**Curriculum Vitæ**
**(including list of scientific publications)**


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|---|---|
| Name : | Mario Trigiante |
| Nationality : | Italian |
| Date and place of birth : | 22 November 1970, Bari (Italy) |
| Marital Status : | Married |
| Languages : | English, Italian |
| Present Position : | Associate Professor at Politecnico di Torino, Torino, Italy |
| Address for correspondence: | via Polonghera 21, 10138 Torino, Italy. |
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## Education and Qualifications

- **1989–1993: He attended a 4–Year course in Physics** at the University of Bari for the first 2 years and at the University of Pisa for the last 2 years
- **July 1994: University Degree** *(Laurea)* **in Physics** at the University of Pisa with full marks and honors

  Supervisors : Prof. Adriano Di Giacomo (University of Pisa)

  Title of the Thesis : *Condensation of Solitons in Gauge Theories: the 3-D XY Model*
- **Nov. 1994:** He won the entrance examination for the Ph.D. course in Elementary Particle Physics at International School of Advanced Studies (ISAS–SISSA, Trieste).
- **Nov. 1994– Oct. 1997: he attended a PhD Course in Particle Physics** at International School of Advanced Studies (ISAS–SISSA). Passed all examinations with full marks.
- **Oct.** $21^{st}$ **1997: PhD Degree in Particle Physics at ISAS–SISSA (Trieste).**

  Supervisors: Prof. Pietro Fré

  Title of the Thesis: *Dualities in Supergravity and Solvable Lie Algebras.*
- **Oct** $1^{st}$ **1997– Sept.** $27^{th}$ **2000: Post–Doctoral position** at the University of Wales Swansea.
- **1 October 2000– 1 November 2003: Post–Doctoral position** at the Spinoza Institute in Utrecht.
- **He has won the E.U. fellowship "M. Curie"** for the period from 1-11-2001 to 1-11-2003
- **He was employed at Politecnico di Torino (Italy)** under a state–contract named "Rientro dei Cervelli" for the period from 1-11-2003 to 1-11-2006

- **He has won the E.U. "M. Curie" grant ERG** for the period from 1-11-2005 to 1-11-2006, for a project entitled "Superstring vacua from supergravity". This grant has been used to employ a post-doc (Dr. Luca Sommovigo) at the physics department of Politecnico of Turin who will collaborate with Dr. M. Trigiante and Prof. R. D'Auria on the project.
- **In November 2006 Politecnico called Mario Trigiante for a position of Associate Professor** after gathering "excellent" references in his favor from international renown experts in Theoretical High Energy Physics. This position was then granted to Politecnico by the Ministry of University and Research after a national selection;
- **He is currently Associate Professor** at the Politecnico of Turin since 1/2/2008.
- **He received in January 2014 the national qualification ("idoneità") to the role of full professor.**

## Teaching Activities

- **During his appointment as a post–doc at the University of Wales Swansea he has given tutorials** on various topics to undergraduate students of physics.
- **He has been contributing to the preparation of the course on neutrino–oscillations held by Prof. G. 't Hooft (Nobel Prize laureate)** at the University of Utrecht.
- **He has been contributing to the preparation of the course on String Theory held by Prof. G. 't Hooft (Nobel Prize laureate)** at the University of Utrecht.
- **At Politecnico of Turin he has been giving from 2004 to 2008 a yearly course on Classical Electromagnetism**.
- **He thought a 100-hour course** on Classical Mechanics, Thermodynamics and Electromagnetism, in English, for foreign students during the period 2/2007–6/2007.
- **In spring 2009 and 2010 he thought a 100-hour course at Politecnico of Turin** on Classical Mechanics and Electromagnetism.
- **Since 2011 he has been teaching, on an yearly basis, a 100-hour course at Politecnico of Turin** on Classical Mechanics and Thermodynamics;
- **In November 2006 he thought a 12-hour class on black holes** in general relativity at the University of Turin.
- **He gave a lecture on black holes in supergravity at the School on Attractor Mechanics (SAM 2009)**, 29 June - 3 July 2009, Frascati Italy.
- **He currently teaches, on a yearly basis, a PhD course on "Group Theory and Some of Its Applications".**
- **He gave, under invitation, a 6-hour course on "Black Holes in Extended Supergravity"** at the Pontificia Universidad Catolica de Valparaiso (Chile) on 18,19,20/6/2014;

## Supervision of Graduate Students and Postdoctoral Fellows

- Dr. Nelson Ruben Merino Moncada, attained the PhD degree on 28/3/2012 at Universidad de Concepción (Chile), with a thesis on "NON-TRIVIAL RELATIONS BETWEEN LIE ALGEBRAS AND ITS PHYSICAL APPLICATIONS". He prepared part of his thesis under his supervision in Politecnico di Torino, within a "cotutelle" project between Politecnico di Torino and Universidad de Concepción;

- Dr. Riccardo Nicoletti attained his PhD degree in November 2011 under his supervision with a thesis entitled "A Geometric Approach to Supergravity Theories";
- He is currently supervising Antonio Gallerati, PhD student at Politecnico di Torino, in the preparation of a PhD thesis on the study of black hole solutions and vacua of extended supergravities;
- He is currently supervising Daniele Ruggeri, PhD student at Università degli Studi di Torino, in the preparation of a PhD thesis on the study of black hole solutions and vacua of extended supergravities;
- He is currently supervising Patrick Keissy Concha Aguilera, PhD student at Universidad de Concepción (Chile) and working in Politecnico di Torino within a "cotutelle" project, in the preparation of a PhD thesis on the study of the geometrical formulation of supergravities;

## Conferences and Presentations

- "Spring school on string theory and quantum gravity", at ICTP (Trieste) - April 1995
- "Spring school on string theory and quantum gravity", at ICTP (Trieste) - April 1996
- He gave a seminar entitled *Spontaneous supersymmetry breaking from* $N = 2$ *to* $N = 1$ at the work-shop on "Gauge Theories, Applied Supersymmetry and Quantum Gravity" at Imperial College (London, 5-10 July 1996)
- April 1997 he was invited to give a seminar entitled *U–duality and Solvable Lie Algebras* at the informal meeting on "Symmetries in QFT and Quantum Gravity", 25-31 March 1997, Vietri (Italy)
- "Spring school on string theory and quantum gravity", at ICTP (Trieste) - April 1997
- He gave a seminar entitled *U–duality and Solvable Lie Algebras* at "Cortona 97 : informal meeting on particle physics "; 4-7 June 1997 Villa Olmo, Como (Italy)
- "String '97", 16-21 June, Amsterdam, The Netherlands
- He was invited to give a seminar entitled *Anti–De Sitter Geometry and Brane Physics* at the "Second Annual European TMR Conference on Integrability, Non-perturbative Effects and Symmetry in Quantum Field Theory", 20 - 27 September 1998, Durham, United Kingdom
- He was invited to give a seminar entitled *AdS/CFT and Singletons* at the SIGRAV (Italian Society of general Relativity) meeting, 20-27 September, Bari (Italy)
- He was invited to give a seminar entitled *BPS Black Holes in* $N = 8$*,* $D = 4$ *Supergravity* at the TMR Mid–Term Review on "Integrability, Non–Perturbative Effects and Quantum Field Theory", 10–12 December 1998, Mons, Belgium
- He attended the Network Spring School, March 18-23 1999, Miraflores de la Sierra, Spain
- Workshop on "Black Hole Physics", 11-17 July, Abdus Salam ICTP, 1999
- He was invited to give a seminar entitled *Counterterms in Less Than Maximal Supergravities* at the TMR meeting 20-25 September 1999, SISSA-ISAS, Trieste, Italy

- He was invited to give a seminar entitled *Regular BPS Black Holes: Pinpointing the Macro-Micro Correspondence* at the Ninth Marcel Grossmann Meeting on "recent developments in theoretical and experimental general relativity, gravitation and relativistic field theories", Rome, July 2 - 8, 2000, University of Rome "La Sapienza"

- He was invited to give a seminar entitled *Four-dimensional BPS black holes: Macroscopic and microscopic correspondence* at the Fourth Annual European TMR Conference on Integrability, Non-perturbative Effects and Symmetry in Quantum Field Theory, Paris, 7-13 September 2000.

- He was invited to give a seminar entitled *Microscopic Entropy of the Most General Four Dimensional BPS Black Hole for Type II/M –Theory on Torii.* at the Workshop on the Quantum Structure of Spacetime and the Geometric Nature of Fundamental Interactions (1st Workshop of RTN Network and 34th International Symposium Ahrenshoop on the Theory of Elementary Particle), Berlin, Germany, 4-10 Oct 2000.

- He was invited to give on 27 April 2001 a seminar entitled *A macroscopic and microscopic analysis on the most general supersymmetric black hole in four dimensions* at the department of theoretical research NIKHEF of the National Institute of nuclear and High Energy Physics, Amsterdam.

- He was invited to give a seminar entitled *Supersymmetric 3–brane solution on smooth ALE manifolds with flux* at the RTN Workshop " The Quantum Structure of Spacetime and the Geometric Nature of Fundamental Interactions", Corfu 13-20 September 2001.

- He was invited to give a seminar entitled *Stable de Sitter solutions in extended supergravities* at the RTN Workshop in Leuven, Sept. 13-19, 2002.

- He was invited to give a seminar entitled *On Gaugings of Extended Supergravities* at the meeting on "Supergravity–Superstrings", Vietri sul Mare (Italy) April 11-16, 2003.

- He was invited to give a seminar entitled $N = 4$ *Supergravity Action for Type IIB Superstring on* $T_6/Z_2$ *orientifold with fluxes and D3–branes* on Apr. 30, 2003 at SISSA–ISAS, Trieste (Italy).

- He attended the RTN workshop on "The quantum structure of space–time and the geometric nature of fundamental interactions", 15-20 Sept. 2003, Copenhagen (Denmark)

- He attended the RTN winter school on "The quantum structure of space–time and the geometric nature of fundamental interactions", 12-16 Jan. 2004, Barcelona (Spain)

- He was invited to give a seminar entitled *Compactification with fluxes, a supergravity point of view* at the University of Torvergata (Rome) on 18/2/2004.

- He was invited to give a seminar entitled *IIB on K3xT2/Z2 orientifold + flux and D3/D7: a supergravity view-point* at the workshop of the RTN network "The quantum structure of space-time and the geometric nature of fundamental interactions ", Kolymbari, Crete, 5-10 Sept., 2004.

- He was invited to give a seminar entitled *Compactification with Fluxes: a Supergravity Viewpoint* on Nov. 4 2004 at the Ludwig-Maximilians-Universität, München, Germany.

- He was invited for collaboration with Prof. S. Ferrara and to give a seminar entitled *M-theory compactifications and gauged supergravity*, during the period from November the 7th 2005 to November the 24th 2005, at the University of California Los Angeles, CA, USA.

- He was invited to give a seminar entitled *M-theory compactifications from dual perspectives* on 2/11/2005 at the Spinoza Institute in Utrecht, The Netherlands.

- He was invited to give a seminar entitled *Duality covariant formulation of gauged supergravity* on 22/2/2006 at L'Université Libre de Bruxelles, Belgium.
- He has been invited as moderator in the Workgroup on"Gauged Supergravity" at the RTN winter school on "Strings, Supergravity and Gauge Theories", 15/1/2007-19/1/2007, CERN (Geneva, Switzerland), where he gave an overview of the recent advances in the field.
- He has been invited to contribute to the Workshop on "Generalized Geometry and Flux Compactifications", 19/2/2007–1/3/2007, DESY (Hamburg, Germany)., where he gave a seminar entitled *Mirror symmetric gauged $N = 2$ supergravities*.
- He was invited by Prof. Vladimir Dobrev at the International Workshop "Lie Theory and Its Applications in Physics", 18-24 June 2007, Varna, Bulgaria. Here he gave a seminar entitled $N = 2$ *supergravities from generalized Calabi-Yau compactifications*.
- He was invited to give a seminar at STRINGS 2007, 25-29/6/2007 Matrid (Spain). The title of the seminar was $N = 2$ *supergravities from generalized Calabi-Yau compactifications*.
- He was invited as a convenor for the parallel session on "Non-Perturbative Field Theory, String Theory, Quantum Groups and Non-Commutative Geometry" of the 2007 Europhysics Conference on High Energy Physics, 19-25 July 2007, Manchester (England).
- He was invited to give a seminar entitled *New superstring compactifications from supergravity* at the University of Valencia (Spain) on the 11/12/2007.
- He was invited to give a seminar entitled *New superstring compactifications from supergravity* at the PRIN meeting "Symmetries of the Universe and of the Fundamental Interactions ", Scuola Normale Superiore, Pisa, 14-15 Dec. 2007.
- He was invited to give a seminar entitled *New superstring compactifications from supergravity* at the University of Groningen (The Netherlands) on the 20/2/2008.
- He was invited to give a seminar entitled *New superstring compactifications from supergravity* at SISSA-ISAS, Trieste (Italy) on the 18/6/2008.
- He was invited to give a lecture on black holes in supergravity at the School on Attractor Mechanics (SAM 2009), 29 June - 3 July 2009, Frascati Italy.
- He was invited to give a seminar entitled "Black Holes and the Hamilton-Jacobi Equation" on 16/2/2010 at the Department of Mathematics of Politecnico of Turin.
- He was invited to give a seminar and to participate in the *ESI Program on Higher Structures in Mathematics and Physics*, Vienna, September 1 - November 7, 2010; Title: *New superstring compactifications from supergravity*;
- He was invited to give a seminar at the Spinoza Institute in Utrecht on 12/11/2010. Title: *Black Holes and Intregrability*;
- He was invited to give a seminar and to participate in the international Workshop "Supersymmetries and Quantum Symmetries" (SQS'2011), Bogoliubov Laboratory of Theoretical Physics (JINR, Dubna) 18-23 July 2011.
- He was invited to give a seminar at Latino-American Workshop on High Energy Physics: Particles and Strings, Havana, Cuba, 15-21 July 2012. The seminar title was: "$D = 4$ Black Holes From Real Nilpotent Orbits";
- He was invited to give a seminar in Università di Torvergata, on 16/11/2012. The title of the talk was "Gauged Supergravities in Different Frames";

- He was invited to give a seminar at the Round Table FRONTIERS OF MATHEMATICAL PHYSICS , Dubna (Russia) from December 15th to December 19th. The title of the talk was "Gauged Supergravities in Different Frames";
- He was invited to give a seminar at the Spinoza Institute in Utrecht on 1/2/2013; The title of the talk was "Gauged Supergravities in Different Frames";
- He was invited to give a seminar at L'Université Libre de Bruxelles, Belgium, on the 20/2/2013; The title of the talk was "Gauged Supergravities in Different Frames";
- He was invited to give a seminar at the conference "SYMMETRIES OF THE UNIVERSE AND OF THE FUNDAMENTAL INTERACTIONS", Scuola Normale Superiore, Pisa, 16-17 May 2013 ; The title of the talk was "Issues on D=4 Rotating Black Holes";
- He was invited to give a plenary talk at the XXI st International Conference on Integrable Systems and Quantum symmetries (ISQS-21) Prague, Czech Republic, from June 11 till June 16, 2013; The title of the talk was "On D=4 Stationary Black Holes"
- He was invited to give a seminar and to participate in the international Workshop "Supersymmetries and Quantum Symmetries" (SQS'2013), Bogoliubov Laboratory of Theoretical Physics (JINR, Dubna) July 29 - August 3, 2013, Dubna (Russia).
- He was invited to give a talk at University of Milano Bicocca on 31/10/1013. The title of the talk was "Dual Rotating Black Holes";
- He was invited to give a talk at University of Amsterdam on 7/2/2014. The title of the talk was "Dual Rotating Black Holes";
- He was invited by Prof. Olivera Miskovic of the Pontificia Universidad Catolica de Valparaiso (Chile) to give a Plenary Talk at the International Meeting "Meeting on the horizon", March 10-14 2014, Valparaiso, Chile. He had to turn down the invitation due to his teaching duties at Politecnico di Torino in that period;
- He gave, under invitation, a 5-hour course on "Black Holes in Extended Supergravity" at the Pontificia Universidad Catolica de Valparaiso (Chile) on 18,19,20/6/2014;
- He was invited to give a talk at the Andrés Bello National Univer4sity of Santiago (Chile) on 25/6/1014. The title of the talk was "Gauged Supergravities in Different Frames";
- He has been invited as a "Special Invited Guest" to give a seminar at the conference EU - Russia year of Science "A Window on Physics, Biology and Technology", at the Abdus Salam International Center for Theoretical Physics, 4 - 6 November 2014, Trieste;
- He has been invited to give a Plenary Talk at the conference "Theoretical Frontiers in Black Holes and Cosmology", to be held at the International Institute of Physics (IIP-UFRN), 8-19 of June 2015, Natal, Rio Grande do Norte, Brazil.

## List of Scientific Publications.


1. *Condensation of Vortices in the XY Model in 3d: a Disorder Parameter.*
   G. Di Cecio, A. Di Giacomo, G. Paffuti and M. Trigiante,
   Nucl. Phys. **B489** (1997) 739, cond-mat/9603139.
2. *Spontaneous $N = 2 \to N = 1$ Local Supersymmetry Breaking with Surviving Compact Gauge Groups*
   P. Fré, L. Girardello, I. Pesando and M. Trigiante,
   Nucl. Phys. **B493** (1997) 231, hep-th/9607032.

3. *R–R Scalars, U–Duality and Solvable Lie Algebras*
L. Andrianopoli, R. D'Auria, S. Ferrara, P. Fré and M. Trigiante,
Nucl. Phys. **B496** (1997) 617, hep-th/9611014.

4. *Solvable Lie Algebras in Type IIA, Type IIB and M Theories*
L. Andrianopoli, R. D'Auria, S. Ferrara, P. Fre, R. Minasian and M. Trigiante,
Nucl. Phys. **B493** (1997) 249, hep-th/9612202.

5. *E(7)(7) duality, BPS black-hole evolution and fixed scalars*
L. Andrianopoli, R. D'Auria, S. Ferrara, P. Fre and M. Trigiante,
Nucl. Phys. **B509** (1998) 463, hep-th/9707087.

6. *G/H M-branes and AdS(p+2) geometries*
L. Castellani, A. Ceresole, R. D'Auria, S. Ferrara, P. Fre and M. Trigiante,
Nucl. Phys. **B527** (1998) 142, hep-th/9803039.

7. *N = 8 gaugings revisited: An exhaustive classification*
F. Cordaro, P. Fre, L. Gualtieri, P. Termonia and M. Trigiante,
Nucl. Phys. **B532** (1998) 245, hep-th/9804056.

8. *The Osp(8|4) Singleton Action from the Super–Membrane*
G. Dall'Agata, D. Fabbri, C. Fraser, P. Fre, P. Termonia and M. Trigiante,
Nucl. Phys. **B542** (1999) 157, hep-th/9807115.

9. *N = 8 BPS black holes with 1/2 or 1/4 supersymmetry and solvable Lie algebra decompositions*
G. Arcioni, A. Ceresole, F. Cordaro, R. D'Auria, P. Fre, L. Gualtieri and M. Trigiante,
Nucl. Phys. **B542** (1999) 273, hep-th/9807136.

10. *N = 8 BPS black holes preserving 1/8 supersymmetry*
M. Bertolini, P. Fre and M. Trigiante,
Class. Quant. Grav. **16** (1999) 1519, hep-th/9811251.

11. *The generating solution of regular N = 8 BPS black holes*
M. Bertolini, P. Fre and M. Trigiante,
Class. Quant. Grav. **16** (1999) 2987, hep-th/9905143.

12. *Regular R–R and NS–NS BPS black holes*
M. Bertolini and M. Trigiante,
Int. J. Mod. Phys. **A15** (2000) 5017., hep-th/9910237 .

13. *Counterterms in Type I Supergravities*
D.C. Dunbar, B. Julia, D. Seminara and M. Trigiante,
JHEP **01** (2000) 46, hep-th/9911158.

14. *Regular BPS black holes: macroscopic and microscopic description of the generating solution*
M. Bertolini and M. Trigiante,
Nucl. Phys. **B582** (2000) 393, hep-th/0002191.

15. *Microscopic entropy of the most general four-dimensional BPS black hole.*
M. Bertolini and M. Trigiante,
JHEP **10** (2000) 002, hep-th/0008201.

16. *Supersymmetric 3-branes on smooth ALE manifolds with flux*
M. Bertolini, V. L. Campos, G. Ferretti, P. Fré, P. Salomonson and M. Trigiante,
Nucl. Phys. B **617** (2001) 3, hep-th/0106186.

17. *Walls from Fluxes: an Analytic RG-Flow*
J. F. Morales and M. Trigiante,
JHEP **0202** (2002) 018, hep-th/0112059.

18. *Stable de Sitter vacua from N = 2 supergravity*
P. Fre, M. Trigiante and A. Van Proeyen,
Class. Quant. Grav. **19** (2002) 4167 , hep-th/0205119.

19. *On Lagrangians and gaugings of maximal supergravities*
B. de Wit, H. Samtleben and M. Trigiante,
Nucl. Phys. B **655** (2003) 93, hep-th/0212239.

20. *N = 4 supergravity Lagrangian for type IIB on $T_6/Z(2)$ in presence of fluxes and D3-branes*
R. D'Auria, S. Ferrara, F. Gargiulo, M. Trigiante and S. Vaula,
JHEP **0306** (2003) 045, hep-th/0303049.

21. *New D=4 gauged supergravities from N=4 orientifolds with fluxes*
C. Angelantonj, S. Ferrara and M. Trigiante,
JHEP **0310**(2003) 015, hep-th/0306185.

22. *Cosmological backgrounds of superstring theory and solvable algebras: Oxidation and branes*,
P. Fre, V. Gili, F. Gargiulo, A. Sorin, K. Rulik and M. Trigiante,
Nucl. Phys. B **685** (2004) 3 , hep-th/0309237.

23. *Unusual gauged supergravities from type IIA and type IIB orientifolds*,
C. Angelantonj, S. Ferrara and M. Trigiante,
Phys. Lett. B **582** (2004) 263, hep-th/0310136.

24. *Potential and mass-matrix in gauged N = 4 supergravity*,
M. de Roo, D. B. Westra, S. Panda and M. Trigiante,
JHEP **0311** (2003) 022, hep-th/0310187.

25. *Maximal supergravity from IIB flux compactifications*,
B. de Wit, H. Samtleben and M. Trigiante,
Phys. Lett. B **583** (2004) 338, hep-th/0311224.

26. *K3 x T**2/Z(2) orientifolds with fluxes, open string moduli and critical points*,
C. Angelantonj, R. D'Auria, S. Ferrara and M. Trigiante,
Phys. Lett. B **583** (2004) 331, hep-th/0312019.

27. *Exact solutions for Bianchi type cosmological metrics, Weyl orbits of E(8(8)) subalgebras and p-branes*,
P. Fre, K. Rulik and M. Trigiante, Nucl. Phys. B **694** (2004) 239, hep-th/0312189.

28. *c-map,very special quaternionic geometry and dual Kaehler spaces*,
R. D'Auria, S. Ferrara and M. Trigiante,
Phys. Lett. B **587** (2004) 138 hep-th/0401161.

29. *Homogeneous special manifolds, orientifolds and solvable coordinates*,
R. D'Auria, S. Ferrara and M. Trigiante,
Nucl. Phys. B **693** (2004) 261 , hep-th/0403204.

30. *Gauging the Heisenberg algebra of special quaternionic manifolds*,
R. D'Auria, S. Ferrara, M. Trigiante and S. Vaula,
Phys. Lett. B **610** (2005) 147, hep-th/0410290.

31. *Scalar potential for the gauged Heisenberg algebra and a non-polynomial antisymmetric tensor theory*,
R. D'Auria, S. Ferrara, M. Trigiante and S. Vaula,
Phys. Lett. B **610** (2005) 270 B, hep-th/0412063.

32. *The maximal D=5 supergravities*,
B. de Wit, H. Samtleben and M. Trigiante,
Nucl. Phys. B **716** (2005) 215, hep-th/0412173.

33. *The Scherk-Schwarz mechanism as a flux compactification with internal torsion*,
L. Andrianopoli, M. A. Lledo and M. Trigiante,
JHEP **0505** (2005) 051, hep-th/0502083.

34. *N = 1 reductions of N = 2 supergravity in the presence of tensor multiplets*,
R. D'Auria, S. Ferrara, M. Trigiante and S. Vaula,
JHEP **0503** (2005) 052, hep-th/0502219.

35. *E(7)(7) symmetry and dual gauge algebra of M-theory on a twisted seven-torus*,
R. D'Auria, S. Ferrara and M. Trigiante,
Nucl.Phys. **B732** (2006) 389., hep-th/0504108.

36. *Curvatures and potential of M-theory in D = 4 with fluxes and twist*,
R. D'Auria, S. Ferrara and M. Trigiante,
JHEP **09** (2005) 035, hep-th/0507225.

37. *The general pattern of Kac Moody extensions in supergravity and the issue of cosmic billiards*,
P. Fre', F. Gargiulo, K. Rulik and M. Trigiante,
Nucl.Phys. **B741** (2006) 42., hep-th/0507249.

38. *Magnetic charges in local field theory*,
B. de Wit, H. Samtleben and M. Trigiante,
JHEP **09** (2005) 016, hep-th/0507289.

39. *Supersymmetric completion of M-theory 4D-gauge algebra from twisted tori and fluxes*,
R. D'Auria, S. Ferrara and M. Trigiante,
JHEP **0601** (2006) 081, [arXiv:hep-th/0511158].

40. *Twisted tori and fluxes: A no go theorem for Lie groups of weak G(2) holonomy*,
P. Frè and M. Trigiante,
Nucl. Phys. B **751** (2006) 343, [arXiv:hep-th/0511158].

41. *Tits-Satake projections of homogeneous special geometries*,
P. Fre, F. Gargiulo, J. Rosseel, K. Rulik, M. Trigiante and A. Van Proeyen, Class. Quant. Grav. **24** (2007) 27, arXiv:hep-th/0606173.

42. *Extremal black holes in supergravity*,
L. Andrianopoli, R. D'Auria, S. Ferrara and M. Trigiante,
contribution to the book "String Theory and Fundamental Interactions", published in celebration of the $65^{th}$ birthday of Gabriele Veneziano, Eds. M. Gasperini and J. Maharana, (Lecture Notes in Physics, Springer Berlin/Heidelberg 2007), Lect. Notes Phys. **737** (2008) 661.

43. *Critical points of the Black-Hole potential for homogeneous special geometries,*
R. D'Auria, S. Ferrara and M. Trigiante,
JHEP **0703** (2007) 097, hep-th/0701090.

44. *On the supergravity formulation of mirror symmetry in generalized Calabi-Yau manifolds*, R. D'Auria, S. Ferrara and M. Trigiante, Nucl. Phys. B **780** (2007) 28, arXiv:hep-th/0701247

45. *Black-hole attractors in N = 1 supergravity*, L. Andrianopoli, R. D'Auria, S. Ferrara and M. Trigiante, JHEP **0707** (2007) 019, arXiv:hep-th/0703178.

46. *The maximal D = 4 supergravities*, B. de Wit, H. Samtleben and M. Trigiante, JHEP **0706** (2007) 049, arXiv:0705.2101 [hep-th].

47. *First Order Description of Black Holes in Moduli Space*, L. Andrianopoli, R. D'Auria, E. Orazi and M. Trigiante, JHEP **0711** (2007) 032, arXiv:0706.0712 [hep-th].

48. *Non-BPS Attractors in 5d and 6d Extended Supergravity*, L. Andrianopoli, S. Ferrara, A. Marrani and M. Trigiante, Nucl. Phys. B **795** (2008) 428, arXiv:0709.3488 [hep-th].

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for a more detailed analysis.

*Source Google Scholar:* As to 8/1/2015, **total number of citations 3332; h-index: 35**

## Scientific Books

- *From Special Relativity to Feynman Diagrams: A Course of Theoretical Particle Physics for Beginners*,
R. D'Auria, M. Trigiante,
about 600 pages, Springer (2011).

## Other Scientific Activities

- **Part of the organizing committee** for the third RTN Winter School "The Quantum Structure of Spacetime and the Geometric Nature of Fundamental Interactions", 17-22 January 2002, Utrecht, The Netherlands.

- **Part of the organizing committee** for the Workshop "D'Auria Fest" in the occasion of the 70th birthday of Prof. Riccardo D'Auria, 22-23 April 2010, Turin.

- **He was invited** by Prof. Antoine Van Proeyen to take part to the reading committee for the PhD thesis of Geert Smet at the Catholic University of Leuven (Belgium), and to take part to the defence on August 24th 2006 in Leuven.

- **He was invited** by Prof. Antoine Van Proeyen to take part to the reading committee for the PhD thesis of Jan Rosseel at the Catholic University of Leuven (Belgium), and to take part to the defence on July 2nd 2007 in Leuven.

- **He was invited** by Prof. Erik Bergshoeff to take part to the reading committee for the PhD thesis of Thomas Van Riet at the University of Groningen (The Netherlands), and to the thesis ceremony on Sept. 28th 2007 in Groningen.

- **He was invited** by Prof. Erik Bergshoeff to take part to the reading committee for the PhD thesis of Wissam Chemissany at the University of Groningen (The Netherlands), and to the thesis ceremony on Sept. 5th 2008 in Groningen.
- **He was invited** by Prof. Henning Samtleben to take part to the PhD defense committee for the PhD thesis of Dr. A. Le Diffon at the ENS of Lyon (France).
- **He was invited** by Prof. Erik Bergshoeff to take part to the PhD defense committee for the PhD thesis of Dr. Teake Nutma at the University of Groningen (The Netherlands).
- **He was invited** by Prof. Claudio Scrucca to take part to the PhD defense committee for the PhD thesis of Dr. Daniel Farquet at the Swiss Federal Institute of Technology Lausanne (Lausanne, Switzerland).
- **He was invited** by Instituto de Fisica Teorica UAM/CSIC-Madrid, as an International Expert, to report on the PhD thesis of Dr. Carlos Shahbazi Alonso entitled "Black Holes in Supergravity with Applications to String Theory".
- **He was invited** by the Research Foundation - Flanders, as an international expert in the field, to review two project proposals for a *Pegasus Grant*;
- **Review Editor** for *Frontiers*;
- **Referee** for *JHEP*;
- **Referee** for *Nuclear Physics B*;
- **Referee** for *Classical and Quantum Gravity*;
- **Referee** for *Foundations of Physics*;
- **Referee** for *Euro Physics Letters*;
- **Referee** for *Journal of Physics A*;
- **Referee** for *Mathematical Reviews*.

## Technical Skills

- **Programming Language:** Fortran.
- **Technical Software Skills:** solid experience in programming in Mathematica, a basic knowledge of Matlab and Unix.

**Research Activity**

My research work began with the degree thesis, under the supervision of Prof. Adriano Di Giacomo. Its results are inserted in the wider study of the phenomenon of *soliton condensation* in gauge theories, which, in the case of QCD, provides a mechanism for *color confinement*. We focused on the 3–D XY model and constructed a *disorder parameter* $\mu$ representing the v.e.v. of a suitable *creation operator* of vortices, which signals the condensation of these solitonic solutions in the vacuum state. The study of the properties of $\mu$ (carried out using Monte Carlo simulations) have been eventually completed in collaboration with Prof. A. Di Giacomo, Prof. G. Paffuti and Dr. G. Di Cecio and led to the publication of a paper (**paper n.1**).
After my first year of my doctorate at SISSA-ISAS, my scientific interests were oriented towards supergravity theories and string dualities and thus I started to work on this topic under the supervision of Prof. Pietro Fré.
In my first work I collaborated with Prof. P. Fré, Prof. L. Girardello and Dr. I. Pesando (**paper n.2**). We defined a mechanism for partial supersymmetry breaking $N = 2 \to N = 1$ in a theory describing supergravity coupled to a generic number of vector multiplets and of hypermultiplets. This mechanism moreover allowed for a rather arbitrary compact gauge group to be left unbroken at the $N = 1$ level. A powerful mathematical tool in order to deal with this problem is Alekseevskii's representation of the scalar manifold of the theory in terms of a group manifold generated by a *solvable Lie algebra* and parameterized by the scalar fields (*SLA representation*). This formulation allowed to define easily the *flat* directions of the scalar potential of the theory as well.

The solvable Lie algebra technique was eventually applied successfully to various different problems related to supergravity and in general to theories where the scalar fields are described by a $\sigma$–model on a non–compact (pseudo)–Riemannian target space admitting an SLA description (e.g. AdS space) . In collaboration with Dr. L. Andrianopoli, Prof. R. D'Auria, Prof. S. Ferrara, Prof. P. Fré the SLA approach was applied (**paper n.3**) to N–extended supergravities in various dimensions, achieving a geometrical intrinsic characterization of the R–R, the NS–NS and the Peccei–Quinn scalars, once these theories were interpreted as low energy limits of suitably compactified superstring theories . Moreover the SLA description provided a systematic way of exploiting the mathematical connections among extended supergravities describing different limits of a same microscopic theory (superstring, M–theory etc..) (**paper n.4**). In the same collaboration we eventually studied systematically BPS (static) black hole solutions of $N = 8$ four dimensional supergravity preserving 1/8 of their original supersymmetries (**paper n.5**) and their properties with respect to the action of the maximal global symmetry group of the field equations ($U$–duality). In particular, using the SLA representation of the scalar manifold it was possible to show that the most general of these solutions modulo $U$–duality transformations (*generating solution*) was solution of a smaller $N = 2$ truncation of the theory (*STU* model). Eventually, in collaboration with G. Arcioni, A. Ceresole, F. Cordaro, R. D'Auria, P. Fre and L. Gualtieri this analysis was extended to BPS black hole solutions of the same theory preserving 1/4 and 1/2 (**paper n.9**) of the original supersymmetries and the corresponding generating solutions were explicitly found.

After being appointed for a two year TMR post–doc position at the University of Wales Swansea I continued the collaboration with the group from Turin and CERN on problems related with gauged $N = 8$ supergravity (**paper n.7**) and with the AdS/CFT duality conjectured by Maldacena. In (**paper n.6**) we addressed the question of generalizing this conjecture on supergravity vacua of the form $AdS \times G/H$ where $G/H$ represents a generic compact homogeneous manifold. Moreover we defined an SLA representation of anti de Sitter space and later (**paper n.8**) of its supersymmetric extension (*Supersolvable parameterization*) which turned out to be the most natural in order to describe the degrees of freedom of a super p–brane in $AdS_{p+2}$. Within this framework the supersingleton CFT action was retrieved from the low–energy oscillations of a super-membrane on the boundary of $AdS_4$.

Eventually, in collaboration with M. Bertolini and P.Fré I continued studying the properties of the

BPS black holes in $N = 8$, $D = 4$ supergravity preserving 1/8 supersymmetries (**paper n.10,11**) and together with M Bertolini alone (**paper n.12**) we achieved a group theoretical characterization of the *STU* models describing generating solutions which carry pure NS–NS or pure R–R charges and of their duality relations. The latter kind of black hole solutions are particularly interesting since they can be described microscopically in terms of D–branes and indeed we gave an exact matching between the macroscopic and microscopic descriptions of the generating solution (**paper n.14**). In a subsequent paper (**paper n. 15**) we achieved a microscopic entropy counting on the R–R charged generating solution, which should account for the entropy of the most general regular BPS black hole in four dimensions. One of the five parameters describing the generating solution at a macroscopic level, determines a non trivial behavior on the black hole configuration of the axion fields. The microscopic interpretation of this quantity had always been obscure in the literature. As a byproduct of our analysis we could achieve a precise microscopic description of this fifth charge, from which its role of determining a non trivial coupling of the microscopic brane system to the axion fields can be naturally understood.

Almost in the same period I have been collaborating with Dr D. Dunbar, Prof. B. Julia and Dr. D. Seminara on the study of counterterms in type I supergravity and its dimensional descendants from a pure field theory point of view using the dimensional reduction regularization scheme (**paper n.13**). In particular we have expressed the counterterm corresponding to the $1/\epsilon$ pole in the four–graviton one loop amplitude in terms of local Lorentz invariants of fourth order in the Riemann tensor and we have found that it *factorizes* in the product of two fourth order invariants in gauge field strengths. This result would have a nice string interpretation, but it is highly non–trivial from a field theory point of view. The long term motivation for this analysis is to understand the effect of dualities on the UV behavior of special theories like type I supergravity.

I have been collaborating with Prof. P. Fré (Universitá degli Studi di Torino), Dr. M. Bertolini (NORDITA, Copenhagen) and G. Ferretti (Göteborg University) on the study of a new family of solutions that we have constructed (**paper n. 16**) in type IIB supergravity and which describe a 3–brane transverse to a six dimensional manifold with topology $\mathbf{R^2} \times \mathbf{ALE}$, characterized by a non trivial flux of the complex 3–from across the exceptional cycles of the ALE space. The presence of this flux is a common feature the above solutions share, il the singular limit of the ALE manifold, with the so called *fractional* D3 branes. The great interest attracted by these latter solutions in the recent literature is motivated by the possibility they offer to extend the gauge–theory/gravity to the non–conformal case, which is physically more realistic. Differently from fractional branes, the conformal symmetry on the world volume theory of the brane solutions constructed by us is broken by two factors: the complex 3–form flux and the geometry of the exceptional cycles, which naturally induces, through Fayet–Iliapoulos terms, a length scale in the world volume theory.

In collaboration with Dr. F. J. Morales (Spinoza Institute, Utrecht), I have carried out an analysis of "kink"–like supergravity solutions which interpolate between Anti de Sitter geometries in suitable spatial limits and which, in the light of AdS/CFT correspondence, could describe the renormalization group flow of a dual field theory from an U.V. conformal fixed point to an I.R. conformal fixed point. In the kind of solutions we are considering the space–time geometry can be interpreted as the result of a deformation of a globally AdS metric realized by coupling gravity to suitable fluxes. In a recent work (**paper n. 17**) we have constructed an instance of this kind of solutions in five dimensions which is dual to the RG flow of a 1+1 SCFT from a U.V. regime with supersymmetry $(4, 4)$ to an I.R. regime with supersymmetry $(4, 0)$. The method for constructing this solution is the same used in the literature to realize higher dimensional generalizations of the Melvin universe. The ultimate aim of this research is to construct "kink" solutions in supergravity which would allow for a geometric description of the RG flow of dual gauge theories as QCD, reproducing in this way their non–perturbative aspects using gravity tools.

Eventually in collaboration with Prof. P. Fré and Prof. A. Van Proeyen (Leuven University) I have been pursuing an analysis of de Sitter space–time solutions in supergravity. This study was moti-

vated by the important role that this kind of solutions have to the formulation of cosmological models describing the evolution of our universe. Indeed, according to the most recent experimental data, the present evolution of our universe can be consistently described by a de Sitter space–time (which is the maximally symmetric solution of Einstein gravity with positive cosmological constant). Unfortunately, until recently no instance of stable de Sitter vacua was known in extended supergravities ($N \geq 2$). The main goal of our research consists in having constructed the first instances of extended supergravity models ($N = 2$) exhibiting a stable de Sitter vacuum and to have defined the essential mathematical ingredients which are necessary in order for the models to admit this kind of solutions. This result led to the publication of an article (**paper n. 18**) and has attracted considerable interest for its application to cosmological model building. In particular researchers like R. Kallosh and A. Linde (Stanford University) have stressed (hep-th/0208156) that the models constructed by us are the only instances of extended supergravities which could provide a description of the evolution of our universe towards a stable de Sitter space–time, triggered by the dynamics of ultra–light scalar fields. At present we are trying to extend these results to supergravities with a higher degree of supersymmetry ($N = 4$, $N = 8$), since they are more directly connected to microscopic theories like string/M–theories. Success in this direction would lead the way to the formulation of a microscopic construction of a de Sitter vacuum, which so far is still missing, and it would be an important progress in the understanding of quantum gravity in space–times with positive cosmological constant.

In collaboration with Dr. H. Samtleben e Prof. B. de Wit (Utrecht University) I have been pursuing a systematic study of gauged maximal supergravities (32 supercharges) through the direct solution of the group theoretical constraints imposed by supersymmetry on the possible local symmetries of the model. This analysis led to the construction of new $N = 8$ models with various local symmetries in four and five dimensions and using the geometric study carried out in articles **n. 4** e **12**, the gauge fields of these models could be interpreted in terms of ten dimensional fields of a type II theory dimensionally reduced on a suitable manifold. A subclass of these new gauged models defines the spontaneously broken supergravities which are the result of a "double" or "triple" Scherk–Schwarz reduction from six or seven dimensions respectively. Models of this kind, according to the choice of the gauge generators, may have scalar potentials with different features and relevant to cosmology: e.g. scalar potentials having Minkowski vacua in which supersymmetry is totally or partially broken, or "run–away" potentials with extrema at infinity in the moduli space, which are relevant to the study of "domain–wall" or "PP–wave" solutions and to the construction of inflationary models. Part of these results are described in paper **n 19**. Our group theoretical method also allowed to construct a new gauged supergravity in four dimensions defining the low–dimensional limit of Type IIB toroidal compactification in the presence of three–form and five–form fluxes (article **n. 25**). This result also shed some light on the relation between fluxes switched on across cycles of an internal compact manifold and the local symmetries of the lower dimensional gauged supergravities: the fluxes are suitably chosen embedding matrices. For a review of these developments see also article **n. 41**.

I have collaborated with Prof. S. Ferrara (CERN) and Prof. R. D'Auria, Dr. F. Gargiulo and Dr. S. Vaulá on the construction of the effective $N = 4$, $D = 4$ supergravity describing the low–energy limit of type IIB superstring theory compactified on a $T_6/Z_2$ orientifold with fluxes and $D3$ branes (see paper **n. 20**). This theory is an example of a "no–scale" model with a non negative scalar potential exhibiting vacua with zero cosmological constant at tree level in which a super–Higgs mechanism is at work and determine a hierarchical supersymmetry breaking from $N = 4$ to $N = 0$. The theory was constructed at a pure supergravity level using the well established gauging procedure which, in particular, allowed to compute, from general symmetry requirements, interaction terms which would have been extremely arduous to compute from a microscopic analysis. The gauge group consisted of the product of abelian Peccei–Quinn symmetries times a $U(N)$ group related to $D3$ brane degrees of freedom. My main contribution to this work is two–fold. On the one hand I derived the symplectic embedding of the global symmetry group, namely the suitable choice of electric and magnetic field strengths for which the desired gauge group was a global symmetry of the action and could be made

local. These models and their generalizations are of considerable interest for phenomenological model building. By applying the embedding tensor technique I could also find an unexpected duality between the Type IIB compactification and a sector of the N=8 four dimensional theory spontaneously broken à la Scherk-Schwarz.

I have been collaborating with Prof. P. Fré and some of his PhD students on the definition and implementation of a solution-constructing technique, as far as ten dimensional cosmological solutions are concerned, based on the large global symmetries of the three and two–dimensional maximal (ungauged) supergravities. This method has allowed the construction of ten dimensional cosmological solutions with different microscopic interpretations (e.g. systems of S(pace) D–branes or pure gravity solutions), from oxidation of three dimensional solutions which were in the same orbit of the three dimensional global symmetry group $E_{8(8)}$ (see articles **n. 22, 27**). These results allowed thus to unveil deep (duality) relationships underlying a class of higher dimensional solutions which would have been totally unclear otherwise.

In collaboration with Prof. R. D'Auria, Prof. S. Ferrara and Dr. C. Angelantonj I have been pursuing a project aimed at the construction of gauged four–dimensional supergravity models with $N = 4, 2$ and 1 which describe the low–energy limit of Type IIB theory on various kind of orientifolds with fluxes. The main ingredient for this construction was the employment of the solvable Lie algebra technique developed by some of us in previous works. The $N = 4$ models describing the bulk sector of Type IIB on $T^{p-3} \times T^{9-p}/Z_2$ orientifolds in the presence of $Dp$–branes, was constructed in collaboration with Prof. S. Ferrara and Dr. C. Angelantonj, see articles **n.21, 23**. They were shown to be consistent truncations of the $N = 8$ gauged supergravity constructed in article **n. 25**.

A personal achievement of mine was the idea that the correspondence between (generalized) flux-compactifiacations and lower-dimensional gauged supergravity describing (a suitable truncation of) the low-energy modes, could be formulated by identifying the embedding tensor defining the gauging with the internal fluxes. This idea allows to identify gauged supergravity models originating from seemingly different flux-compactifications, as was done in paper **20**, provided their embedding tensors are related by duality transformations (i.e. global symmetries of the corresponding ungauged supergravity with respect to which the embedding tensor is formally covariant). The identification emebdding tensor-fluxes was also used in papers **21, 23, 25**.

Eventually, in collaboration with Prof. R. D'Auria, Prof. S. Ferrara and Dr. C. Angelantonj we have extended the four-dimensional gauged supergravity analysis of type IIB vacua on $K3 \times T^2/Z_2$ to the case where also $D3$ and $D7$ moduli, belonging to N=2 vector multiplets, are turned on. In the presence of non–vanishing fluxes (including magnetic fluxes on the D7 branes), we have analyzed supersymmetric critical points which correspond to Minkowski vacua. If both $D3$ nd $D7$–brane moduli are present the overall special geometry of the scalar fields in the vector multiplet sector corresponds to a homogeneous non–symmetric space of the type $K(n_3, n_7)$ in Alekseevskii's classification, whose relevance to supergravity/superstring theory has been unclear so far. In paper **n. 29** this manifold was described in the solvable Lie algebra formalism in which the coordinates had a straightforward microscopic interpretation in terms of bulk and $D$–brane moduli. This allowed to write the sigma model action for the moduli of the problem. In papers **n. 28, 29** we studied of the $N = 1$ Kähler space describing the moduli of Type IIB theory on a Calabi–Yau orientifold (also called "dual" Kähler space). This space was characterized as a submanifold of the quaternionic manifold of dimension $4\,h_{1,1} + 4$ that one would obtain from ordinary Calabi–Yau compactification of the same theory. The relation between the isometries of this Kähler space and the Special Kähler manifold of dimension $2\,h_{1,1} + 2$, image of the quaternionic space through the c-map, is made explicit in the homogeneous case as a mapping between the corresponding generating solvable Lie algebras. This analysis allowed to prove various properties of the "dual" Kähler space, e.g. that in the symmetric case the two Kähler manifolds are both Special Kähler of the same type, since the mapping between the two is an inner automorphism of the solvable Lie algebra generating the parent quaternionic manifold.

In papers **n. 30, 31**, in collaboration with Prof. D'Auria, Prof. Ferrara and Dr. Vaulá we have considered in a $N = 2, D = 4$ supergravity originating from Calabi–Yau compactification, the gauging of the Heisenberg algebra contained in the isometry group of the special quaternionic manifold. Our claim is that this deformation describes the compactification of Type II theory on a generalized *half–flat* manifold in the presence of fluxes and thus allows to extend the characterization of mirror symmetry to such more general compactifications. This construction was generalized in paper **n. 44** to describe compactifications of Type IIA and IIB theories on a generalized Calabi–Yau manifold with $\mathrm{SU}(3) \times \mathrm{SU}(3)$ structure. I was invited to give a seminar about this result at STRINGS 2007 in Madrid.

In collaboration with Prof. de Wit and Dr. Samtleben (paper **n. 32**) we have formulated the most general $D = 5$ maximal supergravity. The formalism we have used allows for a systematic study of all the possible gaugings of the theory, since we have started from an explicit solution to the group theoretical constraints imposed by supersymmetry on the local symmetries of the theory. Tensor fields, which in five dimensions are dual to vectors, are introduced in a gauge-group dependent way, namely vector fields which do not transform in the adjoint of the gauge group are automatically dualized to tensors. We find new vector–tensor couplings.

Later, in collaboration with Dr. L. Andrianopoli and Dr. M. Lledó, we have proven the equivalence between the original Scherk-Schwarz ansaz of dimensional reduction and ordinary Kaluza-Klein reduction on a torus in the presence of a background internal torsion (paper **n. 33**). We finally construct a framework in four dimensional maximal supergravities originating from M/string theory compactified on a torus, in which to systematically study the effect of dualities on flux/torsion vacua. In particular we give evidence, following group theoretical arguments, of the correspondence, through T–duality in Type II theories, between background torsion and NS–NS 3–form flux.

In paper **n. 34**, in collaboration with Prof. R. D'Auria, Prof. S. Ferrara and Dr. S. Vaulá, we systematically study $N = 1$ truncations of the $N = 2$, $D = 4$ theory coupled to antisymmetric tensor fields, which describe orientifold compactifications of type IIB theory, and analyze their vacuum structure.

In papers **n. 35** and **n. 36**, in collaboration with Prof. R. D'Auria, Prof. S. Ferrara, we construct two dual versions of the four dimensional maximal supergravity originating from M-theory compactification on a twisted torus in the presence of 4– and 7–form fluxes. One description contains seven antisymmetric tensors and its local symmetries are encoded in a *free differential algebra*. In the second version of the theory the seven tensors are replaced by seven dual scalars. Its local symmetry property, which is described by a non–semisimple Lie algebra, was deduced by applying the *embedding tensor* method developed in paper **n. 19**. We also work out the general form of the scalar potential and new flat vacua. Our analysis rule out, in these class of models, classical vacua with positive cosmological constant. Eventually, in paper **n. 40**, also AdS kind of vacua (i.e. maximally symmetric solutions with negative cosmological constant) are ruled out, leaving space for just flat or warped solutions. In paper **n. 39** these theories were made supersymmetric and new gaugings of maximal supergravity describing more general flux compactifications were found.

Almost at the same time (paper **n.38**), in collaboration with Dr. H. Samtleben and Prof. B. de Wit, we have constructed a general theory of gravity coupled to a sigma model and antisymmetric tensors. We have shown how the Lagrangian can be made locally invariant under non–perturbative gauge transformations, which are contained in a larger global symmetry group of the ungauged theory, by employing magnetic vector potentials. These latter are eventually integrated out by using the symmetries of the theory. This formulation was later applied to the construction of the most general $D = 4, N = 8$ supergravity (see paper **46**).

In collaboration with Dr. L. Andrianopoli, Prof. R. D'Auria, Prof. S. Ferrara and Dr. E. Orazi, the properties of extremal static, spherically symmetric, black holes in supergravity theories, in relation to string dualities, have been studied (see papers **42,43,45,47,48**). In particular, in paper **47**, a

fist order description for these solutions was found in extended $N > 2$ supergravities, in terms of a prepotential $W$, which was characterized as a specific U-duality invariant function. This function is expected to play a relevant role in the microscopic description of the extremal black hole and has the properties of a c-function associated with the radial flow of the scalar fields on the solution. In paper **56** a general characterization of the $W$ function as a solution to the Hamilton-Jacobi equation associated with an autonomous Hamiltonian system was given. From this property the U-duality invariance of $W$ naturally follows. The general properties of this functions were further studied in paper **58** for both large and small black hole solutions to extended supergravities (i.e. black hole solutions having finite and zero horizon area, respectively). The *Hamilton characteristic function* $W$ was given in this work a general integral form which is manifestly U-duality invariant and was also identified with the Liapunov function of the dynamical system whose existence implies that the horizon is an *asymptotically stable* attractor point. My personal contribution to those works included the characterization of the W-function for black holes as a Hamilton's characteristic function of the associated Hamiltonian system, the general proof of its duality invariance and its identification with the Liapunov function. In paper **64**, in a different collaboration, a general characterization of the solutions to the Hamilton-Jacobi equation associated with the black hole solutions to supergravity theories, describing regular and small black holes is given.

A different approach to the study of four-dimensional black holes is through their correspondence with instantons in an Euclidean $D = 3$ theory resulting from time-reduction of the four dimensional Lorentzian one. The three-dimensional effective description consists in a sigma-model coupled to $D = 3$ gravity. The target manifold is homogeneous-symmetric if and only if the scalar manifold in $D = 4$ is (*symmetric models*). This approach was used in papers **51** and **55** to derive general properties of higher dimensional black holes and wormhole solutions. My contributions to these works included found, among other results, an intrinsic characterization of the extremal black hole solutions to the STU model in terms of states of a *4 q-bit system*, with different degrees of entanglement. This result inspired a number of works on black hole solutions in relation to a 4 q-bit system, starting from the paper by Prof. Peter Levay "STU Black Holes as Four Qubit Systems" (Phys.Rev. **D82** (2010) 026003).

The same approach was used in papers **59** and **61** in the study of black hole solutions to supergravity models with symmetric scalar manifolds in relation to the Liouville integrability of the associated Hamiltonian system.

The effective Euclidean $D = 3$ description of stationary solutions to a four-dimensional supergravity makes a larger global symmetry group $G$, underlying this class of solutions, manifest. It is known that new solutions can be obtained by applying suitable $G$-transformations to known ones (*solution generating technique*). An interesting problem is then to classify stationary four-dimensional black holes and their physical properties in orbits with respect to the larger global symmetry group $G$. The main goal of papers **61** and **65** is the definition, in symmetric models, of a systematic mathematical procedure for constructing such orbits, which was then applied to supergravity models of a certain interest. In papers **n. 68**, **69** and **74**, we focussed on the study of general rotating, single-center solutions. My main contribution to these papers was giving a characterization of the rotational property of the solution which is intrinsic to the sigma-model, through a new matrix $Q_\psi$, computed at radial infinity, which is similar to the Noether charge matrix $Q$ and has value in the Lie algebra of $G$. Using $Q_\psi$ the general transformation property under $G$ of the angular momentum of the black hole can be derived. A second contribution of mine was devising a general geometrical limiting procedure for connecting $G$-orbits of non-extremal solutions to those (nilpotent) of extremal *under-rotating* and static solutions.

The embedding tensor formulation of gauged supergravities has provided a useful approach for studying *non-gemetrical* compactifications of string/M-theory and the underlying web of dualities. By identifying non-geometric fluxes with suitable components of the embedding tensor in lower-dimensions, in paper **49** a wider range of duality connected gauged supergravities were interpreted as originating

from generalized flux-compactifications of string/M-theory.

The obstacle in deriving a U-duality covariant formulation of string theory stems from the fact that the Green-Schwarz formulation does not describe the coupling of strings to R-R fields. This can be overcome in the *pure-spinor* formulation of superstring. In paper **50** the rheonomic formulation of supergravity was used to extend the *pure-spinor* description of superstring to a generic ten-dimensional background.

In paper **53** the embedding tensor formulation is extended to $N = 1$, $D = 4$ supergravity reproducing the Green-Schwarz mechanism of anomaly cancellation by relaxing the first order constraint on the embedding tensor itself.

In paper **52** the $N = 6$, $D = 4$ gauged supergravity is constructed. This theory is relevant for the low energy description of Type IIA on $AdS_4 \times \mathbb{CP}^3$, which is conjectured to be the supergravity *dual* of the ABJM $N = 6$, $D = 3$ Chern-Simons theory.

In paper **n. 67**, applying the embedding tensor description of $N = 8$ four-dimensional gauged supergravity, a new class of models with local SO(8) symmetry was constructed. This was achieved by gauging the SO(8) symmetry group in a family of different symplectic frames, which are not related by global symmetry transformations of the ungauged theory (i.e. $\mathrm{E}_{7(7)}$-transformations). This result has had an important resonance in the scientific community since it contradicted the common lore that the SO(8)-gauged maximal four-dimensional supergravity, originally constructed by de Wit and Nicolai in the eighties, was unique. These new models exhibit a variety of new vacua and their physical properties are still under study.

The problem of embedding inflationary models in supergravity, including the extended theories, is addressed in papers **n. 73** and **75**. In the latter we succeeded in deriving the so-called *Starobinsky potential* for the inflaton field, together with two other instances of the so called $\alpha$-attractor models, which is most favored by the Plank and WMAP data, in an $N = 2$ supergravity.