DIII-D Wall Change Community Forum – Day 2

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Logistics and Goals for Today

- **Breakout sessions were not recorded, but PDFs are being made available on the website**
- **Goal today: evaluate level of consensus within/between BGs**
- **We do not necessarily need to converge on one set of capability gaps, alignment, & approach**
  - Can potentially present multiple options to PAC in late July

Different DIII-D Wall Materials Allow Varying Levels of Progress Toward Physics Gap Closure (part 1)

	SiC	Tungsten	Tungsten Proxy (e.g., Mo, Fe, Ni, V)	Carbon ("Do Nothing")
Resolve compatibility of FPP relevant cores and materials	• Added flexibility due to low radiation, Z_{eff} in plasma core from intrinsic impurities • Allows tailoring of pedestal/core radiation profile • Lower (but non-zero) intrinsic low-Z radiation in divertor than all-C wall	• Challenging, but opportunity to demonstrate compatibility of all-W wall with AT using flexible toolsets – high power ECH – active wall conditioning • But W-core radiation not in reactor relevant regime • Minimal intrinsic low-Z, flexible detachment control using impurity seeding	• Potential better match to core radiation profile expected in FPP, but not a reactor relevant material • Sourcing mitigation strategies likely relevant to tungsten	• None of these goals can be accomplished.

Different DIII-D Wall Materials Allow Varying Levels of Progress Toward Physics Gap Closure (part 2)

	SiC	Tungsten	Tungsten Proxy (e.g., Mo, Fe, Ni, V)	Carbon ("Do Nothing")
Optimize FPP first wall design for PMI	• Goals can be accomplished since SiC considered reactor-relevant material	• Goals can be accomplished since W considered reactor-relevant material • Tungsten may introduce more difficulties in diagnostic interpretation (reflections)	• No testing of reactor-relevant materials • Toroidal symmetrization will help with enhancing predictive capability in the far-SOL	

DIII-D PMI Program Is an Essential Component of the Community-Driven Strategic Plan for Fusion Energy

CPP Strategic Objective	CPP Strategic Elements involving DIII-D PMI Program
FST-SO-A: ***Demonstrate Plasma-Facing Component Solutions***	**Material Migration in a U.S. Confinement Experiment**
	Multiphysics/Multiscale Edge/SOL/Divertor Plasma & Materials Model Validation
	In-situ & Real-Time PMI Measurements
	High Heat Flux, He Gas Cooling, Engineered Materials Development, Advanced Manufacturing Technology
FST-SO-D: ***Advance the Tokamak Physics Basis***	**Test New Solid PFC Materials in Tokamaks**
	Test New Wall Conditioning Techniques in Tokamaks

FESAC-LRP Elements involving DIII-D PMI Program
"Plasma-facing component integration and FPP-relevant scenario development" (p14)
"Plasma-material interactions and material choices for exhaust solutions" (p31)

Leading Role
Supporting Role

International Confinement Facilities Complement DIII-D's Role and Capabilities

Facility	Divertor Material	Main Chamber Material	Capabilities
DIII-D	**C → W, ?**	**C → SiC, W, ?**	**Rapid change-out. Well diagnosed. Conditioning by powder dropping. Core scenario flexibility.**
ASDEX-U	W	W	Boronized, divertor and main chamber manipulators. Minimal AT program, wall is far from plasma, divertor geometry limitations.
EAST	W	C → Mo	Actively cooled divertor. MAPES midplane station. Long pulse. Strong GA-ASIPP team.
JET-ILW	W	Be	Has operated with graphite PFCs. The current PFC configuration may be somewhat relevant to a C/W PFC configuration on DIII-D.
JT-60SA	C → W	C (→ W)	Water-cooled divertor. Heat loads <15 MW/m^2. Superconducting machine. Similar core/edge integration challenge.
KSTAR	W ('23)	C → W coat-ed tiles	DIII-D-like performance, similar core/edge integration challenges. Long pulse
NSTX-U	C → LM	C	Plans to explore viability of liquid metals. Complementary to solid PFC approach studied in DIII-D
SPARC	W-alloy	W	High B-field, high PFC fluxes.
WEST	W	W	Boronized. Operates with two actively cooled tungsten divertors. Long pulse. Limited diagnostic set, substantial O,C impurity issues.

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EAST	W		…Long pulse.
JET-ILW	W		…configuration …ration on DIII-D.
JT-60SA	C → W		…perconducting …
KSTAR	W ('23)		…on challenges.
NSTX-U	C → LM		…entary to solid
SPARC	W-alloy		
WEST	W	W	Boronized. Operates with two actively cooled tungsten divertors. Long pulse. Limited diagnostic set, substantial O,C impurity issues.

- **Core scenario flexibility is key for testing new wall materials**
  - This will lever the imminent increases in DIII-D's ECH capability
- **Diagnostic set is also critical for rapid advancement of solid PFM solutions**