ICTP – Eurasian Centre
for Advanced Research

INAUGURATION CONFERENCE

May 5 - 7, 2014 | Izmir Institute of Technology
Library Conference Hall
Izmir, TURKEY

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The Abdus Salam **– International Centre for Theoretical Physics**
www.ictp.it

ICTP is a driving force behind global efforts to advance scientific expertise in the developing world. It has a two-fold mission: to train scientists from developing countries and pursue cutting-edge research.

Founded in 1964 by Nobel Laureate Abdus Salam, ICTP is governed by UNESCO, IAEA, and Italy, and it is a UNESCO Category 1 Institute.

ICTP is the main partner of the ICTP-ECAR initiative, setting the model and quality standards of its activities.

İzmir Institute of Technology
www.iyte.edu.tr

IZTECH is a state university established in 1992 with a mission of carrying out advanced research and higher education in fields of science and technology.

IZTECH is the host institution of ICTP-ECAR, providing the required infrastructure and facilitating its operations.

"*Scientific thought is the common heritage of mankind*"

Abdus SALAM
Founding Director, ICTP
8 December 1979, Nobel Lecture

"*Hayatta en hakiki mürşit ilimdir*" (*The real guide in life is science*)

Mustafa Kemal ATATÜRK
Founder, Republic of Turkey

Welcome Messages

Dear Guests,

On behalf of İzmir Institute of Technology, it is my great pleasure to welcome you to the Inauguration Conference of ICTP-Eurasian Centre for Advanced Research.

The Conference gathers the local and national scientific communities as well as representatives of administrative and political decision-making institutions. Reflecting the promising regional and international potential of ICTP-ECAR, we have participation of esteemed guests from Iran, Greece, Azerbaijan, Romania, Egypt, Morocco, Palestine, Italy, Germany, France, United States, Switzerland, Austria, and United Kingdom.

ICTP-ECAR is a big step forward in fostering the advancement of science and technology in this part of the world. It will provide an efficient platform for interaction and collaboration of world experts with young, creative minds of the region through various research and visiting programs. We are proud of supporting the creation of this regional Centre of Excellence, and we feel the excitement of hosting it in İzmir.

The scientific content of the Conference is also exciting. There will be twelve stimulating talks to be given by a group of top scientists from all over the world. We are proud and privileged to have their invaluable contributions in fulfilling the ambitious mission of ICTP-ECAR.

I wish you all a very successful conference and would like to express my sincere belief in the role that ICTP-ECAR will play in developing the scientific expertise, prosperity, collaboration and peace in the region.

Sincerely,
Prof. Mustafa Güden
Rector, İzmir Institute of Technology

Dear Colleagues and Participants of the Conference,

The ICTP-Eurasian Centre for Advanced Research which we are inaugurating today is the first initiative of its kind in this region and is the third partner institution of ICTP in the world. Two similar institutions are active in Brazil and Mexico.

Our hope is that it will play an important role in this region similar to the role ICTP has been playing worldwide for almost 50 years.

I would like to welcome you all to this important event.

Sincerely,
Prof. Fernando Quevedo
Director, ICTP

PROGRAM

May 5, 2014 Monday

15:00 Opening Ceremony
18:00 Cocktail

May 6, 2014 Tuesday Morning Session (09:30 – 12:40)

09:30 **Mehmet Sarıkaya, *University of Washington***
Molecular Biomimetics: Joining Biology and Engineered Materials at the Molecular Scale for Technology and Medicine

10:10 **Ramin Golestanian, University of Oxford**
Making Living Matter From The Bottom Up

10:50 **Coffee Break**

11:20 **Allan MacDonald, University of Texas at Austin**
New Physics in Two-Dimensional Materials

12:00 **N. Serdar Sarıçiftçi, *Johannes Kepler University* of Linz**
Solar Energy and Democratization of Energy Supply

May 6, 2014 Tuesday Afternoon Session (14:30 – 17:40)

14:30 **Manfred Sigrist, ETH Zurich**
From Superfluid He-3 to Topological Superconductors

15:10 **Rahmi Güven, Bogazici University**
99 Years of General Relativity

15:50 **Coffee Break**

16:20 **Baha Balantekin, *University of Wisconsin-Madison***
What do Neutrinos Tell Us About the Universe?

17:00 **Ignatios Antoniadis, CERN**
Particle Physics at CERN

May 7, 2014 Wednesday Morning Session (09:30 – 12:40)

09:30 **Vahid Karimipour, *Sharif University of Technology***
Quantum Information, Advancement in Technology and Our Understanding of Quantum Phenomena

10:10 **Gabriel Aeppli, *London Centre for Nanotechnology***
Why Quantum Many-Body Physics Matters For The Future of Computing

10:50 **Coffee Break**

11:20 **Efthimios Kaxiras, Harvard University**
Multiscale Simulations of Materials: Exploring New Physics and Applications

12:00 **Klaus von Klitzing, MPI-Stuttgart**
From Quantum Hall Effect to a New System of Units

Invited Speakers

Prof. Mehmet Sarikaya

(University of Washington)

Molecular Biomimetics: Joining Biology and Engineered Materials at the Molecular Scale for Technology and Medicine

Protein-solid interactions and assembly of proteins on surfaces is utilized in many fields to integrate intricate biological structures and diverse functions with engineered solid materials. Examples include bioelectronics, biosensors, and bioimplants. In biology, proteins are the major biopolymers that enable dynamic organic systems but they also catalyze mineralization, growth, and intricate hard tissue formation with complex multifunctional properties. These are all desirable merits in engineered systems but currently impossible to achieve. Controlling proteins at bio-solid interfaces relies on establishing key correlations between primary sequences and resulting interactions that follow spatial organizations on substrates. Using combinatorial mutagenesis, similarity analysis in bioinformatics and rational design principles, we can engineered short peptides (7-25 amino acids long) by controlling their folding patterns and, hence, tailoring the molecular interactions that leads to a variety of addressable self-assembled peptides (SAP) nanostructures. The peptides are engineered *via* simple point and domain mutations to control fundamental interfacial processes, including initial binding and molecular recognition, surface aggregation and growth kinetics, and intermolecular interactions. Tailoring short peptides and their molecular interactions offers versatile control over molecular self-assembly, resulting in well-defined surface properties essential in building engineered, chemically and electronically rich, bio-solid interfaces. Peptides themselves and SAPs on solids, e.g., on single layer atomic materials, form nanowires, nanoislands and confluent films, and have interesting transport properties. As demonstrated, peptides alone, or in chimeric forms as bifunctional constructs can be used to bridge nanosolids (nanoparticles, quantum dots and single layer atomic materials) to form molecularly hybrid systems for a variety of biophotonics and bioelectronics implementations. This short presentation will give an overview of the molecular biomimetics approaches to peptide design and assembly on solids, recent advances in device implementations, and provide future prospects in controlling bio/solid interfaces towards nanomedicine.

Biography: Mehmet Sarikaya is currently a professor in the departments of MSE, ChemE and Oral Health, at the University of Washington, Seattle, WA, USA. He was the Director of DURINT, a Defense-University Research Initiative on Nanotechnology (2001-2007), supported by US-ARO, Army Research Office, and established GEMSEC, Genetically Engineered Materials Science and Engineering Center, via NSF-MRSEC, (2005-2013). He received his PhD (design of medium C-Steels) at the University of California, Berkeley, CA, in 1982 and, was a post-doc (advanced ceramics and analytical EM techniques) at LBNL and Instructor, in MSE Department at UCB. He joined the UW in 1984 and received Professorship in 2002. He was a visiting professor at Princeton (1993), Nagoya (1997 & 2005), ITU (2001-10), Bilkent University (2012) and TiTech, Japan (2013).

As a materials scientist, he focused on processing-structure-function relationships in a variety of materials including high temperature semiconductors and superconductors in addition to metallic alloys and structural ceramics. Recognizing early on (mid 80s) the power of biology, his group adapted genetic engineering and molecular biology principles to materials engineering and technology, and developed the concepts of interfacing materials and biology using short peptides, initiating fledging new polydisciplinary field, Molecular Biomimetics. His and associated labs demonstrated peptides as linkers, erectors, and self-assemblers as well as tiny enzymes for the synthesis of nanomaterials, major efficacy in practical nanotechnology and medicine, from biosensors, to nanoscale effects and dental therapies. Sarikaya, a co-editor in 7 books and proceedings, is also in the editorial boards of many journals, national and international R&D review committees (e.g., NAS & NAE). He has contributed to the interdisciplinary literature with 250+ archival papers, 300+ Invited, Plenary, and Keynote presentations, and 8 Patents.

Prof. Ramin Golestanian

(University of Oxford)

Making Living Matter from the Bottom Up

There are many ways to study life, and one that is particularly appealing to us is regarding it as self-organized active soft matter that is away from equilibrium “just the right way”. In this talk, we will explore the possibility of how we can begin to put together simple systems - from basic ingredients that we fully understand - that would exhibit the kind of active behaviour we observe in living systems. We will examine how we can make individual components with non-equilibrium (mechanical, chemical, and thermal) activity, and then study their collective properties when they interact with each other. The comprehensive bottom-up approach will allow us to explore possible strategies to engineer large-scale emergent properties of the system by tuning microscopic control parameters.

Biography: Ramin Golestanian is Professor of Theoretical Condensed Matter Physics at the Rudolf Peierls Centre for Theoretical Physics, University of Oxford. He obtained his B.Sc. from Sharif University of Technology, and his M.Sc. and Ph.D. from the Institute for Advanced Studies in Basic Sciences (IASBS), both in Iran. He has been a Visiting Scholar at MIT, Postdoctoral Fellow at the Kavli Institute for Theoretical Physics at UCSB, Joliot Chair and CNRS Visiting Professor at ESPCI, and Visiting Professor at College de France. Before joining Oxford, he held academic positions at IASBS and the University of Sheffield.

AWARDS AND HONOURS:

2014 Nakamura Award and Lecture, University of California at Santa Barbara
2011 Fellow of the Institute of Physics (FInstP)
2001 Distinguished Research Scientist Award, Ministry of Science, Research, and Technology, Tehran, Iran
2000 Kharazmi Award for Young Investigators (1st rank), Tehran, Iran
1992 1st Prize of The National University Olympiad in Science, Iranian Academy of Sciences, Tehran, Iran
1989 Third Prize (Bronze Medal) of The 20th International Physics Olympiad, Warsaw, Poland

Prof. Allan MacDonald

(University of Texas at Austin)

New Physics in Two-Dimensional Materials

In condensed matter physics the most successful strategy for discovering new physics is to create new materials. After mentioning a few examples from the recent history of physics, I will turn my attention to a new class of materials which is now being explored in laboratories around the world - two-dimensional materials. By this phrase I refer materials that are a single atomic or molecular layer in thickness and either suspended or coupled to their environment by weak Van der Waals interactions. Two-dimensional materials can be metals, semiconductors, or gapless semiconductors. I will briefly describe a few examples of new physics that has already been discovered in two-dimensional materials and conclude with some theoretical speculations on possibilities for the future, including the possibility of a new type of two-dimensional superfluid with applications in electronics.

Biography: Allan H. MacDonald received his B.Sc. degree from St. Francis Xavier University, Antigonish, Nova Scotia, Canada in 1973 and the M.Sc. and Ph.D. degrees in physics from the University of Toronto in 1974 and 1978 respectively. He was a member of the research staff of the National Research Council of Canada from 1978 to 1987 and has taught at Indiana University (1987-2000) and the University of Texas at Austin (2000-present), where he now holds the Sid W. Richardson Chair in Physics. He has contributed to research on electronic structure theory, the quantum Hall effect, magnetism, and superconductivity, among a variety of other topics. Dr. MacDonald is a member of the American Academy of Arts and Sciences and the US National Academy of Sciences and has been awarded the Herzberg Medal (1987), the Buckley Prize (2007), and the Ernst Mach Honorary Medal (2012).

Prof. N. Serdar Sariciftci

(Johannes Kepler University of Linz)

Solar Energy and Democratization of Energy Supply

Looking to the potential of solar energy (up to 100.000 Terawatts) it is easy to predict, that a sustainable energy supply in future has to be vastly dominated by solar energy conversion into heat, into electricity (photovoltaics) as well as into chemical fuels. This solar energy revolution has already started and being shaped by the driving force of energy autonomy and energy security using a delocalized and decentralized system. The worldwide fossile energy production and distribution are in the hands of a few companies and even fewer number of countries. This oligarchy is not peacefully sustainable and will be prune to political power struggle and wars. Therefore, the solar energy revolution has a special role to play in the future of energy supply especially in the developing countries.

In this talk we will present different approaches to solar energy conversion into heat, electricity and into artificial fuels. Special emphasis will be given to the recent developments in organic solar cells as well as in "solar fuel" technologies. Using bio-organic semiconductors several devices have been demonstrated which can play an important role in the sustainable device technologies of bio-organic optoelectronics.

Biography: Prof. Sariciftci is Ordinarius Professor for Physical Chemistry and the Founding Director of the Linz Institute for Organic Solarcells (LIOS) at the Johannes Kepler University of Linz/Austria (www.lios.at).
He studied at the University of Vienna (Austria) and graduated as PhD in physics in 1989. After two years postdoctoral study at the University of Stuttgart (Germany) he joined the Institute for Polymers and Organic Solids at the University of California, Santa Barbara, USA, by Prof. Alan J. HEEGER, Nobel leaurate 2000 for Chemistry. His major contributions are in the fields of photoinduced optical, magnetic resonance and transport phenomena in semiconducting and metallic polymers. He is the inventor of conjugated polymer and fullerene based solar cells. Prof. Sariciftci published over 500 publications and with over 40000 citations he is one of the most cited scientists in material science (2011, Thompson Reuter ranking No: 14 of the world best material scientists with an h-index of 89 (Google Scholar)). Sariciftci has composed 8 books and educated several academic and industrial scientists. He also initiated seven spin off companies for organic optoelectronics and solar fuels. He is the organizer of the "Solar Energy for World Peace" conferences (www.solar4peace.org)
AWARDS AND HONOURS (among others):
National Science Prize of Turkey 2006 (TUBITAK BILIM ÖDÜLÜ 2006)
Austrian Scientists of the year Prize for Research 2008
Medal for Humanity of the City of Linz 2009
Kardinal Innitzer Prize for Science of the Archbishop in Vienna 2010
Wittgenstein Prize of Austria 2012
Fellow of the Royal Society of Chemistry (FRSC)
Fellow of SPIE
Member of American Chemical Society, Materials Research Society, Austrian Chemical Society and Austrian Physical Society
Member of the Austrian Academy of Sciences (ÖAW)
Honorary doctorate by the Abo Academy in Finland in 2011 and
Honorary doctorate by the University of Bucharest in Romania in 2012

Prof. Manfred Sigrist

(ETH Zurich)

From Superfluid ^{3}He to Topological Superconductors

Unconventional superconductors and superfluids display most intriguing properties due to symmetries and topological structure of their order parameters, already revealed in superfluid ^{3}He known since the early 1970s. These features are a consequence of the internal structure of the Cooper pair state involving two identical Fermions. In this talk I will give an overview on the underlying concepts of unconventional superconductivity and discuss a few examples of superconductors to draw their relation to superfluid ^{3}He. One example is the chiral p-wave superconductor Sr2RuO4, others are found in the class of non-centrosymmetric or staggered non-centrosymmetric superconductors. For the latter we consider two concrete materials the heavy Fermion superconductor CePt3Si and the pnictide-superconductor SrPtAs. In all cases the superconducting phases display topological properties, which has various physical consequences. Best known are the gapless edge states, being in some cases chiral and in others helical. In the context of topological phases of matter, including Quantum Hall states and topological insulators, topology has emerged recently as a very important concept in recent years.

Biography: Manfred Sigrist obtained his diploma in physics in I986 and his Ph. D. in 1989, both at ETH Zurich. He was a postdoc at the University of Tsukuba, Japan (1989-91), at the Paul Scherrer Institute, Switzerland (1991-93) and at the Massachusetts Institute of Technology, U.S.A. (1993-95). In 1995 he became a Swiss Nationalfonds Research Fellow at ETH Zurich. Between 1997 and 2001 he was a professor at the Yukawa Institute for Theoretical Physics of Kyoto University. Then he moved to ETH Zurich where he is a professor at the Institute for Theoretical Physics since 200I. He is a Fellow of the Institute of Physics (IOP) and of the American Physical Society. His research activities are mainly devoted to strongly correlated electron systems, in particular, unconventional superconductivity, magnetism, quantum phase transitions, topological and transport properties.

Prof. Rahmi Güven
(Bogazici University)

99 Years of General Relativity

Upon its inception in 1915 general theory of relativity was regarded for a long period of time as a research field which is conceptually significant but of little practical value. The purpose of the present talk is to describe how general relativity has evolved from this status into a precision science that is also experimentally and practically significant. Special emphasis will be given to the recent developments in big bang cosmology, gravitational waves and black holes.

Biography: Rahmi Güven is a Professor of Geometry (emeritus) at the Mathematics Department of Boğaziçi University. Previously he has served as the chair of this department and the chair of the Academic Council of Boğaziçi University Foundation. He worked at the Institute for Theoretical Physics, University of Vienna as the Einstein Memorial Foundation Fellow for two years and was a Senior Associate of ICTP for seven years. His research interests are in theoretical physics, in the field of classical and quantum gravity. He made contributions to exact solutions of general relativity, theory of black holes, plane waves and M5-branes. In 1997 he was elected as a full member of the Academy of Sciences of Turkey and resigned in 2011. He is a founding member of the Science Academy, İstanbul. He is the recipient of 1987 Sedat Simavi Foundation Science Prize and 1999 Science Award of the Scientific and Technological Research Council of Turkey.

Prof. A. Baha Balantekin
(University of Wisconsin, Madison)

What do Neutrinos Tell Us About the Universe?

More than half a century after their existence was first postulated, we finally seem to be getting closer to understanding the elusive physics of neutrinos. Their seemingly very small masses and feeble interactions with ordinary matter make neutrinos rather special. For a long time very little experimental information was available about neutrino properties, even though even a small neutrino mass has intriguing cosmological and astrophysical implications. This situation has changed in the recent years. In this talk, following a brief history of the neutrino physics, recent experimental and theoretical developments in solar, atmospheric, and reactor neutrino physics will be reviewed. Implications of those experiments for astronomy and astrophysics will be discussed. The role of neutrinos in the dynamics of core-collapse supernovae and the origin of chemical elements will be elucidated.

Biography: A. Baha Balantekin is the Eugene P. Wigner Professor of Physics at the University of Wisconsin, Madison and an affiliate professor at the University of Washington, Seattle. His research is focused on the science at the interface of particle, nuclear physics and astrophysics/cosmology. Before joining the faculty at the University of Wisconsin he was the Eugene P. Wigner Fellow at the Oak Ridge National Laboratory and a research staff member at the Massachusetts Institute of Technology. Balantekin's undergraduate work was at the Middle East Technical University (B.S., M.S.) and the graduate work at the Yale University (M.Phil, Ph.D.). He has been a visiting professor at the National Astronomical Observatory of Japan (国立天文台), Tohoku University (Sendai, Japan), and the Max-Planck-Institut für Kernphysik (Heidelberg, Germany). Balantekin has served on the Executive Board and numerous committees of the American Physical Society and as the Editor-in-Chief of the Journal of Physics G: Nuclear and Particle Physics. In addition to the Scientific Council of the ICTP-ECAR, Balantekin currently is a member of the U.S. Facility for Rare Isotope Beams Theory Center Steering Committee; Shanghai Jiao Tong University Center for Nuclear Astrophysics International Advisory Committee; and the Chair of the European Center for Theoretical Nuclear Physics and Related Areas Scientific Board. He was also the Chair of the U.S. National Institute for Nuclear Theory Advisory Committee and the TRIUMF National Laboratory of Canada Advisory Committee.

AWARDS AND HONOURS:
Membership in the Turkish Science Academy (2013)
American Physical Society Division of Nuclear Physics Distinguished Service Award (2010)
Fellow of the Institute of Physics (UK) (2004)
Turkish Scientific Research Council (TÜBİTAK) Science Prize (2001)
Wisconsin Alumni Research Foundation Mid-Career Award 1996)
Alexander von Humboldt Foundation Senior Scientist Award (1997)
Fellow of the American Physical Society (1994)
Fellow of the Japan Society for the Promotion of Science (1994)
U.S. National Science Foundation Presidential Young Investigator Award (1987)
Martin Marietta Corporation Jefferson Cup Award (1986)
Martin Marietta Energy Systems Author of the Year (1986)

Prof. Ignatios Antoniadis

(CERN, Geneva and Ecole Polytechnique, Paris)

Particle Physics at CERN

Particle physics studies the elementary constituents of matter and their fundamental forces. Very short distances are explored by particle collisions at very high energies, creating conditions similar to those governing the Universe just after the Big Bang. Laws of Nature become then easier and can be described in terms of simple mathematical theories. The current theory, called Standard Model, provides an accurate description of all known physical phenomena in the micro-cosmos but had until recently a missing component needed to explain the origin of mass of elementary particles. This was the main reason of constructing the Large Hadron Collider (LHC) at CERN, the most powerful machine of colliding protons around Geneva of Switzerland, which has recently made this important discovery, entering into new unexplored territories of physics beyond our current understanding of Universe.

Biography: Ignatios Antoniadis is the Head of the Theory Division at CERN (since 2011) and Academic co-director of the joint Master Program between Ecole Polytechnique of Paris and ETH-Zurich (since 2009).
RESEARCH INTERESTS: Quantum Field Theory, Particle Physics Phenomenology, Quantum Gravity, Cosmology, String Theory. About 250 scientific publications with 20,000 citations.
EDUCATION:
Diploma Degree in Mathematics, Univ. of Athens (1977), Master of Theoretical Physics (Paris, 1978), PhD thesis in Ecole Normale Supérieure (Paris, 1980), Habilitation thesis (doctorat d'Etat, Ecole Polytechnique 1983).
ACADEMIC POSITIONS:
Senior Staff Member at CERN (since 2000). Professor `chargé des cours', Ecole Polytechnique, France (part time since 1997). Scientific Associate at CERN, Geneva (1996-97). Directeur de Recherches in CNRS, Ecole Polytechnique, France (since 1992). Fellow at CERN, Geneva (1986-88). Chargé de Recherches in CNRS, France (1983-92). Research Associate at SLAC, Stanford University (1983-86). Attaché de Recherches in CNRS, France (1982-86).
ADMINISTRATIVE POSITIONS:
Council of National Technical University of Athens (since 2013). Managing Editor of EPJC and Editor of IJMPA and MPLA. Coordinator of European Networks (since 1992). Physics Panels in European Commission (since 1999). Particle Physics Group leader, Ecole Polytechnique, France (1999-00). CNRS Commission for Theoretical Physics, France (2000-01). Invited Editor of the `Comptes Rendus' of the French Academy of Sciences (since 2000). Evaluation panels (University Paris 6, German DFG, Uppsala University, Greece – since 2001). Greece-CERN cooperation national committee (2005-11). Senior jury of Institut Universitaire de France (2007-09).
AWARDS AND ACADEMIC PRIZES:
ERC Advanced Grant Award, European Commission (2008)
Special Prize of the French Physical Society (2002)
Silver medal of CNRS, France (2000)
`Honoris Causa' of Ioannina University, Greece (1995)
Scientific Prize of Bodossaki Foundation on Particle Physics, Greece (1995)

Prof. Vahid Karimipour
(Sharif University of Technology)

Quantum Information, Advancement in Technology and Our Understanding of Quantum Phenomena

I start from the simplest possible classical computer which can be imagined and explain the basic ideas of computation. I then explain the most powerful classical computer, e.g. a Turing machine. I then explain the basic idea of a quantum computer and show why quantum computers can surpass the classical ones by astronomically large factors in speed. I also review the basic concepts involved in quantum information and discuss how a new age of information processing can begin which is deeply rooted in quantum mechanics. Finally I briefly discuss how studies of quantum information can result in a deeper understanding of quantum phenomena, not only at a basic conceptual level of quantum mechanics itself, but also in other fields of physics like condensed matter physics.

Biography:

Formal education:

BS in Electrical Engineering, Shiraz University, Iran (1965)

MS in Physics, Sharif University of Technology, Iran (1967)

PhD in Physics, Sharif University of Technolog, Iran (1993). This was the first time that PhD program in physics and in fact in physical sciences was offered in Iran.

Since then I have been in Sharif and from 2001 I have been professor of physics.

Things which can be mentioned:

I have initiated research and education in the field of quantum information in Iran. From 2007 I have organized and co-chaired an international conference in quantum information (http://iicqi.sharif.ir) which has been supported in part by ICTP of which I have been a frequent visitor from my student years. Through this conference series, which is now well known in the quantum information community worldwide, and extensive training of graduate students, the field of quantum information has been established in Iran as an active field of research in many universities.

In 2013 I was also designated as an outstanding referee of the American Physical Society.

Prof. Gabriel Aeppli
(London Centre for Nanotechnology)

Why Quantum Many-Body Physics Matters For The Future of Computing

The ordinary approach to quantum computing starts with the preparation, manipulation and readout of isolated qubits. Gating via controlled interactions follows later for a very small number of qubits, and in important and obvious ways is at odds - especially in solid state implementations - with obtaining the best single qubit properties, most notably decoherence times. Quantum many-body systems exist in a different regime, where both the numbers of qubits and the couplings between them are very large. We describe what we can learn from such systems which at some future date must be possible to simulate by programmable quantum machines. Examples of relevant phenomena include the emergence of macroscopic quantum phase coherence (1) and novel quantum bits in dense interacting systems, the testing of adiabatic quantum computing concepts using real implementations of the transverse field Ising model(2), and physical measurements of multiparticle entanglement (3).

1. Xu et al., Science 2007 317:1049-1052.doi:10.1126/science.1143831
2. Schmidt et al., Proc Natl Acad Sci USA 2014 Mar 11;111(10):3689-94. doi: 10.1073/pnas.1316070111
3. Christensen et al., Proc Natl Acad Sci USA 2007 104:15264–15269. doi: 10.1073/pnas.0703293104

Biography: Gabriel Aeppli is Professor of Physics at ETHZ and EPFL, Director of the SYN Division at the Paul Scherrer Institute , as well as Quain Professor of Physics at University College London. Prior to taking his current posts in Switzerland, he was co-founder and Director of the London Centre for Nanotechnology, Senior Research Scientist of NEC, Distinguished Member of Technical Staff at Bell Laboratories, Research Assistant at MIT, and industrial co-op student at IBM. He obtained a B.Sc. in Mathematics and PhD, M.Sc. & B.Sc. in Electrical Engineering from MIT. In addition, he has been a member and chairman of many panels, sponsored by the US Department of Energy, the Helmholtz Society, European Union, the governments of Australia, Taiwan, and Hong Kong, the UK Research Councils, and the National Research Council (US), among others. He is also cofounder and non-executive director of the spin-out company Bio-Nano Consulting. His personal research is focused on the implications of photonics and nanotechnology for information processing and health care.

SHORT LIST OF AWARDS AND HONOURS:
Membership of the American Academy of Arts and Sciences (2012)
Fellowship of the Royal Society (FRS) (2010)
IOP (Institute of Physics) Mott Prize (2008)
APS Oliver Buckley Prize (2005)
IUPAP Magnetism Prize/Neel Medal (2003)

Prof. Efthimios Kaxiras

(Harvard University)

Multiscale Simulations of Materials: Exploring New Physics and Application

The manipulation of materials structures at the atomic scale, a long-sought goal of materials science, has become a reality with the discovery of graphene and similar two-dimensional layered heterostructures. These experimental advances call for accurate theoretical tools that will guide the design of next-generation optoelectronic devices. We will describe a computationally efficient implementation of time-dependent density functional theory, that has emerged as a reliable tool for describing complex processes in molecules and solids, and discuss its applications in various fields.

Biography: Efthimios Kaxiras was educated at the Massachusetts Institute of Technology where he received a PhD in theoretical condensed matter physics. He joined the faculty of Harvard University in 1991, where he is currently the John Hasbrouck Van Vleck Professor of Pure and Applied Physics in the Department of Physics and the School of Engineering and Applied Sciences. He is the Founding Director of the Institute for Applied Computational Science. He has also served in faculty appointments and administrative positions in Switzerland (EPFL) and in Greece (University of Crete, University of Ioannina, FORTH). He holds several distinctions, including Fellow of the American Physical Society and Chartered Physicist and Fellow of the Institute of Physics.

His research interests focus on multiscale simulations of the physics of solids and fluids, with recent emphasis on materials for renewable energy and on hemodynamics. He serves on the Editorial Board of several scientific journals, has published over 300 papers in refereed journals and several review articles and chapters in books, as well as a graduate textbook on the properties of solids.

Prof. Klaus v. Klitzing

(Max Planck Institute for Solid State Research, Stuttgart)

From Quantum Hall Effect to a New System of Units

The quantized Hall resistance (Nobel Prize 1985) plays a crucial role for the implementation of a new international system of units (SI units) since this quantum resistance can be used not only for high precision realizations of electrical standards on the basis of fundamental constants but also for a new realization of a kilogram by comparing electrical and mechanical forces with the Watt balance. The talk gives an overview about the development of our present SI system and summarizes the application of the quantum Hall effect in metrology (science of measurements) with the focus on the replacement of the kilogram by a fixed value for the Planck constant.

Biography: Klaus von Klitzing, born in 1943 in Schroda (Posen) studied physics at the Technical University Braunschweig where he initiated as a summer student strong interactions with the Physikalisch Technische Bundesanstalt., the national metrology institute in Germany. There he met his teacher Gottfried Landwehr who introduced him into the research field of solid state physics in strong magnetic fields. He followed his teacher to the University of Würzburg where he finished his Ph.D. work (1972) and his habilitation (1978) with magnetotransport research on tellurium. Part of this research was done at the Clarendon Laboratory in Oxford (1975/76). After his habilitation he earned a Heisenberg grant which allowed him to do experimental research at the Boltzmann Institute and the T.U. in Vienna, the Ecole Normale Superieure in Paris and at the High Magnetic Field Laboratory in Grenoble. There he discovered on 5.2.1980 the quantum Hall effect which led to the Nobel Prize in Physics in 1985 and to an appointment as professor at the Technical University Munich. Prior in taking up in 1985 his present position as director at the Max Planck Institute for Solid State Research in Stuttgart, he was guest scientist at the IBM research laboratories in Yorktown Heights.

Klaus von Klitzing continues his research on quantum phenomena in low dimensional electron systems, received honorary doctoral degrees in 12 countries including Turkey (Bilkent University) and is a member of many academies of sciences worldwide.

For details see: http://www.fkf.mpg.de/4169555/CV_KvK_2014_short.pdf

www.ictp-ecar.org

About ICTP – Eurasian Centre for Advanced Research

The new partner institute of ICTP is intended to foster the advancement of physical and mathematical sciences in Eastern Europe and Near Asia (in particular, Balkan, Black Sea, Inner Asia, Middle East and Northern Africa) countries. The Centre's organization and activities are based on the decades-long successful model of ICTP.

The ICTP – ECAR's goals are the following:

- Conduct scientific research at the highest international standards.
- Provide an international meeting basis for the scientists of the region and the world through visiting programs, schools, workshops, conferences and similar activities.
- Support scientific research in the region countries where the research potential has not been fully realized yet.

Organization:

The highest governing body of the Centre is its Steering Committee whose members consist of the key partners, policy makers and scientists, in Turkey, in the region, and in the international landscape. The Steering Committee decides about the major policies concerning the Centre. This consists of funding of the Centre, selection and appointment of its Director, number of research and administrative positions, and overseeing the spending of the Centre's budget.

A Scientific Council composed of internationally renowned scientists is formed by the Steering Committee. The Council decides about the following major acts: Establishing and overseeing the hiring standards for research staff; approving the hiring, extension and other details of the research staff; approving the annual scientific program of the Centre.

Steering Committee and Scientific Council members of ICTP-ECAR meet during the Inauguration and annual conferences of the Centre.

Programs:

Research, visiting, and interaction programs will constitute the activities of the Centre. A number of full-time and postdoctoral researchers, together with long-term visitors and associates of the Centre will conduct the research programs. Workshop, training school, conference and similar activity proposals are subject to the approval of Scientific Council and will be supported within the allowance of financial and other resources. Local research staff will act as coordinator and facilitator of those activities.

The Inauguration Conference, a scheduled advanced workshop, and possibly a summer school will constitute the major activities of ICTP-ECAR in 2014. Seminars, colloquia, and short term visits to the Centre will contribute to an active interaction among the scientific community. Number of activities is expected to grow in the coming years.

Prof. Tuğrul Senger
Acting Director, ICTP-ECAR

ICTP-ECAR Steering Committee Members

Fernando Quevedo
Steering Committee Chairman (Ex Officio)
ICTP Director

Mustafa Güden
Steering Committee Member (Ex Officio)
IZTECH Rector

Efthimios Kaxiras
Steering Committee Member
Harvard University

Serdar Sariciftci
Steering Committee Member
Johannes Kepler University of Linz

Cumrun Vafa
Steering Committee Member
Harvard University

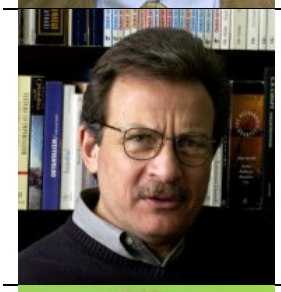
Seifallah Randjbar-Daemi
Steering Committee Coordinator (Ex Officio)
ICTP

ICTP-ECAR Scientific Council Members

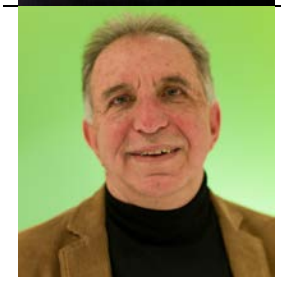
Gabriel Aeppli
Scientific Council Chairman
London Centre for Nanotechnology

Ignatios Antoniadis
Scientific Council Member
CERN

Baha Balantekin
Scientific Council Member
University of Wisconsin-Madison



Nihat Berker
Scientific Council Member
Sabancı University



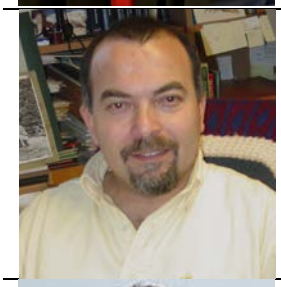
Athanasios Fokas
Scientific Council Member
University of Cambridge

Ramin Golestanian
Scientific Council Member
University of Oxford

Rahmi Güven
Scientific Council Member
Bogazici University

Klaus von Klitzing
Scientific Council Member
MPI-Stuttgart

Seifallah Randjbar-Daemi
Scientific Council Member (Ex Officio)
ICTP



Mehmet Sarikaya
Scientific Council Member
University of Washington

Manfred Sigrist
Scientific Council Member
ETH Zürich

The Abdus Salam International Centre for Theoretical Physics

Cutting edge research, education and training

For the last 50 years, the Abdus Salam International Centre for Theoretical Physics (ICTP) has been a driving force behind global efforts to advance scientific expertise in the developing world.

Founded in 1964 by the late Nobel Laureate Abdus Salam, ICTP seeks to accomplish its mandate by providing scientists from developing countries with the continuing education and skills that they need to enjoy long and productive careers. ICTP has been a major force in stemming the scientific brain drain from the developing world.

ICTP alumni serve as professors at major universities, chairpersons of academic departments, directors of research centres and ministers of science and technology in nations throughout the developing world. Many of them have been recognized in their own countries and internationally for their contributions to science and science policy. The impact of ICTP extends well beyond the Centre's facilities to virtually every corner of the Earth.

An institute run by scientists for scientists

ICTP's mission is to:

> Foster the growth of advanced studies and research in physical and mathematical sciences, especially in support of excellence in developing countries.
>
> Develop high-level scientific programmes keeping in mind the needs of developing countries, and provide an international forum of scientific contact for scientists from all countries.
>
> Conduct research at the highest international standards and maintain a conducive environment of scientific inquiry for the entire ICTP community.

Thanks to the generous funding from the Italian Government, UNESCO and the IAEA, ICTP has been able to initiate and implement various schemes of support and assistance to scientists from developing countries.

Fostering advanced studies in physics and mathematics

The Centre supports research groups in several areas of physical sciences and mathematics.

The bulk of the research at the Centre is carried out by the staff of the scientific sections and their consultants, long-term and short-term visitors engaged in independent or collaborative research, a relatively large cadre of post-doctoral fellows, as well as the Associates. The scientific sections are also responsible for organizing high-level training courses, workshops, conferences and topical meetings throughout the year.

www.ictp.it

ICTP IN NUMBERS 2012

The Abdus Salam International Centre for Theoretical Physics

ICTP VISITORS 2012

5,315 VISITORS FROM **136** NATIONS

56 TRAINING ACTIVITIES AT CAMPUS, **18** IN DEVELOPING COUNTRIES

11 DAYS AVERAGE LENGTH OF VISIT FOR CONFERENCE PARTICIPANTS

49 DAYS AVERAGE FOR RESEARCH VISITORS

63 POSTDOCS ON CAMPUS [56% FROM DEVELOPING COUNTRIES]

150 STUDENTS ENROLLED IN PRE-PHD EDUCATIONAL PROGRAMMES

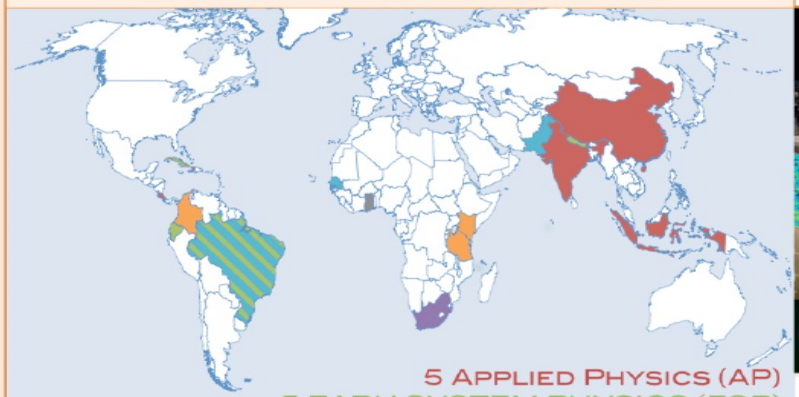
300 SCIENTISTS ENGAGED IN CAREER DEVELOPMENT PROGRAMMES

TOP 10 DEVELOPING COUNTRIES, BY REGION

Africa	N. of visitors	Asia	N. of visitors	Latin America	N. of visitors
Nigeria	92	India	324	Brazil	199
South Africa	73	China	184	Argentina	112
Egypt	57	Iran	180	Cuba	98
Kenya	41	Pakistan	114	Colombia	67
Ghana	40	Turkey	63	Mexico	58
Ethiopia	39	Viet Nam	47	Venezuela	27
Morocco	39	Indonesia	45	Chile	23
Algeria	38	Malaysia	44	Costa Rica	23
Cameroon	35	Korea Rep.	42	Peru	18
Sudan	24	Thailand	21	Ecuador	9

FLOW OF INCOMING VISITORS BY MONTH AT ICTP

18 REGIONAL TRAINING ACTIVITIES



5 APPLIED PHYSICS (AP)
5 EARH SYSTEM PHYSICS (ESP)
3 CONDENSED MATTER PHYSICS (CMSP)
3 MATHEMATICS (MATH)
1 HIGH ENERGY PHYSICS (HECAP)
1 PHYSICS AND DEVELOPMENT (PD)

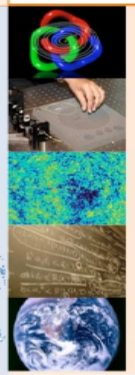
DISTRIBUTION OF FEMALE VISITORS

1160 FEMALE VISITORS [22%]

Asia	330
Latin America	176
Africa	125
Eastern Europe	107

51% OF FEMALE VISITORS ARE FROM DEVELOPING COUNTRIES

COURSE PARTICIPANTS BY RESEARCH AREA



970 CMSP
680 AP
670 HECAP
458 Math
386 ESP

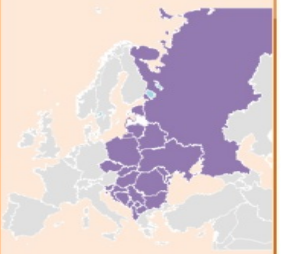
1,440 MONTHS OF TRAINING TO COURSE PARTICIPANTS LECTURED BY MORE THAN 1,000 EXPERTS

COUNTRIES REPRESENTED

20 in LDCs in Africa
14 from rest of Africa

4 from LDCs in Asia
33 from rest of Asia

1 from LDCs Latin America
22 from rest of Latin America



17 from Eastern Europe

ICTP Public Information Office, March 2013.

NOTES

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The Abdus Salam
International Centre
for Theoretical Physics
50th Anniversary 1964–2014

ICTP – Eurasian Centre
for Advanced Research

Advanced Workshop on Landau-Zener Interferometry and Quantum Control in Condensed Matter

29 September – 3 October 2014

ICTP-ECAR Centre, IZTECH (Izmir, Turkey)

The ICTP – Eurasian Centre for Advanced Research (ICTP-ECAR), Center for NanoScience (CeNS, Munich, Germany) and Nanosystems Initiative Munich (NIM, Munich, Germany) are organizing an Advanced Workshop on Landau - Zener Interferometry and Quantum Control in Condensed Matter, to be held in ICTP-ECAR Centre, IZTECH, Izmir (Turkey), from 29th September to 3rd October 2014.

The workshop will address recent developments on Landau-Zener dynamics and related quantum control in complex systems including (but not limited to) many-body effects in ultracold gases, dissipative Landau-Zener transitions, Landau-Zener interferometry in superconducting qubits, double and triple quantum dots, spin & charge qubits, N-V centers and nano-mechanical systems.

The central idea of this workshop is to bring together various condensed matter communities, dealing with complex systems, where the nonequilibrium dynamics at avoided crossings is (other than in pure atomic systems) highly influenced by many-body interactions and, in many cases, environmental fluctuations. We expect about 100 participants including about 25 invited presentations given by the world experts in order to exchange ideas and shape new links beyond the traditional community boundaries. We hope to facilitate Landau-Zener interferometry and quantum control as one of the key spectroscopic tools in condensed matter systems for the future.

TOPICS

- **Quantum control in condensed matter**: semiconducting quantum dots, superconducting qubits, ultracold gases, NV-centers, nanomechanical systems
- **Landau-Zener-Stückelberg-Majorana interferometry**
- **Dissipative Landau-Zener transitions**

About ICTP-ECAR (http://ictp-ecar.org)

"ICTP – Eurasian Centre for Advanced Research (ICTP – ECAR)" is a new regional centre intended to foster the advancement of basic sciences in Eastern Europe and Near Asia (in particular, Balkan, Black Sea, Inner Asia, Middle East and Northern Africa) countries. The Abdus Salam International Centre for Theoretical Physics (ICTP, Trieste-Italy), a United Nations organization working under the umbrella of UNESCO, and the İzmir Institute of Technology (IZTECH, İzmir-Turkey) have agreed to collaborate towards the creation of ICTP – ECAR. The Centre's organization and activities will be truly international following the decades-long successful model of ICTP. The role of Turkey, and IZTECH in particular, is to host and facilitate its operations.

Participation

Scientists and students from all countries which are members of the United Nations, UNESCO or IAEA may attend the Workshop. Priority will be given to advanced undergraduates, graduate students, post-doctoral researchers, faculty and research scientists from Eastern Europe and Near Asia (in particular, Balkan, Black Sea, Inner Asia, Middle East and Northern Africa) countries. As lectures and talks will be given in English, participants should have an adequate working knowledge of that language. Although the main purpose of the Centre is to help research workers from developing countries, through a programme of training activities within a framework of international cooperation, a limited number of students and post-doctoral scientists from developed countries are also welcome to attend. As a rule, travel and subsistence expenses of the participants should be borne by the home institution. There is no registration fee.

HOW TO APPLY FOR PARTICIPATION

The application form can be accessed at the activity website
http://agenda.ictp.it/smr.php?2677
Once in the website, comprehensive instructions will guide you step-by-step, on how to fill out and submit the application form. You may address general requests for information to:

Ms. Milena Poropat (smr. 2677)
The Abdus Salam International Centre for Theoretical Physics
Strada Costiera 11 - 34014 Trieste, Italy
Telephone: +39-040-2240540 - Telefax: +39-040-22407540
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ICTP Home Page: http://www.ictp.it

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Tugrul Senger (Turkey)
Haldun Sevincli (Turkey)

INVITED SPEAKERS

Ehud Altman (Israel) *)
Dimitris Angelakis (Greece & Singapore)
Alexander Altland (Germany)
Pierre Barthelemy (Netherlands)
Guido Burkard (Germany)
Aashish Clerk (Canada)
Francesca Ferlaino (Austria) *)
Steven Girvin (U.S.A.)
Peter Hänggi (Germany)
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Atac Imamoglu (Switzerland) *)
Menderes Iskin (Turkey)
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Jukka Pekola (Finland)
Thomas Pohl (Germany)
Valery Pokrovsky (U.S.A.)
Anatoli Polkovnikov (U.S.A.)
Andrew Sachrajda (Canada)
Richard Warburton (Switzerland)
Eva Weig (Germany)

*) to be confirmed

DEADLINE for applications with financial support request and needing visa:
30th June 2014

DEADLINE for applications NOT requiring financial support, nor visa:
15th August 2014

ICTP – Eurasian Centre
for Advanced Research

We acknowledge support by

atmosfer
technology transfer and licensing service
İzmir Institute of Technology
Technology Transfer Office

İZKA
İzmir Kalkınma Ajansı
Development Agency

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