6 Physics of Atoms and Lasers

Wednesday, 26.03.2008, Room 2160 (2nd floor)

Time	ID	Physics of Atoms and Laser 1: Atomic Physics *Chair: A. Weis, Uni Fribourg*
10:30	**611**	**Controlling Quantum Gases** *Tilman Esslinger, Department of Physics, ETH Zürich* Quantum gases provide highly controllable systems to study fundamental concepts in physics. Yet, a central challenge is to experimentally extract quantitative information on the underlying phenomena. Here, I will report on a new approach in which we have combined the achievements of Bose-Einstein condensation with those of cavity quantum electrodynamics. The cavity is used as a single atom detector allowing us to study the Bose gas in the critical regime of the phase transition, where the fluctuations extend far beyond the length scale of thermal de Broglie waves. We measure the correlation length of these critical fluctuations as a function of temperature and observe the diverging behaviour of the correlation length on approach to the critical temperature. From this we determine the critical exponent of the correlation length for a trapped, weakly interacting Bose gas to be $\nu = 0.67 \pm 0.13$ [1]. [1]: T. Donner, S. Ritter, T. Bourdel, A. Öttl, M. Köhl, and T. Esslinger, Science 315, 1556 (2007).
11:00	**612**	**Controllable dynamical generation of entanglement and frustrated spin states in ultracold bosonic double well superlattices. [1]** *Peter Barmettler, Université de Fribourg, Chemin du Musee 3, 1700 Fribourg* In recent experiments with ultracold bosons in optical lattices the control over superexchange interactions between spinor atoms was achieved [2]. This allows for the realization of exotic states in low dimensional magnetic systems. We propose a method for robust and controllable generation of long-distance entangled pairs using spinor atoms loaded in a period-two superlattice. Our scheme iteratively swaps the entanglement between pairs of atoms by controlling the tunnelling between the double wells. When implemented in a finite linear chain of 2N atoms, it creates a triplet valence bond state with large persistency of entanglement (~ N). We also study the general case of uniformly coupled wells. In this case the many-body dynamics can lead to the formation of frustrated spin states with "spin liquid-like" character and high degree of multi-particle entanglement. We present methods for detection and characterization of the various dynamically generated states. These ideas are a step forward towards the use of atoms trapped by light as quantum information processors and quantum simulators. [1] P. Barmettler, A. M. Rey, E. Demler, M. Lukin, I. Bloch, V. Gritsev, *in preparation* [2] S. Trotzky, *et. al.*, arXiv:0712.1853.

11:15	**613**	**Lifetimes of Cs^*He_n exciplexes in solid ^4He** *Victor Lebedev, Peter Moroshkin, Adrian Hofer, Antoine Weis, Departement de Physique, Université de Fribourg, Chemin du Musée 3, 1700 Fribourg* Alkali-helium excited state complexes (exciplexes) bound by van der Waals forces have been a subject of extensive experimental and theoretical studies in the past 10 years. We present results of our new study of exciplex dynamics in solid He. The lifetimes of the quasimolecules Cs^*He_2 and Cs^*He_7 were obtained by measuring the decay times of the laser-induced fluorescence at selected wavelengths. The lifetime of the triatomic exciplex is very short (≤5 ns). Our analysis shows that this results from quenching by a radiationless process, most likely by the transformation into Cs^*He_7. On the other hand, the lifetime of Cs^*He_7 is much longer (95 ns) than that of the excited $6P_{1/2}$ state of a free Cs atom (34.8 ns). The increase of the radiative lifetime results from the redshift of the transition wavelength and from the modification of the transition dipole matrix element due to the Cs-He interaction.
11:30	**614**	**Hollow Magnesium, Aluminium and Silicon: Photon Energy Dependence of Double 1S Ionization** *Joanna Hoszowska [1], Jean-Claude Dousse [1], Wei Cao [1], Karima Fennane [1], Yves Kayser [1], Matjaz Kavcic [2], Anatoli Kheifets [3], Yves-Patrik Maillard [1], Jakub Szlachetko [4], Monika Szlachetko [1]* *[1] Department of Physics, University of Fribourg, Chemin du Musée 3, 1700 Fribourg* *[2] J.Stefan Institute, Jamova 39, 1001 Ljubljana, Slovenia* *[3] Research School of Physical Sciences, The Australian National University, ACT, 0200 Canberra, Australia* *[4] European Synchrotron Radiation Facility, BP 220, F-38043 Grenoble* Hollow atoms are atoms with an empty 1s shell and outer shells occupied. Double ionization by a single photon leading to an empty 1s shell serves as one of the most sensitive probes of electron-electron correlations. The ejection of two electrons would not occur in the independent electron picture. We report on the investigation of double 1s photoionization of Mg, Al and Si by means of high-resolution x-ray emission spectroscopy. Measurements of the hypersatellite ($1s^{-2}\rightarrow 1s^{-1}2p^{-1}$) x-ray spectra were carried out using the Fribourg high-resolution von Hamos crystal x-ray spectrometer installed at the ID21 and ID26 beam lines at the ESRF. Ratios of double-to-single photoionization probabilities P_{KK} were derived as a function of the incident photon energy from threshold for double photoionizaion to saturation and compared to theoretical models and CCC (convergent close-coupling) calculations. The importance of the dynamical electron-electron scattering contribution to hollow low-Z atom production in single photon ionization was evinced.

11:45	**615**	**Optical detection of the Stern-Gerlach effect** *Paul Knowles, Mateusz Donten, Antoine Weis, Département de Physique, Université de Fribourg, Chemin du Museé 3, 1700 Fribourg* The famous experiment of O. Stern and W. Gerlach which proved space quantization is frequently taught to undergraduates during their introduction to quantum mechanics. Although less frequently seen, advanced undergraduate laboratory apparatus allow students to perform the experiment for themselves, and provide a view into the world of atomic beam physics. At the University of Fribourg, the marriage of a cesium-based Stern-Gerlach apparatus with commodity laser diodes and infrared cameras has allowed the Stern-Gerlach effect to be seen directly, and opens possibilities for students to experimentally study laser-atom interactions. Some details on the system will be presented.
12:00		***Postersession, Lunch***
12:45		***SPS GENERAL ASSEMBLY***
		Physics of Atoms and Laser 2: Metrology *Chair: J.-C. Dousse, Uni Fribourg*
14:00	**621**	**Research on atomic clocks at LTF** *Pierre Thomann, Laboratoire Temps-Fréquence, Institut de Microtechnique, Université de Neuchâtel, Rue A.-L.-Breguet 1, 2000 Neuchâtel* This paper gives an overview of current research directions at the newly created "Laboratoire Temps-Fréquence" of UniNE. 1) Fundamental metrology: our research on laser cooling and manipulation of atoms has led to an original design of primary atomic clocks, based on continuous fountains of laser-cooled Cs atoms. Two primary clocks are under construction/metrological evaluation at METAS. The goal is to reach a relative frequency uncertainty below 10^{-15}, needed for both metrology and fundamental physics tests. Developments towards frequency standards in the optical frequency range are also planned. 2) Miniature atomic clocks: atomic vapor-cell based clocks allow for very small size (1 liter, down to 1 cm^3 in the future): several collaborative projects with Swiss and European partners, both at the prospective research and applications level, are underway to provide the space and telecom industries with the miniature clocks required by their growing applications (eg satellite navigation system GALILEO, network synchronization).
14:30	**622**	**The tensor Stark shift in Cs** *Jean-Luc Robyr, Paul Knowles, Antoine Weis, Université de Fribourg, Département de Physique, Chemin du Musée 3, 1700 Fribourg* The precision of modern atomic clocks is approaching the 10^{-16} level, and at this precision, all perturbations of the cesium hyperfine level splitting must be carefully accounted for. The blackbody radiation shift (AC Stark effect) is one such disturbance. The past few years have seen a renewed interest in the measurement and theoretical description of this effect. We report on progress

		towards the application of coherent population trapping (CPT) in a pump-probe experiment on an atomic beam for a measurement of the full (DC) second order tensor Stark shift that underlies the blackbody shift.
14:45	**623**	**A multichannel second-order gradiometer for imaging the magnetic field of the human heart** *Adrian Hofer, Georg Bison, Natascia Castagna, Gianni Di Domenico, Catherine Macchione, Anatoly Pazgalev, Antoine Weis, Université de Fribourg, Département de Physique, Chemin du Musée 3, 1700 Fribourg* The magnetic field generated by the beating human heart contains valuable information for the medical diagnostic of heart diseases. We present an optical laser magnetometer used for mapping the magnetic field of the human heart. The magnetometer was designed to work in a weakly shielded room with the potential for a future use in a hospital. A first realization of a hardware second-order gradiometer is used to suppress magnetic field noise and has allowed us to measure magnetic field changes of a few pT, while the intrinsic sensitivity of the magnetometers is around 20fT/$\sqrt{}$Hz. First measurements done with a multi-channel system will be presented.
15:00		
15:30		***Coffee Break***
		Physics of Atoms and Laser 3: Light Sources and Spectroscopy *Chair: P. Knowles, Uni Fribourg*
16:00	**631**	**Carrier-envelope phase signature in THz emission from a femtosecond filament in argon** *Christoph Hauri, Paul Scherrer Institut, 5232 Villigen PSI* In our recent experiment we successfully generated efficient THz emission by 40-cm-long filamentation of an intense 0.8 mJ, 30-fs laser pulse in argon at 3 kHz repetition rate. We demonstrated that a specific filament pattern provides strong THz emission in the range of 0.1 THz to ≥1.2 THz, based on our detection capabilities. We furthermore demonstrated that the strength of the generated THz signal depends strongly on the longitudinal position of the detector in relation to the plasma channel. The strongest emission of THz radiation was attributed to efficient spectral pulse broadening to more than an octave, resulting in a symmetry breaking of the electric field due to ω-2ω mixing, and to pulse self-compression to a few optical cycles. In contrast to previous work on CEP dependent THz emission our scheme does not require any laser pulse energy for CEP characterization, is therefore loss-free and allows in principle single-shot CEP determination by means of fast and simple bolometric detection of the THz radiation.

16:15	**632**	**Spectroscopy of GaN nanocolumns grown by molecular beam epitaxy on Si** *Pierre Corfdir [1], Jean-Daniel Ganière [1], Jelena Ristic [1], Pierre Lefebvre [1], Benoît Deveaud-Plédran [1], Enrique Calleja [2]* *[1] EPFL - SB - IPEQ - LOEQ, 1015 Lausanne* *[2] Instituto de Sistemas Optoelectronicos y Microtecnologia, Universidad Politecnica de Madrid, Ciudad Universitaria, 28040 Madrid, Spain* During the last decade group-III nitrides have become promising materials for solid-state emission of visible-UV light. However the heteroepitaxial growth of GaN leads to large densities of defects that spoil the emission properties. One way to overcome this drawback is to produce dense layers of dislocation and strain-free GaN nanometric single crystals called nanocolumns (NCs). Plasma-assisted molecular beam epitaxy was used to grow micrometer high NCs on silicon substrates with diameters comprised between 30 and 150 nm, resulting in large surface-to-volume ratio. The NCs have been studied by time-integrated and time-resolved photoluminescence at 10 K. Two pronounced lines at 3.471 and 3.477 eV are associated to silicon bound and free excitons, respectively. Another intense transition at 3.449 eV is observed. This energy corresponds to the two-electron satellite (TES) of the donor-bound exciton also observed in high-quality GaN epilayers [1]. However, in GaN nanocolumns the 3.449 eV line exhibits much higher intensity in respect to the donor bound exciton line. Since abnormally intense TES lines have previously been observed in ZnO nanorods [2], our observation suggests that the intensity of the TES might be related to the particular geometry of NCs. Luminescence from both the bound exciton and its TES exhibit fast decay times of a few hundreds of picoseconds. We analyse in detail the differences between these decay times and their variation with temperature, excitation conditions, and NC diameters.
16:30	**633**	**Filamentation and Laser Noise Reduction in Rare gazes** *Pierre Béjot [1], Christophe Bonnet [2], Véronique Boutou [2], Roland Ackermann [2], Estelle Salmon [2], Jérome Kasparian [1], Jean-Pierre Wolf [1]* *[1] Gap-Biophotonics, Université de Genève, rue de l'ecole de Médecine, 20, 1211 Genève* *[2] Laboratoire de Spectrométrie Ionique et Moléculaire, Université Lyon 1, Domaine Scientifique de la Doua, Université Claude Bernard Lyon 1 Bâtiment Alfred Kastler, 43, bd du 11 Novembre 1918, F-69622 Villeurbanne* Recently, considerable interest has been devoted to the study of femtosecond lasers filamentation in transparent media. Filamentation is an efficient way to produce an intense and spectrally broad, but poorly stable, source for coherent control spectroscopy. We first described both theoretically and experimentally the filamentation and broadening of a 400 nm ultrashort laser pulse in Argon. By observing the theoretical and experimental spectral cross-correlation in the filament, we then showed that the stability of the source can be improved. The Signal-to-Noise Ratio of the intensity inside the filament is increased up to 7 dB by its spectral filtering which provide a low noise broad spectrum source.

16:45	**634**	**Photon Echo Peak Shift experiments in the UV: Towards investigation of protein dynamics.** *Ahmad Ajdarzadeh Oskouei, Andreas Tortschanoff, Andrea Cannizzo, Olivier Bräm, Frank van Mourik, Majed Chergui* *EPFL SB ISIC LSU, 1015 Lausanne* Ultrafast nonlinear optical experiments are ideal tools to carry out studies on solvation dynamics. In particular, photon-echo peak shift measurements have the capability to trace the band-gap correlation function in much detail [1,2]. Very little work has been done in the UV spectral range, even though there are several issues, which would make UV photon echo experiments extremely interesting. Indeed, most amino-acid residues in proteins absorb in the UV range and studies of their behavior and dynamics with ultrafast spectroscopic techniques provides access to intra-protein dynamics in real time, which is the basis for understanding biological functions. With the final goal of studying ultrafast fluctuation dynamics in wild-type proteins by exciting the aromatic amino acid tryptophan, we have implemented a photon-echo experiment with excitation in the UV region [3]. Here, we report the first results of UV photon-echo peak shift experiments on a dye solution and on tryptophan in water. [1] W. P. de Boeij, M. S. Pshenichnikov, and D. A. Wiersma, Annu. Rev. Phys. Chem. 49, 99 (1998). [2] G. R. Fleming, T. Joo, and M. Cho, Adv. Chem. Phys. 101, 141 (1997). [3] A. Ajdarzadeh Oskouei, O. Br m, A. Cannizzo, F. van Mourik, A. Tortschanoff and M. Chergui, Chemical Physics (accepted).
17:00	**635**	**Filament Induced Electric Events in Thunderstorms** *Jérôme Kasparian [1], Roland Ackermann [2], Guillaume Méjean [2], Estelle Salmon [2], Jin Yu [2], Yves-Bernard André [3], Bernard Prade [3], Grégoire Méchain [3], André Mysyrowicz [3], Philipp Rohwetter [4], Kamil Stelmaszczyk [4], Ludger Wöste [4], Roland Sauerbrey [5], Jean-Pierre Wolf [1]* *[1] GAP-Université de Genève, 20 rue de l'Ecole de Médecine, 1211 Genève* *[2] Universit Lyon 1-CNRS-LASIM, 43 bd du 11 novembre, F-69622 Villeurbanne* *[3] CNRS-ENSTA-LOA, Chemin de la Hunière, F-91761 Palaiseau Cedex* *[4] Institut für Experimentalphysik - FU Berlin, Arnimallee 14, DE-14195 Berlin* *[5] FZ Rossendorf, P.O. Box 510119, DE-01314 Dresden* Following positive laboratory-scale experiments, we investigated the ability to trigger real-scale lightning using ionized filaments generated by ultrashort laser pulses in the atmosphere. Under thunderstorm conditions, we observed electric events synchronized with the laser pulses. These results lead the way to lightning control using lasers.
17:15		***END***
18:15		***Conference Dinner***

ID	Physics of Atoms and Lasers Poster
641	**The Swiss atomic fountain primary frequency standard: present state of the metrological evaluation** *Alain Joyet [1], Gregor Dudle [2], Gianni Di Domenico [1], Pierre Thomann [1]* *[1] Laboratoire Temps-Fréquence, Institut de Microtechnique, Université de Neuchâtel, Rue A.-L. Breguet 1, c/o Institut de Physique, 2000 Neuchâtel* *[2] Swiss Federal Office of Metrology, Lindenweg 50, 3003 Bern-Wabern* We report on the metrological evaluation of a primary frequency standard based on a continuous beam of laser cooled cesium atoms. The standard is located at METAS, the Swiss Federal Office of Metrology. Recently, the motor of the light-trap has been replaced with an electrostatic glass motor which rotates continuously since this change. This improvement will permit to reduce the light-shift by a factor higher than 10^3 allowing reaching the 10^{-15} level of accuracy. The frequency standard is now fully operational to enter in a phase of metrological evaluation. The summary of the present state of the frequency shifts measurements or estimations will be presented together with the corresponding preliminary uncertainty budget.
642	**Components for a micro-fabricated atomic clock** *Christian Schori [1], Gaetano Mileti [1], Vesna Radojkovic [2], Steeve Tanner [2], Giovanni Bergonzi [3], Yves Petremand [3]* *[1] Laboratoire Temps-Fréquence (LTF), Institut de Microtechnique (IMT), Université de Neuchâtel (UNI-NE), Rue A.-L. Breguet 1, C/O: Institut de Physique, 2000 Neuchâtel* *[2] Laboratoire d'electronique et de traitement du signal (ESPLAB), Institut de Microtechnique (IMT), Université de Neuchâtel (UNI-NE), Rue A.-L. Breguet 2, 2000 Neuchâtel* *[3] Sensors, Actuators, and Microsystems Laboratory (SAMLAB), Institut de Microtechnique (IMT), Université de Neuch tel (UNI-NE), Rue Jaquet-Droz 1, 2000 Neuchâtel* During the last decade the micro-fabrication of atomic sensors has been driven by the convergence of three different fields: atomic physics, micro-electromechanical systems (MEMS), and low-power semiconductor lasers [1]. These sensors use a combination of VCSEL lasers and/or RF-coils to probe the hyperfine- and Zeeman resonances of Alkali vapours confined in mm-scale MEMS-fabricated vapour cells. The ultimate goal is to develop portable sensors such as atomic clocks, magnetometers, and gyroscopes. We present preliminary results on the fabrication and testing of key components for a micro-fabricated atomic clock. These components include 795nm VCSEL lasers, MEMS-fabricated rubidium vapour cells, and a low power CMOS local oscillator to link the hyperfine resonance signal to a 10MHz clock-signal. Finally, we discuss the scaling of clock-stability with size and the possible application of micro-fabricated clocks in the field of satellite navigation and wireless communication. [1] J. Kitching, "Time for a Better Receiver", GPS World, November 2007

643 Experimental study of a narrow-linewidth fibre Bragg laser for optical pumping in Rb atomic clocks

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We have experimentally evaluated the spectral properties of a fibre-pigtailed laser diode in view of its application for laser optical pumping in Rb gas-cell atomic frequency standards. Important requirements for this application are, for example, stable single-mode laser operation at the Rb D2 transition (780.24nm) and narrow emission linewidth (around 1 MHz or less). The evaluated laser is composed of a standard laser diode chip, whose light emission is coupled into a single-mode optical fibre containing a fibre Bragg grating. The wavelength-selective reflection from the grating is retro coupled into the diode chip to obtain single-mode operation. We present the spectral properties and tuning characteristics of the laser, and relate them to the laser design. From beat measurements between two identical lasers we obtain a linewidth of 50kHz, without need for external stabilisation or alignment of the laser.

644 Study of lin||lin CPT for application in vapour-cell atomic clocks

Evelina Breschi [1], George Kazakov [2], Roland Lammegger [3], Boris Matisov [2], Laurentius Windholz [3], Gaetano Mileti [1]
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[2] St. Petersburg State Polytechnic University, Polytechnicheskaya 29, 195251 St. Petersburg, Russian Federation
[3] Inst. f. Experimentalphysik, Techn. Univ. Graz, Petersgasse 16, AT-8010 Graz

We investigate the possibility of using Coherent Population Trapping excited with parallelly polarized light fields (lin||lin CPT) on vapour cell atomic clocks. The main problem of lin||lin CPT is that the coherence has quadrupolar nature, as a consequence critically depends on the hyperfine excited state structure. A model based on density matrix has been developed for data interpretation. We study the lin||lin CPT signal depending on the laser detuning. Thanks to the comparison between experimental and theoretical results we can quantify the contribution of each CPT state in the total lin||lin CPT signal. Finally we discuss the role of the laser spectrum and pressure broadening on the lin||lin CPT signal. We demonstrate in which condition the laser linewidth does not affect the lin||lin CPT signal amplitude.

645 Continuous beams of laser cooled atoms for physics and metrology

Gianni Di Domenico, Gurpreet Kaur Gulati, Alain Joyet, Ritayan Roy, Pierre Thomann, Laboratoire Temps-Fréquence, Institut de microtechnique, Université de Neuchâtel, Rue A.-L.-Breguet 2, 2000 Neuchâtel

Since several years, our group is active in the study and production of continuous beams of laser cooled atoms for time and frequency metrology. Within this poster, we will first present our motivations by discussing the metrological interests of the continuous beam approach. Then we will present a summary of the results obtained in the past, show the current situation of our experiments, and discuss our research projects for the immediate future.

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Synchrotron radiation based high-resolution grazing emission x-ray fluorescence detection of Al-impurities on Si wafers

Yves Kayser [1], Jean-Claude Dousse [1], Joanna Hoszowska [1], Wei Cao [1], Monika Szlachetko [1], Jakub Szlachetko [2], Marek Pajek [3], Dariusz Banas [3], Aldona Kubala-Kukus [3], Jean Susini [2], Murielle Salome [2]
[1] Department of Physics University of Fribourg, Chemin du Musée 3, 1700 Fribourg
[2] European Synchrotron Radiation Facility, BP 220, 38043 Grenoble, France
[3] Swietokrzyska Academy Institute of Physics, Swietokrzyska 15 St., 25406 Kielce, Poland

Due to progress in Si-based microelectronic technology, the SEMATECH roadmap predicts that a sensitivity of less than 10^9 atoms/cm^2 will soon be required for the detection of Al-impurities on Si wafers. In this perspective, the high-resolution grazing emission x-ray fluorescence (GEXRF) technique combined with synchrotron radiation was probed. Ultra-low level Al-impurities on Si surfaces were measured at the ESRF ID21 beam line by means of the Fribourg high-resolution von Hamos x-ray spectrometer. The background due to bulk Si was strongly suppressed by observing the x-ray lines below the critical angle of Si and by tuning the energy below the Si K-absorption edge. Using the presented high-resolution GEXRF method with a vapour phase deposition (VPD) preconcentration, a detection limit of about 10^7 atoms/cm^2 could be reached which is below the SEMATECH demand. Thus, we have shown that this novel technique meets the requirements for studying trace amounts of Al-impurities on Si surfaces.

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Solid ^{4}He stabilized by charged impurities below the solidification pressure of pure helium

Peter Moroshkin, Victor Lebedev, Adrian Hofer, Antoine Weis, Departement de Physique, Université de Fribourg, Chemin du Musée 3, 1700 Fribourg

The coexistence of a ^{4}He crystal with superfluid ^{4}He is a model system for investigating fundamental aspects of the growth and melting of quantum crystals. Here we present a dramatic effect that occurs during the melting of solid ^{4}He doped with nanoscopic impurities - alkali atoms, clusters, ions, and electrons: the doped part of the crystal remains solid under conditions at which pure helium is liquid. Using interferometry we found that the density of the solid structure (iceberg) lies between the densities of pure liquid and pure solid helium. In a static electric field of several kV/cm the fragments of the iceberg start to move towards either positive or negative electrode. We tentatively interpret the iceberg as being an aggregation of positively charged particles (snowballs) and electron bubbles.

648 HELVETERA facility: a unique Swiss Femtosecond Terawatt Laser Platform

Yannick Petit, Pierre Béjot, Luigi Bonacina, Jérôme Kasparian, Jean-Pierre Wolf,
GAP-Biophotonics, Université de Genève, 20 rue de l'Ecole de Medecine, 1211 Genève

The HELVETERA laser platform constitutes the most powerful ultrashort and ultraintense laser source in Switzerland. This Chirped-Pulse-Amplified laser provides 30 mJ and 30 fs laser pulses, offering extremely high peak powers (about 1 Terawatt). The high repetition rate of 100 Hz, being an order of magnitude higher than other Terawatt facilities, is of prime importance for numerous applications such as optimal control schemes. This platform is mainly dedicated to the fundamental understanding and control of filamentation. Main applications associated to the HELVETERA research themes are atmospheric pollution monitoring and lightning control. In agreement with the Swiss National Fund, HELVETERA facility is also open to other Swiss groups for ultrashort Terawatt research. Experiments are now in progress, and the first results provided by the HELVETERA facility should be presented.

649 Femtosecond dynamics of UV emitting dyes by broad-band fluorescence upconversion

Olivier Bräm, Andrea Cannizzo, Andreas Tortschanoff, Ahmad Ajdarzadeh Oskouei,
Frank van Mourik, Majed Chergui, EPFL, Cubotron, 1015 Lausanne

Time-resolved luminescence spectroscopy has been greatly revolutionized by fluorescence up-conversion set-ups, which, based on the non linear phenomenon of sum frequency generation,[1] permit detection of time-resolved emission with femtosecond resolution. This technique has been applied to ultrafast dynamics studies and reaction pathways of different physical systems in the condensed phase. In particular, analysis of time resolved fluorescence allows investigation of solvation relaxation and cooling processes. Recently, we have constructed a fluorescence up-conversion setup with a broad band detection in the UV range of 300 to 550 nm, a time resolution of 150 fs, and a tunable excitation from 250 to 300 nm [2].
Here we will present detailed investigations of the time-resolved fluorescence emission of two UV emitting dyes (2,5 diphenyloxazole and p-terphenyl) in three different solvents.

[1] J. Shah, IEEE Journal of Quantum Electronics, 24 (1998), 276.
[2] A. Cannizzo, et al., Optics Letters 32 (2007), 3555.

650 Characterisation of a compact atomic magnetometer for cardiomagnetic measurements

Natascia Castagna, Georg Bison, Gianni Di Domenico, Adrian Hofer, Catherine Macchione,
Anatoly Pazgalev, Antoine Weis, Université de Fribourg, Département de Physique,
Chemin du Musée 3, 1700 Fribourg

We present the construction and the potential performance of a wall-coated cesium cell atomic magnetometer. This magnetic sensor, used for the detection of the beating human heart, has an intrinsic sensitivity of better than 20 fT/$\sqrt{}$Hz. Its characterisation is performed in a three-layer cylindrical magnetic shield to minimise undesired magnetic perturbations. The optical configuration is known in the literature as Double Resonance Orientation Magnetometer (DROM). We report on the measurement of transverse and longitudinal relaxation times, critical values for the intrinsic sensitivity of the sensor, as well as on the possibilities to further improve the performance of the device.

651 **Single photon quantum erasing: a lecture demonstration experiment**

Antoine Weis, Département de Physique, Université de Fribourg, Chemin du Musée 3, 1700 Fribourg
Todorka L. Dimitrova, Faculty of Physics, Plovdiv University, Tsar Assen Street 24, 4000 Plovdiv, Bulgaria

In quantum mechanics two-path interference is a consequence of the indistinguishability of the particles paths and any attempt to put labels on the individual paths leads to a disappearance of the interference pattern. However, it is possible to erase the which-way information in the superposed beams, thereby restoring interference fringes, a phenomenon called quantum erasing.
We present a lecture demonstration experiment of a quantum eraser, in which the two paths in a Mach-Zehnder interferometer (MZI) are labeled via orthogonal polarization, while the interference is recorded on a photon-by-photon basis by a photomultiplier. Rotating a polarizer after the interferometer exit gradually erases the which-way information. The smooth transition from the quantum to the classical case is shown in real-time by varying the light intensity and averaging the photomultiplier signal.