



## **IEC Fusion Background**

#### **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.

 Positive ions are created from and accelerate towards the negatively charged inner grid

2. The ions oscillate through ions in the central region

3. The ions collide. fusion reactions.



charge exchange, creating fast

fusion reactions.

High energy steady state fusion



**D-D** Fusion:

**Fusion Cross Sections** 



### <sup>13</sup>N PET Medical Isotope Cross Section



# **Recent Progress and Applications Using Steady State D-D and D-<sup>3</sup>He Fusion**

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## **Experimental Facility**





Time (s)

1200



http://fti.neep.wisc.edu/iec

### **Results and Applications**

**Key Results** •Have achieved record steady state fusion rates of advanced fuels D and <sup>3</sup>He •1st proof of principle creation of PET medical isotopes using fusion products •Fusion reaction regimes identified using unique IEC diagnostics **Three Different Locations of Fusion Reactions** in the IEC Chamber Have Been Identified Volume Embedded Converged Core D-D: 22 % D-D: 70 % D-D: 8 % **D-<sup>3</sup>He: Negligible D-**<sup>3</sup>**He: 95% D-**<sup>3</sup>**He: 5 %** Percentages of total reaction rate in the chamber **Eclipsing the Cathode from the Proton Detector Revealed the Areas of Fusion Reactions** Eclipsed area of fusion reaction Proton Detector Eclipse Disk Cathode (1 of 3 sizes) **Several Different Chordwire Configurations Were Used to Study Ion Flux Reaching the Cathode Grid** Diagwire Cylinwires



εσΤ \_\_\_\_  $q\Phi_{c}$ 

Where the temperature T is measured using a pyrometer and the ergy before reaching the chordwire  $(q\Phi_c)$  is estimated from the child-langmuir saturation current equation for single species in concentric spheres

Length of the the arrows in the figure is directly proportional to the normalized ion flux reaching the cathode grid.