

Study of CHI Mechanisms by the Dynamo Probe Head

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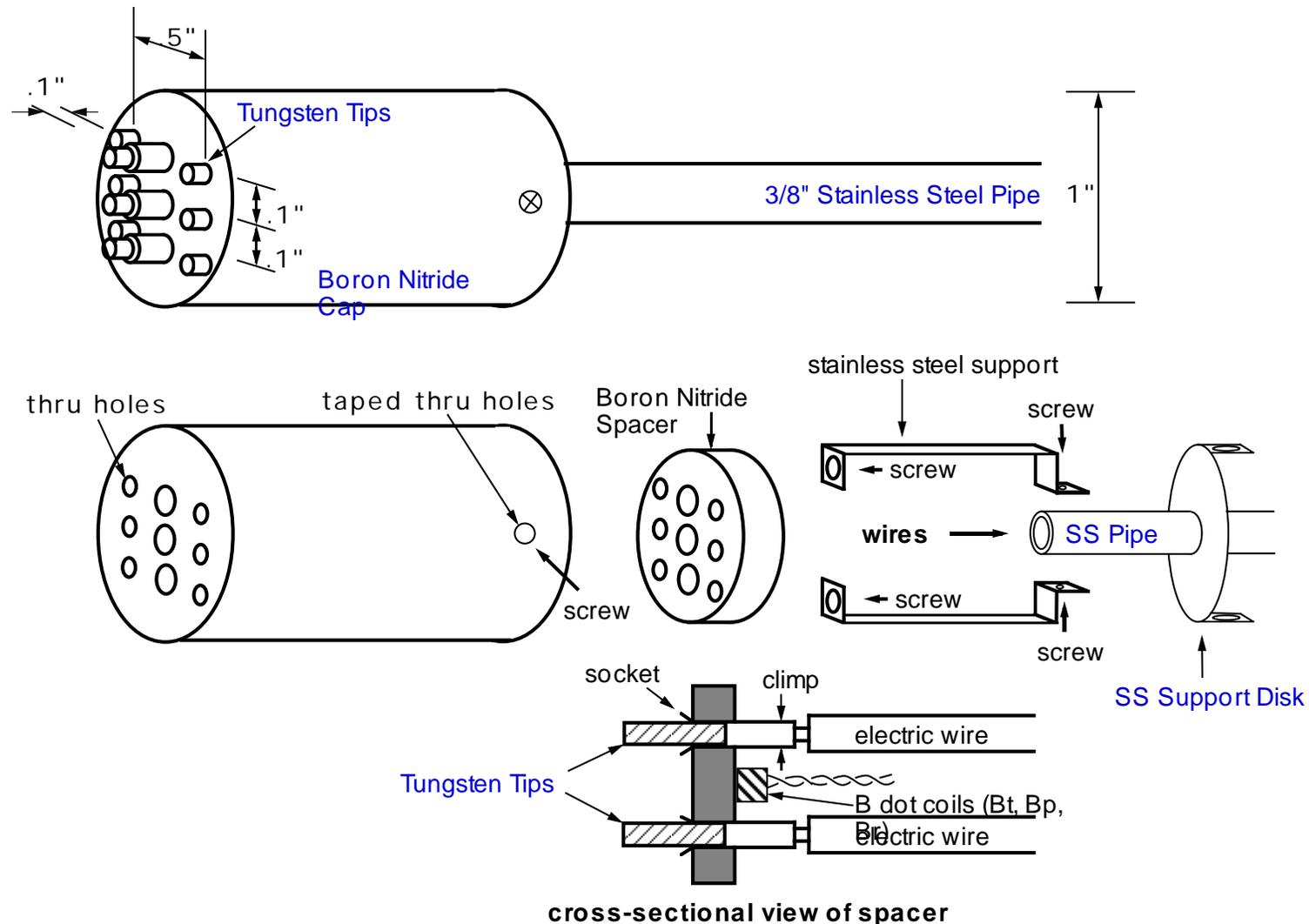
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Introduction

- **Parallel current and magnetic helicity is transported inwards to sustain the plasma current during CHI.**
- **Understanding mechanism(s) of CHI is crucial to assess its effects on confinement and feasibility for current drive in ST.**
- **Three models proposed for the CHI mechanism:**
 - **Plasmoid ejection model --- 2D reconnection**
 - **Turbulent EMF model (the α dynamo effects) --- 3D MHD or two-fluid dynamics**
 - **“Rotamak” model --- 2D two-fluid dynamics**
- **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)



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**

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

$$\left(\nabla_\theta \tilde{p}_e \approx \frac{\Delta \tilde{p}_e}{r \Delta \theta}, \nabla_r \tilde{p}_e \approx \frac{\Delta \tilde{p}_e}{\Delta r} \right)$$

- **The terms needed to determine current (helicity) transport are**

$$\text{MHD dynamo} \underbrace{\frac{\langle \tilde{E}_\theta \tilde{B}_\theta \rangle}{B_0} + \frac{\langle \tilde{E}_r \tilde{B}_r \rangle}{B_0}}_{\text{MHD dynamo}} + \underbrace{\frac{\langle \tilde{B}_\theta \nabla_\theta \tilde{p}_e \rangle}{en} + \frac{\langle \tilde{B}_r \nabla_r \tilde{p}_e \rangle}{en}}_{\text{diamagnetic dynamo (two-fluid effect)}}$$

Proposed Activities in FY04

- Finish manufacturing and installation (J. Boedo, H. Ji)
- Onsite conditioning and system-debugging (J. Boedo, H. Ji, H. Kugel)
- Preliminary tests (H. Ji, J. Boedo)
- Initial measurements (H. Ji, R. Raman, J. Boedo, T. Carter)

Collaborative research among 3 universities and PPPL