

# 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-** ETH Zürich, Professor of Mathematics and Physics

## **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, 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

**March 2003** Elected to the European Academy of Sciences

**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, Tomalla Foundation

**May 2009** Chaire d'Etat, College de France

**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

## Research Fields

Partial differential equations, geometric analysis, general relativity, fluid mechanics.

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

*Extension de la solution du problème de Cauchy d'équations quasilineaires 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 caractéristique pour des systèmes quasilineaires 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 equations classiques des theories 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.