Bubble Chamber Planning Meeting

24 July 2013

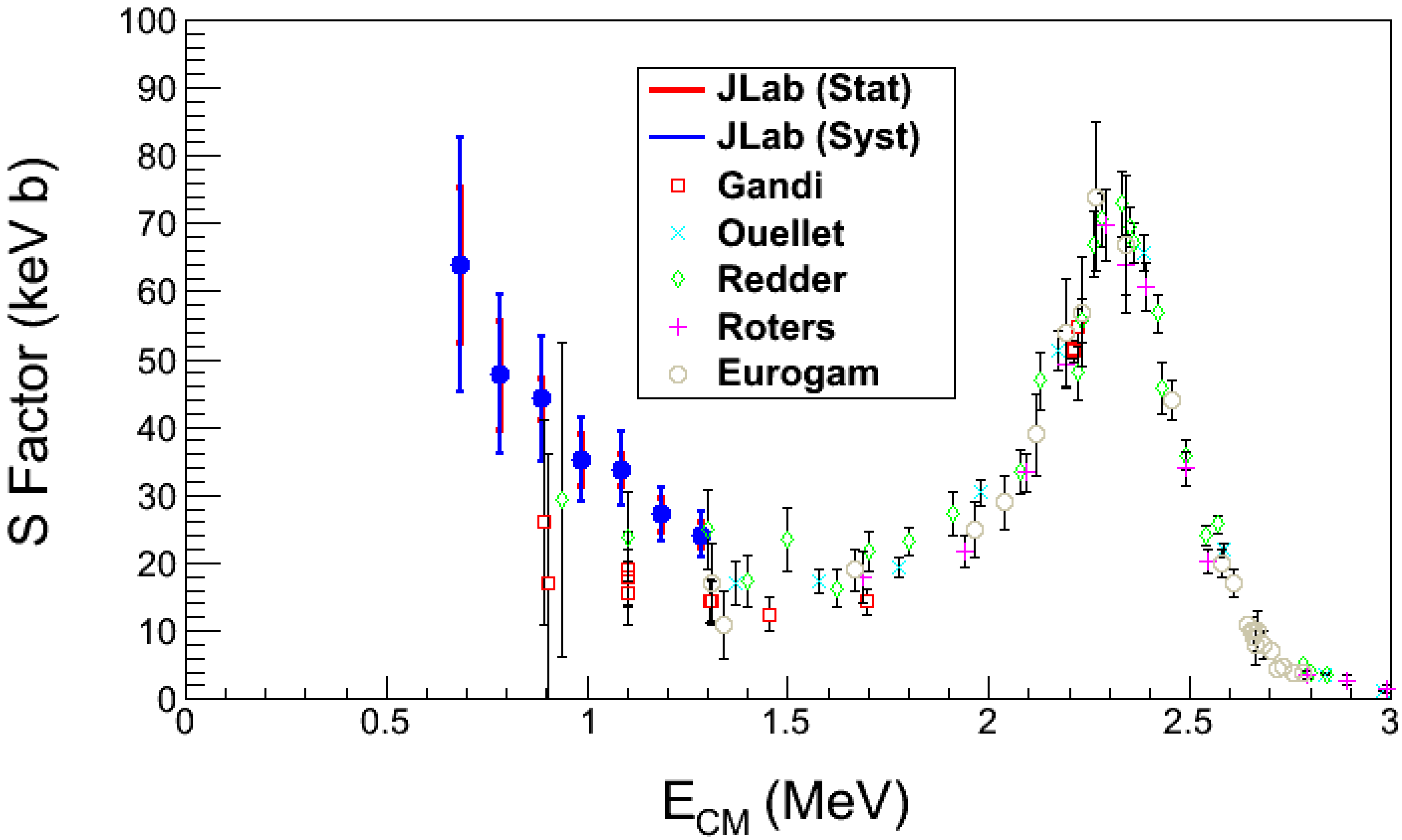
Agenda

1. Schedule
2. Design of beamline, radiator and dump
3. Bubble Chamber work at Argonne
4. Simulation and Background
5. Absolute beam energy
6. Safety

$^{12}C(\alpha, \gamma)^{16}O$ S-Factor

- Statistical Error: dominated by background subtraction from $^{18}O(\gamma,\alpha)^{14}C$ (depletion = 5,000)

- Systematic Error: dominated by absolute beam energy (= 0.2%)



Schedule

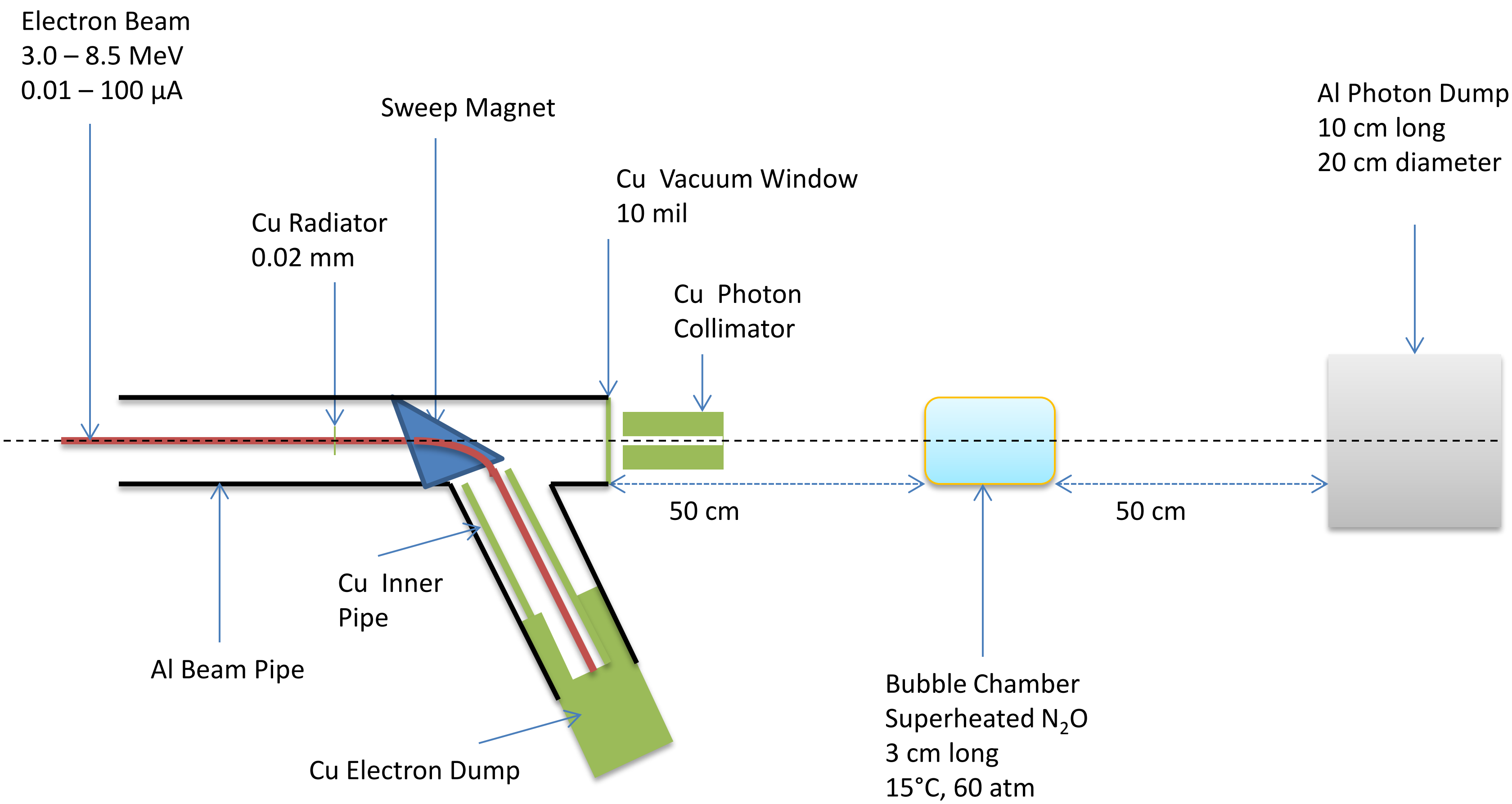
- 12GeV CEBAF Commissioning:

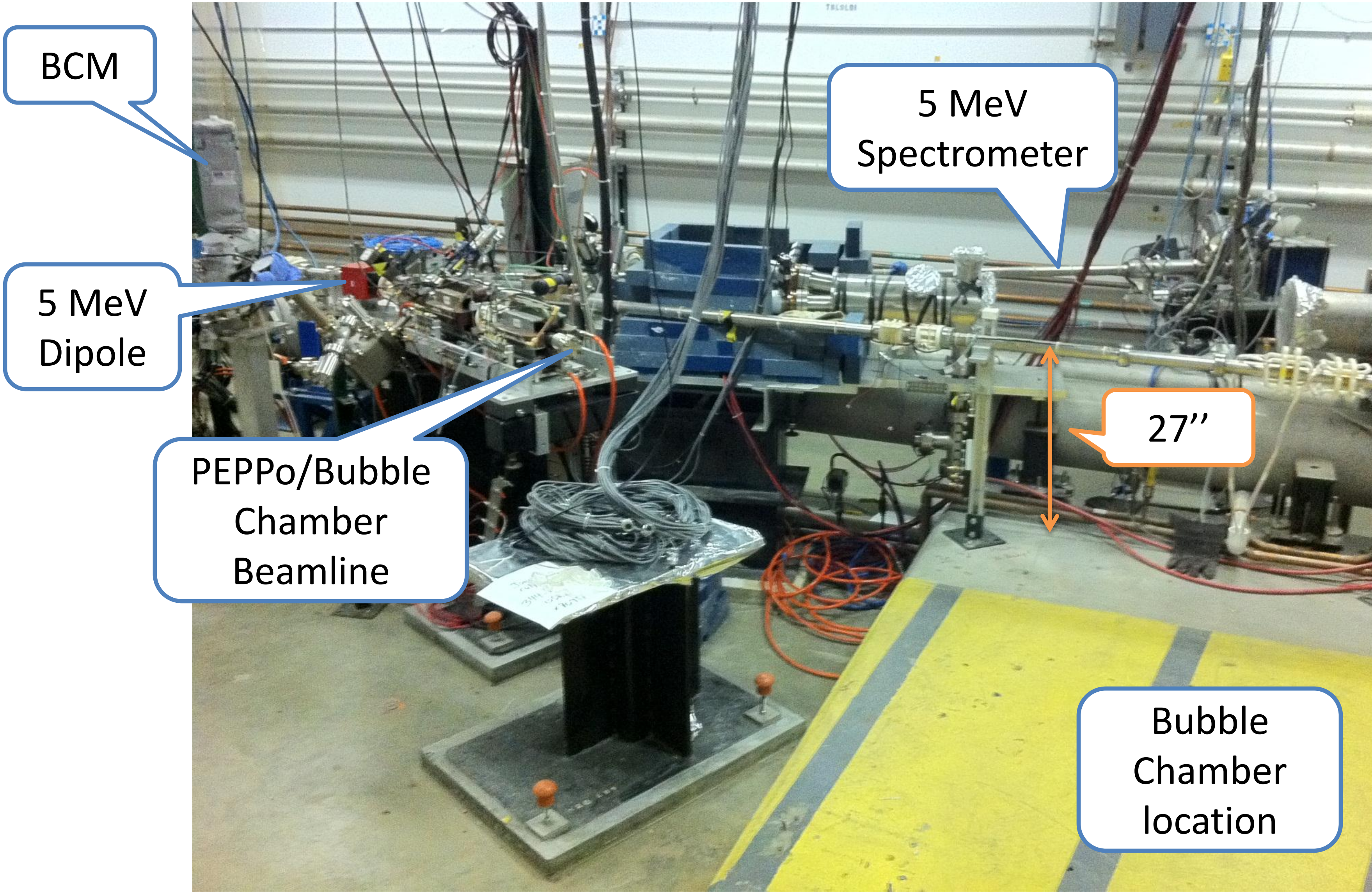
	Start	End
Period I	2013-11-04	2013-12-20
SAD I	2014-01-02	2014-02-05
Period II	2014-02-05	2014-05-07
SAD II	2014-05-07	2014-09-22
Period III	2014-09-22	2014-12-19
SAD III	2015-01-02	2015-02-13
Period IV	2015-02-13	2015-06-12

- Bubble Chamber Activities:
  - Install beamline, radiator and dump
  - Commission beamline, radiator dump
  - Install Bubble Chamber
  - Commission Bubble Chamber
  - Physics run

Design of beamline, Radiator & Dump

- Add BPM to the 5 MeV Spectrometer line
- Need to design new longer beamline to replace PEPPo beamline and increase the distance between the two BPMs
- Radiator: 0.02 mm and 0.1 mm Copper
- Electron Dump: 2kW dump (10 MeV, 200 µA)
- Photon Dump


Electron Beam
3.0 – 8.5 MeV
0.01 – 100 µA
Sweep Magnet
Cu Vacuum Window
10 mil
Al Photon Dump
10 cm long
20 cm diameter
Cu Radiator
0.02 mm
Cu Photon
Collimator
50 cm
50 cm
Cu Inner
Pipe
Al Beam Pipe
Bubble Chamber
Superheated N2O
3 cm long
15°C, 60 atm
Cu Electron Dump


BCM
5 MeV Spectrometer
5 MeV Dipole
PEPPo/Bubble Chamber Beamline
27''
Bubble Chamber location

Simulation

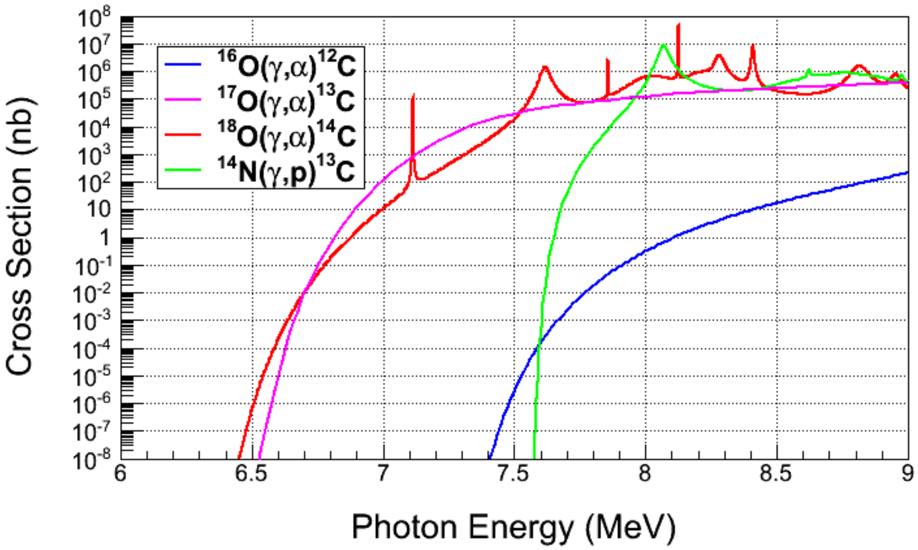
- Two programs:
  I. **GEANT4**
  II. **FLUKA**

- Both use models that calculate wrong cross sections. Both do not allow for user's cross sections. Suggestion:
  I. Use GEANT4 and FLUKA to produce the photon spectrum impinging on the super heated liquid.
  II. Fold the above photon spectrum with our cross sections in stand-alone codes.

- Both GEANT4 and FLUKA are good in neutron tracking. Still need to check the cross sections.

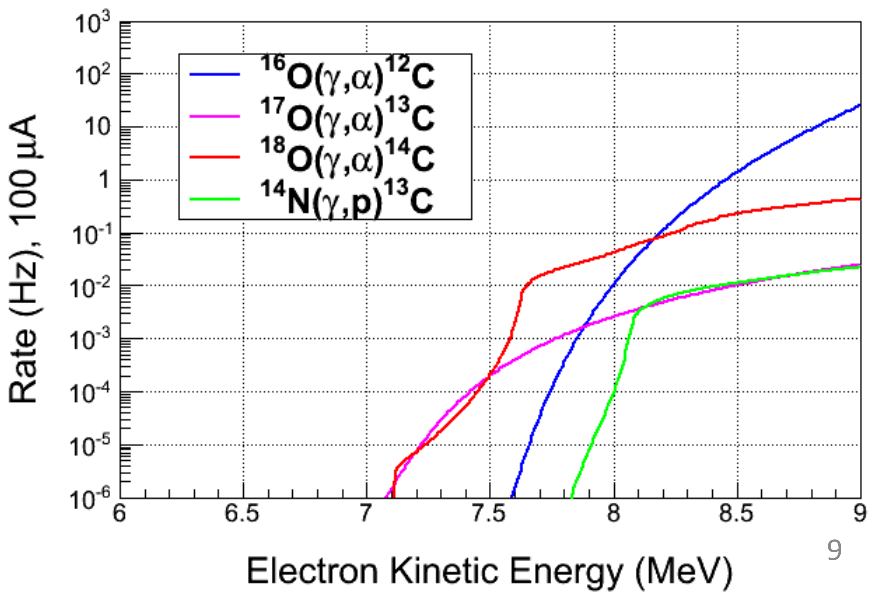
Background

- Must measure:
  I. $^{17}O(\gamma,\alpha)^{13}C$
  II. $^{18}O(\gamma,\alpha)^{14}C$



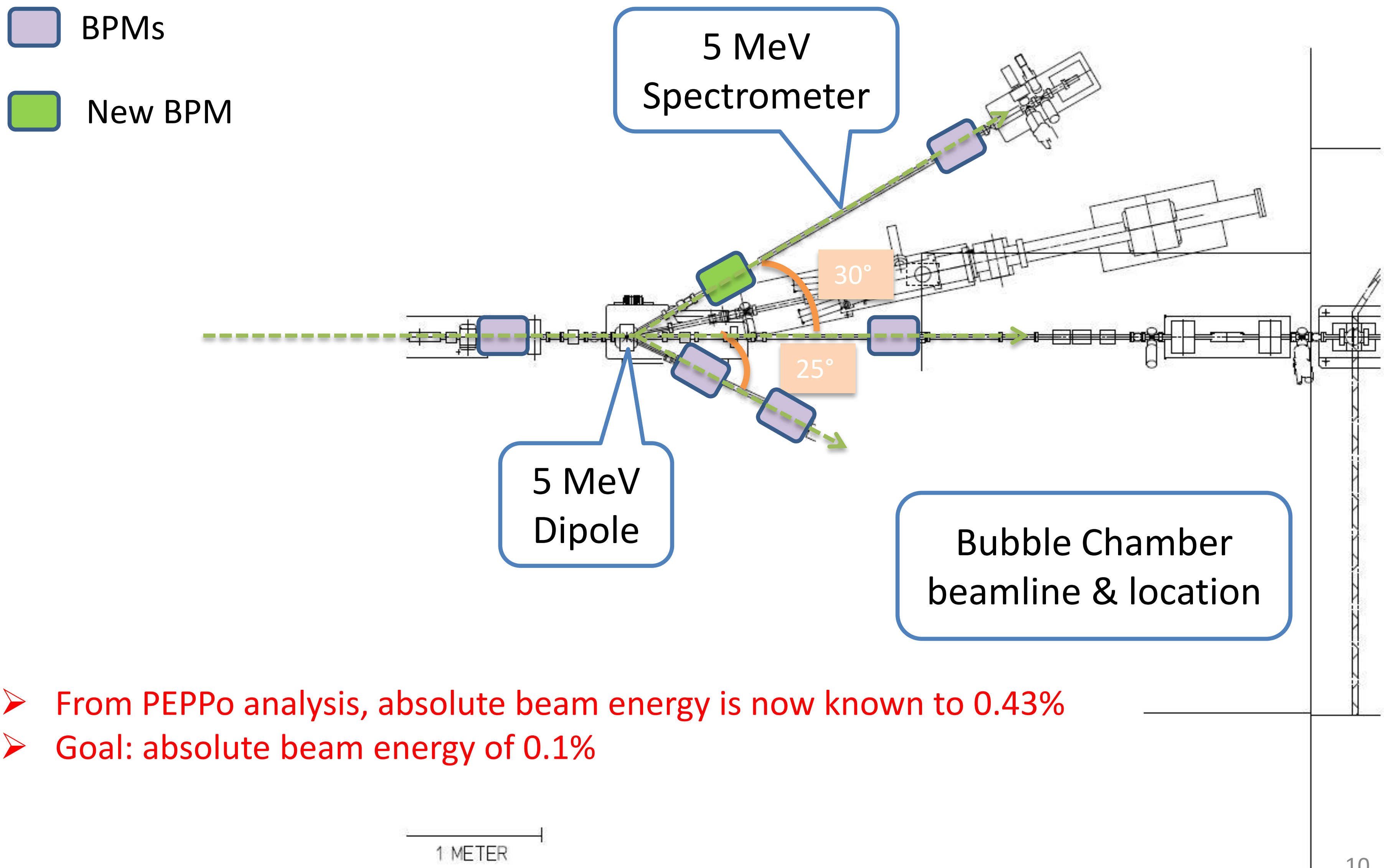
- Rates:
  I. $^{17}O(\gamma,\alpha)^{13}C$, depletion=5,000
  II. $^{18}O(\gamma,\alpha)^{14}C$, depletion=5,000
  III. $^{14}N(\gamma,p)^{13}C$,

  detection efficiency= 10^{-8}



- Still need to study $^{17}O(\gamma,n)^{16}O$, …

Absolute Beam Energy



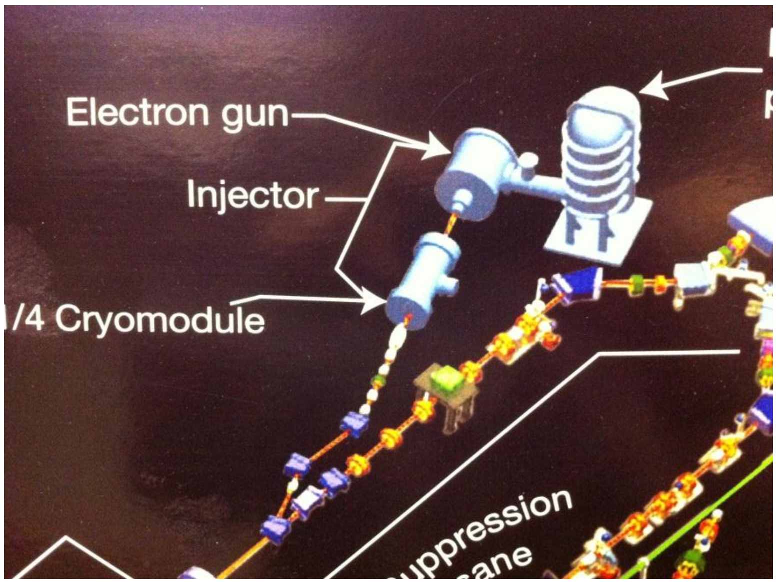
- From PEPPo analysis, absolute beam energy is now known to 0.43%
- Goal: absolute beam energy of 0.1%

Safety

- High pressure system
- Super heated liquid: N_2O or CO_2
- Buffer liquid: Mercury

Running in FEL?

- Absolute Beam Energy: FEL can measure the energy with a precision of 0.4%. However, it could be very hard to improve(?)



- Required Systems:
  I. Personnel Safety System (PSS)
  II. Liquid helium and RF
  III. Gun Laser
  IV. Staff