FI11

Project title: Low-Dimensional Field Theory, Integrable Systems and Applications
National Organizer: Andrea Cappelli

Subgroups: Bologna Cosenza Firenze Genova Perugia Trieste
International collaborations: LAPTH Annecy; Durham Univ.; Univ. de Santiago de Compostela; IPhT, Saclay; PDMI-Steklov, St. Petersbourg; ETH-Zurich; Theoretical Physics, Oxford Univ.; LPTHE, Univ. Paris VI; LPTHE, ENS, Paris (F); Dept. of Physics, Melbourne; School of Physics, Univ. of Western Australia, Perth; JFI, Univ. of Chicago; DESY, Hamburg; Max Planck AEI, Potsdam; Humboldt Univ., Berlin; King's College, London; School of Physics and Astronomy, Univ. of Glasgow; Dept. of Physics, Univ. College Cork; School of Mathematics and Physics, Queen's Univ., Belfast; Dept. of Physics and Astronomy, Univ. College London; Rutherford Appleton Laboratory, Oxford; Landau Institute, Moscow.

Participants

Bologna

Name	Position	INFN Position	Time percentage	Comments
Stefano Evangelisti	Dottorando	Associato	100	Dottorando XXV ciclo
Alessandro Fabbri	Dottorando	Associato	100	Dottorando XXVI ciclo
Davide Fioravanti	Ricercatore	Dipendente	70	
Simone Piscaglia	Dottorando	Associato	100	Dottorando XXVI ciclo
Francesco Ravanini	Prof. Associato	Associato	100	

Cosenza

Name	Position	INFN Position	Time percentage	Comments
Tony John George Apollaro	Assegnista	Associato	100	Titolare di assegno di ricerca: scadenza il 31-08-2014
Antonio De Liguoro	Dottorando	Associato	100	Dottorando senza borsa XXVII ciclo
Francesco Francica	Assegnista	Associato	100	Titolare di assegno di ricerca: scadenza il 31-12-2012
Domenico Giuliano	Ricercatore	Associato	100	Coordinatore Gruppo IV
Salvatore Lorenzo	Dottorando	Associato	100	XXIV Ciclo
Francesco Plastina	Ricercatore	Associato	70	

Firenze

Name	Position	INFN Position	Time percentage	Comments
Marco Ademollo	Prof. Ordinario	Associato	0	
Dario Calvani	Dottorando	Associato	100	XXV Ciclo
Andrea Cappelli	Dirigente di Ricerca	Dipendente	60	10% UE-QICFT
Filippo Colomo	Ricercatore	Dipendente	90	10% UE-QICFT
Alessandro Cuccoli	Prof. Associato	Associato	50	
Paolo Politi	Ricercatore	Associato	50	Ricercatore CNR Firenze

Paola Verrucchi	Ricercatore	Associato	50	Dipendente CNR Firenze

Genova

Name	Position	INFN Position	Time percentage	Comments
Alberto Blasi	Prof. Ordinario	Associato	100	
Giacomo Dolcetto	Borse laureati dottorato	Associato	100	dottorando
Dario Ferraro	Assegnista	Associato	100	
Nicodemo Magnoli	Prof. Associato	Associato	100	

Perugia

Name	Position	INFN Position	Time percentage	Comments
Maria Cristina Diamantini	Ricercatore	Associato	100	
Stefano Mancini	Prof. Associato	Associato	50	
Pasquale Sodano	Ass.Senior	Associato	100	

Trieste

Name	Position	INFN Position	Time percentage	Comments
Marco Beria	Dottorando	Associato	100	XXV ciclo
Eyob Kebede Chere	Dottorando		100	richiesta di associazione inviata
Andrea Coser	Dottorando	Associato	100	richiesta di associazione inviata
Gesualdo Delfino	Prof. Associato	Associato	100	
Andrea Gambassi	Prof. a Contratto	Associato	100	
Paulo Eduardo Goncalves De Assis	Borsista Post doct.	Associato	100	richiesta di associazione inviata
Matteo Marcuzzi	Dottorando	Associato	100	XXIV ciclo
Jamir Marino	Dottorando	Associato	100	XXV ciclo
Giuseppe Menegoz	Dottorando		100	XXV ciclo - richiesta di associazione in fase di esecuzione - XXV ciclo
Giuseppe Mussardo	Prof. Ordinario	Associato	100	
Francesca Pietracaprina	Dottorando		100	richiesta di associazione inviata
Ivan Diego Rodriguez	Borsista Post doct.		100	richiesta in fase di esecuzione
Antonello Scardicchio	Ricercatore	Associato	80	
Mauro Schiulaz	Dottorando		100	richiesta di associazione inviata
Pietro Smacchia	Dottorando		100	XXV ciclo - richiesta di associazione in fase di esecuzione - XXV ciclo
Alessio Squarcini	Dottorando		100	richiesta di associazione inviata
Erik Tonni	Borse post doc estero	Associato	100	

Andrea Trombettoni	Ricercatore	Associato	100	

Scientific project

Introduction
==========
This INFN Initiative involves research activity in the interdisciplinary area between Quantum Field Theory, Condensed Matter Theory and Statistical Physics, especially in low dimension. This domain developed considerably in the last twenty years, with the discovery of new and remarkable physical phenomena due to strong interactions. Such results led to introduce concepts and methods going beyond the ranges of established disciplines.

The main theme is the study of exactly solvable models in two dimensions, namely conformal field theories, integrable systems and perturbations thereof, together with their application to statistical mechanics and condensed matter problems. Exact solutions provide the tools to understand the physics of low-dimensional systems, that are characterized by non-perturbative effects.

The lure of low dimensional systems has attracted theoretical and experimental physicists, and with each advance towards this realm of Flatland, new, exciting and rich physics has emerged. From a theoretical point of view, the advent of Conformal Field Theory in 1984 has opened up an exact approach to massless low-dimensional systems and since then, the field has grown explosively in several directions, including the string theory of fundamental interactions, the statistical mechanics of phase transitions and growth phenomena, and new approaches for strongly-interacting systems. In the same period, one has also witnessed a parallel development in many subjects of mathematics, such as infinite dimensional Lie algebras, integrable equations, random matrices and probability. This blend of mathematical and physical ideas is at the root of the scientific elegance and extraordinary effectiveness that characterize the theoretical results in this area. Among them, let us mention the exact field theory computation of quantum Ising model correlators that has found a direct confirmation by neutron scattering experiments, and the solution of several problems involving transport and strong interactions, as e.g. in the quantum Hall effect, by applying conformal field theory and Bethe ansatz techniques.

Since there is a rather broad spectrum of problems in statistical mechanics and condensed matter, there are, accordingly, several research lines in this INFN Initiative. Let us mention the study of the quantum Hall effect and in general the strongly-interacting electron systems, the one and two-dimensional spin systems, and the quantum integrable statistical systems with meta-stable vacua. Let us also remark the relation between two-dimensional (exactly solvable) field theories and string theory: fruitful interchanges of methods and physical analogies between the two domains have occurred several times in the past and continue nowadays. Three connections that have been recently investigated in this initiative are: i) the matrix gauge theories of D0 branes applied to the fractional quantum Hall effect; ii) the use of integrable spin chains and Bethe Ansatz solutions to obtain the spectrum of anomalous dimensions in N=4 supersymmetric Yang-Mills theory in 4 dimensions; iii) the use of entanglement entropy for characterizing T=0 condensed matter systems and black-hole geometries. Last but not least, the possibility of realizing relativistic fermions in the (2+1) and (3+1) dimensions in graphene, cold atoms and topological insulators.

Quantum field theories or other quantum systems with infinite degrees of freedom are intensively analyzed when subjected to an abrupt change of their coupling constants (quantum quench). A particular important case is given by quantum integrable systems, i.e. with an infinite number of conserved quantities, whose long-time asymptotic behavior is not fully understood: they might thermalize or not and their asymptotic behaviour could be described by generalized Gibbs ensembles.

In addition to the research program, we would like to mention that the members of this Initiative have been traditionally engaged in organizing conferences and schools at European and international level. Let us mention: the "Workshop on Frontiers of Cold Atoms", 6-10 June 2011, ICTP, Trieste; the 8th edition of the "Bologna Workshop in Integrable Models", September 2011; the program "The beauty of Integrability: low-dimensional physics, statistical models and solitons", Natal (Brazil), July 2012; the "Workshop on Quantum Simulations by Cold Atoms", ICTP, Trieste, July 2012.

Research program by groups
==========
Bologna group

"Integrability in gauge/string dualities" (Fioravanti, Piscaglia)
We wish to determine the two-particle S-matrices for all the excitations over the GKP vacuum beyond the scalar sector. We have payed particular attention to the strong coupling limit where they should become relativistic.

"Non-linear sigma model TBA and strong coupling" (Fabbri, Fioravanti, Ravanini)
Continuing previous studies, we would like to fully analyze the prediction for the O(6) TBA in the UV limit and also the finite size corrections beyond the leading order (of the marginal perturbation).

"Entanglement in Integrable models and QFT" (Ravanini, Evangelisti, Ercolessi (NA41-BO))
The exact formula for the Renyi entropy, found for the XYZ model, will be extended to other integrable spin chains, with particular attention to their continuum limit. More specifically, the ABF related spin chains that yield as continuum limit the minimal models perturbed by their phi(1,3) relevant operator will be investigated in many aspects.

"TBA and NLIE in integrable deformations of non-linear sigma models" (Ravanini, Fabbri)
The reductions of TBA equations to the more economical NLIE form for a wide class of integrable theories related to the non-linear sigma models will be studied. They may be relevant for certain applications in the AdS/CFT framework.

Cosenza Group

[Field theory of correlated electronic systems]
We plan to investigate the universal features of the phase transitions(s) at the intermediate coupling phase(s) in the repulsive Hubbard model on the honeycomb lattice. In particular, we shall focus onto the possible mechanism of deconfinement of spinons in these phases. In detail, we plan to build a field-theory model with spinons as elementary excitations interacting via effective gauge degrees of freedom, emerging near by the quantum phase transition, eventually resorting to the standard approach to confinement/deconfinement transitions in gauge theories.

[Effective spin-1/2 description of the one-dimensional Bose-Hubbard model]
By means of the renormalization procedure introduced by Glazek and Wilson, we will conclude our ongoing investigation of the strong coupling expansion of the Bose-Hubbard (BH) model at half-filling. In particular, we expect to show that -even at a finite value of the on-site interaction energy U- it is possible to set a correspondence between the BH and an XXZ spin-1/2 magnetic chain, with pertinently renormalized exchange energy and anisotropy parameter .

[Propagation of quantum information and quantum correlations]
In 2013, we intend to study the propagation of quantum information and of quantum correlations (entanglement and discord) between systems that are coupled either directly or via the action of bosonic "mediator" fields with which the sub-systems locally interact. In particular, for the first case, we will investigate the connection between information flow and decoherence in the general framework of the measures of "non-Markovianity" that has been recently established within the theory of open quantum systems. In the second case, in which two sub-systems are connected via their interaction with a common field, we will specifically consider the dispersive coupling regime.

[Circuit QED]
We will consider physical realizations obtained within the realm of circuit-QED, in which artificial superconducting atoms interact with the quantized electromagnetic field of a strip-line resonator. We will further apply the same analysis briefly described above to the case of spin systems (that can be realized

experimentally with cold atomic gases), in which one or two impurities are coupled to the rest of the spins, so that the information flow and/or the transmission of quantum correlations are mediated by the effective fermionic quasi-particle excitations of the spin medium.

Florence Group

A. Cappelli, G. R. Zemba: "Conformal Field Theory of Composite Fermions in the Quantum Hall Effect"
We shall develop the recently found exact correspondence between the W-infinity CFT and the Jain wavefunctions, by understanding the statistics of quasi-hole and quasi-electrons and the experimental predictions that may emerge from this theory.

P. Politi: "Analytical approaches to spin-ice dynamics"
We plan to apply two different analytical tools to study the athermal dynamics of artificial spin-ice: (i) population dynamics equations, describing the evolution of the system in terms of vertices undergoing two-vertex processes; (ii) networks theory, mapping the evolution in the phase space as a diffusion process in a suitable network.

F. Colomo, A. G. Pronko: "Exactly solvable lattice models"
We are pursuing the investigation of the form and fluctuations of the phase separation curves in the domain wall six-vertex model. While in ferroelectric/disordered phase separation curve the fluctuations are governed by the Gaussian Unitary Ensemble of random matrix models (related to the Kardar-Parisi-Zhang universality class), in the disordered/antiferroelectric phase separation curve fluctuations a different and qualitatively new behaviour is expected. We also plan to investigate further the phase separation phenomena the case of generic regions and boundary conditions. Finally we will study combinatorial applications of some of our recent results.

L. Banchi, D. Calvani, A. Cuccoli, P. Verrucchi: "Quantum spin-chains and Open Quantum Systems"
Spin chains, and especially XY spin model, are investigated as possible channels for quantum state transmission; the role of spin environments for entanglement manipulation, protection or dynamic generation is also studied as a function of model parameters. We also address more general aspects of the dynamics of open quantum systems in the framework of the parametric representation, with application to the spin-star model.

Genova group

"Edge states in fractional quantum Hall effect"
We will study the effect of interactions in 1D models containing Majorana fermions. We would like to characterize the role of interactions on transport properties

"Effective theories of Topological insulators"
We will consider a quantum dot geometry, realized in two-dimensional topological insulators. We expect that this system can lead to peculiar transport properties with possible practical applications. We also plan to extend previous results on BF models with boundary to the non abelian case in 3D, looking at the particular case of zero cosmological constant and to the generic D dimensional case. In the last case we expect to find a generalized duality relation already found in 3 and 4 dimensions.

Perugia group

"Quantum devices"
We shall study systems where impurities are crafted either by a local change of a fabrication or control parameter or by a smart choice of architecture. We shall use tools developed in statistical field theory and quantum information theory for determining new stable phases and new quantum behaviors arising in quantum devices and spin systems. We shall continue our analysis of the phases accessible to Josephson

Junctions networks with pertinent impurities as well as on the study of the long range distance independent quantum entanglement attainable in spin chains mimicking the Kondo effect .

"Long range correlations and entanglement in wires with Majorana edge modes"
Here, we shall focus on condensed matter systems and quantum devices where long range correlations and quantum entanglement between distant points may be achieved by exploiting the emergence of edge Majorana bound modes. We, firstly, provided the basis for computing the non local effects – such as crossed Andreev reflection, teleportation of fermionic matter etc. - induced by the emergence of Majorana edge modes in a variety of devices. Then, we proved how a one dimensional device supporting a pair of Majorana bound states at its edges induces remarkable Hanbury Brown-Twiss like interference effects between well separated Dirac fermions of pertinent energies. Our future efforts will involve the study of superconductor- semiconductor hybrid systems in which the response to external perturbations may lead to experimental signatures of edge Majorana modes.

"Topological superconductors and insulators"
We proposed a mechanism of superconductivity in which the order of the ground state does not arise from spontaneous symmetry breaking but rather from topological order. Contrary to anyon superconductivity the mechanism proposed works in any dimension and it preserves P and T invariance. We showed also that topologically ordered superconductors have a long distance hydrodynamic action which can be formulated in terms of generalized compact gauge fields, the dominant term being the topological BF action. The condensation of topological defects induces quantum phase transitions between different topologically ordered phases characterized by different ground state degeneracy on manifolds with non trivial topology. When describing topological matter in 3 space dimensions another marginal term (the Maxwell term) should be added to the BF action in order to determine the physical content of the model. The quantum phase structure is governed by three parameters: the BF coupling, the electric permittivity and the magnetic permeability. For intermediate values of electric permittivity and magnetic permeability the material behaves as a topological insulator.

"Quantum critical points"
Conformal field theories do not only classify 2D classical critical behavior but they also govern a certain class of 2D quantum critical behavior. In this latter case it is the ground state wave functional of the quantum theory that is conformally invariant, rather than the classical action. We showed that the superconducting-insulating (SI) quantum phase transition in 2D Josephson junction arrays (JJAs) is a (doubled) $c=1$ Gaussian conformal quantum critical point. The quantum action describing this system is a doubled Maxwell-Chern-Simons model in the strong coupling limit. We argue that the SI quantum transitions in frustrated JJAs realize the other possible universality classes of conformal quantum critical behavior, corresponding to the unitary minimal models at central charge $c=1-6/m(m+1)$.

Trieste group

Quantum Field Theory out of Equilibrium” (Mussardo, Coser, Gambassi, Lombardo, Smacchia, Marino, Marcuzzi, Menegoz, de Assis)
Quantum field theories subjected to a quantum quench are intensively analyzed. We will continue the study of these systems with techniques borrowed either by random matrix theory or non-perturbative methods coming from exactly solved models. We plan to complete the analysis done so far of models like the Sine and Sinh-Gordon model and its non-relativistic counterpart, the Lieb-Liniger model, in its attractive or repulsive regime.

"Field theoretical study of universality classes of critical behaviour" (Delfino, Mussardo, Squarcini, Coser)
We plan to continue the studying of universal properties of second order phase transitions by means of quantum field theory, thanks to techniques of Conformal Field Theory and exact S-matrices. Particular emphasis will be paid to geometrical phase transitions, like percolation cluster.

"Analysis of non-integrable quantum field theories by numerical methods" (Mussardo, Beria, de Assis, Chere)
We are continuing our analysis of non-integrable low-dimensional quantum field theories with the

numerical method of Truncation Conformal Approach. Recently we have completed a very efficient numerical program which permits to address questions relative to deformed conformal field theories with central charge larger than 1, i.e. a very difficult challenge which has been elusive in the last years. We plan to study the phase diagram of theories like the O(3) sigma model with topological term by means of these methods and determine the mass spectrum, the crossover between the ultraviolet and the infrared regions and various other dynamical quantities. We also plan to study the status of the so-called “Generalized Gibbs Ensemble” hypothesis in the context of classical integrable quantum field theories.

"Non-relativistic field theory and applications to cold-atoms" (Trombettoni, Mussardo, Menegoz)
We plan to explore in detail cold atom systems by means of the non-relativistic limit of quantum field theory. this promising route to solve cold atom systems with dipolar and long range interactions. Moreover we are working on the theoretical proposal to implement gauge field dynamics and (3+1) Dirac fermions by using appropriate settings of cold atom systems.

Random systems and Quantum Computation (Scardicchio, Schiulatz)
We plan to extend both our previous studies on many-body localization systems and to analyze in more detail efficient protocols of topological quantum computation. In the first topic we will try to identifying whether there is a genuine phase transition or crossover phenomena in quantum random systems by varying their coupling constants. In the second topic, we will take advantage of our recent advances on non-abelian anyon systems.

Entanglement and AdS/CFT (Tonni, Rodriguez, Schiulatz)
With the arrival of Erik Tonni in our group, we have launched a new research area concerning entanglement entropy in conformal field theories and the promising duality correspondence between classical gravity and strongly interacting quantum systems. This topic is full of open questions and we plan in particular to address those concerning off-equilibrium dynamics driven by black hole solution and exact computation of response functions.

Anyons and Topological Phases of Matter (Mussardo, Trombettoni, Pietracaprina)
We plan to explore further the possibility to determine higher virial coefficients of non-abelian anyon systems which can be important for clarifying the partition function of such particles. Moreover, we plan to identity classes of universality of topological phases of interacting anyons.

Activity

Activity report 2011-12
==========
Note: the groups of Cosenza and Perugia have been added during 2012; some of their earlier data may be missing in the Fi11 web pages, owing to technical problems of the database.

Bologna group

- Integrability in gauge/string dualities (Fioravanti, Piscaglia)
We have been looking for the dispersion relations of all the excitations over the GKP vacuum beyond the scalar sector. We have payed particular attention to the strong coupling limit where they should become relativistic particles. We expect that this analysis should shed light on the excitations of the boundary CFT_2 theory (dual to an AdS_3 string theory).

- Twist Wilson Operators in N=4 SYM (Fioravanti)
We have investigated the high spin expansion of the anomalous dimension (energy) of AdS/CFT sl(2) twist sector at strong coupling uncovering the presence of the O(6) NLSM at finite size, though with simpler equations. This shows that the exact low energy string theory simplify into this simple NLSM. In this context we have started the interpretation and construction of the spectrum over the GKP vacuum (as different from those over the BMN vacuum).

- Exact spectrum in N=4 SYM (Fioravanti)
We have implemented numerically and better understood the analytic continuation (in suitable parameters) of the Thermodynamic Bethe Ansatz equations, getting closer to the understanding of states in the su(2) sector.

- Essential singularity in the Renyi entanglement entropy of the one-dimensional XYZ spin-1/2 chain (Ravanini, Evangelisti)
We have studied the Renyi entropy of the one-dimensional XYZ spin-1/2 chain in the entirety of its phase diagram. The model has several quantum critical lines corresponding to rotated XXZ chains in their paramagnetic phase, and four tri-critical points where these phases join. Two of these points are described by a conformal field theory and close to them the entropy scales as the logarithm of its mass gap. The other two points are not conformal and the entropy has a peculiar singular behavior: the model undergoes a discontinuous transition, with a level crossing in the ground state and a quadratic excitation spectrum.

- Correlation Length and Unusual Corrections to the Entanglement Entropy (Ravanini, Evangelisti)
We have investigated analytically the corrections to the leading terms in the Renyi entropy of a massive lattice theory, showing significant deviations from naive expectations. In particular, we show that finite size and finite mass effects give rise to different contributions (with different exponents) and thus violate a simple scaling argument. If the lattice spacing is kept finite, the relation between the mass parameter and the correlation length generates new subleading terms in the entropy. These contributions arise as a consequence of the existence of stable bound states and are thus a distinctive feature of truly interacting theories, such as the XYZ chain.

Cosenza Group

[Field theory of correlated systems]
We have studied the interplay between Andreev reflections at a junction between a normal wire and a superconductor, and the electron interaction in the wire, both in the equilibrium and nonequilibrium case. We showed that, the equilibrium Josephson current in a long quantum wire is fully characterized in terms of the Andreev reflection amplitude at the Fermi energy, which allowed us to compute the equilibrium current within simplified integrable “boundary” models.

[Field theory of quantum-coherent Josephson devices]
Applying an effective boundary field theory formalism, we mapped out the phase diagram of to a tetrahedral qubit coupled to Josephson junction chains acting as Tomonaga-Luttinger liquid leads, In particular, tuning the fabrication and control parameters allows for stabilizing an attractive finite coupling fixed point of the phase diagram, where the system behaves as a quantum doublet which is robust against the noise in the external control parameters, as well as against decoherence.

[Strong coupling, spin-1/2 representation of the one-dimensional Bose-Hubbard model.]
Using a rigorous mapping of the one-dimensional Bose-Hubbard (BH) Hamiltonian onto a spin-1/2 XXZ Hamiltonian with pertinent parameters, we have expressed the correlation functions of single-boson operators in terms of correlation functions of spin-1/2 operators. This implies the possibility of “simulating” spin-spin correlation within the XXZ-model and, possibly, impurities in antiferromagnetic chains (Spin-Kondo effect) within the BH model with controlled parameters

[Decoherence, information flow and quantum correlation]
We have established a simple relationship between recently proposed measures of non-Markovianity and the Loschmidt echo for the purely dephasing dynamics of a qubit. In particular, we considered a quantum Ising spin environment and showed that the qubit dynamics becomes Markovian at the critical point.

[Transmission in coupled atom-photon systems and spin systems.
We also studied the transfer of quantum information, discord and entanglement in spin systems in 1D and showed that high efficiencies can be obtained in the transmission, provided the extremal bonds are modified. We also investigated the dynamics of several types of (classical and quantum) correlations in the Fermi problem. This is an archetypal model to study microcausality in the quantum domain where two

atoms exchange an excitation via the emission and absorption of a photon, a process that generates correlations between them. In particular, we analyzed the role of the light cone in the emergence of such correlations.

Florence Group

A. Cappelli, G. R. Zemba: "Conformal field theory of hierarchical Hall states"
The Jain construction of hierarchical Hall states and the associated picture of composite fermion have been reconsidered in the light of recent analyses that found an exact relation between Jain wavefunctions and conformal field theory correlators. We showed that the underlying conformal theory is actually given by the W-infinity minimal models introduced earlier. In this theory, the composite fermion excitations obey the non-Abelian fractional statistics.

F. Colomo, A Pronko: "Exactly Solvable Models: Limit shapes and Arctic Curves"
We have pursued our investigation of the domain wall six-vertex model, known to give rise to the phenomenon of phase separation and limit shapes. We have derived the exact expression of the phase separating curves, for generic values of the parameters of the model. We have examined in detail some interesting particular cases. We have also derived some determinantal and multiple integral representations for the Row Configuration Probability, a particular multipoint correlation function.

- A. Cappelli, F. Colomo, E. Castellani, P. Di Vecchia "String theory history"
We have completed the writing and editing of the book "The Birth of String Theory". This volume gathers the contributions of many researchers originally involved in the first steps towards the building of the theory. It also includes extensive introductory chapters and appendices for the benefit non-expert readers.

P. Politi: "Disorder effects in the athermal dynamics of two-dimensional spin ices"
Quenched disorder affects how non-equilibrium systems respond to driving. We have studied special frustrated spin systems, called artificial spin-ice, showing that athermal dynamics is strongly dependent on disorder. Our results apply to other systems where disorder does not change the nature of the ground state.

- L. Banchi, A. Cuccoli, D. Calvani, P. Verrucchi "Dynamical behaviour of open quantum systems"

- with T.J.G. Apollaro, S. Campbell, F. Plastina, M. Paternostro and R. Vaia
We have shown that quantum-state transfer with fidelity higher than 0.99 can be achieved in the ballistic regime of an arbitrarily long one-dimensional chain with uniform nearest-neighbor interaction, except for the two pairs of mirror-symmetric extremal bonds. The general framework can describe the end-to-end response in different models, such as fermion or boson hopping models and XX spin chains.

The transport of quantum correlations across a chain of interacting spin-1/2 particles has been studied using a symmetric version of quantum discord as a quantitative figure of merit for the transport of nonclassical correlations. Discord turns out to be better transported than entanglement for a wide range of working points and initial conditions, and this behaviour turns out to be related with the efficiency of propagation of a single excitation across the spin chain.

- with A. Bayat and S. Bose
We have shown that fidelity and entanglement do not necessarily quantify the quality of quantum communication in the same way. Namely, highest entanglement transfer can occur along a spin chain which is different from that giving the highest average fidelity. However, when higher entanglement-transfer is attained, one can always purify/distill entanglement using local operations and subsequently use it for teleportation eventually ending up with a higher fidelity.

- with N. Gidopoulos
We have defined the parametric representation of open quantum systems as a generalization of the operator sum representation for the density matrix of a quantum subsystem. In particular, making use of spin-coherent state, we have shown how the emergence of a Berry phase in the case of a qubit in a

magnetic field can be derived as a semiclassical limit of a composite and fully quantum system, whose entanglement is the binary entropy of the Berry phase.

- with S. Bonzio and M.L. Dalla Chiara
We have adopted the model of open quantum systems to describe the non-local dynamical behaviour of qubits processed by entangling gates, and found that the distinction between evaluation and task-oriented computing steps is not possible. In fact, the use of entangling gates reduces the two separate steps (evaluation and calculation) to a single computational one, which determines an effective computational speed-up.

Genova group

N. Magnoli, D. Ferraro, G. Dolcetto "Edge states in fractional quantum Hall effect"
We have studied the transport properties and the dynamics of edge states in a Hall liquid. We studied the nature of neutral modes in non-Abelian states and their influence on the dynamics of quasiparticles. We evaluated the finite-frequency noise in order to extract useful information about the nature of agglomerates and single quasiparticles involved in the tunneling processes. We also considered the tunnelling in a Quantum Spin Hall system through an extended junction. We analyzed the effects of this geometry on the backscattering current as a function of voltage, temperature, and strength of the electron interactions. We found that this configuration may be useful to confirm the helical nature of the edge states and to extract their propagation velocity.

N. Magnoli"Effective theories of Topological insulators"
We have extended our results on 2D BF theories to the 3D case in presence of a boundary. We have considered two different kind of boundary terms that preserve or break time reversal symmetry. Our analysis has been relevant for application to the field theoretical description of 3D topological insulators.

Perugia group

"Quantum devices with impurities and spin chains mimicking the Kondo physics"
Our analysis evidenced how concepts and paradigms from quantum information theory may be useful to characterize the phases accessible to condensed matter systems and, viceversa, how remarkable non local properties exhibited by particular condensed matter systems may be exploited to engineer devices useful for quantum information processing.

In one paper we showed also that, by scattering appropriate spin polarized electrons from the Majorana bound states, one can engineer a non-local entangler of electronic spins relevant for quantum information applications.

It is well known that, in (d+1) dimensional Multiscale Entanglement Renormalization Ansatz (MERA), tensor networks are connected so as to reproduce the discrete, (d + 2) holographic geometry of Anti de Sitter space (AdSd+2) with the original system lying at the boundary. We analyzed the MERA renormalization flow that arises when computing the quantum correlations between two disjoint blocks of a quantum critical system, to show that the structure of the causal cones characteristic of MERA, requires a transition between two different regimes attainable by changing the ratio between the size and the separation of the two disjoint blocks. We argued that this transition in the MERA causal developments of the blocks may be easily accounted by an AdSd+2 black hole geometry when the mutual information is computed using the Ryu-Takayanagi formula.

In another paper we used BCFT to describe the phases accessible to a tetrahedral qubit coupled to Josephson junction chains acting as Tomonaga-Luttinger liquid leads and proved that, in a pertinent range of the fabrication and control parameters, an attractive finite coupling fixed point emerges due to the geometry of the composite Josephson junction network. Our analysis points out to remarkable similarities of these superconducting networks with systems made with quantum wires, or with atomic condensates and provides evidence that – in a superconducting device- one may test behaviors typical of Kondo

systems.

We also considered the composite system made by two Kondo spin chain joined via an RKYY interaction between the two impurity spins in order to investigate the real space properties of the two impurity Kondo model. Using a DMRG approach, valid in all ranges of the parameters, the composite model was studied using two complementary measures of entanglement, the negativity and the von-Neumann entropy.

"Effective field theories describing topological matter in four dimensions"
In 3+1 dimensions, another marginal term should be added to the BF action in order to fully determine the physical content of the model. The quantum phase structure is governed now by three parameters that drive the condensation of topological defects: the BF coupling, the electric permittivity and the magnetic permeability of the material New states of matter are possible when these parameters cross critical values: a topological superconductor when electric permittivity is increased and magnetic permeability is lowered and a charge confinement phase in the opposite case of low electric permittivity and high magnetic permeability.

Trieste group

“Quantum Field Theory out of Equilibrium” (Mussardo, De Luca, Gambassi, Lombardo, Smacchia, Marino, Marcuzzi, Menegoz, Sotiriadis)
We have made a series of papers on the off-equilibrium dynamics of quantum systems with infinite degrees of freedom, in particular in integrable and non-integrable cases. In particular, thanks to random matrices, we have recently shown the presence of the so-called “rare states” in the quantum dynamics of local systems.

"Field theoretical study of universality classes of critical behaviour" (Delfino, Viti)
Second order phase transitions are associated to the spontaneous breaking of a symmetry; quantum field theory has been an essential and natural tool for capturing the universal properties of strongly correlated systems at and out of criticality. There are however very basic examples, like percolation, in which typical (extended) observables (e.g. the mean cluster size, the average fraction of sites in the infinite cluster) become singular without any obvious notion of symmetry breaking. Such phase transitions are termed geometrical and are at the boundary of mathematics and physics research. Two-dimensional geometric phase transitions can be analyzed by using the exact methods of CFT and S-matrix. For percolation we determined the universal amplitude ratios, the critical bulk three-point connectivity, the tails of off-critical crossing probability, and the density profile of an off-critical spanning cluster.

"Analysis of non-integrable quantum field theories by numerical methods" (Mussardo, Beria, de Assis)
We have made advances in the numerical control of quantum field theories by means both of Truncated Conformal Approach and direct numerical solution of (classical) equation of motion. In particular we were able to compute higher particle matrix elements of local operator and also to observe the thermalization approach in the long time limit of the evolution of the field.

"Non-relativistic field theory and applications to cold-atoms" (Trombettoni, Mussardo, Menegoz)
As shown in a series of our papers, one-dimensional cold atom systems can be described by a suitable non-relativistic limit of quantum field theory. This observation has open a new perspective on the subject, allowing the exact computation of thermodynamical quantities and expectation values of local operators. These quantities will be measured in on-going experiments. We have shown how genuine relativistic (3+1) Dirac fermions can be implemented by means of cold atom setting.

Random systems (Scardicchio, De Luca, Buccheri)
There has been a good deal of advances on the understanding of quantum many-body localization, integrability and random matrices. The topic has a large overlap with many other research topics of the group and the results obtained in this subject (such as properties of Cayley trees, sparse matrices, slow dynamics, etc.) have had stimulating impact on the study of off-equilibrium dynamics, discrete quantum field theory, etc.

Publications

1) PHYS REV B volume 85, article no.115428 MAR 21 2012
Ercolessi et al.
Correlation length and unusual corrections to entanglement entropy

2) PHYS REV A volume 85, article no.052319 MAY 25 2012
Apollaro et al.
99%-fidelity ballistic quantum-state transfer through long uniform channels

3) NEW J PHYS volume 14, article no.045008 APR 10 2012
Budrikis, Z; Politi, P; Stamps, RL
A network model for field and quenched disorder effects in artificial spin ice

4) J APPL PHYS volume 111, article no.07E109 APR 1 2012
Budrikis, Z; Politi, P; Stamps, RL
Disorder regimes and equivalence of disorder types in artificial spin ice

5) NEW J PHYS volume 14, article no.013060 JAN 30 2012
Blasi et al.
Non-Abelian BF theory for 2+1 dimensional topological states of matter

6) PHYS REV B volume 85, article no.195138 MAY 24 2012
Dolcetto et al.
Tunneling between helical edge states through extended contacts

7) NEW J PHYS volume 14, article no.023017 FEB 7 2012
Carrega et al.
Spectral noise for edge states at the filling factor v=5/2

8) J PHYS A-MATH THEOR volume 45, article no.032005 JAN 27 2012
Delfino, G; Viti, J
Crossing probability and number of crossing clusters in off-critical percolation

9) J STAT MECH-THEORY E article no.P02017 FEB 2012
Sotiriadis, S; Fioretto, D; Mussardo, G
Zamolodchikov-Faddeev algebra and quantum quenches in integrable field theories

10) J STAT MECH-THEORY E article no.P01014 JAN 2012
Bonart, J; Cugliandolo, LF; Gambassi, A
Critical Langevin dynamics of the O(N) Ginzburg-Landau model with correlated noise

11) NUCL PHYS B volume 843, 302-343 FEB 1 2011
Cavaglia, A; Fioravanti, D; Tateo, R
Extended Y-system for the AdS(5)/CFT4 correspondence

12) PHYS REV B volume 83, article no.012402 JAN 18 2011
Ercolessi et al.
Essential singularity in the Renyi entanglement entropy of the one-dimensional XYZ spin-1/2 chain

13) NUCL PHYS B volume 852, 235-268 NOV 1 2011
Cirillo et al.
Enhanced coherence of a quantum doublet coupled to Tomonaga-Luttinger liquid leads

14) J PHYS A-MATH THEOR volume 44, article no.195201 MAY 13 2011
Colomo, F; Noferini, V; Pronko, AG
Algebraic arctic curves in the domain-wall six-vertex model

15) J PHYS A-MATH THEOR volume 44, article no.075401 FEB 18 2011
Cappelli, A; Viola, G

Partition functions of non-Abelian quantum Hall states

16) PHYS REV LETT volume 107, article no.217204 NOV 16 2011
Budrikis, Z; Politi, P; Stamps, RL
Diversity Enabling Equilibration: Disorder and the Ground State in Artificial Spin Ice

17) PHYS REV A volume 84, article no.052316 NOV 15 2011
Campbell et al.
Propagation of nonclassical correlations across a quantum spin chain

18) NEW J PHYS volume 13, article no.123006 DEC 2 2011
Banchi et al.
Long quantum channels for high-quality entanglement transfer

19) PHYS REV LETT volume 106, article no.140501 APR 4 2011
Banchi et al.
Nonperturbative Entangling Gates between Distant Qubits Using Uniform Cold Atom Chains

20) PHYS REV A volume 83, article no.062328 JUN 23 2011
Bayat et al.
Initializing an unmodulated spin chain to operate as a high-quality quantum data bus

21) PHYS REV LETT volume 107, article no.146404 SEP 30 2011
Carrega et al.
Anomalous Charge Tunneling in Fractional Quantum Hall Edge States at a Filling Factor nu=5/2

22) PHYS REV B volume 84, article no.094520 SEP 21 2011
Diamantini, MC; Trugenberger, CA
Topological superconductivity, topological confinement, and the vortex quantum Hall effect

23) J PHYS A-MATH THEOR volume 44, article no.115001 MAR 18 2011
Diamantini, MC; Trugenberger, CA
SU(m) non-Abelian anyons in the Jain hierarchy of quantum Hall states

24) PHYS REV A volume 83, article no.013617 JAN 24 2011
Kormos, M; Mussardo, G; Trombettoni, A
Local correlations in the super-Tonks-Girardeau gas

25) NEW J PHYS volume 13, article no.025023 FEB 23 2011
Burrello, M; Mussardo, G; Wan, X
Topological quantum gate construction by iterative pseudogroup hashing

26) J STAT MECH-THEORY E article no.P01002 JAN 2011
Mussardo, G
Integrability, non-integrability and confinement

27) J PHYS A-MATH THEOR volume 44, article no.032001 JAN 21 2011
Delfino, G; Viti, J
On three-point connectivity in two-dimensional percolation

28) SOFT MATTER volume 7, 1247-1253 2011
Gambassi, A; Dietrich, S
Critical Casimir forces steered by patterned substrates

29) J PHYS A-MATH THEOR volume 44, article no.042001 JAN 28 2011
Ikhlef, Y; Rajabpour, MA
Discrete holomorphic parafermions in the Ashkin-Teller model and SLE

30) PHYS REV E volume 83, article no.021122 FEB 28 2011
Nezhadhaghighi, MG; Rajabpour, MA
Contour lines of the discrete scale-invariant rough surfaces

31) J STAT MECH-THEORY E article no.P02039 FEB 2011
Caselle, M; Lottini, S; Rajabpour, MA
Critical domain walls in the Ashkin-Teller model

32) PHYS REV B volume 83, article no.094530 MAR 31 2011
Biroli et al.
Leggett's bound for amorphous solids

33) MOL PHYS volume 109, 1169-1185 2011
Trondle et al.
Trapping colloids near chemical stripes via critical Casimir forces

34) NUCL PHYS B volume 852, 149-173 NOV 1 2011
Delfino, G; Viti, J
Potts q-color field theory and scaling random cluster model

35) EPL-EUROPHYS LETT volume 95, article no.66007 SEP 2011
Gambassi, A; Calabrese, P
Quantum quenches as classical critical films

36) PHYS REV B volume 84, article no.212404 DEC 15 2011
Foini, L; Cugliandolo, LF; Gambassi, A
Fluctuation-dissipation relations and critical quenches in the transverse field Ising chain

37) PHYS REV B volume 84, article no.094203 SEP 19 2011
Buccheri, F; De Luca, A; Scardicchio, A
Structure of typical states of a disordered Richardson model and many-body localization

38) PHYS REV A volume 84, article no.043625 OCT 17 2011
Burrello, M; Trombettoni, A
Ultracold atoms in U(2) non-Abelian gauge potentials preserving the Landau levels

39) J STAT MECH-THEORY E article no.P10021 OCT 2011
Gori, G; Trombettoni, A
The inverse Ising problem for one-dimensional chains with arbitrary finite-range couplings

40) MOL PHYS volume 109, 3037-3047 2011
Iazzi et al.
Vortex lines distribution in inhomogeneous lattices

41) NUCL PHYS B volume 827, 359-380 MAR 11 2010
Fioravanti, D; Grinza, P; Rossi, M
The generalised scaling function: A note

42) PHYS LETT B volume 684, 52-60 FEB 1 2010
Fioravanti, D; Grinza, P; Rossi, M
On the logarithmic powers of sl(2) SYM(4)

43) PHYS LETT A volume 374, 2101-2105 APR 26 2010
Ercolessi, E; Evangelisti, S; Ravanini, F
Exact entanglement entropy of the XYZ model and its sine-Gordon limit

44) NUCL PHYS B volume 834, 543-561 AUG 1 2010
Bombardelli, D; Fioravanti, D; Tateo, R

TBA and Y-system for planar AdS(4)/CFT(3)

45) LETT MATH PHYS volume 93, 213-228 SEP 2010
Baseilhac, P; Belliard, S
Generalized q-Onsager Algebras and Boundary Affine Toda Field Theories

46) SYMMETRY INTEGR GEOM volume 6, article no.094 2010
Belliard, S; Pakuliak, S; Ragoucy, E
Universal Bethe Ansatz and Scalar Products of Bethe Vectors

47) ADV HIGH ENERGY PHYS article no.614130 2010
Fioravanti, D; Rossi, M
The High Spin Expansion of Twist Sector Dimensions: The Planar N=4 Super Yang-Mills Theory

48) INT J MOD PHYS A volume 25, 3307-3351 JUL 10 2010
Doikou et al.
INTRODUCTION TO QUANTUM INTEGRABILITY

49) NEW J PHYS volume 12, article no.025022 FEB 26 2010 2010
Giuliano et al.
Entanglement in a spin system with inverse square statistical interaction

50) NUCL PHYS B volume 837, 153-185 OCT 1 2010
Giuliano, D; Sodano, P
Competing boundary interactions in a Josephson junction network with an impurity

51) ANN PHYS-NEW YORK volume 325, 465-490 FEB 2010
Cappelli, A; Viola, G; Zemba, GR
Chiral partition functions of quantum Hall droplets

52) J STAT PHYS volume 138, 662-700 MAR 2010
Colomo, F; Pronko, AG
The Arctic Curve of the Domain-Wall Six-Vertex Model

53) J STAT MECH-THEORY E article no.L03002 MAR 2010
Colomo, F; Pronko, AG; Zinn-Justin, P
The arctic curve of the domain wall six-vertex model in its antiferroelectric regime

54) NEW J PHYS volume 12, article no.083046 AUG 24 2010
Apollaro et al.
Manipulating and protecting entanglement by means of spin environments

55) PHYS REV A volume 82, article no.052321 NOV 18 2010
Banchi et al.
Optimal dynamics for quantum-state and entanglement transfer through homogeneous quantum systems

56) SIAM J DISCRETE MATH volume 24, 1558-1571 2010
Colomo, F; Pronko, AG
THE LIMIT SHAPE OF LARGE ALTERNATING SIGN MATRICES

57) PHYS REV LETT volume 105, article no.017201 JUN 28 2010
Budrikis, Z; Politi, P; Stamps, RL
Vertex Dynamics in Finite Two-Dimensional Square Spin Ices

58) NEW J PHYS volume 12, article no.013012 JAN 19 2010
Ferraro et al.
Neutral modes' edge state dynamics through quantum point contacts

59) PHYSICA E volume 42, 580-583 JAN 2010
Ferraro et al.
Multiple-quasiparticle agglomerates at v=2/5

60) CLASSICAL QUANT GRAV volume 27, article no.165018 AUG 21 2010
Blasi et al.
Maxwell-Chern-Simons theory with a boundary

61) PHYS REV B volume 82, article no.085323 AUG 23 2010
Ferraro et al.
Charge tunneling in fractional edge channels

62) PHYS REV A volume 81, article no.043606 APR 2010
Kormos, M; Mussardo, G; Trombettoni, A
One-dimensional Lieb-Liniger Bose gas as nonrelativistic limit of the sinh-Gordon model

63) J PHYS A-MATH THEOR volume 43, article no.152001 APR 16 2010
Delfino, G; Viti, J; Cardy, J
Universal amplitude ratios of two-dimensional percolation from field theory

64) PHYS REV LETT volume 104, article no.160502 APR 23 2010
Burrello et al.
Topological Quantum Hashing with the Icosahedral Group

65) J STAT MECH-THEORY E article no.P05014 MAY 2010
Kormos, M; Mussardo, G; Pozsgay, B
Bethe ansatz matrix elements as non-relativistic limits of form factors of quantum field theory

66) NEW J PHYS volume 12, article no.055015 MAY 28 2010
Fioretto, D; Mussardo, G
Quantum quenches in integrable field theories

67) J PHYS A-MATH THEOR volume 43, article no.285002 JUL 16 2010
Matsuda et al.
Distribution of partition function zeros of the +/- J model on the Bethe lattice

68) PHYS REV B volume 81, article no.134305 APR 1 2010 2010
Sotiriadis, Spyros; Cardy, John
Quantum quench in interacting field theory: A self-consistent approximation

69) PHYS REV A volume 81, article no.033624 MAR 2010
Chiacchiera, S; Macri, T; Trombettoni, A
Dipole oscillations in fermionic mixtures

70) PHYS REV B volume 81, article no.195129 MAY 15 2010
Carrasquilla et al.
Characterization of the Bose-glass phase in low-dimensional lattices

71) PHYS REV B volume 82, article no.144302 OCT 11 2010
Rossini et al.
Long time dynamics following a quench in an integrable quantum spin chain: Local versus nonlocal operators and effective thermal behavior

72) NUCL PHYS B volume 840, 513-533 DEC 1 2010
Delfino, G; Viti, J
Universal properties of Ising clusters and droplets near criticality

73) PHYS REV LETT volume 105, article no.125304 SEP 17 2010
Burrello, M; Trombettoni, A
Non-Abelian Anyons from Degenerate Landau Levels of Ultracold Atoms in Artificial Gauge Potentials

74) J STAT MECH-THEORY E article no.P07013 JUL 2010
Brandino, GP; Konik, RM; Mussardo, G
Energy level distribution of perturbed conformal field theories

75) PHYS REV LETT volume 105, article no.059601 JUL 29 2010
Gambassi, A; Dietrich, S
Colloidal Aggregation and Critical Casimir Forces

76) J CHEM PHYS volume 133, article no.074702 AUG 21 2010
Trondle et al.
Critical Casimir effect for colloids close to chemically patterned substrates

77) J STAT MECH-THEORY E article no.P12029 DEC 2010
Gambassi, A; Paul, R; Schehr, G
Dynamic crossover in the persistence probability of manifolds at criticality

78) PHYS REV A volume 81, article no.052324 MAY 2010
De Pasquale et al.
Phase transitions and metastability in the distribution of the bipartite entanglement of a large quantum system

79) JOURNAL OF HIGH ENERGY PHYSICS article no.069 SEP 2010
Nandori et al.
Phase structure and compactness

80) NEW J PHYS volume 12, article no.095012 SEP 30 2010
Fagnocchi et al.
Relativistic Bose-Einstein condensates: a new system for analogue models of gravity

81) EPL-EUROPHYS LETT volume 92, article no.50003 DEC 2010
Lepori, L; Mussardo, G; Trombettoni, A
(3+1) massive Dirac fermions with ultracold atoms in frustrated cubic optical lattices

82) J STAT MECH-THEORY E article no.L05004 MAY 2010
Gliozzi, F; Rajabpour, MA
Conformal curves in the Potts model: numerical calculation

83) J STAT MECH-THEORY E article no.P06027 JUN 2010
Lottini, S; Rajabpour, MA
Ashkin-Teller model on the iso-radial graphs

84) PHYS REV E volume 82, article no.061101 DEC 1 2010
Nezhadhaghighi, MG; Rajabpour, MA
Discrete scale invariance and stochastic Loewner evolution

Talks

1) "The beauty of integrability" Natal (Brasile) 2012-07-15-2012-07-29
Delfino Gesualdo
Universal results for critical and off-critical percolation in two dimensions

2) "Quantum Integrability and its Applications" Seogwipo, Jeju Island (Corea del Sud) 2012-07-09-2012-07-13
Delfino Gesualdo
Phase separation in two dimensions from field theory

3) "Focus Programme: "Finite size technology in low-dimensional quantum systems (VI)"" Seoul (Sud Corea) 2012-06-24-2012-07-09
Ravanini Francesco
Unusual singular behaviour of the Entanglement Entropy in 1D systems

4) "Focus Programme: "Finite size technology in low-dimensional quantum systems (VI)"" Seoul (Sud Corea) 2012-06-24-2012-07-09
Ravanini Francesco
Unusual singular behaviour of the Entanglement Entropy in 1D systems

5) "Finite-size Technology in Low-Dimensional Quantum Systems" Seoul (Corea del Sud) 2012-06-24-2012-07-09
Delfino Gesualdo
Universal results for critical and off-critical percolation

6) "XVII CONVEGNO NAZIONALE DI FISICA STATISTICA E DEI SISTEMI COMPLESSI" Parma () 2012-06-20-2012-06-22
Politi Paolo
Ground state search in artificial spin-ice

7) "New quantum states of matter in and out of equilibrium" Ggi, Arcetri, Florence (Italy) 2012-05-21-2012-05-25
Cappelli Andrea
Conformal field theory of composite fermions in the quantum Hall effect

8) "New quantum states of matter in and out of equilibrium, Galileo Galilei Institute Workshop" Firenze (Italy) 2012-05-10-2012-06-01
Trombettoni Andrea
Quantum simulations with ultracold atoms

9) "Advances in Percolation and Related Topics" Ann Arbor (USA) 2012-05-09-2012-05-12
Delfino Gesualdo
Universal results for critical and off-critical percolation in two dimensions

10) "Workshop New quantum states of matter in and out of equilibrium" Ggi - Firenze (Italia) 2012-04-29-2012-05-19
Gambassi Andrea
Dynamic correlations, fluctuation-dissipation relations and effective temperatures after a quantum quench (of the Ising chain).

11) "Programme “Disordered Quantum Systems”, Institute Henri Poincare"" Paris (France) 2012-04-23-2012-07-20
Trombettoni Andrea
Quantum simulations with ultracold atoms

12) "Quantum State of Matter in and out of equilibrium" Firenze Galileo Galilei Institute (Italy) 2012-04-10-2012-06-01
Mussardo Giuseppe
Quantum Quenches in Quantum Field Theory

13) "Invited talk at the RWTH" Aachen (Germania) 2012-02-17-2012-02-17
Ferraro Dario

Anomalous charge tunnelling in fractional quantum Hall edge states

14) "VIII Workshop of the GISC – Grupo Interdisciplinar de Sistemas Complejos" Madrid (Spagna) 2012-02-03-2012-02-03
Gambassi Andrea
The universal force of critical fluctuations: Casimir, wetting, colloids and all that.

15) "Invited talk at the Ecole Normale Superieur" Lyon (Francia) 2012-02-01-2012-02-01
Ferraro Dario
Anomalous charge tunnelling in fractional quantum Hall edge states

16) "Lattice Models and Combinatorics" Berkeley (USA) 2012-01-16-2012-01-20
Colomo Filippo
Arctic curves of the six-vertex model

17) "XV Workshop on Statistical Mechanics and Nonperturbative Field Theory" Bari (Italia) 2011-09-21-2011-09-23
Delfino Gesualdo
Universal results for two-dimensional percolation near criticality

18) "WORKSHOP on ENTANGLEMENT IN SOLID STATE SYSTEMS (WESSS)" Lecce (Italia) 2011-09-20-2011-09-22
Cuccoli Alessandro
Long-distance high-quality entanglement transfer by unmodulated spin chains

19) "WORKSHOP on ENTANGLEMENT IN SOLID STATE SYSTEMS (WESSS)" Lecce (Italia) 2011-09-20-2011-09-22
Cuccoli Alessandro
Long-distance high-quality entanglement transfer by unmodulated spin chains

20) "8th Bologna Workshop on: CONFORMAL FIELD THEORIES AND INTEGRABLE MODELS" Bologna (Italia) 2011-09-12-2011-09-15
Colomo Filippo
Arctic curves of the six-vertex model

21) "Workshop on "Quantum Field Theory Aspects of Condensed Matter Physics"" Frascati (Italia) 2011-09-06-2011-09-09
Magnoli Nicodemo
BF theory for 2+1 topological states of matter

22) "Workshop on "Quantum Information and Condensed Matter Physics"" Maynooth (Irlanda) 2011-09-05-2011-09-09
Ferraro Dario
Anomalous charge tunnelling in fractional quantum Hall edge states

23) "Conference on "Frontiers of Quantum and Mesoscopic Thermodynamics"" Praga (Repubblica ceca) 2011-07-25-2011-07-30
Magnoli Nicodemo
Spectral noise in composite fractional Quantum Hall states

24) "XX International Laser Physics Workshop" Sarajevo (Bosnia and Herzegovina) 2011-07-11-2011-07-15
Trombettoni Andrea
"Non-abelian anyons with ultracold atoms in artificial gauge potentials"

25) "International conference on statistical physics" Larnaca (Cyprus) 2011-07-11-2011-07-15
Delfino Gesualdo
New universal results for two-dimensional percolation. Connectivities and Amplitude Ratios

26) "Workshop and School on Topological Aspects of Condensed Matter Physics" Ictp, Trieste () 2011-06-27-2011-07-08
Cappelli Andrea
Partition functions of non-Abelian Hall states

27) "Workshop and School on Topological Aspects of Condensed Matter Physics" Trieste (Italia) 2011-06-27-2011-07-08
Ferraro Dario
BF theory for 2+1 topological states of matter

28) ""Non-abelian anyons with ultracold atoms in artificial gauge potentials" - XVI Convegno Nazionale di Fisica Statistica e dei Sistemi Complessi, Parma" Parma (Italy) 2011-06-22-2011-06-24
Trombettoni Andrea
"Non-abelian anyons with ultracold atoms in artificial gauge potentials"

29) "Integrability and its breaking in strongly correlated and disordered systems" Trieste (Italy) 2011-05-23-2011-05-27
Delfino Gesualdo
Magnetic and percolative Ising universality classes. Results from integrable field theory

30) "Conformal Field Theories and Applications" Bogota (Colombia) 2011-05-16-2011-05-21
Mussardo Giuseppe
Five Lectures on Statistical Field Theories

31) "Autumn School of Off-equilibrium Physics" Buenos Aires (Argentina) 2011-05-01-2011-05-15
Mussardo Giuseppe
Quantum Quenches in Quantum Field Theories

32) "Meco36: 36rd Conference of the Middle European Cooperation in Statistical Physics" Lviv (Ukraine) 2011-04-05-2011-04-07
Gambassi Andrea
Steering the Casimir effect: lateral forces, levitation, and dynamics

33) "Topical School of the College Doctoral - Doktorandenkollegien “Statistical Physics of Complex Systems”: Modern Applications of Conformal Invariance" Nancy (France) 2011-03-21-2011-03-23
Gambassi Andrea
Field-theory and non-equilibrium critical phenomena (a primer)

34) "Workshop on Classical and Quantum Integrable Systems (CQIS-2011)" Protvino (moscow Region) (Russia) 2011-01-24-2011-01-27
Colomo Filippo
On the evaluation of correlation functions in the domain-wall six-vertex model

35) "Two Days in Quantum Field Theory" Tor Vergata/laboratori Nazionali Frascati (Italia) 2011-01-11-2011-01-13
Fioravanti Davide
Integrability and Conformal Field Theory: the 4D case AdS5/CFT4

36) "From Field Theory to Quantum Information and Quantum Devices" - QID 2011" Perugia () 2011-01-07-2011-01-08
Cappelli Andrea
Non-Abelian anyons in the quantum Hall effect

37) "Workshop "Fluctuations and Casimir Forces"" Tenerife (Spain) 2010-11-03-2010-11-06
Gambassi Andrea
Steering the Casimir effect: lateral forces, levitation, and dynamics

38) "Optimal Dynamics for Quantum-State and Entanglement Transfer through Homogeneous Quantum Systems" Anacapri (na) (italia) 2010-10-05-2010-10-08
Verrucchi Paola
Emerging Trends in Advanced Correlated Materials

39) "Conference on Quantum Matter in Low Dimensions: Opportunities and Challenges" Nordita Stoccolma (Svezia) 2010-09-06-2010-09-10
Cappelli Andrea
Partition Functions of non-Abelian Quantum Hall States

40) "Nordita Workshop "Quantum Matter in Low Dimensions: Opportunities and Challenges"" Stockholm (Sweden) 2010-08-30-2010-09-24
Delfino Gesualdo
Universal results for two-dimensional percolation from quantum field theory

41) "Nordita Workshop on "Quantum Matter in Low Dimensions: Opportunities and Challenges"" Stoccolma (Svezia) 2010-08-30-2010-09-24
Franchini Fabio
Unusual singular behavior of the entanglement entropy in one dimension

42) "StatPhys24" Cairns (Australia) 2010-07-19-2010-07-23
Mussardo Giuseppe
Breaking integrability in statistical models

43) "Exactly Solvable Models in Statistical Physics" Brisbane (Australia) 2010-07-14-2010-07-17
Cappelli Andrea
Non-Abelian anyons in the quantum Hall effect

44) "Understanding frustrated interactions using nanotechnology" Leeds (Inghilterra) 2010-07-13-2010-07-14
Politi Paolo
Disorder effects in the dynamics of artificial spin ices

45) "Workshop on Emergence of New States of Matter in Magnetic Systems and Beyond" Trieste (Italy) 2010-07-05-2010-07-09
Trombettoni Andrea
Title of the talk: Non-abelian anyons with ultracold atoms in artificial gauge potentials

46) "Finite size technology in low-dimensional quantum systems" Benasque (Spain) 2010-06-27-2010-07-17
Delfino Gesualdo
Universal properties of Ising clusters and droplets near criticality

47) "Lectures on Conformal Field Theories" Benasque (Spain) 2010-06-20-2010-07-03
Mussardo Giuseppe
Lectures on Conformal Field Theories

48) "RAQIS'10: Recent Advances in Quantum Integrable Systems" Annecy-le-vieux (France) 2010-06-15-2010-06-18
Ravanini Francesco
Sine-Gordon TBA and NLIE in Quantum Nonlinear Optics

49) "Quantum Engineering of States and Devices: Theory and Experiments" Obergurgl (austria) () 2010-06-05-2010-06-10
Giuliano Domenico
Local pairing of Cooper Pairs in Josephson junction networks

50) "Quantum engineering of states and devices: theory and experiments" Obergurgl

(austria) (Austria) 2010-06-05-2010-06-10
Mussardo Giuseppe
Non-abelian anyons and topological quantum computation

51) "8th AIMS Conference on Dynamical Systems, Differential Equations and Applications" Dresden (Germany) 2010-05-25-2010-05-25
Trombettoni Andrea
Josephson devices with ultracold atoms

52) ""Nanoelectronics- Concept, Theory and Modelling"" Brema (Germania) 2010-05-17-2010-05-21
Ferraro Dario
"Multiple-quasiparticle tunnelling between edge states in the FQHE"

53) ""“Nanoelectronics - Concepts, Theory and Modeling”" Bremen (Germania) 2010-05-17-2010-05-21
Ferraro Dario
“Multiple-quasiparticle tunnelling between edge states in the FQHE”

54) "Nanoelectronics- concept, theory and modelling." Bremen (Germania) 2010-05-17-2010-05-21
Ferraro Dario
Multiple quasiparticle tunneling between edge states in the FQHE

55) "UK Meeting on Conformal and Integrable Field Theories" Canterbury (United Kingdom) 2010-04-15-2010-04-19
Delfino Gesualdo
Field Theory of Ising Percolating Clusters

56) "MECO 35 35th Conference of the Middle European Cooperation in Statistical Physics" Pont-à-mousson (Francia) 2010-03-15-2010-03-19
Cuccoli Alessandro
Protecting And Controlling Entanglement Between Two Qubits By Properly Designed Spin Environment

57) "Physics in the plane: From condensed matter to string theory" Les Houches (Francia) 2010-02-28-2010-03-05
Ravanini Francesco
Links between TBA and NLIE: exact tools for Finite Size Effects

58) "" () 2010-01-01-2010-01-01
Canovi Elena

Theses

1) Univ. Di Firenze Prof. Paola Verrucchi, 2012-12-31
Calvani Dario
OPEN QUANTUM SYSTEMS: PARAMETRIC REPRESENTATION, ENTANGLEMENT AND BERRY’S PHASE

2) Sissa - Trieste Prof. Giuseppe Mussardo, 2012-09-29
Brandino Giuseppe Piero
Energy spectrum in deformed conformal field theories

3) Univ. Di Firenze Prof. Paola Verrucchi, 2012-04-27
Bonzio Stefano
Looking inside quantum algorithms

4) Univ. Di Genova Prof. Nicodemo Magnoli, 2012-03-22
Caruso Giacomo
Teorie topologiche 2+1 dimensionali con bordo in fisica della materia condensata

5) Univ. Di Firenze Prof. Alessandro Cuccoli, 2012-03-08
Banchi Leonardo
Quantum information transmission in quantum many-body systems

6) Univ. Di Firenze Prof. Paola Verrucchi, 2011-12-31
Banchi Leonardo
Quantum Information Transmission in Quantum Many-Body Systems

7) Univ. Di Bologna Prof. Francesco Ravanini, 2011-12-16
Gozzi Valentina
Applications of Conformal Field Theory to Hawking Evaporation of Black Holes

8) Univ. Di Firenze Prof. Paolo Politi, 2011-12-13
Biagi Sofia
Coarsening e dinamica di fase nella crescita instabile di una superficie

9) Sissa - Trieste Prof. Andrea Trombettoni, 2011-10-26
Macri' Tommaso
Dynamics of cold Fermi gases in multiwell potentials

10) Sissa - Trieste Prof. Andrea Trombettoni, 2011-10-26
Gori Giacomo
Long-range models on lattices: application to Ising and dipolar systems

11) Sissa - Trieste Prof. Giuseppe Mussardo, 2011-09-30
Fioretto Davide
Quantum Quenches in Integrable Quantum Field Theories

12) Sissa - Trieste Prof. Giuseppe Mussardo, 2011-09-29
Burrello Michele
Topological Quantum Computation

13) Sissa - Trieste Prof. Andrea Trombettoni, 2011-09-26
Burrello Michele
Topological Quantum Computation, Anyons and Non-Abelian Gauge Potentials

14) Univ. Di Bologna Prof. Francesco Ravanini, 2011-09-23
Pesolillo Daniele
La gravita' come forza entropica e l'espansione accelerata dell'Universo

15) Univ. Di Genova Prof. Nicodemo Magnoli, 2011-04-07
Ferraro Dario
Neutral modes dynamics in the composite edge states of the fractional Quantum Hall effect

16) Univ. Di Firenze Prof. Andrea Cappelli, 2011-03-24
Viola Giovanni
Partition Function of non-Abelian Quantum Hall States

17) Univ. Di Bologna Prof. Francesco Ravanini, 2011-03-11
Nguyen Trong-nhan
Il paradosso EPR e il teorema di Bell

18) Univ. Di Bologna Prof. Francesco Ravanini, 2011-03-11

Gibilaro Giuseppe
Moti accelerati in relatività ristretta

19) Sissa - Trieste Prof. Giuseppe Mussardo, 2010-10-18
Lepori Luca
QFT Methods in Low Dimensions and in Cold Atoms

20) Univ. Della Calabria Prof. Domenico Giuliano, 2010-10-06
Nava Andrea
Meccanismo di Kibble-Zurek: Difetti nei Cristalli Liquidi

21) Sissa - Trieste Prof. Andrea Trombettoni, 2010-09-27
Lepori Luca
Quantum Field Theory Emerging Models in Condensed Matter Systems

22) Univ. Di Firenze Prof. Paolo Politi, 2010-07-27
Salvestroni Michele
L'instabilità convettiva di Rayleigh-Bénard in un fluido

23) Univ. Della Calabria Prof. Domenico Giuliano, 2010-07-21
Brunetti Aldo
Stati legati e funzioni di correlazione in teorie bosoniche su grafi a stella

24) Univ. Di Bologna Prof. Francesco Ravanini, 2010-03-19
Guerrero Becerra Karina Andrea
Applications of Sine-Gordon theory in Non-Linear Optics

25) Univ. Di Bologna Prof. Francesco Ravanini, 2010-03-19
Piscaglia Simone
Rivisitazione del calcolo dell'energia libera per il sigma-model non lineare O(3) in due dimensioni

Other publications

Bologna

D. Fioravanti and M. Rossi, ``TBA-like equations and Casimir effect in (non-)perturbative AdS/CFT", arXiv:1112.5668

Cosenza

M. Borrelli, C. Sabin, G. Adesso, F. Plastina, S. Maniscalco, "Dynamics of atom-atom correlations in the Fermi problem", submitted to New Journal of Physics

S. Lorenzo, F. Plastina, M. Paternostro, "Controlling spin dynamics through a Markovianity knob", submitted to Phys. Rev.

T. J. G. Apollaro, S. Lorenzo, F. Plastina, "Transport of Quantum Correlations across a spin chain", submitted to Int. J. of Mod. Phys. B

Firenze

A. Cappelli, E. Castellani, F. Colomo, P. Di Vecchia, "The birth of string theory", Cambridge Univ. Press (2012), Cambridge

A.Cappelli, "Composite Fermion Wavefunctions Derived by Conformal Field Theory",arXiv:1207.0094

Genova

A. Amoretti, A. Blasi, N. Maggiore, N. Magnoli, "3D Dynamics of 4D Topological BF Theory With Boundary", arXiv:1205.6156

A. Braggio, D. Ferraro, M. Carrega, N. Magnoli, M. Sassetti, "Environmental induced renormalization effects in quantum Hall edge states", arXiv:1203.1906

Perugia

M. C. Diamantini, P. Sodano, C.A. Trugenberger, "From Topological Insulators to Superconductors and Confinement", New J. Phys. 14, 063013, (2012).

A. Bayat, S. Bose, H. Johannesson, P. Sodano, "Entanglement Probe of the Two Impurity Kondo Physics in a Spin Chain", arXiv:1201.6668

M. C. Diamantini, C. A. Trugenberger, "Charge Spin Separation in 3D", arXiv:1112.3281

M. C. Diamantini, C. A. Trugenberger, "Minimal Models for a Superconductor-Insulator Conformal Quantum Phase Transition", arxiv:1205.2890

Trieste

F. Mancarella, A. Trombettoni, G. Mussardo,"Statistical Mechanics of an Ideal Gas of Non-Abelian Anyons", arXiv:1204.6656

S. Sotiriadis, D. Fioretto, G. Mussardo,"Zamolodchikov-Faddeev Algebra and Quantum Quenches in Integrable Field Theories", J.Stat.Mech. 1202 (2012) P02017

G. P. Brandino, A. De Luca, R. M. Konik, G. Mussardo,"Quench Dynamics in Randomly Generated Extended Quantum Models", Phys. Rev. B 85, 214435 (2012)

A. Gambassi, A. Silva, "Statistics of the Work in Quantum Quenches, Universality and the Critical Casimir Effect", arXiv:1106.2671

A. De Luca, A. Scardicchio, "Many body localization, ergodicity breaking and the distribution of the wave-function coefficients", arXiv:1206.2342

A. Andreanov, A. Scardicchio, "Random perfect lattices and the sphere packing problem", arXiv:1202.5673

C.R. Laumann, R. Moessner, A. Scardicchio, S.L. Sondhi, "The quantum adiabatic algorithm and scaling of gaps at first order quantum phase transitions",
arXiv:1202.3646

P. Calabrese, J. L. Cardy, E. Tonni, "Entanglement negativity in quantum field theory", arXiv:1206.3092

M. Iazzi, S. Fantoni, A. Trombettoni, "Anisotropic Ginzburg-Landau and Lawrence-Doniach Models for Layered Ultracold Fermi Gases", arXiv:1112.6429

G. Delfino, J. Viti, "Phase separation and interface structure in two dimensions from field theory", arXiv:1206.4959

F. Buccheri, "Generating function for the sine-Gordon correlators in finite volume from the inhomogeneous XXZ chain", e-print arXiv:1206.1528

P. Smacchia, L. Amico, P. Facchi, R. Fazio, G. Florio, S. Pascazio, V. Vedral, "Statistical mechanics of the Cluster-Ising model",

J. Marino, A. Silva, "Relaxation, pre-thermalization and diffusion in a noisy Quantum Ising Chain", arXiv:1203.2108

A. De Luca, F. Franchini, "Approaching critical points through entanglement: why take one, when you can take them all?", arXiv:1205.6426

X. Yu, M. Mueller, "Mean field theory of superglasses", arXiv:1111.5956

Financial requests

Site	Missioni interne	Missioni estere	Inviti ospiti stranieri	Tot
Bologna	2.00	6.00		8.00
Cosenza	3.00	6.00		9.00
Firenze	3.00	8.00		11.00
Genova	1.00	3.00		4.00
Perugia	1.00	3.00		4.00
Trieste	5.00	17.00		22.00
Totals	**15.00**	**43.00**		**58.00**