Advance Program

Joint Plenary Session

Monday, 14 January 2008

NETTUNO 4

08.30 - 10.00
Session PLE: JOINT PLENARY SESSION
Session Chair: TBD

PLE1 08.30 - 09.15

Photonic Crystal Fibers: A New Era in the Control of Light, P. St. J. Russell, *University of Erlangen-Nuremberg, Erlangen, Germany*

BIO: Philip Russell is Director of the Max-Planck Research Group for Optics, Information and Photonics and Professor of Physics at the University of Erlangen-Nuremberg, Germany. From 1996 to 2005 he was professor in the Department of Physics at the University of Bath, where he founded and led the Photonics & Photonic Materials Group. He obtained his M.A. (1976) and D.Phil. (1979) degrees at the University of Oxford and subsequently worked in research laboratories and universities in France, Germany and the USA. Since 1980 he has worked on the behaviour of light in periodically structured materials as well as on nonlinear optics, waveguides and optical fibres. He was the founder of the start-up company BlazePhotonics Ltd (April 2001 to August 2004), whose aim was the development and commercial exploitation of photonic crystal fibre. He has over 600 publications and is inventor on 37 patents covering in many aspects of photonics. He is a Fellow of the Royal Society, the Optical Society of America and the Institute of Physics (London) and has won several awards for his research.

ABSTRACT: Through their unique properties – often offering orders of magnitude improvement over previous technologies – photonic crystal fibres are giving rise to numerous new applications spanning many areas of science.

PLE2 09.15 - 10.00

Dispersion Control via Light Confinement for Efficient Nonlinear Optical Devices, A. L. Gaeta, *Cornell University, Ithaca, NY, USA*

ABSTRACT: The high effective nonlinearity and dispersion engineering associated with photonic nanowires made from glasses and semiconductors can be used for a wide variety of nonlinear optical applications ranging from ultralow power devices to the generation of single-cycle optical pulses.

10.00 – 10.30 COFFEE BREAK

Advance Program

Nonlinear Optics in Liquid Crystals

Monday, 14 January 2008

ALL SESSIONS WILL BE HELD IN NETTUNO 1

10.30 - 12.00

Session MC1: NOVEL PROPERTIES
Session Chair: Miroslaw Karpierz, *Warsaw University of Technology, Warsaw, Poland*

MC1.1 10.30 - 11.00 (Invited)

High Birefringence Liquid Crystalline Materials, R. Dabrowski, *Military University of Technology, Warsaw, Poland*, S. Gauza, *University of Central Florida, Orlando, FL, USA*, J. Dziaduszek, P. Kula, *Military University of Technology, Warsaw, Poland*, S. Urban, *Jagiellonian University, Krakow, Poland* and S.-T. Wu, *University of Central Florida, Orlando, FL, USA*

Mesogenic and physicochemical properties of single compounds belonging to biphenyls, terphenyls, quaterphenyls, tolanes, phenyl and biphenyl tolanes will be reviewed. Examples of high birefringence broad range nematic mixtures with high positive or negative or frequency dependent dielectric anisotropy useful for different photonic application will presented.

MC1.2 11.00 - 11.30 (Invited)

Nonlinear Liquid Crystal Nano-Metamaterials, A. Diaz, S. Kubo, D.-H. Kwon, J. H. Park, D. Werner, T. E. Mallouk and I. C. Khoo, *Pennsylvania State University, University Park, PA, USA*

Nano-metamaterials have been shown to exhibit unusual and configurable optical responses. In this paper we study visible-IR nonlinear transmission and all-optical switching enhancement of liquid crystals and neat organic liquids by dispersion of metallic nanospheres.

MC1.3 11.30 - 12.00 (Invited)

Self Phase Modulation Controlled by a Static Electric Field in Dye-Doped Liquid Crystals, L. Lucchetti and F. Simoni, *Università Politecnica delle Marche, Ancona, Italy*

We report on the possibility of observing the amazing ring pattern typical of self phase modulation (SPM) in dye doped liquid crystals with quite low impinging intensity. The rings formation is controlled by an external dc field applied perpendicular to the cell substrates.

12.00 – 14.00 LUNCH BREAK

14.00 - 15.30

Session MC2: NEW TRANSVERSE EFFECTS
Session Chair: Iam Choon Khoo, *Pennsylvania State University, University Park, PA, USA*

MC2.1 14.00 - 14.30 (Invited)

Nonlinear Transverse Effects in Photorefractive Liquid Crystal Light-Valves, S. Residori, *Institut Non Lineaire de Nice, Valbonne-Sophia Antipolis, France*, U. Bortolozzo, *Laboratoire de Physique Statistique de l'ENS, Paris, France*, A. Montina, *University of Florence, Sesto Fiorentino, Italy*, F. T. Arecchi, *Instituto Nazionale di Ottica Applicata, Firenze, Italy* and J.-P. Huignard, *Thales Research and Technology, Palaiseau, France*

Photorefractive liquid crystal light-valves result from a liquid crystal layer tightly coupled with a thin photorefractive crystal. The large optical nonlinearity and large transverse section allow realizing a ring optical cavity with a complex spatio-temporal dynamics.

MC2.2 14.30 - 14.45

Self-Pumped Phase Conjugation in a Liquid Crystal Light-Valve with Tilted Feedback Mirror, U. Bortolozzo, *Laboratoire de Physique Statistique de l'ENS, Paris, France*, S. Residori, *Institut Non Lineaire de Nice, Valbonne-Sophia Antipolis, France* and J.-P. Huignard, *Thales Research and Technology, Palaiseau, France*

Self-pumped phase conjugation is shown in a photorefractive liquid crystal light-valve with tilted feedback mirror. The new scheme allows the self-generation of phase conjugate replica and can be employed for distortion correction applications.

MC2.3 14.45 - 15.15 (Invited)

Helical Modes of Light and Optical Spin-to-Orbital Angular Momentum Conversion in Inhomogeneous Liquid Crystals: Prospects for Nonlinear Optics, L. Marrucci*, University of Naples "Federico II", Napoli, Italy*

A new method for generating helical modes of light by spin-to-orbital angular momentum conversion in a patterned liquid crystal is presented. The prospects of this innovation for the field of nonlinear optics are discussed.

MC2.4 15.15 - 15.30

Gas of Dark Solitons Generated by an Optical Shock, S. Trillo*, University of Ferrara, Ferrara, Italy*, C. Conti, A. Fratalocchi, M. Peccianti, *Centro Studi Ricerche ``Enrico Fermi", Roma, Italy* and G. Ruocco*, University of Rome "La Sapienza", Rome, Italy*

We demonstrate experimentally in a nonlocal medium the formationm of a dispersive shock wave characterized by the onset of fast oscillations that emanate from a singular point in a dark beam.

15.30 – 16.00 COFFEE BREAK

16.00 - 17.00

Session MC3: LIGHT-MATTER INTERACTIONS
Session Chair: Stefania Residori, *Institut Non Lineaire de Nice, Valbonne-Sophia Antipolis, France*

MC3.1 16.00 - 16.30 (Invited)
High Slope Efficiency, Low Threshold and Wavelength Tunable Liquid Crystal Lasers using Bimesogenic Materials: A Route to Quasi-Continuous Working and Incoherent Optical Pumping?, H. Coles*, University of Cambridge, Cambridge, Cambridgeshire, UK*

In this paper we will describe bimesogenic materials and experimental conditions that lead to high slope efficiency (>40%), low threshold (~nJ), high repetition rate(>100Hz), narrow linewidth, (<0.01nm) electric field wavelength tuneable microscopic Lasers based on Chiral Nematic (and indeed wide temperature range Blue Phase) Liquid Crystals with emmission in 1-D, 2-D and 3-D.

MC3.2 16.30 - 16.45

Light Scattering and Lasing in Dye-Doped Nematic Liquid Crystals, A. Veltri, M. Infusino, S. Ferjani and G. Strangi*, University of Calabria, Rende, Cosenza, Italy*

We present a theoretical analisys based on scattering in nematics and on two-level system for the dye action. A simple description of light diffusion is shown to be inadequate to describe processes at the basis of this lasing; different physical phenomena have to be considered.

MC3.3 16.45 - 17.00

Different Reorientational Regimes in a Liquid Crystalline Medium Undergoing Multiple Irradiation, L. Pezzi, A. Veltri, A. De Luca, and C. P. Umeton*, University of Calabria, Arcavacata di Rende, Cosenza, Italy*

We present a numerical approach to the nemato-elasticity differential equation in a nematic liquid crystal cell when irradiated with multiple gaussian beams. Solutions have been carried out on a configuration with two coplanar beams. A new set of experimental measures are also presented.

18.30 – 20.00 WELCOME RECEPTION

Tuesday, 15 January 2008

10.30 - 12.00

Session TuC1: NEMATICONS
Session Chair: Marc Warenghem, *Université d'Artois, Lens, France*

TuC1.1 10.30 - 11.00 (Invited)

Spatial Solitons and Their Deflection in Liquid Crystals, M. Peccianti*, Centro Studi Ricerche ``Enrico Fermi", Roma, Lazio, Italy* and G. Assanto*, Università degli Studi Roma Tre, Rome, Italy*

We review our achievements in tunable deflection of (2D+1) spatial solitons via electrically and optically induced dielectric perturbations in nematic liquid crystal.

TuC1.2 11.00 - 11.30 (Invited)

Nematicons in Twisted and Chiral Nematics, M. Karpierz*, Warsaw University of Technology, Warsaw, Poland*

We present the properties of spatial solitons in nematic liquid crystals, called as nematicons, in different configurations including twisted and chiral nematics. Their formation requires few tenths of milliwats and they propagate at few millimeters.

TuC1.3 11.30 - 11.45

Nonlinear Bouncing of Nematicons at the Boundaries, M. Peccianti, *Centro Studi Ricerche ``Enrico Fermi", Roma, Lazio, Italy*, A. Alberucci and G. Assanto, *Università degli Studi Roma Tre, Rome, Italy*

The interaction of (2D+1) spatial solitons with the boundaries of nonlinear reorientational media is investigated in the presence of a highly nonlocal response. A power-dependent repulsion due to boundaries is demonstrated in nematic liquid crystals.

TuC1.4 11.45 - 12.00

Non-Linear Control of Soliton Spiraling in Nematic Liquid Crystals, A. Piccardi and G. Assanto, *Università degli Studi Roma Tre, Rome, Italy*

We present an experimental study on a cluster of spiraling spatial solitons in nematic liquid crystals. We demonstrate that it is possible to gain non-linear control over the angular momentum associated with the soliton rotation by simply changing the initial power.

12.00 – 14.00 LUNCH BREAK

14.00 - 15.30

Session TuC2: Modeling Nematicons
Session Chair: Gaetano Assanto, *Università degli Studi Roma Tre, Rome, Italy*

TuC2.1 14.00 - 14.30 (Invited)

Mathematical Modelling of Nematicons and Their Interactions, A. Alberucci, *University of Rome 3, Rome, Italy*, C. G. Reimbert, A. A. Minzoni, *Universidad Nacional Autónoma de México, Mexico*, B. D. Skuse, N. Smyth, *University of Edinburgh, Edinburgh, Scotland, UK*, T. R. Marchant and A. L. Worthy, *University of Wollongong, Wollongong, New South Wales, Australia*

The mathematical modelling of guided wave (nematicon) propagation in liquid crystals is considered. Model equations are derived based on suitable trial functions in an averaged Lagrangian. These equations are used to model nematicon interactions.

TuC2.2 14.30 - 15.00 (Invited)

A Simple Ray Tracing to Model Spatial Soliton Propagation in 2D Heterogeneous Nematic Liquid Crystal, M. Warenghem, J.-F. Blach and J.-F. Henninot, *Université d'Artois, Lens, France*

A naïve 2D ray tracing algorithm is proposed to model soliton propagation in a nematic liquid crystal cell. Based on Snell's laws adapted for heterogeneous uniaxial anisotropic medium, it is compared with experimental results: linear optics to model nonlinear effect.

TuC2.3 15.00 - 15.15

Dipole Soliton Formation in Nematic Liquid Crystals, C. Garcia-Reimbert, A. A. Minzoni, *Universidad Nacional Autónoma de México, Mexico*, N. Smyth, *University of Edinburgh, Edinburgh, Scotland, UK* and A. L. Worthy, *University of Wollongong, Wollongong, New South Wales, Australia*

The interaction of two in phase and out of phase guided waves with angular momentum in a nematic liquid crystal is mathematically modelled. It is shown how bound states, such as dipoles, can form.

TuC2.4 15.15 - 15.30

Two-Colour Nematicon Interactions in Local Crystals, B. D. Skuse and N. Smyth, *University of Edinburgh, Edinburgh, Scotland, UK*

The interaction of two-colour nematicons is considered in local NLCs. Approximate equations governing the evolution of the pulses are derived based on a variational method and excellent agreement is found between approximate and numerical solutions.

15.30 – 16.00 COFFEE BREAK

16.00 - 17.30

Session TuC3: Photorefractive and Magnetic Effects
Session Chair: Harry Coles, *University of Cambridge, Cambridge, Cambridgeshire, UK*

TuC3.1 16.00 - 16.30 (Invited)

Surface Driven Photorefractive Effects in Functionalised Liquid Crystals, M. Kaczmarek, G. D'Alessandro, *University of Southampton, Southampton, UK* and O. Buchnev, *National Academy of Sciences of Ukraine, Kiev, Ukraine*

Liquid crystals, functionalized with ferroelectric, inorganic nanoparticles, show improved photorefractive response. Three-fold increase in dielectric anisotropy and optical anisotropy was measured, as well as significant improvement in two-beam coupling gain.

TuC3.2 16.30 - 17.00 (Invited)

Liquid Crystal Inorganic Hybrid Photorefractives, G. Cook*, US Air Force Research Laboratory, WPAFB, OH, USA*, A. V. Glushchenko*, University of Colorado at Colorado Springs, Colorado Springs, CO, USA*, V. Y. U. Reshetnyak*, National Taras Shevchenko University of Kyiv, Kyiv, Ukraine*, E. R. Beckel*, General Dynamics, Dayton, OH, USA*, M. A. Saleh*, UES Inc., Dayton, OH, USA* and D. R. Evans*, Air Force Research Laboratory, Wright Patterson Air Force Base, OH, USA*

We report on the photorefractive properties of liquid crystals doped with nanoparticles of barium nitanate sandwiched between windows of cerium doped strontium barium niobate (Ce:SBN). This adaptable design has been used generate optical gain coefficients exceeding 1400 cm^{-1} in the Bragg Regime.

TuC3.3 17.00 - 17.15

All-Optical Control of Gain via Surface-Induced Photorefractivity in Twistable Nematic, P. Pagliusi*, University of Calabria, Rende, Italy*

We report the first study of SIPRE in optically twistable nematic cells, where different strategies for all-optical control of the gain coefficient have been explored.

TuC3.4 17.15 - 17.30

Magnetic Field Effects on Freely Suspended Nematics MBBA., R. Balakrishnan*, College of Military Engineering, Pune, India*

The orientational distortion originates close to the edges and the pattern symmetry is determined by their relative phase. The transition layers grow linearly with the field and merge to form a linear wall, on increasing field further, the wall transforms into two disclinations.

Wednesday, 16 January 2008

10.30 - 11.30

Session WC1: **PERIODIC STRUCTURES**
Session Chair: Lorenzo Marrucci, *University of Naples "Federico II", Napoli, Italy*

WC1.1 10.30 - 10.45

2D Gratings of Twisted Nematic Induced by Polarization Holography, G. Cipparrone and P. Pagliusi*, University of Calabria, Rende, Italy*

2D gratings consisting of a bidimensional array of different twisted structures of nematic are obtained by a crossed assembling of polarization holograms recorded at the aligning surfaces. Electro-optical manipulation of LC devices is demonstrated.

WC1.2 10.45 - 11.00

Dynamics of Fréedericksz Transition in Periodic Structures, A. E. Miroshnichenko*, Australian National University, Canberra, ACT, Australia*, E. Brasselet*, Université Bordeaux 1, Bordeaux, France* and Y. S. Kivshar*, Australian National University, Canberra, ACT, Australia*

We study the dynamics of the optical Freedericksz transition of liquid crystals in the presence of periodic structures, and show that the transmission coefficient exhibits sharp dynamical resonances when molecules start to rotate.

WC1.3 11.00 - 11.15

Extended Study on Liquid Crystal Photoanisotropic Polarization Gratings beyond the Small Angle Approximation, M. Xu, H. P. Urbach*, Delft University of Technology, Delft, The Netherlands*, C. M. van Heesch and D. K. G. de Boer*, Philips Research Laboratories, Eindhoven, The Netherlands*

By using photo-alignment films, optical birefringence can be induced in liquid crystals. We studied the position dependent permittivity tensor that is induced by the interference of two plane waves beyond the small angle approximation and the diffraction by the thus obtained grating.

WC1.4 11.15 - 11.30

Nonlinear Route from Guiding to Discrete Diffraction in Photonic Liquid Crystal Fibers, M. Karpierz*, Warsaw University of Technology, Warsaw, Poland*

We have investigated the nonlinear light propagation in photonic crystal fibers filled with nematic liquid crystals. The temperature or/and nonlinear effect can lead to the bandgap shifting and changing the type of light beam propagation.

END OF PROGRAM