

IEC Theory

•Inertial-Electrostatic Confinement (IEC) devices operate by ionizing fusion fuels and accelerating ions into a spherical potential well which is created by concentric spherical electrodes



IEC Device Operating at ~7 mtorr

•Present gridded IEC devices operate at relatively high pressures, which substantially degrades ion energy. This makes fusion of fuels such as ³He problematic



Proton

Proton

He Total

The ³He-³He reaction

Reducing neutral pressure will reduce losses, and should make ³He fusion observable



Ion source mounted to IEC schematic



<mark>12.9 M</mark>eV

Inductive Discharge

Helicon Discharge

• High density of helicon mode enables larger ion currents to be extracted from smaller apertures according to Bohm criterion:

 $I_B = 0.61 * nqA \left(\frac{kT}{m}\right)^2$

• For plasma density $\sim 10^{12}$ cm⁻³, a hole of 1 cm² gives a current of \sim 30 mA in helium or deuterium

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Ion Extraction

System

- A differentially pumped ion extraction region separates remaining neutral ga from the ion beam
- Extraction system capable of beam voltages up to 30 kV



Ion extraction system

• Helicon source and ion extraction system should be capable of delivering up to 50 mA at $P < 50 \mu$ tor



Ion source mated to IEC



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	⁴ He beam discharging into IEC at 10 mA 25 kV
rr	Summary
ntenna	 Relatively high current, low pressure ion source needed for ³He-³He fusion
is Inlet	 Helicon ion source constructed

- and tested in multiple gases including H_2 ⁴He and ³He • Ion source, extraction system, and IEC have been operated
- together successfully • Future experiments with fusionable gases (D_2 , ³He) are planned