Global gyrokinetic simulations for stellarators

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The code EUTERPE solves the electrostatic gyrokinetic equation globally for fully three-dimensional equilibria using a particle-in-cell method.
Results from simulations of linear ITG instabilities with adiabatic electrons are presented for the two configurations Wendelstein 7-X and LHD as examples of structurally different equilibria. Using a constant density profile the mode structure and driving mechanism for ITG modes found in these equilibria for different plasma β are discussed.
Since stellarators naturally possess a strongly sheared neoclassical radial electric field it is important to assess its influence on ITG instabilities. In order to do this, a simple model of the radial electric field has been included in the simulations. This model assumes that (for constant density) the electric field is determined by its balance with the pressure gradient. In the framework of this model the influence of a neoclassical electric field on growthrate and structure of ITG instabilities is investigated for the two stellarator configurations.
In order to carry out nonlinear simulations the field equation has to be modified such that it contains the flux surface average of the electrostatic perturbation. Since especially for three-dimensional configurations the corresponding matrix is no longer a sparse one, a scheme is presented which uses a matrix-free approach for the averaging operator.