# Progress Towards Proof of Principle Applications Using Steady State D-$^3$He Fusion

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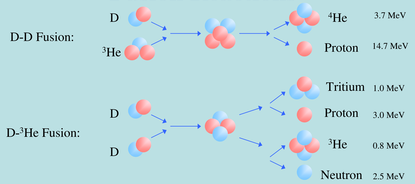
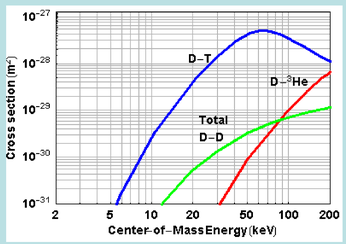
## Background

### Fusion Reactions




### Fusion Cross Sections



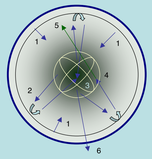

### Inertial Electrostatic Confinement Theory Of Operation

The IEC fusion reactor is a vacuum chamber filled with a fuel gas such as deuterium at low pressure. There are inner and outer spherical wire grids centered inside the chamber. The outer grid is held at nearly zero potential, and the inner grid is held at a high negative potential, typically -100kV.

1. Positive ions are created from the fuel gas near the outer grid, and accelerate towards the negatively charged inner grid.

2. The ions oscillate through the inner grid several times, creating a concentration of high energy ions in the central region.

3. The ions collide, creating fusion reactions.




4. The ions can also undergo charge exchange, creating fast neutrals.

5. Fast neutrals can collide with the neutral gas, also creating fusion reactions.

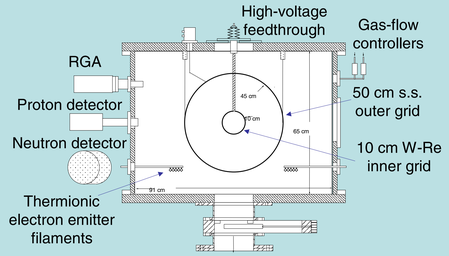
6. High energy fusion products, such as protons and neutrons, are created and can be used in many different applications.

### Steady State Fusion

10 cm

## Experimental Facility

### University of Wisconsin IEC Facility

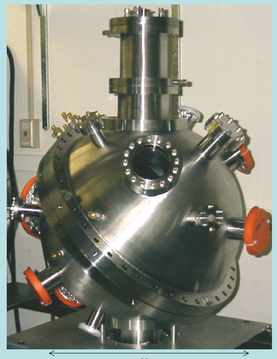



### Air Cooled Aluminum Chamber



100 cm

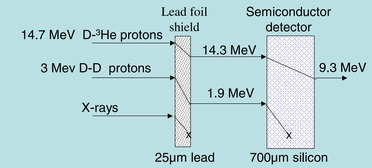
### Water Cooled Stainless Steel Chamber



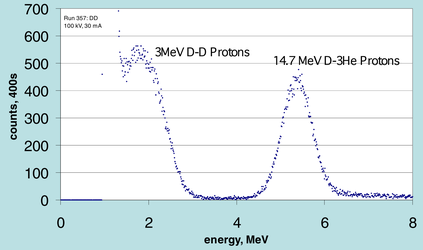
60 cm

## Typical Runs

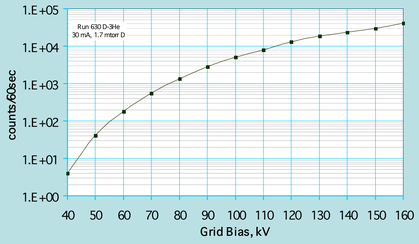
### Solid State Proton Detector



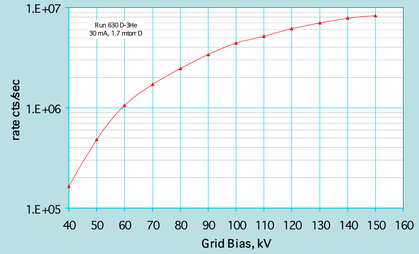

### Proton Energy Spectrum from Detector




### D-$^3$He Proton Counts from Detector

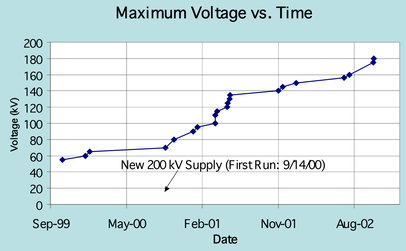



### D-D Neutron Rate vs Cathode Voltage

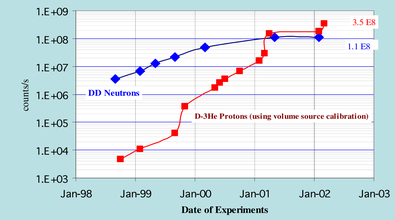



## Recent Progress

### The Progress in Steady State Fusion Using Advanced Fuels Has Been Rapid



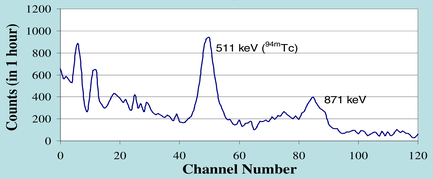

**Steady State Production of Fusion Products Wisconsin IEC Fusion Reactor**




### Medical Isotope Production

**$^{94}$Mo(p,n)$^{94m}$Tc reaction**
About 1 nCi $^{94m}$Tc Was Created
Using embedded fusion in solid molybdenum cathode

**Activation Spectrum**




**$^{16}$O(p,α)$^{13}$N reaction using water in circulator**