# Nonlinear and Chaotic Spatio-Temporal Dynamics in Semiconductor Nanostructures

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Nonlinear transport in semiconductor nanostructure devices can be modelled on the basis of the spatio-temporal dynamics of charge carriers in combination with the electric field and circuit equations. Negative differential conductivity, current instabilities and self-organized pattern formation may arise in the regime of strong nonlinearities far from thermodynamic equilibrium. In this talk we present simulations of complex and chaotic scenarios of the current density and field distributions in nanostructure devices. In particular, we study two models of semiconductor nanostructures which are of current interest [1]:

(i) Charge accumulation in the quantum-well of a double-barrier resonant-tunneling diode (DBRT) may result in lateral spatio-temporal patterns of the current density. Various oscillatory instabilities in form of periodic or chaotic breathing and spiking current filaments may occur. We demonstrate that unstable current density patterns can be stabilized in a wide parameter range by means of a delayed feedback loop.

(ii) Electron transport in semiconductor superlattices (SL) exhibits complex scenarios including chaotic motion of charge accumulation and depletion fronts under time-independet bias conditions. We show that self-stabilization of current oscillations corresponding to travelling field domain modes is possible by a novel low-pass filtered time delayed feedback control.

## References

[1] E. Schöll, *Nonlinear spatio-temporal dynamics and chaos in semiconductors*, Cambridge: Cambridge University Press, 2001.