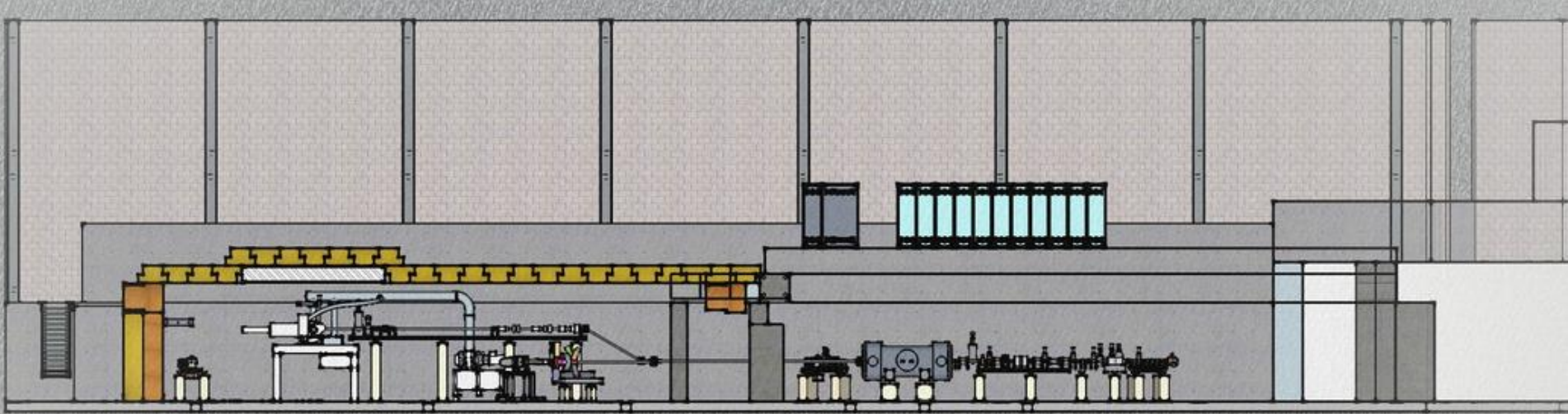


# Upgrade Injector Test Facility: UITF

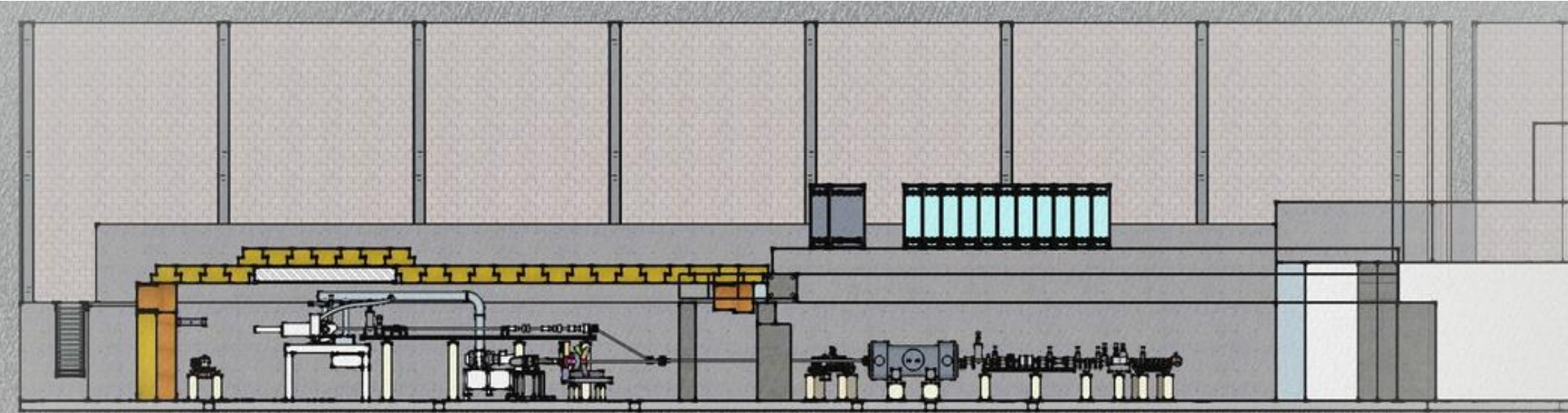


## Why Build It?

CEBAF related

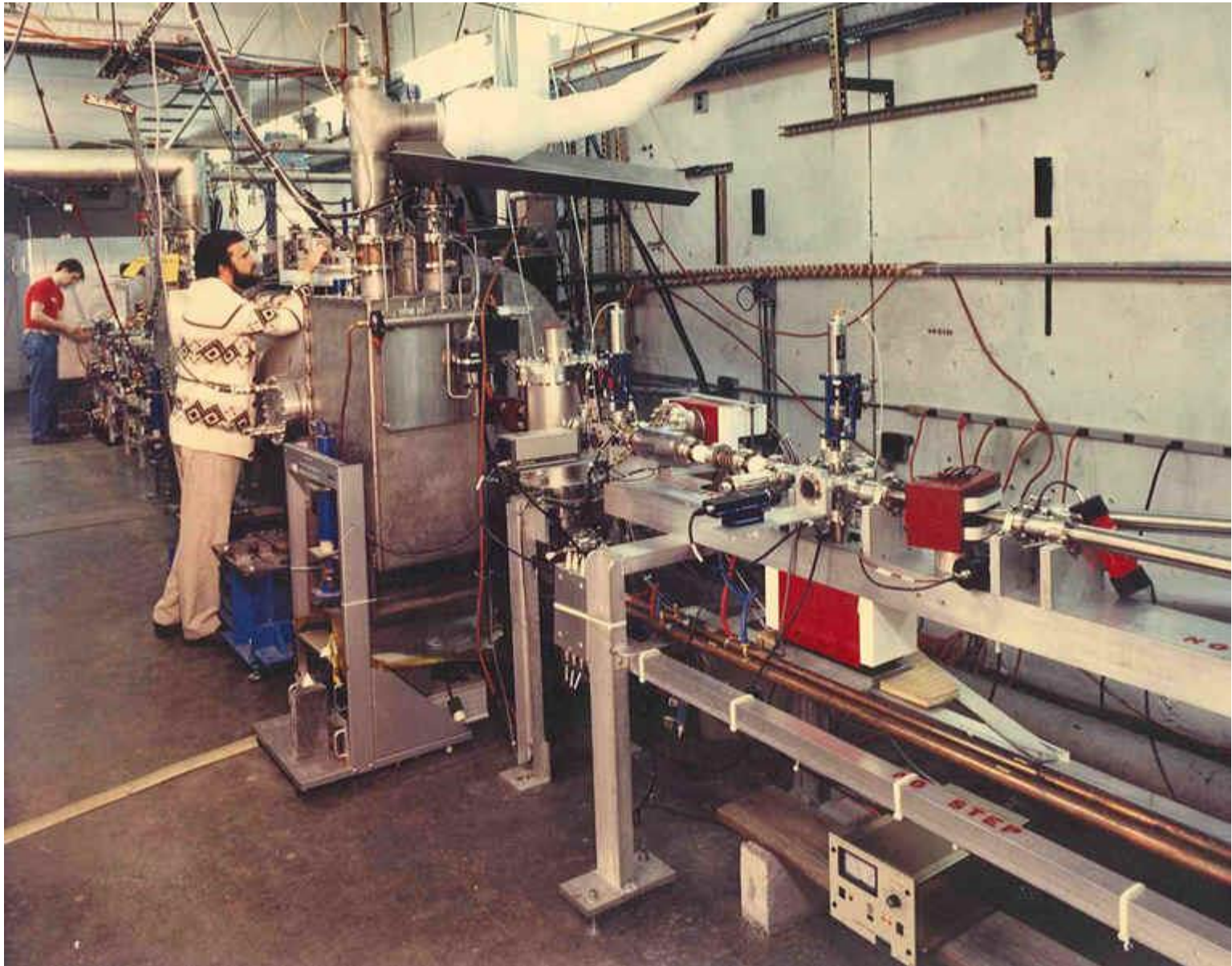
- HDIce commissioning
- Bubble chamber physics with Bremsstrahlung x-rays: photo-disintegration of oxygen into helium and carbon
- In support of parity violation experiments, and CEBAF operations in general: pockels cell improvements, low noise floor current monitors, low current beam position monitors, etc.,
- Commission the new  $\frac{1}{4}$  cryomodule before installation at CEBAF
- Polarized positron source development
- MEIC related: magnetized beam at high current/high bunch charge, fast kicker
- THz light source, drive an SRF cavity with magnetrons?
- Isotope production experiments? Beam with orbital angular momentum?

# UITF Beam Specifications

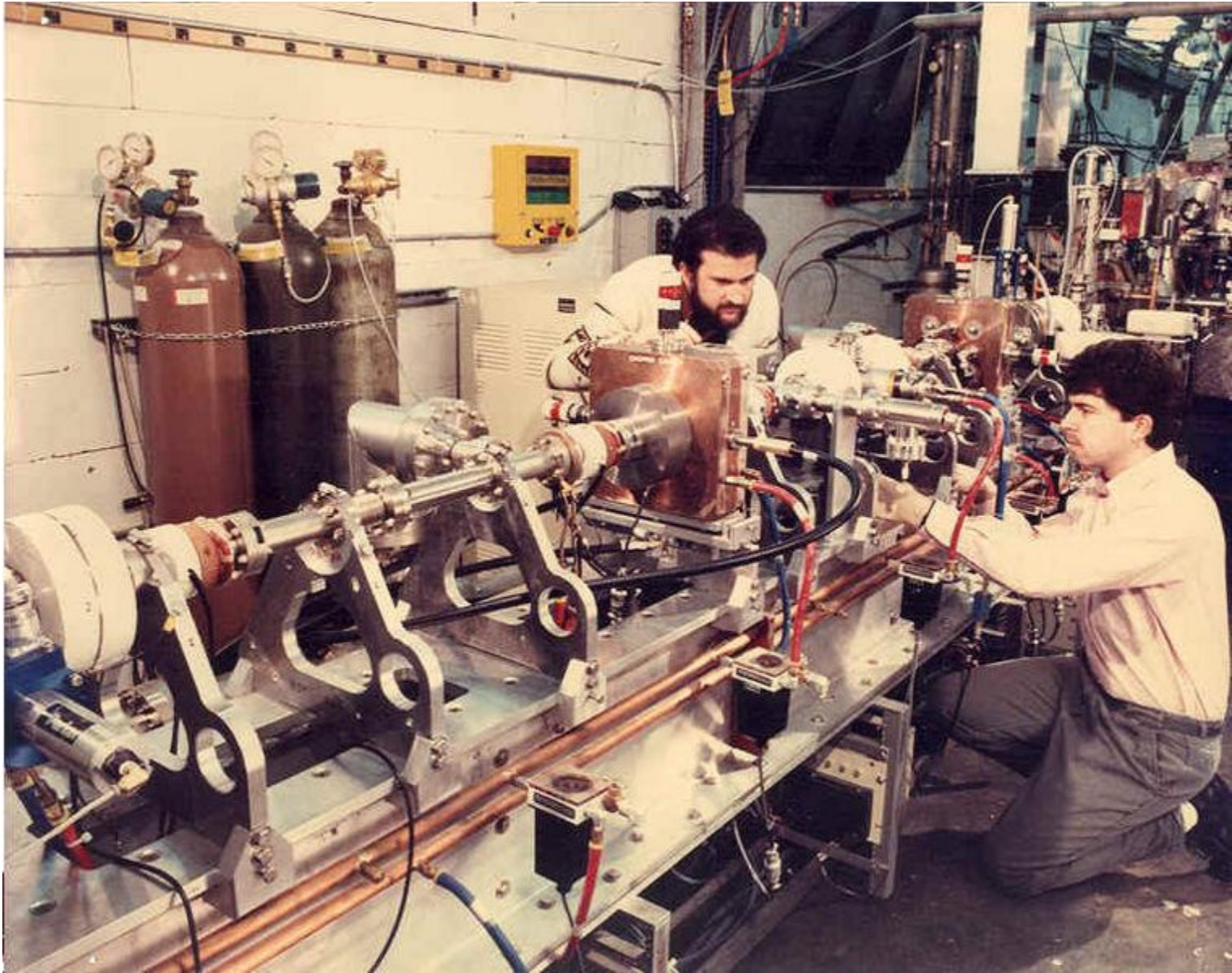


- Approved for HDIce beam conditions: up to 100nA average current at 10 MeV
- Working with RadCon to find a shielding solution for 100uA average current at 10 MeV (e.g., for Bubble Chamber): additional global shielding, local shielding at dumps, beamloss monitors for quick shutdown
- Expect photogun to provide milliampere average beam current: a proving ground for demonstrating feasibility of polarized beam physics at JLab FEL/ERL
- 85% polarization, Wien filter for spin manipulation, accurate Mott polarimeter
- 350kV gun, so higher bunch charge capability compared to CEBAF, 100pC instead of 1pC. Beam quality should be improved, too (energy spread, emittance and bunchlength)
- Discretely variable bunch repetition rates 1497/2n MHz









# Schedule

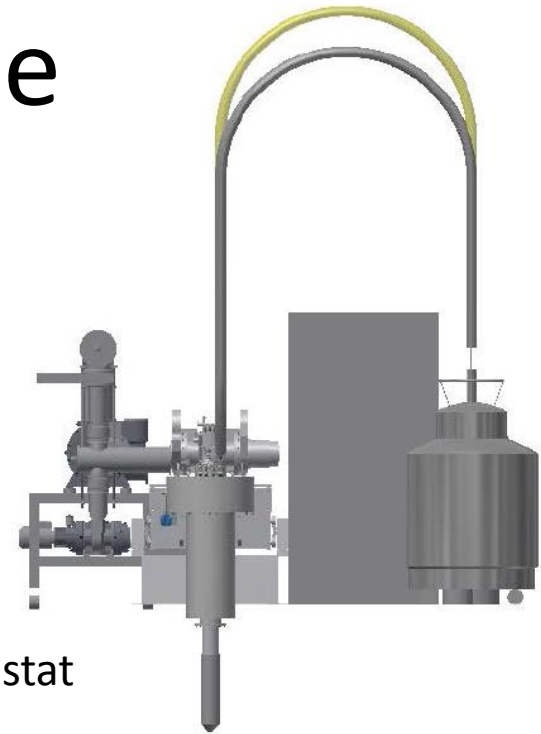
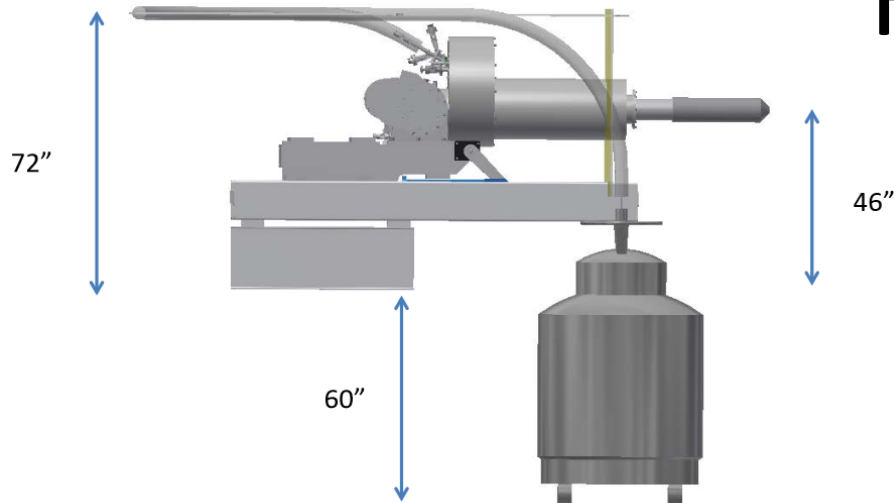
## Schedule Milestones

<b>Civil Work Complete</b> (select demolition, stairs to Cave1, Electric, HVAC, installation of concrete block, structural support added, poured in place concrete, ceiling tiles can be installed later)	<b>November, 2015</b>
<b>Demonstrate Gun happy at 350 kV at FEL GTS</b> (need new insulators and Carlos Hernandez-Garcia)	<b>December, 2015</b>
<b>Commission cold 1/4 CM, no beam</b> (requires LHe, ODH system, high power and low level RF to 1/4 CM, software, PSS and Safety approval)	<b>January, 2016</b>
<b>Beam from Gun to Cup in front of 1/4 CM</b> (requires gun and HV power supply inside SF6 tank, baked beamline, powered racks above Cave1, select I&C, select DC Power, no RF necessary but would be nice to have, more software, PSS, approved shielding and procedures)	<b>March, 2016</b>
<b>Beam through 1/4 at MeV energy delivered to cup in front of HDice</b> (requires all the above + MPS, all RF control, all magnets, all I &C, all software, all required documentation)	<b>June, 2016</b>
<b>Beam to HDice</b>	<b>August, 2016</b>

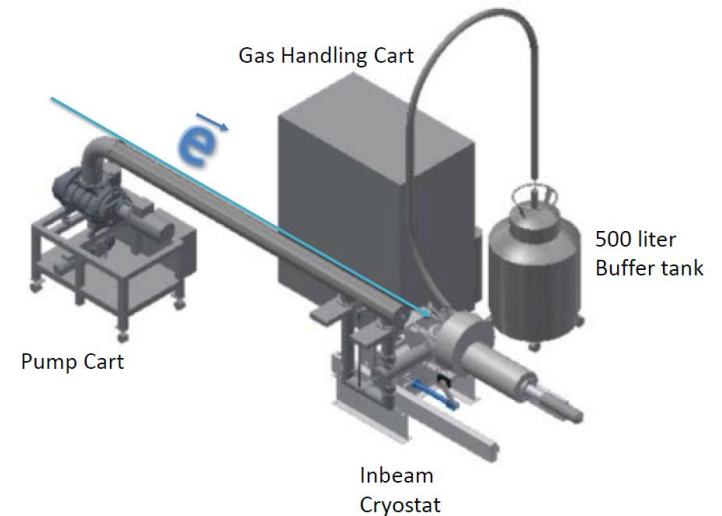
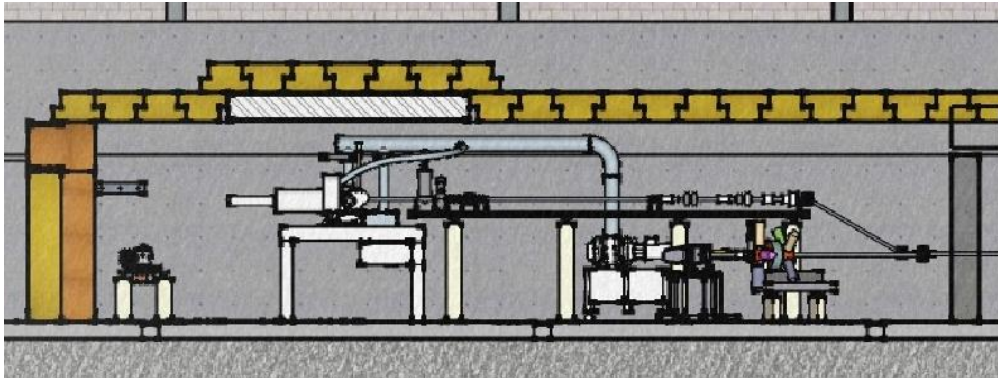
Physics is  
OK with  
this date



# HDIce



- Horizontal to take beam, Vertical for “loading” into cryostat
- Unwieldy plumbing, Lots of ancillary equipment



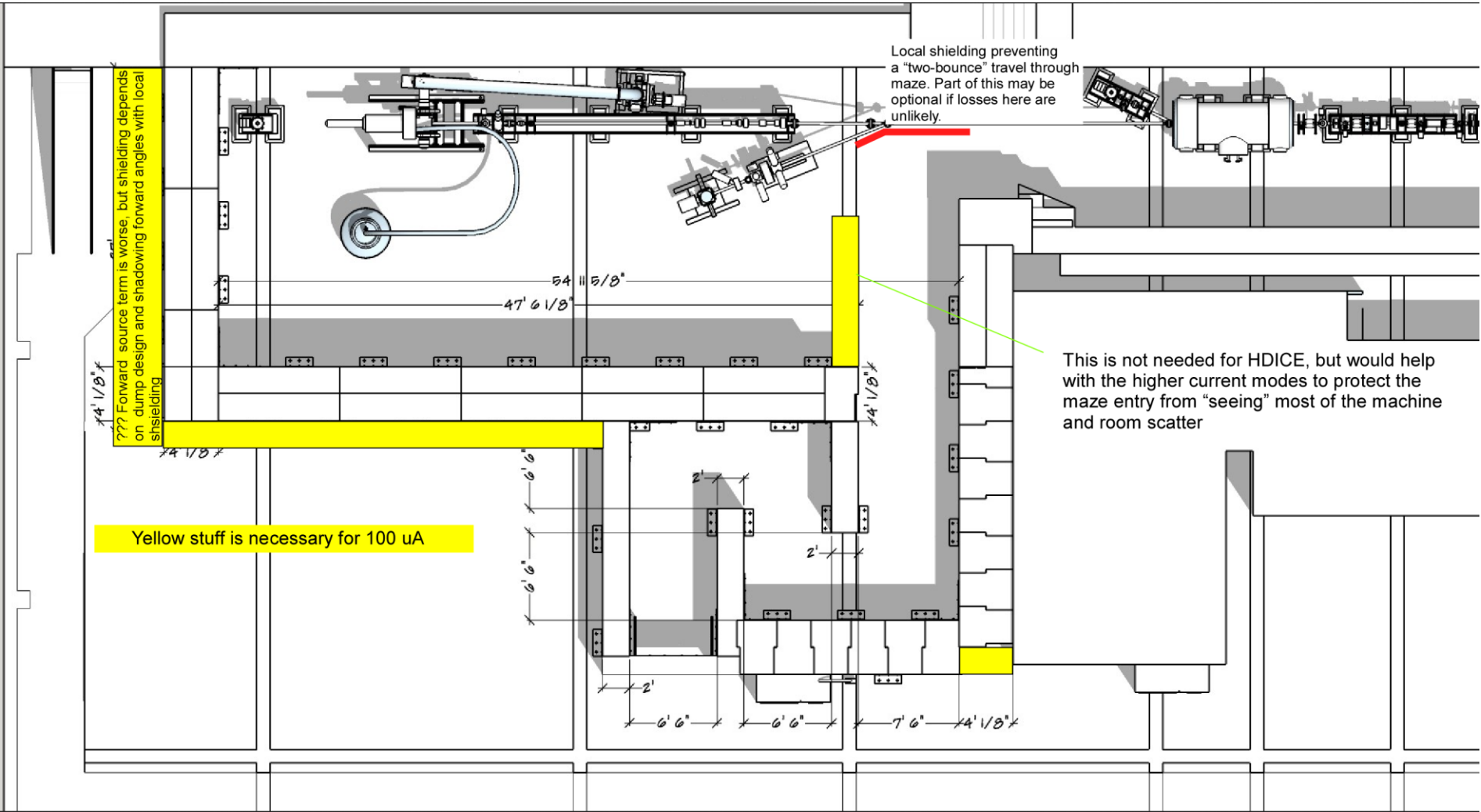
We chose “No Pit” option, build a vertical chicane, taller section added to Cave

Local shielding preventing a "two-bounce" travel through maze. Part of this may be optional if losses here are unlikely.

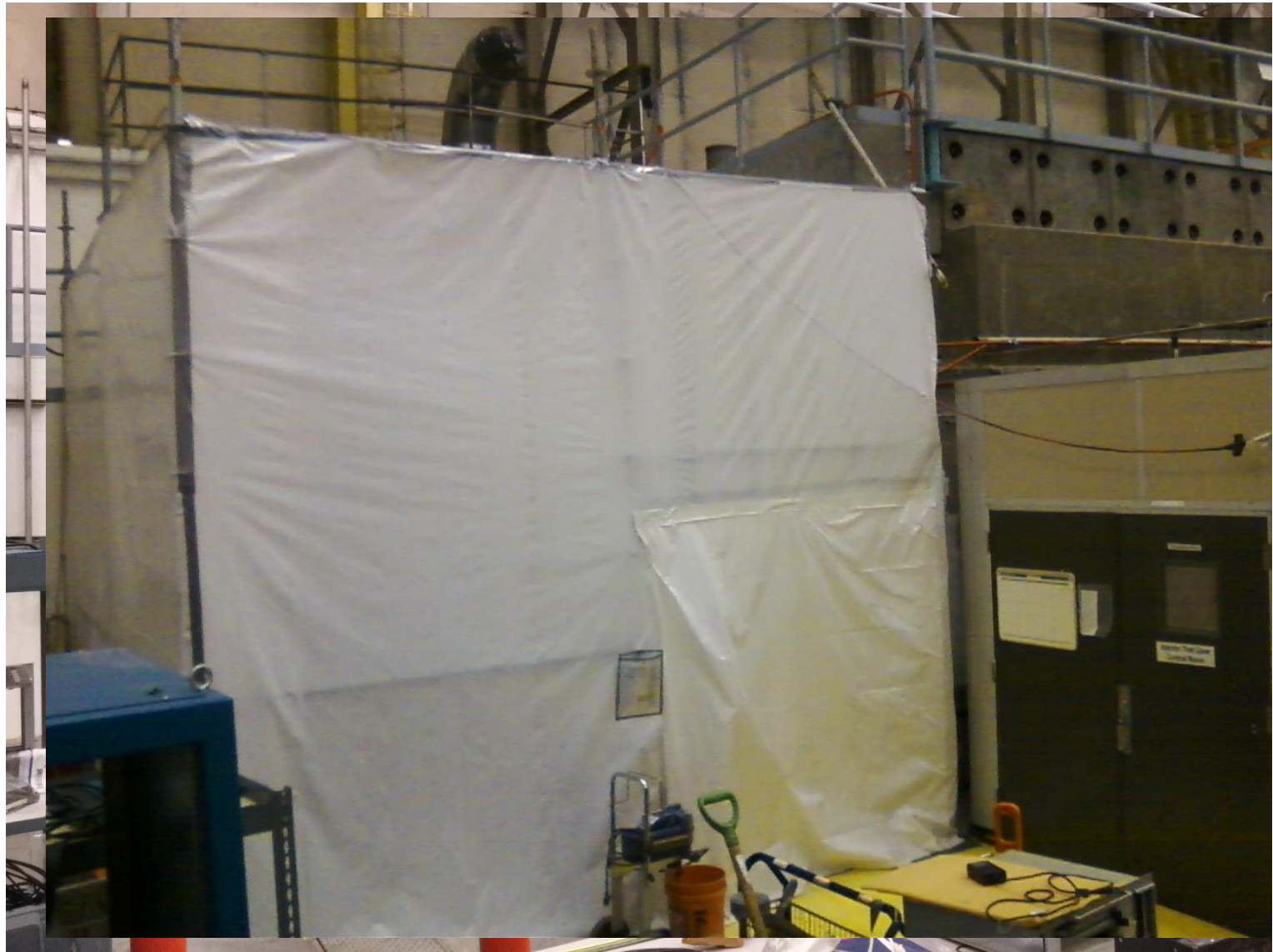
This is not needed for HDICE, but would help with the higher current modes to protect the maze entry from "seeing" most of the machine and room scatter

??? Forward source term is worse, but shielding depends on dump design and shadowing forward angles with local shielding

Yellow stuff is necessary for 100 uA

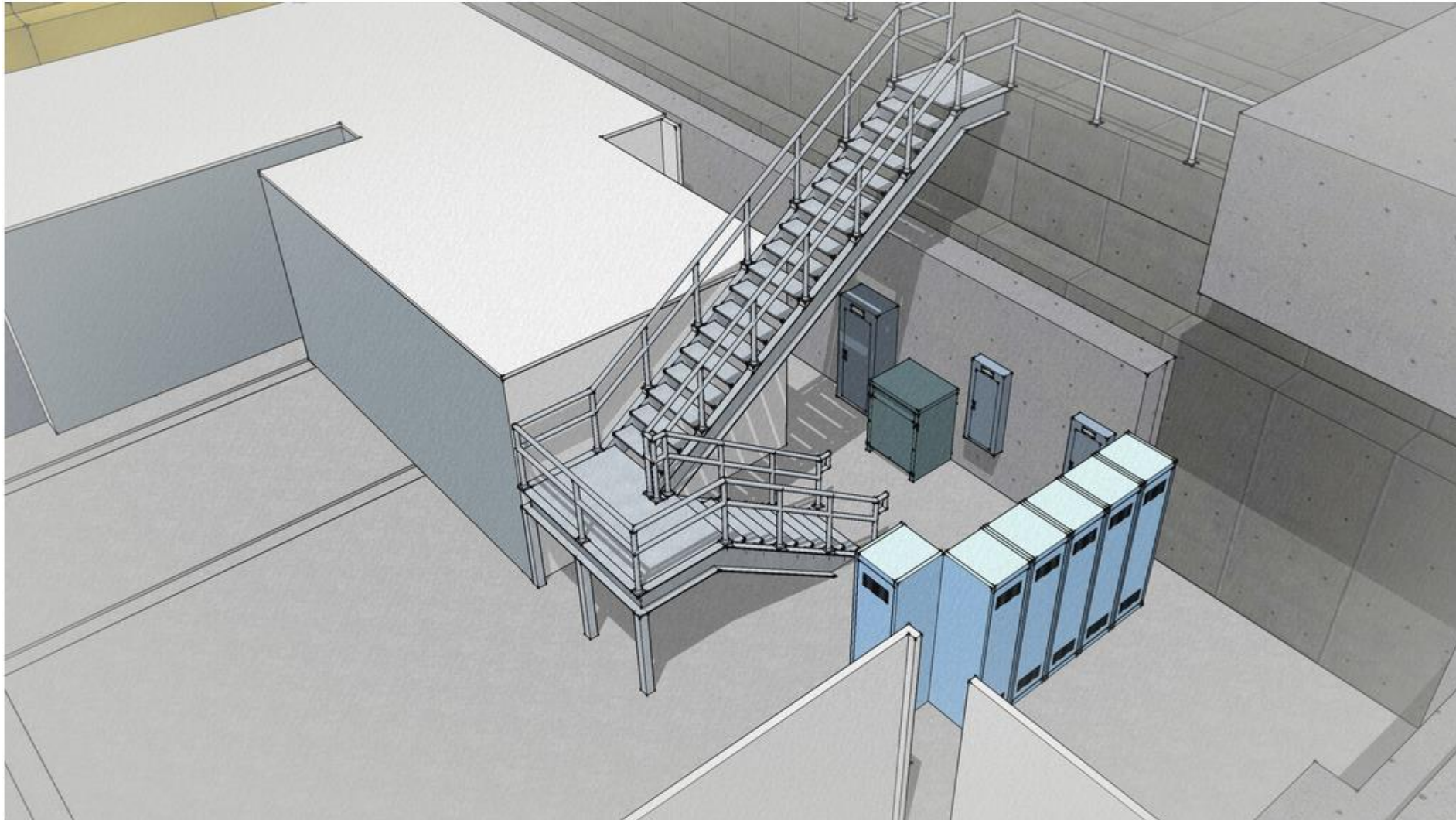




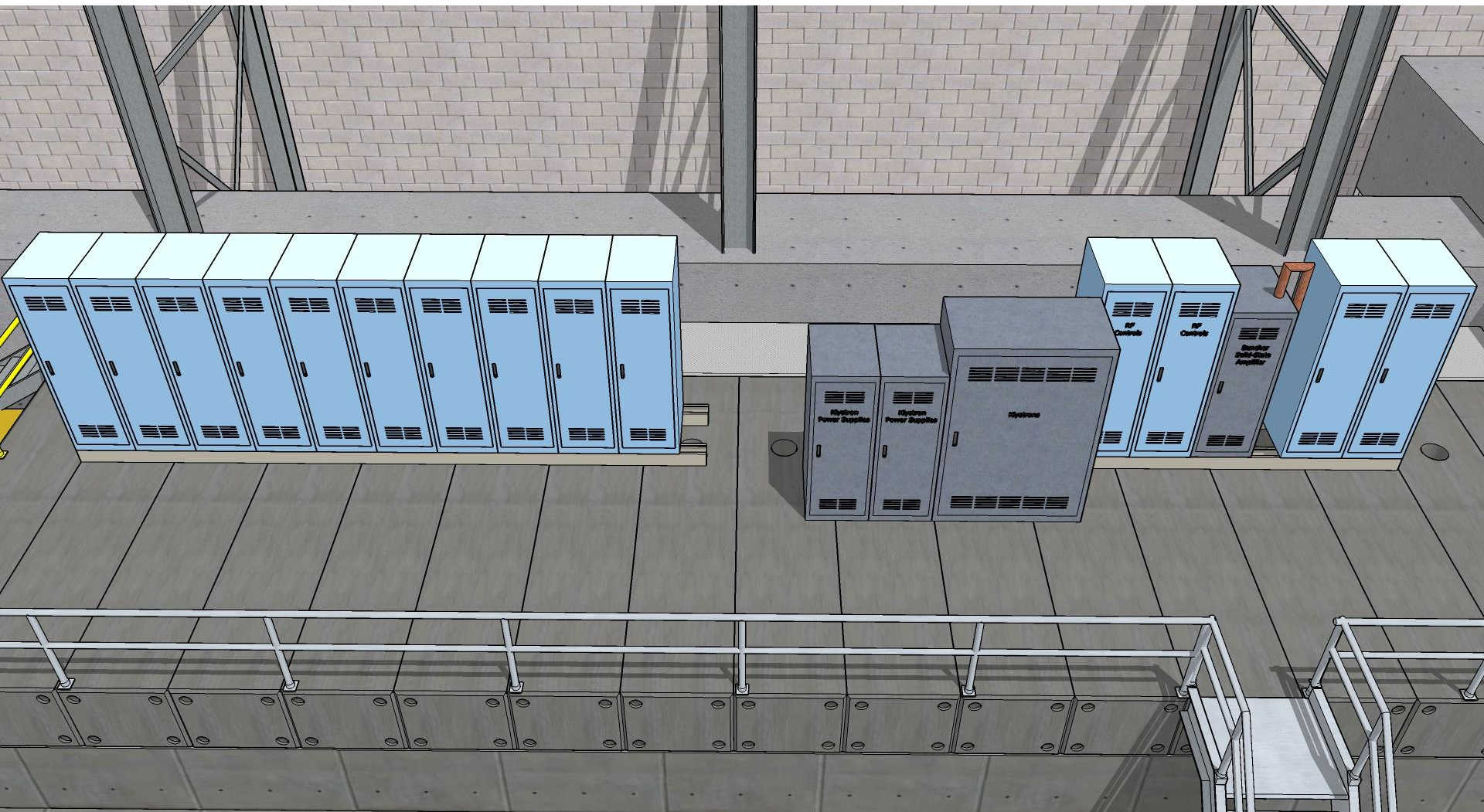




# New stairway happens end of Summer

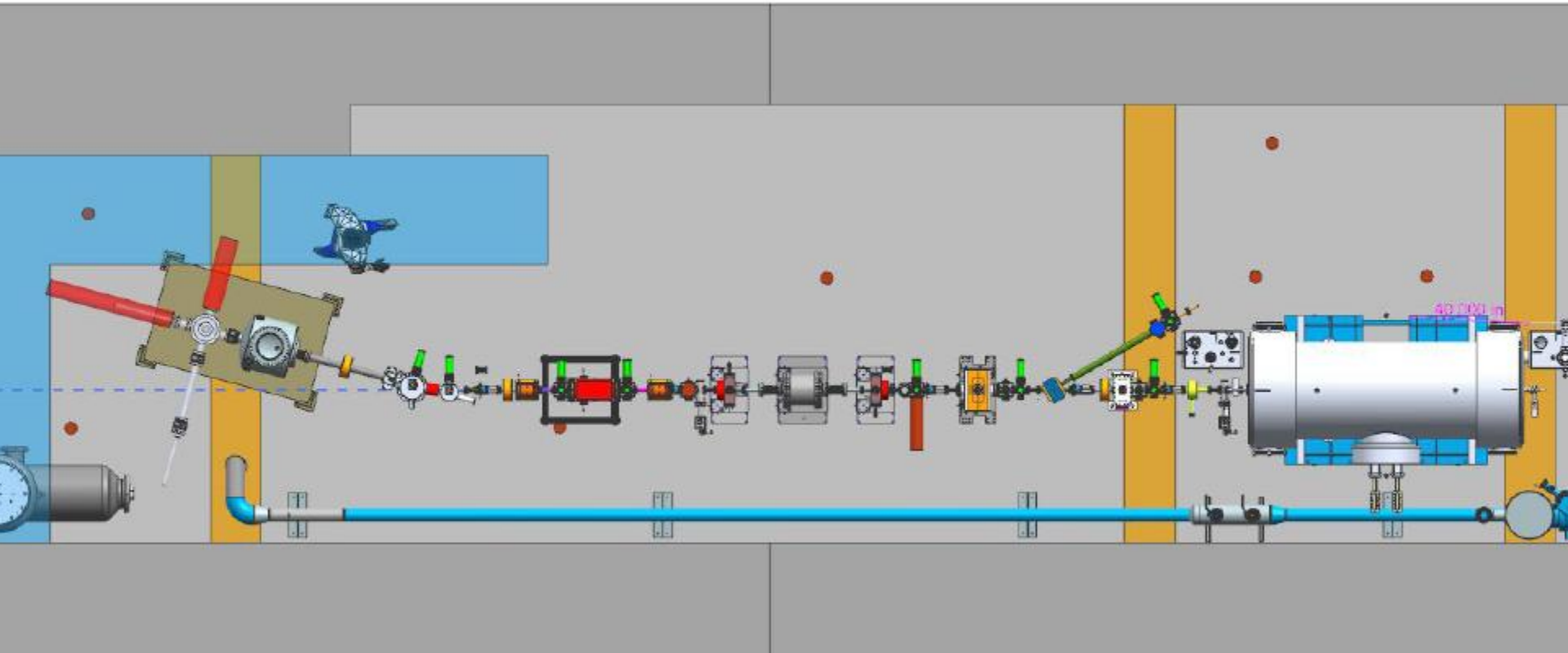


# Rack layout, version 1





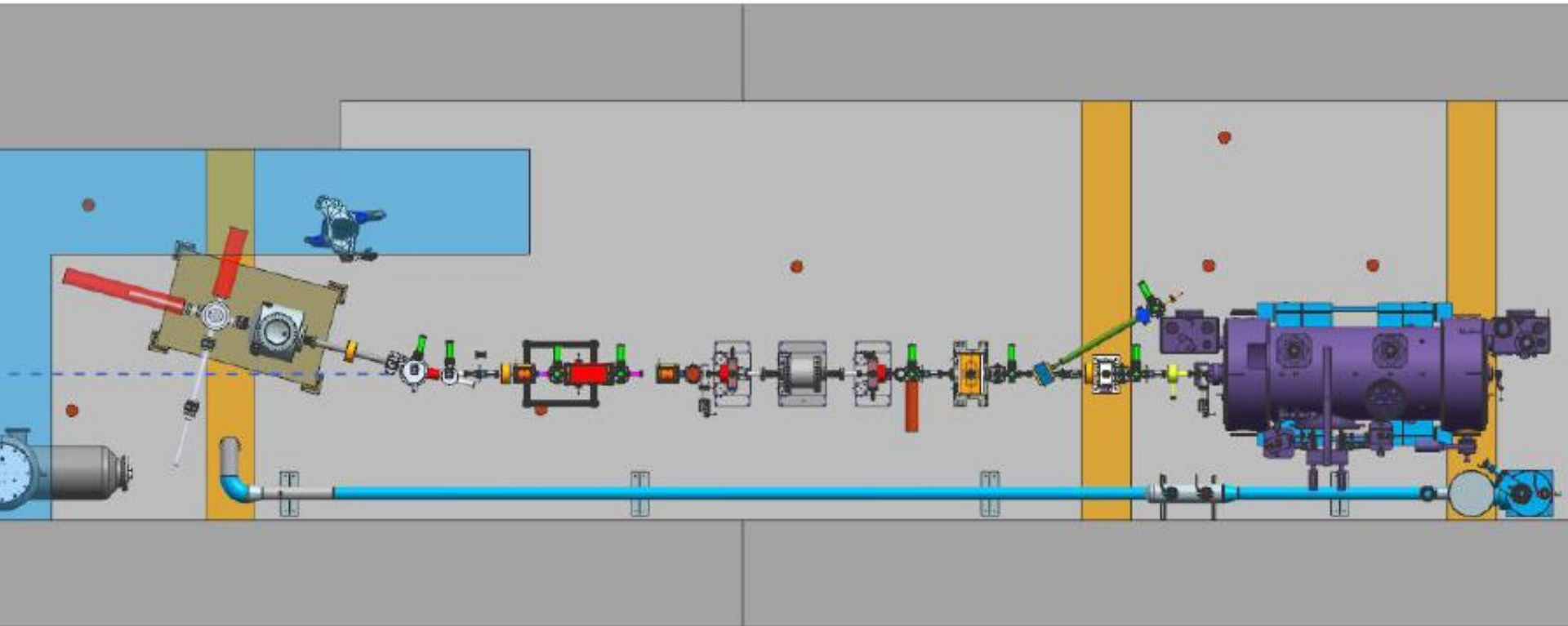
# Today's layout, ready to cut metal.....



Cryo lines hug the wall, waveguides on same side as cryo lines  
Heat exchanger added to the mix, Rao says this will make things more efficient and stable

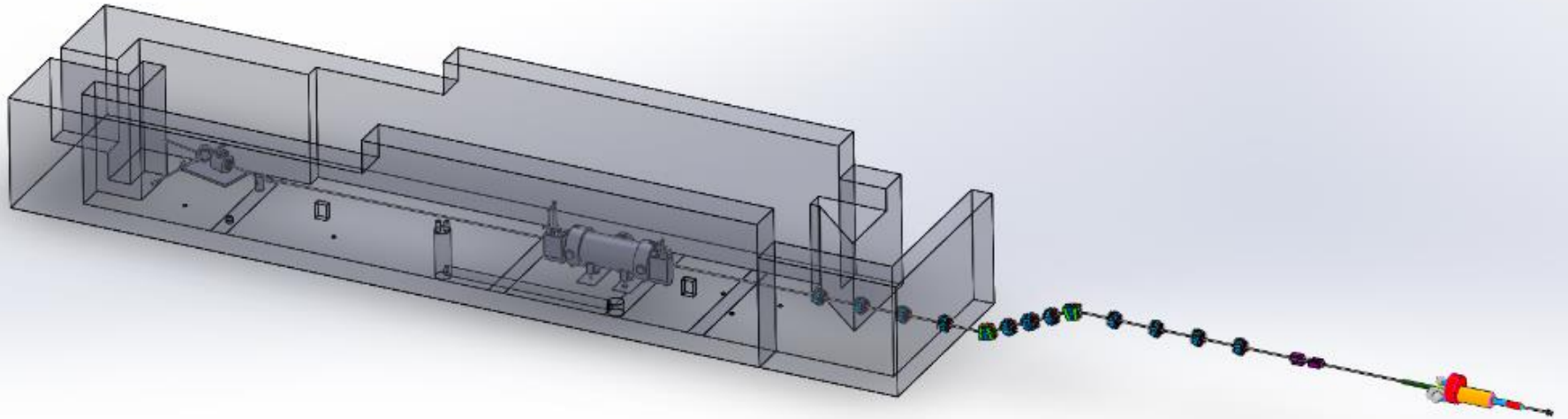


# Cryo lines compatible with old and new $\frac{1}{4}$ CM...



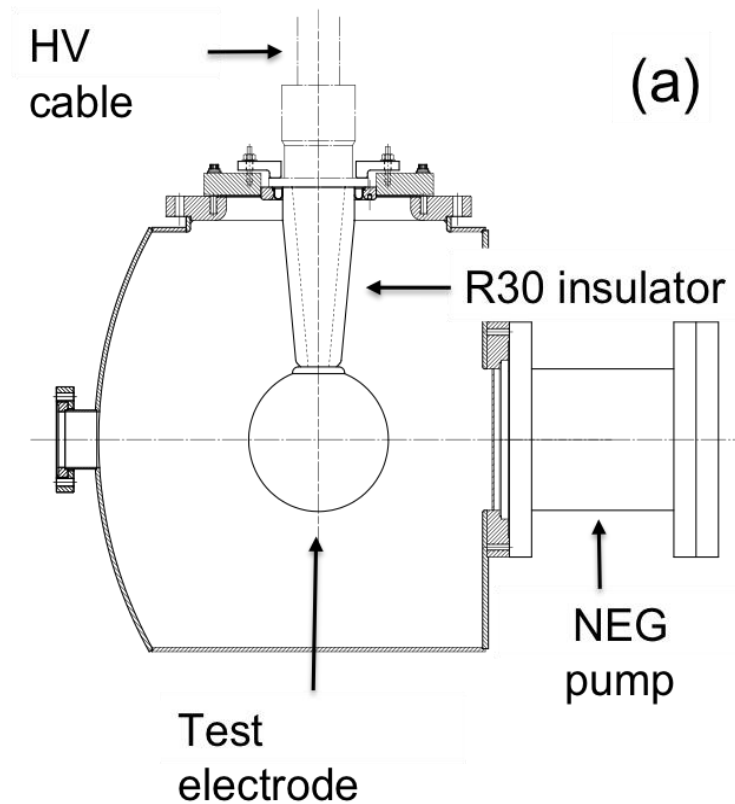
Looks similar to our “upgrade injector” front end

Haven't started designing the MeV beamline yet...

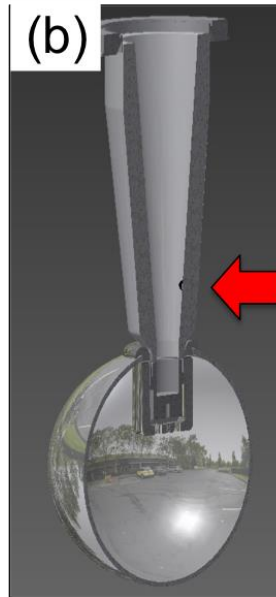
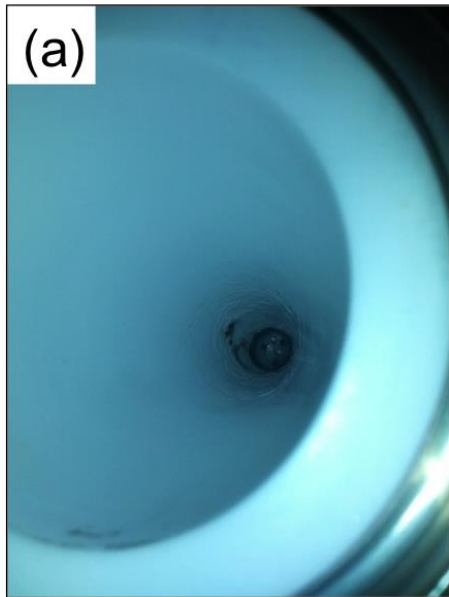
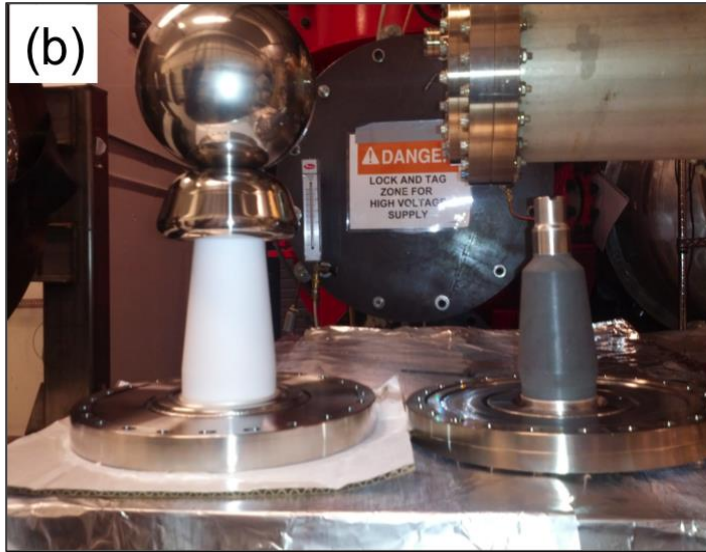


# BUILDING THE 350 kV GUN

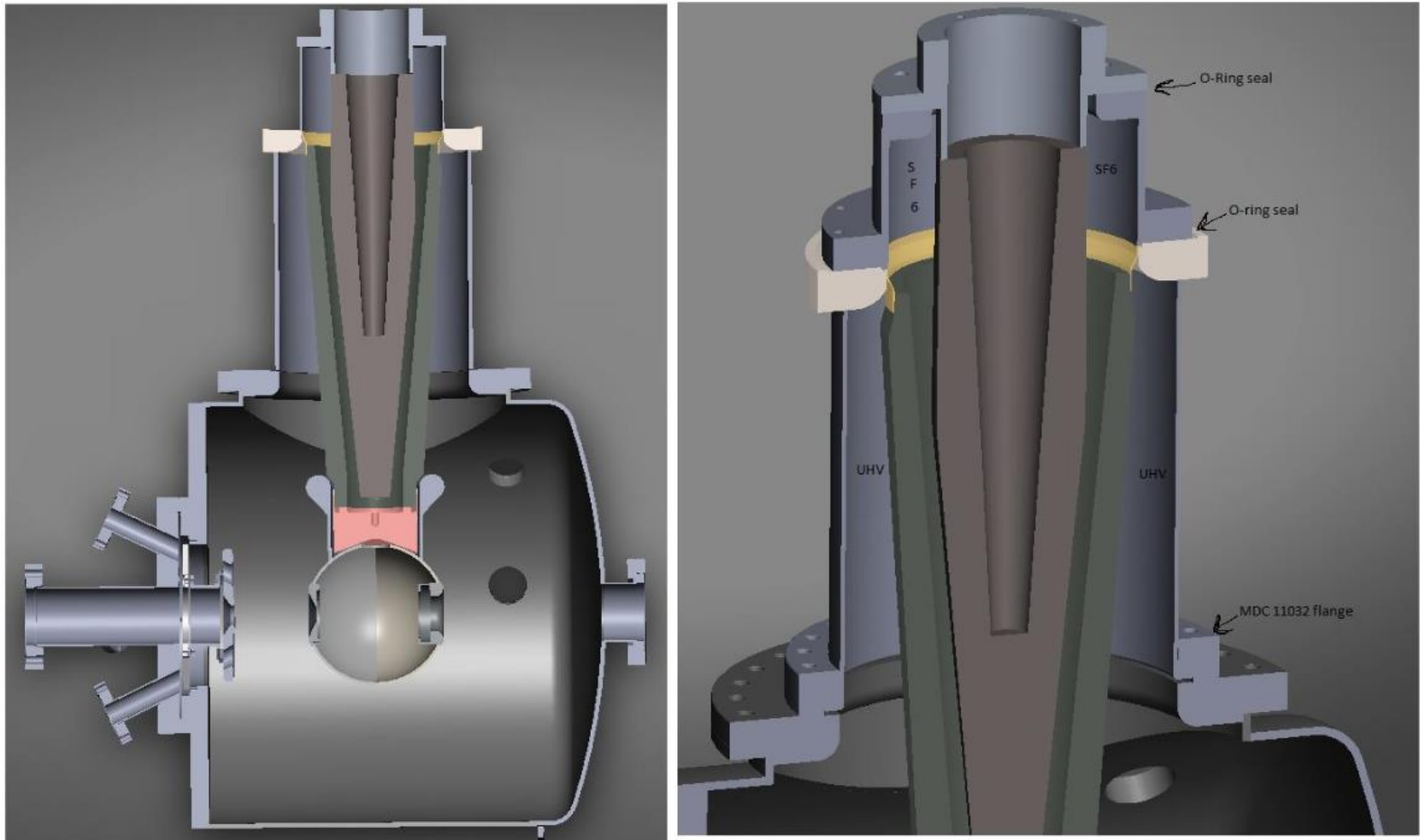
- Start with “dummy” electrodes and test different insulators and cathode screening electrode





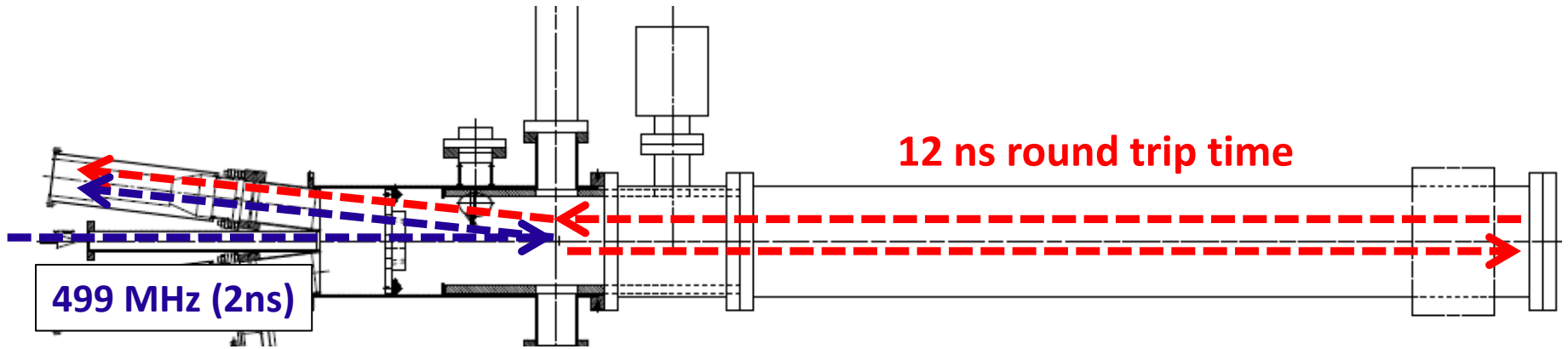


# Plan Z: use big insulators purchased by FEL

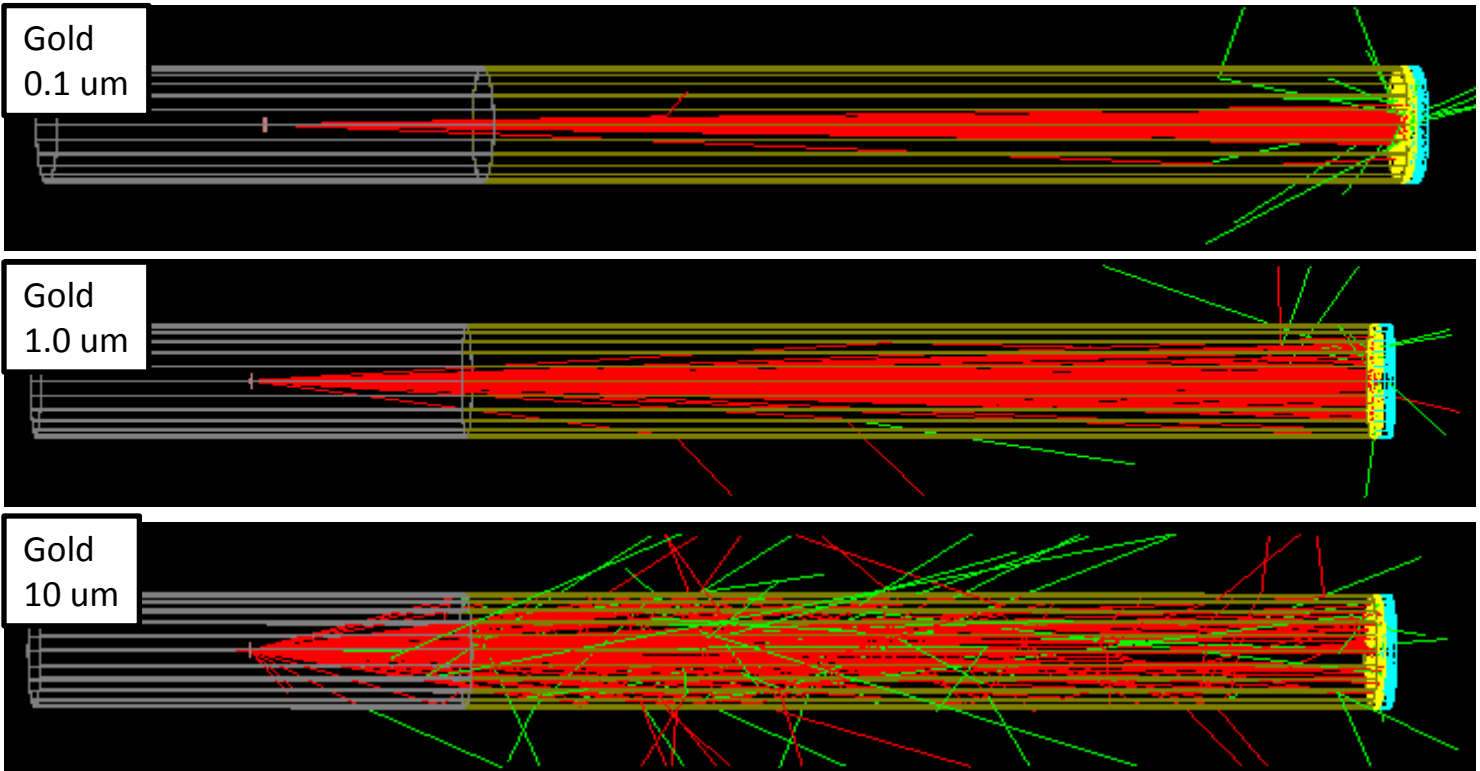


Longer insulator, adopt beneficial “shed”-style geometry, insulator + receptacle + SF6

# 5 MeV electrons on thin gold foil



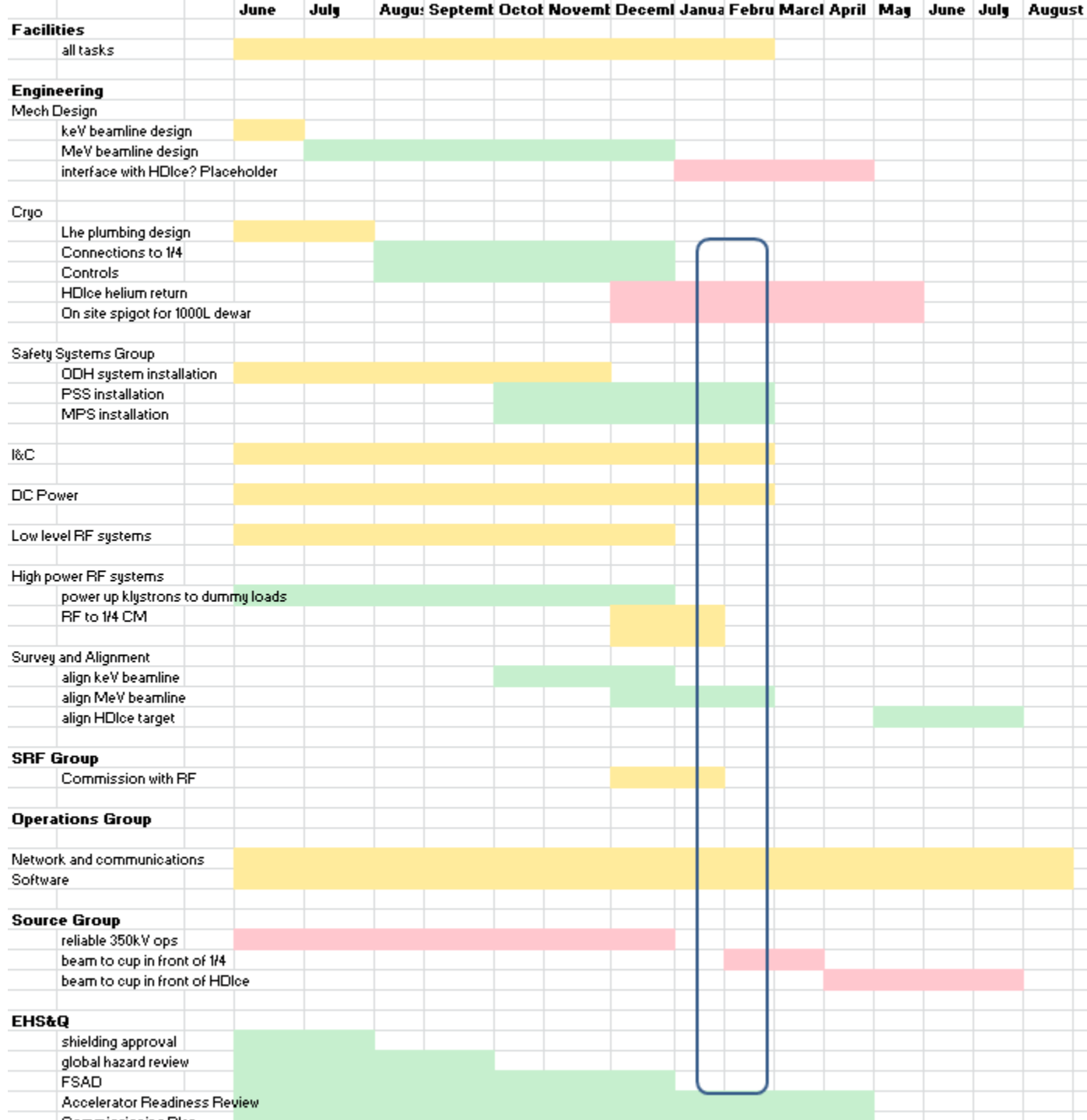
*Won't things be worse for HDIce?*





# Resources Needed

- Facilities: Demolition and Cave2 structural integrity, AC power and lighting, HVAC, fire suppression, LCW and stairway to top of Cave1, door or gate to new Cave2 (0.8 FTE)
- Engineering: Cryo, helium to  $\frac{1}{4}$  CM and HDIce (2 FTE)
- Engineering: Mechanical design of beamline (1.5 FTE)
- Engineering: Instrument & Control, viewers, BPMs, valves, etc., (1 FTE)
- Engineering: DC Power for magnets ( $\sim 60$  magnet channels) (0.3 FTE)
- Engineering: Low level and high power RF (up to 8 devices) (4 FTE)
- Engineering: Safety System Group – ODH, PSS and MPS (0.3 +  $\sim 2$ FTE)
- Engineering: Survey and Alignment (0.5 FTE)
- Accelerator Operations: Software control of all elements, network connections and terminals in control room (1.25 FTE)
- Accelerator CIS: dc high voltage gun, beamline optics modeling, beamline construction, make and deliver the beam to User (1.25 FTE)
- Physics: Cave design, concrete block placement, and HDIce team
- and EHS&Q....



# AWP Planned FY15 activities

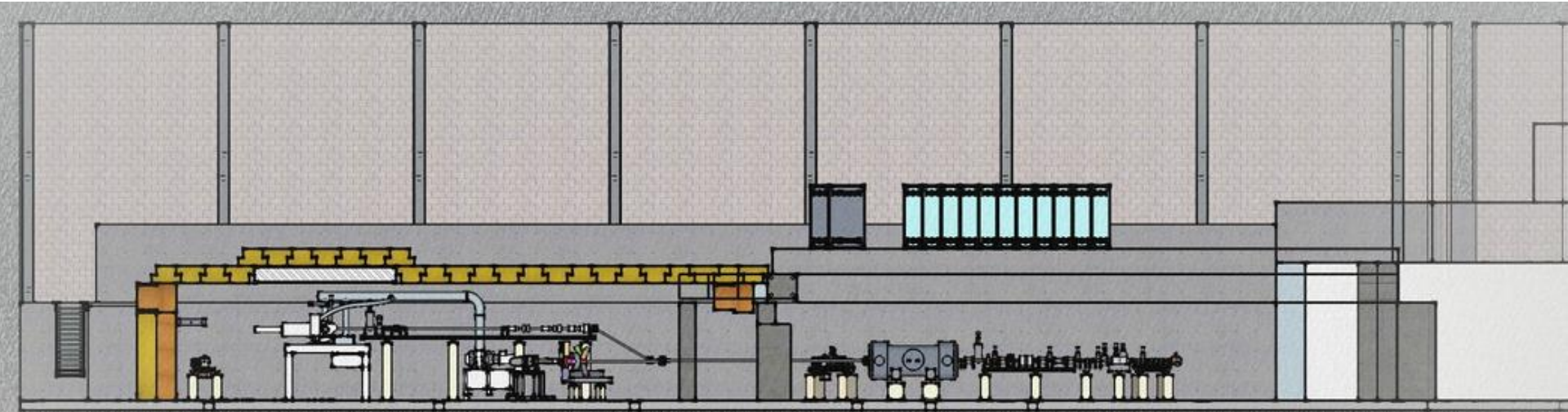
- Facilities: Cave1 demolition, electric, assess Cave2 proposed design, HVAC, fire suppression, new stairway to Cave1 roof. Civil work to extend into FY16
- Engineering Mechanical Design of beamline
- Engineering Cryo: LHe to the cave, supply and return lines, controls: plus heat exchanger, more in FY16.
- Engineering Safety System Group: ODH system
- RF procurements, magnets, BPM electronics. We have budget for other stretch goals...

# AWP Planned FY16 activities

- All the rest of the work

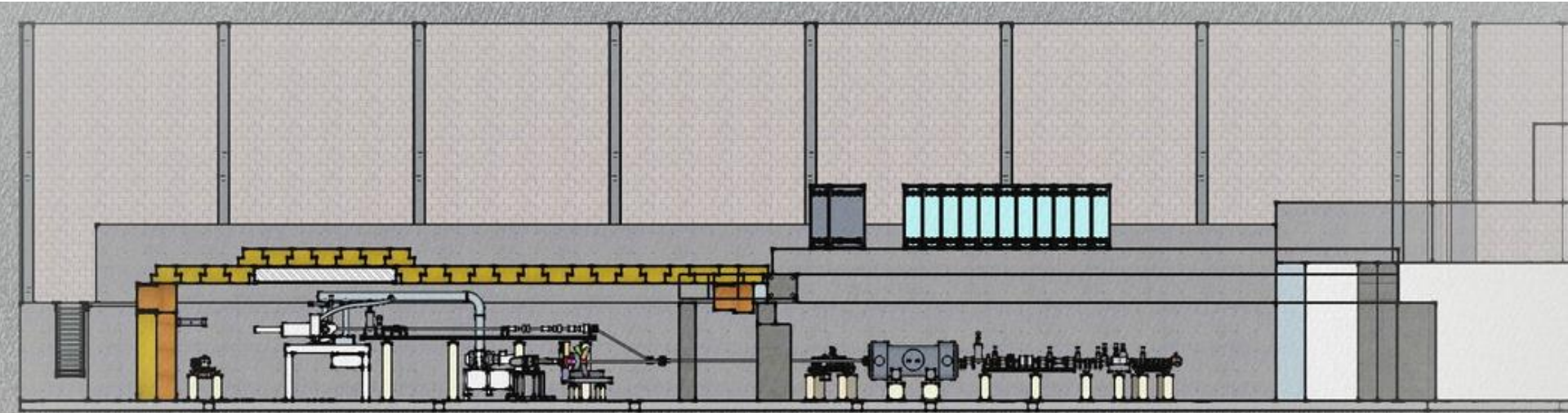


# Concerns



- Adding another LHe User to the already-taxed CTF refrigerator
- Need to vet beamline design with on-site experts, it's got to work....
- Hopefully we appreciate all HDIce requirements (raster, low energy e-beam through 5T solenoid – will beam make it to dump?, what about scattered electrons from dump? Do they return to depolarize target?). Team HDIce meets with us regularly
- Rad Con approval, adequate shielding, for projects beyond HDIce?
- Documentation: FSAD, ODH, OSPs, Physics and Accelerator Readiness Reviews, etc.,
- After construction, there will be costs to operate it

# On the other hand...

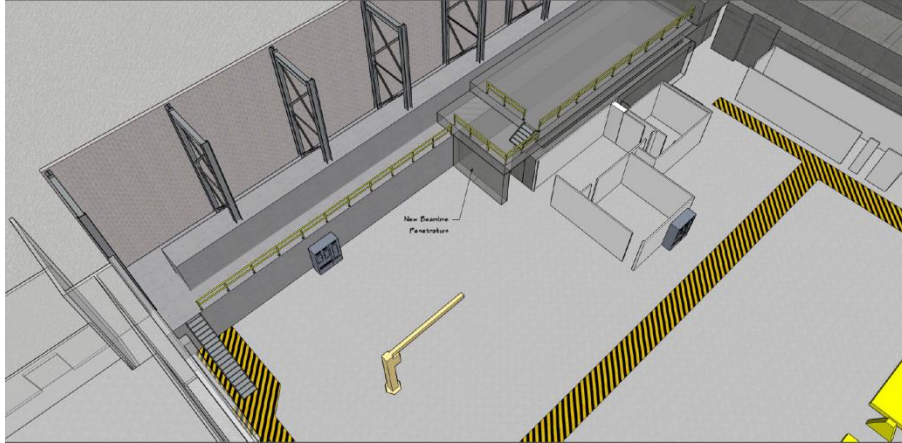


- What a great opportunity for us. Hope you feel enthusiastic about working on this project...



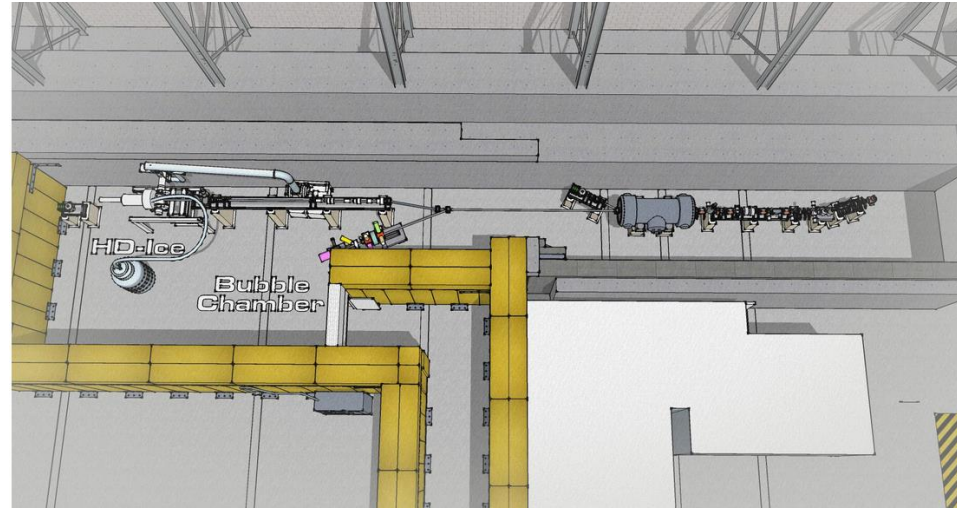
# drawings by Walt Akers

Today



UITF as imagined

beamline design and entry/exit need work



need to refine rack layout, AC power, add stairs