



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:





¹³N PET Medical Isotope Cross Section



Recent Progress and Applications Using Steady State D-D and D-³He 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 ³He •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-³He: Negligible D-**³**He: 95% D-**³**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

Image: space of the space of	Diagwire		Cylinwires
HorplanarPlanarImage: Strain		cathode	
Power balance on the chordwires gives the ion flux per unit area reaching the wire.	Horplanar		Planar
Power balance on the chordwires gives the ion flux per unit area reaching the wire.			
	Power balance on th	e chordwires gives the ion flux per unit area r	eaching the wire.

εσΤ ____ = _____ $q\Phi_{c}$

Where the temperature T is measured using a pyrometer and the ion energy 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.