Advanced Tokamak Modes
for the
Fusion Ignition Research Experiment (FIRE)

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Symposium on Fusion Engineering
Albuquerque, NM

October 27, 1999

http://fire.pppl.gov

FIRE Fusion Ignition Research Experiment

FIRE Advanced Tokamak Modes

- generate burning AT experiments with Q=5-10, over pulse length as high as 4 times the current diffusion time (4×15s)
- bootstrap current profile for various n(ψ) and T(ψ)
  - variations on CD power for variations in bootstrap profile
  - requirement for relaxation of ITB's to spread out gradients
- ideal MHD stability
  - configurations that do not require kink stabilization
  - kink stabilization above β_N=3.5
  - interaction of bootstrap current, safety factor, and stability boundaries
- alpha particle losses
  - ripple (collisionless and collisional) strong dependence on q(ψ)
  - TAE's have strong dependence on q(ψ) and β_α
  - try to keep q-axis less than 2.5 and q-min greater than 2.0
- neo-classical tearing modes
  - stable in region with dq/d$\psi < 0$
  - stability in outer region where dq/d$\psi > 0$
  - collisionality
  - saturated width and its effect on β and confinement
  - ECCD/ECH/LHCD stabilization

- **P_{aux} heating/CD requirements**
  - **high H-factor, high β, high f_{bs} —-> low P_{aux}**
  - **low H-factor, low β, low f_{bs} —-> high P_{aux}**
- **plasma edge/divertor solutions**
  - **n_{edge} compatible with ITB's and divertor power**
  - **is there an H-mode or an L-mode edge**
  - **is a large radiated power fraction consistent with advanced modes**
  - **can the SOL be used to radiate power efficiently**