EP-TSG meeting
05/16/2017

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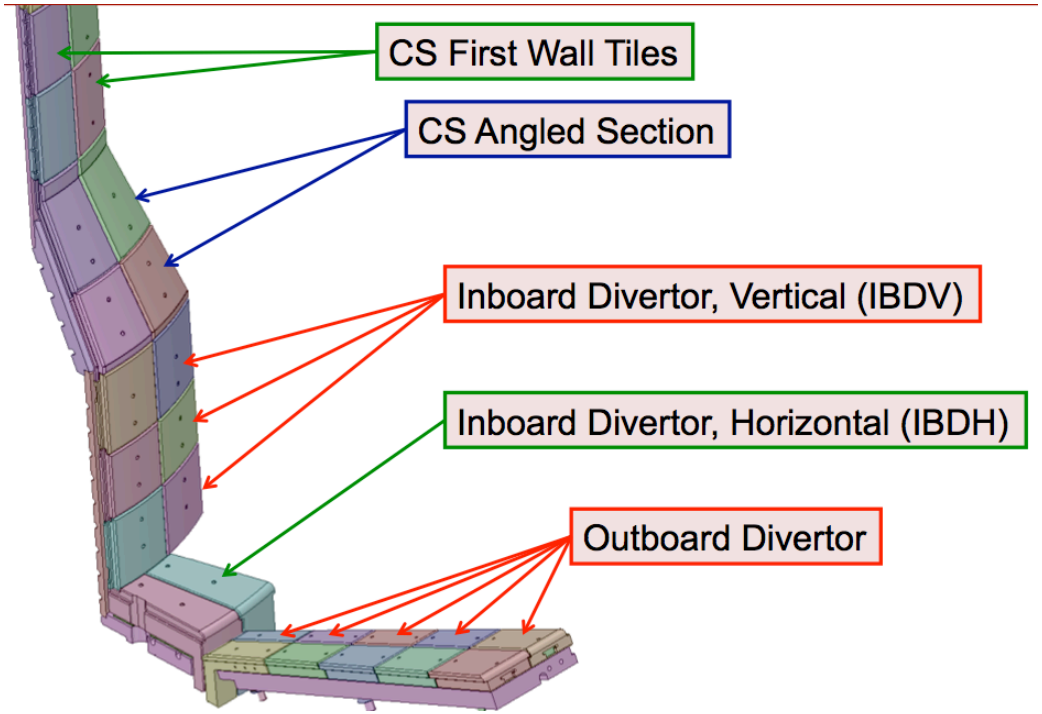
Notes from the meeting inserted in red

Agenda:

- Physics needs/desires based on considered changes to NSTX-U “polar regions”
- Adapt FY18-19 Research Milestones

Changes to "polar regions" being considered to address heat flux issues et al.

From NSTX-U Team meeting 04/28:



- Tile fish-scaling required in several regions to manage high heat fluxes → Eliminates reversed B_T
  - Bi-directional tiles may be an option for lower $q_\perp$ divertor regions
- Need additional specs of requested range of ΔR_{SEP}, duration, κ, δ, R_{strike}
  - Up/down asymmetric boundary increases q_{peak}, reduces Δt_{flat}

We need to assess impact of changes on EP-TSG Physics needs/desires

- Main knobs for EP-TSG experiments seem not directly affected by choice of PFCs, considered changes:
  - q-profile
  - Injected NB power 1-8MW
    - Max allowed NB power and shot duration do depend on PFC choice
  - NB configuration (vary source mix)
  - L- vs H-mode (vary thermal plasma profiles)
  - RMPs with variable spectrum
  - About 2 sec flat-top for current equilibration, stationary profiles
    - Also required for diagnostics - e.g. average over NB modulation cycles, improve statistics

- Would-be-nice-to-have items:
  - RF with ~4MW of HHFW power
    - Impact of proposed changes unclear
    - Are RF losses through SOL to divertor a driver for PFC choice? Any limit on max RF power? Also: RF interaction with fast ions may cause additional load to RF limiter
  - USN (in addition to LSN and inner wall limited)
    - May require “symmetric” top/bottom polar regions
    - Other factors: asymmetry of heat flux between LSN and USN, difference in L-H power threshold (e.g. to force the plasma to stay in L-mode)
    - USN may help interpretation of some diagnostics such as vertical FIDA: direct view of lower divertor increases background signal & cold D-alpha signal, lower SNR

Additional considerations

- Expect center-stack limited plasmas with P_{NB}<3-4MW during 0.5sec to be OK
  - We pushed harder than this on NSTX
  - Inner-wall limited plasmas are important for EP-TSG research: simple configuration makes it easier comparison with code/theory, good for diagnostics, good reproducibility, …
  - Suggested to require ~1sec instead, better for diagnostics, NB modulation, stationary conditions
  - Warning: heat load not the only concern; mechanical forces are concern too (and combination between the two); may have to limit duration and/or NB power for inner wall limited plasmas
- Likely: reversed B_t operations NOT possible
  - Most likely affects "diagnostics" XMPs, e.g. for FIDA
    - We may have other options for those experiments, e.g. use top+bottom pCHERS fibers to test FIDA signal, profile shift, etc.
  - What physics would we miss?
    - Reversed ***Ip*** would probably be more interesting for EP-TSG than rev-Bt. EP losses may increase a lot, though.
- EP-related XPs relatively insensitive to X-point radius, exact equilibrium
  - Reliability (e.g. of NB sources) & reproducibility more relevant
  - Exception: TAE stability *does* depend on κ, δ
  - But: stability studies w/ AE antenna arguably run at low P_{NB}
    - Agree – these experiments would start in ohmic plasmas, then move to low-Pnb shots to assess damping vs drive. Also require a working AE antenna… not even tested yet

Summary of EP-TSG Physics needs/desires

What range of parameters we expect for EP-related XP/XMP?

Machine conditions *(specify **ranges** as appropriate, strike out inapplicable cases)*

Set minimum Bt=3.5kG to touch basis with previous NSTX experiments – may lose some diagnostics, though

B_T Range (T): **0.5-1.0** Flattop Duration (s):

I_P Range (MA): **0.6-1.5** Flattop Duration (s): **2.0**

Allowed outer gap will depend on Pnb (losses to RF limiter), Bt (EP larmor radius), expected NB deposition location (shift of outboard magnetic surfaces)

Configuration: **Inner Wall Limited / DN / LSN / USN**

Outer gap (m): **0.05-0.15** Inner gap (m): **0-0.05** Z position (m): +/-0.05

Elongation: Triangularity (U/L): OSP radius (m):

Gas Species: Injector(s):

Make sure to specify max Pnb required for each configuration in Memo to Jon. E.g., won't put 8MW into center stack limited plasma, etc.

NBI Species: **D** Heating Duration (s): **2** NB Power (MW): **1-8**

Voltage (kV) 50 cm (1C): **60-90** 60 cm (1B): 70 cm (1A):

Voltage (kV) 110 cm (2C): 120 cm (2B): 130 cm (2A):

ICRF Power (MW): **4** Phase between straps (°): Duration (s): **0.5**

Not clear at this point what role RF will have, especially at the beginning of NSTX-U operations

Update on FY18-19 EP Milestones

- JRT-18: Test predictive models of fast ion transport by multiple AEs (led by NSTX-U)
  - OK, no changes required

- R18-4: Optimization of the EP distribution function for improved plasma performance
  - Will incorporate collaboration with MAST-U
  - Contribute to DIII-D work with variable NBI parameters? (To be discussed with DIII-D EP group)

  Collaborate with DIII-D on validation of "chirping criterion" – will be part of JRT-18 anyway, low-hanging fruit

- R19-2: Assess the effects of neutral beam injection parameters on the fast ion distribution function and neutral beam driven current profile
  - Will include stronger collaboration with DIII-D, MAST-U

  Already have ongoing collaborations for ITPA-EP (JEX led by NSTX-U)