

UNIVERSITÀ DEGLI STUDI DI MILANO

Procedura di selezione per la chiamata a professore di II fascia da ricoprire ai sensi dell'art. 18, commi 1 e 4, della Legge n. 240/2010 per il settore concorsuale **02/A2 - Fisica Teorica delle Interazioni Fondamentali**, (settore scientifico-disciplinare **FIS/02 - Fisica Teorica Modelli e Metodi Matematici**)

presso il Dipartimento di **di FISICA "ALDO PONTREMOLI"**,
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Davide Fioravanti

CURRICULUM VITAE

Name and Surname: Davide Fioravanti

Born: July 12, 1969 in Ascoli Piceno (AP), Italy

Languages: Italian, English, German, French

Address: Sezione INFN–Bologna,

Dept. of Physics, University of Bologna, via Irnerio 46, I-40126, Bologna
ITALY

E-mail: fioravanti@bo.infn.it

0. Bibliometric Indicators

--- From **Inspire** (up-to-date as of 8-th September 2020):

- Number of publications: 64 (search: a fioravanti, d)
- Citations: 1802
- h-index: 22

--- About **Isi-Web-of-Knowledge**: the paper A. Cavaglià, D. Fioravanti, M. Mattelliano and R. Tateo, *On the AdS_5/CFT_4 TBA and its analytic properties*, Infinite Analysis 10 (Developments in Quantum Integrable Systems (IA 10), ISSN 1881-6193, Refereed) (2011) 17 (arXiv:1103.0499 [hep-th]) will be indexed in Isi.

1. Higher Education

Aug. 1985 *Goethe Institut* equalised course of German (very good, high level), Graz Austria

1988-1993 *Laurea* (Master Degree) in Physics (110/110 *cum laude*) at University of L'Aquila, Italy

1992-1993 Compulsory civil service in substitution to the military one

1993-1997 Ph.D. in (Theoretical) Physics (*optimum* (=very good) *cum laude*) at University of Bologna *Alma Mater Studiorum*, Italy (final examination: 8-7-1997, La Sapienza, Rome)

1995- Schools and Workshops in Mathematical Physics and Theoretical Physics

2. Research Experience (<http://www-th.bo.infn.it/activities/pi14/>)

1991-1993 Research towards the obtention of the *Laurea* (Doctorate) in Physics at University of L'Aquila, ITALY. Advisors: Prof. A. Sagnotti, Prof. F. de Pasquale

1993-1997 Research towards the obtention of the Ph.D. in (Theoretical) Physics at University of Bologna, ITALY. Supervisors: Prof. G. Venturi, Prof. F. Ravanini

1997-1999 Senior Research Assistant at the Department of Mathematical Sciences of University of Durham (UK)

1999-2001 I.N.F.N. fellow at S.I.S.S.A.-I.S.A.S. Trieste (ITALY)

2000-2002 E.P.S.R.C. fellow (individually awarded fellowship) at the Department of Mathematical Sciences of University of Durham (UK)

2002-2005 Senior Leverhulme fellow (individually awarded fellowship) at the Department of Mathematical Sciences of the Universities of Durham and of York (UK): STAFF MEMBER since October 2003

Oct. 2005-Dec. 2005 Assegnista di Ricerca (2 Year Temporary University Researcher) at the Department of Mathematics and of Physics of the University of Trento (ITALY)

Dec. 2005 *Idoneita`* (Qualification) as INFN Researcher

Dec. 2005-2 Jan 2011 Researcher at Istituto Nazionale Fisica Nucleare, Sezione di Bologna (*Art. 23.: a tempo determinato= tenure track*)

3 Jan 2011- (Permanent) Researcher at Istituto Nazionale Fisica Nucleare, Sezione di Bologna (First Position at the National Competitive Exam, obtaining the related further steps within Fascia Stipendiale)

2013-2014 Contract Professor at Scuola Normale Superiore, Pisa, Italy

2014 Abilitazione Scientifica Nazionale (ASN) as university professor, I (full professor) and II (associate professor) Fascia on Fisica Teorica delle Interazioni Fondamentali (Settore concorsuale 02/A2, dall' 8/1/2014 al 8/1/2023).

2015 Admission to final interview of the National Competitive Exam as Primo Ricercatore.

2019 Admission to final interview of the National Competitive Exam as Primo Ricercatore.

2019 Admission to final list of the National Competitive Exam as Dirigente di Ricerca (>70/100).

2019-2020 Visiting Professor at Scuola Normale Superiore, Pisa, Italy

3. Teaching and Third Mission Experiences

1996-1997 Supply Teacher of Mathematics at I.T.I.S. *N. Copernico* in Ferrara(FE), Italy (undergraduate level)

1996-1997 Series of Lectures on *Symmetry in Physics* University of Camerino, Italy (Ph. D. level)

1997-1999 University of Durham, United Kingdom (undergraduate level: 'Algebra and Calculus')

1999-2001 S.I.S.S.A.-I.S.A.S., Trieste, Italy (Ph.D. level: 'Group Theory')

Sep. 2000 habilitation and permanent position (waived) as Teacher of Mathematics, Physics and Mathematics–Physics in Italian secondary schools

2000-2001 University of Camerino, Italy (undergraduate level: 'Physics')

2000-2003 University of Durham, United Kingdom (undergraduate level: 'Algebra and Calculus')

2003-2005 University of York, United Kingdom (undergraduate level: 'Advanced Calculus' and 'Mechanics')

2005 University of Trento, Italy (Ph. D. level: a course on 'Critical Phenomena versus Conformal Field Theories and beyond')

2006- University of Bologna, Ph. D./Master course 'Statistical field theory'

2013-2014 Scuola Normale Superiore, (Under)graduate course 'Thermodynamic Bethe Ansatz'

2015- Educational and outreach seminars and conferences ((by Circoli Cittadini, Secondary Schools, participation in *Notte dei Ricercatori*, ecc.)

2017- INFN Bologna Group for 3M (Third Mission) activities

2019-2020 Scuola Normale Superiore, (Under)graduate course 'Fields and Gravity II'

2020 Lectures (recorder and registered) for Third Mission and national formation activities for INFN employees

4. Students

2006-2009 Dr. Diego Bombardelli, Ph. D. in Physics, Univ. of Bologna. Thesis: 'Aspects of Integrability in Gauge/String Correspondences'.

2007-2008 Francesco Buccheri, Laurea Specialistica (Master Degree) in Physics, Univ. of Bologna. Thesis: 'The integrable $O(6)$ sigma model and string/gauge duality'.

2009-2010 Simone Piscaglia, Laurea Specialistica (Master Degree) in Physics, Univ. of Bologna. Thesis: 'Rivisitazione del calcolo dell'energia libera per il sigma model non-lineare $O(3)$ in due dimensioni'.

2009 Andrea Cavaglià, Laurea Specialistica (Master Degree) in Physics, Univ. of Turin (jointly with prof. R. Tateo). Thesis: 'Modelli integrabili e corrispondenza AdS/CFT'.

2010 Massimo Mattelliano, Laurea Specialistica (Master Degree) in Physics, Univ. of Turin (jointly with prof. R. Tateo). Thesis: 'Integrabilit  in $N=4$ Super Yang-Mills: soluzioni numeriche delle equazioni TBA'.

2010-2014 Dr. Alessandro Fabbri, Ph. D. in Physics, Univ. of Bologna (jointly with prof. F. Ravanini). Thesis: 'Quantum Integrability in Non-Linear Sigma Models related to Gauge/String Correspondences'.

2010 - 2014 Dr. Simone Piscaglia, Ph. D. in Physics, Univ. of Bologna. Thesis: 'On the GKP Vacuum in Gauge/Gravity Correspondences'.

2013 - 2018 Dr. Alfredo Bonini, Ph. D. in Physics, Univ. of Bologna. Thesis: 'Supersymmetric 4d gauge theories and integrability'

2016-2020 Dr. Alberto Fachechi, Ph. D. in Physics, Univ. of Lecce (jointly with prof. M. Beccaria).

2017 - 2018 Dr. Daniele Gregori, Laurea Specialistica (Master Degree) in Physics, Univ. of Bologna. Thesis: 'N=2 gauge theories from the Ordinary Differential Equations/Integrable Models (ODE/IM) correspondence perspective'.

2018 - Dr. Daniele Gregori, Ph. D. in Physics, Univ. of Bologna.

2019 - 2020 Dr. Alessandro Bagagli, Laurea Specialistica (Master Degree) in

Physics, Univ. of Bologna. Thesis: 'An attempt to understand thermodynamics in 2D in the light of string theory'.

2019 - Giacomo Belli, Laurea Specialistica (Master Degree) in Physics, Univ. of Bologna. Thesis: On scattering amplitudes and Wilson loops in (susy) gauge theories.

5. Post-Doctoral Fellows mentored as coordinator of a 'little group' on 'Integrability in gauge and string theories'

2013-2015 Dr. Diego Bombardelli, with assegno di ricerca (fellowship) by the Univ. of Bologna.

2014-2016 Dr. Jean-Emile Bourgine, with I.N.F.N. post-doctoral fellowship.

2018-2020 Dr. Hasmik Poghosyan, with assegno di ricerca (fellowship) by the Univ. of Bologna.

2021-2023 I.N.F.N. post-doctoral IS GAST fellow on 'String and gauge theories: string phenomenology and exact results' (approved by INFN Consiglio Direttivo/President)

6. Awards and Prizes

1993 1st Special Research Award of the *Pio Sodalizio dei Piceni*, for the research *Laurea* Thesis, Rome, Italy.

1999-2001 Alma Mater (Univ. of Bologna) Fellowship (waived)

1999 I.N.F.N. Research Fellowship.

2000 E.P.S.R.C. (individually awarded) fellowship at the Department of Mathematical Sciences of University of Durham (UK). Title: 'New symmetries for 2D conformal field theories and their integrable perturbations'. Grant code: GR/M66370. Budget: 71800 GBP (2 years)

2002 Senior Leverhulme (individually awarded) fellowship at the Department of Mathematical Sciences of the Universities of Durham and of York (UK).

Project shared (as Co-investigator) with Prof. E. Corrigan (Univ. of York) (with Profs. P.E. Dorey, A. Taormina (Univ. of Durham)). Title: 'The Classification, States and Reflection Factors for Integrable Models with Boundaries'. Grant code: F/00224/G. Budget: 113760 GBP (3 years).

2011 Best paper prize of Journal of Physics A, awarded by the Institute of Physics (IOP) and Royal Society (of UK).

2017 Appointment of publication [33] as one of the **Most Influential paper in the 50th Anniversary** of Journal of Physics A

2017 Selection of publication [56] **for inclusion in the Journal of Physics A Highlights of 2017 collection** <http://iopscience.iop.org/journal/1751-8121/page/Highlights-of-2017>;

7. Grants and Networks

1995-1998 NATO Grant CRG 950751 as Ph.D. Investigator at the Univ. of Bologna and Post-Doc Univ. of Durham.

1996-2000 TMR Contract ERBFMRXCT960012 'Integrability, Non-Perturbative Effects and Symmetry in Quantum Field Theories' as Post-Doc (at the Univ. of Durham and Investigator at SISSA-ISAS)

1998-2001 NATO Collaborative Linkage Grant PST.CLG.980424 as Investigator

2002-2006 EC FP5 Network "EUCLID", contract number HPRN-CT-2002-00325 as STAFF INVESTIGATOR at Univ. of York

2005- STAFF INVESTIGATOR of INFN Iniziative Specifiche (IS) FI11 'Low-Dimensional Field Theory, Integrable Systems and Applications' and PI14 'Nonperturbative Dynamics in Gauge Theories and in String Theory'; 'Gauge and String Theories' (GAST)

2006-2008 MIUR-PRIN 'Statistical mechanics, quantum field theory, and quantum phase transitions for low dimensional systems' as STAFF INVESTIGATOR at INFN and Univ. of Bologna

2008-2010 International Agreement INFN-MEC-2008 as STAFF INVESTIGATOR

2008-2011 MIUR-PRIN 2007JHLPEZ 'Fisica Statistica dei Sistemi Fortemente Correlati all'Equilibrio e Fuori Equilibrio: Risultati Esatti e Metodi di Teoria dei Campi' as Staff Investigator

2011-2013 MIUR-PRIN contract 2009-KHZKRX 'Simmetrie dell' Universo e dell Interazioni Fondamentali' as Staff Investigator with the Head Coordinating Node of Scuola Normale Superiore (prof. A. Sagnotti), Pisa (IT)

2011-2016 ESF Network HoloGrav 'Holographic methods for strongly coupled systems' (09-RNP-092 (PESC)) as Local Coordinator

2013-2017 European COST Action 'The String Theory Universe' as Local Coordinator

2013-2016 UniTo-SanPaolo research grant TO-Call3-2012-0088 "Modern Applications of String Theory" (MAST) as External Expert

2016- Node Coordinator (Cooperation Partner) of the EU NETWORK (Marie Curie Action) GATIS (Gauge Theory as an Integrable System, grant n. 317089)

2018- Node Coordinator of the INFN Iniziativa Specifica 'Gauge and String Theories' (GAST)

2019- MIUR-PRIN contract 2017CC72MK_003 'Supersymmetry Breaking with Fields, Strings and Branes' as Staff Investigator with the Head Coordinating Node of Scuola Normale Superiore (prof. A. Sagnotti), Pisa (IT)

8. Scientific and Administrative Experience

1997-2002 Vice-President and member of the Board of Governors of the University Council *Consorzio Universitario Piceno* for promotion and diffusion of scientific and university knowledge (with mandate to organising seminars, e.g. the series 'Scienza Nuda')

1999-2001 Member of the Technical-Scientific Committee of *Parco Scientifico e Tecnologico della Regione Marche*

2011-2013 Member of the Committee *Commissione per Assegni di Ricerca INFN-Bologna* (Nominata dal Presidente INFN)

2012- Member of the Committee *Consiglio di Sezione INFN-Bologna*, as *Rappresentante Ricercatori e Docenti INFN-Bologna*

2012 Member of the Committee *Commissione per Assegno di Ricerca Università di Bologna* and Mentor of the Recipient

2013-2018 Member of the Committee for the INFN agreement (room and resources) with the University of Bologna

2013 President of INFN-University Electoral Committee

2014 Member of the Selection Committee for the INFN (international) Post-doctoral Fellowship ‘Non-perturbative aspects in gauge and string theories’ in IS GAST

2016 Member of the Selection Committee for the Post-doctoral Fellowship of the Bologna Theory Group

2017 Member of the Selection Committee for the Post-doctoral Fellowship of the Bologna Theory Group

2018 Member of the Committee *Commissione per Assegno di Ricerca Università di Bologna*

2018 Member of the Committee *Premio di laurea ‘Yassen Stanev’* of the second University of Rome, Tor Vergata

2020- Member of the Collegio del Dottorato (Ph. Academic Committee) in Physics, Univ. of Bologna

9. Research Interests

—(Massive) Integrable Systems, Bethe Ansatz and Spin Chains, Applications of Integrable Systems to Particle Physics: e.g. the use of Bethe Ansatz in (Supersymmetric) Gauge Theories, Integrability tools and structures in the AdS/CFT correspondence;

— Non-Linear Integral equations and Thermodynamic Bethe Ansatz for AdS/CFT and Integrable Systems;

— (Hidden Non-local) Symmetries of non-abelian nature in Integrable

massive Theories; Deformed Virasoro algebras and Quantum Groups;
(Symmetries of) Integrable Hierarchies of PDEs; Quantum Inverse Scattering;
Perturbed Conformal Field Theories;

— S-matrix and its consequences; Form Factors, Statistical Mechanical
Systems and Universal Quantities; Conformal Field Theories with boundaries
and crosscaps for (Super) String Theories; (Integrable) Systems with
boundaries and defects.

10. Main Research Achievements

— Completion of the CFT/string building constraints by the crosscap one (ref. 2).

— New investigation of 2D CFT and integrable models by (re-)discovering non-abelian symmetries and using them (refs. 3,8,9,11,16). Classical/quantum interplay and correspondence, namely Ordinary Differential Equation/Integrable Models (ODE/IM) Correspondence (refs. 20,56)

— Renormalisation group/Condensed Matter applications of perturbative and non-perturbative methods, like the spectral or Form Factor expansion (refs. 19,10,12).

— Extensive study of the wrapping free regime for the energy/anomalous dimension of string/gauge theory with the outcome of exact - sometimes explicit - formulae thereof (refs. 23,24,26,28,29,31,32,34-37), by using non-linear integral eqs ideas of refs 5,17,18. Calculation of the 2D excitation scattering (as in ref. 21) in this setup (refs. 43,45) for aiming at the 4D amplitudes/Wilson loops (refs. 50,54,55,58,59,62). Understanding of the first wrapping correction (ref. 30). Thermodynamic Bethe Ansatz (TBA) idea and Quantum Spectral Curve for the treatment of all of them exactly (refs. 33,38,40,49,57).

— Integrability for more realistic anomalous dimensions (the $N=4$ SYM and QCD reciprocity, ref. 52) and Wilson Loop or quark-anti-quark potential (the QCD-string, ref. 44).

— $N=4$ amplitudes/Wilson Loops exact series and strong coupling (string)

TBA and corrections (refs. 54, 55, 58, 59, 62,63). Relation between 4D Wilson Loops and 2d (conical) twist fields (ref. 59). Computational analogies with $N=2$ Nekrasov partition functions (55, 58, 59, 62,63). In this relation, generalisations of integrable Seiberg-Witten structures (ref. 60, 61), with special emphasis on small background expansion (refs. 51,53, 60,62,63).

11. Most cited papers

— D. Bombardelli, D. Fioravanti, R. Tateo, *Thermodynamic Bethe Ansatz for planar AdS/CFT: a proposal*, J. Phys. A42 (2009) 375401 (arXiv:0902.3930[hep-th], requested for publication by Journal of Physics A on the advise of Editor Prof. A Tseytlin) (**Winner of the Journal of Physics A Best Paper Prize 2011**), reprinted (2017) in the **50th Anniversary** Journal of Physics A **Most Influential paper** volume (309);

— D. Fioravanti, A. Mariottini, E. Quattrini, F. Ravanini, *Excited State Destri-de Vega Equation for Sine Gordon and Restricted Sine Gordon Models*, Phys.Lett. B390 (1997) 243 (153);

— A. Cavaglià, D. Fioravanti and R. Tateo, *Extended Y-system for the AdS₅/CFT₄ correspondence*, Nucl. Phys. B 843 (2011) 302 (arXiv:1005.3016[hep-th]) (104);

— D. Fioravanti, G. Pradisi, A. Sagnotti, *Sewing Constraints and Non-Orientable Open Strings*, Phys.Lett. B321 (1994) 349 (96);

— D. Bombardelli, D. Fioravanti, R. Tateo, *TBA and Y-system for planar AdS₄/CFT₃*, Nucl. Phys. B 834 (2010) 543 (arXiv:0912.4715 [hep-th]) (71);

— M. Caselle, D. Fioravanti, G. Gliozzi and R. Tateo, *Quantisation of the effective string with TBA*, JHEP 07 (2013) 071 (arXiv:1305.1278 [hep-th]) (60);

— A. Cavaglià, D. Fioravanti, N. Gromov and R. Tateo, *Quantum Spectral Curve of the $N=6$ supersymmetric Chern-Simons theory*, Phys. Rev. Lett. 113 (2014) 021601 (arXiv:1403.1859 [hep-th]) (59);

12. Main (invited) Seminars and series of lectures

December 1995 Dept. of Physics, Rome II Italy

March 1996 Workshop in Statistical Mechanics, Trieste, Italy

October 1997 Dept. of Mathematical Sciences, Durham, United Kingdom

January 1998 Series of Lectures at the Dept. of Physics, Rome II, Italy

March 1998 Dept. of Mathematical Physics, Montpellier II, France

September 1998 TMR Conference, Durham, United Kingdom

October 1998 Dept. of Physics, Bologna, Italy

October 1998 TMR Conference, Mons, Belgium

March 1999 Dept. of Physics, Bologna, Italy

June 1999 4-th Workshop *CFT and Integrable Models*, Bologna, Italy,

September 1999 TMR Conference, Trieste, Italy,

February 2000 Dept. of Mathematics, Ancona, Italy,

September 2000 TMR Conference, Paris, France

September 2000 X Workshop on Statistical Field Theory (plenary talk), Bari, Italy,

September 2000 NATO Advanced Research Workshop (plenary talk), Kiev, Ukraine

February 2001 Dept. of Mathematics, York, United Kingdom

July 2001 4-th Conference *Symmetry in Mathematical Physics* (plenary talk), Kiev, Ukraine

September 2001 5-th Workshop *CFT and Integrable Models*, Bologna, Italy,

October 2001 Invited Lectures at Asian Pacific Centre for Theoretical Physics, Seoul, South Korea

April 2002 Series of Lectures at the Dept. of Physics, Bologna, Italy

May 2003 S.I.S.S.A.-I.S.A.S., Trieste, Italy

May 2003 Joint U. of Edinburgh/Heriot-Watt U. Seminar, Edinburgh, UK

December 2003 Workshop *Finite-size Technology in Low Dimensional Quantum Field Theory* (plenary talk), Yong Pyong, South Korea

April 2004 Dept. of Physics, Bologna, Italy

September 2004 6-th Workshop *CFT and Integrable Models* (plenary talk), Bologna, Italy

March 2005 Dept. of Physics, University of Trento, Italy

September 2005 Workshop *Recent Advances in Quantum Integrable Systems*, (invited talk), Annecy, France

January 2007 Workshop *From Statistical Mechanics to Conformal and Quantum*, Field Theory, Melbourne, Australia

February 2007 *XIII St.Petersburg School on Theoretical Physics*, (invited lecture), St. Petersburg, Russia
April 2007 Dept. of Physics, University of Florence,

June 2007 IS PI14 Miniworkshop: 'Topics in non-perturbative gauge dynamics in field and string theory', Padova, Italy,

June 2008 Workshop 'String and Gauge Theories, Villa Mondragone, Rome

October 2008 Workshop 'Integrability in String Theory', GGI Florence

December 2008 Institut de Physique Theorique, CEA-Saclay, Paris

March 2009 Spinoza Institute for Theoretical Physics, Utrecht, The Netherlands

December 2008 Scuola Normale Superiore, Pisa, Italy

December 2009 Workshop 'Lattice Gauge Theories and Integrable Models', Turin, Italy

June 2010 Conference on 'Integrability in Gauge and String Theory', Nordita,

Stockholm, Sweden

July 2010, IS Conference 'Theory of Fundamental Interactions', Perugia, Italy,

October 2010 XIX SIGRAV Conference on 'General Relativity and Gravitational Physics', Scuola Normale Superiore, Pisa, Italy

August 2011 Programme on 'Exact Results in Gauge/Gravity Dualities', Perimeter Institute, Waterloo, Canada

January 2012 IS Conference, 'Theory of Fundamental Interactions', International School for Advanced Studies, Trieste, Italy,

February 2012 Programme on 'Exact Results in Gauge-String Dualities', Nordita, Stockholm, Sweden

February 2013 GATIS (European ITN Network) Kickoff Workshop 'Gauge Theory as an Integrable System', DESY, Hamburg, Germany

June 2013 University of Porto, Porto, Portugal

June 2014 Programme and Workshop 'Finite size and integrability in low dimensional quantum systems' (plenary talk), Budapest, Hungary.

July 2014 Workshop 'Solving AdS/CFT 2', Asian Pacific Centre for Theoretical Physics, Pohang, South Korea.

August 2014 Workshop 'New Trends in Quantum Groups and Integrable Systems', University of Surrey, Guildford, UK.

September 2014 Workshop 'Geometric Correspondences of Gauge Theories 4', SISSA, Trieste, Italy.

May 2015 Conference 'Flux Tubes', Perimeter Institute, Waterloo, Canada.

July 2016 Conference 'Latin-American conference on High Energy Physics: Particle and Strings, Havana, Cuba

September 2016 Workshop 'New Trends in Low-Dimensional Physics: Quantum Integrability and Applications', Beijing, China

April 2017 Workshop 'New Developments in AdS₃/CFT₂ Holography', GGI Florence, Italy

June 2017 X. International Symposium ‘QUANTUM THEORY AND SYMMETRIES’, Varna, Bulgaria.

July 2017 Workshop ‘Integrability in Low-Dimensional Quantum Systems’, MATRIX Institute, Melbourne, Australia

May 2018 Workshop ‘Supersymmetric Quantum Field Theories in the Non-perturbative Regime’, GGI Florence, Italy

June 2018 Workshop ‘Correlation Functions in Solvable Models’, NORDITA, Stockholm, Sweden

May 2019 Dept. of Mathematical Physics, Univ. of Lisbon, Portugal

May 2019 Conference ‘Supersymmetric Wilson loops and related topics’ Univ. of Modena, Italy

Oct. 2019 Conference ‘The wonders of theoretical physics’, ICTP Trieste, Italy

Dec. 2019 PRIN Kick-off Meeting, Scuola Normale Superiore, Pisa, Italy

Jan. 2020 Winter School on ‘Integrable Systems and Representation Theory’, Dept. of Math., Univ. of Bologna, Italy

13. Editor’s and Referee’s Actions

Editor of the Journal ‘*Symmetry*’ (MDPI).

Referee for the international Journals: Journal of High Energy Physics (JHEP), Physical Review, Nuclear Physics B, Physics Letters B, Journal of Physics A, Journal of Statistical Mechanics (JSTAT), Journal of Modern Physics A (JMPA), Physica A, Il Nuovo Cimento, Molecular Physics, SIGMA, Physica Scripta.

Referee for the italian University and Research Ministry (MIUR), European Community Institutions, British Colleges and Universities, Italian Universities and Foundations.

14. Organisation of Conferences and Workshops

July 2006 7-th Workshop on 'CFT and Integrable models', Bologna, Italy

September 2011 8-th Workshop on 'CFT and Integrable models', Bologna

September 2013 9-th Workshop on 'CFT and Integrable models', Bologna

May 2014 Meeting of the INFN IS GAST in Bologna

August 2019 Member of the International Board of Organisers of IGST (Integrability in Gauge and String Theory) annual International Conference

November 2019 Member of Advisory Committee of the Conference "Great Lessons from Exact techniques and Beyond", Padova, September 2020

July 2021 Organiser of IGST (Integrability in Gauge and String Theory) annual International Conference in Italy (Turin with prof. R. Tateo)

15. Computer Expertise

Over my research activity I have been using *Mathematica*, *MathLab*, *Maple*, the program language *Fortran*; the word processors *Word*, *TEX* and *LaTEX*. I have also used the computer operative systems *Linux*, *Unix*, *Mac OS X* and *Windows*.

16. Publications List (including Laurea and Ph.D. Theses)

[1] D. Fioravanti, *Sewing Constraints for Open String Theories*, *Laurea* (Master Degree) Thesis (in italian), University of Rome II "Tor Vergata" (1993);

[2] D. Fioravanti, G. Pradisi, A. Sagnotti, *Sewing Constraints and Non-*

Orientable Open Strings, Phys.Lett. B321 (1994) 349;

[3] D. Fioravanti, F. Ravanini, M. Stanishkov, *Generalized KdV and Quantum Inverse Scattering Description of Conformal Minimal Models*, Phys.Lett. B 367 (1996) 113;

[4] S. Amadesi, D. Fioravanti, *A Proof of Gibbs Canonical Distribution*, Nuovo Cimento B111 (1996) 1187;

[5] D. Fioravanti, A. Mariottini, E. Quattrini, F. Ravanini, *Excited State Destri-de Vega Equation for Sine Gordon and Restricted Sine Gordon Models*, Phys.Lett. B390 (1997) 243;

[6] D. Fioravanti, *New and Old geometrical Methods in two dimensional (Integrable) Theories*, Ph.D. Thesis, Bologna preprint DFUB 96-26 (1996);

[7] D. Fioravanti, M. Stanishkov, *On the Null Vectors in the Spectra of the 2D Integrable Hierarchies*, Phys.Lett. B430 (1998) 109;

[8] D. Fioravanti, M. Stanishkov, *Non-Local Virasoro Symmetries in the mKdV Hierarchy*, Phys.Lett. B447 (1999) 277;

[9] D. Fioravanti, M. Stanishkov, *Hidden local, quasi-local and non-local Symmetries in Integrable Systems*, Nucl. Phys. B577 (2000) 500;

[10] D. Fioravanti, G. Mussardo, P. Simon, *Universal Ratios in the 2-D Tricritical Ising Model*, Phys. Rev. Lett. 85 (2000) 126;

[11] D. Fioravanti, M. Stanishkov, *Hidden Virasoro Symmetry of (Soliton Solutions of) the Sine Gordon Theory*, Nucl. Phys. B591 (2000) 685;

[12] D. Fioravanti, G. Mussardo, P. Simon, *Universal Amplitude Ratios of The Renormalization Group: Two-Dimensional Tricritical Ising Model*, Phys. Rev. E63, 016103 (2000);

[13] D. Fioravanti, *Hidden Virasoro Symmetry of the Sine Gordon Theory*, (refereed) JHEP Proceedings of the Conference *Non-perturbative Quantum Effects 2000*, Paris, France, pages 1-6;

[14] D. Fioravanti, M. Rossi, *From the braided to the usual Yang-Baxter relation*, J. Phys. A34 (2001) L567;

[15] D. Fioravanti, *Aspects of Symmetry in Sine Gordon Theory*, Proceedings

(refereed) of the 4-th International Conference *Symmetry in Nonlinear Mathematical Physics*, (2001) Kiev, Ukraine, page 323;

[16] D. Fioravanti, M. Rossi, *A braided Yang-Baxter Algebra in a Theory of two coupled Lattice Quantum KdV: algebraic properties and ABA representations*, J. Phys. A35 (2002) 3647;

[17] D. Fioravanti, M. Rossi, *Exact conserved Quantities on the cylinder I: critical case*, JHEP 0307 (2003) 031;

[18] D. Fioravanti, M. Rossi, *Exact conserved Quantities on the cylinder II: off-critical case*, JHEP 0308 (2003) 042;

[19] P. Dorey, D. Fioravanti, C. Rim, R. Tateo, *Integrable quantum field theory with boundaries: the exact g-function*, Nucl. Phys. B696 (2004) 445;

[20] D. Fioravanti, *Geometrical Loci and CFTs via the Virasoro Symmetry of the mKdVSG hierarchy: an excursus*, Phys. Lett. B609 (2005) 173;

[21] D. Fioravanti, M. Rossi, *From finite geometry exact quantities to (elliptic) scattering amplitudes for spin chains: the 1/2 - XYZ*, JHEP 0508 (2005) 010;

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Allegato al curriculum: Breve relazione sulla propria ricerca scientifica attraverso le pubblicazioni più rilevanti (richiamate sotto come appaiono nel curriculum).

La mia prima **pubblicazione [2]** si colloca nel periodo della tesi di laurea e immediatamente successivo: sotto la guida del prof. A. Sagnotti e del prof. G. Pradisi, ho passato in attenta disamina tutti i vincoli di costruzione di una

teoria 2D conforme/di stringa su superficie di Riemann/Klein generica (non necessariamente orientabile), già da loro o altri trovati come diagramma della serie di Polyakov. In realtà, essi immaginavano che i vincoli esistenti non fossero completi, ed infatti si è trovato un ulteriore vincolo coinvolgente un costituente fondamentale di superfici aperte non orientabili, il (vincolo di) crosscap. **Ho effettuato il calcolo dettagliato che lo deriva: la più interessante novità è stata che coinvolge in forma lineare quantità del settore aperto, legandole a quantità del settore chiuso.**

Durante il dottorato ho imparato gli aspetti teorici e matematici dei modelli integrabili, inizialmente come perturbazioni di teorie conformi 2D. Queste erano già patrimonio conoscitivo a Bologna, ma non v'era conoscenza specialistica delle varie metodologie di Bethe Ansatz che si applicano anche a modelli integrabili più generali (ad es. le catene di spin, ecc.): ho approfondito queste ultime coll'ausilio di vari specialisti internazionali, in particolare il prof. C. Destri (allora a Parma) che mi ha segnalato una sua tecnica per studiare il vuoto. Colla collaborazione di alcuni bolognesi, **son riuscito a generalizzare in [5] questa sua tecnica, imperniata su una non-linear integral equation (nlie), agli stati eccitati, fornendo nuove idee sullo spettro di una teoria integrabile.**

Ho applicato proprio questa metodologia, allora assolutamente innovativa, in [28] al Bethe Ansatz asintotico della teoria $N=4$ SYM in 4d (duale ad una teoria di stringa IIB su $AdS_5 \times S^5$) assieme al mio primo studente di dottorato bolognese (DB) e ad un mio collaboratore di lunga data (MR, della Vostra Università): in questa pubblicazione mostriamo, migliorando un famoso lavoro di Beisert-Eden-Staudacher (BES), che l'eq. integrale si linearizza a grande spin anche per l'ordine successivo al primo (virtual scaling function). Infatti, di ritorno a Bologna alla fine del 2005, dopo vari anni fuori, ho formulato l'intendimento di cercare di **instaurare e coordinare lì una piccola unità scientifica** che si occupasse di metodi non perturbativi, ed in particolare integrabilità, in teorie di gauge e stringa: l'idea era quella di esplorare varie quantità fisiche, ad es. le dimensione anomale, con metodologie oltre il weak coupling e possibilmente equazioni esatte. Era questo un requisito fondamentale per varie finalità, tra cui quello della dimostrazione e comprensione delle dualità weak/strong coupling delle teorie gauge/stringa, in particolare la corrispondenza AdS/CFT. Infatti, solo con equazioni esatte si poteva sperare di andare dal regime weak coupling della teoria di gauge a quello di strong coupling della teoria di stringa. Ma, viceversa, anche per la teoria dell'integrabilità, la sua presenza

nel mondo gauge/stringa ha permesso di allargare vastamente gli orizzonti a concetti più ampi e generali. A loro volta questi ultimi si stanno rivelando viepiù utili per teorie con meno supersimmetrie (ad es. $N=2$ SYM che si può anche rompere variamente a $N=1$ in settori chirali della teoria di Seiberg-Witten) e tecniche di gauge e stringa (ad es. la localizzazione dei path integrals).

Questo gruppo di ricerca bolognese, con forti connessioni esterne, ha di fatto avuto adito e appoggio in Sezione/Dipartimento: **ne sono prima testimonianza le pubblicazioni [29] e [34] — da me ispirate e perseguite dettagliatamente nel calcolo —, che sono il diretto approfondimento e prosecuzione di [28] (linearizzazione dell'eq. integrale anche nel caso di grande momento angolare S_5)**. In particolare, [29] mostra per la prima volta come sia calcolabile dal Bethe Ansatz della teoria di gauge il mass-gap della teoria di campo (integrabile) $O(6)$ non-linear-sigma-model in termini del (grande) accoppiamento di 't Hooft, dando così corpo e sostanza alla congettura di Alday e Maldacena secondo cui a strong coupling la stringa avesse questo semplice limite non-perturbativo integrabile. Peraltro questo limite ad una teoria di scalari con simmetria $SO(6)$ ha poliedriche conseguenze e sfaccettature. Ad ogni buon modo, è questa una linea prolifica ed interessante — che abbiamo anche ripreso più recentemente per determinare le ampiezze gluoniche/Wilson loops, soprattutto nella forma che assume in [34] —, ma che ancora poggiava sulle equazioni asintotiche, esatte solo a grandi numeri quantici.

E' solo in [30] che con il mio studente di dottorato (DB) prendiamo in considerazione il tipo di correzioni, dette di wrapping o di Luescher, alle eqq. asintotiche per analizzare come la forma esponenzialmente piccola nella lunghezza si comporti a weak e strong coupling (invero questo in una teoria di $N=6$ Super-Chern-Simons, sul bordo piatto di $AdS_4 \times CP^3$, più variegata e meno 'battuta' di $N=4$ SYM).

Lo studio di queste correzioni leading poteva dare un'idea solo vaga, per quanto fisicamente probante, delle possibili equazioni che governavano esattamente le dimensioni anomale. **Consistentemente col mio piano pluriennale di indagine, queste equazioni esatte sono state derivate finalmente in [33]**, con l'importante apporto di uno specialista esterno (RT) per la derivazione delle equivalenti eqq. funzionali (dette Y-system). **Esse mi hanno richiesto il riesame di una passata idea — dovuta ad Al. Zamolodchikov limitatamente a teorie di campo relativistiche integrabili**

2D — per analizzare l'energia di vuoto di una teoria su lunghezza finita con la termodinamica, a temperatura finita, sulle equazioni asintotiche che avevo così tanto studiato fino a quel momento. In aggiunta, era questa del Thermodynamic Bethe Ansatz (TBA) una procedura da me approfondita durante il mio dottorato bolognese.

Con azione e ruolo analoghi ho portato avanti l'indagine che si conclude con la formulazione nella pubblicazione [38] del TBA per le dimensioni anomale della teoria di $N=6$ Super-Chern-Simons (sul bordo di $AdS_4 \times CP^3$ con relativa teoria di stringa di tipo IIA) le cui prime correzioni avevamo analizzato nella ref. [30].

Queste eqq. di TBA sono, tuttavia, infinite e definite su una complicata superficie di Riemann (a infiniti fogli); quindi **ho avuto l'idea, concretizzatasi in [40], che bisognasse desumere da esse delle condizioni di discontinuità per passare da foglio a foglio (oltre a quelle propriamente funzionali di [33], Y-system, sullo stesso foglio): questa della non-unicità del foglio non è una novità nei sistemi integrabili (cfr. ad es. il modello di Hubbard), ma mai nessuno aveva analizzato le condizioni di discontinuità. Ho così allargato la nozione di Y-system come di sistema di eqq. funzionali e di discontinuità equivalente a un sistema di eqq. integrali non lineari** e si è di fatto aperta la via alla loro riformulazione o 'risommazione' in un numero finito di eqq. (come in definitiva faceva la referenza [5] nel caso, ad es. di quantum Sine-Gordon, ma su un solo foglio). E' questo un cosiddetto problema di Riemann-Hilbert, con un numero finito di variabili, anche rinominato in gergo quantum spectral curve, in analogia con il caso classico.

In conclusione (solo di questo scritto), **penso di aver contribuito in maniera decisiva, a livello internazionale, alla definitiva formulazione della quantum spectral curve per la determinazione esatta delle dimensioni anomale/energie di stringa.** In particolare, questo è avvenuto in esplicito nella pubblicazione [49] per il caso del generale problema di Riemann-Hilbert di $N=6$ Super-Chern-Simons ovvero stringa su $AdS_4 \times CP^3$. Inoltre, queste idee innovative per le teorie esatte contengono *in nuce* la possibilità di capire meglio **un formulazione efficace per un TBA** che si avvicini a spiegare **teorie di gauge più vicine agli esperimenti**, come la semplice simulazione del **tubo di flusso delle Cromodinamica Quantistica (QCD) di [44]** (che in tempi recentissimi ha acquisito viepiù fama e applicazioni).

Bologna, 14 Settembre 2020