A Basic Probe to Measure Magnetic Helicity Flux

NSTX

M.J. Schaffer

General Atomics, San Diego, CA, U.S.A.

NSTX Research Forum
PPPL
2002 September 11 - 12

GENERAL ATOMICS

Perhaps Magnetic Helicity Flux Can Be Measured Simply:

NSTX

- **Helicity transported across a closed surface S(x,t) bounding a volume V(x,t) can be written as**

$$\text{Helicity out of S} = \int_{S(t)} \left(\mathbf{A}' \times \frac{\partial \mathbf{A}'}{\partial t} + \phi' \mathbf{B}' \right) \cdot \mathbf{n} \, d^2 x$$

- **With Moses' gauge for A, we can drop the primes (moving coordinate system on S) and use variables in fixed lab frame. Furthermore,**

$$\int_{S(t)} \mathbf{A}' \times \frac{\partial \mathbf{A}'}{\partial t} \cdot \mathbf{n} \, d^2 x = 0.$$

- **Therefore, we only need to measure the simple helicity flux term**

$$\overline{\phi \mathbf{B}} \cdot \mathbf{n}$$

  - **...just B(t) normal to the plasma average magnetic surface and the *plasma* potential**
  - **Harmonic probe can measure high frequency plasma potential.**

GENERAL ATOMICS

Simple Helicity Flux Probe Concept

B_n Pickup Coil

Insulating Ring

Conducting Ring

Structural Tube

Harmonic Potential Probe

GENERAL ATOMICS