Effects of magnetic field geometry on microinstabilities in an advanced stellarator

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The analysis of microinstability is important for understanding the turbulent transport of magnetically confined plasma. Since magnetic field configuration affects microinstabilities [1], the effects of magnetic field configuration should be analyzed for improvement of plasma confinement performance. An advanced stellarator concept, CHD-U is discussed as a stellarator device that can control magnetic field configuration from quasi-axisymmetric (QA) to quasi-isodynamic (QI) configurations. The QA configuration is nearly axisymmetric like tokamaks. The QI configuration of CHD-U has a large variation in magnetic field strength, with the maximum value of magnetic field strength being about twice as large as the minimum value [2]. In this work, we focused on Ion Temperature Gradient (ITG) instability in these configurations and executed linear instability analysis by a local fluxtube gyrokinetic Vlasov code GKV [3].

Figure shows R_0/L_{Ti} dependence of the maximum growth rate γ_{max} for $\rho = 0.5$ at field line label $\alpha = \zeta_B - q\theta_B = 0, 0.3\pi$ and 0.5π obtained from gyrokinetic simulation with adiabatic electron model, where ρ is normalized minor radial coordinate, ζ_B and θ_B are toroidal and poloidal angles in Boozer coordinate. R_0/L_{Ti} dependence of γ_{max} for QA and QI configurations is similar in the case of $\alpha = 0$, while the difference of R_0/L_{Ti} dependence of γ_{max} between QA and QI configurations becomes big when α is close to 0.5π. Therefore, we might be able to observe the effect of the difference between QA and QI configurations on microinstabilities by the measurement of turbulence driven by microinstabilities near the point where $\alpha = 0.5\pi$ for both QA and QI configurations.

Furthermore, the higher R_0/L_{Ti} is, the bigger the difference of γ_{max} depending on field line label appears in the QI configuration compared to the QA configuration. The critical temperature gradient is $R_0/L_{Ti,crit}{\sim}2$ regardless of field line label and magnetic field configuration. Magnetic field geometry changes greatly depending on field line label in the QI configuration, whereas it changes slightly in the QA configuration. That is to say, the difference of magnetic field geometry depending on field line label and magnetic field configuration has strong effects on the growth rate and its R_0/L_{Ti} dependence, and weak effects on the critical temperature gradient in CHD-U configuration.

The effects of magnetic field geometry on R_0/L_n dependence of ITG instability will be also discussed in the presentation.

References
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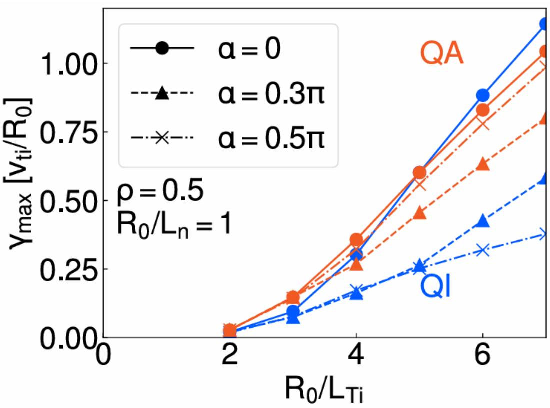

Figure. R_0/L_{Ti} dependence of γ_{max} at $\alpha = 0$ (solid lines with circles), 0.3π (dashed lines with triangles) and 0.5π (dash-dotted lines with crosses) for QA (orange lines) and QI (blue lines) configurations.