Curriculum Vitae

Dario Rosa

Personal Information

Current Position	Research Fellow
Work Contact	School of Physics, Room 1529, Korea Institute for Advanced Study, 85 Hoegi-ro, Dongdaemun-gu, Seoul, 02455, Korea Phone: +82-2-958.2653 Email: Dario85@kias.re.kr
Private Address	Hoegi Dong 103-188 (201) Dongdaemun-Gu, Seoul, Korea
Date of Birth	2nd of April, 1985
Place of Birth	Milan, Italy
Citizenship	Italian
Languages	Italian, English
Coding Skills	Wolfram Mathematica (excellent), Python (good), C++ (basic)

Education

01/2015	University of Milan-Bicocca, PhD Thesis *Advisor: Alessandro Tomasiello* *Title: From spinors to forms: results on G-structures on supergravity and on topological field theories*
11/2011 – 11/2014	University of Milan-Bicocca, PhD program *Advisor: Alessandro Tomasiello*
07/2011	University of Genova, Master Thesis *Advisor: Camillo Imbimbo* *Title: Chern-Simons gauge theories and topological strings* *Final grade: 110/110, cum laude*
10/2008 – 07/2011	University of Genova, Master degree in Physics
10/2004 – 10/2007	University of Genova, Bachelor degree in Physics *Final grade: 110/110, cum laude*

Working Experience

since 09/2016   Korea Institute for Advanced Study, Research Fellow

09/2014 – 08/2016 Seoul National University, Research Fellow

Teaching Experience

05/2016   Seoul National University, I have organized and taught the last part of the course "Introduction to QFT" to the students of the master degree in Physics

01/2015 – 09/2015 I have introduced Jin-Beom Bae (at that time PhD student in Seoul National University) to the topic of supersymmetric QFTs in curved spaces. The results of our collaboration have been published in the last months of the same year

Talks & Seminars

Oct 2019   Workshop *"Universality and ergodicity in quantum many-body systems"*, SCGP, Stony Brook
Talk's title: *"Non local interactions enhance the performances of quantum batteries : the case of SYK'*

Sep 2019   Workshop *"Higher Spin Gravity: Chaotic, Conformal and Algebraic Aspects"*, APCTP, Pohang
Talk's title: *"The importance of the tail: chaotic/integrable and Hawking-Page phase transitions in SYK-like systems"*

Jun – Jul 2019   Milano-Bicocca University, Milan   *20 Jun*
IFT, Madrid,   *27 Jun*
IJS, Ljubljana   *2 Jul*
"The importance of the tail: chaotic/integrable and Hawking-Page phase transitions in SYK-like systems"

Apr 2019   University of Cape Town, Cape Town   *10 Apr*
"An Introduction to Quantum Chaos"

Mar 2019   Chulalongkorn University, Bangkok   *19 Mar*
"An Introduction to Quantum Chaos"

Nov 2018   Workshop *"Holographic Tensors"*, Okinawa
Talk's title: *"The Thouless time for mass deformed SYK"*

Aug 2018   Conference *"Holography and Geometry of Quantum Entanglement"*, Seoul
Set of two lectures. Lectures titles:
1) SYK basics
2) SYK and random matrices.

Dec 2017   Workshop *"XIII AVOGADRO MEETING on Strings, Supergravity and Gauge Theories"*, Padova
Talk's title: *"From SYK to Tensor Models"*

Nov 2017   Sichuan University, Chengdu   *24 Nov*
Seoul National University, Seoul   *29 Nov*
"Contrasting SYK-like Models: RMT and Chaos"

Jun 2017	Workshop *"X. International Symposium on Quantum Theory and Symmetries"*, Varna Talk's title: *"A cohomological classification of supersymmetric backgrounds in supergravity"*
Feb 2017	Workshop *"Workshop on Fields, Strings and Gravity"*, Seoul Talk's title: *"The coupling of Poisson sigma models to topological backgrounds"*
Dec 2016	Workshop *"Current Topics in String Theory: Conformal Field Theories"*, Seoul Talk's title: *"Unfolded equations for higher-spin fields"*
Oct 2016	APCTP, Pohang *"Coupling topological field theories to topological backgrounds: the 2d example"*
Nov – Dec 2015	Tsinghua University, Beijing *18 Dec* KIAS, Seoul, *7 Dec* Sichuan University, Chengdu *26 Nov* *"New supersymmetric localizations from topological gravity"*
Nov 2015	Workshop *8th Taiwan String Workshop*, Hsinchu Talk's title: *"New supersymmetric localizations from topological gravity"*
Sep 2015	Workshop *"Liouville, Integrability and Branes (11)"* , Pohang Talk's title: *"New localizations from topological gravity"*
Jan 2015	Conference *"Joint Winter Conference on Particle Physics, String and Cosmology"*, Gangwongdo, Korea Talk's title: *"Coupling topological field theories to topological backgrounds"*
Jan 2015	Sogang university, Seoul *"Generalized geometry's techniques for supergravity"*
Nov 2014	KIAS, Seoul *"Coupling topological field theories to topological backgrounds"*
Sep 2014	Workshop *"Liouville, Integrability and Branes (10)"* , Pohang KIAS Workshop *"Autumn Symposium on String/M Theory"* , Seoul Talk's title: *"AdS solutions for higher dimensional CFTs"*
Nov – Dec 2013	Universidad de Oviedo, Oviedo *12 Dec* Université Libre de Bruxelles, Bruxelles *26 Nov* Ipht CEA-Saclay, Paris *20 Nov* Imperial College, London *8 Nov* *"All AdS$_7$ solutions of type II supergravity"*
Jul 2013	Università Milano-Bicocca, Milan *"Two dimensional YM-yheories, quantum deformations and applications"*
Jun 2013	University of Genova, Genova *"Pure spinor equations to lift gauged supergravity"*

Past research achievements

Here I will briefly summarize the five most relevant results I obtained so far in my career:

- *All AdS$_7$ solutions of type II supergravity*

  I have fully classified *all* the supersymmetric AdS$_7$ vacua that can be constructed in type II supergravity. The geometrical tool I have used is *generalized complex geometry*, an elegant framework that incorporates and unifies both symplectic geometry and complex geometry.

  More recently I turned my research interests to the field of quantum chaos, with the major goals of developing a unique notion of quantum chaos, encompassing both the early time definition (based on the OTOCs and the associated Lyapunov exponents) and the late time definition of quantum chaos (based on the Bohighas-Giannoni-Schmit conjecture), and of studying how much quantum chaos is a peculiar property of black holes and not of other, more generic, backgrounds in gravity. My most important results so far are summarized in the following two papers.

- *The Thouless time for mass-deformed SYK*

  In this paper I studied the chaos/integrable transition for a variant of the SYK model, called *mass deformed* SYK model, which beyond the quartic interaction term of SYK includes also a quadratic, random mass, term. By increasing the strength of the random mass term, the Lyapunov exponent gets decreased to vanish and the model turns to the integrable behavior. I investigated the RMT properties of this model and checked whether they are affected (and how) by varying the strength of the early-time chaos. I have shown that the Thouless time (the time scale at which the RMT effects become dominant) can be put in relation with the Lyapunov exponent. I have also understood that the chaos/integrable transition as seen by the OTOCs is mostly controlled by the low-lying modes of the spectrum and hence, in order to have an agreement between the definition of chaos based on the OTOCs and the definition of chaos based on the BGS conjecture, one has to develop efficient statistical tools to study the RMT signatures of chaos for the very first excited states.

- *Quantum chaos transition in a two-site SYK model dual to an eternal traversable wormhole*

  In this paper I studied the RMT characterization of a two-site SYK model, which has been argued by Maldacena and Qi to be dual to a traversable wormhole geometry. In particular the gravity dual exhibits a Hawking-Page phase transition from a traversable wormhole geometry to a two-sided black-hole geometry. My analysis has shown that the Hawking-Page phase transition can be characterized in the RMT language as a chaos/integrable transition. This is the first time that such a characterization of the Hawking-Page transition has been obtained. Moreover, I have found that the wormhole geometry is not dual to a chaotic quantum mechanical system, thus suggesting that quantum chaos is a peculiar feature of black holes.

  Finally, I recently worked also on quantum thermodynamics and, more specifically, on models of quantum batteries. I recently wrote two papers on the subject, showing that highly non-local (and chaotic) quantum systems (like the SYK model) can increase dramatically the performances of a generic quantum battery.

- *Ultra stable charging of fastest scrambling quantum batteries*

  I have studies the impact of non-local correlations on the energy stored in a system of N QBs. A unitary charging protocol based on a SYK quench hamiltonian is thus introduced and analyzed. I have demonstrated that, once charged, the average energy stored in the QB is very stable, realizing an ultraprecise charging protocol. By characterizing fluctuations of the average energy stored, I have shown that temporal fluctuations are strongly suppressed by the presence of non-local correlations at all time scales. Comparison with other paradigmatic examples of many-body QBs shows that this is linked to the fast rise of collective dynamics of SYK model and its high level of entanglement. I conjectured that such feature relies on the fastest scrambling property of the SYK hamiltonian, and on its fast thermalization

properties, promoting this as an ideal model for the ultimate temporal stability of a generic quantum battery.

- *Quantum charging supremacy via Sachdev-Ye-Kitaev batteries*

  In this Letter, I have demonstrated that the optimal charging power of a SYK quantum battery displays a super-extensive scaling with the number of Majorana fermions, that stems from genuine quantum mechanical effects. To the best of my knowledge, this is the first quantum many-body battery model where fast charging occurs due to the maximally-entangling underlying quantum dynamics.

PUBLICATIONS

I am author so far of **15** papers, which have attracted around **360** citations with an *h-index* of **9**. [1]

1. D. Rosa, D. Rossini, G. M. Andolina, M. Polini and M. Carrega,
   Ultra stable charging of fastest scrambling quantum batteries,
   arXiv:1912.07247 [cond-mat.str-el].

2. D. Rossini, G. M. Andolina, D. Rosa, M. Carrega and M. Polini,
   Quantum charging supremacy via Sachdev-Ye-Kitaev batteries,
   arXiv:1912.07234 [cond-mat.str-el].

3. A. M. García-García, T. Nosaka, D. Rosa and J. J. M. Verbaarschot,
   Quantum chaos transition in a two-site SYK model dual to an eternal traversable wormhole,
   Phys. Rev. D **100**, no. 2, 026002 (2019) arXiv:1901.06031 [hep-th].

4. T. Nosaka, D. Rosa and J. Yoon,
   The Thouless time for mass-deformed SYK,
   JHEP **1809**, 041 (2018), arXiv:1804.09934 [hep-th].

5. D. Rosa
   The cohomological structure of generalized Killing spinor equations,
   arXiv:1801.09347 [hep-th].
   Dobrev V. (eds) Quantum Theory and Symmetries with Lie Theory and Its Applications in Physics Volume 2. LT-XII/QTS-X 2017. Springer Proceedings in Mathematics and Statistics, vol 255. Springer, Singapore

6. C. Imbimbo and D. Rosa,
   The topological structure of supergravity: an application to supersymmetric localization,
   JHEP **1805**, 112 (2018), arXiv:1801.04940 [hep-th].

7. C. Krishnan, K. V. Pavan Kumar and D. Rosa,
   Contrasting SYK-like Models,
   JHEP **1801**, 064 (2018), arXiv:1709.06498 [hep-th].

8. D. Rosa,
   The coupling of Poisson sigma models to topological backgrounds,
   JHEP **1612**, 043 (2016), arXiv:1610.05659 [hep-th].

9. J. Bae, C. Imbimbo, S. J. Rey and D. Rosa,
   New Supersymmetric Localizations from Topological Gravity,
   JHEP **1603**, 169 (2016), arXiv:1510.00006 [hep-th].

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[1] All the citation data (updated in January 2020) are taken from `http://inspirebeta.net`, the database run by SLAC, which is the one commonly used in High-Energy Theory community.

10. C. Imbimbo and D. Rosa,
    Topological anomalies for Seifert 3-manifolds,
    JHEP **1507**, 068 (2015), arXiv:1411.6635 [hep-th].

11. F. Apruzzi, M. Fazzi, A. Passias, D. Rosa, A. Tomasiello,
    AdS$_6$ solutions of type II supergravity,
    JHEP **1411**, 099 (2014) [JHEP **1505**, 012 (2015)], arXiv:1406.0852[hep-th]

12. D. Rosa,
    Generalized Geometry of two-dimensional vacua,
    JHEP **1407**, 111 (2014), arXiv:1310.6357[hep-th]

13. F. Apruzzi, M. Fazzi, D. Rosa, A. Tomasiello,
    All AdS$_7$ solutions of type II supergravity,
    JHEP **1404**, 064 (2014), arXiv:1309.2949[hep-th]

14. D. Rosa, A. Tomasiello,
    Pure spinor equations to lift gauged supergravity,
    JHEP **1401**, 176 (2014), arXiv:1305.5255[hep-th]

15. S. Giusto, C. Imbimbo, D. Rosa,
    Holomorphic Chern-Simons theory coupled to off-shell Kodaira-Spencer gravity,
    JHEP **1210**, 192 (2012), arXiv:1207.6121[hep-th]

References

These persons are familiar with my professional qualifications and my character:

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