Integrating Plasma Performance Enhancements

- NSTX has ambitious goals

"Integrate high confinement and high beta" (IPPA 3.2.1.6)

"...assessing high-beta stability, confinement, self-consistent high-bootstrap operation, and acceptable divertor heat flux, for pulse lengths much greater than energy confinement times" (FESAC 5-year Objective #2.1)

  - Already have Milestone FY03-2:

"... beta near the "no-wall" limit simultaneously with high energy confinement for durations >> τ_E"

    - Requires $\beta_T \approx 30\%$, H ~ 2, t ~ 200ms

- Future milestones will extend goal to 5s pulse
  - Add requirements for high bootstrap fraction
  - Can only be achieved at $B_T \leq 0.3$T with present CS
  - Efficient non-inductive current drive needed
  - Energy input will become an issue

Active Controls Needed

- Stabilization
  - Ideal modes – p(r), q(r), wall influence
  - RWM – error field reduction, control
  - NTM – control of local p'
- Current drive and non-inductive startup
  - Efficiency – counts against τ_E
    - HHFW parasitic interaction with fast ions
  - Localization
  - Role of CHI
  - Controllability
- Density control
  - Localized internal fueling: pellets, CTs
  - Wall material changes: tiles, coatings
  - Edge pumping: cryo-pump, lithium module

Active Controls (2)

- Power handling
  - Enhanced edge radiation
    - Intrinsic impurities
    - Recycling gases
  - Strike point sweeping
  - Edge ergodization or segmented biasing
    - MAST example