Study of Angular Momentum Transport due to Magnetic Fluctuations by the Dynamo Probe Head

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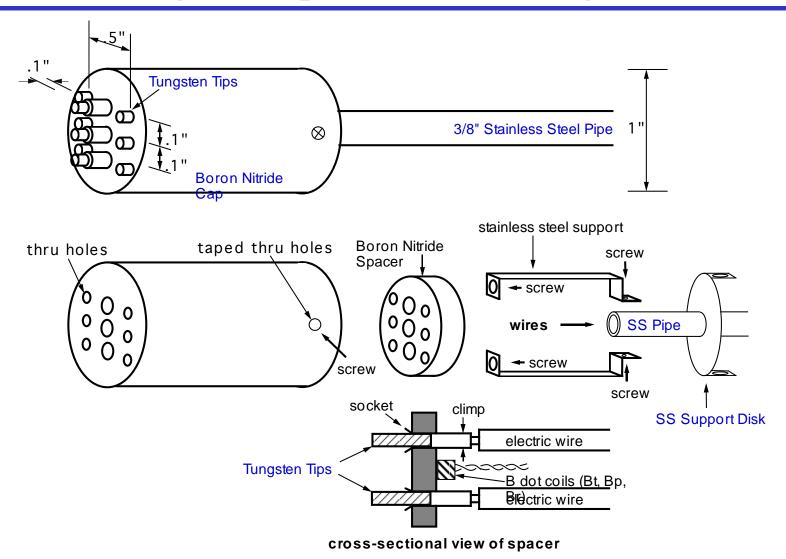
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Introduction

- **Significant angular momentum measured at NSTX.**

- **Understanding transport mechanism(s) of angular momentum may provide important clues for ion dynamics in a small aspect ratio and is possibly related to the high ion temperature.**

- **Two models proposed for the momentum transport:**
  - **Reynolds stress --- can be purely electrostatic**
  - **Magnetic Reynolds stress --- fully electromagnetic, could be more relevant to high-beta plasmas**

- **The dynamo probe head will provide crucial information on these models by directly measuring the candidate terms due to fluctuations.**

Conceptual Design of The Probe
(Consisting of 3 Triple Probes and 3 Magnetic Probes)

5 "

.1 "

Tungsten Tips

3/8" Stainless Steel Pipe   1 "

.1 "

.1 "

Boron Nitride Cap

thru holes

taped thru holes

Boron Nitride Spacer

stainless steel support

screw

screw

wires ⟶   SS Pipe

screw

screw

SS Support Disk

screw

socket   climp

electric wire

Tungsten Tips

B dot coils (Bt, Bp, Br)

electric wire

cross-sectional view of spacer

Measured and Deduced Quantities

- **Measured Fluctuations:**
  - $\left(\tilde{\phi}_f, \tilde{T}_e, \tilde{n}\right)$ **at 2 poloidal and 2 radial locations**
  - $\left(\tilde{B}_\theta, \tilde{B}_\phi, \tilde{B}_r\right)$ **at one location**
- **Deduced Fluctuations**

$$\left(\tilde{E}_\theta \approx -\frac{\Delta\tilde{\phi}_s}{r\Delta\theta}, \tilde{E}_r \approx -\frac{\Delta\tilde{\phi}_s}{\Delta r}\right)$$

- **The terms needs to determine momentum transport are**

$$T_{\theta r} = \frac{\left\langle \tilde{E}_\theta \tilde{E}_r \right\rangle}{B_0^2} - \frac{\left\langle \tilde{B}_\theta \tilde{B}_r \right\rangle}{\mu_0 m_i n}$$

Reynolds stress
(available already)

magnetic Reynolds stress
(new measurements)

Planned Activities in FY03

- Finish manufacturing and installation by the next run (J. Boedo of UCSD)
- Onsite conditioning and system-debugging (J. Boedo, H. Ji, H. Kugel)
- Preliminary tests (H. Ji, J. Boedo)
- Initial measurements (H. Ji, J. Boedo, G. Tynan)