Background, Motivation, and Previous Results (2000)

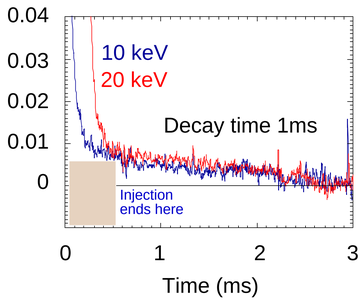
Confinement in standard RFP plasma is poor due to magnetic fluctuation induced transport.

Question:
How do the magnetic fluctuations affect the confinement of energetic ions?

Extremely important for auxiliary heating with NBI and for high T_i plasmas.

Confinement of fast ions injected with Diagnostic Neutral Beam was measured

Fast CX neutral flux (a.u.) from plasma for 10 keV and 20 keV injection



Fast ion confinement time 1ms is of the order of plasma confinement time.

Expected stochastic losses $E^{1/2}$ - not observed.

- 10 keV and 20 keV ions seem to behave similarly
- If confinement time is 1ms for bulk (200 eV) ion then for 20keV ions it is expexted to be 0.1 ms

We tried to measure fast ion confinement in improved plasmas (smaller fluctuations) but CX flux was too low to detect.

We also measured the rate of fast ion energy loss and found it to be consistent with the classical i-e slow down time

What is the fast ion loss mechanism?
Stochastic diffusion?
Charge exchange?
Direct drift orbit losses?

Goals and Directions

Effect of stochasticity on fast ion confinement

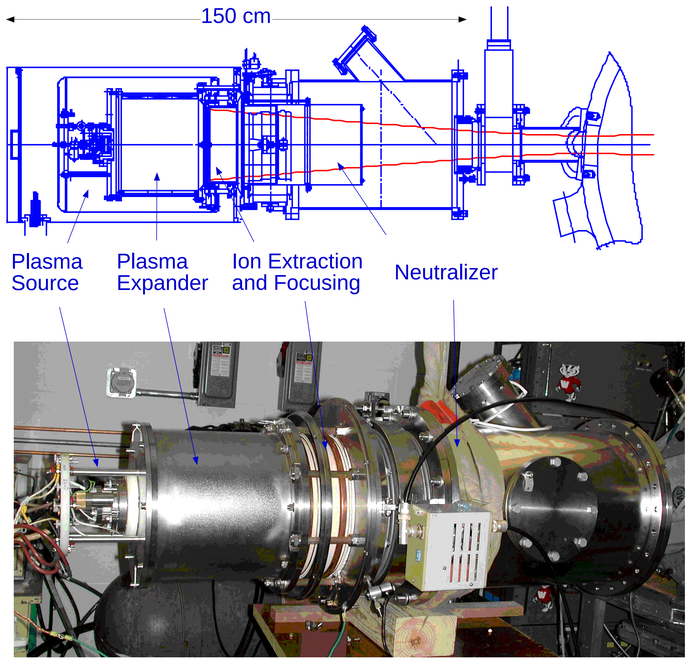
Role of background neutrals and CX losses

Macroscopic effect of NBI - plasma heating and induced rotation

Fast ions energy losses

Numerical simulations - see poster by Ben Hudson

New Tool
60A/25keV/1ms
Neutral Beam Injector

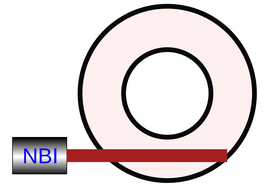


Possible Macroscopic Effects of Injection

Heating
Fast ion energy content - 1 kJ
Plasma thermal energy content - from 3 kJ to 10 kJ

Plasma rotation
Rate of fast ion toroidal momentum injection - 1 kg•m/s^2
Rate of plasma momentum change during sawtooth -10kg•m/s^2

Schematic of experiment



a = 0.5 m
R = 1.5 m
V = 7.4 m^3

Diagnostics:

- Fast ion confinement and plasma ion heating - NPAs, CHERS
- Electron heating - Thomson Scattering
- Plasma rotation - magnetics and Doppler spectrometry

Beam Testing Preliminary Results

Designed Parameters

I_{beam}	60 A
U_{beam}	25 kV
Duration	1.2 ms