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Novel divertor designs and their motivation

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Abstract

Divertor designs based on novel magnetic geometries are explored. We estimate that such designs may be required for reactors if:

1) recent experimental results which imply that main chamber recycling dominates over divertor recycling are found to extrapolate to reactors

2) extreme requirements for reliability of very high heat flux components in unprecedented neutron environments cannot be met

3) fusion reactors with very large power output (e.g. for hydrogen production) are considered

Two novel geometries are considered: 1) the extraction of the separatrix flux to outside the TF coils and 2) inducing a *second* x point along the separatrix some distance outside the main plasma, but in vessel. These innovations could enable operation with reduced SOL density and radiation near the plasma, and reduced engineering heat fluxes. We estimate that these may be crucial advantages if blob transport leads to strong main chamber recycling in reactors, which could lead to unacceptable erosion and helium recycling for more conventional divertor concepts. Also, the challenges with conventional divertors increase for larger reactor power levels. Liquid wall and divertor concepts are also considered as potential solutions.