Demetrios Christodoulou

Curriculum Vitae

Demetrios Christodoulou is a Greek mathematician and physicist born in Athens on October 19, 1951. He holds dual Greek and U.S. citizenship.

Educational History

M.A. (physics) Princeton University, 1970
Ph.D. (physics) Princeton University, 1971

Professional History

1971-1972 California Institute of Technology, Research Fellow

1972-1973 University of Athens, Greece, Professor of Physics

1973-1974 CERN, Geneva, Visiting Scientist

1974-1976 International Center for Theoretical Physics, Trieste

1976-1981 Max Planck Institute, Munich, Humboldt Fellow

1981-1983 Courant Institute, Visiting Member

1983-1985 Syracuse University, Associate Professor of Physics

1985-1987 Syracuse University, Professor of Mathematics

1988-1992 Courant Institute, Professor of Mathematics

1992-2001 Princeton University, Professor of Mathematics

2001-2017 ETH Zürich, Professor of Mathematics and Physics

2017- ETH Zürich, Emeritus Professor

Honors, Awards and Prizes

June 1981 Otto Hahn Medal, Max Planck Society

August 1990 Invited Address, International Congress of Mathematicians, Kyoto

November 1991 Basilis Xanthopoulos Award, GRG Society

June 1993 MacArthur Fellows Award (in mathematics and physics), MacArthur Foundation

March 1996 Excellence in the Sciences Award, Academy of Athens

June 1996 Honorary Doctorate in the Sciences, University of Athens

April 1998 John Simon Guggenheim Fellow

January 1999 Bôcher Memorial Prize, American Mathematical Society

January 2000 Zenon Prize, Mathematical Society of Cyprus

May 2000 Honorary Doctorate in the Sciences, National Technical University, Athens, Greece

July 2000 Taxiarchis of the Order of Phoenix, the President of the Hellenic Republic

April 2001 Elected to the American Academy of Arts and Sciences

May 2001 Honorary Doctorate in the Sciences, Brown University

May 2003 Honorary Doctorate in the Sciences, University of Cyprus

October 2003 Leonardo Da Vinci Lecture, University of Milan

June 2006 Aristeio Bodossaki, Bodossaki Foundation

May 2007 Mordell Lecture, Cambridge University

January 2008 Tomalla Prize (gravitation), Tomalla Foundation

May 2009 Chaire d'Etat, College de France

August 2009 Plenary Lecture, International Congress of Mathematical Physics, Prague

September 2009 Hot Topics Workshop centered on Christodoulou's work on black hole formation, MSRI, Berkeley

April 2010 Honorary Doctorate in the Sciences, Aristotle University of Thessaloniki

March 2011 Honorary Professor of Physics, University of Crete

June 2011 Shaw Prize in Mathematical Sciences, jointly with Richard Hamilton

May 2012 Elected to the U.S. National Academy of Sciences

May 2012 Calderon-Zygmund Lectures, University of Chicago

June 2012 Honorary plaque, Hellenic Society of Relativity, Gravitation and Cosmology

June 2012 Prize in Science, Letters and Arts, Technical University of Crete

November 2012 Inaugural Class of Fellows, American Mathematical Society

February 2013 Honorary plaque, Hellenic Mathematical Society

August 2014 Plenary Lecture, International Congress of Mathematicians, Seoul

June 2016 Elected to the Academia Europea

October 2016 Nemitsas Foundation Prize for Mathematics

Research Fields

Nonlinear hyperbolic partial differential equations,
general relativity, mechanics of compressible fluids.

Publications

Reversible and irreversible transformations in black hole physics, Phys. Rev. Letters, **25** (1970), 1596-1597.

(with R. Ruffini) *Reversible transformations of a charged black hole*, Phys. Rev., **D4** (1971), 3552-3555.

Investigations in Gravitational Collapse and the Physics of Black Holes, Ph. D. thesis, Physics Department, Princeton University, 1971.

(with Y. Choquet-Bruhat and M. Francaviglia) *Cauchy data on a manifold*, Ann. Inst. H. Poincaré Sect. A (N.S.), **29** (1978), 241-255.

(with Y. Choquet-Bruhat and M. Francaviglia) *On the wave equation in curved spacetime*, Ann. Inst. H. Poincaré Sect. A (N.S.), **31** (1979), 399-414.

(with A. Aurilia) *Theory of strings and membranes in an external field I. General formulation*, J. Math. Phys., **20** (1979), 1446-1452.

(with A. Aurilia) *Theory of strings and membranes in an external field II. The string*, J. Math. Phys., **20** (1979), 1692-1699.

(with B. Schmidt) *Convergent and asymptotic iteration methods in general relativity*, Commun. Math. Phys., **68** (1979), 275-289.

Extension de la solution du probléme de Cauchy d'équations quasilinéaires hyperboliques, C.R. Acad. Sci. Paris Sér. A-B, **290** (1980), 641-644.

The boost problem for weakly coupled quasilinear hyperbolic systems of the second order, J. Math. Pures et Appl., **60** (1980), 99-130.

(with Y. Choquet-Bruhat) *Systèmes elliptiques sur une variété euclidienne à l'infini*, C.R. Acad. Sci. Paris Sér. A-B, **290** (1980), 781-785.

(with Y. Choquet-Bruhat) *Elliptic systems in $H_{s,\delta}$ spaces on manifolds which are Euclidean at infinity*, Acta Mathematica, **146** (1981), 129-150.

(with N. O'Murchadha) *The boost problem in general relativity*, Commun. Math. Phys., **80** (1981), 271-300.

(with H. Müller zum Hagen) *Problème de valeur initiale charactéristique pour des systèms quasilinéairs du second ordre*, C.R. Acad. Sci. Paris, **293**, Series A (1981), 39-42.

Solutions globales des equations de champ de Yang-Mills, C.R. Acad. Sci. Paris, **293**, Series A (1981), 139-141.

(with Y. Choquet-Bruhat) *Existence de solutions globales des équations classiques des théories de jauge*, C.R. Acad. Sci. Paris, **293**, Series A (1981), 195-199.

(with Y. Choquet-Bruhat) *Existence of global solutions of the Yang-Mills, Higgs and spinor field equations in 3 + 1 dimensions*, Annales des Ecole Normale Superieur 4th Series, **14** (1981), 481-500.

(with Y. Choquet-Bruhat) *Cauchy Problem at Past Infinity for Nonlinear Equations in Curved Spacetime*, pp. 73-91 in *Studies in Applied Mathematics*, Advances in Mathematics, Supplementary Studies, Volume 8, Victor Guillemin (editor), Academic Press, 1983.

Violation of cosmic censorship in the gravitational collapse of a dust cloud, Commun. Math. Phys., **93** (1984), 171-195.

Gravitational collapse of a dust cloud and the cosmic censorship conjecture, pp. 27-36 in *General relativity and gravitation, Padova 1983*, Fund. Theories Phys., Reidel, 1984.

Global solutions of nonlinear hyperbolic equations for small initial data, Commun. Pure & Appl. Math., XXXIX (1986), 267-281.

Gravitational collapse, pp. 147-154 in *12th Texas Symposium on Relativistic Astrophysics, Jerusalem 1984*, Annals of the New York Academy of Sciences **470**, 1986.

The problem of a self-gravitating scalar field, Commun. Math. Phys., **105** (1986), 337-361.

Global existence of generalized solutions of the spherically symmetric Einstein-scalar equations in the large, Commun. Math. Phys., **106** (1986), 587-621.

The structure and uniqueness of generalized solutions of the spherically symmetric Einstein-scalar equations, Commun. Math. Phys., **109** (1987), 591-611.

A mathematical theory of gravitational collapse, Commun. Math. Phys., **109** (1987), 613-647.

(with S.T. Yau) *Some remarks on the quasi-local mass*, Contemporary Mathematics **71**, 9-14, American Mathematical Society, 1988.

(with S. Klainerman) *Asymptotic properties of linear field equations in Minkowski space*, Commun. Pure & Appl. Math., **43** (1990), 137-199.

The nonlinear nature of gravitation and gravitational wave experiments, Phys. Rev. Letters, **67** (1991), 1486-1489.

Notes on the geometry of null hypersurfaces, U.S. Copyright Office, Library of Congress, Registration Number TXu 832-728, ©1991, Demetrios Christodoulou, All Rights Reserved.

The stability of Minkowski spacetime, pp. 1113-1121 in *Proceedings of the International Congress of Mathematicians, Kyoto 1990*, The Mathematical Society of Japan, Springer-Verlag, 1991.

The formation of black holes and singularities in spherically symmetric gravitational collapse, Commun. Pure & Appl. Math., XLIV (1991), 339-373.

Recent mathematical results in general relativity and their implications for gravitational wave experiments, pp. 789-799 in *6th Marcel Grossmann Meeting, Kyoto 1991*, World Sci. Publishing, 1992.

(with A. Shadi Tahvildar-Zadeh) *On the regularity of spherically symmetric wave maps*, Commun. Pure & Appl. Math., XLVI (1993), 1041-1091.

(with A. Shadi Tahvildar-Zadeh) *On the asymptotic behavior of spherically symmetric wave maps*, Duke Math. Journ., **71** (1993), 31-69.

Bounded variation solutions of the spherically symmetric Einstein-scalar field equations, Commun. Pure & Appl. Math., XLVI (1993), 1131-1220.

(with S. Klainerman) *The Global Nonlinear Stability of the Minkowski Space* (monograph, 514 pp.), Princeton Mathematical Series, **41**, Princeton University Press (ISBN 0-691-08777-6), 1993.

Examples of naked singularity formation in the gravitational collapse of a scalar field, Ann. Math., **140** (1994), 607-653.

The mathematical theory of gravitational collapse pp. 121-150 in *Current Trends in Applied Mathematics*, dirigido por Miguel A. Herrero & Enrique Zuazua, Editorial Complutense (ISBN 84-89365-94-6), 1995.

Relativistic fluids and gravitational collapse, pp. 38-54 in *Differential equations and mathematical physics, Birmingham, AL, 1994*, Int. Press, 1995.

Self-gravitating relativistic fluids: a two-phase model, Arch. Rat. Mech. Anal., **130** (1995), 343-400.

Self-gravitating relativistic fluids: the continuation and termination of a free phase boundary, Arch. Rat. Mech. Anal., **133** (1996), 333-398.

Self-gravitating relativistic fluids: the formation of a free phase boundary in the phase transition from soft to hard, Arch. Rat. Mech. Anal., **134** (1996), 97-154.

Relativistic fluids and gravitational collapse, pp. 19-36 in *7th Marcel Grossmann Meeting, Stanford 1994*, World Sci. Publishing, 1996.

Phase transitions in self-gravitating relativistic fluids, pp. 16-29 in *Hyperbolic problems: theory, numerics, applications, Stony Brook, NY, 1994*, World Sci. Publ., 1996.

On the geometry and dynamics of crystalline continua, Ann. Inst. Henri Poincaré, **69** (1998), 335-358.

Symplectic geometry and partial differential equations, pp. 27-37 in *Proceedings of Symposia in Pure Mathematics* **65**, *Differential Equations: La Pietra 1996*, American Mathematical Society, 1999.

The instability of naked singularities in the gravitational collapse of a scalar field, Ann. Math., **149** (1999), 183-217.

The stability of Minkowski spacetime, pp. 365-385 in *Surveys in differential geometry: essays on Einstein manifolds, Surv. Diff. Geom. VI*, International Press, Boston, MA, 1999.

On the global initial value problem and the issue of singularities, Classical Quantum Gravity **16** (1999), no. 12A (Millennium Issue), A23-A35.

The initial value problem in the large and spacetime singularities, pp. 97-109 in *Studies in Advanced Mathematics* **16**, *Differential Equations and Mathematical Physics*, American Mathematical Society, International Press, 2000.

On hyperbolicity, pp. 17-28 in *Nonlinear Wave Equations*, Contemporary Mathematics **263**, American Mathematical Society, 2000.

The notion of hyperbolicity for systems of Euler-Lagrange equations, pp. 327-338 in *International Conference on Differential Equations, Berlin, 1999*, World Sci. Publ., 2000.

The Action Principle and Partial Differential Equations (monograph, 319 pp.), Ann. Math. Stud., **146**, Princeton University Press (ISBN 0-691-04957-2), 2000.

(with H. Lindblad) *On the motion of the free surface of a liquid*, Commun. Pure & Appl. Math., **53** (2000), 1536-1602.

Recent developments in nonlinear hyperbolic PDE, pp. 843-852 in *Mathematics in the new millenium, Seoul, 2000*, J. Korean Math. Soc., **38** (2001).

The global initial value problem in general relativity, pp. 44-54 in *9th Marcel Grossmann Meeting, Rome 2000*, World Sci. Publishing, 2002.

The Formation of Shocks in 3-Dimensional Fluids (monograph, 992 pp.), EMS Monographs in Mathematics, EMS Publishing House (ISBN 978-3-03719-031-9), 2007.

The Euler equations of compressible fluid flow, Bull. Amer. Math. Soc. **44** (2007), 581-602.

The formation of shocks in 3-dimensional fluids, pp. 17-30 in *Recent Advances in Nonlinear Partial Differential Equations and Applications: Toledo 2006*, Proceedings of Symposia in Applied Mathematics **65**, American Mathematical Society, 2007.

Mathematical Problems of General Relativity I, (157 pp.), Zurich Lectures in Advanced Mathematics, EMS Publishing House (ISBN 978-3-03719-005-0), 2008.

The Formation of Black Holes in General Relativity, (monograph, 589 pp.), EMS Monographs in Mathematics, EMS Publishing House (ISBN 978-3-03719-068-5), 2009.

The formation of black holes in general relativity, pp. 45-55 in *16th International Congress in Mathematical Physics, Prague, 2009*, World Sci. Publ., 2010.

The formation of black holes in general relativity, pp. 247-283 in *Geometry and Analysis, Vol. I*, *Advanced Lectures in Mathematics* **17**, Lizhen Ji (editor), Higher Education Press and International Press, 2011.

The formation of black holes in general relativity, pp. 24-34 in *12th Marcel Grossmann Meeting, Paris 2009*, World Sci. Publishing, 2012.

(with I. Kaelin) *On the mechanics of crystalline solids with a continuous distribution of dislocations*, Advances in Theoretical and Mathematical Physics, **17**, No 2 (2013), 399-477 (http://arxiv.org/abs/1212.5125).

The analysis of shock formation in 3-dimensional fluids, pp. 119-138 in *Geometric Partial Differential Equations*, Antonin Chambolle, Matteo Novaga and Enrico Valdinoci (editors), Edizioni Della Normale (ISBN 978-88-7642-472-4), 2013.

(with S. Miao) *Compressible Flow and Euler's Equations*, (monograph, 596 pp.), Surveys in Modern Mathematics Volume 9, International Press (ISBN 9781571462978), 2014.

Hyperbolic P.D.E. and Lorentzian Geometry, Plenary Lecture, International Congress of Mathematicians, Seoul, 2014.

(with A. Lisibach) *Self-gravitating relativistic fluids: The formation of a free phase boundary in the phase transition from hard to soft*, Arch. Rat. Mech. Anal. (2016) doi:10.1007/s00205-016-1015-x (http://arxiv.org/abs/1411.4888)

(with A. Lisibach) *Shock development in spherical symmetry*, Annals of PDE (2016) 2:3.doi:10.1007/s40818-016-0009-1 (http://arxiv.org/abs/1501.04235)

(with D.R. Perez) *On the formation of shocks of electromagnetic plane waves in non-linear crystals*, J. Math. Phys. **57** (2016), 081506 doi:10.1063/1.4960044 (http://arxiv.org/abs/1505.04101)

The Shock Development Problem, (monograph, 920 pp.), EMS Monographs in Mathematics, EMS Publishing House (ISBN 978-3-03719-192-7), 2019.