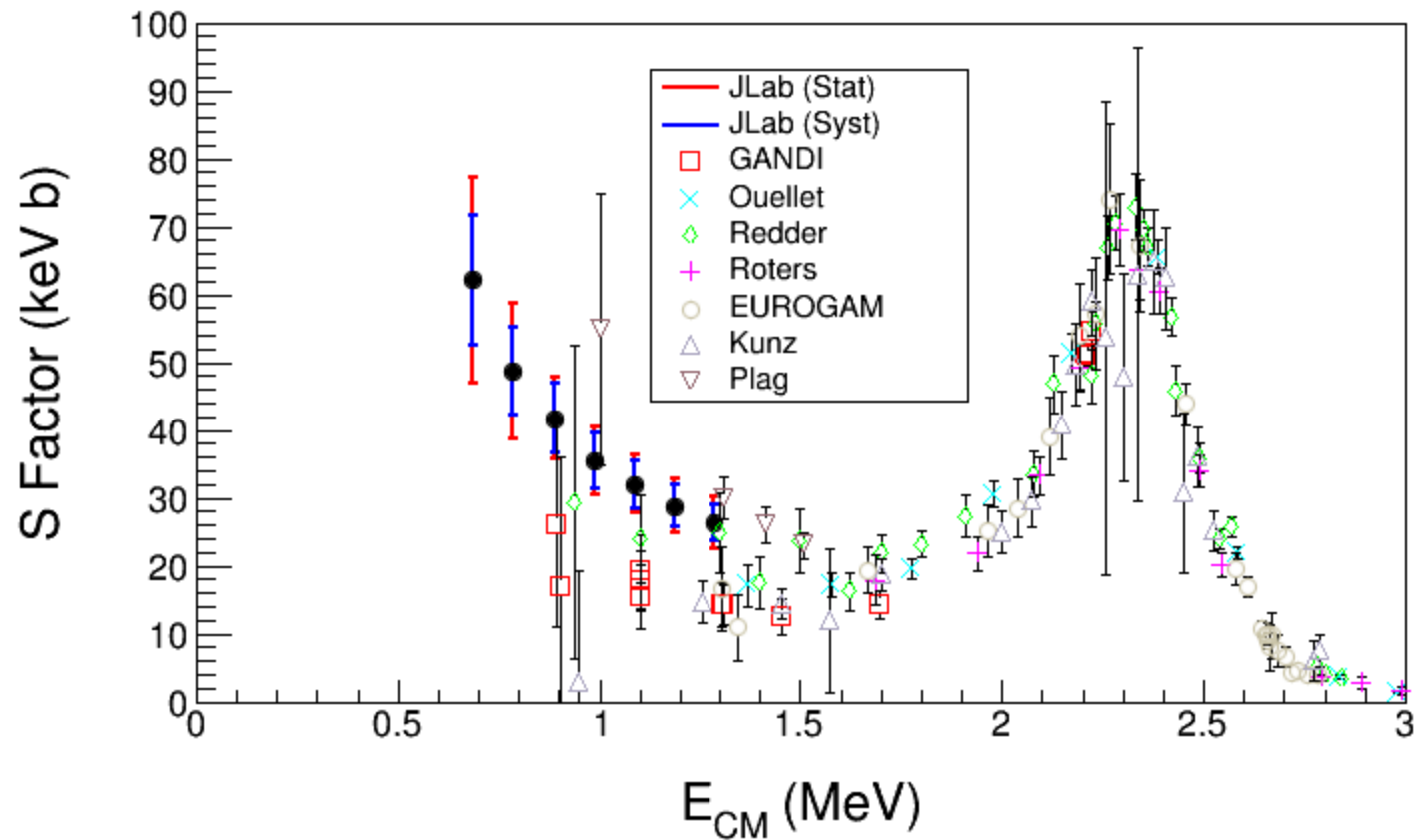


# Bubble Chamber Experimental Readiness Review

September 11, 2014

[https://wiki.jlab.org/ciswiki/index.php/Bubble\\_Chamber](https://wiki.jlab.org/ciswiki/index.php/Bubble_Chamber)

# ASTROPHYSICAL S-FACTOR $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$



# OUTLINE

- Beam Requirements
- Bubble Chamber
- Bubble Chamber Status
- Test Beamlines
- Test Beamline Commissioning
- Experiment Beamline
- Schedule
- Safety Reviews
- Readiness Documents

# BEAM REQUIREMENTS

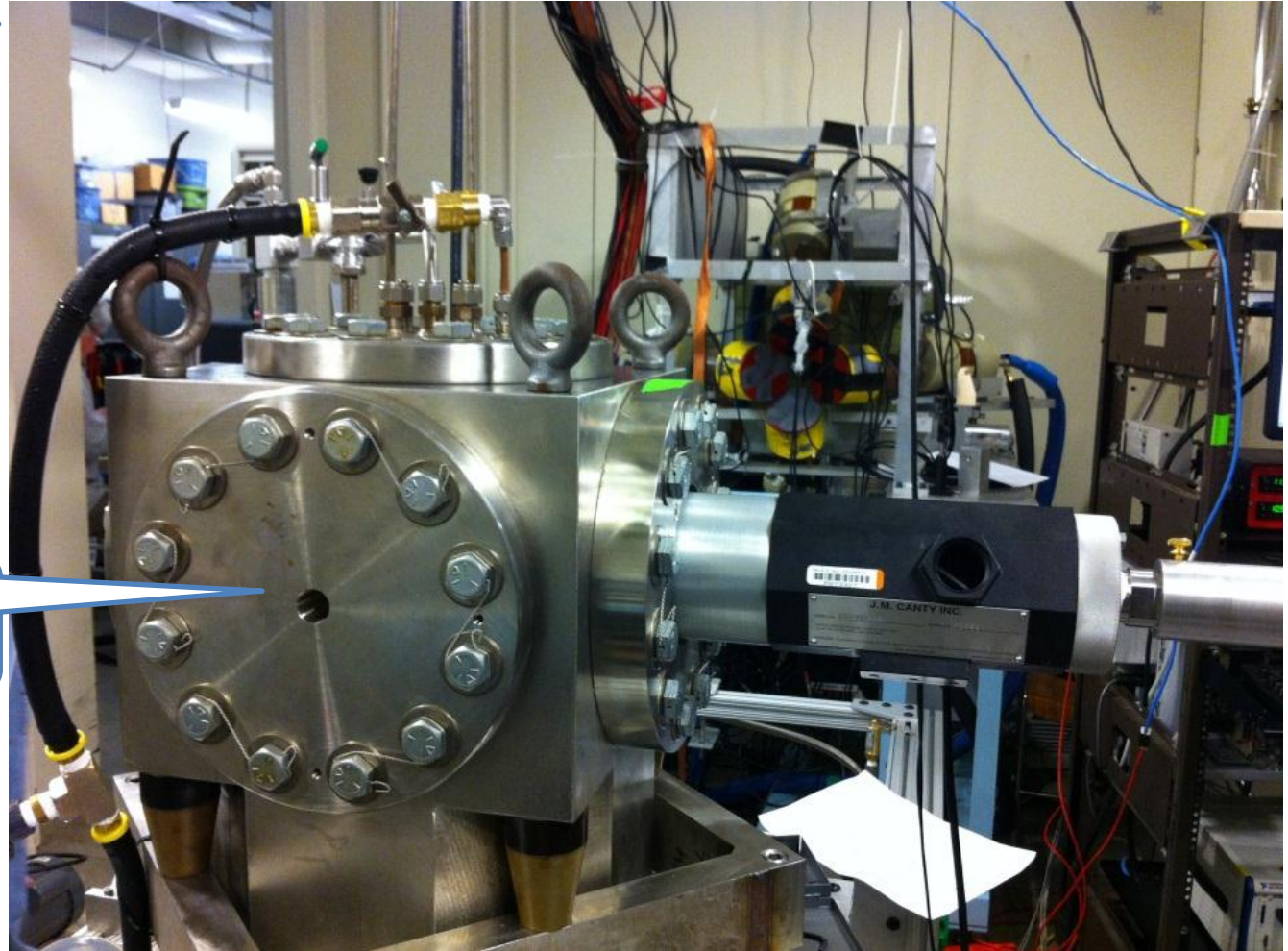
## I. Beam Properties at Radiator:

Beam Kinetic Energy, (MeV)	7.9–8.7
Beam Current ( $\mu\text{A}$ )	0.01–100
Absolute Beam Energy Uncertainty	<0.1%
Relative Beam Energy Uncertainty	<0.02%
Energy Resolution (Spread), $\sigma_T/T$	<0.06%
Beam Size, $\sigma_{x,y}$ (mm)	1–2
Polarization	None

# BUBBLE CHAMBER

Bubble Chamber  
at HIGS  
April 2013

Photon Beam  
Entrance



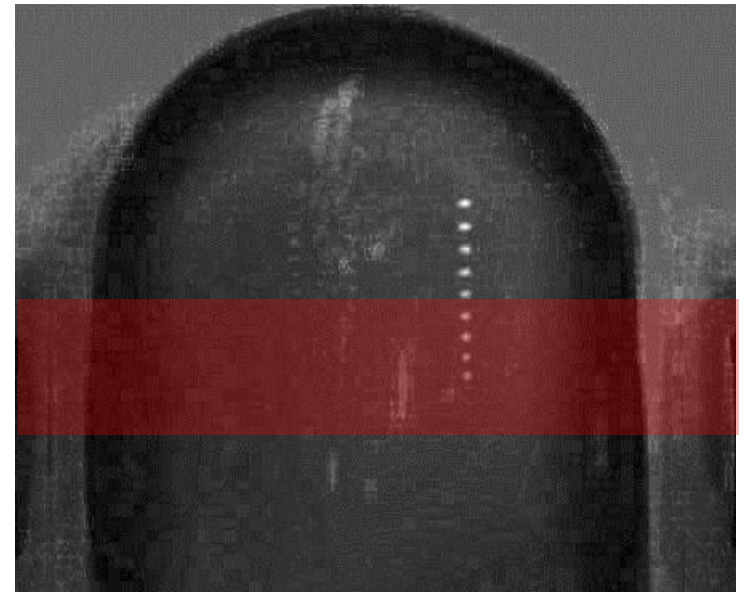
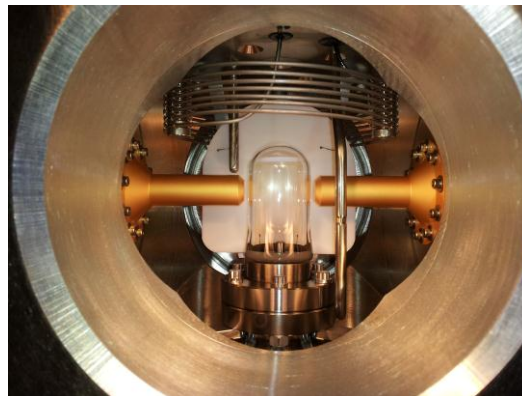
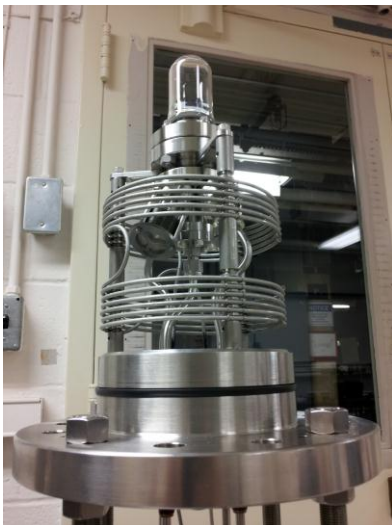
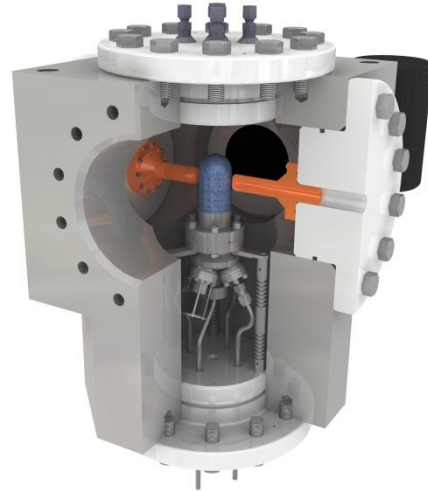
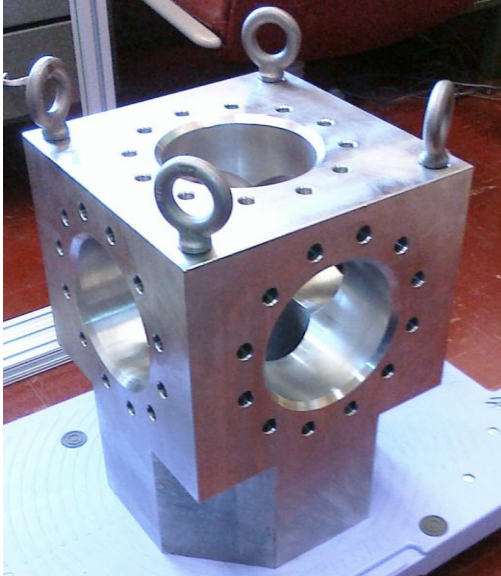
# $\text{N}_2\text{O}$ Bubble Chamber

$T = -5^\circ\text{C}$

$P = 60 \text{ atm}$

First  $\gamma + \text{O} \rightarrow \alpha + \text{C}$  bubble

April 2013

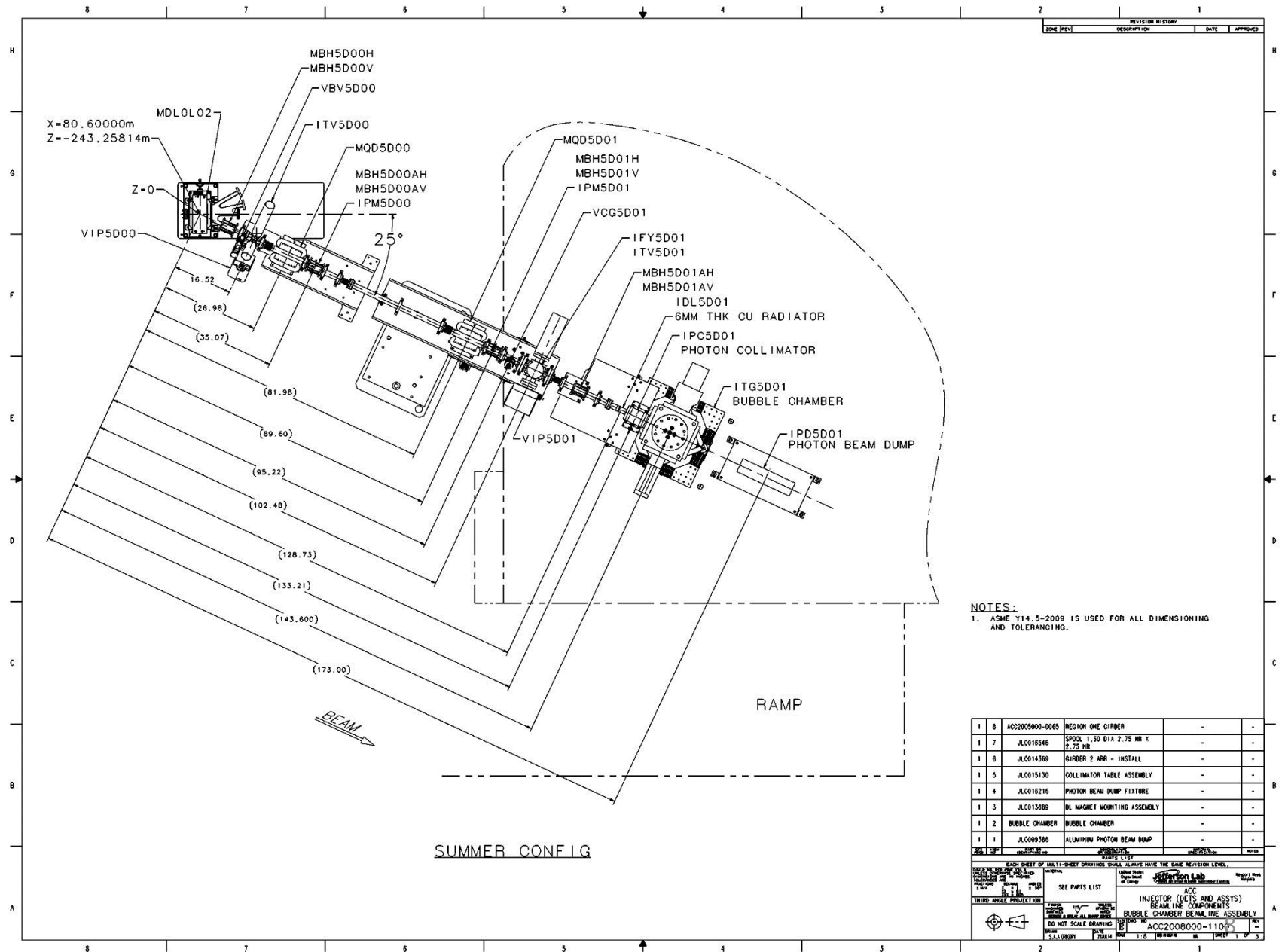


# BUBBLE CHAMBER STATUS

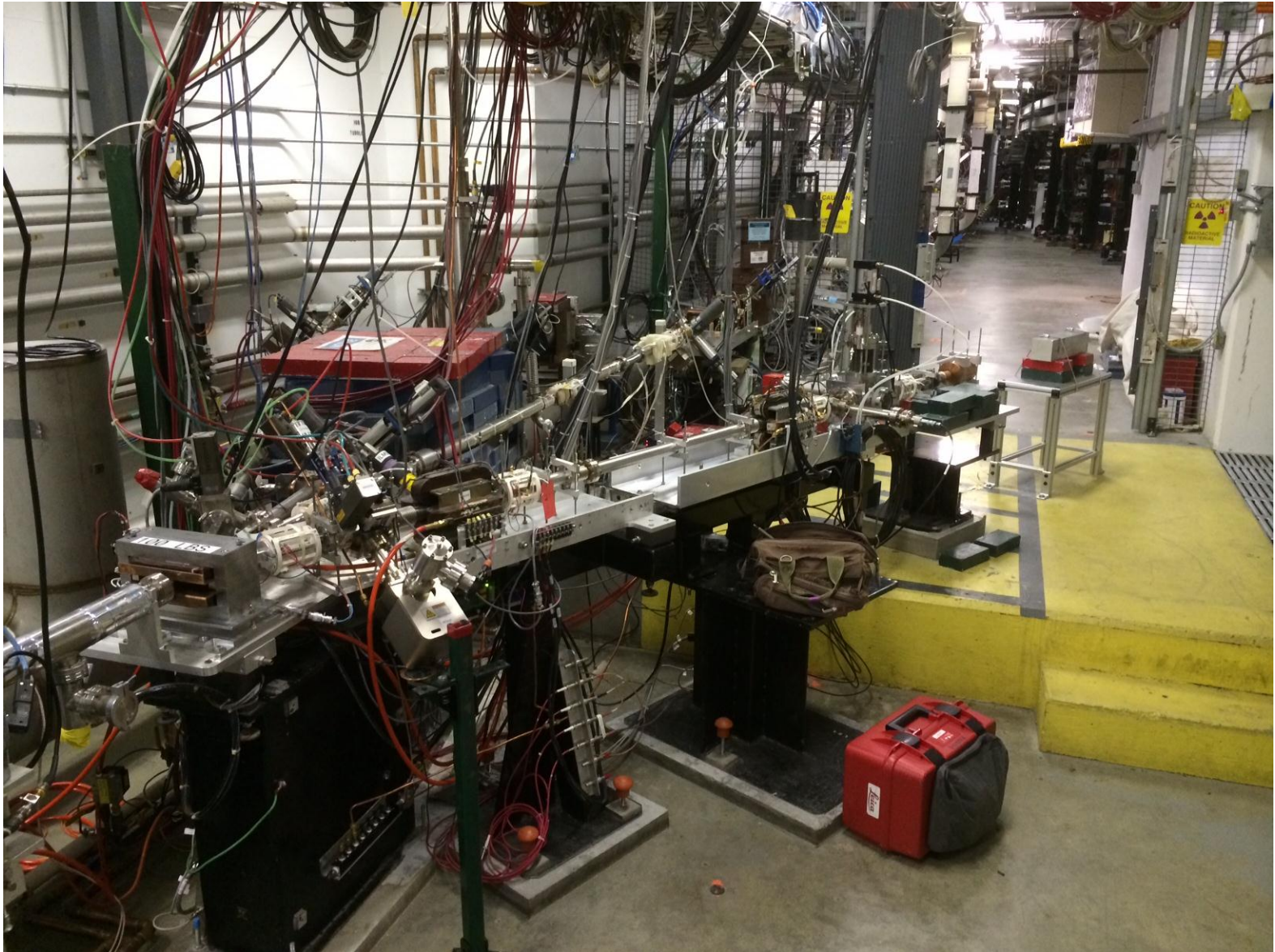
- Problem with buffer liquid: water mixes with  $\text{N}_2\text{O}$
- Changed buffer liquid to mercury
- Problem: nucleation at the interface between mercury and the  $\text{N}_2\text{O}$
- Tried differentially cooled mercury ( $\text{N}_2\text{O}$  at meniscus is not superheated) ... No more bubbles at interface
- Finalizing design and ready for testing very soon



# TEST BEAMLINE





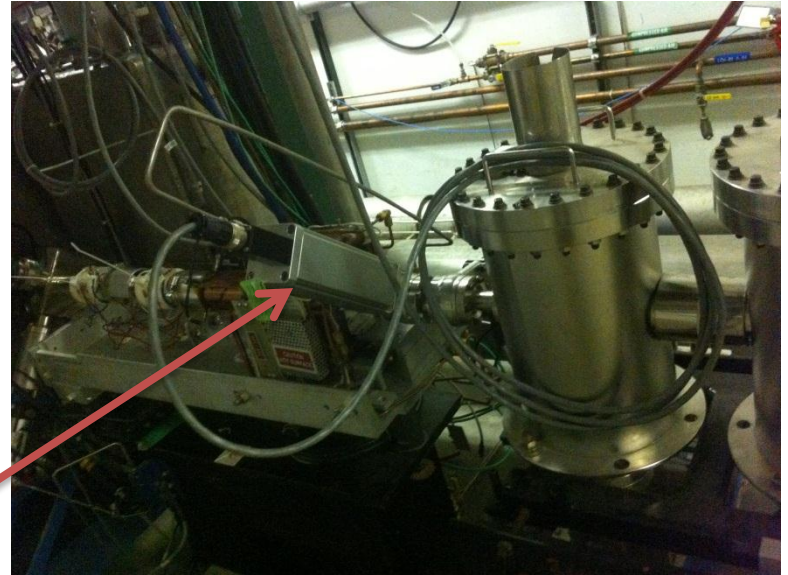


# NEW BEAMLINE ELEMENTS

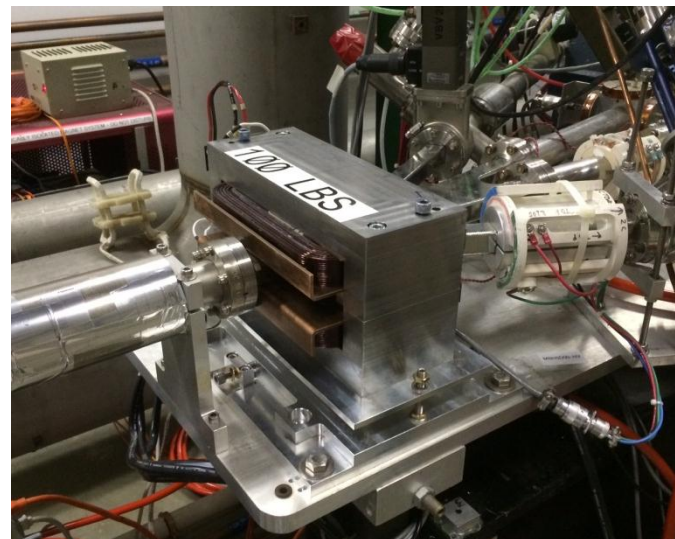
New Beamline elements installed in support of Bubble Chamber experiment:

I. Fast Valve after  $\frac{1}{4}$  Cryounit

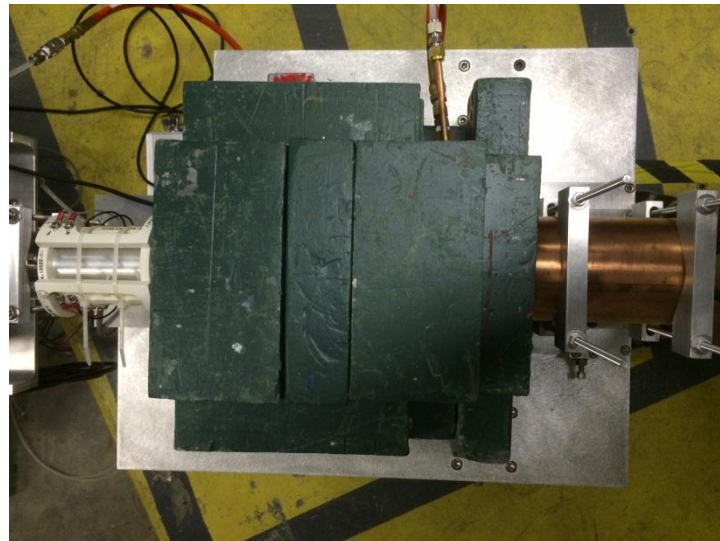
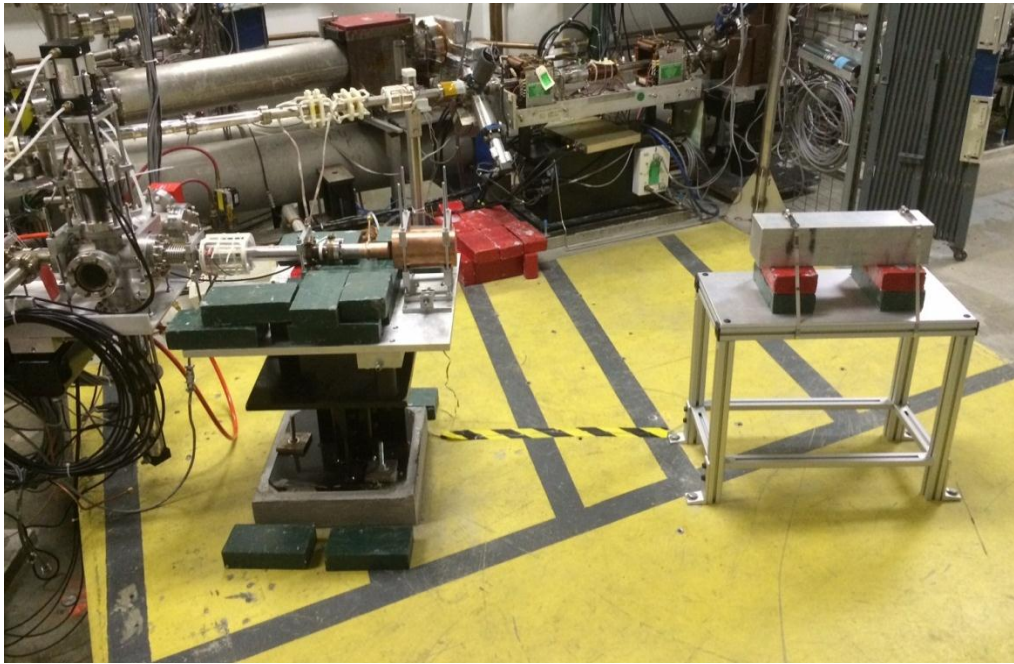
protect from  
vacuum failure in  
front of  $\frac{1}{4}$  Cryo-unit



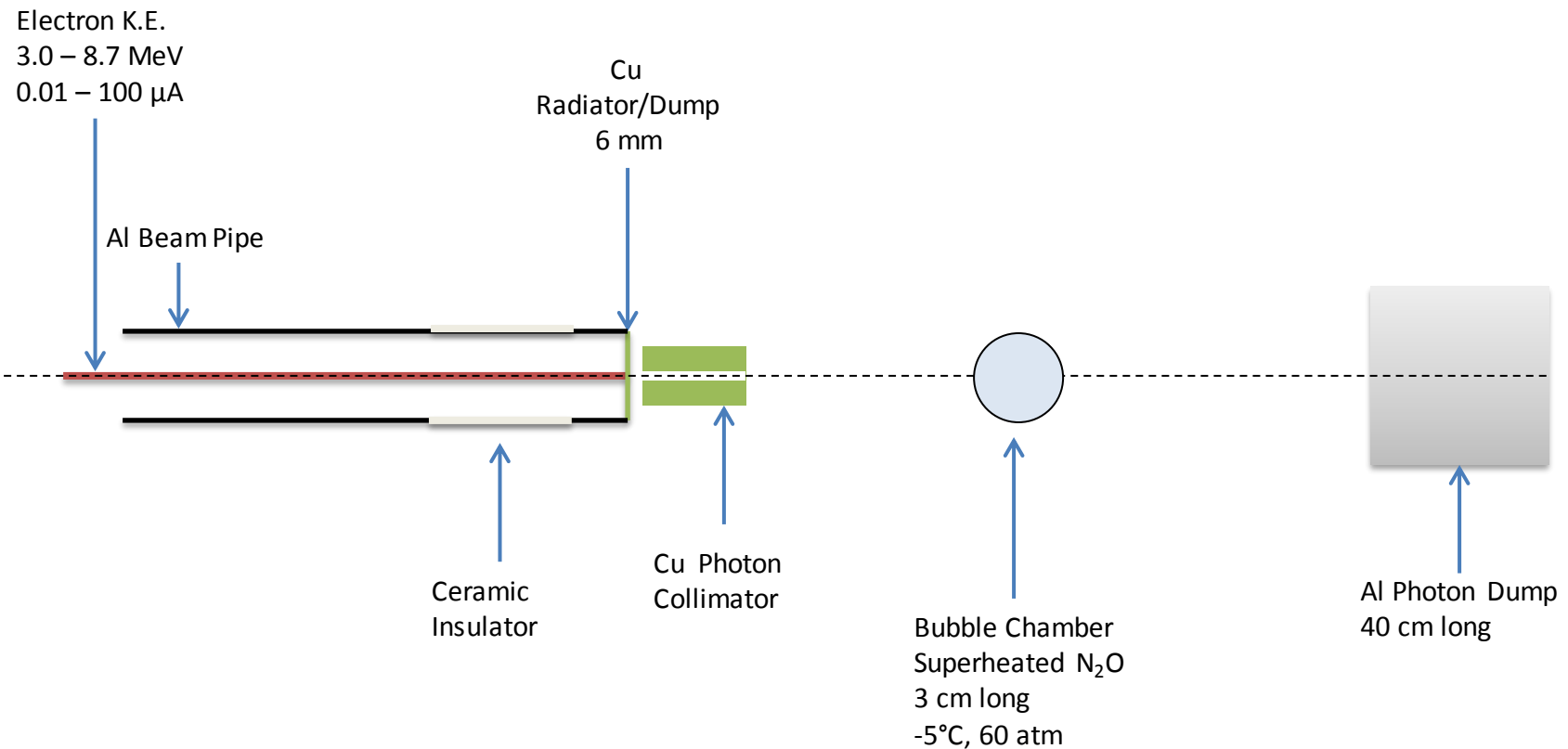
II. New MDL0L02 Dipole Magnet







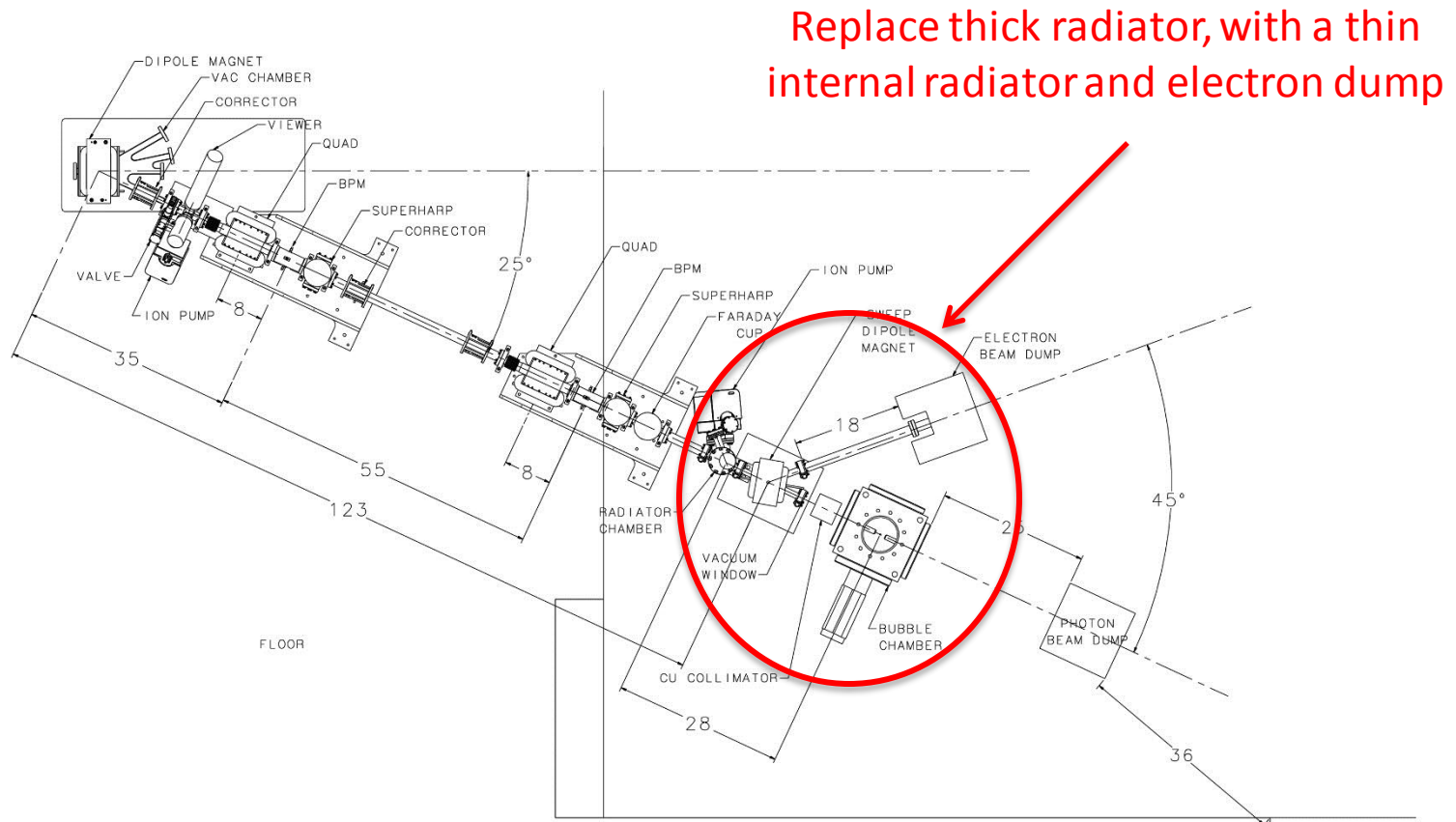
- Use pure Copper and Aluminum
- Radiator/dump isolated and current in EPICS readback



# TEST BEAMLINE COMMISSIONING

- New Test Beamline is ready for Fall 2014 run
- Commissioning plan will be submitted:
  - I. Checklist of machine protection interlocks and controls (no review is required)
  - II. Checkout of beamline with electron beam
- Beam Studies:
  - I. Momentum measurement
  - II. Measure Bremsstrahlung spectra
  - III. Operation at high current
  - IV. Measure beam charge at different currents

# EXPERIMENT BEAMLINE



To be installed early  
Summer 2015

# SCHEDULE

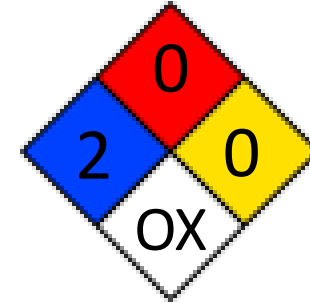
May 3 – September 18, 2014	Summer Shutdown, CHL@4K	Commission Test Beamline
September 19 – December 22, 2014	1.82 GeV/pass	
Fall 2104	Bubble Chamber commissioning at HIGS	
December 23, 2014 – February 5, 2015	Winter Shutdown, CHL@2K	1 <sup>st</sup> Opportunity in January 2015
February 6, 2015 – June 12, 2015	Hall A Physics, Hall D Eng. Run	
June 13, 2015 – September 10, 2015	Summer Shutdown, CHL@2K (?)	2 <sup>nd</sup> Opportunity in Summer 2015

For helium processing of Cryo-modules



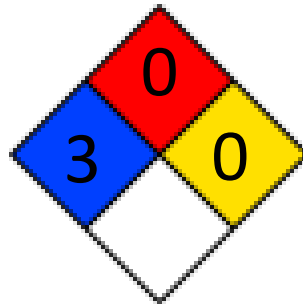
# BUBBLE CHAMBER SAFETY REVIEWS

- Superheated liquid:  $\text{N}_2\text{O}$ , Nitrous oxide (laughing gas)
  - I. At room temperature, it is colorless, non-flammable gas, with slightly sweet odor and taste



- High pressure system:
  - I. Design Authority: Dave Meekins
  - II.  $T = -5^\circ\text{C}$
  - III.  $P = 60\text{ atm}$

- Buffer liquid: Mercury
  - I. Closed system
  - II. Volume: 135 mL  
(less than VA state reportable limit of 168 mL)



All done at  
Argonne. How to  
transfer to JLab?

- Operational Safety Procedures (**OSP**)

# READINESS DOCUMENTS

1. Conduct of Operations (**COO**)
2. Experiment Safety Assessment Document (**ESAD**)
3. Radiation Safety Assessment Document (**RSAD**)
4. Emergency Response Guidelines (**ERG**)

Similar to  
PEPPo