Bubble Chamber Planning Meeting

07 August 2013

Agenda

1. Bubble Chamber progress at Argonne
2. Bubble Chamber cost estimate: procurement and labor
3. Running at FEL pros and cons
4. Background from $^{17}O(\gamma,n)^{16}O$ and subsequent neutron elastic scattering with ^{16}O and ^{14}N nuclei
5. Background from $^{13}C(\gamma,n)^{12}C$ (in case we decide to use CO_2 instead of N_2O)

Cost Estimate

Item	Material Procurement	Shop	Labor
New BPM on Spectrometer line		Pipe + BPM ($5,000)	P. Francis (1 week)
New Dipole Magnet	Dipole Magnet ($10,000)		Mapping (1 week) + Alignment (2 weeks)
New Power Supply	Power Supply ($5,000)		Software (2 days)
New Beamline		Pipes + Pedestals ($20,000)	Design (6 weeks) Alignment (2 weeks)
Radiator	0.02 and 0.10 mm Cu foils ($1,000)		Design (1 week)
Sweep Dipole			Mapping (2 days)
Electron Dump	Pure Cu ($5,000)	Dump + Pipes ($10,000)	Design (2 week)
Cu Collimator	Pure Cu ($3,000)	Collimator + Stand ($5,000)	
Photon Dump	Pure Al ($1,000)		Design (2 days)
Safety Review			Engineering + EH&Q ($10,000)
Total	$25,000	$40,000	$55,000

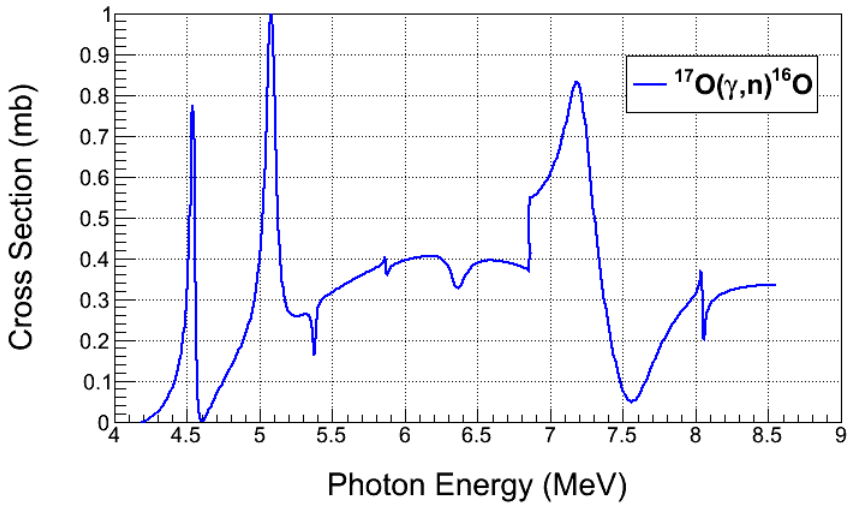
Running in FEL? Cons and Pros

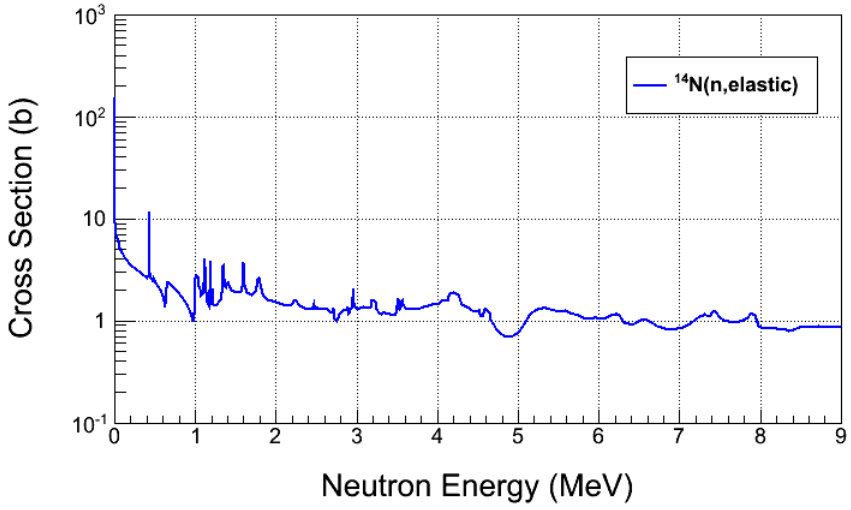
Pros	Cons
No other users	
9.5 MeV (with FE)	
	Completely new beamline

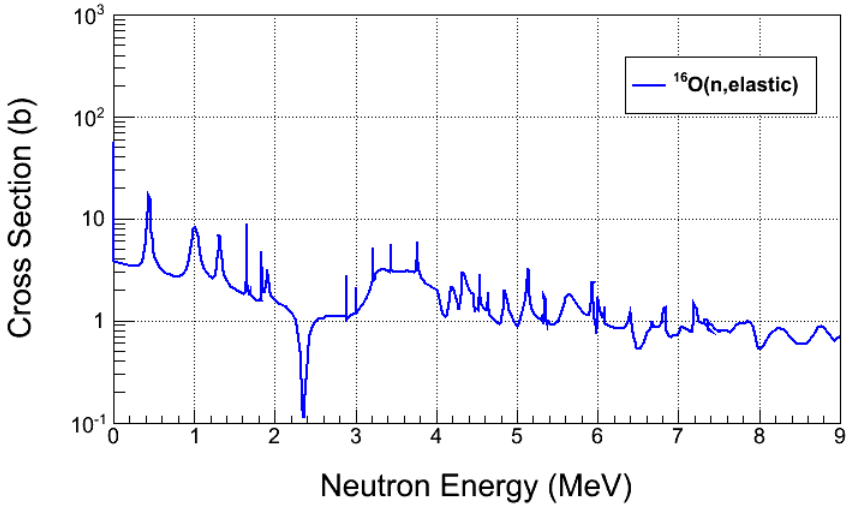
Electron Beam Properties

Beam Energy, E (MeV)	3.0 – 8.5
Beam Current (μA)	0.01–200
Absolute Beam Energy	0.67%
Relative Beam Energy	0.1%
Energy Resolution (Spread), σ_E /E	0.06%
Beam Size, $\sigma_{x,y}$ (mm)	1 – 2

$^{17}O(\gamma,n)^{16}O$ Background

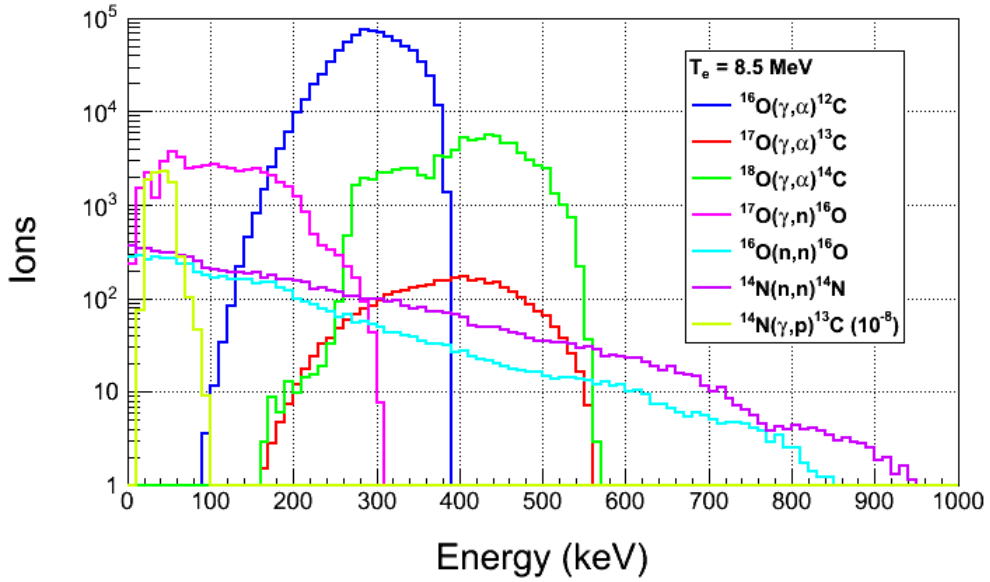


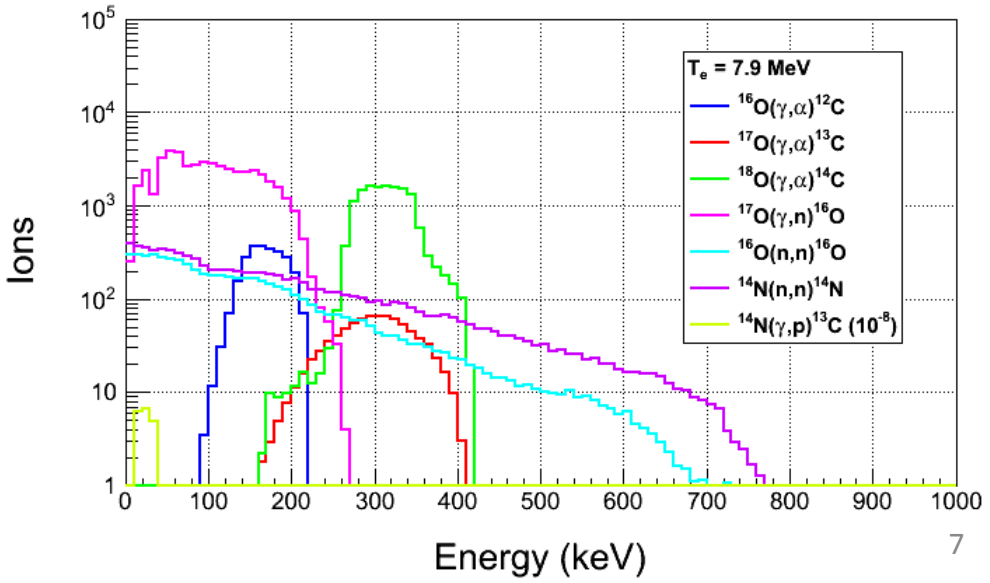


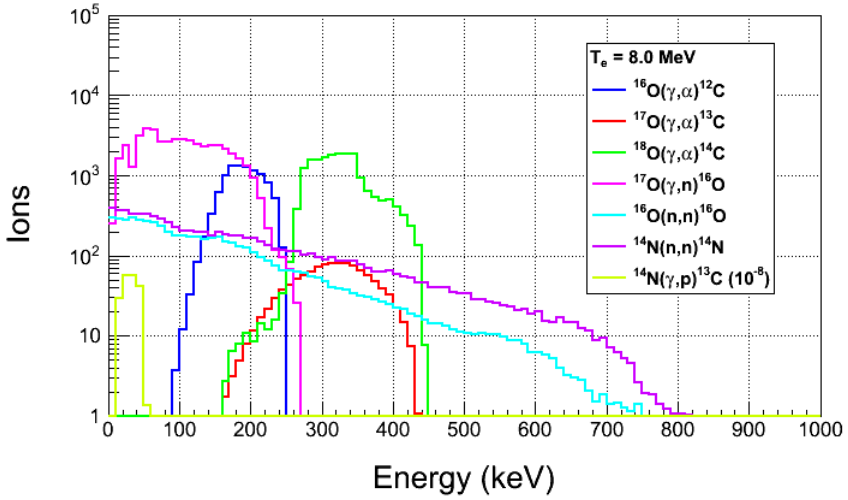


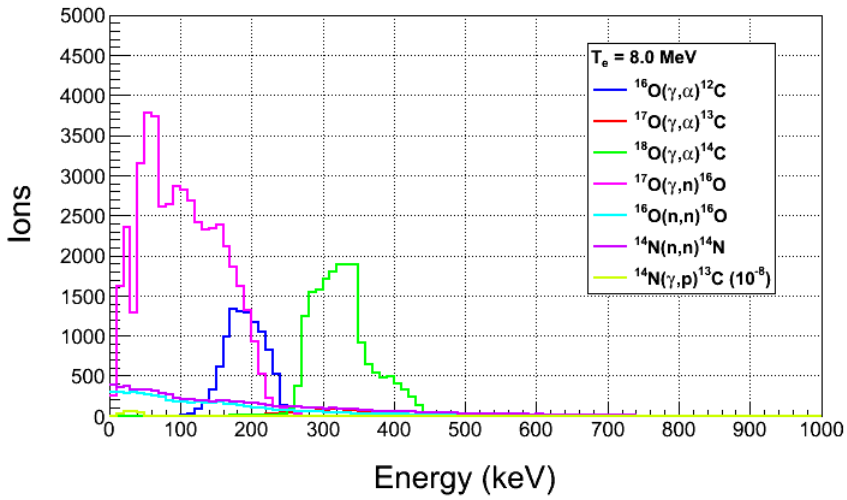
Ion Energy Distribution

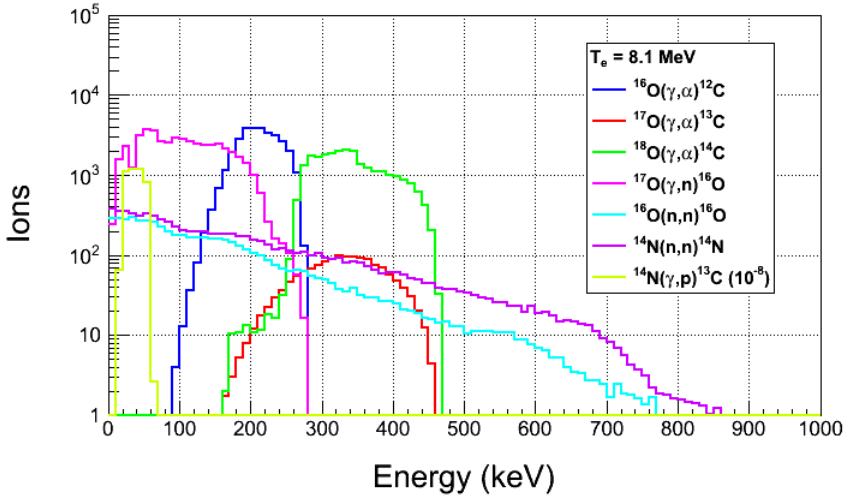
- Depletion:
  - I. ^{17}O depletion=5,000
  - II. ^{18}O depletion=5,000
- Natural Abundance:
  - I. ^{17}O: 0.038%
  - II. ^{18}O: 0.205%

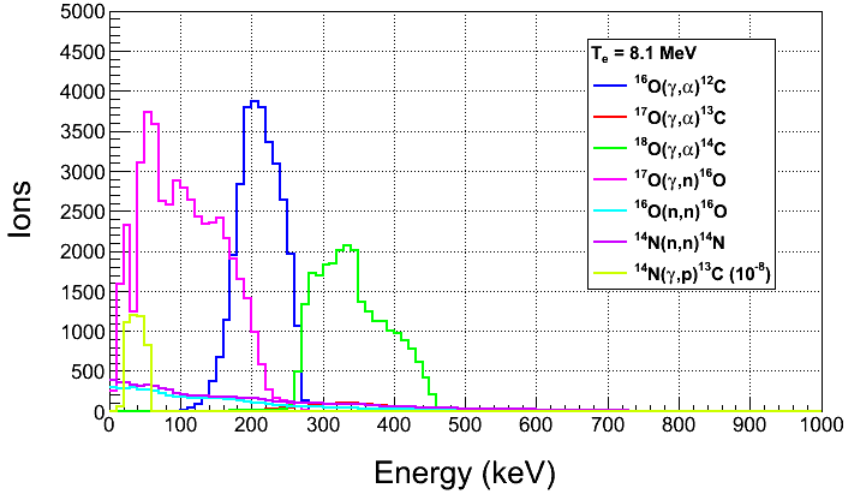





Ions
Energy (keV)
T_e = 8.0 MeV
$^{16}O(\gamma,\alpha)^{12}C$
$^{17}O(\gamma,\alpha)^{13}C$
$^{18}O(\gamma,\alpha)^{14}C$
$^{17}O(\gamma,n)^{16}O$
$^{16}O(n,n)^{16}O$
$^{14}N(n,n)^{14}N$
$^{14}N(\gamma,p)^{13}C$ (10^{-8})

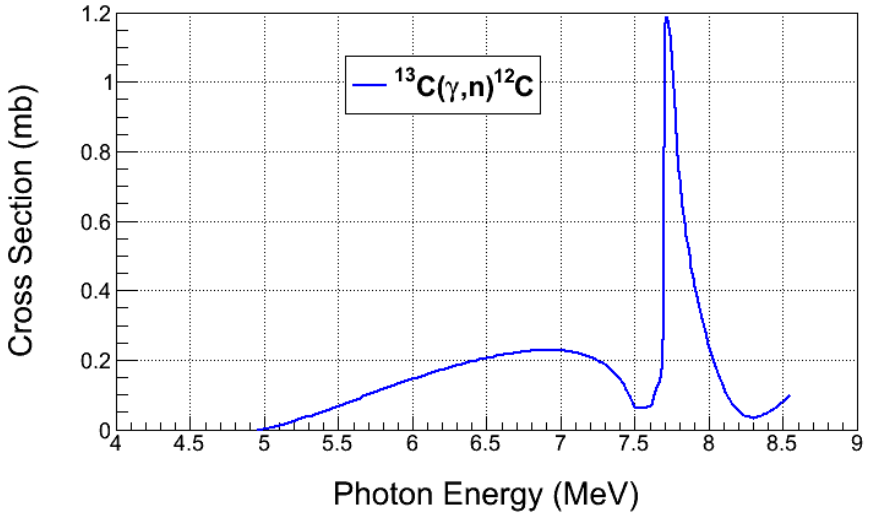

Ions
Energy (keV)
T_e = 8.0 MeV
$^{16}O(\gamma,\alpha)^{12}C$
$^{17}O(\gamma,\alpha)^{13}C$
$^{18}O(\gamma,\alpha)^{14}C$
$^{17}O(\gamma,n)^{16}O$
$^{16}O(n,n)^{16}O$
$^{14}N(n,n)^{14}N$
$^{14}N(\gamma,p)^{13}C$ (10^{-8})


Ions
Energy (keV)
T_e = 8.1 MeV
$^{16}O(\gamma,\alpha)^{12}C$
$^{17}O(\gamma,\alpha)^{13}C$
$^{18}O(\gamma,\alpha)^{14}C$
$^{17}O(\gamma,n)^{16}O$
$^{16}O(n,n)^{16}O$
$^{14}N(n,n)^{14}N$
$^{14}N(\gamma,p)^{13}C$ (10^{-8})


Ions
Energy (keV)
T_e = 8.1 MeV
$^{16}O(\gamma,\alpha)^{12}C$
$^{17}O(\gamma,\alpha)^{13}C$
$^{18}O(\gamma,\alpha)^{14}C$
$^{17}O(\gamma,n)^{16}O$
$^{16}O(n,n)^{16}O$
$^{14}N(n,n)^{14}N$
$^{14}N(\gamma,p)^{13}C$ (10^{-8})

$^{13}C(\gamma,n)^{12}C$ Background

- Depletion:
  I. ^{13}C depletion=1,000
- Natural Abundance:
  I. ^{13}C: 1.07%



For comparison, $^{17}O(\gamma,n)^{16}O$