Production of $^{13}$N Using D-$^3$He Fusion Protons

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Agenda

- Experiment purpose
- Experimental setup
- Lessons learned
- Expected Results
- Summary
Experiment will create $^{13}$N from D-$^3$He fusion protons

- Create $^{13}$N using 14.7 MeV protons from D-$^3$He reaction via $^{16}$O (p,$\alpha$) $^{13}$N
- Selected $^{13}$N because
  - Limited commercial production due to 10-minute half life
  - $^{13}$N PET scans should increase in response to Medicare/Medicaid coverage
  - Cross sections match proton energies
Oxygen cross section matches proton energy

Cross section data from IAEA cross section database for radioisotope production
Water target setup

Filter out $^{13}\text{NH}_3$ with ion exchange resin

1. Pump
2. Heat exchanger
3. Valve
Water containment apparatus

- First versions were Al
  - Model AI-M1
  - Model AI-M2
- Latest version stainless steel; Model SS-M1
- Radiator is 61 cm x 61 cm
- Tube wall thickness ~ 0.127 mm
- Protons lose ~ 2.2 MeV in stainless steel tube wall

Model AI-M1
D-\(^3\)He protons easily pass through tube wall

Proton Range in Stainless Steel

- Energy (MeV)
- Range (mm)
Al-M1 radiator during construction
AI-M1 radiator mounted in UW IEC chamber
AI-M1 radiator was sensitive to electron jets
$^{13}$N can be extracted from a water target

- Assume point source of $10^8$ p/s at 12.4 MeV, 2720 cm$^2$ target and 15 minute run time
- Yield $\sim 6$ nCi $^{13}$N
- Capturing all protons would yield $\sim 35$ nCi
- Clinical $^{13}$N PET routine requires $\sim 35$ mCi
Summary

• Water target should yield ~ 6 nCi of $^{13}$N
• Radiator models Al-M1 & Al-M2 had several limitations
• Model SS-M1 stainless steel radiator under construction
• Need increased reaction rate to improve yield