

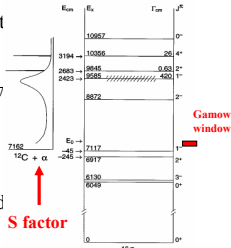
Measurement of ^{16}N β Delayed- α Spectrum with a new technique

X. D. Tang¹, M. Notani^{1,*}, K. E. Rehm¹, I. Ahmad¹, C. Brune², A. Champagne³, J. Greene¹, A. A. Hecht¹, D. Henderson¹, R. V. F. Janssens¹, C. L. Jiang¹, L. Jisonna⁴, E. F. Moore¹, R. C. Pardo¹, M. Paul⁵, G. Savard¹, J. P. Schiffer¹, R. E. Segel⁴, S. Sinha¹ and A. Wuosmaa⁶

¹ Argonne National Laboratory, ² Ohio University, ³ University of North Carolina, ⁴ Northwestern University, ⁵ Hebrew University, ⁶ Western Michigan University, *Supp. by JINA

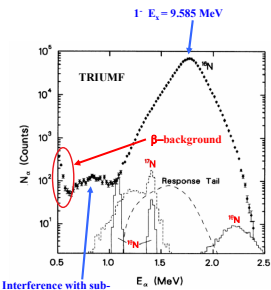
Motivation

- The $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ reaction has significant effects on $^{12}\text{C}/^{16}\text{O}$ ratio produced by helium burning, subsequent nucleosynthesis and supernova explosion
- Cross section required for energies of about 0.3 MeV ($\sigma \sim 10^{-17}$)
 - Direct measurement possible only for $E_{c.m.} \geq 0.9$ MeV
 - Extrapolation to the lower energies using R- or K-matrix theories, but complicated by two sub-threshold states, $J_p=1-$ and $2+$.



"...the determination of the ratio $^{12}\text{C}/^{16}\text{O}$ produced in helium burning is a problem of paramount importance in Nuclear Astrophysics."
W. Fowler
Nobel Lecture 1983

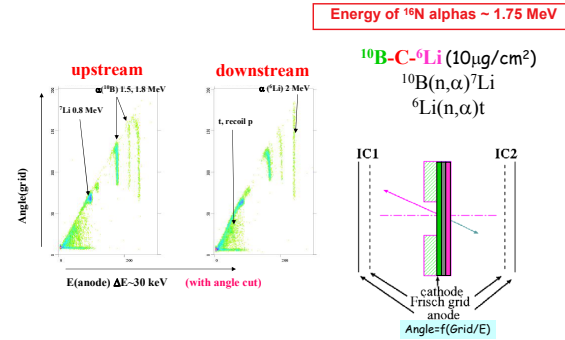
Previous Measurements of the β -delayed α decay of ^{16}N



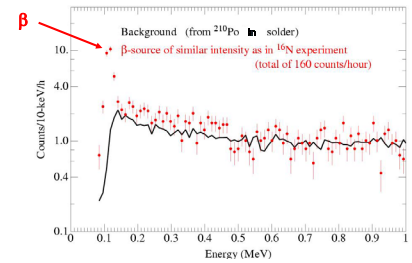
Mainz (1969-1974) Si 35 μm
 Yale (1993-1997) Si 50 μm
 Seattle (1994-1995) Si ? μm
 TRIUMF (1993-1997) Si 11-16 μm
Goal of our experiments: reduce low-energy background

Gas Detector selected
 Thickness (P10 gas, 50mm, 150 Torr) - Si 5.1 μm

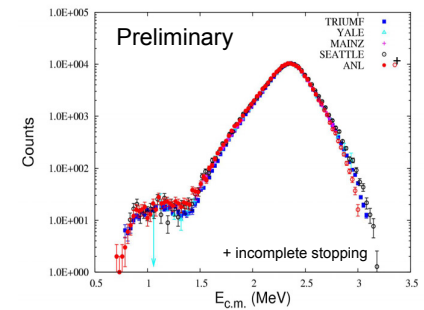
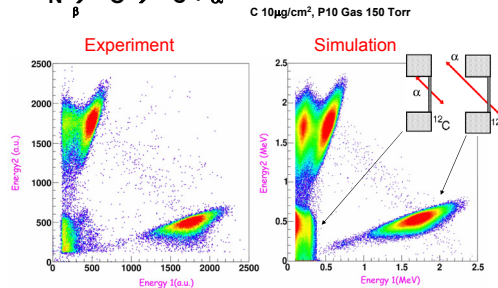
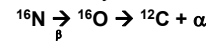
Energy Calibration with a mixed ^{10}B - ^6Li source



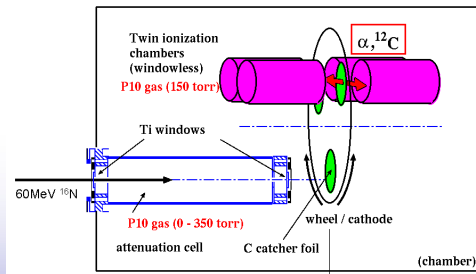
Beta Background Test



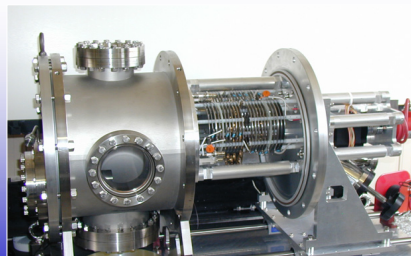
Preliminary Results



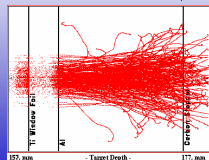
Experimental Setup for Study of the β -delayed α decay of ^{16}N



- Choose exact thickness as needed limiting the pulse height from β 's to a minimum
- No contamination from $^{17,18}\text{N}$
- Thin catcher foil ($10 \mu\text{g}/\text{cm}^2$)
- Possibility for angle measurement



Simulation with Monte Carlo Code
 P(P10 gas) = 149 Torr
 Eff_{calc} = 3.7%
 Eff_{exp} = 5.5%



Present Status

- Preliminary result $S(E1) = 80$ keV b, systematical uncertainties still being investigated
- Very clean ^{16}N beam
- High efficiency detectors
- Very low sensitivity to β 's
- First test run in 4 days gave 1.6×10^5 alphas
- Second run is being analyzed