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Geometry effects on zonal flow dynamics and turbulent transport in optimized stellarators

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Maximizing effects of zonal flows and radial electric field Er is desirable in the design of optimized stellarators to improve confinement of thermal plasmas and alpha particles. We find through global GTC [1] gyrokinetic simulations that the reduction of ion temperature gradient (ITG) transport by zonal flows in quasi-helical (QH) and quasi-isodynamic (QI) geometry can be more significant than quasi-axisymmetric (QA) geometry or a tokamak, thanks to higher linear residual levels and lower nonlinear frequencies of the zonal flows. [2][3] We also show that the intrinsic 3D magnetic geometry in the stellarators provides a unique opportunity for manipulating the Er by deliberately injecting the neutral beam (NBI) in loss regions of the phase space. We will report self-consistent simulations of the interactions between the Er and fast ion transport to assess the feasibility of controlling Er by the NBI.

References:
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