

Topics in Gauge-Gravity duality

Graduate Lecture Course

University of Oxford

Trinity Term 2012

Room 501, DWB, Department of Physics

Mondays, 14:00-16:00

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References

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

Main reviews 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].

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].

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].

Reviews on Gauge-Gravity Duality:

J. Polchinski, “Introduction to Gauge/Gravity Duality,” arXiv:1010.6134 [hep-th].

Comment: modern view, deep and insightful, not an easy read

G. T. Horowitz and J. Polchinski, “Gauge/gravity duality,” In *Orliti, 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.

Comment: two highly readable and short introductions to AdS/CFT correspondence from one of its authors.

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].

Comment: Section 6 discusses thermal physics and holography, including the critique of the viscosity-entropy bound conjecture.

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].

Comment: a positive feature of this text (perhaps the only positive feature) is that it is very short.

Duality in QFT and Statistical Mechanics:

R. Rajaraman, “Solitons And Instantons. An Introduction To Solitons And Instantons In Quantum Field Theory,” Amsterdam, Netherlands: North-holland (1982) 409p

R. Savit, “Duality in Field Theory and Statistical Systems,” Rev. Mod. Phys. **52**, 453 (1980).

J. A. Harvey, “Magnetic monopoles, duality and supersymmetry,” In *Trieste 1995, High energy physics and cosmology* 66-125 [hep-th/9603086].

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