Linear microinstabilities in the standard and the high-bumpiness configuration of Heliotron-J

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In the nearly-quasi-isodynamic stellarator Heliotron-J [1] neoclassical transport is expected to be low, rendering turbulent transport as the dominant transport channel in large parts of the plasma. Here we investigate which types of electrostatic microinstabilities are dominant for typical temperature and density gradients with the help of linear, electrostatic, collisionless flux-tube simulations using the GENE code [2]. The ultimate goal would be to identify a configuration with overall reduced turbulence levels. For both the standard and the so-called high-bumpiness configuration of Heliotron-J we present stability maps, containing growth rates and quasi-linear estimates of the heat flux over large ranges of temperature and density gradients. Ion-temperature-gradient modes (ITG), trapped-electron modes (TEM) and ion-driven trapped-electron modes (iTEM) are found and distinguished with the help of frequency analysis and an energy transfer diagnostic. We find that the—more quasi-isodynamic—high-bumpiness configuration has generally lower levels of quasi-linear heat flux and especially lower TEM growth rates. This is very much in line with the theoretical prediction, according to which classical density-gradient-driven TEM should be stabilised in quasi-isodynamic configurations [3]. Even though the high-bumpiness configuration does seem to suffer less from turbulent transport than the standard configuration, the difference might be too small to be observed experimentally. It would thus be desirable to modify the magnetic field even more to potentially obtain even lower levels of turbulence.

References

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