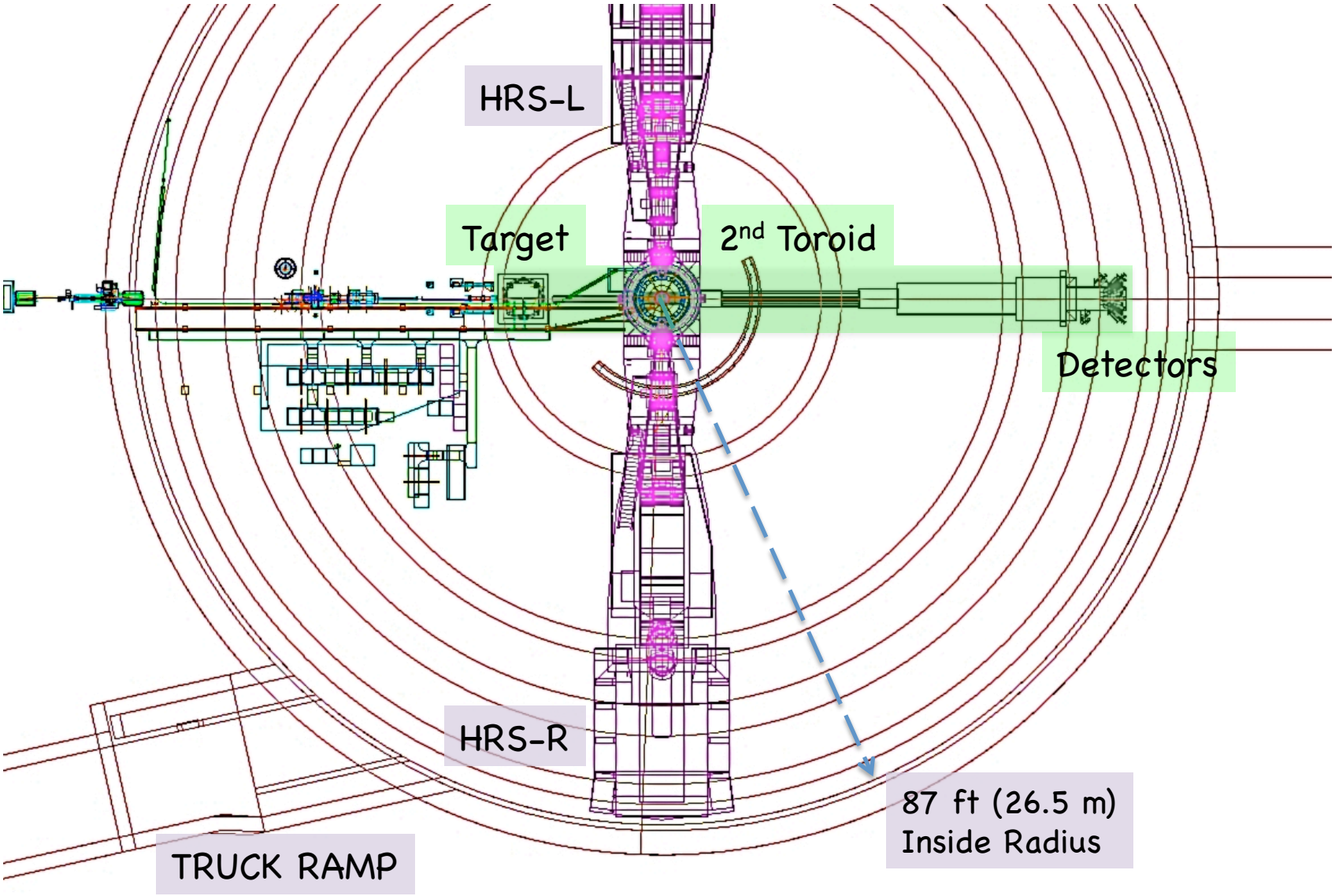
Infrastructure

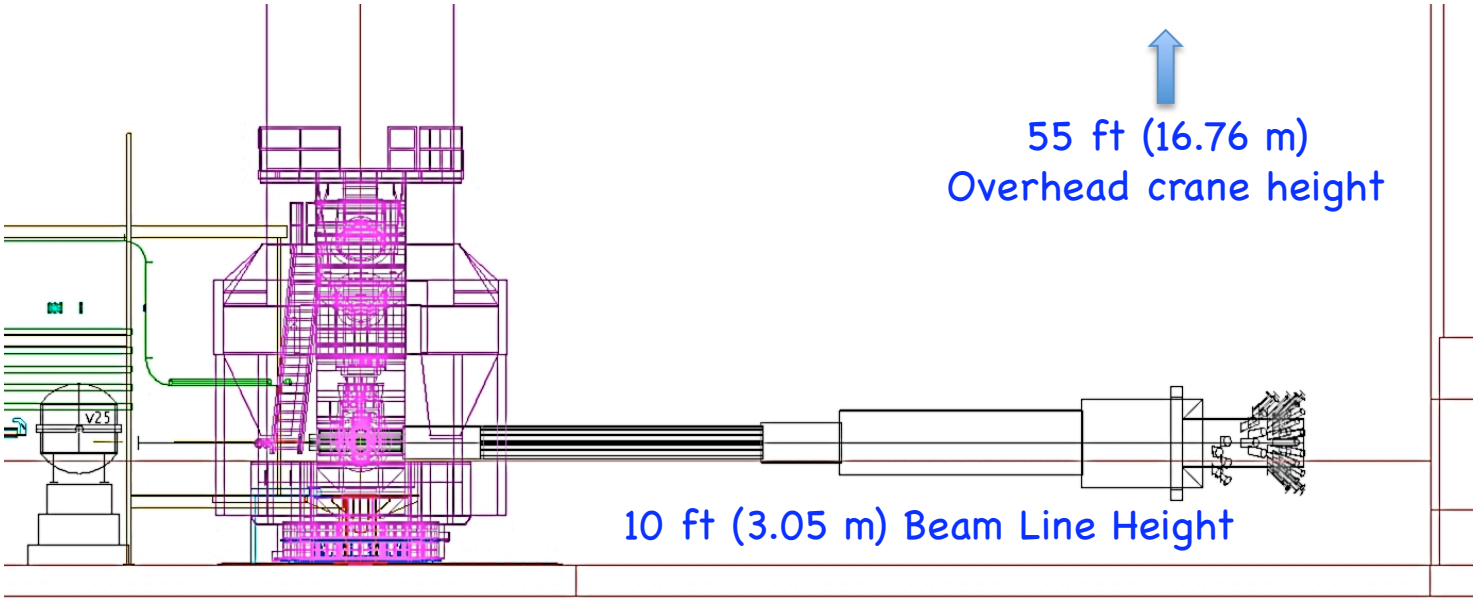
J. Gomez (Jlab)

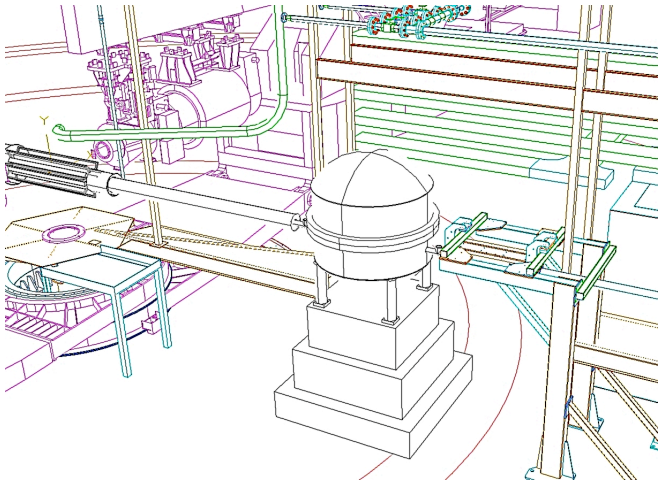
- Installation in Hall A
- Hall A beam line modifications
- Radiation issues
- Concrete shielding
- Hall A electrical power
- Collimator and magnet cooling
- Cryogenics

Installation in Hall A – Top View

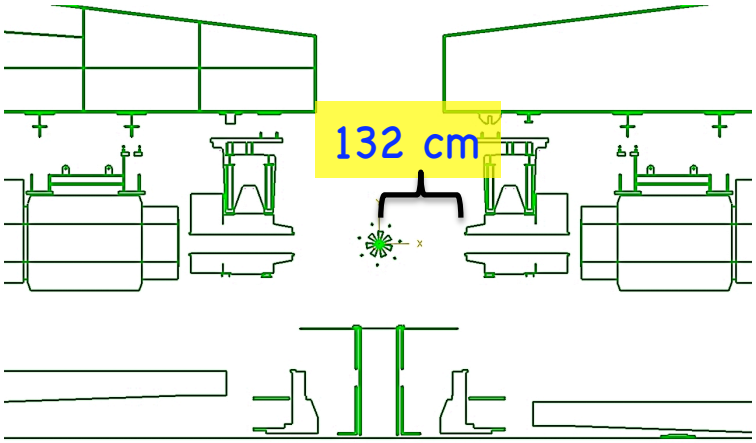


Installation in Hall A – Side & Detail Views





Target & 1st Toroid



Xsection of 1st Toroid at HRS Pivot

Installation in Hall A – Summary

✓ No major obstruction found.

Even without the necessary beam line changes shown later on, separation between the last set of beam line quadrupoles and the new target position would have been ~ 0.7 m.

✓ Cryogenic target must be installed from the side.

Utilities lines (Cryo, LCW, electrical, ...) restrict the use of the overhead crane. Some utilities support posts may have to be modified.

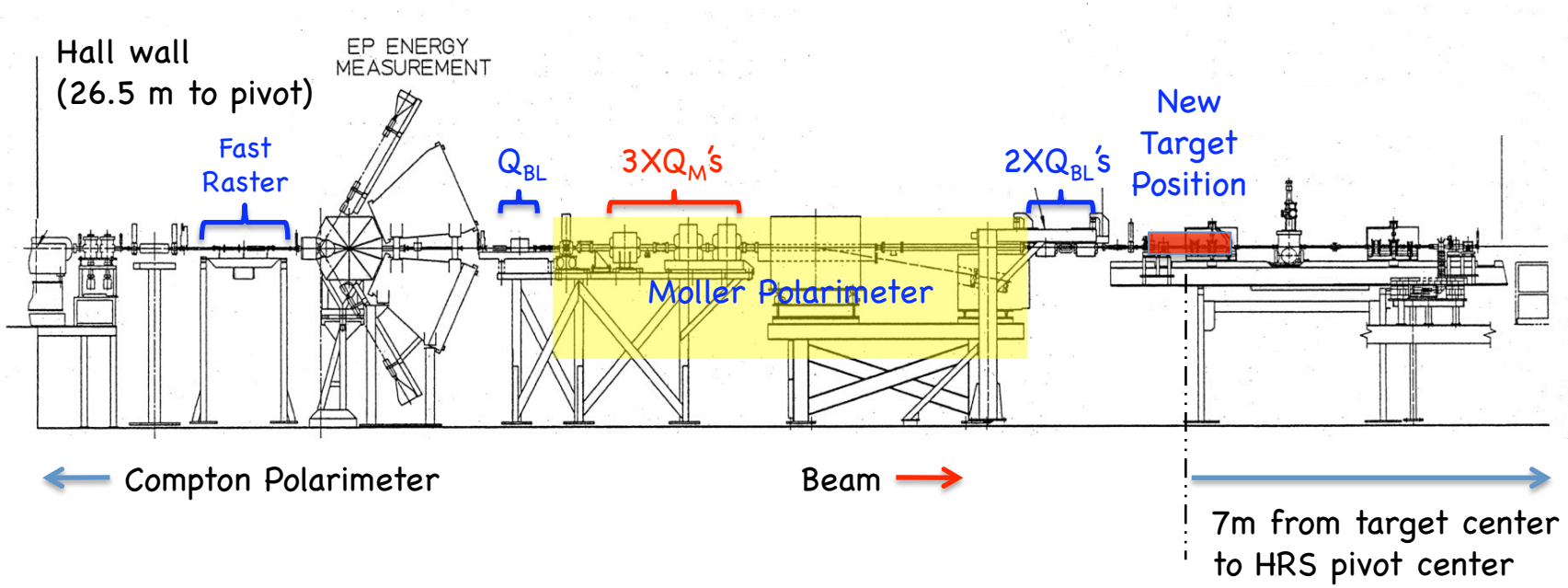
✓ Estimated cost of new exit beam line is 335 k$ (E. Folts)

Cost highlights:

- Aluminum pipe: 250 k$
  (~ 2 X diameter of present corrugated aluminum pipe)
- Vacuum fittings, flanges, bellows & instrumentation: 5 k$
- Beam line support modifications: 10 k$
- Larger diameter entrance wall at beam dump: 10 k$
- Larger diameter Beryllium diffuser window: 25 k$
- Roots blower for exit beam pipe: 25 k$
- Differential pump plate on flange: 10 k$

Hall A Beam Line Modifications

Present-day Beam Line

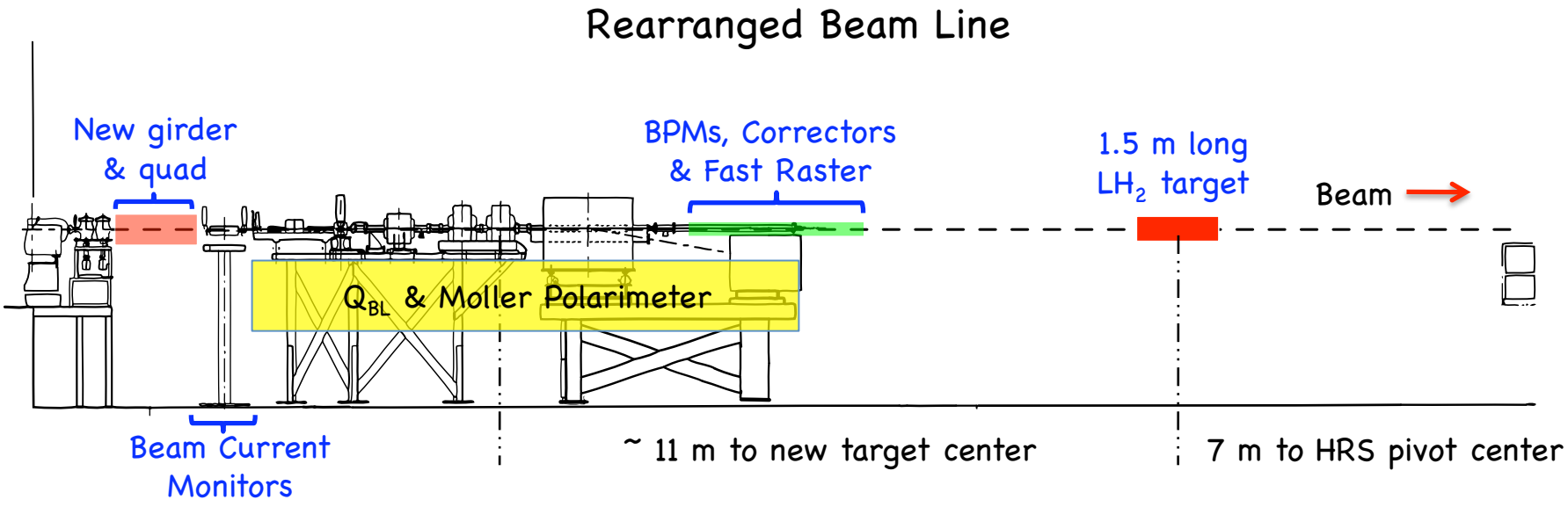


Optical elements to set beam properties at pivot:

- Three beam line quadrupoles (Q_{BL}'s).
- Three Moller polarimeter quadrupoles which also double as beam line elements (Q_M's).

Reduced distance between new target position and optical elements severely limits their usefulness.

Hall A Beam Line Modifications – Benesh Proposal



Design, procurement & installation cost estimate is 500k$.

Cost highlights:

- New quadrupoles: 85 k$
- New girders, stands & one inverted girder: 40 k$
- Four additional BPMs & electronics: 88 k$
- Three additional H/V correctors with power supplies: 42 k$
- New fast raster system (coils & amps): 100 k$
- Design & installation: 100 k$

Radiation Issues

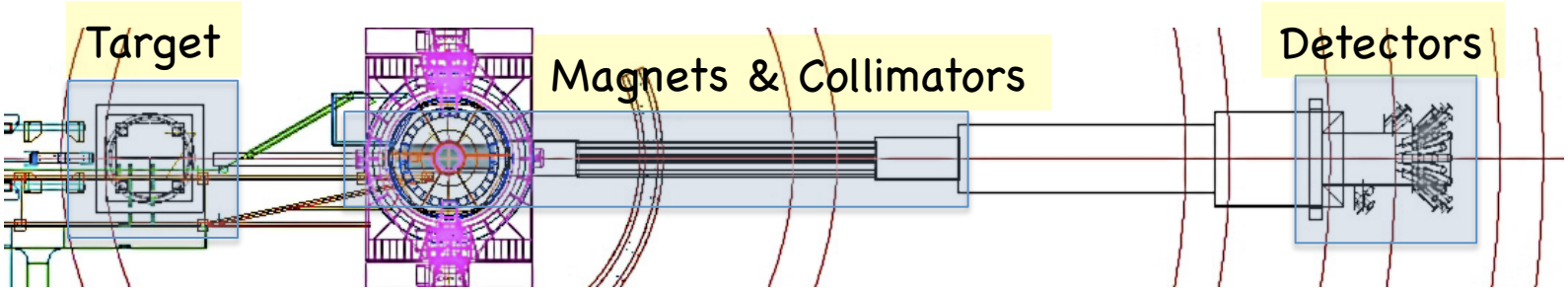
Had first meeting with members of Jlab's RadCon group (Vashek Vylet, Pavel Degtiarenko & Keith Welch) on 12/7/09 to discuss issues brought up by this experiment.

✓ Design of the experiment shielding (e.g. concrete) will be critical to stay below the established radiation levels at the lab perimeter. Next step should be to integrate a detailed model of the experiment into the GEANT Monte Carlo used by RadCon so that the various sources of radiation could be evaluated and their impact minimized.

✓ Storage of activated parts (e.g. collimators, blocks,...) should be considered early on - specially for a multiyear experiment with other experiments taking place in between.

✓ Activation of underground water (under hall floor) does not appear to be an issue -- water is not standing still, it is constantly being pumped away.

Concrete Shielding



Expected Concrete Shielding Locations – Top View

Use concrete blocks of unique shape & size for critical and space constrained areas of the experiment – compact size shielding would facilitate experiment installation & transition between experiments while providing the coverture and access to the equipment needed.

Use already available blocks whenever else possible

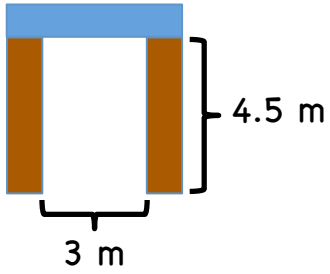
Block fabrication (SS rebar & lift points) – cost rate ($/m^3)

- Rate1 for blocks of large size & quantity: 2500 – S. Chandra (Jlab/Civil)
- Rate2 for one of a kind block: 4000 -- Qweak bids

Concrete Shielding

Assumptions taken to estimate cost of concrete shielding (no detailed design available yet):

Amount of concrete used for block fabrication: 300 m^3 .
Equiv. to a 4.5 m (H) X 3 m (W) X 20 m (L) tunnel with 1 m thick walls.



Block fabrication – effective cost rate: 2900 $/$m^3$.
Equiv. to 75% of the blocks fabricated at Rate1 and 25% at Rate2.

Cost of concrete blocks: 870 k$

Cost of installing concrete blocks: 60 k$
(5 days, two 8h shifts at contractor rate obtained for Qweak installation)

Hall A Electrical Power

✓ Available power is 1800 A @ 480 V = 0.86 MW (1 MW substation)

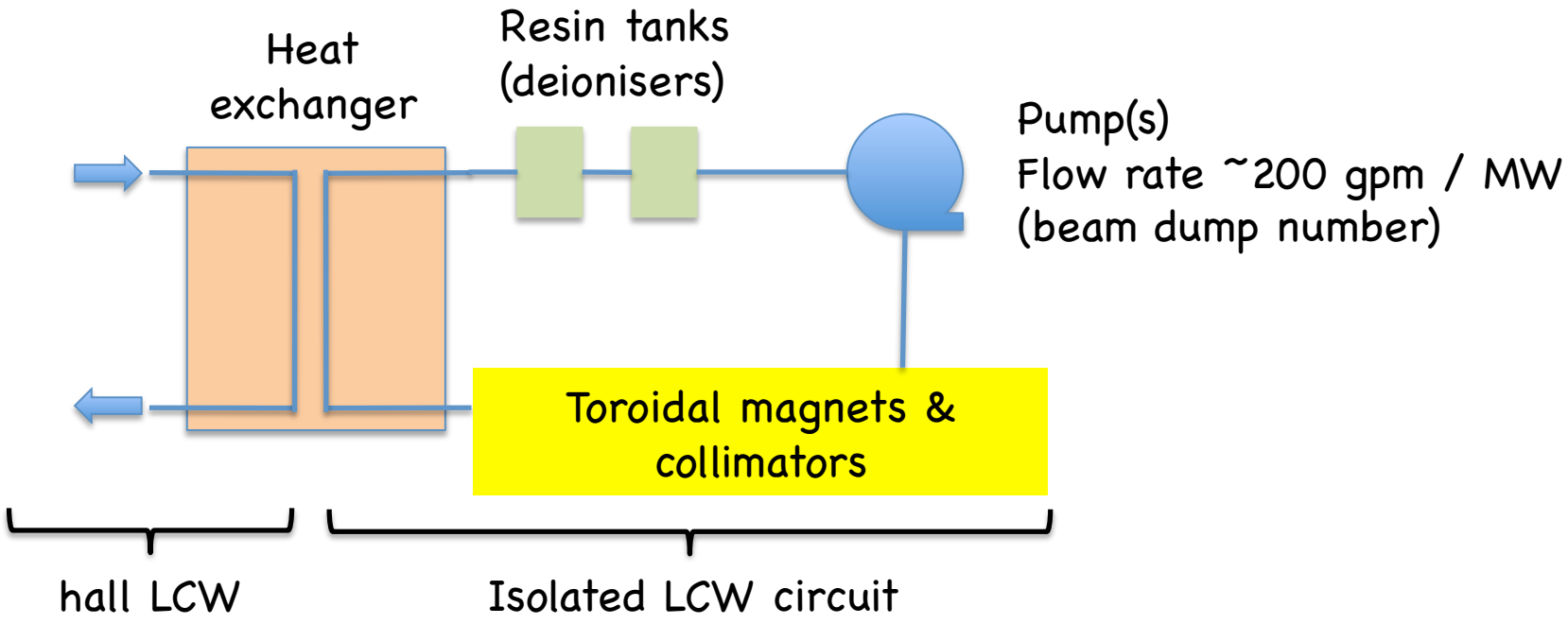
✓ Total power to be used by the MOLLER experiment (e.g. MOLLER magnets, target, vacuum pumps, …) appears to be smaller than available power - the 2nd toroidal magnet, by far the largest load, it is not expected to exceed 600 kW. The HRS spectrometers will not be in use.

➢ BUT, cost estimate includes 300 k$ to add a 2 MW substation if needed (parts & labor, based on Hall C purchase for Qweak)

Magnet & Collimator Cooling

✓ Low conductivity water used for cooling of collimators and toroidal magnets will be activated by the beam.

✓ Implement an isolated LCW circuit similar to those being used for beam line magnet cooling in the Beam Switchyard, FEL & Hall D.



Cost of parts & labor ~ 200 k$ (C. Whitlatch / C. Jones, Jlab Fac. Manag.)

Cryogenics

- ✓ Most of the cryogenics used by this experiment is for target cooling. The experiment calls for beam currents of 75 microA or larger into a 1.5 m long liquid Hydrogen target (5+ kW of cooling required)
- ✓ The other user of cryogenics in the hall during this experiment is expected to be the Moller polarimeter superconducting magnet (the HRS superconducting magnets will not be in use)
- ✓ Cooling of the cryogenic target requires the ESR-II upgrade (5+ kW) + present day ESR (1.2 kW). Specific operating parameters unknown at this time (e.g. pressure drop).

Cryogenics – cont.

✓ Best solution for cryogen transfer between the upgraded ESR cluster and MOLLER target can be determined only after the operating parameters of the new ESR cluster have been pinned down. Potential solutions are,

- reuse of present day cryogenic transfer lines by redefining the use of the various spaces in the lines (Qweak solution, possibly the lowest cost)

- build dedicated transfer line(s) for this experiment (existing Hall transfer lines remain as they are)

- ??

✓ Cooling of the Moller polarimeter with its own small refrigerator (~ 50 k$) will allow substantial more freedom in the design of the high power cryogenic target cooling system and its connection to the upgraded ESR.

A guesstimate of 1 M$ has been added to cover the cryogenic needs of this exp. The amount is the estimated cost of replacing all the Hall A transfer lines.