



MHD Science Focus Group

ELM mitigation discussion and 2008 research plans

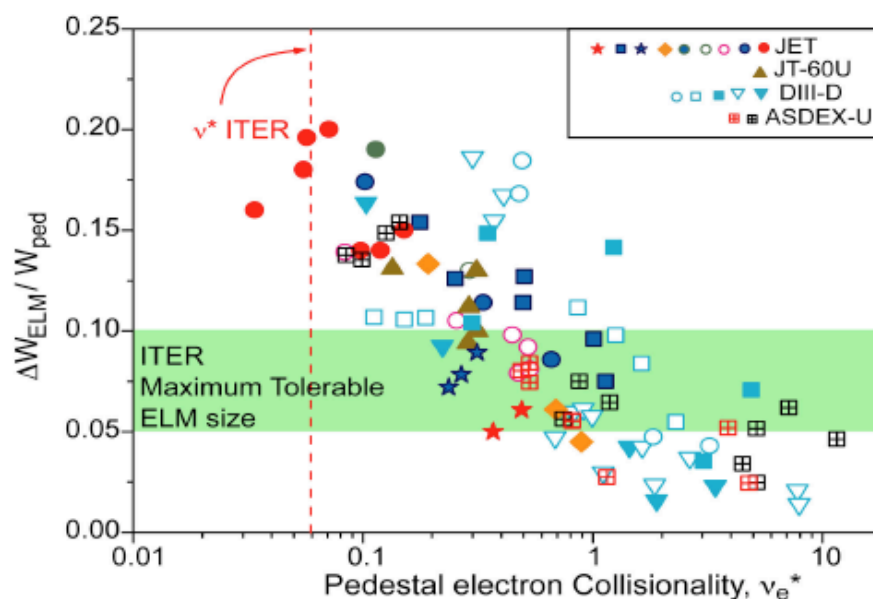
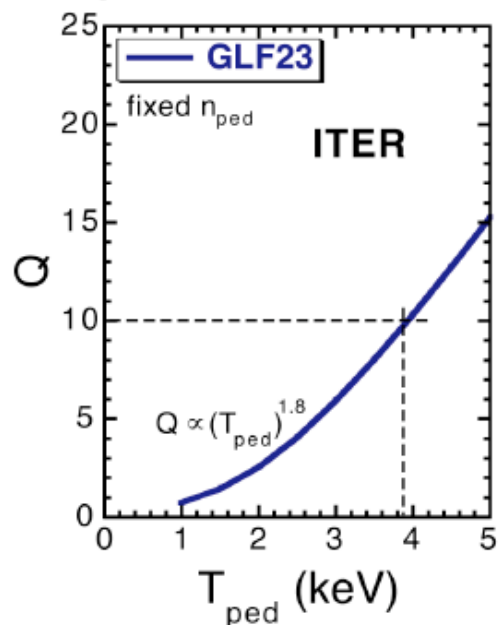
D. A. Gates

December 11, 2007

ELM control is a high priority ITER issue

Evans EX2-5Ra

- $T_{e\text{ ped}} \geq \sim 4 \text{ keV}$ for $Q \geq 10$ in ITER

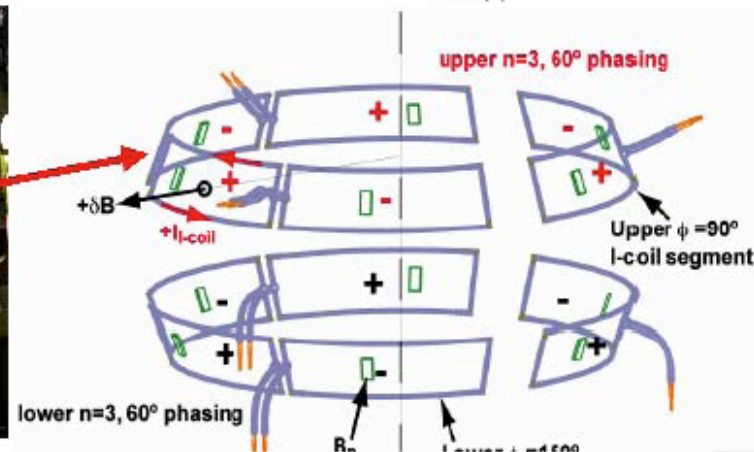
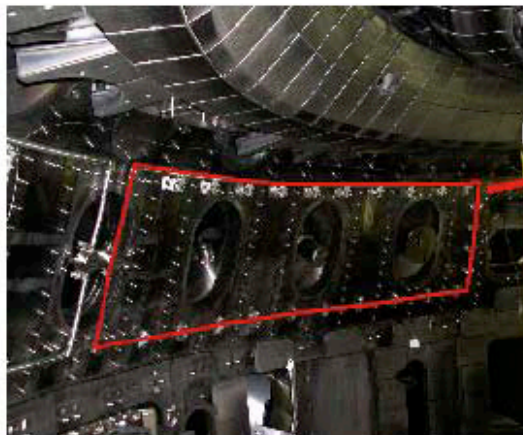
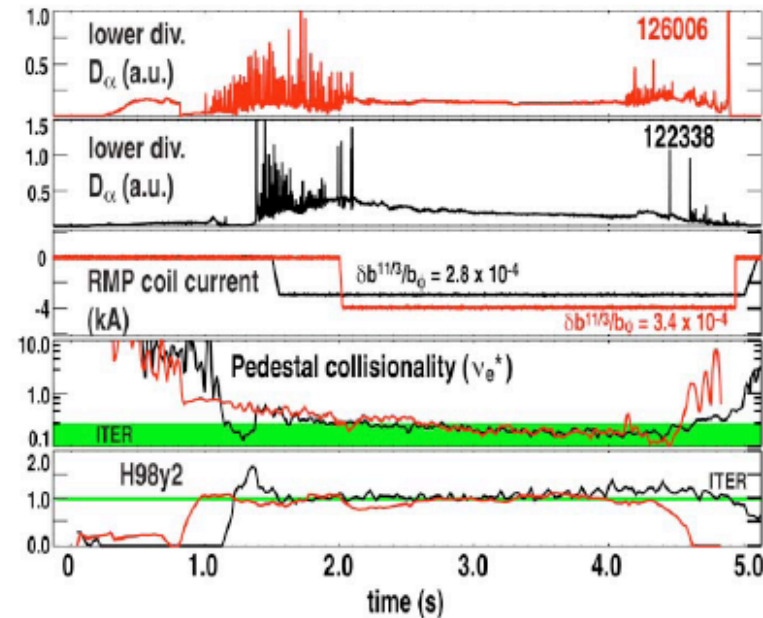


- Normalized ELM energy ($\Delta W_{\text{ELM}}/W_{\text{ped}}$) increases with $T_{e\text{ ped}}$
- In ITER $\Delta W_{\text{ELM}}/W_{\text{ped}} > 20\%$
 - exceeds carbon ablation limit by a factor of 2-4



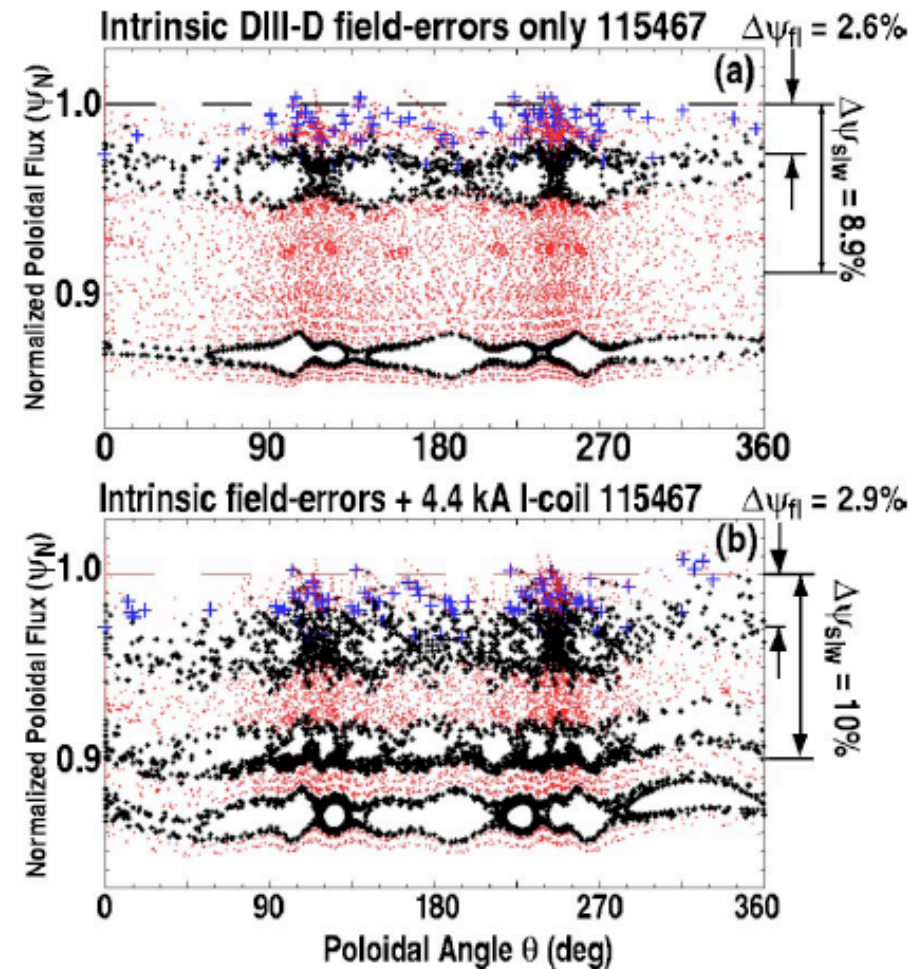
ELM suppression by ergodization

- Ergodization works for D3D (and JET).
- WG-1 has proposed to use a set of 36 Resonant Magnetic Perturbation coils similar to DIII-D



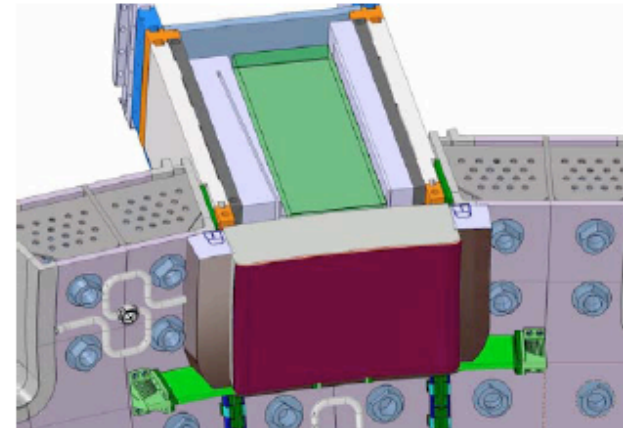
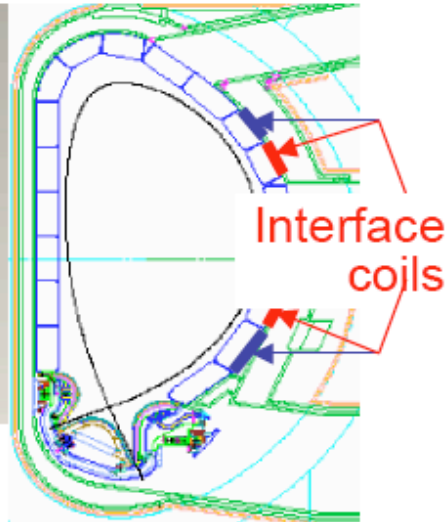
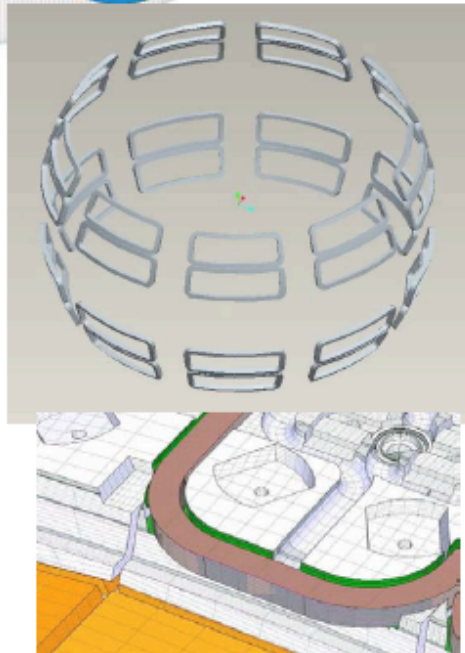
Plasma response poorly understood

- Experiments based on expectation of ergodization from vacuum fields
 - Ergodization usually characterized by Chirikov parameter
- Chirikov parameter not well correlated with mitigation

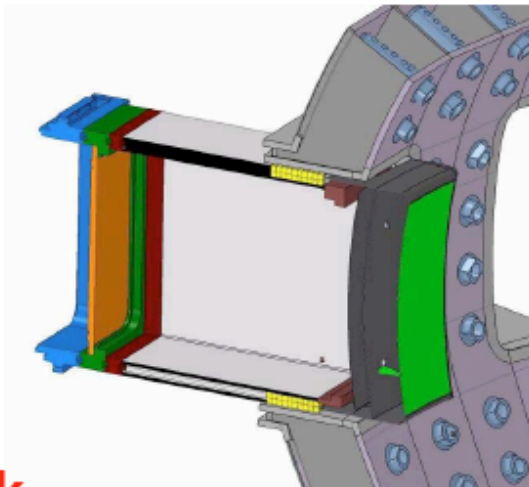




ELM Control Coils options studied



Picture frame coils



Port-plug coils

Blanket-Vessel Interface coils

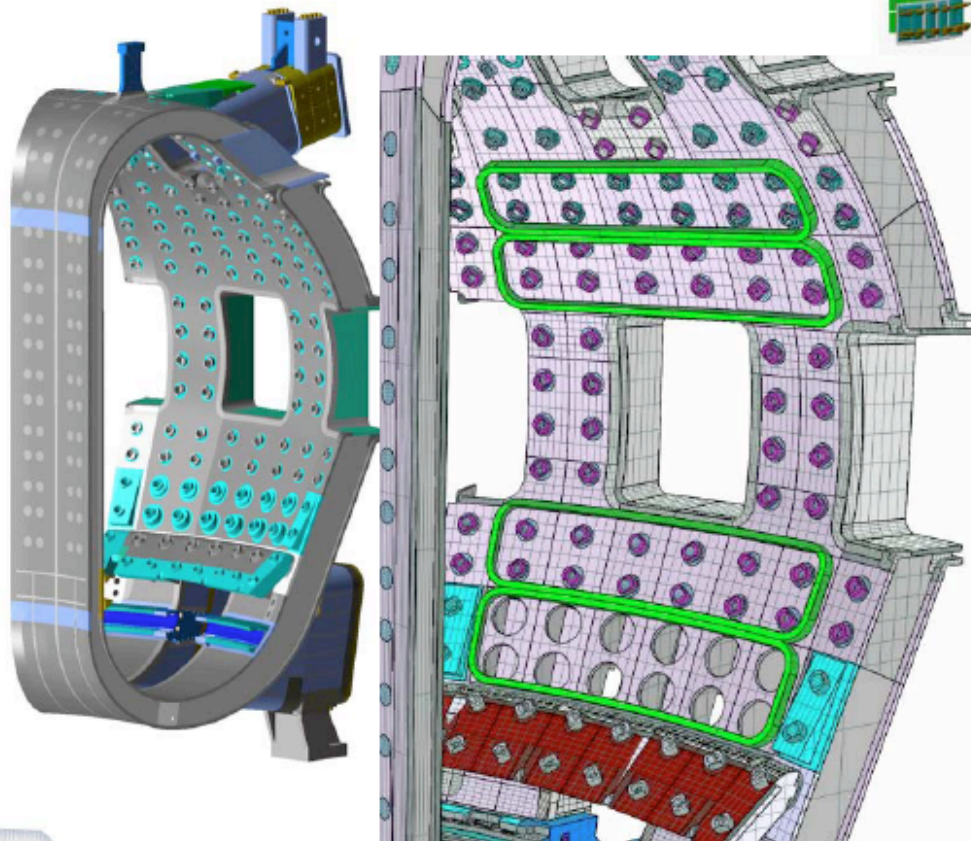
Three concepts studied by WG1 and costed by IO

**Only 36 coil option will most likely work
change location to between VV shells**

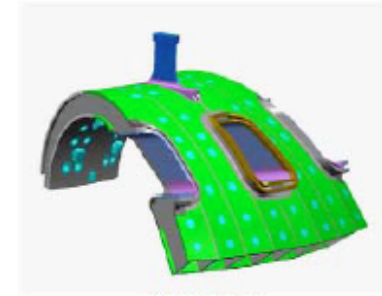


Vacuum Vessel – ELM coils between shells

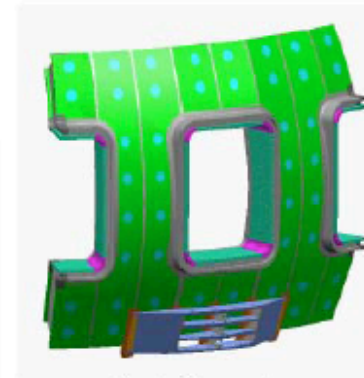
STAC ask for this study until their next meeting



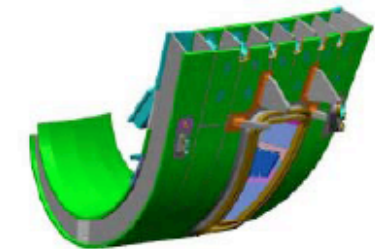
Inboard segment



Upper segment



Equatorial segment



Lower segment

A working group (IO, EU, US, KO) will study this option

Conceptual design to be available until end of February

Then check schedule – cost- and safety impact

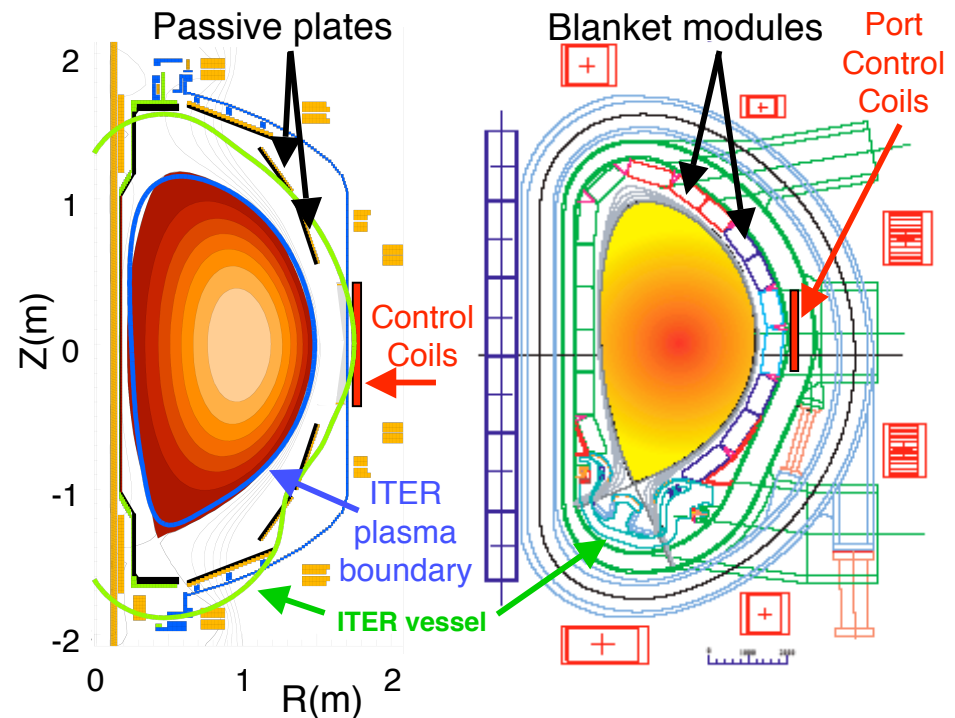


Cost and schedule impact of the design review

- Approximately 80 DCRs are related to the design review process
- **The total cost of the design review related changes will be in the order of 150 M€ +/- 50 M€ including the items asked for by STAC**
- Most changes have a small cost impact or non, only a few have a large cost impact
 - (e.g. ELM coils (40 to 55 M€) and magnet cold test (30 to 50 M€))
- **Only a few changes will have a schedule impact**
 - magnet cold test (~ 3 month on TF procurement)
 - ELM coils between VV shells (~ 6 month on VV)

NSTX RWM coil mimics proposed ITER port plug coils

- High cost of coilset drives consideration of multiple use coils
- Can a single row of midplane coils (useful for RWM feedback) also suppress ELMs?
- What tools can PPPL contribute to this effort on the applicable timescale (a few months)



New capability allows modification of toroidal EF spectrum on NSTX

- Three independent power supplies
 - connected to one or more coils each by movable jumpers
- What mode spectra are likely to produce ELM mitigation?
- How does the physics of ELM mitigation scale with plasma parameters
- What determines the plasma response to the applied 3D field?

