HAPPEX-III, PVDIS, PREx targets

D.S. Armstrong April 17 '09

1) Cryotargets

- *what we requested: new 25 cm racetrack cells*
- *status*

2) Solid Targets for HAPPEX-III/PVDIS

- *plan*

3) Solid Targets for PREx *(from ROM)*

The College of WILLIAM & MARY

Jefferson Lab

Cryotargets for HAPPEX-III/PVDIS

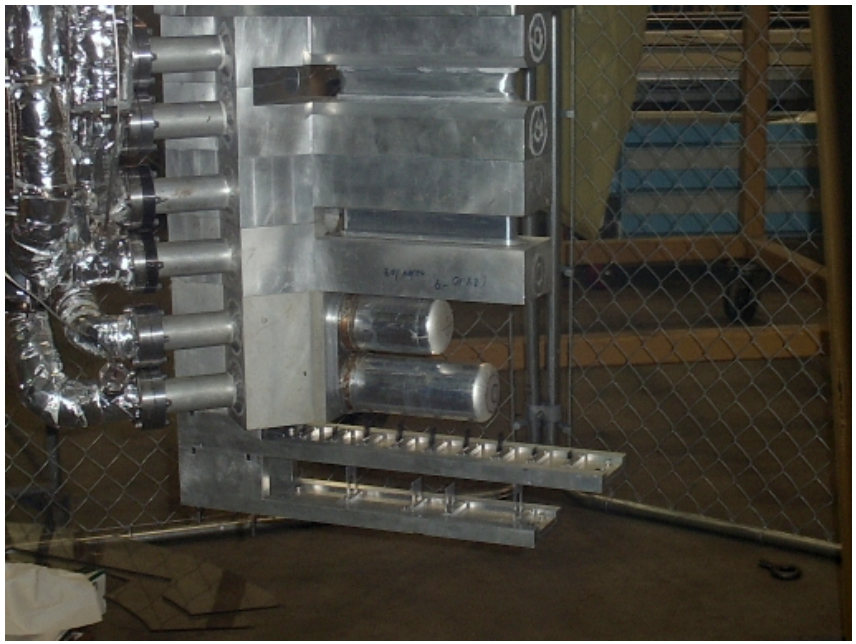
HAPPEX-II used 20 cm “racetrack” cell (design: Dimitri Margaziotis, Cal State LA)

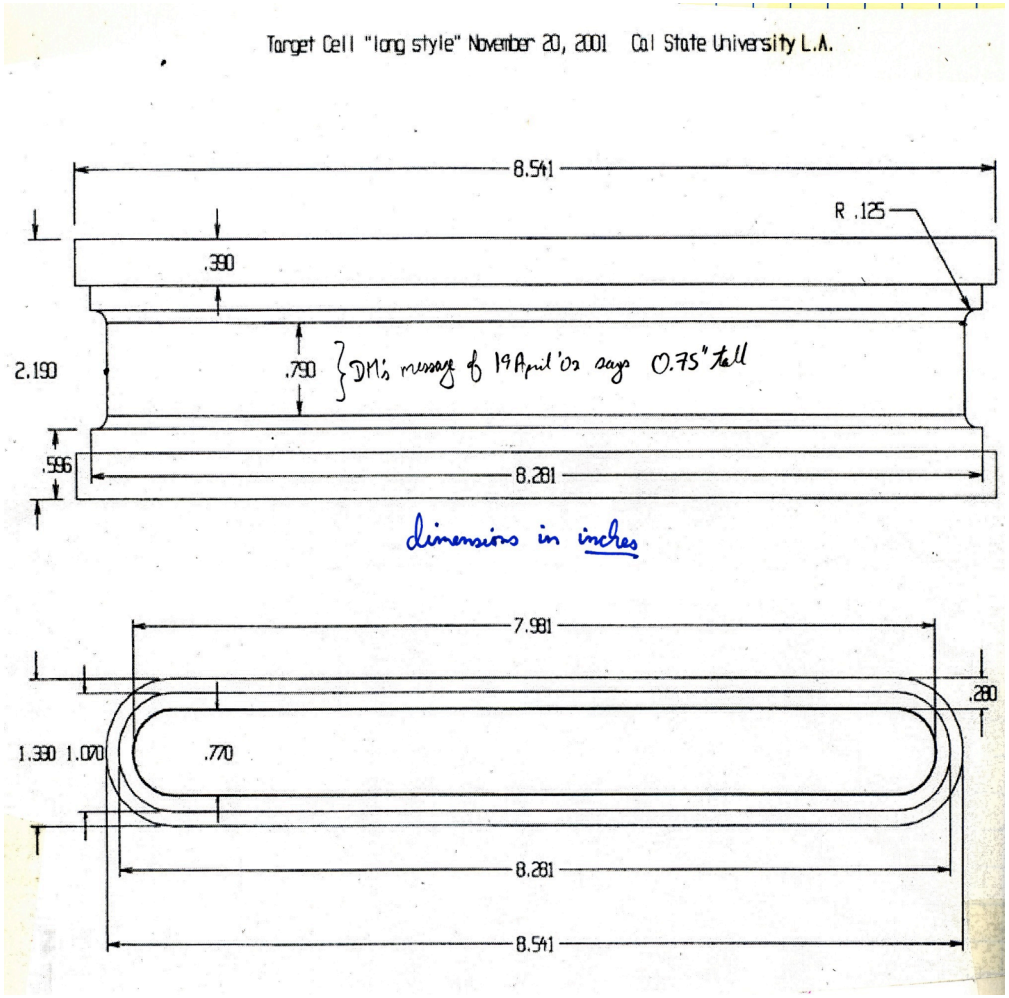
transverse-flow design

- Excellent boiling performance
- Geometry – no problem using at HAPPEX-III/PVDIS angles with up to ±4 mm raster

(vertical acceptance is issue)

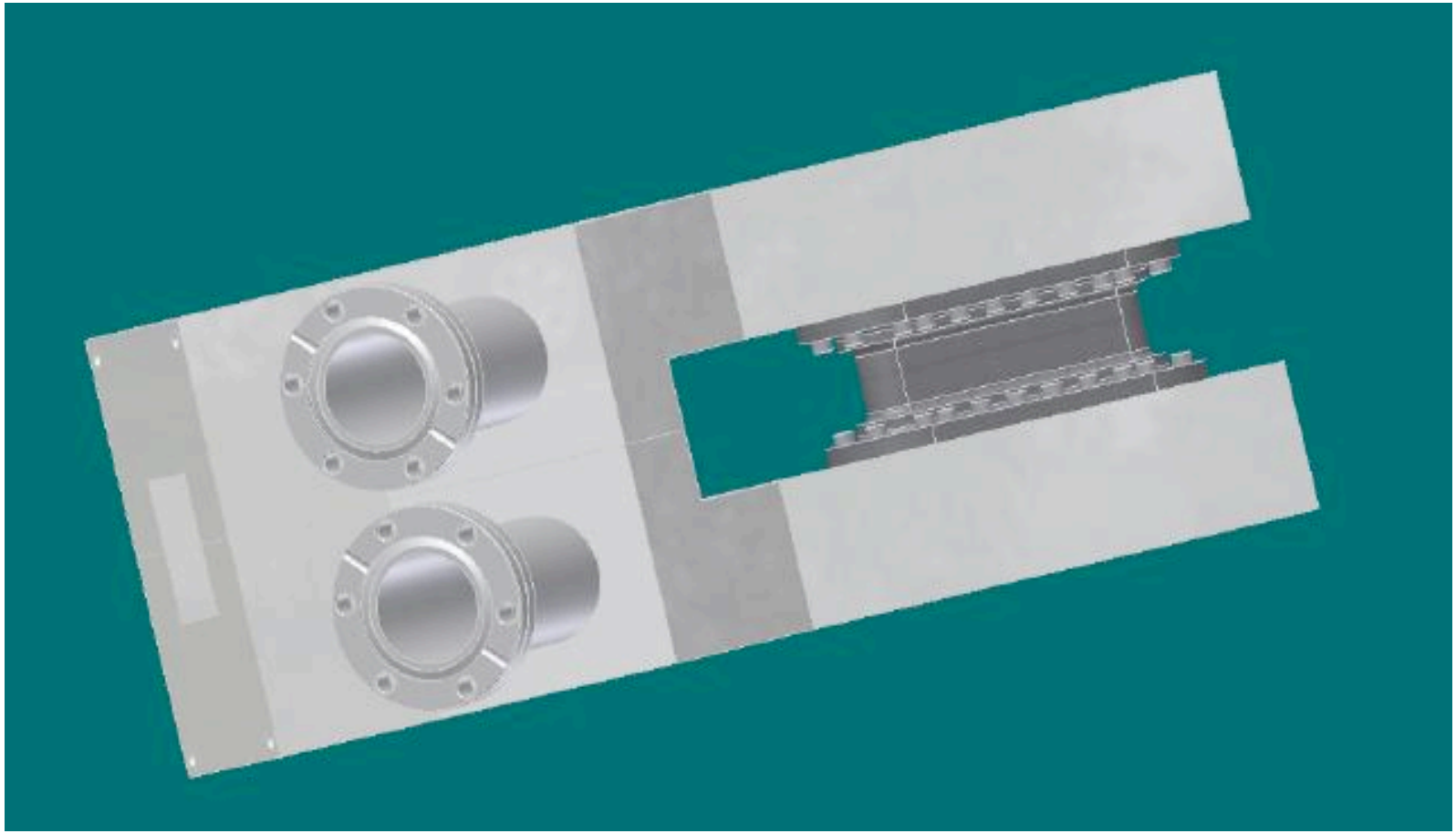
- PVDIS asked for 25 cm version





New Cell Block Design

from Dave Meekins (this is for 10 cm cell)



Cell length for HAPPEX-III

25 cm cell also?

Advantages:

1. Swap-compatible with PVDIS cell (mutual spares)
2. Ratio of Al (windows) to lH_2 smaller by ≈0.8
   - reduced QE background
   - perhaps reduced boiling (*if* film boiling at window dominates)
3. somewhat reduced acceptance (≈10-15%) at detector for Al windows
4. Luminosity (assuming cryogen load can be delivered)

Disadvantages:

1. Increase radiative tail losses: 15-20% increase in radiative effects, taking into account Al windows; and, they are the "worst" kind (before scattering vertex, reduces asymmetry)
2. Perhaps a bit harder to manufacture
3. Maybe boiling performance worse, *if* bulk-dominated... We know 20 cm was good.

Cryotargets – request

- Requested identical 25 cm cells for PVDIS, HAPPEX-III:

  act as mutual spares in case of leaks; changeover of lH_2 to lD_2 on a loop is a couple of shifts; much better than replacing entire cell block on target ladder.....

- Can have three cells on cryotarget ladder now (was not the case for HAPPEx-II)
- Have one working 20 cm cell (hydrogen: thin-walled) from HAPPEx-II
- Requested:

Loop 1	25 cm "race-track" style	(hydrogen)
Loop 2	25 cm "race-track" style	(deuterium)
Loop 3	20 cm "race-track" style	(existing HAPPEX-II/H cell)

- For new (25 cm) cells:
  - Side walls thickness: aim for ≤7 mils.
  - Entrance and exit windows: aim for ≤ 5 mils.
  - Important to have good measurement of window thicknesses, particularly in 1cm x 1cm region around the nominal central ray
    (allowing for ±4 mm raster and a ≤5 mm offset of the beam axis)

- ASME issues seemed to have calmed down...

Aluminum window thickness

HAPPEX-1 15 cm “beer can” cell:

Entrance window	2.8 mil
Exit window	3.7 mil
Side walls	7.0 mil

Al background: (1.4 ± 0.1) %

HAPPEX-II 20 cm “racetrack” cell:

Entrance window	7.0 mil
Exit window	2.8 mil
Side walls	5.4 mil

Al background: (0.91 ± 0.12) % (2004)

(0.76 ± 0.25) % (2005)

Machining and measurement tolerances; chatter of bit ...

Need integrating mode data with variable density gas (target warming) to scale “xt” factor

Cryotargets – status

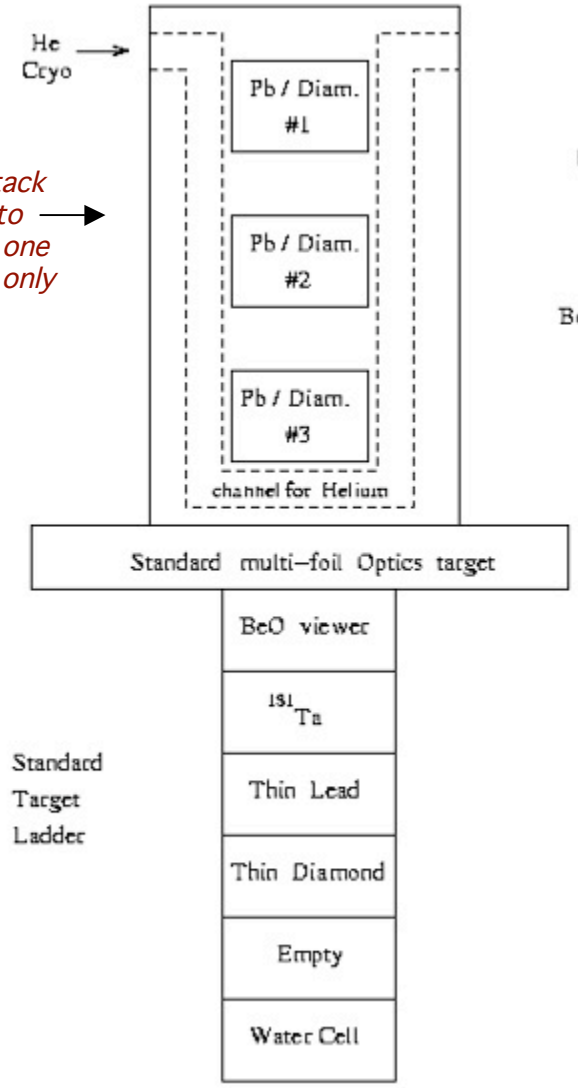
- ASME issues seemed to have calmed down (non-trivial!)
- Mike Seely resigned from Targets group (December 2008)
- I was late getting all specs to Targets group
  & getting info to Kees to justify $$ (*mea culpa)*
- Dave Meekins has been busy with other targets *(SANE, Qweak…)*
- Cells not yet made, but still have adequate time:
  a few weeks needed for machining & a few weeks for testing
- Dave M.: time is “not yet a problem”

Solid Targets – HAPPEx-III & PVDIS

- H_2O cell (pointing angle measurement)
- BeO viewer
- Al dummy foils, located 25 cm apart (at the windows of the long racetrack cells) with 1.00 mm thickness
- Standard C multi-foil optics target as we used in 2005
- Carbon single foil target
- Ta foil target (pointing angle measurement)
- empty position

  - Can't run H_2O cell when cryotarget cold *(duuh...)*
  - Run optics/pointing measurements first with H_2O cell installed, then break vacuum (all running at low current to this point), remove H_2O cell, cool target. Estimate 2-day turnaround. Note: point angle measurement done at 1-pass beam energy, so there is also parallel overhead to restore 3-pass beam.

Solid Targets – PREx



Top of stack (closest to cooling); one cryoloop only

Standard Target Ladder

PREX TARGETS

R. Michaels, Mar 2009

This is a conceptual sketch.
An engineering sketch will follow.

Element provided by	Thickness
Bob (Pb/Diam.)	0.5 mm lead isotopically pure
	0.15 mm diamond
Meekins	100 mg/cm^2 each foil
Meekins	100 mg/cm^2
Meekins	100 mg/cm^2
Bob	0.05 mm (67 mg/cm^2)
Bob	0.15 mm (45 mg/cm^2)
Meekins	
Meekins	steel: 0.001" (20 mg/cm^2) 2 such steel windows Water: 5 mm (500 mg/cm^2)

1. Start with warm target: water cell & truncated target ladder (BeO, Ta, empty?)
2. Break vacuum, remove water cell (no high current on Pb yet)
3. Run with cold target and full solid target ladder.