Nicholas D. Alikakos

Professor of Mathematics

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University of Athens
15784 Athens
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Personal information

I was born in Athens, Greece. I graduated from Athens College (Kollegion Athinon), the University of Massachusetts at Amherst (B.S.), and Brown University (Ph.D.). I was elected Professor at the University of Crete in 1988 and Professor at the University of Athens in 1993. I have served on the faculties of Purdue University, University of Tennessee at Knoxville, and the University of North Texas. I was a Visiting Scholar at Stanford University from February 1 to June 1 in 2009, and also in 2012, and Professeur Invité at the Université Pierre et Marie Curie for the month of July in 2010 as well as at the Université Paris-Sud (April 4–18 and May 30–June 14, 2015). Finally, I visited the Courant Institute from February 1 to March 31, 2016.

Honors

ARISTEIA GRANT PDEGE,36 months, 175000 E,2012-2015

Invited AMS address, Birmingham, AL, 2000

Keynote Lecture, EQUADIFF 1999, Berlin

Advisory Board member of the Bulletin of the Hellenic Mathematical Society

Doctoral students

Vangelis Stefanopoulos, 1993 (Professor, University of Patras)

Micha l Kowalczyk, 1995 (Professor, University of Chile)

Georgia Karali, 2002 (Professor, University of Crete)

Christos Sourdis, 2006 (Research Fellow, Foundation of Research and Technology – Hellas)

Nikolaos Katzourakis, 2011 (Associate Professor, University of Reading)

Panayiotis Smyrnelis, 2012 (Assistant Professor, University of Athens (EKPA))

Apostolos Damialis, 2012 (Editorial Director, European Mathematical Society)

Panagiotis Antonopoulos, 2015 (Education Inspector)

Apostolos Faliagas, 2015 (Ministry of Finance)

Dimitrios Gazoulis, 2024 (jointly with Ch. Makridakis, University of Crete)

Publications

A. Books and monographs

[1] *Elliptic Systems of Phase Transition Type*, Progress in Nonlinear Differential Equations and Their Applications 91, xii+343 pp., Birkhäuser, Basel, 2018 *(with Giorgio Fusco and Panayotis Smyrnelis)*

[2] *Partial Differential Equations*, in Greek, second edition, Synchroni Ekdotiki Publications, Athens, 2017 *(with Georgios Akrivis)*

[3] *Ordinary Differential Equations*, in Greek, Synchroni Ekdotiki Publications, Athens, 2003 *(with Grigoris Kalogeropoulos)*

B. Preprints

[4] A maximum principle for elliptic systems involving the fractional Laplacian, preprint *(with Athanasios N. Yannacopoulos)*

C. Elliptic systems

[5] On the triple junction problem on the plane without symmetry hypotheses, preprint (with Zhiyuan Geng), to appear in the Archives of Rational Mechanics and Analysis

[6] Sharp lower bounds for the vector Allen–Cahn energy and qualitative properties of minimizers under no symmetry hypotheses (2023), in Bulletin of the Hellenic mathematical Society , New Series, vol 67, pp 12 - 58

[7] Asymptotic behavior of the free interface for entire vector minimizers in phase transitions (with Z. Geng and A. Zarnescu) Journal of Functional Analysis 283 (2022) No. 6, pp. 109565

[8] Entire Minimizers of Allen–Cahn Systems with Sub-Quadratic Potentials (with D. Gazoulis and A. Zarnescu) Journal of Dynamics and Differential Equations 74 (2021)

[9] Almost entire solutions of the Burgers equation. *Electron. J. Differ. Equ.* **2018**, No. 53, pp. 1–6. *(with Dimitrios Gazoulis)*

[10] Stability criteria for multiphase partitioning problems with volume constraints. *Discrete Contin. Dyn. Syst.* **37**, No. 2 (2017), pp. 663–683. *(with Apostolos Faliagas)*

[11] Asymptotic behavior and rigidity results for symmetric solutions of the elliptic system $\Delta u - W_u(u) = 0$. *Ann. Sc. Norm. Super. Pisa, Cl. Sci.* (5) **15**, Special Issue (2016), pp. 809–836. *(with Giorgio Fusco)*

[12] Density estimates for vector minimizers and applications. *Discrete Contin. Dyn. Syst.* **35** No. 12 (2015), pp. 5631–5663. *(with Giorgio Fusco)*

[13] A maximum principle for systems with variational structure and an application to standing waves. *J. Eur. Math. Soc.* **17**, No. 7 (2015), pp. 1547–1567. *(with Giorgio Fusco)*

[14] On the structure of phase transition maps for three or more coexisting phases. In *Geometric partial differential equations*, edited by M. Novaga and G. Orlandi, Publications of the Scuola Normale Superiore, CRM Series, Birkhäuser, Basel, 2013

[15] Plateau angle conditions for the vector-valued Allen–Cahn equation. *SIAM J. Math. Anal.* **45** No. 6 (2013), pp. 3823–3837 *(with Panagiotis Antonopoulos and Apostolos Damialis)*

[16] A new proof for the existence of an equivariant entire solution connecting the minima of the potential for the system $\Delta u - W_u(u) = 0$. *Comm. Partial Diff. Eqs* **37** No. 12 (2012), pp. 2093–2115.

[17] Existence of lattice solutions to semilinear elliptic systems with periodic potential. *Electron. J. Diff. Equ.* **2012** No. 15 (2012), pp. 1–15 *(with Panayotis Smyrnelis)*

[18] The stress-energy tensor and Pohozaev's identity for systems. *Acta Math. Scientia* **32** No. 1 (2012), pp. 433–439 *(with Apostolos Faliagas)*

[19] On an elliptic system with symmetric potential possessing two global minima. *Bull. Greek Math. Soc.* **58** (2011) pp. 1–21. *(with Giorgio Fusco)*

[20] Entire solutions to equivariant elliptic systems with variational structure. *Arch. Rat. Mech. Anal.* **202** No. 2 (2011), pp. 567–597 *(with Giorgio Fusco)*

[21] Some basic facts on the system $\Delta u - W_u(u) = 0$. *Proc. Amer. Math. Soc.* **139** No. 1 (2011), pp. 153–162

[22] Heteroclinic travelling waves of gradient diffusion systems. *Trans. Amer. Math. Soc.* **363** No. 3 (2011), pp. 1362–1397 *(with Nikolaos I. Katzourakis)*

[23] Entire solutions to nonconvex variational elliptic systems in the presence of a finite symmetry group. In *Singularities in nonlinear evolution phenomena and applications* M. Novaga and G. Orlandi eds. Publications of the Scuola Normale Superiore, CRM Series, Birkhäuser, 2009 *(with Giorgio Fusco)*

[24] On the connection problem for potentials with several global minima. *Indiana Univ. Math. J.* **57** No. 4 (2008), pp. 1871–1906 *(with Giorgio Fusco)*

[25] Explicit stationary solution in multiple well dynamics and non-uniqueness of interfacial energy densities. *Eur. J. Appl. Math.* **17** No. 5 (2006), pp. 525–556 *(with Santiago I. Betelú and Xinfu Chen)*

D. Phase transitions / Geometric evolution / Sharp interfaces

[26] Singular perturbation problems arising from the anisotropy of crystalline grain boundaries. *J. Dyn. Diff. Equations* **19** No. 4 (2007), pp. 935–949 *(with Paul C. Fife, Giorgio Fusco, and Christos Sourdis)*

[27] Analysis of the heteroclinic connection in a singularly perturbed system arising from the study of crystalline grain boundaries. *Int. Free Bound.* **8** No. 2 (2006), pp. 159–183 *(with Paul C. Fife, Giorgio Fusco, and Christos Sourdis)*

[28] Ostwald ripening in two dimensions—the rigorous derivation of the equations from the Mullins–Sekerka dynamics. *J. Diff. Equations* **205** No. 1 (2004), pp. 1–49 *(with Giorgio Fusco and Georgia Karali)*

[29] Continuum limits of particles interacting via diffusion. *Abstr. Appl. Anal.* **3** (2004), pp. 215–237 *(with Giorgio Fusco and Georgia Karali)*

[30] The effect of the geometry of the particle distribution in Ostwald ripening. *Comm. Math. Phys.* **238** No. 3 (2003), pp. 481–488 *(with Giorgio Fusco and Georgia Karali)*

[31] Ostwald ripening for dilute systems under quasistationary dynamics. *Comm. Math. Phys.* **238** No. 3 (2003), pp. 429–479 *(with Giorgio Fusco)*

[32] The normalized mean curvature flow for a small bubble in a Riemannian manifold. *J. Diff. Geom.* **64** No. 2 (2003), pp. 247–303 *(with Alexandre Freire)*

[33] The effect of distribution in space in Ostwald ripening. In *Nonlinear Dynamics and Renormalization Group*. Proceedings of the Workshop held at the Centre de recherches mathématiques, Montreal, QC, 1999. *CRM Proc. Lect. Notes* **27**, American Mathematical Society, Rhode Island, 2001. pp. 17–28 *(with Giorgio Fusco)*

[34] Mullins–Sekerka motion of small droplets on a fixed boundary. *J. Geom. Anal.* **10** No. 4 (2000), pp. 575–596 *(with Peter W. Bates, Xinfu Chen, and Giorgio Fusco)*

[35] The equations of Ostwald ripening for dilute systems. *J. Stat. Phys.* **95** No. 5–6 (1999), pp. 851–866 *(with Giorgio Fusco)*

E. Singular perturbations / Phase transitions / Diffused interfaces

[36] Analysis of a corner layer problem in anisotropic Interfaces. *Discrete Contin. Dyn. Syst., Ser. B* **6** No. 2 (2006), pp. 237–255 *(with Peter W. Bates, John W. Cahn, Paul C. Fife, Giorgio Fusco, and Gamze B. Tanoglu)*

[37] Motion of bubbles towards the boundary for the Cahn–Hilliard Equation. *Eur. J. Appl. Math.* **15** No. 1 (2004), pp. 103–124 *(with Giorgio Fusco and Georgia Karali)*

[38] Motion of a droplet by surface tension along the boundary. *Calc. Var.* **11** No. 3 (2000), pp. 233–305 *(with Xinfu Chen and Giorgio Fusco)*

[39] Critical points of a singular perturbation problem via reduced energy and local linking. *J. Diff. Equations* **159** No. 2 (1999), pp. 403–426 *(with Micha l Kowalczyk)*

[40] Slow motion in the gradient theory of phase transitions via energy and spectrum. *Calc. Var.* **6** No. 1 (1998), pp. 39–66 *(with Lia Bronsard and Giorgio Fusco)*

[41] Slow dynamics for the Cahn–Hilliard equation in higher space dimensions: The motion of bubbles. *Arch. Rat. Mech. Anal.* **141** No. 1 (1998), pp. 1–61 *(with Giorgio Fusco)*

[42] Motion by surface tension along a fixed boundary. In *Differential equations and applications*, edited by P. W. Bates, S.-N. Chow, K. Lu, and X. Pan. Proceedings of the US-China Conference, Hangzhou, China, 1996. International Press, 1997. pp. 1–13 *(with Xinfu Chen and Giorgio Fusco)*

[43] Finite dimensional dynamics and interfaces intersecting the boundary: Equilibria and quasi-invariant manifold. *Indiana Univ. Math. J.* **45** No. 4 (1996), pp. 1119–1155 *(with Giorgio Fusco and Micha l Kowalczyk)*

[44] Critical spectrum and stability of interfaces for a class of reaction-diffusion equations. *J. Diff. Equations* **126** No. 1 (1996), pp. 106–167 *(with Giorgio Fusco and Vagelis Stefanopoulos)*

[45] Asymptotics of the Cahn–Hilliard flow. In *Curvature Flows and Related Topics*, edited by A. Damlamian, J. Spruck, and A. Visintin. Proceedings of the International Conference on Curvature Flows and Related Topics, Levico, Italy, 1994. *GAKUTO Int. Ser., Math. Sci. Appl.* **5** (1995), pp. 13–23 *(with Peter W. Bates and Xinfu Chen)*

[46] Some aspects of the dynamics of the Cahn–Hilliard equation. *Resen. Inst. Mat. Estat. Univ. São Paulo* **1** No. 4 (1994), pp. 517–530 *(with Giorgio Fusco)*

[47] Convergence of the Cahn–Hilliard equation to the Hele–Shaw model. *Arch. Rat. Mech. Anal.* **128** No. 2 (1994), pp. 165–205 *(with Peter W. Bates and Xinfu Chen)*

[48] Slow dynamics for the Cahn-Hillard equation in higher space dimensions. Part I: Spectral estimates. *Comm. Partial Diff. Equations* **19** No. 9–10 (1994), pp. 1397–1447 *(with Giorgio Fusco)*

[49] Equilibrium and dynamics of bubbles for the Cahn–Hilliard equation. In *EQUADIFF 1991*, edited by C. Perelló, C. Simó, and J. de Sola-Morales. Proceedings of the International Conference on Differential Equations EQUADIFF '91, Barcelona, Spain, 1991. World Scientific, London, 1993. pp. 59–67 *(with Giorgio Fusco)*

[50] The spectrum of the Cahn–Hilliard operator for generic interface in higher space dimensions. *Indiana Univ. Math. J.* **42** No. 2 (1993), pp. 637–674 *(with Giorgio Fusco)*

[51] Slow motion manifolds for a class of singular perturbation problems: The linearized equations. In *Differential equations and mathematical physics*, edited by C. Bennewitz. Proceedings of the International Conference held at the University of Alabama, Birmingham, AL, 1990. *Math. Sci. Eng.* **186** (1992), pp. 1–24 *(with Peter W. Bates and Giorgio Fusco)*

[52] Slow motion for the Cahn–Hilliard equation in one space dimension. *J. Diff. Equations* **90** No. 1 (1991), pp. 81–135 *(with Peter W. Bates and Giorgio Fusco)*

[53] Remarks on the equilibrium theory for the Cahn–Hilliard equation in one space dimension. In *Reaction-Diffusion Equations*, edited by K. J. Brown and A. A. Lacey. Proceedings of the Reaction-Diffusion Symposium Year held at Heriot-Watt University, Edinburgh, UK, 1987–1988. Clarendon Press, Oxford, 1990. pp. 75–93 *(with William R. McKinney)*

[54] On the singular limit in a phase field model of phase transitions. *Ann. Inst. H. Poincaré, Anal. Non Linéaire* **5** No. 2 (1988), pp. 141–178 *(with Peter W. Bates)*

[55] A variational approach for a class of singular perturbation problems and applications. *Proc. R. Soc. Edinb.* **107A** (1987), pp. 27–42 *(with Henry C. Simpson)*

[56] On the singular limit for a class of problems modelling phase transitions. *SIAM J. Math. Anal.* **18** (1987), pp. 1453–1462 *(with Kerchung C. Shaing)*

F. Monotone systems

[57] A dynamical systems proof of the Krein–Rutman theorem and an extension of the Perron theorem, *Proc. R. Soc. Edinb.* **117A** No. 3/4 (1991), pp. 209–214 *(with Giorgio Fusco)*

[58] Lyapunov operators and stabilization in strongly order-preserving dynamical systems. *Diff. Int. Equations* **4** No. 1 (1991), pp. 15–24 *(with Peter Hess)*

[59] Discrete order preserving semigroups and stability for periodic parabolic differential equations. *J. Diff. Equations* **82** No. 2 (1989), pp. 322–341 *(with Peter Hess and Hiroshi Matano)*

[60] An invariance principle for a class for monotone systems and applications to degenerate parabolic equations. *Rocky Mt. J. Math.* **18** No. 2 (1988), pp. 215–224 *(with Peter W. Bates)*

[61] Stabilization of solutions for a class of degenerate equations in divergence form in one space dimension. *J. Diff. Equations* **73** No. 2 (1988), pp. 363–393 *(with Peter W. Bates)*

[62] On stabilization of discrete monotone dynamical systems. *Isr. J. Math.* **59** (1987), pp. 185–194 *(with Peter Hess)*

G. The porous medium equation

[63] On the pointwise behavior of the solutions of the porous medium equations as t approaches zero or infinity. *Nonlinear Anal.* **9** (1985), pp. 1085–1113

[64] Large time estimates for solutions to the porous medium equation with nonintegrable data via comparison. *Proc. R. Soc. Edinb.* **100A** (1985), pp. 1–10 *(with Rouben Rostamian)*

[65] On the uniformization of the solutions of the porous medium equation in $\mathbb{R}^N$. *Israel J. Math.* **47** (1984), pp. 270–290 *(with Rouben Rostamian)*

[66] Classification of initial data for the porous medium equation in $\mathbb{R}^N$. In *Differential Equations*, edited by I. W. Knowles and R. T. Lewis. Proceedings of the International Conference on Differential Equations held at the University of Alabama, Birmingham, AL, USA, 1983. *North-Holland Mathematics Studies* **92** (1984) pp. 19–24 *(with Rouben Rostamian)*

[67] Continuity of the gradient for weak solutions of a degenerate parabolic equation. *J. Math. Pures Appl.* **62** (1983), pp. 253–268 *(with Lawrence C. Evans)*

[68] Gradient estimates for degenerate diffusion equations. II. *Proc. R. Soc. Edinb.* **91A** (1982), pp. 335–346 *(with Rouben Rostamian)*

[69] Gradient estimates for degenerate diffusion equations. I. *Math. Ann.* **259** (1982), pp. 53–70 *(with Rouben Rostamian)*

[70] Lower bound estimates and separable solutions for homogeneous equations of evolution in Banach space. *J. Diff. Equations* **43** (1982), pp. 323–344 *(with Rouben Rostamian)*

[71] Stabilization of solutions of the equation $\partial u/\partial t = \Delta\phi(u) - \beta(u)$. *Nonlinear Anal.* **6** (1982), pp. 637–647 *(with Rouben Rostamian)*

[72] Large time behavior of solutions of Neumann boundary value problem for the porous medium equation. *Ind. Univ. Math. J.* **30** (1981), pp. 749–785 *(with Rouben Rostamian)*

H. Reaction-diffusion equations

[73] Periodic traveling waves and locating oscillating patterns in multidimensional domains. *Trans. Amer. Math. Soc.* **351** No. 7 (1999), pp. 2777–2805 *(with Peter W. Bates and Xinfu Chen)*

[74] Solutions to the nonautonomous bistable equation with specified Morse index. I: Existence. *Trans. Amer. Math. Soc.* **340** No. 2 (1993), pp. 641–654 *(with Peter W. Bates and Giorgio Fusco)*

[75] Blow up for a diffusion-advection equation. *Proc. R. Soc. Edinb.* **113A** No. 3/4 (1989), pp. 181–190 *(with Peter W. Bates and Christopher P. Grant)*

[76] A remark on positively invariant regions for parabolic systems with an application arising in superconductivity. *Quart. Appl. Math.* **45** (1987), pp. 75–80 *(with Daniel Phillips)*

[77] Erratum: Estimates for the eigenvalues of the Jordan product of Hermitian matrices. *Linear Algebra Appl.* **65** (1985), p. 282 *(with Peter W. Bates)*

[78] Estimates for the eigenvalues of the Jordan product of Hermitian matrices. *Linear Algebra Appl.* **57** (1984), pp. 41–56 *(with Peter W. Bates)*

[79] Quantitative maximum principles and strongly coupled gradient-like reaction-diffusion systems. *Proc. R. Soc. Edinb.* **94A** (1983), pp. 265–286

[80] Stabilization of solutions for a system with a continuum of equilibria and distinct diffusion coefficients. In *Systems of Nonlinear Partial Differential Equations*, edited by J. M. Ball. Proceedings of the NATO Advanced Study Institute on Systems of Nonlinear Partial Differential Equations held at the University of Oxford, UK, 1982. *NATO ASI Ser. C* **111** (1983), pp. 433–441

[81] Regularity and asymptotic behavior for the second-order parabolic equation with nonlinear boundary conditions. *J. Diff. Equations* **39** (1981), pp. 311–344

[82] Remarks on invariance in reaction-diffusion equations. *Nonlinear Anal.* **5** (1981), pp. 593–614

[83] A Liapunov functional for a class of reaction-diffusion systems. In *Modeling and differential equations in biology*, edited by T. A. Burton. Lect. Notes Pure Appl. Math. **58** (1980), pp. 153–170

[84] L^p bounds of solutions of reaction-diffusion equations. *Comm. Partial Diff. Equations* **4** (1979), pp. 827–868

[85] An application of the invariance principle to reaction-diffusion equations. *J. Diff. Equations* **33** (1979), pp. 201–225

I. Reviews

[86] *Nonlinear Differential Equations of Monotone Type in Banach Spaces*, by V. Barbu. *SIAM Review* **53** No. 3 (2011), p. 583.

[87] *Blow-up in Quasilinear Parabolic Equations*, by A. A. Samarski, V. A. Galaktionov, S. P. Kurdyumov, and A. P. Mikhailov. *Bull. Amer. Math. Soc.* **33** (1996), pp. 483–486

J. Unpublished

[88] On a singularly perturbed semilinear parabolic problem, 1991 *(with Peter Hess)*

[89] A homogenization estimate for a class of parabolic equations, 1981

Institutions visited in the last ten years

2010 University of Paris VI (1 month), University of Rome Tor Vergata (3 days)

2011 University of L'Aquila (3 days), University of Bath (3 days)

2012 Stanford University (sabbatical), University of Maryland, Baltimore County (2 days), Michigan State University (1 week), Basque Center for Applied Mathematics, Centro De Giorgi

2013 Technion, Mittag-Leffler Institute, Universidad Complutense de Madrid

2014 Freie Universität Berlin, University of Reading (3 days), Ecole Polytechnique Fédérale de Lausanne, Universität Bonn, University of Ioannina

2015 Université Paris-Dauphine, Université Joseph-Fourier Grenoble, SISSA, University of Sussex

2016 Stanford University, Courant Institute (sabbatical)

2017 Basque Center for Applied Mathematics, Katowice, Poland

2018 Basque Center for Applied Mathematics, Polish Academy of Sciences

2019 Field's Institute

2021 Courant Institute

2022 University of Reading

(Updated February 2024)