Comparison of Cylindrical and Spherical Geometry in a New Inertial Electrostatic Confinement Device

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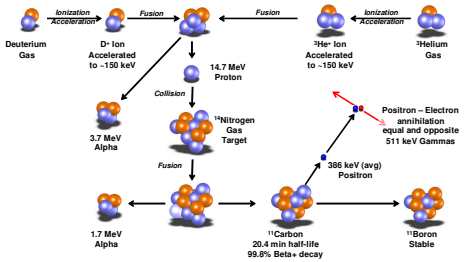
Objectives:

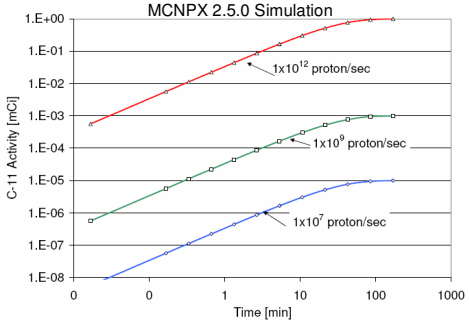
- Commission a new IEC device
- Investigate cathode and anode geometries
- Increase D-^{3}He fusion rates
- Produce radiopharmaceuticals in an IEC Device

Application:

PET Isotope Production

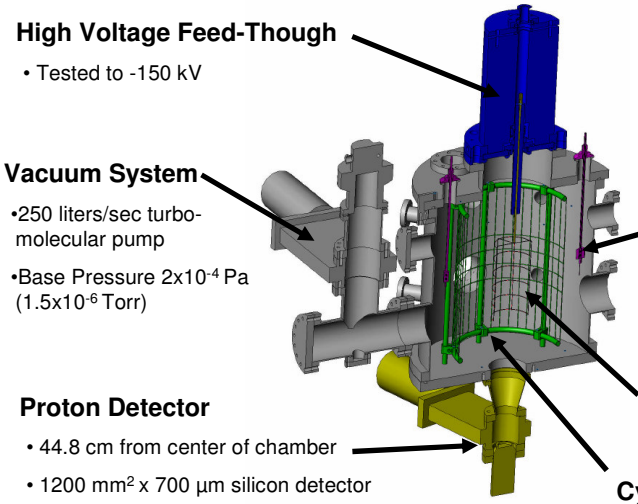


Predicted ^{11}C Activity at Different Fusion Rates



New Inertial Electrostatic Confinement Device

^{3}HeCTRE: ^{3}Helium Cylindrical Transmutation Reactor



High Voltage Feed-Though

- Tested to -150 kV

Vacuum System

- 250 liters/sec turbo-molecular pump
- Base Pressure 2x10^{-4} Pa (1.5x10^{-6} Torr)

Ion Source

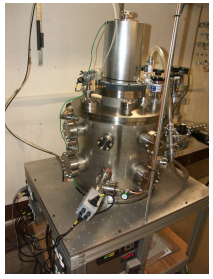
- Tungsten light bulb filaments
- 4 filaments (maximum of 6) 60° apart around perimeter
- Adjustable along Z-axis, currently aligned with the chamber midpoint

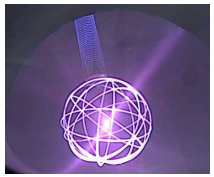
Proton Detector

- 44.8 cm from center of chamber
- 1200 mm^2 x 700 µm silicon detector

Cathode

Cylindrical Anode





Milestones:

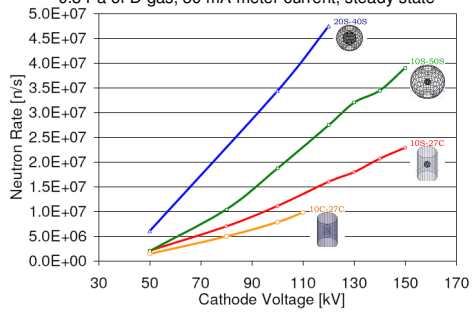
- Began construction July 2005
- First D-D reactions April 2006
- Best neutron rate **2.7x10^7 neutrons/sec** at 145 kV, 35 mA, and 0.3 Pa (2 mTorr)
- First D-^{3}He reactions Oct 18, 2006
- Best proton rate **2.0x10^7 protons/sec** at 130 kV, 30 mA and 0.3 Pa (2 mTorr)

Fusion Rate Comparison:

Anode and Cathode Geometry

Chamber Details	Electrodes Used
1st UW IEC •470 liter volume •95 cm diameter x 66 cm high •Aluminum	**10S-50S** •10 cm Spherical Cathode •50 cm Spherical Anode **20S-40S** •20 cm Spherical Cathode •40 cm Spherical Anode
^{3}HeCTRE •75 liter volume •46 cm diameter x 46 cm high •Stainless Steel	**10S-27C** •10 cm Spherical Cathode •27 cm x 43 cm Cylindrical Anode **10C-27C** •10 cm x 19 cm Cylindrical Cathode •27 cm x 43 cm Cylindrical Anode

D + D → ^{3}He (0.82 MeV) +n (2.45 MeV)
0.3 Pa of D gas, 30 mA meter current, steady state



D + ^{3}He → ^{4}He (3.7 MeV)+ p (14.7 MeV)
0.3 Pa of D and ^{3}He gas mixture, 30 mA meter current, steady state