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The Role of 3D Geometry on Reducing Turbulent Transport in Stellarators[1] BENJAMIN FABER, AARON BADER, PAUL TERRY, CHRIS HEGNA, University of Wisconsin - Madison — The large space of possible stellarator configurations offers the possibility of changing the magnetic geometry to optimize different physics properties, including turbulent transport. Detailed analysis of the nonlinear three-wave turbulent interactions in a fluid model of ITG turbulence indicates that for the HSX stellarator, energy transfer is strongly influenced by three-wave nonlinear interactions between unstable modes and stable modes at similar scales. This nonlinear model provides a natural optimization metric, as nonlinear energy transfer is quantified by a three-wave interaction time, where the frequencies involved in the interaction time are strongly influenced by geometry. HSX possess the ability to alter its MHD equilibrium by adding a magnetic well or hill component. Both nonlinear GENE simulations and fluid calculations show an ITG turbulence minimum when the magnetic hill is increased and maximum with increased magnetic well, indicating a more prominent role of stable modes with increasing magnetic hill. This picture will be compared against detailed analysis of the spectral gyrokinetic energy transfer, by tracking the evolution of nonlinear energy transfer between different wavenumbers and eigenmodes to expose the role of stable modes in turbulence saturation.

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