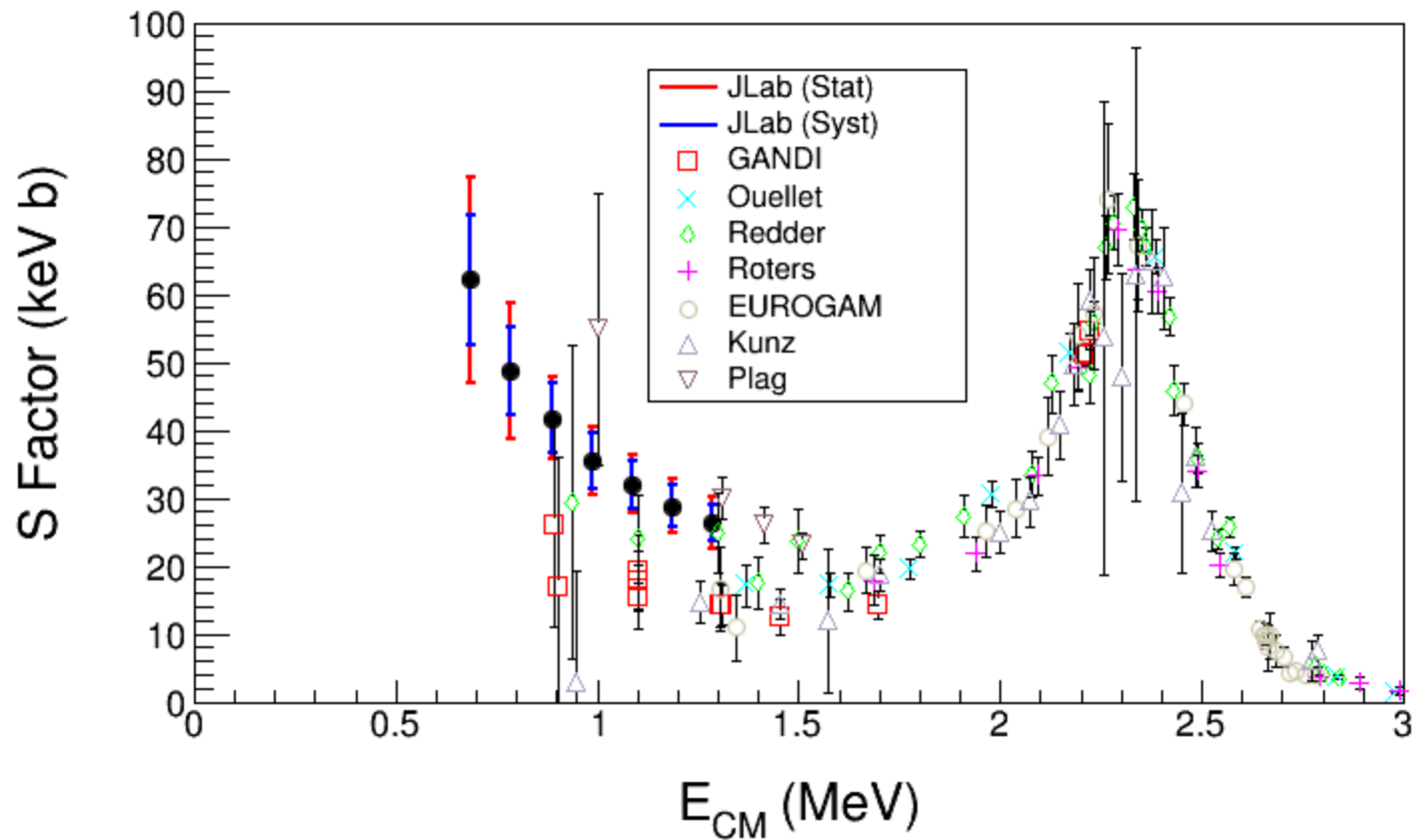


# Bubble Chamber Experimental Readiness Review

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

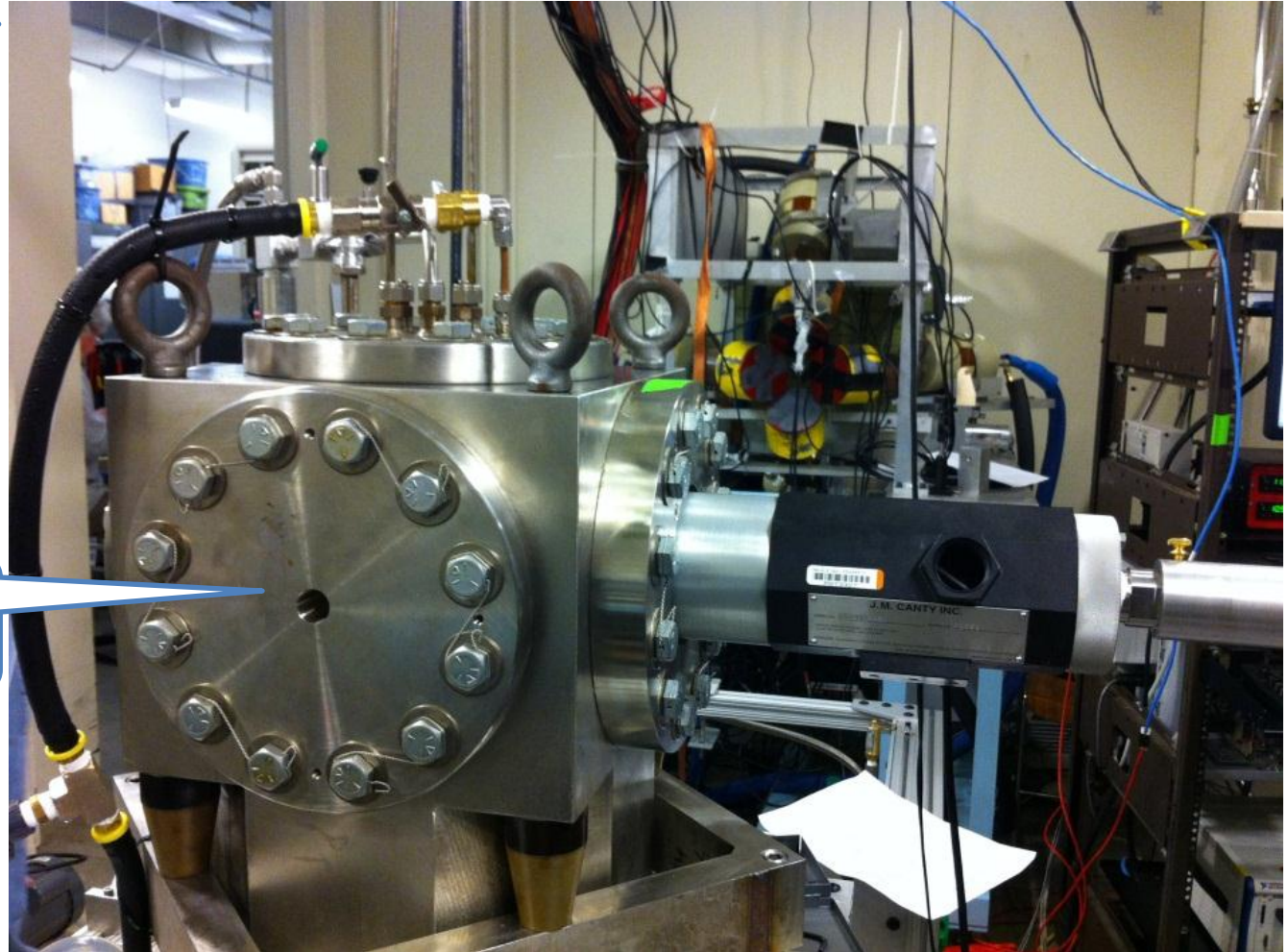
## I. Beam Properties at Radiator:

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



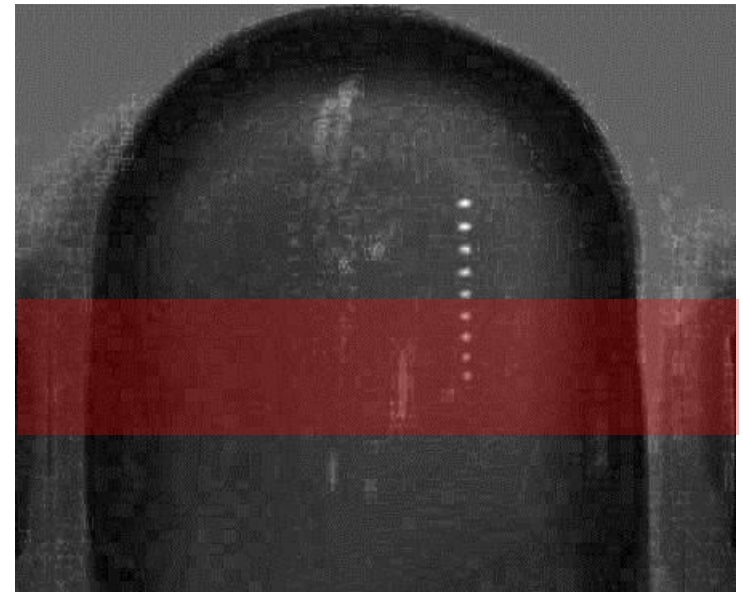
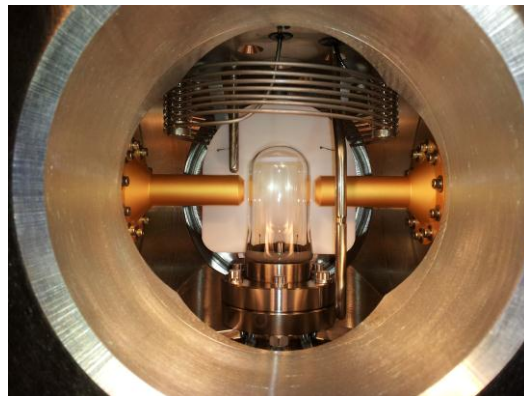
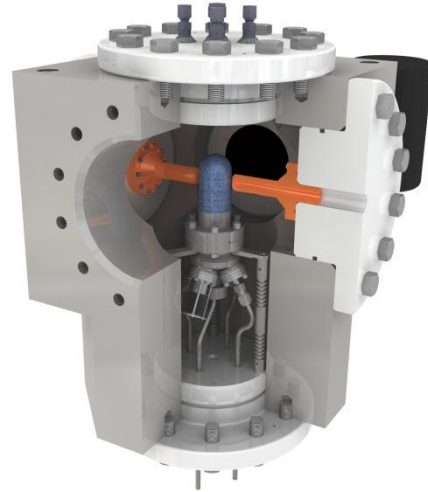
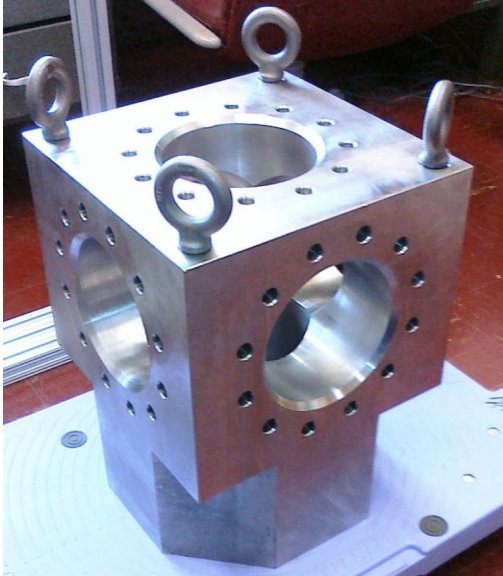
# N<sub>2</sub>O Bubble Chamber

T = -5°C

P = 60 atm

First  $\gamma+O \rightarrow \alpha+C$  bubble

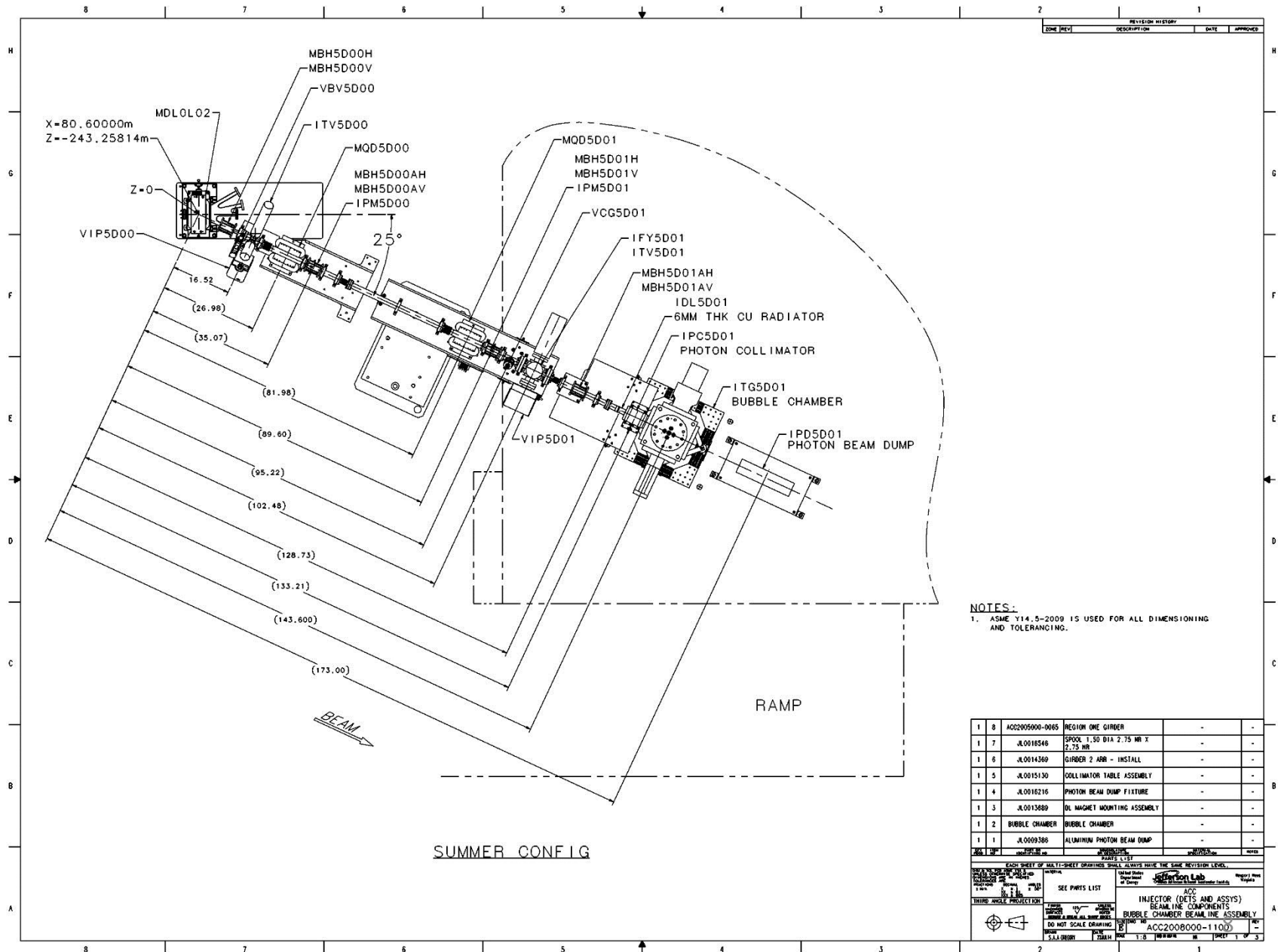
April 2013



# BUBBLE CHAMBER STATUS

- Problem with buffer liquid: water mixes with  $N_2O$
- Changed buffer liquid to mercury
- Problem: nucleation at the interface between mercury and the  $N_2O$
- Tried differentially cooled mercury ( $N_2O$  at meniscus is not superheated) ... No more bubbles at interface
- Finalizing design and ready for testing very soon

# TEST BEAMLINE



**NOTES:**  
 1. ASME Y14.5-2009 IS USED FOR ALL DIMENSIONING AND TOLERANCING.

REV	NO	DESCRIPTION	DATE	APPROVE
1	8	ACC2005000-0065 REGION ONE GIRDER	-	-
1	7	JL0018548 SPOOL 1.50 DIA 2.75 MR X 2.75 MR	-	-
1	6	JL0014360 GIRDER 2 ARR - INSTALL	-	-
1	5	JL0015130 COLLIMATOR TABLE ASSEMBLY	-	-
1	4	JL0018216 PHOTON BEAM DUMP FIXTURE	-	-
1	3	JL0015889 DL MAGNET MOUNTING ASSEMBLY	-	-
1	2	BUBBLE CHAMBER	-	-
1	1	JL0009386 ALUMINUM PHOTON BEAM DUMP	-	-

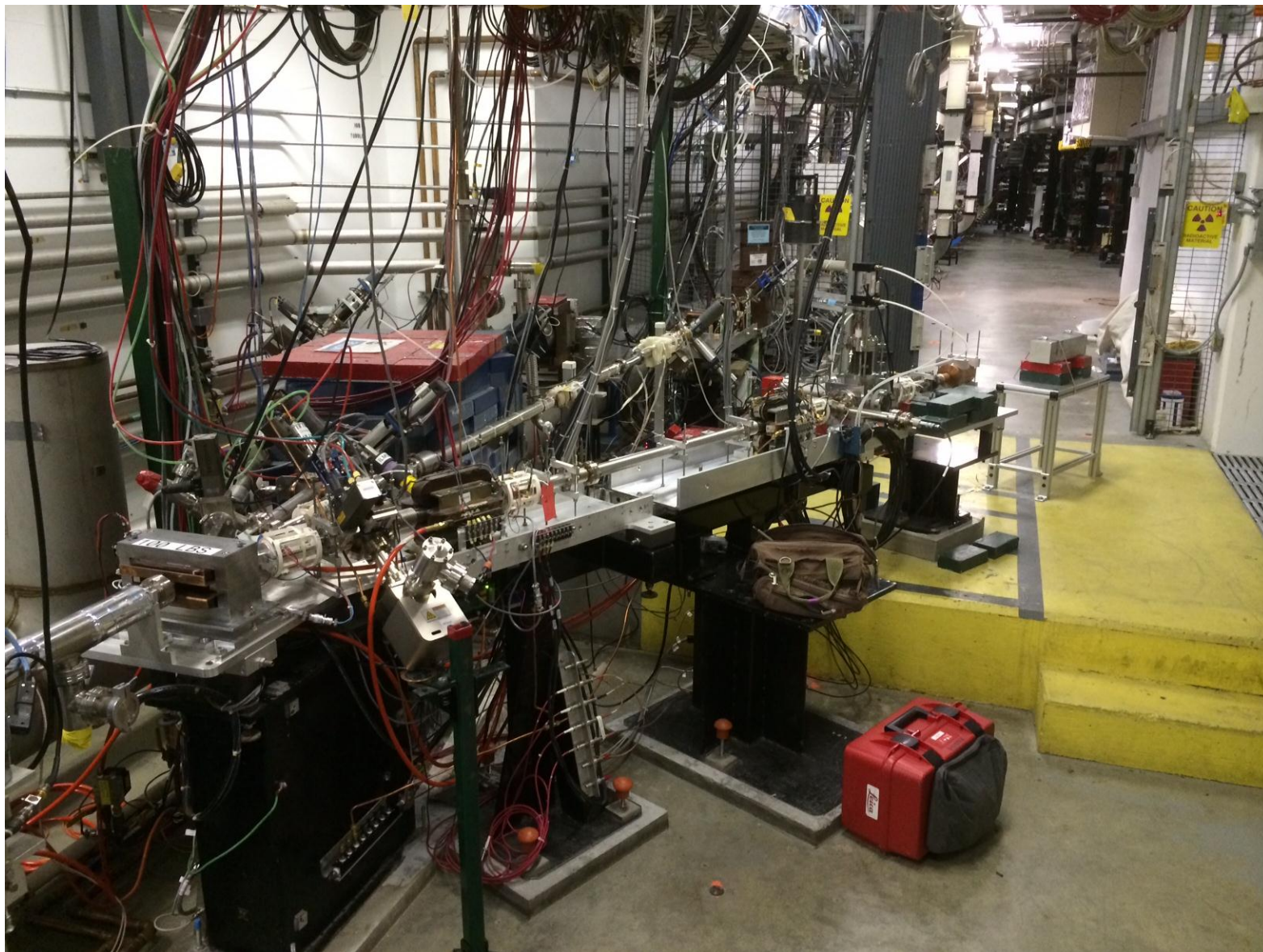
  

REV	NO	DESCRIPTION	DATE	APPROVE
1	1	ACC2008000-1100	-	-

REV	NO	DESCRIPTION	DATE	APPROVE
1	1	ACC2008000-1100	-	-



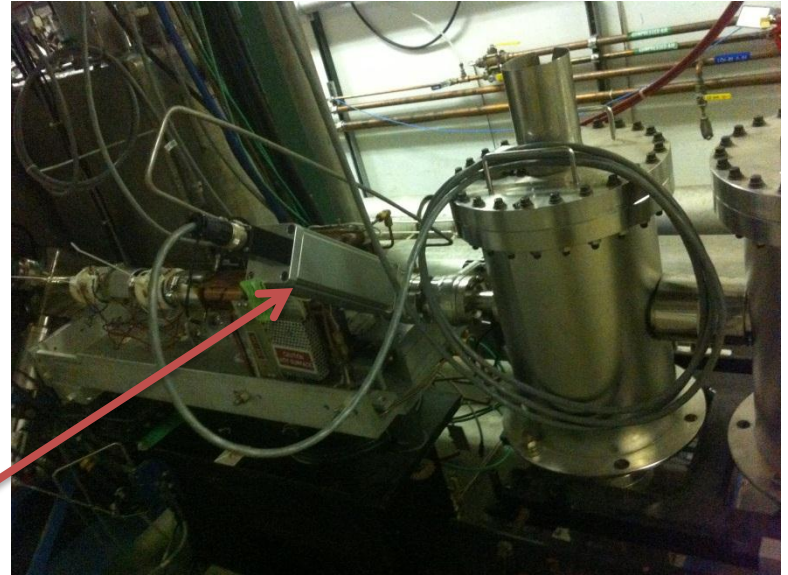


# NEW BEAMLINE ELEMENTS

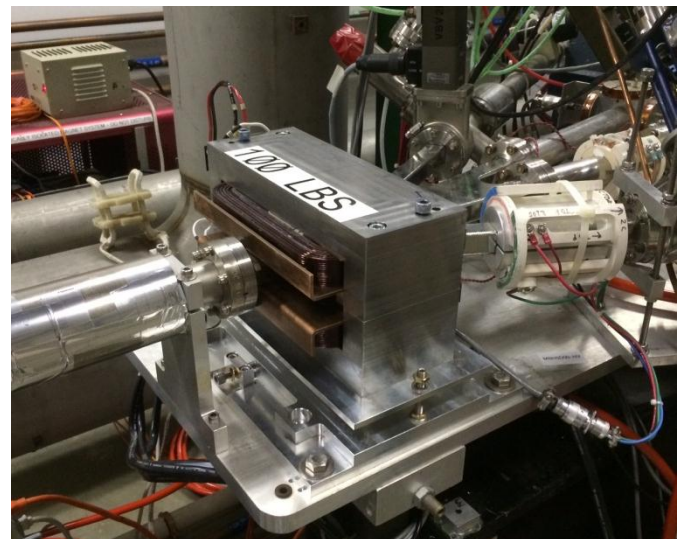
New Beamline elements installed in support of Bubble Chamber experiment:

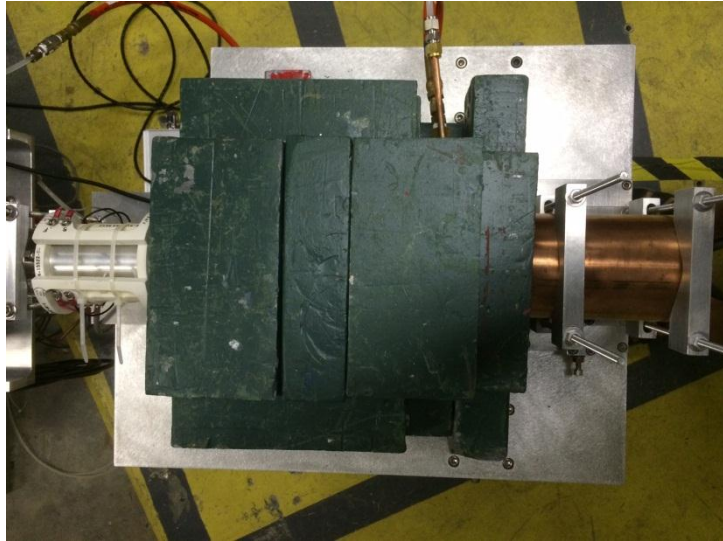
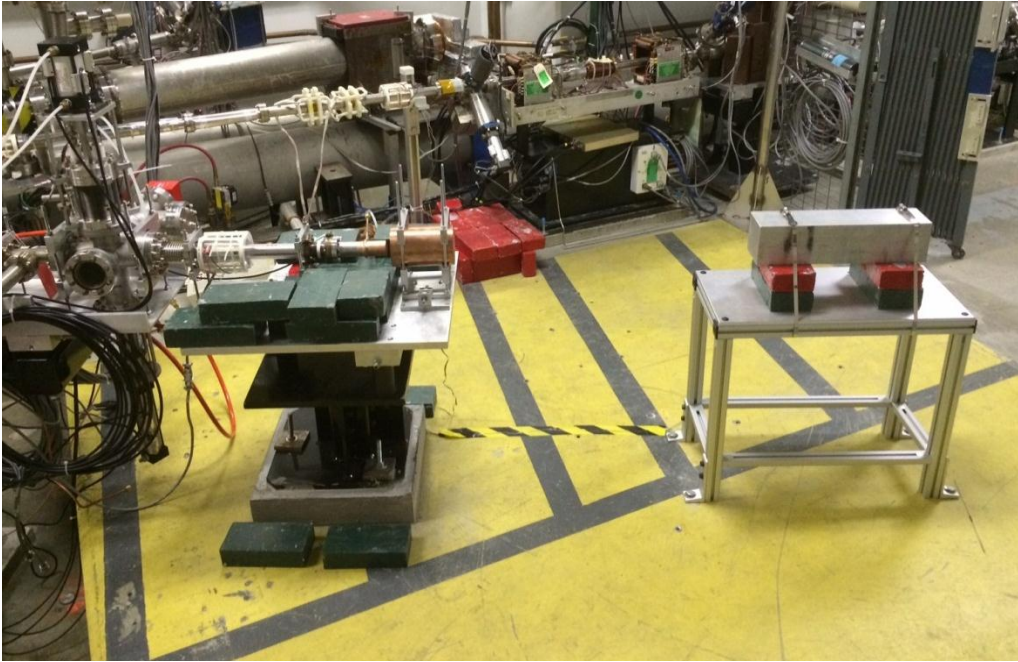
I. Fast Valve after  $\frac{1}{4}$  Cryounit

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

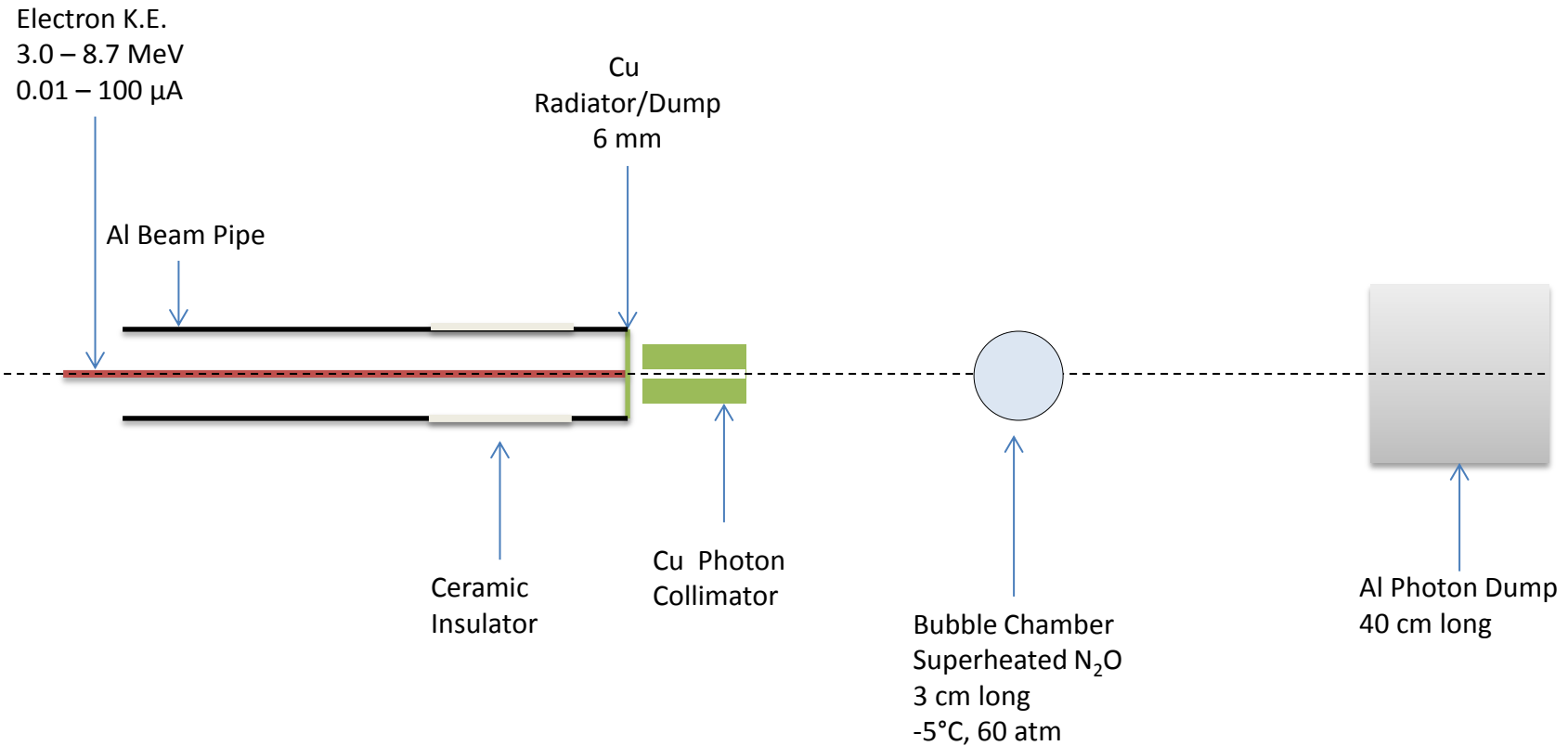


II. New MDL0L02 Dipole Magnet





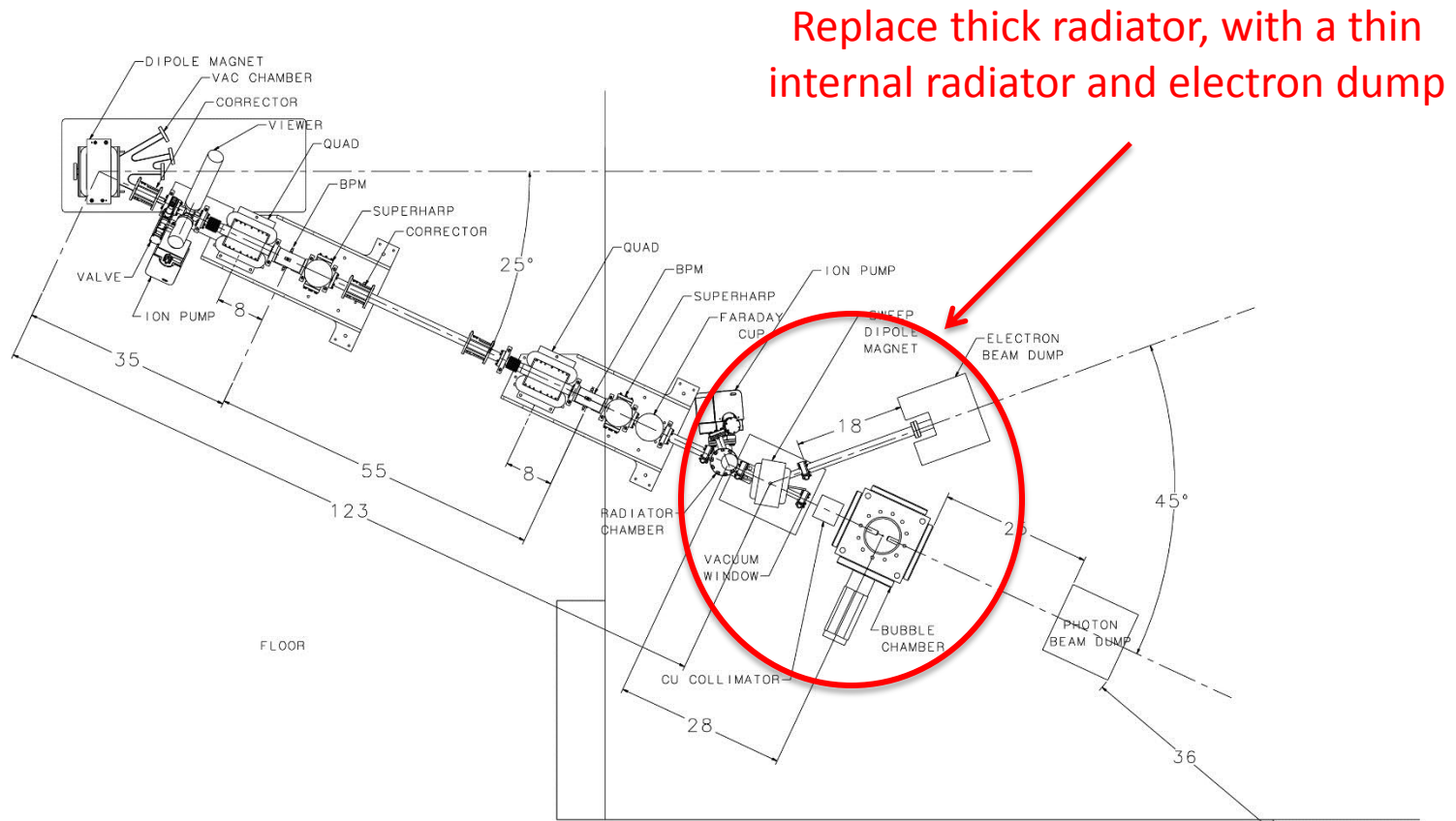
- Use pure Copper and Aluminum
- Radiator/dump isolated and current in EPICS readback



# 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
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
February 6, 2015 – June 12, 2015	Hall A Physics, Hall D Eng. Run
June 13, 2015 – September 10, 2015	Summer Shutdown, CHL@2K (?)

Commission Test Beamline

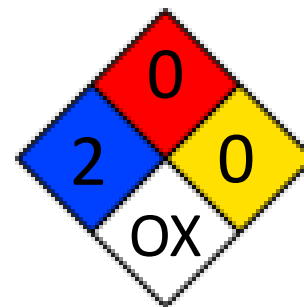
1<sup>st</sup> Opportunity in January 2015

2<sup>nd</sup> Opportunity in Summer 2015

For helium processing of Cryo-modules

# BUBBLE CHAMBER SAFETY REVIEWS

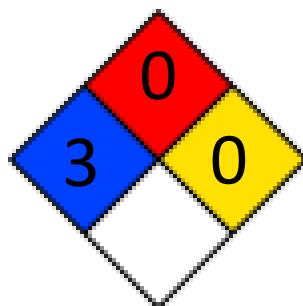
- Superheated liquid:  $N_2O$ , Nitrous oxide (laughing gas)
  - I. At room temperature, it is colorless, non-flammable gas, with slightly sweet odor and taste



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



# READINESS DOCUMENTS

1. Conduct of Operations (**COO**)
2. Experiment Safety Assessment Document (**ESAD**)
3. Radiation Safety Assessment Document (**RSAD**)
4. Operational Safety Procedures (**OSP**)

Similar to  
PEPPo