

# Hiroshi Ooguri

Fred Kavli Professor of Theoretical Physics and Mathematics  
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## Education

1989 University of Tokyo Doctor of Science  
 1986 Kyoto University Master of Science  
 1984 Kyoto University Bachelor of Science

## Academic Appointments

### *California Institute of Technology*

2007 – Fred Kavli Professor of Theoretical Physics and Mathematics  
 2014 – Founding Director of the Walter Burke Institute for Theoretical Physics  
 2010 – 2015 Deputy Chair of the Division of Physics, Mathematics and Astronomy  
 2000 – 2007 Professor of Theoretical Physics and Mathematics

### *Aspen Center for Physics*

2023 – Honorary Trustee for Life  
 2021 – Chair of the Board of Trustees  
 2016 – 2019 President  
 2011 – 2016 Trustee  
 2010 – 2011 Scientific Secretary  
 2003 – 2023 General Member

### *Other Academic Institutions*

2025 –	Louis Michele Chair	Institut des Hautes Études Scientifiques
2024 –	University Professor	University of Tokyo
2018 – 2023	Director of Kavli IPMU	University of Tokyo
1994 – 2000	Professor	University of California, Berkeley
1996 – 2000	Faculty Senior Scientist	Lawrence Berkeley National Laboratory
1990 – 1996	Associate Professor	Kyoto University
1989 – 1990	Assistant Professor	University of Chicago
1988 – 1989	Member	Institute for Advanced Study, Princeton
1986 – 1989	Assistant Professor	University of Tokyo

## Awards & Honors

2024	Frontiers of Science Award	International Congress of Basic Science, China
2023	Guggenheim Fellowship	Guggenheim Foundation, USA
2021	Benjamin Lee Distinguish Professor	Korean Physical Society and APCTP
2019	Medal of Honor with Purple Ribbon	Emperor of Japan
2018	Hamburg Prize	Joachim Herz Foundation, Germany
2016	Fellow	American Academy of Arts and Sciences, USA
2016	Chunichi Cultural Prize	Chunichi Shimbun, Japan
2016	Best Educational Product Award	International Planetarium Society
2014	Kodansha Prize for Science Books	Kodansha, Japan
2012	Fellow	American Mathematical Society, USA
2012	Simons Investigator (renewed in 2023)	Simons Foundation, USA

2009	Nishina Memorial Prize	Nishina Memorial Foundation, Japan
2009	Takagi Lecturer	Mathematical Society of Japan
2008	Humboldt Research Award	Humboldt Foundation, Germany
2008	Eisenbud Prize for Mathematics and Physics	American Mathematical Society, USA

### Distinguished Lectures

2023	Arnold Sommerfeld Lectures	Ludwig Maximilian University of Munich
2022	Science Lectureship Award	Chiba University
2019	Nishina Memorial Lecture	Nishina Memorial Foundation
2019	Wolfgang Pauli Lectures	Hamburg University and DESY
2019	Bethe Colloquium	University of Bonn
2019	Hamilton Colloquium	Princeton University
2018	Distinguished Lecture	ICTS, Bangalore
2017	Annual General Assembly Lecture	Physical Society of Japan
2016	Distinguished Lecture	Taiwan National Center for Theoretical Sciences
2013	Lecture at the First Annual Meeting	Simons Foundation, Mathematics & Physical Sciences
2012	Annual General Assembly Lecture	RIKEN
2009	Ehrenfest Colloquium	Leiden University

### Services to Caltech

2003 – 2023	Physics Colloquium Committee (Chair in 2012 – 2015 and 2019 - 2023 )	Member
2001 – 2002, 2010 – 2012	PMA Long Term Strategic Planning Committee (Chair in 2010 - 2012)	Member
2011 – 2014	Caltech Faculty Board (Steering Committee Member in 2012 – 2014)	Member
2001 – 2019	Physics Faculty Search Committee (Co-Chair in 2003 - 2006)	Member
2004 – 2017	Mathematics Faculty Search Committee	Member
2012 – 2015	Undergraduate Admissions Committee	Member
2015 – 2016	Physics Graduate Committee	Member

### Prize Selection Committee

American Academy of Arts and Sciences Membership Panel (2024)  
 Marie Sklodowska Curie Award Selection Committee (2022, 2023, 2024)  
 Soros Fellowships for New American Selection Committee (2017, 2018, 2022, 2023, 2024)  
 Nishina Memorial Prize Selection Committee (2016 - 2021)  
 Inamori Research Institute for Science Fellowship Selection Committee (2019)  
 Hosi Shin-ichi Prize for Science Fictions Selection Committee (2018)  
 Kyoto Prize (2014)

### Review Boards and Advisory Boards

DOE and NSF Review Panels (multiple years)  
 Scientific Advisory Committee, Leung Center for Cosmology and Particle Astrophysics, Taiwan  
 (2024 - present)  
 International Advisory Board, Center for Mathematical Physics Hamburg (2023 - 2025)  
 Advisory Board, Universities for International Research Excellence, MEXT, Japan (2023 - 2025)

Planning Committee for Strings Conferences (2022 - present)  
 Scientific Committee of Pollica Physics Centre in Salerno, Italy (2022 - present)  
 International Advisory Board, Tohoku Forum for Creativity, Tohoku University (2020 - present)  
 Scientific Committee, Beijing Inst of Mathematical Sciences and Applications (2020 - present)  
 Committee of Visitors, US Department of Energy, Office of High Energy Physics (2020)  
 Steering Committee, String-Math Conference Series (2019 - present)  
 Cluster of Excellence, Hamburg University (2019 - present)  
 Center for Quantum Mathematics and Physics, University of California, Davis (2018 - present)  
 Steering Committee of Kavli Asian Winter School (2011 - present)  
 Solvay Institute, Brussels, Belgium (2008 - present)  
 Scientific Council, ICTP-AP, Beijing (2019)  
 Theory Group, CERN (2016 and 2019)  
 Tata Institute of Fundamental Research (2018)  
 Korea Institute for Advanced Study (2018)  
 Research Institute for Mathematical Sciences, Kyoto University (2013 - 2017)  
 International Congress of Mathematical Physics (2013 - 2015)  
 Chinese Academy of Sciences (2013)  
 Banff International Research Station, Banff, Canada (2008 - 2011)  
 Kavli Institute for Theoretical Physics, University of California, Santa Barbara (2005 - 2008)

### Editorial Boards

Communications in Mathematical Physics (2014 - 2015)  
 Journal of High Energy Physics (1997 - 2006)  
 Nuclear Physics B (1998 - 2013)  
 Physical Review D (2006 - 2009)  
 Advances in Theoretical and Mathematical Physics (1997 - present)

### Selected Plenary Talks and Invited Lectures in 2018 - 2023

KITP Conference, UCSB (April 2 - 5, 2024)  
 KITP Discussion Session Leader, UCSB (March 13, 2024)  
 Tsinghua-Tokyo Workshop Tsinghua-Tokyo workshop on Calabi-Yau (January 15 - 19, 2024)  
 Theoretical Physics Symposium, Hamburg (September 19 - 21, 2023)  
 New York University Colloquium (September 20, 2023)  
 Swamplandia, Real Jardín Botánico, Madrid (September 13 - 15, 2023)  
 Strings in Seoul 2023 (September 11 - 15, 2023)  
 Strings 2023, Perimeter Institute, Closing Remarks (July 28, 2023)  
 String-Math 2023, Melbourne, Australia (10 -14 July, 2023)  
 Simons Workshop, Simons Center for Geometry and Physics (July 6, 2023)  
 University of Heidelberg (July 3, 2023)  
 Sommerfeld Lectures, Ludwig Maximilian University of Munich (June 27 - 30, 2023)  
 Roberto Longo's 70th Birthday, Enrico Fermi Research Center, Rome (June 21 - 23, 2023)  
 SUSY 50, University of Minnesota (May 18 - 20, 2023)  
 Eastern Hemisphere Colloquium on Geometry and Physics (January 18, 2023)  
 Frontier of Mathematics, TSIMF, China (December 22-29, 2022)  
 Simons Summer Workshop (July 25, 2022)

Strings 2022 in Vienna, Summary Talk (July 22, 2022)  
Verlinde Symposium in Amsterdam (July 14, 2022)  
Opening Lecture, Tehran School on Swampland (May 16, 2022)  
Colloquium, Kyoto University (April 28, 2022)  
One World IAMP Mathematical Physics Seminar (April 19, 2022)  
Western Hemisphere Colloquium on Geometry and Physics (January 24, 2022)  
Kashiwa Campus Colloquium, University of Tokyo (December 5, 2021)  
Conference in honor of the 60th birthday of Atsushi Moriwaki (December 2, 2021)  
Yale University Particle Theory Seminar (November 30, 2021)  
Local Quantum Physics Colloquium (November 24, 2021)  
Benjamin Lee Lecture Series at APCTP (November 1 and 2, 2021)  
Korean Physical Society Meeting, Benjamin Lee Award Lecture (October 20, 2021)  
Humboldt Kolleg, Corfu, Greece (September 17 - 21, 2021)  
Strings 2021 Summary Talk, São Paulo (June 21 - July 2, 2021)  
PASCOS 2021, South Korea (June 14-18, 2021)  
Colloquium, Universität Würzburg, Germany (June 7, 2021)  
Colloquium, the Galileo Galilei Institute, Florence, Italy (February 17, 2021)  
Colloquium, UC Santa Cruz (January 14, 2021)  
Seminars, Harvard, Stanford, and Technische Universität Wien (July and August, 2020)  
Nishina Memorial Lecture, Tokyo (December 6, 2019)  
UC Berkeley Colloquium (November 25, 2019)  
Theory Seminar, KITP, UC Santa Barbara (November 21, 2019)  
Opening Symposium, Institute for Advanced Research, Nagoya University (November 15, 2019)  
Amherst Workshop “Theoretical Tests of the Swampland” (October 21 - 23)  
KIPC Conference “Cosmic Controversy” (October 5 - 8, 2019)  
Pauli Lectures, Hamburg University (September 30 - October 2, 2019)  
IFT Conference “Navigating the Swampland” (September 27, 2019)  
Colloquium, IFT-Madrid (September 26, 2019)  
10th Anniversary of J-PARC (September 24, 2019)  
Biennial European Physical Society Conference, Ghent (July 10 - 17, 2019)  
Strings 2019, Brussels (June 25 - 29, 2019)  
It from Qubit Workshop and School, Kyoto (June 17 - 28, 2019)  
SUSY 2019, Texas (May 20 - 24, 2019)  
String Field Theory and String Worldsheet Theory, Florence (May 6 - 10, 2019)  
Bethe Colloquium, University of Bonn (April 25, 2019)  
Colloquium, Princeton University (April 9, 2019)  
Colloquium, University of Chicago (February 21, 2019)  
Colloquium, Cornell University (February 18, 2019)  
CERN Winter School, 4 lectures (February 4 - 8, 2019)  
Colloquium, DESY (November 11, 2018)  
Colloquium, Aspen Center for Physics (August 23, 2018)  
Simons Summer Worksho 2018, SCGP (August 1, 2018)  
50 Years of Veneziano Model, GGI Florence (May 14, 2018)  
Feynman Centennial Symposium, Caltech (May 12, 2018)

Quantum Gravity and Holography, Kavli IPMU (April 2 - 6, 2018)  
 Colloquium, Harvard University (March 26, 2018)  
 Accelerating Universe, Sendai, Japan (February 11, 2018)  
 Robert Brout Memorial Symposium, NTU, Singapore (January 18, 2018)  
 Distinguished Lecture, ICTS, Bangalore, India (January 15, 2018)

### Selected Public Lectures in 2018 - 2023

Public Lecture at the inauguration of the new Chunichi Building (scheduled: May 26, 2024)  
 Lecture at the Nagoya University Medical School (November 10, 2023)  
 Lecture at the 150th Anniversary of Gifu High School (October 29, 2023)  
 Public Lecture at ESO planetarium, Munich (June 29, 2023)  
 Lecture at the annual meeting of the Japan Endocrine Society (June 1, 2023)  
 50th Anniversary of the Kobayashi-Maskawa Theory, Tokyo, Japan (February 18, 2023)  
 Lecture at the annual meeting of the Japan Society of Anesthesia (December 2, 2022)  
 Tokyo Forum 2022 "Dialogue between Philosophy and Science" (December 1, 2022)  
 Special Public Lecture at the University of Tokyo, "What is Gravity" (October 22, 2022)  
 Dialogue with Cumrun Vafa, Tokyo, Japan (October 19, 2022)  
 Public lecture at the Embassy of Japan in London, UK (September 16, 2022)  
 Science and Music, Aspen, Colorado (August 8, 2022)  
 Science & Cocktails, Amsterdam (July 13, 2022)  
 Horikawa High School, Kyoto (April 27, 2022)  
 Forum of Industry Leaders in Japan (April 25, 2022)  
 15th Anniversary Symposium of the Kavli IPMU (April 24, 2022)  
 Entrance Ceremony of the University of Tokyo Graduate Schools (April 12, 2022)  
 IFI Symposium, University of Tokyo (February 22, 2022)  
 Philosophers in Greater Tokyo (July 14, 2021)  
 Public Lectures in Tokyo, Yokohama, and Osaka (April 18/May 22/July 24, 2021)  
 WPI Science Symposiu, University of Tokyo (January 12, 2020)  
 University of Tokyo Kashiwa Open Campus (October 26, 2019)  
 Hamburg Planetarium, Hamburg, Germany (October 1, 2019)  
 University of Tokyo Executive Program (June 27, 2019)  
 Hamburg Planetarium, Hamburg, Germany (November 8, 2018)  
 Aspen Rotary Club, Aspen, Colorado (August 24, 2018)  
 Okinawa Institute for Science and Technology (June 30, 2018)  
 Tohoku University (June 23, 2018)  
 Nehru Planetarium, Mumbai, India (April, 2018)  
 Nehru Planetarium, Bangalore, India (January 14, 2018)

### Conference Organizations in 2016 - 2023

KITP Program, UCSB (February 18 - March 13, 2020)  
 Kavli Asian Winter School 2020, Sendai, Japan (January 13 - 22, 2020)  
 Strings 2018, Okinawa, Japan (June 25 - 29, 2018)  
 String-Math 2018, Sendai, Japan (June 18 - 22, 2018)  
 The 10th Anniversary Symposium of the Kavli IPMU (October 16 - 18, 2017)  
 Simons Symposium on Quantum Entanglement, Elmau, Germany (May 1 - 5, 2017)

The 75th Birthday Symposium for John Schwarz, Caltech (November 18 - 19, 2016)

General Relativity at One Hundred, Caltech (March 10 - 12, 2016)

F-Theory at 20, Caltech (February 22 - 26, 2016)

Statistics, Quantum Information, and Gravity, Tokyo, Japan (September 27, 2016)

Asian Winter School in String Theory, Okinawa, Japan (January 6 - 16, 2016)

# Publication

1. **“Universal Bound on Effective Central Charge and Its Saturation,”**  
A. Karch, Y. Kusuki, H. Ooguri, H. Y. Sun, M. Q. Wang.  
arXiv: 2404.01515 [hep-th]
2. **“Symmetry-resolved entanglement entropy, spectra & boundary conformal field theory,”**  
Y. Kusuki, S. Murciano, H. Ooguri and S. Pal.  
arXiv:2309.03287 [hep-th]  
JHEP **11**, 216 (2023)
3. **“Universality of Effective Central Charge in Interface CFTs,”**  
A. Karch, Y. Kusuki, H. Ooguri, H. Y. Sun, M. Q. Wang.  
arXiv:2308.05436 [hep-th]  
JHEP **11**, 126 (2023)
4. **“Universal Asymptotics for High Energy CFT Data,”**  
N. Benjamin, J. Lee, H. Ooguri, and D. Simmons-Duffin.  
arXiv:2306.08031 [hep-th]  
JHEP **03**, 115 (2024)
5. **“Universal formula for the density of states with continuous symmetry,”**  
M. J. Kang, J. Lee, and H. Ooguri,  
arXiv:2206.14814 [hep-th]  
Phys. Rev. D **107**, no.2, 026021 (2023)
6. **“A universal formula for the density of states in theories with finite-group symmetry,”**  
D. Harlow and H. Ooguri,  
arXiv:2103.15826 [hep-th]  
Class. Quant. Grav. **39**, no.13, 134003 (2022)
7. **“Narain to Narnia,”**  
N. Benjamin, C. A. Keller, H. Ooguri and I. G. Zadeh,  
arXiv:2109.03838 [hep-th]  
Commun. Math. Phys. **390**, no.1, 425 (2022)
8. **“On Rational Points in CFT Moduli Spaces,”**  
N. Benjamin, C. A. Keller, H. Ooguri and I. G. Zadeh,  
arXiv:2011.07062 [hep-th]  
JHEP **04**, 067 (2021)
9. **“Singularities of thermal correlators at strong coupling”**  
M. Dodelson and H. Ooguri,  
arXiv:2010.09734 [hep-th]  
Phys. Rev. D **103**, no.6, 066018 (2021)
10. **“Cobordism Conjecture in AdS”**  
H. Ooguri and T. Takayanagi,  
arXiv:2006.13953 [hep-th]
11. **“Duality and Axionic Weak Gravity”**  
S. Andriolo, T. C. Huang, T. Noumi, H. Ooguri and G. Shiu,  
arXiv:2004.13721 [hep-th]  
Phys. Rev. D **102**, no.4, 046008 (2021)

12. **“High-energy behavior of Mellin amplitudes”**  
M. Dodelson and H. Ooguri,  
arXiv:1911.05274 [hep-th]  
Phys. Rev. D **101**, no.6, 066008 (2020)
13. **“Light-cone modular bootstrap and pure gravity”**  
N. Benjamin, H. Ooguri, S. H. Shao and Y. Wang,  
arXiv:1906.04184 [hep-th]  
Phys. Rev. D **100**, no.6, 066029 (2019)
14. **“Distance and de Sitter Conjectures on the Swampland”**  
H. Ooguri, E. Palti, G. Shiu and C. Vafa.  
arXiv:1810.05506 [hep-th]  
Phys. Lett. B **788**, 180 (2019)
15. **“Distance and de Sitter Conjectures on the Swampland”**  
H. Ooguri, E. Palti, G. Shiu and C. Vafa.  
arXiv:1810.05506 [hep-th]  
Phys. Lett. B **788**, 180 (2019)
16. **“Constraints on symmetry from holography”**  
D. Harlow and H. Ooguri.  
arXiv:1810.05337 [hep-th]  
Phys. Rev. Lett. **122**, no.19, 191601 (2019)
17. **“Symmetries in quantum field theory and quantum gravity”**  
D. Harlow and H. Ooguri.  
arXiv:1810.05338 [hep-th]  
Commun. Math. Phys. **383** (2021) 3, 1669-1804
18. **“De Sitter Space and the Swampland”**  
G. Obied, H. Ooguri, L. Spodyneiko and C. Vafa.  
arXiv:1806.08362 [hep-th]
19. **“Distinguishability of Black Hole Microstates”**  
N. Bao and H. Ooguri.  
arXiv:1705.07943 [hep-th]  
Phys. Rev. D **96**, no. 6, 066017 (2017)
20. **“New Kaluza-Klein Instantons and the Decay of AdS Vacua”**  
H. Ooguri and L. Spodyneiko.  
arXiv:1703.03105 [hep-th]  
Phys. Rev. D **96**, no. 2, 026016 (2017)
21. **“Shortening Anomalies in Supersymmetric Theories”**  
J. Gomis, Z. Komargodski, H. Ooguri, N. Seiberg and Y. Wang.  
arXiv:1611.03101 [hep-th]  
JHEP **1701**, 067 (2017)
22. **“Non-supersymmetric AdS and the Swampland”**  
H. Ooguri and C. Vafa.  
arXiv:1610.01533 [hep-th]  
Adv. Theor. Math. Phys. **21**, 1787 (2017)
23. **“Gravitational Positive Energy Theorems from Information Inequalities”**  
N. Lashkari, J. Lin, H. Ooguri, B. Stoica and M. Van Raamsdonk.  
arXiv:1605.01075 [hep-th]  
PTEP **2016**, no. 12, 12C109 (2016)
24. **“Bulk Local States and Crosscaps in Holographic CFT”**  
Y. Nakayama and H. Ooguri.



- arXiv:1605.00334 [hep-th]  
JHEP **1610**, 085 (2016)
25. **“Reflections on Conformal Spectra”**  
H. Kim, P. Kravchuk and H. Ooguri.  
arXiv:1510.08772 [hep-th]  
JHEP **1604**, 184 (2016)
  26. **“Bulk Locality and Boundary Creating Operators”**  
Y. Nakayama and H. Ooguri.  
arXiv:1507.04130 [hep-th]  
JHEP **1510**, 114 (2015)
  27. **“The Holographic Entropy Cone”**  
N. Bao, S. Nezami, H. Ooguri, B. Stoica, J. Sully and M. Walter.  
arXiv:1505.07839 [hep-th]  
JHEP **1509**, 130 (2015)
  28. **“Locality of Gravitational Systems from Entanglement of Conformal Field Theories”**  
J. Lin, M. Marcolli, H. Ooguri and B. Stoica.  
arXiv:1412.1879 [hep-th]  
Phys. Rev. Lett. **114**, 221601 (2015)
  29. **“Hall Viscosity and Angular Momentum in Gapless Holographic Models”**  
H. Liu, H. Ooguri and B. Stoica.  
arXiv:1403.6047 [hep-th]  
Phys. Rev. D **90**, no. 8, 086007 (2014)
  30. **“Angular Momentum Generation by Parity Violation”**  
H. Liu, H. Ooguri and B. Stoica.  
arXiv:1311.5879 [hep-th]  
Phys. Rev. D **89**, no. 10, 106007 (2014)
  31. **“Out of Equilibrium Temperature from Holography”**  
S. Nakamura and H. Ooguri.  
arXiv:1309.4089 [hep-th]  
Phys. Rev. D **88**, no. 12, 126003 (2013)
  32. **“Spontaneous Generation of Angular Momentum in Holographic Theories”**  
H. Liu, H. Ooguri, B. Stoica and N. Yunes.  
arXiv:1212.3666 [hep-th]  
Phys. Rev. Lett. **110**, no. 21, 211601 (2013)
  33. **“Modular Constraints on Calabi-Yau Compactifications”**  
C. A. Keller and H. Ooguri.  
arXiv:1209.4649 [hep-th]  
Commun. Math. Phys. **324**, 107 (2013)
  34. **“Lectures on topological string theory”**  
H. Ooguri.  
Lect. Notes Phys. **851**, 233 (2012).
  35. **“Instability in magnetic materials with dynamical axion field”**  
H. Ooguri and M. Oshikawa.  
arXiv:1112.1414 [cond-mat.mes-hall]  
Phys. Rev. Lett. **108**, 161803 (2012)
  36. **“Comments on Worldsheet Description of the Omega Background”**  
Y. Nakayama and H. Ooguri.  
arXiv:1106.5503 [hep-th]  
Nucl. Phys. B **856**, 342 (2012)

37. **“Spatially Modulated Phase in Holographic Quark-Gluon Plasma”**  
H. Ooguri and C. S. Park.  
arXiv:1011.4144 [hep-th]  
Phys. Rev. Lett. **106**, 061601 (2011)
38. **“Holographic End-Point of Spatially Modulated Phase Transition”**  
H. Ooguri and C. S. Park.  
arXiv:1007.3737 [hep-th]  
Phys. Rev. D **82**, 126001 (2010)
39. **“Wall Crossing As Seen By Matrix Models”**  
H. Ooguri, P. Sulkowski and M. Yamazaki.  
arXiv:1005.1293 [hep-th]  
Commun. Math. Phys. **307**, 429 (2011)
40. **“Notes on the K3 Surface and the Mathieu group  $M_{24}$ ”**  
T. Eguchi, H. Ooguri and Y. Tachikawa.  
arXiv:1004.0956 [hep-th]  
Exper. Math. **20**, 91 (2011)
41. **“Supersymmetry Breaking and Gauge Mediation”**  
R. Kitano, H. Ooguri and Y. Ookouchi.  
arXiv:1001.4535 [hep-th]  
Ann. Rev. Nucl. Part. Sci. **60**, 491 (2010)
42. **“Gravity Dual of Spatially Modulated Phase”**  
S. Nakamura, H. Ooguri and C. S. Park.  
arXiv:0911.0679 [hep-th]  
Phys. Rev. D **81**, 044018 (2010)
43. **“Wall Crossing and M-theory”**  
M. Aganagic, H. Ooguri, C. Vafa and M. Yamazaki.  
arXiv:0908.1194 [hep-th]  
Publ. Res. Inst. Math. Sci. Kyoto **47**, 569 (2011)
44. **“Supersymmetric non-relativistic geometries in M-theory”**  
H. Ooguri and C. S. Park.  
arXiv:0905.1954 [hep-th]  
Nucl. Phys. B **824**, 136 (2010)
45. **“Emergent Calabi-Yau Geometry”**  
H. Ooguri and M. Yamazaki.  
arXiv:0902.3996 [hep-th]  
Phys. Rev. Lett. **102**, 161601 (2009)
46. **“Geometry As Seen By String Theory”**  
H. Ooguri.  
arXiv:0901.1881 [math.AG]  
Jpn. J. Math. (2009) 4, 95.
47. **“Crystal Melting and Toric Calabi-Yau Manifolds”**  
H. Ooguri and M. Yamazaki.  
arXiv:0811.2801 [hep-th]  
Commun. Math. Phys. **292**, 179 (2009)
48. **“The Entropic Principle and the Landscape in SUSY Gauge Theories”**  
H. Ooguri.  
Subnucl. Ser. **45**, 117 (2009).
49. **“Superconformal Chern-Simons Theories and the Squashed Seven Sphere”**  
H. Ooguri and C. S. Park.

arXiv:0808.0500 [hep-th]  
JHEP **0811**, 082 (2008)

50. **“Current Correlators for General Gauge Mediation”**  
H. Ooguri, Y. Ookouchi, C. S. Park and J. Song.  
arXiv:0806.4733 [hep-th]  
Nucl. Phys. B **808**, 121 (2009)
51. **“Extremal N=(2,2) 2D Conformal Field Theories and Constraints of Modularity”**  
M. R. Gaberdiel, S. Gukov, C. A. Keller, G. W. Moore and H. Ooguri.  
arXiv:0805.4216 [hep-th]  
Commun. Num. Theor. Phys. **2**, 743 (2008)
52. **“New Anomalies in Topological String Theory”**  
P. L. H. Cook, H. Ooguri and J. Yang.  
arXiv:0804.1120 [hep-th]  
Prog. Theor. Phys. Suppl. **177**, 120 (2009)
53. **“Metastable Vacua in Perturbed Seiberg-Witten Theories. Part 2. Fayet-Iliopoulos Terms and Kahler Normal Coordinates”**  
J. Marsano, H. Ooguri, Y. Ookouchi and C. S. Park.  
arXiv:0712.3305 [hep-th]  
Nucl. Phys. B **798**, 17 (2008)
54. **“Comments on the Holomorphic Anomaly in Open Topological String Theory”**  
P. L. H. Cook, H. Ooguri and J. Yang.  
arXiv:0706.0511 [hep-th]  
Phys. Lett. B **653**, 335 (2007)
55. **“Metastable Vacua in Perturbed Seiberg-Witten Theories”**  
H. Ooguri, Y. Ookouchi and C. S. Park.  
arXiv:0704.3613 [hep-th]  
Adv. Theor. Math. Phys. **12**, no. 2, 405 (2008)
56. **“Gauge Mediation in String Theory”**  
T. Kawano, H. Ooguri and Y. Ookouchi.  
arXiv:0704.1085 [hep-th]  
Phys. Lett. B **652**, 40 (2007)
57. **“Nondecoupling of Maximal Supergravity from the Superstring”**  
M. B. Green, H. Ooguri and J. H. Schwarz.  
arXiv:0704.0777 [hep-th]  
Phys. Rev. Lett. **99**, 041601 (2007)
58. **“Baby universes and string theory”**  
R. Dijkgraaf, R. Gopakumar, H. Ooguri and C. Vafa.  
Int. J. Mod. Phys. D **15**, 1581 (2006).
59. **“Direct Mediation of Meta-Stable Supersymmetry Breaking”**  
R. Kitano, H. Ooguri and Y. Ookouchi.  
hep-ph/0612139  
Phys. Rev. D **75**, 045022 (2007)
60. **“Quantum Entanglement of Baby Universes”**  
M. Aganagic, H. Ooguri and T. Okuda.  
hep-th/0612067  
Nucl. Phys. B **778**, 36 (2007)
61. **“Entropy of small black holes”**  
H. Ooguri.  
Prog. Theor. Phys. Suppl. **163**, 355 (2006).

62. **“Meta-Stable Supersymmetry Breaking Vacua on Intersecting Branes”**  
H. Ooguri and Y. Ookouchi.  
hep-th/0607183  
Phys. Lett. B **641**, 323 (2006)
63. **“Landscape of supersymmetry breaking vacua in geometrically realized gauge theories”**  
H. Ooguri and Y. Ookouchi.  
hep-th/0606061  
Nucl. Phys. B **755**, 239 (2006)
64. **“On the Geometry of the String Landscape and the Swampland”**  
H. Ooguri and C. Vafa.  
hep-th/0605264  
Nucl. Phys. B **766**, 21 (2007)
65. **“Baby universes in string theory”**  
R. Dijkgraaf, R. Gopakumar, H. Ooguri and C. Vafa.  
hep-th/0504221  
Phys. Rev. D **73**, 066002 (2006)
66. **“Hartle-Hawking wave-function for flux compactifications”**  
H. Ooguri, C. Vafa and E. P. Verlinde.  
hep-th/0502211  
Lett. Math. Phys. **74**, 311 (2005)
67. **“Black holes, q-deformed 2d Yang-Mills, and non-perturbative topological strings”**  
M. Aganagic, H. Ooguri, N. Saulina and C. Vafa.  
hep-th/0411280  
Nucl. Phys. B **715**, 304 (2005)
68. **“Black hole attractors and the topological string”**  
H. Ooguri, A. Strominger and C. Vafa.  
hep-th/0405146  
Phys. Rev. D **70**, 106007 (2004)
69. **“D-branes and phases on string world sheet”**  
T. Okuda and H. Ooguri.  
hep-th/0404101  
Nucl. Phys. B **699**, 135 (2004)
70. **“S duality and topological strings”**  
N. Nekrasov, H. Ooguri and C. Vafa.  
hep-th/0403167  
JHEP **0410**, 009 (2004)
71. **“On the world sheet derivation of large N dualities for the superstring”**  
N. Berkovits, H. Ooguri and C. Vafa.  
hep-th/0310118  
Commun. Math. Phys. **252**, 259 (2004)
72. **“Planar gravitational corrections for supersymmetric gauge theories”**  
R. Dijkgraaf, M. T. Grisaru, H. Ooguri, C. Vafa and D. Zanon.  
hep-th/0310061  
JHEP **0404**, 028 (2004)
73. **“Gravity induced C deformation”**  
H. Ooguri and C. Vafa.  
hep-th/0303063  
Adv. Theor. Math. Phys. **7**, no. 3, 405 (2003)

74. **“The C deformation of Gluino and nonplanar diagrams”**  
H. Ooguri and C. Vafa.  
hep-th/0302109  
Adv. Theor. Math. Phys. **7**, no. 1, 53 (2003)
75. **“Quantum aspects of Seiberg-Witten map in noncommutative Chern-Simons theory”**  
K. Kaminsky, Y. Okawa and H. Ooguri.  
hep-th/0301133  
Nucl. Phys. B **663**, 33 (2003)
76. **“Inside the horizon with AdS / CFT”**  
P. Kraus, H. Ooguri and S. Shenker.  
hep-th/0212277  
Phys. Rev. D **67**, 124022 (2003)
77. **“World sheet derivation of a large N duality”**  
H. Ooguri and C. Vafa.  
hep-th/0205297  
Nucl. Phys. B **641**, 3 (2002)
78. **“Penrose limit of N = 1 gauge theories”**  
J. Gomis and H. Ooguri.  
hep-th/0202157  
Nucl. Phys. B **635**, 106 (2002)
79. **“Boundary states for AdS(2) branes in AdS(3)”**  
P. Lee, H. Ooguri and J. w. Park.  
hep-th/0112188  
Nucl. Phys. B **632**, 283 (2002)
80. **“Permeable conformal walls and holography”**  
C. Bachas, J. de Boer, R. Dijkgraaf and H. Ooguri.  
hep-th/0111210  
JHEP **0206**, 027 (2002)
81. **“Strings in AdS(3) and the SL(2,R) WZW model. Part 3. Correlation functions”**  
J. M. Maldacena and H. Ooguri.  
hep-th/0111180  
Phys. Rev. D **65**, 106006 (2002)
82. **“Holography and defect conformal field theories”**  
O. DeWolfe, D. Z. Freedman and H. Ooguri.  
hep-th/0111135  
Phys. Rev. D **66**, 025009 (2002)
83. **“Open strings on AdS(2) branes”**  
P. Lee, H. Ooguri, J. W. Park and J. Tannenhauser.  
hep-th/0106129  
Nucl. Phys. B **610**, 3 (2001)
84. **“Seiberg-Witten transforms of noncommutative solitons”**  
K. Hashimoto and H. Ooguri.  
hep-th/0105311  
Phys. Rev. D **64**, 106005 (2001)
85. **“Strings in AdS(3) and SL(2,R) WZW model”**  
H. Ooguri.  
Int. J. Mod. Phys. A **16**, 677 (2001).
86. **“An Exact solution to Seiberg-Witten equation of noncommutative gauge theory”**  
Y. Okawa and H. Ooguri.

- hep-th/0104036  
Phys. Rev. D **64**, 046009 (2001)
87. **“Energy momentum tensors in matrix theory and in noncommutative gauge theories”**  
Y. Okawa and H. Ooguri.  
hep-th/0103124
88. **“How noncommutative gauge theories couple to gravity”**  
Y. Okawa and H. Ooguri.  
hep-th/0012218  
Nucl. Phys. B **599**, 55 (2001)
89. **“Nonrelativistic closed string theory”**  
J. Gomis and H. Ooguri.  
hep-th/0009181  
J. Math. Phys. **42**, 3127 (2001)
90. **“Holography in superspace”**  
H. Ooguri, J. Rahmfeld, H. Robins and J. Tannenhauser.  
hep-th/0007104  
JHEP **0007**, 045 (2000)
91. **“Strings in AdS(3) and the SL(2,R) WZW model. Part 2. Euclidean black hole”**  
J. M. Maldacena, H. Ooguri and J. Son.  
hep-th/0005183  
J. Math. Phys. **42**, 2961 (2001)
92. **“Strings in AdS(3) and SL(2,R) WZW model 1.: The Spectrum”**  
J. M. Maldacena and H. Ooguri.  
hep-th/0001053  
J. Math. Phys. **42**, 2929 (2001)
93. **“Wilson loops and minimum surfaces”**  
H. Ooguri.  
Prog. Theor. Phys. Suppl. **134**, 153 (1999).
94. **“Knot invariants and topological strings”**  
H. Ooguri and C. Vafa.  
hep-th/9912123  
Nucl. Phys. B **577**, 419 (2000)
95. **“Gauge theory and string theory: An Introduction to the AdS / CFT correspondence”**  
H. Ooguri.  
hep-lat/9911027  
Nucl. Phys. Proc. Suppl. **83**, 77 (2000)
96. **“Wilson loops in large N theories”**  
H. Ooguri.  
hep-th/9909040  
Class. Quant. Grav. **17**, 1225 (2000)
97. **“Large N field theories, string theory and gravity”**  
O. Aharony, S. S. Gubser, J. M. Maldacena, H. Ooguri and Y. Oz.  
hep-th/9905111  
Phys. Rept. **323**, 183 (2000)
98. **“Wilson loops and minimal surfaces”**  
N. Drukker, D. J. Gross and H. Ooguri.  
hep-th/9904191  
Phys. Rev. D **60**, 125006 (1999)

99. **“Gauge theories on branes”**  
H. Ooguri.  
Nucl. Phys. Proc. Suppl. **67**, 172 (1998).
100. **“Gauge theory and gravity: A new synthesis”**  
H. Ooguri.  
In \*Goeteborg 1998, Novelties in string theory\* 1-6
101. **“String theory on AdS(3)”**  
J. de Boer, H. Ooguri, H. Robins and J. Tannenhauser.  
hep-th/9812046  
JHEP **9812**, 026 (1998)
102. **“On the field theory limit of D instantons”**  
H. Ooguri and K. Skenderis.  
hep-th/9810128  
JHEP **9811**, 013 (1998)
103. **“Glueballs and their Kaluza-Klein cousins”**  
H. Ooguri, H. Robins and J. Tannenhauser.  
hep-th/9806171  
Phys. Lett. B **437**, 77 (1998)
104. **“Glueball mass spectrum from supergravity”**  
C. Csaki, H. Ooguri, Y. Oz and J. Terning.  
hep-th/9806021  
JHEP **9901**, 017 (1999)
105. **“Aspects of large N gauge theory dynamics as seen by string theory”**  
D. J. Gross and H. Ooguri.  
hep-th/9805129  
Phys. Rev. D **58**, 106002 (1998)
106. **“Spectrum of large N gauge theory from supergravity”**  
G. T. Horowitz and H. Ooguri.  
hep-th/9802116  
Phys. Rev. Lett. **80**, 4116 (1998)
107. **“Membrane scattering in curved space with M momentum transfer”**  
J. de Boer, K. Hori and H. Ooguri.  
hep-th/9802005  
Nucl. Phys. B **525**, 257 (1998)
108. **“Branes and dynamical supersymmetry breaking”**  
J. de Boer, K. Hori, H. Ooguri and Y. Oz.  
hep-th/9801060  
Nucl. Phys. B **522**, 20 (1998)
109. **“Geometry and quantum field theory: A brief introduction”**  
B. R. Greene and H. Ooguri.  
In \*Greene, B. (ed.): Yau, S.T. (ed.): Mirror symmetry II\* 3-27
110. **“Kahler potential and higher derivative terms from M theory five-brane”**  
J. de Boer, K. Hori, H. Ooguri and Y. Oz.  
hep-th/9711143  
Nucl. Phys. B **518**, 173 (1998)
111. **“Why matrix theory is hard”**  
M. R. Douglas and H. Ooguri.  
hep-th/9710178  
Phys. Lett. B **425**, 71 (1998)

112. **“M theory five-brane and SQCD”**  
H. Ooguri.  
hep-th/9709211  
Nucl. Phys. Proc. Suppl. **68**, 84 (1998)
113. **“D-brane actions on Kahler manifolds”**  
M. R. Douglas, A. Kato and H. Ooguri.  
hep-th/9708012  
Adv. Theor. Math. Phys. **1**, 237 (1998)
114. **“Strong coupling dynamics of four-dimensional N=1 gauge theories from M theory five-brane”**  
K. Hori, H. Ooguri and Y. Oz.  
hep-th/9706082  
Adv. Theor. Math. Phys. **1**, 1 (1998)
115. **“NonAbelian conifold transitions and N=4 dualities in three-dimensions”**  
K. Hori, H. Ooguri and C. Vafa.  
hep-th/9705220  
Nucl. Phys. B **504**, 147 (1997)
116. **“Issues in (M)atrix model compactification”**  
M. R. Douglas, H. Ooguri and S. H. Shenker.  
hep-th/9702203  
Phys. Lett. B **402**, 36 (1997)
117. **“Geometry of N=1 dualities in four-dimensions”**  
H. Ooguri and C. Vafa.  
hep-th/9702180  
Nucl. Phys. B **500**, 62 (1997)
118. **“Non-Abelian conifold transitions and N=4 dualities in three dimensions”**  
K. Hori, H. Ooguri and C. Vafa.
119. **“TASI lectures on perturbative string theories”**  
H. Ooguri and Z. Yin.  
hep-th/9612254
120. **“Mirror symmetry in three-dimensional theories,  $SL(2, Z)$  and D-brane moduli spaces”**  
J. de Boer, K. Hori, H. Ooguri, Y. Oz and Z. Yin.  
hep-th/9612131  
Nucl. Phys. B **493**, 148 (1997)
121. **“Mirror symmetry in three-dimensional gauge theories, quivers and D-branes”**  
J. de Boer, K. Hori, H. Ooguri and Y. Oz.  
hep-th/9611063  
Nucl. Phys. B **493**, 101 (1997)
122. **“Supersymmetric cycles in exceptional holonomy manifolds and Calabi-Yau 4 folds”**  
K. Becker, M. Becker, D. R. Morrison, H. Ooguri, Y. Oz and Z. Yin.  
hep-th/9608116  
Nucl. Phys. B **480**, 225 (1996)
123. **“Summing up D instantons”**  
H. Ooguri and C. Vafa.  
hep-th/9608079  
Phys. Rev. Lett. **77**, 3296 (1996)
124. **“D-branes on Calabi-Yau spaces and their mirrors”**  
H. Ooguri, Y. Oz and Z. Yin.  
hep-th/9606112  
Nucl. Phys. B **477**, 407 (1996)



125. **“Loop amplitudes of N=2 string”**  
H. Ooguri.  
In \*Los Angeles 1995, Future perspectives in string theory\* 400-413
126. **“String solitons and singularities of K(3)”**  
H. Ooguri.  
In \*Toyonaka 1995, Frontiers in quantum field theory\* 69-73
127. **“Two-dimensional black hole and singularities of CY manifolds”**  
H. Ooguri and C. Vafa.  
hep-th/9511164  
Nucl. Phys. B **463**, 55 (1996)
128. **“N=2 string amplitudes”**  
H. Ooguri.  
Nucl. Phys. Proc. Suppl. **46**, 173 (1996).
129. **“Quantization of mirror symmetry”**  
H. Ooguri.  
Workshop on String Theory, Gauge Theory and Quantum Gravity, 28-29 Apr 1993. Trieste, Italy
130. **“All loop N=2 string amplitudes”**  
H. Ooguri and C. Vafa.  
hep-th/9505183  
Nucl. Phys. B **451**, 121 (1995)
131. **“Note on holomorphic anomalies in topological field theories”**  
H. Ooguri.  
In \*Toyonaka 1994, Group theoretical methods in physics\* 41-53
132. **“Note on holomorphic anomalies in topological field theories”**  
H. Ooguri.  
In \*Istanbul 1994, Strings and symmetries\* 15-25
133. **“Quantization of the mirror symmetry”**  
H. Ooguri.  
In \*Berkeley 1993, Proceedings, Strings '93\* 316-327
134. **“Kodaira-Spencer theory of gravity and exact results for quantum string amplitudes”**  
M. Bershadsky, S. Cecotti, H. Ooguri and C. Vafa.  
hep-th/9309140  
Commun. Math. Phys. **165**, 311 (1994)
135. **“Holomorphic anomalies in topological field theories”**  
M. Bershadsky, S. Cecotti, H. Ooguri and C. Vafa.  
hep-th/9302103  
Nucl. Phys. B **405**, 279 (1993)
136. **“Schwinger-Dyson equation in three-dimensional simplicial quantum gravity”**  
H. Ooguri.  
hep-th/9210028  
Prog. Theor. Phys. **89**, 1 (1993)
137. **“Topological lattice models in four-dimensions”**  
H. Ooguri.  
hep-th/9205090  
Mod. Phys. Lett. A **7**, 2799 (1992)
138. **“Partition functions and topology changing amplitudes in the 3-D lattice gravity of Ponzano and Regge”**  
H. Ooguri.  
hep-th/9112072  
Nucl. Phys. B **382**, 276 (1992)

139. **“The Annihilating ideals of minimal models”**  
 B. L. Feigin, T. Nakanishi and H. Ooguri.  
 Int. J. Mod. Phys. A **7S1A**, 217 (1992), [Int. J. Mod. Phys. A **7**, 217 (1992)].
140. **“Discrete and continuum approaches to three-dimensional quantum gravity”**  
 H. Ooguri and N. Sasakura.  
 hep-th/9108006  
 Mod. Phys. Lett. A **6**, 3591 (1991)
141. **“N=2 heterotic strings”**  
 H. Ooguri and C. Vafa.  
 Nucl. Phys. B **367**, 83 (1991).
142. **“The Induced action of W(3) gravity”**  
 H. Ooguri, K. Schoutens, A. Sevrin and P. van Nieuwenhuizen.  
 Commun. Math. Phys. **145**, 515 (1992).
143. **“Modular invariant partition functions for the doubly extended N=4 superconformal algebras”**  
 H. Ooguri, J. L. Petersen and A. Taormina.  
 Nucl. Phys. B **368**, 611 (1992).
144. **“Geometry of N=2 strings”**  
 H. Ooguri and C. Vafa.  
 Nucl. Phys. B **361**, 469 (1991).
145. **“Geometry of the N=2 string theory”**  
 H. Ooguri.  
 In \*New York 1990, Proceedings, Quarks, symmetries and strings\* 193-206. (see HIGH ENERGY PHYSICS INDEX 29 (1991) No. 12259)
146. **“Selfduality and  $N = 2$  String MAGIC”**  
 H. Ooguri and C. Vafa.  
 Mod. Phys. Lett. A **5**, 1389 (1990).
147. **“Superconformal Symmetry and Geometry of Ricci Flat Kahler Manifolds”**  
 H. Ooguri.  
 Int. J. Mod. Phys. A **4**, 4303 (1989).
148. **“Borel Summation of String Theory for Planck Scale Scattering”**  
 P. F. Mende and H. Ooguri.  
 Nucl. Phys. B **339**, 641 (1990).
149. **“Hidden  $Osp(N,2)$  Symmetries in Superconformal Field Theories”**  
 M. Bershadsky and H. Ooguri.  
 Phys. Lett. B **229**, 374 (1989).
150. **“Hidden  $SL(n)$  Symmetry in Conformal Field Theories”**  
 M. Bershadsky and H. Ooguri.  
 Commun. Math. Phys. **126**, 49 (1989).
151. **“Application Of Superconformal Symmetry To String Compactification”**  
 T. Eguchi, H. Ooguri, A. Taormina and S. K. Yan.  
 IN \*TSUKUBA 1988, PROCEEDINGS, SUPERSTRINGS\* 32-54.
152. **“Superconformal Algebras and String Compactification on Manifolds with  $SU(N)$  Holonomy”**  
 T. Eguchi, H. Ooguri, A. Taormina and S. K. Yang.  
 Nucl. Phys. B **315**, 193 (1989).
153. **“Differential Equations for Characters of Virasoro and Affine Lie Algebras”**  
 T. Eguchi and H. Ooguri.  
 Nucl. Phys. B **313**, 492 (1989).

154. **“Differential equations in moduli space”**  
T. Eguchi and H. Ooguri.  
2nd Meeting on Quantum Mechanics of Fundamental Systems, 17-20 Dec 1987. Santiago, Chile
155. **“Conformal Field Theory On A Riemann Surface”**  
H. Ooguri.  
IN \*KANPUR 1987, PROCEEDINGS, PARTICLE PHYSICS - SUPERSTRING THEORY\* 184-198.  
(SEE CONFERENCE INDEX)
156. **“Effective Action Including String Loop Effects: String Loop Corrections From Fusion Of Handles And Vertex Operators”**  
H. Ooguri and N. Sakai.  
IN \*TSUKUBA 1987, PROCEEDINGS, SUPERSTRINGS\* 1-3.
157. **“String Multiloop Corrections to Equations of Motion”**  
H. Ooguri and N. Sakai.  
Nucl. Phys. B **312**, 435 (1989).
158. **“Differential Equations for Conformal Characters in Moduli Space”**  
T. Eguchi and H. Ooguri.  
Phys. Lett. B **203**, 44 (1988).
159. **“String Loop Corrections From Fusion of Handles and Vertex Operators”**  
H. Ooguri and N. Sakai.  
Phys. Lett. B **197**, 109 (1987).
160. **“Chiral Bosonization on Riemann Surface”**  
T. Eguchi and H. Ooguri.  
Phys. Lett. B **187**, 127 (1987).
161. **“Soliton Equations and Free Fermions on Riemann Surfaces”**  
N. Ishibashi, Y. Matsuo and H. Ooguri.  
Mod. Phys. Lett. A **2**, 119 (1987).
162. **“Conformal and Current Algebras on General Riemann Surface”**  
T. Eguchi and H. Ooguri.  
Nucl. Phys. B **282**, 308 (1987).
163. **“String Field Theory With Space-time Supersymmetry”**  
H. Ooguri.  
Phys. Lett. B **172**, 204 (1986).
164. **“Gauge Field Theory Of Free Superstrings”**  
H. Ooguri.
165. **“Spectrum of Hawking Radiation and Huygens’ Principle”**  
H. Ooguri.  
Phys. Rev. D **33**, 3573 (1986).
166. **“Gauge Invariant Local Action of String Field From BRS Formalism”**  
K. Itoh, T. Kugo, H. Kunitomo and H. Ooguri.  
Prog. Theor. Phys. **75**, 162 (1986).
167. **“Nambu-goldstone Bosons In Curved Space-time”**  
T. Inami and H. Ooguri.  
Phys. Lett. B **163**, 101 (1985).
168. **“Dynamical Breakdown Of Supersymmetry In Two-dimensional Anti-de Sitter Space”**  
T. Inami and H. Ooguri.  
Nucl. Phys. B **273**, 487 (1986).
169. **“One Loop Effective Potential in Anti-de Sitter Space”**  
T. Inami and H. Ooguri.  
Prog. Theor. Phys. **73**, 1051 (1985).