

## Hannes Uecker, Research

My research centers around the analysis of nonlinear PDE over unbounded domains. Another focus are Mathematical Modeling and numerical simulation. For an overview, my research can be arranged into 4 overlapping areas:

1. Fluid flow, in particular film flow with a free boundary over inclined planes [7, 6, 10, 23, 21, 28, 17, 27, 31]
2. Nonlinear Optics and related systems (NLS related problems) [3, 8, 15, 18, 19, 25, 29, 36]
3. Dynamics of pattern formation ((dissipative) problems in which the Ginzburg–Landau equation and variants play important roles) [1, 4, 2, 12, 9, 22, 35, 3]
4. Miscellaneous PDE systems from physics, chemistry and biology, e.g., Reaction–diffusion systems from surface catalysis, and plasmonic nano–particles, [5, 13, 11, 14, 24, 33, 32, 38]

From the analytic point of view the focus are existence and stability problems and approximation by amplitude or modulation equations. Concerning stability the main issue are continuous spectra up to the imaginary axis, which for parabolic problems yields at most diffusive stability, characterized by polynomial decay rates of spatially algebraically localized perturbations. The amplitude equations are important for model reduction and unification. A recent development is the consideration of problems which are not translationally invariant, e.g., spatially periodic problems or slowly varying coefficients.

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## Publications

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Hint: the linked preprints may differ slightly from the published versions.

## Preprints

- 38 Statistics for surface modes of nanoparticles with shape fluctuations, Preprint, 2009, (mit F. Rütting) preprint
- 37 Approximating the dynamics of active cells in a diffusive medium by ODEs Homogenization with Localization, Preprint, 2009, (mit A. Hutzenthaler und J. Müller) preprint
- 36 Interaction of modulated pulses in nonlinear oscillator chains, *J. Diff. Eq. Appl.*, to appear, 2009 (mit G. Schneider und M. Wand) preprint
- 35 Diffusive stability and diffusive mixing of periodic wave trains in reaction diffusion systems. Preprint, 2009. (mit B. Sandstede, A. Scheel and G. Schneider)
- 34 Local existence and uniqueness of solutions of the weak electrolyte model describing electro-convection in nematic liquid crystals. Preprint, 2009. (mit W.-P. Düll und G. Schneider)

## Peer reviewed Journals and Book chapters

- 33 Well-posedness of some initial-boundary-value problems for dynamo-generated poloidal magnetic fields, *Proc. Royal Soc. Edinburgh*, 139A, 1209-1235, 2009 (mit R. Kaiser) preprint

- 32 Perturbation theory for plasmonic eigenvalues, *Phys. Rev. B*, 80:245405, 2009, (mit D. Grieser, S. Biehs, O. Huth, F. Rütting, and M. Holthaus) preprint
- 31 An integral boundary layer equation for film flow over inclined wavy bottoms, *Phys. of Fluids*, 21, 092105, 2009. (mit T. Häcker) preprint
- 30 A short ad hoc introduction to spectral methods for parabolic PDE and the Navier–Stokes equations, in *Summer School Modern Computational Science, Oldenburg 2009*, Universitätsverlag Oldenburg, 2009 preprint, software
- 29 Coupled Mode Equations and Gap Solitons for the 2D Gross-Pitaevsky equation with a non-separable periodic potential, *Physica D*, 238: 860-879, 2009. (mit T. Dohnal) preprint
- 28 Linear Resonance in viscous films on inclined planes. *IJ Multiphase Flow* 34: 580–589, 2008. (mit A. Wierschem, V. Bontozoglou, C. Heining, und N. Aksel)
- 27 A Hopf-bifurcation theorem for the vorticity formulation of the Navier-Stokes equations in  $\mathbb{R}^3$ , *Comm. PDE* 33:5, 772–783, 2008. (mit A. Melcher and G. Schneider) preprint
- 26 A remark about the justification of the nonlinear Schrödinger equation in quadratic spatially periodic media, *ZAMP*, 59:1-4, 2008 (mit C. Blank, M. Chirilus-Bruckner, C. Chong, V. Lescarret and G. Schneider) preprint
- 25 Separation of internal and interaction dynamics for NLS-described wave packets with different carrier waves, *Math. Anal. Appl.* 347, 304314 (2008), (mit M. Chirilus-Bruckner, C. Chong, and G. Schneider) preprint
- 24 Mass transport of alkali metal with pulses in a surface reaction, *Phys. Rev. E*, 78:055203(R), 2008, (mit M. Hinz, R. Imbuhl, Y. Kevekekidis und Q. Liang) preprint
- 23 Long time persistence of KdV solitons as transient dynamics in a model of inclined film flow, *Proc. Roy. Soc. Edinb.*, 137A: 133–146, 2007. (mit R.L. Pego and G. Schneider) preprint
- 22 Exponential averaging and traveling waves in rapidly varying periodic media, *Mathematische Nachrichten*, 280:4, 408-422, 2007 (mit K. Matthies and G. Schneider) preprint
- 21 Self-similar decay of localized perturbations of the Nusselt solution for the Navier–Stokes equations on an inclined plane, *Arch. Rat. Mech. Anal.* 184:3, 401–447, 2007 preprint
- 20 The amplitude equations for the first instability of electro-convection in nematic liquid crystals in case of two unbounded space directions, *Nonlinearity* 20:1361-1386, 2007. (mit G. Schneider) preprint
- 19 On the interaction of modulating pulses with different carrier waves, *Mathematical Methods Applied Sciences*, 30:15, 1965–1978, 2007. (mit M. Chirilus-Bruckner und G. Schneider) preprint
- 18 The mathematics of light pulses in dispersive media, *Jahresberichte der DMV*, 109:3, 139-161, 2007 (mit G. Schneider) preprint
- 17 A spatially periodic Kuramoto-Sivashinsky equation as a model problem for inclined film flow over wavy bottom. *EJDE* 118, 1-18, 2007, (mit A. Wierschem) preprint

- 16 Simulation of the life cycle of adsorbate islands on the Pt(100) surface during the NO+NH<sub>3</sub> reaction. *Chem. Phys. Letters*, 421:4–6, 577–583, 2006. (mit M. Rafti, J. L. Vicente and R. Imbihl) preprint
- 15 Justification of the Nonlinear Schrödinger equation in spatially periodic media, *ZAMP*, 57:6, 905–939, 2006 (mit K. Busch, G. Schneider and L. Tkeshelashvili) preprint
- 14 Pattern formation for NO+NH<sub>3</sub> on Pt(100) – 2-dimensional numerical results, *Phys. Rev.E*, 71, 016207, 2005. preprint
- 13 Standing waves, clustering, and phase waves in 1d-simulations of kinetic relaxation oscillations in NO+NH<sub>3</sub> on Pt(100) coupled by diffusion. *Physica D* 190:249–265, 2004. preprint
- 12 Stable transport of information near essentially unstable localized structures. *Discrete Contin. Dyn. Syst.B* 4:2, 349–390, 2004. (mit Th. Gallay und G. Schneider) preprint
- 11 Relaxed plasma vacuum states in cylinders. *Q.J. Mech. Appl. Math.*, 57:1, 1–17, 2004. (mit R. Kaiser) preprint
- 10 Self-similar decay of localized perturbations in the Integral Boundary Layer equation. *Journal Diff. Eq.*, 207:2, 407–422, 2004.preprint
- 9 Validity of the Ginzburg-Landau approximation in pattern forming systems with time periodic forcing. *Dynamics and Bifurcations of Patterns in Dissipative Systems*, World Scientific, 39–57, 2004. (mit N. Breindl und G. Schneider) preprint
- 8 Existence and stability of modulating pulse solutions in Maxwell’s equations describing nonlinear optics. *ZAMP* 54, 677-712, 2003. (mit G. Schneider) preprint
- 7 Approximation of the Integral Boundary Layer equation by the Kuramoto–Sivashinsky equation. *SIAM J. Appl. Math.* 63:4, 1359–1377, 2003. preprint
- 6 Almost global existence and transient self similar decay for Poiseuille flow at criticality over exponentially long times. *Physica D* 185:3–4, 209–226, 2003. (mit G. Schneider) preprint
- 5 Adiabatic reduction and hysteresis of the LFI-model of NO+NH<sub>3</sub> on Pt(100). *Chem. Phys. Let.*, 382, 232–244, 2003. (mit R. Imbihl, M. Rafti, I.M. Iruzun, J.L. Vicente und E.E. Mola) preprint
- 4 Stability and diffusive dynamics on unbounded domains. In *Ergodic Theory, Analysis and Efficient Simulation of Dynamical Systems*, ed. B. Fiedler, Springer, 563-584, 2001. (mit A. Mielke und G. Schneider)preprint
- 3 Nonlinear coupled mode dynamics in hyperbolic and parabolic periodically structured spatially extended systems. *Asymptot. Anal.* 28:2, 163-180, 2001. (mit G. Schneider) preprint
- 2 Stable modulating multi-pulse solutions for dissipative systems with resonant spatially periodic forcing. *J. Nonlin. Sci.*,11:2, 89-121, 2001. preprint
- 1 Diffusive stability of rolls in the two-dimensional real and complex Swift–Hohenberg equation. *Comm. PDE* 24:11&12, 2109-2146, 1999.preprint

## Proceedings

- P5 Modeling of film flows over inclined wavy bottoms, *PAMM* 8:10721-10722, 2009 (mit T. Häcker)
- P4 Resonance in viscous film flow over topography *PAMM* 7:4100025–4100026, 2008 (mit C. Heining, A. Wierschem, V. Bontozoglou und N. Aksel)
- P3 Mathematical theory for the Ginzburg-Landau approximation in pattern forming systems with time-periodic forcing – with applications to electro-convection in nematic liquid crystals. *Proceedings of Equadiff-11*: 507–517, 2005. (mit N. Breindl and G. Schneider) preprint
- P2 Local in time nonlinear stability of pulses in an unstable medium. *XIV<sup>th</sup> International Congress on Mathematical Physics, Lisboa 2003*, 296–303, World Scientific, 2005. (mit R.L. Pego und G. Schneider)
- P1 Rolls and modulating pulses in Swift–Hohenberg type of equations, in *International Conference on Differential Equations, Equadiff 99*, World Scientific, 408-413, 2000.

### Thesis

- Stabilitätsuntersuchungen in einem Modell für Formgedächtnislegierungen, Diplomarbeit, Universität Hannover, 1996. Veröffentlicht als Preprint A3 der Reihe *Spannungs- und Verzerrungsbedingte Phasenübergänge in Ingenieurwerkstoffen*, Forschungsprojekt der VW–Stiftung: I70 284. pdf
- Rollen und modulierende Multipulse in musterbildenden Systemen, Dissertation, Universität Bayreuth, 2000. (siehe 1,2)
- Qualitative Theorie nichtlinearer partieller Differentialgleichungen der Mathematischen Physik, Habilitationsschrift, Universität Karlsruhe, 2004. (kumulativ, siehe 3–15, 22)

Homepage