Sommaire

[2009-002T] DeTami

Porteur : **D. Boiron**

Thème **1**

Acoustic Analog to the Dynamical Casimir Effect in a Bose-Einstein Condensate

Article publié en 2012

Auteurs : Jaskula, J. -C.; Partridge, G. B.; Bonneau, M.; Lopes, R.; Ruaudel, J.; Boiron, D.; Westbrook, C. I.

Réf. : PHYSICAL REVIEW LETTERS Volume: 109 Issue: 22 Article Number: 220401 DOI: 10.1103/PhysRevLett.109.220401 Published: NOV 26 2012

We have modulated the density of a trapped Bose-Einstein condensate by changing the trap stiffness, thereby modulating the speed of sound. We observe the creation of correlated excitations with equal and opposite momenta, and show that for a well-defined modulation frequency, the frequency of the excitations is half that of the trap modulation frequency.

Violation of the Cauchy-Schwarz Inequality with Matter Waves

Article publié en 2012

Auteurs : Kheruntsyan, K. V.; Jaskula, J-C.; Deuar, P.; Bonneau, M.; Partridge, G. B.; Ruaudel, J.; Lopes, R.; Boiron, D.; Westbrook, C. I.

Réf. : PHYSICAL REVIEW LETTERS Volume: 108 Issue: 26 Article Number: 260401 DOI: 10.1103/PhysRevLett.108.260401 Published: JUN 25 2012

The Cauchy-Schwarz (CS) inequality-one of the most widely used and important inequalities in mathematics-can be formulated as an upper bound to the strength of correlations between classically fluctuating quantities. Quantum-mechanical correlations can, however, exceed classical bounds. Here we realize four-wave mixing of atomic matter waves using colliding Bose-Einstein condensates, and demonstrate the violation of a multimode CS inequality for atom number correlations in opposite zones of the collision halo. The correlated atoms have large spatial separations and therefore open new opportunities for extending fundamental quantum-nonlocality tests to ensembles of massive particles.

[2009-007T] RADICAUX

Porteur : **Christian Alcaraz**

Thème **2**

Threshold Photoelectron Spectroscopy of Cyclopropenylidene, Chlorocyclopropenylidene, and Their Deuterated Isotopomeres

Article publié en 2010

Auteurs : Hemberger P, Noller B, Steinbauer M, Fischer I, Christian Alcaraz, de Miranda BCK, Garcia GA, Soldi-Lose H

Réf. : JOURNAL OF PHYSICAL CHEMISTRY A 114 (2010) 11269-11276

Cyclopropenylidene (c-C3H2), chlorocyclopropenylidene (c-C3HCl), and their deuterated isotopomers were studied by the threshold photoelectron-photoion coincidence (TPEPICO) technique using VUV synchrotron radiation. The carbenes were generated via flash pyrolysis. In all species a change in geometry is visible upon ionization, with significant activity in the C=C, C-C-stretching mode and, in the case of c-C3H2/D-2, the C-H-bending mode. The electron is removed from an sp(2) like hybrid orbital centered on the carbene C atom. The mass selected threshold photoelectron (TPE) spectra were fitted by a Franck-Condon simulation, yielding the equilibrium geometry of the cation ground state ((1)A(1)). The adiabatic ionization energy IEad of c-C3H, was determined to be 9.17 eV, in good agreement with calculations and literature values. Two vibrational wavenumbers of the cation were determined experimentally (nu(+)(3) = 1150 cm(-1) and nu(+)(2) = 1530 cm(-1)). Chlorocyclopropenylidene was also studied by TPE spectroscopy and has a similar IEad of 9.17 eV. The spectrum also shows a vibrational progression that corresponds to the C=C- and C-C-stretching modes of the cation. The equilibrium geometry was also determined by a Franck-Condon fit. The IEad of the deuterated isotopomers, c-C3D2 and c-C3DCl, were also determined to be 9.17 eV. The spectra confirm the assignments for the nondeuterated species.

Photoionization of Propargyl and Bromopropargyl Radicals: A Threshold Photoelectron Spectroscopic Study

Article publié en 2011

Auteurs : Hemberger Patrick; Lang Melanie; Noller Bastian; et al.

Réf. : JOURNAL OF PHYSICAL CHEMISTRY A Volume: 115 Issue: 11 Pages: 2225-2230 DOI: 10.1021/jp112110j Published: MAR 24 2011

In this Article, we present mass-selected threshold photoelectron spectra of propargyl as well as the 1- and 3-bromopropargyl radicals. The reactive intermediates were produced by flash pyrolysis of suitable precursors and ionized by VUV synchrotron radiation. The TPES of the propargyl radical was simulated using data from a recent high-level computational study. An ionization energy (IE) of 8.71 +/- 0.02 eV was obtained, in excellent agreement with computations, but slightly above previous experimental IEs. The pyrolysis of 1,3-dibromopropyne delivers both 1- and 3-bromopropargyl radicals that can be distinguished by their different ionization energies (8.34 and 8.16 eV). To explain the vibrational structure, a Franck-Condon simulation was performed, based on DFT calculations, which can account for all major spectral features. Bromopropargyl photoionizes dissociatively beginning at around 10.1 eV. Cationic excited states of 1- and 3-bromopropargyl were tentatively identified. The dissociative photoionization of the precursor (1,3-dibromopropyne) was also examined, delivering an AE(0K) (C(3)H(2)Br(+)/C(3)H(2)Br(2)) of 10.6 eV.

The photoionisation of propargylene and diazopropyne

Article publié en 2011

Auteurs : Michael Steinbauer, Lang, Melanie Fischer, Ingo; Cunha de Miranda, Barbara K.; Romanzin, Claire; Alcaraz, Christian

Réf. : PHYSICAL CHEMISTRY CHEMICAL PHYSICS 13 (40): 17956-17959 10.1039/c1cp22265a 2011

The photoionisation of the C(3)H(2) isomer propargylene was studied using synchrotron radiation and coincidence techniques. An adiabatic ionisation energy (IE(ad)) of 8.99 +/- 0.02 eV was determined. The precursor diazopropyne was investigated as well. Ionisation and appearance energies were measured.

Comprehensive vacuum ultraviolet photoionization study of the CF3 center dot trifluoromethyl radical using synchrotron radiation

Article publié en 2012

Auteurs : Dossmann (Soldi-Lose) Heloise; Garcia Gustavo A.; Nahon Laurent; et al.

Réf. : JOURNAL OF CHEMICAL PHYSICS Volume: 136 Issue: 20 Article Number: 204304 DOI: 10.1063/1.4719529 Published: MAY 28 2012

The trifluoromethyl radical, CF3 center dot, is studied for the first time by means of threshold photoelectron spectroscopy (TPES). The radical is produced in the gas phase using the flash-pyrolysis technique from hexafluoroethane as a precursor. CF3+ total ion yield and mass-selected TPES of the radical are recorded using a spectrometer based upon velocity map imaging and Wiley-McLaren time-of-flight coupled to the synchrotron radiation. The high resolution of the instrument and of the photons allows the observation of rich vibrational progressions in the TPES of CF3 center dot. By using Franck-Condon factors computed by Bowman and coworkers, we have been able to simulate the TPES. The initial vibrational temperature of the radical beam has been evaluated at 350 +/- 70 K. The structures have been identified as transitions between (n(1), n(2)) and (n(1)(+), n(2)(+)) vibrational levels of CF3 and CF3+ with small excitation of the breathing mode, nu(+)(1), and large excitation (n(2)(+) = 10-26) of the umbrella mode, nu(+)(2), in the cation. From the energy separation between the two resolved peaks of each band, a value of 994 +/- 16 cm(-1) has been derived for the nu(+)(1) breathing frequency of CF3+. For the high-lying n(2)(+) levels, the apparent nu(+)(2) umbrella spacing, 820 +/- 14 cm(-1), is fairly constant. Taking into account the nu(+)(2) anharmonicity calculated by Bowman and coworkers, we have deduced nu(+)(2) = 809 +/- 14 cm(-1), and semi-empirical estimations of the adiabatic ionization energy IEad.(CF3 center dot) are proposed in good agreement with most of previous works. A value of the vertical ionization potential, IEvert.(CF3 center dot) = 11.02 eV, has been derived from the observation of a photoelectron spectrum recorded at a fixed photon energy of 12 eV. (C) 2012 American Institute of Physics. [http://dx.doi.org.gate4.inist.fr/10.1063/1.4719529]

[2009-009T] RHEO2D

Porteur : **Dominique Langevin**

Thème **3**

Amorphous freezing in two dimensions: From soft coils to rigid particles

Article publié en 2010

Auteurs : Maestro, A; Dominique Langevin; Monroy, F

Réf. : EUROPEAN PHYSICAL JOURNAL E 31 (2010) 89-94

The topic of the gel transition in two dimensions is revisited by considering data on the shear elasticity of Langmuir monolayers of different spherical objects. Amorphous freezing can be associated to structural percolation in a lattice able to resist shear stresses. The shear modulus and its dependence on the packing fraction are found to strongly depend on the details of the interaction potential and largely differ from expectations for entropic networks. This behaviour can be interpreted in terms of more elaborated percolation theories including central forces and bond-bending forces.

Reptation in langmuir polymer monolayers

Article publié en 2010

Auteurs : Maestro, A. Hilles, HM. Jean-Michel Ortega, F. Rubio, RG. Dominique Langevin. Monroy, F

Réf. : SOFT MATTER 6 (2010) 4407-4412

We report the existence of reptation motion typical of entangled polymer chains in dense polymer monolayers spread at the air-water interface. Ellipsometry determinations of the layer thickness reveal a thickening of the layers in the semi-dilute region, enabling the existence of entanglements. Relaxation measurements were performed using compression and shear surface deformations. The resulting dependence on the chain concentration and size are compatible with the existence of diffusion reptation motions controlling molecular transport inside the monolayer. As in the bulk, these features are observed above a critical number of monomers, N-e, for which chain entanglements become possible.

Active membranes with bound F-actin: sliding vs. sticking conditions

Article publié en 2011

Auteurs : Isanta Silvia; Espinosa Gabriel; Rodriguez-Garcia Ruddi; et al.

Réf. : SOFT MATTER Volume: 7 Issue: 7 Pages: 3100-3107 DOI: 10.1039/c0sm00880j Published: 2011

Actin is a multifunctional protein able to polymerise under ATP consumption as dynamic filaments involved in a number of membrane processes. Its ability to perform treadmilling motion is efficiently exploited to exert directed forces on the membrane structures where filaments are attached. In addition to the structural impact of fastening rigid actin filaments to a flexible membrane, out-of-equilibrium actin motions must impinge special membrane activity features. In this paper, we report an experimental study on the compression and shear rheology of lipid monolayers where filamentous actin is attached. Two different binding scenarios are proposed to simulate respectively sliding and sticking conditions. Covalent actin binding causes a significant enhancement of membrane fluidity, observed as a systematic decrease of compression and shear surface viscosities upon filament sticking. This fluidification can be only understood as a dynamical consequence of actin activity. These results constitute a first piece of rheological evidence on the active viscoelasticity of actin-based membranes.

Dynamic Surface Tension of Aqueous Solutions of Ionic Surfactants: Role of Electrostatics

Article publié en 2011

Auteurs : Ritacco, H; Dominique Langevin; Diamant, H; Andelman, D

Réf. : LANGMUIR 27 (2011) 1009-1014

The adsorption kinetics of the cationic surfactant dodecyltrimethylammonium bromide at the air water interface has been studied by the maximum bubble pressure method at concentrations below the critical micellar concentration. At short times, the adsorption is diffusion-limited. At longer times, the surface tension shows an intermediate plateau and can no longer be accounted for by a diffusion-limited process. Instead, adsorption appears kinetically controlled and slowed down by an adsorption barrier. A Poisson-Boltzmann theory for the electrostatic repulsion from the surface does not fully account for the observed potential barrier. The possibility of a surface phase transition is expected from the fitted isotherms but has not been observed by Brewster angle microscopy.

Shear rheology of lipid monolayers and insights on membrane fluidity

Article publié en 2011

Auteurs : Espinosa, G; Lopez-Montero, I; Monroy, F; Dominique Langevin

Réf. : PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 108 (15): 6008-6013 APR 12 2011

The concept of membrane fluidity usually refers to a high molecular mobility inside the lipid bilayer which enables lateral diffusion of embedded proteins. Fluids have the ability to flow under an applied shear stress whereas solids resist shear deformations. Biological membranes require both properties for their function: high lateral fluidity and structural rigidity. Consequently, an adequate account must include, in addition to viscosity, the possibility for a nonzero shear modulus. This knowledge is still lacking as measurements of membrane shear properties have remained incomplete so far. In the present contribution we report a surface shear rheology study of different lipid monolayers that model distinct biologically relevant situations. The results evidence a large variety of mechanical behavior under lateral shear flow.

Solid Character of Membrane Ceramides: A Surface Rheology Study of Their Mixtures with Sphingomyelin

Article publié en 2011

Auteurs : Catapano Elisa R.; Arriaga Laura R.; Espinosa Gabriel; et al.

Réf. : BIOPHYSICAL JOURNAL Volume: 101 Issue: 11 Pages: 2721-2730 DOI: 10.1016/j.bpj.2011.10.049 Published: DEC 7 2011

The compression and shear viscoelasticities of egg-ceramide and its mixtures with sphingomyelin were investigated using oscillatory surface rheology performed on Langmuir monolayers. We found high values for the compression and shear moduli for ceramide, compatible with a solid-state membrane, and extremely high surface viscosities when compared to typical fluid lipids. A fluidlike rheological behavior was found for sphingomyelin. Lateral mobilities, measured from particle tracking experiments, were correlated with the monolayer viscosities through the usual hydrodynamic relationships. In conclusion, ceramide increases the solid character of sphingomyelin-based membranes and decreases their fluidity, thus drastically decreasing the lateral mobilities of embedded objects. This mechanical behavior may involve important physiological consequences in biological membranes containing ceramides.

[2009-014T] MELYSCO

Porteur : **Medhi ZEGHAL**

Thème **3**

Long-Range Architecture of Single Lipid-Based Complex Nanoparticles with Local Hexagonal Packing

Article publié en 2011

Auteurs : Tresset Guillaume; Lansac Yves

Réf. : JOURNAL OF PHYSICAL CHEMISTRY LETTERS Volume: 2 Issue: 1 Pages: 41-46 DOI: 10.1021/jz101430e Published: JAN 6 2011

The three-dimensional architecture of single nanoparticles made of inverse micellar lipids templated on polyelectrolytes and exhibiting a local hexagonal packing is elucidated by high-resolution cryoelectron microscopy and coarse-grained Monte Carlo simulations. Cryoelectron microscopy demonstrates that the internal structure of the complexes is less ordered than commonly recognized from X-ray diffraction. We have devised a coarse-grained model of self-avoiding flexible tubes mimicking the lipid-coated polyelectrolytes and interacting via a short-range attractive potential. Consistently with cryoelectron microscopy, the resulting clusters obtained through a Monte Carlo scheme exhibit a varying degree of order ranging from weakly organized aggregates to partially organized spooled and straight bundles, depending on the length and on the persistence length of the tubes. These findings may help in the design of self-assembled lipid-based complexes for biomechanical and nanotechnological applications.

Supramolecular Assemblies of Lipid-Coated Polyelectrolytes

Article publié en 2012

Auteurs : Tresset Guillaume; Lansac Yves; Romet-Lemonne Guillaume

Réf. : LANGMUIR Volume: 28 Issue: 13 Pages: 5743-5752 DOI: 10.1021/la2048135 Published: APR 3 2012

We reveal the existence of a general class of supramolecular assemblies made up of lipid-coated polyelectrolytes including the celebrated lipid nucleic acid complexes. With the aid of high-resolution cryo-electron microscopy, we unveil the nanoscale internal organization of assemblies generated with a wide range of synthetic and biological polyelectrolytes, several of them being investigated in this context for the first time, namely, poly(styrene sulfonic acid), carboxylmethylcellulose, and filamentous actin. Using an original coarse-grained model representing lipid-coated polyelectrolytes as semiflexible tubes, we thoroughly explored the morphologies resulting from the self-assembly process as a function of tube lengths and rigidities; the computed structures are fully consistent with the experimental observations. In particular, we found a strong extension of the correlation range of the order parameter as the rigidity of the lipid-coated polyelectrolytes increases. Electrostatic interactions provide a stabilizing mechanism leading to finite-size equilibrium assemblies. These assemblies may constitute a generic route for interfacing polyelectrolytes to living cells to perform gene delivery, for instance.

[2009-016T] SURFOAM

Porteur : **Wiebke Drenckhan**

Thème **3**

On the origin of the stability of foams made from catanionic surfactant mixtures

Article publié en 2011

Auteurs : Varade, D.; Carriere, D.; Arriaga, L. R.; Fameau, A. -L.; Rio, E.; Langevin, D.; Drenckhan, W.

Réf. : SOFT MATTER 7 (14): 6557-6570 10.1039/c1sm05374d 2011

Using mixtures of the anionic myristic acid (C(13)COOH) and the cationic cetyl trimethylammonium chloride (C(16)TA(+)Cl(-)) in aqueous solutions at a 2 : 1 ratio, we show that the outstanding stability of foams generated

from sufficiently concentrated "catanionic" surfactant mixtures can be explained by a synergy effect between two fundamentally different mechanisms. Applying a multi-scale approach, in which we link static and dynamic properties of the bulk solutions, isolated gas/liquid interfaces, thin liquid films and foams, we identify these two mechanisms to be as follows: firstly, cationic mixtures create tightly packed surfactant layers at gas/liquid interfaces, which are strongly viscoelastic and also confer high disjoining pressures when two interfaces are approaching each other to form a thin liquid film. Foams created with such kind of interfaces tend to be extremely stable against coalescence (film rupture) and coarsening (gas exchange). However, typical time scales to cover the interfaces are much longer than typical foaming times. This is why a second mechanism plays a key role, which is due to the presence of micron-sized catanionic vesicles in the foaming solution. The bilayers of these vesicles are in a gel-like state, therefore leading to nearly indestructible objects which act like elastic micro-spheres. At sufficiently high concentrations, these vesicles jam in the presence of the confinement between bubbles, slowing down the drainage of liquid during the initial foaming process and therefore providing time for the interfaces to be covered. Furthermore, the tightly packed vesicles strongly reduce bubble coalescence and gas transfer between bubbles.

[2009-017T] FRACHET

Porteur : **Elisabeth Bouchaud**

Thème **3**

Permeability of self-affine aperture fields

Article publié en 2010

Auteurs : Talon L, Auradou H, Hansen A

Réf. : PHYSICAL REVIEW E 82 (2010) 046108 Part 2

We introduce a model that allows for the prediction of the permeability of self-affine rough channels (one-dimensional fracture) and two-dimensional fractures over a wide range of apertures. In the lubrication approximation, the permeability shows three different scaling regimes. For fractures with a large mean aperture or an aperture small enough to the permeability being close to disappearing, the permeability scales as the cube of the aperture when the zero level of the aperture is set to coincide with the disappearance of the permeability. Between these two regimes, there is a third regime where the scaling is due to the self-affine roughness. For rough channels, the exponent is found to be 3-1/H, where H is the Hurst exponent. For two-dimensional fractures, it is necessary to introduce an equivalent aperture b(c) to make the scaling regime apparent. bc is defined as the hydraulic aperture of the most restrictive barrier crossing the fracture normal to the flow direction. This regime is characterized by an exponent higher than that for the one-dimensional case: it is 2.25 for H=0.8 and 2.16 for H=0.3.

[2009-019T] TSI2D

Porteur : **Claire Marrache-Kikuchi**

Thème **4**

Tunable Superconducting Properties of a-NbSi Thin Films and Application to Detection in Astrophysics

Article publié en 2011

Auteurs : Crauste, O; Claire Marrache-KikuchiA; Berge, L; Collin, S; Dolgorouky, Y; Marnieros, S; Nones, C; Dumoulin, L

Réf. : JOURNAL OF LOW TEMPERATURE PHYSICS (2011) 163

We report on the superconducting properties of amorphous Nb (x) Si1-x thin films. The normal-state resistance and critical temperatures can be separately adjusted to suit the desired application. Notably, the relatively low electron-phonon coupling of these films makes them good candidates for an "all electron bolometer" for Cosmological Microwave Background radiation detection. Moreover, this device can be made to suit both high and low impedance readouts.

[2009-020T] MONOSUPFER

Porteur : **Florence RULLIER-ALBENQUE**

Thème **4**

Different effects of Ni and Co substitution on the transport properties of BaFe(2)As(2)

Article publié en 2011

Auteurs : Olariu A.; Rullier-Albenque F.; Colson D.; et al.

Réf. : PHYSICAL REVIEW B Volume: 83 Issue: 5 Article Number: 054518 DOI: 10.1103/PhysRevB.83.054518 Published: FEB 28 2011

We report resistivity and Hall effect results on Ba(Fe(1-x)Ni(x))(2)As(2) and compare them with those in Ba(Fe(1-x)Co(x))(2)As(2). The Hall constant R(H) is negative for all x values from 0.01 to 0.14, which indicates that electron carriers dominate the transport in both the magnetic and the paramagnetic regimes. We analyze the data in the framework of a two-band model. Without any assumption on the number of carriers, we show that the electron resistivity can be estimated with good accuracy in the low-temperature paramagnetic range. Although the phase diagrams of the two families are very similar with respect to the extra electrons added in the system, we find that the transport properties differ in several aspects. First, we evidence that the contribution of holes to the transport is more important for Ni doping than for Co doping. Second, Ni behaves as a stronger scatterer for the electrons, as the increase of residual electron resistivity Delta rho(e)/x is about four times larger for Ni than for Co in the most doped samples.

Incommensurate spin density wave versus local magnetic inhomogeneities in Ba(Fe1-xNix)(2)As-2: a Fe-57 Mossbauer spectral study

Article publié en 2012

Auteurs : Olariu A.; Bonville P.; Rullier-Albenque F.; et al.

Réf. : NEW JOURNAL OF PHYSICS Volume: 14 Article Number: 053044 DOI: 10.1088/1367-2630/14/5/053044 Published: MAY 29 2012

We report Fe-57 Mossbauer spectral results in pure and doped Ba(Fe1-xNix)(2)As-2 with x = 0.01 and 0.03. We show that all these materials present a first-order magnetic transition towards a magnetically ordered state. In the doped compounds, a broad distribution of Fe hyperfine fields is present in the magnetic phase. We successfully fit the Mossbauer data in Ba(Fe1-xNix)(2)As-2 in the framework of two different models: (i) an incommensurate spin density wave (IC-SDW); (ii) a dopant-induced perturbation of the Fe polarization, recently proposed to interpret As-75 NMR data in Ba(Fe1-xNix)(2)As-2, which is valid only in the very dilute limit x = 0.01. Moreover, we show here that these NMR data can also be successfully analysed in terms of the 'incommensurate model' for all doping contents by using the parameters obtained from the Mossbauer spectral analysis. Therefore it is not possible to rule out the presence of an IC-SDW on the basis of the As-75 NMR data.

[2009-023T] IMMAGE

Porteur : **Julien Gauthier**

Thème **5**

Table-top resonant magnetic scattering with extreme ultraviolet light from high-order harmonic generation

Article publié en 2011

Auteurs : Vodungbo, B; Sardinha, AB; Gautier, J; Lambert, G; Lozano, M; Sebban, S; Meltchakov, E; Delmotte, F; Lopez-Flores, V; Arabski, J; Boeglin, C; Beaurepaire, E; Delaunay, R; Luning, J; Philippe Zeitoun

Réf. : EPL 94 (5): Art. No. 54003 JUN 2011

We demonstrate for the first time the applicability of high-order harmonic generation for probing magnetization properties with nanometer spatial resolution. High harmonics were generated by focusing an infrared femtosecond laser into a neon-filled gas cell. Using a high throughput monochromator, EUV pulses with a photon energy resonant to the magnetically dichroic Co M-2,M-3 absorption resonance were obtained. These were focused onto a CoPd alloy film and the magnetic scattering pattern was recorded in a transmission geometry. The scattering pattern induced by the magnetic domain structure consists of two well-defined bright spots revealing the presence of stripe domains of about 63nm in width. With the inherent femtosecond time resolution given by high harmonics, this demonstration paves the way to investigate ultrafast magnetization dynamics with femtosecond time and nanometer spatial resolutions, in jitter-free experiment based on table-top EUV light sources.

[2009-023T] IMMAGE & [2009-084T] POL-IMMAGE

Porteur : **Julien Gauthier**

Thème **5** et Axe **A**

Laser-induced ultrafast demagnetization in the presence of a nanoscale magnetic domain network

Article publié en 2012

Auteurs : Vodungbo, Boris; Gautier, Julien; Lambert, Guillaume; Sardinha, Anna Barszczak; Lozano, Magali; Sebban, Stephane; Ducousso, Mathieu; Boutu, Willem; Li, Kaigong; Tudu, Bharati; Tortarolo, Marina; Hawaldar, Ranjit; Delaunay, Renaud; Lopez-Flores, Victor; Ar

Réf. : NATURE COMMUNICATIONS Volume: 3 Article Number: 999 DOI: 10.1038/ncomms2007 Published: AUG 2012

Femtosecond magnetization phenomena have been challenging our understanding for over a decade. Most experiments have relied on infrared femtosecond lasers, limiting the spatial resolution to a few micrometres. With the advent of femtosecond X-ray sources, nanometric resolution can now be reached, which matches key length scales in femtomagnetism such as the travelling length of excited 'hot' electrons on a femtosecond timescale. Here we study laser-induced ultrafast demagnetization in [Co/Pd](30) multilayer films, which, for the first time, achieves a spatial resolution better than 100 nm by using femtosecond soft X-ray pulses. This allows us to follow the femtosecond demagnetization process in a magnetic system consisting of alternating nanometric domains of opposite magnetization. No modification of the magnetic structure is observed, but, in comparison with uniformly magnetized systems of similar composition, we find a significantly faster demagnetization time. We argue that this may be caused by direct transfer of spin angular momentum between neighbouring domains.

[2009-024T] SeMicMag

Porteur : **Aristide Lemaitre**

Thème **5**

Track heating study for current-induced domain wall motion experiments

Article publié en 2010

Auteurs : Curiale J, Aristide Lemaitre , Faini G , Jeudy V

Réf. : APPLIED PHYSICS LETTERS 97 (2010) 243505

We investigate the Joule heating produced by current pulses in (Ga,Mn)(As,P) ferromagnetic semiconducting nanotracks. The transient and the stationary heating regimes are determined experimentally. A good quantitative agreement is obtained with simulations and analytical calculations. The temperature of the tracks is shown to be essentially determined by the heat diffusion through the substrate. Implications for current-induced domain wall motion experiments are discussed. (C) 2010 American Institute of Physics.

Current induced domain wall motion in GaMnAs close to the Curie temperature

Article publié en 2011

Auteurs : Jeudy V.; Curiale J.; Adam J-P; et al.

Réf. : JOURNAL OF PHYSICS-CONDENSED MATTER Volume: 23 Issue: 44 Article Number: 446004 DOI: 10.1088/0953-8984/23/44/446004 Published: NOV 9 2011

Domain wall dynamics produced by spin transfer torques is investigated in (Ga, Mn) As ferromagnetic semiconducting tracks with perpendicular anisotropy, close to the Curie temperature. The domain wall velocities are found to follow a linear flow regime which only slightly varies with temperature. Using the Doring inequality, boundaries of the spin polarization of the current are deduced. A comparison with the predictions of the mean field k . p theory leads to an estimation of the carrier density whose value is compatible with results published in the literature. The spin polarization of the current and the magnetization of the magnetic atoms present similar temperature variations. This leads to a weak temperature dependence of the spin drift velocity and thus of the domain wall velocity. A combined study of field-and current-driven motion and deformation of magnetic domains reveals a motion of domain walls in the steady state regime without transition to the precessional regime. The ratio between the non-adiabatic torque beta and the Gilbert damping factor alpha is shown to remain close to unity.

[2009-024T] SeMicMac & [2010-033T] SeMicMagII

Porteur : **Aristide Lemaitre**

Thème **5**

Spin Drift Velocity, Polarization, and Current-Driven Domain-Wall Motion in (Ga,Mn)(As,P)

Article publié en 2012

Auteurs : Curiale J.; Lemaitre A.; Ulysse C.; et al.

Réf. : PHYSICAL REVIEW LETTERS Volume: 108 Issue: 7 Article Number: 076604 DOI: 10.1103/PhysRevLett.108.076604 Published: FEB 17 2012

Current-driven domain-wall motion is studied in (Ga,Mn)(As,P) ferromagnetic semiconducting tracks with perpendicular anisotropy. A linear steady state flow regime is observed over a large temperature range of the ferromagnetic phase (0.1T(c) < T < T-c). Close to 0 K, the domain-wall velocity is found to coincide with the spin drift velocity. This result is obtained below the intrinsic threshold for domain-wall motion which implies a nonadiabatic contribution to the spin transfer torque. The current spin polarization is deduced close to 0 K and to T-c. It suggests that the temperature dependence of the spin polarization can be inferred from the domain-wall dynamics.

[2009-026T] FemtoCombo

Porteur : **Marc Hanna**

Thème **7**

Coherent beam combination of narrow-linewidth 1.5 mu m fiber amplifiers in a long-pulse regime

Article publié en 2011

Auteurs : Lombard L.; Azarian A.; Cadoret K.; et al.

Réf. : OPTICS LETTERS Volume: 36 Issue: 4 Pages: 523-525 DOI: 10.1364/OL.36.000523 Published: FEB 15 2011

We report what we believe to be the first experimental demonstration of coherent beam combining of two fiber amplifiers in a 100 ns pulse regime using a signal leak between the pulses. Pulses of similar to 100 W stimulated-Brillouin-scattering limited peak power are combined with 95% efficiency, a residual phase error of lambda/27, and no significant beam quality degradation. (C) 2011 Optical Society of America

Coherent beam combining of two femtosecond fiber chirped-pulse amplifiers

Article publié en 2011

Auteurs : Daniault, L. Marc Hanna. Lombard, L. Zaouter, Y. Mottay, E. Goular, D. Bourdon, P. Druon, F. Georges, P.

Réf. : OPTICS LETTERS 36 (2011)

We demonstrate coherent beam combining of two femtosecond fiber chirped-pulse amplifiers seeded by a common oscillator. Using a feedback loop based on an electro-optic phase modulator, an average power of 7.2W before compression is obtained with a combining efficiency of 90%. The spatial and temporal qualities of the oscillator are retained, with a recombined pulse width of 325 fs. This experiment opens up a way to scale the peak/average power of ultrafast fiber sources. (C) 2011 Optical Society of America

Impact of spectral phase mismatch on femtosecond coherent beam combining systems

Article publié en 2012

Auteurs : Daniault L.; Hanna M.; Lombard L.; et al.

Réf. : OPTICS LETTERS Volume: 37 Issue: 4 Pages: 650-652 Published: FEB 15 2012

We experimentally investigate the impact of spectral phase mismatch on the coherent beam combining of two femtosecond fiber chirped-pulse amplifiers. By measuring the differential spectral phase, both linear and nonlinear contributions are identified. An accumulated nonlinear phase as high as 6 rad has been measured, for which a combination efficiency of 91% can be obtained by symmetrizing the pump and injection powers. This also allows us to quantitatively separate the spatial and temporal contributions of the nonperfect combining efficiency. (C) 2012 Optical Society of America

[2009-028T] JECAL

Porteur : **Koenig M**

Thème **6**

Laser-driven plasma jets propagating in an ambient gas studied with optical and proton diagnostics

Article publié en 2010

Auteurs : Gregory CD , Loupias B, Waugh, Dono S, Bouquet S, Falize E, Kuramitsu Y, Michaut C, Nazarov W, Pikuz SA, Sakawa Y, Woolsey NC, Koenig M

Réf. : PHYSICS OF PLASMAS 17 (2010) 052708

The results of an experiment to propagate laser-generated plasma jets into an ambient medium are presented. The jets are generated via laser irradiation of a foam-filled cone target, the results and characterization of which have been reported previously [Loupias , Phys. Rev. Lett. 99, 265001 (2007)] for propagation in vacuum. The introduction of an ambient medium of argon at varying density is seen to result in the formation of a shock wave, and the shock front displays perturbations that appear to grow with time. The system is diagnosed with the aid of proton radiography, imaging the perturbed structure in the dense parts of the shock with high resolution. (C) 2010 American Institute of Physics.

[2009-029T] AGRAWAL

Porteur : **Nicolas Dubreuil**

Thème **7**

Raman amplification of optical pulses in silicon nanowaveguides: Impact of spectral broadening of pump pulses

Article publié en 2011

Auteurs : Baron Alexandre; Dubreuil Nicolas; Delaye Philippe; et al.

Réf. : JOURNAL OF THE EUROPEAN OPTICAL SOCIETY-RAPID PUBLICATIONS Volume: 6 Article Number: 11030 DOI: 10.2971/jeos.2011.11030 Published: 2011

We consider the Raman amplification problem for silicon waveguides in the regime in which both the pump and signal pulses are relatively short but wide enough that their duration exceeds the phonon lifetime (about 3 ps in silicon). We use the coupled pump-signal equations for numerical simulations that include all competing nonlinear effects such as self- and cross-phase modulations, two-photon and free-carrier absorptions, and changes in the refractive index induced by the free carriers. However, numerical simulations do not provide much physical insight. For this reason, we also develop an approximate analytic approach for solving the Raman amplification problem. We introduce the concept of an effective Raman gain and show analytically how it depends on the pump bandwidth. As the pump spectrum broadens inside the silicon waveguide, the effective Raman gain is reduced considerably. We obtain an analytical form of the nonlinear phase accumulated during propagation inside a silicon waveguide and use it to calculate the total spectral broadening experienced by a

pump pulse. Using this result, we can predict changes in the effective Raman gain as a function of pump pulse energy. A comparison of our predictions with the recent experimental data shows that our model is reasonable and captures the essential physics. [DOI: 10.2971/jeos.2011.11030]

[2009-030T] MINAO

Porteur : **Riad Haïdar**

Thème **7**

Coherent beam combination of narrow-linewidth 1.5 mu m fiber amplifiers in a long-pulse regime

Article publié en 2011

Auteurs : Lombard, L; Azarian, A; Cadoret, K; Bourdon, P; Goular, D; Canat, G; Jolivet, V; Jaouen, Y; Vasseur, O

Réf. : OPTICS LETTERS 36 (2011) pages 523-525

We report what we believe to be the first experimental demonstration of coherent beam combining of two fiber amplifiers in a 100 ns pulse regime using a signal leak between the pulses. Pulses of similar to 100 W stimulated-Brillouin-scattering limited peak power are combined with 95% efficiency, a residual phase error of lambda/27, and no significant beam quality degradation. (C) 2011 Optical Society of America

[2009-031T] PICORRE

Porteur : **Pascale SENELLART**

Thème **7**

Polariton Condensation in Photonic Molecules

Article publié en 2012

Auteurs : Galbiati Marta; Ferrier Lydie; Solnyshkov Dmitry D.; et al.

Réf. : PHYSICAL REVIEW LETTERS Volume: 108 Issue: 12 Article Number: 126403 DOI: 10.1103/PhysRevLett.108.126403 Published: MAR 20 2012

We report on polariton condensation in photonic molecules formed by two coupled micropillars. We show that the condensation process is strongly affected by the interaction with the cloud of uncondensed excitons and thus strongly depends on the exact localization of these excitons within the molecule. Under symmetric excitation conditions, condensation is triggered on both binding and antibinding polariton states of the molecule. On the opposite, when the excitonic cloud is injected in one of the two pillars, condensation on a metastable state is observed and a total transfer of the condensate into one of the micropillars can be achieved. Our results highlight the crucial role played by relaxation kinetics in the condensation process.

[2009-033T] HACOR

Porteur : **Marie-Claire SCHANNE-KLEIN**

Thème **7**

Polarization-resolved Second Harmonic microscopy in anisotropic thick tissues

Article publié en 2010

Auteurs : Gusachenko Ivan; Latour Gael; Schanne-Klein Marie-Claire

Réf. : OPTICS EXPRESS Volume: 18 Issue: 18 Pages: 19339-19352 Published: AUG 30 2010

We thoroughly analyze the linear propagation effects that affect polarization-resolved Second Harmonic Generation imaging of thick anisotropic tissues such as collagenous tissues. We develop a theoretical model that fully accounts for birefringence and diattenuation along the excitation propagation, and polarization scrambling upon scattering of the harmonic signal. We obtain an excellent agreement with polarization-resolved SHG images at increasing depth within a rat-tail tendon for both polarizations of the forward SHG signal. Most notably, we observe interference fringes due to birefringence in the SHG depth profile when excited at pi/4 angle from the tendon axis. We also measure artifactual decrease of rho = chi(xxx)/chi(xyy) with depth due to diattenuation of the excitation. We therefore derive a method that proves reliable to determine both r and the tendon birefringence and diattenuation. (C) 2010 Optical Society of America

In vivo structural imaging of the cornea by polarization-resolved second harmonic microscopy

Article publié en 2012

Auteurs : Latour Gael; Gusachenko Ivan; Kowalczuk Laura; et al.

Réf. : BIOMEDICAL OPTICS EXPRESS Volume: 3 Issue: 1 Pages: 1-15 Published: JAN 1 2012

The transparency and mechanical strength of the cornea are related to the highly organized three-dimensional distribution of collagen fibrils. It is of great interest to develop specific and contrasted in vivo imaging tools to probe these collagenous structures, which is not available yet. Second Harmonic Generation (SHG) microscopy is a unique tool to reveal fibrillar collagen within unstained tissues, but backward SHG images of cornea fail to reveal any spatial features due to the nanometric diameter of stromal collagen fibrils. To overcome this limitation, we performed polarization-resolved SHG imaging, which is highly sensitive to the submicrometer distribution of anisotropic structures. Using advanced data processing, we successfully retrieved the orientation of the collagenous fibrils at each depth of human corneas, even in backward SHG homogenous images. Quantitative information was also obtained about the submicrometer heterogeneities of the fibrillar collagen distribution by measuring the SHG anisotropy. All these results were consistent with numerical simulation of the polarization-resolved SHG response of cornea. Finally, we performed in vivo SHG imaging of rat corneas and achieved structural imaging of corneal stroma without any labeling. Epi-detected polarization-resolved SHG imaging should extend to other organs and become a new diagnosis tool for collagen remodeling. (C) 2011 Optical Society of America

[2009-034 T] COX

Porteur : **Mourad Idir**

Axe **A**

Assessment of grating-based X-ray phase-contrast CT for differentiation of invasive ductal carcinoma and ductal carcinoma in situ in an experimental ex vivo set-up

Article publié en 2013

Auteurs : Sztrokay, Aniko; Herzen, Julia; Auweter, Sigrid D.; Liebhardt, Susanne; Mayr, Doris; Willner, Marian; Hahn, Dieter; Zanette, Irene; Weitkamp, Timm; Hellerhoff, Karin; Pfeiffer, Franz; Reiser, Maximilian F.; Bamberg, Fabian

Réf. : EUROPEAN RADIOLOGY Volume: 23 Issue: 2 Pages: 381-387 DOI: 10.1007/s00330-012-2592-1 Published: FEB 2013

Limited contrast between healthy and tumour tissue is a limiting factor in mammography and CT of the breast. Phase-contrast computed tomography (PC-CT) provides improved soft-tissue contrast compared with absorption-based techniques. In this study, we assessed the technical feasibility of grating-based PC-CT imaging of the breast for characterisation of ductal carcinoma in situ (DCIS). Grating-based PC-CT was performed on one breast specimen containing an invasive ductal carcinoma and DCIS using monochromatic radiation of 23 keV. Phase-contrast and absorption-based images were compared qualitatively and quantitatively with histopathology in a blinded fashion. Grating-based PC-CT showed improved differentiation of soft-tissue components. Circular structures of high phase-shift contrast corresponding to the walls of the dilated ductuli of the DCIS were visualised with a contrast-to-noise ratio (CNR) of 9.6 using PC-CT but were not detectable on absorption-based images (CNR = 0.27). The high phase-shift structures of the dilated ductuli were identifiable in the PC-CT volume data set allowing for 3D characterisation of DCIS. Our results indicate that unlike conventional CT, grating-based PC-CT may allow the differentiation between invasive carcinoma and intraductal carcinoma and healthy breast tissue and provide 3D visualisation of DCIS. aEuro cent Phase-contrast computed tomography (CT) yields improved soft-tissue contrast. aEuro cent The method can resolve the fine structure of a breast tumour. aEuro cent Invasive and intraductal carcinoma can be differentiated. aEuro cent Differentiation is possible by visual inspection and quantification. aEuro cent The method could improve early breast cancer diagnosis.

ANKAphase: software for single-distance phase retrieval from inline X-ray phase-contrast radiographs

Article publié en 2011

Auteurs : Weitkamp T.; Haas D.; Wegrzynek D.; et al.

Réf. : JOURNAL OF SYNCHROTRON RADIATION Volume: 18 Pages: 617-629 DOI: 10.1107/S0909049511002895 Part: Part 4 Published: JUL 2011

A computer program named ANKAphase is presented that processes X-ray inline phase-contrast radiographs by reconstructing the projected thickness of the object(s) imaged. The program uses a single-distance non-iterative phase-retrieval algorithm described by David Paganin et al. [(2002), J. Microsc. 206, 33-40]. Allowing for non-negligible absorption in the sample, this method is strictly valid only for monochromatic illumination and single-material objects but tolerates deviations from these conditions, especially polychromaticity. ANKAphase is designed to be applied to tomography data (although it does not perform tomographic reconstruction itself). It

can process series of images and perform flat-field and dark-field correction. Written in Java, ANKAphase has an intuitive graphical user interface and can be run either as a stand-alone application or as a plugin to ImageJ, a widely used scientific image-processing program. A description of ANKAphase is given and example applications are shown.

Interlaced phase stepping in phase-contrast x-ray tomography

Article publié en 2011

Auteurs : Zanette I, Bech M Pfeiffer F, Weitkamp T

Réf. : APPLIED PHYSICS LETTERS 98 094101 (2011)

We report on an interlaced acquisition scheme in grating-based x-ray phase-contrast tomography in which different viewing angles are used to retrieve a single differential phase projection. This interlaced acquisition scheme is particularly beneficial for region-of-interest tomography since it substantially reduces the artifacts caused by the external region and can eliminate the need for stop-and-go motion of the tomography rotation axis. In this letter, the higher accuracy of the region-of-interest phase reconstructions obtained with the interlaced approach is demonstrated by numerical simulation and experimental results. (C) 2011 American Institute of Physics.

Quadriwave lateral shearing interferometry in an achromatic and continuously self-imaging regime for future x-ray phase imaging

Article publié en 2011

Auteurs : Rizzi Julien; Weitkamp Timm; Guerineau Nicolas; et al.

Réf. : OPTICS LETTERS Volume: 36 Issue: 8 Pages: 1398-1400 Published: APR 15 2011

We present in this Letter a type of quadriwave lateral shearing interferometer for x-ray phase imaging. This device is based on a phase chessboard, and we take advantage of the large spectrum of the source to produce interferograms with a propagation-invariant contrast. Such a grating has been created for hard x-ray interferometry and experimentally tested on a synchrotron beamline at Soleil. (C) 2011 Optical Society of America

Global and local hard X-ray tomography of a centimeter-size tumor vessel tree

Article publié en 2012

Auteurs : Sabrina Lang, Marco Dominietto, Philippe Cattin, Alexandra Ulmann-Schuler, Timm Weitkamp, Bert Mueller

Réf. : JOURNAL OF SYNCHROTRON RADIATION, 19 114-125; Part 1 10.1107/S0909049511046139 JAN 2012

The visualization of the vascular network in tumors down to the smallest vessels requires high spatial resolution and reasonable contrast. Stained corrosion casts of the microvasculature network guarantee superior X-ray absorption contrast and highest reproduction fidelity. Tomography of a centimeter-size tumor, however, is unfeasible at the spatial resolution needed to reveal the smallest vessels. Therefore, local tomography has been performed to visualize the smallest capillaries within the region of interest. These three-dimensional data show the detailed morphology, but the reconstructed absorption coefficients obtained in local tomography differ substantially from the absorption coefficients retrieved from the less detailed global tomography data. This paper deals with the adaptation of local tomography data using the global data and considers two-parameter histogram matching of the radiographs, sinogram extension, and multi-parameter cupping correction. It is demonstrated that two-parameter histogram matching of the radiographs already provides reasonable agreement. The change

of the lens in front of the detector's camera, however, significantly affects the obtained local X-ray absorption coefficients in the tomograms predominantly owing to the dissimilar point-spread functions of the two configurations used, and much less to the fact that one of the data sets was acquired in a local geometry.

Numerical comparison of X-ray differential phase contrast and attenuation contrast

Article publié en 2012

Auteurs : Hahn Dieter; Thibault Pierre; Bech Martin; et al.

Réf. : BIOMEDICAL OPTICS EXPRESS Volume: 3 Issue: 6 Pages: 1141-1148 Published: JUN 1 2012

We present a numerical tool to compare directly the contrast-to-noise-ratio (CNR) of the attenuation- and differential phase-contrast signals available from grating-based X-ray imaging for single radiographs. The attenuation projection is differentiated to bring it into a modality comparable to the differential phase projection using a Gaussian derivative filter. A Relative Contrast Gain (RCG) is then defined as the ratio of the CNR of image values in a region of interest (ROI) in the differential phase projection to the CNR of image values in the same ROI in the differential attenuation projection. We apply the method on experimental data of human breast tissue acquired using a grating interferometer to compare the two contrast modes for two regions of interest differing in the type of tissue. Our results indicate that the proposed method can be used as a local estimate of the spatial distribution of the ratio delta/beta, i.e., real and imaginary part of the complex refractive index, across a sample. (C) 2012 Optical Society of America

X-ray vector radiography for bone micro-architecture diagnostics

Article publié en 2012

Auteurs : Potdevin Guillaume; Malecki Andreas; Biernath Thomas; et al.

Réf. : PHYSICS IN MEDICINE AND BIOLOGY Volume: 57 Issue: 11 Pages: 3451-3461 DOI: 10.1088/0031-9155/57/11/3451 Published: JUN 7 2012

The understanding of large biophysical systems at the systems level often depends on a precise knowledge of their microstructure. This is difficult to obtain, especially in vivo, because most imaging methods are either limited in terms of achievable field of view, or make use of penetrating ionizing radiations such as x-rays, in which case the resolution is severely limited by the deposited dose. Here, we describe a new method, x-ray vector radiography (XVR), which yields various types of information about the local orientation, anisotropy and average size of the sample microstructures. We demonstrate the feasibility by showing first experimental XVRs of human vertebra bone samples, giving information on the trabecular structures even with a pixel resolution of half a millimetre, much larger than the structures themselves. This last point is critical for the development of low-dose measurement methods which will allow for in vivo studies and potentially in the future for new medical diagnostics methods of bone metabolic disorder diseases such as osteoporosis.

Fabrication of two-dimensional hard X-ray diffraction gratings

Article publié en 2013

Auteurs : Rutishauser, S.; Bednarzik, M.; Zanette, I.; Weitkamp, T.; Boerner, M.; Mohr, J.; David, C.

Réf. : MICROELECTRONIC ENGINEERING Volume: 101 Pages: 12-16 DOI: 10.1016/j.mee.2012.08.025 Published: JAN 2013

Hard X-ray grating interferometry has shown promising results in phase and scattering imaging, as well as in metrology applications. Recently, the technique has been extended to two dimensions, recording the full phase gradient vector and a directional scattering signal. Here, we present a process for fabricating the key optical elements required for this technique: phase and absorption gratings with periods of few micrometers and high

aspect ratios, with a particular focus on two-dimensional grating structures. The fabrication process is based on deep reactive ion etching in silicon and electroplating of gold. (C) 2012 Elsevier B.V. All rights reserved.

Numerical comparison of X-ray differential phase contrast and attenuation contrast

Article publié en 2012

Auteurs : Hahn, Dieter; Thibault, Pierre; Bech, Martin; Stockmar, Marco; Schleede, Simone; Zanette, Irene; Rack, Alexander; Weitkamp, Timm; Sztrokay, Aniko; Schlossbauer, Thomas; Bamberg, Fabian; Reiser, Maximilian; Pfeiffer, Franz

Réf. : BIOMEDICAL OPTICS EXPRESS Volume: 3 Issue: 6 Pages: 1141-1148 Published: JUN 1 2012

We present a numerical tool to compare directly the contrast-to-noise-ratio (CNR) of the attenuation- and differential phase-contrast signals available from grating-based X-ray imaging for single radiographs. The attenuation projection is differentiated to bring it into a modality comparable to the differential phase projection using a Gaussian derivative filter. A Relative Contrast Gain (RCG) is then defined as the ratio of the CNR of image values in a region of interest (ROI) in the differential phase projection to the CNR of image values in the same ROI in the differential attenuation projection. We apply the method on experimental data of human breast tissue acquired using a grating interferometer to compare the two contrast modes for two regions of interest differing in the type of tissue. Our results indicate that the proposed method can be used as a local estimate of the spatial distribution of the ratio delta/beta, i.e., real and imaginary part of the complex refractive index, across a sample. (C) 2012 Optical Society of America

Trimodal low-dose X-ray tomography

Article publié en 2012

Auteurs : Zanette, I.; Bech, M.; Rack, A.; Le Duc, G.; Tafforeau, P.; David, C.; Mohr, J.; Pfeiffer, F.; Weitkamp, T.

Réf. : PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA Volume: 109 Issue: 26 Pages: 10199-10204 DOI: 10.1073/pnas.1117861109 Published: JUN 26 2012

X-ray grating interferometry is a coherent imaging technique that bears tremendous potential for three-dimensional tomographic imaging of soft biological tissue and other specimens whose details exhibit very weak absorption contrast. It is intrinsically trimodal, delivering phase contrast, absorption contrast, and scattering ("dark-field") contrast. Recently reported acquisition strategies for grating-interferometric phase tomography constitute a major improvement of dose efficiency and speed. In particular, some of these techniques eliminate the need for scanning of one of the gratings ("phase stepping"). This advantage, however, comes at the cost of other limitations. These can be a loss in spatial resolution, or the inability to fully separate the three imaging modalities. In the present paper we report a data acquisition and processing method that optimizes dose efficiency but does not share the main limitations of other recently reported methods. Although our method still relies on phase stepping, it effectively uses only down to a single detector frame per projection angle and yields images corresponding to all three contrast modalities. In particular, this means that dark-field imaging remains accessible. The method is also compliant with data acquisition over an angular range of only 180 degrees and with a continuous rotation of the specimen.

X-ray vector radiography for bone micro-architecture diagnostics

Article publié en 2012

Auteurs : Potdevin, Guillaume; Malecki, Andreas; Biernath, Thomas; Bech, Martin; Jensen, Torben H.; Feidenhans'l, Robert; Zanette, Irene; Weitkamp, Timm; Kenntner, Johannes; Mohr, Juergen; Roschger, Paul; Kerschnitzki, Michael; Wagermaier, Wolfgang; Klaushofer, Kla

Réf. : PHYSICS IN MEDICINE AND BIOLOGY Volume: 57 Issue: 11 Pages: 3451-3461 DOI: 10.1088/0031-9155/57/11/3451 Published: JUN 7 2012

The understanding of large biophysical systems at the systems level often depends on a precise knowledge of their microstructure. This is difficult to obtain, especially in vivo, because most imaging methods are either limited in terms of achievable field of view, or make use of penetrating ionizing radiations such as x-rays, in which case the resolution is severely limited by the deposited dose. Here, we describe a new method, x-ray vector radiography (XVR), which yields various types of information about the local orientation, anisotropy and average size of the sample microstructures. We demonstrate the feasibility by showing first experimental XVRs of human vertebra bone samples, giving information on the trabecular structures even with a pixel resolution of half a millimetre, much larger than the structures themselves. This last point is critical for the development of low-dose measurement methods which will allow for in vivo studies and potentially in the future for new medical diagnostics methods of bone metabolic disorder diseases such as osteoporosis.

[2009-035T] GULFSTREAM II

Porteur : **Pierre Pillet**

Axe **A**

Vibrational cooling of cesium molecules using noncoherent broadband light

Article publié en 2009

Auteurs : Sofikitis Dimitris; Horchani Ridha; Li Xiaolin; et al.

Réf. : PHYSICAL REVIEW A Volume: 80 Issue: 5 Article Number: 051401 DOI: 10.1103/PhysRevA.80.051401 Published: NOV 2009

We demonstrate selective vibrational population transfer in cold cesium dimers using a simple approach based on the use of a shaped incoherent broadband diode laser near threshold. Optical pumping into a single vibrational level is accomplished with an incoherent light source by eliminating transitions from the targeted vibrational level. The broadband spectrum of the laser is wide enough to electronically excite several vibrational states of the molecule simultaneously. This method is relatively inexpensive, simple, and flexible to allow for development of new applications, in particular, the preparation of optically closed molecular system, opening the way to direct laser cooling of molecules.

Photoionization spectroscopy of excited states of cold caesium dimers

Article publié en 2010

Auteurs : Bouloufa Nadia; Favilla Elena; Viteau Matthieu; et al.

Réf. : MOLECULAR PHYSICS Volume: 108 Issue: 18 Pages: 2355-2368 Article Number: PII 925129227 DOI: 10.1080/00268976.2010.495732 Published: 2010

Photoionization spectroscopy of cold caesium dimers obtained by photoassociation of cold atoms in a magneto-optical trap is reported here. In particular, we report on the observation and on the spectroscopic analysis of all the excited states that have actually been used for efficient detection of cold molecules stabilized in the triplet [image omitted] ground state. They are: the [image omitted] state connected to the 6s + 6p asymptote, the [image omitted] and (2)3g states connected to the 6s + 5d asymptote and finally the [image omitted] state connected to the 6s + 7s asymptote. The detection through these states spans a wide range of laser energies, from 8000 to 16,500 cm-1, obtained with different laser dyes and techniques. Information on the initial distribution of cold molecules among the different vibrational levels of the [image omitted] ground state is also provided. This spectroscopic knowledge is important when conceiving schemes for quantum manipulation, population transfer and optical detection of cold caesium molecules.

Deeply bound cold caesium molecules formed after 0(g)(-) resonant coupling

Article publié en 2011

Auteurs : Lignier H.; Fioretti A.; Horchani R.; et al.

Réf. : PHYSICAL CHEMISTRY CHEMICAL PHYSICS Volume: 13 Issue: 42 Pages: 18910-18920 DOI: 10.1039/c1cp21488h Published: 2011

Translationally cold caesium molecules are created by photoassociation below the 6s + 6p(1/2) excited state and selectively detected by resonance enhanced two photon ionization (RE2PI). A series of excited vibrational levels belonging to the 0(g)(-) symmetry is identified. The regular progression of the vibrational spacings and of the rotational constants of the 0(g)(-) (6s + 6p(1/2)) levels is strongly altered in two energy domains. These deviations are interpreted in terms of resonant coupling with deeply bound energy levels of two upper 0(g)(-) states dissociating into the 6s + 6p(3/2) and 6s + 5d(3/2) asymptotes. A theoretical model is proposed to explain the coupling and a quantum defect analysis of the perturbed level position is performed. Moreover, the resonant coupling changes dramatically the spontaneous decay products of the photoexcited molecules, strongly enhancing the decay into deeply bound levels of the a (3)Sigma(+)(u) triplet state and of the X(1)Sigma(+)(g) ground state. These results may be relevant when conceiving population transferring schemes in cold molecule systems.

Loading a dipole trap from an atomic reservoir

Article publié en 2011

Auteurs : Sofikitis D.; Stern G.; Kime L.; et al.

Réf. : EUROPEAN PHYSICAL JOURNAL D Volume: 61 Issue: 2 Pages: 437-442 DOI: 10.1140/epjd/e2010-10261-5 Published: JAN 2011

Loading a dipole trap from an atomic reservoir is considered to be an efficient method for the preparation of trapped atoms at high density, which has led to notable results for the case of Rb and Cr atoms. It was also theoretically predicted to provide efficient loading also in the cesium case. In this article, we report on the experimental study of the loading of a single-arm and of a crossed dipole trap for cesium atoms. This study is performed by comparing several types of reservoirs from which the atoms are loaded: a magnetic trap, a Dark-SPOT and a compressed MOT. In all cases the number of atoms is found to decrease shortly after the beginning of the loading process. A few possible phenomena leading to such a behavior, namely the limited reservoir lifetime and/or a possible heating in the reservoir, are discussed. The loading dynamics is fitted by a phenomenological rate equation. From an experimental point of view, the reservoir loading method can be considered efficient in terms of number of transferred atoms for the single arm dipole trap. On the contrary, it

does not seem to provide, for the case of cesium atoms in a crossed dipole trap, an attractive alternative in comparison with existing loading methods such as Raman sideband cooling.

Observation of a Resonant Four-Body Interaction in Cold Cesium Rydberg Atoms

Article publié en 2012

Auteurs : Gurian J. H.; Cheinet P.; Huillery P.; et al.

Réf. : PHYSICAL REVIEW LETTERS Volume: 108 Issue: 2 Article Number: 023005 DOI: 10.1103/PhysRevLett.108.023005 Published: JAN 11 2012

Cold Rydberg atoms subject to long-range dipole-dipole interactions represent a particularly interesting system for exploring few-body interactions and probing the transition from 2-body physics to the many-body regime. In this work we report the direct observation of a resonant 4-body Rydberg interaction. We exploit the occurrence of an accidental quasicoincidence of a 2-body and a 4-body resonant Stark-tuned Forster process in cesium to observe a resonant energy transfer requiring the simultaneous interaction of at least four neighboring atoms. These results are relevant for the implementation of quantum gates with Rydberg atoms and for further studies of many-body physics.

Triplet-singlet conversion by broadband optical pumping

Article publié en 2012

Auteurs : Horchani R.; Lignier H.; Bouloufa-Maafa N.; et al.

Réf. : PHYSICAL REVIEW A Volume: 85 Issue: 3 Article Number: 030502 DOI: 10.1103/PhysRevA.85.030502 Published: MAR 6 2012

We demonstrate the conversion of cold Cs-2 molecules initially distributed over several vibrational levels of the lowest triplet state a(3) Sigma(+)(u) into the singlet ground state X-1 Sigma(+)(g). This conversion is realized by a broadband laser exciting the molecules to a well-chosen state from which they may decay to the singlet state through two sequential single-photon emission steps: The first photon populates levels with mixed triplet-singlet character, making possible a second spontaneous emission down to several vibrational levels of the X-1 Sigma(+)(g) states. By adding an optical scheme for vibrational cooling, a substantial fraction of molecules are transferred to the ground vibrational level of the singlet state. The efficiency of the conversion process, with and without vibrational cooling, is discussed at the end of the article. The presented conversion is general in scope and could be extended to other molecules.

[2009-038T] DYNQG

Porteur : **Grégory SHLYAPNIKOV**

Axe **B**

Quantum gates driven by microwave pulses in hyperfine levels of ultracold heteronuclear dimers

Article publié en 2011

Auteurs : P. Pellegrini, M.Desouter-Lecomte

Réf. : EUROPEAN PHYSICAL JOURNAL D 64 (1): 163-170 10.1140/epjd/e2011-20128-x SEP 2011

We theoretically investigated the implementation of universal quantum gates in hyperfine levels of ultracold heteronuclear polar molecules in their lowest rotational manifolds. Quantum bits are manipulated by microwave pulses, taking advantage of the strong state mixing generated by the hyperfine interactions. Gate operations are either driven by a sequence of Gaussian pulses or by a pulse shaped by optimal control theory. Alkaline molecules of experimental interest are considered. We show that high fidelity gates can be driven by microsecond pulses. The richness of the energy structure and the state mixing offer promising perspectives for the manipulation of a large number of qubits.

[2009-039T] CIRMOLIQ

Porteur : **Michèle Desouter**

Axe **B**

Controlled full adder-subtractor by vibrational computing

Article publié en 2010

Auteurs : Lauvergnat D ; Remacle F ; Desouter-Lecomte M

Réf. : PHYSICAL CHEMISTRY CHEMICAL PHYSICS 12 (2010) Pages : 15628-15635

The implementation of a quantum-controlled full adder-subtractor of two binary digits and of a "carry in" or a "borrow in" is simulated by encoding four qubits in the vibrational eigenstates of a tetra-atomic molecule (trans-HONO). The laser field of the gate is computed using optimal control theory by treating dynamics in full dimensionality. A controlled qubit enforces the addition or the subtraction. The global unitary transformation that connects the inputs to the outputs is driven by a single laser pulse. This decreases the duration of the operation and allows for a better use of the optical resources and for an improvement of the fidelity (>97%). Initialization and reading out are discussed. The timescale of the sequence initialization, gate and read out is <100 ps.

Toward scalable information processing with ultracold polar molecules in an electric field: A numerical investigation

Article publié en 2010

Auteurs : Bomble, L; Pellegrini, P; Ghesquiere, P; Desouter-Lecomte, M

Réf. : PHYSICAL REVIEW A 82 (2010) 062323

We numerically investigate the possibilities of driving quantum algorithms with laser pulses in a register of ultracold NaCs polar molecules in a static electric field. We focus on the possibilities of performing scalable logical operations by considering circuits that involve intermolecular gates (implemented on adjacent interacting molecules) to enable the transfer of information from one molecule to another during conditional laser-driven population inversions. We study the implementation of an arithmetic operation (the addition of 0 or 1 on a binary digit and a carry in) which requires population inversions only and the Deutsch-Jozsa algorithm which requires a control of the phases. Under typical experimental conditions, our simulations show that high-fidelity logical operations involving several qubits can be performed in a time scale of a few hundreds of microseconds, opening promising perspectives for the manipulation of a large number of qubits in these systems

Implementing quantum algorithms in hyperfine levels of ultracold polar molecules by optimal control

Article publié en 2011

Auteurs : Pellegrini Philippe; Vranckx Stephane; Desouter-Lecomte Michele

Réf. : PHYSICAL CHEMISTRY CHEMICAL PHYSICS Volume: 13 Issue: 42 Pages: 18864-18871 DOI: 10.1039/c1cp21184f Published: 2011

We numerically implement quantum algorithms in hyperfine levels of ultracold polar molecules. Logical operations are driven by pulses optimized by optimal control theory. All implementations take place in the lowest two rotational levels of the ground vibrational state of the ground (1)Sigma(+) electronic state, exploiting the richness of the hyperfine energy structure and state mixing in static external fields. We show that it is possible to realize high fidelity complex logical operations with microsecond pulses. The possibility to run algorithms implemented on two interacting molecules is also demonstrated. (41)K(85)Rb and (41)K(87)Rb molecules are considered for the numerical simulations but the results are general and can be extended to other species.

Quantum gates driven by microwave pulses in hyperfine levels of ultracold heteronuclear dimers

Article publié en 2011

Auteurs : Pellegrini P.; Desouter-Lecomte M.

Réf. : EUROPEAN PHYSICAL JOURNAL D Volume: 64 Issue: 1 Pages: 163-170 DOI: 10.1140/epjd/e2011-20128-x Published: SEP 2011

We theoretically investigated the implementation of universal quantum gates in hyperfine levels of ultracold heteronuclear polar molecules in their lowest rotational manifolds. Quantum bits are manipulated by microwave pulses, taking advantage of the strong state mixing generated by the hyperfine interactions. Gate operations are either driven by a sequence of Gaussian pulses or by a pulse shaped by optimal control theory. Alkaline molecules of experimental interest are considered. We show that high fidelity gates can be driven by microsecond pulses. The richness of the energy structure and the state mixing offer promising perspectives for the manipulation of a large number of qubits.

[2009-042T] ASSENSOR

Porteur : **Travis Wade**

Axe **D**

Functionalized nanoporous track-etched beta-PVDF membrane electrodes for lead(II) determination by square wave anodic stripping voltammetry

Article publié en 2011

Auteurs : Bessbousse, H; Nandhakumar, I; Decker, M; Barsbay, M; Cuscito, O; Lairez, D; Clochard, MC; Wade, TL

Réf. : ANALYTICAL METHODS 3 (6): 1351-1359 10.1039/c1ay05038a JUN 2011

Track-etched functionalized nanoporous beta-PVDF membrane electrodes, or functionalized membrane electrodes (FMEs), are electrodes made from track-etched, poly(acrylic acid) (PAA) functionalized nanoporous beta-poly(vinylidene fluoride) (beta-PVDF) membranes with thin porous Au films sputtered on each side as electrodes. In order to form the P-PVDF nanoporous membranes, beta-PVDF films are irradiated by swift heavy ions. After irradiation, radical tracks are left in the membranes. Etching removes some of the radical tracks revealing nanopores. The remaining radicals initiate radio grafting of PAA from the pore walls of the nanoporous beta-PVDF. PAA is a cation exchange polymer that adsorbs metal ions, such as Pb(2+), from aqueous solutions thus concentrating the ions into the membrane. After a calibrated time, the FME is transferred to an electrochemical cell for analysis. A negative potential is applied to the Au film of the FME for a set time to reduce the adsorbed ions on to the Au film working electrode. Square-wave anodic stripping voltammetry was performed on the FME to determine the Pb(2+) ion concentration in the original solution based on calibration. The zero current intercept of the calibration for Pb(2+) is 0.13 ppb (mu g L(-1)) and three times the sample blank deviation (3S/N) is 0.050 ppb.

[2009-051T] NEXT

Porteur : **K. Cassou**

Thème **6**

Laser-plasma electron acceleration in dielectric capillary tubes

Article publié en 2011

Auteurs : G. Genoud, K. Cassou, F. Wojda, H.E. Ferrari, C. Kamperidis,M. Burza, A. Persson, J. Uhlig, S. Kneip, S.P.D Mangles, A. Lifschitz, B. Cros, C.G. Wahlstrom

Réf. : APPLIED PHYSICS B-LASERS AND OPTICS Volume: 105 Issue: 2 Pages: 309-316 DOI: 10.1007/s00340-011-4639-4 Published: NOV 2011

Electron beams and betatron X-ray radiation generated by laser wakefield acceleration in long plasma targets are studied. The targets consist of hydrogen filled dielectric capillary tubes of diameter 150 to 200 microns and length 6 to 20 mm. Electron beams are observed for peak laser intensities as low as 5x10(17) W/cm(2). It is found that the capillary collects energy outside the main peak of the focal spot and contributes to keep the beam self-focused over a distance longer than in a gas jet of similar density. This enables the pulse to evolve enough to reach the threshold for wavebreaking, and thus trap and accelerate electrons. No electrons were observed for capillaries of large diameter (250 mu m), confirming that the capillary influences the interaction and does not have the same behaviour as a gas cell. Finally, X-rays are used as a diagnostic of the interaction and, in particular, to estimate the position of the electrons trapping point inside the capillary.

[2009-052T] DYNMAG

Porteur : **Sawako Nakamae**

Thème **1**

Experimental Evidence for Violation of the Fluctuation-Dissipation Theorem in a Superspin Glass

Article publié en 2011

Auteurs : Komatsu K, L'Hote D, Nakamae S, Mosser V, Konczykowski M, Dubois E, Dupuis V, Perzynski R

Réf. : PHYSICAL REVIEW LETTERS 106 (15): Art. No. 150603 APR 14 2011

We present the experimental observation of the fluctuation-dissipation theorem violation in an assembly of interacting magnetic nanoparticles in the low temperature superspin-glass phase. The magnetic noise is measured with a two-dimension electron gas Hall probe and compared to the out of phase ac susceptibility of the same ferrofluid. For "intermediate" aging times of the order of 1 h, the ratio of the effective temperature T-eff to the bath temperature T grows from 1 to 6.5 when T is lowered from T-g to 0.3 T-g, regardless of the noise frequency. These values are comparable to those measured in an atomic spin glass as well as those calculated for a Heisenberg spin glass.

[2009-053T] FemtoARPES2

Porteur : **Marino Marsi**

Thème **4**

A microscopic view on the Mott transition in chromium-doped V(2)O(3)

Article publié en 2010

Auteurs : Lupi S.; Baldassarre L.; Mansart B.; et al.

Réf. : NATURE COMMUNICATIONS Volume: 1 Article Number: 105 DOI: 10.1038/ncomms1109 Published: NOV 2010

V(2)O(3) is the prototype system for the Mott transition, one of the most fundamental phenomena of electronic correlation. Temperature, doping or pressure induce a metal-to-insulator transition (MIT) between a paramagnetic metal (PM) and a paramagnetic insulator. This or related MITs have a high technological potential, among others, for intelligent windows and field effect transistors. However the spatial scale on which such transitions develop is not known in spite of their importance for research and applications. Here we unveil for the first time the MIT in Cr-doped V(2)O(3) with submicron lateral resolution: with decreasing temperature, microscopic domains become metallic and coexist with an insulating background. This explains why the associated PM phase is actually a poor metal. The phase separation can be associated with a thermodynamic instability near the transition. This instability is reduced by pressure, that promotes a genuine Mott transition to an eventually homogeneous metallic state.

Evolution of the electronic structure of a Mott system across its phase diagram: X-ray absorption spectroscopy study of (V(1-x)Cr(x))(2)O(3)

Article publié en 2011

Auteurs : Rodolakis F.; Rueff J. -P.; Sikora M.; et al.

Réf. : PHYSICAL REVIEW B Volume: 84 Issue: 24 Article Number: 245113 DOI: 10.1103/PhysRevB.84.245113 Published: DEC 13 2011

V(2)O(3) is an archetypal system for the study of correlation-induced, Mott-Hubbard metal-insulator transitions. Despite decades of extensive investigations, the accurate description of its electronic properties remains an open problem in the physics of strongly correlated materials, also because of the lack of detailed experimental data on its electronic structure over the whole phase diagram. We present here a high-resolution x-ray absorption spectroscopy study at the V K edge of (V(1-x)Cr(x))(2)O(3) to probe its electronic structure as a function of temperature, doping, and pressure, providing an accurate picture of the electronic changes over the whole phase diagram. We also discuss the relevance of the parallel evolution of the lattice parameters, determined with x-ray diffraction. This allows us to draw two conclusions of general interest: First, the transition under pressure presents peculiar properties, related to a more continuous evolution of the lattice and electronic structure; second, the lattice mismatch is a good parameter describing the strength of the first-order transition, and is consequently related to the tendency of the system toward the coexistence of different phases. Our results show that the evolution of the electronic structure while approaching a phase transition, and not only while crossing it, is also a key element to unveil the underlying physical mechanisms of Mott materials.

[2009-059T] ARPNIC

Porteur : **V. Brouet**

Thème **4**

Opening of the superconducting gap in the hole pockets of Ba(Fe1-xCox)(2)As-2 as seen via angle-resolved photoelectron spectroscopy

Article publié en 2012

Auteurs : Mansart B.; Papalazarou E.; Jensen M. Fuglsang; et al.

Réf. : PHYSICAL REVIEW B Volume: 85 Issue: 14 Article Number: 144508 DOI: 10.1103/PhysRevB.85.144508 Published: APR 6 2012

We present an angle-resolved photoelectron spectroscopy study of the changes in the electronic structure of electron-doped Ba(Fe1-xCox)(2)As-2 across the superconducting phase transition. By changing the polarization of the incoming light, we were able to observe the opening of the gap for the inner hole pocket alpha and to compare its behavior with the outer holelike band beta. Measurements along high-symmetry directions show that the behavior of beta is consistent with an isotropic gap opening, while slight anisotropies are detected for the inner band alpha. The implications of these results for the s +/- symmetry of the superconducting order parameter are discussed, in relation to the nature of the different iron orbitals contributing to the electronic structure of this multiband system.

[2009-060T] IRAHOC-MIS

Porteur : **TEILLET-BILLY Dominique**

Axe **B**

Enhanced H-2 catalytic formation on specific topological defects in interstellar graphenic dust grain models

Article publié en 2010

Auteurs : Ivanovskaya, VV; Zobelli, A; Teillet-Billy, D; Rougeau, N; Sidis, V; Briddon, PR

Réf. : PHYSICAL REVIEW B 82 (2010) 245407

First-principles models of the formation of H-2 on interstellar media carbonaceous grains are usually concerned with processes occurring on ideal graphenic surfaces. Until now these models are unable to explain the formation of molecular hydrogen due to the presence of absorption barriers that cannot be overcome at the low temperatures of the interstellar media. We propose an approach emphasizing the role of specific topological defects for molecular hydrogen catalysis at interstellar dust grain models. Using the nudged elastic band method combined with density-functional techniques, we obtain the full catalytic cycle for the formation of the H-2 molecule on complex carbon topologies involving the presence of pentagonal rings and C adatoms. Depending on structures, reaction paths can be barrierless or have adsorption barriers as low as 10(-3)-10(-2) eV, which might be easily overcome at the temperatures of the interstellar medium. Such low adsorption barriers indicate that specific carbon grains topological defects are preferential sites for the molecular hydrogen formation in the interstellar medium.

[2009-066T] eLight

Porteur : **Kociak, M**

Axe **A**

Nanometer Scale Spectral Imaging of Quantum Emitters in Nanowires and Its Correlation to Their Atomically Resolved Structure

Article publié en 2011

Auteurs : Zagonel, LF; Mazzucco, S; Tence, M; March, K; Bernard, R; Laslier, B; Jacopin, G; Tchernycheva, M; Rigutti, L; Julien, FH; Songmuang, R; Kociak, M

Réf. : NANO LETTERS (2011) 568-573

We report the spectral imaging in the UV to visible range with nanometer scale resolution of closely packed GaN/AlN quantum disks in individual nanowires using an improved custom-made cathodoluminescence system. We demonstrate the possibility to measure full spectral features of individual quantum emitters as small as 1 nm and separated from each other by only a few nanometers and the ability to correlate their optical properties to their size, measured with atomic resolution. The direct correlation between the quantum disk size and emission

wavelength provides evidence of the quantum confined Stark effect leading to an emission below the bulk GaN band gap for disks thicker than 2.6 nm. With the help of simulations, we show that the internal electric field in the studied quantum disks is smaller than what is expected in the quantum well case. We show evidence of a clear dispersion of the emission wavelengths of different quantum disks of identical size but different positions along the wire. This dispersion is systematically correlated to a change of the diameter of the AlN shell coating the wire and is thus attributed to the related strain variations along the wire. The present work opens the way both to fundamental studies of quantum confinement in closely packed quantum emitters and to characterizations of optoelectronic devices presenting carrier localization on the nanometer scale.

[2009-069T] BIGRAPH

Porteur : **Natacha Kirova**

Thème **1**

Anisotropy of graphite optical conductivity

Article publié en 2010

Auteurs : Falkovsky LA

Réf. : JETP LETTERS 92 (2010) Pages: 348-351

The graphite conductivity is evaluated for frequencies between 0.1 eV, the energy of the order of the electronhole overlap, and 1.5 eV, the electron nearest hopping energy. The in-plane conductivity per single atomic sheet is close to the universal graphene conductivity e (2)/4A and, however, contains a singularity conditioned by peculiarities of the electron dispersion. The conductivity is less in the c direction by the factor of the order of 0.01 governed by electron hopping in this direction.

[2009-070T] BIRD

Porteur : **Isabelle Philip**

Thème **7**

Identification of the stimulated-emission threshold in high-beta nanoscale lasers through phase-space reconstruction

Article publié en 2011

Auteurs : Hachair, X; Braive, R; Lippi, GL; Elvira, D; Le Gratiet, L; Lemaitre, A; Abram, I; Sagnes, I; Robert-Philip, I; Beveratos, A

Réf. : PHYSICAL REVIEW A 83 (5): Art. No. 053836 MAY 26 2011

Nanoscale lasers sustain a few optical modes so that the fraction of spontaneous emission beta funnelled into the useful (lasing) mode is high (of the order of 10(-1)) and the threshold, which traditionally corresponds to an abrupt kink in the light-in-light-out curve, becomes ill defined. We propose an alternative definition of the

threshold that is based on the dynamical response of the laser and is valid even for beta = 1 lasers. The laser dynamics is analyzed through a reconstruction of its phase-space trajectory for pulsed excitations. Crossing the threshold, brings about a change in the shape of the trajectory and in the area contained in it. An unambiguous determination of the threshold in terms of this change is shown theoretically and illustrated experimentally in a photonic-crystal laser.

[2009-072T] DESIRABLE

Porteur : **Xavier Checoury**

Thème **7**

All-silicon photonic crystal photoconductor on silicon-on-insulator at telecom wavelength

Article publié en 2010

Auteurs : Haret LD ; Checoury X ; Han Z ; Boucaud P ; Combrie S ; De Rossi A

Réf. : OPTICS EXPRESS 18 (2010) 23965-23972

We demonstrate an all-silicon photodetector working at telecom wavelength. The device is a simple metal-semiconductor-metal detector fabricated on silicon-on-insulator. A two-dimensional photonic crystal nanocavity (Q = 60,000) is used to increase the response that arises from the linear and two-photon absorption of silicon. The responsivity of the detector is about 20 mA/W and its bandwidth is larger than 1 GHz. (C) 2010 Optical Society of America

[2009-079T] SHYLAX

Porteur : **P. Zeitoun**

Thème **6**

Optical and electrical properties of laser doped Si:B in the alloy range

Article publié en 2012

Auteurs : Bhaduri, A.; Kociniewski, T.; Fossard, F.; Boulmer, J.; Debarre, D.

Réf. : APPLIED SURFACE SCIENCE Volume: 258 Issue: 23 Pages: 9228-9232 DOI: 10.1016/j.apsusc.2011.10.077 Published: SEP 15 2012

We have probed the dopant activity of silicon B-doped by Gas Immersion Laser Doping (GILD). Here, we report on the comparison of optical, electrical and structural properties of Si: B, over a wide concentration range, up to 1.5 x 10(21) cm(-3) by steps of 1.5 x 10(19) cm(-3). Data obtained by reflectance FTIR spectroscopy are used within a Drude model to extract concentration, thickness and mobility. Resulting carrier concentration and

conductivity are checked with 4-point probe electrical and X-ray diffraction measurements. FTIR proved to be very sensitive to the dopant distribution inside the layer, despite its thinness. It clearly reveals a moderate dopant accumulation at the interfaces. (C) 2011 Elsevier B. V. All rights reserved.

Soft x-ray plasma-based seeded multistage amplification chain

Article publié en 2012

Auteurs : Oliva, Eduardo (1); Fajardo, Marta (2);Li, Lu (1); Sebban, Stephane (1); Ros, David (3); Zeitoun, Philippe (1)

Réf. : OPTICS LETTERS Volume: 37 Issue: 20 Pages: 4341-4343 Published: OCT 15 2012

To date, plasma-based soft x-ray lasers have demonstrated experimentally 1 mu J, 1 ps (1 MW) pulses. This Letter reports extensive study using time-dependant Maxwell-Bloch code of seeding millimeter scale plasmas that store more than 100 mJ in population inversion. Direct seeding of these plasmas has to overcome very strong amplified spontaneous emission (ASE) as well as prevent wake-field amplification. Below 100 nJ injected energy, seed produces pulses with picosecond duration. To overcome this limitation, a new scheme has been studied, taking advantage of a plasma preamplifier that dramatically increases the seed energy prior to entering the main plasma amplifier leading to ASE and wake-free, fully coherent 21.6 mu J, 80 fs pulses (0.27 GW). (C) 2012 Optical Society of America

[2009-082T] FibNanoSynth

Porteur : **F. Fortuna**

Axe **C**

Bismuth-Catalyzed and Doped Silicon Nanowires for One-Pump-Down Fabrication of Radial Junction Solar Cells

Article publié en 2012

Auteurs : Yu, Linwei; Fortuna, Franck; O'Donnell, Benedict; Jeon, Taewoo; Foldyna, Martin; Picardi, Gennaro; Roca i Cabarrocas, Pere

Réf. : NANO LETTERS Volume: 12 Issue: 8 Pages: 4153-4158 DOI: 10.1021/nl3017187 Published: AUG 2012

Silicon nanowires (SiNWs) are becoming a popular choice to develop a new generation of radial junction solar cells. We here explore a bismuth- (Bi-) catalyzed growth and doping of SiNWs, via vapor-liquid-solid (VLS) mode, to fabricate amorphous Si radial n-i-p junction solar cells in a one-pump-down and low-temperature process in a single chamber plasma deposition system. We provide the first evidence that catalyst doping in the SiNW cores, caused by incorporating Bi catalyst atoms as n-type dopant, can be utilized to fabricate radial junction solar cells, with a record open circuit voltage of V-oc = 0.76 V and an enhanced light trapping effect that boosts the short circuit current to J(sc) = 11.23 mA/cm(2). More importantly, this bi-catalyzed SiNW growth and doping strategy exempts the use of extremely toxic phosphine gas, leading to significant procedure simplification and cost reduction for building radial junction thin film solar cells.

[2009-083T] SYMTCOB2

Porteur : **Henri Alloul**

Thème **1**

Nuclear quadrupole resonance and x-ray investigation of the structure of Na2/3CoO2

Article publié en 2009

Auteurs : Platova, TA. Mukhamedshin, IR. Alloul, H. Dooglav, AV. Collin, G

Réf. : PHYSICAL REVIEW B 80 (2009) 224106

We have synthesized various samples of the x=2/3 phase of sodium cobaltate NaxCoO2 and performed x-ray powder diffractions spectra to compare the diffraction with the structure proposed previously from NMR and nuclear quadrupole resonance (NQR) experiments [H. Alloul, I. R. Mukhamedshin, T. A. Platova, and A. V. Dooglav, EPL 85, 47006 (2009)]. Rietveld analyses of the data are found in perfect agreement with those and confirm the concentration x=2/3 obtained in the synthesis procedure. They even give indications on the atomic displacements of Na inside the unit cell. The detailed NQR data allow us to identify the NQR transitions and electric field gradient parameters for four cobalt sites and three Na sites. The spin-lattice and spin-spin relaxation rates are found much smaller for the nonmagnetic Co3+ sites than for the magnetic sites on which the holes are delocalized. The atomic ordering of the Na layers is therefore at the source of this ordered distribution of cobalt charges. The method used here to resolve the Na ordering and the subsequent Co charge order can be used valuably for similar structural determinations for various phases with x>0.45 for which Na ordering has been established.

[2009-088T] SUPRASPIN

Porteur : **Javier Villegas**

Thème **1**

Controllable manipulation of superconductivity using magnetic vortices

Article publié en 2011

Auteurs : Javier Villegas, Schuller IK

Réf. : SUPERCONDUCTOR SCIENCE & TECHNOLOGY 24 (2011) 024004

The magneto-transport of a superconducting/ferromagnetic hybrid structure, consisting of a superconducting thin film in contact with an array of magnetic nanodots in the so-called 'magnetic vortex state', exhibits interesting properties. For certain magnetic states, the stray magnetic field from the vortex array is intense enough to drive the superconducting film into the normal state. In this fashion, the normal-to-superconducting phase transition can be controlled by the magnetic history. The strong coupling between superconducting and magnetic subsystems allows characteristically ferromagnetic properties, such as hysteresis and remanence, to be dramatically transferred into the transport properties of the superconductor.

Imprinting nanoporous alumina patterns into the magneto-transport of oxide superconductors

Article publié en 2011

Auteurs : Javier Villegas; Swiecicki, I; Bernard, R; Crassous, A; Briatico, J; Wolf, T; Bergeal, N; Lesueur, J; Ulysse, C; Faini, G; Hallet, X; Piraux, L

Réf. : NANOTECHNOLOGY 22 (2011) 075302

We used oxygen ion irradiation to transfer the nanoscale pattern of a porous alumina mask into high-T-C superconducting thin films. This causes a nanoscale spatial modulation of superconductivity and strongly affects the magneto-transport below T-C, which shows a series of periodic oscillations reminiscent of the Little-Parks effect in superconducting wire networks. This irradiation technique could be extended to other oxide materials in order to induce ordered nanoscale phase segregation.