Wendelstein 7-X: Proposal for Operational Phase 2 “He exhaust at Wendelstein 7-X (from the island divertor and sub-divertor volume perspective)”

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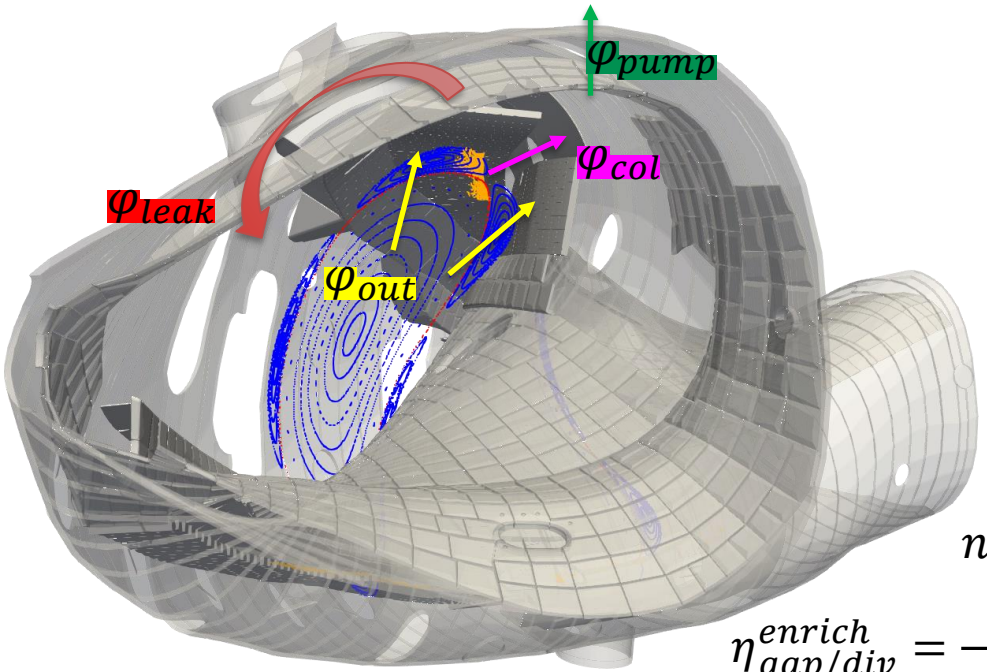
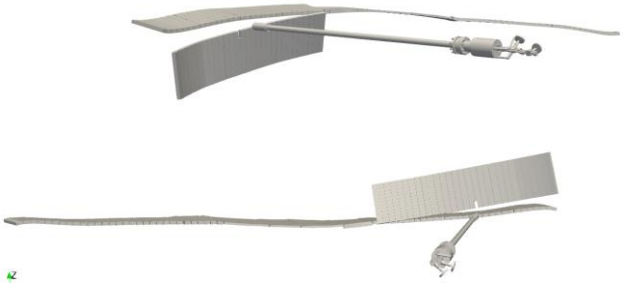
Proposal

1. He removal and enrichment (maximization) - Questions to answer:
    1. τα*/τE < 10?
    2. How can we decrease τα*, study it properly?
    3. How can we increase the pumping gap neutral pressure (and later also further to the pumps)?
    4. Can we de-couple He from H (T) exhaust – He enrichment?
    5. Is He retention good enough for the IRC vs ERC regimes?
2. Knobs
    1. Strike-line location (I_{cc} = [0..2] kA)
    2. Island size (correct its position) (-> optimum λ_0 for He -> EMC3-EIRENE)
    3. Magnetic configuration: standard vs high/low-i – islands connection
    4. Density scan
    5. Power scan
    6. Different puffing locations
3. Metrics
    1. Puff/pump studies
    2. He-NBI/pump studies
    3. $\eta_{gap/div}^{enrich}$
    4. $P_{He}(t)$, $P_{H2}(t)$
    5. τ_{He}, τ_{H2}
    6. HeI, H balmer lines
    7. He, H densities
4. Attachment -> Detachment: pressure stays constant (should drop) – done for H. But what about He?
5. Non-resonant configuration (Geiger + Schmitz + Garcia)
6. Influence of He on neutral conductance by Dieter
7. Cryo pumps will increase H_2 pumping => He enrichment? + Possibly Ar frosting.

Characteristic parameters





$$\eta^{enrich}_{gap/div} = \frac{n^{gap}_{He} / 2n^{gap}_{H_2}}{n^{div}_{He} / n^{div}_{H}} \; ? \; \frac{p^{gap}_{He} / 2p^{gap}_{H_2}}{n^{div}_{He} / n^{div}_{H}}$$

$\tau^{*}_{He,p}$ ← Edge spectroscopy

p^{gap}_{He} ← WISP gauges

n^{div}_{He}, n^{div}_{H} ← S/XB + spectroscopy

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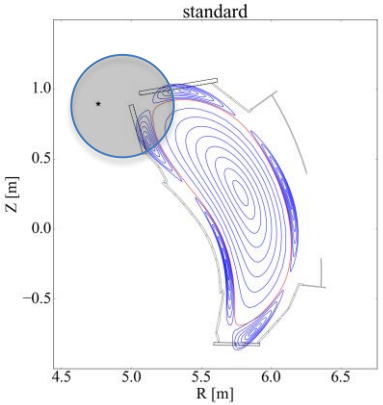
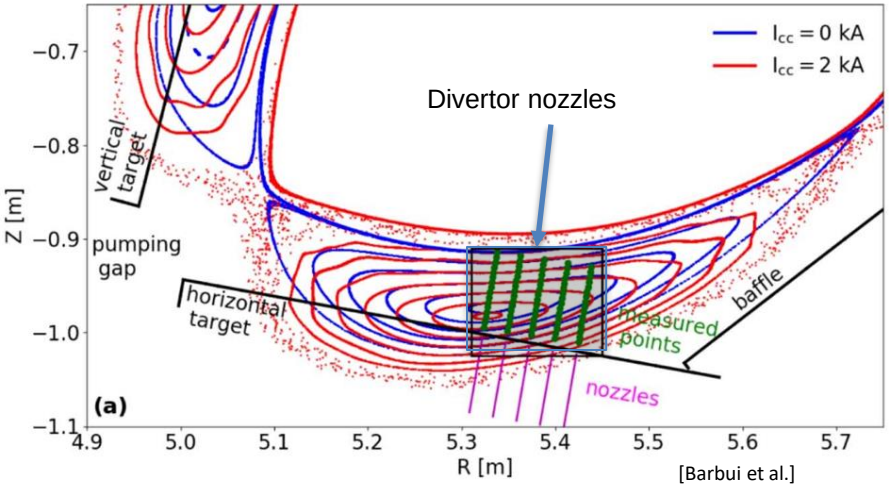
Neutral pressure at the island divertor



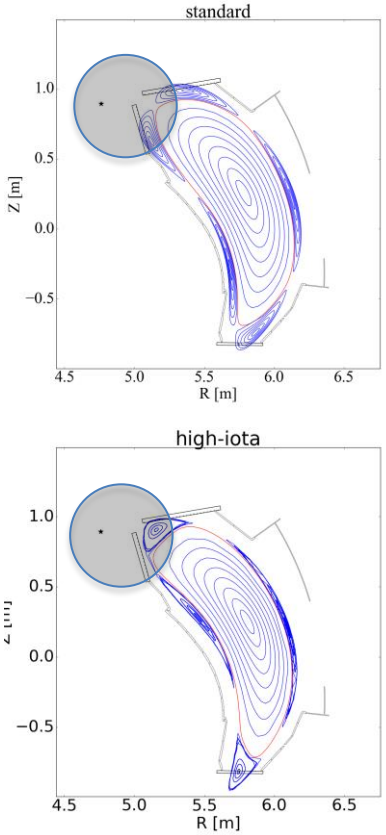
1. **Strike line location**
2. Detachment (Thierry?)



[Barbui et al.]

- Sensitive to plasma current and can be tuned by the Control Coils (I_{cc})
- Change recycling position

Neutral pressure at the island divertor



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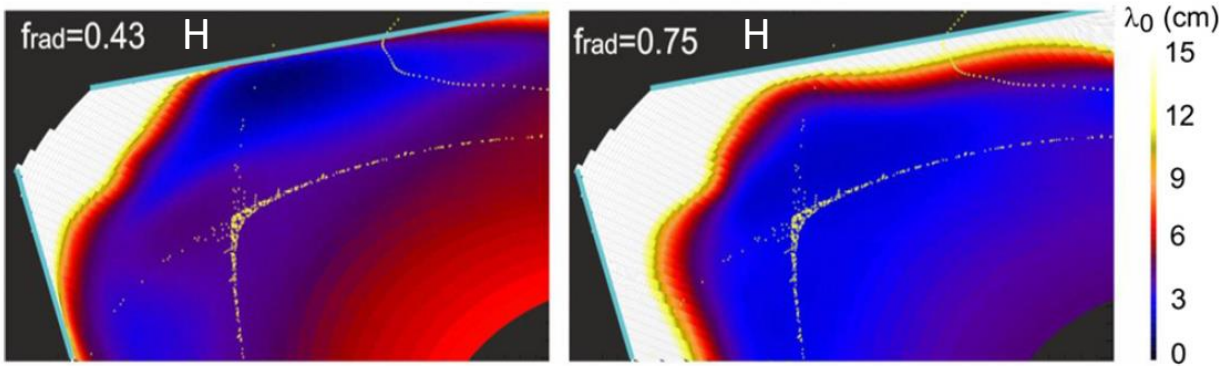

[Feng et al., NF2021]

- $\Gamma_{recycling}$ ↓, but ionization reduces -> H pressure didn't drop!
- He has longer λ_0 than H. What about He and its enrichment?

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Q&A