Hall C Infrastructure Projects Update

- Outline
  - Targets
    - Input from tgt group
  - Polarimetry
    - Input from Dave G.
  - Some Other Stuff

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JLab
Jan. 2006

Target Upgrade- Basic Philosophy

- Need smaller SC for SHMS → new SC
- Need bigger smiles for Gep → new SC
  - Surprise → time now a factor
- Need bigger smiles for SANE/BETA too → new SC
- Qweak → new SC (building on existing sample SC)
- Want to improve reliability & servicibility
- Want to improve performance
  - Less current dependence
  - Higher power
  - Less vacuum motion
- Money more of a problem these days

Target Upgrade- The Plan

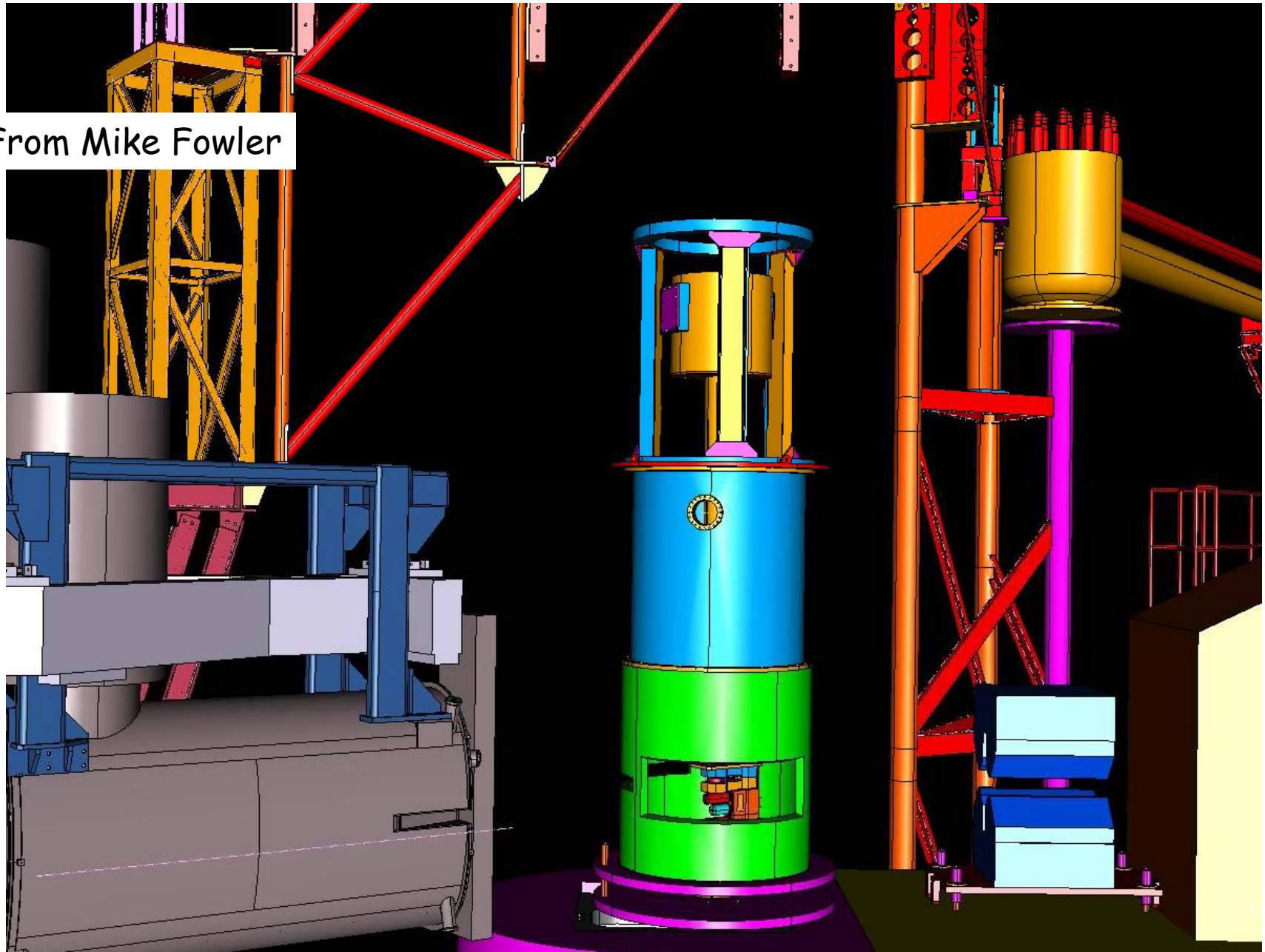
- Toss existing Hall C SC & tgts into storage
  - Keep intact as a deep spare option
  - Loops, cells, HXs, fans, heaters, lifter all stay in old SC in storage
- Build completely new SC & targets based on (latest) Hall A design
  - Can capture (steal) their spares this way:
    - Bellows, HXs, lifter, even some cells. Saves $$ & time.
    - New: fans, heaters, instrumentation, feedthroughs, etc.
  - Smaller SC Φ SHMS compatible. On-axis vacuum load. Larger smiles for Gep.
  - No rotation. Solid tgts hung below cryostack:
    - 4-5 tgts ~ 25 x 25 mm^2, plus 3 optics tgts

Postponed

(until money and time are both available)

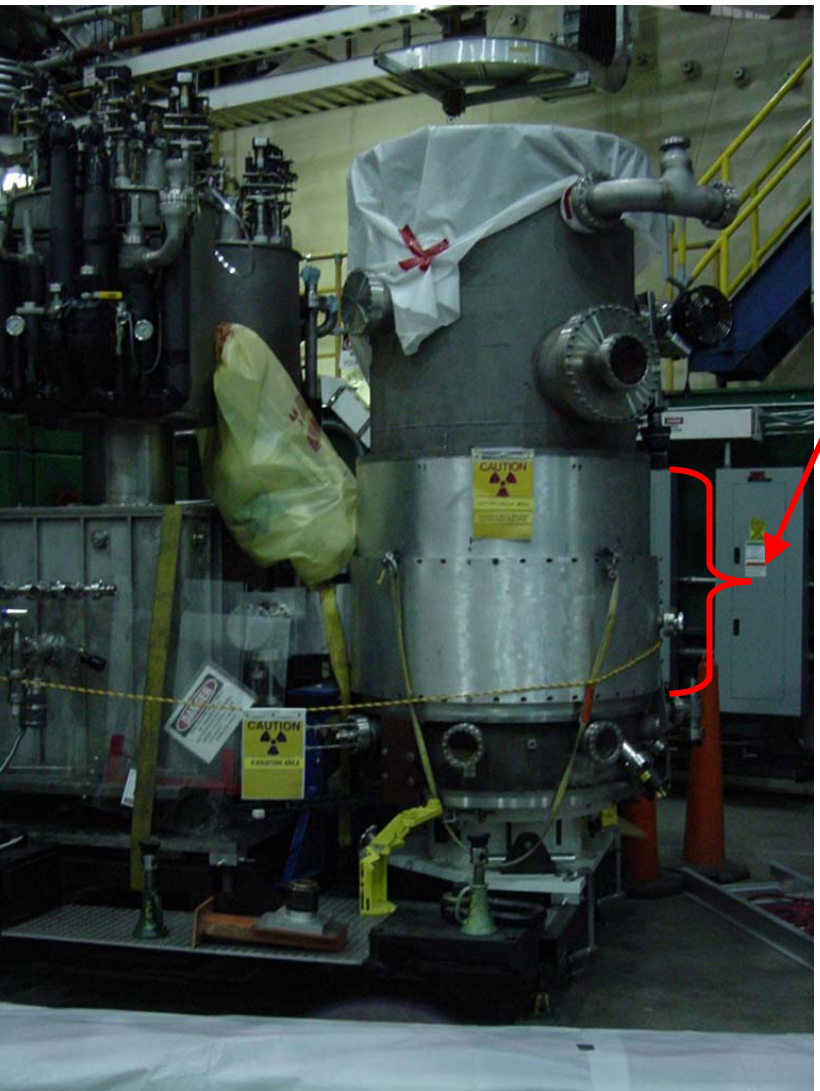
- Re-design of cell blocks to eliminate flow restriction causing large $\Delta\rho/\rho(I_{beam})$
  - Note this will almost certainly require going to 2 loops (with 2 tgts each) or 3 loops (with 1 tgt each)
- Improved fan motors
- HX re-design to decouple fan from HX
  - Get fan out of HX central bore
- Improved impellers (bigger! $v_{flow} \sim r^2$)
- Common spares
  - For now A spares C and C spares A

New Hall C Scattering Chamber



New Scattering Chamber

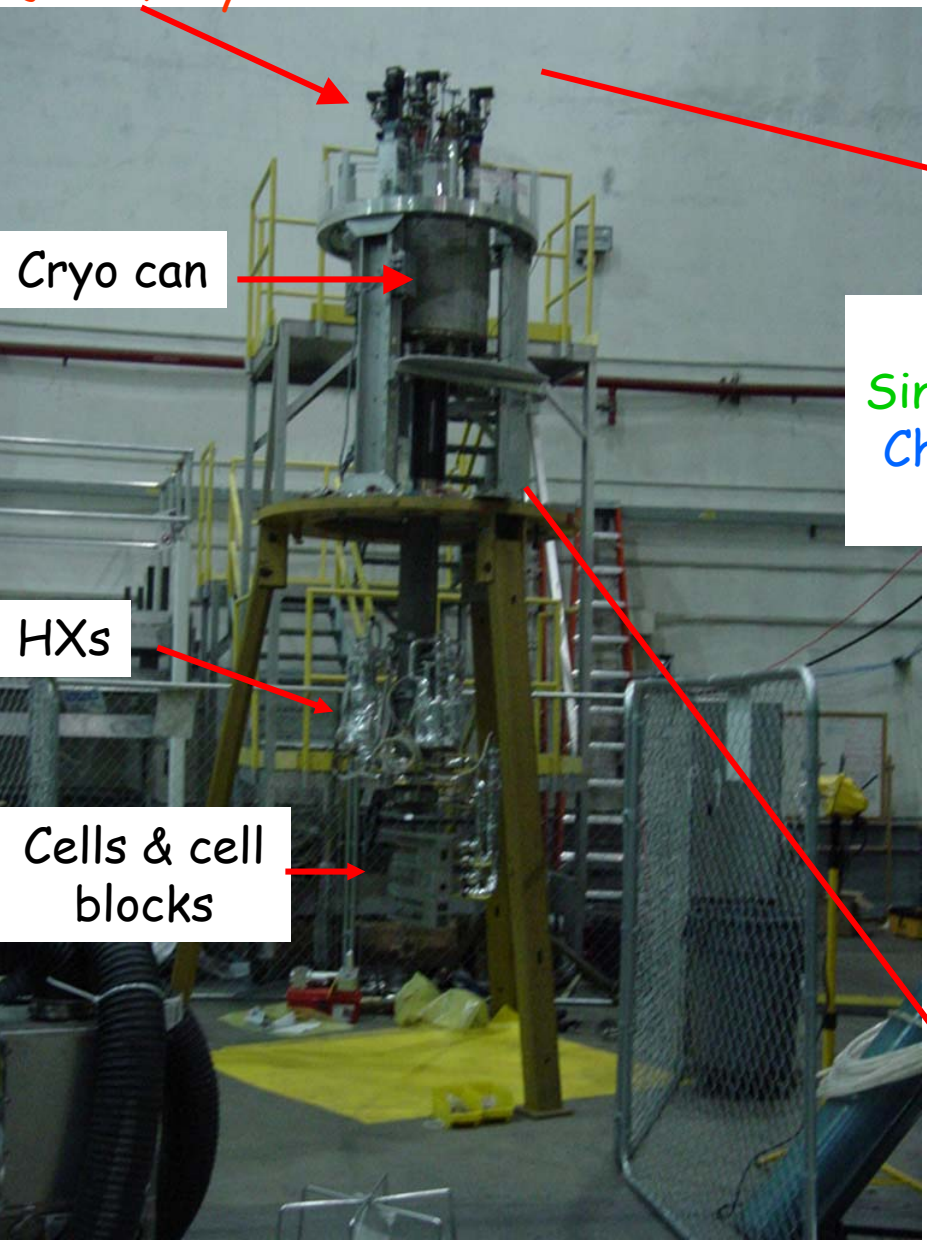
Hall A:

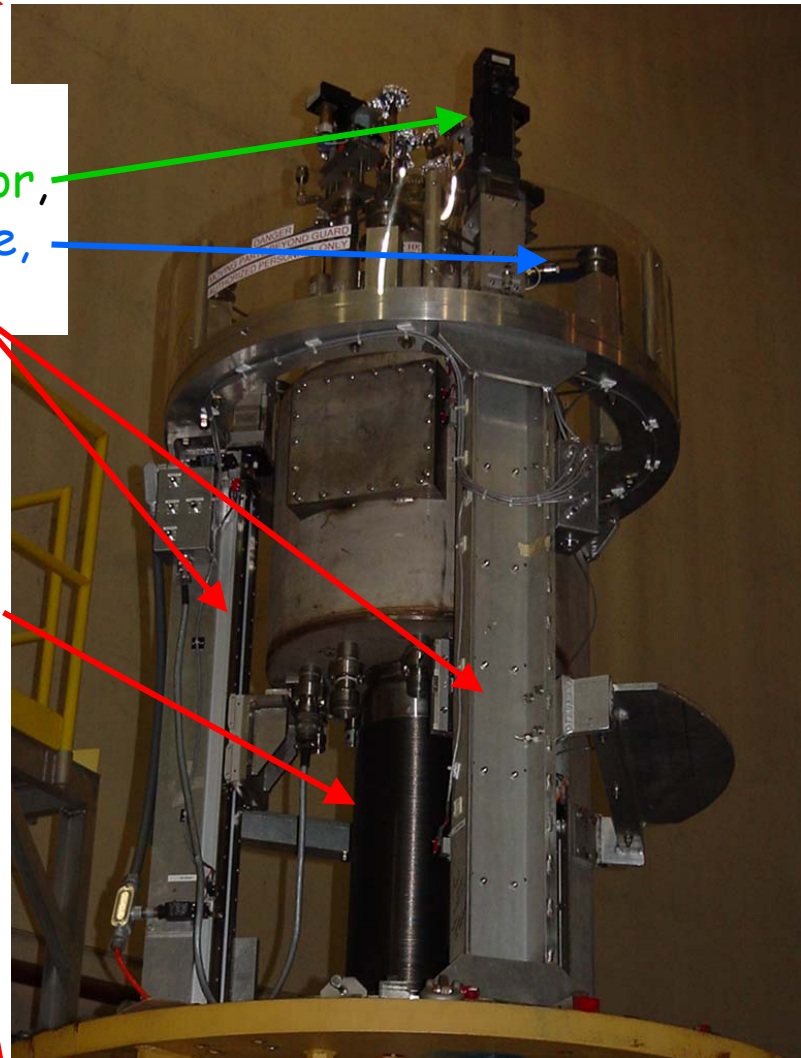


Hall C (proposed):

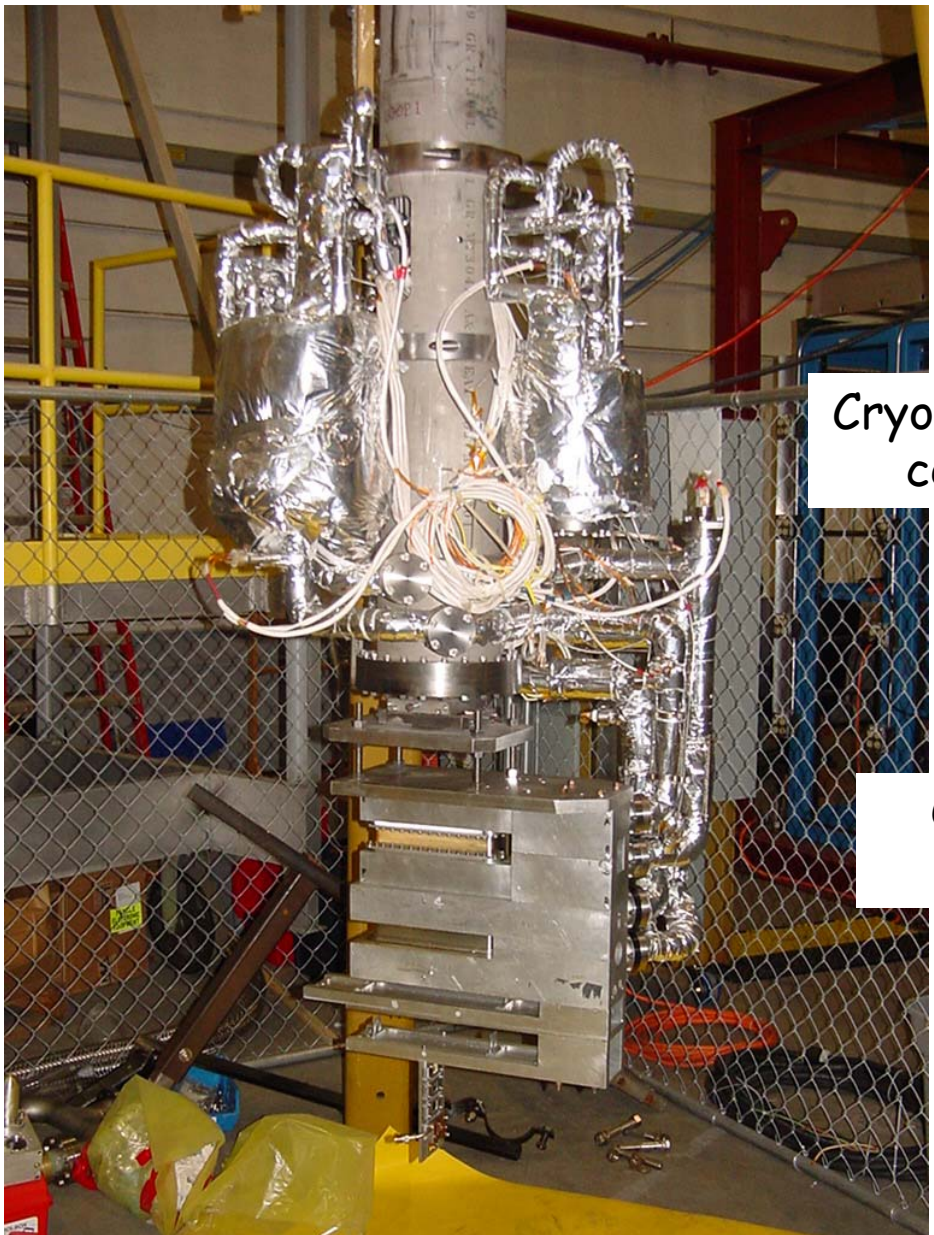
- Inner diam. ~ 104 cm
- Height ~ 120 cm
- SOS/SHMS smile:
  - 36 cm high (~ ± 20°)
  - 3° < θ < 118°
- HMS smile:
  - 8.5 cm high (~ ± 4.7°)
  - 5.5° < θ < 118°

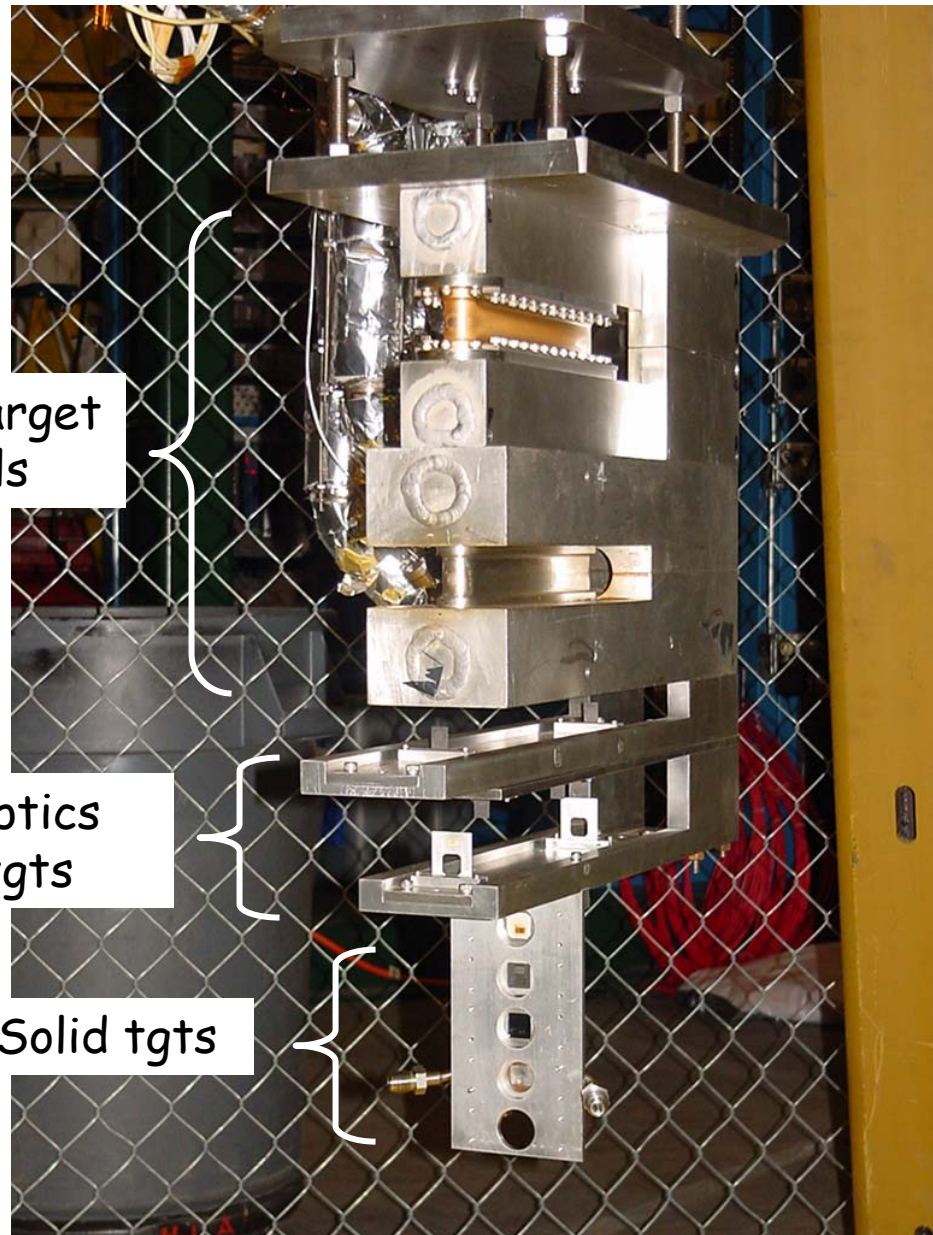
The Guts of it



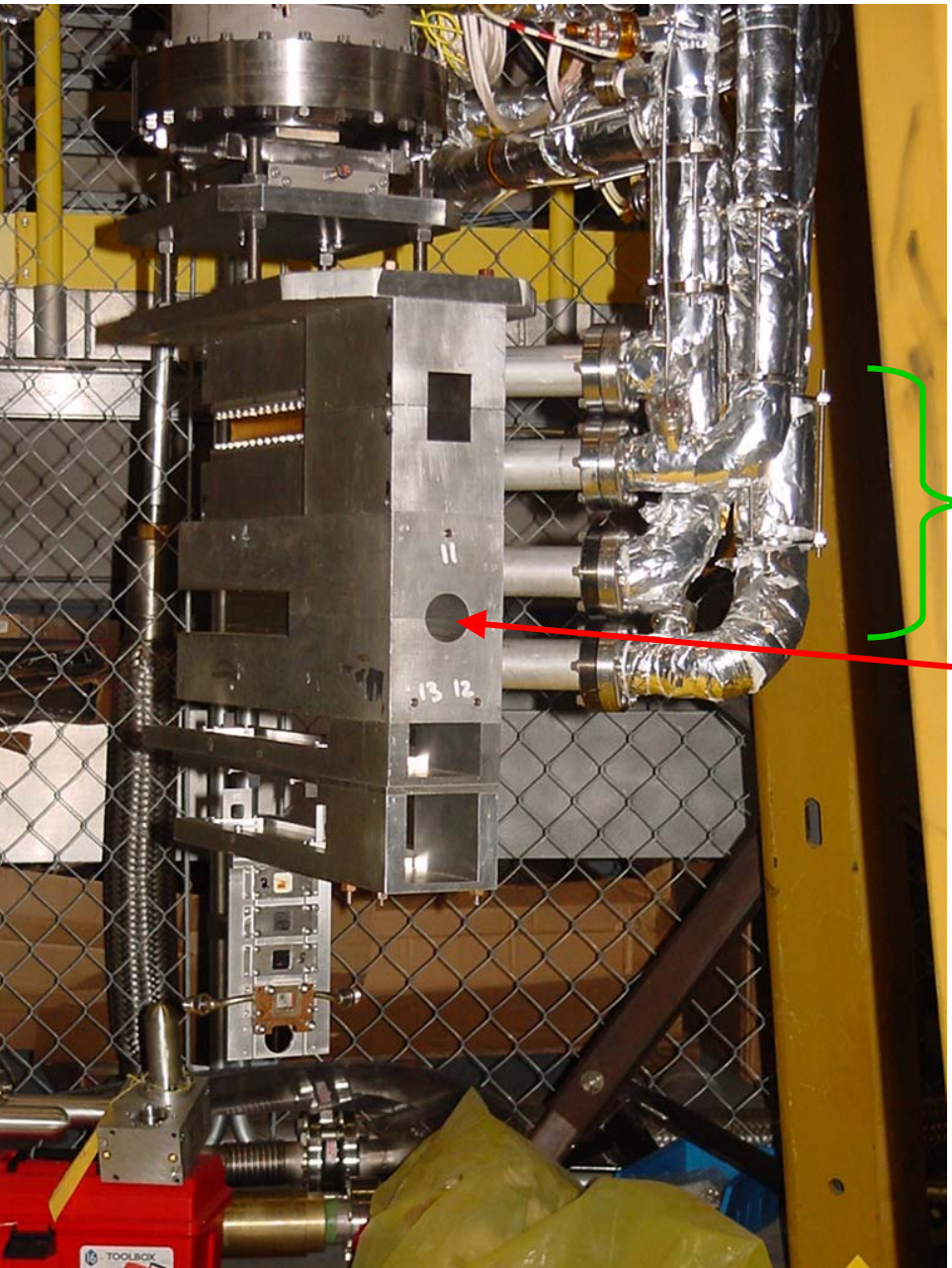


Hall A's current (waterfall) config.





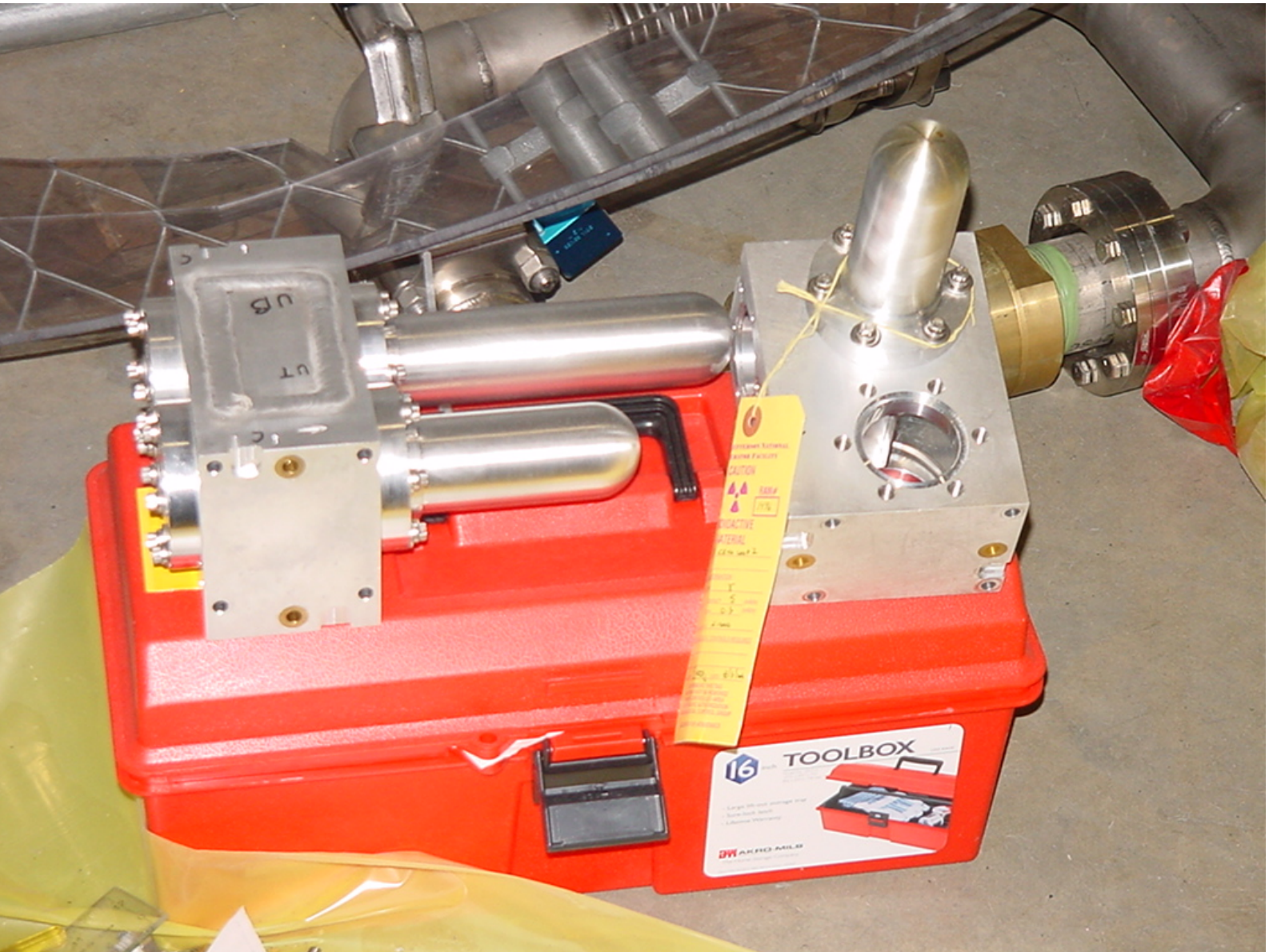
From behind



Gas I/O at an extreme back angle to keep clear of spectrometer acceptance

beam

Hall A machined cells & cell blocks



What you will notice

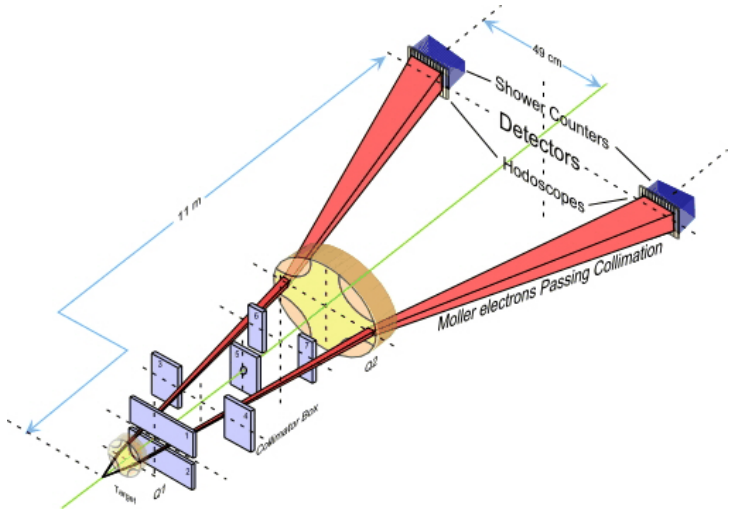
- Nothing, hopefully….
  - Same control system
  - Same cell options as now, *plus waterfall*
    - 3 loops each with 15 & 4 cm cells
    - 4-5 solid tgts, plus optics tgts
  - Same basic 3-axis, single motor lifter mech.
  - No solid tgt rotator (whew!)
  - Less vacuum motion & corresponding survey issues
- Should have fewer IOC reboots
  - Because we will move the tgt IOC out of the hall
- No retraining should be necessary!

Acc. Maintenance Breaks

- Past:
  - Usually we staff the cryotgt over these 4 day breaks
  - Sometimes we warm up in spite of thermal stress
  - For long breaks we always warm up (and will continue to do so)
- Future: Staffing short breaks sucks!
  - Proposal: Replace LH2 with cold He gas
    - Stay below 30K to avoid transition to warm return
    - Maintain trickle flow of coolant
    - Relieves us of our staffing obligation
    - Downsides:
      - Going sub-atmospheric can introduce ice
      - While unstaffed the target could warm up
      - To recondense again takes time & some (daytime) preparation

Basel/Hall C Møller Upgrade

From Dave G:

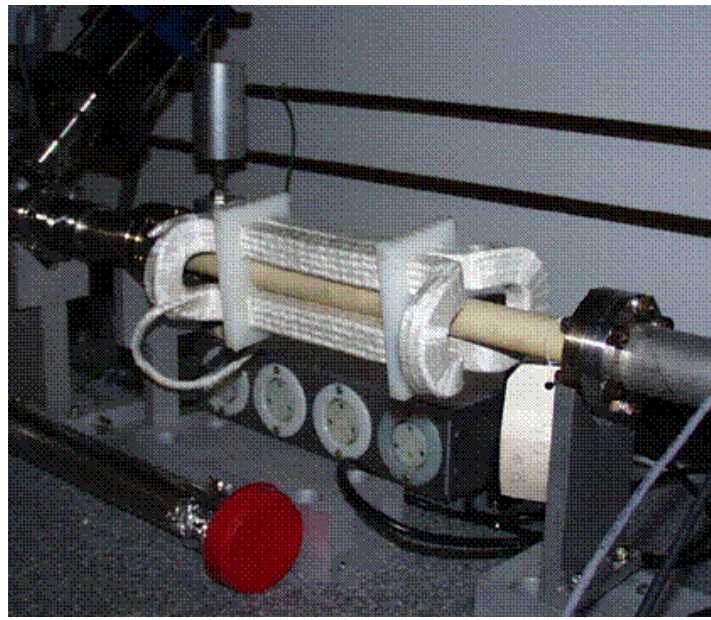


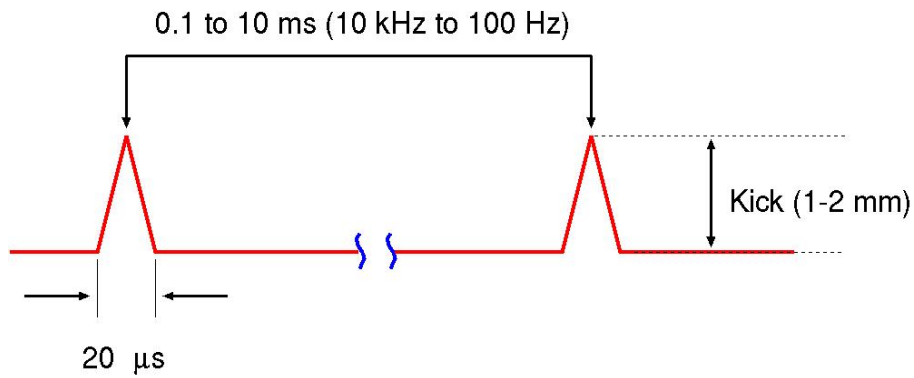
- Existing Hall C Møller can do 1% measurements (stat) in a few minutes
- Limitations
  - -Maximum current ~ 10 μA. At higher currents the Fe target depolarizes due to target heating
  - -Measurement is destructive
- Goals for and upgraded Møller
  - Measure beam polarization at 100 μA or higher
  - Make measurement quasi-continuously

Kicker Magnet for High Current Møller Polarimetry

- We can overcome target heating effects by using a fast kicker magnet to scan the electron beam across an iron wire or strip target
- Kicker needs to move beam quickly and at low duty cycle to minimize time on iron target and beam heating
- First generation kicker was installed in Fall 2003

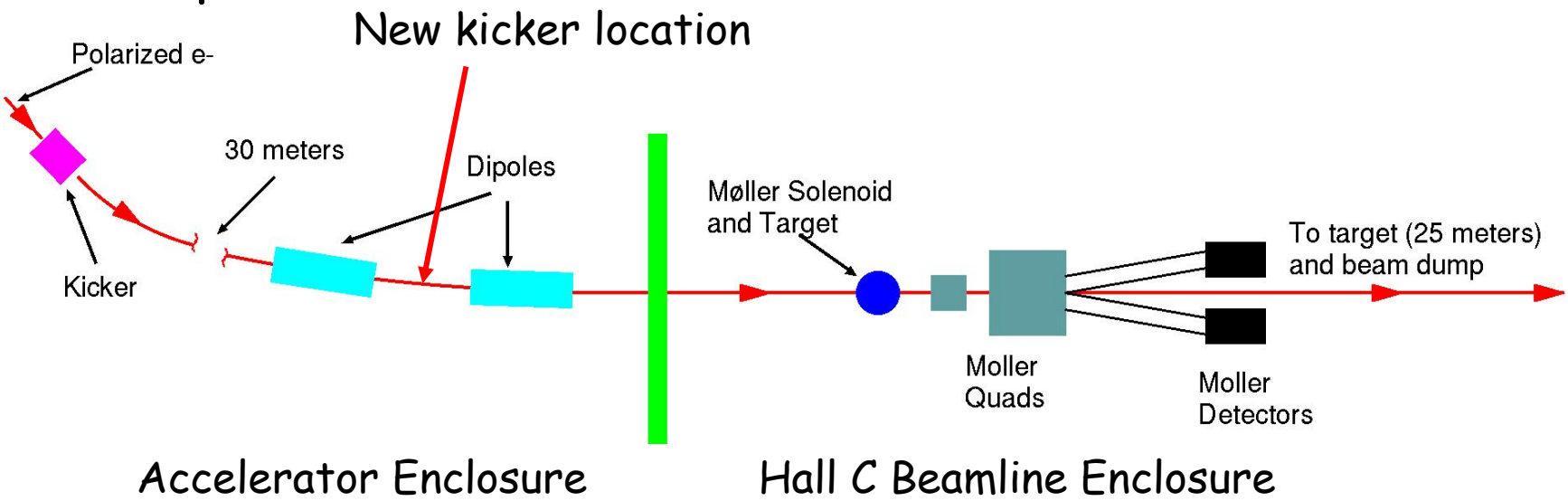
From Chen Yan:





Kicker + Møller Layout

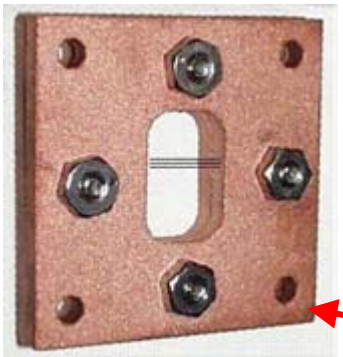
- Kicker located upstream of Møller target in Hall C arc
- Beam excursion ~ 1-2 mm at target
- The kick angle is small and the beam optics are configured to allow beam to continue cleanly to the dump



Kicker Progress to date

From Dave G:

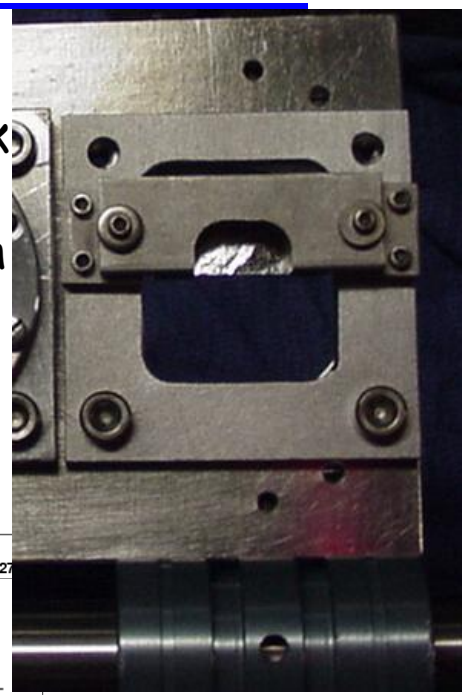
- Fall '03: Kicker + wire



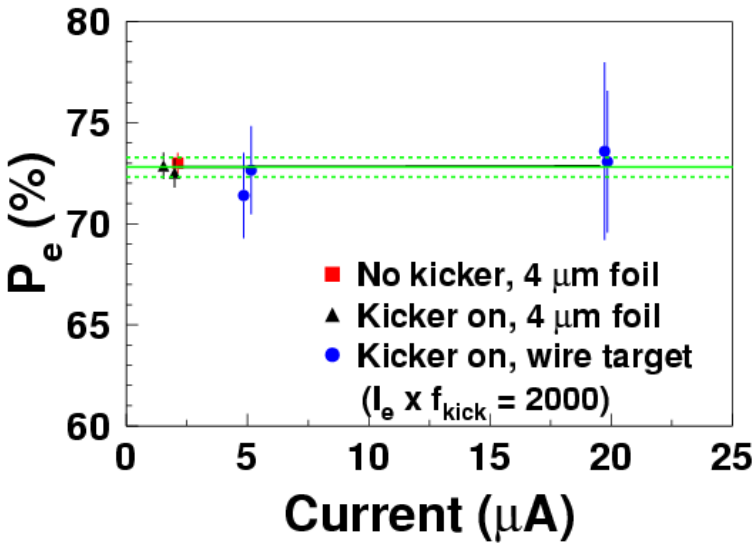
- 25μ wire too thick
- Inst. Rates too hi
- Established principle
- Got to 20 μA

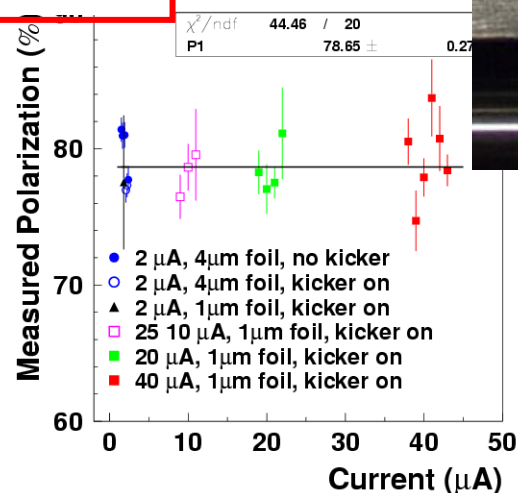
- Fall '04: Kicker + Foil

- 1μ foil
- Inst. Rates ok
- Got to 40 μA
- Short test though



From Dave Meekins:



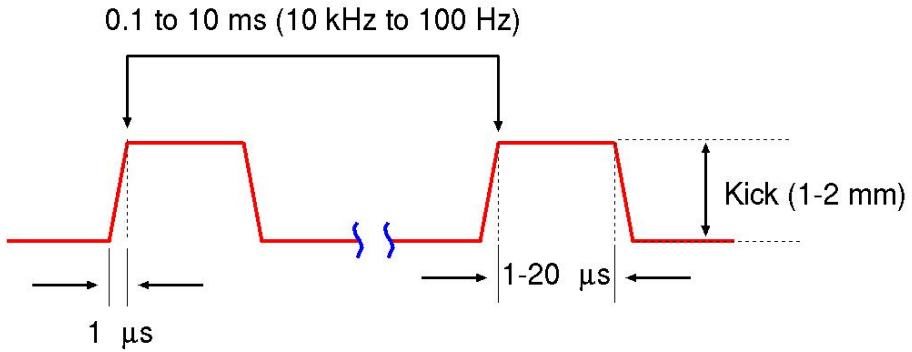


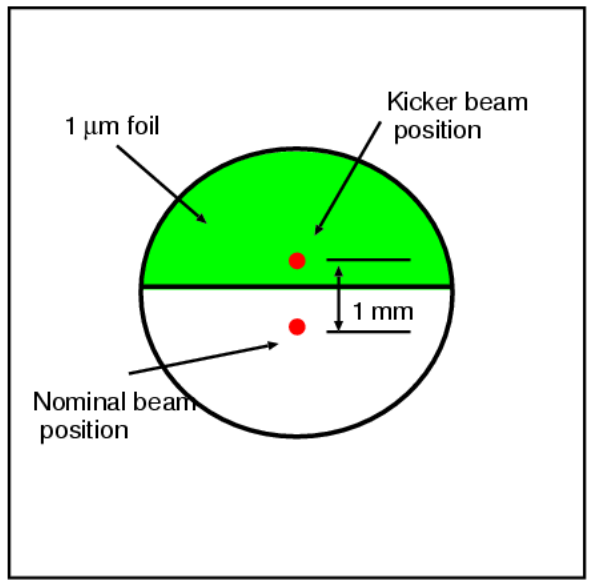
Need a double focus

Future Plans: Optimized Kicker with "Half-Target"

From Dave G:

- Modify kicker:
  - The ideal kicker would allow the beam to dwell on the target for a few μs rather than continuously move across the foil
- Improve target:
  - The 1 μm target is crucial, but we need to improve the mounting scheme to avoid wrinkles and deformations

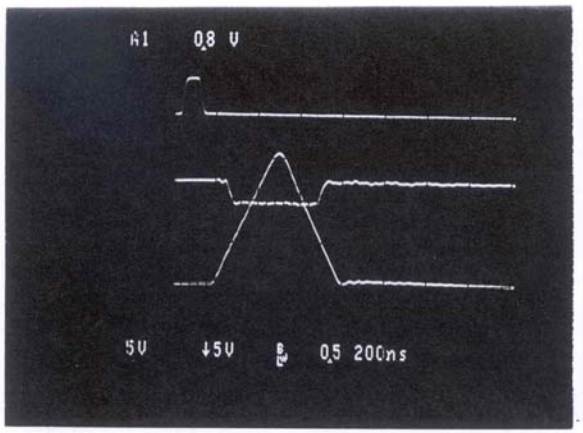


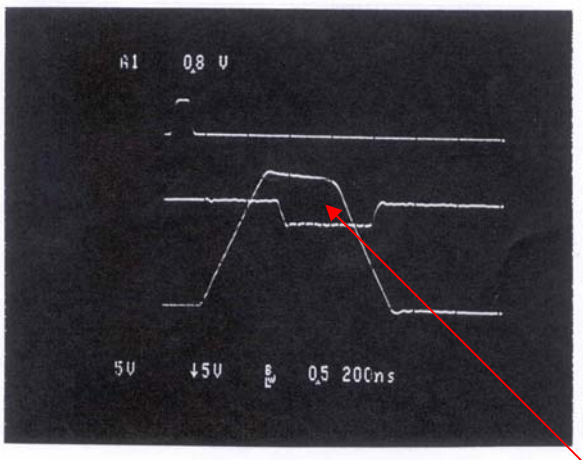


Kicker R&D

Kicker Current Waveform from Pearson Probe

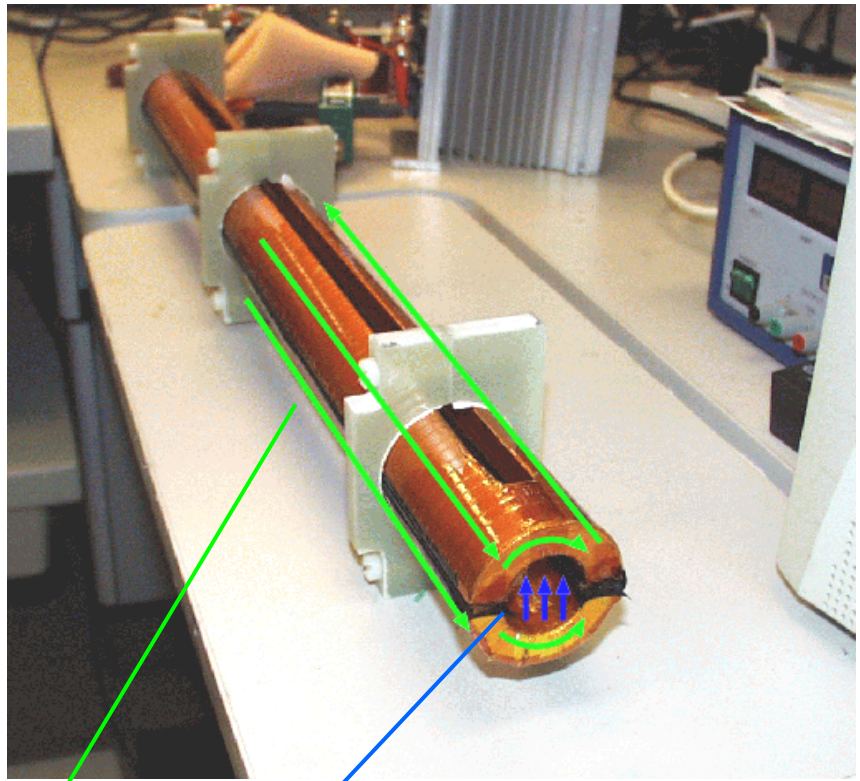
Base width ~ 600 ns, Reputation ~ 5 kHz, I_{peak} ~ 100 A





Quasi-flat top kicker interval

From Chen Yan:



Current flow

Magnetic field

"Two turn" kicker – 2 μs total dwell time!

Møller + Kicker Performance

Configuration	Kick width achieved	Precision	Max. Current
Nominal	-	<1%	2 μA
Prototype I	20 μs	few %	20 μA
Prototype II	10 μs	few %	40 μA
G0 Bkwd. (2006)	3.5-4 μs	Required:2% Goal:1%	80 μA
Q_{Weak}	2 μs	Required:1% Goal:1%	180 μA

Kicker Summary

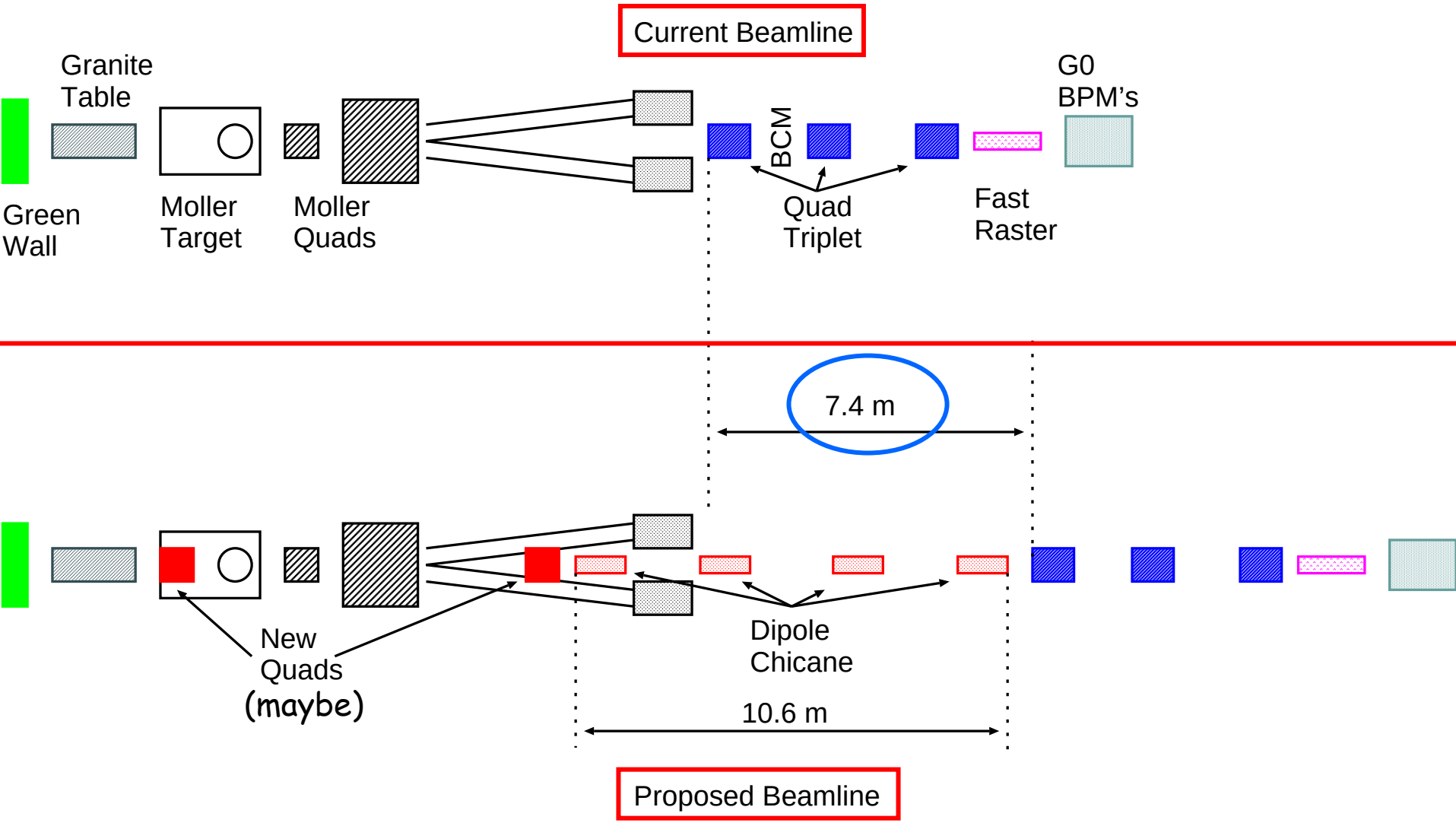
- Fast kicker magnet and thin Fe foil target will allow very precise (1% syst.) msrmnts of P_{beam} at full beam current
- R&D progressing well:
  - The 2 test runs we've had so far have been invaluable in getting the system ready for prime time
  - Next round of tests during commissioning for G0 Bkwrd
    - New 1μ half-moon foil target
    - Improved (1 μs, step function) kicker
    - High current tests with good statistics
- Our goal:
  - 1% polarization measurements at ~80 μA during G0 Backward
  - 1% polarization measurements at 180 μA during Q_{weak}

Hall C Compton Polarimeter

From Dave:

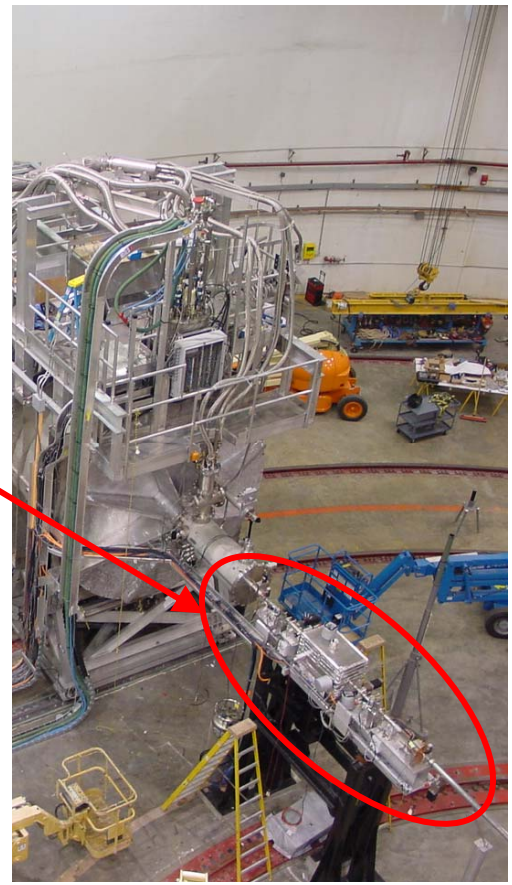
- Chicane will be designed at Bates
  - MOU in final stages
  - Chicane PR this FY?
- Laser will be a pulsed green laser
  - PR as late as possible → cheaper & better that way
- Yerevan has built a candidate photon detector
  - Working prototype is lead-tungstate
    - Needs to be characterized with a tagged photon beam
- TRIUMF/UManitoba NSERC grant request submitted to build a Si μ-strip e-detection arm
- Will go between legs of Moller
  - 1st chicane magnet for pol. tgt expts will move downstream & needs to be beefed up
- Installation work needs to begin at next changeover
  - ~ 6 months of work!

Compton Chicane and Beamline



Beamline

- Cavity BPMs and BCM now available
  - Electronics too now..
  - Aka “G0 long girder”
  - Also with striplines, OTR, etc.
- Ion Chamber electronics being moved to our access tunnel
  - Big grey panel just past key room
- Massive beamline rework in Moller tunnel being planned for upcoming Compton installation



Electronics

From Steve:

- F1 TDC experience during HKS was bad
  - TDCs would crash/freeze
    - Radiation? Hall B has not reported problems with them (just fictitious particles…)
    - Firmware? (upgrades coming)
    - Will learn from upcoming Hall A Gep expt.
  - Spectrometers stay on FB
  - F1's for 3rd arm stuff only
- DAQ test stand in EEL for small detector tests

Electrical Infrastructure

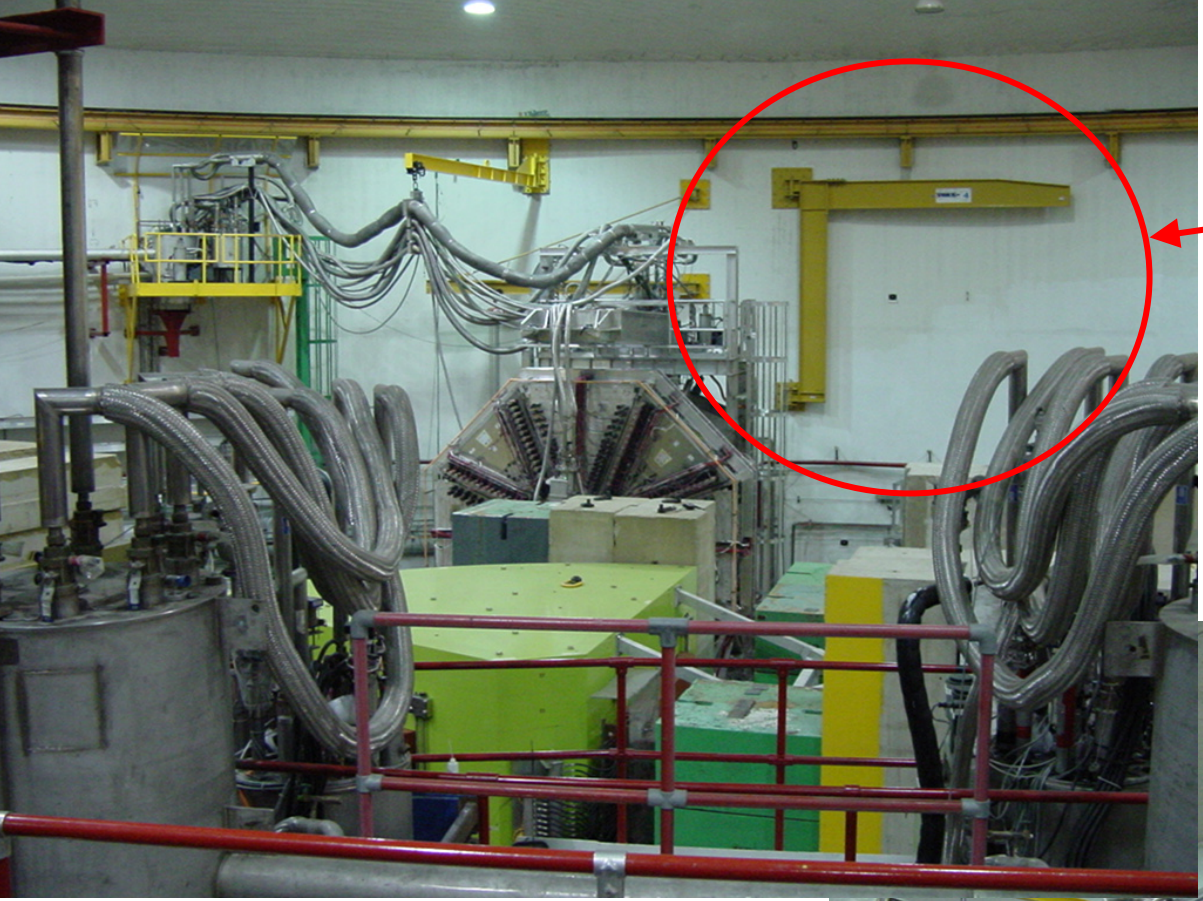
From Bill:

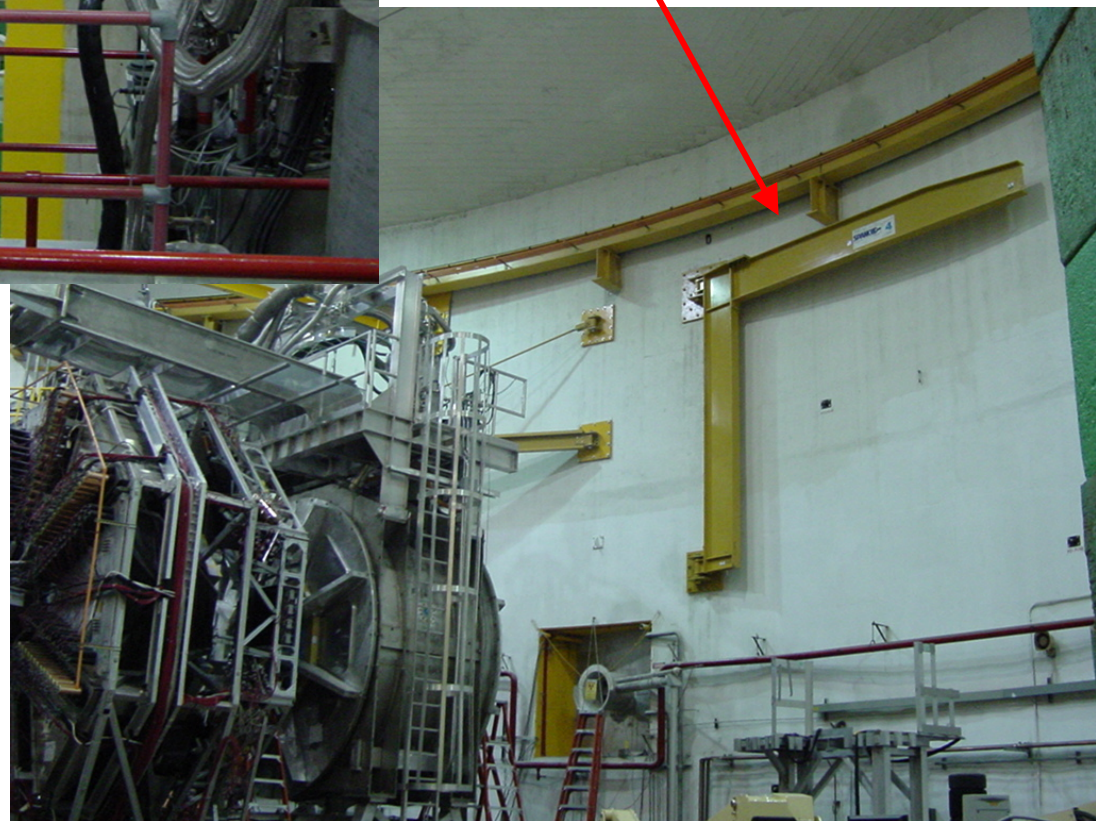
- New 2.0 MVA transformer bringing power into hall
  - Installed (already used by HKS)
- New DC power supply ordered
  - Portable, general purpose
  - Rated for 9500 A, 170 V
- Arc flash calc's. done

Infrastructure Infrastructure

- New 4T crane above dump entrance
  - To facilitate shielding placement outside nominal crane radius
- A-can/Bayonet can access platform under construction
  - To facilitate stinging of U-tubes
- Raised platform & ramps in SOS area
  - Meant to be used to move HKS dipole to side
    - But the dipole has not moved
  - Facilitates jig & forklift access
  - For now locks SOS to ~120 degrees

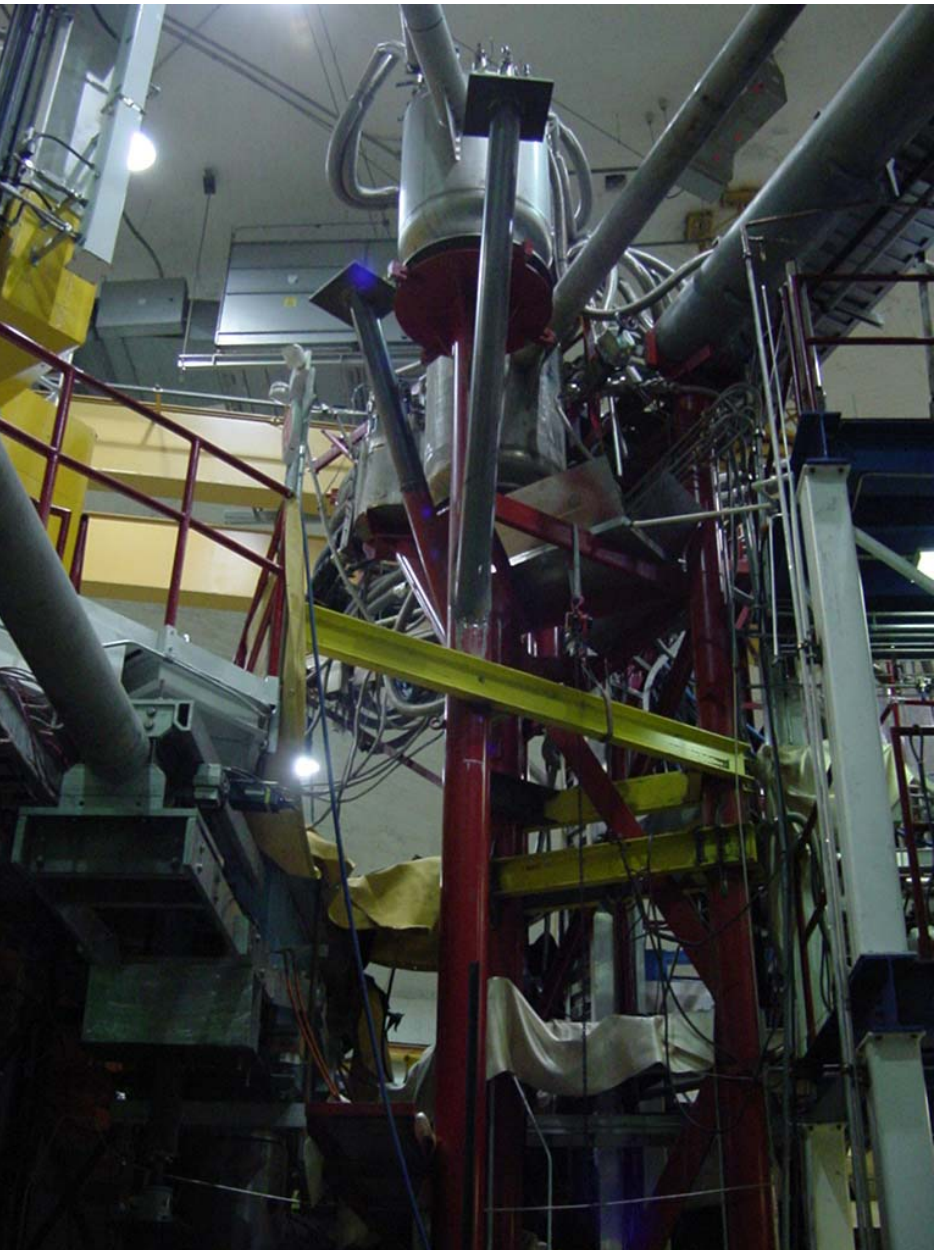
New 4T crane

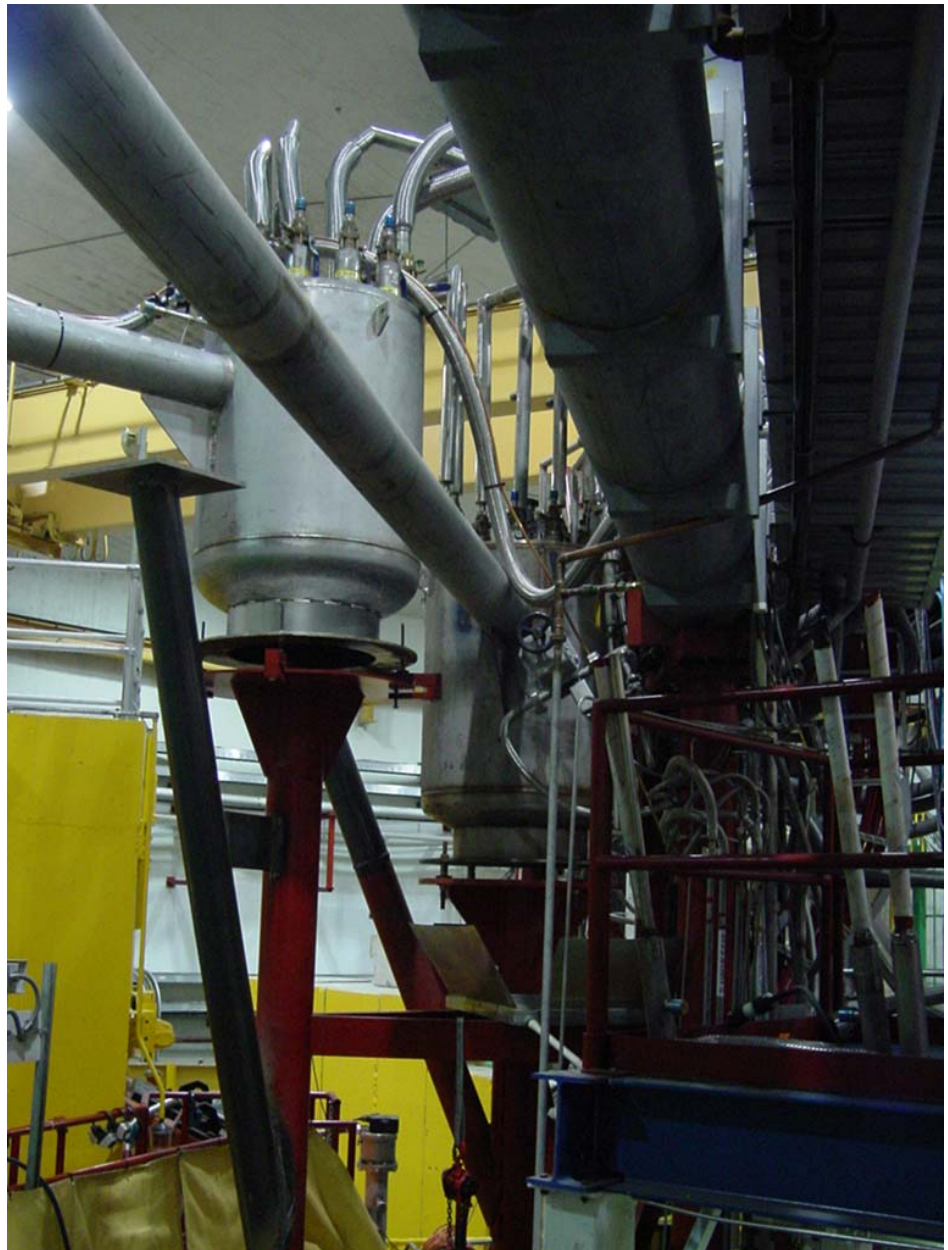




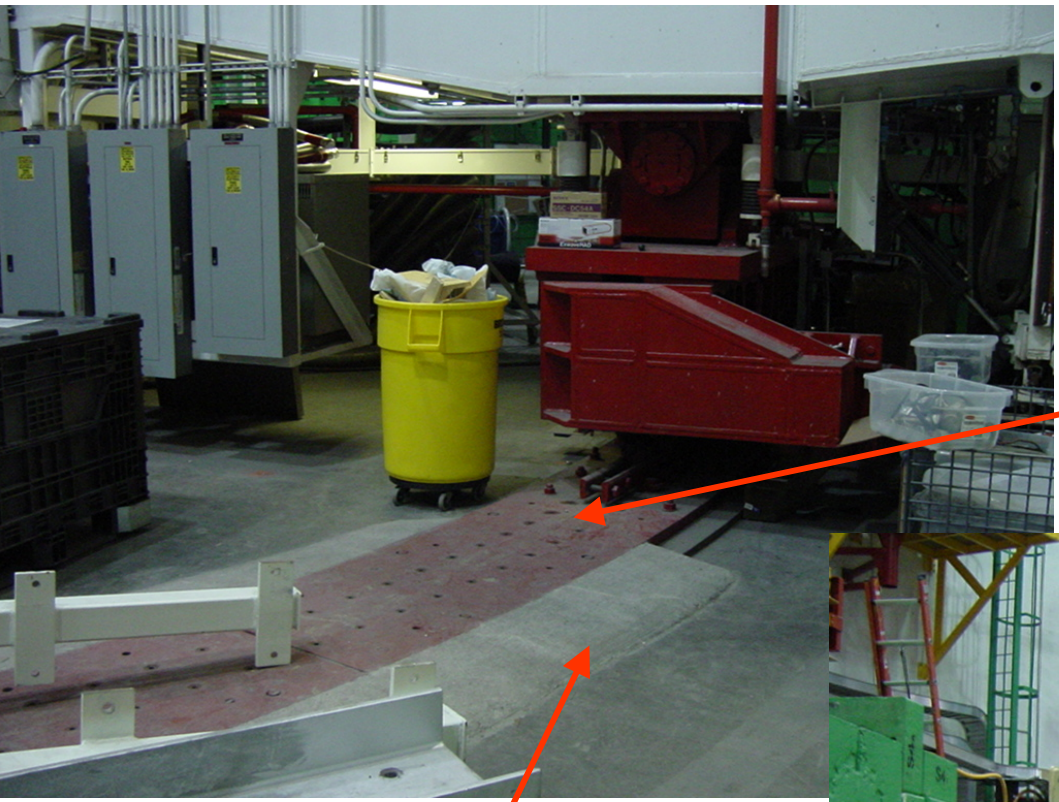
To drop shielding blocks (concrete) outside radial crane radius

A-can Platform going in now

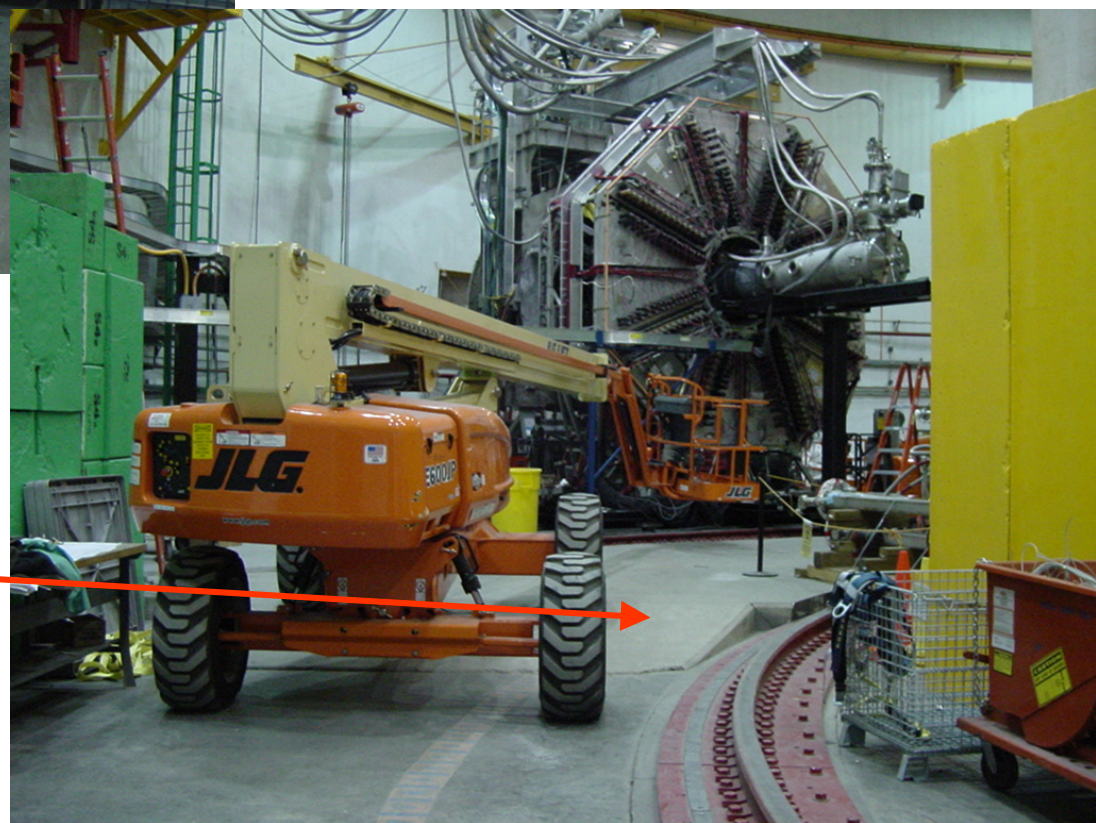




Ramps & Rails



Rail missing- SOS frozen



ramps

END