

The Abdus Salam International Centre for Theoretical Physics United Nations Educational, Scientific and Cultural Organization

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WINTER COLLEGE ON QUANTUM AND CLASSICAL ASPECTS OF INFORMATION OPTICS

30 January -10 February 2006

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International Atomic Energy Agency

WINTER COLLEGE ON QUANTUM AND CLASSICAL ASPECTS OF INFORMATION OPTICS

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The Abdus Salam International Centre for Theoretical Physics (ICTP), in collaboration with the International Commission for Optics (ICO), the Optical Society of America (OSA), the International Society for Optical Engineering (SPIE), and the International Society on Optics Within Life Sciences (OWLS), will organize a Winter College on Quantum and Classical Aspects of Information Optics, which will be held at the ICTP, Trieste, Italy, from 30 January to 10 February 2006. The participants from Eastern-Central European Countries are supported by CEI (Central European Initiative) Secretariat.

DIRECTORS:

M.L. Calvo (Universidad Complutense de Madrid, Spain)P. Knight (Imperial College London, U.K.)P. Tombesi (University of Camerino, Italy)

LOCAL ORGANIZER:

G. Denardo (ICTP, Italy)

I. <u>PURPOSE AND NATURE</u>

The College will expose the participants to modern issues of both classical and quantum optics in the processing, transmission and storage of information. The programme consists of lectures by international experts and group discussions. The aim is to provide the background needed to follow the most advanced literature.

II. PRELIMINARY PROGRAMME

(all lectures will be held in the Main Lecture Hall, Main Building)

<u>WEEK 1</u>

MONDAY, 30 January

08:30 - 09.30	REGISTRATION - Lobby, Main Building
09:30 - 10:00	Opening
10:00 - 11.00	Plenary Lecture " <i>Classical and Quantum Imaging</i> " P. Knight (Imperial College London, U.K.)
11:00 - 11.30	Coffee Break
11:30 - 12 :30	Optical Coherence: The Classical Insight <i>"Foundations and Background"</i> A. Friberg (Royal Institute of Optics, Stockholm, Sweden)
12:30 - 14.30	Lunch
14:30 - 15.30	Optical Coherence: The Classical Insight <i>"Polarization of EM Fields"</i> A. Friberg (Royal Institute of Optics, Stockholm, Sweden)
15:30 - 16:30	Representation of Signals in a Combined Domain <i>"Linear Signal Dependence"</i> M. Bastiaans (Eindhoven University of Technology, The Netherlands)
16:30 - 16:45	Coffee Break
16:45 - 17:45	Introduction to the ICTP Computer System and Organization of LAMP Seminars

TUESDAY, 31 January

09:00 - 10.00	Representation of Signals in a Combined Domain <i>"Bilinear Signal Dependence"</i> M. Bastiaans (Eindhoven University of Technology, The Netherlands)
10:00 - 11:00	Optical Coherence: The Classical Insight " <i>Electromagnetic Coherence"</i> A. Friberg (Royal Institute of Optics, Stockholm, Sweden)
11:00 - 11.30	Coffee Break
11:30 - 12.30	Representation of Signals in a Combined Domain <i>"Relatives of the Wigner Distribution"</i> M. Bastiaans (Eindhoven University of Technology, The Netherlands)
12:30 - 14.30	Lunch
14:30 - 15.30	Optical Integral Transforms for Information Processing <i>"From Geometric Optics to Wave Optics"</i> T. Alieva (Complutense University of Madrid, Spain)
15:30 - 16.30	Optical Integral Transforms for Information Processing <i>"Optical Integral Transforms: Basic Properties and Optical Schemes"</i> T. Alieva (Complutense University of Madrid, Spain)

WEDNESDAY, 1 February

09:00 - 10:00	 Angular Momentum Properties of Light Beams "The Origin of Light's Angular Momentum" M. Padgett (University of Glasgow, Scotland, U.K.)
10:00 - 11.00	Optical Integral Transforms for Information Processing "Applications for Information Processing" T. Alieva (Complutense University of Madrid, Spain)

11:00 - 11.30	Coffee Break
11:30 - 12.30	Angular Momentum Properties of Light Beams "Spin and Orbital Angular Momentum, their Similarities and Differences" M. Padgett (University of Glasgow, Scotland, U.K.)
12:30 - 14.30	Lunch
14:30 - 15.30	Angular Momentum Properties of Light Beams "Optical Vortices, the Generic State of Light" M. Padgett (University of Glasgow, Scotland, U.K.)
15:30 - 16.30	ICO-ICSU Celebration
16:30 - 17.00	Coffee Break
17:00 - 18:00	ICO/ICTP Prize Award and Seminar
18:30 -	ICO Reception

THURSDAY, 2 February

09:00 - 10.00	Characterization of Classical Optical Beams & Related
	Experiments
	"Ince-Gaussian Modes of the Paraxial Wave Equation and Laser
	Resonators"
	J.C. Gutierrez-Vega (Tecnológico de Monterrey, Mexico)
10:00 - 11.00	Characterization of Classical Optical Beams & Related
	Experiments
	"Propagation Properties of Nondiffracting Beams"
	J.C. Gutierrez-Vega (Tecnológico de Monterrey, Mexico)
11:00 - 11.30	Coffee Break

Characterization of Classical Optical Beams & Related
Experiments
"Scalar and Vector Helmholtz-Gauss Beams"
J.C. Gutierrez-Vega (Tecnológico de Monterrey, Mexico)

- 12:30 14.30 Lunch
- 14:30 16.30 LAMP Seminars

FRIDAY, 3 February

09:00 - 10.00	Fundamentals of Holographic Data Storage: Diffraction of Light by Volume Holographic Gratings <i>"The Physical Principles"</i>
	M.L. Calvo (Complutense University of Madrid, Spain)
10:00 - 11.00	 Fundamentals of Holographic Data Storage: Diffraction of Light by Volume Holographic Gratings "Optical Media and Holographic Techniques" M.L. Calvo (Complutense University of Madrid, Spain)
11:00 - 11.30	Coffee Break
11:30 - 12.30	 Photonics for Information Technologies: Materials, Devices, and Applications <i>"Fundamentals and Background"</i> P. Cheben (National Research Council of Canada)
12:30 - 14.30	Lunch
14:30 - 15.30	 Photonics for Information Technologies: Materials, Devices, and Applications "Modern Photonics. Telecom and Beyond" P. Cheben (National Research Council of Canada)
15:30 - 16.30	 Photonics for Information Technologies: Materials, Devices, and Applications <i>"Advanced Devices and Future Trends"</i> P. Cheben (National Research Council of Canada)

<u>WEEK 2</u>

MONDAY, 6 February

09:00 - 10.00	<i>"Introduction to Quantum Optics, Coherent and Squeezed States"</i> P. Tombesi (University of Camerino, Italy)
10:00 - 11.00	"Density Operator and Master Equation"
	P. Tombesi (University of Camerino, Italy)
11:00 - 11.30	Coffee Break
11:30 - 12.30	" <i>Optimal Quantum-State Estimations"</i> V. Buzek (Slovak Academy of Sciences, Bratislava, Slovakia)
12:30 - 14.30	Lunch
14:30 - 15.30	"Optimal Manipulations with Quantum Information" V. Buzek (Slovak Academy of Sciences, Bratislava, Slovakia)
15:30 - 16.30	"Quantum Repeaters" I. Cirac (Max-Planck-Institut für Quanten Optik, Garching, Germany)

TUESDAY, 7 February

09:00 - 10.00	"Quantum Computing" I. Cirac (Max-Planck-Institut für Quanten Optik, Garching, Germany)
10:00 - 11.00	"Realization of a Decoherence-Free Mesoscopic Quantum Superposition" F. De Martini (Universita' La Sapienza, Rome, Italy)
11:00 - 11.30	Coffee Break
11:30 - 12.30	"Introduction to Photonic Quantum Information" J. Rarity (Bristol University, U.K.)

12:30 - 14.30	Lunch
14:30 - 15.30	"Quantum Cryptography, Free Space Experiments" J. Rarity (Bristol University, U.K.)
15:30 - 16.30	Dynamics of Open Systems from a Perspective of Quantum Information" V. Buzek (Slovak Academy of Sciences, Bratislava, Slovakia)

WEDNESDAY, 8 February

09.00 - 10.00	"Introduction to Multi-Photon Quantum Logic" J. Rarity (Bristol University, U.K.)
10.00 - 11.00	" <i>Optical Communication and Its Quantum Limits"</i> P. Kumar (Northwestern University, Evanston, Illinois, U.S.A.)
11.00 - 11.30	Coffee Break
11.30 - 12.30	" <i>Communication Channels"</i> P. Kumar (Northwestern University, Evanston, Illinois, U.S.A.)
12.30 - 14.30	Lunch
14.30 - 16.30	LAMP Seminars

THURSDAY, 9 February

09.00 - 10.00	"Bits and Qubits: an Introduction to Quantum Information 1" P. Knight (Imperial College London, U.K.)
10.00 - 11.00	<i>"Fiber-Optic Quantum Communication and Applications"</i> P. Kumar (Northwestern University, Evanston, Illinois, U.S.A.)
11.00 - 11.30	Coffee Break

11.30 - 12.30	"Bits and Qubits: an Introduction to Quantum Information 2" P. Knight (Imperial College London, U.K.)
12.30 - 14.30	Lunch
14.30 - 16.30	LAMP Seminars

FRIDAY, 10 February

09.00 - 10.00	"The Wigner Representation"	
	P. Tombesi (University of Camerino, Italy)	
10.00 - 11.00	"Recent Results on Digital Processing of Information and Digital Holography" L. Yaroslavsky (University of Tel-Aviv, Israel)	
11.00 - 11.30	Coffee Break	
11.30 - 12.30	Lecture and Concluding Remarks "Quantum Optical Realizations of Qubits" P. Knight (Imperial College London, U.K.)	
12.30 - 14.30	Lunch	
14.30 - 16.30	LAMP Seminars	

The LAMP (Laser, Atomic and Molecular Physics) programme will include group discussions and internal seminars by participants.. Those who intend to deliver a seminar are expected to come to the ICTP prepared with all the material needed for their talk.

The ICO - ICTP Prize will be awarded during the ICTP Winter College.

III. ICO/ICTP Award Ceremony 2006

ICO, the International Commission for Optics, has established three awards: the 'ICO Prize', the ICO Galileo Galilei Award and the ICO/ICTP Award. The latter was established jointly with ICTP and the International Commission for Theoretical Physics.

The ICO/ICTP Award is reserved for young researchers from developing countries (as defined by the United Nations), who are active in research in Optics and have contributed to the promotion of research activities in Optics in their own or another developing country.

For further details on the ICO view the Web page http://www.ico-optics.org.

The Award consists of the following:

- 1) the ICO gives a cash amount of US\$ 1000 and a certificate;
- 2) the ICTP invites the winner to attend a College at the ICTP, Trieste, when the next appropriate opportunity arises, and to give a seminar on his/her work. ICTP will pay for travel and living expenses.

The award will be delivered to the winner in Trieste in the presence of representatives of ICO and ICTP. This award is given every year. The winner is selected on the basis of nominations received by the Award Committee in response to a 'Call for Nominations' published by both the ICO and the ICTP.

The winners of previous awards are:

- 2000: Arbab Ali Khan (Pakistan)
- 2001: Arashmid Nahal (Iran) and Fernando Perez Quitian (Argentina)
- 2002: Aiphan Sennaroglu (Turkey)
- 2003: Robert Szipocs (Hungary)
- 2004: Imrana Ashraf Zahid (Pakistan) and Revati Nitin Kulkarni (India)
- 2005: Sarun Sumriddetchkajorn (Thailand)

IV. SCHOOL on MATHEMATICAL METHODS for OPTICS

A Preparatory School on Mathematical Methods for Optics will be held the week before the Winter College on Quantum and Classical Aspects of Information Optics 2006. A limited number of participants of the Winter College is invited to attend the school.

This school will cover several mathematical tools used in classical and quantum optics. Its aim is to provide participants with useful mathematical techniques, complementary to those presented at the *Winter College in Optics*. Applications in both classical and quantum optics will be stressed. Each topic will be presented in a 3 hour morning lecture (subdivided into two sessions), supplemented with an afternoon workshop session.

ORGANIZERS:	V. Lakshminarayanan	(University of Missouri, U.S.)
	M.A. Alonso	(University of Rochester, U.S.)
	T.D. Visser	(Free University, Netherlands)

Below is a list of the presentations:

1) *Introduction to matrix and operator techniques*. Instructor: Prof. Vasudevan Lakshminarayanan (U. of Missouri, U.S.).

2) <u>An Introduction to singular optics</u>. Instructor: Prof. Taco D. Visser (Free U., The Netherlands).

3) <u>Uncertainty relations in optics</u>. Instructor: Prof. Riccardo Borghi (U. Roma Tre, Italy).

4) <u>Phase space methods in optics.</u> Instructor: Amalia Torre (Frascati ENEA Center, Italy)

5) *Asymptotic techniques and their applications in optics.* Instructor: Miguel A. Alonso (U. of Rochester, U.S.).

A contribution from SIOF (Italian Society for Optics and Photonics) and SPIE is acknowledged.

Last update: 24 January 2006