Eugene Wigner Colloquium

event of SFB 910

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"Solitary States in Coupled Oscillators and Power Grids"

Networks of coupled oscillators with inertia can display remarkable spatiotemporal patterns in which one or a few oscillators split off from the main synchronized cluster and start oscillate with different averaged frequency (Poincare winding number). These are so-called solitary states. They are impossible in the standard, pure phase Kuramoto model with sinusoidal coupling. However, this kind striking behavior generically arise when inertia is introduced moreover, in an essential domain of the parameter space.

We report the solitary state appearance for Kuramoto model with inertia in the case of local, non-local, and global couplings. It is shown that solitary states arise in a homoclinic bifurcation and they preserve in both thermodynamic and conservative limits [1]. We find that this kind striking behavior is characteristic for power grids, considering a sample circle model and the Scandinavian grid. In power grids, solitary states co-exist with the desired synchronous regime (as soon as transmission losses are taken into account) and hence, they can provoke a prompt grid desynchronization when sudden (not small) disturbances occur [2].

[1] P. Jaros, D. Dudkovsky, S. Brezetsky, R. Levchenko, T. Kapitaniak, and Yu. Maistrenko, *Solitary states for coupled oscillators with inertia.*Chaos **28**, 011103 (2018).

[2] F.Hellman, P.Schultz, P. Jaros, R. Levchenko, T. Kapitaniak, J.Kurths, and Yu.Maistrenko, *Network induced multistability: Lossy coupling and exotic solitary states.* (sumbitted).

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