

University of Oxford
Department of Physics

Oxford Master Course in Mathematical and Theoretical Physics

Introduction to Gauge-String Duality

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References

Updated: April 2018

- **Books on Gauge-String Duality**

1. M. Ammon and J. Erdmenger, “Gauge/Gravity Duality: Foundations and Applications”, Cambridge University Press, 2015.
2. J. Casalderrey-Solana, H. Liu, D. Mateos, K. Rajagopal and U. A. Wiedemann, “Gauge/String Duality, Hot QCD and Heavy Ion Collisions,” Cambridge University Press, 2014.

There exists a slightly older on-line version:

J. Casalderrey-Solana, H. Liu, D. Mateos, K. Rajagopal and U. A. Wiedemann, “Gauge/String Duality, Hot QCD and Heavy Ion Collisions,” arXiv:1101.0618 [hep-th].

3. Jan Zaanen, Yan Liu, Ya-Wen Sun, Koenraad Schalm: “Holographic Duality in Condensed Matter Physics”, Cambridge University Press, 2015.
4. Horatiu Nastase: “Introduction to the AdS/CFT Correspondence”, Cambridge University Press, 2015.
5. Horatiu Nastase: “String Theory Methods for Condensed Matter Physics”, Cambridge University Press, 2017.

- **Reviews directly relevant for this course**

- O. Aharony, S. S. Gubser, J. M. Maldacena, H. Ooguri and Y. Oz, “Large N field theories, string theory and gravity,” Phys. Rept. **323**, 183 (2000) [arXiv:hep-th/9905111].
- D. T. Son and A. O. Starinets, “Viscosity, Black Holes, and Quantum Field Theory,” Ann. Rev. Nucl. Part. Sci. **57**, 95 (2007) [arXiv:0704.0240 [hep-th]].
- A. O. Starinets, “Transport coefficients of strongly coupled gauge theories: Insights from string theory,” Eur. Phys. J. A **29**, 77 (2006) [arXiv:nucl-th/0511073].
- S. A. Hartnoll, A. Lucas and S. Sachdev, “Holographic quantum matter,” arXiv:1612.07324 [hep-th].

- **Reviews of Gauge-String Duality and Applications**

- J. Polchinski, “Introduction to Gauge/Gravity Duality,” arXiv:1010.6134 [hep-th].
- G. T. Horowitz and J. Polchinski, “Gauge/gravity duality,” In *Orti, D. (ed.): Approaches to quantum gravity* 169-186 [gr-qc/0602037].
- J. McGreevy, “Holographic duality with a view toward many-body physics,” Adv. High Energy Phys. **2010**, 723105 (2010) [arXiv:0909.0518 [hep-th]].
- I. R. Klebanov, “TASI lectures: Introduction to the AdS/CFT correspondence,” arXiv:hep-th/0009139.

I. R. Klebanov, “From threebranes to large N gauge theories,” arXiv:hep-th/9901018.
 E. D’Hoker and D. Z. Freedman, “Supersymmetric gauge theories and the AdS / CFT correspondence,” hep-th/0201253.
 M. K. Benna and I. R. Klebanov, “Gauge-String Dualities and Some Applications,” arXiv:0803.1315 [hep-th].

- **Duality in Lattice Statistical Mechanics**

R. Savit, “Duality in Field Theory and Statistical Systems,” Rev. Mod. Phys. **52**, 453 (1980).
 H. .P. McKean, Jr, “Kramers-Wannier Duality for the 2-Dimensional Ising Model as an Instance of Poisson’s Summation Formula”, J. Math.Phys., **5**, n.6, 775 (1964).
 Yu. M. Zinov’ev, ”Duality in Abelian gauge theories on a lattice”, Theoretical and Mathematical Physics, Volume 43, Issue 3, pp 481-490 (1980).
 K. Drühl and H. Wagner, ”Algebraic Formulation of Duality Transformations for Abelian Lattice Models”, Annals of Physics **141**, 225-253 (1982) .
 S. Caracciolo and A. Sportiello, “General duality for Abelian group valued statistical mechanics models,” J. Phys. A **37**, 7407 (2004), [cond-mat/0308515].
 A.A.Kirillov, ”Elements of the Theory of Representations”, Springer Berlin Heidelberg (1976).
 Y. Katznelson, ”An Introduction to Harmonic Analysis”, Cambridge U. Press, 2004.
 R. J. Baxter, ”Exactly Solved Models in Statistical Mechanics”, Academic Press, London New York, 1982

- **Duality in QFT**

J. A. Harvey, “Magnetic monopoles, duality and supersymmetry,” In *Trieste 1995, High energy physics and cosmology* 66-125 [hep-th/9603086].
 R. Rajaraman, “Solitons And Instantons. An Introduction To Solitons And Instantons In Quantum Field Theory,” Amsterdam, Netherlands: North-Holland (1982) 409p.
 Y. Frishman and J. Sonnenschein, ”Non-Perturbative Field Theory: From Two Dimensional Conformal Field Theory To QCD In Four Dimensions”, Cambridge U. Press, 2010.

- **Large N expansion**

A. M. Polyakov, “Gauge Fields And Strings,” Contemp. Concepts Phys. **3**, 1 (1987).
 Y. .Makeenko, “Methods of contemporary gauge theory,” Cambridge, UK: Univ. Pr. (2002) 417 p

- **Black hole thermodynamics, Bekenstein-Hawking entropy and microstates counting**

A. Sen, “Black Hole Entropy Function, Attractors and Precision Counting of Microstates,” Gen. Rel. Grav. **40**, 2249 (2008) [arXiv:0708.1270 [hep-th]].
 S. Carlip, “Black Hole Thermodynamics and Statistical Mechanics,” Lect. Notes Phys. **769**, 89 (2009) [arXiv:0807.4520 [gr-qc]].
 P. Fre, (ed.), V. Gorini, (ed.), U. Moschella, (ed.) and G. Magli, (ed.), “Classical and quantum black holes,” Bristol, UK: IOP (1999) 348 p

- **Black branes**

K. S. Stelle, “Lectures on supergravity p-branes,” In *Trieste 1996, High energy physics and cosmology* 287-339 [hep-th/9701088].

- **The original AdS/CFT papers**

J. M. Maldacena, “The large N limit of superconformal field theories and supergravity,” Adv. Theor. Math. Phys. **2**, 231 (1998) [Int. J. Theor. Phys. **38**, 1113 (1999)] [arXiv:hep-th/9711200].

S. S. Gubser, I. R. Klebanov and A. M. Polyakov, “Gauge theory correlators from non-critical string theory,” Phys. Lett. B **428**, 105 (1998) [arXiv:hep-th/9802109].

E. Witten, “Anti-de Sitter space and holography,” Adv. Theor. Math. Phys. **2**, 253 (1998) [arXiv:hep-th/9802150].

- **Original papers relevant for the course**

D. T. Son and A. O. Starinets, “Minkowski space correlators in AdS / CFT correspondence: Recipe and applications,” JHEP **0209**, 042 (2002) [hep-th/0205051].

P. K. Kovtun and A. O. Starinets, “Quasinormal modes and holography,” Phys. Rev. D **72**, 086009 (2005) [hep-th/0506184].

- **Holography and phenomenology of heavy ion physics**

P. Romatschke and U. Romatschke, “Relativistic Fluid Dynamics In and Out of Equilibrium – Ten Years of Progress in Theory and Numerical Simulations of Nuclear Collisions,” arXiv:1712.05815 [nucl-th].

- **Books on string theory**

M. B. Green, J. H. Schwarz and E. Witten, “Superstring Theory. Vols. 1: Introduction,” Cambridge, UK: Univ. Pr. (1987) 469 P.

M. B. Green, J. H. Schwarz and E. Witten, “Superstring Theory. Vol. 2: Loop Amplitudes, Anomalies And Phenomenology,” Cambridge, UK: Univ. Pr. (1987) 596 P.

E. Kiritsis, “String theory in a nutshell,” Princeton University Press, 2007

B. Zwiebach, “A first course in string theory,” Cambridge, UK: Univ. Pr. (2009) 673 p

J. Polchinski, “String theory. Vol. 1: An introduction to the bosonic string,” Cambridge, UK: Univ. Pr. (1998) 402 p

J. Polchinski, “String theory. Vol. 2: Superstring theory and beyond,” Cambridge, UK: Univ. Pr. (1998) 531 p

- **Online lecture courses**

J. McGreevy, MIT lectures, TASI lectures and other recordings online.

S. Hartnoll, Nordita lectures and other recordings online.

H. Liu, MIT lectures online.