

Main nuclear responses of the DEMO tokamak with different in-vessel components configurations

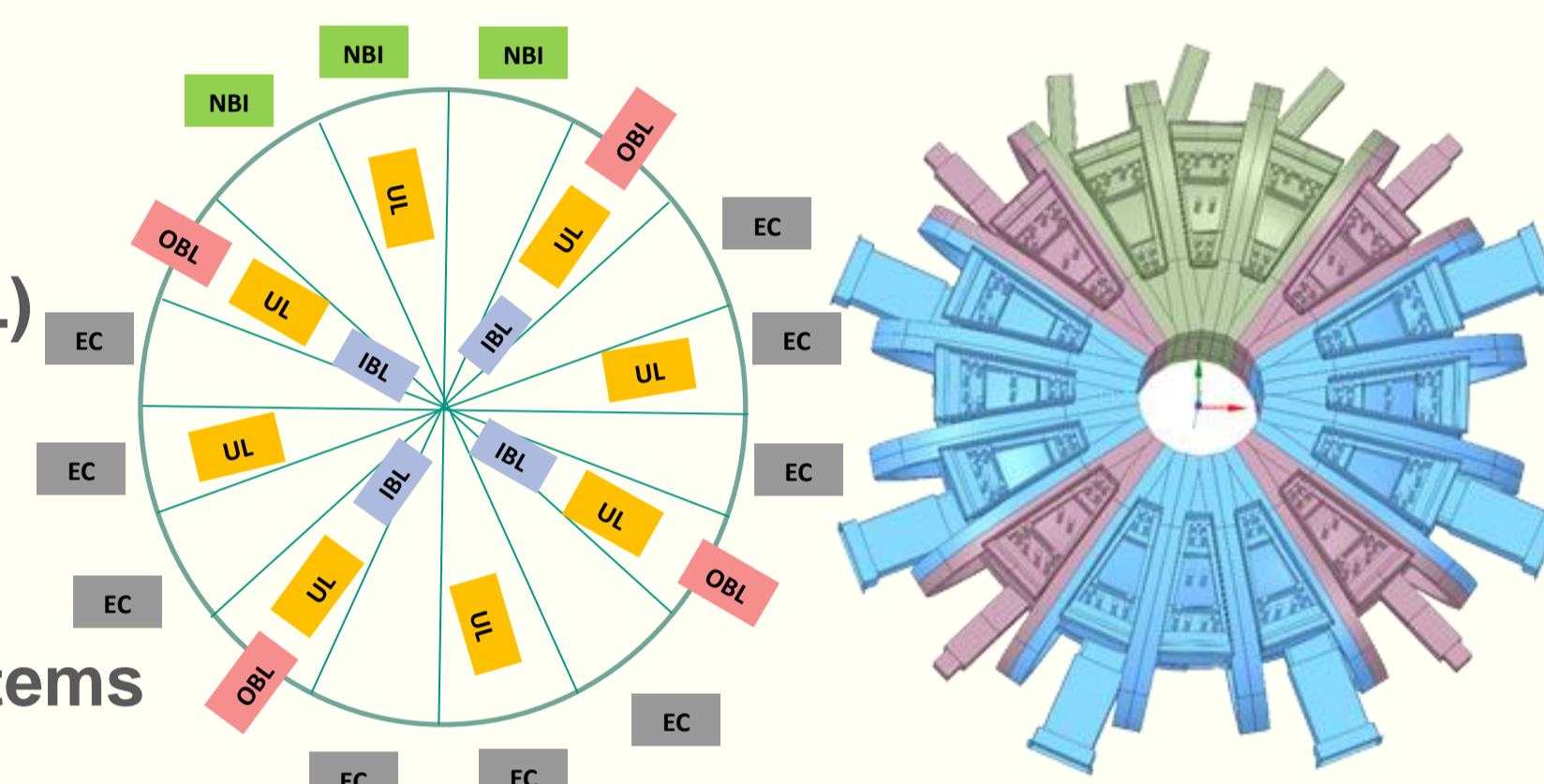
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Objectives

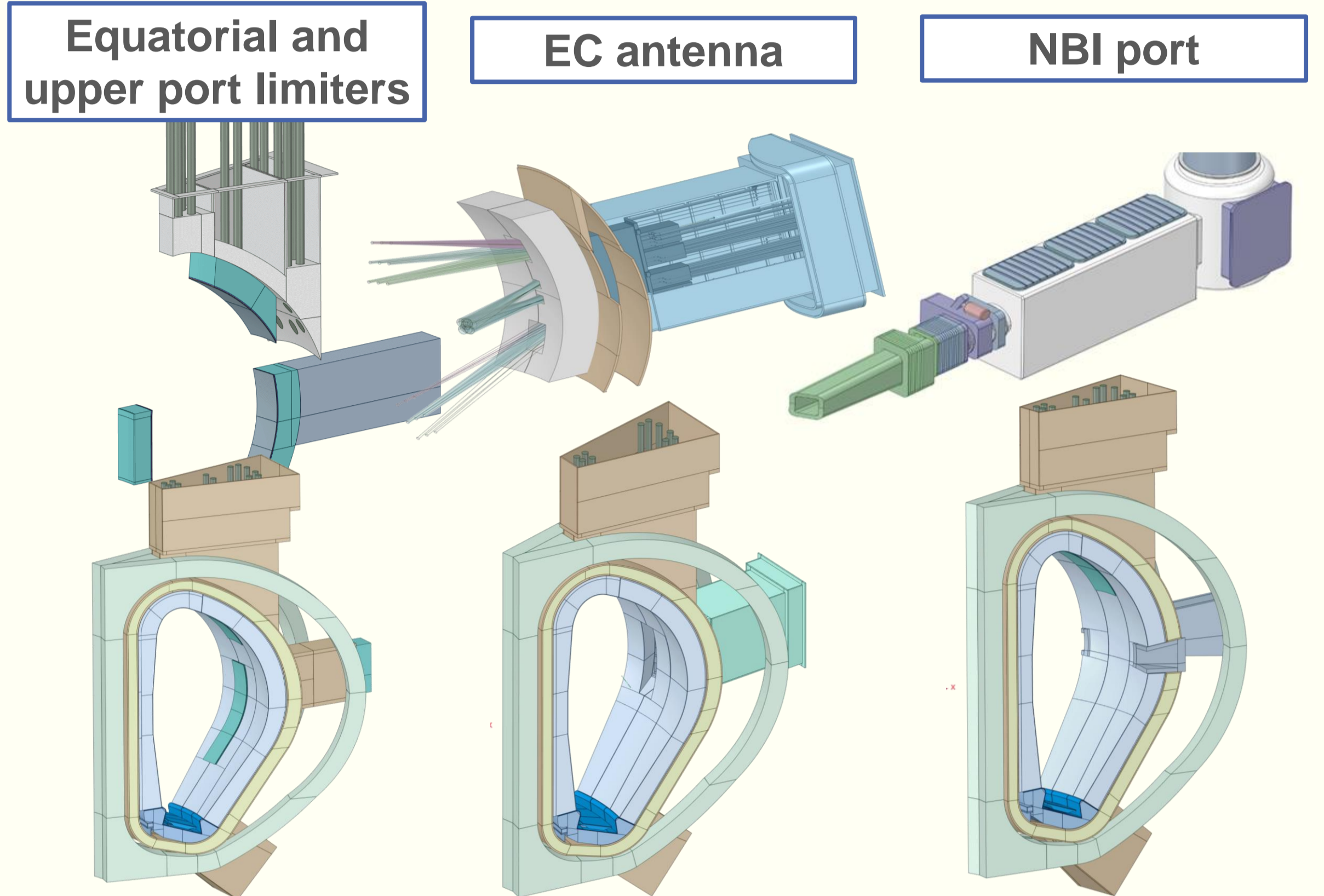
- TBR reduction from limiter and NBI and EC
 - Each limiter, NBI and EC port effect on TBR
- Effect analysis for each various heterogeneous BB concepts
 - HCPB, WCLL, WLCB concepts

IVCs configuration in DEMO¹⁾

- 4 x inboard mid-plane limiter (IBL)
- 4 x outboard mid-plane limiter (OBL)
- 8 x upper port limiter (UPL)
- 4 x lower mid-plane limiter
- 3 x Neutral Beam Injector (NBI) systems
- 9 x Electron cyclotron (EC) antennas



CAD geometry models

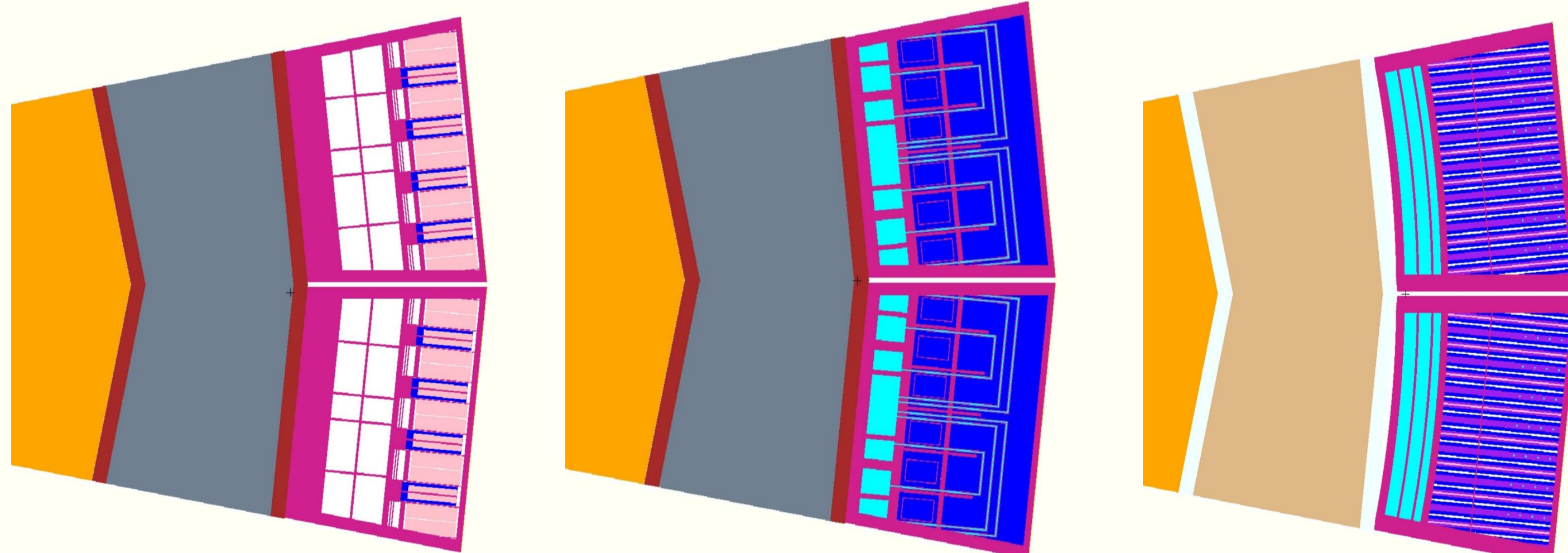


Breeding blanket models

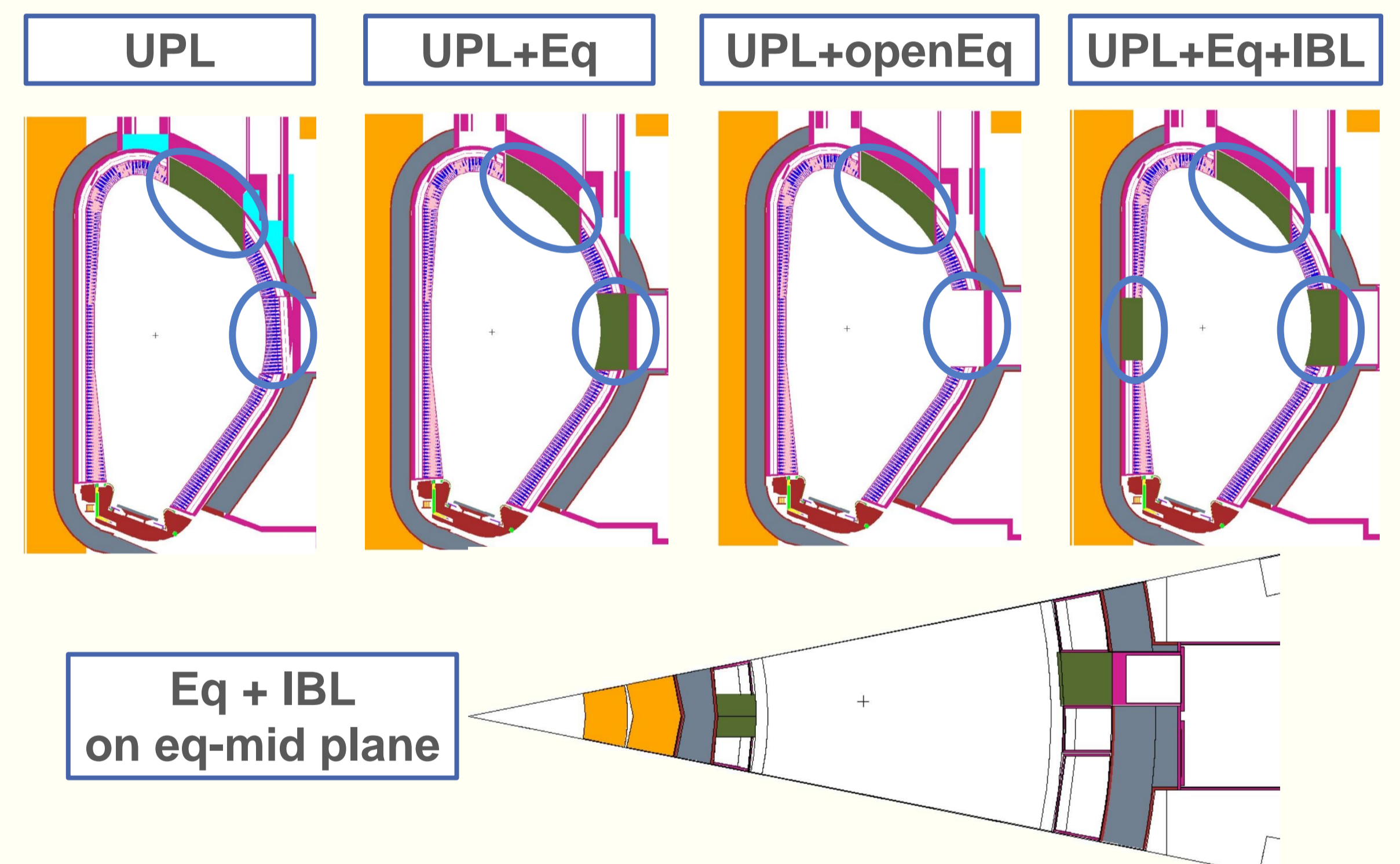
HCPB²⁾

WCLL³⁾

WLCB⁴⁾



Limiter configuration on MCNP models



TBR reduction rate for single port or limiter, and TBR reduction rate for the entire 360° model. (units: %)

	Homogeneous HCPB ⁵⁾		Homogeneous WCLL ⁵⁾		Heterogeneous HCPB		Heterogeneous WCLL		Heterogeneous WLCB	
	δ TBR single port or limiter	δ TBR 360° Tokamak	δ TBR single port or limiter	δ TBR 360° Tokamak	δ TBR single port or limiter	δ TBR 360° Tokamak	δ TBR single port or limiter	δ TBR 360° Tokamak	δ TBR single port or limiter	δ TBR 360° Tokamak
EC	0.272	2.448	0.261	2.350	0.218	1.966	0.266	2.397	0.185	1.661
NBI	0.160	0.480	0.240	0.720	0.218	0.655	0.266	0.799	0.185	0.554
UPL	0.612	4.896	0.499	3.990	0.517	4.135	0.440	3.522	0.503	4.022
IBL					0.192	0.767	0.212	0.848	0.165	0.662
OBL (mid-plane)	0.773	3.092	0.803	3.210	0.373	2.984	0.386	3.087	0.299	2.393
OBL (lower)					0.373		0.386		0.299	
Total in tokamak		10.916		10.270		10.507		10.653		9.292

Conclusion

Regardless of the BB concepts TBR reduction due to limiter, NBI and EC – up to 11%

Reference

- P. Pereslavl'tsev, PMI-3.3-T036-D001: Different IVC configurations, <https://idm.euro-fusion.org/default.aspx?uid=2MY49Y>
- G. Zhou, F.A. Hernández, P. Pereslavl'tsev, B. Kiss, A. Retheesh, L. Maqueda, J.H. Park, The European DEMO Helium Cooled Pebble Bed Breeding Blanket: Design Status at the Conclusion of the Pre-Concept Design Phase, *Energies* 2023, 16, 5377
- P. Arena et al., The DEMO Water-Cooled Lead-Lithium Breeding Blanket: Design Status at the End of the Pre-Conceptual Design Phase, *Appl. Sci.* 11 (2021) 11592
- P. Pereslavl'tsev, F. Hernandez, G. Zhou, Lei Lu, Ch. Wegmann, U. Fischer, Nuclear analyses of solid breeder blanket options for DEMO: status, challenges and outlook, *Fus. Eng. Design*, v.146 (2019) 563-567
- P. Pereslavl'tsev, C. Bachmann, J.H. Park, DEMO tritium breeding performances with different in-vessel components configurations, *Fus. Eng. Design*, v.166 (2021), 112319



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