



## Richard Schoen

Anne T. and Robert M. Bass Professor in the School of Humanities and Sciences, Emeritus

Mathematics

 Curriculum Vitae available Online

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### Bio

#### ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Mathematics

#### ADMINISTRATIVE APPOINTMENTS

- Graduate Fellowship, National Science Foundation, (1972-1975)
- Sloan Postdoctoral Fellowship, Alfred P. Sloan Foundation, (1979-1979)
- MacArthur Prize Fellowship, MacArthur Foundation, (1983-1988)
- Fellow, Amer. Assoc. for Adv. of Science, (1995-1995)
- Guggenheim Fellowship, Guggenheim Foundation, (1996-1996)
- Fellow, American Mathematical Society, (2012-2012)
- Lecturer, University of California, Berkeley, (1976-1978)
- Assistant Professor, Courant Institute, New York University, (1978-1980)
- Professor, University of California, Berkeley, (1980-1984)
- Professor, University of California, San Diego, (1984-1987)
- Professor, Stanford University, (1987-1992)
- Bass Professor, Humanities and Sciences, Stanford University, (1992- present)
- Visiting Member, Institute for Advanced Study, (1979-1980)
- Spring Visiting Member, Institute for Advanced Study, (1984-1984)
- Visiting Professor, Courant Institute, New York University, (1989-1990)
- Distinguished Visiting Professor, Institute for Advanced Study, (1992-1993)
- Autumn Visiting Professor, Harvard University, (1999-1999)
- Autumn Eilenberg Chair, Columbia University, (2009-2009)

#### HONORS AND AWARDS

- Lobachevsky Medal and Prize, Russian Academy of Sciences and Kazan State University (2017)
- Heinz Hopf Prize, ETH Zurich (2017)
- Rolf Schock Prize in Mathematics, Royal Swedish Academy of Sciences (2017)
- Wolf Prize in Mathematics, Wolf Foundation (2107)
- Bocher Prize, American Mathematical Society (1989)

## BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Editor, Journal of Differential Geometry
- Editor, Communications in Analysis and Geometry
- Editor, Calculus of Variations and PDE
- Chair, Mathematics Department, Stanford University (2001 - 2004)
- Member, Fachbeirat for Max Planck Institute for Gravitation (2004 - 2010)
- Member, Scientific Advisory Committee of Mathematical Sciences Research Institute (2007 - 2012)
- Co-Chair, Scientific Advisory Committee of Mathematical Sciences Research Institute (2009 - 2012)
- Chair, Committee to choose director of Mathematical Sciences Research Institute (2012 - 2012)
- Clay Senior Scholar, Park City Mathematics Institute (2013 - 2013)
- Chair of review committee, National Center for Theoretical Sciences Hsinchu (2013 - 2013)
- Member of Advisory Board, Institute of Mathematics Academia Sinica (2013 - 2013)
- Program Committee and lecturer, Mathematical Congress of the Americas (2013 - 2013)
- Organizer, Mathematical Sciences Research Institute program in Mathematical General Relativity (2013 - 2013)
- Member, National Academy of Sciences (1991 - 1991)
- Member, American Academy of Arts and Sciences (1988 - 1988)

## PROFESSIONAL EDUCATION

- Ph.D., Stanford University (1977)
- B.S., University of Dayton (1972)

## Publications

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### PUBLICATIONS

- **Existence and geometric structure of metrics on surfaces which extremize eigenvalues** *BULLETIN OF THE BRAZILIAN MATHEMATICAL SOCIETY*  
Schoen, R.  
2013; 44 (4): 777-807
- **Convexity of Reduced Energy and Mass Angular Momentum Inequalities** *ANNALES HENRI POINCARÉ*  
Schoen, R., Zhou, X.  
2013; 14 (7): 1747-1773
- **Minimal surfaces and eigenvalue problems** *Contemporary Mathematics*  
Schoen, R. M., Fraser, A.  
2013; 599: 105-122
- **Specifying Angular Momentum and Center of Mass for Vacuum Initial Data Sets** *COMMUNICATIONS IN MATHEMATICAL PHYSICS*  
Huang, L., Schoen, R., Wang, M.  
2011; 306 (3): 785-803
- **ON THE EXISTENCE OF HAMILTONIAN STATIONARY LAGRANGIAN SUBMANIFOLDS IN SYMPLECTIC MANIFOLDS** *AMERICAN JOURNAL OF MATHEMATICS*  
Joyce, D., Lee, Y., Schoen, R.  
2011; 133 (4): 1067-1092
- **The first Steklov eigenvalue, conformal geometry, and minimal surfaces** *ADVANCES IN MATHEMATICS*  
Fraser, A., Schoen, R.  
2011; 226 (5): 4011-4030

- **CURVATURE, SPHERE THEOREMS, AND THE RICCI FLOW** *BULLETIN OF THE AMERICAN MATHEMATICAL SOCIETY*  
Brendle, S., Schoen, R.  
2011; 48 (1): 1-32
- **Riemannian manifolds of positive curvature** *Proceedings of the International Congress of Mathematicians*  
Schoen, R. M., Brendle, S.  
2010
- **Gravitating opposites attract** *CLASSICAL AND QUANTUM GRAVITY*  
Beig, R., Gibbons, G. W., Schoen, R. M.  
2009; 26 (22)
- **Manifolds with 1/4-pinched curvature are space forms** *JOURNAL OF THE AMERICAN MATHEMATICAL SOCIETY*  
Brendle, S., Schoen, R.  
2009; 22 (1): 287-307
- **Isoperimetric inequality for fiat surfaces** *Proceedings of the 13th International Workshop on Differential Geometry and Related Fields*  
Schoen, R. M., Choe, J.  
2009
- **Sphere theorems in geometry** *Geometry, analysis, and algebraic geometry: forty years of the Journal of Differential Geometry*  
Schoen, R., Brendle, S.  
Int. Press.2009 : 49–84
- **On static n-body configurations in relativity, 10 page preprint** *Classical and Quantum Gravity*  
Schoen, R. M., Beig, R.  
2009; 26: 7
- **A COMPACTNESS THEOREM FOR THE YAMABE PROBLEM** *JOURNAL OF DIFFERENTIAL GEOMETRY*  
Khuri, M. A., Marques, F. C., Schoen, R. M.  
2009; 81 (1): 143-196
- **Classification of manifolds with weakly 1/4-pinched curvatures** *ACTA MATHEMATICA*  
Brendle, S., Schoen, R. M.  
2008; 200 (1): 1-13
- **A generalization of Hawking's black hole topology theorem to higher dimensions** *COMMUNICATIONS IN MATHEMATICAL PHYSICS*  
Galloway, G. J., Schoen, R.  
2006; 266 (2): 571-576
- **On the asymptotics for the vacuum Einstein constraint equations** *JOURNAL OF DIFFERENTIAL GEOMETRY*  
Corvino, J., Schoen, R. M.  
2006; 73 (2): 185-217
- **Entire spacelike hypersurfaces of prescribed Gauss curvature in Minkowski space** *JOURNAL FUR DIE REINE UND ANGEWANDTE MATHEMATIK*  
Guan, B., Jian, H., Schoen, R. M.  
2006; 595: 167-188
- **Minimal submanifolds in higher codimension** *Matematica Contemporanea*  
Schoen, R. M.  
2006; 30: 169-199
- **The mathematics of general relativity: Problems and progress** *Sesquicentennial Conference of Mathematics at Washington University*  
Schoen, R.  
AMER MATHEMATICAL SOC.2006: 119–132
- **KIDs are non-generic** *ANNALES HENRI POINCARÉ*  
Beig, R., Chrusciel, P. T., Schoen, R.  
2005; 6 (1): 155-194

- **Mean curvature in geometry and general relativity** *Proceedings of the 2001 Clay Summer School*  
Schoen, R. M.  
edited by Hoffman, D.  
2005: 113–36
- **Special lagrangian submanifolds** *Proceedings of the 2001 Clay Summer School*  
Schoen, R. M.  
edited by Hoffman, D.  
2005: 655–66
- **The volume functional for Lagrangian submanifolds, Lectures on partial differential equations** *New Stud. Adv. Math*  
Schoen, R. M.  
edited by Wolfson, J.  
Int. Press, Somerville, MA.2003: 181–191
- **Minimizing area among Lagrangian surfaces: The mapping problem** *JOURNAL OF DIFFERENTIAL GEOMETRY*  
Schoen, R., Wolfson, J.  
2001; 58 (1): 1-86
- **Refined asymptotics for constant scalar curvature metrics with isolated singularities** *INVENTIONES MATHEMATICAE*  
Korevaar, N., Mazzeo, R., Pacard, F., Schoen, R.  
1999; 135 (2): 233-272
- **Recent proofs of the Riemannian Penrose conjecture in General Relativity** *Current developments in mathematics*  
Schoen, R. M., Bray, H.  
Int. Press, Somerville, MA.1999: 1–36
- **Minimizing volume among Lagrangian submanifolds** *Proc Symp Pure Math*  
Schoen, R. M., Wolfson, J.  
edited by Shatah, J.  
1999: 181–199
- **Theorems of Barth-Lefschetz type and Morse theory on the space of paths** *MATHEMATISCHE ZEITSCHRIFT*  
Schoen, R., Wolfson, J.  
1998; 229 (1): 77-89
- **Global existence theorems for harmonic maps to nonlocally compact spaces** *Comm Anal Geom*  
Schoen, R. M., Korevaar, N.  
1997; 5: 333-387
- **Lectures on Harmonic Maps**  
Schoen, R. M., Yau, S. T.  
International Press Inc., Boston.1997
- **Prescribed scalar curvature on the n-sphere** *CALCULUS OF VARIATIONS AND PARTIAL DIFFERENTIAL EQUATIONS*  
Schoen, R., Zhang, D.  
1996; 4 (1): 1-25
- **The effect of curvature on the behavior of harmonic functions and mappings** *Nonlinear Partial Differential Equations in Differential Geometry*  
Schoen, R. M.  
edited by Hardt, R., Wolf, M.  
AMS.1996: 127–185
- **ON THE CONFORMAL AND CR AUTOMORPHISM-GROUPS** *GEOMETRIC AND FUNCTIONAL ANALYSIS*  
Schoen, R.  
1995; 5 (2): 464-481
- **Lectures on Differential Geometry**  
Yau, S. T., Schoen, R. M.

International Press Inc., Boston.1994

- **THE ROLE OF HARMONIC-MAPPINGS IN RIGIDITY AND DEFORMATION PROBLEMS** *OSAKA INTERNATIONAL CONF ON COMPLEX GEOMETRY AND RELATED TOPICS*  
SCHOEN, R. M.  
MARCEL DEKKER.1993: 179–200
- **Sobolev spaces and harmonic maps for metric space targets** *Comm Anal Geom*  
Schoen, R. M., Korevaar, N.  
1993; 1: 561-659
- **HARMONIC MAPS INTO SINGULAR SPACES AND P-ADIC SUPERRIGIDITY FOR LATTICES IN GROUPS OF RANK-ONE** *PUBLICATIONS MATHEMATIQUES*  
Gromov, M., Schoen, R.  
1992: 165-246
- **A report on some recent progress on nonlinear problems in geometry** *Surveys in Differential Geometry*  
Schoen, R. M.  
1991; 1: 204-241
- **On the number of constant scalar curvature metrics in a conformal class** *Differential Geometry*  
Schoen, R. M.  
edited by Lawson, Tenenblat  
Longman Scientific and Technical.1991: 311–320
- **THE EXISTENCE OF WEAK SOLUTIONS WITH PRESCRIBED SINGULAR BEHAVIOR FOR A CONFORMALLY INVARIANT SCALAR EQUATION** *COMMUNICATIONS ON PURE AND APPLIED MATHEMATICS*  
SCHOEN, R. M.  
1988; 41 (3): 317-392
- **CONFORMALLY FLAT MANIFOLDS, KLEINIAN-GROUPS AND SCALAR CURVATURE** *INVENTIONES MATHEMATICAE*  
Schoen, R., Yau, S. T.  
1988; 92 (1): 47-71
- **Variational theory for the total scalar curvature functional for Riemannian metrics and related topics** *Topics in Calculus of Variations*  
Schoen, R. M.  
edited by Giaquinta, M.  
Springer.1988: 120–155
- **Recent progress in geometric partial differential equations** *Proc ICM*  
Schoen, R. M.  
1986: 121–130
- **CONFORMAL METRICS WITH PRESCRIBED SCALAR CURVATURE** *INVENTIONES MATHEMATICAE*  
Escobar, J. F., SCHOEN, R. M.  
1986; 86 (2): 243-254
- **Positive harmonic functions on manifolds of negative curvature** *Annals of Math*  
Schoen, R. M., Anderson, M.  
1985; 121: 429-461
- **THE SPACE OF MINIMAL EMBEDDINGS OF A SURFACE INTO A 3-DIMENSIONAL MANIFOLD OF POSITIVE RICCI CURVATURE** *INVENTIONES MATHEMATICAE*  
Choi, H. I., Schoen, R.  
1985; 81 (3): 387-394
- **REGULARITY OF MINIMIZING HARMONIC MAPS INTO THE SPHERE** *INVENTIONES MATHEMATICAE*  
Schoen, R., Uhlenbeck, K.  
1984; 78 (1): 89-100
- **On the isoperimetric inequality for minimal surfaces** *Ann Scuola Norm Sup Pisa*

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- Schoen, R. M., Li, P., Yau, S. T.  
1984; 9: 237-244
- **Analytic aspects of the harmonic map problem** *Seminar on Nonlinear PDE*  
Schoen, R. M.  
edited by Chern, S. S.  
Springer-Verlag, 1984: 321-358
  - **LP AND MEAN-VALUE PROPERTIES OF SUBHARMONIC FUNCTIONS ON RIEMANNIAN-MANIFOLDS** *ACTA MATHEMATICA*  
Li, P., Schoen, R.  
1984; 153 (3-4): 279-301
  - **CONFORMAL DEFORMATION OF A RIEMANNIAN METRIC TO CONSTANT SCALAR CURVATURE** *JOURNAL OF DIFFERENTIAL GEOMETRY*  
Schoen, R.  
1984; 20 (2): 479-495
  - **REGULARITY OF SIMPLY CONNECTED SURFACES WITH QUASICONFORMAL GAUSS MAP** *ANNALS OF MATHEMATICS STUDIES*  
Schoen, R., Simon, L.  
1983: 127-145
  - **BOUNDARY-REGULARITY AND THE DIRICHLET PROBLEM FOR HARMONIC MAPS** *JOURNAL OF DIFFERENTIAL GEOMETRY*  
Schoen, R., Uhlenbeck, K.  
1983; 18 (2): 253-268
  - **UNIQUENESS, SYMMETRY, AND EMBEDDEDNESS OF MINIMAL-SURFACES** *JOURNAL OF DIFFERENTIAL GEOMETRY*  
SCHOEN, R. M.  
1983; 18 (4): 791-809
  - **THE EXISTENCE OF A BLACK-HOLE DUE TO CONDENSATION OF MATTER** *COMMUNICATIONS IN MATHEMATICAL PHYSICS*  
Schoen, R., Yau, S. T.  
1983; 90 (4): 575-579
  - **ESTIMATES FOR STABLE MINIMAL-SURFACES IN 3 DIMENSIONAL MANIFOLDS** *ANNALS OF MATHEMATICS STUDIES*  
Schoen, R.  
1983: 111-126
  - **ON THE GAUSS MAP OF COMPLETE-SURFACES OF CONSTANT MEAN-CURVATURE IN  $R^3$  AND  $R^4$**  *COMMENTARII MATHEMATICI HELVETICI*  
Hoffman, D. A., Osserman, R., Schoen, R.  
1982; 57 (4): 519-531
  - **A LOWER BOUND FOR THE 1ST EIGENVALUE OF A NEGATIVELY CURVED MANIFOLD** *JOURNAL OF DIFFERENTIAL GEOMETRY*  
Schoen, R.  
1982; 17 (2): 233-238
  - **COMPLETE 3 DIMENSIONAL MANIFOLDS WITH POSITIVE RICCI CURVATURE AND SCALAR CURVATURE** *ANNALS OF MATHEMATICS STUDIES*  
Schoen, R., Yau, S. T.  
1982: 209-228
  - **A REGULARITY THEORY FOR HARMONIC MAPS** *JOURNAL OF DIFFERENTIAL GEOMETRY*  
Schoen, R., Uhlenbeck, K.  
1982; 17 (2): 307-335
  - **A NEW PROOF OF THE REGULARITY THEOREM FOR RECTIFIABLE CURRENTS WHICH MINIMIZE PARAMETRIC ELLIPTIC FUNCTIONALS** *INDIANA UNIVERSITY MATHEMATICS JOURNAL*  
Schoen, R., Simon, L.  
1982; 31 (3): 415-434
  - **A REMARK ON MINIMAL HYPERCONES** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA-PHYSICAL SCIENCES*

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- Schoen, R.  
1982; 79 (14): 4523-4524
- **ON THE EXISTENCE OF HARMONIC DIFFEOMORPHISMS BETWEEN SURFACES** *INVENTIONES MATHEMATICAE*  
Jost, J., Schoen, R.  
1982; 66 (2): 353-359
  - **Minimal surfaces and positive scalar curvature** *Proc ICM*  
Schoen, R. M.  
1982: 575-578
  - **PROOF OF THE POSITIVE MASS THEOREM .2.** *COMMUNICATIONS IN MATHEMATICAL PHYSICS*  
Schoen, R., Yau, S. T.  
1981; 79 (2): 231-260
  - **REGULARITY OF STABLE MINIMAL HYPERSURFACES** *COMMUNICATIONS ON PURE AND APPLIED MATHEMATICS*  
Schoen, R., Simon, L.  
1981; 34 (6): 741-797
  - **THE ENERGY AND THE LINEAR MOMENTUM OF SPACE-TIMES IN GENERAL-RELATIVITY** *COMMUNICATIONS IN MATHEMATICAL PHYSICS*  
Schoen, R., Yau, S. T.  
1981; 79 (1): 47-51
  - **Geometric bounds on the low eigenvalues of a compact surface** *Proc Symp Pure Math*  
Schoen, R. M., Wolpert, S., Yau, S. T.  
1980: 279-285
  - **THE STRUCTURE OF COMPLETE STABLE MINIMAL-SURFACES IN 3-MANIFOLDS OF NONNEGATIVE SCALAR CURVATURE** *COMMUNICATIONS ON PURE AND APPLIED MATHEMATICS*  
FISCHERCOLBRIE, D., Schoen, R.  
1980; 33 (2): 199-211
  - **POSITIVITY OF THE TOTAL MASS OF A GENERAL SPACE-TIME** *PHYSICAL REVIEW LETTERS*  
Schoen, R., Yau, S. T.  
1979; 43 (20): 1457-1459
  - **PROOF OF THE POSITIVE MASS CONJECTURE IN GENERAL-RELATIVITY** *COMMUNICATIONS IN MATHEMATICAL PHYSICS*  
Schoen, R., Yau, S. T.  
1979; 65 (1): 45-76
  - **EXISTENCE OF INCOMPRESSIBLE MINIMAL SURFACES AND THE TOPOLOGY OF THREE DIMENSIONAL MANIFOLDS WITH NONNEGATIVE SCALAR CURVATURE** *ANNALS OF MATHEMATICS*  
Schoen, R., Yau, S. T.  
1979; 110 (1): 127-142
  - **COMPACT GROUP ACTIONS AND THE TOPOLOGY OF MANIFOLDS WITH NON-POSITIVE CURVATURE** *TOPOLOGY*  
Schoen, R., Yau, S. T.  
1979; 18 (4): 361-380
  - **STRUCTURE OF MANIFOLDS WITH POSITIVE SCALAR CURVATURE** *MANUSCRIPTA MATHEMATICA*  
Schoen, R., Yau, S. T.  
1979; 28 (1-3): 159-183
  - **PROOF OF THE POSITIVE-ACTION CONJECTURE IN QUANTUM RELATIVITY** *PHYSICAL REVIEW LETTERS*  
SCHOEN, R. M., Yau, S. T.  
1979; 42 (9): 547-548
  - **UNIValent HARMONIC MAPS BETWEEN SURFACES** *INVENTIONES MATHEMATICAE*  
Schoen, R., Yau, S. T.  
1978; 44 (3): 265-278

- **INCOMPRESSIBLE MINIMAL SURFACES, 3-DIMENSIONAL MANIFOLDS WITH NONNEGATIVE SCALAR CURVATURE, AND POSITIVE MASS CONJECTURE IN GENERAL RELATIVITY** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*  
Schoen, R., Yau, S. T.  
1978; 75 (6): 2567-2567
- **REGULARITY AND SINGULARITY ESTIMATES ON HYPERSURFACES MINIMIZING PARAMETRIC ELLIPTIC VARIATIONAL INTEGRALS** *ACTA MATHEMATICA*  
Schoen, R., Simon, L., ALMGREN, F. J.  
1977; 139 (3-4): 217-265
- **HARMONIC MAPS AND TOPOLOGY OF STABLE HYPERSURFACES AND MANIFOLDS WITH NONNEGATIVE RICCI CURVATURE** *COMMENTARII MATHEMATICI HELVETICI*  
Schoen, R., Yau, S. T.  
1976; 51 (3): 333-341
- **CURVATURE ESTIMATES FOR MINIMAL HYPERSURFACES** *ACTA MATHEMATICA*  
Schoen, R., Simon, L., Yau, S. T.  
1975; 134 (3-4): 275-288