Oberseminar Nichtlineare Differentialgleichungen

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Weak Diffusive Stability Induced by High-order Spectral Degeneracies

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Abstract: The Lyapunov stability of equilibria in dynamical systems is determined by the interplay between the linearization and nonlinear terms. In this talk, we present our recent results on the case when the spectrum of the linearization is diffusively stable with high-order spectral degeneracy at the origin. Roll solutions at the zigzag boundary of the Swift-Hohenberg equation are shown to be nonlinearly stable, serving as examples that linear decays weaker than the classical diffusive decay, together with quadratic nonlinearity, still give nonlinear stability of spatially periodic patterns. The study is conducted on two physical domains: the 2D plane and the infinite 2D torus. Linear analysis reveals that, instead of the classical $t^{(-1)}$ diffusive decay rate, small perturbations of zigzag stable roll solutions decay with slower algebraic rates ($t^{(-\frac{3}{4})}$ for the 2D plane; $t^{(-\frac{1}{4})}$ for the infinite 2D torus) due to the high-order degeneracy of the translational mode at the origin in the Bloch-Fourier spaces. The nonlinear stability proofs are based on decompositions of the neutral translational mode and the faster decaying modes, and fixed-point arguments, demonstrating the irrelevancy of the nonlinear terms.

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