11 September 2017

Young

Florence

BOOK OF ABSTRACTS

Satellite event of the 10th Italian conference on Quantum Information Science

The Young Italian Quantum Information Science conference, as a satellite event of the IQIS2017 conference, is a one-day special event dedicated to the young scientists. The aim of the conference is to provide opportunities of professional development to all young partecipants, who will have the opportunity to develop skills in effective scientific communication, as well as a network of colleagues in the field, and to join lab tours at LENS and at Physics Department.

Chair Organizer

Filippo Caruso - iqis2017@gmail.com

Local Organising Committee

Maja Colautti
Hoang-Van Do
Cosimo Lovecchio
Stefano Gherardini

Venue

The Young IQIS2017 will take place on Monday September 11th in the Physics Department of Florence University, via Sansone 1, Sesto Fiorentino (see Travel Information).

Contents

Schedule

YOUNG IQIS2017 FIRENZE		
TIME	MONDAY	
9:00 AM	YOUNG IQIS2017 WELCOME	
9:45 AM	Quantum Games	
10:00 AM		
10:15 AM		
10:30 AM		
10:45 AM		
11:00 AM		
11:15 AM		
11:30 AM		
12:00 PM	Tatiana Mihaescu	Matteo Rossi
12:15 PM	Matteo Rosati	Matteo Schiavon
12:30 PM	Emanuele Roccia	Matteo Caiaffa
12:45 PM	Alessandro Farsi	Ian Ward
1:00 PM	LUNCH	
2:45 PM	Giacomo De Palma	Pietro Liuzzo Scorpo
3:00 PM	Luca Mazzarella	Francesco Tacchino
3:15 PM	Joelle Boutari	Luca Innocenti
3:30 PM	Giacomo Sorelli	Angelo Piga
3:45 PM	Felix Binder	
4:00 PM	Coffee-break	
4:30 PM	LAB TOUR	

Available networks:
-eduroam
-FirenzeWifi (free access, 500Mb max)

Program

9:00 AM
Room A

YOUNG IQIS 2017 WELCOME

9:45 AM
Room A

Quantum Games

Gamifying quantum research: harnessing human intuition

Jacob Sherson
University of Aarhus, Aarhus, Denmark
sherson@phys.au.dk

In the emerging field of citizen science ordinary citizens have already contributed to research in as diverse fields as astronomy, protein and RNA folding, and neuron mapping by playing online games. In the www.scienceathome.org project, we have extended this democratized research to the realm of quantum physics by gamifying a class of challenges related to optimization of gate operations in a quantum computer. The games have been played by more than 200,000 players and perhaps surprisingly we observe that a large fraction of the players outperform state-of-the-art optimization algorithms. Surprisingly, player trajectories bunched into discrete solution strategies (clans) yielding clear, distinct physical insight.

In recent work, we address fundamental questions concerning such strategies. In science, strategies are formulated based on observations, calculations, or physical insight. For any given physical process, often several distinct strategies are identified. Are these truly distinct or simply low dimensional representations of a high dimensional continuum of solutions? In the latter case, the human need for identifying patterns may lead us to stop searches too early. We demonstrate that this is indeed the case in a theoretical study of single atom transport in an optical tweezer. We employ this insight into the topological structure of the optimization problem to develop a novel global entirely deterministic search methodology yielding dramatically improved results. We demonstrate that this "bridging" of conventional solution strategies can also be applied to the case of experimental closed-loop optimization of the production of Bose-Einstein condensates. Here, we find improved solutions using two distinct implementations of a novel remote interface protocol. First, a team of theoretical optimal control researchers employ a Remote version of their dCRAB optimization algorithm (RedCRAB), and secondly a gamified “democratic-lab” interface allowed 600 citizen scientists from around the world to participate in the optimization. In both cases solutions improving previous best performance were found.

With a palette of additional games within cognitive science, behavioral economics, and corporate innovation we investigate the general features of individual and collaborative problem solving to shed additional light on the process of human intuition and innovation and potentially develop novel models of artificial intelligence.

Gaussian quantum steering of two bosonic modes in a squeezed thermal environment

12:00 PM
Room A

Tatiana Mihaescu

Horia Hulubei National Institute of Physics and Nuclear Engineering Department of Theoretical Physics, Bucharest - Magurele, Romania

mihaescu92tatiana@gmail.com

Einstein-Podolsky-Rosen steerability of quantum states is a property that is different from entanglement and Bell nonlocality. We describe the time evolution of a recently introduced measure that quantifies steerability for arbitrary bipartite Gaussian states in a system consisting of two bosonic modes embedded in a common squeezed thermal environment.
We work in the framework of the theory of open systems. If the initial state of the subsystem is taken of Gaussian form, then the evolution under completely positive quantum dynamical semigroups assures the preservation in time of the Gaussian form of the states.
It was shown that the thermal noise and dissipation introduced by the thermal environment destroy the steerability between the two bosonic modes. In the case of the squeezed thermal bath we show the dependence of the Gaussian steering on the squeezing parameters of the bath and of the initial state of the system. A comparison with other quantum correlations for the same system shows that, unlike Gaussian quantum discord, which is decreasing asymptotically in time, the Gaussian quantum steerability suffers a sudden death behaviour, like quantum entanglement.

All-optical quantum simulator of qubit noisy channels

12:00 PM
Room B

Matteo Rossi
Università degli Studi di Milano, Milano, Italy
matteo.rossi@unimi.it

A quantum simulator is a quantum system where the initial preparation and the subsequent time evolution may be controlled and monitored. The inherent parallel structure of quantum simulators makes them suitable to solve problems that are intractable on conventional supercomputers.
In this work, we suggest and implement an all-optical quantum simulator for single-qubit noisy channels originating from the interaction with a fluctuating field. It employs the polarization degree of freedom of a single photon and exploits its spectral components to average over the realizations of the stochastic dynamics. To demonstrate the operation of our apparatus, we run the simulation of two different single-qubit dephasing channels, arising from the interaction of the quantum system with an external fluctuating (stochastic) field. These channels correspond to exact effective models for the interaction of qubits with complex environments and are found in a variety of physical implementations, such as solid-state, superconducting qubits, and magnetic systems.

S. Cialdi, M. A. C. Rossi, C. Benedetti, B. Vacchini, D. Tamascelli, S. Olivares, and M. G. A. Paris, Appl. Phys. Lett. 110, 081107 (2017)

Optimal quantum state discrimination via nested binary measurements

12:15 PM
Room A

Matteo Rosati
NEST Scuola Normale Superiore and Istituto Nanoscienze-CNR, Pisa, Italy
matt.rosati@gmail.com

A method to compute the optimal success probability of discrimination of N arbitrary quantum states is presented, based on the decomposition of any N-outcome measurement into sequences of nested two-outcome ones. In this way the optimization of the measurement operators can be carried out in successive steps, optimizing first the binary measurements at the deepest nesting level and then moving on to those at higher levels. We obtain an analytical expression for the maximum success probability after the first optimization step and examine its form for the specific case of N = 3,4 states of a qubit. In this case, at variance with previous proposals, we are able to provide a compact expression for the success probability of any set of states, whose numerical optimization is straightforward; the results thus obtained highlight some lesser-known features of the discrimination problem.

DOI: 10.1103/PhysRevA.95.042307

Experimental realization of equiangular three-state quantum key distribution

12:15 PM
Room B

Matteo Schiavon
University of Padova, Padova, Italy
matteoschiav@yahoo.it

The security of quantum-key distribution is based on the use of non-orthogonal states for the encoding of information, such as in the BB84, which uses four states in two non-orthogonal bases, and the B92, using just two non-orthogonal states. While the former is secure for a bit error rate up to 11%, the latter has a security threshold dependent on channel losses. This can be solved by adding a third state, as in the protocol introduced in 2000 by Phoenix-Barnett-Chefles (PBC00) [1], which is secure for a bit error rate up to 9.81% [2]. This configuration also allows a direct estimation of the error from the number of inconclusive event, as proposed by Renes in 2004 (R04) [3].
We have implemented the R04 protocol by using a source of polarization-entangled photons based on a Sagnac interferometer and two identical POVMs for Alice and Bob, built with passive optics in a linear scheme [4]. With this setup, we obtain an asymptotic secure key rate higher than 10 kbit/s and a mean QBER of 1.6% for at least 2 hours of continuous acquisition. We then extend a recent study of the finite key security of the PBC00 [5] to the R04, evaluating the secure key rate for both collective and general attacks.

[1] S. Phoenix, et al., J. Mod. Opt 47, 507 (2000)
[2] J.-C. Boileau et al., PRL 94, 040503 (2005)
[3] J. M. Renes, PRA 70, 052314 (2004)
[4] M. Schiavon, et al., Scientific Reports 6, 30089 (2016)
[5] M. Mafu, et al., PRA 90, 032308 (2014)

Entangling measurements for multiparameter estimation with two qubits

12:30 PM
Room A

Emanuele Roccia
Università degli Studi Roma Tre, Rome, Italy
emanuele.roccia@uniroma3.it

Careful tailoring of the quantum state of probes offers the capability of investigating matter at unprecedented precisions. Rarely however the interaction with the sample is fully encompassed by a single parameter thus the information contained in the probe needs to be partitioned on multiple parameters. In this experimental work we explore the extension of quantum metrology methods addressed at joint-estimation of multi parameters (M. Szczykulska et al Adv. Phys. X 1 621-639 (2016)). This task is not a mere extension of single-parameter techniques (V. Giovannetti et al L. Quantum metrology Phys. Rev. Lett. 96 010401 (2006)) instead it requires an approach addressing specific instances. These are nevertheless informative on general aspects and considerations. Here we perform entangling measurements on two photons for two parameter estimations. We show that this strategy offers an advantage with respect the use of individual measurements when the two parameters under consideration are a phase and its diffusion. However the same doesn't occur when two different phases are measured. We trace the origin of this asymmetry in consideration of the single photon scenario.

Channel discrimination power of bipartite quantum states

12:30 PM
Room B

Matteo Caiaffa
SUPA and Department of Physic University of Strathclyde, Glasgow, United Kingdom
matteocaiaffa@gmail.com

We quantify the usefulness of a bipartite quantum state in the ancilla-assisted channel discrimination of arbitrary quantum channels formally defining a worst case-scenario channel discrimination power for bipartite quantum states. We show that such a quantifier is deeply connected with the operator Schmidt decomposition of the state. We compute the channel discrimination power exactly for pure states and provide upper and lower bounds for general mixed states. We show that highly entangled states can outperform any state that passes the realignment criterion for separability. Furthermore while also unentangled states can be used in ancilla-assisted channel discrimination we show that the channel discrimination power of a state is bounded by its quantum discord.

Interference between different colors in single photons and photon pairs

12:45 PM
Room A

Alessandro Farsi
Columbia University, New York City, Italy
af2886@columbia.edu

Optical frequency translation (FT), originally developed to fully shift the color of a light field [1], provides a tunable coherent coupling between different frequencies, similar to the action of a beamsplitter on spatial modes [2]. Using an implementation of FT based on four-wave mixing Bragg Scattering (FWM-BS) [3], a parametric nonlinear process, we demonstrate this same coherency, also in quantum photon states.
In our first experiment, a single photon is placed in a bi-color superposition by a FWM-BS interaction set to 50% efficiency. After free propagation, it undergoes a second 50% efficiency interaction: first order interference is observed, with fringes that depend on temporal separation between the two stages, in an optical analogue of a Ramsey interferometer [4].
In the second experiment, a pair of non-degenerate energy-correlated photons is mixed together via FWM-BS. Measurement of the coincidences shows the characteristic dip of Hong-Ou-Mandel interference when their energy separation matches

the FT shift.
FT provides a tool to manipulate the relatively unexplored high-dimensional frequency space, with the practical application of scaling-up linear optical quantum devices to 100s of modes.

[1] Kumar, Optics Letters 15 (1990),
[2] Raymer et al , Optics Communications 283, (2010),
[3] McKinstrie et al. Optics Express 13, 9131 (2005),
[4] Clemmen, et al. arXiv:1601.01105 (2016).

Parameter Learning and Model Selection for Robust Control of Quantum Devices

12:45 PM
Room B

Ian Ward
Cardiff University, Cardiff, United Kingdom
WardIA@cardiff.ac.uk

Optimal quantum control provides methods to steer the dynamics of a quantum device, enabling to efficiently realise quantum operations. This requires a precise model of the quantum system to be controlled to capture the relevant dynamics under uncertainties from fabrication, in the control fields, environmental noise, etc. Jointly with quantum error correction this holds the promise to achieve robust and scalable devices. We present an approach to not only identify device parameters, but also select the most suitable model from a range of user-defined, parameterised control models based on single-shot or ensemble measurements. Specific examples include controlling information flow in spin-1/2 networks for quantum routing and simulation towards computation.
A naïve Bayesian model represents the probability that a model with specific parameters explains the measurements. The probability distribution is represented by a fixed number of sample points. Their probabilities are updated as measurements are acquired and their position adjusted to track the emerging maximum likelihood parameter vector. Especially for higher-dimensional parameter spaces a large number of samples is required. We alleviate this by converting the nD sampling problem to a 1D problem via a space-filling curve. To select a model, the probability distribution is extended across multiple models, with a space-filling curve representing the parameter space for each model, to track the maximum across all models.

1:00 PM

LUNCH

Gaussian optimizers in quantum information

2:45 PM
Room A

Giacomo De Palma
QMATH Department of Mathematical Sciences University of Copenhagen, Copenhagen, Denmark
giacomo.depalma@math.ku.dk

We prove the longstanding conjecture stating that Gaussian input states minimize the output von Neumann entropy of any one-mode quantum Gaussian channel among all the input states with a given entropy. This conjecture was open since 2008. Quantum Gaussian channels model the propagation of electromagnetic signals in the quantum regime. Our result is crucial to determine the maximum communication rates for the noiseless Gaussian amplifier in two scenarios. The first is the triple trade-off coding, i.e. the simultaneous transmission of public and private information and generation of a shared secret key. The second is broadcast communication, i.e. communication to two receivers. Moreover, our result extends to the quantum regime the Entropy Power Inequality that plays a key role in classical information theory. Our proof exploits a completely new technique based on majorization theory and on the determination of the $p \to q$ norms of quantum Gaussian channels. This technique can be applied to any quantum channel.

Based on:
[1] GdP, Dario Trevisan, Vittorio Giovannetti, IEEE Trans. Inf. Theory 62, 2895 (2016)
[2] IEEE Trans. Inf. Theory 63, 728 (2017)
[3] arXiv:1610.09967
[4] arXiv:1610.09970, to appear in Phys. Rev. Lett.

Optimal teleportation of Gaussian coherent states with finite-energy resources

2:45 PM
Room B

Pietro Liuzzo Scorpo
University of Nottingham, Nottingham, United Kingdom
pmxpl2@nottingham.ac.uk

In this work we solve the general problem of finding the best protocol to teleport an ensemble of coherent states of light given a certain amount of entanglement available as a resource by an optimisation within Gaussian quantum channels and we provide practical schemes relying on nonsymmetric twin beams that attain the maximal fidelity for the given entanglement. The schemes we propose can be readily implemented experimentally by a conventional continuous variable teleportation protocol with an optimally tuned gain and can be integrated efficiently in quantum optical communication networks.

Quantum State Comparison Amplifier with Feed-forward State Correction

3:00 PM
Room A

Luca Mazzarella
University of Strathclyde, Glasgow, United Kingdom
luca.mazzarella@strath.ac.uk

Quantum State Comparison AMPlifier (SCAMP) is a probabilistic amplifier that works for a known set of coherent states (CSs) [1]. Alice picks uniformly at random an input state and passes it to Bob who has to amplify it. To do so, he mixes the signal with a guess CS at a beam splitter (one arm of which being connected to a detector). The output is accepted as the successfully amplified state conditioned on no counts being recorded, one the other hand the detector firing means that Bob's guess is wrong. This systems can be realized with "classical" resources (lasers, linear optics, and APD detectors) and has been shown to achieve high gain, repetition rates and fidelity [2].
In this work, we show how the performance of this class of systems are enhanced by concatenating SCAMPs together with a feed-forward state correction strategy. Our figure of merits compare favourably with other schemes. Most notably, the probability-fidelity product [3] is higher than the unambiguous discrimination based amplifier proposed in [4] and requires no more complex resources. Due to its simplicity, our system might be an ideal candidate as a recovery station to counteract quantum signal degradation and as a quantum receiver for QKD protocols using weak CSs.

[1] E. Eleftheriadou et al., Phys. Rev. Lett. 111, 213601 (2013).
[2] R. Donaldson et al., Phys. Rev. Lett. 114, 120505 (2015).
[3] S. Pandey, et al., Phys. Rev. A 88, 033852 (2013).
[4] V. Dunjko & E. Andersson, Phys. Rev. A 88, 042322 (2012).

Autonomous quantum machine for steady state entanglement generation via bath engineering

3:00 PM
Room B

Francesco Tacchino
University of Pavia, Pavia, Italy
francesco.tacchino01@ateneopv.it

We propose an elementary quantum device able to generate a significant amount of steady state entanglement without the need for any coherent driving, thus showing that entanglement can be created relying only on incoherent energy sources. It consists of a pair of incoherently driven qubits coupled to a quantised electromagnetic cavity mode: under specific conditions, the cavity mode provides an effective channel for mutual qubits interaction, which can be interpreted as dissipative bath engineering. Heat flowing through the system helps maintaining the non-local nature of the steady state, which is quantified by the negativity of the density matrix and can reach steady state values up to 20% of the theoretical maximum. We also provide a description in terms of effective temperatures, which means that the device can work as a nanoscale thermal machine. More generally, this setup belongs to the class of autonomous quantum machines, since it can operate without any accurate external control on the dynamics. With respect to the existing literature, our implementation explicitly provides a technique to structurally obtain a stable effective qubit-qubit coupling. Moreover, we point out the possible role of non-local baths as a key ingredient for further developments in the design of quantum engines. Special attention is paid to realistic parameters in view of future tests and realisations in solid state systems.

F. Tacchino, A. Auffèves, M. F. Santos, D. Gerace, manuscript in preparation.

Multiphoton interference in time with a fiber-integrated interferometer

3:15 PM
Room A

Joelle Boutari
University of Oxford, Oxford, UK
joelle.boutari@gmail.com

In this talk I present quantum interference between multiple indistinguishable photons using a time-bin encoding and optical fiber-integrated platform. Multiphoton interference lies at the core of several quantum information processing tasks. For this purpose, complex on-chip interferometers have been developed to manipulate the spatial mode structure of single photons. We develop an alternative guided-wave approach using time-bin modes [1,2], and fiber optics, which provides a route to large-scale devices requiring few physical components.
In our work, heralded single photons are generated at standard telecommunications wavelengths by a spontaneous parametric wave-mixing. The photons randomly populate a sequence of temporal modes which access a fiber network [3] through an optical switch. The optical network is composed of multiple cavities with path length differences matching the delay separating time bins. The cavities are connected by evanescent coupling. For two cavities, interference between any set of input modes is achieved after a number of round trips in the network equal to the number of input modes. The time-bins are then released and measured by photon counting. We verify non-classical features of quantum interference and discuss technical requirements and prospects for large-scale operation.

[1] P.C. Humphreys et al, Phys. Rev. Lett. 111, 150501 (2013)
[2] A. Regensburger et al, Phys. Rev. Lett. 107, 233902 (2011)
[3] J. Boutari et al, J. Opt 18 (9), 094007 (2016)

Machine learning inspired open map engineering

3:15 PM
Room B

Luca Innocenti
Queen's University Belfast, Belfast, Northern Ireland, United Kingdom
linnocenti01@qub.ac.uk

The last years have seen a growing interest in the merging of the fields of classical machine learning and quantum physics. In particular a number of machine learning techniques originally developed for big data analysis have been shown to be fruitfully adaptable to solve problems arising in quantum information science and many body theory. Notable recent examples include the use of neural networks to solve the many-body problem (Carleo and Troyer Science 2017) and do quantum state tomography (Torlai et al. arXiv:1703:05334 2017). While in these works standard neural network architectures have been used it is possible to borrow the techniques used for neural networks but apply them to substantially different architecture. This kind of neural-network-inspired optimization has already been demonstrated in the context of quantum gate learning where a set of pairwise interactions implementing a specific gate is automatically found through an adaptive procedure using the same kind of stochastic gradient descent technique that is commonly used to train neural networks (Banchi et al. Nature npjqi 2016). Building on that work we generalize their method and using automatic differentiation we make it possible to explore networks of 8 and more qubits optimizing over hundreds of possible pairwise interactions. We use this method to train qubit networks finding the set of pairwise interactions implementing after tracing of some ancillary qubits target open maps.

Entanglement of photonic-orbital-angular momentum states after an obstruction.

3:30 PM
Room A

Giacomo Sorelli
Physics Department University of Freiburg, Freiburg, Germany
giacomo.sorelli@physik.uni-freiburg.de

Orbital angular momentum (OAM) of twisted photons spans an infinite dimensional Hilbert space, therefore it allows to increase channel capacity and security of quantum communication. Unfortunately, this degree of freedom is fragile with respect to disturbance along the propagation path. In this contribution we explore robustness of entanglement after a circular obstruction of biphoton states of different OAM modes.
In particular, we focus on two sets of modes: Laguerre-Gaussian (LG) and Bessel-Gaussian (BG). Whereas LG modes are commonly used in the study of OAM entanglement, BG modes are famous in classical optics for the ability to reconstruct their intensity distribution after hitting an obstacle. A recent experiment [1] suggested that this self healing makes OAM entanglement in the BG basis more robust with respect to the disturbance caused by an obstruction. However a systematic analysis of how the transmission of OAM entanglement through obstructed paths

depends on obstacles' properties as well as on the mode structure, was missing. We show that crosstalk between different OAM modes, which is the main cause of degradation for entanglement, is always lower for BG modes. We quantify the crosstalk for different sizes and positions of the obstacle. Finally, we relate the entanglement behaviour of obstructed LG modes to the phase correlation length introduced in [2].

[1] M. McLaren et al., Nat. Commun. 5: 3248 (2014)
[2] N. D. Leonhard et al., Phys. Rev. A 91: 012345 (2015)

Efficient Determination of Ground States of Infinite Quantum Lattice Models in Three Dimensions

3:30 PM
Room B

Angelo Piga
ICFO - Institut de Ciencies Fotoniques, Barcelona, Spain
angelo.piga@icfo.eu

Understanding reliably and accurately the ground states and low-lying states of strongly correlated quantum systems is one of the most important challenges in modern physics. In particular three dimensional (3D) many-body systems, rich geometries and strong competition between quantum fluctuation and magnetic ordering, provide a fertile ground for various exotic phenomena. Except for remarkable advances with traditional approaches, there are still many 3D models that remain unsolved to a large extent, such as, among others the Fermi-Hubbard model, which is usually invoked to describe high temperature superconductivity of cuprates that consist of strongly correlated 2D planes weakly coupled in the transverse direction. Here we propose a fundamental numeric Tensor Network-based approach that can efficiently determine the ground states of infinite 3D lattice models. In general, the basic idea of this approach is to transform an infinite system into a finite one defined on a cluster that is embedded in an "entanglement bath" without requiring any prior knowledge of the ground state. Its high flexibility and simplicity allows for incorporating existing algorithms (e.g. Density Matrix Renormalization Group, Quantum Monte Carlo), and for efficient simulations of a wide range of systems without any conceptual changes.

Ref: arXiv:1703.09814

Simulating complex, non-Markovian processes with quantum physics

3:45 PM
Room A

Felix Binder
NTU, Singapore, Singapore
quantum@felix-binder.net

Stochastic processes are as ubiquitous throughout the quantitative sciences as they are notorious for being difficult to simulate and predict. Weather patterns, stock prices, and biological evolution are just some of the most prominent examples. In the last decades a sophisticated framework, called 'computational mechanics', has been developed that studies the complexity of such processes in terms of the minimal memory required for their simulation. More recently, it was discovered that this memory requirement for simulation may be further reduced by using a quantum instead of a classical memory substrate. Based on these results, we have developed a generic method for constructing a unitary quantum simulator for a large class of stochastic processes. Unlike previous works which were focused on fundamental aspects of statistical complexity our construction opens the door to experimental implementation by providing a construction which is both simple and practical.
In this talk I will give a brief an introduction to computational mechanics and statistical complexity as well as their extension to quantum memory. I will then describe a proposal for the construction of a unitary quantum simulator which is applicable to a large class of stochastic processes.

4:00 PM

COFFEE BREAK

4:30 PM

LAB TOUR

Participants

Agnesi, Costantino (Università di Padova)
Albarelli, Francesco (Università di Milano)
Avesani, Marco (Università di Padova)
Benedetti, Claudia (Università di Milano)
Biagi, Nicola (INO-CNR Firenze)
Binder, Felix (NTU Singapore)
Boutari, Joelle (University of Oxford)
Caiaffa, Matteo (University of Strathclyde Glasgow)
Calderaro, Luca (University of Padova)
Caruso, Filippo (Università di Firenze & LENS)
Cavina, Vasco (Scuola Normale Superiore Pisa)
Ciampini, Mario Arnolfo (Sapienza Università di Roma)
Colautti, Maja (Università di Firenze & LENS)
Costanzo, Luca Salvatore (INO-CNR Firenze)
Cusumano, Stefano (Scuola Normale Superiore Pisa)
De Palma, Giacomo (University of Copenhagen)
Dermez, Rasim (Afyon Kocatepe University)
Detti, Amelia (Università di Firenze)
Ding, Yunhong (Technical University of Denmark)
Do, Hoang-Van (Università di Firenze & LENS)
Donati, Ludovica (Università di Firenze)
Farsi, Alessandro (Columbia University)
Ferioli, Giovanni (Università di Firenze & LENS)
Foti, Caterina (Università di Firenze)
Frascella, Gaetano (Max Planck Institute Erlangen)
Gabbrielli, Marco (Università di Firenze)
Gherardini, Stefano (Università di Firenze & LENS)
Innocenti, Luca (Queen's University Belfast)
Knott, Paul (University of Nottingham)
Liuzzo Scorpo, Pietro (University of Nottingham)
Lombardi, Pietro Ernesto (INO-CNR, Sesto Fiorentino)
Losero, Elena (DISAT, Politecnico di Torino, INRiM)
Lostaglio, Matteo (Postdoc Researcher at ICFO)
Lovecchio, Cosimo (Università di Firenze & LENS)
Majury, Helena (Queens University Belfast)
Marcantoni, Stefano (University of Trieste and INFN Trieste)
Mascherpa, Fabio (Ulm University)

Masi, Leonardo (Università di Firenze)
Mazzarella, Luca (University of Strathclyde)
Mihaescu, Tatiana (IFIN-HH Bucharest)
Mueller, Matthias (Università di Firenze & LENS)
Napoli, Carmine (University of Nottingham)
Pazzagli, Sofia (Università di Firenze)
Perego, Elia (Politecnico di Torino & INRiM)
Piga, Angelo (ICFO Barcelona)
Poggiali, Francesco (Università di Firenze & LENS)
Roccia, Emanuele (Università Roma Tre)
Rosati, Matteo (Scuola Normale Superiore Pisa)
Rossi, Matteo (Università di Milano)
Schiavon, Matteo (University of Padova)
Sherson, Jacob (Aarhus University)
Sorelli, Giacomo (University of Freiburg)
Tacchino, Francesco (University of Pavia)
Tesi, Lorenzo (Università di Firenze)
Torre, Gianpaolo (University of Salerno)
Vedovato, Francesco (University of Padova)
Ward, Ian (Cardiff University)
Webb, Anna (University of Sussex)
Zavatta, Alessandro (INO-CNR Firenze)
Zens, Matthias (Vienna University of Technology)

Travel Information

The event will take place in the Department of Physics and Astronomy of the University of Florence, located in Sesto Fiorentino, close to Florence. To reach the department by bus, take the bus "59-Schiff" from the stop "Rifredi Fs Vasco De Gama", located in front of one of the two exits of the train station Rifredi FS, and get off the bus at the last stop "Schiff". The bus takes 15 minutes to reach the destination. You can either buy a bus ticket in one of the many Tabacchi stores around the city (1.20 €), or send the SMS text message "ATAF" to the number 4880105 (1.50 €). You will receive a text message confirming the successful purchase.

Bus 59 morning timetable:

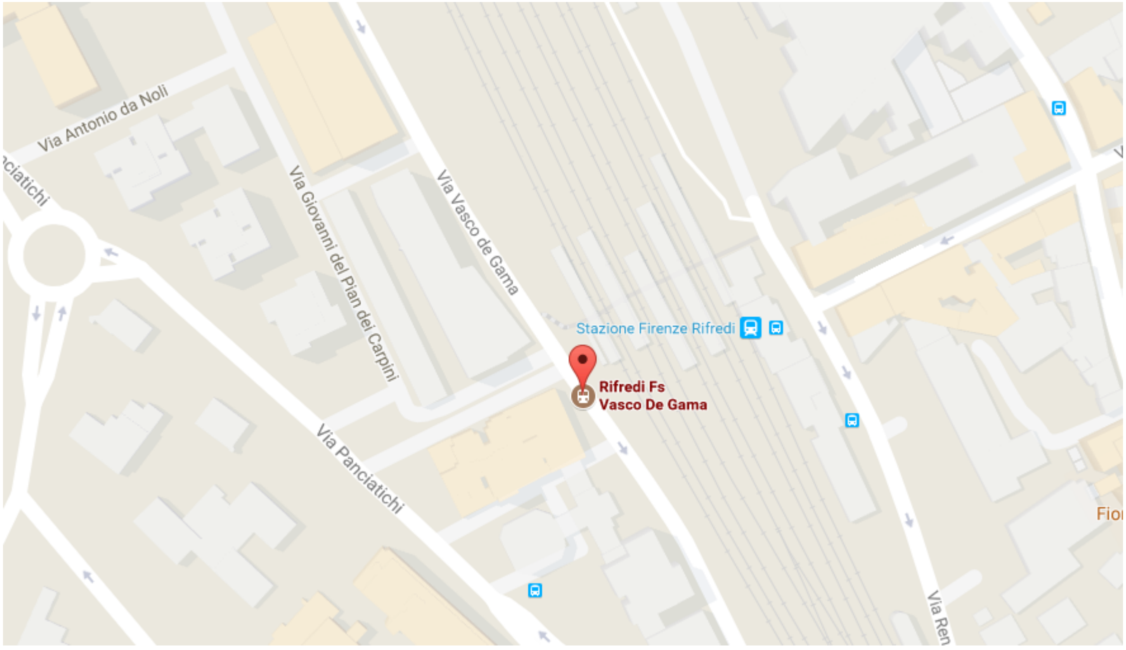
Starts from Rifredi Fs Vasco de Gama

07:20	07:34	07:47	08:00	08:11	08:22	08:32	08:42	08:52	09:02	09:12	09:22

Stops at Schiff

07:35	07:49	08:02	08:15	08:27	08:38	08:48	08:58	09:08	09:17	09:27	09:37

Rifredi Fs Vasco De Gama bus stop position



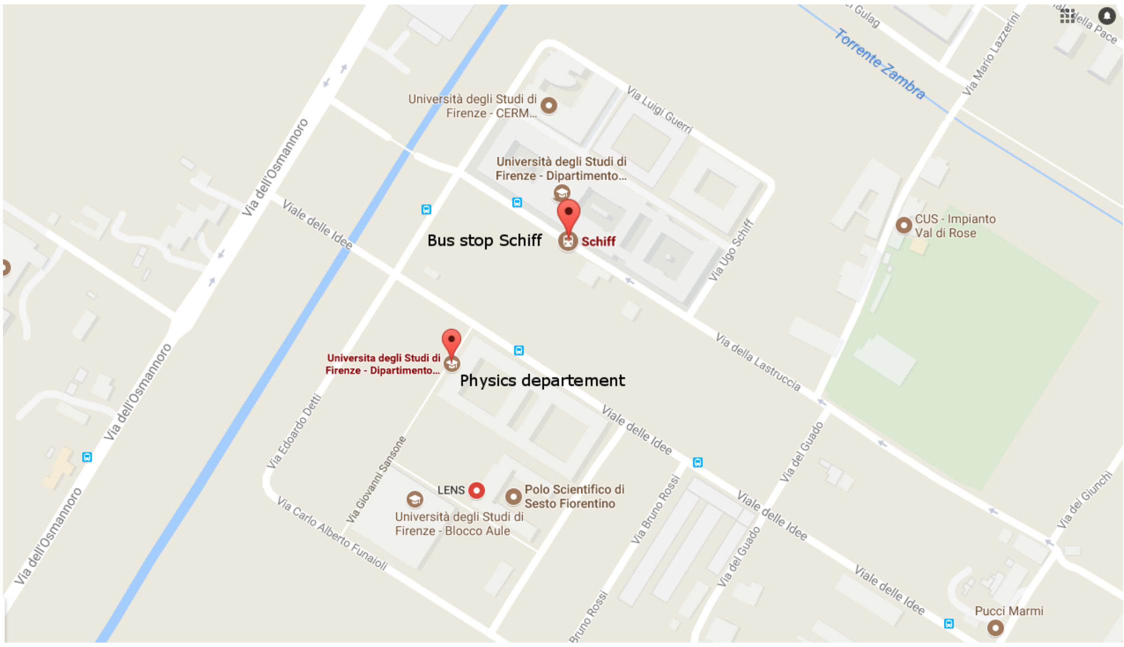
If you are accommodated in the city center you can easily reach the train station Firenze Rifredi FS by bus, or by train starting from the train station Firenze Santa Maria Novella (SMN) (almost every train which has as final destination Pisa, Livorno, Empoli or Prato stops at Rifredi). The bus tickets are valid also in the train within the Firenze metropolitan area.

Trains from Firenze SMN to Firenze Rifredi in the morning:

Starts from SMN	Stops at Rifredi	Final destination of the train
07:10:00 AM	07:15:00 AM	Viareggio
07:16:00 AM	07:21:00 AM	Empoli
07:28:00 AM	07:33:00 AM	Livorno Centrale
07:33:00 AM	07:38:00 AM	Pisa Centrale
07:38:00 AM	07:44:00 AM	Lucca
07:53:00 AM	07:58:00 AM	Viareggio
08:05:00 AM	08:10:00 AM	Pisa Centrale
08:10:00 AM	08:10:00 AM	Viareggio
08:10:00 AM	08:15:00 AM	Siena
08:28:00 AM	08:33:00 AM	Livorno Centrale
08:38:00 AM	08:43:00 AM	Pistoia
08:47:00 AM	08:52:00 AM	Pistoia
08:53:00 AM	08:58:00 AM	Pisa Centrale
09:10:00 AM	09:15:00 AM	Viareggio
09:10:00 AM	09:15:00 AM	Siena

Conference venue

The conference will take place at the Department of Physics and Astronomy of the University of Florence in Sesto Fiorentino, a short walk from Schiff bus stop (Bus 59). Please see site map below.



Author Index