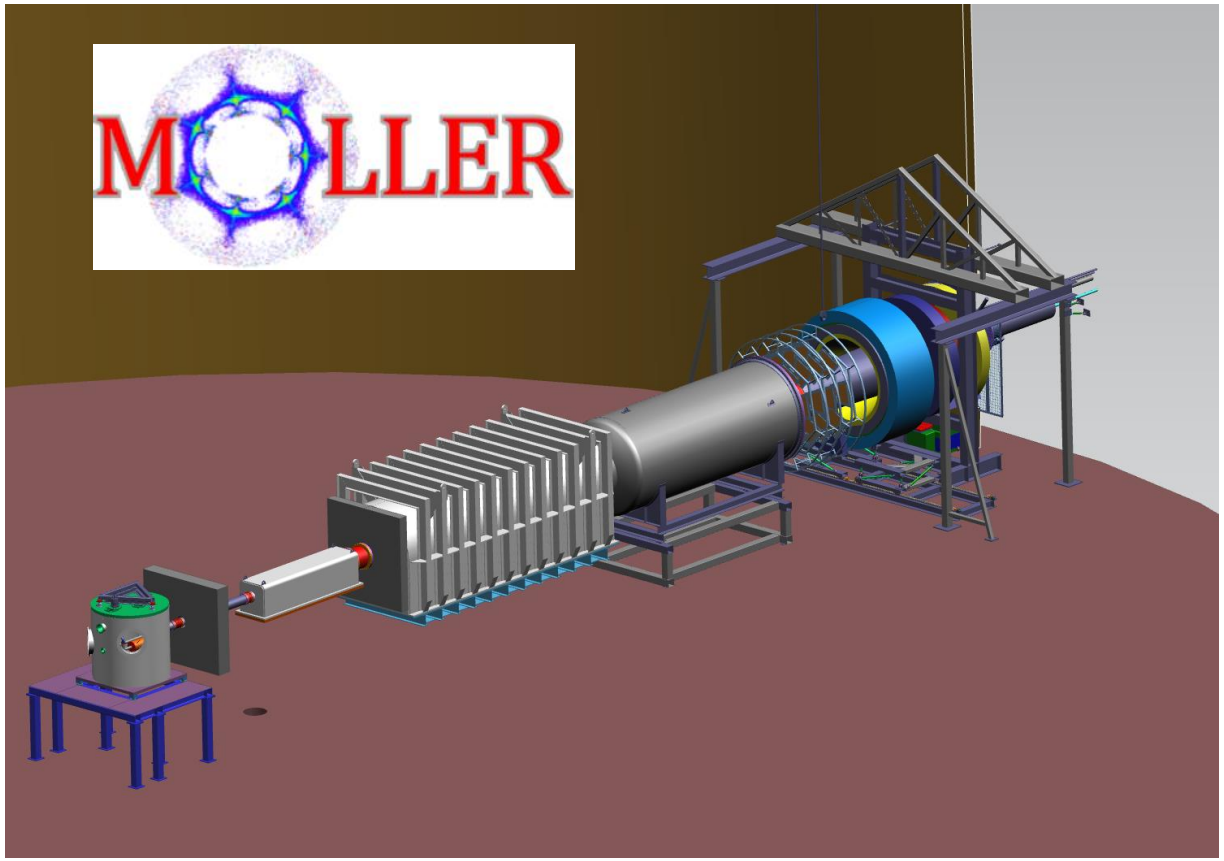
MOLLER ERR

Safety and Machine Protection Systems

(Charge questions 4,10)



Robin Wines

July 30, 2025

Jefferson Lab

U.S. DEPARTMENT OF ENERGY | Office of Science

JSA

Machine Protection (MPS) and Personnel Safety Systems(PSS)

- MOLLER experiment requires modifications to upstream and downstream beamline and Hall equipment resulting in relocation of safety and protection systems.
- In discussions with Keith Cole and Jerry Kowal:
  - MPS
    - Methods and equipment for machine protection will remain the same. Since same or existing the equipment will be relocated as needed and certified during Hot Checkout and beam commissioning. This includes dump line protection, beam line protection, beam loss monitoring and fast shutdown devices.
    - Target isolation is achieved by upstream fast valve and downstream differential pumping orifice.
    - Any required opening of penetrations for cabling requires separate process from Hot Checkout.
    - Continued use and placement of ion chambers for beamline (machine) protection as customary for all experiments.
    - Existing MPS infrastructure in the Hall is capable of accepting discrete electrical and optical as well as analog electrical signals for any additional interlocks.

  - PSS

    - SSG will open a Safety Concern Form with SCMB to document and review impact of any proposed work and potential changes.

    - SSG will decommission Hall A PSS System, starting in early SAM25, to support MOLLER related modifications.

    - SSG will temporarily disconnect PSS wiring in the hall in several locations to support MOLLER beamline and girder replacement.

    - SSG has done preliminary review of overall MOLLER experiment layout and finds no additional PSS requirements at this time.

    - Further discussion between SSG, DSO and Hall A/MOLLER staff is needed regarding sweeping of the detector arms.

    - SSG will modify/relocate PSS wiring of the Hall A truck ramp to support gas lines routing.

    - All changes to PSS system will be completed, and system commissioned and certified before start of the MOLLER experiment.

ODH

- Target is only use of Cryogens in Hall A during MOLLER experiment. Re-evaluation of ODH classifications to be submitted for reduced volumes.

From discussions with SSG:

- SSG will open a Safety Concern Form with SCMB to document and review impact of any proposed work and potential changes to the ODH system (might be combined with PSS SCForm).
- SSG needs to further discuss with Hall A/MOLLER staff a potential decomissioning of the system and any necessary changes. Access to HRSs may not be needed thus monitoring there is under discussion.
- ODH system will be certified before start of the MOLLER experiment.

Hazard Analysis

- Confined Space/Enclosures- Shielding required to enclose target and spectrometer regions. Target region has upstream area open and full visibility into enclosure. Spectrometer area has additional blocks added to prevent personnel access- full enclosure. HRS-L and HRS-R detector huts will be locked by Hall A and not accessible. No confined space entry required.
- Magnetic fields- Evaluation indicates magnetic fields do not extend beyond boundaries of enclosures. Regions will be indicated in Hall by boundaries and signage during experiment.
- Fire Protection and mitigation
  - Target utilizes Hydrogen requiring design and fabrication of system according to ASME pressure system and NFPA regulations. System has been reviewed by external fire safety engineer. Ventilation and fire suppression implemented according to review recommendations and code requirements. (details in Target ERR)
  - Required modification of utilities along upstream beamline results in sprinkler system modifications. Discussions have begun to implement, schedule and re-certify this system. Other existing sprinkler system in Hall remains in use.

Hazard Analysis

- Electrical
  - New electrical distribution along beamline to detectors and around perimeter of Hall to magnet power supplies is required. All work being done by approved electricians and to be certified prior to use.
  - Grounding of electrical equipment is being done according to standard Hall practices and according to MOLLER Grounding Procedure document.

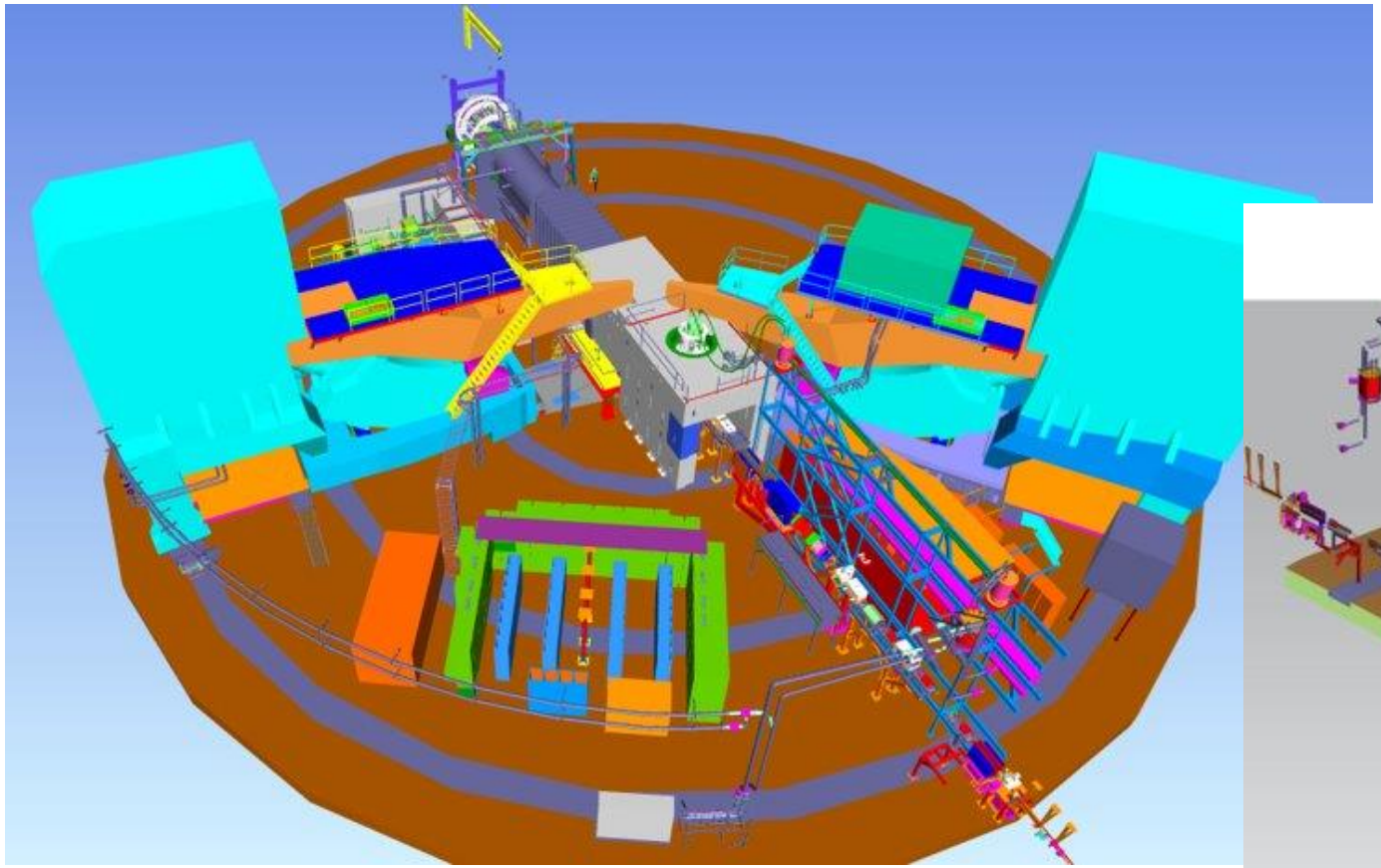
- Ozone- Determined that ozone levels will require environment monitors. Industrial Hygiene notified.
- Radiation- details presented by Ciprian.
- Monitoring Hall- 3 cameras have been installed to monitor conditions. Cameras have view of beam-right, beam-left and electronics bunkers.

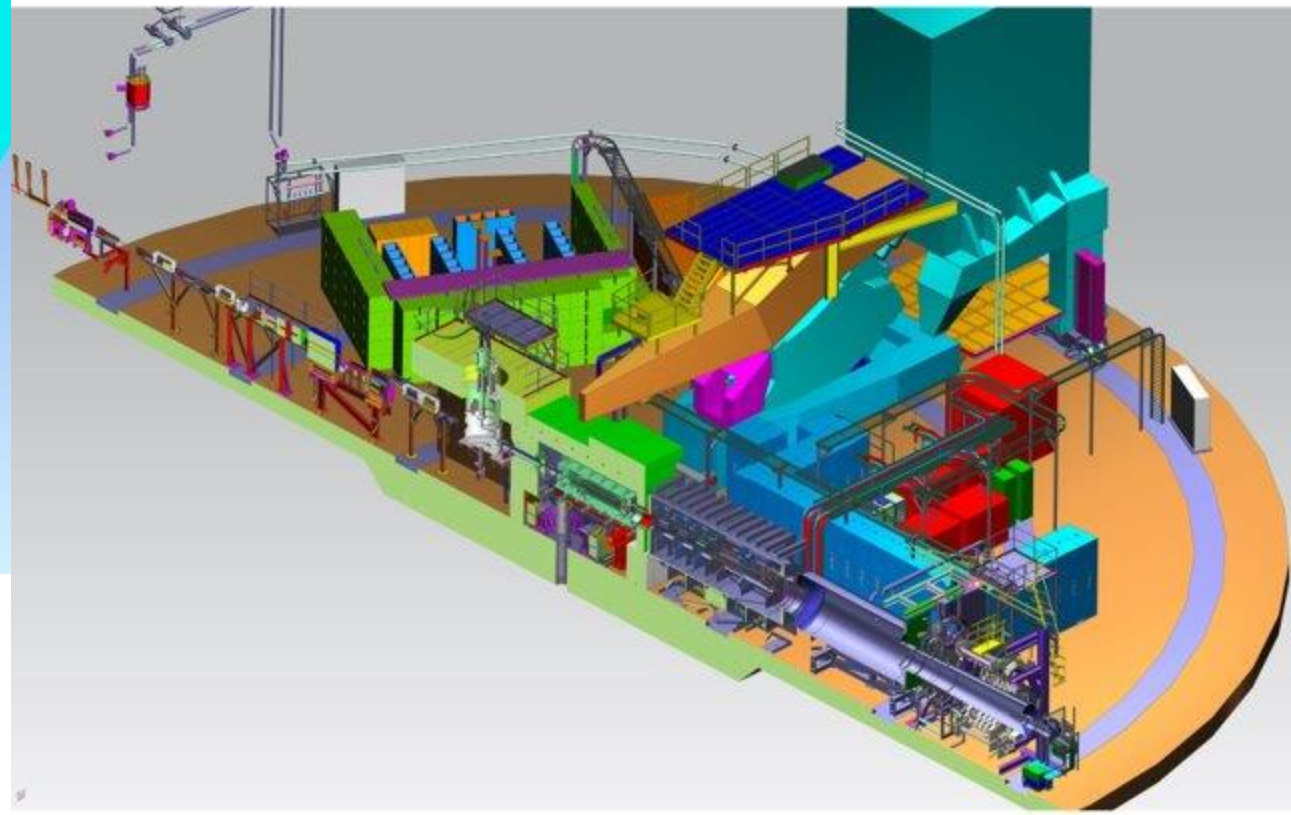
Hazard Analysis

- Gas- All gas systems are designed, fabricated and tested according to ASME Pressure Piping code requirements.
  - GEMs- GEMs will utilize the existing Hall A Ar/CO2 gas and Nitrogen systems with addition of manifold for distribution. Requires 15 scfh.
  - Cooling of Detectors- Two compressed air systems will be utilized to supply continuous cooling flow to detectors. These systems will have monitoring from manifold systems. Main Detectors require 3100 scfh.
- LCW/cooling water
  - US and DS Toroid magnets will be cooled by LCW system. Continuous monitoring of temperature and flow is implemented into these magnets. Existing LCW system is being modified to include branches to service magnets and power supplies.
  - Blocker/Sieve and collimators are cooled by a closed loop water system with monitoring of temperature and flow.
  - Magnet power supplies will be cooled by LCW system. Temperature and flow is monitored by standard Hall methods.

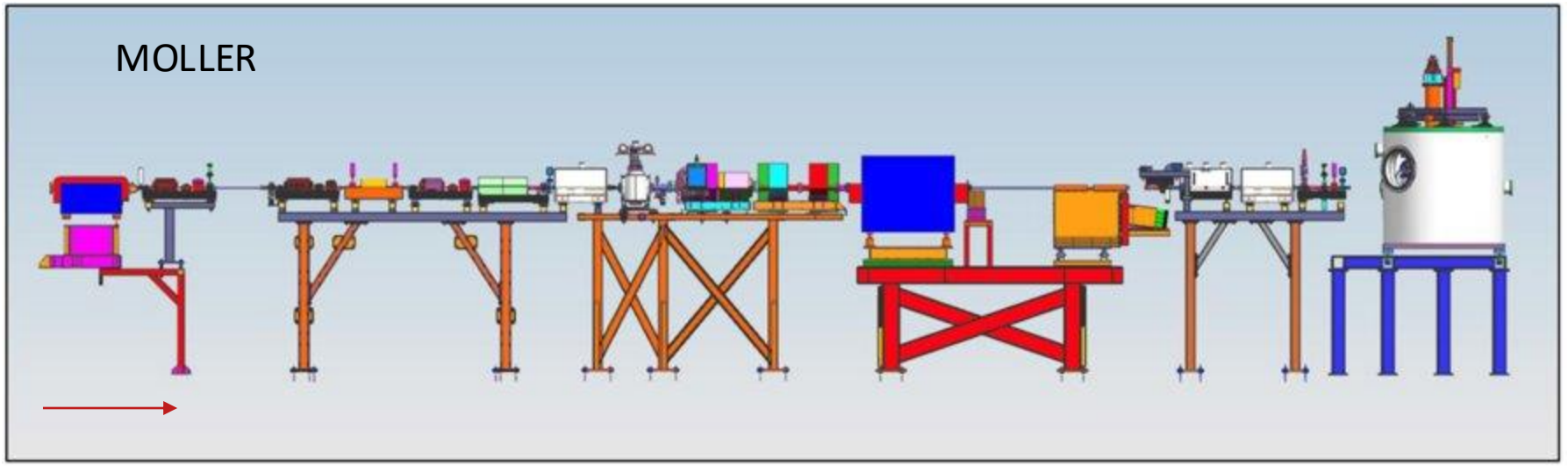
APPENDIX

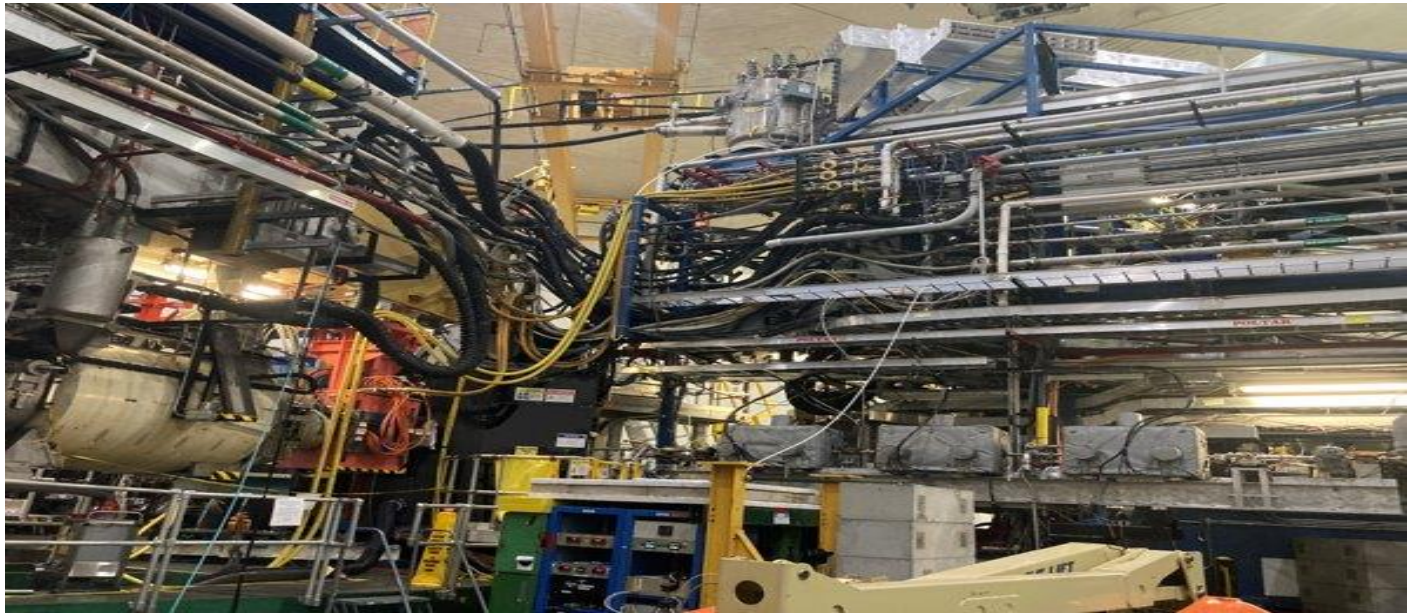
Hall A and MOLLER images





Beamline and Utility Images

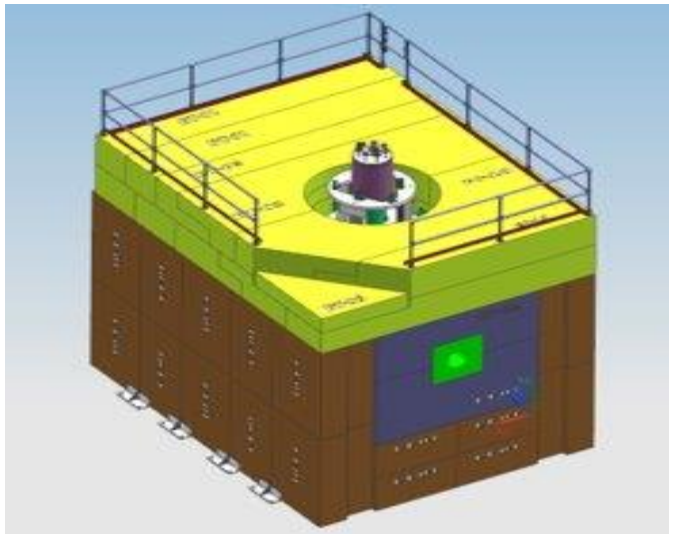


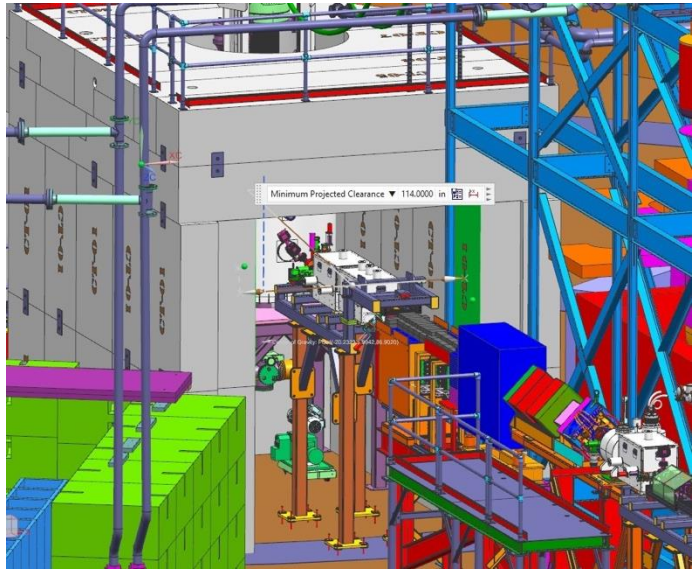


Existing

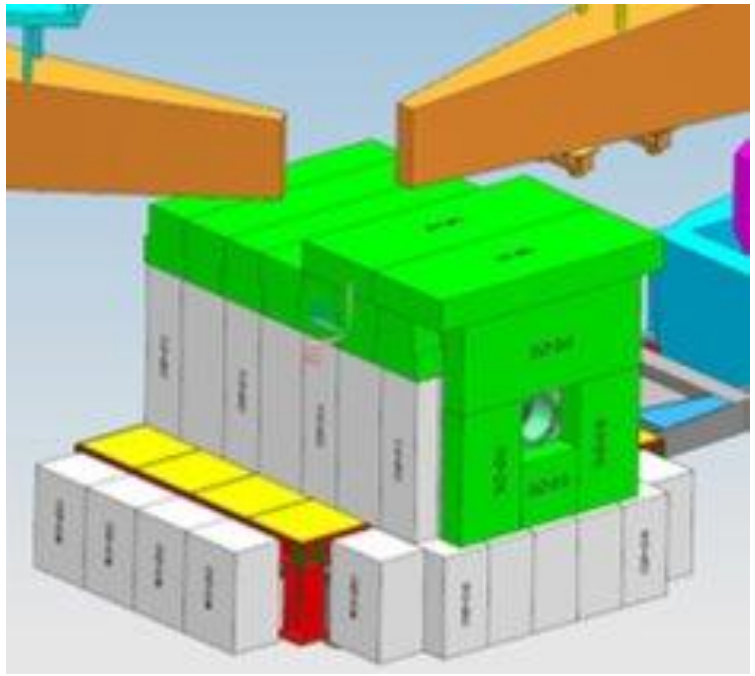
Shielding Enclosure images

Target enclosure





Spectrometer enclosure



MPS enclosure