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PROGRAM

FRIDAY, 1 JUNE – SALA CAMINO

9:00 OPENING CEREMONY

Chairman: **Franco PERSICO**

9:30 **SUOMINEN Kalle-Antti**
Quantum jumps and non-Markovian evolution

10:00 **BOŽIĆ Mirjana**
Non-stationary wave functions of one and two quantons behind a beam splitter

10:30 **YUASA Kazuya**
Coherence of Field-Emitted Electrons

11:00 - 11:30 **COFFEE BREAK**

Chairman: **Mihaly BENEDICT**

11:30 **SOLOMON Allan**
Decoherence of Entanglement

11:50 **RODRIGUEZ Cesar**
Classical Correlations and Completely Positive Maps

12:10 **BOVINO Fabio Antonio**
Nonlinear Inequalities and Entropy-Concurrence Plane

12:30 **PAGANELLI Simone**
An analytical approach to the coherence properties in the dynamics of two-site tunnelling system coupled to a harmonic oscillator

12:50 - 15:00 **LUNCH**

Chairman: **Vladimir MAN'KO**

15:00 **YATSENKO Leonid**
Recent Progress in Laser Based Rapid-Adiabatic-Passage

15:30 **MILOSEVIC Dejan**
Atomic processes in a strong laser field

16:00 **SHUMOVSKY Alexander**
Spin systems: an example of entanglement without nonlocality

16:30 - 17:00 **COFFEE BREAK**

Chairman: **Zdenek HRADIL**

17:00 **BREUER Heinz-Peter**
Optimal entanglement criteria for mixed quantum states

17:20 **LUPO Cosmo**
A critical point of view about the robustness argument of holonomic quantum gates

17:40 **SCHEEL Stefan**
CPT Maps consisting of Mixed Unitaries

18:00 **BINICIOGLU CETINER Sinem**
Entanglement of a Single Spin-1 Object: An Example of Ubiquitous Entanglement

FRIDAY, 1 JUNE – SALA WAGNER

Chairman: **André CARVALHO**

11:30 **WALLENTOWITZ Sascha**
On "spin squeezing"by polarimetric measurements

11:50 **CASAGRANDE Federico**
Entanglement sharing and maximum atom-atom inseparability in driven Jaynes-Cummings dynamics

12:10 **DAVIDOVIČ Milena**
Should particle trajectories comply with transverse momentum distribution?

12:30 **D'ANGELO Milena**
Is entanglement indispensable for quantum lithography?

12:50 - 15:00 **LUNCH**

Chairman: **Allan SOLOMON**

17:00 **VOURDAS Apostolos**
Fourier multiport devices

17:20 **WHITE Andrew**
Efficient quantum logic circuits: or, How I Learned to Stop Worrying and Love Hilbert Space

17:40 **OLIVARES Stefano**
Interspecies teleportation and telecloning between light and cold atoms

18:00 **FILIPP Stefan**
Ultra Cold Neutrons and the Stability of the Geometric Phase

SATURDAY, 2 JUNE – SALA CAMINO

Chairman: Giuseppe MARMO

9:00 **SUDARSHAN George**
Geometry of Dynamical Maps

9:30 **HRADIL Zdenek**
Tomography for quantum diagnostics

10:00 **VITANOV Nikolay**
Navigation in Hilbert space by quantum state reflections

10:30 - 11:00 **COFFEE BREAK**

Chairman: Heinz-Peter BREUER

11:00 **SOLIMENO Salvatore**
CV Entanglement generation in a non-degenerate Optical Parametric Oscillator

11:20 **FERRARO Elena**
A criterion for entanglement in two two-level systems

11:40 **PUDDU Emiliano**
Ghost imaging with intense entangled fields from PDC seeded by a thermal field

12:00 **RANGELOV Andon**
STIRAP into continuum

12:20 **KLIMOV Andrei**
Discrete phase-space structure and MUB tomography

12:40 - 15:00 **LUNCH**

Chairman: Kalle-Antti SUOMINEN

15:00 **MAN'KO Margarita**
Classical radiation in optical fibers as model for quantum entanglement

15:30 **BENEDICT Mihaly**
Quasidegenerate multilevel dynamics, Landau-Zener theory and beyond

16:00 **CARVALHO André**
Robust control of entanglement by quantum-jump based feedback

16:30 - 17:00 **COFFEE BREAK**

Chairman: Sascha WALLENTOWITZ

17:00 **MUSAKHANYAN Viktor**
An exact solution of Dirac's equation in the field of plane EM wave: physical consequences.

17:20 **PLASTINA Francesco**
Critical properties of entanglement and Berry's phase in the superradiant phase transition

17:40 **STRELKOV Vasily**
Control of attosecond pulse emission via ellipticity gating: theory and experiment

18:00 - 19:00 **POSTER SESSION**

SATURDAY, 2 JUNE – SALA WAGNER

Chairman: <u>**Federico CASAGRANDE**</u>

11:00 **WELSCH Dirk-Gunnar**
QED in arbitrary linear media: A unified macroscopic approach

11:20 **MASTELLONE Andrea**
Mesoscopic BCS pairing in the repulsive one dimensional Hubbard model

11:40 **MEL'NIKOV Igor**
Generation of slow intense optical solitons in a resonance photonic crystal

12:00 **FERMANI Rachele**
On the feasibility of studying vortex noise in 2D superconductors with cold atoms

12:20 **MANGANO Giuseppe**
Stimulated Raman Adiabatic Passage with a Cooper Pair Box

12:40 - 15:00 **LUNCH**

Chairman: <u>**Roberto PASSANTE**</u>

17:00 **NAVEZ Patrick**
Mind the gap in a Bose Einstein condensate!

17:20 **BIROL Turan**
Spontaneous Symmetry Breaking, Thin Spectrum and Excitation Life Time in Bose-Einstein Condensates

11:40 **GIORGI Gian Luca**
Bose-Einstein Condensation in coupled photon systems

18:00 - 19:00 **POSTER SESSION**

SUNDAY, 3 JUNE – SALA CAMINO

Chairman: **Saverio PASCAZIO**

9:00 **RAIMOND Jean-Michel**
Observing the quantum jumps of light

9:30 **MARMO Giuseppe**
Entanglement in the geometric formulation of quantum mechanics

10:00 **MUSTECAPLIOGLU Ozgur**
Control of Optical Dynamic Memory Capacity of an Atomic Bose-Einstein Condensate

10:30 - 11:00 **COFFEE BREAK**

Chairman: **Apostolos VOURDAS**

11:00 **MANISCALCO Sabrina**
Measurement induced manipulation of the quantum-classical border

11:20 **FACCHI Paolo**
Master equation and initial factorization

11:40 **MESSINA Riccardo**
Casimir-Polder force density between an atom and a conducting plate

12:00 **PHILBIN Thomas**
Quantum levitation by left-handed metamaterials

12:20 **BRAGGIO Caterina**
Recent developments in the MIR experiment

12:40 - 15:00 **LUNCH**

TOUR AND SOCIAL DINNER

SUNDAY, 3 JUNE – SALA WAGNER

Chairman: **Arkadiusz ORLOWSKI**

11:00 **MAN'KO Vladimir**
Strong subadditivity condition and Renyi entropy in quantum information within the framework of tomographic-probability representation

11:20 **GENES Claudiu**
Quantum effects in optomechanical systems

11:40 **TANAS Ryszard**
Birth and death of entanglement in a two-atom system

12:00 **PARIS Matteo G A**
Optimal quantum estimation of loss in bosonic channels

12:20 **BISHOP Raymond**
Extended Quantum Phase Space for Quantum Information Theory

12:40 - 15:00 **LUNCH**

TOUR AND SOCIAL DINNER

MONDAY, 4 JUNE – SALA CAMINO

Chairman: **Luis SANCHEZ-SOTO**

9:00 **RAUCH Helmut**
Neutrons as Manipulable Quantum Objects

9:30 **BRAMBILLA Enrico**
Quantum spatial correlations in parametric down-conversion and detection of faint images

10:00 **ORLOWSKI Arkadiusz**
Decoherence of entangled states in multi-mode cavities

10:30 - 11:00 **COFFEE BREAK**

Chairman: **Dirk-Gunnar WELSCH**

11:00 **LININGTON Ian**
Dissipation control in cavity QED with oscillating boundaries

11:20 **LO FRANCO Rosario**
Efficient Generation of Generalized Binomial States in a Cavity

11:40 **OGDEN Christopher**
Concentration and purification of entanglement for qubit systems with ancillary cavity fields

12:00 **DUSEK Miloslav**
Various experimental realizations of symmetric and asymmetric phase-covariant quantum cloners

12:20 **PERINOVA Vlasta**
Invariant-subspace method of solution of nonlinear Heisenberg equations

12:40 - 15:00 **LUNCH**

Chairman: **Francesco PETRUCCIONE**

15:00 **MARANGOS Jonathan**
Molecular Imaging in the Attosecond Regime using High Harmonic Generation

15:30 **PASCAZIO Saverio**
Quantum Zeno subspaces

16:00 **SHATOKHIN Vyacheslav**
The coherent backscattering spectrum of two atoms

16:30 - 17:00 **COFFEE BREAK**

Chairman: **Hiromichi NAKAZATO**

17:00 **ANDREEV Vladimir**
The tomographic approach to analysis of entanglement property

17:20 **ISKHAKOV Timur**
High-visibility multi-photon interference for classical light

17:40 **TAMMA Vincenzo**
Reliability of NOON-state production schemes

18:00 **DE GUISE Hubert**
Picturing the Wigner function of angular momentum intelligent states

18:20 **GLUSHKOV Alexander**
Optics and spectroscopy of cooperative laser-electron nuclear processes in atomic, molecular and cluster systems - new trend in quantum optics

MONDAY, 4 JUNE – SALA WAGNER

10:30 - 11:00 **COFFEE BREAK**

Chairman: **Dejan MILOSEVIC**

11:00 **USENKO Vladyslav**
Quantum communication with photon-number entangled states of light upon realistic conditions

11:20 **GHIU Iulia**
Probabilistic implementation of a two-output quantum processor for quDits

11:40 **FLORIO Giuseppe**
Multipartite entanglement characterization of a quantum phase transition via probability density function

12:00 **SERGI Alessandro**
Quantum-Classical Dynamics of Wave Fields

12:20 **ALLEVI Alessia**
Quantum and classical correlations in tripartite states of light

12:40 - 15:00 **LUNCH**

16:30 - 17:00 **COFFEE BREAK**

Chairman: **Giuseppe COMPAGNO**

17:00 **ISAR Aurelian**
Quantum fidelity for Gaussian states describing the evolution of open systems

17:20 **MAUGERI Alessio Gerardo**
Structured environments in solid state systems: crossover from Gaussian to non-Gaussian behavior

17:40 **BONDANI Maria**
Experimental demonstration of sub-shot-noise intensity correlations in an intense twin-beam

18:00 **BONANNO Giovanni**
Photoionization and electron energy control by attosecond pulses

18:20 **THÉ George A.P.**
Optical setup for teleportation of the XOR function using coherent state qubits

TUESDAY, 5 JUNE – SALA CAMINO

Chairman: Mirjana BOŽIĆ

9:00 **MARIAN Paulina**
Gaussian entanglement of formation for two-mode Gaussian states

9:30 **GENET Cyriaque**
Casimir in the nanoworld

10:00 **SANCHEZ SOTO Luis L.**
Quantum reconstruction of an intense polarization squeezed optical beam

10:30 - 11:00 **COFFEE BREAK**

Chairman: Margarita MAN'KO

11:00 **ABD AL-KADER Gamal**
A class of nonlinear two-mode squeezed coherent states

11:20 **MACOVEI Mihai**
Light interference and localization of strongly driven multiparticle systems

11:40 **SAHRAI BARENJI Mostafa**
The effect of the spontaneously generated coherence on the dynamical behaviors of the dispersion and the absorption

12:00 **DI PIAZZA Antonino**
Nonlinear interaction of strong laser fields in vacuum

12:20 **INTRAVAIA Francesco**
Dissipation and Non-locality in the Casimir Effect

12:40 - 15:00 **LUNCH**

Chairman: Leonid YATSENKO

15:00 **DE SIENA Silvio**
Study of quantum correlations in nonclassical entangled states

15:20 **POPOV Alexander**
Quantum switching in negative-index metamaterials

15:40 **D'ARRIGO Antonio**
Quantum Capacity of a dephasing channel with memory

16:00 **JIMÉNEZ HENRÍQUEZ Omar Alejandro**
Experimental scheme for unambiguous discrimination between linearly independent symmetric states.

16:20 - 17:00 **CLOSING CEREMONY**

TUESDAY, 5 JUNE – SALA WAGNER

10:30 - 11:00 **COFFEE BREAK**

Chairman: Vyacheslav SHATOKHIN

11:00 **COMPAGNO Giuseppe**
Decoherence induced by finite time measurements

11:20 **LULLI Alfredo**
Dynamics of entanglement transfer from two quantized radiation modes to two qubits

11:40 **DAVIDOVIĆ Dragomir**
Scaling invariance of the Husimi distributions - possible physical implications

12:00 **CARIÑENA José F.**
A new approach to Ermakov systems and applications in quantum physics

12:20 **CICCARELLO Francesco**
Teleportation of atomic states via cavity QED and position measurements

12:40 - 15:00 **LUNCH**

Chairman: Helmut RAUCH

15:00 **CHIMONIDOU Antonia**
Relaxation Phenomena in a System of Two Harmonic Oscillators

15:20 **OLSEN Murray**
Teleportation of massive particles without shared entanglement

15:40 **VILLARREAL Carlos**
High Tc Superconductivity and Quasi-2D Bose-Einstein Condensation

16:00 **KUMAR Rakesh**
Antibunching of light in interaction of two two-level atoms with a single mode coherent radiation

16:20 - 17:00 **CLOSING CEREMONY**

ABSTRACTS

Plenary sessions will take place in “sala Camino”
Sessions A will take place in “sala Camino”
Sessions B will take place in “sala Wagner”

ABD AL-KADER Gamal *Talk: Tue 11:00*

A class of nonlinear two-mode squeezed coherent states

G.M. Abd Al-Kader and A.-S. F. Obada
Al-Azhar University

Nonlinear extensions of the single-mode, two-mode squeezed vacuum and squeezed coherent states are constructed. Nonlinear two-mode squeezed coherent states (NTMSCS's) are defined and special cases of these states are discussed. Two cases of the definition are considered for unitary and non-unitary deformation operator function. Some nonclassical properties of these states are discussed. The Glauber second-order coherence function is calculated. Analytical and numerical results for the quadrature component distributions for the NTMSCS's are presented. The s-parameterized quasi-probability function, especially the Wigner function is discussed.

AL-AWFI Saud *Poster*

Influence of fluctuations of a laser light on the reflection process of atomic mirror

Saud Al-Awfi and Smail Bougouffa
Department of Physics, Taibah University, Madina Munawwarah, P.O.Box 344,Saudi-Arabia

The influence of phase fluctuations of a laser light on the atomic reflection process of evanescent modes is investigated. This influence is one of the main factors that limit the performance of the atomic mirror action obstructing the ultimate goal of near-perfect coherent reflection process. It is concluded that this influence plays a significant role hence should be incorporated in the treatment of quantum dynamics. By operating at low intensities, this influence can only be minimized. We derive mathematical expressions for the optical forces, considering the phase fluctuations due to the laser light source. All treatments of the phase diffusion model are deduced from the well-known master equation. Different effects arising from application of various phase fluctuations values are considered. These include enhancement of the spontaneous force, and decreasing the dipole forces magnitudes. The changes of the atom trajectories due to these effects are pointed out and discussed.

ALLEVI Alessia *Talk: Mon 12:20 B*

Quantum and classical correlations in tripartite states of light

A. Allevi[1], M. Bondani[2], M. G. A. Paris[3] and A. Andreoni[1]
[1] *C.N.R.-I.N.F.M.-C.N.I.S.M., Dipartimento di Fisica e Matematica, Università dell'Insubria, Como (Italy)*
[2] *National Laboratory for Ultrafast and Ultraintense Optical Science - C.N.R.-I.N.F.M., Como (Italy)*
[3] *Dipartimento di Fisica, Università di Milano (Italy)*

Interest in continuous variable multipartite entanglement has recently grown due to its apparent usefulness as an enabling technology in quantum information and communication protocols such as quantum dense coding and teleportation networks. Here we present a compact experimental realization of fully inseparable three-mode entangled states of radiation (entangled triplet) by two interlinked nonlinear interactions taking place simultaneously in a second-order nonlinear crystal that operates starting from vacuum. The tripartite output state is endowed with entanglement properties in the number of photons: in particular, the number of photons in one of the parties must equal the sum of photons in the other two. This implies the existence of strong intensity correlations among the generated fields so that intensity-correlation measurements, also in the case of imperfect photodetection, can be viewed as a diagnostic tool for the identification of the entangled triplet. Nevertheless, the existence of strong intensity correlations among the generated fields is necessary but not sufficient to demonstrate the entangled nature of the triplet. In fact, we demonstrate by explicit evaluation that, for the entangled triplet, the correlation coefficient between the three parties taken in pairs must approach unity regardless the quantum or classical nature of the correlations. On the other hand, discrimination between classical and quantum statistics

can be done in terms of the fluctuations of suitable combinations of the photocurrents measured on the parties of the triplet. We also prove that a sufficient criterion for the full inseparability of the generated state is given by the possibility of realizing a true tripartite quantum protocol, such as the symmetric and asymmetric telecloning scheme.

ANDREEV Vladimir *Talk: Mon 17:00 A*

The tomographic approach to analysis of entanglment property

V. Andreev
Lebedev Physical Institute, Moscow, Russia

The alternative approach to study quantum nonlocality and entanglment property of multiparticle spin states is proposed. The spin states are described with the help of tomographic variables. These variables are probabilities of some measurable quantities. The multiparticle spin states are defined by the probability distributions of the spin projections on some selected axes in configurational space. The direction of each axis is fixed by two angles. We investigate dependence of the probability distributions of the spin projections on these angles. The form of these functions defines the type of a state. For some functions it is factorizable, and for other - entangled.

BELLOMO Bruno *Poster*

Thwarted evolution by repeated measurements

Bruno Bellomo,[1] Giuseppe Compagno,[1] H. Nakazato,[2] K. Yuasa [3]
[1] *Department of Physical and Astronomical Sciences - University of Palermo*
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Repeated measurements on a given system has been shown to influence the dynamics of another system interacting with it. This has been studied in the case of discrete levels systems [1]. Here we study the case of two interacting continuous levels systems represented by a free charged particle and the quantized electromagnetic field. Recently it has been proposed,in the context of environment induced decoherence, an approximations scheme that allows to treat exactly the unitary dynamical evolution of the particle + field system [2]. Here we use this scheme to analyze the influence that repeated measurements on the particle have on the evolution of the field initially taken in the vacuum state.
[1] H. Nakazato, T. Takazawa and K. Yuasa, Phys. Rev. Lett. 90 060401 (2003).
[2] B. Bellomo, G. Compagno and F. Petruccione, Phys. Rev. A 74 052112 (2006).

BENEDICT Mihaly *Talk: Sat 15:30*

Quasidegenerate multilevel dynamics, Landau-Zener theory and beyond

P. Földi, M. G. Benedict
University of Szeged, Department of Theoretical Physics

We consider the time evolution of the populations of a quasidegenerate multilevel system in an external time-dependent field, with fast sweep rates. We show that the process can be described as a sequence of two-level transitions between adiabatic states. The multilevel nature of the problem causes the transition probabilities to deviate significantly from the predictions of the Landau-Zener-Stueckelberg model. The calculations are based on the 'exact' numerical solution of the time dependent dynamical problem. When including phase relaxation by means of an appropriate master equation, we observe an interplay between coherent dynamics and decoherence. We apply the method to magnetic molecules attracting much interest recently.

BINICIOGLU CETINER Sinem *Talk: Fri 18:00 A*

Entanglement of a Single Spin-1 Object: An Example of Ubiquitous Entanglement

Sinem Binicioglu, M. Ali Can, Alexander A. Klyachko, and Alexander S. Shumovsky
Bilkent University, Science Faculty

Using a single spin-1 object as an example, we discuss a recent approach to quantum entanglement. The key idea of the approach consists in presetting of basic observables in the very definition of quantum system. Specification of basic observables defines the dynamic symmetry of the system. Entangled states of the system are then interpreted as states with maximal amount of uncertainty of all basic observables. The approach gives purely physical picture of entanglement. In particular, it separates principle physical properties of entanglement from inessential. Within the model example under consideration, we show relativity of entanglement with respect to dynamic symmetry and argue existence of single-particle entanglement. A number of physical examples are considered.

BIROL Turan *Talk: Sat 17:20 B*

Spontaneous Symmetry Breaking, Thin Spectrum and Excitation Life Time in Bose - Einstein Condensates

T. Birol, O. E. Mustecaplioglu
Department of Physics, Koc University

We consider the phase decoherence of an atomic Bose-Einstein condensate in the dilute gas limit. We show that apart from the collapse of the ground state, there is also another mechanism of phase decoherence limiting the life time of any excitation above the ground state. This mechanism is related with the presence of a 'thin spectrum', which is a group of states with energy difference much lower than experimental precision, and its validity for any type of quantum system is recently proved [J. van Wezel et. al., Phys. Rev. B, 94, 094430 (2006)]. We also clarify how thin spectrums emerge from spontaneously broken continuous symmetries and discuss different symmetries that can be broken in Bose-Einstein condensates.

BISHOP Raymond *Talk: Sun 12:20 B*

Extended Quntum Phase Space for Quantum Information Theory

Raymond F. Bishop
The University of Manchester

A complete description of quantum information theory needs to take into account simultaneously at least three important concepts or principles, namely: (a) quantum entanglement, (b) quantum coherence versus decoherence (i.e., in the presence of dissipation), and (c) the quantum-classical limit (or quantum-classical interface). We discuss how the concept of quantum phase space can be enlarged to provide just such a unified and consistent description. The usual (x-p) phase-space formulation of quantum mechanics has its practical origins in work of Wigner from over 70 years ago, where he originated the idea of a quantum phase-space distribution function. The formalism has since been developed and utilised in many fields of physics, including statistical physics, quantum optics and electronics, collision theory, and quantum chaos. It has the especially attractive feature that it provides a framework in which quantal phenomena can be described using as much classical language as possible. The phase-space formalism provides important insights into one of the key issues, namely of quantum-classical correspondence or non-correspondence. Here we show how, by going right back to a reformulation of classical mechanics in an extended (x-p-X-P) phase space, one can also introduce a corresponding extended quantum phase space with extremely appealing properties for a consistent description of quantum information theory. The doubling of the number of degrees of freedom, which, rather surprisingly, has its roots in classical mechanics, has strong overlaps with a similar feature of thermo-field dynamics, and hence with the treatment of quantum systems subject to thermal noise. We show how the extended (x-p-X-P) phase space also provides a natural means to describe simultaneously the quantum fluctuations or quantum noise (in the x-p variables) and the quantum correlations (in the (X-P) variables) present in a quantal system. Thus, the extended quantum phase-space framework provides a very natural vehicle to discuss all three of the above-mentioned concepts inherent to quantum information theory. It also unifies the description of mixed states, and provides a means to discuss together the Wigner and Weyl functions of a quantal system. Finally, the framework enables us to utilise in a very unified fashion the coherent mixed states (or thermal coherent states) associated with the displaced harmonic oscillator at finite temperature, that we have introduced previously as a "random" (or "thermal" or "noisy") basis in Hilbert space.

BONANNO Giovanni *Talk: Mon 18:00 B*

Photoionization and electron energy control by attosecond pulses

S. Bivona, G. Bonanno, R. Burlon, C. Leone
Di.F.Te.R. University of Palermo and C.N.I.S.M.

We report on numerical results of energy spectra of photoelectrons emitted by irradiating a hydrogen atom with a bichromatic field. The spectra have been obtained by numerical integration of the Schrodinger equation. The highest frequency component of the pulse has been assumed to have low intensity and such a frequency that a single photon may ionize the atom. The intensity of the lowest frequency component has been taken in such a way that a large number of low-frequency photons may be exchanged with the ejected electron. We have found that the photoelectrons energy spectra strongly depend on both the relative phase and time lag of the fields of the pulse.

BONDANI Maria *Talk: Mon 17:40 B*

Experimental demonstration of sub-shot-noise intensity correlations in an intense twin-beam

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[3] *Dipartimento di Fisica dell'Università di Milano*

It is well known that twin-beam states exhibit perfect quantum correlations in the photon number for any mean photon value. In principle, true twin-beam states are those generated by spontaneous parametric downconversion (SPDC) in traveling-wave optical parametric amplifiers (OPA), though approximations to them can be obtained by optical parametric oscillators, where the intensity can be increased at the price of introducing a classical amplitude and additional noise. Here we present the demonstration of sub-shot noise correlations in a twin beam obtained from a pulsed OPA starting from the vacuum state in the mesoscopic (more than 1000 photons) regime by direct measurement of the number of photons in the two parties of the twin state. This procedure yields complete information on the photon statistics and makes the system available for applications, such as the production of conditional states, which is actually feasible. The SPDC emission is characterized by the presence of coherence areas and it is necessary to spatially select the correct twin areas on signal and idler in order to match the single-mode theoretical description. We demonstrate that this experimental condition minimizes the amount of detected spurious light and maximizes the quantum noise reduction. Our OPA consists of a 4-mm-thick BBO I crystal pumped by 349-nm 4.5-ps pulses at 500 Hz repetition rate. Signal and idler are chosen non-degenerate in frequency (signal wavelength: 632.8 nm and idler wavelength: 778.2 nm). The intensities of signal and idler are measured independently by two amplified p-i-n photodiodes. Accurate calibrations of the voltage outputs of the amplifiers give the sensitivities to be used for converting the recorded data into numbers of detected photons. The resulting numbers are then subtracted from each other to demonstrate quantum noise reduction in the difference. Upon correcting for the background noise, we found that the variance of the detected-photon difference goes below the shot-noise limit by 3.25 dB.

BOUGOUFFA Smail *Poster*

Dynamical aspects in the optical Bloch equations

Smail Bougouffa and Saud Al-Awfi
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In quantum optics, we are often concerned with the dynamics of atoms coupled to an electromagnetic field (laser). Some simple models are required to describe many aspects of this dynamics. In these models, the field may be described either classically or fully quantum mechanically, while the atomic system is adequately described by a small number of essential states. This simplest atomic model is of course the two-level-atom. The classical treatment of the field is valid when the field contains many photons. In this case, the quantum correlations of the atomic operators and the field are neglected. In general, the physical mechanisms of the atomic motion in laser are governed by the optical Bloch equations which are coupled differential equations and they are solved in the steady-state. On the other hand, to investigate the transient aspects on atomic motion, we have to solve the coupled system which does not, in general, permit exact analytic solutions. We present an analytic separation approach to solve this coupled system. The conditions that permit an exact solutions form an interesting physical trends. The case of sodium atom moving along sanding-wave is treated with some details.

BOVINO Fabio Antonio *Talk: Fri 12:10 A*

Nonlinear Inequalities and Entropy-Concurrence Plane

Fabio A. Bovino
ELSAGDATAMAT

Nonlinear inequalities based on the quadratic Renyi entropy for mixed two-qubit states are characterized on the Entropy-Concurrence plane. This class of inequalities is stronger than Clauser-Horne-Shimony-Holt (CHSH) inequalities and, in particular, are violated "in toto" by the set of Type I Maximally-Entangled-Mixture States (MEMS I).

BOYACIOGLU Bahadir *Poster*

Quantized Magnetic Fluxes Through the Excited State Orbits of Hydrogen Atom

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We investigate the quantized magnetic fluxes through the excited state orbits, corrresponding to the (n, l, m_j) states of hydrogen atom in the absence of an external magnetic field. The sources of the magnetic fields are taken to be that of proton's magnetic moment and electron's magnetic moment which has two components, namely the orbital part and the spinning part .We show that the quantized magnetic fluxes through these orbits take the form of $(n - l - m_j)hc/e$. The present result gives access to the spin flip-floppings in the optical transitions of hydrogen atom. It is also believed to serve a significant help for understanding the recent observations of spin relaxation in excitonic transitions (such as 1s-2p or 2p-3d) in nanostructures.

BOŽIĆ Mirjana *Talk: Fri 10:00*

Non-stationary wave functions of one and two quantons behind a beam splitter

Mirjana Božić,[1] Milena Davidović[2] and Dušan Arsenović[1]
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[2] *Faculty of Civil Engineering, Belgrade*

Beam splitter is a device which is in the heart of quantum interferometry [1], attosecond metrology [2], modern quantum information processing. But, its name emphasizes only one of its essential properties: that its splits an initial beam into two beams. This name does not take into account either the mutual coherence of the two beams, which it generates from an initial beam, or the influence of this coherence on a particle associated with a wave. We propose to regard a beam splitter as a generator of a wave field (photon field or matter wave field), which has narrow maxima at the points along and in close vicinity of two particular lines, and negligible values at all other points. Such a field is generated from an initial narrow beam. A particle associated with a wave acquires randomly at the grating a new value of momentum. This new momentum directs a particle to one of the lines, along which it moves following the time evolution of a wave field. This picture is derived by considering a diffraction grating as a model of a beam splitter. A time dependent wave function of a single particle, behind a diffraction grating, describes the wholeness of a wave and of its evolution behind a grating [3,4]. The possible paths of a particle are at the same time the lines along which its wave function has maxima [3]. This explains the intriguing finding of quantum interferometry, that a single particle moving along one of the paths has the information about the existence of other paths [1] : this information is due to the wholeness of particles wave function along and in between these paths. The beam splitter is also important because it may act as an entangler [5]. We study entangling properties of a beam splitters by evaluating time dependent wave functions of two quantons for various initial states.

[1] H. Rauch and S.A. Werner, Neutron Interferometry: Lessons in Experimental Quantum Mechanics (Clarendon Press, Oxford, 2000) p. 350-365.

[2] E. Goulielmakis et al., Appl. Phys. B 74 (2002) 74.
[3]. M. Božić, D. Arsenović and L. Vušković, Phys. Rev. A 69 (2004) 053618
[4]. D. Arsenović, M. Božić, O.V. Man'ko and V.I.Man'ko, J.Russ. Las. Res. 26 (2005) 95.
[5]. M.S.Kim, W. Son, V. Bužek and P.L. Knight, Phys. Rev. A 65 (2002) 032323.

BRAGGIO Caterina *Talk: Sun 12:20 A*

Recent developments in the MIR experiment

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università di padova, INFN Pavia, INFN padova, INFN LNL, INFN Roma

The radiation generated by time modulation of the quantum vacuum is a subject that has gained importance in the last decade, following the experimental results obtained in the measurement of the static Casimir effect. The so-called dynamic Casimir effect should occur when the motion of the boundaries is performed with non constant acceleration, giving rise to photon production from the vacuum. Recent theories including the effect of losses in the MIR (Motion Induced Radiation) experimental apparatus will be analysed, showing that in even in a dissipative environment of a real cavity, the number of produced photons should be in the sensitivity range of the devised eterodyne receiver. Spurious effects such as blackbody emission during the experiment and pre-existing thermal fields inside the cavity will be discussed as well.

BRAMBILLA Enrico *Talk: Mon 9:30*

Quantum spatial correlations in parametric down-conversion and detection of faint images

Enrico Brambilla, Alessandra Gatti, Lucia Caspani, Ottavia Jedrkiewicz and Luigi Lugiato
Università dell'Insubria

A recent experiment has demonstrated the quantum nature of spatial fluctuations in the high gain regime of parametric down-conversion. We show theoretically and numerically that, by exploiting the local character of these spatial correlations, it is possible to image weak amplitude objects with a sensitivity beyond the standard quantum limit.

BREUER Heinz-Peter *Talk: Fri 17:00 A*

Optimal entanglement criteria for mixed quantum states

Heinz-Peter Breuer
Physikalisches Institut, Universitaet Freiburg, Hermann-Herder-Strasse 3, D-79104 Freiburg, Germany

We develop a strong and computationally simple entanglement criterion. The criterion is based on an elementary positive map Φ which operates on state spaces with even dimension $N \geq 4$. It is shown that Φ detects many entangled states with positive partial transposition (PPT) and that it leads to a class of optimal entanglement witnesses. This implies that there are no other witnesses which can detect more entangled PPT states. The map Φ yields a systematic method for the explicit construction of high-dimensional manifolds of bound entangled states.

CARIÑENA José F. *Talk: Tue 12:00 B*

A new approach to Ermakov systems and applications in quantum physics

José F. Cariñena
Departamento de Física Teórica, Facultad de Ciencias, Universidad de Zaragoza

Milne-Pinney equation $\ddot{x} = -\omega^2(t)x + k/x^3$ is usually studied together with the time-dependent harmonic oscillator $\ddot{y} + \omega^2(t)y = 0$ and the system is called Ermakov system, and actually Pinney showed in a short paper that the general solution of the first equation can be written as a superposition of two solutions of the associated harmonic oscillator. A recent generalization of the concept of Lie systems for second order differential equations and the usual techniques of Lie systems will be used to study the Ermakov system. Several applications of Ermakov systems in Quantum Mechanics as the relation between Schroedinger and Milne equations or the use of Lewis–Riesenfeld invariant will be analysed from this geometric viewpoint.

CARVALHO André *Talk: Sat 16:00*

Robust control of entanglement by quantum-jump based feedback

André R. R. Carvalho
Department of Physics, The Australian National University

We present a feedback strategy, based on quantum-jump detection, to generate highly entangled steady states of atoms in a cavity. The scheme overcomes spontaneous emission effects, and is robust against detection inefficiencies and errors in the control Hamiltonian.

CASAGRANDE Federico *Talk: Fri 11:50 B*

Entanglement sharing and maximum atom-atom inseparability in driven Jaynes-Cummings dynamics

F. Casagrande and A. Lulli
Università degli Studi di Milano - Dipartimento di Fisica

We investigate the entanglement of a tripartite system where a cavity field mode is off-resonantly coupled to two atoms that are driven by a resonant coherent field [1]. In the Hamiltonian regime and under strong driving conditions we find that for moderately detuned atom-field coupling the system entanglement can alternatively concentrate either (fully) in the atom-atom or (partially) in the two atom-field subsystems. Also completely separable states can be approximately implemented. In the case of dispersive coupling the atomic entanglement grows up monotonically to the maximum value and remains nearly stationary in the absence of atom-field entanglement, contrary to the case of resonant atom-field coupling where only the atom-field subsystems entangle and the atomic correlations are classic [2]. Including cavity dissipation we describe the increase of the atomic entanglement for increasing values of the cavity decay rate.

[1] F. Casagrande and A. Lulli, submitted for publication.
[2] F. Casagrande and A. Lulli, Int. J. Q. Inf., in press (2007)

CHIMONIDOU Antonia *Talk: Tue 15:00 B*

Relaxation Phenomena in a System of Two Harmonic Oscillators

Antonia Chimonidou, E.C.G Sudarshan
University of Texas at Austin

In quantum information, one is often interested in a physical system C, composed of two quantum subsystems A and B, interacting through some external interaction Hamiltonian. We are interested in how the interaction Hamiltonian forces the two subsystems to relax when in contact with each other. Entanglement between two initially uncoupled subsystems leads to the exchange of quantities such as purity or polarization, or for thermodynamical systems, temperature. We would like to understand the process by which this exchange occurs. Starting from the initial density matrices of the two subsystems, it is possible to calculate the corresponding time-evolved density matrices of the subsystems at some future time, by taking partial trace of the density matrix describing the complete interacting system. In this poster, we present the mechanisms which generate relaxation of a bipartite system composed of two harmonic oscillators A and B. Both the systems A and B are initially at equilibrium at temperatures T1 and T2 respectively, and are assumed to be uncoupled. We apply a general interaction Hamiltonian for some time interval t, and study how the two subsystems evolve under this operation. After successive application of the interaction Hamiltonian, we expect that, for each oscillator, the initial Boltzmann distribution will be replaced by another Boltzmann distribution at a new equilibrium temperature. We calculate this new temperature by numerical methods.

CICCARELLO Francesco *Talk: Tue 12:20 B*

Teleportation of atomic states via cavity QED and position measurements

M. Tumminello, F. Ciccarello
University of Palermo

We present a scheme for conditionally teleporting an unknown atomic state in cavity QED which requires two atoms and one cavity mode. The translational degrees of freedom of the atoms are accounted for using the optical Stern-Gerlach model. We show that successful teleportation with probability 1/2 can be achieved through local measurements of the cavity photon number and atomic positions. Neither Bell-state measurement nor holonomous interaction time-constraints are required.

CIOBANU Nellu *Poster*

Entropy Evolution of Two Radiators in interaction with Cavity Field

Nellu Ciobanu and Nicolae A. Enaki
Institute of Applied Physics, Academy of Sciences of Moldova

Over the past decade a greet attention is devoted to quantum mixing of two-subsystems which enter in interaction. Modern experiments in quantum electromagnetic cavity have achieved the exceptional circumstance of strong coupling for which single quanta can profoundly impact the dynamics of the atom-interaction impact. Moreover the regime of strong coupling, in which coherent quantum interactions between atoms and cavity field dominate dissipation, offers a unique setting for the study of open quantum systems. We develop a theoretical model of trapping effects for the cooling atom in an optical trap inside an optical cavity, as relevant to recent experiments. Here we open the possibilities for investigations of optical processes with single atoms and photons in lithographically fabricated microresonators. In this paper we present a new quantum model for a three-level atom in V- configuration interacting with cavity radiation. We found the conditions for which the radiator and cavity field become factorized in the process of evolution. These factorized states describe the possibilities of reversibility between the two quantum oscillators in interaction processes. If the flying time through the micro cavity coincides with the reversible time, the system formed from two quantum oscillators becomes disentangled. In opposite case the system remains entangled. The temporal behavior of Shannon entropy is studied in this difficult interaction between two quantum oscillators with different nature.

COMPAGNO Giuseppe *Talk: Tue 11:00 B*

Decoherence induced by finite time measurements

Bruno Bellomo, Giuseppe Compagno, Francesco Persico
Department of Physical and Astronomical Sciences - University of Palermo

When a free particle interacts with a field in its vacuum state, it is subject to dynamical dressing which is connected with the zero point field induced decoherence [1]. Finite time measurements on a fully dressed particle are known to be able only to observe the particle as not fully dressed [2]. Here we investigate if this effect may give place to a loss of coherence in the observation of the interference of fully dressed states. To this purpose We consider a Young like experiment where a fully dressed particle is first diffracted and then observed by a measurement process lasting a finite time. We show that the result of these measurements produces a reduction of the visibility of the observed interference fringes interpreted as a loss of coherence.

[1] B. Bellomo, G. Compagno and F. Petruccione, Phys. Rev. A 74 052112 (2006).
[2] G. Compagno, R. Passante and F. Persico, Atom-Field Interactions and Dressed Atoms, (Cambridge University Press) (1995).

CONTRERAS-REYES Ana *Poster*

Quantum Electrodynamics of an atom in front of a dielectric slab

Ana Contreras-Reyes and Claudia Eberlein
University of Sussex

The energy-level shift of a ground state atom that is located near a non-dispersive and non-dissipative dielectric slab is calculated. The shift is due to the interaction of the atom with electromagnetic field fluctuations, which are affected by the presence of the slab. The calculation is done by quantizing the electric field by means of a normal-mode expansion and applying second-order perturbation theory to the interaction Hamiltonian. We also check for completeness of the modes, which in past papers has simply been assumed to be satisfied for this system. It is shown that the contribution coming from traveling modes can be transform into a sum over the poles of the reflection coefficient, which are related to the dispersion relations of the trapped modes. Therefore, it is possible to combine contributions coming from both traveling and evanescent modes.

CORSO Pietro Paolo *Poster*

Evidence of Nuclear Motion in Hydrogen-like molecules by means of high Harmonic Generation

G. Castiglia, P.P. Corso, R. Daniele, E. Fiordilino, F. Morales, G. Orlando, F. Persico
CNISM and Dipartimento di Scienze Fisiche ed Astronomiche and Dipartimento di Fisica e Tecnologie Relative

We study the dynamics of one dimensional hydrogen-like molecules subjected to an intense laser field using a semiclassical model in which the two electrons are described as quantum particles interacting with classical nuclei. The dynamics of the nuclei is given by two coupled Newton equations of motion taking into account the interaction with the electron clouds. Such an interaction is responsible for nuclear vibrational motion whose frequency scales as $1/\sqrt{M}$. The emitted spectra take clear evidence of such oscillations showing a series of sidebands around the odd harmonic peaks, regularly spaced. In this way it is possible to use the high order harmonic generation spectra as a tool to investigate the nuclear motion.

D'ANGELO Milena *Talk: Fri 12:30 B*

Is entanglement indispensable for quantum lithography?

Milena D'Angelo
Univ. degli studi di Bari

We analyze the two-photon image produced in a lithographic setup both by entangled two-photon and by coherent and chaotic radiation, with a particular emphasis on the different physics behind the three processes. Our analysis indicates that classical light cannot simulate the effect of quantum lithography: only the peculiar nature of entangled two-photon systems can improve the resolution of a two-photon image by a factor of two. Two-photon diffraction is, in fact, radically different from the diffraction of two independent photons and yields a different spatial resolution: the entangled pair stops in the image plane within a spot twice narrower than the one obtained in classical imaging at the same wavelength.

D'ARRIGO Antonio *Talk: Tue 15:40 A*

Quantum Capacity of a dephasing channel with memory

A. D'Arrigo, G. Benenti, G. Falci
MATIS-INFM, DFMCI-Universita degli Studi di Catania, CNISM, CNR-INFM and Center fo Nonlinear and Complex Systems Università degli Studi dell'Insubria, INFN Sezione di Milano

Quantum channels with memory are the natural theoretical framework for the study of any quantum communication system suffering from noise with correlation times longer that the time between consecutive uses. We show that the amount of coherent quantum information that can be reliably transmitted down a memory dephasing channel - a model relevant for systems in which relaxation is much slower than dephasing- is maximized by separable input states. In particular, we model the channel as a Markov chain or a multimode environment of oscillators. While in the first model the maximization is achieved for the maximally mixed input state, in the latter it is convenient to exploit the presence of a decoherence-protected subspace generated by memory effects. We explicitly compute the quantum channel capacity for the first model while numerical simulations suggest a lower bound for the latter. In both cases memory effects enhance the coherent information.

DAVIDOVIČ Milena *Talk: Fri 12:10 B*

Should particle trajectories comply with transverse momentum distribution?

Milena Davidović [1], Dušan Arsenović [2], Mirjana Božić [2], Angel S. Sanz [3] and Salvador Miret-Artes [3]
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[2] *Institute of Physics, Belgrade, Serbia*
[3] *Instituto de Matematicas y Fisica Fundamental, Madrid, Spain*

Quantum interference experiments with beams of one per one particle have intensified theoretical search of the forms of particle trajectories behind an interference grating [1-5]. The aim of all approaches is to get consistency between quantum mechanical particle distribution and the distribution associated with particle's trajectories. In this paper we compare the features of Feynmann's paths, the de Broglie-Bohm's (BB) trajectories and of trajectories determined using momentum distribution (MD trajectories) associated with a particle wave function. The BB trajectories reproduce perfectly quantum mechanical distribution in the far field as well as in the near field [1,3,5]. The consistency of the set of BB trajectories in the near field behind a multiple slit grating with Talbot effect is remarkable [5]. We investigate in this paper consistency of BB trajectories with transverse momentum distribution associated with particle wave function. We find that there is the consistency in the far field. In the near field the distribution of transverse momenta associated with BB trajectories change with the distance from a grating. Essential feature of BB deterministic trajectories is that particle passing through different slits may not reach the same point at the screen [1]. But, MD trajectories from different slits may reach the same point on the screen [2,4]. This property is a consequence of contextuality in addition of probabilities in QM [2]. Momenta of particles moving along MD trajectories are distributed in accordance to the momentum distribution determined by the particle wave function. MD trajectories reproduce well quantum mechanical space distribution in the far field. It seems that better agreement of MD trajectories in the near field could be obtained by combining peaces of various BB trajectories [5], understood as lines of a quantum mechanical current.

[1] R. Guantes, A.S. Sanz, J. Margalef-Roig and S. Miret-Artes, Surf. Scie. Rep. 53 (2004) 199.
[2] D. Arsenovič, M. Božič and L. Vukovič, J. Opt. B: Quantum Semiclassical Opt. 4 (2002) S358.
[3] M. Gondran and A. Gondran, Am. J. Phys. 73 (2005) 507.
[4] M. Božič and D. Arsenovič, Acta Physica Hungarica B 26/1-2 (2006) 219.
[5] A.S. Sanz and S. Miret-Artes, arXiv.quant-ph/0702224 (2007).

DAVIDOVIĆ Dragomir *Talk: Tue 11:40 B*

Scaling invariance of the Husimi distributions - possible physical implications

Dragomir M. Davidović [1] and Milena D. Davidović [2]
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A rigorous proof is given that, after scaling with a parameter smaller than unity and corresponding renormalization, any Husimi distribution remains in the class of Husimi distributions. It is also shown that no other quasidistribution from the Cohens class has this property. Purely mathematical scaling transformation is related to a concrete physical processing of the quantum state, namely, it is shown that this transformation may be physically interpreted as the Glauber most quiet phase insensitive amplification of the initial quantum state. So, Glauber amplification process [1] may be considered as one possible concrete model for decoherence of a quantum state, but of course not the unique model. It is shown that with decreasing of the scaling parameter, the initial quantum state becomes more and more close to the quantum state which behaves classically, in the sense as defined earlier in [2]. The possibility to relate the value of the scaling parameter and its magnitude with the closeness of state to classical state, is also discussed.

[1] R. Glauber Ann.NY Acad.Sci. 480 (1987) 115
[2] D.M.Davidovic and D.Lalovic J.Phys.A:Math.Gen. 31 (1998) 2281

DE GUISE Hubert *Talk: Mon 18:00 A*

Picturing the Wigner function of angular momentum intelligent states

Hubert de Guise and Ryan Vilim
Department of Physics, Lakehead University, Thunder Bay, ON, P7B 5E1 Canada

We present a pictorial survey of Wigner functions on the sphere for angular momentum intelligent states.

DE SIENA Silvio *Talk: Tue 15:00 A*

Study of quantum correlations in nonclassical entangled states

F. Dell'Anno, S. De Siena, F. Illuminati
Dipartimento di Matematica e Informatica, Università di Salerno

We study the entanglement properties, and their role in the framework of Quantum Information, of some nonclassical states associated both to continuous and to discrete variables.

DEGIOVANNI Ivo Pietro *Poster*

Separability and Ghost Imaging in Multimode-Thermal-Seeded Parametric-Down-Conversion

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Ghost imaging consists in the capability of retrieving an object transmittance pattern by the evaluation of a fourth-order correlation function at the detection planes of a light field which has never interacted with the object and a correlated one that passed through the object [1]. A general ghost-imaging scheme involves a source of correlated bipartite field and two propagation arms usually called Test (T) and Reference (R). In the T-arm, where the object is inserted, a bucket (or a pointlike) detector measures the total light transmitted by it. The R-arm contains an optical setup suitable for reconstructing the image of the object and a position-sensitive detector. Nowadays it is ascertained that ghost imaging can be performed with light in bipartite states both inseparable, such as those from spontaneous parametric down-conversion (PDC) [1], and separable, such as those from a multi-mode pseudo-thermal (MMPT) source divided by a beam-splitter [2, 3, 4]. Several papers discuss analogies and differences between the two cases, for instance in terms of achievable visibility and optics of the imaging configuration [5,6,7]. In particular several authors claim that the fulfilment of the Klyshkos thin-lens equation, which is necessary for systems utilizing spontaneous PDC, is a clear signature of the quantum (entangled) nature of the light source [6, 8, 9]. Here we demonstrate that PDC seeded with two MMPT fields generates a bipartite correlated state, whose separability properties can be controlled by changing the seed intensities [10]. This kind of light allows ghost-image reconstruction with the same optical setup as that of systems exploiting spontaneous PDC, thus obeying the thin-lens equation. Actually we already demonstrated that such a setup works with the inseparable state generated by PDC seeded with a single MMPT field [11].

[1] T. B. Pittman, et al., Phys. Rev. A 52, R3429 (1995)
[2] A. Valencia, et al., Phys. Rev. Lett. 94, 063601 (2005).
[3] D. Zhang, et al., Opt. Lett. 30, 2354 (2005).
[4] F. Ferri, et al., Phys. Rev.Lett. 94, 183602 (2005).
[5] A. Gatti, et al., Phys. Rev.Lett. 93, 093602 (2004).

[6] De-Zhong Cao, et al., Phys. Rev. A 71, 013801 (2005).
[7] M. DAngelo, et al., Phys. Rev. A 72, 013810 (2005).
[8] Y. Cai, et al., Opt. Lett. 29, 2716 (2004).
[9] Y. Cai, et al., Phys. Rev. E 71, 056607 (2005).
[10] I.P. Degiovanni, in preparation
[11] E. Puddu, et al., Opt. Lett., in press.

DI PIAZZA Antonino *Talk: Tue 12:00 A*

Nonlinear interaction of strong laser fields in vacuum

A. Di Piazza, K. Z. Hatsagortsyan, and C. H. Keitel
Max-Planck-Institute for Nuclear Physics

Quantum electrodynamics predicts that electromagnetic fields interact among each other also in vacuum. We study the possibility to reveal experimentally this interaction by using soon available laser fields with intensities of order of 10^{24}-10^{25} W/cm^2. In particular, we show that by making to collide two ultrastrong laser pulses then high-order harmonic generation occurs in vacuum. The experimental feasibility of the related process of light-by-light scattering is also investigated [1]. Finally, the importance of including the diffraction effects in the description of the nonlinear interaction between two strong laser pulses in vacuum is pointed out [2].

[1] A. Di Piazza, K. Z. Hatsagortsyan, and C. H. Keitel, Phys. Rev. D **72**, 085005 (2005).
[2] A. Di Piazza, K. Z. Hatsagortsyan, and C. H. Keitel, Phys. Rev. Lett. **97**, 083603 (2006). See also hep-ph/0602039.

DIMITRIJEVIĆ Jelena *Poster*

Width of electromagnetically induced absorption in a Doppler broadened medium

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Institute of physics, 11080 Belgrade, Serbia

We have studied theoretically interaction between the linearly polarized laser light and Zeeman sublevels for $^2S_{1/2}F_g = 2 \rightarrow^2 P_{3/2}F_e = 3$ transition in ^{87}Rb. We present the behavior of amplitudes and widths of electromagnetically induced absorption (EIA). Calculations were done for Hanle configuration in Doppler broadened medium by solving optical Bloch equations. The results show maximums for both amplitudes and widths for laser intensities at $1 - 2$ mW/cm^2. Recent experiments [1] agree with our results. We also show non vanishing EIA amplitude, non-monotonic increase of EIA width and large changes of shape of Hanle EIA curves with the laser intensity. These features are entirely due to Doppler broadening.

[1] M. M. Mijailović, J. Dimitrijević, A. J. Krmpot, Z. D. Grujić, B. M. Panić, D. Arsenović, D. V. Pantelić, B. M. Jelenković, Opt. Exp. **15**, 1328 (2007).

DUSEK Miloslav *Talk: Mon 12:00 A*

Various experimental realizations of symmetric and asymmetric phase-covariant quantum cloners

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We compare several optical implementations of phase covariant $1 \rightarrow 2$ cloning machines for equatorial states of a qubit. In the first set of experiments qubits were represented by polarizations of photons created in the process of spontaneous parametric down-conversion. The probabilistic cloning operation was based on the use of a beam splitter with different splitting ratios for vertical and horizontal polarization components. In one implementation this beam splitter was emulated by a Mach-Zehnder interferometer in the other one we used a custom-made dielectric beam splitter. We also implemented a cloner based on the state filtering. It used a balanced beam splitter followed by glass plates introducing polarization dependent losses. In the second set of experiments the state of each qubit was encoded into a single photon which could propagate through two spatial modes (fibers). Realization of cloning transformation utilized a fiber interferometric setup with variable ratio couplers.

FACCHI Paolo *Talk: Sun 11:20 A*

Master equation and initial factorization

P. Facchi, G. Kimura, H. Nakazato, I. Ohba, S. Pascazio, S. Tasaki and K. Yuasa,
Università di Bari, Waseda University Tokyo

We analyze the dynamics of a quantum mechanical system in interaction with a reservoir when the initial state is not factorized. In the weak-coupling (van Hove) limit, the dynamics can be properly described in terms of a master equation, but a consistent application of NakajimaZwanzigs projection method requires that the reference (not necessarily equilibrium) state of the reservoir be endowed with the mixing property.

FERMANI Rachele *Talk: Sat 12:00 B*

On the feasibility of studying vortex noise in 2D superconductors with cold atoms

Stefan Scheel, Rachele Fermani, and E.A. Hinds
Quantum Optics and Laser Science, Blackett Laboratory

We investigate the feasibility of using ultracold neutral atoms trapped near a thin superconductor to study vortex noise close to the Kosterlitz-Thouless-Berezinskii transition temperature. Alkali atoms such as rubidium probe the magnetic field produced by the vortices. We show that the relaxation time T1 of the Zeeman sublevel populations can be conveniently adjusted to provide long observation times. We also show that the transverse relaxation times T2 for Zeeman coherences are ideal for studying the vortex noise. We briefly consider the motion of atom clouds held close to the surface as a method for monitoring the vortex motion.

FERRARO Elena *Talk: Sat 11:20 A*

A criterion for entanglement in two two-level systems

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Dipartimento di Scienze Fisiche ed Astronomiche, Università di Palermo, via Archirafi 36, 90123 Palermo, Italy

To establish whether a multipartite system exhibits entanglement is surely a basic task in the context of many physical contexts. In principle after reconstructing the quantum state we can apply some separability criteria even if it would be highly desirable to have at disposal criteria to verify the presence of quantum correlations on the basis of measurements of few physical observables. Focusing our attention on two two-level systems, we demonstrate the possibility to infer the presence of entanglement by verifying simple conditions involving few physical observables easily measurable in laboratory. More in detail we prove the existence of a necessary and sufficient condition for entanglement, simple enough to be of experimental interest. Our results are finally exploited in the context of a specific physical system, namely a spin star system, in order to analyzing its entanglement evolution.

FILIPP Stefan *Talk: Fri 18:00 B*

Ultra Cold Neutrons and the Stability of the Geometric Phase

Stefan Filipp
Atominstitut, TU Wien

In recent years there has been broad interest in the concept of the geometric phase. This phase is a property of the geometry of the state space of a quantum system only. Theoretical investigations show that due to this fact the geometric phase is more resilient to certain types of noise spoiling the ideal evolution of the system than the dynamical phase which depends explicitly on the evolution time and the energy. Due to their weak environmental coupling and their intrinsic spin-1/2 structure neutrons are particularly suited for fundamental tests of quantum mechnanics. In particular, trapped ultra-cold neutrons can be used for the experimental verification of the robustness of the geometric phase.

FIORDILINO Emilio *Poster*

H_2^+ harmonic spectra as a tool to study the nuclear motion

G. Castiglia, P.P. Corso, R. Daniele, E. Fiordilino, F. Morales, G. Orlando and F. Persico
CNISM and Dipartimento di Scienze Fisiche ed Astronomiche and Dipartimento di Fisica e Tecnologie Relative

The high harmonic generation spectra emitted by hydrogen molecular ion H_2^+, in the presence of an intense radiation field, are a good tool for investigating the nuclei dynamics. We study the dynamics of the simple onedimensional molecular ion using a full quantum approach, which means we assume as quantum degrees of freedom for the system both electron and internuclear distance coordinates. Under these assumptions, the motion of the electron cloud stimulates molecular vibrations. Such vibrations are responsible for the presence of sidebands around odd harmonics of the emitted spectra, whose spacing is directly related to period of nuclei vibrations. Such a result is in good agreement with analogous results previously obtained with a semiclassical model. These features points toward the possibility to investigate the dynamics of the system trhough the observation of the emitted radiation.

FLORIO Giuseppe *Talk: Mon 11:40 B*

Multipartite entanglement characterization of a quantum phase transition via probability density function

G. Florio, P. Facchi, G. Costantini, S. Pascazio
Università di Bari and INFN Sezione di Bari

A probability density characterization of multipartite entanglement is introduced and tested on several classes of states and on the one-dimensional quantum Ising model in a transverse field. The average and second moment of the probability distribution are numerically shown to be good indicators of the quantum phase transition. We comment on multipartite entanglement generation at a quantum phase transition.

GENES Claudiu *Talk: Sun 11:20 B*

Quantum effects in optomechanical systems

Claudiu Genes, Paolo Tombesi, David Vitali
Università di Camerino

Optomechanical systems such as the one formed by a quantized cavity field and a moving end-mirror, or a free space classical laser field scattered off an oscillating mirror are investigated with the purpose of performing ground state cooling and quantum information exchange among mechanical and optical modes. In the field of cooling, the cold damping technique, a feedback induced cooling method is compared to the cavity-detuning-induced method and similar limitations are found. With the purpose of producing optomechanical entanglement, a regime in which sidebands of a free or cavity trapped field are produced, during the interaction with the moving mirror, is analyzed. In the free space setup, steady state sideband entanglement that survives the destructive action of the brownian noise is found, while the cavity case presents an interesting 'self-pulsing' behavior where strong coupling between sidebands and the mirror can be achieved. In the limit of large cavity length, some conclusions apply to the LIGO setup.

GENET Cyriaque *Talk: Tue 9:30*

Casimir in the nanoworld

Cyriaque Genet
Laboratoire des Nanostructures (CNRS, ULP), Strasbourg

Casimir force is an important prediction of quantum field theory. The associated attraction between objects scattering vacuum field fluctuations is signifcant for scatterers at sub-micronic distances. It thus plays a key role in nano-machines integrating mechanical elements.

GHIU Iulia *Talk: Mon 11:20 B*

Probabilistic implementation of a two-output quantum processor for quDits

Iulia Ghiu [1] and Gunnar Bjork [2]
[1] *University of Bucharest, Romania,*
[2] *Royal Institute of Technology (KTH), Kista, Sweden*

We propose two different implementations of an asymmetric two-output probabilistic quantum processor, which can implement a restricted set of one-qubit operations. One of them is constructed by combining asymmetric telecloning with a quantum gate array. The schemes require only local operations and classical communication, presenting the advantage of transmitting the two output states directly to two spacially separated receivers. Further we generalize the two schemes for D-dimensional systems.

GIORGI Gian Luca *Talk: Sat 17:40 B*

Bose-Einstein Condensation in coupled photon systems

Ferdinando de Pasquale, Gian Luca Giorgi, Simone Paganelli
Università La Sapienza,CNR-INFM Centro di Meccanica Statistica e Complessità, Università dell'Aquila

Bose-Einstein condenstates in restricted geometries are currently considered as macroscopic quantum systems suitable for quantum information processing. We show that two coupled photon systems exhibit, under realistic conditions, the same properties of BEC systems. Under particular condition the vacuum state is unstable with respect to a perturbation (symmetry-breaking field) which can be associated to a fixed classical current. The new ground state exhibits BEC and squeezing. In the new ground state, as a result of squeezing, the systems are entangled. We study the statistical correlation of the two system both in the steady state and in the quantum oscillation regime as a function of the symmetry-breaking field. Peculiarities of a vanishing small symmetry-breaking field limit (Goldstone theorem) are discussed. A comparison with a different model of photon superfluid is carried out.

GLADUSH Yuriy *Poster*

Wave pattern generated in a stationary flow of Bose-Einstein condensate past an obstacle

Yu.G. Gladush, G.A. El, A. Gammal, A.M. Kamchatnov
Institute of Spectroscopy of Russian Academy of Sciences

In framework of Gross-Pitaevskii mean-field approximation we investigate a supersonic flow of Bose-Einstein condensate past obstacle generated by a laser beam. It is shown that occurring wave pattern consists of two regions – one filled in by nonlinear wave inside Mach cone and another one outside the Mach cone where linear "ship waves" propagate. The developed analytical theory is confirmed by numerical simulations.

GLADUSH Maxim *Poster*

Emission spectra and intrinsic optical bistability in a dense two-level medium

M.G. Gladush, Vl.K. Roerich, A.A. Panteleev
State research center of Russian Federation, Troitsk Institute for Innovation and Fusion Research

Scattering of resonant radiation in dense two-level media is studied theoretically with account for local field effects and collective relaxation. Complex intrinsic optical bistability is considered as switching between different spectral patterns of fluorescent light controlled by intensity of the pump field. Response spectra are calculated for the hysteresis loop of atomic excitation. The spectral triplets are shown to have density-dependent line shifts and redistribution of intensities between the central and side components. The equations to describe the non-linear interaction of an atomic ensemble with light are derived from the Bogolubov-Born-Green-Kirkwood-Yvon hierarchy for reduced single particle density matrices of atoms and quantized field modes and their correlation operators. The equation for spectral intensity of scattered light with separated coherent and incoherent constituents is obtained straightforwardly within the hierarchy. The analytical expressions for the steady-state spectra are given for the critical regions of the bistable response.

GLUSHKOV Alexander *Poster*

Modelling a populations differences dynamics of the resonant levels of atoms in a non-rectangular form laser pulse: New manifestation of the optical bistability effect

A. Glushkov
Odessa University

Present paper has for an object (i) to simulate numerically a temporal dynamics of populations' differences at the resonant levels of atoms in a large-density medium in a nonrectangular form laser pulse and (ii) to determine possibilities that features of the effect of internal optical bistability at the adiabatically slow modification of effective filed intensity appear in the sought dynamics. It is known that the dipole-dipole interaction of atoms in dense resonant mediums causes the internal optical bistability at the adiabatically slow modification of radiation intensity [1-4]. The experimental discovery of bistable cooperative luminescence in some matters, in crystal of Cs3Y2Br9Yb3+ particularly, showed that an ensemble of resonant atoms with high density can manifest the effect of optical bistability in the field of strong laser emis-sion [1]. The Z-shaped effect is actually caused by the first-type phase transfer. Most attractive potentialities of sought effect are associated with the development of new system for op-tical information processing as well as with the creation of optical digital and analog processors. The

creation of optical computer with an optical radiation as the data carrier excludes the necessity in the multiple transformation of electric energy into optical one and vice-versa. This consequently leads to the energy saving and abrupt increase of computer speed. The progress in the stated areas is especially defined by the creation of optical ele-ments for the computer facilities on basis of optical bistability phenomenon [1]. On basis of the modified Bloch equations, we simulate numerically a temporal dynamics of populations' differences at the resonant levels of atoms in the field of pulse with the nonrectangular ch-1t form. Furthermore, we compare our outcomes with the results [3], where there are considered the interaction between the ensemble of high- density atoms and the rectangularly- and sinusoidally-shaped pulses. The modified Bloch equations describe the interaction of resonance radiation with the ensemble of two-layer atoms taking into account the dipole-dipole interaction of atoms. A fundamental aspect lies in the advanced possibility that features of the effect of internal optical bistability at the adiabatically slow modification of effective filed intensity for pulse of ch(-1)t form, in contrast to the pulses of rectangular form, appear in the temporal dynamics of populations' differences at the resonant levels of atoms. We use the modified Bloch equations, which describes the interaction of resonance radiation with the en-semble of two-layer atoms subject to dipole-dipole interaction of atoms. We carried out the numerical modeling using the program complex "Superatom"[2,3]. The temporal dynamics for the popula-tions' (n = N1 - N2 ; the populations' differences at the resonant levels) differences at the resonant levels of atoms in a nonrectangular form 1/ch pulse field has been studied. In the numerical experiment t varies within 0<t/T1<Tp/T1 and Tp is equal to 101 (T1 is the lon-gitudinal relaxation time). It is shown that on the assumption of b> 4 and b > —d— (b ∼m**2 N T2/2h is the constant of dipole-dipole interaction, d = T2(w - w21) is the offset of the frequency w of effective field from the frequency of resonance transition w21; N is the density of resonance atoms, m is the dipole moment of transition) with d < 0 (the long-wavelength offset of incident light frequency is less than Lorenz frequency wL = b/T2) and if the intensity of light field has certain value I then there are three epositive stationary states n (two from them with maximal and minimal value of n are at that stable). This can be considered as evidence and manifestation condition of the internal optical bistability effect in the system. We present the results of our numerical modeling the temporal dynamics of populations' differences at the resonant levels of atoms for the nonrectangular, rectangular- and sinusoidal shaped pulses. The increase of field intensity above certain value I = 2.5 for selected parameters leads to the abrupt increase of populations' differences. This fact represents the Z-shaped pattern of dependence n(I) observed in the stationary mode. It is important to note that there is the significant difference between the model results for the pulses of various forms. For given values of rectanularly-shaped pulse intensity, which is equal to several values of T1, the dependence n(t) tends to stationary state with magnitude defined by zero values of the Bloch eqs.right-hand terms). For the sinusoidally-shaped pulse, the slow rise of intensity is typical, and the explicit hysteresis pattern for the dependence of populations' differences from the field intensity is obtained. For the nonrentagular pulse the sought effect looks more ex-plicitly. This is especially important from the standpoint of using the sought effect to simulate efficient neural networks and their components. Substantial fact also is the implementation of hysteresis in the dependence of populationsdifferences from the field intensity if a threshold values for b and d<0 have a place. This corresponds to the situation when the frequency of radiation w is within the range, which is formed by the proper frequency w21 and a frequency with the local-field correction w21*=w21-4pim(**)2 N/3h. Note that if above mentioned fre-quencies are almost equal or, e.g., a multimode electromagnetic field (chaotic light) is used, a stochastic resonance can be observed in the analyzed system. So, for a case of nonrentagular laser pulse it has been found a strengthen possibility of manifestation of the internal optical bi-stability effect special features in the temporary dynamics of populations for the atomic resonant levels under adiabatic slow changing the acting field intensity in comparison with a case of the rectangular form pulses.

[1] H. M. Gibbs Optical Bistability: Controlling Light with Light. New York: Academic Press, 1985, 471 pp.

[2]. A. V. Glushkov, L. N. Ivanov, Phys. Lett. A. 170, 33 (1992); J. Phys. B: At. Mol. Opt. Phys., 26, L379 (1993); A.V.Glushkov, A.Loboda, J.Appl.Spectr. 74, N2 (2007).

[3]. A.V. Glushkov, S.V. Malinovskaya, In: New projects and new lines of research in nuclear physics. Eds. G.Fazio and F.Hanappe, Singapore : World Scientific, 2003, p.242-250.

[4]. A.Glushkov, O.Yu.Khetselius, Sensor Electr. Microsyst.Techn. 4, 31 (2007).

GLUSHKOV Alexander *Talk: Mon 18:20 A*

Optics and spectroscopy of cooperative laser-electron nuclear processes in atomic, molecular and cluster systems - new trend in quantum optics

A. Glushkov, S.Malinovskaya
Odessa University

A new class of problems has been arisen in quantum optics and connected with modelling the cooperative laser-electron-nuclear phenomena in the atomic, molecular and cluster systems in a presence of super intense laser field. It includes a calculation of the probabilities and energies of the mixed gamma-optical quantum transitions in atomic, molecular, cluster systems, intensities of the complicated gamma-transitions due to the changing of the atomic excited states population due to an action of laser radiation, quantum mechanical calculation of the complex "laser-electron-nuclear" systems [1-3]. The nuclear emission or absorption spectrum of the atomic system possesses a set of electron satellites, which are due to an alteration of the state of electron shell. The mechanism of forming satellites in different systems (neutral atom, highly charged ion) is different. In the first case (loose electron shell) a shaking of the shell resulting from the interaction between the nucleus and g quantum is predominant. In the second case (rigid electron shell) the mechanism involves a direct interaction between gamma quantum and electrons. The second mechanism is important in the case of dipole nuclear transitions and dominates at g quantum energies <4 z keV (z is effective nuclear charge). The traditional selection rules and familiar intensity hierarchy with respect to electron transition multiplicity do not pertain to the second mechanism. So, the satellite spectrum is much enriched and transitions between the fine and hyper fine structure components, 0-0 transitions and transitions, which do not involve a change in the electron configuration, can be considered. We at first develop a new, consistent, QED approach to calculation of the electron-nuclear gamma transition spectra (set of vibration satellites in molecule) of nucleus in atomic system, based on the relativistic multielectron formalism and energy approach (S-matrix formalism of Gell-Mann and Low) [2,3]. Within an energy QED approach with QED scattering matrix, a decay probability is presented as an imaginary part of the energy shift. The intensities of satellites are linked with imaginary part of the nucleons-electron shells-electromagnetic field system. For radiative decays it is manifested as effect of the retarding in interaction and self-action. In the second QED PT order a full width of level is divided into the sum of the partial contributions, connected with the radiation decay into definite final states of system. These contributions are proportional to the probabilities of the corresponding transitions. The system of red (blue) satellites corresponds to the transitions with excitation (de-excitation) of the electron shell. As example, the nuclear transition in the isotope (57)Fe with energy 14,41 keV is considered for O-and F-like ions of Fe [2]. It is shown that the electron-nuclear lines in spectra of emission or absorption can be experimentally observed in plasma of the O-and F-like multicharged ions and it is very important that they are not overlpping by the Doppler broadening. Such a situation may be realized in the thermalized plasma of multicharged ions. Calculation results of the electron-nuclear gamma -transition spectra of a nucleus in some multiatomic systems are given too. In particular, we present the detailed studying a spectrum of emission and adsorption of nucleus (127)I (E=203keV) in molecule HI. Estimates are made for vibration-nuclear transition probabilities for set of molecules: diatomics, 3-atomic XY2 (Dh), 4-atomic XY3(D3h), 5-atomic XY4(Td), 6-atomic XY3Y2 (D3h), 7-atomic XY6(Oh) ones too. We present the results of studying the electron-nuclear gamma -transition spectra of a nucleus in the carbon, alkali atoms clusters in neutral form and also single-, double-charged ones. Calculation is carried in the basis of the density-functional (DF) [1] and relativistic perturbation theory (PT) with the DF zeroth approximation [3]. Preliminary results are presented for single buckminsterfullerene (C60) system too.

[1]. L.N.Ivanov, V.S.Letokhov, JETP. 93, 83 (1987); L.N.Ivanov, E.P.Ivanova, E.V.Aglitsky, Phys. Rep. 166, 315 (1988); A.V.Glushkov, L.N.Ivanov, Phys.Lett.A. 170,33 (1992);
[2]. A.V. Glushkov and S.V. Malinovskaya, In: New projects and New Lines of Research in Nuclear Physics, eds. G.Fazio and F.Hanappe (World Pub., Singapore), 2003,p.242-264; Int. J. Quant. Chem. 99, 889 (2004).
[3]. A.V.Glushkov, et al, Int. Journ.Quant.Chem. 99, 936 (2004); 104, 486 (2005); 104, 512 (2005); 105, 562 (2005); J.Phys. CS 178, 199 (2005); 35, 420 (2006); Recent Advances in Theory of Phys. and Chem. Systems (Springer), Eds. J.Maruani, J.-P.Julien, 15, 286 (2006).

GUZMAN ESTRADA Robert Paul *Poster*

Two photon generation with trapped ions: spectral properties

R. GUZMAN, J. C. RETAMAL
Universidad de la Frontera

Spectral properties of two photons, generated using trapped ions in a cavity, are studied. Both, spontaneous emision and cavity losses effects are considere in order to obtain a more realistic description.

HÄRKÖNEN Kari *Poster*

Quantum control over motional states in time-dependent double-well potentials

K. Härkönen, O. Kärki, and K.-A. Suominen
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A method to selectively move populations between motional states in a double-well potential is presented and theoretically examined. The tailoring is done by modulating the geometry of the potential surface in time. The dynamics of the process is interpreted by investigating the energy spectrum of the corresponding time-dependent eigenstate basis, i.e., the adiabatic basis. The central feature is that the system undergoes diabatic jumps between eigenstates, as the two energy levels at issue encounter each other closely enough. Except for these rapid crossings, the evolution is adiabatic. As a conclusion, starting from the motional ground state of one well, the population can be selectively moved to an arbitrary motional eigenstate of either of the two wells at issue. Our treatment is of general nature and it can have various implementations ranging from internal dynamics of molecules to motional dynamics of atomic clouds confined in, e.g., double wells or optical lattices.

HASOVIC Elvedin *Poster*

Simulation of above-threshold ionization experiments with noble gases using the strong-field approximation

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Above-threshold ionization (ATI) of atoms by a strong laser field is an interesting nonperturbative quantum-mechanical phenomenon [1,2]. In this process more photons are absorbed than is necessary for ionization. Since its discovery in 1979, the interest in ATI has been renewed many times. For example, in the nineties several novel phenomena including characteristic features in the angular distributions, a plateau in the electron energy spectra, and resonancelike enhancements of the yield of certain groups of ATI peaks were discovered. With the development of new laser systems and specially designed detectors, it became possible to measure two-dimensional electron momentum spectra. Recently performed ATI experiments with noble gases allow the determination of the complete energy and angular distribution of the emitted photoelectrons. We have developed a numerical code for the calculation of ATI spectra in order to achieve a realistic simulation of ATI experiments with the noble gases He, Ne, Ar, Kr, and Xe. Our method is based on an improved version of the strong-field approximation and includes focal averaging [3]. We will present the ATI energy and angular distribution of the emitted photoelectrons. In particular, we will analyze the effects of channel closings on the high-energy spectra. In this part of the spectrum we have found two types of enhancements and explained them in terms of constructive interference of long quantum orbits. The first type develops for not too long orbits and appears in the form of peaks for laser intensities which are few percentages lower than the channel-closing intensity. The second type of enhancements develops only for very long quantum orbits and appears exactly at the closing of particular channels. The position of these enhancements, in the photoelectron energy - laser intensity plane, shifts to the next channel-closing intensity with the change of the ground-state parity.

[1] W. Becker, F. Grasbon, R. Kopold, D. B. Milosevic, G. G. Paulus, and H. Walther, Adv. At., Mol.,

Opt. Phys. 48, 35 (2002).
[2] D. B. Milosevic, G. G. Paulus, D. Bauer, and W. Becker, J. Phys. B 39, R203 (2006).
[3] E. Hasovic, M. Busuladzic, A. Gazibegovic-Busuladzic, D. B. Milosevic, and W. Becker, Laser Phys. 17, 376 (2007).

HENKEL Carsten *Poster*

Micromaser theory in explicit Lindblad form

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We discuss the laser theory for a single-mode micromaser that is pumped with a dilute stream of excited two-level atoms. In the weak-coupling regime, an expansion in the coupling strength is developed that preserves the Lindblad form of the master equation. This expansion breaks rapidly down above threshold. This can be improved with an alternative approach, not restricted to weak coupling: the Lindblad operators are expanded in orthogonal polynomials adapted to the probability distribution for the atom-laser interaction time. We present results for the photon statistics and the laser linewidth and compare the different approximations.

HRADIL Zdenek *Talk: Sat 9:30*

Tomography for quantum diagnostics

Z. Hradil, D. Mogilevtsev, J. Rehacek
Palacky University, Olomouc

We show that quantum tomography used for the diagnostics of quantum objects cannot be reduced merely to finding the state best representing the data. Relevant errors should be quantified as well by means of the Fisher information matrix. This is illustrated with an example of the diagnostics of non-classicality in terms of the negativity of the Wigner function at the origin. A proper analysis of realistic experimental schemes suggests that some earlier claims of obtaining successful reconstructions of nonclassical states may appear too optimistic. Our resolution measure also provides the necessary tools for optimization and resolution tuning of tomography schemes.

INTRAVAIA Francesco *Talk: Tue 12:20 A*

Dissipation and Non-locality in the Casimir Effect

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The Casimir force is one of the most accessible experimental consequences of vacuum fluctuations in the macroscopic world. It is the most significant force between neutral, non-magnetic objects at distances between the nanometer and the micrometer. Its study is interesting for both fundamental physics and technology: this force indeed can be used as contactless force to actuate nano- or micro-mechanical devices; at the same time it can prevent their correct functioning. During the last years this field has attracted a lot of attention because the force has been measured with modern experimental techniques, achieving an accuracy permitting a precise comparison between theory and experiment [1]. Here we will discuss the Casimir effect between two parallel metallic plates, with emphasis on the role of dissipation and of a non-local current response [2]. We will show in the case of dissipative materials, the Casimir energy can be expressed in terms of a sum-over-modes formula which can be interpreted in light of the theory of a quantum dissipative osciallator [3]. The introduction of non-locality in the theoretical analysis shows an extra contribution to the Casimir force coming the bulk modes living essentially inside the plates. Both aspects play a role for the finite-temperature correction to the Casimir force on which a consensus is currently lacking [4].

[1] S. K. Lamoreaux. The casimir force: background, experiments, and applications. Reports on Progress in Physics, 68(1):201236, 2005.
[2] R. Esquivel-Sirvent, C. Villarreal, W. L. Mochan, A. M. Contreras-Reyes, and V. B. Svetovoy. Spatial dispersion in casimir forces: a brief review. Journal of Physics A: Mathematical and General, 39(21):63236331, 2006.
[3] K. E. Nagaev and M. Buttiker. Ground-state energy fluctuations of a system coupled to a bath. Europhys. Lett., 58:475, 2002.
[4] R. Onofrio. Casimir forces and non-newtonian gravitation. New Journal of Physics, 8(10):237, 2006.

ISAR Aurelian *Talk: Mon 17:00 B*

Quantum fidelity for Gaussian states describing the evolution of open systems

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In the framework of the theory of open systems based on quantum dynamical semigroups, we study the quantum fidelity for Gaussian states, which are an important kind of states of continuous variable systems, intensively applied at present in the field of quantum information processing and communication. We use the Gaussian states to describe the time evolution of a harmonic oscillator interacting with an environment, in particular with a thermal bath. Under the influence of the decoherence phenomenon, which takes place during this interaction, the initial Gaussian pure state, taken of the form of a correlated squeezed state, remains Gaussian, but it becomes mixed. We study the dependence of the quantum fidelity for these states on the initial squeezing and correlation parameters, dissipation coefficient and temperature of the bath.

ISKHAKOV Timur *Talk: Mon 17:20 A*

High-visibility multi-photon interference for classical light

T.Sh.Iskhakov, M.V.Chekhova, I.N.Agafonov
Lomonosov Moscow State University

The classical limit of two-photon interference visibility is 50, but we demonstrate that it is much higher for multi-photon case. In particular, coherent radiation provides third-order and fourth-order interference with 81,8% and 94% visibility, respectively.

IVANOV Svetoslav *Poster*

Transition probabilities and quantum interferences in a coherently driven three-state system

Svetoslav Ivanov, Nikolay Vitanov
Sofia University St. Kliment Ohridski

We calculate the propagator and the transition probabilities for a three-state system, driven coherently by either a constant or a pulse-shaped chirped-frequency field. We assume independent pairwise Landau-Zener transitions occurring instantly in the relevant avoided crossings and adiabatic evolution elsewhere for the constant coupling case. Quantum interferences are identified, which occur due to different possible evolution paths in Hilbert space between an initial and a final state. For the pulsed-shaped field we account also for the nonadiabatic coupling (due to the time dependence), which induces nonadiabatic transitions in two separate regions in the wings of the pulse. These nonadiabatic transitions lead to interferences in the transition probabilities between the three states, which happen to dominate over the quantum interferences due to the different paths between the level crossings. We present a detailed comparison between the analytical solution and the numerical calculations for three pulse shapes: gaussian, hypergaussian and hyperbolic secant, and define conditions for validity of the analytical solution. These results can be verified experimentally in ladder climbing in alkali atoms by chirped laser pulses. They can be also of relevance to transitions between the magnetic sublevels of a J=1 angular-momentum level in a magnetic field. The results for the three-state system can be generalized, without essential difficulties, to higher dimensions.

JAKOB Matthias *Poster*

Dynamics of entangled qubits in a non-Markovian reservoir model

Matthias Jakob
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We study the dynamics of an entangled bipartite qubit system which decays into a non-Markovian reservoir. The qubits are represented by two-level atoms which allow us to utilize a simple model that has been recently introduced for the non-Markovian thermalization of a single qubit [1]. This model leads to an exact non-Markovian master equation of the Nakajima-Zwanzig from and its main advantage is that the generator of motion forms a completely positive map. This ensures that density operators are mapped into density operators which is a property that is not in general satisfied in models of non-Markovian reservoirs [2]. We assume both atoms to be individually coupled to the non-Markovian bath. Consequently, we can treat their dynamical evolution independently according to the equations derived from the model of the single qubit thermalization [1]. The bath, therefore, is not able to entangle the atoms. We numerically study the dynamics of an initially, completely entangled two-atom state in this model. In addition, we investigate the evolution of the quantitative entanglement measure concurrence [3] which features interesting effects that are explicitly caused by the non-Markovian reservoir. In particular, collapses and revivals govern the dynamics of the concurrence of the entangled quantum system. These collapses and revivals are a strong manifestation of the non-Markovian reservoir. Indeed, they are explicitly enforced by the memory effects of the non-Markovian reservoir which remembers to some extent that the system was entangled initially. The revivals may even appear when the reservoir has finite temperature which induces that concurrence dies out at finite times [4]. In this case extended periods of time appear where the concurrence is completely vanishing before it partially revive and this recurs periodically until the concurrence eventually dies out. We finally present a possible realization of this model which is based on two three-level ions that are trapped in an ion trap.

[1] J. Salo, S. M. Barnett, and S. Stenholm, Opt. Commun. 259, 772 (2006).
[2] S. M. Barnett and S. Stenholm, Phys. Rev. A 64, 033808 (2001).
[3] W. K. Wootters, Phys. Rev. Lett. 80, 2245 (1998).
[4] T. Yu and J. H. Eberly, Phys. Rev. Lett. 93, 140404 (2004).

JIMÉNEZ HENRÍQUEZ Omar Alejandro *Talk: Tue 16:00 A*

Experimental scheme for unambiguous discrimination between linearly independent symmetric states.

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[2] *Instituto de Física Universidad de Guanajuato. P. O. Box E-143, 37150, Len Gto. México.*
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We propose an experimental setup for the discrimination between four linearly independent nonorthogonal symmetric quantum states using linear optics. The theory results agrees with Chefles optimum boundary published in Phys. Letts A 250-223. This experimental scheme can be systematically extended for the discrimination between 2^n nonorthogonal symmetric quantum states.

JIVULESCU Anastasia *Poster*

Dynamical localization in 1-D lattices driven by dc-bichromatic electric fields

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[2] *Dipartimento di Scienze Fisiche ed Astronomiche, Università di Palermo, via Archirafi 36, 90123 Palermo, Italy*

We investigate the dynamical localization conditions of a charged particle moving in one dimensional (1-D) lattice under the influence of a dc-bichromatic electric field proceeding beyond the nearest-neighbour description with the help of the quasy-energy description. The analytical formula of the quasi-energy spectrum is derived; also, it is reported its dependence on a parameter called "the electric matching ratio" ω_B/ω. , where $\omega_B = eE_0a/\hbar$ and $\omega = 2\pi/T$ stand for the Bloch and field frequencies.

JOVIC Dragana *Poster*

Three dimensional time-dependent Gaussian induced rotation of beams in optically induced periodic fixed photonic lattices

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Time-dependent rotation of counterpropagating mutually incoherent self-trapped Gaussian beams in periodic optically induced fixed photonic lattices is investigated numerically. For some values of control parameters rotation occurs. The solitonic solutions are found using modified Petviashvili's method for parameters of such rotation. It is shown that they correspond to the lowest values of propagation constant in the power diagrams and relation between observed rotation and less confined discrete solitonic solutions are demonstrated. The parameters characterizing these solitonic solutions, derived for the steady state of governing equations, are those for which Gaussian induced time-dependent rotation occurs.

KÄRKI Ollijuhani *Poster*

Tailoring motional states of strongly interacting Bose-Einstein condensates by means of time-dependent double-well potentials

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University of Turku, Department of Physics

We have previously proposed a method in order to tailor the populations of motional quantum states in an efficient way [1]. It is based on time-dependent double-well potentials and one-component description. In this method, the time-dependence and the whole origin of the double-well potential originates from a three-component system. However, the method in question was designed only for noninteracting systems. As a consequence, it can be successfully applied to weakly interacting systems only. When interactions become strong enough, this method fails. Now we are studying the possibility to generalize this method so that it could be successfully applied to strongly interacting systems. As a specific example, we are interested in strongly interacting Bose-Einstein condensates. Furthermore, we are anxious to know the reasons causing the failure of the previous method. In the absence of interactions, the previous method could be applied with considerable freedom of choice of suitable parameters. In the case of strongly interacting systems, suitable parameter values become much more important. Therefore, we have made a scanning of parameter values, and to each parameter set we have calculated a corresponding time-evolution. In addition, when considering noninteracting systems there is very little difference between the behaviours of 1D and 2D systems. However, when interactions are significant there is a remarkable difference between the behaviours of 1D and 2D systems.

[1] K.Hrknen, O.Krki and K.-A. Suominen, Phys.Rev. A 74, 043404 (2006)

KHETSELIUS Olga *Poster*

Atomic stabilization and generation of ultra-short VUV and X-ray pulses in atomic and cluster systems in a strong laser field

O.Khetselius
Odessa University

An effective approach to adequate treating and sensing a spectral hierarchy and dynamical stabilisation in atomic systems in the intense laser field is considered and based on relativistic operator perturbation theory [1], time-dependent complex rotation method (for atomic systems) and non-Hermitian Floquet formalism (for molecular systems). The stabilization of helium (study of the 2D two-electron atom) in intense high-frequency laser pulses is modelled within the relativistic scheme. It has been carried out modeling generation of the atto-second VUV and X-ray pulses under ionization of atomic (molecular) system by femto-second optical pulse. We present the original results of modeling generation of the atto-second VUV and X-ray pulses under ionization of cluster system in a strong field of laser radiation and predicting the effective regime of generation. We carried out the non-relativistic anr relativistic calculatuin of the stabilization effect for helium (study of the 2D two-electron atom) in intense high-frequency laser pulses. The non-relativistic and relativistic studying of the system gives in fact the same results. For the numerical integrations, we have chosen grids with equidistant spacing of 0.2 au and total sizes ranging between 409.6 and 512.0 au in each spatial dimension; these parameters have been chosen to ensure that the wavepackets can evolve without boundary problems in position space while their maximal momenta are resolved. The ionization probability of the outer electron in dependence of the peak laser electric-field amplitude is calculated; the laser pulses of four optical cycles linear turn-on and four cycles constant intensity of frequency w=1a.u. have been employed. Calculation shows the typical features of stabilization: after a rise in ionization probability with increasing laser peak intensity, ionization is suppressed for a certain intensity regime; after this region of stabilization, the ionization probability rises again with increasing intensity, as expected due to the Lorentz force. At high laser intensities with electron-electron repulsion, the probability for ionization is higher for the outer electron, while at a laser electric field around Eo=5,3au a substantially larger fraction of the inner electron wavefunction ionizes. The largest degree of stabilization is not at the same intensity for both electrons;theouter electron stabilizes best at Eo=8 au,the inner at Eo=10 au maximal electric-field strength. Regarding the role of ionic core, tight binding to the nucleus disturbs the regular motion of the electrons in the laser field. Thus higher laser intensities are necessary for optimal stabilization for the inner electron compared to outer one. Further we present the original results of modelling and predicting the generation of the atto-second VUV and X-ray pulses under ionization of the cluster system N10 in a intense laser field [4]. In ref. [2] the results of our modelling the generation of the atto-second VUV and X-ray pulses under ionization of the cluster system molecular system 2D H2+ by femto-second optical pulse have been presented. We have studied in details the cluster Na10 response, the molecular H2+ response for different internuclear distances 2.5, 3.5, 7.4, 16a.u. (comparison carried out with other calculations [2]) with smoothed Coulomb potential and atomic (H) response (spectral dependence) under ionization of the system by femto-second optical pulse.Our calculation shows that the generation of the atto-second pulses in the cluster system is more effective and profitable (as minimum the 2-3 orders) than in similar molecular atomic one. Correspondingly, we confirmed that the generation of the atto-second pulses in molecular system is more profitable too (as minimum the 1-2 orders) than in similar atomic one. Corresponding spectral dependences of atomic (atom of H) response is also presented.. Last experimental achievements in field of generating high harmonics of optical radiation during atomic ionization by powerful femtosecond laser pulses demonstrated a possibility of construction of the compact sources of VUV radiation.

[1] Glushkov A.V., Ivanov L.N., J.Phys.B. 26, 379 (1993); Glushkov A.V., et al, Int.Journ.Quant.Chem. 99, 936 (2004); 104, 562 (2005).
[2] Emelin M.Yu., Ryabikin M.Yu., Sergeev A.M. et al, JETP Lett. 77, 254 (2003); Fomichev S.V., Zaretsky D.F., Bauer D., Becker W., Phys.Rev. A.71, 013201 (2005).
[3] Glushkov A.V., Khetselius o.Yu., Recent Advances in theory of Phys, and Chem. Systems (Springer) 15, 285 (2006); Khetselius O.Yu., Photoelectronics, 15 131 (2006); Sensor Electr. Microsyst. Techn. 4, 21 (2007).

KIMURA Gen *Poster*

How to estimate a correlation from partial information for quantum mechanical systems

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Division of Mathematics, Graduate School of Information Sciences, Tohoku University

The problem to estimate a possible correlation between the system of interest and an environment only from the measurements of the sub system will be investigated. We show a general method for this purpose in any quantum mechanical systems.

KLIMOV Andrei *Talk: Sat 12:20 A*

Discrete phase-space structure and MUB tomography

Andrei Klimov
Universidad de Guadalajara

Tomographic procedure using Mutually Unbiased Bases offers several advantages with respect to the standard quantum state tomography of finite systems. Nevertheless, the main shortcut of such approach consists in using non-local operations (CNOT gates). In this respect the most appropriate MUB tomography scheme involves the smallest number of non-local gates, which leads to the problem of classification of non-isomorphic set of MUBs. In the standard approach the MUBs are associated with rays in the finite phase space. We show that the admissible MUBs for the N-quibit case are related to the bundles of Abelian commutative non-singular curves and develop a new method of MUBs construction based on the analysis of geometrical structures in the finite phase-space. In the case of N quibits there exist several classes of curve bundles with different properties, lines being a special case. We also consider transformations between different kinds of curves, and show that in the two-qubit case, they all correspond to local transformations, and more specifically they correspond to rotations around the Bloch-sphere principal axes. Nevertheless, in the case of more that two quibits several non isomorphic structures appear, which can be naturally classified in terms of discrete curves bundles. The existence and a possibility of regular searching of non isomorphic MUBs allows us to introduce a concept of complexity of tomographic scheme for state determination of a multy-quibit systems and determine the optimal for tomographic purposes set of MUBs.

KOROLI Vlad *Poster*

Exact periodicity of the squeezing oscillations in a microcavity

V. I. Koroli and V. Zalamaiv
Institute of Applied Physics of the Academy of Sciences of Moldova

We investigate the interaction between the equidistant three-level radiator and the single-mode electromagnetic field. The dipole moment matrix transition elements between the adjacent atomic levels d12 and d23 are assumed to be different. This problem generalizes the model of the pair of indistinguishable two-level atoms examined by Koroli 2007 which is equivalent to the equidistant three-level atom with equal dipole moment matrix transition elements between the adjacent levels. The intensity-dependent coupling is assumed between the three-level atom and the radiation field. In this situation we suppose that at the initial moment the field is in the Holstein-Primakoff SU(1,1) coherent state and obtain the exact analytical solution for the state-vector of the atom-field system. The quantum-statistical and squeezing properties of the field are investigated. The obtained results are compared with those for the single two-level atom model obtained by Vladimir Buzek 1989. We observe that the exact periodicity of the squeezing revivals that was observed in the case of the single two-level atom is violated in the model involving the equidistant three-level radiator with different dipole moment matrix transition elements. In the other words, the exact periodicity of the physical quantities can be destroyed only if the radiation field interacts with a system of more than one two-level atom. The two limiting cases of interest are

considered. In the first case when d12 tends to the d23 the quantum-statistical properties are similar with those for the pair of indistinguishable two-level atoms. In the second one in which the dipole moment matrix transition element d12 tends to zero value takes place the exact periodicity of the squeezing oscillations. This limiting case is equivalent to the system of the single two-level atom.
Koroli V I 2007 International Journal for Quantum Information 8 pages. Buzek V 1989 Phys. Rev. A, V.39, 3196.

KRAMO Aida *Poster*

Above-threshold detachment of electrons from negative ions by a two-color bicircular laser field

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We present numerical results for the above-threshold detachment of electrons from negative ions by a bicircular laser field [1]. The results are obtained within the strong-field approximation. Our bicircular field consists of two counter-rotating circularly polarized fields with angular frequencies equal to r and s times the fundamental laser frequency (r and s are integers). The energy and angle resolved spectra of the detached electron are invariant with respect to a rotation by the angle 360/(r+s) degrees. The results obtained are explained in terms of the interference of contributions to the T-matrix element from different complex solutions of the saddle-point equation.
[1] A. Kramo, E. Hasovic, D. B. Milosevic, and W. Becker, Laser Phys. Lett. 4, 279 (2007).

KUMAR Rakesh *Talk: Tue 16:00 B*

Antibunching of light in interaction of two two-level atoms with a single mode coherent radiation

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In the present paper, we consider interaction of a single mode radiation initially in a coherent state with an assembly of two two-level atoms in some different states using the Hamiltonian, $H = w(a^\dagger a + S_z) + g(aS_+ + a^\dagger S_-)$ in the natural units, where a+ and a are creation and annihilation operators for radiation, Sz, S are the collective Dicke operators, g is the coupling constant, w is the energy of the photons and energy difference between the two atomic levels, and solve it exactly. We study antibunching of radiation, when atoms are fully excited or are in ground state. We find that the case of two excited two-level atoms shows larger antibunching than the case of a single excited two-level atom. Also, we find that there is no definite relationship between squeezing and antibunching of light. We find that for large coupling time gt, Fano factor shows collapses and revivals phenomena. We also discuss variation of Fano factor with square root of mean photon number.

KUMAR Rupesh *Poster*

Two way Quantum communication without entanglement.

Rupesh Kumar, M. Lucamarini, G.D Giuseppe,S.Mancini,D.Vitali and P.Tombesi
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In this poster we present different aspects of a two way quantum communication protocol LM05 and its implementation at telecom wave length over a length of optic fibre. Theoretical background will explain in addition to the experimental setup. Also cover the analysis of the results obtained.

LASTRA PEREZ Freddy Antonio *Poster*

Disentanglement Evolution of bipartite d-dimensional systems

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In this work we study the entanglement evolution of several bipartite d -dimensional systems. We study the case of two qutrits interacting to a common bath at zero temperature in the general Lindblad frame. We also study the case of two-level atoms interacting with an electromagnetic eld in a lossy cavity in the frame of the Dicke Model. The entanglement evolution is studied through a recently proposed analytical lower bound for the Entanglement of Formation (EOF) by Chen, et. al.

LAZAROU Constantinos *Poster*

Non-Markovian Dynamics in Atom-Laser Outcoupling from a double-well Bose-Einstein Cndensate

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The development of a continuous high-flux atom laser remains one of the main goals in the field of atom optics. The most crucial prerequisite for the realization of a continuous atom laser is the pumping mechanism replenishing the trapped condensate as atoms are outcoupled from it. Up to date, perhaps the most promising scheme towards the realization of a continuous source of condensed atoms was demonstrated by the MIT group [1], and relies on the use of optical tweezers for the transport and the merging of independently produced BECs. Motivated by these experiments, we have investigated [2] the dynamics of an effectively one-dimensional atom laser model [3], based on the merging of in- dependently formed atomic condensates. In a first attempt to understand the dynamics of the system, we consider two independent elongated Bose-Einstein condensates which approach each other and focus on intermediate inter-trap dis- tances so that a two-mode model is well justified. As we approach the traps, a Josephson tunneling is established between the two BECs, while atoms are coherently outcoupled. The structured atomic continuum for the free atoms is associated with strongly non-markovian phenomena which cannot be described in the framework of Born and Markov approximations. Hence, our theoretical approach relies on the discretization of the atomic continuum which, in general, allows the treatment of arbitrary forms of outcoupling and the incorporation of interatomic interactions [4]. We discuss the quasi steady-state population of the traps as well as the energy distribution and the coherence of the outcoupled atoms [2]. In addition to its relevance to the atom laser, this work pertains also to the general field of non-markovian reservoirs.

[1] A. P. Chikkatur, Y. Shin, A. E. Leanhardt, D. Kielpinski, E. Tsikata, T. L. Gistavson, D. E. Pitchard and W. Ketterle, Science 282, 2193 (2002).
[2] C. Lazarou, G. M. Nikolopoulos and P. Lambropoulos, submitted to J. Phys. B (2007).
[3] W. Guerin, J.-F.Riou, J. P. Gaebler, V. Josse, P. Bouyer and A. Aspect, Phys. Rev. Lett. 97, 200402 (2006).
[4] G. M. Nikolopoulos, P. Lambropoulos and N. P. Proukakis, J. Phys. A 36, 2797 (2003).

LAZAROU Constantinos *Poster*

Adiabatic Cavity QED with pairs of atoms

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We analyze the problem of a single mode field interacting with a pair of two level atoms. Instead of the usual constant coupling, we assume a sequential time dependent coupling between the atoms and the field. In considering the adiabatic limit, we were able to demonstrate an energy crossing in the vicinity of a local degeneracy. Furthermore, we show that for large photon numbers the system has a similar behaviour to the single atom Jaynes-Cummings model. For this to be the case a condition with respect to the initial atomic states must be satisfied. Exploring the main features of this system, we propose two experimental setups for implementing a SWAP and a C-NOT gate.

LININGTON Ian *Talk: Mon 11:00 A*

Dissipation control in cavity QED with oscillating boundaries

Ian Linington and Barry Garraway
University of Sussex

Relaxation processes in open quantum systems arise through interaction with the system's external environment, which acts as a reservoir for decay and decoherence. An important example in quantum optics, with applications in quantum information science, is the case where the system is a two-level atom and the reservoir is an optical cavity. The cavity mode structure is usually treated as essentially static. However, here we present results from a recent investigation into the effects on the atomic dynamics of a reservoir which is non-trivially time dependent at a microscopic level. To bring out the new features, the chosen system is one for which the macroscopic properties of the reservoir (density of states, spectral dependence) remain static. We show that when the microscopic bath-frequencies are modulated periodically in time, interference between the various decay-channels for emission can strongly modify the atomic decay-rate. Thus, small changes in the environmental manipulation can lead to significant effects, which may be useful for quantum control.

LO FRANCO Rosario *Talk: Mon 11:20 A*

Efficient Generation of Generalized Binomial States in a Cavity

R. Lo Franco, G. Compagno, A. Messina, and A. Napoli
Dipartimento di Scienze Fisiche ed Astronomiche, Università di Palermo

Here we show that generalized binomial states of electromagnetic field with a maximum number of photons N [1] can be formally made to correspond to atomic coherent states [2] of cooperation number J = N/2. On the one hand this permits to simply obtain generalized binomial states properties [3], on the other hand it suggests a procedure for their generation by the use of interactions among field and atoms of pseudo-spin J. In particular, here we propose an efficient scheme to generate generalized binomial states in a high-Q cavity, by exploiting resonant interactions between the cavity field and N consecutive pseudo-spin J = 1/2 atoms [4]. Finally, we briefly analyze the possible implementation of this generation scheme.

[1] D. Stoler, B. E. A. Saleh, and M. C. Teich, Opt. Acta 32, 345 (1985).
[2] F. T. Arecchi, E. Courtens, R. Gilmore, and H. Thomas, Phys. Rev. A 6, 2211 (1972).
[3] R. Lo Franco, G. Compagno, A. Messina, and A. Napoli, Phys. Rev. A 72, 053806 (2005).
[4] R. Lo Franco, G. Compagno, A. Messina, and A. Napoli, Phys. Rev. A 74, 045803 (2006).

LULLI Alfredo *Talk: Tue 11:20 B*

Dynamics of entanglement transfer from two quantized radiation modes to two qubits

F. Casagrande, A. Lulli, and M. G. A. Paris
Università degli Studi di Milano, Dipartimento di Fisica

The transfer of entanglement between a quantized radiation field and qubits is a much investigated problem due to its intrinsic interest and the possible applications in quantum information [1]. We investigate the entanglement transfer between a two-mode radiation field and a pair of qubits such as two two-level atoms placed inside an optical cavity [2]. We assume that each mode of the radiation couples to one qubit via the detuned Jaynes-Cummings interaction and that the qubits can be prepared initially also in a superposition state. First we evaluate the entanglement transfer efficiency for different radiation fields such as Bell-like states, twin-beam (TWC) and pair-coherent (TMC) states; all these states can be realized experimentally and are widely used in quantum information processes [3]. Under resonance conditions, equal interaction times of both qubits and different initial states, we find that the entanglement transfer is more efficient for TMC than for TWB states. In the perspective of applications in QED systems with Rydberg atoms in microwave cavities [4], we consider the effects of off-resonance interactions, as well as different injection and interaction times for the two qubits. In addition, we fully investigate the coupling of each radiation mode to the cavity mode both in a static and in a dynamical way, also including the effect of cavity field dissipation.

[1] M. Paternostro, G. Falci, M. Kim, G. M. Palma, Phys. Rev. B 69, 214502 (2004); J. Zou et al., Phys. Rev. A 73, 042319 (2006); J. Lee, M. Paternostro, M.S. Kim, S. Bose, Phys. Rev. Lett. 96, 080501 (2006).
[2] F. Casagrande, A. Lulli, M.G.A. Paris, Phys. Rev. A 75, 032336 (2007).
[3] A. Ferraro, S. Olivares, M.G.A. Paris, Gaussian States in Quantum Information, Napoli Series on Physics and Astrophysics (Bibliopolis, Napoli, 2005); G. S. Agarwal, Phys. Rev. Lett. 57, 827 (1986).
[4] J.M. Raimond, M. Brune, S. Haroche, Rev. Mod. Phys. 73, 265 (2001); M. Paternostro et al., Phys. Rev. A 70, 022320 (2004).

LUPO Cosmo *Talk: Fri 17:20 A*

A critical point of view about the robustness argument of holonomic quantum gates

Cosmo Lupo
Università di Napoli "Federico II" and INFN sezione di Napoli

Holonomic quantum gates are believed to be robust against certain kind of parametric noise. The geometric character which is present in the adiabatic regime is at the heart of the argument in favor of the robustness of holonomic quantum computation: if the fluctuations of the noise are fast enough their contribution is believed to average out leaving the holonomic evolutor unchanged. We discuss this argument and show in which regime it cannot be applied.

MACOVEI Mihai *Talk: Tue 11:20 A*

Light interference and localization of strongly driven multiparticle systems

Mihai Macovei, Joerg Evers, and Christoph H. Keitel
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Spontaneous emission of a single excited particle surrounded by the standard free space vacuum modes follows the usual dipole radiation pattern. The spatial emission properties, however, are significantly modified when a collection of particles is considered. Then, for example, different patterns are obtained from ensembles confined in a volume smaller or larger than the emission wavelength, or with random or regular particle positions. Here, we discuss our recent results on the spatial distribution of light in strongly driven multiparticle systems. First, we consider an atomic chain of independent, distinguishable and non-overlapping two-state emitters. In this setup, the light interference effects depend on the pump field intensity. In particular, it has been shown that the first-order interference vanishes for an intensely pumped atomic chain in free space. We demonstrate how this strong-field interference can be recovered by tailoring the surrounding vacuum modes [1]. We also consider second-order correlations of the scattered photons, where the spatial interference already present in plain vacuum can be modified favorably at strong driving. Second, we describe a scheme capable of localizing an ensemble of two-level atoms which are bunched together in a volume much smaller than an emission wavelength within a standing wave laser field [2]. Due to the laser-pumping of the atomic sample, it collectively emits fluorescence light with properties depending on the ensemble position in the standing wave. Based on these results, we extract information on the spatial localization, the number of interacting particles, and the linear dimension of the sample.

[1] M. Macovei, J. Evers, G.-x. Li, and C. H. Keitel, Phys. Rev. Lett. 98, 043602 (2007).
[2] M. Macovei, J. Evers, C. H. Keitel, M. S. Zubairy, Phys. Rev. A 75, 033801 (2007).

MÄKELÄ Harri *Poster*

Inert states of spin-S systems

H. Mäkelä and K.-A. Suominen
Department of Physics, University of Turku

We calculate the inert states of spin-S systems assuming that the symmetry group of the energy is U(1)xSO(3). Inert states are states which correspond to stationary points of the energy regardless of the exact form of the energy functional. Our results can be applied for example in the study of spinor Bose-Einstein condensates.

MALINOVSKY Andrey *Poster*

Light diffraction on modulations of surface relief and low threshold IR multi-photon dissociation of molecules near surface: optimal model

A.Malinovsky, S.Ambrosov
Odessa University

The light diffraction on relief of surface can make a significant influence on dynamics of laser induced reactions on relief with spatial modulated profile [1]. Velocity of photoprocesses is significantly dependent on the form and depth of surface relief, optical constants of materials and laser radiation parameters. We present new approach to modelling the optimal scheme for isotopic selective low threshold IR multi-photon dissociation of molecules near surface with periodic relief. The system is molecular gas SiH4 (SF6, UF6), that is resonantly excited by the CO2 laser radiation near surface of the periodic Cu lattice. A definition of the local electromagnetic fields and their increasing near surface is carried out within non-linear theory of diffraction of the limited 2D and 3D light beams on surface with arbitrary discrete Fourier spectrum of relief [1]. A task, connected with a powerful laser action on the gas is more less adequately described by multi-level models, that leads to necessity of consideration of the solving the Focker-Plank type equations for density of molecules with vibration-rotation energy and operators, describing the RT relaxation and action of a laser radiation [1]. New multi-level model for optimization of excitation of the molecular gas and definition of the optimal form for laser pulse to reach the maximal effectiveness of laser action in process is based on differential equation of the Focker-Plank type and optimal governing theory. Numerical testing of optimized model for molecules of SiH4 , UF6 is carried out. The obtained results allowed to propose new laser isotope separation scheme with application to the U isotope separation.

[1]. V.Bagratashvili et al, Sov.Quant. Electr. 15, 2173 (1988); A.V.Glushkov, S.V.Ambrosov et al, J.Techn.Phys.38,219(1997); A.V.Malinovsky, S.V.Ambrosov, Sensor electr.Micrisyst.Tehn. 4, 131 (2007).

MANGANO Giuseppe *Talk: Sat 12:20 B*

Stimulated Raman Adiabatic Passage with a Cooper Pair Box

J. Siewert, G. Falci, G. Mangano, E. Paladino and T. Brandes
D.M.F.C.I., CRS MATIS, INFM-CNR

The rapid experimental progress in the feld of superconducting nanocircuits gives rise to an increasing quest for advanced quantum-control techniques for these macroscopically coherent systems. Here we demonstrate theoretically that stimulated Raman adiabatic passage (STIRAP) should be possible with the quantronium setup of a Cooper-pair box. The scheme appears to be robust against decoherence and should be realizable even with the existing technology. STIRAP can be applied to generate single-phonon states of a resonator by vacuum-stimulated adiabatic passage with the superconducting nanocircuit coupled to the resonator.

MANISCALCO Sabrina *Talk: Sun 11:00 A*

Measurement induced manipulation of the quantum-classical border

S. Maniscalco, J. Piilo, and K.-A. Suominen
Department of Physics, University of Turku, Finland

During the last three decades a huge number of experiments have confirmed the predictions of quantum theory. At the same time many technological applications based on its most peculiar features, such as entanglement, have been discovered. Nevertheless, various aspects concerning the foundations of quantum mechanics still remain to be clarified. Among them, the transition from a microscopic probabilistic world into a macroscopic deterministic one, also known with the pictorial name of quantum-classical border. The consensus today is that classical behaviour is an emergent property of quantum systems induced by their interaction with the environment. In this paper we focus on a paradigmatic open quantum system, namely the quantum Brownian motion model in a harmonic potential. Such a system, namely a damped harmonic oscillator, possesses a classical limit and it is therefore possible to monitor the transition from quantum to classical dynamics caused by decoherence induced by the environment.We demonstrate how appropriate sequences of nonselective measurements of the energy of such system give rise to quantum Zeno or anti-Zeno effects, allowing to manipulate the quantum-classical border by prolonging or shortening, respectively, the persistence of quantum features in the initial state [1].

[1] S. Maniscalco, J. Piilo, and K.-A. Suominen, Phys. Rev. Lett. 97, 130402 (2006).

MAN'KO Margarita *Talk: Sat 15:00*

Classical radiation in optical fibers as model for quantum entanglement

Margarita A. Man'ko
P.N. Lebedev Physical Institute, Moscow

Using known description of classical electromagnetic radiation propagating in optical fibers by Schroedinger-like equation (Fock–Leontovich paraxial approximation), the model of entanglement phenomenon is considered. The Gaussian light beams in optical fibers demonstrate a formal mathematical identity to Gaussian two-mode quantum fields. In view of this, the criterion of separability and entanglement of Gaussian light beams are implemented in fiber optics.

MAN'KO Vladimir *Talk: Sun 11:00 B*

Strong subadditivity condition and Renyi entropy in quantum information within the framework of tomographic-probability representation

Vladimir Man'ko
P.N. Lebedev Physical Institute, Moscow

Using description of spin states by standard probability distributions, the machinery of probability theory including Shannon entropy and Renyi entropy is implemented in quantum information. New relations in the form of inequalities like subadditivity and strong subadditivity conditions are discussed for tomographic joint probability distributions describing multiqudit states.

MARANGOS Jonathan *Talk: Mon 15:00*

Molecular Imaging in the Attosecond Regime using High Harmonic Generation

J.P.Marangos,[1] S.Baker,[1] R.Torres,[1] N.Kajumba,[1] C.Haworth,[1] J.Robinson, J.W.G.Tisch, [1] M.Lein,[2] C.Chirila,[2] C.Altucci[3] and R.Velotta[3]
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[2] *University of Kassel, Germany*
[3] *Coherentia-INFM and Dipartimento di Scienze Fisiche, Università di Napoli "Federico II", Napoli, Italy*

Our recent work has looked in particular at the signal from high order harmonic generation which contains rich information about the structure and intra-molecular dynamics of small molecules. This we will illustrate by two types of experiment; (a) measurements of HHG from aligned molecular samples to observe two-centre recombination interference and electronic structure dependence of the angle dependent yield, (b) reconstruction of intra-molecular proton dynamics from the spectral dependence of the HHG using the intrinsic chirp of recolliding electrons.

MARIAN Paulina *Talk: Tue 9:00*

Gaussian entanglement of formation for two-mode Gaussian states

Paulina Marian and Tudor A. Marian
University of Bucharest, Romania

In recent years many attempts to quantify the entanglement of a Gaussian state have been made due to the experimental interest in using such states in quantum information processing. In this work we give a novel approach to the problem of evaluating the entanglement of formation for two-mode Gaussian states. We perform an analysis of pure-state decompositions of such mixed states in terms of characteristic functions. In fact, we prove that an entangled Gaussian state is the superposition between a pure Gaussian state and a classical, and therefore, separable one. Then we show that the optimal pure-state decomposition is determined by the properties of the classical state. Finally, we evaluate and discuss the entanglement of formation in several particular but popular cases.

MARIAN Tudor A. *Poster*

Gaussian measures of entanglement for symmetric two-mode Gaussian states

Paulina Marian and Tudor A. Marian
University of Bucharest, Romania

Our aim in the present work is to apply the Bures metric as a measure of entanglement for symmetric two-mode Gaussian states (TMGSs) in the framework of the Gaussian approach. We thus want to compare a distance-type Gaussian amount of inseparability to the exact expression of the entanglement of formation for a symmetric TMGS. To this end we go on the following programme: i) exploit the property of the covariance matrix of a equally scaled symmetric standard state of being diagonalized by a specific beam-splitter transformation. ii) exploit the Uhlmann fidelity of a pair of arbitrary two-mode Gaussian states. Here we can prove that the closest separable Gaussian state to a symmetric inseparable one is a symmetric state with equal local squeezing factors. iii) maximize the fidelity with respect to the set of all separable symmetric states, which are identified by taking advantage of the Peres-Simon separability criterion. We have obtained that the Gaussian degree of entanglement measured by Bures distance depends only on the smallest symplectic eingenvalue of the covariance matrix of the partially transposed state. Thus, it is in agreement with the exact entanglement of formation and enforces our previous idea that, even in the Gaussian approximation, the Bures distance is a reliable measure of entanglement.

MARMO Giuseppe *Talk: Sun 9:30*

Entanglement in the geometric formulation of quantum mechanics

G.Marmo
Università "Federico II" di Napoli - INFN sezione di Napoli

Within the geometrical formulation of quantum mechanics we show how to deal with separability and entanglement for composite systems.

MASTELLONE Andrea *Talk: Sat 11:20 B*

Mesoscopic BCS pairing in the repulsive one dimensional Hubbard model

Luigi Amico,[1] Andrea Mastellone,[1] and Andreas Osterloh[2]
[1] *MATIS-INFM and DMFCI, Università di Catania, viale A. Doria 6, I-95125 Catania, Italy*
[2] *Institut fur Theoretische Physik, Universitat Hannover, 30167 Hannover, Germany*

We study mesoscopic pairing in the one dimensional repulsive Hubbard model and its interplay with the BCS model in the canonical ensemble. The key tool is comparing the Bethe ansatz equations of the two models in the limit of small Coulomb repulsion. For the ordinary Hubbard interaction the BCS Bethe equations with infinite pairing coupling are recovered; a finite pairing is obtained by considering a further density-dependent phase-correlation in the hopping amplitude of the Hubbard model. We find that spin degrees of freedom in the Hubbard ground state are arranged in a state of the BCS type, where the Cooper-pairs form an un-condensed liquid on a "lattice" of single particle energies provided by the Hubbard charge degrees of freedom; the condensation in the BCS ground state corresponds to Hubbard excitations constituted by a sea of spin singlets.

MAUGERI Alessio Gerardo *Talk: Mon 17:20 B*

Structured environments in solid state systems: crossover from Gaussian to non-Gaussian behavior

Alessio Gerardo Maugeri
MATIS CNR-INFM, Catania and Dipartimento di Metodologie Fisiche e Chimiche (DMFCI), Università di Catania

The variety of noise sources typical of the solid state represents the main limitation toward the realization of controllable and reliable quantum nanocircuits, as those allowing quantum computation. Such "structured environments" are characterized by a non-monotonous noise spectrum sometimes showing resonances at selected frequencies. Here we focus on a prototype structured environment model: a two-state impurity linearly coupled to a dissipative harmonic bath. We identify the time scale separating Gaussian and non-Gaussian dynamical regimes of the Spin-Boson impurity. By using a path-integral approach we show that a qubit interacting with such a structured bath may probe the variety of environmental dynamical regimes.

MEL'NIKOV Igor *Talk: Sat 11:40 B*

Generation of slow intense optical solitons in a resonance photonic crystal

I. V. Mel'nikov
Optolink Ltd, Moscow, Russia

We demonstrate previously unforeseen properties of generation, stable propagation, and trapping of a slow higher-order solitons of self-induced transparency which is mediated by an inversion inside the resonance photonic crystal. This is in a sharp contrast to the well-known fact of the breakup of the higher-order ?;n-pulse into a train of isolated ?; pulses with different amplitudes, speeds, and durations.

MESSINA Riccardo *Talk: Sun 11:40 A*

Casimir-Polder force density between an atom and a conducting plate

R. Messina, R. Passante
Dipartimento di Scienze Fisiche ed Astronomiche, Università degli Studi di Palermo, Via Archirafi 36, 90123 Palermo

We consider the Casimir - Polder force density on a metallic plate due to the presence of a neutral atom, evaluating the quantum average of the electromagnetic stress tensor on the two sides of the plate. This local force can be useful in evaluating Casimir torques or stresses on the wall. The integral of the force density over the plate yields the well-known expression of the total force acting on the plate; this shows that many - body components of the force proportional to the atomic polarizability are included in our result. We finally discuss quantum fluctuations of the Casimir-Polder atom - wall force.

MILOSEVIC Dejan *Talk: Fri 15:30*

Atomic processes in a strong laser field

Dejan B. Milosevic
Faculty of Science, University of Sarajevo, Bosnia and Herzegovina, and Max-Born-Institut, Berlin

Various atomic processes in strong laser fields are reviewed [1]. A particular emphasis is on the explanation of common features of different high-order atomic processes, which is based on the following sequence of theoretical methods: S-matrix formalism - strong-field approximation (SFA) quantum-orbit theory [2]. It has been commonly assumed that the S-matrix theory, as an in-out formalism, conveys no information about what happens in between. Applying the SFA and the formalism of quantum orbits to above-threshold ionization (ATI) by ultrashort laser pulses [3,4] we show that this is not so. By expanding an S-matrix element in terms of such quantum orbits, whose space-time evolution is known, one can review the options that are available to the electron and follow their paths on the attosecond time scale. The theory presented is used for simulation of two recently performed experiments: ATI of inert gases (Garching), and above-threshold detachment of halogen negative ions (Freiburg). This theory can also be generalized to molecular processes in a strong field. Our first step in this direction is the analysis the results for the strong-field ionization of diatomic molecules, obtained applying different gauges [5].

[1] D. B. Miloševic and F. Ehlotzky, "Scattering and reaction processes in powerful laser fields", Adv. At. Mol. Opt. Phys. 49, 373-532 (2003).
[2] D. B. Miloševic, D. Bauer, and W. Becker, "Quantum-orbit theory of high-order atomic processes in strong fields", J. Mod. Opt. 53, 125-134 (2006).
[3] W. Becker, F. Grasbon, R. Kopold, D. B. Miloševic, G. G. Paulus, and H. Walther, "Above-threshold ionization: from classical features to quantum effects", Adv. At. Mol. Opt. Phys. 48, 35-98 (2002).
[4] D. B. Miloševic, G. G. Paulus, D. Bauer, and W. Becker, "Above-threshold ionisation by few-cycle pulses", J. Phys. B 39, R203-R262 (2006).
[5] D. B. Miloševic, "Strong-field approximation for ionization of a diatomic molecule by a strong laser field", Phys. Rev. A 74, 063404 (1-14) (2006).

MOREVA Ekaterina *Poster*

Anisotropically high entanglement of biphotons generated in spontaneous parametric down conversion

M.V. Fedorov, M.A. Efremov, S.P. Kulik, E. V. Moreva, S.S. Straupe, P.A. Volkov
Moscow State University, A.M.Prokhorov General Physics Institute of Russian Academy of Sciences

We show that a wave packet of a biphoton generated via spontaneous parametric down conversion is strongly anisotropic. The formulated theory is corroborated by experimental observation of such anisotropy in single-particle and coincidence biphoton momentum distributions. A method of biphoton detection which discloses a very high degree of entanglement is suggested.

MUSAKHANYAN Viktor *Talk: Sat 17:00 A*

An exact solution of Dirac's equation in the field of plane EM wave: physical consequences.

Viktor Musakhanyan
Dept. of MedBioPhys@Informatics, Yerevan State Medical Univ

Solution of Dirac's equation for a charged particle interacting with the field of a plane electromagnetic wave (EM) wave, so called Volkovś solution, is known for a long time. It was theoretically obtained even before the lasersépoch and has been used abundantly in theoretical papers to describe the interaction of electrons with EM wave. However, analysis of the mentioned theoretical solution shows that the initial momentum of a charged particle is not a physical one and implicitly hidden in these solutions by the gauge invariance and possibility of shifting of an initial value of vector-potential. Besides, the exponent of the

wave function contains classical action of the particle, which should turn into the exact solution of Lorenzś equation in the classical limiting case. All these and other grave physical disadvantages are lacking in the new and exact solution of Dirac's equation presented by us: one has correct limiting cases and results to new effects, such, as the frequency shift linear by parameter of intensity in Compton effect. It is shown as well that at the moment of occurrence of a charged particle in the wave field, when the initial momentum and coordinate are still classical and can be found at the same time in the experiment, this wave function becomes unity, i.e. from probabilistic description the opportunity of deterministic description occurs, thus in this case no additional problem arises with the interpretation of wave function of the obtained solution.

MUSTECAPLIOGLU Ozgur *Talk: Sun 10:00*

Control of Optical Dynamic Memory Capacity of an Atomic Bose-Einstein Condensate

Devrim Tarhan [1] and Ozgur E. Mustecaplioglu [2]
[1] *Harran University, Physics Dept., Sanliurfa, Turkey*
[2] *Ko University, Physics Dept., Istanbul, Turkey.*

There are various potential applications of atomic Bose-Einstein condensates such as atom lasers, atom lithography, atom chips, atom interferometers and precision measurements. Due to the impressive developments in control of light and matter waves in ultraslow light experiments, one of the most promising applications is storage of coherent optical information. In order to make an atomic condensate a practical optical memory device, it is necessary first of all, to increase our capability to control the amount of information stored in the condensate. For that aim, we have performed a series of studies. This talk will report some of our recent results. We have found that optical dynamic memory capacity of the condensate can be optimized by choosing a certain set of experimental control parameters, in particular coupling laser Rabi frequency and temporal width of the probe pulse for a given atomic condensate. Axial density profile of the condensate helps to preserve the probe pulse shape against group velocity dispersion. Further enhancement of the memory capacity is possible by taking into account radial confinement of the probe pulse. Particular radial density profile of the condensate reduces the effect of modal dispersion and contributes to the pulse shape preservation. While the optical control parameters are beneficial for optimizing the memory capacity, properties of the atomic cloud can also be exploited to enhance the maximum capacity available. Ultraslow waveguiding regimes are investigated and characterized. Propagation constants and the conditions on the number of ultraslow optical modes are determined. Detailed numerical examinations revealed the ultraslow mode profiles that can be supported by the atomic condensate. We will also briefly discuss dispersion compensation by optical nonlinearity in the context of ultraslow dark and bright solitons.

NAVEZ Patrick *Talk: Sat 17:00 B*

Mind the gap in a Bose Einstein condensate!

Patrick Navez
Laboratorium voor Vaste-Stoffysica en Magnetisme, Katholieke Universiteit Leuven, Belgium

We investigate the dynamic response of population transfer between two components of a finite temperature spinor Bose condensed gas to a time-dependent coupling potential. Comparison between results in the generalized random phase approximation (GRPA) and in the Bogoliubov-Popov approximation (BPA) shows noticeable discrepancies. In particular, the inter-component current response function calculated in the GRPA displays a gapped spectrum due to the exchange interaction energy whereas the corresponding density response function is gapless. This gapped spectum not predicted within BPA originates from a new branch of thermal excitation modes different from the gapless (or Goldstone) modes associated to the spontaneous breaking of SU(2) symmetry. We argue that the GRPA is superior since, contrary to the BPA, it preserves the SU(2) symmetry and the f-sum rule associated to the spinor gas. In order to validate this approximation, we propose an experimental setup that allows the observation of the predicted gap.
Ref: cond-mat/0703612

OGDEN Christopher *Talk: Mon 11:40 A*

Concentration and purification of entanglement for qubit systems with ancillary cavity fields

C. D. Ogden, M. Paternostro, and M. S. Kim
Queen's University Belfast

We propose schemes for entanglement concentration and purification for qubit systems encoded in flying atomic pairs. We use cavity-quantum electrodynamics as an illustrative setting within which our proposals can be implemented. Maximally entangled pure states of qubits can be produced as a result of our protocols. In particular, the concentration protocol yields Bell states with the largest achievable theoretical probability while the purification scheme produces arbitrarily pure Bell states. The requirements for the implementation of these protocols are modest, within the state of the art, and we address all necessary steps in two specific set-ups based on experimentally mature microwave technology.

OLIVARES Stefano *Talk: Fri 17:40 B*

Interspecies teleportation and telecloning between light and cold atoms

Stefano Olivares, Mary Cola, Matteo G A Paris
Università di Milano

An interaction scheme to realize interspecies teleportation and telecloning between light and cold atoms is suggested. The atoms-radiation entanglement needed for the quantum information transfer is established through the interaction of a single mode with cold atoms in a condensate in the presence of a strong far off-resonant pump laser.

OLSEN Murray *Talk: Tue 15:20 B*

Teleportation of massive particles without shared entanglement

M.K. Olsen, A.S. Bradley, S.A. Haine and J.J. Hope
University of Queensland and Australian National University

We show how two Raman atom laser mechanisms may be used to transfer a beam of atoms between two spatially separated condensates. Only the sharing of classical information between the sender and receiver is necessary to establish this procedure. The quantum information from the first atomic beam is transferred to an optical field which performs the role of signal field for a Raman outcoupler at the second, receiving condensate. In principle, fidelities of arbitrarily close to one can be achieved.

ORLOWSKI Arkadiusz *Talk: Mon 10:00*

Decoherence of entangled states in multi-mode cavities

M. Janowicz, A. Orlowski
Instytut Fizyki PAN, Warszawa, Poland

New results on decoherence of the Schrdinger-cat-like states in two-mode cavities are discussed within Cavity QED framework. The cat states are assumed to be produced by the measurement of the energy of a three-level atom which have passed through the cavity. Interesting dependence of the decoherence time of the two-mode cat states on the degree of entanglement is observed. Possible generalization to multi-mode cases are presented and implications for decoherence of entanglement in the macroscopic scales are discussed.

PAGANELLI Simone *Talk: Fri 12:30 A*

An analytical approach to the coherence properties in the dynamics of two-site tunnelling system coupled to a harmonic oscillator

Simone Paganelli and Sergio Ciuchi
Dipartimento di Fisica dell'Università dell'Aquila (Italy)

Tunneling of a charge between localized sites, in a crystal or a molecular system, can be severely affected by coupling with optical phonon modes. The competition between kinetic energy of the charge and localization effects due to local coupling with phonon produces the a small polaron, i.e. a charge dressed by a cloud of multiphonon processes, when the latter prevails. Following a block diagonalization technique, we obtain analytical (or very fast numerical) results for the quantum propagators. These results has been used for calculating exactly the finite temperature spectral functions, of both electron and polaron, and to characterize the band-width behavior with temperature. Even if the spectral analysis can give a significant indication on the competing coherent and incoherent (phonon driven temperature activation) processes, it is useful to study the dynamics also to better characterize the coherence properties of the system. A polaronic reduced density matrix is introduced. In the strong coupling regime, the electron coherence fastly goes down and it localizes, while the polaron remains coherent (for temperatures below the inverse of the phonon energy). A finite temperature analysis has been done on each regime (adiabatic, antiadiabatic, intermediate) going beyond the usuals approximations and giving a more precise characterization of the crossover between coherent and incoherent regimes.

PARIS Matteo G A *Talk: Sun 12:00 B*

Optimal quantum estimation of loss in bosonic channels

Matteo G A Paris
Università di Milano

We address the estimation of the loss parameter of a bosonic channel probed by Gaussian signals. We derive the ultimate quantum bound on precision and show that no improvement may be obtained by having access to the environment degrees of freedom. We found that, for small losses, the variance of the optimal estimator is proportional to the loss parameter itself, a result that represents a qualitative improvement over the shot noise limit. An observable based on the symmetric logarithmic derivative is derived, which attains the ultimate bound and may be in principle implemented using Gaussian operations and photon counting.
Refs: Optimal quantum estimation of loss in bosonic channels Alex Monras, Matteo G. A. Paris quant-ph/0701216 (to appear on PRL)

PASCAZIO Saverio *Talk: Mon 15:30*

Quantum Zeno subspaces

S. Pascazio
Dipartimento di Fisica, Universita di Bari

If very frequent measurements are performed on a quantum system, in order to ascertain whether it is still in its initial state, transitions to other states are hindered and the quantum Zeno effect takes place. This phenomenon stems from very general features of the Schroedinger equation, that yield quadratic behavior of the survival probability at short times. However, the quantum Zeno effect does not necessarily freeze everything. On the contrary, for frequent projections onto a multi-dimensional subspace, the system can evolve away from its initial state, although it remains in the "Zeno" subspace defined by the measurement. This continuing time evolution within the projected subspace is named "quantum Zeno dynamics" and has interesting features. We give an introduction to these issues, look at some significant examples (in Bose-Einstein condensates, atomic physics and quantum optics discuss their practical relevance. We focus on decoherence and irreversibility.

PERINA Jan *Poster*

Transverse Properties of Entangled Two-photon States Generated in Nonlinear Photonic-band-gap Structures

J. Perina Jr, M. Centini, C. Sibilia, M. Bertolotti, M. Scalora
Institute of Physics of AS CR in Olomouc, Università La Sapienza di Roma, Charles M. Bowden Research Center in Alabama

Transverse characteristics (intensity profiles, correlation area) of the spontaneously generated down-converted fields have been studied for structures composed of up to several tens of thin GaN/AlN layers using a vectorial quantum model.

PERINOVA Vlasta *Talk: Mon 12:20 A*

Invariant-subspace method of solution of nonlinear Heisenberg equations

V. Perinova and A. Luks
Laboratory of Quantum Optics, Faculty of Natural Sciences, Palacky University, Olomouc, Czech Republic

A number of nonlinear optical processes are solvable in the Schroedinger picture, when the unitary evolution operator is expressed as a matrix in all finite-dimensional invariant subspaces. The eigenvalues and eigenvectors of this operator offer complete information on the process. We show how they enter the equivalent solution in the Heisenberg picture. We conform to the recent non-perturbative solution [L. Mista, Jr., and R. Filip, J. Phys. A: Math. Gen. 34 (2001) 5603.], which provides one with insight into nonlinear quantal interaction. We extend the illustration with the case of a frequency detuning of the modes.

PHILBIN Thomas *Talk: Sun 12:00 A*

Quantum levitation by left-handed metamaterials

Ulf Leonhardt and Thomas Philbin
University of St Andrews

Left-handed metamaterials make perfect lenses that image classical electromagnetic fields with significantly higher resolution than the diffraction limit. Here we consider the quantum physics of such devices. We show that the Casimir force of two conducting plates may turn from attraction to repulsion if a perfect lens is sandwiched between them. For optical left-handed metamaterials this repulsive force of the quantum vacuum may levitate ultra-thin mirrors.

PIILO Jyrki *Poster*

Quantum Brownian motion for periodic coupling to engineered bath

J. Piilo, S. Maniscalco, and K.-A. Suominen
Department of Physics, University of Turku, Finland

Fundamental research on open quantum systems has traditionally focused on interactions between the reduced system and its natural environment. Recent theoretical and experimental developments in engineering the properties of the environments open a new avenue by creating artificial controlled reservoirs with whom the reduced system interacts. Reservoir engineering and environment mediated schemes allow the indirect control of quantum systems - the quantum control being the essential ingredient in the development of quantum simulators. Generally speaking, the importance of the open system studies stems from their central role in understanding the quantum-classical border and from the role of decoherence as an obstacle for creating quantum information processors. Reservoir engineering provides a so far

largely unexplored way to approach these issues which have both fundamental and applicative character. We show theoretically how the periodic coupling between an engineered reservoir and a quantum Brownian particle leads to the formation of a dynamical steady state which is characterized by an effective temperature above the temperature of the environment [1]. The average steady state energy of the system has a higher value than expected from the environmental properties. The system experiences repeatedly a non-Markovian behavior - as a consequence the corresponding effective decay for long evolution times is always on average stronger than the Markovian one. We also highlight the consequences of the scheme to the Zeno - anti-Zeno crossover [2] which depends, in addition to the periodicity, also on the total evolution time of the system. Moreover, we discuss how an earlier proposal to use single trapped ions as quantum simulators for open systems [3] has to be modified to implement the scheme presented here.

[1] J. Piilo, S. Maniscalco, and K.-A. Suominen, Phys. Rev. A 75, 032105 (2007).
[2] S. Maniscalco, J. Piilo, and K.-A. Suominen, Phys. Rev. Lett. 97, 130402 (2006).
[3] J. Piilo and S. Maniscalco, Phys. Rev. A 74, 032303 (2006)

PLASTINA Francesco *Talk: Sat 17:20 A*

Critical properties of entanglement and Berry's phase in the superradiant phase transition

F. Plastina, G. Liberti
Dip. Fisica, Università della Calabria

By employing the adiabatic approximation, we discuss the thermodynamic-limit and finite-size scaling properties of both quantum correlations (entanglement) and of the geometric (Berry's) phase in the Dicke model. In the thermodynamic limit, we entanglement shows a non-analytic behavior at the super-radiant transition point and at the same time a nonzero Berry phase is obtained only if a path in parameter space is followed that encircles this critical point. Precursors of the critical behavior are present for a system with finite size. To show this, we evaluate the leading orders in the 1/N expansion to obtain analytically various bipartite entanglement measures and the Berry phase, together with their critical exponents.

POLETTI Dario *Poster*

BEC induced quantum ratchet

D. Poletti
National Univerisity of Singapore - Physics Department - Centre for Computational Science and Engineering

We study the dynamics of a dilute Bose-Einstein condensate (BEC) in the mean-field limit. We show that in presence of BEC it is possible to have directed transport when forbidden for cold-atoms.

POPOV Alexander *Talk: Tue 15:20 A*

Quantum switching in negative-index metamaterials

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Quantum switching from strong absorption to transparency and amplification by two control lasers in solids doped by resonant impurities is studied. The results are discussed in the context of compensation of losses in negative-index metamaterials (NIMs), which is recognized now as one of the most challenging problems that needs to be addressed for numerous applications of these revolutionary artificial electromagnetic materials. Counter-intuitive features of nonlinear-optical coupling in NIMs are shown that originate from opposite directions of the energy flows of the coupled waves. The opportunities offered by coherent quantum control in such scheme are illustrated by the numerical experiments.

PRVANOVIC Slobodan *Poster*

Transfer of angular momentum from vortex beams to optically induced copropagating and counterpropagating trigonal photonic lattices

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Angular momentum transfer from vortex beams to optically induced photonic lattices is demonstrated and essential difference between counterpropagating and copropagating cases is stressed. In the case of interacting incoherent counterpropagating beams it is found that the sum of angular momentum is not conserved, whereas their difference is. The sum of angular momenta of copropagating interacting beams is strictly conserved. It is also found that the transfer of angular momentum in counterpropagating interacting beams is minimal, amounting to few percent, while the transfer in copropagating interacting beams is substantial, amounting to tens of percent. Our results suggest that the difference of angular momenta is conserved in all physical systems where interaction occurs between counterpropagating incoherent beams.

PUDDU Emiliano *Talk: Sat 11:40 A*

Ghost imaging with intense entangled fields from PDC seeded by a thermal field

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[2] *National Laboratory for Ultrafast and Ultraintense Optical Science (U.L.T.R.A.S.)-C.N.R.-I.N.F.M., Como, Italy*
[3] *Istituto Nazionale di Ricerca Metrologica, Torino, Italy*

We present a ghost imaging experiment performed by using, in the Test and Reference arms, the intense fields generated by a parametric downconversion (PDC) seeded with multi-mode chaotic light. A beta-Barium-Borate crystal is pumped by the second-harmonic output of an amplified Q-switched Nd-YAG laser and allows non-collinear type I phase-matching at frequency degeneracy. The seed field, from the laser fundamental output, is made pseudo-thermal by two rotating ground-glass plates and, after parametric amplification, hits the object-mask in the Test arm, where the bucket detector is located. The idler field travels in the Reference arm, where the "imaging lens" (focal length f) is located, and is finally mapped by a position-sensitive detector, which is a CCD camera. The distances of object and lens from the crystal and that of lens from CCD sensor obey the thin lens equation. The object, a hole of 1.6 mm diameter crossed by a straight wire of 0.5 mm caliber, results to be illuminated by a "spatially incoherent" field with $\sim$320 m speckle size. Thus $\sim$25 coherence areas cover the object area. We use the experimental data, maps produced by the CCD camera and energy values measured by the bucket detector over a series of laser shots, to calculate the fourth-order correlation function, which, as in the case of PDC from vacuum, is point by point proportional to the object transmittance. Studying the local visibility of the ghost images demonstrates that our results are rather consistent with the statistical properties of the multi-mode chaotic light that we measured independently. In addition, we notice that our seeded PDC source as compared to spontaneous PDC sources would make it easier to optimize the number and diameter of the speckles with respect to the size of the object details. Moreover recording intense fields might make ghost-imaging a less time-consuming procedure.

RAIMOND Jean-Michel *Talk: Sun 9:00*

Observing the quantum jumps of light

J.M. Raimond
Laboratoire Kastler Brossel, dept de physique, ENS

A microscopic system under continuous observation exhibits at random times sudden jumps between its states. The detection of this essential quantum feature requires a quantum non-demolition (QND) measurement repeated many times during the system evolution. This is a challenging condition for light quanta. Usual photodetectors absorb light and are thus unable to detect the same photon twice. We have been able to overcome this limitation and to observe, in real time, the quantum jumps of light. Microwave photons are stored in a superconducting cavity for times in the second range. They are repeatedly probed by a stream of non-absorbing circular Rydberg atoms. We have observed the birth, life and death of single thermal photons in the cavity. We have recently extended the method to larger photon numbers and observed the cascade down the Fock states ladder due to relaxation. These experiments open new perspectives for the exploration of the quantum to classical boundary.

RANGELOV Andon *Talk: Sat 12:00 A*

STIRAP into continuum

A. A. Rangelov,[1] N. V. Vitanov,[1,2]
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We present results from a study of the coherence properties of a system involving three discrete states coupled via a continuum. Two of the states, 1 and 2, form a ladder configuration coupled to the continuum and the third discrete state is coupled to the continuum with a control field, which creates a laser-induced continuum structure (LICS). The objective is to drive the population of the initially populated lowest state 1 into the continuum, through state 2, but without populating the (spontaneously decaying) state 2 at any time, i.e. to produce ionization without transient excitation. We show that the efficiency of population transfer into continuum can be considerably improved by applying stimulated Raman adiabatic passage (STIRAP) in the ladder configuration into the continuum and simultaneously the control field that embeds the third discrete state into the continuum. The presence of LICS introduces some coherence in the continuum, which enables a STIRAP-like population transfer to the continuum. Experimental verification of these results will open opportunities for many applications, such as Rydberg atom ionization efficiency close to unity with negligible population into discrete states and efficient photoionization of a Bose-Einstein condensate. An analytic approximation and numerical results are presented for Gaussian pulse shapes.

RAUCH Helmut *Talk: Mon 9:00*

Neutrons as Manipulable Quantum Objects

Helmut Rauch
Atominstitut der Oesterreichischen Universitaeten, Wien, Austria

Quantum mechanics with massive particle become an important tool for fundamental research and applied science since many previously named “Gedankenexperiments” become feasible and new perspectives for advanced technologies arised. Neutrons are massive particles which couple to gravitational, nuclear and electro-magnetic interactions and they are sensitive to topological effects, as well. Therefore they are proper tools for testing quantum mechanics where several previously named “hidden” parameters become measurable. Widely separated coherent beams can be produced inside perfect crystal interferometers and they can be influenced individually. Spinor symmetry, spin superposition and quantum beat effect experiments have been performed and topological phases have been observed. Recent experiments related to the decoherence problem have shown that interference effects can be revived even when the overall interference pattern has lost its contrast. Related post-selection experiments shed a new light on questions of quantum non-locality and support the request for more complete quantum measurements in future. Typical Schroedinger cat-like states have been identified and their sensitivity against any kind of fluctuations and dissipative effects will be discussed. More recently a confinement induced phase shift has been observed and quantum contextuality has been proven. In both cases the entanglement with the boundary and with various degrees of freedom are demonstated. Quantum state reconstruction experiments are further topics for discussion. This shows that many more parameters characterizing a quantum system can be extracted than previously. The basis for a related quantum state engineering will be discussed.

REHACEK Jaroslav *Poster*

Is objective quantum homodyne tomography possible?

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A point is made that quantum homodyne tomography used for the diagnostics of quantum objects cannot be reduced merely to finding the state best representing the homodyne data. Relevant errors should be quantified as well by means of the Fisher information matrix. This is illustrated with an example of the diagnostics of non-classicality in terms of the negativity of the Wigner function at the origin. In this context, some earlier claims of obtaining successful reconstruc tions of nonclassical states may appear as not being supported by the experimental evidence. A conclusion is drawn that homodyne measurement is not able to determine quantum states in the objective - data based only - way, unless much prior information about the state is available.

RIZZUTO Lucia *Poster*

Casimir-Polder interaction between an accelerated atom and a perfectly reflecting plate

L. Rizzuto
Dipartimento di Scienze Fisiche ed Astronomiche, Universit degli Studi di Palermo and CNISM

We investigate the Casimir-Polder interaction energy between a uniformly accelerated atom and a reflecting plate. We consider the contributions of vacuum fluctuations and of the radiation reaction field to the atom-wall Casimir-Polder interaction and discuss their dependence from the acceleration of the atom. We show that, as a consequence of the non-inertial motion of the atom, a thermal term is present in the vacuum fluctuation contribution to the Casimir-Polder interaction. The relation of this result with the Unruh effect is discussed.

RODRIGUEZ Cesar *Talk: Fri 11:50 A*

Classical Correlations and Completely Positive Maps

Cesar Rodriguez, Kavan Modi, Aik-meng Kuah, Anil Shaji, ECG Sudarshan
University of Texas at Austin, University of New Mexico

We expand the set of initial states of a system and its environment that are known to guarantee completely positive reduced dynamics for the system when the combined state evolves unitarily. We characterize the correlations in the initial state in terms of its quantum discord. We prove that initial states that have only classical correlations lead to completely positive reduced dynamics. The induced maps can be not completely positive when quantum correlations including, but not limited to, entanglement are present. We outline the implications of our results to quantum process tomography experiments.

ROMERO Guillermo *Poster*

Direct measurement of concurrence for atomic two-qubit pure states

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[2] *Physics Department, ASC, and CeNS, Ludwig-Maximilians-Universität.*
[3] *Sección Física, Departamento de Ciencias, Pontificia Universidad Católica del Perú.*

We propose a general scheme to measure the concurrence of an arbitrary two-qubit pure state in atomic systems. The protocol is based on one- and two-qubit operations acting on two available copies of the bipartite system, and followed by a global qubit readout. We show that it is possible to encode the concurrence in the probability of finding all atomic qubits in the ground state. Two possible scenarios are considered: atoms crossing three-dimensional microwave cavities and trapped ion systems.

SAHRAI BARENJI Mostafa *Talk: Tue 11:40 A*

The effect of the spontaneously generated coherence on the dynamical behaviors of the dispersion and the absorption

M. Sahrai
University of Tabriz

This paper investigates the effects of the spontaneously generated coherence (SGC) and incoherent pumping field on the dynamical behaviors of the dispersion and the absorption. Using three-level Λ-type atomic atomic medium, the influence of the relative phase between applied fields on the transient dispersion and absorption are discussed. It is shown that the phase dependence of the dispersion, the absorption and the group index not only depend on the existence of SGC, but they depend on the existence of the incoherent pumping field as well. We show that the medium can be used as an optical switch in which the propagation of the laser pulse can be controlled by another laser field. Moreover, the effect of the atomic parameters on the switching time has also been discussed.

SANCHEZ SOTO Luis L. *Talk: Tue 10:00*

Quantum reconstruction of an intense polarization squeezed optical beam

L. L. Sanchez-Soto, Ch. Marquardt, J. Heersink, R. Dong, M. V. Chekhova, A. B. Klimov, U. Andersen and G. Leuchs
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We perform a reconstruction of the polarization sector of the density matrix of an intense polarization squeezed beam starting from a complete set of Stokes measurements. By using an appropriate quasidistribution, we map this onto the Poincaré space providing a full quantum mechanical characterization of the measured polarization state.

SCALA Matteo *Poster*

The Dissipative Jaynes-Cummings model with and without the Rotating Wave Approximation

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A microscopic derivation of the master equation for the Jaynes-Cummings model with cavity losses is provided. We compare, in various atom-cavity coupling regimes, our master equation with the phenomenological master equation used in the literature and single out the conditions under which the phenomenological model is justified. Some examples wherein the phenomenological and the microscopic master equations give rise to different predictions are discussed in detail.

SCHEEL Stefan *Talk: Fri 17:40 A*

CPT Maps consisting of Mixed Unitaries

Stefan Scheel and Koenraad M.R. Audenaert
Imperial College London

In this paper we answer two questions about quantum maps. The first question is, given any completely positive trace-preserving (CPT) map, how can one determine whether this map can be decomposed as a convex combination of unitary maps (random unitary maps)? The second, and very much related, question we answer here is about finding a proper distance measure between a CPT map and the set of random unitary maps, and methods for calculating it. The physical motivation behind these questions is the desire to distinguish various error mechanisms afflicting the preparation and processing of quantum states such as in the realisation of quantum gates in. If the only error mechanism occurring is a classical uncertainty, for instance in a phase parameter, then the resulting "gate" will not be described by a particular unitary, but rather by a mixture of such unitaries. If on the other hand, other mechanism can occur, such as spontaneous decay or photon loss, then the resulting "gate" can not even be described by such a random unitary map anymore. In a sense, the distance between this particular map and the set of random unitary maps determines the presence of these non-classical error mechanisms.

SCHETTINI Valentina *Poster*

Reduced Deadtime and Higher Rate Photon-Counting Detection using a Multiplexed Detector Array

Stefania Castelletto,[1] Ivo Pietro Degiovanni,[1] Alan Migdall,[2] Sergey Polyakov,[2] Valentina Schettini[2]
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As the quantum information field advances, the need for improved single-photon devices is becoming more critical. Quantum information systems are often limited by the detector deadtime to operate at counts rate of a few MHz, at best, and often at significantly lower rates. We present a scheme for a photon counting detection system that can be operated at incident photon rates higher than otherwise possible by suppressing the effects of detector deadtime. The method uses an array of N detectors and a 1-by-N optical switch with a control circuit to direct input light to live detectors. Our calculations and models highlight the advantages of the technique. In particular, using this scheme, a group of N detectors provides an improvement in operation rate that can exceed the improvement that would be obtained by a single detector with deadtime reduced by 1/N, or of a group of N detectors with passive switching. We model the system for continous and pulsed light sources, and we compare the results with the ones obtained with Montecarlo simulations. Furthermore the results of preliminary experimental

tests obtained with a prototypal realization of these systems, realized with N=2 detectors, are presented.

SERGI Alessandro *Talk: Mon 12:00 B*

Quantum-Classical Dynamics of Wave Fields

Alessandro Sergi
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An approach to the quantum-classical mechanics of phase space dependent operators, which has been proposed recently [1], is remodeled as a formalism for wave fields. Such wave fields obey a system of coupled non-linear equations that can be written by means of a suitable non-Hamiltonian bracket. As an example, the theory is applied to the relaxation dynamics of the spin-boson model. In the adiabatic limit, a good agreement with calculations performed by the operator approach is obtained. Moreover, the theory proposed in this paper can take nonadiabatic effects into account without resorting to surface-hopping approximations. Hence, the results obtained follow qualitatively those of previous surface-hopping calculations and increase by a factor of (at least) two the time length over which nonadiabatic dynamics can be propagated with small statistical errors. Moreover, it is worth to note that the dynamics of quantum-classical wave fields here proposed is a straightforward non-Hamiltonian generalization of the formalism for non-linear quantum mechanics that Weinberg introduced recently [2].
[1] R. Kapral and G. Ciccotti, J. Chem. Phys., **110**, 8919 (1999).
[2] S. Weinberg, Phys. Rev. Lett. **62** 485 (1989).

SHATOKHIN Vyacheslav *Talk: Mon 16:00*

The coherent backscattering spectrum of two atoms

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B.I. Stepanov Institute of Physics, Minsk, Belarus, University of Erlangen, Germany, Universite Piere et Marie Curie, Paris, France, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

We present a detailed analytical and numerical analysis of the inelastic coherent backscattering spectrum of laser light incident on cold atoms. We identify frequency domains where the interference contribution can be positive as well as negative – or exhibits dispersive character. These distinctive features are explained by reciprocity arguments and dressed state two-photon scattering amplitudes. We also discuss an alternative approach to multiple scattering of intense light in an optically thick sample of cold atoms.

SHUMOVSKY Alexander *Talk: Fri 16:00*

Spin systems: an example of entanglement without nonlocality

A.A. Klyachko, B. Oztop, A.S. Shumovsky
Faculty of Science, Bilkent University, Bilkent, Ankara, Turkey

Basing on the Majorana representation of spin systems (E. Majorana, Nuovo Cimento 9, 43 (1932)) and our recent result on measure of entanglement (A.A. Klyachko, B.Oztop, A.S. Shumovsky, Phys. Rev. A 75, 032315 (2007)), we show that spin $s > 1/2$ systems manifest entanglement. Their entangled states can be interpreted as the symmetric multi-qubit states. We show that entanglement of those states can be quantified by only three global measurements independent of the number of qubits. We also show that states of a single spin can violate Bell-type inequalities with respect to global observables.

SOLIMENO Salvatore *Talk: Sat 11:00 A*

CV Entanglement generation in a non-degenerate Optical Parametric Oscillator

V. D'Auria, S. Fornaro, A. Porzio and S. Solimeno
Università "Federico II" di Napoli

A Non-degenerate "triply resonant" Optical Parametric Amplifier (NOPA) is able to generate CV bright entangled beams. In this contribution we analyse the role of the different noise sources, including laser technical noise, acoustic vibrations and crystal temperature fluctuations, on the OPO dynamics. The limit of a linearised approach will be discussed by looking at second order effects. In the second part we will give a glance on the current experiment going on at the University of Napoli Quantum Optics Laboratory. Preliminary measurements show that entanglement is realized. Reliable triply resonance condition is obtained by combining temperature phase-matching and crystal tilting in the optical cavity.

SOLOMON Allan *Talk: Fri 11:30 A*

Decoherence of Entanglement

Allan Solomon[1] and Sonia Schirmer[2]
[1] *Open University*
[2] *Cambridge University*

We discuss the effects of interaction with the environment on the dissipation of entanglement.

SPAGNOLO Salvatore *Poster*

Casimir-Polder potential between two atoms embedded in a magneto-dielectric medium

S. Spagnolo, D.A.R. Dalvit, P.W. Milonni
Dipartimento di Scienze Fisiche ed Astronomiche di Palermo, Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM 87545, USA

We consider the Casimir-Polder potential energy between two ground-state neutral atoms embedded in a magneto-dielectric medium. We calculate the interaction using two approaches, the first based on the quantized electromagnetic field in a dispersive medium without absorption and the second on Green functions that allow for absorption. We show that the two methods yield the same results and so that in order to obtain the ground state energy of the system, we can neglect the absorption of the host medium.

STRELKOV Vasily *Talk: Sat 17:40 A*

Control of attosecond pulse emission via ellipticity gating: theory and experiment

V.V. Strelkov, I. J. Sola, L. Elouga, E. Mével, E. Constant, L. Poletto, P. Villoresi, E. Benedetti, J-P. Caumes, S. Stagira, C. Vozzi, G. Sansone, M. Nisoli
General Physics Institute of the Russian Academy of Sciences, Moscow, Russia. Centre Lasers Intenses et Applications, Université Bordeaux I, Bordeaux, France. CNR-INFM, Laboratory of Ultraviolet and X-ray Optical Research, Department of Information Engineering, University of Padova, Padova, Italy. CNR-INFM - National Laboratory for Ultrafast and Ultraintense Optical Science, Department of Physics, Politecnico of Milan, Milano, Italy

By modulating the polarization of a carrier-envelope phase stabilized short laser pulse we control the dynamics of the photoionized electron wavepacket. Under optimised conditions we observe the signature of a single return of the electron, accompanied with the emission of an isolated attosecond pulse with a broad and tunable bandwidth. Compression of the attopulse down to the sub-100 as duration is discussed.

SUDARSHAN George *Talk: Sat 9:00*

Geometry of Dynamical Maps

E C G Sudarshan
Center for Statistical Mechanics and Complex Systems

The statistical state of an open system changes linearly but not by a unitary transformation. All density matrices are mapped linearly into other density matrices and a sub class of this is called Completely Positive (CP). Any such map can be realised as the contraction of the unitary evolution of a larger system. For a Qubit the set of density matrices constitute the unit disk in three dimensions and is bounded by a spherical surface. Linear maps of such matrices involve a mapping into an ellipsoidal disc and its center may be displaced from its original position. Any such map may be described in terms of at most N^2 matrices. The CP maps form a convex set and the extremals need only N matrices at most. The decomposition of a generic map into extremal components requires it to be generated by the unitary transformation of each extremal component being coupled to a distinct state. The group of these transformations is $SL(2,R)XT(3)$.

SUOMINEN Kalle-Antti *Talk: Fri 9:30*

Quantum jumps and non-Markovian evolution

Jyrki Piilo, Sabrina Maniscalco and Kalle-Antti Suominen
Dept. of Physics, Univ. of Turku, Finland

The Monte Carlo wave function (MCWF) method has become a strong tool for simulations of the dynamics of Markovian open quantum systems. In addition to computational speed-up, it also offers a conceptual view of the physical processes and single-system evolution. One of the key issues is the identification of possible jump operators and the corresponding probabilities for a jump to occur. In certain non-Markovian systems the identification of jump processes is hampered by the fact that jump probabilities become time-dependent and can have negative values. Here we present a novel method for the treatment of non-Markovian evolution as an ensemble of quantum jump histories. Our approach agrees with the standard MCWF for positive probabilities, but it is also able to handle the negative probabilities in a consistent way, and it is an exceptionally simple approach in the sense that it does not e.g. involve any artificial extensions of the Hilbert space for the system.

TAMMA Vincenzo *Talk: Mon 17:40 A*

Reliability of NOON-state production schemes

Milena D'Angelo, Augusto Garuccio, Vincenzo Tamma
Università degli studi di Bari

The so called NOON states are the main ingredient of many quantum information schemes. The reliability of NOON-state production schemes clearly plays an important role in view of practical applications. The production schemes proposed so far can be divided in two categories: the ones relying on single photon detection and the ones relying on non-detection. Hence, in realistic situations, the reliability of NOON-state sources will strongly depend on photodetection efficiency. We start our analysis by comparing the reliability of the two types of sources by taking into account the detection efficiency of SPCMs. We discuss and compare the reliability of NOON-state protocols based on both single-photon and zero-photon detection. Our result may be of great interest for practical implementation of NOON-state schemes.

TANAS Ryszard *Talk: Sun 11:40 B*

Birth and death of entanglement in a two-atom system

Ryszard Tanas and Zbigniew Ficek
Nonlinear optics Division, Institute of Physics, Adam Mickiewicz University, Department of Physics, School of Physical Sciences, The University of Queensland, Brisbane, Australia

Effect of sudden death of entanglement has been widely discussed recently. It is also well known that entanglement can be created when two-atom system emits spontaneously. The entanglement can be created continously, without the time delay, but can start also after some finite time. We use standard Markovian master equation to describe the collective behaviour of the two-atom system and discuss both birth and death of entanglement in such a system for various initial states.

THÉ George A.P. *Talk: Mon 18:20 B*

Optical setup for teleportation of the XOR function using coherent state qubits

João Batista Rosa Silva,[1] George Andrè Pereira Thé,[2] Rubens Viana Ramos [1]
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[2] *Electronics Department, Polytechnic of Turin, Corso Duca degli Abruzzi 24, 10129, Torino, Italia.*

The teleportation of the xor function between two classical bits has been used for implementation of several quantum information protocols as, quantum key distribution, error correction, access control and contract signature. In this work, it is described an optical setup for implementation of the quantum teleportation of the xor function between two classical bits with coherent states qubits using only linear optics devices and without teleportation, which is common in the implementation of coherent state single-qubit gates. The efficiency of the proposed setup is 1/2. The key element to become possible the realization of this setup is a GHZ-type entangled coherent states and its generation also is proposed.

THÉ George A.P. *Poster*

Electron localization in coupled quantum dot structure via Variational approach with application in quantum cellular automata

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[2] *Federal University of Ceara*

Coherent destruction of tunneling (CDT) of electrons in quantum well and quantum dot structures has been the topic of many investigations in the last few years, especially in two coupled quantum dots systems, which are of great importance to the development of quantum computer architectures. In a system composed by an electron and two quantum dots, it is also referred as electron localization and occurs when the tunneling of the particle is suppressed due to, e.g., the application of a suitable external AC electric field. Traditionally, the mathematical approach commonly used to derive the equations which govern the dynamical behaviour of the electron consists of taking the Hamiltonian of the unperturbed system, H0(t), and the potential due to the interaction between the quantum dot structure and the external AC field, V(t), and applying them into the time-dependent Schrdinger equation, in order to obtain a set of nonlinear, coupled different equations (hereafter set A). This set is usually solved by Runge-Kutta numerical method. Instead of using this approach, in this work we propose to use the Variational method in order to obtain a set of equations easier to solve than that obtained by following the procedure described above. In this way, we start describing the system by a Lagrangian and, then, using the Euler-Lagrange equations and suggesting an ansatz, we discover a new set of coupled differential equations (hereafter set B). By using Runge-Kutta method we solve set B and show it requires less computational efforts than set A. In fact, set B requires, in average, 22.57% less time to be solved than set A. The numerical results obtained show the dependence of the electron localization on the frequency and shape of the electrical field used. As an application of this double-dot structure electrically controlled, we show how it can be used to control a quantum dot cellular automata and, by its turn, the implementation of logic devices at nano-scale and quantum gates.

TOPUZOSKI Suzana *Poster*

Transfer of a Gaussian laser beam through the fork-shaped hologram for atom trapping purposes

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In this paper we deduce and study in detail the analytical expressions for Fresnel diffraction of a Gaussian laser beam by fork-shaped hologram with arbitrary integer singularity p. The wave and the irradiance distributions are discussed in the near and far field, supported by numerical analyse, as well as the specialization of the results for the plane wave incidence. The study of intensity distribution arround the vortex and far from it, as well as the expressions for the vortex radius performed in this work, can provide an information about the trapping potential and widht of the guide walls, which is of interest for atom trapping and guiding.

TRAINA Paolo *Poster*

Realization of high precision interferomenters for experiments on Quantum Information.

Giorgio Brida, Marco Genovese, Fabrizio Piacentini, Paolo Traina
INRIM - Istituto Nazionale di Ricerca Metrologica

We present our recent progresses in the realization of Mach-Zender interferometers addressed to the implementation of experiments on Quantum Information and Tests of Local Realism. The possible applications of our system concern: double entanglement, Quantum Communication exploiting ququats, CGLMP tests in the 4-dimensional Hilbert space and full photon statistics reconstruction.

USENKO Vladyslav *Talk: Mon 11:00 B*

Quantum communication with photon-number entangled states of light upon realistic conditions

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We investigate efficiency and applicability of the quantum communication schemes based on the photon-number entangled states (PNES) of light in the realistic conditions. The two PNES state types namely twin beam (TWB) and two mode coherently-correlated (TMC) states are considered in comparison to the classically correlated thermal states. The effect of losses on the beams statistics is investigated and the optimal bit discrimination thresholds maximising channel mutual information are obtained both for symmetric and asymmetric lossy channels. The states statistics is shown to preserve upon channel losses thus enabling the realistic security of the TMC-scheme. The influence of the imperfect detection is also examined and the thermal noise bounds to the PNES-based schemes applicability are obtained.

VASYLYEV Dmytro *Poster*

Propagation of quantized radiation fields throught semiconductor media

D. Vasylyev, W. Vogel, T. Schmielau, K. Henneberger, D.-G. Welsch
Institute of Physics, NAS of Ukraine, Universitaet Rostock, Friedrich- Schiller-Universitaet Jena

The methods developed independently in Quantum Optics and Semiconductor Physics for description of light propagation in matter with significant dispersion and absorption effects are compared. The relations between the basic quantities in two kinds of methods are derived. It is shown the way how to extend the Quantum Optical theory to include gain in the medium. As an example, propagation of two-mode squeezed light through the semiconductor slab is studied for both absorption and gain cases.

VILLARREAL Carlos *Talk: Tue 15:40 B*

High Tc Superconductivity and Quasi-2D Bose-Einstein Condensation

C. Villarreal
Universidad Nacional Autonoma de Mexico

A model for high Tc superconductivity based on Bose-Einstein condensation of Cooper pairs in quasi-bidimensional regions is presented. The boson number and internal energy of the system are calculated by considering the exact mode density for narrow slabs of finite width d. Predictions for Tc consistent with experimental data for cuprates are obtained when $d \sim 1/k_F$, being k_F the Fermi wave number.

VITANOV Nikolay *Talk: Sat 10:00*

Navigation in Hilbert space by quantum state reflections

.A. Ivanov, E.S. Kyoseva, B.T. Torosov and N.V. Vitanov
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Manipulation of superpositions of discrete quantum states has a mathematical counterpart in the motion of a unit-length statevector in an N-dimensional Hilbert space. Any such statevector motion can be regarded as, and produced by, a succession of two-dimensional rotations. But the desired statevector change can also be treated as a succession of reflections, the generalization of Householder transformations. In a multidimensional Hilbert space such reflection sequences offer more efficient procedures for producing statevector changes than do sequences of rotations. We propose a simple physical implementation of the quantum Householder reflection (QHR) in a quantum system of N degenerate states (forming a qunit) coupled simultaneously to an ancillary (excited) state by N resonant or nearly resonant pulsed external fields. We use this operator as a building block in synthesizing arbitrary preselected unitary transformations. We show that the most general U(N) transformation can be factorized, and thereby constructed, by at most N - 1 QHRs and a one-dimensional phase gate. Viewed mathematically, this QHR factorization provides a parameterization of the U(N) group. As an example, we propose a recipe for constructing the quantum Fourier transform (QFT) by at most N - 1 interaction steps. For example, QFT requires a single QHR for N = 2, and only two QHRs for N = 3 and 4. We use this QHR factorization to propose a very efficient technique that connects any two arbitrary (pure or mixed) superposition states of a qunit. We show that any two pure states can be linked by just a single QHR. The transfer between any two N-dimensional mixed states with the same dynamic invariants (e.g., the same density matrix eigenvalues) requires in general N QHRs. Moreover, we propose recipes for synthesis of arbitrary preselected mixed states using a combination of QHRs and incoherent processes (pure dephasing or spontaneous emission). We extend these results to a system with lower and upper levels of arbitrary degeneracies. Then the propagators within the two sets of degenerate states are expressed by products of QHRs.

VOURDAS Apostolos *Talk: Fri 17:00 B*

Fourier multiport devices

A. Vourdas, S. Zhang, C. Lei, J. Dunningham
University of Bradford

Fourier multiport devices in which the creation (annihilation) operators at the output are related to the creation (annihilation) operators at the input through a finite Fourier transform, are studied.Various inputs are considered and the corresponding output is calculated. For thermal states at the input the device can be used as a thermometer.

WALLENTOWITZ Sascha *Talk: Fri 11:30 B*

On "spin squeezing" by polarimetric measurements

Sascha Wallentowitz
Pontificia Universidad Católica de Chile

In recent years spin squeezing in atomic media has been obtained experimentally by Faraday rotation of polarized light and its subsequent polarimetric measurement. In this contribution it is pointed out that reasonable doubts can be raised on whether true atomic spin-squeezed states are obtained in this manner.

WELSCH Dirk-Gunnar *Talk: Sat 11:00 B*

QED in arbitrary linear media: A unified macroscopic approach

C. Raabe[1], S. Scheel[2], D.-G.Welsch[1]
[1] *Friedrich-Schiller-University Jena,* [2] *Imperial College London*

We give a unified approach to macroscopic QED in arbitrary linearly responding media, based on the quite general, nonlocal form of the conductivity tensor as it can be introduced within the framework of linear response theory, and appropriately chosen sets of bosonic variables. The formalism generalizes the quantization schemes that have been developed previously for diverse classes of linear media to a universally applicable scheme. In particular, it turns out that the scheme developed for locally responding linear magnetodielectric media can be recovered from the general scheme as a limiting case for weakly spatially dispersive media.

WHITE Andrew *Talk: Fri 17:20 B*

Efficient quantum logic circuits: or, How I Learned to Stop Worrying and Love Hilbert Space

A. G. White, M. Pereira de Almeida, M. Barbieri, D. N. Biggerstaff, R. B. Dalton, A. Gilchrist, G. Gillett, D. F. V. James (†), N. K. Langford, B. N. Lanyon, K. J. Resch (‡), T. Weinhold
University of Queensland, Brisbane, Australia (†) University of Toronto, Ontario, Canada (‡) University of Waterloo, Ontario, Canada

We demonstrate significantly compacted quantum algorithms and demonstrate a Fock-state filter by going outside the qubit corner of Hilbert space. We obtain a complete error budget for an entangling gate when driven with independent photons.

YATSENKO Leonid *Talk: Fri 15:00*

Recent Progress in Laser Based Rapid-Adiabatic-Passage

Leonid Yatsenko
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We discuss recent results of the investigation and application of the techniques of coherent population transfer and coherent superposition creation by adiabatic interaction of pulsed laser fields with atoms and molecules. The results were obtained in collaboration of University of Kaiserslautern (Germany), Universite de Bourgogne (France), Sofia University (Bulgaria) and Institute of Physics of NASU, Kiev (Ukraine). In particular, we study, as theoretically and experimentally, a method for controlling the flow of excitation through decaying levels in a three-level ladder excitation scheme. We present the experimental demonstration of coherent population transfer, induced by stimulated Raman adiabatic passage, via continuum states in helium atoms and experimental data to demonstrate coherently driven population inversion by retroreflection-induced bichromatic adiabatic passage. Population transfer from an initial to a target state in metastable helium atoms is induced by coherent interaction of the atoms in a supersonic beam with two counterpropagating and temporally delayed laser pulses of different intensities. We show that the technique of Stark-chirped rapid adiabatic passage (SCRAP), hitherto used for complete population transfer between two quantum states, offers a simple and robust method for complete population transfer amongst three states in atoms and molecules. Traditional two-photon excitation suffers from two difficulties that prevent complete population transfer: dynamic Stark shifts and multiphoton ionization. We describe a technique for overcoming these limitations by using a second field to control dynamic Stark shifts via Stark-chirped rapid adiabatic passage (SCRAP) and simultaneously suppress undesired photoionization via laser-induced continuum structure (LICS). We analyze experimentally feasible implementations of single-qubit quantum gates based on stimulated Raman adiabatic passage (STIRAP) between magnetic sublevels in atoms coupled by elliptically polarized pulsed laser fields and discuss some new methods of creating and control of coherent superposition of quantum states.

YUASA Kazuya *Talk: Fri 10:30*

Coherence of Field-Emitted Electrons

Kazuya Yuasa
National Institute of Advanced Industrial Science and Technology (AIST), Tokyo, Japan

Understanding quantum coherence is important not only for the foundations of quantum mechanics but also for quantum information. In particular, the latter requires a better understanding of entanglement, the coherence of multi-particle systems. We discuss the coherence among the electrons emitted from a material. Since the electrons are fermions, they exhibit antibunching, but how they antibunch heavily relies on the properties of the source. It is therefore interesting to discuss the antibunching of electrons emitted from a superconductor. The field emission of electrons from a superconductor was reported in [1]. In order to take account of the properties of the source, it is crucial to treat the source as a dynamical quantum system. The field emission of the electrons is dynamically described in the framework of the quantum field theory, and it is revealed how the superconducting state of the emitter affects the coherence properties of the field-emitted electrons.

[1] K. Nagaoka et al., Nature 396, 557 (1998).