Performance Evaluation & Enhanced Confinement Plans

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NCSX Team Meeting
23 March 2000

Performance Evaluation - Present

- GTC calculations of thermal confinement, electrons & ions
  - Using fixed n_e, T_e & T_i profiles; assume $e\Phi(0) = T_i(0)$
  - Some parametric scans for c10
  - One case where profiles were iterated with 1D transport code (Transp) to approach self-consistency

- Monte-Carlo simulations of NB fast-ion losses

- 0-D spreadsheet projection of operating points, including global-confinement scaling (for anomalous transport) & constraints

Performance Assessment - Problems

- Very labor intensive to generate self-consistent profiles

- Confinement evaluation with fixed profiles mainly sensitive to edge transport

- GTC calculates fluxes for a single set or parameters
  ⇨ expensive & hard to determine parametric scalings
  ⇨ hard to get fully self-consistent 0D projections

Plan: GTC with Self-consistent Profiles

(Lewandowski, Lin, Mynick)

- Modify GTC to calculate variation of pressure anisotropy
  - Collaboration with Williams and Boozer (Columbia)
  - Can use to calculate $\Gamma_{e,i}^{ns}$, flow damping rate

- Either:
  - Modify GTC to include particle & heat sources, solve for ambipolar $\Phi(s)$, and iteratively evolve T_e & T_i profiles; or
  - Couple GTC to 1D transport solver, which includes sources; iteratively evolve Φ, T_e & T_i profiles

Both options being investigated to prepare for decision on path to pursue.

Need Better Characterization of Performance Tradeoffs

- NCSX is considering not using PBX-M TF coils
  $\Rightarrow$ must choose aspect ratio and plasma size for experiment

- To compare different configurations, must compare their ability to access desire parameters cost-effectively
  - I.e. β=4% at P=6 MW
  - Can reduce neoclassical losses by increasing size

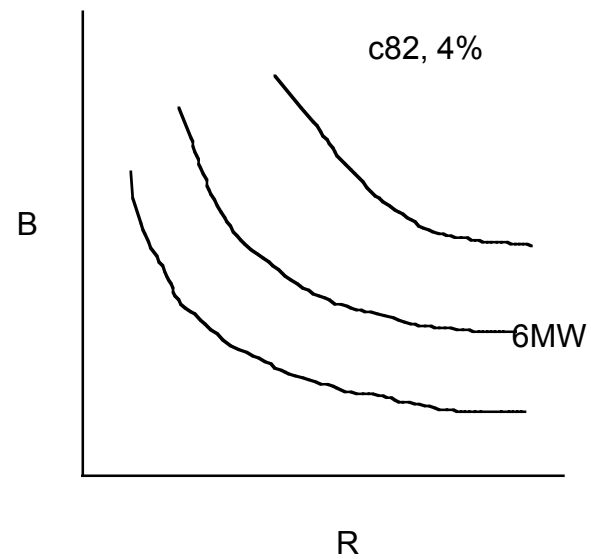
Review and continue development of confinement evaluation for configurations

Plan: Stellarator Survey

(Mikkelsen, ??, Zarnstorff)

- modify Mikkelsen's SURVEY code to characterize projected performance as function of (R, B, P, density)
  - use DKES to evaluate and characterize neoclassical transport
  - 1D transport solution for profiles
  - optimize b by varying density at given R, B, P

- produce operating curves as input to engineering, to evaluate lowest-cost path



Enhanced Confinement

- Investigate and define requirements to be able to access enhanced confinement, to ensure access to high-β (c82 needs > 2.3 x ISS95)

  – H-modes thresholds (Synakowski) - *do we need a divertor?*
  – Pellets (??)
  – Hot-ion regimes (??) - *requirement on ion confinement*
  – RI mode (enhanced edge radiation) (??)
  – Driven rotation effects (??)
  – Other ways to control Er (??) - *are there any?*

  – *Requirement on flow-damping?*

- Problem: have not been able to find anyone to carry out most of these studies