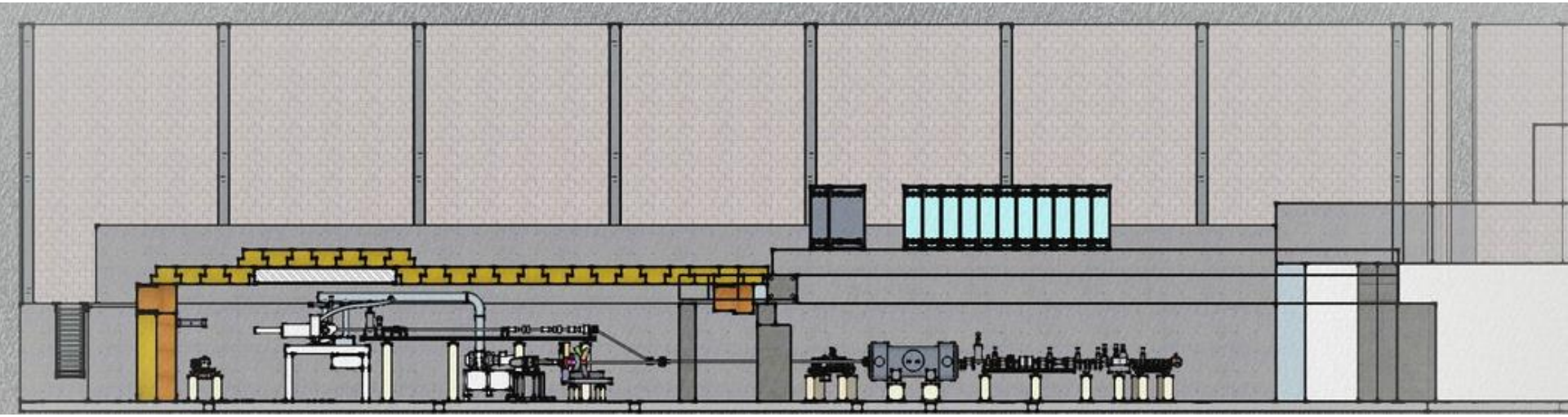
STAGE 3 –DECISION BRIEFING TO LABORATORY LEADERSHIP

- Include the following elements:
  a. Outside Work Opportunity Title and Partner
  b. Overview of opportunity: description of work with deliverables and milestones
  c. Details of the opportunity: duration; resources needed, key skills, infrastructure needs, partner contribution
  d. Complete Budget Estimate form through the Budget Office (By FY, FTEs by skill, and non-labor)
  e. Benefit to Lab (how does opportunity supports JLab's mission and scientific goals, core competencies, etc.)
  f. Proposed method for receiving funds (FOA, Grants, proposals, CRADAs in support of SBIR/STTR proposals, Work for Others, IAA, CRADAs, IWOs, etc.)
- Lab Leadership recommends to the Laboratory Director either approve/disapprove the initiative. Some initiatives may need DOE approval.

Upgrade Injector Test Facility: UITF

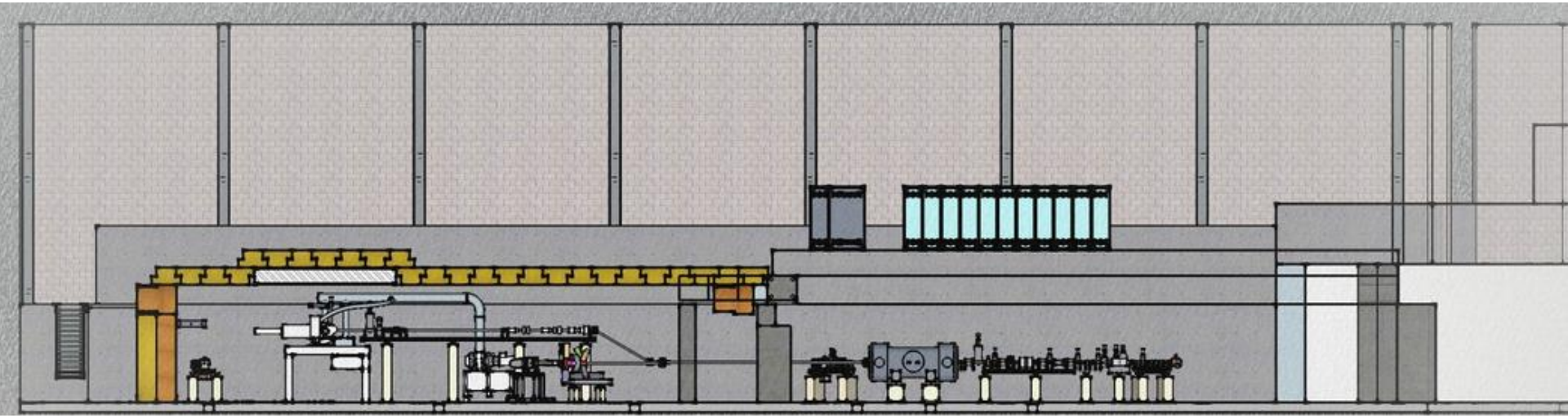


Why Build It?

CEBAF related

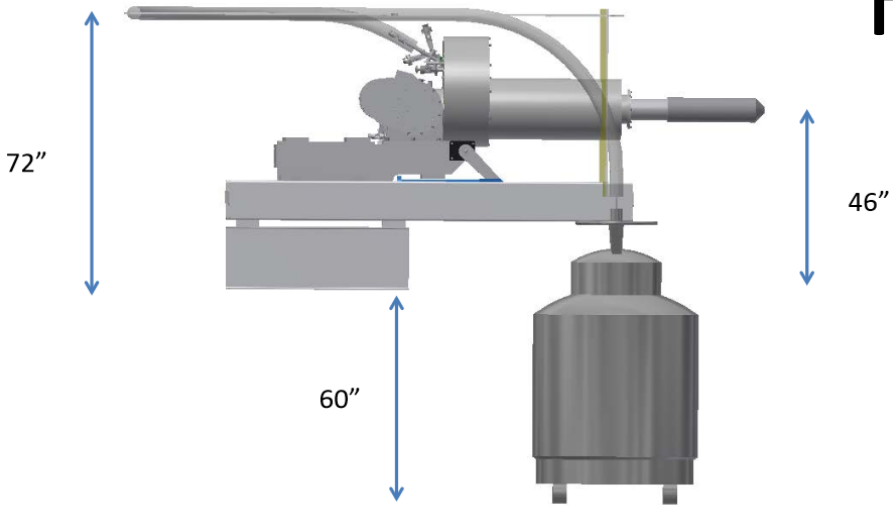
- HDIce commissioning
- Bubble chamber physics with Bremsstrahlung x-rays: photo-disintegration of oxygen into helium and carbon
- In support of parity violation experiments, and CEBAF operations in general: pockels cell improvements, low noise floor current monitors, low current beam position monitors, etc.,
- Commission the new ¼ 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?

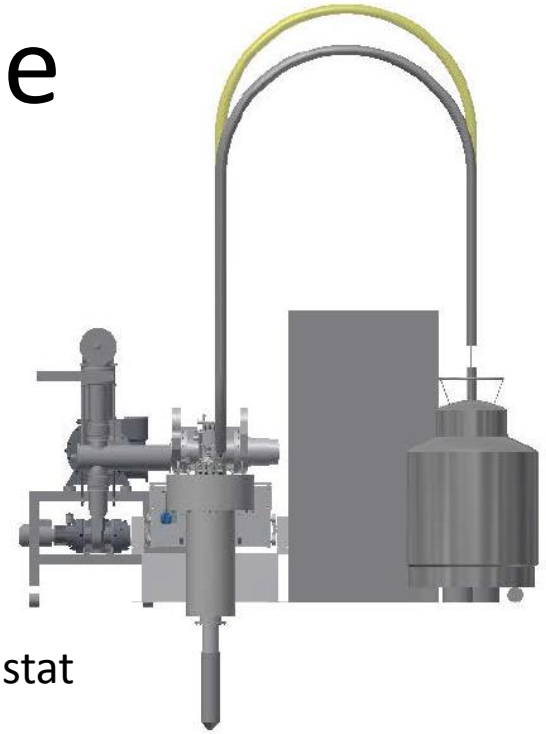
UITF Beam Specifications



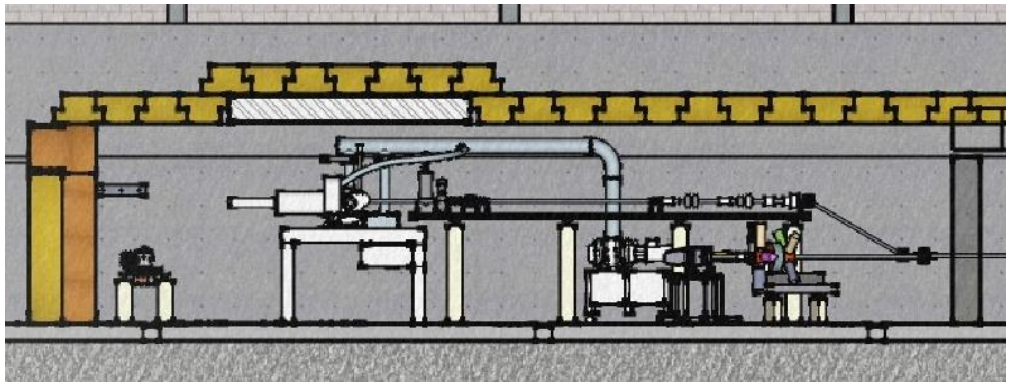
- Approved for HDIce beam conditions: up to 100nA average current at 10 MeV
- Working with RadCon to find a shielding solution for 100uA average current at 10 MeV (e.g., for Bubble Chamber): additional global shielding, local shielding at dumps, beamloss monitors for quick shutdown
- Expect photogun 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

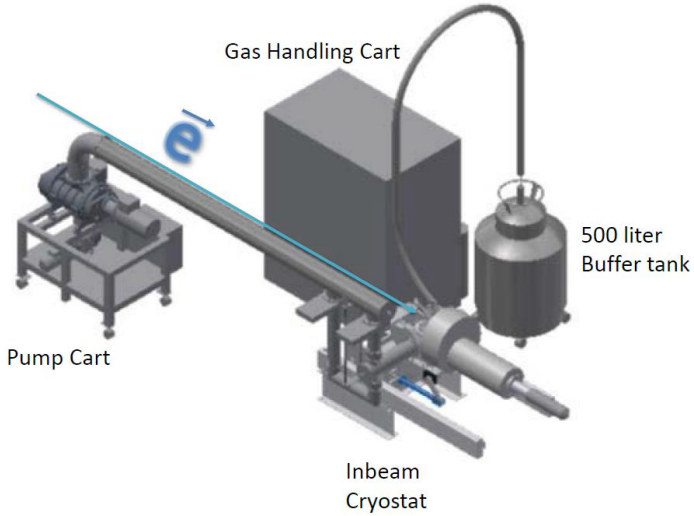
HDIce





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

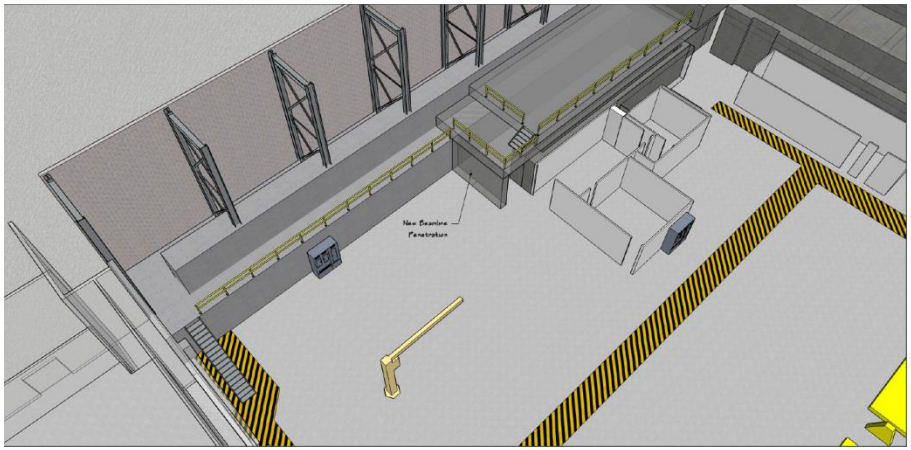




We chose “No Pit” option, build a vertical chicane, taller section added to Cave

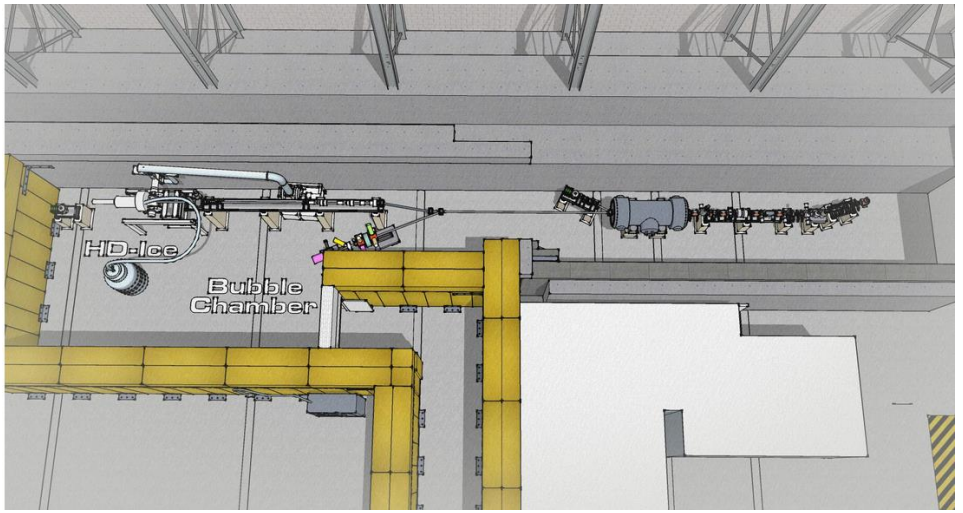
drawings by Walt Akers

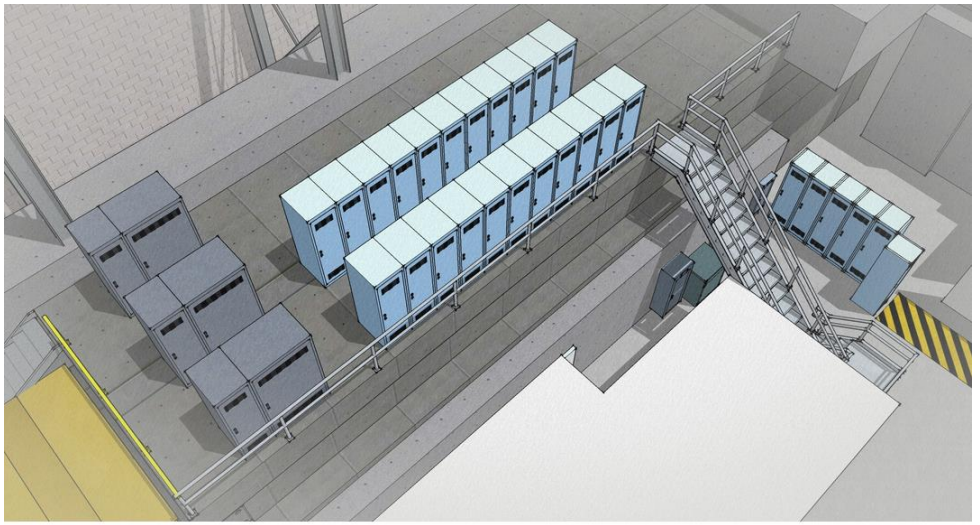
Today



UITF as imagined

beamline design and entry/exit need work





need to refine rack layout, AC power, add stairs

Not a Cadillac

- Re-using concrete shield blocks
- Spare ¼ cryomodule
- Control room and laser room already exist
- No “pit”, it was too complicated
- 350kV gun, not free, but less expensive than 100kV gun + 1M$ capture section
- Old 1497 MHz chopper cavities, “free” FEL buncher
- Free (partial) ODH system from FEL
- Use “wimpy” CEBAF klystrons
- Many beamline components on the shelf: solenoids, valves, ion pumps, BCM cavity, and there are some examples of using fully-functional older equipment that once lived at CEBAF, e.g., our 60Hz timing system
- Much of the drive laser already exists
- Hall B raster system already exists
- Radiation monitors taken from our high voltage test stand apparatus

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 ¼ 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 (~ 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 + ~ 2FTE)
- 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

New Total Cost Estimates

(these are loaded numbers)

Original Est. by Hari Areti		FTEs	Labor	Proc	Total	
on 2-7-2014	FY14	3.7	682.705	671.232	1,353.937	
	FY15	2.5	465.000	830.074	1,295.074	
	FY16	0	-	-	-	
	Total	6.2	1,333.458	1,501.306	2,649.011	
Revised Est.		FTEs	Labor	Proc	Total	
by Matt Poelker	FY14	1.2	233.082	274.293	507.374	47.6%
on 5-13-2015	FY15	8.6	1,396.674	907.950	2,304.624	49.0%
	FY16	7.9	1,422.804	1,333.458	2,756.262	51.3%
	Total	17.7	3,052.559	2,515.701	5,568.261	
Dfference from original estimate		(11.5)	(1,719.10)	(1,014.40)	(2,919.25)	

labor costs have tripled

procurement costs nearly doubled

* these numbers reflect an ambitious timeline and spending beyond approved FY15 AWP, slide intended to highlight total cost escalation. More on timeline in subsequent slides.

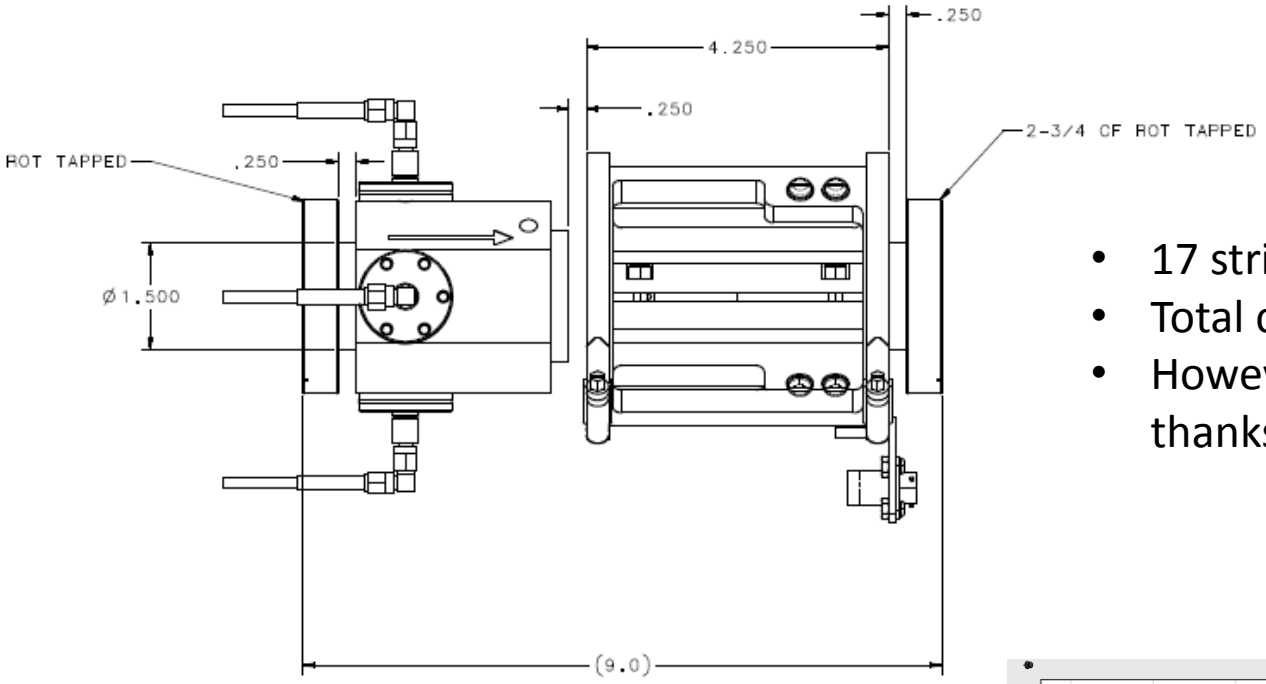
Why Does UITF Cost More Now?

- Some estimates were made with insufficient information from project leaders (me, Hari), e.g., magnets, beamline elements, etc.,
- Some estimates were made assuming the use of older CEBAF technology that had been replaced with new stuff, e.g., old RF control modules (there were none), CAMAC controlled magnet current supplies (discontinued hardware, not a good long-term option, there were no “free” trim cards)
- Better appreciation of HDIce requirements (very low current), we needed to add some unanticipated hardware: stripline BPMs to detect nA current, chopper cavities to limit temporal acceptance of machine
- Not as many quad, dipole and steering magnets available as first imagined
- Some estimates were made without enough thoughtful consideration from service providers (“we’ve talked about UITF for years, it never goes anywhere, why spend time on estimate?”)
- A global JLab “problem” of underestimating labor? Maybe not a bad thing, consider it an indication of a “can-do” attitude?

Biggest Cost Deviations

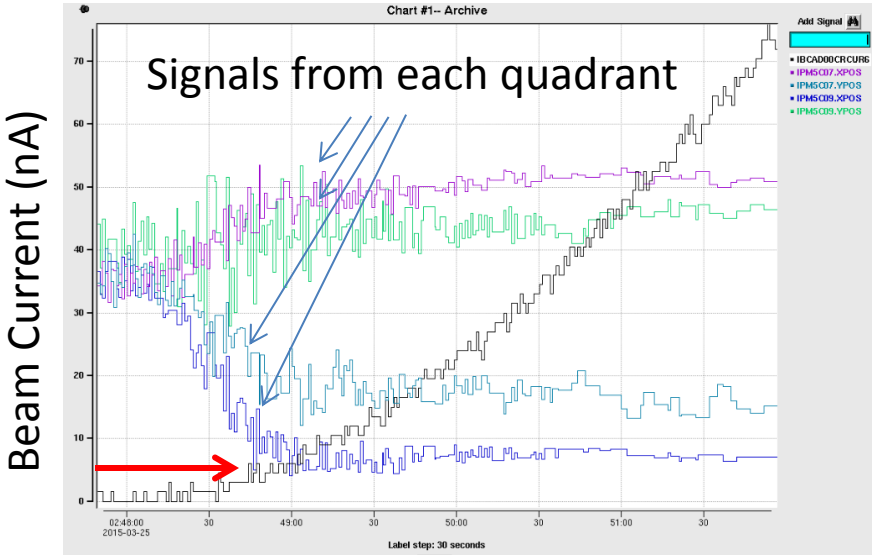
- 6 versus 18 FTEs: labor significantly underestimated for nearly every aspect of UITF
- Biggest unanticipated procurements include:
  - RF: low level control modules 8 x 6k$ea = 48k$, high voltage power supply for klystrons: 52k$, chopper amplifiers: 50k$ … total RF procurements sum to 252k$
  - Magnet trim cards: 112k$
  - Magnets (steering coils, quads and dipoles): 120k$
  - Stripline BPMs: 102k$
  - Pneumatic gate valves: 60k$
  - Beamline girder hardware and machine shop fab could reach 100k$

An example of added procurement expense….

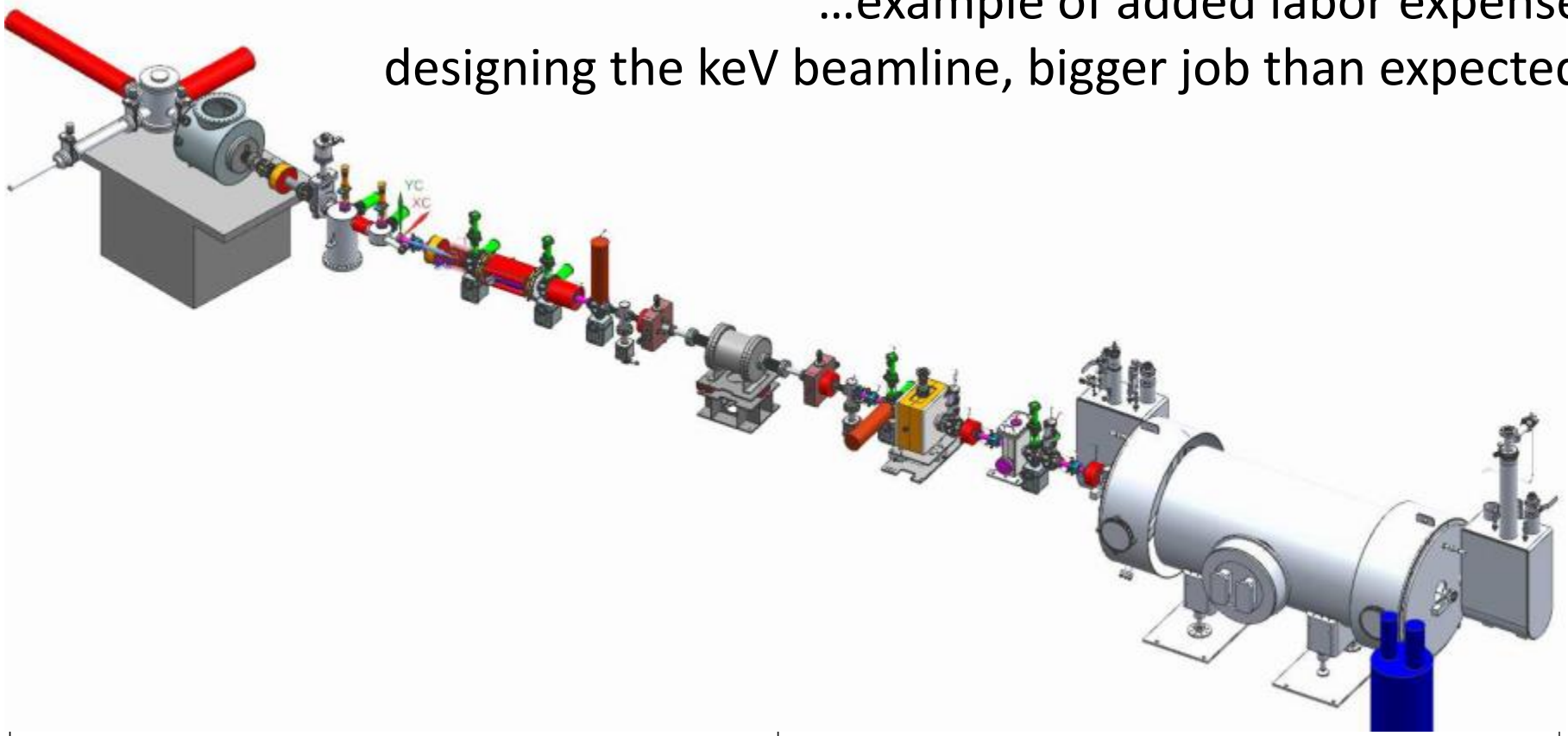


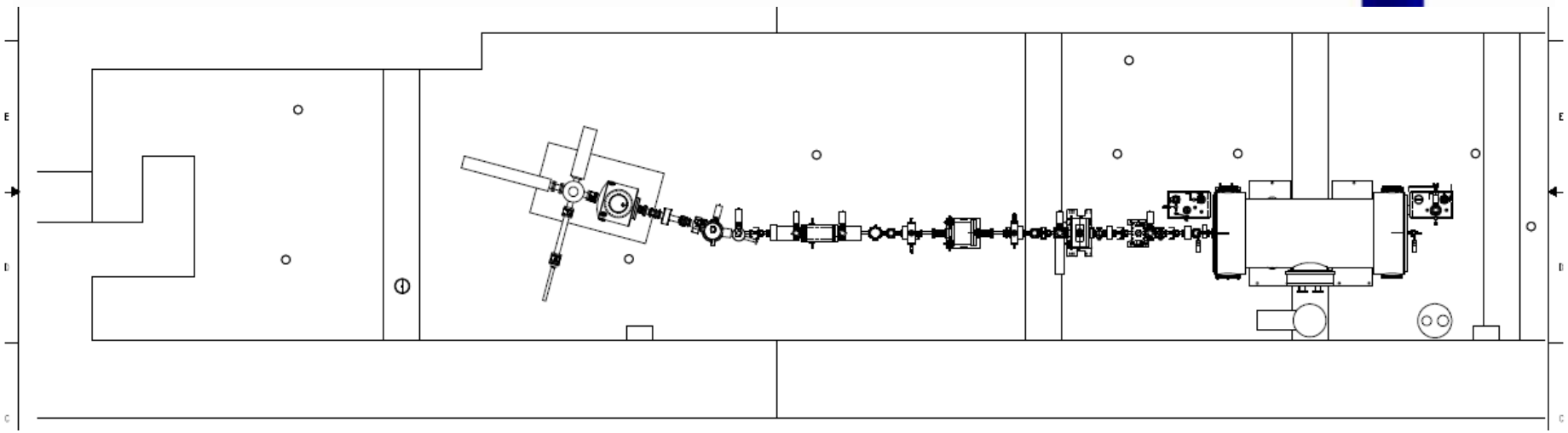
- 17 stripline BPMs @ 6k$ ea
- Total cost 102k$
- However the design was “free” thanks to 12 GeV

- We expect HDIce to operate at 1nA or less, prefer not to run “blind”…
- Stripline BPMs can see beam at just 5 to 7nA, hope that further improvements can be made to see even lower current

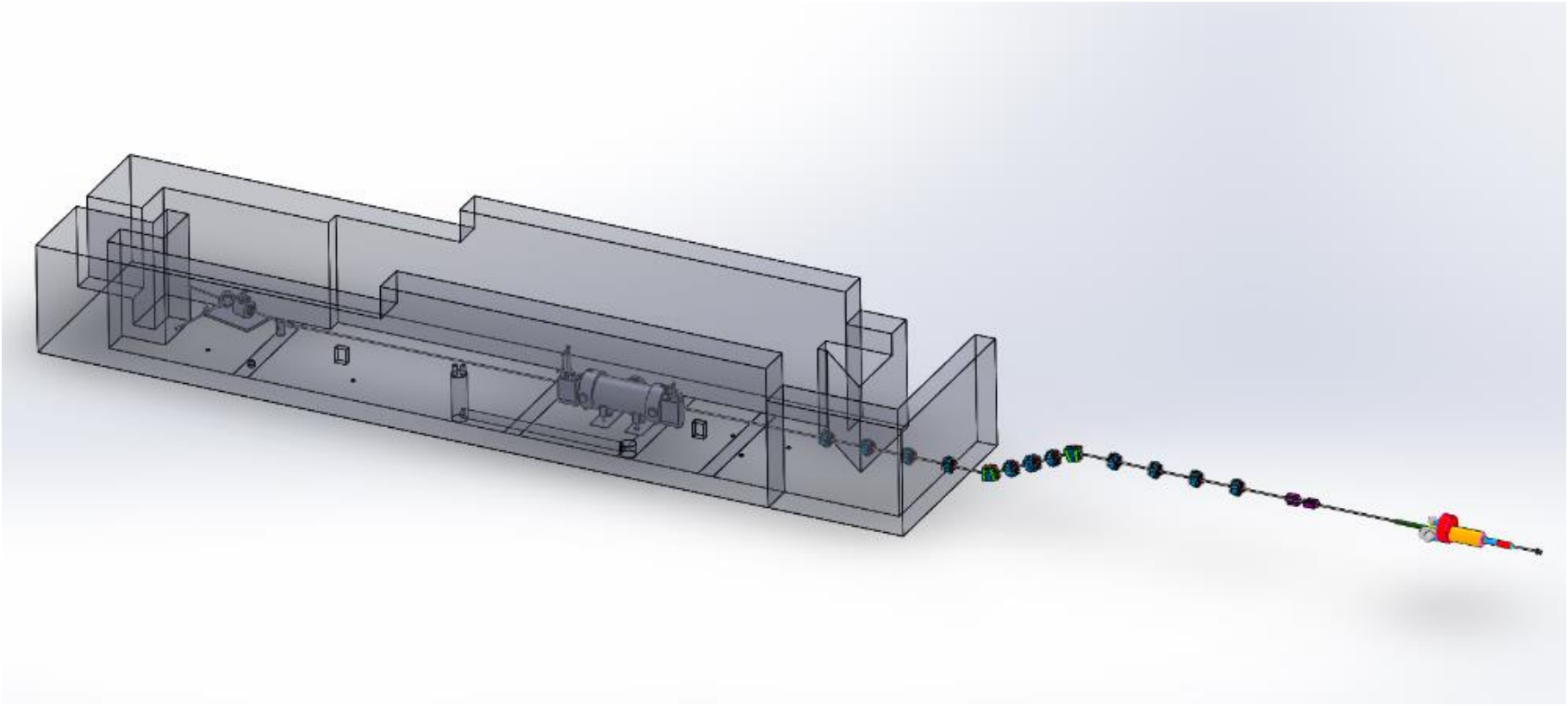


…example of added labor expense
designing the keV beamline, bigger job than expected





Haven’t started designing the MeV beamline yet…



New Schedule*

Schedule Milestones

Civil Work Complete (select demolition, stairs to Cave1, Electric, HVAC, installation of concrete block, structural support added, poured in place concrete, ceiling tiles can be installed later)	**November, 2015**
Demonstrate Gun happy at 350 kV at FEL GTS (need new insulators and Carlos Hernandez-Garcia)	**December, 2015**
Commission cold 1/4 CM, no beam (requires LHe, ODH system, high power and low level RF to 1/4 CM, software, PSS and Safety approval)	**January, 2016**
Beam from Gun to Cup in front of 1/4 CM (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)	**March, 2016**
Beam through 1/4 at MeV energy delivered to cup in front of HDIce (requires all the above + MPS, all RF control, all magnets, all I &C, all software, all required documentation)	**June, 2016**
Beam to HDIce	**August, 2016**

Physics is OK with this date

* FY15 budget allocation allows only Facilities, Cryo, Mechanical Design and hopefully ODH. This schedule assumes I&C, RF, DC power, Safety System, Software troops begin marching now

New Schedule

Schedule Milestones

Civil Work Complete (select demolition, stairs to Cave1, Electric, HVAC, installation of concrete block, structural support added, poured in place concrete, ceiling tiles can be installed later)	**November, 2015**
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Beam through 1/4 at MeV energy delivered to cup in front of HDIce (requires all the above + MPS, all RF control, all magnets, all I &C, all required documentation)	**June, 2016**
Beam to HDIce	**August, 2016**

these milestones push out if we wait until FY16 to begin I&C, RF, DC power, Safety System, Software: beam to HDIce by February 2017

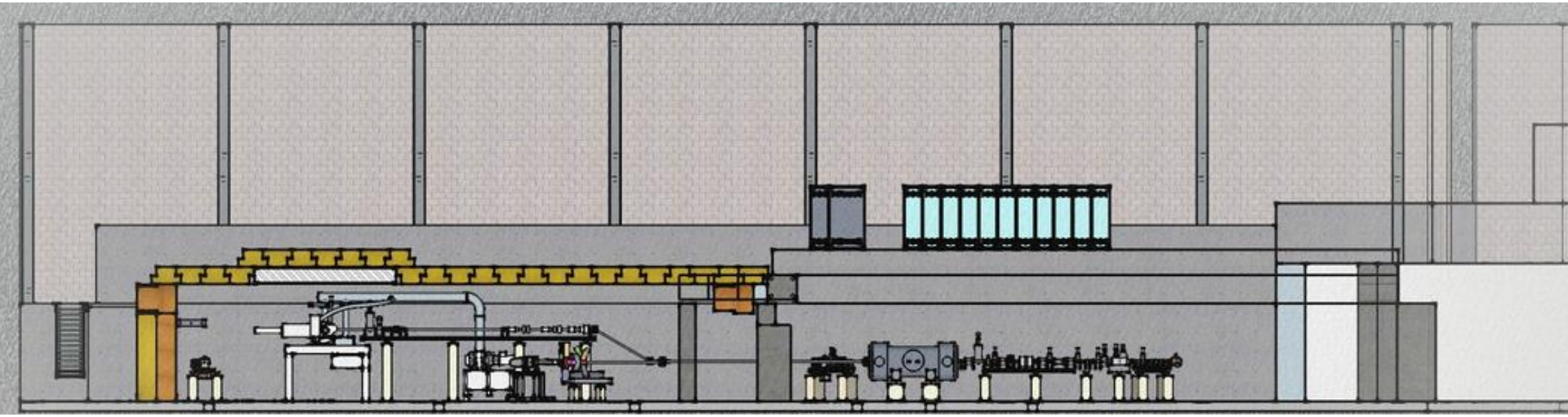
AWP Planned FY15 activities

- Facilities: Cave1 demolition, electric, assess Cave2 proposed design, HVAC, fire suppression, new stairway to Cave1 roof: budgeted labor and procurement…waiting for bids. Civil work to extend into FY16
- Engineering Mechanical Design of beamline
- Engineering Cryo: LHe to the cave, supply and return lines, controls: labor and procurement plus there will be added cost for heat exchanger, more in FY16. CEBAF cryo work could take precedent over UITF….
- Engineering Safety System Group: ODH system
- Some procurements and machine shop work
- These jobs mostly fit inside the FY15 Budget box: $840k direct, $1.25M loaded

Encouraged to support other FY15 activities

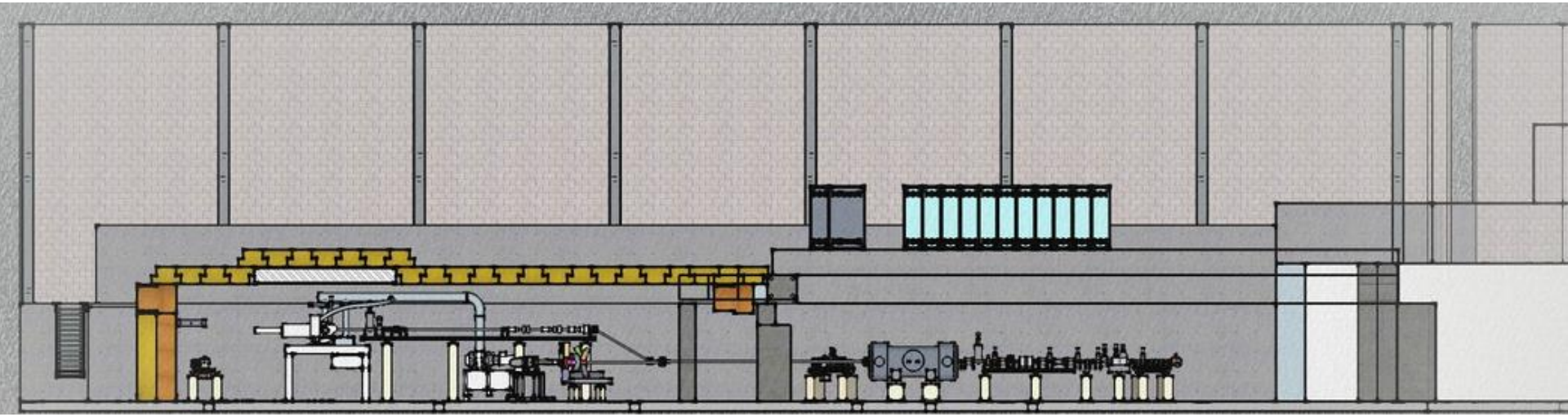
- Engineering: low level and high power RF, purchase control modules, electronics interface to power supplies, water skids, populate racks
- Engineering: Instrument & Controls, populate racks
- Engineering: DC power, fabricate trim cards, populate racks
- Much of this work could start now if FY15 planned activities don’t happen, and/or if additional funds were made available

Concerns



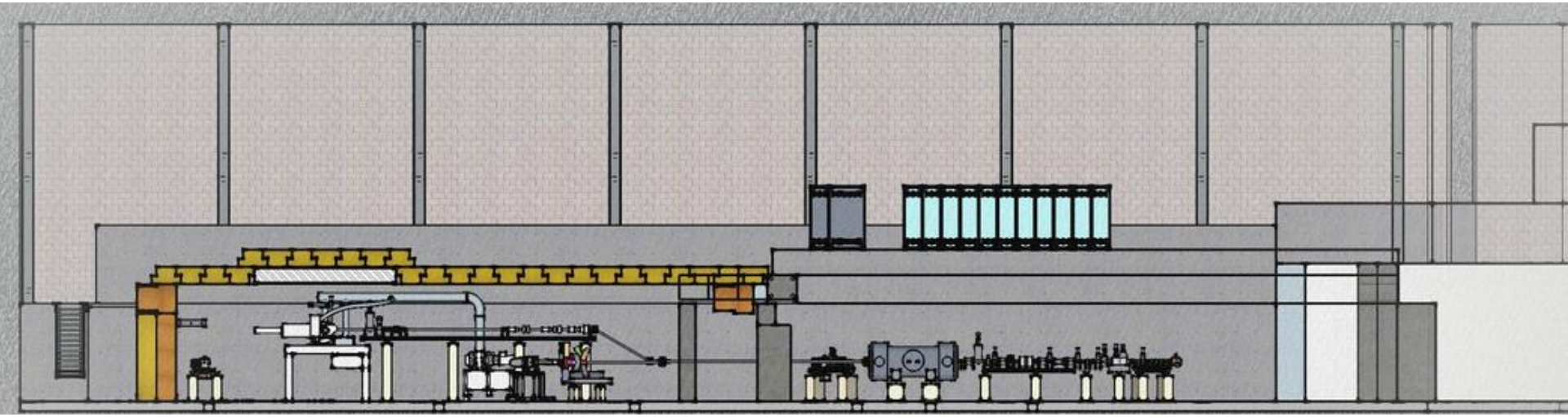
- Rolf, Volker and Andrew want beam on HDIce by August 2016
- Biggest Concern, getting a jump on RF, I&C, DC power, PSS and Software
- I've approved work and purchases that sum up to more than FY15 allocation
- A great deal of progress can be made with just labor, and it seems labor resources in some categories could be available now….
- Are we really trapped in a fiscal box when it comes to labor?
- Pleasing two bosses (people who want it NOW, and those who prefer I not bust the bank)
- The start/stop/start/stop approach of approving work frustrates Service Providers
- Hamstrung by estimates…

More 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 de-polarize 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

UITF Summary



- Not a Cadillac or Accelerator sandbox. It will be a valuable tool to facilitate Nuclear Physics at CEBAF. Some experiments will augment the CEBAF nuclear physics program
- Yes, it will cost more than first proposed. The biggest cost overrun due to labor
- Would prefer to finish construction sooner, rather than later. Extending construction duration won't bother me as much as it would bother Rolf. I would need to better manage expectations

Another example of added procurement expense….