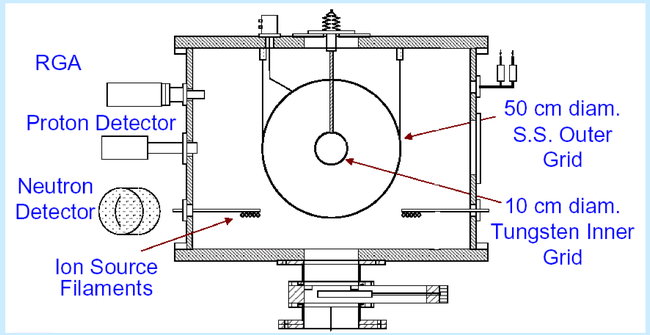
MEDICAL ISOTOPE PRODUCTION USING D-^{3}HE FUSION IN AN INERTIAL ELECTROSTATIC CONFINEMENT DEVICE

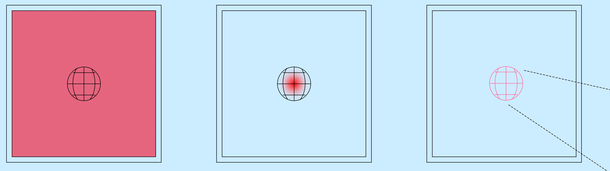
Benjamin B. Cipiti, Fusion Technology Institute, University of Wisconsin-Madison

IEC & EMBEDDED REACTIONS

Wisconsin IEC Schematic



Three Possible Reaction Regimes



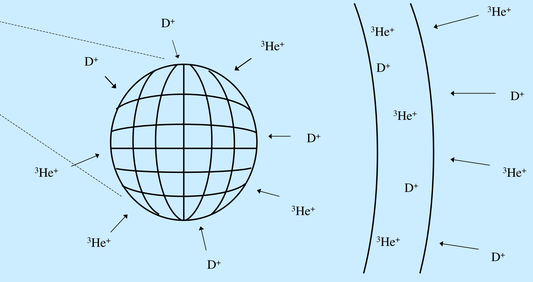
Volume Source Regime
Charge exchange neutrals fuse with background gas (>1 mtorr)

Converged Core Regime
Ion-ion and ion-background reactions (<<1 mtorr)

Embedded Regime
Implantation reactions in cathode wires

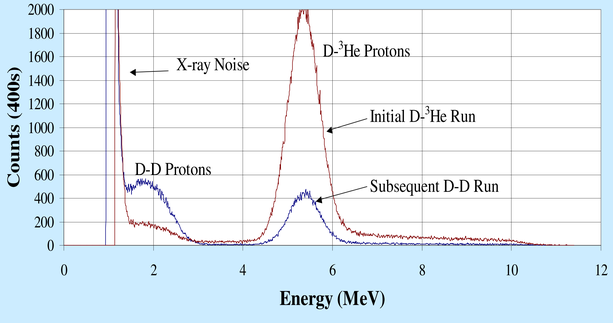
The high-energy D-^{3}He protons can be used to produce medical isotopes

Embedded D-^{3}He reactions occur due to ion implantation in the cathode grid wires, and account for **2/3 of the rate**



Evidence of D-^{3}He Embedding

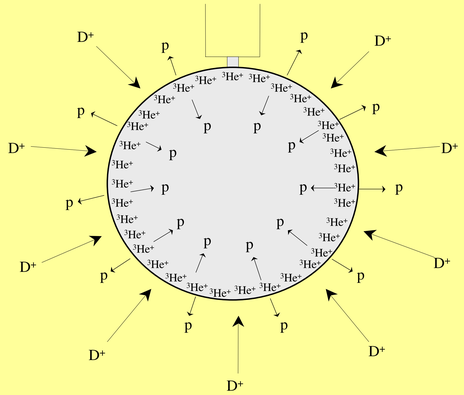
Proton Energy Spectrum vs Fuel 100 kV, 30 mA, 2.1 mTorr



- D-D plasmas produced D-^{3}He protons even though no ^{3}He was in the chamber
- ^{3}He implants into the inner cathode in D-^{3}He runs
- Subsequent D$^+$ bombardment initiates embedded D-^{3}He reactions

MEDICAL ISOTOPE PRODUCTION

Can we use D-^{3}He embedded reactions to produce isotopes?



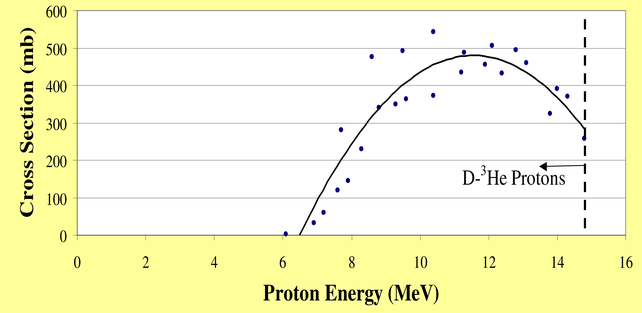
→ With a solid cathode, embedded D-^{3}He reactions produce protons isotropically

The protons generate ^{94m}Tc in a molybdenum cathode due to a large ^{94}Mo(p,n)^{94m}Tc cross section

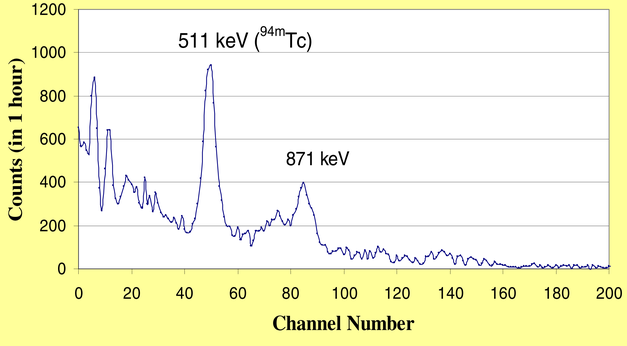
Molybdenum Cathode Experiment

20 min run time at 110 kV, 30 mA

^{94}Mo(p,n)^{94m}Tc $t_{1/2}$=52 min



Moly Target Activation Spectrum (Background Subtracted) 40 min after run



- **1 nCi of ^{94m}Tc was produced**
- **This is the first use of the D-^{3}He reaction to produce radioisotopes**

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