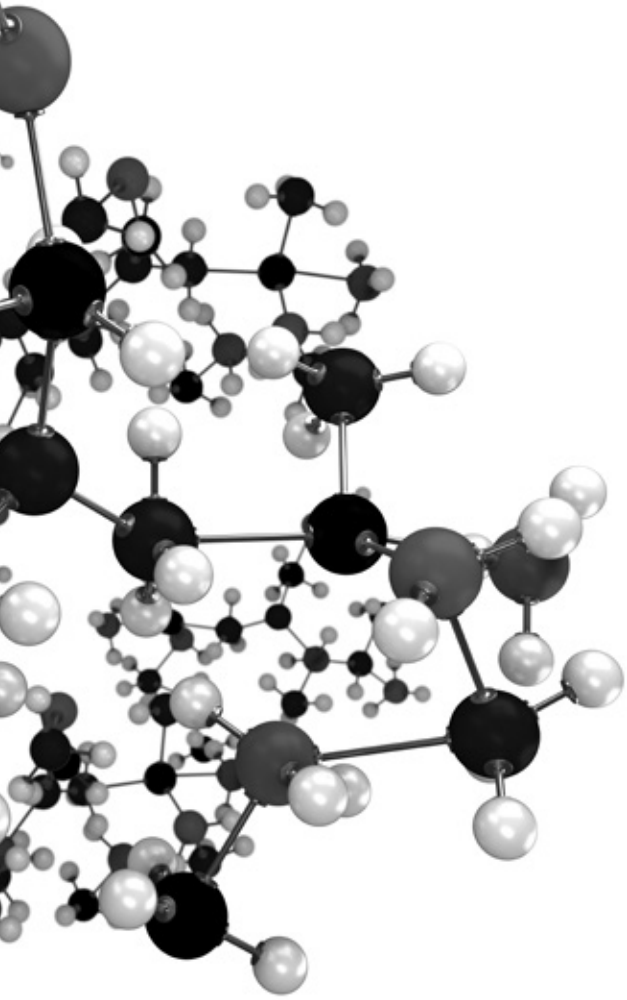

63rd Lindau Nobel Laureate Meeting

Programme

30 June – 5 July 2013
Lindau & Mainau Island, Germany

THE MEETINGS ONLINE

Lindau Nobel Social Media Community
lindau.nature.com

The Lindau Mediatheque
mediatheque.lindau-nobel.org

Nobel Labs 360°
nobellabs.lindau-nobel.org

Lindau Alumni Community
alumni.lindau-nobel.org

Facebook
www.facebook.com/LindauNobelLaureatesMeeting

Twitter
twitter.com/lindaunobel (#lnlm13)

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With 35 Nobel Laureates and approximately 600 young researchers from up to 80 countries, the 63rd Lindau Nobel Laureate Meeting is a landmark on the agenda of the international scientific dialogue. The most esteemed scientists of our times and promising young talents will share their enthusiasm for science, discuss the latest research findings, and help expand a community across generations, cultures and disciplines. It is a great pleasure for the Council for the Lindau Nobel Laureate Meetings and the Foundation Lindau Nobelprizewinners Meetings at Lake Constance to welcome our appreciated guests.

Since 1951, Nobel Laureates in physiology or medicine, physics, and chemistry have gathered annually in Lindau to mentor and inspire the next generation of excellent scientists. From their beginnings in 1951, the Lindau Meetings have evolved into an international forum for global debate. The 63rd Lindau Nobel Laureate Meeting is dedicated to chemistry. Once again, Nobel Laureates have been invited to lecture on a topic of their deliberate choice and showcase the wide range of research fields. Three main themes have emerged: Green Chemistry; Chemical Energy Storage and Conversion; and Biochemical Processes and Structures. It comes as no surprise that the concept of sustainability is a clear reference point for all issues to be raised.

In the last two decades the term sustainability has already been prominently featured in science and society. Nonetheless the discussion about

WELCOME

sustainability is probably more important than ever, taking into consideration that nature as the basis for human life is threatened in many ways. In this context, how can science contribute to sustainable development? What responsibility should scientists really take on?

The Lindau Nobel Laureate Meetings have always encouraged promising and passionate young scientists from around the globe not only to strive for excellence in their fields of research but also to look beyond their actual research. The responsibility of scientists and the concept of sustainability have been integral aspects in the countless debates and discussions since the early years of the Lindau Meetings.

This year´s meeting will again stimulate the valuable exchange of knowledge and ideas. Our leitmotif "Educate. Inspire. Connect." embodies a holistic and therefore sustainable understanding of the concept of learning. At the Lindau Nobel Laureate Meetings, education means more than learning from textbooks. It should be part of everyone's education to make inspiring and lasting experiences and share them with others. This approach distinguishes the Lindau Meetings from common scientific conferences.

In order to foster the understanding of science in society, our "Mission Education" comprises various initiatives and projects, including the Lindau Mediatheque, educational films, the initiative Teaching Spirit and the travelling exhibition "Sketches of Science". They all have the potential to generate public awareness of the importance and fascination of science and research.

The council and the foundation would like to express their gratitude to the participating Nobel Laureates, this meeting's scientific chairs, our academic partners from all continents, the donors and benefactors as well as all supporters for their continuous commitment to our Mission Education. We welcome you to join and share an unforgettable experience.

Council for the Lindau Nobel Laureate Meetings

Foundation Lindau Nobelprizewinners Meetings at Lake Constance

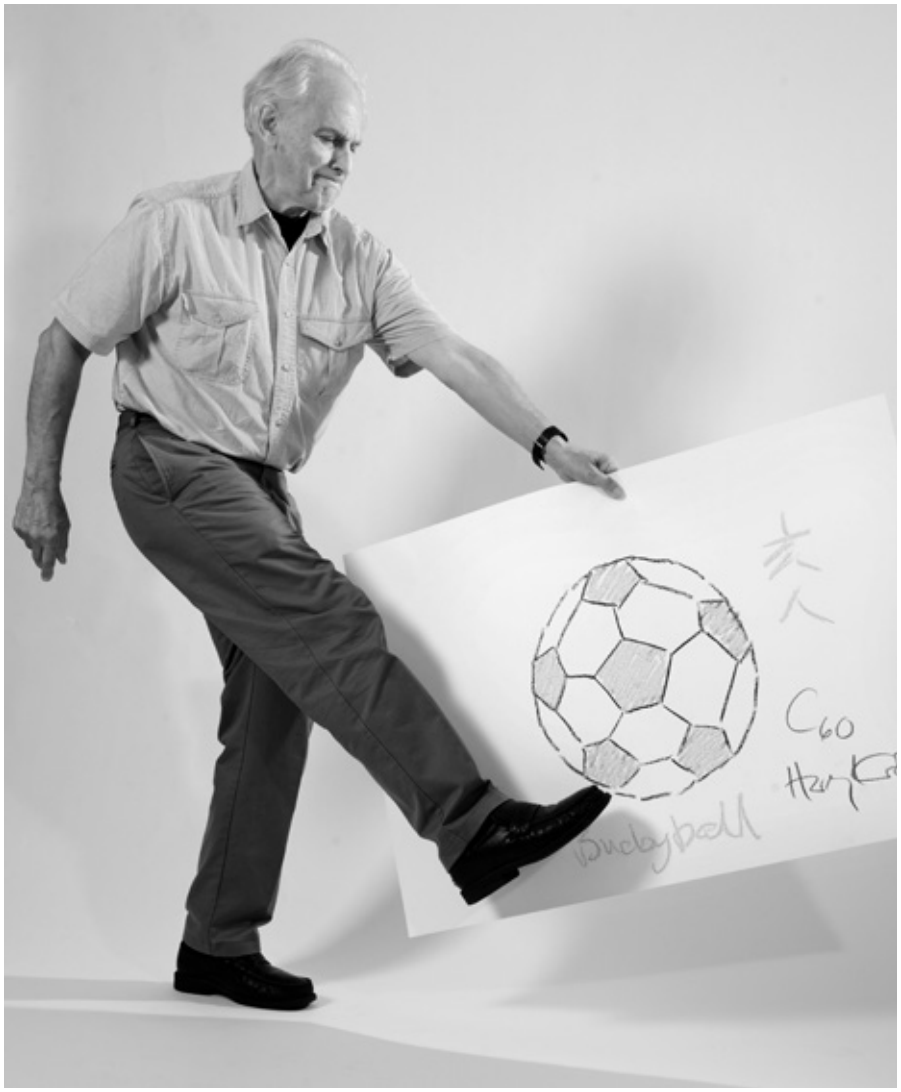
35 NOBEL LAUREATES

PETER AGRE WERNER ARBER
MARTIN CHALFIE STEVEN CHU
AARON CIECHANOVER PAUL J. CRUTZEN
ROBERT F. CURL JR. RICHARD R. ERNST
GERHARD ERTL EDMOND H. FISCHER
WALTER GILBERT ROY J. GLAUBER
ROBERT H. GRUBBS THEODOR W. HÄNSCH
SERGE HAROCHE AVRAM HERSHKO ROBERT HUBER
BRIAN K. KOBILKA WALTER KOHN HAROLD W. KROTO
JEAN-MARIE LEHN RUDOLPH A. MARCUS HARTMUT MICHEL
MARIO J. MOLINA K. ALEX MÜLLER ERWIN NEHER
JOSÉ RAMOS-HORTA RICHARD R. SCHROCK DAN SHECHTMAN
AKIRA SUZUKI JOHN E. WALKER DAVID J. WINELAND
KURT WÜTHRICH ADA E. YONATH HARALD ZUR HAUSEN

PROGRAMME OVERVIEW

	Sunday, 30 June	Monday, 1 July	Tuesday, 2 July
07.00		*Science Breakfast* **ScienceBreakfast** upon invitation of the Republic of Korea	*Science Breakfast* **Science Breakfast** upon invitation of Mars, Incorporated
08.00			
09.00		*Lecture* **Kobilka** *Lecture* **Ertl** *Lecture* **Suzuki**	*Lecture* **Ciechanover** *Lecture* **Neher** *Lecture* **Lehn**
10.00	**Registration** 10 - 20 hrs	**Coffee Break**	**Coffee Break**
11.00		*Lecture* **Wineland** *Lecture* **Haroche** *Lecture* **Walker** *Lecture* **Michel**	*Lecture* **Yonath** *Lecture* **Marcus** *Lecture* **Schrock** *Lecture* **Grubbs**
12.00			
13.00		**Lunch Break** upon invitation of the Republic of Korea	**Lunch Break**
14.00			
15.00	**Opening Ceremony**	*YR Discussions* Ertl | Haroche Kobilka | Michel Suzuki | Walker Wineland *Lecture & Disc.* Curl	*YR Discussions* Ciechanover Grubbs | Lehn Marcus | Neher Schrock | Yonath *Lecture & Disc.* Kohn
16.00		**Break**	**Break**
17.00	Reception upon invitation of the Republic of Austria **Concert** Ensemble of the Vienna Philharmonic Orchestra	*Workshop* Presentation Skills Kroto *Master Class* Ciechanover	*Presentation* Opportunities for Research Excellence in Europe (EC) *Master Class* Shechtman Wüthrich
18.00		**Break**	**Break**
19.00	*Social Function*	*Social Function*	*Social Function*
20.00	**Dinner** at various locations limited attendance	**International Get-Together** upon invitation of the Republic of Korea	**Academic Dinners** at various locations upon invitation of the Academic Partners or **Grill & Chill** upon invitation of the Council & Foundation and City of Lindau with the Lindau Citizens
21.00			
22.00			

	Wednesday, 3 July	Thursday, 4 July	Friday, 5 July
07.00	*Science Breakfast* **Science Breakfast** upon invitation of the Austrian Federal Ministry of Science and Research	*Science Breakfast* **Science Breakfast** upon invitation of BASF and Chemical Industry Fund (Note: Session starts at 06.45 hrs)	**Baden-Württemberg Boat Trip** to Mainau Island upon invitation of the State of Baden-Württemberg
08.00			
09.00	*Lecture* **Chalfie** *Lecture* **Chu** *Lecture* **Agre**	*Lecture* **Arber** *Lecture* **Molina** *Lecture* **Hershko**	
10.00	**Coffee Break**	**Coffee Break**	
11.00	*Lecture* **Shechtman** *Lecture* **Crutzen** *Lecture* **Wüthrich** *Lecture* **Ernst**	*Lecture* **Hänsch** *Lecture* **Müller** *Lecture* **Huber** *Lecture* **Kroto**	*Closing Session* **Award Ceremony** **Dialogue** Ramos-Horta, Stalsett **Panel Discussion Green Chemistry** Braungart, Chu, Molina
12.00			
13.00	**Lunch Break**	**Lunch Break**	**Lunch Break**
14.00			
15.00	*Panel Discussion* Chemical Energy Conversion and Storage Ertl, Grubbs, Kohn, Michel, Schrock	*Panel Discussion* Why Communicate? Engelke, Gilbert, Kobilka, Kroto, Lugger, Yonath	**Farewell Ceremony**
16.00	**Break**	**Break**	
17.00	*YR Discussions* Agre | Chalfie | Chu Crutzen | Ernst Shechtman | Wüthrich	*YR Discussions* Arber | Hershko Hänsch | Huber Kroto | Molina Müller	**Return Boat Trip** to Lindau upon invitation of the State of Baden-Württemberg
18.00	**Break**	**Break**	
19.00	*Social Function* **Dinner** at various locations	*Social Function* **Bavarian Evening** upon invitation of the Elite Network of Bavaria & Free State of Bavaria	
20.00	**Free Evening**		
21.00			
22.00			



SKETCHES OF SCIENCE

Exhibition

5 July – 30 August 2013, Mainau Island, Germany

16 September – 23 November, Singapore Science Centre, Singapore

SUNDAY, 30 JUNE

10.00
Registration
Inselhalle

Meeting Registration
from 10.00 – 20.00 hrs continuously

15.00
Opening
Ceremony
Inselhalle

Opening Ceremony

Welcome

Countess Bettina Bernadotte
President of the Council

Welcome Address

Johanna Wanka
Federal Minister of Education and Research (Germany)

Welcome Address

Geneviève Fioraso
Minister of Higher Education and Research of the French Republic

Induction of New Members to the Honorary Senate of the Foundation Lindau Nobelprizewinners Meetings

Gunnar Stålsett
Bishop Emeritus of Oslo, Member of the Nobel Peace Prize Committee

Marcus Storch
Chairman of the Nobel Foundation 2005 - 2013

Klaus Tschira
Founder and Chairman, Klaus Tschira Stiftung gGmbH

The award ceremony for Marcus Storch will take place during the closing session on Friday, 5 July 2013, 11.00 hrs.

Access: all participants

16.30

Break

17.00
Concert
City Theatre

Reception & Concert

Ensemble of the Vienna Philharmonic Orchestra

Reception upon invitation of the Austrian Federal Ministry for Science and Research

Access: Laureates, young researchers, guests

19.00
Dinner
Various Locations

Dinner

Please see your personal agenda for details.

07.00
Science Breakfast
Forum am See

How Does Surface Science Contribute to Solve Global Energy and Environmental Issues?
upon invitation of the Republic of Korea
Gerhard Ertl
Department of Physical Chemistry,
Fritz Haber Institute of the Max Planck Society
Kyungtae Kang
Post-doc, Department of Chemistry,
Korea Advanced Institute of Science and Technology (KAIST)
Jeong Young Park
Group Leader, Center for Nanomaterials and Chemical Reactions,
Institute for Basic Science (IBS)
Associate Professor, EEWS Graduate School,
Korea Advanced Institute of Science and Technology (KAIST)
Moderator: Seung Bum Park
Professor, Department of Chemistry, Seoul National University
Access: with online pre-registration only

09.00
Plenary Lecture
Inselhalle

Brian K. Kobilka
G Protein Coupled Receptors: Challenges for Drug Discovery

09.30
Plenary Lecture
Inselhalle

Gerhard Ertl
Catalysis at Surfaces: From Atoms to Complexity

10.00
Plenary Lecture
Inselhalle

Akira Suzuki
Cross-Coupling Reactions of Organoboranes: An Easy Way for Carbon-Carbon Bonding

10.30

Coffee Break
upon invitation of the Republic of Korea

11.00
Plenary Lecture
Inselhalle

David J. Wineland
Superposition, Entanglement, and Raising Schrödinger's Cat

11.30
Plenary Lecture
Inselhalle

Serge Haroche
Controlling Photons in a Box and Exploring the Quantum to Classical Boundary

12.00
Plenary Lecture
Inselhalle

John E. Walker
The Fuel of Life

12.30
Plenary Lecture
Inselhalle

Hartmut Michel
Structure and Mechanism of Otto Warburg`s Respiratory Enzyme, the Cytochrome c Oxidase

13.00
Catering Tent

Lunch Break
upon invitation of the Republic of Korea
Access: young researchers only

15.00
Lecture & Disc.
Hotel Bay. Hof

Robert F. Curl Jr.
The Chemistry of Elemental Carbon

15.00
Discussion
City Theatre

Gerhard Ertl
Discussion with young researchers

15.00
Discussion
Altes Rathaus

Serge Haroche
Discussion with young researchers

15.00
Discussion
Forum am See

Brian K. Kobilka
Discussion with young researchers

15.00
Discussion
Altes Rathaus

Hartmut Michel
Discussion with young researchers

15.00
Discussion
Evang. Hospital

Akira Suzuki
Discussion with young researchers

15.00
Discussion
Landratsamt

John E. Walker
Discussion with young researchers

15.00
Discussion
Altes Rathaus

David J. Wineland
Discussion with young researchers

16.30

Break

MONDAY, 1 JULY

17.00
Workshop
City Theatre

Harold W. Kroto
Workshop: Presentation Skills

17.00
Master Class
Altes Rathaus

Master Class with Aaron Ciechanover
New Frontiers in Deciphering Mechanisms of Diseases and in Drug Development

Nathalie Busschaert
University of Southampton

Mahmoud El-Sabahy
Assiut University

Francesca Re
University of Milano-Bicocca

Anke Roth
Yale University

Access: with online pre-registration only

18.30

Break

19.00
Social Function
Inselhalle

International Get-Together

upon invitation of the Republic of Korea

Welcome

Countess Bettina Bernadotte
President of the Council

Welcome Address

Jae-Shin Kim
Ambassador, Korean Embassy in Berlin, Republic of Korea

Hwang-Sik Kim
Former Prime Minister of the Republic of Korea (2010 – 2013)

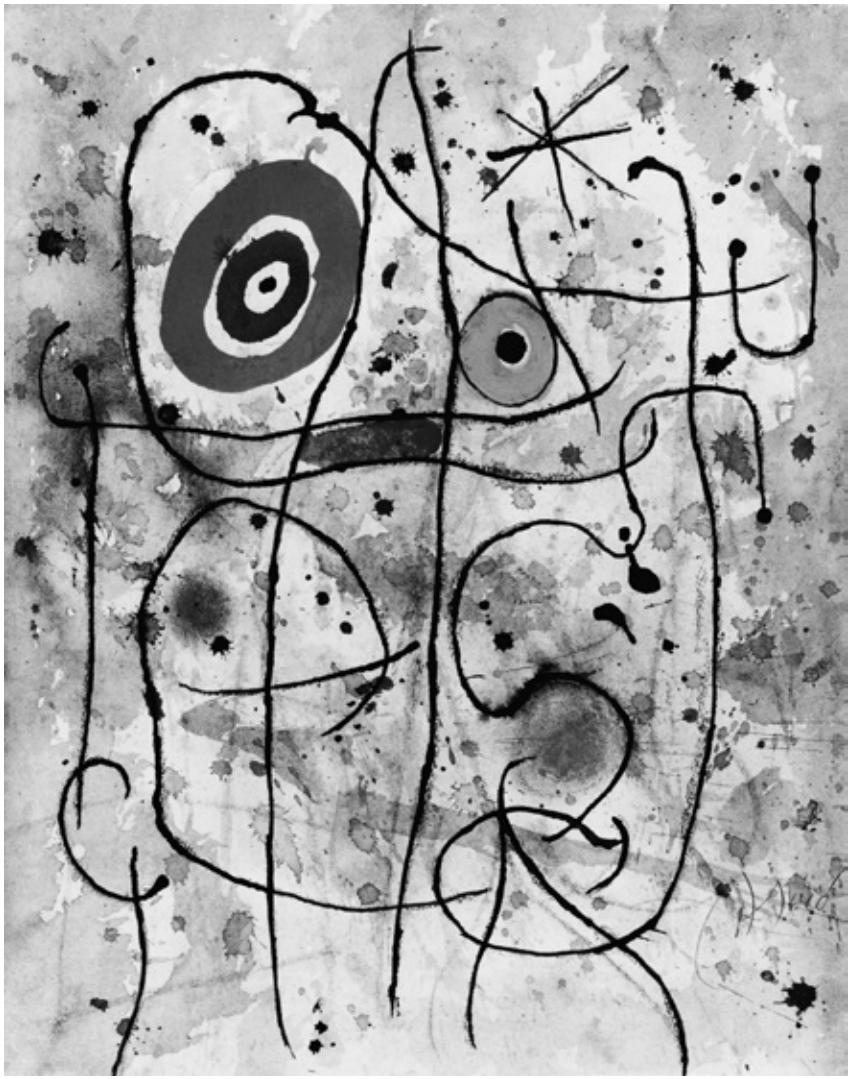
Save the Earth: Blue Beyond Green

Dr. YoungJoo Ko
Director, Strategy & Cooperation Division, Korea Research Institute of Chemical Technology (KRICT)

Dinner

Cultural Performance & Dance

Access: all participants



Joan Miró, Composition, 1965 © Successió Miró VG Bild-Kunst, Bonn 2013

STARRY NIGHTS by JOAN MIRÓ

24 March - 1 September 2013
City Museum Lindau
Free exhibition access with YR name badge

07.00
Science Breakfast
Forum am See

How Can Science Drive Solutions That Better Use the Planet's Resources?
upon invitation of Mars, Incorporated

Steven Chu
Physics Department, Stanford University

Howard-Yana Shapiro
Chief Agricultural Officer, Mars, Incorporated
Senior Fellow in Plant Sciences, University of California, Davis

Young researcher (tbd)

Moderator: Adam Smith
Editorial Director, Nobel Media AB

Access: with online pre-registration only

09.00
Plenary Lecture
Inselhalle

Aaron Ciechanover
Drug Development in the 21st Century - Are We Going to Cure All Diseases?

9.30
Plenary Lecture
Inselhalle

Erwin Neher
Chemistry Helps Biology: Fluorescent Labels and Caged Compounds

10.00
Plenary Lecture
Inselhalle

Jean-Marie Lehn
Perspectives in Chemistry - Towards Adaptive Chemistry

10.30

Coffee Break

11.00
Plenary Lecture
Inselhalle

Ada E. Yonath
Curiosity and its Fruits: From Basic Science to Advanced Medicine

11.30
Plenary Lecture
Inselhalle

Rudolph A. Marcus
Single Molecule Studies of Initial Steps in Dye Sensitized Solar Cells and of Quantum Dots - Examples of Electron Transfer and Relation to Ensemble Studies

12.00
Plenary Lecture
Inselhalle

Richard R. Schrock
Advances in Olefin Metathesis Employing Molybdenum and Tungsten Catalysts

12.30
Plenary Lecture
Inselhalle

Robert H. Grubbs
Green Chemistry and Catalysis

13.00
Catering Tent

Lunch Break
Access: for young researchers only

15.00
Lecture & Disc.
Hotel Bay. Hof

Walter Kohn
Macular Distortion – Diagnosis and Correction

15.00
Discussion
Inselhalle

Aaron Ciechanover
Discussion with young researchers

15.00
Discussion
Evang. Hospital

Robert H. Grubbs
Discussion with young researchers

15.00
Discussion
Altes Rathaus

Jean-Marie Lehn
Discussion with young researchers

15.00
Discussion
Inselhalle

Rudolph A. Marcus
Discussion with young researchers

15.00
Discussion
Altes Rathaus

Erwin Neher
Discussion with young researchers

15.00
Discussion
Landratsamt

Richard R. Schrock
Discussion with young researchers

15.00
Discussion
Forum am See

Ada E. Yonath
Discussion with young researchers

16.30

Break

17.00
Master Class
Altes Rathaus

Master Class with Dan Shechtman
The Power of Transmission Electron Microscopy (TEM)

Evelyn Auyeung
Northwestern University

Lindsay Baker
Utrecht University

Thomas Lunkenbein
Fritz Haber Institute of the Max Planck Society

Julia Mahamid
Max Planck Institute of Biochemistry

Mehtap Özaslan
Paul Scherrer Institute

Access: with online pre-registration only

17.00
Master Class
Altes Rathaus

Master Class with Kurt Wüthrich
Magnetic Resonance in Chemistry, Structural Biology and Medical Diagnosis

Axel Abelein
Stockholm University

Cristina Airoldi
University of Milano-Bicocca

Irene Marco-Rius
University of Cambridge

Mirco Zerbetto
University of Padova

Access: with online pre-registration only

17.00
Presentation
Inselhalle

Opportunities for Research Excellence in Europe – the Pillar of Horizon 2020

The European Commission presents proposed research opportunities in the "Excellence" pillar of the new programme; followed by a short demonstration of the EURAXESS-Researchers in Motion service.

Moderator: Mike W. Rogers
Higher education and international affairs
DG Education & Culture, European Commission

Access: all participants

18.30

Break

19.00
Social Function
Various Locations

Academic Dinners
upon invitation of the Academic Partners
Access: by invitation only

19.00
Social Function
Toskanapark

Grill & Chill: Connecting Cultures
upon invitation of the Council & Foundation
Access: by invitation only

MISSED SOMETHING?

Watch it online at
mediatheque.lindau-nobel.org

07.00
Science Breakfast
Forum am See

Quantum Information Processing – Where Do We Stand And Where Do We go?
upon invitation of the Austrian Federal Ministry of Science and Research

Serge Haroche
Collège de France, Ecole Normale Supérieure

David J. Wineland
Physical Measurement Laboratory, The National Institute of Standards and Technology (NIST)

Young researcher (tbd)

Introduction & Moderator: Rainer Blatt
Institute of Experimental Physics, University of Innsbruck

Access: with online pre-registration only

09.00
Plenary Lecture
Inselhalle

Martin Chalfie
Tickling Worms: Surprises From Basic Research

9.30
Plenary Lecture
Inselhalle

Steven Chu
The Energy and Climate Change Challenges and Opportunities

10.00
Plenary Lecture
Inselhalle

Peter Agre
Aquaporin Water Channels: From Atomic Structure to Malaria

10.30

Coffee Break

11.00
Plenary Lecture
Inselhalle

Dan Shechtman
Quasi-Periodic Materials - Crystal Redefined

11.30
Plenary Lecture
Inselhalle

Paul J. Crutzen
Atmospheric Chemistry and Climate in the 'Anthropocene'

12.00
Plenary Lecture
Inselhalle

Kurt Wüthrich
Conformational Plasticity of G-protein-coupled Receptors (GPCRs) Studied by NMR in Solutions

12.30
Plenary Lecture
Inselhalle

Richard R. Ernst
Widen Your Scope by Extracurricular Activities: My Example

13.00
Catering Tent

Lunch Break
Access: for young researchers only

15.00
Panel Discussion
Inselhalle

Panel Discussion: Chemical Energy Conversion & Storage

Gerhard Ertl
Department of Physical Chemistry, Fritz Haber Institute of the Max Planck Society

Robert H. Grubbs
Division of Chemistry and Chemical Engineering, California Institute of Technology

Walter Kohn
Department of Physics, University of California at Santa Barbara

Hartmut Michel
Department of Molecular Membrane Biology, Director Max Planck Institute of Biophysics

Richard R. Schrock
Department of Chemistry, Massachusetts Institute of Technology (MIT)

Moderators:

Astrid Gräslund
Professor of Biophysics, Department of Biochemistry and Biophysics, Stockholm University

Wolfgang Lubitz
Director, Max Planck Institute for Chemical Energy Conversion

16.30

Break

17.00
Discussion
Evang. Hospital

Peter Agre
Discussion with young researchers

17.00
Discussion
Altes Rathaus

Martin Chalfie
Discussion with young researchers

17.00
Discussion
Inselhalle

Steven Chu
Discussion with young researchers

17.00 Discussion Hotel Bay. Hof	*Paul J. Crutzen* **Discussion with young researchers**
17.00 Discussion Altes Rathaus	*Richard R. Ernst* **Discussion with young researchers**
17.00 Discussion Forum am See	*Dan Shechtman* **Discussion with young researchers**
17.00 Discussion Landratsamt	*Kurt Wüthrich* **Discussion with young researchers**
18.30	**Break**
19.00 Catering Tent	**Dinner** Access: young researchers only

HAVING A BRILLIANT THOUGHT?

Share it with us at
twitter.com (#lnlm13)

06.45 Science Breakfast Forum am See	**It Is All About Chemistry. How We Tackle the Energy Challenges of the Future!** upon invitation of BASF and Chemical Industry Fund *Hartmut Michel* Department of Molecular Membrane Biology, Director Max Planck Institute of Biophysics *Mario J. Molina* Centro Mario Molina para Estudios Estratégicos sobre Energía y Medio Ambiente A.C. *Richard R. Schrock* Department of Chemistry, Massachusetts Institute of Technology (MIT) *Carla Seidel* Vice President, E-Power-Management, BASF New Business GmbH *Thomas Weber* Senior Vice President, Science Relations and Innovation Management, BASF *Moderator: Julian Geuder* bridging positions Access: with online pre-registration only
09.00 Plenary Lecture Inselhalle	*Werner Arber* **Cultural Values of Scientific Knowledge**
09.30 Plenary Lecture Inselhalle	*Mario J. Molina* **Communicating Climate Change Science**
10.00 Plenary Lecture Inselhalle	*Avram Hershko* **The Ubiquitin System**
10.30	**Coffee Break**
11.00 Plenary Lecture Inselhalle	*Theodor W. Hänsch* **What Can We Do With Laser Frequency Combs?**
11.30 Plenary Lecture Inselhalle	*K. Alex Müller* **Novel Synthesis for Ceramics: Superconductors, Magnets and Others**

12.00
Plenary Lecture
Inselhalle

Robert Huber
Proteases and Their Control in Health and Disease

12.30
Plenary Lecture
Inselhalle

Harold W. Kroto
Four Horsemen of the 21st Century Apocalypse

13.00
Catering Tent

Lunch Break
Access: for young researchers only

15.00
Panel Discussion
City Theatre

Panel Discussion: Why Communicate?

Simon Engelke
Founder of Storage4, Maastricht University

Walter Gilbert
Department of Molecular and Cellular Biology, Harvard University

Brian K. Kobilka
Department of Molecular and Cellular Physiology, Stanford University

Harold W. Kroto
Department of Chemistry and Biochemistry, The Florida State University

Beatrice Lugger
Deputy Scientific Director, National Institute for Science Communication

Ada E. Yonath
Department of Structural Biology, Weizmann Institute of Sciences

Moderator: Adam Smith
Editorial Director, Nobel Media AB

16.30

Break

17.00
Discussion
Hotel Bay. Hof

Werner Arber
Discussion with young researchers

17.00
Discussion
Altes Rathaus

Theodor W. Hänsch
Discussion with young researchers

17.00
Discussion
Landratsamt

Avram Hershko
Discussion with young researchers

17.00
Discussion
Altes Rathaus

Robert Huber
Discussion with young researchers

17.00
Discussion
Forum am See

Harold W. Kroto
Discussion with young researchers

17.00
Discussion
Evang. Hospital

Mario J. Molina
Discussion with young researchers

17.00
Discussion
Altes Rathaus

K. Alex Müller
Discussion with young researchers

18.30

Break

19.00
Social Function
Inselhalle

Bavarian Evening
upon invitation of the Elite Network of Bavaria and the Free State of Bavaria

Words of Welcome
Wolfgang Heubisch
Bavarian State Minister of Sciences, Research and the Arts

Bavaria - Land of Science and Research
Robert Huber
Max Planck Institute of Biochemistry

Current Research Projects in the Elite Network of Bavaria
Nadja Bertleff, Thomas Hopf

Presentation of the Elite Network Design Award
Victoria Raab

Bavarian Buffet Dinner

Bavarian Music & Folk Dance

Access: all participants

07.15
MS Sonnenkönigin

Baden-Württemberg Boat Trip to Mainau Island
upon invitation of the State of Baden-Württemberg
Access: Laureates, young researchers, guests;
access for Media by invitation only

07.15
Lindau Harbour

Check in (Lindau)

07.45
Lindau Harbour

Departure (Lindau)

08.00
Bad Schachen

Arrival (Hotel Bad Schachen)

08.15
Bad Schachen

Departure (Hotel Bad Schachen)

Welcome
Theresia Bauer
Minister of Science, Research and the Arts, Baden-Württemberg

10.20
Mainau Island

Arrival (Mainau Island)

11.00
Closing Session
Mainau Island
Castle Meadow

Induction of a New Member to the Honorary Senate of the Foundation Lindau Nobelprizewinners Meetings
Marcus Storch
Chairman of the Nobel Foundation 2005 - 2013

Challenges to Peace and Justice in the 21st Century
A conversation between a statesman, politician and diplomat José Ramos-Horta and religious leader and peace ambassador Gunnar Stålsett

José Ramos-Horta
Nobel Laureate (Peace, 1996)

Gunnar Stålsett
Bishop Emeritus of Oslo, Member of the Nobel Peace Prize Committee

Moderator: Fred Guterl
Executive Editor, Scientific American

Panel Discussion: Green Chemistry

Michael Braungart
Founder and Scientific Director,
EPEA Internationale Umweltforschung GmbH

Steven Chu
Physics Department, Stanford University

Mario J. Molina
Centro Mario Molina para Estudios Estratégicos sobre Energía y Medio Ambiente A.C.

Moderator: Fred Guterl
Executive Editor, Scientific American

Access: all participants

13.00
Lunch Break
Mainau Island

Lunch Break
upon invitation of the State of Baden-Württemberg

15.30
Castle Courtyard

Conclusion & Farewell
Countess Bettina Bernadotte
President of the Council

16.30
Mainau Harbour

Departure (Mainau Island)
Boat Trip from Mainau Island to Lindau
upon invitation of the State of Baden-Württemberg

Access: Laureates, young researchers, guests;
access for Media by invitation only

18.30
Bad Schachen

Arrival (Hotel Bad Schachen)

18.45
Lindau Harbour

Arrival (Lindau)

Note: For all participants departing on Friday and not returning to their hotel: No travel luggage may be taken on the boat. Two luggage buses will be available; please place your luggage accordingly.
a) to "Mainau Island": for those not returning to Lindau. Pick-up at main entrance on Mainau Island.
b) to "Lindau": for those leaving directly after their return to Lindau. Pick-up at Lindau harbour.

Certificates of Attendance will be available on the boat.

LECTURE ABSTRACTS *(in alphabetical order by last name)*

Peter Agre

Aquaporin Water Channels: From Atomic Structure to Malaria

Session: Wednesday, 3 July 2013, 10.00 hrs

Aquaporin (AQP) water channel proteins enable high water permeability of certain biological membranes. Discovered in human red cells but expressed in multiple tissues, AQP1 has been thoroughly characterized and its atomic structure is known. Expression patterns of the thirteen known human homologs predict phenotype. Individuals lacking Colton blood group antigens have mutations in AQP1. In people with no AQP1, lack of water causes defective urine concentration and reduced fluid exchange between capillary and interstitium in lung. Mutations in AQP0, expressed in lens fiber cells, result in familial cataracts. Mutations in AQP2, expressed in renal collecting duct principal cells, result in nephrogenic diabetes insipidus. AQP2 underexpression is found in disorders with reduced urinary concentration, AQP2 overexpression in those with fluid retention.

Mistargeting of AQP5, normally expressed in the apical membranes of salivary and lacrimal gland acini, can occur in Sjogren's syndrome. Aquaporins also are implicated in brain edema and muscular dystrophy (AQP4), anhidrosis (AQP5), renal tubular acidosis (AQP6), conversion of glycerol to glucose during starvation (AQP7 and AQP9) and cystic fibrosis (several aquaporins).

Werner Arber

Cultural Values of Scientific Knowledge

Session: Thursday, 4 July 2013, 09.00 hrs

The acquisition of scientific knowledge largely depends on the availability of appropriate research approaches and methodologies. Novel scientific knowledge represents cultural values. On the one hand, it enriches our world view with impacts on our orientational knowledge. On the other hand, basic scientific knowledge can lead to technological innovations to the benefit of humans and of the environment. These general principles shall be illustrated by a look at genetic investigations in the past 70 years.

In this timespan, DNA was discovered as the carrier of genetic information; the double-helical nature of DNA molecules was described; the very long DNA molecules became dissected into specific fragments; such fragments were then spliced into natural gene vectors, which enabled the researchers to obtain sufficient material for structural and functional studies. The question of conjectural risks of recombinant DNA methodologies led to studies comparing intentionally in vitro produced genetic variants with naturally produced, spontaneous genetic variants. This revealed a high similarity of the underlying processes and thus also of conjectural risks. Biotechnology, including agricultural practices, no longer depends on chance findings in the natural biodiversity. By now, innovations based on targeted transfer of genetic information for particular, useful traits have become possible. An outlook into possible future developments will be given.

References:

W. Arber, The impact of science and technology on the civilization, Biotech.Adv.27,940-944 (2009).

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Martin Chalfie

Tickling Worms: Surprises From Basic Research

Session: Wednesday, 3 July 2013, 09.00 hrs

Research, at least my research, has never been linear. I have found that my lab and I often double back on problems after years of inactivity or go off in entirely new directions as dictated by the work and people's interests. This lack of direction results, at least in part, from the fact that I am a geneticist and mutants have an annoying, yet wonderful, habit of leading one into new areas of study. I will describe how a simple assay to look for mutants in the nematode Caenorhabditis elegans that are insensitive to touch (stroking animals with an eyebrow hair glued to a toothpick) led me and my lab to investigate problems in cell determination, cell differentiation, mechanosensory transduction and modulation, and neural circuitry and the integration of sensory signals. Along the way, these studies resulted in

the introduction of Green Fluorescent Protein (GFP) as a biological marker, several other methods, and maybe even some insights into a few human diseases. Although we actually have answered some of the questions we set out to study, the excursions far from what I thought I was studying have often been the most exciting.

Steven Chu

The Energy and Climate Change Challenges and Opportunities

Session:Wednesday, 3 July 2013, 09.30 hrs

Science and technology has profoundly transformed the world. After giving a few historical examples, beginning with the industrial revolution, I will discuss the challenges, opportunities and necessity for the world to transition to a sustainable energy future.

Aaron Ciechanover

Drug Development in the 21st Century – Are We Going to Cure All Diseases?

Session: Tuesday, 2 July 2013, 09.00 hrs

Many important drugs such as penicillin, aspirin, or digitalis, were discovered by serendipity – some by curious researchers who accidentally noted a "strange" phenomenon, and some by isolation of active ingredients form plants known for centuries to have a specific therapeutic effect. Other major drugs like the cholesterol reducing statins were discovered using more advanced technologies, such as targeted screening of large chemical libraries. In all these cases, the mechanism of action of the drug were largely unknown at the time of their discovery, and were unraveled only later. With the realization that patients with apparently similar diseases at diagnosis – breast or prostate cancer, for example – respond differently to similar treatments, and the clinical behavior of the disease differs from patient to patient, we have begun to understand that the mechanistic/molecular basis of what we thought is the same disease entity, is different. Thus, breast cancer or prostate cancers appear to be sub-divided to smaller distinct classes according to their molecular characteristics. As a result, we are exiting the era where our approach to treatment of these and many other diseases is "one

size fits all", and enter a new era of "personalized medicine" where we shall tailor the treatment according to the patient's molecular/mutational profile. Here, unlike the previous era, the understanding of the mechanism will drive the development of new drugs. This era will be characterized initially by the development of technologies where sequencing and data processing of individual genomes will be fast (few hours) and cheap (<US$ 1,000), by identification and characterization of new disease-specific molecular markers and drug targets, and by design of novel, mechanism-based drugs to modulate the activities of these targets. It will require a change in our approach to scientific research and development and to education, where interdisciplinarity will domineer and replace in many ways the traditional, discipline-oriented approach. Entry into this era will be accompanied also by complex bioethical problems, where detailed genetic information of large populations in developed countries will be available, and protection of privacy will become an important issue for health authorities.

Paul J. Crutzen

Atmospheric Chemistry and Climate in the 'Anthropocene'

Session: Wednesday, 3 July 2013, 11.30 hrs

Despite their relatively small mass, 10^{-5} of the earth biosphere as a whole, generations of ambitious 'homo sapiens' have already played a major and increasing role in changing basic properties of the atmosphere and the earth's surface. Human activities accelerated in particular over the past few hundred years, creating a new geological era, the 'Anthropocene', as already foreseen by Vernadsky in 1928: "...the direction in which the processes of evolution must proceed, namely towards increasing consciousness and thought, and forms having greater influence on their surroundings."

Vernadsky's predictions were more than fulfilled. Human activities are affecting, and in many cases out-competing, natural processes, for instance causing the 'ozone hole', the rise of greenhouse gases with their impact on climate, urban and regional air pollution, 'acid rain', with all their consequences for human and ecosystem health. These problems are also increasingly affecting the developing nations of the world. Despite the tremendous

progress that has been made, major questions remain and much research needs to be done.

There are major uncertainties regarding future human activities and their impact on climate and environmental chemistry. Some examples are given. Because major impacts, for instance global warming beyond the 'tolerable window', > 2°C or 0.2°C/decade, cannot be excluded, it is proposed that research on climate engineering should not be tabooed anymore, for instance through enhancing earth's albedo by injection of H_2S and SO_2 in the stratosphere, where it is oxidized to sulphate particles, which reflect solar radiation and thus cool earth. An alternative is injection of soot particles. The albedo enhancement should only be conducted if research shows that it leads to positive results.

Robert F. Curl Jr.

The Chemistry of Elemental Carbon

Session: Monday, 1 July 2013, 15.00 hrs

Because of its remarkable ability to make strong single, double, and triple bonds with itself, the chemistry of elemental carbon is remarkably rich. The forms of carbon containing single bonds only are the tetrahedral networks of diamond and lonsdaleite. Diamond, in particular, has valuable practical uses especially in cutting softer materials and as an efficient transporter of heat.

A completely different elemental structure is the hexagonal network of alternating single and double bonds (in aromatic resonance) of graphene. Scientific and economic interest in structures based upon this motif, as often modified by the introduction of five and seven membered rings, became intense with the discovery in 1985 that if elemental carbon vapor condenses under the right conditions molecular carbon spheroidal shells (fullerenes) form. The development in 1990 of a simple method for making macroscopic quantities of these molecules resulted in enormous interest in the fullerenes and in general in heightened interest in the structures and uses of all forms of elemental carbon. The discovery in 1992 that a single layer of graphene could roll into a tube and join edges (a single-walled carbon nanotube) and

ABSTRACTS

that this material could be produced in quantity resulted in new opportunities for studying and using this material. The theory of these tubes showed that these tubes could come in a variety of chiralities and diameters and showed that 2/3 of these varieties should conduct electricity like a semiconductor and the other 1/3 like a metal. These electronic properties and the enormous predicted tensile strength of the tubes suggested a number of important applications for these tubes. The latest major development in elemental carbon chemistry is the isolation of graphene. Although a reasonable theoretical treatment of a single graphene sheet was published in 1947 and it has been well known even longer that graphite consists of stacked layers of graphene, it was not until 2004 that a graphene sheet was isolated and its properties studied experimentally.

In spite of all these developments, we are still profoundly ignorant of the structure of charcoal – known to homo erectus a million years ago and used at least thirty thousand years ago by homo sapiens to produce the first works of art: the oldest known of which are the cave drawings at Chauvet. And our structural ignorance extends to at least two other well-known forms of elemental carbon.

Richard R. Ernst

Widen Your Scope by Extracurricular Activities: My Example.

Session: Wednesday, 3 July 2013, 12.30 hrs

Some observers might think that fierce scientific competition borders on a rat race. According to Wikipedia: "A rat race is an endless, self-defeating, or pointless pursuit. It conjures up the image of the futile efforts of a lab rat trying to escape while running around a maze or in a wheel." Surely, this analogy gives a strongly distorted view of research. Nevertheless, we scientists and science teachers must ensure that not the slightest pretence of a rat race remains in the image of competitive science. In other words, all human values that are associated with curiosity, wisdom, and creativity shall be preserved and enhanced by research. One of the best means is to encourage the development of passions in fields as remote to the research subject as ever conceivable. Such projects help to balance one's own endeavours and prevent one-sidedness.

In my personal case it is nuclear magnetic resonance with its fascinating applications in chemistry, biology, and medicine, contrasted to the mysterious world of Tibetan Buddhist painting art that establishes the necessary balance and provides revealing insights into philosophy, psychology, and religion expressed by the beauty of superb artworks. In both fields, symbolic and metaphoric languages have been developed to describe features that are difficult to express in mathematical formulae or in words.

It was a surprise to me that science is useful, after all, also for the analysis of artworks, to understand their historical context, for example by the analysis of the chemical pigments used for painting by methods such as Raman spectroscopy. Pigments contain rich information on painting history and also on the geographical provenience of paintings. It is gratifying to experience how the two ends of the thread match; indeed science and art have much in common.

References:

R. R. Ernst, "In situ Raman microscopy applied to large Central Asian paintings", J. Raman Spectrosc. 2010, 41, 275-287.

R. R. Ernst, "A chemist remains a chemist", Angew. Chem. Int. Ed. Engl. 2013, 52, 61-67.

Gerhard Ertl

Catalysis at Surfaces: From Atoms to Complexity

Session: Monday, 1 July 2013, 09.30 hrs

Catalysis by solid surfaces is, among others, of importance for the chemical industry (e.g. the Haber-Bosch process) as well as for environmental chemistry (car exhaust catalyst). Surface physical techniques enable investigation of the underlying elementary processes on atomic scale, as will be exemplified mainly by carbon monoxide oxidation. Under certain steady-state conditions such an open system may exhibit characteristic phenomena of complexity such as the formation of spatio-temporal concentration patterns which may be considered as models for self-organisation in various other areas of nature.

Robert H. Grubbs

Green Chemistry and Catalysis

Session: Tuesday, 2 July 2013, 12.30 hrs

Much of the chemical industry is based on processes that were developed decades ago. The change in the cost of petroleum carbon and energy sources and the need to control emissions of carbon dioxide and other pollutants will change the rules of the industry. As the rules change new processes will be required. Catalytic processes provide green routes to many old and new chemicals and open new sources of carbon. We will use examples from our work on olefin metathesis to give examples of how catalysis can be used to meet the challenges imposed by the changing conditions.

The conversion of bio-renewable sources of carbon into known chemical intermediates or new materials will often require the removal of functionality (or reduction) since most bio-renewable sources of carbon are over oxidized. This will require new catalytic processes to replace those that have been developed using petroleum as a carbon source that are focused on the introduction of functionality instead of its removal. Of the readily available bio-renewable carbon sources, seed oils are the most reduced materials. Since the fatty acids in these systems are mostly unsaturated, they are easy to modify. The cleavage of the double bond by the use of olefin metathesis catalysts results in a hydrocarbon and a functional olefin. The hydrocarbon can be utilized as a fuel or normal petrochemical and the functionalized part can be utilized as a chemical intermediate. This process is now being developed on a significant scale.

Each step in a synthetic process generates wastes. Catalysts can eliminate steps and protecting groups. Examples will be given where catalytic processes can be much more efficient than the present transformations.

An important area of green chemistry that is often ignored is the replacement of polluting materials with those that are more benign. Such materials can be easier to recycle or are less polluting. For example, pesticides allows the efficient production of food stuffs, however, they are persistent and have shown significant environmental problems. The development of

alternative methods such as those based on pheromones could significantly reduce the impact of pest control. Recently, a family of catalysts has been developed that promises to provide cost effective routes to the production of an array of pheromones.

Theodor W. Hänsch

What Can We Do With Laser Frequency Combs?

Session: Thursday, 4 July 2013, 11.00 hrs

The spectrum of a frequency comb, commonly generated by a mode-locked femtosecond laser consists of several hundred thousand precisely evenly spaced spectral lines. Such laser frequency combs have revolutionized the art measuring the frequency of light, and they provide the long-missing clockwork for optical atomic clocks. The invention of the frequency comb technique has been motivated by precision laser spectroscopy of the simple hydrogen atom. The availability of commercial instruments is facilitating the evolution of new applications far beyond the original purpose. Laser combs are becoming powerful instruments for broadband molecular spectroscopy by dramatically improving the resolution and recording speed of Fourier spectrometers and by creating new opportunities for highly multiplexed nonlinear spectroscopy, such as two-photon spectroscopy or coherent Raman spectroscopy. Other emerging applications of frequency combs range from fundamental research in astronomy, chemistry, or attosecond science to telecommunications and satellite navigation.

Serge Haroche

Controlling Photons in a Box and Exploring the Quantum to Classical Boundary

Session: Monday, 1 July 2013, 11.30 hrs

The founders of quantum theory assumed in "thought experiments" that they were manipulating isolated quantum systems, obeying the counter-intuitive laws which they had just discovered. Technological advances have recently turned these virtual experiments into real ones by making possible the actual control of isolated quantum particles. Many laboratories are realizing such experiments, in a research field at the frontier between physics and information science. Fundamentally, these studies explore the transition between the microscopic world ruled by quantum laws and our macroscopic environment which appears "classical". Practically, physicists hope that these experiments will result in new technologies exploiting the strange quantum logic to compute, communicate or measure physical quantities better than was previously conceivable. In Paris, we perform such experiments by juggling with photons trapped between superconducting mirrors. I will give a simple description of these studies, compare them to similar ones performed on other systems and guess about possible applications.

Avram Hershko

The Ubiquitin System

Session: Thursday, 4 July 2013, 10.00 hrs

The selective degradation of many short–lived proteins in eukaryotic cells is carried out by the ubiquitin-mediated proteolytic system. In this pathway, proteins are targeted for degradation by covalent ligation to ubiquitin, a highly conserved small protein. The ligation of ubiquitin to protein involves the successive action of three types of enzymes: the ubiquitin-activating enzyme E1, a ubiquitin-carrier protein E2 and a ubiquitin-protein ligase, E3. The selectivity and the regulation of the degradation of a specific protein are usually determined by the properties of its specific ubiquitin ligase (E3) enzyme. We have been studying two ubiquitin ligase complexes that have

important roles in different aspects of cell cycle regulation. One is the Anaphase-Promoting Complex/Cyclosome (APC/C), which acts on mitotic cyclins and some other cell cycle regulators whose degradation is essential for exit from mitosis. A different ubiquitin ligase complex, SCF^{Skp2} (Skp1-Cullin-F-box protein-Skp2) is involved in the degradation of p27, a mammalian G1 Cdk inhibitor, in the G1 to S-phase transition.

Work from other laboratories has shown that ubiquitin-mediated degradation of regulatory proteins is involved in a large variety of basic biological processes including the control of cell proliferation, inflammation and immunity, embryonic development, signal transduction and gene expression. Abnormalities in protein degradation are involved in diseases such as some types of cancer and neurodegenerative disorders. The mode of the involvement of the ubiquitin system in cancer will be discussed in some detail.

Recommended Reading

Hershko, A. (2005) The ubiquitin system for protein degradation and some of its roles in the control of cell division (Nobel lecture). Cell Death Differ. 12, 1191-1197.

Hershko, A. (2009) Some lessons from my work on the biochemistry of the ubiquitin system. J. Biol. Chem. 284, 10291-10295.

Robert Huber

Proteases and Their Control in Health and Disease

Session: Thursday, 4 July 2013, 12.00 hrs

Proteolytic enzymes catalyse a very simple chemical reaction, the hydrolytic cleavage of a peptide bond. Nevertheless, they constitute a most diverse and numerous lineage of proteins. The reason lies in their role as components of many regulatory physiological cascades in all organisms. To serve this purpose and to avoid unwanted destructive action, proteolytic activity must be strictly controlled. Control is based on different mechanisms which I will discuss and illustrate with examples thereby focussing on intracellular proteases.

The regulatory principles seen offer opportunities for therapeutic intervention.

The basis of the studies described and of molecular biology in general is X-ray diffraction of crystals, discovered by Laue in 1912 in München. We celebrated the Laue Centennial in the year 2012. With a few slides, I shall commemorate history and the development of Laue's discovery which revolutionized many fields of science.

Brian K. Kobilka

G Protein Coupled Receptors: Challenges for Drug Discovery

Session: Monday, 1 July 2013, 09.00 hrs

G protein coupled receptors (GPCRs) conduct the majority of cellular responses to hormones and neurotransmitters, and are therefore the largest group of pharmaceutical targets for a broad spectrum of diseases. Identification of genes for GPCRs, initially through cloning and subsequently through database mining, raised hopes for the rapid discovery of new therapeutics. However, the number of new approved drugs for GPCR targets over the past two decades has fallen short of expectations. I will discuss challenges in GPCR drug discovery and the potential impact of structural biology and other scientific advances on future drug discovery efforts.

Walter Kohn

Macular Distortion – Diagnosis and Correction

Session: Tuesday, 2 July 2013, 15.00 hrs

Age-related Macular Degeneration (AMD) is globally the leading cause of blindness for persons aged 65 or over. Early stages or mild forms of AMD allow some vision, though distorted. Our research aims to diminish the perceived distortions. A status report, including a demonstration, will be presented.

Harold W. Kroto

Four Horsemen of the 21st Century Apocalypse

Session: Thursday, 4 July 2013, 12.30 hrs

The "Common Sense" that is needed to survive does not necessarily provide correct answers to the way the Universe works. Science is actually not that old, it really only started in about the 16th Century and was a byproduct of "The Enlightenment". This lecture probes the reasons why it was not born earlier as well as the circumstances surrounding the traumatic events and brave people who were responsible for the difficult birth and its detachment from the dogma-based mystical constructs that had been accepted as "true" heretofore. Science is actually a direct consequence of Natural Philosophy which is the only philosophical construct we have devised to determine truth with any degree of reliability and Natural Philosophy is the bedrock of "Enlightened" thinking.

Science was actually born when the "odd" motions of the planets, in particular the orbit of Mars, were determined to be ellipses with the Sun at one focus and the underlying Laws of Classical Mechanics codified by Newton. Prior to this moment humans relied on common sense and empirical observation but had no understanding of the underlying principles which controlled the way objects, such as the Sun, planets and apples (!), moved. We owe a great debt to Galileo, Kepler and others, such as Giordano Bruno, who was executed for fighting for the freedom to doubt and question authority based on dogma, that today there is some freedom to doubt in some countries. These freedoms were recognised by people like Spinoza, Hume and Kant in Europe and in North America by the architects of the US Constitution: Paine, Jefferson, Madison and Franklin as fundamental planks of Democracy. In the latter half of the 20th Century we in the West have taken these freedoms for granted but now as the 21st begins there is strong evidence that they are being eroded quickly. Indeed it is interesting to note that only where Natural Philosophy has managed to survive and counteract dogma to some degree are both Science and Democracy significant factors in society. The Enlightenment, and in fact the survival of the Human Race itself, are now under threat and four of the major enemies are highlighted in this presentation.

Jean-Marie Lehn

Perspectives in Chemistry – Towards Adaptive Chemistry

Session: Tuesday, 2 July 2013, 10.00 hrs

Supramolecular chemistry lies beyond molecular chemistry. It aims at implementing highly complex chemical systems from molecular components held together by non-covalent intermolecular forces and effecting molecular recognition, catalysis and transport processes.

A further step consists in the design of systems undergoing self-organization, i.e. systems capable of spontaneously generating well-defined functional supramolecular architectures by self-assembly from their components, thus behaving as programmed chemical systems.

Supramolecular chemistry is intrinsically a dynamic chemistry in view of the lability of the interactions connecting the molecular components of a supramolecular entity and the resulting ability of supramolecular species to exchange their components. The same holds for molecular chemistry when the molecular entity contains covalent bonds that may form and break reversibility, so as to allow a continuous change in constitution by reorganization and exchange of building blocks. These features define a Constitutional Dynamic Chemistry (CDC) on both the molecular and supramolecular levels. CDC takes advantage of dynamic constitutional diversity to allow for variation and selection in response to either internal or external factors to achieve adaptation.

The implementation of selection in chemistry introduces a fundamental change in outlook with respect to the usual molecular chemistry. The combination of dynamics and reversibility with constitutional and structural diversity points towards the emergence of Adaptive and Evolutive Chemistry on the way towards Complex Matter.

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Lehn, J.-M., From supramolecular chemistry towards constitutional dynamic chemistry and adaptive chemistry, Chem. Soc. Rev. 2007, 36, 151.

Lehn, J.-M., Perspectives in Chemistry – Steps towards Complex Matter, Angew. Chem. Int. Ed. 2013, 52, 2836-2850.

Rudolph A. Marcus

Single Molecule Studies of Initial Steps in Dye Sensitized Solar Cells and of Quantum Dots – Examples of Electron Transfer and Relation to Ensemble Studies

Session: Tuesday, 2 July 2013, 11.30 hrs

We consider two fields of single molecule studies of intermittently fluorescing systems. In both fields the intermittency is assumed to involve diffusion controlled electron transfer. One of these studies involves the initial steps in dye-sensitized semiconductor systems, in which an electron is injected from a photo-excited dye molecule into the conduction band of a semiconductor, for example, into a film of sintered nanoparticles or a crystal, or into the band gap of the semiconductor. The theory has as a consequence a diffusion-based power law for the distribution of waiting times P (times between events) for the return of the electron to the dye. The plot of log P versus log t has a slope of of -1, consistent with diffusion for the given geometry. When the electron injection is instead into the band gap, a power law is also predicted for the injection, again with a power of -1. The presently sparse existing data are consistent with these findings, and will be discussed. We also consider the interplay between single molecule and ensemble studies and the role of time scales in understanding some of the relationships.

Another study of intermittent fluorescence is that on semiconductor quantum dots, whose behavior is assumed to be due to a "structural-diffusion"(spectral diffusion) together with an electron transfer at and also beyond the surface. Among the many data are a power law for the distribution of waiting times with a slope of around -1.5 for the 'dark' state and also for the 'light' state, with the latter having in addition an exponential tail whose onset depends on the intensity of the excitation light. Biexcitons have been recently invoked in an explanation of the tail. Theory is evolving and a comparison with experiment is given. The complementarity of single molecule and ensemble studies again plays a role in the analysis.

These studies were made in collaboration with Drs. Wei-Chen Chen and Zhaoyan Zhu.

Hartmut Michel

Structure and Mechanism of Otto Warburg`s Respiratory Enzyme, the Cytochrome c Oxidase

Session: Monday, 1 July 2013, 12.30 hrs

The oxygen, you breathe in, is converted to water by cytochrome c oxidase, using electrons provided by cytochrome c and protons from the aqueous milieu of the body. This fundamental enzyme has been discovered already in 1886, and studied extensively by Otto Warburg, who worked in Berlin, Germany, and received the Nobel Prize "for his discovery of the nature and mode of action of the respiratory enzyme" in 1931, and by David Keilin in Cambridge, England. Nevertheless, hundreds of scientists still try to work out its function and mechanism of action.

Otto Warburg did not know: Cytochrome c oxidase is located in the inner membranes of mitochondria and of many prokaryotes. The electrons are provided from the outer side of the membrane, whereas the protons originate from the inner side. This separation of the charged substrates leads to the generation, upon water formation, of an electric voltage across the membranes. This electric voltage is enhanced by the additional "pumping" of protons across the mitochondrial or bacterial membranes. The electric voltage ("membrane potential") and to a minor extent the transmembrane pH gradient drive protons back via the ATP-synthase leading to the synthesis of the universal biological energy carrier adenosine-5'-triphosphate ("ATP") from adenosine-5'-diphosphate ("ADP") and inorganic phosphate.

Despite the fact that we have published the first atomic structure of a cytochrome c oxidase already in 1995 the reaction catalysed by the cytochrome c oxidase is understood insufficiently and the subject of controversial discussions. There are proton transfer pathways in the enzyme which allow and control the access of protons, required for water formation, to the active site. One of these pathways is also used for protons to be pumped. More recently we have determined the structure of a cbb_3 type cytochrome c oxidase. These enzymes are essential for biological nitrogen fixation, and for the pathogenicity of some bacteria like Helicobacter and Campylobacter.

The cbb_3 type cytochrome c oxidases show a very high affinity for oxygen and possess only one proton transfer pathway. Nevertheless they pump protons. For all cytochrome c oxidase it is unclear which chemical entity is bound to the active site when the enzyme is in its oxidized form. Evidence will be presented that the oxidized form contains a peroxide dianion, the classical reaction cycle of the enzyme may have to be revised completely.

Mario J. Molina

Communicating Climate Change Science

Session: Thursday, 4 July 2013, 09.30 hrs

Climate change represents one of the most serious challenges that society is facing in this century. It is important for humanity to limit its interference with the climate system by profoundly modifying activities such as burning fossil fuels and deforestation, a change that amounts to having a second industrial revolution. For this purpose, it is necessary to communicate to the public and to decision makers in government, with clarity and objectivity, the causes, consequences and solutions to climate change, so that society implements without much delay the necessary actions to confront the challenge.

Although there remain uncertainties in our understanding of the science of climate change, such as those connected with the feedback effects of clouds and aerosols, the scientific foundation of the problem is very well established, and is based to a large extent on laws of physics and chemistry discovered at the beginning of the 20th century. The average temperature of the Earth's surface has increased so far by about 0.8 degrees Celsius, and there is a very clear consensus among experts that this increment is a consequence of human activities. Furthermore, it is clear that the risk of causing changes in the climate system with potentially catastrophic consequences increases rapidly if the average surface temperature of the planet increases three or more degrees Celsius.

Extreme weather events such as heat waves, floods and droughts have occurred with increased frequency in recent years. An important question is

whether there is any connection between such events and climate change. Until a few years ago the scientific community stated that there was no statistical evidence to give a positive answer to the question. However, more recently, scientists have published a series of papers indicating that there is indeed a connection. The confusion was due in good measure to the way the question was asked: there is indeed little, if any direct evidence that specific extreme events are caused by climate change; on the other hand, evidence is accumulating that the intensity of many such events has increased recently, and that the probability that this increment is a consequence of climate change is indeed significant. For example, a recent report based on satellite measurements of surface temperatures in the northern hemisphere indicates that the probability of occurrence of heat waves, defined as those with temperature departures from the 1950's mean reaching three standard deviations, has increased tens of times in the last 50 years; the report attributes the increment to the change in composition of the atmosphere, which is in turn caused by human activities. Yet another paper that appeared in the literature recently examined six specific extreme events that took place in 2011, including the Texas and northern Mexico drought that had sizeable economic consequences, the conclusion being that five of the six events were connected with climate change; the exception, namely a flood in Thailand that also had important economic consequences, was not connected with climate change, as the amount of rain in the affected region was not really unusual; the problem was caused by changes in river basins carried out by society. Yet another example of an extreme weather event was Hurricane Sandy, which had devastating consequences in the East Coast of the United States in 2012. Here again, experts did not try to establish that the hurricane was caused by climate change, but rather investigated if the intensity and other characteristics of the storm were affected by climate change, and concluded that there was indeed a very likely connection. Among other factors, the surface temperature of the oceans affects quite substantially the power of a hurricane. The overall conclusion is that climate change poses a threat not only to future generations towards the end of the century, but also to our children and to our own generation.

Experts agree as well that a solution to the climate change challenge is indeed feasible, although by no means easy, and it requires implementing many actions simultaneously. These include using energy much more efficiently in the transportation, construction and industrial sectors, as well as reducing emissions of carbon dioxide caused by burning fossil fuels both by utilizing renewable energy sources such as wind, geothermal and biomass, and possibly also by developing and using safer nuclear energy power plants. A number of leading environmental economists estimate the cost of such measures as something between -1% and 3% of global GDP, the most likely number being between 1 and 2% per year. It is clear that the cost of not taking the necessary measures is larger, considering the damage caused by droughts, floods, forest fires, intense hurricanes, etc. In addition, it appears that the countries that will be most affected are those with least resources, which makes it imperative for the entire planet to seek an equitable solution to the problem.

Furthermore, given the uncertainties in our understanding of climate change science and likely future emissions of greenhouse gases, one cannot rule out temperature increments of more that 4 or 5 degrees Celsius towards the end of the century. The associated risk is unacceptable for society. It is important to clarify, though, that science itself does not tell us what to do; it can only inform us what is likely to happen as a consequence of our activities. It is, thus, an ethical responsibility for us and for society as a whole to respond to the messages conveyed by climate change science, in order to insure that the human population can enjoy now and in the future a quality of life at least as good as the one many of us have today.

K. Alex Müller

Novel Synthesis for Ceramics: Superconductors, Magnets and Others

Session: Thursday, 4 July 2013, 11.30 hrs

The discovery of superconductivity in hole doped La_2CuO_4 was motivated by the interest to find this phenomenon in an oxide. After the discovery near 35 K, copper oxides with transition temperatures of up to 131 K at normal pressure were found, i.e. above the boiling temperature of inexpensive liquid nitrogen. Therefore the interest in applications rose quickly. These occur in two different areas: In the weak current field as e.g. high Q resonators in communications or SQUIDS (Superconducting Quantum Interferometers) for accurate magnetic field detection. The other prospect was the high current field, as in generators of large magnetic fields, current transport in cables or current limiters to protect generators, to name just a few of the more important applications.

Early on it became clear what the requirements for the superconducting cuprates are: pure phases, oriented crystallites for optimum superconducting current and the necessity to overcome the notorious brittleness of oxides. Over the past quarter of the last century this goal has been met by a global effort in many laboratories to such an extent that it is comparable to the quality achieved in semiconductor technology, especially for silicon. At the start, to reach such a high degree of technology, it appeared an impossible reachable goal. The products who meet these requirements have as a consequence a price. For the low current applications where there are no alternatives to the superconducting devices – such as square filters in communications or the sensitivity of SQUIDS – the price is not impeding their use. Also the HTS superconductor is deposited on a rigid surface and not prone to mechanical strain. The latter situation is considerably different in large current applications where the current is carried in more or less flexible cables.[1)]

In the latter case two methods have been developed, the first one based on a nearly conventional drawing process and the other on thin film deposition. The first consists of introducing the HTS Material in powder form in a silver tube, which is then drawn in successive steps and annealed. The first generation wires were manufactured by this “Powder In Tube” i.e. PIT method. It is restricted to the Bi–Cuprates because the crystals cleave easily. Cleavage takes place during drawing between neighboring BO planes weakly bound by van der Waals forces. Platelets having their large faces parallel to the CuO_2 planes are formed. Current in the planes flows parallel to the platelets, and passes from one platelet to another through their larger faces. Multifilamentary Bi-2223 and Bi-2212 wires and tapes are commercially produced in kilometer lengths [2)]. The second method consists of growing HTS films on

suitably oriented substrates. It is used for YBCO or the "123" family cuprates which do not cleave easily. The reduced anisotropy of YBCO makes it a more desirable superconductor than the Bi-2223 or 2212 because of the better vortex pinning. Here contact occurs between YBCO grains and is only through alignment of the grains present. It requires hetero-epitaxial growth on well oriented substrates. Manufacturing these "coated conductors" involves deposition of up to a dozen different layers starting with i.e. NiW alloy tapes or Haste alloy. The RABITS (Rolling Assisted Bi-axially Textured Substrate), or the IBAD (Ion Beam Assisted Deposition) methods to which various "buffer" layers are added [2].

To reach optimal current carrying properties in either, the powder in tube or the RABITS and IBAD processes requires a careful adjustment of the oxygen content of the doped cuprate used. This is carried out by letting the strand transverse a sequence of regions at various temperatures, and implies long-term (for tens of hours) heating of reactants in powder form at high temperatures (800º-1200ºC) in a furnace, which is a highly time and energy consuming process and increases product costs. Therefore there is a significant effort to develop technologies to considerably reduce the solid state reaction temperature and time. Here it appears that a novel formation procedure discovered at the Tiblissi State University in Georgia under the leadership of Prof. Alexander Shengelaya may be employed, especially in the production with the RABBIT or IBAD technologies: In a collaboration of the group of Shengelaya and the chemistry department in Tiblissi a solid state synthesis of oxide materials was found, which enables a dramatic increase of the reaction speed along with lowering the temperature of the reaction. This method involves the irradiation of the mixture of starting oxides by light in a broad spectral range from infrared to ultraviolet with intensities sufficient for starting the solid state reaction between the reagents contained in the powder mixture. It was shown that the rate of the resulting reaction exceeds the conventional thermal solid state reaction rate in a furnace by about two orders of magnitude in thin film HTS materials [3]. This novel reaction method can as well be used to produce thin film magnetic materials. Because oxides become more and more important in other applications e.g. in catalysis it may receive sufficient attention.

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G. Deutscher, New Supereconductors. World Scientific Publ. Co. Pte. Ltd. 2006 New Jersey etc. Chapter 9. Page 189 & ff.

A. Shengelaya[1], D. Daraselia[1], D. Japaridze[1], Z. Jibuti[1], K. A. Müller[2], to be submitted for publication 2013 and int. patent application 15. Jan. 2013.

Erwin Neher

Chemistry Helps Biology: Fluorescent Labels and Caged Compounds

Session: Tuesday, 2 July 2013, 09.30 hrs

Modern imaging techniques have transformed the biosciences. Genetically encoded fluorophores, as well as synthetic fluorescent dyes allow researchers to specifically label proteins and to monitor second messengers, such as the concentration of intracellular Ca^{++} ions ($[Ca^{++}]$). Furthermore, novel methods of ultra-resolution light microscopy produce images of the labeled substances at sub-micrometer resolution. Last but not least, light can be used as a tool to manipulate cellular processes by means of caged compounds and light-activated proteins.

I will give a short overview over these recent developments and report on one example from our own work: the use of caged-Ca^{++} to calibrate the Ca^{++} dependence of neurotransmitter release.

Synaptic transmission is a complicated process, by which two neurones communicate with each other. The 'presynaptic' neuron sends a signal by releasing a substance – the neurotransmitter. This diffuses across a thin gap to the receiving or "postsynaptic" neuron. Binding to special receptors, the neurotransmitter opens ion channels in the membrane, leading again to an electrical signal. This multistep process happens within a fraction of a millisecond.

It has been known since the early 1960s that neurotransmitter release is initiated by an influx of calcium ions into the presynaptic nerve terminal. This

leads to an increase in intracellular calcium concentration ($[Ca^{++}]_i$), which – in turn – causes small vesicles (which contain the neurotransmitter) to fuse with the cell membrane and to release their contents. It has also been known for long that the Ca^{++} influx occurs through ion channels, which are specific for the permeation of Ca^{++} ions and which open in response to the nerve impulse. These channels must be located very close to synaptic vesicles. Only at close distance can they elicit the release within the shortest time possible. However, it has not been known until recently, how short the distances between ion channels and vesicles are and how much the local Ca^{++} signal must rise, in order to elicit the proper response.

$[Ca^{++}]$ can be measured using so-called Ca^{++} indicator dyes, which bind calcium ions and, upon binding, change their fluorescence. Cells can be loaded with such substances and one can observe under the fluorescence microscope localized changes in fluorescence, which mirror local changes in $[Ca^{++}]_i$. This way many features of the Ca^{++} signal can be studied. However, conventional Ca^{++} imaging studies are limited by the spatial resolution of light microscopy. This means that no details of Ca^{++} signals can be observed on the length scale of 100 nm and shorter. This, however, is exactly the range of distances, which are relevant for the assemblies of Ca^{++} channels and synaptic vesicles.

In order to obtain more insight into the properties of the relevant Ca^{++} signal we borrowed another tool from chemistry: caged Ca^{++}. Such compounds, e.g. DM nitrophen are chelators, which bind Ca^{++} tightly, but are light sensitive (Ellis-Davies & Barsotti, 2005). Exposure to a flash of UV-light causes them to disintegrate and to quickly release Ca^{++}. This way we can increase $[Ca^{++}]_i$ in a step-like fashion. We use a special large nerve terminal, the Calyx of Held, which can be loaded with both a Ca^{++} indicator dye and a caged Ca^{++} compound. $[Ca^{++}]_i$ is increased by a flash of UV-light while the response of the postsynaptic cell is measured. The increase of $[Ca^{++}]$ is spatially uniform in this experiment, such that the $[Ca^{++}]$, which we measure by means of the indicator dye is the same, which acts on the vesicle. Thus, we can calibrate the biological sensor for $[Ca^{++}]$, or more precisely: We can establish a quantitative relationship between the speed of the response and the amplitude of

the $[Ca^{++}]$ signal. Once we have established such a 'dose-response-curve', we can ask what $[Ca^{++}]_i$ is required to achieve a response as fast and large as the physiological one. Such reasoning, together with a more quantitative biophysical model of the release mechanism, allows one to conclude, that the effective Ca^{++} signal at the location of the vesicle has an amplitude of about 20 µM and lasts for less than a millisecond. Further biophysical modeling shows that such signals are expected to occur at distances of 30 to 50 nm from Ca^{++} channels, when these open for sub-millisecond periods.

Using caged-Ca^{++} we were able to learn indirectly about processes, which happen on length-scales below the limit of conventional light microscopy. More recently new methods of 'super-resolution light microscopy' have been introduced, by which objects separated by 50 to 100 nm can be resolved (Berning et al., 2012). Here again advances in chemistry play a major role, since the success of these methods depends critically on extreme photo stability of the chromophores and on a property, which before was of no relevance to fluorescent indicator dyes: For some of these methods the chromophores have to be photo switchable. New chromophores, synthesized during the last few years, have greatly contributed to the success of these exciting new techniques. Last but not least, fluorescent proteins, which can be expressed in a tissue-specific manner and can be linked to other proteins of interest allow for specific labeling of cellular components, opening up new options for the study of biological processes, which were beyond imagination a short while ago.

References:

Ellis-Davies, G.C.R. and R.J. Barsotti (2006). Tuning caged calcium: Photolabile analogues of EGTA with improved optical and chelation properties. Cell Calcium 39, 75-83.

Berning, S., Willig, K.I., Steffens, H., Dibaj, P. and S.W. Hell (2012). Nanoscopy in a living mouse brain. Science 335, 551

Richard R. Schrock

Advances in Olefin Metathesis Employing Molybdenum and Tungsten Catalysts

Session: Tuesday, 2 July 2013, 12.00 hrs

Olefin metathesis is an irresistable way to make C=C bonds catalytically in organic molecules[1] and polymers,[2] both as a consequence of its very nature, i.e., the synthesis of C=C bonds from C=C bonds, and because of the control that can be exercised through the use of well-defined alkylidene complexes as catalysts for those reactions. In the last several years we have been especially interested in exploring MonoAryloxide Pyrrolide (MAP) imido alkylidene complexes of Mo and W for Z-selective olefin metathesis reactions, especially complexes that contain sterically demanding 2,6-terphenoxides such as HMTO (O-2,6-(2,4,6-$Me_3C_6H_3)_2C_6H_3$), HIPTO (O-2,6-(2,4,6-$i\text{-}Pr_3C_6H_3)_2C_6H_3$), DFTO (O-2,6-$(C_6F_5)_2C_6H_3$), or related monoprotected biphenolate ligands. $Mo(NC_6F_5)(CHCMe_2Ph)(DFTO)_2$ complexes attracted our attention because analogous bisHMTO or bisHIPTO complexes could not be prepared. We also have begun to explore tungsten oxo alkylidene complexes, which were the first type of high oxidation state alkylidene species to be prepared more than 25 years ago. Highlights of some recent work on Mo- and W-based olefin metathesis catalysts will be discussed.

References:

[1] Schrock, R. R.; Hoveyda, A. H. Angew. Chem. Int. Ed. 2003, 42, 4592-4633.

[2] Schrock, R. R. Dalton Trans. 2011, 40, 7484-7495.

Dan Shechtman

Quasi-Periodic Materials – Crystal Redefined

Session: Wednesday, 3 July 2013, 11.00 hrs

Crystallography has been one of the mature sciences. Over the years, the modern science of crystallography that started by experimenting with x-ray diffraction from crystals in 1912, has developed a major paradigm – that all crystals are ordered and periodic. In-deed, this was the basis for the definition of "crystal" in textbooks of crystallography and x-ray diffraction.

Based upon a vast number of experimental data, constantly improving research tools, and deepening theoretical understanding of the structure of crystalline materials no revolution was anticipated in our understanding the atomic order of solids.

However, such revolution did happen with the discovery of the Icosahedral phase, the first quasi-periodic crystal (QC) in 1982, and its announcement in 1984 [1, 2]. QCs are ordered materials, but their atomic order is quasiperiodic rather than periodic, enabling formation of crystal symmetries, such as icosahedral symmetry, which cannot exist in periodic materials. The discovery created deep cracks in this paradigm, but the acceptance by the crystallographers' community of the new class of ordered crystals did not happen in one day. In fact it took almost a decade for QC order to be accepted by most crystallographers. The official stamp of approval came in a form of a new definition of "Crystal" by the International Union of Crystallographers. The paradigm that all crystals are periodic has thus been changed. It is clear now that although most crystals are ordered and periodic, a good number of them are ordered and quasi-periodic.

While believers and nonbelievers were debating, a large volume of experimental and theoretical studies was published, a result of a relentless effort of many groups around the world. Quasi-periodic materials have developed into an exciting interdisciplinary science.

This talk will outline the discovery of QCs and describe the important role of electron microscopy as an enabling discovery tool.

References:

[1] D. Shechtman, I. Blech, Met. Trans. 16A (June 1985) 1005-1012.

[2] D. Shechtman, I. Blech, D. Gratias, J.W. Cahn, Phys. Rev. Letters, Vol 53, No. 20 (1984) 1951-1953.

Akira Suzuki

Cross-Coupling Reactions of Organoboranes: An Easy Way for Carbon-Carbon Bonding

Session: Monday, 1 July 2013, 10.00 hrs

The palladium-catalyzed cross-coupling reaction between different types of organoboron compounds and various organic halides in the presence of base provides a powerful and general methodology for the formation of carbon-carbon bonds. The (sp^3)C-B compounds (alkylboron compounds) and (sp^2)C-B compounds (such as aryl- and 1-alkenylboron derivatives) readily cross-couple with organic electrophiles to give coupled products selectively in high yields. Recently, the (sp)C-B compounds (1-alkynylboron derivatives) have been also observed to react with organic electrophiles to produce expected cross-coupled products. Such coupling reactions offer several advantages:

As one of defects of the reaction, one would point out the use of bases. However, we could overcome the difficulty by using suitable solvent systems and adequate bases. Consequently, these coupling reactions have been actively utilized not only in academic laboratories but also in industrial processes.

In this lecture, the overview of the coupling reaction will be discussed.

John E. Walker

The Fuel of Life

Session: Monday, 1 July 2013, 12.00 hrs

The lecture will be devoted to the topic of how the biological world supplies itself with energy to make biology work, and what medical consequences ensue when the energy supply chain in our bodies is damaged or defective. We derive our energy from sunlight, which, via photosynthesis in green plants, provides high energy components in the foods that we ingest. We harvest that energy, effectively by "burning" (oxidising) the high energy components, releasing cellular energy in a controlled way to generate the fuel of life, in the form of the molecule known as adenosine triphosphate (or ATP for short). The key steps in this process take place in the mitochondria

inside the cells that make up our tissues. They serve as biological "power stations" that contain millions of tiny molecular turbines, the ATP synthase, that rotate rather like man-made turbines churning out the cellular fuel in massive quantities, which is then delivered to all parts of our bodies to provide the energy to make them function. Each of us makes and expends about 60 kg of this fuel every day of our lives. Defects in the fuel supply process are increasingly being recognised as important components of complex human diseases such as cancer, neurodegeneration and neuromuscular diseases, and they may also be part of the process of ageing.

ATP synthase found in chloroplasts has many features in common with the ATP synthases found in eubacteria and mitochondria. Their overall architectures are similar, and they all consist of two rotary motors linked by a stator and a flexible rotor. When rotation of the membrane bound rotor is driven by proton motive force, the direction of rotation ensures that ATP is made from ADP and phosphate in the globular catalytic domain. When ATP serves as the source of energy and is hydrolysed in the catalytic domain, the rotor turns in the opposite sense and protons are pumped outwards through the membrane domain, and away from the catalytic domain. The lecture will describe the common features of their catalytic mechanisms. However, the ATP synthase from chloroplasts, eubacteria and mitochondria differ in several key features, in their mechanisms of regulation and most fundamentally in the energy cost that is paid to make an ATP molecule. The most efficient ATP synthase is found in the mitochondria from multicellular animals. The ATP synthases in unicellular organisms, and chloroplasts, pay various higher costs that seem to reflect the supply of available energy in the biological niches that they inhabit.

David J. Wineland

Superposition, Entanglement, and Raising Schrödinger's Cat

Session: Monday, 1 July 2013, 11.00 hrs

In 1935, Erwin Schrödinger, one of the inventors of quantum mechanics, illustrated his discomfort with the theory by pointing out that its extension to the macroscopic world could lead to bizarre situations such as a cat be-

ing simultaneously alive and dead, a so-called superposition state. Today, we can create analogous situations on a small scale, such as putting an atom in a "bowl" and placing it on the left and right sides of the bowl simultaneously.

Superpositions can be used as clocks. For example, the wave function that describes the superposition of two different energy levels in an atom oscillates at a frequency given by the energy level difference divided by Planck's constant. The duration required to count a prescribed number of these oscillations can be used to define a unit of time such as the second. Today, atomic clocks run at rates that are uncertain at a level of only 1 part in 10^{17}.

Superpositions might also be useful for computation. For example, two energy levels in an atom, labeled "0" and "1," can be used to store information like the bits in our laptops. However, as in the atom/bowl experiment, we can arrange the quantum bit to be in a superposition, thereby storing both states of the bit simultaneously. This property leads to a memory and processing capacity that increases exponentially with the number of bits. This and a related property called "entanglement" would enable a quantum computer to efficiently solve certain classes of problems that are intractable on conventional computers. So far, scientists have constructed quantum computers composed of only a few bits, but with advances in technology, a useful processor may someday become a reality. A macroscopic quantum processor would realize a close analog to Schrödinger's cat. These topics will be briefly discussed in the context of trapped atomic ions.

Additional reading:

Nielsen, M. A. & Chuang, I. L. Quantum Computation and Quantum Information (Cambridge Univ. Press, Cambridge, UK, 2000).

"Entangled states of trapped atomic ions," R. Blatt and D. Wineland, Nature 453, 1008-1015 (2008).

Kurt Wüthrich

Conformational Plasticity of G-protein-coupled Receptors (GPCRs) Studied by NMR in Solution

Session: Wednesday, 3 July 2013, 12.00 hrs

As an introduction, some principles of nuclear spin physics applying to studies of integral membrane proteins (IMP) will be reviewed. Applications of resulting nuclear magnetic resonance (NMR) techniques will then be illustrated with studies of G-protein-coupled receptors (GPCR). GPCRs are targets for more than 30% of the presently available prescription drugs approved for use in human medicine. The family of GPCRs are IMPs located on the cell surface, where they mediate a wide range of intercellular communications. Binding of a variety of drug molecules to the extracellular GPCR surface elicits intracellular signaling by conformational changes in locations at distances of more than 30 A from the Iigand binding site. We use solution NMR techniques to collect data on the associated allostery-related conformational equilibria and rate processes. Specifically, ^{19}F NMR spectroscopy and site-specific mutagenesis is used to monitor equilibria between inactive and activated states of GPCRs, which affords novel insights into the pathways for signaling to intracellular partner proteins.

References:

Liu, J. J., Horst, R., Katritch, V., Stevens, R. C. and Wüthrich, K. (2012) Science 335, 1106-1110. Biased signaling pathways in ß2-adrenergic receptor characterized by ^{19} F-NMR.

Stevens, R. C., Cherezov, V., Katritch, V., Abagyan. R., Kuhn, P., Rosen, H. and Wüthrich, K.(2013) Nat. Rev.Drug Disc. 12, 1-10. The GPCR Network: a large-scale collaboration to determine human GPCR structure and function.

Ada E. Yonath

Curiosity and its Fruits: From Basic Science to Advanced Medicine

Session: Tuesday, 2 July 2013, 11.00 hrs

Ribosomes, the universal cellular machines that translate the genetic code into proteins, are targeted by many antibiotics that paralyze them by binding to their functional sites. Antibiotics binding modes, inhibitory actions and synergism pathways have been determined for almost all ribosomal an-

tibiotics. These indicated the principles of differentiation between patients and pathogens, suggested mechanisms leading to bacterial resistance and paved ways for improvement of existing antibiotics as well as for the design of advanced therapeutics capable of minimizing antibiotics resistance.

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PANEL DISCUSSION ABSTRACTS

Ertl, Grubbs, Kohn, Michel, Schrock

Chemical Energy Conversion & Storage

Session: Wednesday, 3 July 2013, 15.00 hrs

Our world is at present mostly running on fossil fuels – oil, coal and natural gas – using energy harnessed from the sun and stored by photosynthetic organisms many million years ago. The rapid exploitation of these valuable resources over the last 2 centuries, which are not renewable on a human time scale, has led to inevitable shortages – and the economic, social and political consequences are already being felt today. Furthermore the burning of carbon-rich fuels has increased CO_2 concentrations in the atmosphere that are related to climate changes with many adverse effects for our planet and human society. Human population and economic growth, particularly in fast-developing countries, will lead to further increases in energy demand.

It is therefore one of the great challenges of mankind to identify and develop alternative sustainable energy sources. The extensive use of nuclear energy has no support in our society and many countries therefore decided to discontinue this technology. The prospected nuclear fusion reactors are still in the early development stage. Alternative physical energy conversion techniques, for example based on hydrodynamic power, wind-propelled generators and photovoltaic devices, are increasingly used to generate electricity, but suitable techniques to directly obtain large quantities of fuels in a renewable way, e.g. to replace gasoline and diesel, are still lacking. Here the exploitation of solar energy has enormous potential. The problem is developing technologies that allow this energy source to be efficiently captured and converted not only to heat or electricity but stored in form of chemical fuels.

Chemical bonds are the best way to store energy – by far superior to batteries and mechanical devices. The efficient production of a clean storable "solar fuel" would therefore represent a very important breakthrough in the chemical sciences. Such a fuel must be made from abundant, inexpensive, non-toxic materials such as water, which could be split by light into molecu-

lar oxygen and hydrogen ("artificial photosynthesis"). Molecular hydrogen is considered the ideal primary fuel of the future, since its combustion yields only water as waste product. Furthermore it can be converted to many other important energy-rich materials (e.g. with CO_2 to methane, methanol, hydrocarbons) for further storage and transport. These compounds also have uses in other industrial sectors.

Enormous scientific, technological and economical efforts are needed to initiate the "Energiewende" (energy transition) – away from the dominance of fossil energy carriers. Future energy systems will be based substantially on renewable solar primary energy but cannot be operated without a suite of technologies of chemical energy conversion dealing with storage and interconversion of energy carriers. The central discipline in this endeavor is catalysis. In this respect much can be learned from Nature which has developed many metallo-enzymes for the conversion of small molecules with low overpotentials, high turnover numbers, long lifetimes and build-in protection and repair mechanisms.

This topic – and in particular the place of chemistry in this endeavor – will be discussed in the panel discussion with several Nobel Laureates.

Engelke, Gilbert, Kobilka, Kroto, Lugger, Yonath

Why Communicate?

Session: Thursday, 4 July 2013, 15.00 hrs

These days, with so much emphasis placed on the need for public engagement with science, the question "Why communicate?" might appear almost redundant. Isn't it obvious that scientists need to tell the world what they are doing, and that the more energy they put into doing so the better? Well, perhaps, but this panel, featuring a mix of Nobel Laureates and 'professional' science communicators (and even, in at least one case, a combination of the two!), seeks to take stock of the current science communication scene and reflect on what all this effort is for.

With more opportunities and channels for communication available than ever before, scientists are probably in closer contact with the public than at

any other period. Scientists are under increasing pressure to communicate, from funding agencies, their own universities and companies, and indeed from the media. But all this communication takes time, potentially posing the practising scientist with the dilemma: whether to focus on their research or to take time out to talk about it? On one side lies the attraction of the ivory tower, on the other the attractions of the public arena. How should one decide on the appropriate balance?

And what, in fact, do we want to achieve? Is the goal to demonstrate why scientific research is beneficial to society, or to demonstrate why scientific understanding is important in itself? If both, are these goals necessarily interrelated, or should we be trying to separate our approaches to them? These questions themselves raise the more fundamental issue of why we undertake scientific research at all, and whether scientists expect the public to engage with not only the outcomes of science, but the practice of science too. What, fundamentally, do we want to convey when we communicate 'science'?

To address questions such as these we have assembled a diverse group of panelists: four Nobel Laureates (Walter Gilbert, Brian Kobilka, Sir Harold Kroto and Ada Yonath), Beatrice Lugger, (Deputy Director of the German National Institute for Science Communication), and Simon Engelke, a student participant and entrepreneur. Together they span the range from those who take obvious joy in communicating science to those who, as a rule, prefer not to step into the limelight. The panel discussion, moderated by Adam Smith (Editorial Director of Nobel Media), will aim to devote approximately equal time to discussion within the panel and questions from the audience.

Braungart, Chu, Molina

Green Chemistry

Session: Friday, 5 July 2013, 11.00 hrs

Green chemistry can be interpreted in the narrow sense as approaches to finding new synthesizing processes by inventing and applying new cata-

lysts that avoid toxic residues. For the purposes of this panel, however, we will take a broader view by focusing on the key role of chemistry in bringing about a sustainable world – one that can handle a population that is projected to approach 10 billion people by century's end without depleting resources, spoiling habitat and catastrophically altering the oceans and atmosphere. To address this end, we have assembled a diverse panel of experts.

Our industrial processes have evolved by happenstance without much through to their aggregate impact on the planet – until recently. Michael Braungart, a pioneer in sustainable industry, will address the subject of how humans, by changing the fundamental processes by which we support our civilization, can have a positive net impact on world environments.

Michael Braungart is Academic Chair for Cradle-to-Cradle Innovations and Quality at Rotterdam School of Management at the University of Twente in the Netherlands and is founder of several commerical companies. A chemist by training, he is a pioneer in sustainability of industrial processes, and has said that humans, through sustainable practices and science, can have a net positive effect on the planet.

Steven Chu is professor of physics and molecular and cellular physiology at Stanford University. He was co-recipient of the Nobel Prize in Physics in 1997 for his work on trapping atoms with laser light. During his term as Secretary of Energy in the administration of U.S. President Barack Obama, the Dept. launched several initiatives to spur the development of new technologies. As the nation's most visible scientist, he provided an influential and rational voice on climate change and other pressing matters of scientific policy.

Mario Molina was co-recipient of the Nobel Prize in Chemistry in 1995 for his work on elucidating the threat to the atmospheric ozone layer from chloroflourocarbon gases. He has been eloquent in speaking about the need for sustainable practices in cities to contain air pollution.

Host and interviewer: Fred Guterl is Executive Editor of Scientific American magazine, which for more than a hundred years has been a respected

ABSTRACTS

of science and technology for a wide international audience. He is former Deputy Editor of Newsweek International. He has received honors from the American Association for the Advancement of Science, the Overseas Press Club, and the American Association of Magazine Editors for his writing and editing. He is author of the highly acclaimed book The Fate of the Species: Why the Human Race May Cause Its Own Extinction and How to Stop It (Bloomsbury). He makes frequent appearances as a public speaker and as a radio and television personality.

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SCIENCE BREAKFAST ABSTRACTS

Science Breakfast upon invitation of the Republic of Korea

How does Surface Science Contribute to Solve Global Energy and Environmental Issues?

Session: Monday, 1 July 2013, 07.00 hrs

The global energy and environmental crises have become essential issues for mankind. The energy crisis drives rapid developments in interface chemistry for nanocatalysts. Production of only one desired molecule that may be used as a fuel or chemical out of several thermodynamically possible molecules is called catalytic selectivity and is the foundation of "green chemistry."

In this panel discussion, we will discuss the global energy and environmental crises and the role of basic science to overcome these challenges. We will share insights and perspectives of surface science in the research of nanocatalysts, renewable energy conversion, and environmental science.

The panelists are:

Prof. Jeong Young Park, one of the leaders in the field of surface physics and chemistry, the science of surfaces and interfaces of materials.

Prof. Dr. Gerhard Ertl, who won the 2007 Nobel Prize in Chemistry "for his studies of chemical processes on solid surfaces."

Kyungtae Kang, a postdoctoral associate in the Department of Chemistry, KAIST (Korea Advanced Institute Science and Technology) working on surface organic chemistry and molecular electronics.

Surface science has been combined with nanoscience, leading to the development of novel functional materials, new catalysts, and energy conversion devices. Surface science has evolved such that new instruments for surface analysis on the molecular scale could be used in a vacuum or at realistic conditions (e.g., at high pressures and at solid-liquid interfaces where chemical processes typically operate), which has led to new physical and chemical concepts at working conditions. Overall, the materials and techniques of modern surface science may bring the breakthroughs in global energy and environmental problems the world needs.

Prof. Jeong Young Park will give a short presentation on the role of surface science in addressing the global energy and environmental crises. The presentation will be followed by discussion with the audience.

Prof. Jeong Young Park is a group leader at the Center for Nanomaterials and Chemical Reactions, IBS (Institute for Basic Science), and an Associate Professor at KAIST. He is leading the Scale Laboratory that combines surface science and catalysis with atomic-level engineering (http://scale.kaist.ac.kr/).

Prof. Dr. Gerhard Ertl is a Professor Emeritus in the Department of Physical Chemistry, Fritz-Haber-Institut der Max-Planck-Gesellschaft in Berlin, Germany. Professor Ertl's research laid the foundation of modern surface chemistry, which has helped explain how fuel cells produce energy without pollution, how catalytic converters clean up car exhaust, and even why iron rusts.

http://www.research-in-germany.de/main/researcher-portraits/nobel-laureates/73028/gerhard-ertl.html

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/2007/

The panel will be moderated by Prof. Seung Bum Park, who is a world-renowned scientist in the field of diversity-oriented synthesis and chemical biology, medicinal and combinatorial chemistry, and a Professor in the Department of Chemistry, Seoul National University.

Science Breakfast upon invitation of Mars, Incorporated

How Can Science Drive Solutions That Better Use the Planet's Resources?

Session: Tuesday, 2 July 2013, 07.00 hrs

Society is faced with a broad range of complex and interrelated resource issues, from climate change to nutrition security. At the Mars, Incorporated Science Breakfast, Adam Smith (Editorial Director of Nobel Media) will moderate a panel discussion focusing on the role of science and innovation in the improved management of our global resources. The panel will feature the views of Steven Chu (Physics Nobel Laureate and Former US Secretary of Energy) and Howard-Yana Shapiro (Chief Agricultural Officer, Mars, Incorpo-

rated and Senior Fellow in Plant Sciences, University of California, Davis), as well as a selected young researcher.

Professor Steven Chu was awarded the Nobel Prize in Physics in 1997 for his work on the development of methods to cool and trap atoms with laser light. He served as US Secretary of Energy from 2009 to 2013 and during this time launched several initiatives with the aim of fostering the development of high-risk, high-reward technologies. Prof. Chu also helped identify and recruit a dozen leading scientists and engineers to the Department of Energy to work toward a sustainable energy future. Taken together, his efforts helped double the deployment of renewable energy in the United States.

Dr. Howard-Yana Shapiro has more than 35 years experience working with sustainable agricultural and agroforestry systems, plant systems, plant genetics, and food production systems across the world. In his role as Chief Agricultural Officer at Mars, Incorporated, Dr. Shapiro is responsible for the plant science of the company's primary agricultural products, as well as the investigation of potential new plant-based solutions. Dr. Shapiro directed Mars' global cacao genome sequencing work, which was conducted in conjunction with the USDA's Agricultural Research Service and IBM, and culminated in the release of the cacao genome into the public domain in 2010. Dr. Shapiro now leads Mars involvement in the African Orphan Crops Consortium (AOCC), a cross-sector collaboration to sequence, assemble and annotate the genomes of 100 traditional African food crops to improve their nutritional value, productivity and climatic adaptability.

The discussion will bring together the panel's expertise, as well as the perspectives of the young researchers present, to explore the importance of science and technology in improving the management of our global resources. This will include a discussion of the need for new, multidisciplinary approaches that combine science, environmental considerations and economic factors. It will explore the importance of collaboration between science, government and industry in bringing about a shift in our approach to resource management, and will highlight the actions currently being taken and the steps required to address global food needs while developing productive, stable and equitable farming systems.

The Mars, Incorporated Science Breakfast will bring together the views of Laureates, industry scientists and young researchers – both on the panel and in the audience – to trigger robust discussion on the role of science and scientists in managing our global resources.

Science Breakfast upon invitation of the Austrian Federal Ministry of Science and Research

Quantum Information Processing –
Where Do We Stand And Where Do We Go?

Session: Wednesday, 3 July 2013, 07.00 hrs

Information processing is today at the heart of all sciences and plays an impact in our everyday life. Computers are very fast, classical switching machines that can solve problems by stepping very quickly through sequences of gate operations realized by changing currents and voltages in electronic devices. Over the last decades computing power increased dramatically by going to ever smaller devices that hold, store and process information in terms of binary digits (bits). It is foreseeable that this cannot continue forever since eventually the single atom/molecule level will be reached to realize the elements to store and handle information. Clearly, with very few atoms or molecules available, we enter the quantum world necessary to describe storage and processing of information. While classical information is encoded in bits, quantum features allow for the superposition of states and more, for the superposition of seemingly separable degrees of freedom, which is termed entanglement. As has been shown over the last two decades, superposition and entanglement allow for the storage and processing of quantum information, encoded for example in atomic, molecular or photonic two-level systems, so-called quantum bits (qubits). Moreover, some algorithms have been developed that promise a computing power for certain problems, which is much beyond what is available with classical computers.

This science breakfast will briefly introduce the state-of-the-art of quantum information processing, some of its platforms and its current capabilities. In the discussion, together with the panelists and students we will try to

explore what the future applications of quantum information processing and its impact on science will be.

Science Breakfast upon invitation of BASF and Chemical Industry Fund

It Is All About Chemistry.
How We Tackle the Energy Challenges of the Future!

Session: Thursday, 4 July 2013, 06.45 hrs

One of the major challenges of today and even more in the future is how to secure the energy supply for a growing world population: Energy demand is predicted to double by 2050 when over nine billion people will live on earth. With limited resources in fossil fuels, increasing prices, the carbon conundrum and its role in climate change scientists are looking for new ways to meet the needs of the growing population while safeguarding the environment.

As global challenges of this size cannot be easily solved on the basis of currently known technologies, we will explore still to be developed technologies, unconventional ideas and approaches in a world café with dedicated researchers from science and industry. Many answers will come from chemistry as key enabler for countless innovative solutions. Future-oriented innovative applications from chemical research and development are the key approach to solving these questions.

Thomas Weber, BASF's Senior Vice President Science Relations and Innovation Management, and Carla Seidel, Vice President, responsible for E-Power-Management at BASF New Business GmbH will discuss with Nobel Laureates, young scientists and a team of experienced researchers how chemistry can enable solutions to key problems in energy supply, storage and use. Which disciplines need to be connected to identify potential applications and stimulate change? What is necessary to develop energy efficient products and processes for regional markets which are at the same time robust and affordable? What are the lessons learned from Germany's energy turnaround for power researchers?

Energy Supply: With decreasing fossil resources raw material change gets a prominent place in energy scenarios. For example, methods to capture and recycle CO_2 to methanol (CCR) – renewable methanol – are increasingly translated into practical industrial use. Today CO_2 is mainly used as an industrial gas or chemical raw material, e.g. in the production of epoxy resins. How can we utilize solar energy for hydrogen generation? Are sugar and biomass options as renewable raw materials for our value chains?

Energy distribution and storage: As a prerequisite to synchronize supply and demand from intermittent renewable energy in large dimensions and improve grid capacity electrochemistry is a strategic science for Germany's energy turnaround. Which processes are sustainable and can be integrated into existing infrastructure to guarantee synchronized demand and supply (storage) and reliable transmission and distribution (grids)? How can sources of renewable energy be used more efficiently?

Use of energy: Heating and cooling, lighting, driving a car – more and more people share a contemporary lifestyle. The way we live has become the key factor for quality of life. What has chemistry to offer for the use of energy? Will research on new materials such as graphene make a difference? What is to be expected of organic electronics – energy wise?

Format: The world café is a participatory and creative process for facilitating a collaborative dialogue. It encourages knowledge and idea sharing to create a living network of conversation and action. Participants discuss in small groups. The ideas are summarized in a plenary session by the table hosts and follow-up possibilities are exchanged.

Recommended Literature:

Ausfelder, F., Isenburg, T., & Deutsche Bunsen-Gesellschaft für Physikalische Chemie. (2010). Feuerlöscher oder Klimakiller? Kohlendioxid CO2 - Facetten eines Moleküls. Frankfurt, M: Dt. Bunsen-Ges. für Physikalische Chemie.

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Kreimeyer, A. (2013). New Directions in Industrial Chemical Research as Reflected in Angewandte Chemie. Angewandte Chemie International Edition, 52(1), 147–154. doi:10.1002/anie.201208912

Schaub, T., & Paciello, R. A. (2011). A Process for the Synthesis of Formic Acid by CO2 Hydrogenation: Thermodynamic Aspects and the Role of CO. Angewandte Chemie International Edition, 50(32), 7278–7282. doi:10.1002/anie.201101292

The Meetings

The Lindau Nobel Laureate Meetings – established in 1951 – provide globally recognised forums for the exchange of knowledge between Nobel Laureates and young researchers. They inspire scientific generations and build sustainable networks of young researchers from around the world.

The participants at the Lindau Meetings are characterised by diversity. They all come from a variety of national and scientific backgrounds and have very different ways of communicating. This makes the Nobel Laureate Meetings unique in the world and a model of the kind of visionary cooperation which science will increasingly need in the future. Furthermore, scientific progress will need to be firmly anchored in international and interdisciplinary networks of individuals working together. Lindau provides the stimulus for such networks to take root and grow.

The original idea of the meetings goes back to the two Lindau physicians Dr. Franz Karl Hein and Professor Dr. Gustav Wilhelm Parade as well as Count Lennart Bernadotte af Wisborg, a member of the Swedish royal family who quickly became the spiritus rector of the Lindau Meetings. It was him who recognised the significance of the meetings for the reconciliation of the peoples of post-war Europe early and thus systematically developed it to an international forum for the exchange of knowledge between nations, cultures and disciplines.

The Organisers

The Council for the Lindau Nobel Laureate Meetings and the Foundation Lindau Nobelprizewinners Meetings at Lake Constance organise the annual meetings. The Executive Secretariat is responsible for their planning and realisation.

Countess Bettina Bernadotte af Wisborg is president of the council, which sets the course for the Lindau Dialogue concept and programme. Internationally accredited scientists from the fields of medicine, physics, chemistry and the economic sciences are members of the council. The work of the

ABOUT THE MEETINGS

council benefits from the commitment of the secretaries of the committees responsible for awarding the Nobel Prizes: at least one of the two scientific co-ordinators of each conference is a member of the institutions that select the Nobel Laureates.

The foundation was founded in the year 2000 by the council and the Bernadotte family on the initiative of 50 Nobel Laureates. Prof. Dr. h.c. Wolfgang Schürer serves as the chairman of the board of the foundation. Joint initiatives regarding the advancement of the Lindau Meetings and the establishment of an international network of academic partners are key priorities besides ensuring sustainable funding.

The Lindau Meetings enjoy widespread support. More than 260 Nobel Laureates are members of the founders' assembly of the foundation and demonstrate – through their membership and their participation in the Lindau Dialogue – their support for the principle of the Lindau Nobel Laureate Meetings. Personalities from the worlds of science, politics and industry have been inaugurated into the foundation's honorary senate in recognition of the special commitment they have shown towards scientific excellence and the promotion of young researchers.

Funding of the Lindau Nobel Laureate Meetings

The Lindau Nobel Laureate Meetings are enabled thanks to the support received from companies, associations and private patrons, on the one hand, and from national and state ministries, the International Lake Constance Conference and the European Commission on the other.

International companies, selected foundations, associations and private patrons assure the material basis for the Lindau Meetings by making donations to the assets of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance. Interest earned on the endowment, plus additional annual contributions by benefactors cover the budget of the Lindau Meetings. Donations in kind also play an important role in raising the professional level of the Meetings. The success of the Lindau Meetings can also be attributed not least to the commitment shown by the Nobel Laureates, members of the

council and the board of the foundation during the preparation, realisation and evaluation of the meetings. They all give their support on a pro bono basis.

A full list of supporters is enclosed in this programme.

The Academic Partners Network

The Lindau Nobel Laureate Meetings interact closely with a global network of academic partners to identify highly-talented young scientists and to nominate them for participation. Partners include national academies of science, ministries, research institutions, top-ranking universities, foundations and international scientific organisations. Without this support, the Lindau Nobel Laureate Meetings would not be able to identify and invite the most gifted scientific talents world-wide.

The world's best young scientists of tomorrow submit applications to attend the Lindau Nobel Laureate Meetings. An international, multi-stage selection process makes sure that the scientific elite of the future is able to come together with the Nobel Laureates in Lindau. Every year, several thousand young researchers worldwide apply.

A full list of academic partners can be found in the Participants Directory.

Lanyard Color Key

Turquoise	Nobel Laureates
Grey	Young Researchers
Red	Guests
Yellow	Journalists
Purple	Host Families & Lindau Citizens
White	Lindau Alumni (from 1980 & 1983)
Brown	Contractors of Third Parties
Orange	Contractors
Green	Council & Foundation
Black	Staff of the Executive Secretariat

ABOUT THE MEETINGS

Programme Session Types

The 63rd Lindau Nobel Laureate Meeting features a variety of session formats.

In general, the mornings usually offer plenary formats, while the afternoons add more interactive elements.

Plenary Lecture

Plenary lectures are given by Nobel Laureates only. They may choose a topic of their liking – be it their Nobel Prize research, be it something else. As the time is limited to thirty minutes, there is usually no discussion.

Plenary Panel Discussion

In a plenary panel discussion, several Laureates jointly discuss one topic. This year, three discussions are offered: on Wednesday („Chemical Energy Conversion & Storage"), on Thursday ("Why Communicate?") and on Friday („Green Chemistry").

Discussion Sessions

In the afternoon, all lectures held in the morning can be discussed in a separate discussion session. These research-oriented discussions are strictly limited to Laureates and young researchers, and switching between sessions should be avoided.

Master Class

This format will offer a most intense exchange between young researchers and Laureates, as selected young researchers present their research and then engage in an in-depth discussion with a Laureate. Attendance requires online pre-registration.

Science Breakfasts

Science breakfasts are additional options for a more informal exchange. They are organised by Lindau's partners, featuring talks, discussions and a joint breakfast with a Nobel Laureate. Attendance requires online pre-registration.

The Lindau Nobel Laureate Meetings would like to thank all maecenates, patrons and donors for their contributions to the endowment of the foundation.

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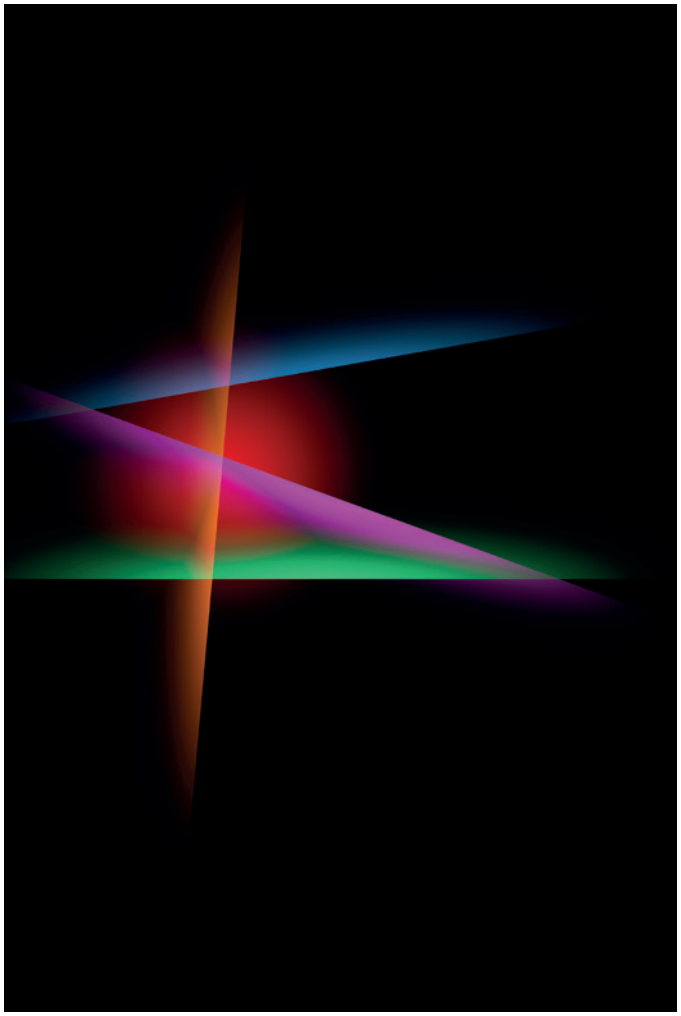

DIGITAL CONSTELLATIONS

An Art Exhibition
By Nobel Laureate Wally Gilbert
City Museum Lindau

LINDAU MAP


Inselhalle
Evangelisches Hospital
Toskanapark
City Museum
Landratsamt
City Theatre
Forum am See
Altes Rathaus
Hotel Bayerischer Hof
Lindau Harbour
Bus stop
Rotkreuz-Platz
P4
P5
Zwanzigerstraße
Auf der Mauer
Thierschbrücke
Lindenschanze
Sina-Kinkelin-Platz
Thierschstraße
Zeppelinstraße
Paradiesplatz
Unterer Schrannenplatz
Oberer Schrannenplatz
Storchengasse
Hofstattgasse
In der Grub
Schneeberggasse
Bürstergasse
Zitronengasse
Schanzgasse
Alter Schulplatz
Pfeiffergässele
Neugasse
Kaffeegässele
Schmiedgasse
Kirchplatz
Stiftsplatz
Pfaffengasse
Felsgässele
Cramergasse
Maximilianstraße
Schafgasse
Bismarckplatz
Salzgasse
Ludwigstraße
Reichsplatz
Mautgässle
Kronengasse
Bindergasse
Lingstraße
Burggasse
Barfüßer-Platz
Fischergasse
An der Kalkhütte
Gerberschanze
Kickengasse
Auf dem Wall
Kaserngasse
Hintere Insel
Dreierstraße
Graf-Lennart-Bernadotte-Straße
Bahnhof
Inselgraben
Hintere Metzgergasse
Vordere Metzgergasse
Dammgasse
Färbergasse
Brettermarkt
Rüberplatz
Schiffswerfte
Segelhafen
Römerschanze
Gustav-Kahl-Uferweg
Alfred-Nobel-Platz
Hafenpromenade
Schützinger Weg
Lindau - Bregenz
Lindau - Bad Schachen/Meersburg/Konstanz

LINDAU VICINITY MAP
LINDAU VICINITY MAP
Pestfriedhof
Unterreitnau
Rickatshofen
Bahnholz
Paradies
Dachsberg
Metzlers
Grübels
Weißensberger Weiher
Campingpark Gitzenweiler Hof
Rehlings
Bruckgraben
B 31
Hengnau
Bruggach
Taubenberg
Oberrengersweiler
Weissensberg
Niederhaus
Zeisertsweiler
Anschlußstelle Sigmarszell
B 308
Ringoldsberg
Diepoldsberg
Tunnel
Schönbühl
Kemptener Str.
Schönau
Tobel
Witzigmän
Golfplatz
Waldlehrpfad
Entenberg
Hochbuch
Heimesreutin
Schießstand
Motzach
Streitelsfingen
Bösenreutin
Bettnau
Bodolz
Hoyren
Enzisweiler
Wasserburg
LI 16
B 12
A 96
Feuerwache West
Krankenhaus
Aeschach
Wannental
Bichelweiher
Reutenen
Schachen
Lugeck-siedlung
Reutiner Straße
Schulzentrum
Reutin
Rickenbach
Techn. Hilfswerk
Feuerwache Ost
Villa Lindenhof
Lindenhofpark
Lindenhofbad
Strandbad Bad Schachen
Aeschacher Bad
Am Alpengarten
Aeschacher Ufer
Kanu/Ruderclub
Alter Friedhof-Park
ZUP Stadtbus Lindau
Kolpingstr.
Ladestraße
Stadtverwaltung
Europa Platz
Karl-Bever-Platz
Jugendherberge
Hallenbad
Landratsamt
Berliner Platz
Eislaufplatz
Strandbad Eichwald
Eichwaldstraße
Bregenzer Straße
ADAC
Kläranlage
Anschlußstelle Lindau
Oberhochsteg
Zech
Park-Camping Lindau am See
Sporthafen
Tierheim
Kleiner See
Insel Hoy
0 100 500 1000 m
Kleiner See
Seebrücke
Bootsvermietung
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Gerberschanze
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Karlsbastion
Insel
0 100 200m
Seehafen
Yachtschule
Römerschanze
Segelhafen
Segelclub
Römerbad
Schiffsrundfahrten
Kursschiffe
Bodensee
Seepromenade

BUS LINES & TIME TABLE

Special Operating Hours during the Meeting

On Monday night, 1 July, the last buses leave at 00.10 hrs from the central connection point (ZUP) and serve all stops along their lines.

On Tuesday night, 2 July, the last buses leave at 23.40 hrs from the central connection point (ZUP) and serve all stops along their lines.

How to Read the Time Table

The time table on the opposite page shows operating hours and departure times for all four lines and both directions. The first three columns (earliest, Saturday, Sunday) indicate when the earliest bus runs from each stop, while the last columns show the last service. The two middle columns (every hour at) show when buses depart between the first and last service. Example: 24/54 means that this bus departs from the station every hour at minute 24 and 54 (e.g. at 15.24 hrs and 15.54 hrs).

Bus Line #1 from Oberhochsteg via ZUP to Main Station (Island)	earliest	Saturday	Sunday	every hour at		latest
Oberhochsteg	5.24	6.24	7.24	24	54	22.24
Rickenbach	5.25	6.25	7.25	25	55	22.25
Bayerstraße	5.26	6.26	7.26	26	56	22.26
Nobelstraße	5.27	6.27	7.27	27	57	22.27
Wannental	5.28	6.28	7.28	28	58	22.28
Lugeck	5.29	6.29	7.29	29	59	22.29
Schule Reutin	5.30	6.30	7.30	30	00	22.30
Wiedemannstraße	5.31	6.31	7.31	31	01	22.31
Josefskirche	5.32	6.32	7.32	32	02	22.32
Köchlin	5.34	6.34	7.34	34	04	22.34
Blauwiese	5.35	6.35	7.35	35	05	22.35
Bodensee-Gymnasium	5.36	6.36	7.36	36	06	22.36
Anheggerstraße (ZUP)	5.40	6.40	7.40	40	10	22.40
Langenweg	5.41	6.41	7.41	41	11	22.41
Toskana	5.42	6.42	7.42	42	12	22.42
Heidenmauer	5.43	6.43	7.43	43	13	22.43
Inselhalle	5.44	6.44	7.44	44	14	22.44
Hauptbahnhof/Insel an	5.46	6.46	7.46	46	16	22.46

Bus Line #1 from Main Station (Island) via ZUP to Oberhochsteg	earliest	Saturday	Sunday	every hour at		latest
Hauptbahnhof/Insel	5.21	6.21	7.21	21	51	22.21
Altes Rathaus	5.28	6.28	7.28	28	58	22.28
Stadttheater	5.30	6.30	7.30	30	00	22.30
Maxhof	5.31	6.31	7.31	31	01	22.31
Toskana	5.33	6.33	7.33	33	03	22.33
Langenweg	5.34	6.34	7.34	34	04	22.34
Anheggerstraße (ZUP)	5.40	6.40	7.40	40	10	22.40
Bodensee-Gymnasium	5.41	6.41	7.41	41	11	22.41
Blauwiese	5.42	6.42	7.42	42	12	22.42
Köchlin	5.43	6.43	7.43	43	13	22.43
Josefskirche	5.44	6.44	7.44	44	14	22.44
Wiedemannstraße	5.45	6.45	7.45	45	15	22.45
Schule Reutin	5.46	6.46	7.46	46	16	22.46
Lugeck	5.47	6.47	7.47	47	17	22.47
Wannental	5.48	6.48	7.48	48	18	22.48
Nobelstraße	5.49	6.49	7.49	49	19	22.49
Bayerstraße	5.50	6.50	7.50	50	20	22.50
Rickenbach	5.51	6.51	7.51	51	21	22.51
Oberhochsteg an	5.53	6.53	7.53	53	23	22.53

Bus Line #2 from Unterreitnau via ZUP to Main Station (Island)	earliest	Saturday	Sunday	every hour at		latest
Unterreitnau	5.24	6.24	7.24	24	54	22.24
Eggatsweiler	5.25	6.25	7.25	25	55	22.25
Schönau	5.28	6.28	7.28	28	58	22.28
Entenberg	5.29	6.29	7.29	29	59	22.29
Hoyren	5.30	6.30	7.30	30	00	22.30
Hochbuch	5.32	6.32	7.32	32	02	22.32
Heimesreutin	5.33	6.33	7.33	33	03	22.33
Gstäudweg	5.34	6.34	7.34	34	04	22.34
Schloß Moos	5.35	6.35	7.35	35	05	22.35
Christuskirche	5.36	6.36	7.36	36	06	22.36
Anheggerstraße (ZUP)	5.40	6.40	7.40	40	10	22.40
Langenweg	5.41	6.41	7.41	41	11	22.41
Toskana	5.42	6.42	7.42	42	12	22.42
Heidenmauer	5.43	6.43	7.43	43	13	22.43
Inselhalle	5.44	6.44	7.44	44	14	22.44
Westliche Insel	5.45	6.45	7.45	45	15	22.45
Hauptbahnhof/Insel an	5.50	6.50	7.50	50	20	22.50

Bus Line #2 from Main Station (Island) via ZUP to Unterreitnau	earliest	Saturday	Sunday	every hour at		latest
Hauptbahnhof/Insel	5.26	6.26	7.26	26	56	22.26
Altes Rathaus	5.28	6.28	7.28	28	58	22.28
Stadttheater	5.30	6.30	7.30	30	00	22.30
Maxhof	5.31	6.31	7.31	31	01	22.31
Toskana	5.33	6.33	7.33	33	03	22.33
Langenweg	5.34	6.34	7.34	34	04	22.34
Anheggerstraße (ZUP)	5.40	6.40	7.40	40	10	22.40
Christuskirche	5.41	6.41	7.41	41	11	22.41
Schloß Moos	5.42	6.42	7.42	42	12	22.42
Gstäudweg	5.43	6.43	7.43	43	13	22.43
Heimesreutin	5.44	6.44	7.44	44	14	22.44
Hochbuch	5.45	6.45	7.45	45	15	22.45
Hoyren	5.47	6.47	7.47	47	17	22.47
Entenberg	5.48	6.48	7.48	48	18	22.48
Schönau	5.49	6.49	7.49	49	19	22.49
Unterreitnau an	5.53	6.53	7.53	53	23	22.53

Bus Line #3 from Oberreitnau Nord via ZUP to Grenzsiedlung/Zech	earliest	Saturday	Sunday	every hour at		latest
Oberreitnau Nord	5.23	6.23	7.23	23	53	22.23
Emersberg/Oberreitnau	5.24	6.24	7.24	24	54	22.24
Marienplatz/Oberreitnau	5.25	6.25	7.25	25	55	22.25
Kapelle	5.26	6.26	7.26	26	56	22.26
Paradies	5.27	6.27	7.27	27	57	22.27
Schönau	5.29	6.29	7.29	29	59	22.29
Entenberg	5.30	6.30	7.30	30	00	22.30
Hoyren	5.31	6.31	7.31	31	01	22.31
Krankenhaus	5.33	6.33	7.33	33	03	22.33
Holbeinstraße	5.34	6.34	7.34	34	04	22.34
Am Torggel	5.35	6.35	7.35	35	05	22.35
Aeschach	5.36	6.36	7.36	36	06	22.36
Anheggerstraße (ZUP)	5.40	6.40	7.40	40	10	22.40
Jugendherberge/LIMARE	5.42	6.42	7.42	42	12	22.42
Berliner Platz	5.43	6.43	7.43	43	13	22.43
Buttlerhügel	5.44	6.44	7.44	44	14	22.44
Kamelbuckel	5.45	6.45	7.45	45	15	22.45
Stadtwerke	5.46	6.46	7.46	46	16	22.46
Von-Behring-Straße	5.46	6.46	7.46	46	16	22.46
Gewerbegebiet	5.47	6.47	7.47	47	17	22.47
Metzeler	5.48	6.48	7.48	48	18	22.48
Versöhnerkirche	5.49	6.49	7.49	49	19	22.49
Kopernikusplatz/Zech	5.52	6.52	7.52	52	22	22.52
Leiblachstraße	5.52	6.52	7.52	52	22	22.52
Grenzsiedlung/Zech an	5.55	6.55	7.55	55	25	22.55

Bus Line #3 from Grenzsiedlung/Zech via ZUP to Oberreitnau Nord	earliest	Saturday	Sunday	every hour at		latest
Grenzsiedlung/Zech	5.25	6.25	7.25	25	55	22.25
Kunert	5.26	6.26	7.26	26	56	22.26
Metzeler	5.27	6.27	7.27	27	57	22.27
Gewerbegebiet	5.29	6.29	7.29	29	59	22.29
Von-Behring-Straße	5.30	6.30	7.30	30	00	22.30
Stadtwerke	5.30	6.30	7.30	30	00	22.30
Kamelbuckel	5.31	6.31	7.31	31	01	22.31
Buttlerhügel	5.32	6.32	7.32	32	02	22.32
Berliner Platz	5.33	6.33	7.33	33	03	22.33
Jugendherberge/LIMARE	5.35	6.35	7.35	35	05	22.35
Anheggerstraße (ZUP)	5.40	6.40	7.40	40	10	22.40
Aeschach	5.41	6.41	7.41	41	11	22.41
Am Torggel	5.42	6.42	7.42	42	12	22.42
Holbeinstraße	5.43	6.43	7.43	43	13	22.43
Krankenhaus	5.44	6.44	7.44	44	14	22.44
Hoyren	5.45	6.45	7.45	45	15	22.45
Entenberg	5.46	6.46	7.46	46	16	22.46
Schönau	5.47	6.47	7.47	47	17	22.47
Paradies	5.48	6.48	7.48	48	18	22.48
Kapelle	5.49	6.49	7.49	49	19	22.49
Marienplatz	5.50	6.50	7.50	50	20	22.50
Oberreitnau Nord an	5.52	6.52	7.52	52	22	22.52

Bus Line #4 from Rehlings/Weißensberg via ZUP to Alwind	earliest	Saturday	Sunday	every hour at		latest
Rehlings/Weißensberg	5.23	6.23	7.23	23	53	22.23
Lindenstraße/Weißensberg	5.25	6.25	7.25	25	55	22.25
Motzacher Wald	5.28	6.28	7.28	28	58	22.28
Motzach	5.29	6.29	7.29	29	59	22.29
Inselbrauerei	5.30	6.30	7.30	30	00	22.30
Rotmoosstraße	5.31	6.31	7.31	31	01	22.31
Rennerle	5.33	6.33	7.33	33	03	22.33
Friedhof Aeschach	5.34	6.34	7.34	34	04	22.34
V.-Heider-Gymnasium	5.35	6.35	7.35	35	05	22.35
Anheggerstraße (ZUP)	5.40	6.40	7.40	40	10	22.40
Lärche	5.41	6.41	7.41	41	11	22.41
Musikschule	5.42	6.42	7.42	42	12	22.42
Wackerstraße	5.43	6.43	7.43	43	13	22.43
Giebelbach	5.44	6.44	7.44	44	14	22.44
Schwesternberg	5.45	6.45	7.45	45	15	22.45
Schachener Hof	5.46	6.46	7.46	46	16	22.46
Enzisweiler Post	5.48	6.48	7.48	48	18	22.48
Johannes d. Täufer	5.49	6.49	7.49	49	19	22.49
Ebnet	5.50	6.50	7.50	50	20	22.50
Degelstein	5.51	6.51	7.51	51	21	22.51
Alwind an	5.53	6.53	7.53	53	23	22.53

Bus Line #4 from Alwind via ZUP to Rehlings/Weißensberg	earliest	Saturday	Sunday	every hour at		latest
Alwind	5.24	6.24	7.24	24	54	22.24
Degelstein	5.25	6.25	7.25	25	55	22.25
Ebnet	5.26	6.26	7.26	26	56	22.26
Johannes d. Täufer	5.27	6.27	7.27	27	57	22.27
Enzisweiler Post	5.28	6.28	7.28	28	58	22.28
Schachener Hof	5.30	6.30	7.30	30	00	22.30
Schwesternberg	5.31	6.31	7.31	31	01	22.31
Giebelbach	5.32	6.32	7.32	32	02	22.32
Wackerstraße	5.33	6.33	7.33	33	03	22.33
Musikschule	5.34	6.34	7.34	34	04	22.34
Lärche	5.35	6.35	7.35	35	05	22.35
Anheggerstraße (ZUP)	5.40	6.40	7.40	40	10	22.40
V.-Heider-Gymnasium	5.41	6.41	7.41	41	11	22.41
Friedhof Aeschach	5.42	6.42	7.42	42	12	22.42
Rennerle	5.43	6.43	7.43	43	13	22.43
Rotmoosstraße	5.45	6.45	7.45	45	15	22.45
Inselbrauerei	5.46	6.46	7.46	46	16	22.46
Hasenbank	5.47	6.47	7.47	47	17	22.47
Schönbühl	5.50	6.50	7.50	50	20	22.50
Niederhaus	5.51	6.51	7.51	51	21	22.51
Rehlings/Weißensberg an	5.52	6.52	7.52	52	22	22.52

Opening Hours Registration Desk

Sunday, 30 June	10.00 – 20.00
Monday, 1 July	08.30 – 13.00 14.00 – 15.00
Tuesday, 2 July	08.30 – 13.00 14.00 – 18.30
Wednesday, 3 July	08.30 – 13.00 14.00 – 18.30
Thursday, 4 July	08.30 – 14.00

Onsite Contacts

The office can be reached during the meeting as follows:

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Emergency	112
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Scientific Chairs of the 63rd Lindau Nobel Laureate Meeting

Astrid Gräslund
Professor of Biophysics, Department of Biochemistry and Biophysics, University of Stockholm (Sweden)

Wolfgang Lubitz
Director, Max Planck Institute for Chemical Energy Conversion (Germany)

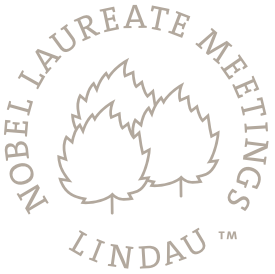
Future Meetings

64th Lindau Nobel Laureate Meeting (Physiology/Medicine)
29 June – 4 July 2014

5th Meeting on Economic Sciences
19 – 23 August 2014

4th Interdisciplinary Lindau Nobel Laureate Meeting
28 June – 3 July 2015

Programme Editors: Wolfgang Huang, Susanne Wieczorek, Nikolaus Turner



Council for the Lindau Nobel Laureate Meetings
Foundation Lindau Nobelprizewinners Meetings at Lake Constance

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