Compact quasi-axisymmetric stellarator-tokamak hybrids: 3D-Optimized Tokamaks

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The novel compact stellarator-tokamak hybrid concept has the potential to merge the advantages of stellarators and tokamaks into a single, advantageous magnetically confined fusion design [1]. The stellarator component is quasi-axisymmetric [2], a type of stellarator that shares many neoclassical properties with tokamaks. To realize this new concept, only one type of stellarator coil is required in addition to traditional tokamak coils, potentially allowing for the upgrading of existing machines [1,3]. We have demonstrated the ability to numerically optimize this new class of designs, including several key physics targets such as Mercier stability and self-consistent bootstrap currents [4,5]. Our work suggests that minimal external current drive is needed in addition to the bootstrap current, which would enable access to steady-state conditions. Furthermore, the rotational transform produced by the coils falls within a range that has been shown to be capable of stabilizing disruptions in experiments [6].
More recently, we have initiated an analysis of the turbulent transport properties of these hybrids and are working to optimize them for reduced turbulent transport. This adds to the list of benefits of this novel concept, further solidifying its potential as a promising approach to magnetically confined fusion.

References

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