Status of Plasma Boundary Configuration Studies and Vacuum Vessel Design

NCSX

Peter Mioduszewski

for

NCSX Plasma Boundary Group

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Main Power- and Particle Control Tasks

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- Define vacuum vessel contour, i.e. the envelope of the field line excursions of the boundary plasma.
  - for day-1 plasma configuration √
  - for future upgrades including divertor plates/baffles and pumping √
- Define location and shape of the plasma-facing components
  - peaking factors of power handling
  - optimized for neutrals control
- Set up 3-D neutrals calculations
  - to estimate atomic effects in the bean-shaped cross-section and
  - to provide guidance for the design of the plasma-facing components

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Need Sufficient Magnetic Connection Lengths for Decoupling of Separatrix and Divertor Temperatures

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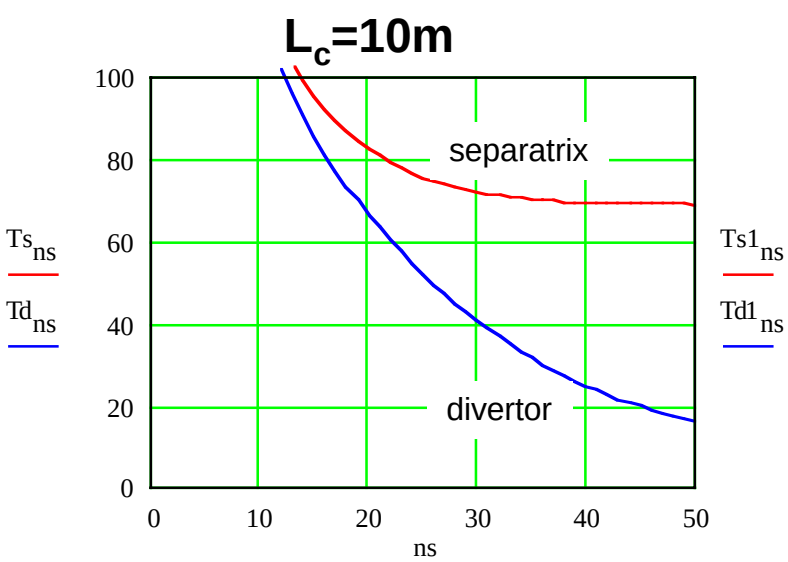
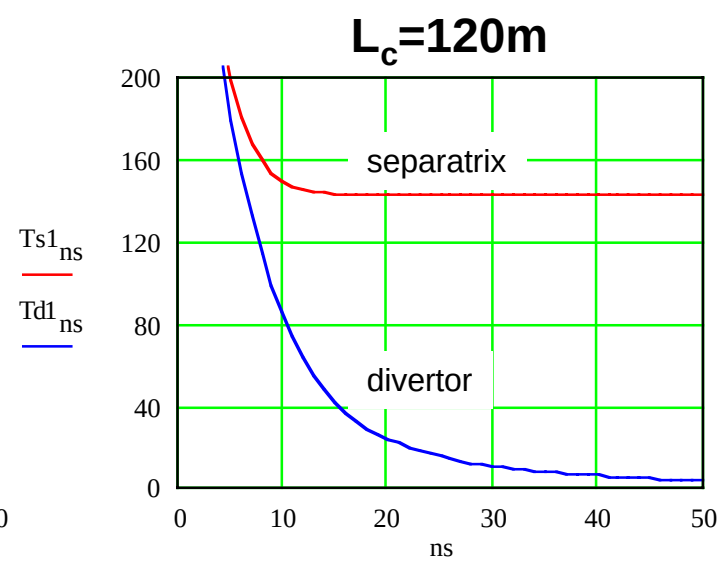
- Example, calculated with 2-point divertor model:
  - **input at separatrix: P = 3 MW, for $n_s = 3 \times 10^{19}\ m^{-3}$ =>**
  - **Lc=10m: 40-70 eV, or Lc=120m: 10-140 eV**



separatrix density x $10^{18}\ m^{-3}$



separatrix density x $10^{18}\ m^{-3}$

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Connection length considerations

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- Starting close to the LCMS, connection lengths can be very long: several hundred meters
- Moving out radially, the field becomes more ergodic, connection lengths to the wall are getting shorter
- There is a distribution of connection lengths and we need to make sure that we allow a sufficiently large fraction of this distribution to have the desired length
- Field-line-following studies show that field-lines launched within 2 cm of the LCMS can survive ≥ 20 revolutions, i.e. have L_c ~ 200m
- Assuming a perpendicular e-folding length of 2cm, we should have about 2/3 of the field-lines within 2cm of the LCMS being sufficiently long
- The divertor consists of the "plates", taking most of the power (on long field-lines), and the "baffles" taking some particle flux (on short field-lines)

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Present Status and Activities

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- Our development plasma configuration is Li383 with 1017 coil configuration.
- Art Grossman has generated free boundary calculation for the R=1.4 m case and will discuss details on field-line-following results.
- We have performed field-line following for connection lengths of 100-200m to map out “stay-out” zone.
- Post-processing of existing “data” will yield distributions of connection lengths.
- Next step is to include field-line diffusion.
- First step for this will be benchmarking the respective versions of the MFBE and Gourdon codes against each other (with and without field line diffusion).

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