CURRICULUM VITÆ

Igor PESANDO

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Curriculum vitæ of Igor Pesando

Personal Information

Name: Igor Pesando

Place of birth: Torino, Italy

Date of birth: 9th November 1964

Citizenship: Italian

Addresses

Present (work): Dipartimento di Fisica
Universitá di Torino
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Research Interests:

- Supersymmetry and Strings
- Quantum Field Theory and Critical Phenomena

Education:

- 20.07.1983: **"Maturità Scientifica"** (final examination of the italian high school for scientific studies) with (54/60).
- 10.07.1987: **"Laurea in Fisica"** (degree in Physics) with maximum marks (110/110) cum laudae at the University of Turin.

  Thesis: *String compactification schemes by free fermions*

  Advisor: Prof. F. Gliozzi
- 23.09.1992: **"Dottorato di Ricerca in Fisica"** (Philosophiæ Doctor) with a sucessful defense of the Ph.D. thesis.

  Thesis: *Effective theory for heterotic string*

  Advisor: Prof. F. Gliozzi

Academic Career:

- 1983-1987: Undergraduate student at the Turin University, Turin, Italy.
- 15.12.1988: Beginning of Ph.D. (Dottorato di Ricerca in Fisica), after a public competition.
- 01.10.1992: One year fellowship at the Niels Bohr Institut, Copenhagen, Denmark.
- 01.10.1993: Grant from the Danish Education Ministry for a 4 months staying at the Niels Bohr Institut, Copenhagen, Denmark.
- 01.02.1994: Beginning of a "Human Capital and Mobility" EU fellowship at Nordita under the guidance of Prof. Paolo Di Vecchia.
- 01.09.1995: Permanent position as researcher at the Department of Theoretical Physics of the Turin University, Turin, Italy
- 26.12.2004-: Permanent position as Associate Professor at the Department of Physics of the Turin University, Turin, Italy

Teaching Experience

- From 2011/2012 on: course "Physics" for undegraduate programme in Information Technology
- From 2009/10 on: course "General Relativity" for master programme in Physics
- From 2008/09 on: short course "Introduction to Supersymmetry" for PhD programme
- From 2005/06 til 2007/08: course "Non Perturnative Field Theory" for PhD programme
- From 2006/07 til 2010/11: course "Econophysics" for undergraduate programme in Physics and Mathematics for Finance and Insurance.
- From 2004/05 til 2008/09: course "Physics" for undegraduate programme in Risk Prevention
- From 1996/1997 til 2004/2005: esercise sessions on Mechanics and Special Relativity

Refereeing Experience

- Referee for JHEP, Nucl Phys B, PLB, CQG
- Referee for Belgian and French universities

Organizing experiences

- organizer "RTN Winter School on Strings, Supergravity and Gauge Theories", Torino, 7-11 Gennaio 2003. Among the editors of the proceedings, published in Fortschritte der Physik, Vol 52, no 2-3 (February-March 2004).
- organizer Workshop of the European R.T.N. network "The quantum structure of spacetime and the geometric nature of fundamental interactions", Leuven, September 13-19, 2002. Among the editors of the proceedings, published in Class. Quantum Grav. 20 (2003) 321-579.

- organizer School on "Quantum aspects of gauge theories, supersymmetry and quantum gravity", Torino, January, 26 - February, 2 2000. Among the editors of the proceedings, published in Class. Quant. Grav. 17 (2000) 3377-3597.

- in charge of Erasmus exchanges for Physics students since 2002.

- in charge of the local unity of the national project MI12 funded by INFN since 1999 60%

Participation to research projects I participated/ am participating to the following national and international research projects:

- MIUR-PRIN contract 2009KHZKRX-007, "Symmetries of the Universe and of the Fundamental Interactions".

- MIUR-PRIN-2005023102, "Strings, D-branes and Gauge Theories".

- European RTN network project HPRN-CT-2000-00131 "The quantum structure of spacetime and the geometric nature of fundamental interactions".

- MIUR-PRIN-2003023852 project "Physics of fundamental interactions: gauge theories, gravity and strings".

- MIUR 2001-1025492 project "Teoria dei campi, superstringhe e supergravit".

- European TMR network project ERBFMRX-CT96-0045 "Quantum Aspects of Gauge Theories, Supersymmetry and Unification"

Schools and Conferences

- Oct. 1988: Contribution at "Congressino sulle Stringe", Torino, Italy
- Sep. 1990: "Condensed Matter and High Energy Physics", Chia (CA), Italy
- Apr. 1991: "Spring school on string theory and quantum gravity", ICTP (Trieste), Italy
- May 1991: "Convegno Nazionale di Fisica Teorica " (National seminars of Theoretical Physics), Isola d'Elba, Italy
- Sep. 1991: "Seminario Nazionale di Fisica Teorica" (National School of Theoretical Physics (for Ph. D. students)) , Parma (PR), Italy
- Oct. 1991: "Scuola Nazionale di Fisica della Materia", Villa Gualino Torino , Italy
- May 1992: "Convegno informale di Fisica Teorica ", Isola d'Elba, Italy
- Sep. 1992: "Condensed Matter and High Energy Physics", Chia (CA), Italy
- Sep. 1992: "Workshop on strings and quantum gravity", Accademia Nazionale dei Lincei Roma, Italy
- May 1993: Contribution at "EC collaboration meeting", Trieste, Italy
- Jul.-Aug. 1993: School "Recent Advances in Statistical Mechanics", Istanbul, Turkey
- Aug. 1993: Contribution at "Network meeting", Copenhagen, Denmark
- Jun. 1994 "XVIII-th Triangle Meeting on Modern Field Theory", Copenhagen, Denmark
- Sep. 1994 Contribution at "Network meeting", Turin, Italy
- Apr. 1995 "String Spring School", Trieste, Italy

- Jul. 1995 "Gauge Theories, Applied Supersymmetry and Quantum Gravity II", London, UK
- Apr. 1996 "String Spring School", Trieste, Italy

RESEARCH ACTIVITY

Igor Pesando

. Supergravity and conformal, topological, super-symmetric field theorie - Strings and gravitational instantons. - String dualities. - AdS/CFT.

2. D-brane physics

- D-brane interactions. Boundary states. - D-branes in type 0 theories and non-BPS D-branes. - D-branes on orbifolds. - D-branes on pp-waves. - "Gauge/gravity" relations. - Istantons and open strings. - Open strings in non-trivial backgrounds and deformations of gauge theories. - "Brane-worlds": branes at angles, magnetized branes. - Effects of background fluxes on brane-world theories. - Exotic instantons. - Computation of non perturbative effects in string and field theories by means of localization techniques. - New perspectives on the exact low energy description of N=2 gauge theories inspired by their D-brane realizations. - Non-perturbative aspects of Gauge/gravity duality.

- **1986-1987:** My degree (laurea) thesis has been mainly devoted to the study of the possibility of compactifying strings from D=10 to D=4 adding to the action free fermions.

- **1987-1988:** After my degree in collaboration with P. Fré and R. D'Auria I continued the research in string theory but following the low energy approach: we studied the D=4 effective heterotic string field theory , which is obtained by adding a Lorentz Chern-Simons form to the axion field strength in the new minimal formulation of the N=1 D=4 supergravity.

- **1988-1990:** During my Ph.D. I pursued this approach to string theory and I derived the equations of motion of the minimal anomaly free supergravity : this is the D=10 effective heterotic string field theory and it is obtained by the request of having a local field theory, at most quadratic in curvature interactions, free of both gravitational and gauge anomalies, supersymmetric and with the same massless spectrum of the heterotic string. To this purpose, I developed a LISP written program running in the REDUCE environment by which it took about

five months to get the desired results. I could estimate that without the computer aid the computations would have taken about three or four years of man work. I also showed that these equations are satisfied by a Calabi-Yau manifold. As an application of these equations, A.K. Tollsten and I looked at the Strominger's heterotic instanton and we found new solutions of the symmetric type ; in particular some of them are conformally flat D'Auria-Regge gravitational instantons.

By exploiting the capabilities of my program in collaboration with L. Castellani we were able to construct on the group manifold one of the missing supergravity lagrangians, that of the N=2 D=10 chiral supergravity . The previous results are the subject of my Ph. D. thesis.

- **1990-1992:** During the Ph.D. I developed other research interests: I become interested in statistical mechanics, in particular in polymers and the application of the topological field theory to the statistical mechanics.

  My research on polymers started noticing that De Gennes' approach to polymers, based on the $O(n)$ model, while extremely fruitful and useful, requires the unphysical limit $n \to 0$. As a consequence in collaboration with D. Cassi a model , which is directly related to the self avoidness propriety of the self avoiding walks was developed: we associated to every step of a walk a product of two fermionic variables , one associated with the starting site and the other with the ending one, in such a way that when a walk intersects there is a product of two identical fermionic variables that annihilates the path weight.

  Motivated by the De Gennes' limit $n \to 0$, which naively means the absence of classical propagating degrees of freedom we were able to write a new topological action à la Witten equivalent to the McKane-Parisi-Sourlas one. The main hope behind this approach was to be able to compute both the β function and the Z factors exactly, being so able to compute the exact critical exponents for the self avoiding walks. With a 2 loop computation I showed how this hope is not fulfilled and that the theory has both IR and UV "Landau poles". We were also able to show the explicit connection between our model and the topological version of the McKane-Parisi-Sourlas action : the

keypoint is a gaussian transformation on some composite fields of the theory.

- **1992-1993:** When I came at the NBI I pursued further my research on polymers and I showed how it is possible to have critical exponents different from De Gennes' theory in presence of different kinds of monomers (colors) . I became so interested in the induced QCD and its relation to polymer physics: I therefore examined the simplest version of "Induced QCD" , where the QCD is induced by vectors in place of matrices. This yielded to the prove of the existence of theories with local gauge invariance and upper critical dimension 6, the partition functions of which describe the generating functions of branched polymers with special values for the activities.

- **1993-1994:** In collaboration with P. Di Vecchia an approach to the large N QCD_2 based on the use of the master field was developed: here the master field is a bilocal object in the fermionic variables, i.e. a meson. I applied this technique to the generalized QCD_2 case , obtaining a direct and straightforward derivation of the large N equation for the most general case.

- **1994-1995:** Motivated by the possible application of the light cone techniques to the QCD and in order to get a better understanding of their possibilities and limits, I examined the Gross-Neveu model using the light cone quantization and solving the constraints directly. I could explicitly prove the triviality of the vacuum and recover the running coupling constant as a normal ordering effect. Moreover I showed how the renormalized fermion condensate is zero, being proportional to the v.e.v of the light cone hamiltonian.

- **1995:** Excited by the very interesting results obtained by Seiberg on $N = 1$ $D = 4$ matter coupled gauge theories I considered the first and simplest exceptional gauge group G_2 .

- **1996:** Because of the interesting results on spontaneous supersymmetry breaking in rigid and local $N = 2$ $D = 4$ supersymmetry, we generalized previous results in the local case to .

- **1996:** We recovered the boundary state from string amplitudes factorization and we showed that in the closed bosonic string the n (parallel) branes scattering is equivalent to a $n-1$ holes amplitude in open bosonic string . Then we showed that in superstring boundary states can be used as linear sources for massless fields, i.e. one can read the long distance field amplitude for the massless fields directly by computing the scalar product of the boundary with the asymptotic state corresponding to the massless field.

- **1997:** We showed that it is possible to read the long distance massless closed string state fields directly from the boundary state.

- **1998:** We computed the κ symmetry gauge fixed GS superstring action for the $AdS_5 \times S^5$ and $AdS_3 \times S^3$ backgrounds.

- **2001:** We computed and examined the enhancon background in supergrvity.

- **2002:** We computed the boundary states for a superstring in a Hpp wave background. We showed that mixed disks involving $D3$ and $D(-1)$ can be used to read the instantonic profile and to build the ADHM instantonic measure in $N = 4$ SYM.

- **2002-:** We applied our stringy instantonic techniques to many different cases.

- **2008:** We showed how the gauge group rank reduction phenomenon in presence of a discrete B field can be understood as due to the presence of a background field strength.

- **2011:** We showed that our previous computations of the instantonic profile missed a stringy form factor which however does not affect our previous results in the low energy limit.

- **2011-:** We computed all the possible twist correlators for the branes at angle setup extending and improving the previous derivation. We want to be able to compute all possible correlators involving basic and excited twists with untwisted operators.