NSTX Physics Considerations

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NSTX Mission

The mission of NSTX is to investigate, with broad participation by laboratories and universities, the physics principles of

- Confinement and transport
- Stability and resilience to disruptions
- Non-inductive initiation and current sustainment
- Scrape-off layers and divertors

in a low aspect ratio (spherical) torus as a plasma confinement innovation. These principles are to be investigated in scientifically interesting regimes relevant to the VNS and future power plants, characterized by

- High average β_T (25 to 45%)
- High pressure gradient driven current fraction (~50 to 90%)
- Fully relaxed, non-inductively sustained current profile
- Collisionless plasmas with high temperatures and densities
- Low aspect ratios, $R/a \geq 1.25$, and high elongation, $\kappa \leq 2.2$

NSTX Experimental Research Areas

The experimental research topics for the NSTX program follow closely the primary mission objectives

- Confinement and transport
  - Scaling of global/thermal energy confinement
  - Suppression of microinstabilities
  - Formation of transport barriers (internal and edge)
- MHD studies and mode stabilization
  - Access to high-β
  - Plasma terminations/Halo currents
- Non-inductive current drive
  - Start-up
  - Sustainment (including pressure-driven currents)
- Divertor/SOL physics
  - Power handling

The discussion will give an overview of the possible research topics to be carried out on NSTX

- The details of the research and experiments will be developed in conjunction with the Science Working Groups

NSTX Device Capabilities Form A Self-Consistent Set For Achieving Its High Performance Mission

Operating Parameters:	$R = 0.85$ m $a = 0.68$ m (R/a≥1.25) $I_p = 1$ MA $B_T = 0.3$ T $\kappa_{95} = 2.0$
Start-Up	Inductive, ECH pre-ionization, CHI
Wall Stabilization	Conducting Shell ($r_{wall}/a \leq 1.25$)
Aux. Htg. and CD	HHFW (6 MW), NBI (5 MW), CHI (20 kA)
Profile Control	HHFW, NBI, CHI
Pulse Length	5 seconds
Performance Objectives:	$S = I_p q_\psi / a B_T \leq 80$ $\beta_t \leq 45\%$ $\beta_n \leq 8.5$ $I_{boot}/I_p \leq 0.9$