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Ray tracing for ballooning modes in quasi-symmetric stellarators[1]

E. MONDLOCH, A. S. WARE, University of Montana, R. SANCHEZ, Universidad Carlos III de Madrid, D. S. SPONG, D. DEL-CASTILLO-NEGRETE, Oak Ridge National Laboratory — The ray tracing techniques introduced by Dewar and Glasser [R. L. Dewar and A. Glasser, Phys. Fluids **26**, 3038 (1983)] are used to examine global ballooning stability for three different quasi-symmetric stellarator equilibria: the quasi-poloidally symmetric QPS, the quasi-helically symmetric HSX, and the quasi- axisymmetric NCSX. In the ray tracing method, global ballooning mode stability is calculated by following rays in the eigenvalue space determined by the results of local, infinite- n ballooning theory. For all three of these configurations, the unstable structures are of the localized, ballooning type and are limited to narrow bands of field lines. This is true even well above a marginal stable β. The range of *alpha* (where α is the field line label) for which unstable surfaces are found is broader in QPS than in NCSX while the range of θ_k (where $\theta_k = k_q/k_\alpha$ is the ballooning parameter) for which unstable surfaces are found is narrower in QPS than in NCSX. For HSX, the weak global shear results in modes which only weakly depend on the ballooning parameter, θ_k. This weak dependence makes the ray tracing for HSX challenging.

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