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Development of High Non-Inductive Fraction H-Modes

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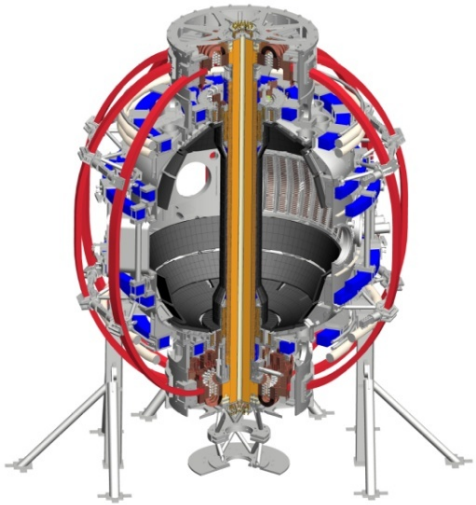
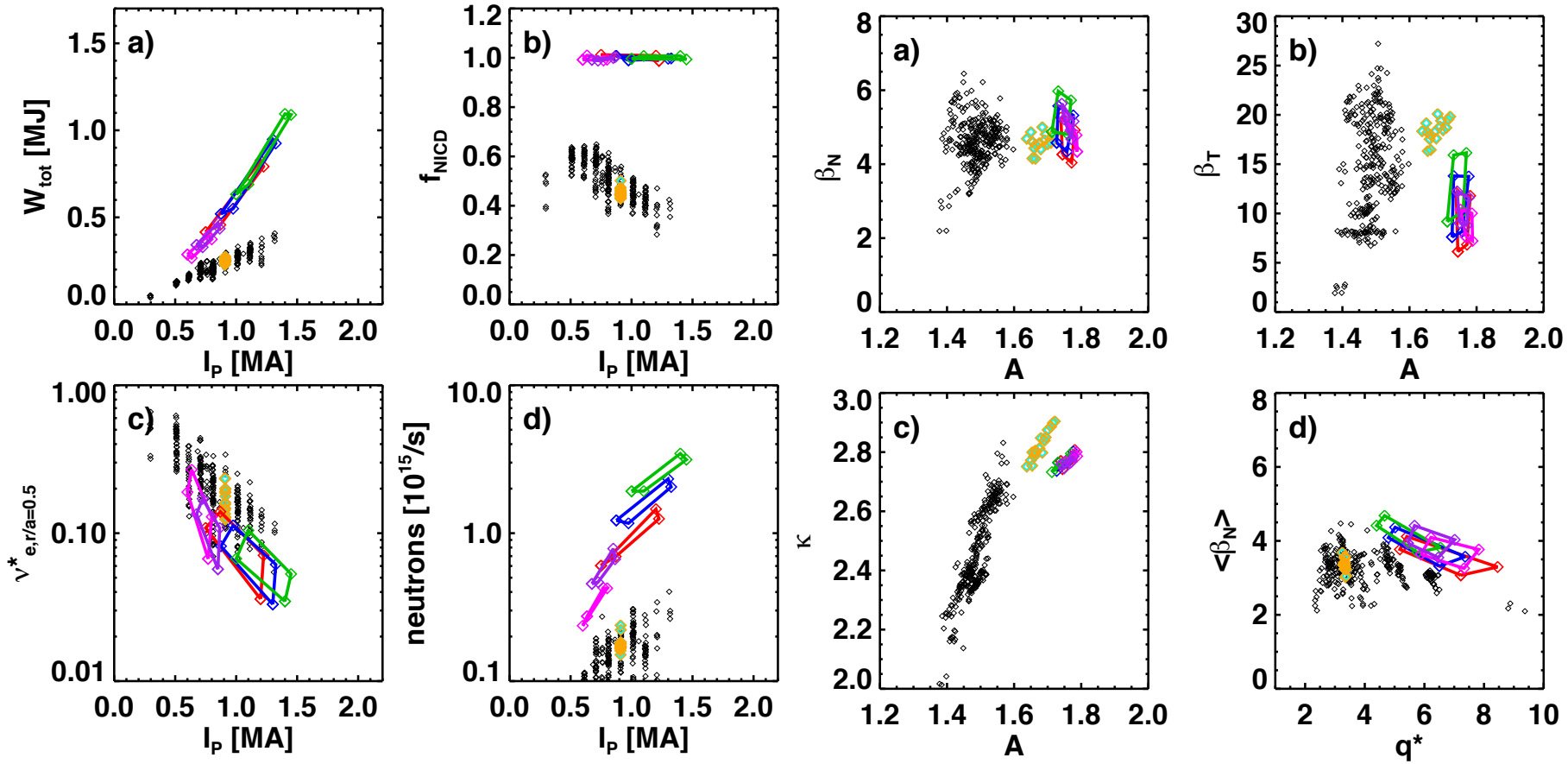


Outline and General Process

- Goal: Develop a high non-inductive fraction H-mode scenario, ideally achieving full non-inductivity.
- Features of the XP idea:
  - Fix the I_P request, and continue to do I_P feedback via the loop voltage.
  - Use standard inductive current ramps.
    - Develop the non-inductive state after SoFT.
  - Beam heating only…no RF requested.
  - Use the highest TF allowable.
  - 10-15 cm outer gaps, highest elongation that can be reasonably achieved.
  - Use the loop voltage, simple scaling for the confinement and non-inductive fraction to guide the XP.
    - Between shot TRANSP sure would be nice…

Anticipate Developing 100% Non-Inductive Scenarios at the 500-700 kA Range



All: f_{GW}=0.7, f_{NI}=100%, 15 cm outer gap
6x80 kV, B_T=1 T
6x90 kV, B_T=1 T
6x100 kV, B_T=1 T
4x80 kV, B_T=0.75 T
4x90 kV, B_T=0.75 T

All: f_{GW}=0.7, f_{NI}=100%, 15 cm outer gap
6x80 kV, B_T=1 T
6x90 kV, B_T=1 T
6x100 kV, B_T=1 T
4x80 kV, B_T=0.75 T
4x90 kV, B_T=0.75 T

Roughest Shot Plan

- From modeling, determine a likely operating point.
  - Right now, I think 0.65 T, 600 kA, 6-8 MW made up of [60,70,130] + other sources.
- Establish baseline at this field and current, ~65-75% of the baseline power.
  - Reduced power to avoid hard beta limits.
- Increase the power towards the non-inductive value, until either fully non-inductive, or reaching beta limit.
- If it becomes clear that non-inductivity is not possible at this current, then reduce the plasma current and power, and repeat the power scan.
- Once a near non-inductive point is found, then:
  - Scan the beam sources around that operating point.
  - For different beam sources, make small modifications to the plasma current request around that operating point, to account for different beam current drive efficiencies.

Other Considerations

- Density: Target f_{GW}~0.6-0.8, but in the end will take what we can get.
  - Use whatever fuelling scheme seems most reliable at that time, but would prefer to minimize the HFS fuelling to the extent that it is possible.
- PFC conditioning:
  - Would prefer to do this in both Boronized and Lithiumized PFCs.
  - Boronized case with ELMs provides Z_{eff} control, but maybe D_2 accumulation.
  - Lithiumized case provides higher confinement and D_2 control, maybe with too high a Z_{eff}.
  - If the granule injector proves capable of triggering ELMs in the Lithiumized state, then may want to use that on a few shots.
- OH coil dynamics…will have essentially a flat I_{OH} waveform during the flat-top.
  - Need to pick a value of the pre-charge that will result in OH heating at about the same rate as the TF heats.
  - May want to have a small precharge, so that we swing through zero and have negative I_{OH} during the flat-top
    - makes returning I_{OH} to zero easier.
    - Makes the scenario more forgiving to changes in the ramp-up flux consumption (?).