

70

**70th Lindau
Nobel Laureate
Meeting**
Annual Report
2021

70th Lindau Nobel Laureate Meeting Annual Report 2021

Programme
Overview
and highlights of
#LINO70

Participants
Nobel Laureates,
young scientists and
special guests

Pictures
Impressions from
Lindau and the
digital community

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LINDAU
NOBEL LAUREATE
MEETINGS

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I very much enjoyed
my discussion with young
scientists and with the
superb host.

Kip S. Thorne

As in my presentation
here, physics limits itself
by its emphasis on the
matter aspect of reality.
This will change in the
next scientific revolution,
currently under way!

Brian D. Josephson

The closing ceremony was
very thought-provoking.

Vinton G. Cerf

You have young scientists,
you have hope!

Khalid El Bairi

Super useful resource
and mindblowing amount
of data. Great work!

Vladyslav Bondarenko

Fascinating discussion ...
I think I understood
some of it!

Max S. Carey

Amazing performance!!
This music makes my day!! :-)

Amrita Mukherjee

Harvey Alter's talk
on Hep C was masterful!

George P. Smith

Time flies ... I enjoyed the
lectures ... so much! Hope to
go to Lindau physically
in the future.

Sok Kuan Wong

70th Lindau Nobel Laureate Meeting Annual Report 2021

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The Annual Report 2021 is published with three different title motifs – corresponding to the interdisciplinary 70th Lindau Nobel Laureate Meetings' disciplines. Keep an eye out for the other titles, perhaps also sent to your institution.

Re-Strengthening Scientific Cooperation

Most of us look back on a challenging and tiring year. However, as 2021 draws to a close, we look forward with hope. We were often forced to leave tried and tested paths and established routines, perhaps not always to our detriment. Although we learnt a lot and really rose to the challenge of organising a digitised meeting, this phase was not easy for the Lindau Nobel Laureate Meetings, and we would like to thank all our benefactors and contributors for their continued support. From numerous supporters from the private and public sector, we feel that the German Federal Ministry of Education and Research as well as the Bavarian State Ministry of Science and the Arts are worthy of particular mention.

As far as the pandemic is concerned, we hope we have reached a turning point: despite dangerous virus variants and infection rates that remain high in some countries we have found an important key, although it may not be the only one, to solve the crisis, and it is a scientific key: vaccinations. Once again, we realise that science is absolutely crucial for analysing and understanding problems as well as for solving them.

Another fundamental challenge, that of climate change, shows how difficult it is to implement solutions.

Both the spread of COVID-19 and climate change are the result of human activity, and we are realising more and more clearly that our way of life may not be viable in its current form. Scientific progress – and this is the other side of the coin – has enabled humanity to embark on a path of development that is increasingly proving to be unsustainable. Because it is a path that overexploits natural resources, that takes too much advantage of global imbalances and that is not always oriented towards the greater good of people and their environment.

It will take all our efforts to explore a new path – the sooner, the better. Reshaping the processes by which our society, economy, perhaps even politics work, towards sustainability is a huge challenge of a magnitude comparable to the first industrial revolution 150 years ago.

It will need all our creativity, openness for change, a global team-spirit and huge investments. A particular challenge will be gaining the acceptance of societies as a whole. Here, the art will be in overcoming conflicts and in turning opposing factions – young versus old, developing countries versus developed ones and different philosophies of life – into a cooperating team that stands shoulder to shoulder pulling in the same direction.



Countess Bettina Bernadotte af Wisborg, President of the Council for the Lindau Nobel Laureate Meetings
Jürgen Kluge, Chairman of the Board of Directors of the Foundation Lindau Nobel Laureate Meetings

For those who do not know where to start: The 10 goals of the Lindau Guidelines can help with some orientation in the scientific context. This agenda for global, sustainable and cooperative open science in the 21st century was initiated by Nobel Laureate Elizabeth H. Blackburn and endorsed by many other Laureates in the run-up to this year's meeting. They have now been signed by many individual researchers and scientists around the world and have been adopted by several scientific organisations.

Goal #2 seems particularly pertinent with its call to “Cooperate Globally on Global Problems” – or more in detail: “scientists, funders and politicians must cooperate globally to increase efficiency, speed, and effectiveness. While the creative benefits of differing approaches and the stimulus of competition are to be acknowledged, inefficiency by unnecessary parallelism or obstruction must be avoided.”

This objective brings us to the core of the Lindau Nobel Laureate Meetings and to the reason why they exist: the founders Franz Karl Hein, Gustav Wilhelm Parade and Count Lennart Bernadotte had the noble goal of re-strengthening scientific cooperation between nations after the devastation of World War II. This year we cele-

brated the 70th anniversary of the Lindau Meetings. However small or great their influence may have been, we are gratified that the meetings have brought together people from different countries, from different cultures and religions, from different disciplines and schools of thought. Seventy years ago, the founders had a dream. And that dream endures in the scientists and Nobel Laureates of the future: strong scientific exchange and cooperation. On that note, we are looking forward to the two Meetings in 2022: one in Chemistry, one on Economic Sciences – hopefully welcoming the participants in person and on site again, in Lindau.

It has never been easier
to enable full participation
of young scientists world-
wide, even if attendance
on site is not possible.

Countess Bettina Bernadotte



Opening Day

The anniversary meeting was opened with a film that reflected the last 70 years of the Lindau Nobel Laureate Meetings. A highlight was the attendance of six Nobel Laureates and ministers from Berlin and Munich onsite in Lindau. Two musical performances proved that the expertise of the Lindau community does not only lie in excellent science.



Participants in the Opening on the Lindau Nobel Laureate Pier



The Lindau Virtual Band with "Say a little prayer"

Welcome

Countess Bettina Bernadotte, President of the Council

Welcome Address

Frank-Walter Steinmeier, President of the Federal Republic of Germany

Greetings from Stockholm

Vidar Helgesen, Executive Director of the Nobel Foundation

Welcome Speech

Anja Karliczek, German Federal Minister of Education and Research

Welcome Address

Bernd Sibler, Minister of Science and the Arts, Bavaria

Ode to Joy

The Lindau Virtual Symphony Orchestra

Discussion: Made in Germany –

Perspectives for International Young Scientists with Reinhard Genzel, Anja Karliczek and Bernd Sibler

Congratulatory Message

Heinz Faßmann, Minister of Education, Science and Research, Austria

Programme Highlights

Wolfgang Lubitz and Rainer Blatt, two of the meeting's scientific chairpersons

Say a Little Prayer

The Lindau Virtual Band

"I do hope you will benefit from meeting these outstanding people and take the experience home when you leave Lindau."
Count Lennart Bernadotte af Wisborg,
opening film



Courage – in Research, Dialogue, Political and Ethical Challenges



This is the 70th time that some of the world's leading scientists have come together for a Lindau Nobel Laureate Meeting. As always, you have drawn up a concrete programme for your dialogue and a challenging agenda for scientific discussion. You are focusing in particular on a debate on the ethical questions and problems which scientific advances constantly unearth – whether within individual disciplines or between them.

Scientific progress is something that you have driven forward often with ground-breaking discoveries and revolutionary research findings – or, as young researchers, you are just embarking on this journey. But the questions as to whether this scientific progress can also be used to benefit humanity or whether it contains known or potential risks are at least as important as the research findings themselves. Much of this can only be considered through interdisciplinary and above all international cooperation. These days there probably aren't any problems or crises that do not end up as global challenges sooner or later. That is why it is so important for the best minds whose reputation is rooted in basic research to come together to precisely discuss these questions.

You are those who are most keenly aware of the most fundamental prerequisites and implications of your subject. You are familiar with the foundation stones and know their nature, how secure they are and where they perhaps need to be re-assessed, re-considered or even re-built. No-one would ever have been awarded a Nobel Prize if they had been scared of what is new, scared of the unfamiliar, scared of questions which at first sight may seem barely solvable.

I am delighted that you harness the same courage that you use in your own research to enter into dialogue with colleagues from around the world. And that you approach the political and ethical challenges with the same courage that you display in uncovering new findings and examining their implications.

Vidar Helgesen, Executive Director of the Nobel Foundation, Sweden

Greetings from Stockholm



As the new CEO of the Nobel Foundation, I had a lot to learn, but I actually knew of Lindau long before I came here. A good friend of mine is now a professor of physics at the University of Oslo. He told me what the Lindau Meetings meant to him. What inspiration it was to meet other young people and not least Laureates, to share the wonders of scientific collaboration in practice.

Meetings of minds are more important in today's world than ever. We need minds to meet in order to bridge global divides. We need minds to meet in order to inspire the innovations that we need, in order to solve global challenges. The last year has shown us exactly the importance of international collaboration and not least international collaboration in science.

The shared response to the pandemic from the scientific community has been extraordinary. Society can best meet challenges and crises if we share in the efforts, if we work together, if we enable minds to meet to address those shared challenges, and not least if we base those discussions and public decision-making on evidence, on facts, on science.

The Lindau Meetings provide for exactly that. It is a way of building bridges between individuals and institutions from across the world. It is a way of inspiring innovation by bringing minds together to discuss in a beautiful setting. Which this year, of course, is not so beautiful, given the digital reality.

But the minds are not digital – the minds are magnificent. And that's why I believe this year's meeting will also yield much of that same inspiration. And that's very much in the legacy of Alfred Nobel: to inspire innovation for the benefit of humanity.

I look forward on behalf of the Nobel Foundation to continuing our partnership with Lindau because we share the same ambition. We share the same pursuit of unleashing that great power of inspiration in the Nobel Prize. And not least in the Nobel Laureates who make such a wonderful contribution to the Lindau Meetings. I wish you this year, as well as in previous years, a great meeting of minds, if not in Lindau, then in the digital sphere.

Anja Karliczek, Federal Minister of Education and Research

Greetings from Berlin – delivered in Lindau



The pandemic has provoked a great deal of action, and action is exactly what we need right now. I would not be among successful scientists here today, if you did not constantly choose to get involved and shape develop-

ments. I only have to mention mRNA technology to point out that science was at the source of success last year. As difficult as the past year has been for so many people, there have been special moments. For me as the Federal Research Minister this, of course, included those moments when it was announced that two Nobel Prizes had been awarded to scientists in Germany.

Together with our partners, we're strengthening Europe's technological sovereignty. This is not about isolating ourselves from the rest of the world. It's more about self-determination. This involves strategic cooperation on an equal footing. To achieve this, we make use of the advantages of open economic and scientific relations. Because we are in a global competition with the USA which invests heavily in research; and also with China. And it is vital that we win it on this level.

Bernd Sibler, Bavarian State Minister of Science and the Arts

Greetings from Bavaria

We aim to establish a setting in which science can truly excel. Bavaria is a highly attractive location for young researchers from all over the world. With our 'High-Tech Agenda Bavaria', we are placing our focus on IT and AI. From 2020 to 2023 we are investing an additional sum of about €2 billion in our university and innovation systems. (Speech also delivered at the Inselhalle in Lindau)



Winfried Kretschmann, Minister-President of Baden-Württemberg

Greetings from Baden-Württemberg



Knowledge and facts, science and critical thinking – they are particularly significant now, at a time when knowledge and science are under attack from various quarters. And despite the fact that knowledge, openness of thought and reliable facts are fundamental to democracy and progress. In this respect, the Nobel Laureate Meetings are also a celebration of knowledge and science.

Heinz Faßmann, Federal Minister of Education, Science and Research, Austria

Greetings from Austria

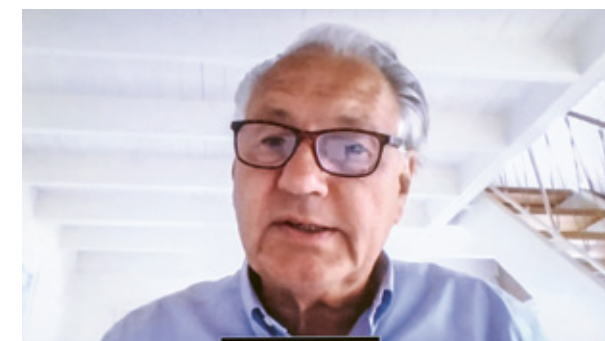
The annual meetings in Lindau provide a unique opportunity for young scientists to meet colleagues from all over the world and be inspired by the world's most renowned researchers. International cooperation and networking opportunities are crucial for a dynamic higher education system and research landscape and the advancement of scientific careers. We are glad to be able to support this event that is so splendidly organized every year and will feature so many important topics and see so many renowned researchers participating in its 70th anniversary edition this year.



Recommendations From the Scientific Chairs

Spotlight on the Programme

On behalf of the scientific chairpersons of all three disciplines, Wolfgang Lubitz and Rainer Blatt presented their personal programme highlights at the Inselhalle in Lindau during the opening day of #LINO70.



Opening Moderator Jeanne Rubner, Head of the Science and Education Desk, Bayerischer Rundfunk, with Rainer Blatt, Scientific Chair Physics, and Wolfgang Lubitz, Scientific Chair Chemistry – Klas Kärre, Scientific Chair Physiology/Medicine – Stefan H.E. Kaufmann, Scientific Chair Physiology/Medicine – Heiner Linke, Scientific Chair Chemistry, recently Physics

On the meeting's opening day, the vice president and the member of the Council discussed some of their personal highlights from the 70-hour programme. Both were united in not wanting to miss any of the seven (a record number) panel discussions. They also highlighted the traditional Heidelberg Lecture (see p. 34) and the conversation with Henry Kissinger.

Rainer Blatt was delighted that no less than 73 Nobel Laureates participated in the online programme. "But I am missing the direct encounters with the young scientists", he continued. That's why he emphasised their con-

tribution to the programme by presenting their research in the Next Gen Science Sessions.

Most of the Laureates offered exchange sessions in addition to their lectures and Agora Talks. In these 60 Open Exchanges, which were hosted mainly by Lindau Alumni and which were not streamed to the public, Laureates discussed a topic of their choosing with the young scientists. Wolfgang Lubitz concluded "that these Open Exchanges would surely enable unforgettable dialogues between Nobel Laureates and the participating researchers."

In other years, the
foyer of the Inselhalle is
not full of technology,
but is enlivened by
600 young scientists.

Wolfgang Huang



Nobel Laureates

73 Nobel Laureates from 13 countries took part in the 70th Lindau Nobel Laureate Meeting.



Emmanuelle Charpentier
Nationality: France
Nobel Prize: Chemistry
Year: 2020
Prize Motivation:
"for the development of a method for genome editing"



Steven Chu
Nationality: USA
Nobel Prize: Physics
Year: 1997
Prize Motivation:
"for development of methods to cool and trap atoms with laser light"



Aaron Ciechanover
Nationality: Israel
Nobel Prize: Chemistry
Year: 2004
Prize Motivation:
"for the discovery of ubiquitin-mediated protein degradation"



Martin J. Evans
Nationality: United Kingdom
Nobel Prize: Physiology or Medicine
Year: 2007
Prize Motivation:
"for their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells"



Peter Agre
Nationality: USA
Nobel Prize: Chemistry
Year: 2003
Prize Motivation:
"for the discovery of water channels"



James P. Allison
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 2018
Prize Motivation:
"for their discovery of cancer therapy by inhibition of negative immune regulation"



Harvey J. Alter
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 2020
Prize Motivation:
"for the discovery of Hepatitis C virus"



Hiroshi Amano
Nationality: Japan
Nobel Prize: Physics
Year: 2014
Prize Motivation:
"for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources"



Ben L. Feringa
Nationality: The Netherlands
Nobel Prize: Chemistry
Year: 2016
Prize Motivation:
"for the design and synthesis of molecular machines"



Edmond H. Fischer
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 1992
Prize Motivation:
"for their discoveries concerning reversible protein phosphorylation as a biological regulatory mechanism"



Joachim Frank
Nationality: Germany/USA
Nobel Prize: Chemistry
Year: 2017
Prize Motivation:
"for developing cryo-electron microscopy for the high-resolution structure determination of biomolecules in solution"



Reinhard Genzel
Nationality: Germany
Nobel Prize: Physics
Year: 2020
Prize Motivation:
"for the discovery of a super-massive compact object at the centre of our galaxy"



Barry C. Barish
Nationality: USA
Nobel Prize: Physics
Year: 2017
Prize Motivation:
"for decisive contributions to the LIGO detector and the observation of gravitational waves"



Françoise Barré-Sinoussi
Nationality: France
Nobel Prize: Physiology or Medicine
Year: 2008
Prize Motivation:
"for their discovery of human immunodeficiency virus"



Elizabeth H. Blackburn
Nationality: Australia/USA
Nobel Prize: Physiology or Medicine
Year: 2009
Prize Motivation:
"for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase"



Martin Chalfie
Nationality: USA
Nobel Prize: Chemistry
Year: 2008
Prize Motivation:
"for the discovery and development of the green fluorescent protein, GFP"



Walter Gilbert
Nationality: USA
Nobel Prize: Chemistry
Year: 1980
Prize Motivation:
"for their contributions concerning the determination of base sequences in nucleic acids"



David J. Gross
Nationality: USA
Nobel Prize: Physics
Year: 2004
Prize Motivation:
"for the discovery of asymptotic freedom in the theory of the strong interaction"



Robert H. Grubbs
Nationality: USA
Nobel Prize: Chemistry
Year: 2005
Prize Motivation:
"for the development of the metathesis method in organic synthesis"



F. Duncan M. Haldane
Nationality: United Kingdom
Nobel Prize: Physics
Year: 2016
Prize Motivation:
"for theoretical discoveries of topological phase transitions and topological phases of matter"



John L. Hall
Nationality: USA
Nobel Prize: Physics
Year: 2005
Prize Motivation:
"for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique"



Serge Haroche
Nationality: France
Nobel Prize: Physics
Year: 2012
Prize Motivation:
"for ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems"



Leland H. Hartwell
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 2001
Prize Motivation:
"for their discoveries of key regulators of the cell cycle"



Harald zur Hausen
Nationality: Germany
Nobel Prize: Physiology or Medicine
Year: 2008
Prize Motivation:
"for his discovery of human papilloma viruses causing cervical cancer"



Stefan W. Hell
Nationality: Germany
Nobel Prize: Chemistry
Year: 2014
Prize Motivation:
"for the development of super-resolved fluorescence microscopy"



Richard Henderson
Nationality: Scotland
Nobel Prize: Chemistry
Year: 2017
Prize Motivation:
"for developing cryo-electron microscopy for the high-resolution structure determination of biomolecules in solution"



Avram Hershko
Nationality: Israel
Nobel Prize: Chemistry
Year: 2004
Prize Motivation:
"for the discovery of ubiquitin-mediated protein degradation"



Jules A. Hoffmann
Nationality: Luxembourg/France
Nobel Prize: Physiology or Medicine
Year: 2011
Prize Motivation:
"for their discoveries concerning the activation of innate immunity"



Tasuku Honjo
Nationality: Japan
Nobel Prize: Physiology or Medicine
Year: 2018
Prize Motivation:
"for their discovery of cancer therapy by inhibition of negative immune regulation"



Robert Huber
Nationality: Germany
Nobel Prize: Chemistry
Year: 1988
Prize Motivation:
"for the determination of the three-dimensional structure of a photosynthetic reaction centre"



Brian D. Josephson
Nationality: United Kingdom
Nobel Prize: Physics
Year: 1973
Prize Motivation:
"for theoretical predictions of the properties of a supercurrent through a tunnel barrier, in particular those phenomena which are generally known as the Josephson effects"



William G. Kaelin, Jr.
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 2019
Prize Motivation:
"for their discoveries of how cells sense and adapt to oxygen availability"

73 Laureates on Stage and 9 Laureates in the Online Audience

Interdisciplinarity



37%
Physics



35%
Chemistry



25%
Physiology/
Medicine



3%
Peace

Age

Youngest

Konstantin S. Novoselov

46

Oldest

Edmond H. Fischer

101

Records

First Participation

- James P. Allison
- Harvey J. Alter
- Barry C. Barish
- Emmanuelle Charpentier
- Reinhard Genzel
- Richard Henderson
- Tasuku Honjo
- William G. Kaelin, Jr.
- Henry A. Kissinger
- Anthony Leggett
- Didier Queloz
- Gregg L. Semenza
- George P. Smith
- Thomas C. Südhof
- Kip S. Thorne
- M. Stanley Whittingham

Most Participations: 24

- Robert Huber
- Hartmut Michel

Earliest Award: 1973

- Brian D. Josephson – Physics
- Henry A. Kissinger – Peace

Most Recent Nobel Prize: 2020

- Harvey J. Alter – Physiology/Medicine
- Emmanuelle Charpentier – Chemistry
- Reinhard Genzel – Physics

Nationalities

United States 36	Japan 3	Italy 1
Germany 8	Canada 2	Netherlands 1
France 6	Switzerland 2	Norway 1
United Kingdom 6	Australia 1	Scotland 1
Israel 3	India 1	Sweden 1



Takaaki Kajita
Nationality: Japan
Nobel Prize: Physics
Year: 2015
Prize Motivation:
"for the discovery of neutrino oscillations, which shows that neutrinos have mass"



Henry A. Kissinger
Nationality: Germany/USA
Nobel Prize: Peace
Year: 2015
Prize Motivation:
"for jointly having negotiated a cease fire in Vietnam in 1973"



Klaus von Klitzing
Nationality: Germany
Nobel Prize: Physics
Year: 1985
Prize Motivation:
"for the discovery of the quantized Hall effect"



Brian K. Kobilka
Nationality: USA
Nobel Prize: Chemistry
Year: 2012
Prize Motivation:
"for studies of G-protein-coupled receptors"



Barry J. Marshall
Nationality: Australia
Nobel Prize: Physiology or Medicine
Year: 2005
Prize Motivation:
"for their discovery of the bacterium Helicobacter pylori and its role in gastritis and peptic ulcer disease"



Arthur B. McDonald
Nationality: Canada
Nobel Prize: Physics
Year: 2015
Prize Motivation:
"for the discovery of neutrino oscillations, which shows that neutrinos have mass"



Hartmut Michel
Nationality: Germany
Nobel Prize: Chemistry
Year: 1988
Prize Motivation:
"for the determination of the three-dimensional structure of a photosynthetic reaction centre"



William E. Moerner
Nationality: USA
Nobel Prize: Chemistry
Year: 2014
Prize Motivation:
"for the development of super-resolved fluorescence microscopy"



J. Michael Kosterlitz
Nationality: United Kingdom/USA
Nobel Prize: Physics
Year: 2016
Prize Motivation:
"for theoretical discoveries of topological phase transitions and topological phases of matter"



Robert B. Laughlin
Nationality: USA
Nobel Prize: Physics
Year: 1998
Prize Motivation:
"for their discovery of a new form of quantum fluid with fractionally charged excitations"



Robert J. Lefkowitz
Nationality: USA
Nobel Prize: Chemistry
Year: 2012
Prize Motivation:
"for studies of G-protein-coupled receptors"



Sir Anthony J. Leggett
Nationality: USA
Nobel Prize: Physics
Year: 2003
Prize Motivation:
"for pioneering contributions to the theory of superconductors and superfluids"



Edvard I. Moser
Nationality: Norway
Nobel Prize: Physiology or Medicine
Year: 2014
Prize Motivation:
"for their discoveries of cells that constitute a positioning system in the brain"



Gérard A. Mourou
Nationality: France
Nobel Prize: Physics
Year: 2018
Prize Motivation:
"for their method of generating high-intensity, ultra-short optical pulses"



Sir Konstantin S. Novoselov
Nationality: Russia/United Kingdom
Nobel Prize: Physics
Year: 2010
Prize Motivation:
"for groundbreaking experiments regarding the two-dimensional material graphene"



Christiane Nüsslein-Volhard
Nationality: Germany
Nobel Prize: Physiology or Medicine
Year: 1995
Prize Motivation:
"for their discoveries concerning the genetic control of early embryonic development"



Jean-Marie Lehn
Nationality: France
Nobel Prize: Chemistry
Year: 1987
Prize Motivation:
"for their development and use of molecules with structure-specific interactions of high selectivity"



Michael Levitt
Nationality: USA/Israel
Nobel Prize: Chemistry
Year: 2013
Prize Motivation:
"for the development of multiscale models for complex chemical systems"



Tomas Lindahl
Nationality: Sweden
Nobel Prize: Chemistry
Year: 2015
Prize Motivation:
"for mechanistic studies of DNA repair"



Rudolph A. Marcus
Nationality: Canada/USA
Nobel Prize: Chemistry
Year: 1992
Prize Motivation:
"for his contributions to the theory of electron transfer reactions in chemical systems"



Saul Perlmutter
Nationality: USA
Nobel Prize: Physics
Year: 2011
Prize Motivation:
"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae"



William D. Phillips
Nationality: USA
Nobel Prize: Physics
Year: 1997
Prize Motivation:
"for development of methods to cool and trap atoms with laser light"



Didier Queloz
Nationality: Switzerland
Nobel Prize: Physics
Year: 2019
Prize Motivation:
"for the discovery of an exoplanet orbiting a solar-type star"



Adam G. Riess
Nationality: USA
Nobel Prize: Physics
Year: 2011
Prize Motivation:
"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae"

... Albeit at a Distance

The comprehensive programme would not have been possible without the commitment of so many Nobel Laureates to engage live and remotely. Only a small group of Laureates was able to gather on site in Lindau. No matter how they participated, their quotes speak for themselves.

My open exchange with students was the highlight of my experience. Being able to see and hear them made a great difference in engagement. Participating remotely was a distant second best to participating personally. But on the whole, the remote experience was well worth it.

George P. Smith

I enjoyed my open exchange a lot and think the students did, too. Most important for me will be to be in Lindau again in person. I miss real people so much, especially the students.

Michael Levitt

My interaction with the students following my talk was excellent.

Avram Hershko

This was good in the remote format, but not as good as my in-person experiences. I think it was better remotely than I expected, possibly because we have all had so much experience in the past year or so, but it cannot replace the in-person experience.

Anonymous

The organisers had to react flexibly in these difficult times. It was nice to have at least partial personal contact, even if the most important participants, the young scientists, could not be present.

Klaus von Klitzing

It has been a pleasure to participate and hopefully, next time, it will be in Lindau!

Françoise Barré-Sinoussi

Given the difficulties caused by COVID, I believe that the Lindau program was as good as possible. We all look forward to an on-site meeting in 2022.

Peter Agre



Michael M. Rosbash
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 2017
Prize Motivation:
"for their discoveries of molecular mechanisms controlling the circadian rhythm"



Carlo Rubbia
Nationality: Italy
Nobel Prize: Physics
Year: 1984
Prize Motivation:
"for decisive contributions to the large project, which led to the discovery of the field particles W and Z, communicators of weak interaction"



Kailash Satyarthi
Nationality: India
Nobel Prize: Peace
Year: 2014
Prize Motivation:
"for their struggle against the suppression of children and young people and for the right of all children to education"



Randy W. Schekman
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 2013
Prize Motivation:
"for their discoveries of machinery regulating vesicle traffic, a major transport system in our cells"



Brian P. Schmidt
Nationality: Australia/USA
Nobel Prize: Physics
Year: 2011
Prize Motivation:
"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae"



Richard R. Schrock
Nationality: USA
Nobel Prize: Chemistry
Year: 2005
Prize Motivation:
"for the development of the metathesis method in organic synthesis"



Gregg L. Semenza
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 2019
Prize Motivation:
"for their discoveries of how cells sense and adapt to oxygen availability"



George P. Smith
Nationality: USA
Nobel Prize: Chemistry
Year: 2018
Prize Motivation:
"for the phage display of peptides and antibodies"



Donna Strickland
Nationality: Canada
Nobel Prize: Physics
Year: 2018
Prize Motivation:
"for their method of generating high-intensity, ultra-short optical pulses"



Thomas C. Südhof
Nationality: USA
Nobel Prize: Physiology or Medicine
Year: 2013
Prize Motivation:
"for their discoveries of machinery regulating vesicle traffic, a major transport system in our cells"



Kip S. Thorne
Nationality: USA
Nobel Prize: Physics
Year: 2017
Prize Motivation:
"for decisive contributions to the LIGO detector and the observation of gravitational waves"



Samuel C. C. Ting
Nationality: USA
Nobel Prize: Physics
Year: 1976
Prize Motivation:
"for their pioneering work in the discovery of a heavy elementary particle of a new kind"



Arieh Warshel
 Nationality: Israel/USA
 Nobel Prize: Chemistry
 Year: 2013
 Prize Motivation:
"for the development of multiscale models for complex chemical systems"



Rainer Weiss
 Nationality: USA
 Nobel Prize: Physics
 Year: 2017
 Prize Motivation:
"for decisive contributions to the LIGO detector and the observation of gravitational waves"



M. Stanley Whittingham
 Nationality: United Kingdom
 Nobel Prize: Chemistry
 Year: 2019
 Prize Motivation:
"for the development of lithium-ion batteries"



Kurt Wüthrich
 Nationality: Switzerland
 Nobel Prize: Chemistry
 Year: 2002
 Prize Motivation:
"for his development of nuclear magnetic resonance spectroscopy for determining the three-dimensional structure of biological macromolecules in solution"



Ada E. Yonath
 Nationality: Israel
 Nobel Prize: Chemistry
 Year: 2009
 Prize Motivation:
"for studies of the structure and function of the ribosome"



Vinton G. Cerf
 Nationality: USA
 Award: ACM A.M. Turing Award
 Year: 2004
 Prize Motivation:
"for pioneering work on internet-working, including the design and implementation of the Internet's basic communications protocols, TCP/IP, and for inspired leadership in networking"



Jeffrey A. Dean
 Nationality: USA
 Award: ACM Prize in Computing
 Year: 2012
 Prize Motivation:
"for their leadership in the science and engineering of Internet-scale distributed systems"

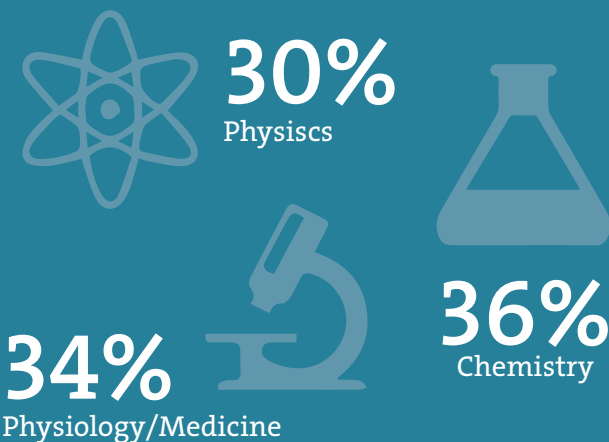
Find CVs of all participating Nobel Laureates in the Lindau Mediatheque.



Seventeen Thousand Eight Hundred and Sixteen

... or in numbers 17,816 was the amount of total hours online which young scientists spent on the event platform during the 70th Lindau Meeting. Here are more interesting figures:

Interdisciplinarity



Gender Balance



Representing 79 Countries and 297 Institutions



Young Scientists on #LINO70

A Sense of Community

We are delighted that our survey among young scientists (and Nobel Laureates) revealed consistently positive impressions among the global audience of young scientists. They were not only present as listeners for a week – but were actively involved in the programme.

Thank you to the wonderful Nobel Laureates for your time and for wanting to share your thoughts and experiences on all sorts of matter and thank you to all of us young scientists for your inputs and energy throughout.

Louise C. Druedahl, University of Copenhagen, Denmark

I love the networking. So much fun to meet people from diverse backgrounds working in all kinds of research areas not just limited to biology.

Lukas Heumos, Eberhard-Karls-Universität Tübingen, Germany

I really enjoyed the scientific discussion with Nobel Laureates, open exchange and live music. Thanks to the world famous Lindau Nobel Laureate Meeting Council.

Murali Adhigan, Central Institute of Petrochemicals Engineering & Technology, India

Last year was an extraordinary year for science and technology. So, I'm really glad to be able to take part in this year's #LINO70, exchange ideas, connect and learn from many amazing scientists, academics and ex-academics, who inspired me to pursue STEM in the first place!

Lučka Bibič, Dephion, Netherlands

And so, the fabulous, most open, interactive, inclusive, exciting 5 days of #LINO70 come to an end with us young scientists now as the Lindau Alumni! Last year and this year have both been incredible experiences and have left me more motivated as a scientist!

Saumya Kumar, Instituto de Medicina Molecular João Lobo Antunes, Portugal

Having attended many online meetings this last year, this has been the only one from which I've received a sense of community and it has got me so excited. Congratulations to all the people involved in pulling off this unique online experience :)

Max S. Carey, University of Southampton, United Kingdom

Young Scientist's Experience

Unforgettable Fan Moments

María Clara Miserendino studies Biotechnology at Universidad Nacional de Córdoba, Argentina. One of her interests is to promote STEM education. As a participant in the 70th Lindau Meeting and both the Sciathons in 2020 and 2021, she looks forward to experiencing #LINO22 on site.

#LINO70 was unforgettable and I had some amazing 'fan moments': imagine you are a big fan of football and you had the chance to talk and be advised by Leo Messi. I almost didn't sleep that week because of the time zone shift. But it was worth it.

My favourite session was the MARS partner event. It was a very important session to me because I had the chance to be a panelist along with Nobel Laureate Ada Yonath and the Vice President of the Mars Advanced Research Institute, Abigail Stevenson. I still can't believe that I had the chance to talk with Ada. I remember when I read about her story back at High School when I was studying for the National Biology Olympiad. Her bravery, humanity and passion marked me. Ada, thank you for your advice, maybe the best I've ever had, which by the way is "Never ask for advice"!

The whole event was not one where we merely collected a certificate, but one where we nurtured friendships, gained inspiration and shared our passion and love for science. Networking is part of that. Being a young scientist in Latin America is completely different from Europe or North America. Networking and cooperation are the bridge to break down those barriers. I'm very concerned about my next steps and having the chance of talking with other international students pursuing excellent scientific careers abroad was very meaningful to me. I think that the virtual environment made it easier to get in touch with other colleagues at the event.



I was also part of the Sciathon this year and last year. Both editions were very exciting. I really enjoy meeting new people and at the Sciathon you can make very good friends.

"The message from the Laureates was full of hope, motivation, and inspiration to us, the future generations."
María Clara Miserendino



Academic Partners

Our academic partners form a global network of local contact points for interested scientists. These academies of sciences, leading universities, research institutions, foundations and innovative enterprises identify and nominate talented researchers.



Jagdeep Singh Bachher



Matthias Frosch



Andreas Terfort

University of California

“Enabling promising young scientists to participate in the Lindau Meetings is a sound investment in our collective future. I have a dream that one day at least one of our UC Lindau fellows will win a Nobel Prize themselves. Of the two-year total of 50 UC fellows, I’m particularly proud that 22 are from underrepresented groups and 20 are women.”

Jagdeep Singh Bachher, University of California chief investment officer and sponsor of the UC President’s Lindau Nobel Laureate Meetings Fellows program

Mathematisch-Naturwissenschaftlicher Fakultätentag

“The Faculties of Mathematics and Natural Sciences (MNFT) support the Lindau Nobel Laureate Meetings based on the deep conviction that real added value will be created, especially for students from our subject cluster.

Meeting with the best thinkers of our time is often not only impressive for young people but also formative for their further lives. We hope our organisations will be able to work together for a long time.”

Andreas Terfort, Speaker of MNFT and professor for Inorganic and Analytical Chemistry at Goethe University Frankfurt

Medizinischer Fakultätentag

“The medical faculties (MFT) stand for first-class research and internationally renowned medical education. In this sense, the MFT as its umbrella organisation supports initiatives such as the Lindau Nobel Laureate Meetings. They give young scientists the opportunity to exchange ideas across disciplines and form the basis for new scientific findings.”

Matthias Frosch, President of MFT

Application Process

Requirements

Undergraduates, Master or PhD Students, or Post-Docs
<35 Years of Age
Top 5% of Class Recommendations



Application



Regular:
Nomination
by Academic Partners
(Internal Selection)



Exception:
Open Application
(if no Academic
Partner is responsible)

Evaluation and Selection

Review Panel of the Council
400–600 Participants
(Depending on Meeting Type)



Participation

One-Time Only



Lindau Alumni Community

About 35,000 Former Participants
Since 1951

Nominating Institutions

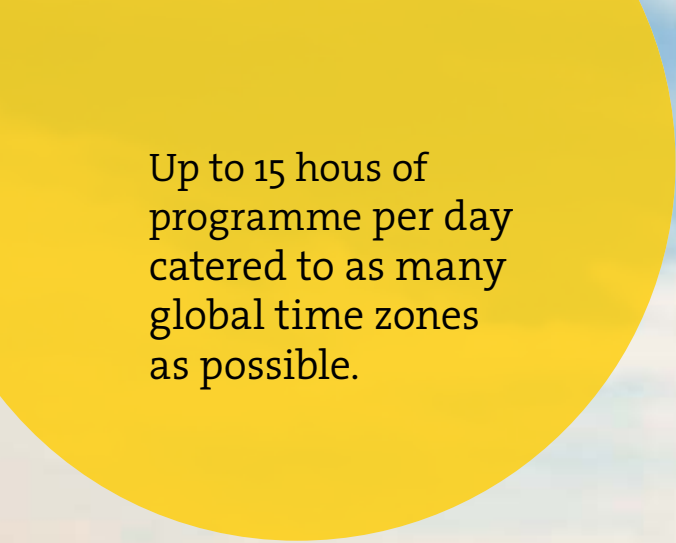
Academia Sinica, Taiwan
Académie Nationale des Sciences et Techniques du Sénégal (ANSTS)
Academy of Science of South Africa (ASSAf)
Academy of Sciences Malaysia
acatech – National Academy of Science and Engineering, Germany
Alexander von Humboldt Foundation, Germany
American University of Beirut, Lebanon
Australian Academy of Science
Austrian Academy of Sciences
Bangladesh Academy of Sciences (BAS)
Bavarian Academy of Sciences and Humanities, Germany
Bielefeld University, Germany
Brazilian Academy of Sciences (BAS)
Bulgarian Academy of Sciences
Calouste Gulbenkian Foundation, Portugal
Canadian Institutes of Health Research (CIHR)
Canadian Student Health Research Forum
Carl von Ossietzky University of Oldenburg, Germany
Charité – Universitätsmedizin Berlin, Germany
Chemnitz University of Technology, Germany
Chilean Academy of Sciences
Columbus Association
Croucher Foundation, Hong Kong
Czech Academy of Sciences
Department of Science & Technology, Government of India
Elite Network of Bavaria, Germany
Else Kröner-Fresenius-Stiftung, Germany
Estonian Academy of Sciences
European Commission
European Molecular Biology Laboratory (EMBL)
European Science Foundation (ESF)
Federation of European Biochemical Societies (FEBS)
Forschungszentrum Jülich GmbH, Germany
Foundation for Polish Science

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., Germany
Freie Universität Berlin, Germany
Friedrich Schiller University Jena, Germany
Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany
Fund for Scientific Research - FNRS, Belgium
Georg-August-Universität Göttingen, Germany
Gerhard C. Starck Stiftung, Germany
German Academic Exchange Service (DAAD)
German Academic Scholarship Foundation
German Aerospace Center (DLR)
German National Academy of Sciences Leopoldina
Global Young Academy
Goethe University Frankfurt, Germany
Göttingen Graduate Center for Neurosciences, Biophysics, and Molecular Biosciences (GGNB), Germany
Hannover Medical School, Germany
Heidelberg University, Germany
Heinrich Heine University Düsseldorf, Germany
Helmholtz Association of German Research Centres, Germany
Honoris United Universities
Human Frontier Science Program
Humboldt-Universität zu Berlin, Germany
Hungarian Academy of Sciences
ICREA - Catalan Institution for Research and Advanced Studies, Spain
Independent Research Fund Denmark
Internationale Bodensee-Hochschule, Switzerland
Irish Research Council
Jacobs University Bremen gGmbH, Germany
Japan Society for the Promotion of Science (JSPS)
Johannes Gutenberg University Mainz, Germany
Julius-Maximilians-Universität Würzburg, Germany
Justus Liebig University Giessen, Germany

Karlsruhe Institute of Technology, Germany
Kiel University, Germany
Klaus Tschira Stiftung gGmbH, Germany
Körber Foundation, Germany
Leibniz Association, Germany
Leibniz University Hannover, Germany
Leipzig University, Germany
Ludwig-Maximilians-Universität Munich, Germany
Luxembourg National Research Fund
Max Planck Society, Germany
Mexican Academy of Sciences
Ministry of Education of the Republic of the Union of Myanmar
Ministry of Education, Tertiary Education, Science and Technology, Mauritius
Ministry of Research, Technology and Higher Education of the Republic of Indonesia (MoRTHE)
Mongolian Academy of Sciences
National Academy of Sciences of the Republic of Armenia
National Academy of Sciences of Uruguay
National Institute of Materials Physics, Romania
National Research Foundation, Singapore
National Science and Technology Development Agency, Thailand
Oak Ridge Associated Universities (ORAU), USA
Osnabrück University, Germany
Otto von Guericke University Magdeburg, Germany
Paderborn University, Germany
Pakistan Institute of Engineering & Applied Sciences (PIEAS)
Ragnar Söderberg Foundation, Sweden
Research Foundation - Flanders (FWO), Belgium
Royal Netherlands Academy of Arts and Sciences
Ruhr-Universität Bochum, Germany
RWTH Aachen University, Germany
Saarland University, Germany
Sharif University of Technology, Iran
Sino-German Center for Research Promotion, China
St Petersburg State University, Russian Federation
Swiss Academy of Sciences (SCNAT)
Szeged Scientists Academy, Hungary
Technical University of Darmstadt, Germany
Technical University of Munich, Germany
Technische Universität Berlin, Germany
Technische Universität Braunschweig, Germany
Technische Universität Dresden, Germany
Technische Universität Ilmenau, Germany
Technische Universität Kaiserslautern, Germany

The African Academy of Sciences
The Council of Finnish Academies
The Korean Academy of Science and Technology
The Lithuanian Academy of Sciences
The Research Council, Oman
The Royal Society, UK
The Royal Swedish Academy of Sciences, Sweden
The Slovenian Academy of Sciences and Arts
TU Bergakademie Freiberg, Germany
TU Dortmund University, Germany
TÜBİTAK - The Scientific and Technological Research Council of Turkey
TWAS – The World Academy of Sciences
Ulm University, Germany
Universität Hamburg, Germany
Universität Regensburg, Germany
Universität zu Lübeck, Germany
University Medical Center Hamburg-Eppendorf, Germany
University of Augsburg, Germany
University of Bayreuth, Germany
University of Bonn, Germany
University of California (UC), USA
University of Cologne, Germany
University of Duisburg-Essen (UDE), Germany
University of Freiburg, Germany
University of Greifswald, Germany
University of Hohenheim, Germany
University of Iceland
University of Kassel, Germany
University of Konstanz, Germany
University of Liechtenstein
University of Malta
University of Münster, Germany
University of Nicosia, Cyprus
University of Potsdam, Germany
University of Rostock, Germany
University of Siegen, Germany
University of Stuttgart, Germany
University of Tübingen, Germany
University of Wuppertal, Germany
Verband der Chemischen Industrie e.V. (VCI), Germany
Volkswagen Foundation, Germany
Weizmann Institute of Science, Israel
Wilhelm Sander-Stiftung, Germany

Up to 15 hours of programme per day catered to as many global time zones as possible.



An infographic titled "LICHT UND SEINE ZUSAMMENSETZUNG" (Light and its composition) in German. It features a red and white color scheme with various icons and text boxes. At the top, it says "LICHT UND SEINE ZUSAMMENSETZUNG". Below this, there are several sections of text, a small image of a computer monitor, and a diagram of a human head with a brain, illustrating the concept of light and its effects. The infographic is presented on a vertical panel.

Lectures

James P. Allison	Immune Checkpoint Blockade in Cancer Therapy: New Insights Into Therapeutic Mechanisms
Harvey J. Alter	Hepatitis C: The End of the Beginning and Possibly the Beginning of the End
Barry C. Barish	How to Detect Gravitational Waves
Emmanuelle Charpentier	CRISPR-Cas9: Transforming Life Sciences With Bacteria
Reinhard Genzel	A 40-Year Journey
Richard Henderson	60 Years of Structural Biology, From Myoglobin and X-Ray Crystallography to the Recent Impact of Electron Cryomicroscopy
Tasuku Honjo	Serendipities of Acquired Immunity
William G. Kaelin, Jr.	The von Hippel-Lindau Hereditary Cancer Syndrome: From Bedside to Bench to Bedside
Sir Anthony J. Leggett	Why Can't Time Run Backwards?
Didier Queloz	The Exoplanet Revolution
Gregg L. Semenza	Hypoxia-Inducible Factors in Physiology and Medicine
George P. Smith	Scientific Achievements Are Nobody's Intellectual Property
Thomas C. Südhof	Neuroscience Research in the 21 st Century
Kip S. Thorne	Storms in Spacetime from Colliding Black Holes
M. Stanley Whittingham	Storage Is Ready to Address Climate Change
Ada E. Yonath	Next Generation Antibiotics

Rewatch your favourite lecture in the Lindau Mediatheque



Heidelberg Lecture

The Heidelberg Laureate Forum (HLF) was founded in 2013 by Klaus Tschira after the model of the Lindau Nobel Laureate Meetings. The HLF dedicates its meetings to prize-winning and aspiring young scientists from mathematics and computer science. To emphasise the close links and the outstanding partnership, Lindau hosts Heidelberg Lectures every year, and Lindau Lectures are part of every HLF programme.

In this year's Heidelberg Lecture, Jeffrey A. Dean (Google Inc., recipient of the ACM Prize in Computing), known for his contributions to the science and engi-

neering of large-scale distributed computer systems, discussed recent advances in the application of AI and machine learning that improved the ability of computers to see, hear, and understand the world around them.

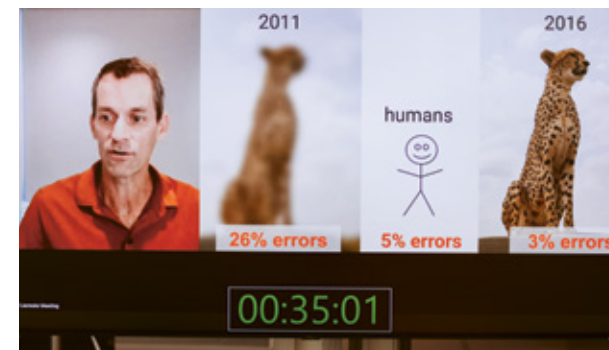
A Golden Decade of Advances in Computing Driven by Deep Learning



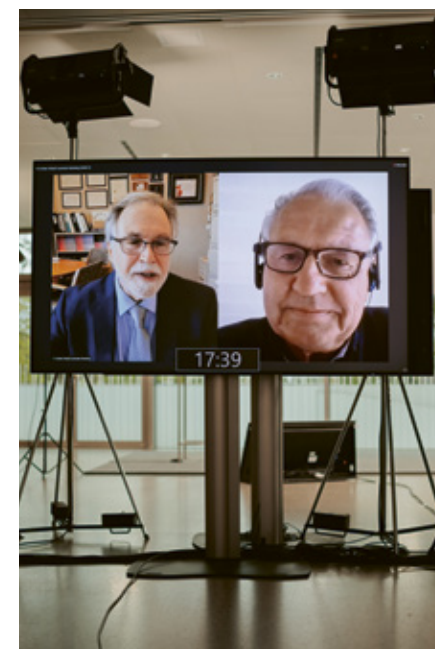

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5

- 1 Lecture: Neuroscience Research in the 21st Century – Thomas C. Südhof
- 2 Lecture: Why Can't Time Run Backwards? – Sir Anthony J. Leggett
- 3 Heidelberg Lecture: A Golden Decade of Advances in Computing Driven by Deep Learning – Jeffrey A. Dean
- 4 Gregg L. Semenza and Klas Kärre
- 5 Lecture: Storms in Spacetime from Colliding Black Holes – Kip S. Thorne

Programme Structure

Lindau Time	Sunday, 27 June	Monday, 28 June	Tuesday, 29 June	Wednesday, 30 June	Thursday, 1 July	Friday, 2 July
07				<u>Panel Discussion</u> Energy and Climate Chu, Haug, Laughlin, Mengis, Michel, Schmidt	<u>Panel Discussion</u> Open Science Blackburn, Datsaris, Jex, Schekman	
08		<u>Partner Events</u> • BASF SE, Germany • vfa, Verband forschender Pharma-Unternehmen	<u>Partner Events</u> • Austrian Federal Ministry of Education, Science and Research • Mars, Incorporated • Rolex SA			
09		<u>Break</u> Workout	<u>Break</u> Networking	<u>Break</u> Workout	<u>Break</u> Networking	<u>Welcome from Mainau Island</u>
10		<u>Lecture</u> Queloz	<u>Conversation</u> Fischer	<u>Lecture</u> Honjo	<u>Next Gen Science</u> presentations by young scientists	<u>Panel Discussion</u> Why Trust Science? Abderrahman, Heldin, Rheinberger, Schmidt
11	<u>Public Lecture Lindau</u> Genzel	<u>Break</u> Networking	<u>Social Programme</u> Concert: Max Raabe & Palastorchester	<u>Break</u> Networking	<u>Social Programme</u> Concert: Kerber Brothers Bavarian Breakfast	<u>Closing</u>
12		<u>Panel Discussion</u> Gene Editing Buyx, Charpentier, Jansing, Nüsslein-Volhard	<u>Open Exchange</u> Evans, Haroche, Huber, Kajita, Levitt, Marshall, Michel, Novoselov, Rubbia, Wüthrich, zur Hausen	<u>Lecture</u> Henderson	<u>Lecture</u> Yonath	
13				<u>Next Gen Science</u> presentations by young scientists	<u>Conversation</u> Kissinger	
14	<u>Opening</u>	<u>Project Presentation</u> Lindau Guidelines <u>Agora Talk</u> • Agre, Amano • Lehn • Frank, Hell	<u>Project Presentation</u> Mentoring Hub <u>Agora Talk</u> • Haroche, Phillips • Nüsslein-Volhard • Rubbia	<u>Open Exchange</u> Gilbert, Henderson, Hershko, Josephson, Moser, Mourou, Yonath	<u>Project Presentation</u> Lindau Online Sciathon <u>Agora Talk</u> • Haldane, Kosterlitz • Kajita, McDonald • Moser, Rosbash	
15		<u>Open Exchange</u> Agre, Alter, Barré-Sinoussi, Charpentier, Feringa, Frank, Genzel, Hell, Lehn, Queloz	<u>Lecture</u> Leggett		<u>Panel Discussion</u> Artificial Intelligence: Promises and Threats Cerf, Eckhoff, El-Harouni, Karatza, Levitt, Schölkopf	
16	<u>Panel Discussion</u> Corona and Emerging Pandemics Alter, Barré-Sinoussi, Neher, Huisman		<u>Lecture</u> Whittingham	<u>Lecture</u> Allison		
17	<u>Break</u> Networking	<u>Break</u> Networking	<u>Break</u> Workout	<u>Break</u> Networking	<u>Break</u> Workout	
18	<u>Lecture</u> Charpentier		<u>Lecture</u> Semenza	<u>Agora Talk</u> • Chalfie, Schekman • Hall, Mourou, Strickland • Hartwell	<u>Lecture</u> Smith	
19	<u>Lecture</u> Genzel	<u>Lecture</u> Barish	<u>Lecture</u> Kaelin	<u>Panel Discussion</u> Dark and Black Genzel, Gross, Perlmutter, Plura, Weiss	<u>Lecture</u> Südhof	
20	<u>Lecture</u> Alter	<u>Lecture</u> Thorne	<u>Next Gen Science</u> presentations by young scientists	<u>Heidelberg Lecture</u> Dean	<u>Agora Talk</u> • Chu, Moerner • Grubbs, Schrock • Perlmutter, Riess	
21	<u>Social Programme</u> Concert: Karl Frierison Icebreaker Party	<u>Agora Talk</u> • Kobilka, Lefkowitz • Warshel	<u>Open Exchange</u> Blackburn, Kaelin, Leggett, Marcus, Phillips, Semenza, Ting, Whittingham	<u>Open Exchange</u> Allison, Chalfie, Gross, Hall, Hartwell, Laughlin, Perlmutter, Schekman, Strickland, Weiss	<u>Open Exchange</u> Chu, Grubbs, Haldane, Kosterlitz, Riess, Rosbash, Schrock, Smith	<u>Social Programme</u> Concert: Hazmat Modine Sunset Party

Browse the programme booklet with many details on all sessions.



Panel Discussions



Corona and Emerging Pandemics

- Harvey J. Alter, National Institutes of Health, USA
- Françoise Barré-Sinoussi, Institut Pasteur, France
- Richard Neher, University of Basel, Switzerland
- Jana Huisman, ETH Zurich, Switzerland
- Stefan H.E. Kaufmann, Scientific Chairperson Physiology/Medicine, Council for the Lindau Nobel Laureate Meetings, Germany (Moderator)



Dark and Black

- Saul Perlmutter, University of California, Berkeley, USA
- Reinhard Genzel, Max Planck Institute for Extraterrestrial Physics, Germany
- David J. Gross, University of California, Santa Barbara, USA
- Sibylle Anderl, Frankfurter Allgemeine Zeitung/ARD-alpha, Germany (Moderator)
- Rainer Weiss, LIGO MIT, USA
- Saskia Plura, Johannes Gutenberg-University Mainz, Germany

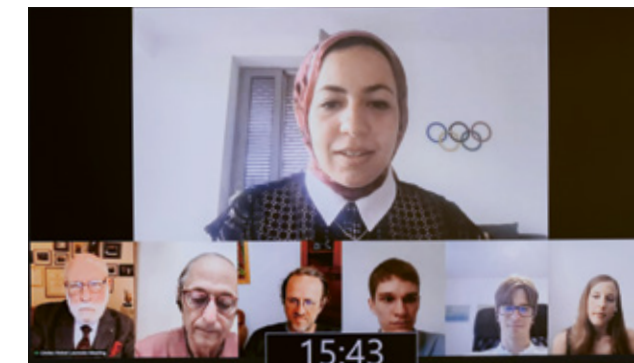
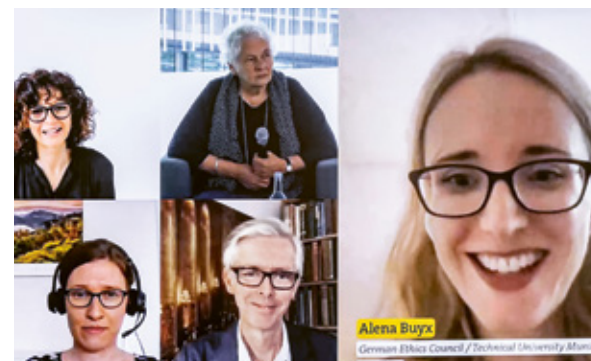


Why Trust Science?

- Adam Smith, Chief Scientific Officer, Nobel Prize Outreach, Sweden (Moderator)
- Brian P. Schmidt, The Australian National University
- Hans-Jörg Rheinberger, Max Planck Institute for the History of Science, Germany
- Balkees Abderrahman, The University of Texas MD Anderson Cancer Center, USA
- Carl-Henrik Heldin, The Nobel Foundation/Uppsala University, Sweden

Gene Editing

- Emmanuelle Charpentier, Max Planck Unit for the Science of Pathogens, Germany
- Christiane Nüsslein-Volhard, Max Planck Institute for Developmental Biology, Germany
- Julia Jansing, Maastricht University, Netherlands
- Adam Smith, Chief Scientific Officer, Nobel Prize Outreach, Sweden (Moderator)
- Alena Buyx, German Ethics Council/Technical University Munich, Germany



Artificial Intelligence: Promises and Threats

- Dina ElHarouni, German Cancer Research Center, Germany
- Vinton G. Cerf, Google, Inc., USA
- Michael Levitt, Stanford University, USA
- Bernhard Schölkopf, Max Planck Institute for Intelligent Systems, Germany
- Marco Eckhoff, Georg-August-Universität Göttingen, Germany
- Tarek Besold, DEKRA, Germany (Moderator)
- Eleni Karatza, University of North Carolina, USA

All panels: order from top left

Panel Discussions

Energy and Climate

- Nadine Mengis, Geomar, Helmholtz Centre for Ocean Research, Germany
- Steven Chu, Stanford University, USA
- Robert B. Laughlin, Stanford University, USA
- Hartmut Michel, Max Planck Institute of Biophysics, Germany
- Brian P. Schmidt, The Australian National University
- Jim Skea, Co-chair IPCC Working Group III, Imperial College, UK (Moderator)
- Gerald Haug, German National Academy of Sciences Leopoldina



Open Science

- Elizabeth H. Blackburn, University of California, San Francisco, USA
- Randy W. Schekman, University of California, Berkeley, USA
- Stephanie Dawson, Managing Director of ScienceOpen, Germany (Moderator)
- Michal Jex, Czech Technical University
- George Datseris, Max Planck Institute for Meteorology, Germany

Rewatch the Panel Discussions of the 70th Lindau Nobel Laureate Meeting in the Lindau Mediatheque.



Session Formats

17 Lectures
By Nobel Laureates
Free Choice of Topic

7 Panel Discussions
Topical and Relevant Issues
High Profile Panelists: Laureates, Young Scientists, Civil Society Attendees



3 Conversations
In-Depth Talks with Nobel Laureates
Non-Academic Subjects

5 Partner Events
Discussions Hosted by Partners of the Lindau Meetings

23 Agora Talks
Laureates Interact During Presentation
Moderator Leads Q&A from the Audience
Flexible and Interactive

60 Open Exchanges
Informal Discussions
Between a Laureate and Young Scientists Only
Time for Q&A, Hosted by Lindau Alumni



20 Next Gen Science Sessions
Research Presentations by Selected Young Scientists
Opportunity for Q&A, also at their Virtual Booths



3 Laureates – 266 Years of Wisdom

Science, Politics and the New World Order

In conversation with Adam Smith, Nobel Peace Laureate Henry Kissinger declared his fascination with “the philosophical side” of science and discussed his recent endeavour to outline ontological implications of advancing AI technology and its impacts on science, societies and politics.

After an intense period of learning and exchange with peers on the issue, Kissinger believes that AI will likely “alter the perception of reality in significant ways and will therefore have an impact on human consciousness.” He compared the gravity of these developments to those of the Enlightenment period and its advances in the natural sciences; however, he also voiced the criticism that with AI today, “the technical scientists are far ahead of the conceptual thinkers,” leading to a lack of contemplation about its application and indications.

The impacts of AI are already visible, finds the former US Secretary of State, claiming it has almost reversed the traditional scientific conduct of gradually increasing knowledge through experimentation: “It’s a different mode of thinking,” he avers, stressing that he neither praises nor condemns either one. Instead, Kissinger calls for new ways to comprehend a reality and world order dominantly shaped by AI: “I think we have to develop a conceptual understanding of it that is parallel to the enormous, extraordinary advances that science has made.” But, he concedes, he could not give the answer to his own question.

Yet, he did not only raise questions for his audience, but had some guidance too. Young scientists should extend their skills into “some reflections on history and society” to develop their understanding of how these have evolved and operate. Ultimately, Kissinger advised, what is needed is “humility in relation to the totality of the subject.”



“I’m not pretending that I have an answer. Other generations will have to fill it in.”
Henry A. Kissinger



Questions to the Centenarian

Good friend of the Lindau Meetings and with 101 years the oldest participant Edmond H. Fischer talked to Lindau Alumnus Stefano Sandrone to answer questions from the Lindau community – sadly, for the last time, as he passed away in August. He recapitulated his life as a scientist, receiving the Nobel Prize and his special connection to Lindau: “Lindau is a wonderful, wonderful place. Some of my best friends are from Lindau.” Other recent interviews with Countess Bettina Bernadotte and Marc Pachter contribute to ‘Eddy’s’ scientific legacy. The Council, the Foundation and everyone who had met him in Lindau will never forget him.



“Research has always been a lot of fun for me.”
Edmond H. Fischer



COVID-19: Impact on Children in Developing Countries

In his conversation with Countess Bettina Bernadotte, Nobel Peace Laureate Kailash Satyarthi discussed the impact of the COVID-19 pandemic on children in developing countries, underlining their special vulnerability: “In every crisis the children – particularly the most marginalised children – are the biggest sufferers; they are the biggest victims.”

“As a human being, as a consumer and as a citizen, we have to feel this modern responsibility that this so-called development must not happen at the cost of billions of children in the world.”
Kailash Satyarthi



Agora Talks

Peter Agre and Hiroshi Amano	Light, Clean Water and Diseases
Martin Chalfie and Randy W. Schekman	Cell Biology
Steven Chu and William E. Moerner	New Methods for Biological Imaging
Aaron Ciechanover and Ben L. Feringa	Next Generation Medicine
Martin J. Evans and Tomas Lindahl	Preserving and Controlling Genetic Information
Joachim Frank and Stefan W. Hell	Pushing the Limits of Microscopy
Robert H. Grubbs and Richard R. Schrock	New Chemical Reactions, Catalysis, Green Chemistry
F. Duncan M. Haldane and J. Michael Kosterlitz	Topology of New Materials
John L. Hall, Gérard A. Mourou and Donna Strickland	Application of Laser Technology: From Health to Metrology
Serge Haroche and William D. Phillips	Quantum Science
Leland H. Hartwell	Science Education
Harald zur Hausen and Barry J. Marshall	Infectious Agents and Cancer
Jules A. Hoffmann	Innate Immunity
Robert Huber, Hartmut Michel and Kurt Wüthrich	Structural Biology and its Key Role in the Life Sciences
Takaaki Kajita and Arthur B. McDonald	Neutrino Oscillations and Observations
Klaus von Klitzing	Practical Impact of the SI System
Brian K. Kobilka and Robert J. Lefkowitz	Review and Outlook: The Nobel Prize in Chemistry 2012
Jean-Marie Lehn	Supramolecular Chemistry
Edvard I. Moser and Michael M. Rosbash	Time and Localization
Christiane Nüsslein-Volhard	Animal Beauty
Saul Perlmutter and Adam G. Riess	Expansion of the Universe
Carlo Rubbia	Particles Generated on Earth and in the Cosmos
Arieh Warshel	New Models to Understand Molecular Dynamics

The Agora Talks were moderated by
Rainer Blatt, University of Innsbruck, Austria
Klas Kärre, Karolinska Institute, Sweden
Stefan Kaufmann, Max Planck Institute for Infection Biology, Germany
Karan Khemka, EMK Capital, Singapore
Kai Kupferschmidt, Science Journalist, Germany
Heiner Linke, Lund University, Sweden

Wolfgang Lubitz, Max Planck Institute for Chemical Energy Conversion, Germany
Olaf Reimer, University of Innsbruck, Austria
Susanne Schultz-Hector
Anna Sjöström Douagi, Nobel Prize Center, Sweden
Adam Smith, Nobel Prize Outreach, Sweden



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1 Edvard I. Moser and Michael M. Rosbash talked with moderator Anna Sjöström Douagi about 'Time and Localization'.

2 Stefan W. Hell attended on site in Lindau and gathered virtually with Joachim Frank and Moderator Adam Smith.

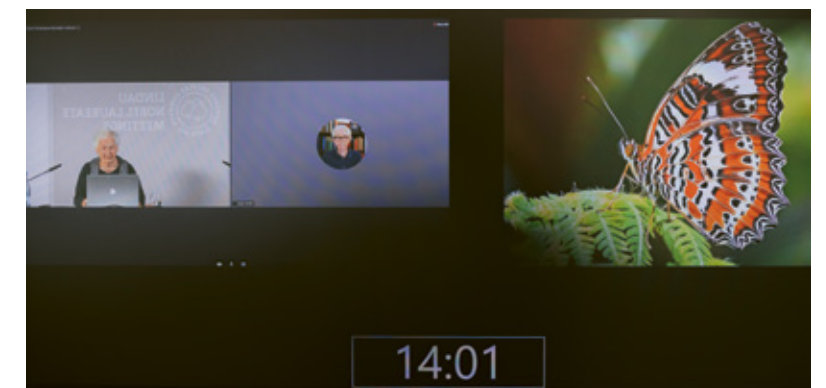
3 Moderator Wolfgang Lubitz and Robert Huber contributed on site to the Agora Talk with Hartmut Michel and Kurt Wüthrich.

4 Christiane Nüsslein-Volhard showed examples of 'Animal Beauty' on screen.

5 Klaus von Klitzing held his Agora Talk in Lindau on his birthday!



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Find all Agora Talks of #LINO70 in the Lindau Mediatheque.



The Future of Interdisciplinary Research

Twenty selected young scientists, representing all three disciplines, had the opportunity to present their cutting-edge work and discuss their projects in a virtual expo booth.



Matteo Aldeghi presents his work online – and on screen in the studio in Lindau.

Physics

Seven physicists presented their work during the three Next Gen Science sessions:

A Scalable Photothermal Catalytic Reactor for CO₂ Conversion

Xiangkun (Elvis) Cao, Massachusetts Institute of Technology (MIT), Session I

Proteome-Scale Discovery of Protein Interactions With Structural Resolution Using Sequence Coevolution

Hadeer Elhabashy, Max Planck Institute for Developmental Biology, Session II

Virome: The Dark Matter of the Human Gut Microbiome

Sanzhima Garmaeva, University Medical Center Groningen, Session II

Towards a Quantum Network:

Entangled Crystals in the Barcelona Area

Samuele Grandi, ICFO – The Institute of Photonic Sciences, Session II

Estimating the Effective Reproductive Number (Re) of SARS-CoV-2

Jana Huisman, ETH Zurich, Session II

Controlling Chemistry with Mirrors: How Strong Interaction Between Light and Matter Can Modify Chemistry and Physics

Christian Schäfer, Max-Planck-Institute for the Structure and Dynamics of Matter, Session II

Confocal Lifetime-Resolved Single-Molecule Localization Microscopy

Jan Christoph Thiele, University of Göttingen, Session I

Chemistry

Seven chemists presented their research to the audience at #LINO70:

Data-Driven Experiment Planning in Chemistry

Matteo Aldeghi, Massachusetts Institute of Technology, Session I

Photoelectrochemical Hydrogen Production in Microgravity Environments

Katharina Brinkert, University of Warwick, Session II

Multifunctional Fe₃O₄-MOF Core-Shell Nanoparticles for Cancer Therapy

Romy Ettlinger, University of St. Andrews, Session III

Learning From the Past to Inform a Better Future for Our Oceans

Nicole Foster, Flinders University, Session III

Next-Generation Materials for Sustainable Energy Technologies

Maria Gélvez Rueda, AMOLF, Session III

Light-Controlled Polymer Formation and Recycling

Christoph Jurissek, Humboldt-Universität zu Berlin, Session III

Self-Supervised Learning Resolves Subcellular Protein Localization

Hirofumi Kobayashi, Chan Zuckerberg Biohub, Session I

Physiology/Medicine

Six young scientists discussed their research in biology, physiology or medicine:

Spying on Viruses: Replication Dynamics of Single RNA Viruses

Sanne Boersma, Hubrecht Institute, Session I

Engineering Microenvironment for Mouse Embryo Implantation

Vladyslav Bondarenko, European Molecular Biology Laboratory, Session III

Dynamics and Plasticity of the Human Brain Network During Cognition

Karolina Finc, Nicolaus Copernicus University, Session III

Quantum Computational Advantage With Photons

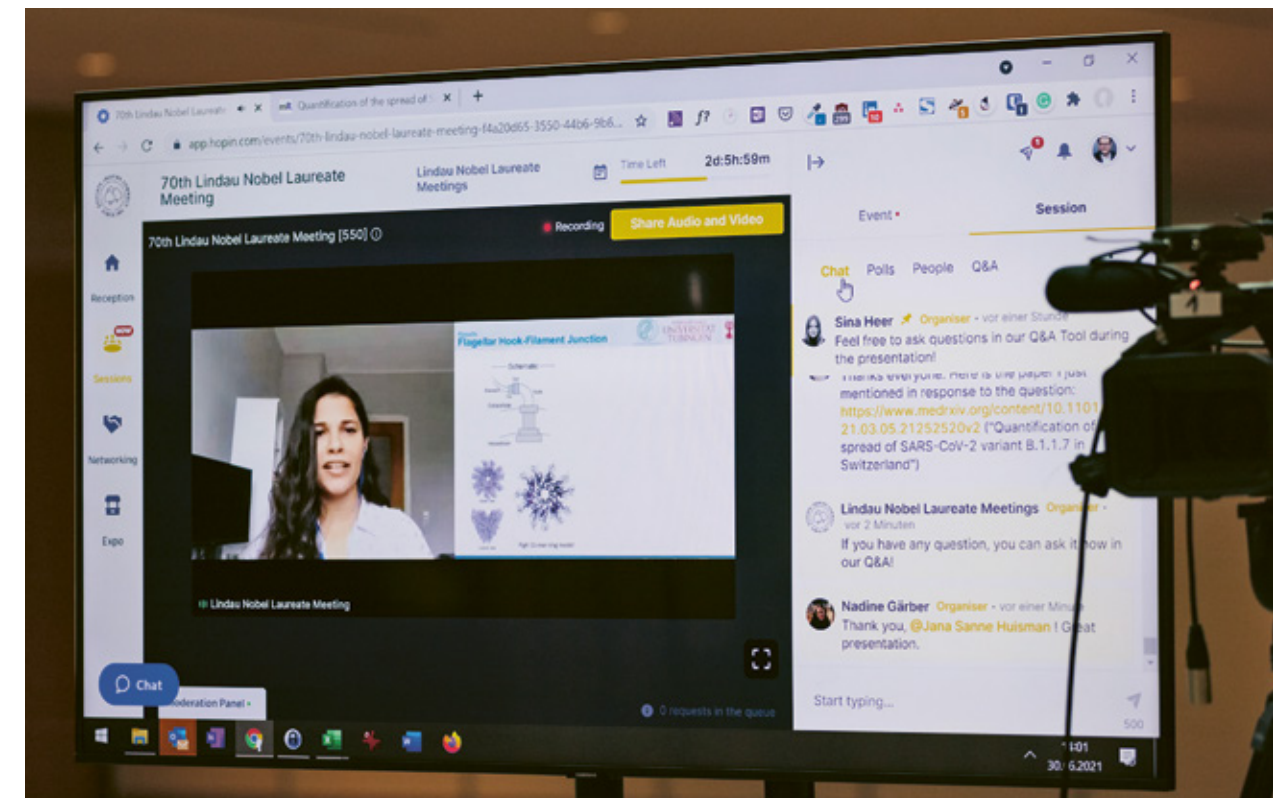
Yuhao Deng, University of Science and Technology of China, Session III

Synaptic Diversity Broadens the Range of Sound We Can Hear

Özge Demet Özcete, Harvard Medical School, Session I

How T Cells Avoid Traffic Jams

Jérémy Postat, McGill University, Session I



Hadeer Elhabashy talks about her interdisciplinary research.



Jérémy Postat presents his work on T cells.

Find every
Next Gen Science presentation
in the Lindau Mediatheque.



Partner Events



Sustainability Drives BASF. BASF Drives Sustainability.

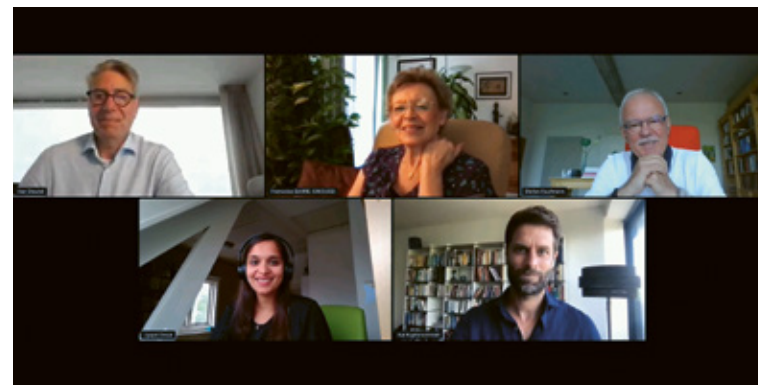
hosted by BASF SE, Germany

- Melanie Maas-Brunner, Member of the Board, BASF SE, Germany
- Yaqian Liu, BASF Advanced Chemicals, China
- Priya Anand, BASF SE, Germany
- Stefan Haefner, BASF SE, Germany
- Kerstin Schierle-Arndt, BASF SE, Germany
- Norman Funk, BASF Services Europe
- Jens Assmann, BASF SE, Germany (Moderator)

New Vaccines Against New (and Old) Threats?

hosted by vfa, Verband forschender Pharma-Unternehmen

- Han Steutel, vfa, Germany
- Françoise Barré-Sinoussi, Institut Pasteur, France
- Stefan Kaufmann, Max Planck Institute for Infection Biology, Germany
- Jyaysi Desai, Erasmus Medical Center, The Netherlands
- Kai Kupferschmidt, Science Journalist, Germany (Moderator)



From Science to Practice: Was the Pandemic an Accelerator?

hosted by the Austrian Federal Ministry of Education, Science and Research

- Stefanie Nagel, Austrian Federal Ministry of Education, Science and Research
- Eva Schernhammer, Medical University of Vienna, Austria (Moderator)
- Harald zur Hausen, German Cancer Research Center
- Johanna Gassler, Institute of Molecular Biotechnology (IMBA), Austria



How Can Genomics Help Achieve Global Food Security?

hosted by Mars, Incorporated

- Abigail Stevenson, Mars Advanced Research Institute (MARI), USA
- Adam Smith, Nobel Prize Outreach, Sweden (Moderator)
- María Clara Miserendino, Universidad Nacional de Córdoba, Argentina
- Ada E. Yonath, Weizmann Institute of Science, Israel



Excellence in Science for Society

hosted by Rolex SA

- Konstantin S. Novoselov, University of Manchester, United Kingdom and National University of Singapore, Singapore
- Faith McLellan, World Health Organization, Switzerland (Moderator)
- Felix Brooks-church, Social Entrepreneur and Inventor, USA and Tanzania
- Fatima Enam, Stanford University, USA



Networking Breaks

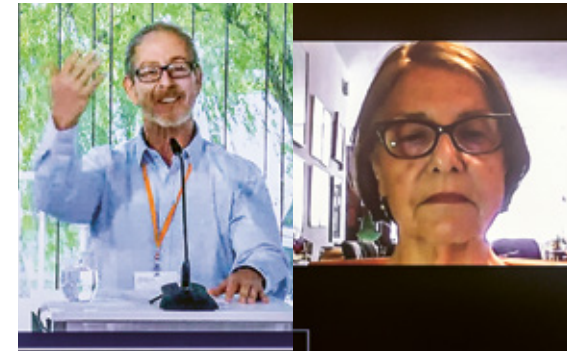
Hopin, Wonder – And Many Other Stories

During the extensive scientific programme many breaks were reserved for networking as an integral part of the Lindau Meetings’ credo to ‘Educate. Inspire. Connect.’ In addition to ‘speed dating’ in Hopin or the virtual rooms on Wonder, moderator Brian Malow also conducted many interesting interviews in which the exciting topics of the meetings were discussed.

	Morning Workout
Lindau Alumnae Martine Abboud and Nataly Naser Al Deen	Alumni Memories of 2018 and Current Projects
Claudia Alfons, Lord Mayor (1)	The Meaning of the Meetings for Lindau
Muhammad Aftab Rafiq, Pakistan Institute of Engineering and Applied Sciences	Pakistan Watch Party
Felix Henningsen, TU Munich	Growing up with the Lindau Meetings and Becoming a Young Scientist
Beate Hein Bennett (2)	Memories of Franz Karl Hein, Co-Founder of the Lindau Meetings
Countess Bettina Bernadotte	The Legacy of the Bernadotte Family
Susanne Wiczorek, Deputy Director, Executive Secretariat, Head of Conference Management (3)	COVID-19 Protocols
Alumna Natasha Tomm	Current Research and Lindau Memories
Jürgen Kluge, Foundation Board Chairman and Council Member	The Role of the Lindau Foundation
Bob Powell, UC California (4)	Tasks and Benefits of Being an Academic Partner
Stephanie Mouchbahani-Constance and Nicholas Clifton	2020 Sciathon Project authentiSci
Gustav Källstrand (5)	Alfred Nobel
Peter Badge	Nobel Portraits
Nadine Gärber, Head of Young Scientist Support and Academic Partner Relations (6)	How to be Selected as a Young Scientist
Wolfgang Huang	Sustainability / Marshland Renaturation / IDEA
Volker Steger (7)	Sketches of Science
Tränkle Guest Family	The Experience of Hosting Young Scientists
Jana Huisman, ETH Zurich	Being on a Digital Lindau Panel as a Young Scientist
	Networking on the Wonder Platform (8)



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Concerts

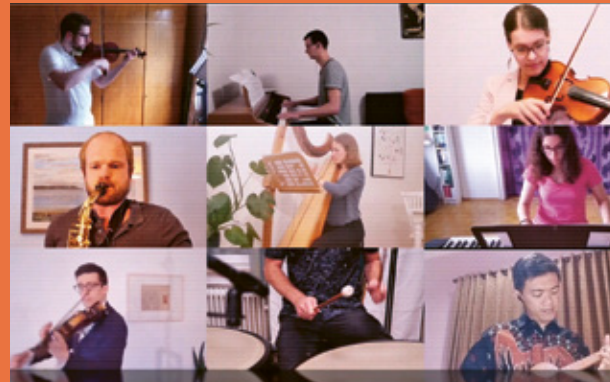
Music for Inspiration

Diverse musical contributions shaped the festive character of the anniversary meeting. Renowned musicians of different genres took part in the programme. And Nobel Laureates, young scientists and Lindau Alumni even formed a virtual band and a virtual orchestra – connecting globally through music.



The Lindau Virtual Band

Say a Little Prayer for You



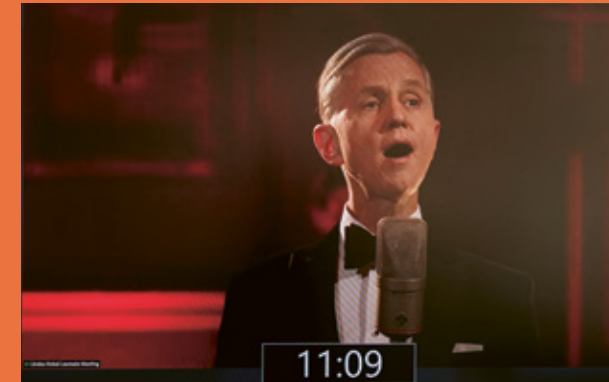
The Lindau Virtual Symphony Orchestra

Ode to Joy



Edmond H. Fischer

Playing the intro to Ode to Joy



Max Raabe & Palast Orchester

Inspiration Concert from Berlin



Hazmat Modine

Concert from New York City



Vienna Philharmonic

Chamber Music from Vienna



The Kerber Brothers

Live from the Engel in Lindau



Karl Frierson

Live from the Zeughaus in Lindau

Making Research Understandable

In recognition of the close bonds between the Klaus Tschira Stiftung and the Lindau Nobel Laureate Meetings the most relevant funding schemes for scientists initiated by the foundation from Heidelberg were presented online in the run-up to #LINO70.



Gero von der Stein and Isa Fünfhausen representing the Klaus Tschira Foundation

Even before the actual start of the meeting, German-speaking young scientists had the opportunity to learn about funding opportunities in the field of science communication – and to get to know a major supporter of the Lindau Meeting: The Klaus Tschira Stiftung promotes natural sciences, mathematics and computer science in general, in the form of their own projects as well as via support for other initiatives, organisations and events – like the meetings in Lindau. Therefore, the partners from Heidelberg could also be found in the anniversary programme: The Heidelberg Lecture 2021 by Jeffrey Dean was dedicated to “A Golden Decade of Advances in Computing Driven by Deep Learning” (see p. 34).

The Klaus Tschira Stiftung also presented their 'KlarText-Preis', an award for science communication that is a great opportunity for German-speaking scientists who have submitted their doctoral theses within the preceding two years. To participate in the competition, postdocs have to send in two pages in German describing their research. The award aims to support science communication that makes research understandable for a broad public audience. The winners in seven categories will be presented with their work, for example in a magazine

published by the foundation. All participants are invited to a workshop about science communication.

Other projects with the goal of linking research and society supported by the foundation are “NaWik”, the National Institute for Science Communication, and the Science Media Center Germany, which provides the media with expert statements and substantiated knowledge. ‘Ratgeber Promotion’ is a comprehensive guide for all aspects of deciding, planning and persevering in a PhD which is published by the Klaus Tschira Stiftung and is available for download. The engaging attitude of the presentation was a perfect prelude to the opening of the 70th Lindau Nobel Laureate Meeting.

The deadline for submissions for the KlarText-Preis will be the end of February 2022.




Science Meets Politics

Although the scientific programme was packed from early in the morning until late in the evening, Nobel Laureates and politicians did not miss the chance to take advantage of other opportunities for exchange and virtual networking on the fringes of the meeting.



On tour with her 'Karliczek meets...' series of discussions with notables, the Federal Minister of Education and Research invited Nobel Laureate Reinhard Genzel to a lively 90-minute exchange on research policy. This format was also designed to be interactive, so young scientists could participate in the discussion live. Also on the panel was Countess Bettina Bernadotte, who described a very typical situation at a Lindau conference: Laureates and young scientists meet, find their common topic – and after 20 seconds at the latest they have completely forgotten what is happening around them.

Reinhard Genzel – who was in great demand not only at the Lindau meeting in the first year after his Nobel Prize – was also a guest in the Munich State Chancellery during the meeting week. After the awarding of the Nobel Prize there (lower left, accompanied by H.E. Per Thöresson, Ambassador of Sweden to Germany, and Countess Bettina Bernadotte) this time, however, virtually via video conference. The occasion was an appreciation by Minister-President Markus Söder of newly appointed professors in Bavaria, for whom the live link to a Nobel Laureate was certainly a great inspiration. (lower right)

A person's hands are holding a black tablet computer. The background is a blurred outdoor scene with trees and a building. Overlaid on the image are four colored circles containing text. The largest circle is yellow and contains the text 'KEY TOPICS #LINO70 INTERDISCIPLINARY'. To its right are three smaller circles: an orange one with 'PHYSICS', a green one with 'PHYSIOLOGY MEDICINE', and a teal one with 'CHEMISTRY'.

KEY TOPICS
#LINO70
INTERDISCIPLINARY

PHYSICS

PHYSIOLOGY
MEDICINE

CHEMISTRY

Spurring Creativity and Collaboration

Around the world, the Open Science movement continues to gain support from a growing number of researchers and members of the public – a scientific meta topic also represented in the Lindau Meeting programme in 2021.

Elizabeth H. Blackburn, recipient of the 2009 Nobel Prize in Physiology or Medicine for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase, began the conversation in the panel discussion on Open Science by highlighting the Lindau Guidelines (see p. 96). “I basically think of them as a sort of Hippocratic oath for scientists, and the idea in part is to foster what we hope will be increasing the public’s trust in science,” said Blackburn, who first introduced the initiative during the 68th Lindau Nobel Laureate Meeting in 2018. “By the way, I’m happy that at least 42 of the Nobel Laureates participating in this meeting have already endorsed these guidelines.”

George Datsaris, a postdoctoral researcher at the Max Planck Institute for Meteorology, chimed in with his perspective on preprints. For every paper eventually submitted to a peer-reviewed journal, he first published the manuscript on a preprint server. The benefit to Datsaris includes the opportunity to discuss the results with colleagues who are not in the same research group but who work on the same topic.

The floor then went to Randy Schekman, recipient of the 2013 Nobel Prize in Physiology or Medicine for his discovery of the machinery regulating vesicle traffic. He is widely known for his commitment to Open Science and as the founding editor-in-chief of *eLife*, an open-access journal published by the Howard Hughes Medical Institute, the Max Planck Society and the Wellcome Trust. Schekman described the pervasive influence of a journal’s impact factor. He considers it to be a false metric, arguing that impact factors cannot be sustained by the data on

which they are based. Schekman felt that young scholars would nevertheless rely on it when deciding where to submit their work.

“As the editor of the Proceedings of the National Academy of Sciences, I tried to do away with any consideration of that number. I encountered difficulty from some of the staff at the journal who said we need to improve the impact factor, and the best way to do that is to reject more manuscripts. I couldn’t believe that this was the logic that had come to play in a very important journal like the Proceedings.”

Lastly, Michal Jex reported on a project he developed with Group Wernicke at the Online Sciathon 2020 (for 2021 edition see p. 102). As a postdoctoral researcher at the Czech Technical University in Prague, he has been confronted with many problems with the current peer review process. Besides being incredibly slow, Jex and the other team members found that the process is often not transparent, hinders scientific communication and obscures the crucial contribution of reviewers. Their concept for the platform RevEasy includes open discussion between reviewers and authors, as well as publication of the reviews with the paper and an online comment section.

In 2018, George P. Smith was awarded the Nobel Prize in Chemistry for the development of an elegant method known as phage display that uses bacteriophages to evolve new proteins. His lecture during #LINO70 emphasized that this scientific achievement was anything but a solo effort. “Only when contributions of individual scientists are freely shared with the community so they can augment and recombine with the incremental contribu-



Panel Discussion: Elizabeth H. Blackburn, Stephanie Dawson (Moderator), George Datsaris, Michal Jex, Randy W. Schekman

tions of many others does an important advance arise.” For this reason, Smith believes that intellectual property rights that include the ability to withhold information or resources from the scientific community – what he calls “intellectual hoarding” – are greatly detrimental to science. He brought up the controversy of intellectual property rights owned by pharmaceutical companies which allow them to charge monopoly prices that greatly exceed competitive market prices. For instance, did the companies which developed and produced the COVID-19 vaccines deserve patent monopolies for their vaccines? And was the promise of patent monopolies the best way for governments to foster development of the vaccines?

“My answer to both questions is an emphatic no,” he said. “If phage display illustrates the communal nature of scientific creativity on a miniature scale, RNA vaccine technology illustrates it on a gargantuan scale. That technology has depended critically on hundreds of discoveries in immunology over at least a century in many dozens of countries, and of course stands on the shoulders of modern molecular biology and virology.” Instead, Smith argues that a better way to stimulate vaccine development would have been through public funding.



Lecture: Scientific Achievements Are Nobody’s Intellectual Property – George P. Smith, introduction by Wolfgang Lubitz

“Individual scientists in the lab make important contributions to be sure, but these contributions are incremental.”
George P. Smith



Can We Stop It in Time?

At the 65th Lindau Nobel Laureate Meeting, Nobel Laureate Brian P. Schmidt became spokesman of what was to become the Mainau Declaration on Climate Change. Fittingly, this year he attended a panel on energy and climate – one of several events dedicated to climate questions at #LINO70.

This panel, which also featured Nobel Laureates Steven Chu, Robert B. Laughlin, and Hartmut Michel, as well as climate scientist Nadine Mengis and geologic climatologist Gerald Haug, stressed just how big of a challenge tackling climate change really is. Even the ongoing pandemic was said to fade in comparison.

In this context, greenhouse gas emissions have recently been analysed by the Intergovernmental Panel on Climate Change (IPCC). A key finding of the IPCC is that if we want to avoid many of the catastrophic effects of climate change, we should ensure that warming stays within 1.5 degrees Celsius over pre-industrial levels – or 2 degrees at most. But Laughlin doesn't see it happening. "My bet is that the IPCC CO₂ limits are not going to be met and the world is going to blow past that number." Gerald Haug is also not very optimistic about our odds. "I'm not an economist, but if we don't put a price on carbon, I don't think we'll meet any target."

Steven Chu, who also served as the 12th United States Secretary of Energy, knows a thing or two about how hard it is to address climate change. "It's not just about carbon-free electricity and transportation, it's also about the chemicals in the construction materials we use, our agricultural activity, and so on. We essentially need a 4th agricultural revolution."

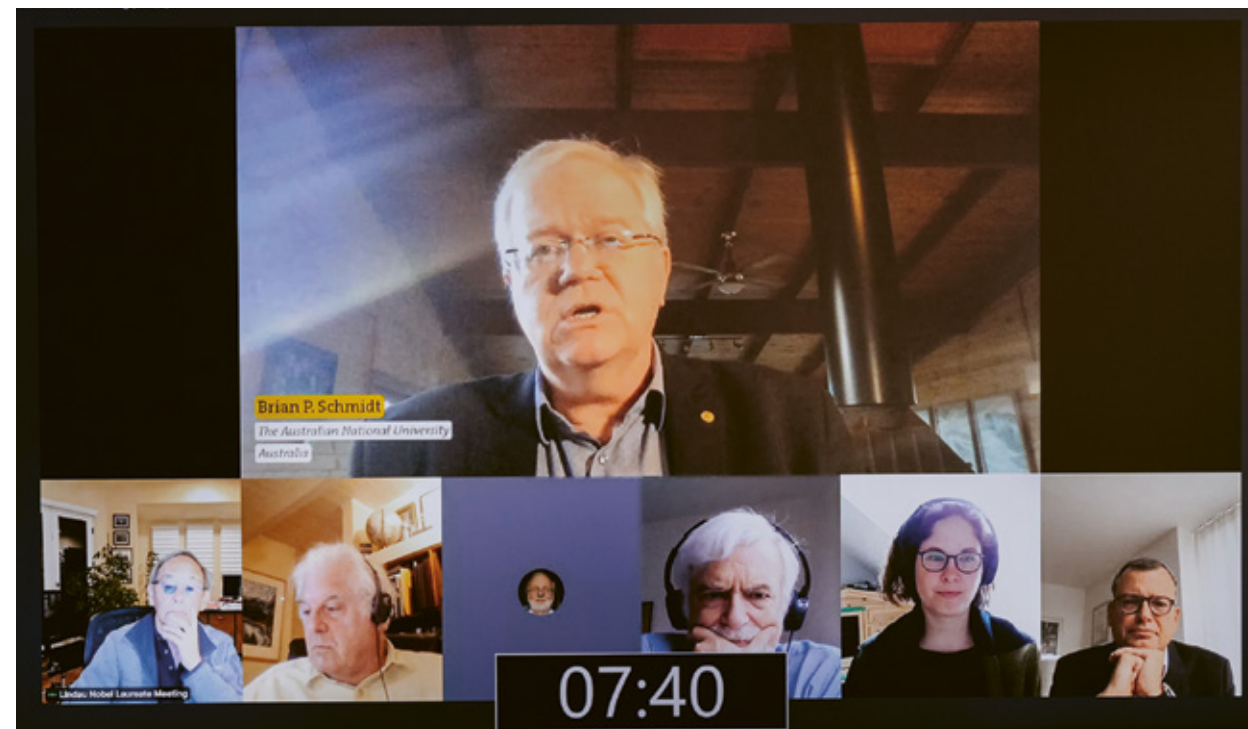
Indeed, while much of the climate solutions are systemic and complex, others are very simple, and they can start with what we have on our plates. For instance, meat has been repeatedly shown to be a significant contributor to our individual carbon footprint. "We have to make sure that people don't eat steaks all the time," Michel

points out. Mengis also noted that we need to get to a point where it becomes easier for people to make sustainable decisions. "There is a difference between individual change and systemic change. We need to get to a point in the system where every individual can lead a carbon-free lifestyle."

But while we shouldn't rely on new technologies to save us, it's good to know that progress is being made. Someone who knows a lot about this progress is M. Stanley Whittingham, one of the key figures behind the development of lithium-ion batteries, which now are used in everything from smartphones and laptops to electric vehicles. In his #LINO70 lecture he gave an insight into his work. "Governments have to invest and have a supply chain on their own continent. It can become sustainable, especially when we consider recycling. The batteries in your laptops and phones must be recycled."

Sometimes, our quest for energy improvements also takes us to unexpected places. For his work on the invention of efficient blue light-emitting diodes, Hiroshi Amano was awarded the 2014 Nobel Prize in Physics. In a separate Agora Talk, Amano explained that it's not just the energy consumption that's attractive about this type of LEDs, but also the fact that they can be used to deactivate viruses and other pathogens. "By irradiating water for 6–7 seconds, we can deactivate 99.9% of viruses", he mentions.

Peter Agre's findings also came about somewhat unexpectedly. In the same talk, he explained how an accident (and a lot of curiosity) set him on a path that would lead to a Nobel Prize. Agre was recognised for discovering aquaporins – proteins used for water transport in many

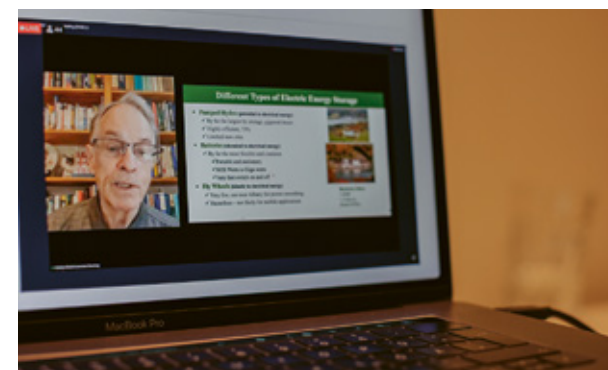


Panel Discussion: Energy and Climate – Brian P. Schmidt, Steven Chu, Robert B. Laughlin, Hartmut Michel, Jim Skea (Moderator), Nadine Mengis, Gerald Haug

organisms, including the human kidneys. Now, aquaporins are researched as water filtration mechanisms and could be soon deployed in parts of the developing world where access to clean water is still a challenge.

Nobel Laureates in Chemistry Robert Grubbs and Richard Schrock also shared a few of their insights into how developments in one field can sometimes be applied in another. However, it's also important that sustainable solutions are not just developed, but also made cost-effective, which is where the work of Grubbs and Schrock truly shines, as metathesis has enabled the development of catalysts widely used in everything from renewable energy to vaccines.

Climate change is a gargantuan threat, a hydra with many heads. But hearing laureates at #LINO70 discuss all these aspects of it, as well as solutions developed to tackle them, gives you a feeling that maybe, just maybe, we can solve it in time. At the very least, some of the world's greatest minds are working on it.



Lecture: Storage Is Ready to Address Climate Change – M. Stanley Whittingham

"When you develop new technologies, you never know where the people are going to find it useful."
Robert H. Grubbs



It's up to Us to Use It for Good

A revolution is ongoing in computation and algorithms, and we're already starting to see this technology applied in a multitude of fields, from healthcare to agriculture. Given its growing importance, AI couldn't be absent from the schedule at #LINO70.

In the past decade or so, Machine Learning (ML) and Artificial Intelligence (AI) have gone from relatively obscure fields of research to become almost ubiquitous. Jeffrey Dean has been a key figure in this development, which is why he was awarded the 2012 ACM Prize in Computing. Dean is the lead of Google AI, one of the major companies driving innovation in the field. In his Heidelberg Lecture (see p. 34), Dean started off by explaining how much the field has taken off with an intriguing comparison: the field of machine learning is growing faster than processing power (represented by Moore's Law).

This explosive growth has enabled a massive range of applications. Dean mentions an example from the Netherlands, where people are using machine learning to track cow fitness and see if their behaviour is indicative of any problem. In fact, machine learning can be put to great use in agriculture, especially in the developing world. For instance, a single phone app can be used to take photos of some crops, aid with disease diagnosis and with determining a suitable treatment.

AI can also do some pretty crazy things, like take text input and produce image output. For instance, Dean described how you can tell some algorithms to synthesise

an image of a giraffe in a funny hat "and the system will produce a lot of images of giraffes wearing funny hats."

"Robotics is also something that will be making significant advances in the next few years because we can sense the world around us much better." Dean says one such robot is able to learn how to pour liquids into a cup just by watching videos.

In healthcare, the potential is also tremendous. Algorithms can help clinicians reduce their workload, for instance by analyzing large sets of patient data. No longer limited to the lab or online companies, ML seems ready to take on the real world. "The last decade has really shown remarkable progress in a number of different areas, computers can now perceive the world, see around them, and that has dramatic implications", says Dean.

That's exactly why some people are a bit worried. "I am [...] concerned that [AI and machine learning] don't always work the way we expect them to", says Vinton G. Cerf, who is widely regarded as one of the fathers of the internet. A panel discussion at #LINO70 also featured Nobel Laureate in Chemistry 2013 Michael Levitt, Bernhard Schölkopf, a leading researcher in the machine learning community, Post-Doc Eleni Karatza, Doctoral



Panel Discussion: Artificial Intelligence – Promises and Threats – Eleni Karatza, Vinton G. Cerf, Michael Levitt, Bernhard Schölkopf, Marco Eckhoff, Dina ElHarouni, Tarek Besold (Moderator)

researcher Dina ElHarouni and PhD candidate Marco Eckhoff.

For many researchers, ML is essentially a time machine, says ElHarouni. Anything that was taking a researcher two or three weeks can now be automated and done not just faster, but at a fraction of the cost. In healthcare, the area Karatza is focused on, AI and ML are particularly useful for finding connections and variability between patients, something which is very useful in pediatrics, she notes. Michael Levitt also seems to agree. "I think the next big thing is gonna be AI in medicine."

But for all its potential, there are also concerns surrounding the emergence of AI. While it is excellent at finding correlations, it cannot help us understand and interpret these correlations. Secondly, AI works with real-life data, which means it can reflect real-life biases, and even accentuate these biases. This is why, both Karatza and Dean explained, special measures are taken to address these problems.

But the societal implications and potential threats of AI extend far beyond that. Vinton G. Cerf foresees "a lot of interesting court cases" in the coming decade, especially with the rise of autonomous cars. All participants

stressed the importance of not just using AI to aid society but using it in a way that is responsible and sustainable. According to Dean, it's up to all of us to ensure that AI is used for good.

"I'm concerned about autonomous weapons [...], we need to establish societal norms for what kind of things it could be used for, we can draw a societal line and say this is not what we want", Dean concludes. "I think it's up to all of us to collectively make sure that this is a tool that is used in the best possible ways."

"I have followed very carefully the discoveries in Machine Learning. I am particularly interested in a kind of democratised, decentralised way of doing science."
Michael Levitt



Signals From the Void

Since Galileo Galilei, astronomy has relied on telescopes and similar technologies to capture visible light and other electromagnetic radiation emanating from the universe. So how do we ‘see’ a black hole when its staggering gravitational pull is so strong that no light can escape?

How can we unmask the nature of dark matter – thought to make up roughly 25 percent of the universe – when it does not absorb, reflect or emit light? As for dark energy, which appears to be roughly 70 percent of the universe, all we know for certain is that it is causing the rate of expansion of the universe to increase.

These were the deep questions at the heart of a panel discussion on day 4 of #LINO70. Primed to offer their thoughts on the ‘dark universe’ were young scientist Saskia Plura as well as Nobel Laureates Reinhard Genzel, David J. Gross, Saul Perlmutter and Rainer Weiss.

By observing stars in the area around Sagittarius A* at the heart of the Milky Way, Genzel indirectly observed the gravitational pull from an invisible massive object. For this, he was awarded a share of the 2020 Nobel Prize in Physics “for the discovery of a supermassive compact object at the centre of our galaxy”.

Moderator Sybille Anderl was quick to point out that the Nobel announcement made no mention of the object being a ‘black hole’. So, is it really a supermassive black hole? “While it’s highly plausible that what we have seen is indeed a black hole, there are still some loopholes”, explained Genzel.

To provide incontrovertible proof, researchers will need to measure the object’s spin and to check if it conforms to the no-hair theorem, meaning that it can be completely characterised by its mass, electric charge and angular momentum.

The announcement of Weiss’ 2017 Nobel Prize in Physics made no mention of black holes either, but instead focused on what he, Barry C. Barish and Kip S. Thorne as key members of the LIGO Collaboration had achieved in detecting the first gravitational waves.

At the time of the discovery, Weiss too was cautious to claim that what LIGO had picked up was indeed the faint ripples in spacetime caused by the violent collision of two distant black holes. With the detection of additional and different signals later in 2015, everyone began to believe that it wasn’t a fake.

Gravitational wave astronomy was born, opening an entirely new window to the universe. Might this new window offer a view into the nature of other dark elements of the universe besides black holes? For example dark energy? One way to do so would be providing a new method to measure the Hubble constant, which is the yardstick for the universe’s expansion rate today.



Panel Discussion: Dark and Black – David J. Gross, Reinhard Genzel, Sibylle Anderl (Moderator), Saul Perlmutter, Rainer Weiss, Saskia Plura

Currently, there is a discrepancy in the values derived by the two main techniques to calculate it, commonly called the ‘Hubble tension’. “If they don’t agree, that has a severe impact on our understanding of dark energy pressure, and it is an enormous challenge to the Standard Model of Cosmology”, said Gross.

Perlmutter – who received the 2011 Nobel Prize in Physics with Brian P. Schmidt and Adam Riess for discovering the accelerating expansion of the universe – stood ready to explain this Hubble tension and its relevance to dark energy; which, in his words, is a “placeholder name” for whatever is driving the universe’s accelerated expansion.

Perlmutter and Riess clarified in their Agora Talk that the challenge in exposing dark energy’s nature is not a lack of ideas. The real difficulty is in ensuring these ideas line up with all the observations that have gone before – something only the Standard Model of Cosmology comes close to doing.

While deciphering the nature of dark energy appears to be at an embryonic stage, exposing dark matter’s identity is a more palpable prospect. For instance, just three months before #LINO70, researchers working on

the Muon g-2 particle physics experiment at Fermilab confirmed an existing anomaly and announced a new one in the magnetic properties of the muon. “All these anomalies can surely help us find new physics beyond the Standard Model [of Particle Physics], be it dark matter or something else”, suggested young scientist Plura.

Most encouraging for Gross is that scientists have more to go on with dark matter than dark energy: “Dark matter has been observed gravitationally by our colleagues in astronomy – the evidence is overwhelming. But what is it made out of, what are the constituents that make up dark matter?”

“There are so many new models of dark matter waiting to be tested. It’s an exciting time to be working on this.”
Saskia Plura



Hunting for Order in the Cosmic Forest

Multiple sessions during #LINO70 invited the audience to go on a journey through the universe, marvel at its beauty and explore its riddles. For several Laureates contributing to this discussion, it was the first participation in a Lindau Meeting.

“Astronomy is like a journey through the universe, which I often compare to a forest”, said 2020 Nobel Laureate in Physics Reinhard Genzel during his #LINO70 talk. “We see the beautiful trees and the enormous complexity, and on very rare occasions in this beauty we begin to see a certain order.”

Genzel’s journey began in 1980, when he joined the group of 1964 Physics Nobel Laureate Charles Townes as a postdoc. Just a few years earlier, Townes had taken gas measurements of the Milky Way, revealing a huge mass near its centre – a strong hint of a supermassive black hole, but no proof.

From the 1990s onwards, Genzel’s team peered into the heart of the Milky Way to look for more conclusive signatures of this black hole, dubbed Sagittarius A*. They reasoned that the stars near such an extreme object would have tell-tale orbits, accelerating as they fell ever closer to the centre.

With Genzel using the telescopes of the European Southern Observatory in Chile, and his Nobel co-recipient Andrea Ghez the Keck telescopes on Hawaii, by 2008/9, they had proof. The trajectories of several close-in stars indicated that Sagittarius A* measures less than 125 times the distance between Earth and the Sun, even though it contains 4 million solar masses. “I would say it’s very likely to be a black hole”, said Genzel.

For Genzel, slowly uncovering order in the universe’s complexity has been most satisfying. By monitoring the motions and spectroscopy of the stars near the massive black hole over time, his team can compare their observations with what Einstein’s general relativity predicts: “All

of this is in exact agreement with what is expected from general relativity.”

In 2016, the first direct observation of gravitational waves presented a similar extraordinary agreement with Einstein’s theory. The collaborations of LIGO and Virgo observatories presented cosmic ripples in the fabric of spacetime predicted 100 years earlier. In his lecture, Kip S. Thorne (Nobel Prize in Physics 2017) showed the audience the now famous “GW150914” gravitational wave signal perfectly matching theory’s predictions.

It is the relic of two black holes colliding 1.3 billion years ago, which for about 1/10 of a second produced ripples of distorted space with a power 50 times larger than that of all the stars in the universe combined. “When black holes collide, they create a storm in the shape of space and the rate of flow of time”, he explained. “And that storm generates the gravitational waves that LIGO and Virgo have observed.”

Describing our very latest understanding of black hole collisions, gravitational waves and the many remaining questions, Thorne ended optimistically: “Think back to the huge revolution in our understanding of the universe from electromagnetic astronomy by itself over the last several centuries.”

Didier Queloz (2019 Nobel Prize in Physics) spoke about another revolution in astronomy: his 1995 discovery of the first planet outside the Solar system – 51 Pegasi b, roughly 50 light years away in the Pegasus constellation – changed our understanding of Earth’s place in the cosmos and gave birth to exoplanet research, an entirely new field of physics.



Lecture: The Exoplanet Revolution – Didier Queloz, closely followed by Klaus von Klitzing

In the meantime, scientists have discovered approximately 4,800 confirmed exoplanets, changing perceptions of what a planetary system should be.

“You may have learned at school we have these three categories of planets”, said Queloz, referring to gas giants, ice giants and terrestrial planets. “We can just stop learning that because in the universe, there is a continuity between all these planets. You have a lot of categories.”

Queloz too ended his talk with optimism and excitement for the future, suggesting we are on course for being able to test for hints of life on distant worlds without having to travel vast cosmic distances to get there: “You can imagine that there are certainly 1,000 stars around us for which we can look at the detailed planet compositions, and we will learn quite a lot. I think exploring other planetary systems will have some kind of impact on our own civilization.”



Lecture: How to Detect Gravitational Waves – Barry C. Barish

“I invite you to speculate what may happen with gravitational wave astronomy and multi-messenger astronomy over the next several decades and centuries. It’s going to be very exciting.”
Kip S. Thorne



Extreme Light Illuminates a Way to the Energy of the Future

The Agora Talk with Nobel Laureates John Hall, Gérard Mourou and Donna Strickland at #LINO70 treated the audience to a rare insight into how two important but seemingly disparate areas of laser physics are in fact intimately linked.

Though Hall, Strickland and Mourou all come from the laser physics community, their fields of research couldn't be farther apart. Strickland and Mourou shared half of the 2018 Nobel Prize in Physics for jointly inventing a new technique to create ultrashort high-intensity laser pulses in the 1980s. Called chirped pulse amplification, the technique stretches short laser pulses to reduce their power, then amplifies them, and finally compresses them back down. Chirped pulse amplification is used today in everything from proton therapies that treat deep-tissue tumours to machining the cover glass used in smartphones.

Meanwhile, Hall and Theodor Hänsch were awarded half of the 2005 Nobel Prize in Physics for their fundamental contributions to the development of laser-based precision spectroscopy, in particular Hall's invention of the optical frequency comb around the year 2000. An optical frequency comb is a special laser source originally developed to count the cycles from optical atomic clocks and used more broadly in high-precision metrology. "High-intensity laser physics is all about making as short a pulse as possible", said Strickland. "This is the opposite of high-resolution spectroscopy." So what do

the two fields have in common? It is the mode-locked laser. As our high-school physics teachers taught us, laser light is unlike any natural light. Lasers produce an intense light beam where all the light waves have similar wavelengths and all their peaks are lined up, or in phase. Within the laser's resonant cavity, the light bounces between opposing mirrors, leading to the formation of standing waves or modes. A regular laser allows these modes to oscillate independently from one another.

In contrast, a mode-locked laser forces each mode to operate with a fixed phase between it and the other modes. As a result, these modes periodically and constructively interfere with one another, allowing the laser to produce pulses of powerful laser light of short duration. The mode-locked laser was the obvious starting point for Mourou and Strickland to go on to produce the shortest and most intense laser pulses up to that time. But for Hall, its relation to his specialism – precision spectroscopy – was far from clear initially.

In his talk, Hall described the situation in 1999, when his team was "trying to make the lasers the most stable that they can possibly be. But then there were people such as Gérard Mourou who were saying 'let's make the laser



Agora Talk: Application of Laser Technology – From Health to Metrology – Gérard A. Mourou, Donna Strickland, Rainer Blatt (Moderator), John L. Hall

as rapidly changing as possible." And this got Hall thinking. Using a similar type of mode-locked laser as Mourou and Strickland had used in their work, Hall built a spectrum of light split up into a very fine series of pulses at equally spaced intervals of frequency that resembled the teeth of a comb. An unknown frequency could then be determined by relating it to one of the frequencies along the 'frequency comb'.

Changing tack, Mourou's talk aimed to show how 'extreme light' derived from the latest high-intensity laser physics research can help the planet in transitioning from fossil fuel-based energy to a cleaner way forward. "The biggest existential problems that this planet is facing is a problem of energy", he said. "We've found a way to solve it by using a very, very short burst of light which is in the femtosecond regime; a millionth of a billionth of a second." These short pulses could be used to produce clean and efficient thorium-based nuclear energy. Using a GW power plant as an example, Mourou said that 3 million tonnes (or equivalently, 100 trains with 100 cars) of coal are needed to power a big city for a year. This drops to 300 tonnes if using uranium. But a thorium-based power plant would only require 1 tonne of raw

material. What's more, a thorium nuclear power plant would not have to be based on traditional nuclear fission. "By using this phenomenally big light pressure, you can do fission or fusion", he said. "Using extreme light, I think we have now a new way to really look at energy production in a safe and abundant way."

"Whether you want a short pulse or you want all the pulses so that you can have this great frequency comb, you're going to start with the mode-locked laser."
Donna Strickland



Impressions

Beyond the Programme Sessions

In addition to numerous photos documenting the scientific programme with Nobel Laureates and young scientists, many memorable scenes outside the session formats could be observed at the 70th Lindau Meeting. Even more impressions can be found on Flickr and in the 'Daily Recaps' on the Lindau blog.

1 Natalie Schunck speaking at the closing ceremony on Mainau island on behalf of all young scientists

2 Countess Bettina Bernadotte

3 The Pool filmcrew enabled numerous live casts and recordings on site

4 Lindau Island with the Nobel Laureates' Gallery in the foreground

5 Peter Agre's photograph from the 'Sketches of Science' on the facade of the Inselhalle

6 Christiane Nüsslein-Volhard in the Inselhalle studio



A Pair of Scissors for the Genome

Gene editing is not new, it's been done for decades in one form or another, but we're still just at the start of the road. In a set of talks, Nobel Laureates and leading researchers discussed the advantages and opportunities gene editing offers but also the ethical challenges it brings.

Emmanuelle Charpentier and Jennifer Doudna received the 2020 Nobel Prize in Chemistry for the discovery of one of the sharpest tools in genetic engineering: the genetic scissors CRISPR/Cas9. It allows researchers to alter the DNA of microorganisms, plants and animals with high precision. This technology has revolutionised life sciences, opened up new possibilities for plant breeding and innovative cancer therapies and could make the dream of curing inherited diseases come true.

In 2012, a landmark paper presenting the last steps of the procedure was published, and by 2014, there were already 1,000 published studies using the technique. Now, we are nearing 20,000 published papers, and several clinical trials using the method are well underway. CRISPR/Cas9 is already used as an experimental method to treat sickle cell disease as well as some forms of blindness. Researchers are now eyeing ways to deploy CRISPR/Cas9 to help millions fight hunger, by tweaking crops and making them more resilient to things like pests and climate change.

Understanding and applying CRISPR/Cas9 required technologies that simply weren't available a few decades ago; it was only thanks to recent advancements in biotechnology that the work of CRISPR pioneers was possible – a remarkable case of science helping science. CRISPR/Cas9 offers not only the precision we are looking for, but also unprecedented simplicity in gene editing. This has made the field more democratic and open, enabling multiple labs to play a role and refine and improve the technique even further. "CRISPR/Cas9 is one of the newest tools. It has become popular thanks to its simplic-

ity and its ability to be delivered in many cells and edit genes and their expressions", Charpentier notes.

"I would like to see other gene-editing technologies coming up in the future to be combined with CRISPR and increase our ability to edit genes in an even broader and precise manner." Molecular biotechnologist Julia Jansing, who has worked with CRISPR since 2014, fully agrees: "I'm always surprised with how many more methods teams are finding." But for all its advantages and ease of use, CRISPR/Cas9 is not without its share of controversy.

A stellar panel brought together Charpentier, Jansing, developmental biologist and Nobel Laureate Christiane Nüsslein-Volhard, and ethicist Alena Buyx. The four discussed the potential and implications of CRISPR/Cas9 and gene editing in general. After a moment of enthusiasm regarding the benefits gene editing could bring, things quickly heated up when it came to the ethics.

"I join all my colleagues in their excitement", Buyx said. "This technology has such amazing potential, not just for plants and animals, but also for treatment. What we did experience, however, and what I deeply regret, was an event in 2018, when the Chinese scientist He Jiankui edited the genomes of human embryos", not to cure them of any threatening health condition, but rather to make them less susceptible to HIV. The announcement shocked the world and immediately drew widespread criticism from researchers in the field.

Not long after, the World Health Organization issued a call to halt all work on human genome editing, and pressure grew for tighter regulations. During the discussion, the two laureates argued that fears regarding gene

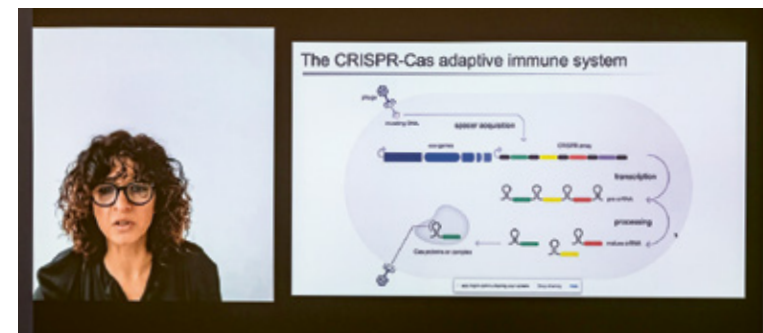


Panel Discussion: Gene Editing – Emmanuelle Charpentier, Julia Jansing, Alena Buyx, Adam Smith (Moderator), Christiane Nüsslein-Volhard

editing are at least somewhat overblown. Checkpoints are already in place, and with the exception of rogue events like the one in 2018, the method is being used in a safe way that can benefit humanity. "We eat foreign genes all the time – you eat beef, you eat a foreign gene. This worry is irrational", Nüsslein-Volhard quipped.

In a subsequent Agora Talk, Nobel Laureates Tomas Lindahl and Sir Martin Evans discussed some of the ways regenerative medicine has benefitted from a better understanding of genetic processes. For instance, DNA damage is connected to almost all processes related to ageing, Lindahl explains – so that's probably a good place to start looking if we want to tackle ageing.

But there doesn't need to be any practical benefit to this research – or at least not directly. Oftentimes, understanding the underlying biology is more valuable down the road in finding an immediate use.



Lecture: CRISPR-Cas9 – Transforming Life Sciences With Bacteria – Emmanuelle Charpentier

"You don't have to spend every minute of your day tied to the bench. You need a life. You ought to be interested in a lot of things that are not what you're studying."
Tomas Lindahl



A Window Into the Living World

Rapid technological advances over the past decades have opened a window into aspects of biology once thought impossible to visualise. During #LINO70, the state of the art in modern biological imaging was discussed in several Agora Talks.

Stefan Hell began his Agora Talk by pointing out that “in the 20th century, it was widely accepted that the resolution of any lens-based microscope was fundamentally limited by diffraction to about half the wavelength of light, or about 200 nanometres.” The scattering of incoming light at the entrance to the microscope objective results in a loss of information that prevented early instruments from pinpointing the exact location of a light source within samples.

Hell, along with Eric Betzig and William E. Moerner, invented two separate super-resolution techniques to bypass this limitation that brought optical microscopy into the nano dimension and earned them the 2014 Nobel Prize in Chemistry: stimulated emission depletion (STED) microscopy and single-molecule microscopy.

Both techniques rely on the principle of separating out fluorescent features or molecules in order to shrink the minimum distance between two distinguishable points in the sample. STED microscopy considerably improved the resolution to 20 nanometres (nm), just short of the theoretical limit of 1 nm. “The goal in my lab in the last years has been to get down to that limit”, said Hell.

And with some success: By combining the strengths of the two super-resolution techniques – STED microscopy

and single-molecule microscopy – he has developed a new method, called MINFLUX, with an incredible spatial resolution of 1 to 3 nm.

“This is really crazy. I remember in the late 80s and early 90s, people warned me not to speak about breaking the diffraction barrier, and definitely not about improving the resolution by more than a factor of two because this is not acceptable and so on”, he said. “But now we are better by a factor of 100, and this barrier is gone.”

Next, Joachim Frank, 2017 Nobel Laureate in Chemistry, spoke about single-particle cryo-EM, which uses beams of electrons rather than light to visualise biological molecules in their native states. “Electrons strongly damage the molecules and there is a need for a very low dose. As a consequence, images are very noisy and normally to get any clear structure, you need to average over many molecules that have the same structure”, said Frank.

The revolutionary electron microscopy technique cools molecules to cryogenic temperatures in order to reduce beam-induced radiation damage. It then gathers structural information from images of single, unattached molecules that were free to assume all naturally occurring conformations. Many of these images result



Agora Talk: Pushing the Limits of Microscopy – Stefan W. Hell, Joachim Frank, Adam Smith (Moderator)

in enough information for a detailed three-dimensional reconstruction. To date, cryo-EM is responsible for more than 4,500 depositions into the Protein Data Bank, a worldwide database for the three-dimensional data of large biological molecules.

In his talk, William E. Moerner described efforts to combine the power of super-resolution fluorescence microscopy with that of cryo-EM. Moerner received the 2014 Nobel Prize in Chemistry for the development of single-molecule microscopy, a super-resolution optical technique that uses fluorescent proteins to switch biomolecules on and off.

With single-molecule microscopy, specific proteins can be labelled and identified, while using cryo-EM is difficult to directly distinguish different types of molecules. On the other hand, cryo-EM has a much higher spatial resolution than single-molecule microscopy and can show the surrounding structural and morphological context of a sample. Moerner highlighted their complementarity and discussed new developments and challenges in uniting the techniques.

Finally, 1997 Nobel Laureate in Physics Steven Chu spoke about the application of upconversion nanoparticles – nanoscale particles that convert two or more

incident photons of low energy into one emitted photon with higher energy – as optical probes to biological imaging. They have several advantages such as a high signal-to-noise ratio, photostability and biocompatibility. His laboratory learnt over time to improve their usability. “These nanoparticles are photostable and go for many, many hours at the highest intensities with no degradation, nor do they show any blinking”, explained Chu, and closed by presenting some practical applications of the method.

“The strengths of super-resolution fluorescence actually are the weaknesses of electron microscopy and vice versa.”

William E. Moerner



The Stories Behind Recent Nobel Prizes – and New Findings

Several of the most recent Nobel Laureates in Physiology or Medicine participated in the 70th Lindau Meeting and gave their first lecture – online. Among many other interesting details it was also revealed where the ‘Lindau’ in VHL comes from.

“Oxygen is both providing us with energy for the enjoyment of life but at the same time is decreasing the length of time that we will be around for such enjoyment.” This quote from Nobel Laureate Paul Boyer’s lecture in Lindau in 2002 encapsulates the balancing act of oxygen in our bodies, known as oxygen homeostasis. Gregg L. Semenza, Nobel Laureate in Physiology or Medicine 2019, began his lecture by describing the levels of oxygen in the Earth’s atmosphere at different stages of its history. 250 million years ago the atmosphere consisted of 35 percent oxygen, which resulted in insects with a huge body mass. Currently, oxygen has to be delivered to each one of our 50 trillion cells, which explains the complex circulatory and respiratory systems of humans and animals.

As a post-doc, Semenza began studying the gene encoding the hormone erythropoietin (EPO). EPO levels rise when not enough oxygen reaches tissues, a condition known as hypoxia. During hypoxia more red blood cells are produced. Semenza identified the protein complex that regulates the cell’s response to hypoxia and named it hypoxia-inducible factor -1 (HIF-1). During the lecture, Semenza explained the critical role HIFs play in such processes as iron uptake, the development of the circulatory

system in embryos and protection against cardiovascular disease. However, the role of HIFs may also be pathogenic; HIF-1 activity increases in various types of cancer.

Meanwhile in the late 1980s, William G. Kaelin, Jr., started to work on the Von-Hippel-Lindau syndrome (VHL), a genetic illness that often leads to several types of cancer (the name of the disease is derived from the scientists who first described the disease, Eugen von Hippel and Arvid Lindau). Under normal oxygen levels, HIF-1 α , a DNA-binding protein which is part of the HIF-1 complex, binds to the VHL protein. This leads to the rapid degradation of HIF-1 α . At low oxygen levels (hypoxia), HIF-1 α is stabilised and activates the genes for vascular endothelial growth factor (VEGF), a key regulator of blood vessel formation, and EPO, which promotes red blood cell production. These processes drive tumor growth and the spread of cancer.

“VHL loss (the inactivation of the VHL tumor suppressor gene) is the initiating event in most sporadic clear cell renal cell carcinoma”, said Kaelin, noting that VEGF inhibitors have been approved as treatment for this type of kidney cancer. A HIF-2 α inhibitor, which treats anemia resulting from chronic kidney disease, is currently in a



Lecture: The von Hippel-Lindau Hereditary Cancer Syndrome – From Bedside to Bench to Bedside – William G. Kaelin, Jr.

phase III study. Kaelin concluded his lecture by showing social media messages from patients whose health has improved after this treatment.

Harvey J. Alter, Nobel Laureate in Physiology or Medicine 2020 together with Michael Houghton and Charles M. Rice ‘for the discovery of Hepatitis C virus’, also gave his first lecture during #LINO70. He told the captivating story of the search for the causative agent of hepatitis C, a blood-borne disease, which may lead to liver cancer and causes 400,000 deaths each year. In the late 1960s, Alter began to study transfusion-associated hepatitis when 30% of patients who had had blood transfusions became ill with hepatitis. There was no way to screen blood for hepatitis from donors.

By 1975, both the hepatitis B and A viruses had been discovered, but there appeared to be another agent that caused hepatitis, which was called ‘non-A, non-B.’ Alter described how the infected blood of one particular patient, Mr. H, was used in many experiments, which provided valuable information on the type of virus and also on disease progression (Mr. H died 32 years later, but not of liver failure). However, due to the limited technologies of the time, Alter was not able to isolate the virus’s

DNA. The clone was found by Michael Houghton and his colleagues in the late 1980s: “They looked at six million clones over a period of six years”, remarked Alter.

The virus was officially named hepatitis C in 1990 and with the availability of an assay, post-transfusion hepatitis rates dropped to 4.1% in 1990 and zero by 1997. Milestones in therapy have also been reached, with drugs able to cure 95–98% of cases in 8–12 weeks. However, there is still no vaccine for hepatitis C. Alter summed up his long research career by showing a slide of a card he had received after winning the Nobel Prize: “There is no elevator to success, you have to take the stairs.”

“Just as respiration required photosynthesis, the formation of multicellular organisms required respiration.”
Gregg L. Semenza



There's More to Immunity Than Vaccines

The hot topic of immunity was also discussed during #LINO70 by Nobel Laureates Jules Hoffmann and Tasuku Honjo.

Renowned German immunologist Stefan Kaufmann who moderated Hoffmann's Agora Talk noted that through his work, we know that "the innate immune system can and does scan the body for foreign invaders and independently, adjusts to the type of foreign invader – viruses, parasites and so on – and then can initiate a strong, effective response. Moreover, we now also know that, in this way, innate immunity instructs acquired immunity."

The innate immune system is one of two main immune strategies found in vertebrates, the other being adaptive (or acquired) immunity. It is also the older of the two, but it is not as rudimentary as was once thought. "Innate immunity was essentially understood as phagocytosis – taking up cells and demolishing them," Hoffmann explained. But there is much more to innate immunity than researchers had realised a century ago. Hoffmann was awarded the Nobel Prize for his work on the Toll gene in innate immunity, but he has been studying innate immunity for decades. "We showed that innate immunity is present in all animal forms", he pointed out.

Much of Hoffmann's work was carried out on insects. This may seem surprising at first glance but is actually very relevant. Invertebrates represent 95 percent of all

species on Earth now, and insects alone represent around 80 percent of all living species.

Over the years, it became apparent that innate immunity is much more complex and multifaceted, and many findings were unexpected. For instance, Hoffmann notes that the main enemies of bacteria are other bacteria – and bacteria deploy antibacterial peptides to counteract each other. This is not just an interesting story but can be useful for us to find antibacterial defenses.

From Hoffmann's research down to the ongoing pandemic, we have continued to learn more and more about how our immune systems help fight pathogens. But the interactions of the immune system with the rest of the human body go far beyond just pathogens. As Tasuku Honjo explained in a separate lecture, it even has a lot to do with cancer.

In 1992, Honjo and his colleagues came across a molecule called programmed cell death protein 1 (PD-1) and then showed that this molecule functions as a brake system in acquired immunity. Essentially, PD-1 helps keep the immune system in check and can suppress T-cell inflammatory activity. This is excellent for preventing autoimmune diseases, but it can also stop the immune



Lecture: Serendipities of Acquired Immunity – Tasuku Honjo

system from killing cancer cells. Too much PD-1 and the immune system won't do its job properly; too little of it, and you run the risk of autoimmune disease.

Things progressed steadily in the following years. In 2002, Honjo and colleagues showed that blocking PD-1 in mice models can cure tumors by reactivating acquired immunity. Then, in a landmark moment in 2014, the treatment of cancer in humans by PD-1 blockade was approved by regulatory bodies in Japan and the USA.

Progress didn't stop in 2014, either. There are over 1,000 clinical trials ongoing, the method seems effective against numerous types of tumors and the effect seems to be long-lasting. "When you stop the treatment, the effect still continues", Honjo explains. Cancer won't be eradicated anytime soon, Honjo believes. But it could be kept well under control by 2050. It's remarkable to even think that it could be less than three decades before we start controlling the dreaded disease, but given the speed at which PD-1 treatments are progressing, it's possible, Honjo believes. There's one big catch, however.

"We can block the tumor growth in young mice, but not in aging mice," Honjo states. It was shown that older mice are far less responsive to the therapy than

their younger counterparts. Surprisingly, experiments like this are rare, especially because older mice are more expensive, Honjo notes. But if we want to get the true idea of what's happening, older mice are essential – because older people are more likely to develop tumors.

For the young researchers in related fields, there's plenty of room to find new things. "Immunotherapy is just beginning", he concluded. "There must be an enormous possibility for clinical application."

"We have met by necessity billions of microbes, essentially of viruses, of bacteria and so on and rarely do we become sick."
Jules Hoffmann



Chronic Inflammations Triggering Common Human Cancers

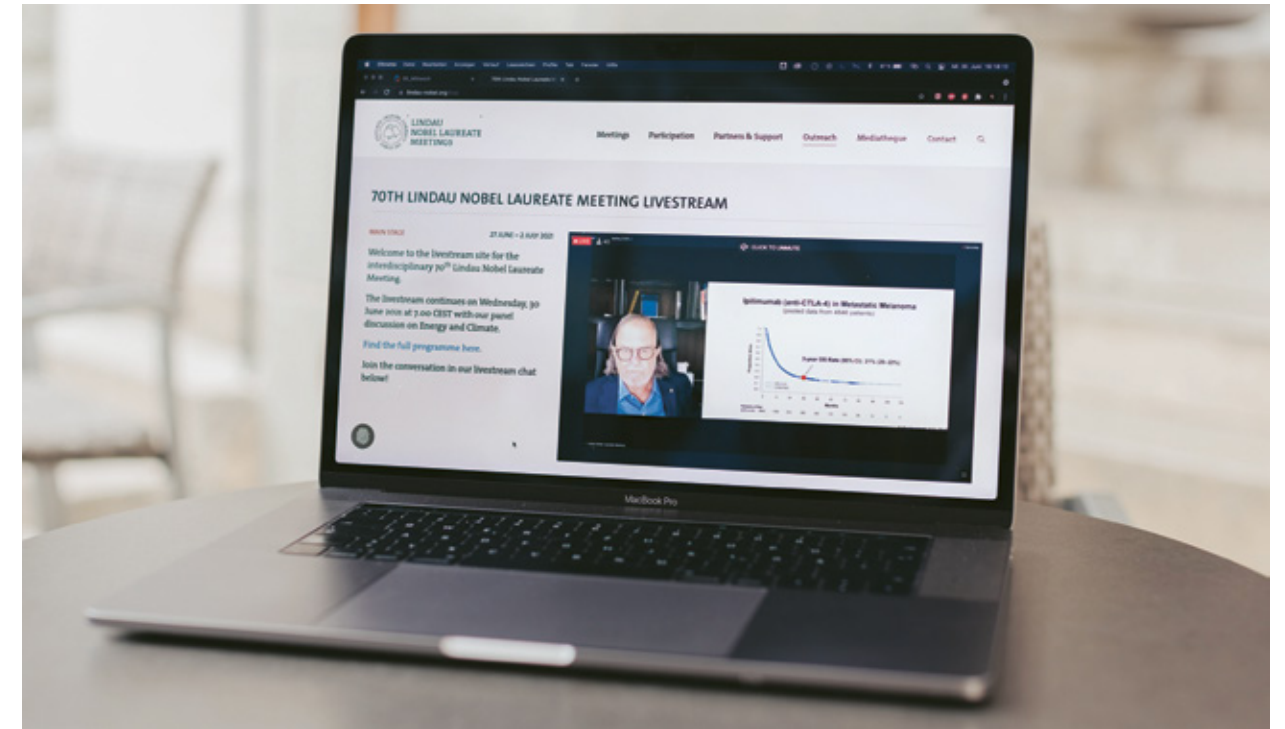
In an Agora Talk by Nobel Laureates Harald zur Hausen and Barry J. Marshall and a talk on immune therapy by James P. Allison meeting participants gained insights into viruses and bacteria that cause cancer.

Over 20% of cancers are the result of an infection, but the infectious agents (viruses, bacteria or parasites) do not cause cancer on their own. The cancer emerges after genetic modifications, and this may take decades. The link between infectious agents and cancer is still an area of interest for Harald zur Hausen who received the Nobel Prize in Physiology or Medicine in 2008 “for his discovery of human papilloma viruses causing cervical cancer.” For the past decade, he has studied the influence of red meat consumption, particularly Eurasian dairy cattle, on the incidence of colon and breast cancers. During his talk, zur Hausen discussed recent findings, where bovine meat and milk factors, infectious agents resembling plasmids, are found in the tissues of colon cancer patients. Zur Hausen also explained the many protective aspects for babies of prolonged breastfeeding, which may reduce the risk for several acute and chronic diseases such as arteriosclerosis, multiple sclerosis, diabetes type 1 and 2, acute infections such as those caused by rotavirus as well as leukemia, breast, colon, lung and ovarian cancer.

Barry J. Marshall, recipient of the 2005 Nobel Prize in Physiology or Medicine along with J. Robin Warren,

“for their discovery of the bacterium *Helicobacter pylori* and its role in gastritis and peptic ulcer disease” began his talk by introducing a little-known fact: in 1930, gastric cancer was the most common cancer in the US and Europe. Infection with *Helicobacter pylori* was and is one of the leading causes of gastric cancer, but an important factor contributing to the decrease of incidence rates was the widespread use of refrigerators in homes after 1930, which improved diets by allowing increased consumption of fresh fruit and vegetables.

Helicobacter pylori lives in crevices of the gastric epithelium, a thin layer of cells lining the stomach. The bacteria separate the cells, causing them to leak, which may cause ulcers. Stomach acid protects the stomach from cancers, but *Helicobacter pylori* survives very well in acid and is present in the stomachs of approximately 50% of the world’s population. In most people, the bacteria do not cause any symptoms, especially if high acid secretion is maintained in the stomach. Marshall gave listeners some dietary advice regarding gastric health: “Fresh fruit and vegetables and an adequate amount of protein is important ... and maybe not so many barbecues with carcinogens ...”



Lecture: Immune Checkpoint Blockade in Cancer Therapy – New Insights Into Therapeutic Mechanisms – James P. Allison

For James P. Allison it was the first participation in a Lindau Meeting. He won the Nobel Prize in Physiology or Medicine in 2018, together with Tasuku Honjo, “for their discovery of cancer therapy by inhibition of negative immune regulation.” During his lecture, Allison focused on how years of basic science research have gone into the development of drugs to treat cancer. The therapy, now known as immune checkpoint blockade, uses the immune system to attack cancer cells. In the 1990s, Allison studied a T-cell protein, CTLA-4, which inhibits the response of T cells, key players in the immune system. Allison hypothesised that using an antibody to block the function of CTLA-4 would generate an immune response and kill cancer. The approach worked in the very first laboratory experiment; mice injected with anti-CTLA-4 were cured of cancer. As Allison wrote in his Nobel biography, “It was astounding. By blocking a single molecule, CTLA-4, we had reversed tumor growth and death!” It was a eureka moment, but it would take 17 years until the drug, *ipilimumab*, would become widely available to those who needed it.

“We know that checkpoint blockade works”, said Allison, but he admitted that it doesn’t work against all tu-

mors. Prostate and pancreatic cancers appear to be the hardest to tackle, due to the lack of immune cell infiltration in these tumors, which are for this reason termed “cold tumors”. One approach is to combine anti-CTLA-4 with hormonal therapy, turning cold tumors into hot ones, which are more susceptible to treatment. While there are thousands of ongoing clinical trials of new cancer drugs, combination therapy is a promising strategy for improving the survival rate. Allison summed up his lecture by saying that the progress in cancer treatment has been amazing, and the outlook after diagnosis has changed even in the last 5 years.

“High risk regions for colon cancer seem to be linked to dairy beef consumption.”
Harald zur Hausen



Science is Everywhere

With the pandemic having a major impact on the format of the 2021 Lindau Meeting, the continuing challenges and consequences of COVID-19 were also discussed on the online stage of the scientific programme.

The 70th Lindau Nobel Laureate Meeting got off to a great start with the 'COVID-19 and Emerging Pandemics' panel discussion, moderated by the immunologist Stefan H. E. Kaufmann. The panelists were Nobel Laureates Françoise Barré-Sinoussi (Physiology or Medicine in 2008 for the discovery of the HI virus) and Harvey J. Alter (Physiology or Medicine in 2020 for the discovery of the hepatitis C virus), Professor Richard Neher and Jana Huisman, a PhD student in computational evolution at ETH Zürich.

When asked at what point did they realise that the COVID-19 pandemic was going to be a catastrophe, the researchers all agreed that they were concerned about the virus becoming a worldwide problem in January 2020. Richard Neher said that the severity of the virus became apparent to him when he observed a larger number of obituaries in early March 2020.

"We lost a lot of time at the beginning", said Françoise Barré-Sinoussi, describing the lack of planning and slow procedures in declaring that the pandemic was indeed an emergency. This sentiment was echoed by Harvey J. Alter, who said the pandemic was a triumph in medical science, but a failure in social science. Alter pointed out the "dichotomy in what public health and governments

were recommending", and the inaction in terms of universal masking, contact tracing and isolation. Had these measures been enforced from the start, "hundreds of thousands of lives could have been saved." On the positive side, Alter stated that the U.S. government deserves credit for early investment in vaccine development.

There are numerous ways in which the COVID-19 pandemic has reshaped the vaccine landscape, with respect to scientific advances, such as mRNA technology, but also the acceleration of the processes by regulatory agencies. Nevertheless, both Nobel Laureates acknowledged the difficulty in developing effective vaccines for Hepatitis C and HIV, due to the nature of these viruses. During the discussion on slow COVID-19 vaccination rates in low-income countries, Alter stressed that the rich have to give to the poor, "to the benefit of the donor, as well as the recipient", with the aim of avoiding "a smouldering pandemic." The race to find adequate drugs for COVID-19 treatment among existing ones reminded Barré-Sinoussi of the beginning of the HIV epidemic in the 1980s. In this context it is anticipated that monoclonal antibodies could be effective in terms of COVID-19 therapeutics.



Panel Discussion: COVID-19 and Emerging Pandemics – Stefan H. E. Kaufmann (Moderator), Françoise Barré-Sinoussi, Richard Neher, Jana Huisman, Harvey J. Alter

All panellists provided examples of the benefits the pandemic has provided, particularly concerning scientific collaboration and communication. Despite the obvious setbacks in not being able to discuss with colleagues in person and less knowledge transfer, the development of online communication has progressed at an incredible pace, especially benefiting scientists from low-income countries. Jana Huisman described the organisation of an online summer school with participants from countries such as Brazil and Columbia, who may not have had the chance to participate otherwise. Huisman also commented on how the pandemic generated "the year of most pre-prints ever", showing the potential of open science. Alter said he was impressed by how daily newspapers publish statistics on the pandemic, often using beautiful graphics. "People are aware of what's going on – science is everywhere", he remarked.

Barré-Sinoussi said she hoped that the lessons learned from the COVID-19 pandemic will mirror those learned from HIV: the importance of multidisciplinary science, but also social science, and a strong interaction with civil society. Alter predicted that with the current vaccination rate, it may take several years to eradicate the corona-

virus, but at least from now on countries will be better prepared for the next infectious agent. Richard Neher emphasised the significance of a "much better global system for viral surveillance", something more comprehensive, so that severe diseases can be caught earlier. Jana Huisman had the last word, by underlining the huge inequality in health outcomes worldwide, and how the pandemic has made these inequalities visible. "The inequality will come back to us in the end if the disease is untreated."

"I hope for a much better comprehensive global surveillance of all sorts of diseases to catch these things early and have the desired response."
Richard Neher



Tailoring Treatment to Each Patient

The incredible achievements in medicine over the last 100 years have done wonders to extend the human lifespan. Chemistry Nobel Laureates Aaron Ciechanover and Ben L. Feringa discussed the next wave of technologies for treating disease in an individualised manner.

Advances like medical imaging, antibiotics, vaccination, and others have allowed people today to live roughly three decades longer than they did in 1900. Now, with the advent of precision treatments and genome editing, we are on the brink of another revolution in medicine. “Personalised medicine is going to be a suit-like medicine, tailored to our genetic make-up”, said Ciechanover, who received the 2004 Nobel Prize in Chemistry for the discovery of ubiquitin-mediated protein degradation. “Rather than just treating a disease, we are treating a disease within the context of a patient.”

When he was studying medicine, the tools for investigating the underlying molecular mechanisms of a specific patient’s disease did not yet exist. If a patient had a tumor, for instance, doctors would use medical imaging such as X-ray or computed tomography (CT) to determine whether surgery could extract the mass. “If a tumor was not resectable because it was too big or touching essential organs, then you try to decrease its size by chemotherapy or radiation”, he said. “They are not discriminating between healthy tissue and sick tissue.”

In the early 2000s, the first human genome sequences were published in nearly complete draft form,

which marked the beginning of a new era in medicine. In the twenty years that have passed since that pivotal discovery, researchers have made enormous progress in leveraging that knowledge of our genetic makeup towards improving the precision and personalisation of medicine.

Many patients with cancer today are no longer subjected to a one-size-fits-all treatment regimen that comes with adverse side effects and damage to healthy tissue. Instead, tumor sequencing is used to analyse cancers at the molecular level in order to identify genetic mutations that drive their particular disease. By knowing the underlying mechanism, the cancer can then be treated with targeted therapies that often work more efficiently and with less side effects than chemotherapy and radiation therapy. “With the new revolution of personalised medicine, we are going to change dramatically the basic three fundamental definitions upon which medicine is standing: disease, patient, and treatment”, Ciechanover said.

With the refinement of genome editing techniques like CRISPR/Cas9, the disease might be found in the sperm or egg through genetic screening and edited out before it can even manifest in a human being. Such ad-



Agora Talk: Next Generation Medicine – moderated by Klas Kärre, Ben L. Feringa and Aaron Ciechanover, here in discussion with young scientist Alan Kádek

vances would represent a complete paradigm shift for medicine that has the potential to eliminate the burden of disease and extend the human lifespan to its limits.

Feringa took less of a big-picture approach to his Agora Talk and focused on one particular aspect of precision medicine, a budding field known as photopharmacology. Pharmaceutical development has gone through various stages throughout history, from drugs being discovered purely by accident to high-throughput screening of small molecule compounds. Today, the more sophisticated approach involves looking at the genome to find specific disease-associated loci that can be targeted by naturally occurring or man-made molecules.

However, he believes that researchers in the field can go a step further by incorporating light-dependent controls into pharmaceuticals in order to boost their precision. “Photopharmacology is a development that you see now around the world of people building light switches into the molecule”, said Feringa, who received the 2016 Nobel Prize in Chemistry for the design and synthesis of molecular machines. “You switch your computer on and off, and you switch your smartphone on and off. Here you take advantage of new developments in physics, chem-

istry, and molecular biology to switch on the activity of a drug on the spot.”

These smart pharmaceuticals, as he calls them, would add a level of spatiotemporal specificity to treatment with drugs that does not currently exist. Two main areas of application include photocontrolled antibiotics and precision chemotherapy. For example, take the situation of a patient given a broad-spectrum antibiotic modified with a light-dependent molecular switch. Exposure to light would activate the antibiotic only in the part of the body with the infection, and only for a controlled amount of time, which prevents resistance build-up. Or imagine a photocontrollable anti-tumor drug that is given to a patient. Doctors would only illuminate the cancer tissue to switch on the drug, while healthy tissue is kept in the dark and spared.

“Appreciate each other’s problems, between different disciplines and then we will build the future of medicine.”
Ben L. Feringa



Antibiotics, Animal Beauty and Drug Design

Various lectures and Agora Talks on different aspects of biological research asked where we have been, summarised the current state of the art, and speculated about what the future may hold for the field. The diverse spread of topics included structural biology, colour pattern evolution in animals, vaccination and super-resolution fluorescent microscopy.

Robert Huber, who received the 1988 Nobel Prize in Chemistry for determining the three-dimensional structure of a photosynthetic reaction centre, kicked off the session with an overview of the past and present of structural biology. “We have the tools to see and image small molecules and eukaryotic cells with these different methods.”

He noted all the diverse imaging techniques available within the structural biologist’s wheelhouse today, and how they can be synergistically combined. For example, the complementary approaches of single-particle cryo-electron microscopy (cryo-EM) and X-ray crystallography increases the range of possibilities.

Next, Kurt Wüthrich – recipient of the 2002 Nobel Prize in Chemistry for the development of nuclear magnetic resonance (NMR) spectroscopy – made a brief statement about imaging macromolecules in solution, which are under the regime of Brownian motion.

Random motion is averaged out in single-molecule approaches like cryo-EM and causes unwanted artifacts. This issue does not affect X-ray crystallography, since Brownian motion is suppressed for molecules in crystals.

Lastly, Hartmut Michel (1988 Nobel Prize in Chemistry) summarised the three most impactful methods in the field – X-ray crystallography, NMR spectroscopy and cryo-EM – and their integral role in the development of new drugs. He described how structure-based drug design directs the discovery of a drug lead, which is a compound with a certain affinity for a target. From there, more research is needed to convert a drug lead into a drug that will be both effective and tolerated by the human body.

In her Agora Talk Christiane Nüsslein-Volhard spoke about the vivid colours and patterns that appear throughout the animal kingdom. “We enjoy beauty of animals in the same way that we enjoy arts and music”, said Nüsslein-Volhard, who received the 1995 Nobel Prize in Physiology or Medicine. “The products of art are made by humans for humans, but how about the colours, ornamentations and melodies of animals?”

In her own laboratory, Nüsslein-Volhard studies the physical basis of colour and patterns in vertebrates. Colours are most rich and variable in fish, amphibians and reptiles, where different kinds of pigment cells are deposited in superimposed layers beneath the skin. She



Lecture: 60 Years of Structural Biology, From Myoglobin and X-Ray Crystallography to the Recent Impact of Electron Cryomicroscopy – Richard Henderson, introduction by Wolfgang Lubitz

uses zebrafish as a model to understand the genetic basis of color pattern variation in vertebrates.

Richard Henderson began his esteemed career in structural biology 55 years ago, work which culminated in a much-deserved 2017 Nobel Prize in Chemistry for the development of cryo-EM. His lecture traced the history of the field from 5 years before his involvement to the present era, where cryo-EM is regarded as a highly revolutionary technique for the generation of 3D images of biomolecular structures at near-atomic resolution.

Ada Yonath, who received the 2009 Nobel Prize in Chemistry for studies of the structure and function of the ribosome, foresees a life-saving application for cryo-EM: the development of next-generation antibiotics. Yonath’s lecture reviewed her past work uncovering the structure of a ribosomal subunit from bacteria with X-ray crystallography, as well as the close relationship between ribosomes and antibiotics.

Martin Chalfie, who received the 2008 Nobel Prize in Chemistry for the discovery and development of green fluorescent protein, first discussed the many lingering questions that still remain unanswered in cell biology. And he feels that there is no better time to investigate

these questions than today. “I feel that right now is the golden age of science. We always are at the peak of what we can do, and of course, it always gets better. New techniques like CRISPR and super-resolution microscopy will allow scientists to go back to the fundamental questions.”

Randy Schekman took a different approach with his Agora Talk, specifically tailoring his wise words of advice to the young scientists in the audience aiming to do research in cell biology. He spoke about how to plan a future career in cell biology, as well as how to best represent your work in the form of publications. Schekman emphasised that students need to challenge themselves to pursue new avenues in research: “It is your opportunity, going forward, to make a difference.”

“The main problem is resistance, and with next-generation antibiotics we are trying to fight against it.”
Ada Yonath



Changes towards
sustainability require
acceptance by society.

Jürgen Kluge



The Path to Climate Neutrality

The Lindau Innovation Forums were established in 2010 at the initiative of Nobel Laureate Martin Chalfie. Their aim is to bring together top-level scientists and business executives for an informal exchange of thoughts on current problems and solutions for tomorrow.



Opening of the Innovation Forum by Jürgen Kluge

Since the beginning of the Biden presidency in the US and with the COVID-19 pandemic hopefully becoming more manageable, the fight against climate change comes back into focus as the greatest political, societal, industrial and technical challenge of our times. Many of the largest greenhouse gas-emitting states have now committed themselves to achieving net-zero within only a few decades: Germany by 2045, the United States even by 2035.

The translation and implementation of these targets into actual policy will have a persistently, massive effect on all actors, be they producers or consumers. Whole industries will have to change their production technologies. Mobility will undergo its most profound change since the invention of cars and airplanes. Energy providers need to continue and even speed up the shift from fossil to renewable energy, including climate-neutral fuels.

But can politics effectively coordinate all the required measures internationally and nationally? What are the best strategies to achieve net-zero emissions? Which role can market design and market instruments play? And who is going to pay the bill, in case of success, and in case of failure? These topics were discussed by international business leaders and experts, including 16 Nobel Laureates dur-

ing the 14th Lindau Innovation Forum, held online and as is the custom on the day before the opening of the meeting.

The programme was structured into four sessions: covering the challenges of renewable electricity generation and distribution, the promises of green fuels, the revolutions of net-zero industries, as well as a bold outlook into the future, looking at smart nets, upcoming regulation, and CO₂ removal.

Daniel G. Nocera concluded as follows: “In these days of quarterly earnings reports, I can only begin to imagine the tightrope corporate leaders walk in keeping climate change on center stage. I believe change is in the air, and such corporate leadership will be rewarded by our society in the not-too-distant future. And to those who support the Lindau Nobel Laureate Meetings, I also pass along my thanks and deepest gratitude. The US over the past four years has shown how fragile sensibilities are within our cultures. Thus forums, such as the Lindau Meetings, for rational discourse on the topic of climate change are essential to push back on the rampant irrationality that can so easily spread through our society.”



Nobel Laureate Serge Haroche (lower right) addressing a question to the Innovation Forum during Session III on Green Industry

<p>Welcome Jürgen Kluge, Chairman, Foundation Lindau Nobel Laureate Meetings</p> <p>Introduction Katrin Prüfig, Moderator</p> <hr/> <p>Session I: Green Electricity – Generation and Distribution</p> <p>Green Electricity Generation Eicke Weber, UC Berkeley</p> <p>Challenges in Green Energy Distribution Munib Amin, E.ON Strategy and Innovation</p> <p>Discussion</p> <hr/> <p>Session II: Green Fuels and Mobility</p> <p>Solar Fuels Hydrogen Daniel G. Nocera, Harvard University</p> <p>Discussion</p>	<p>Session III: Green Industry</p> <p>Climate-Neutral Chemistry Martin Brudermüller, BASF</p> <p>Green Steel and Cement Reinhold Achatz, ThyssenKrupp</p> <p>Strategies and Policies for Net Zero Emissions in Heavy Industry Lars Nilsson, Lund University</p> <p>Discussion</p> <hr/> <p>Session IV: Green Systems</p> <p>Energy and the Internet of Things (IoT) Jan Brockmann, Bosch Thermotechnologie</p> <p>The Carbon Market: Regulation, Taxes and Certificates Klaus Schmidt, LMU Munich, Council Member and Scientific Chairperson Economics, Lindau Nobel Laureate Meetings</p> <p>Direct Air Capture and Storage Daniel Egger, Climeworks</p> <p>Discussion</p>
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Responsibility and Sustainability

By fostering exchange and offering a platform for scientific advancements and solutions for global issues, the Lindau Meetings aim to contribute to an open and inclusive scientific community, societal progress and environmental sustainability.

The Lindau Nobel Laureate Meetings build bridges across generations, disciplines and continents. But as with every event and activity, the organisation and realisation of the meetings come with certain negative impacts on the environment. The Council and the Foundation constantly work on improving their own impacts in various ways, as well as on enabling others to do the same. At the core of these efforts are the reduction of environmental impacts (CO₂ emissions, material use) and the promotion of societal progress.

Since 2018, the Lindau Meetings have supported the nearby Degermoos and other marshland renaturation projects to offset carbon emissions caused by the meetings and their participants' air travel. While recent developments towards more remote and digitalised work have led to reduced CO₂ emissions due to less travel and resource use, it is our conviction that physically meeting each other is an important part of what makes the Lindau Meetings so inspiring and precious. Offsetting unavoidable future emissions through compensation projects will therefore remain a cornerstone of our commitment to reduce negative environmental impacts.

Therefore, the Lindau Nobel Laureate Meetings have decided from this year to invest €7,500 per year in marshland restoration. Using the 'Klimaschutzprogramm Bayern 2050' environmental protection grant scheme, this amount is increased every year to €75,000. While it is not possible to calculate this precisely, estimates are that the

Lindau Meetings thereby overcompensate by about 50% the emissions calculated for a single meeting. The next major project to be realised with these funds will again be implemented in Degermoos, and it will take several years to be completed.

Many more single measures contribute to the goal of reducing unwanted impacts on nature. Technically speaking, the introduction of IT cloud services recently superseded the use of more energy-intensive hard-drives, minimising indirect emissions and reducing the organisation's footprint within its possibilities. This is especially relevant as more digitalised work also means increased energy consumption. Furthermore, the Lindau Meetings compensate all CO₂ emissions caused by print products through certification. For example, this annual report bears a 'Climate Partner' certification, ensuring its carbon neutral production.

Another aspect is sustainable nutrition: Like for past meetings, vegetarian catering options were available for staff and the few guests physically present in Lindau during #LINO70. Ingredients were organic and regional whenever possible. By maintaining and even increasing this offer at future meetings, we hope to encourage more and more people to consider lower-impact dietary options. A holistic and far-reaching approach to environmental sustainability will remain fundamental for the Lindau Meetings in the future – also, and especially, in a world that has overcome or is still living with COVID-19.



Renaturation project in Geiwitzenmoos, currently still in progress

Responsibility also implies diversity. In this respect the Lindau Meetings could hardly be more international: every year, Nobel Laureates and young scientists from every corner of the world come to Lindau (find key figures regarding the community of the 70th Lindau Nobel Laureate Meeting on pages 19 and 25). This diversity is inherent to the meetings, much like the equal and respectful exchange between generations, cultures and individuals. The Lindau Meetings, as well as the people they connect each year – online as much as physically – stand for an open, just, equitable and inclusive way of living and conducting science together.

We are constantly working on ensuring these standards and improving the well-being and access of all participants – in close exchange with our community. Following an open letter by a group of Lindau Alumni of the 69th Meeting in 2019, their IDEA initiative (inclusion, diversity, equity, accessibility – see also the Lindau blog)

is in most parts being implemented into existing concepts for future meetings. In doing so, the Lindau Nobel Laureate Meetings continuously assume their responsibility towards their community, its individuals and society as a whole.

Impressions and information
on the Lindau Marshland
Renaturation Project



Open for Signatures – Endorsed by 40 Laureates

The Lindau Guidelines consist of ten goals for open, cooperative science where data and knowledge are freely shared. With the opening of the meeting, scientists can now sign them and show that they are working according to their spirit.

In her 2018 keynote speech, Nobel Laureate Elizabeth H. Blackburn laid the basis for the Lindau Guidelines by suggesting a new approach for more sustainable and global science – following the example of the Paris Agreement 2015 for climate change mitigation. As the Lindau Nobel Laureate Meetings focus on young scientists at all stages of academic training as well as early-career scientists, the idea emerged of developing helpful and practical guidelines for scientific research and conduct that will support global, sustainable and cooperative open science in the long-term. These plans were further developed and elaborated together with the Lindau community over the subsequent years. Goal 1 for example – Adopt an Ethical Code – was a suggestion from the online discussion of the text.

The guidelines provide a framework for science to confront global challenges more efficiently by emphasizing a global scientific community that shares data and resources openly. “The truly vexing problems now facing humanity – such as environmental degradation, the global climate crisis and its effects on health, emerging infectious diseases and pandemics and the need for alternative energy sources – call for building something new: a global framework to support fundamental scientific research”, was how Elizabeth Blackburn summarised it during her #LINO18 speech.

As a contribution to society, the Lindau Guidelines are in line with the declarations that were based on Lindau

initiatives, traditionally announced during the closing day on Mainau Island. In 1955, Nobel Laureates published the first Mainau Declaration, which was directed against the use of nuclear weapons. And in 2015, it was Brian P. Schmidt who constituted the declaration on climate change, which was handed over to politicians in advance of the successful COP21 climate summit in Paris.

The Lindau Online Science Days 2020 marked the final debate about the ten goals that build the Lindau Guidelines. In June 2021 a binding version was published in the run-up to the 70th Lindau Nobel Laureate Meeting. Besides information about the process and the scientific background as well as an example of the application of the Lindau Guidelines in practice – the browser extension Authentisci – the Lindau Guidelines website allows digital signing of the goals. As an initial show of support, 40 Nobel Laureates immediately endorsed the guidelines. Scientists worldwide as well as research institutions now have the opportunity to sign the Lindau Guidelines and declare their support for the ten goals. Meanwhile several hundred individuals have shown their will to adopt them. With the final goals ready for signing digitally the Lindau Guidelines are a valuable contribution from the Lindau Meetings for the future of science.



Integral part of the meeting programme: Lindau Guidelines initiator Elizabeth H. Blackburn during a networking break with Moderator Brian Malow and Wolfgang Huang, Director of the Executive Secretariat of the Council, giving a comprehensive insight into the implementation process of the ten goals.



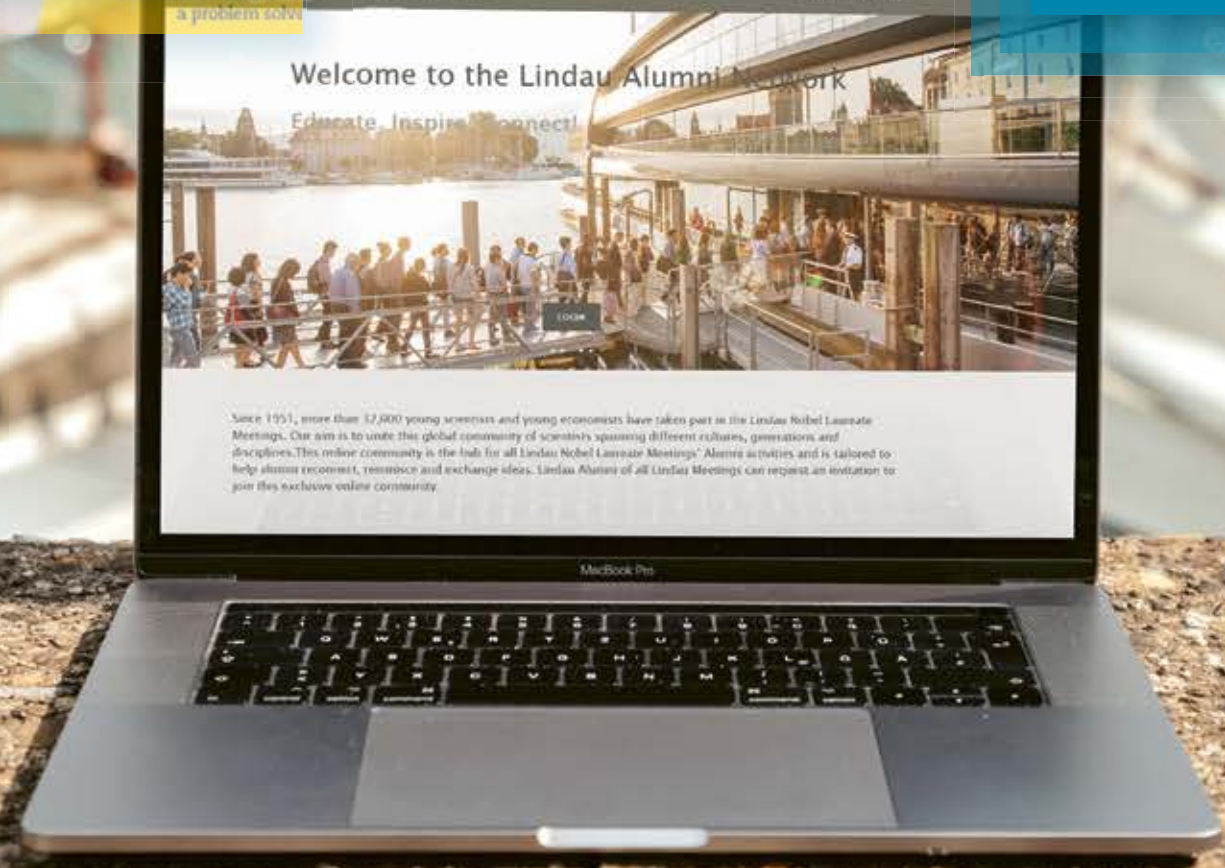
The Lindau Guidelines' Ten Goals – lindauguidelines.org

- 1 Adopt an Ethical Code
- 2 Cooperate Globally on Global Problems
- 3 Share Knowledge
- 4 Publish Results Open Access
- 5 Publish Data to Repositories
- 6 Work Transparently and Truthfully
- 7 Change Reward Systems
- 8 Support Talent Worldwide
- 9 Communicate to Society
- 10 Engage in Education

10 goals explained in 10 minutes:
Watch our recent Mini Lecture about
the Lindau Guidelines.



The Lindau Alumni initiative aims to extend the Lindau Spirit beyond the boundaries of the annual meetings.



Keeping the Lindau Spirit Alive

From evaluating abstract submissions, organising watch parties around the globe, to hosting Open Exchange sessions, Lindau Alumni were actively involved in the 70th Lindau Nobel Laureate Meeting

Lindau Alumni Peer Review

As part of the application process for this year's Next Gen Science sessions (see p. 46), the Lindau Meetings received a wealth of abstracts in the three natural science disciplines. Continuing the successful collaboration of the past three years, former participants got involved in the review process for these sessions.

Once again, the response to the call for peer reviewers was outstanding: More than 150 Lindau Alumni volunteered to give back to the Lindau Meetings community by offering their time and expertise. We would like to thank all Lindau Alumni reviewers for being actively involved in the online activities this way. We are looking forward to continuing this well-established, cooperative effort for the next meetings as well. For the upcoming 71st Lindau Meeting, more Lindau Alumni than ever before contributed reviewers in the nomination and application process.

Open Exchange Hosts

The nature of the interdisciplinary, interactive, albeit online 70th Lindau Meeting presented the challenge of conducting 60 virtual Open Exchanges, our format for the direct exchange between a Nobel Laureate and a smaller group of young scientists. Only former young scientists already familiar with the atmosphere could host this unique virtual space, and almost 100 Lindau Alumni offered to help facilitate the conversations.

Throughout the meeting week, an international team of 33 Lindau Alumni representing more than a dozen Lindau Meetings contributed as hosts and made it possible

to recreate the direct dialogue between two generations of researchers online.

Local #LINO70 Events

However, not even the best interactive online programme can entirely replace the experience of an in-person meeting. Several Lindau Alumni cooperated with the Lindau Meetings to organise small “watch parties” for the 70th Lindau Nobel Laureate Meeting – where the local situation, regulations and safety permitted.

We'd like to thank all Lindau Alumni who organised these local events: In Pakistan, Ayesha Mohyuddin organised a watch party at the University of Management and Technology, Lahore, and Saima Shabbir hosted a group of students at the Institute of Space Technology, Islamabad. Marialaura Marchetti organised small get-togethers at the University of Parma, Italy. Thanks to Danielle Douglas-Henry, researchers at Nelson Mandela University, Summerstrand, South Africa, followed an Agora Talk live. Martin Klapper introduced students and researchers at the Hans-Knöll-Institute in Jena, Germany, to the lecture by Ada Yonath. Margoth Córdova-Castro hosted a party at Institut Langevin in Paris, France. Spozmai Panezai organised a watch programme at Nicolaus Copernicus University in Torun, Poland.

Lindau Alumni Network

Since 2017, the Lindau Alumni Network has been the digital space for Lindau Alumni. It includes tools that enable users worldwide to find fellow alumni, share their work, swap stories, and register for Lindau Alumni events. Either



Lahore, Pakistan



Jena, Germany



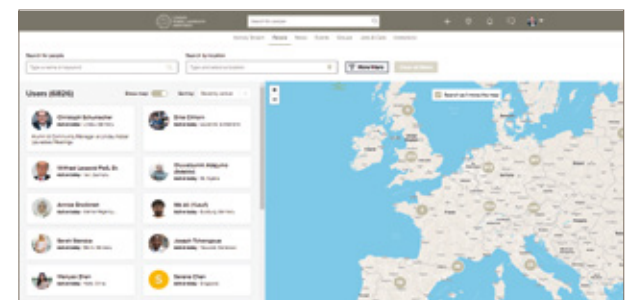
Summerstrand, South Africa

via a browser or through the updated mobile app, the platform makes it easier to stay connected to our growing global community. Launched in the winter of 2021, the Lindau Mentoring Hub gives Lindau Alumni even more opportunity to grow and give back to the community (see p. 104).

Of course, Lindau Alumni were the driving force behind the second Lindau Online Sciathon 2021 (next page). In advance of the Sciathon, an online seminar conducted by Professor Olaf Kramer and Dr Markus Gottschling of the University of Tübingen gave interested Lindau Alumni a primer on effective science communication and rhetoric.

In the new year, the Executive Secretariat will continue to organise online seminars and hopefully will return to organising local meet-ups and similar events to extend the 'Lindau Spirit' beyond the boundaries of a weeklong conference.

The Lindau Meetings express their sincere gratitude to the German Federal Ministry of Education and Research for supporting the project. All former participants are invited to enrich the Lindau Alumni Network with their own ideas and perspectives on how to educate, inspire and connect.



The search map makes it easy to find Lindau Alumni in your region.

All Lindau Alumni can join the online community at www.lindau-alumni-network.org.



Over 20 Projects in 48 Hours

Second Lindau Online Sciathon

From 10–12 September 2021, Lindau Alumni once again came together to work for 48 hours on projects in four topic categories based on discussions during the 70th Lindau Nobel Laureate Meeting.

Based on the wide interest and the promising results of the first Lindau Online Sciathon last year, the Council for the Lindau Nobel Laureate Meetings decided to host a second edition of the hackathon-type competition for the Lindau Alumni community in the fall of 2021.

Lindau Alumni, including #LINO70 young scientists, had the opportunity to submit a project idea in one of four topic categories. Each category was derived from the panel discussions during the anniversary meeting; in this way the Sciathon gave our community an opportunity to continue the exchange and to work on novel ideas in (open) science.

Close to 100 Lindau Alumni and 2022 young economists worked on unique projects in 23 groups, led by those Lindau Alumni who pitched the respective project idea. At the end of an intense weekend, all groups handed in a short concept paper and a video that summed up the work over the course of 48 hours and introduced the resulting concepts.

This year, the organisers worked closely with a Scientific Chair in each topic in advance of the event and for the evaluation of the projects. The Chairs headed an expert jury that judged the creativity and feasibility of each project as well as the quality and relevance of the results and determined a winner in the respective category. Each category winner received prize money.

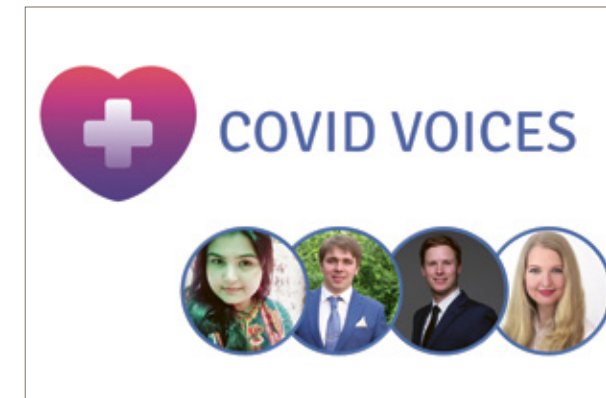
Once again, the variety of ideas and number of promising concepts was astonishing. Hopefully, the groups will continue to work on realising their projects. The Lindau Meetings will support the groups, for example by publishing the results on sciathon.org.

**Emerging Threats and New Tools:
New Approaches and Advancements to Address
Future Global Health Issues**
Chair: Stefan H. E. Kaufmann, Council Member
Ulrich Schaible, Lindau Alumnus 1984
Julia Jansing, Lindau Alumna 2021

**Energy and Climate:
New Ideas for Greener Energy and
More Sustainable Industries**
Chair: Heiner Linke, Council Member
Hartmut Michel, Nobel Laureate 1988
Lars J. Nilsson, Lund University

**Unknown Frontiers in Physics:
From Astrophysics to High Energy Physics and
Particle Physics**
Chair: Burkhard Fricke, fmr. Vice-President of the Council
Jürgen Kluge, Chairman of the Board of the Foundation
Kathrin Göbel, Lindau Alumna 2016

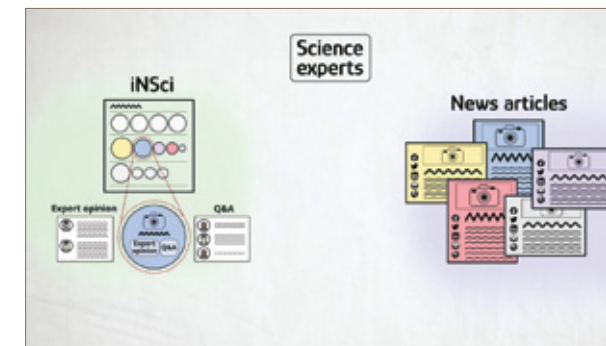
**How Can Open Science Improve the Public's Trust
In Science?**
Chair: Helga Nowotny, Vice-President of the Council
Elizabeth H. Blackburn, Nobel Laureate 2009
Tarek Besold, DEKRA Digital



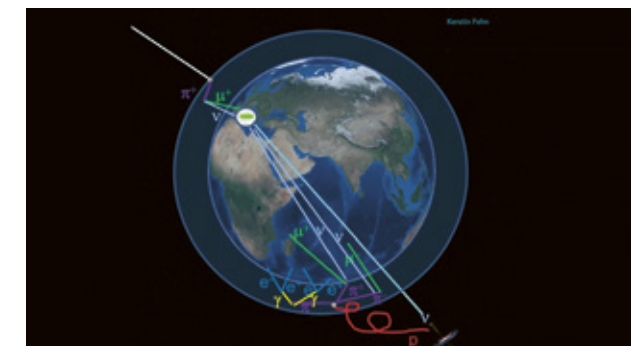
Upscaling and Digitalizing COVID VOICES e.V.
The group lead by Stefan Maier was ranked first in the 'Emerging Threats and New Frontiers in Global Health' category with their project to share COVID-19 tales and to empower those affected.



Integrating Sustainability in Different Spaces
Preethi Thomas and Elzina Bala won the 'Energy and Climate' category. Their project IncSustain is an online platform that offers ways to integrate greener living into everyday life.



**iNSci: A News Platform That Connects Scientists
With the General Public**
Group Chen convinced the jury in the 'Open Science' category with a virtual space for dialogue between non-scientists and researchers about science news.



Astroparticle Physics: Science Fascinating People
Kerstin Fehn and her group created a card game to teach the fascinating concepts of astroparticle physics to young and old – convincing the jury in the physics category.

Find more information on the winners, all groups, the jury and more on sciathon.org.



New Platform for Our Community

Introducing the Lindau Mentoring Hub

The new app, developed in a bottom-up approach, gives Lindau Alumni a new opportunity to connect with mentors or give back to the community by working with mentees.

The development of the Lindau Mentoring Hub started at the first Lindau Online Sciathon 2020: Ten Lindau Alumni, young scientists and young economists representing 14 countries came together to work on the exciting idea of developing a mentoring platform for (aspiring) academics and scientists. The group was led by Michael Bogdan Mărgineanu, who pitched the project based on an initiative he started in his home country Romania to help identify mentors for high school and university students interested in biomedical research.

At the end of the 48-hour event, the group had developed a proposal for a volunteer-based global online platform that aims to support students and early career researchers from all backgrounds. The proposal planned to utilise the strengths of the Lindau community and addressed five of the goals of the Lindau Guidelines: support talent worldwide (Goal 1), communicate science to society (Goal 2), engage in education (Goal 3), share knowledge (Goal 4) and cooperate globally on global problems (Goal 5). The proposal convinced the expert jury, and Group Mărgineanu won first prize in the Implementing the Lindau Guidelines category.

The Lindau Nobel Laureate Meetings share the group's belief in the value of mentoring and the potential of the Lindau Alumni community. Thus, after the Sciathon, Group Mărgineanu and the Executive Secretariat agreed to collaborate to create a global, open-source mentoring platform as a strategic next step in the Lindau Alumni initiative. After an exploratory phase in the winter 2020/21, the Lindau Nobel Laureate Meetings and Team Mentoring Hub started developing the software platform from

the ground up, working with Dutch-Romanian software development company BusyMachines. Lindau Alumni could sign up for early access to the site in time for the second Lindau Online Sciathon this September.

The goal of the new Lindau Mentoring Hub, launched in November 2021, is to make sure that Lindau Alumni, young scientists and young economists have access to support and guidance. From the start, the Lindau Mentoring Hub addresses a variety of cases, including short-term advice and longer-term career development mentoring, and mentoring topics, including transitioning between academia and industry or diversity in science. Leading up to the next nomination and application process in 2022, potential applicants will be able to see advice from Lindau Alumni on the process.

One of the strengths of the Mentoring Hub is that it allows users to assume a dual role: Lindau Alumni can sign up for the new platform to seek advice as a mentee, to share advice as a mentor – or to do both. This allows former and future participants of the meetings in all career-stages to find value in the mentoring platform. The user-friendly, browser-based digital platform utilises a powerful search function to allow mentees to find suitable mentors. Once connected, mentors and mentees can use the built-in communication features, including video or audio calls, a messaging system and calendar, to schedule meetings and have conversations.

As an additional strength, the Lindau Mentoring Hub includes a resource library. Mentors can choose to share video recordings with the community, creating a growing advice database which, over time, will reduce repeti-

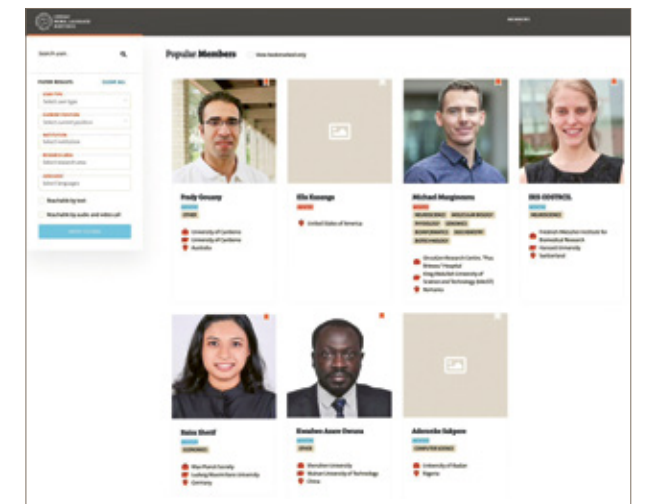


Behind the scenes of the Mentoring Hub project presentation during #LINO70

tive questions and will give mentors and mentees more time to address individual aspects. A detailed feedback system and abuse prevention feature, combined with a code of conduct developed by Team Mentoring Hub and the Executive Secretariate, ensures the safety and quality of the mentoring platform.

In line with the Lindau Guidelines, the Lindau Mentoring Hub is based on open-source code and is ready to be released in an open repository, making it one of the first open access mentoring platforms worldwide. While initially an exclusive offer for the community of the Lindau Meetings, the Mentoring Hub will hopefully be utilised by other research communities to support talent worldwide.

The Lindau Mentoring Hub is run by the Lindau Nobel Laureate Meetings and the original Sciathon group: Greta Babakhanova, Frady Gouany, Ella Kasanga, Caroline Kijogi, Krishna Maremanda, Michael Bogdan Mărgineanu, Iris Odstreil, Kwadwo Asare Owusu, Aderonke Sàkpere and Raisa Sherif. The Executive Secretariat will organise events and other offers for mentors and mentees as part of the Lindau Alumni initiative. The Lindau Nobel Laureate Meetings and Team Mentoring Hub gratefully acknowledge the support of the Dieter Schwarz Foundation for the development of the platform. All Lindau Alumni are encouraged to join the platform.



The search page of lindau.mentoringhub.org

All Lindau Alumni can now sign up for the Lindau Mentoring Hub.



The German edition of the Nobel Posters is one of our popular offers for schools.



Der Nobelpreis 2020 für Physik
Schwarze Löcher und das dunkelste Geheimnis der Milchstraße

Der Nobelpreis für Physiologie oder Medizin 2020
Die Heilwirkung für Prostatakreuzer

Der Nobelpreis 2020 für Chemie
Mit der Gen-Schere den Code des Lebens neu schreiben

Der Preis der Deutschen Akademie für Wirtschaftswissenschaften
Auktionen gibt es überall

Galaxies and Black Holes



This year's meeting started off with a public lecture by Nobel Laureate Reinhard Genzel. He invited interested Lindau citizens to join him on his captivating journey through the galaxies via livestream. Genzel was awarded the Nobel Prize in Physics 2020 jointly with Andrea Ghez "for the discovery of a supermassive compact object at the centre of our galaxy". Since the 1990s, they have been mapping the stars' orbits around Sagittarius A*, a bright radio source at the centre of our galaxy. To see through the Earth's atmosphere and the huge clouds of interstellar gas and dust, they developed new methods and used the world's largest telescopes. With the help of more sensitive light sensors and better optics, they were able to determine the stars' positions more accurately. The elliptical orbits of the stars reveal how they are affected by an invisible and very heavy object. This is the most convincing evidence yet that there is a supermassive black hole at the centre of our galaxy.

Presentation

Reinhard Genzel, Director at the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, and Professor at the University of California, USA

Moderator

Rainer Blatt, Member of the Council and scientific chairperson of the Lindau Meetings dedicated to physics, Professor of Experimental Physics at the University of Innsbruck and Scientific Director at the Institute for Quantum Optics and Quantum Information (IQOQI) of the Austrian Academy of Sciences (ÖAW)

Explore the darkest secrets of our universe
(for the Lindau audience in German).



Explaining the Nobel Prizes



Moderation of the Lindau Matinee by Hendrik Groth, Editor-in-Chief, Schwäbische Zeitung

During the 11th edition of the Lindau Matinee the speakers explained the latest Nobel Prize science to the local audience from afar due to the online format. This was more than compensated for by the fact that two of them knew the Laureates up close – as members of their research teams.

The Nobel Prize in Physics:

Roger Penrose for the discovery that black hole formation is a robust prediction of the general theory of relativity and **Reinhard Genzel**, **Andrea Ghez** for the discovery of a supermassive compact object at the centre of our galaxy **Hannah Übler**, Lindau Alumna 2019, PhD Candidate in the team of **Reinhard Genzel** at the Max Planck Institute for Extraterrestrial Physics

The Nobel Prize in Chemistry:

Emmanuelle Charpentier, **Jennifer A. Doudna** for the development of a method for genome editing **Enrique Lin Shiao**, Lindau Alumnus 2018, Postdoctoral Research Fellow in the team of **Jennifer A. Doudna**



Hannah Übler



Enrique Lin Shiao



Stefan H.E. Kaufmann



Klaus M. Schmidt

The Nobel Prize in Physiology/Medicine:

Harvey J. Alter, **Michael Houghton**, **Charles M. Rice** for the discovery of Hepatitis C virus **Stefan H.E. Kaufmann**, Director Emeritus at the Max Planck Institute for Infection Biology in Berlin and at the Max Planck Institute for Biophysical Chemistry in Göttingen, Professor of Microbiology and Immunology at the Charité, Berlin, as well as scientific chair for Physiology/Medicine at the Council for the Lindau Meetings

Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel:

Paul R. Milgrom, **Robert B. Wilson** for improvements to auction theory and inventions of new auction formats **Klaus M. Schmidt**, Professor of economics at Ludwig-Maximilians-Universität München and scientific chairperson for economics at the Council for the Lindau Meetings

The 2021 Lindau Matinee
is also available in
the Lindau Mediatheque
(in German).



Two More Stations

The regular presence of Nobel Laureates has left visible traces in Lindau: The Lindau Science Trail winds its way through the town and invites citizens and visitors to learn more about the researchers. Two more stations have now completed the path which is also featured in an app.



Lindau Science Trail website



Nobel Laureates featured on the most recent pylon referring to the topic of water.

Throughout Lindau, 18 stations offer background information in English and German about the people behind the Nobel Prizes. The content of the pylons is connected to the place where the station is located. For example, the new station 'Reutiner Bucht' can be found in a small nature reserve on the shore of Lake Constance and provides information about the topic of water. Ada Yonath and Peter Agre, Laureates who contributed to the 2021 meeting programme, are presented among others with their research linked to water-related fields.

The second new station is near the Inselhalle, the venue of the Lindau Meetings, and provides information about the idea behind the Nobel Prize and the first scien-

tists to become Nobel Laureates at the beginning of the 20th century. Both stations are now integrated to the app for the Lindau Science Trail. Using a smartphone and QR codes, you can find additional information on all the pylons.

The website wissenspfad.de was redesigned recently and presents various ways to experience the Lindau Science Trail: on site in Lindau, on your smartphone with the app, or in the form of the 'Virtual Science Trail' at home.

What is your favourite way to explore the Lindau Science Trail?



Meet the Laureates on Their Pier

The Lindau Nobel Laureate Pier as a central station of the local Science Trail gathers together all Laureates who have ever participated in a meeting – with one new entry from summer 2021.



Reinhard Genzel upon discovering his 'scientific father'



Gianfranco Antonio Calabretti, Member of the Foundation Board, Deputy Chairman, Prof. Otto Beisheim Stiftung, with Countess Bettina Bernadotte and Jürgen Kluge

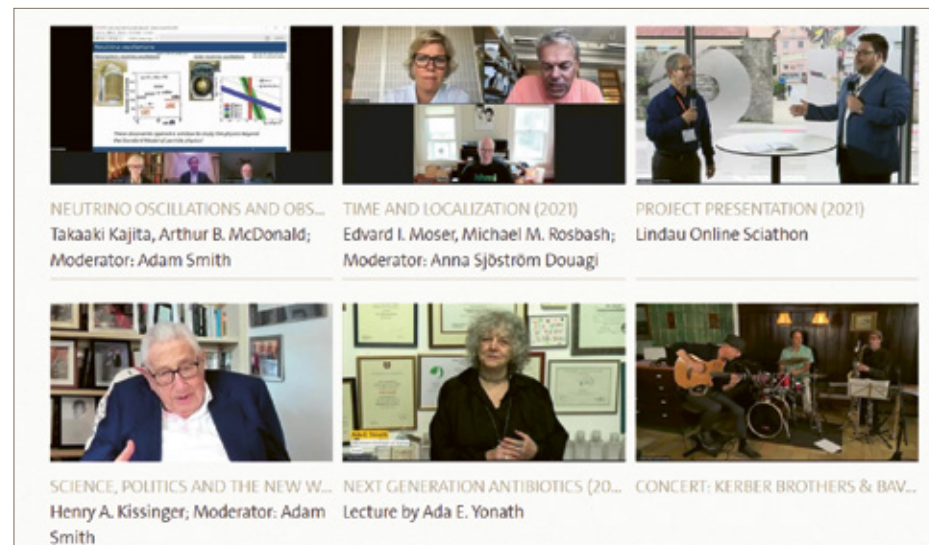
On the opening day of the 70th Lindau Nobel Laureate Meeting Reinhard Genzel inaugurated his entry on the Nobel Pier on the shore of the "Small Lake". With this ceremony the Nobel Laureate in Physics 2020 became part of the installation that brings together almost 400 Nobel Laureates in one place. All Nobel Laureates who participated in a meeting are named together with the year of their award and their first visit to Lindau on their personal bar in the guardrail. One of them is Charles H. Townes, whom the recently rewarded Laureate regards as his "scientific father": Reinhard Genzel was very happy to find the name of the Nobel Laureate 1964 in Physics at the pier and to find his own bar not far away.

Located near the meeting venue Inselhalle the pier is an attractive site both for residents as well as visitors to the island of Lindau. The Nobel Laureate Pier was realised thanks to the support of the Beisheim Stiftung and the City of Lindau and can also be visited digitally to learn more about the research behind the prizes.

Search for the names of Nobel Laureates on the pier.



Sparking Public Fascination for Science



With content dating back to 1952, the Lindau Mediatheque offers a far-reaching historic perspective on the development of major research traditions in the areas of natural and social sciences. The mediatheque's numerous original recordings, images and videos represent a unique multimedia treasure trove. Each year, new scientific content in various media formats is edited for different audiences.

One can not only find an overview of the 70-year history of the Lindau Meetings, but also research profiles of Nobel Laureates, their Life Paths ('Penzias Painting') and virtual tours through their laboratories in Nobel Labs 360°. Topic Clusters are dedicated to special subjects and provide a compact historic overview of the available material. Following a contemporary didactic approach, the mediatheque is enriched with short, animated videos outlining key issues of science in a fashion that is both educational as well as entertaining. Much of the con-

tent is well-suited for use in schools, as it conveys scientific topics in an accessible and comprehensive manner. The content is produced in cooperation with an established network of expert authors.

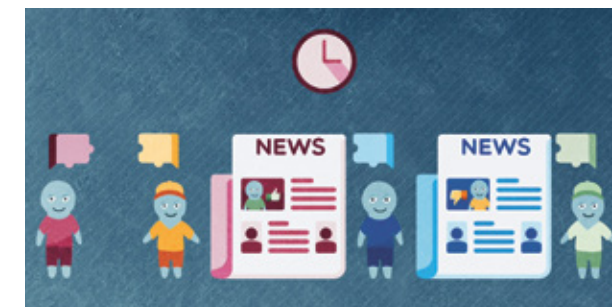
Thirteen years after being brought into existence, the Lindau Mediatheque will be renewed to keep pace with contemporary usability criteria. The new interface is designed to provide an experience that is consistent with the overall online presence of the Lindau Meetings. The goal of the relaunch is obvious: presenting scientific content in an attractive manner that makes it even more easily accessible for different target groups.

Find your favourite piece of content in the Lindau Mediatheque.



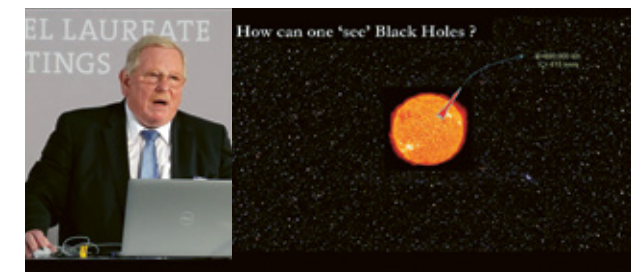
Teaching Material for Use in School

The continual development of the content in the Lindau Mediatheque aims to provide a unique learning infrastructure and research source for scientists, teachers, students and those fascinated by science. Nearly 800 original lectures by Nobel Laureates are featured, including the talks, debates and conversations held during #LINO70. As in previous years, new Mini Lectures, Topic Clusters and Teaching Guides were produced based on the growing collection of video material from the Meetings.



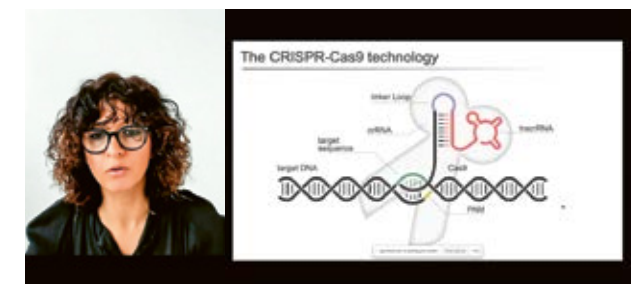
Mini Lecture: COVID-19

This three-part film discusses the role of science during the COVID-19 pandemic. Since the discovery of the virus in late 2019, science has received unprecedented attention, which has contributed to great pressure on researchers to identify effective solutions, particularly in their role as policy advisors. Learn more about the essential role of international collaboration and the three cornerstones that may help science to respond more successfully to future crises.



Teaching Guides

Teaching Guides are pedagogic, bilingual units (German/English) enhanced with appropriate worksheets, films and methodologies. The lessons support students in acquiring a deeper understanding of competencies in the fields of natural and social sciences as well as economics. This year's Teaching Guides illuminate the key principles of black holes and exoplanets.



Topic Cluster on Gene Editing

Starting with the most topical findings of Emmanuelle Charpentier and Jennifer Doudna with CRISPR/ Cas9, this Topic Cluster maps the rich scientific history of gene editing. While of course exploring the benefits of gene editing, the Topic Cluster also addresses the profound ethical questions regarding the subject.

Lessons of a Different Kind

“The most important thing in any industry is to follow your interests. If possible, you shouldn't compromise and start with jobs that you don't really stand up for. If you work on the topics that are close to your heart, it is much easier to cope with the busy day-to-day life in research.” – Heiner Linke



The educational outreach activities of the Lindau Nobel Laureate Meetings aim to spark interest in research and science among the younger generation. For this reason, the Council organises an annual school visit with a dialogue between a scientist and high school students from the four-country region of Lake Constance. After last year's success, the second edition of Online Science@School brought together students from 16 schools to attend the online lecture by Professor Heiner Linke, nanoscientist and member of the Council for the Lindau Nobel Laureate Meetings.

Linke, who was born in the surroundings of Lake Constance, is Professor for Nanophysics at the Physics Department and Deputy Dean of the Faculty of Engineering (LTH) at Lund University, Sweden. In his exciting lecture, the students were given an insight into a world that cannot be grasped with the human eye alone.

How big are nanoparticles and what special properties do materials have when they exist as very small particles? What are nanoscientists working on and what opportunities for climate, health and society does this key technology of the 21st century offer? Linke answered these and many other questions about the fascinating profession of a scientist during the event. In line with health regulations, some students were able to watch the lecture collectively from their classrooms.

Learn more about where we can find 'nano' in our everyday lives.

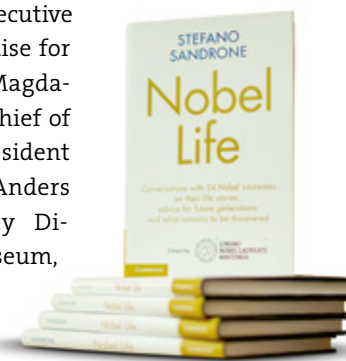


Their Words, Photos and Drawings

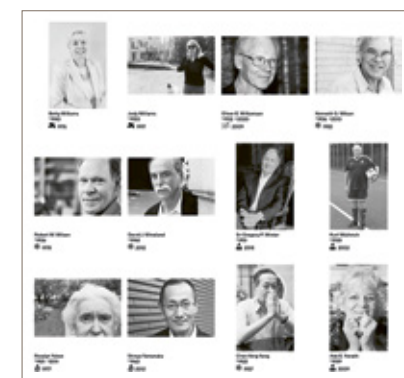
While branching out extensively into online activities, the Lindau Nobel Laureate Meetings did not neglect their print publications either. Some of these are new editions of established works, but one new book was also published.

At the end of May, **'Nobel Life – Conversations with 24 Nobel Laureates'** was published. Its Author Stefano Sandrone, a neuroscientist working at Imperial College London, was so inspired by participating in the 64th Lindau Meeting that he continued his exchanges with the Laureates by conducting interviews with them which were arranged by the Executive Secretariat. Advance praise for the book came from Magdalena Skipper, Editor in Chief of Nature, former ERC President Helga Nowotny and Anders Bárány, former Deputy Director of the Nobel Museum, among others.

ISBN: 978-1-108-83828-3



Also in preparation and in a new and updated edition, **'Ingenious Encounters'** will be published by Steidl Books (printed also in German: 'Geniale Begegnungen', ISBN 978-3-95829-718-0). As soon as the pandemic allowed it, Berlin photographer Peter Badge continued his project 'Nobel Laureates in Portrait', which he started in 2000,



and he is now able to present the most recent Laureates from 2020 and 2021. As in the first edition, the second one is a collaboration with author Sandra Zarrinbal.



In cooperation with the Nobel Prize Museum and with Klaus Tschira Stiftung as principal funder, there will soon be a new and much enlarged 2nd edition of the **'Sketches of Science'**. In his photos, Volker Steger captures the spontaneity and creativity of the Nobel Laureates and the enthusiasm of these outstanding scientists as they graphically represent ideas or discoveries that won them the Nobel Prize. An exhibition of about 40 photos of the series was launched at the Nobel Prize Museum in Stockholm in June 2012. Now, almost 10 years later and with many exhibits on different continents, the second edition of the art book will feature 120 laureates and comes with accompanying texts by Adam Smith, Chief Scientific Officer at Nobel Prize Outreach. During the 70th Lindau Meeting some of the photographs were presented on the facade of the Inselhalle – creating the impression that the Laureates were themselves in attendance in Lindau.

Regional, National, Global



1 Schwäbische Zeitung
2 Frankfurter Allgemeine Zeitung
3 Expo 2020 Dubai book

In spring, the focus of communications work was on the fundamental redesign of the Lindau Meetings' branding. The new concept will also be applied to the individual disciplines in the coming years.

Almost 100 journalists were accredited online for the anniversary meeting, with a focus on various publi-

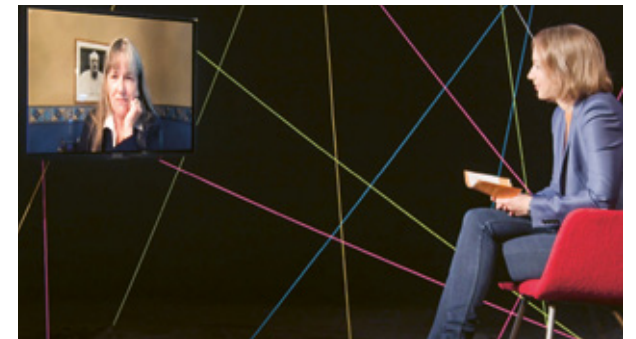
cations in South America this year. After a year's break, and thanks to the commitment of our partner Rolex, a supplement in the Frankfurter Allgemeine Zeitung could be realised again. On a regional level, we succeeded in positioning the meeting in the context of the recent debate on the role of science in times of COVID-19. And internationally, Lindau was mentioned in the tributes to the death of Edmond H. Fischer, for example in the New York Times and Washington Post.

Finally, there were good opportunities to highlight the tradition of the meetings in guest contributions. The Expo 2020 Dubai book 'World Majlis: The Essays – Conversations about Innovation and our Future' and the 'Future Navigator 2022' by the Roman Herzog Institute are worthy of particular mention.

70 Years – with 'Bonus Tracks'



Mainau Declaration 2015, shown during the opening film



Nobel Laureate Donna Strickland interviewed by Sybille Anderl for ARD-alpha



Young scientist Lorenz Adlung



Rainer Blatt moderated the exchange of Nobel Laureates Henry A. Kissinger with David J. Gross and William D. Philipps

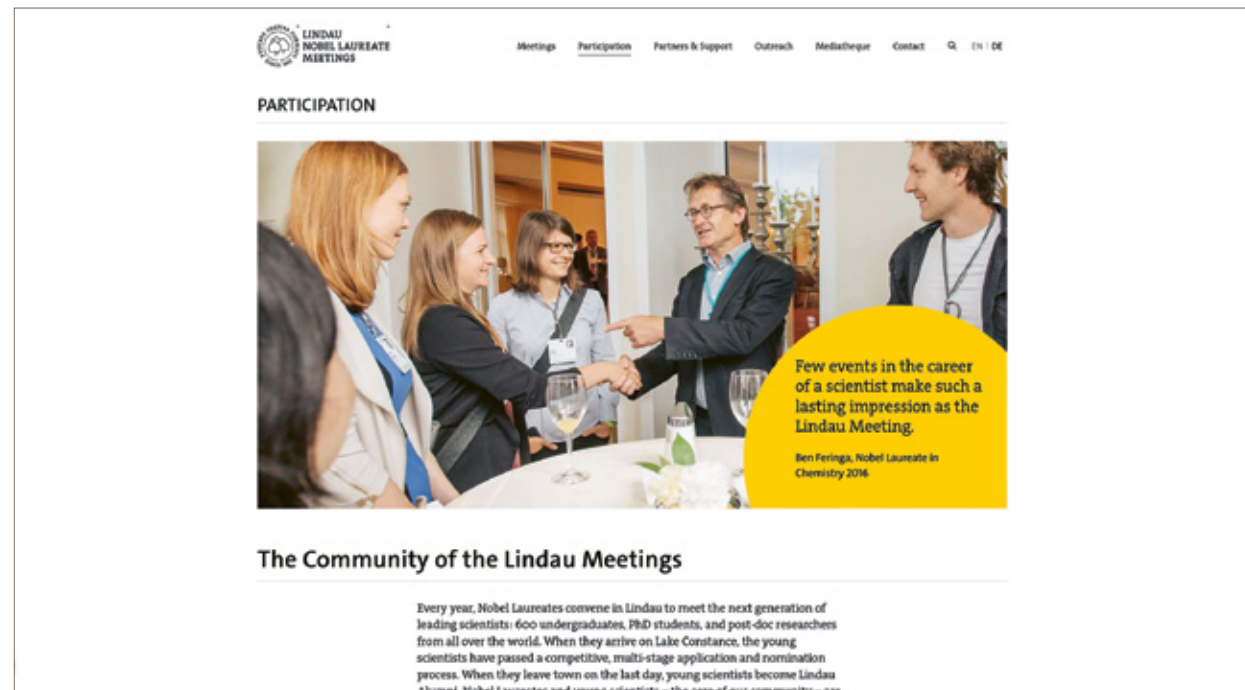
In the run-up to the meeting, the opening film was the focus of this year's video productions, which of course was to tell the 70-year history of the Lindau Nobel Laureate Meetings. Film text and photos were also prepared for an up-to-date short history on the website.

During the meeting, TV interviews by our media partner ARD-alpha with Nobel Laureates were again on the agenda – remotely this year as well. Thanks to the production company's months of experience, however, this time the technical effort was comparatively low. What still had to be navigated was the coordination between different time zones. Also in between programme sessions, young scientist Lorenz Adlung talked to Brian Malow about his path to the Lindau Meetings, his research on systems immunology, his new lab in Hamburg, science slams as well

as the importance of outreach and networking. Another interesting 'bonus track' is a conversation between musician Wade Schuman of Hazmat Modine and Wolfgang Huang about the connection between science and music and the scene in New York during the pandemic.

Henry A. Kissinger's interest in an exchange with Nobel Laureates in physics led to another opportunity: for his current book together with Eric Schmidt (formerly Google/Alphabet) and Daniel Huttenlocher (MIT) on AI he also turned his mind to quantum physics. At his request, the Lindau Nobel Laureate Meetings gathered some of the finest minds from the world of physics and technology to discuss the challenges faced by scientists and statesmen of the future. Excerpts from this exchange were published in the Lindau Mediatheque.

Facelift for our Website



The website of the Lindau Nobel Laureate Meetings is the first point of contact for practically everyone who is interested in learning more about the meetings. As the 70th Lindau Meeting was conducted online, this was the perfect occasion to relaunch lindau-nobel.org and create an up-to-date online presence – including revised graphics, an optimised menu structure as well as enhanced content in both English and German. The result is a streamlined website, which tailors information to our main stakeholder groups in the sections 'Participation' and 'Partners & Support'.

The home page is the stage for all currently relevant topics regarding the Lindau Meetings: recently added content, like news and blog posts, as well as calls to action, for example, to register for the Sciathon or to apply for the next meeting. What remains unchanged, however, is the ambition of our blog section to take up current scientific issues, for example, the research behind newly awarded Nobel Prizes. For everyone interested in science and the stories behind the meetings, following the blog is the perfect way to stay abreast of the current developments. Regularly published articles also portray participants of the meetings or the research of Lindau Alumni.

From #LINO70 to #LINO22

Connecting people and sharing ideas is at the core of the Lindau Meetings' mission. In 2021, the contact with our community through social media and on other digital platforms has proven to be truly crucial.



Close to 11,000 Lindau Alumni, young scientists, young economists, partners and other interested users follow us on Twitter. Around the virtual #LINO70, engaging our community in this digital space was particularly important. We are already looking forward to exchanging thoughts and memes for #LINO22 and #LINOecon.

About 16,500 users like the Lindau Nobel Laureate Meetings on Facebook. Key sessions of the 70th Lindau Meeting were livestreamed on our page, as were the Sciathon events. We update our community on news from Lindau year-round and engage in discussions on science-related topics.

Our community on LinkedIn, the networking platform for professionals, continues to grow. The Lindau Meetings' page is a great way to create and maintain relationships with partners and friends of Lindau – and particularly to reconnect with Lindau Alumni. Throughout the year, we continuously share news, videos and other related content.

More and more young scientists and alumni are engaging with us on Instagram, sharing snapshots made during #LINO70 from their homes and offices as posts and interactive Instagram stories. Several times a week, we share visual highlights from past Lindau Meetings, new blog posts and other digital content.

The performances by the Lindau Virtual Orchestra and the Lindau Virtual band are highlights on our YouTube channel this year. Also available is bonus material from the 70th Lindau Meeting, such as interviews with young scientist Lorenz Adlung and musician Wade Schuman of Hazmat Modine. New Mini Lectures supplement our educational content on a platform widely used by a younger audience.

Several interviews with economists – Laureates and Lindau Alumni – on YouTube served as preludes for the 7th Lindau Meeting on Economic Sciences 2022.



Council and Foundation
preserve the idea of
the founders and
the tradition of
the meetings.



Foundation Lindau Nobel Laureate Meetings is 20

Well on the Way to Self-Sustainability

The 70th Lindau Meeting was not the only anniversary commemorated this year in Lindau: The Foundation Lindau Nobel Laureate Meetings has now been in existence for 20 years. This body has been instrumental in providing a solid bedrock for the meetings, which will be especially important for the times to come. – By Nikolaus Turner



Extra-curricular events, such as the Lindau Nobel Laureate Meetings, play a pivotal role in boosting young people's enthusiasm for natural sciences. The transfer of knowledge occurs in an unstrained environment. But what is more important is the informal connection of Nobel Laureates as role models with young top talents.

Jürgen Kluge, Chairman of the Board of Directors of the Foundation

If we want to secure the future of the Lindau Nobel Laureate Meetings, we must start by reminding ourselves of the origins and history of this unique institution. The Lindau Meetings were conceived as a European initiative for reconciliation and scientific dialogue in the aftermath of World War II. The Lake Constance region is not only a cradle of European culture, it has also always been a site of intellectual ferment, reaching well beyond national borders.”

Wolfgang Schürer, Honorary Chairman and Chairman of the Board of Directors 2000–2015



The Board of the Foundation: Jürgen Kluge (Chairman), Nikolaus Turner (Managing Director), Wolfgang Lubitz (permanent guest as Vice President of the Council), Reinhard Pöllath, Countess Bettina Bernadotte, Thomas Ellerbeck – former members from its inception were Wolfgang Schürer (founding Chairman 2000–2015), Countess Sonja Bernadotte (2000–2008[†]), Werner F. Ebke (2005–2012) and Ludwig E. Feinendegen (2000–2005)

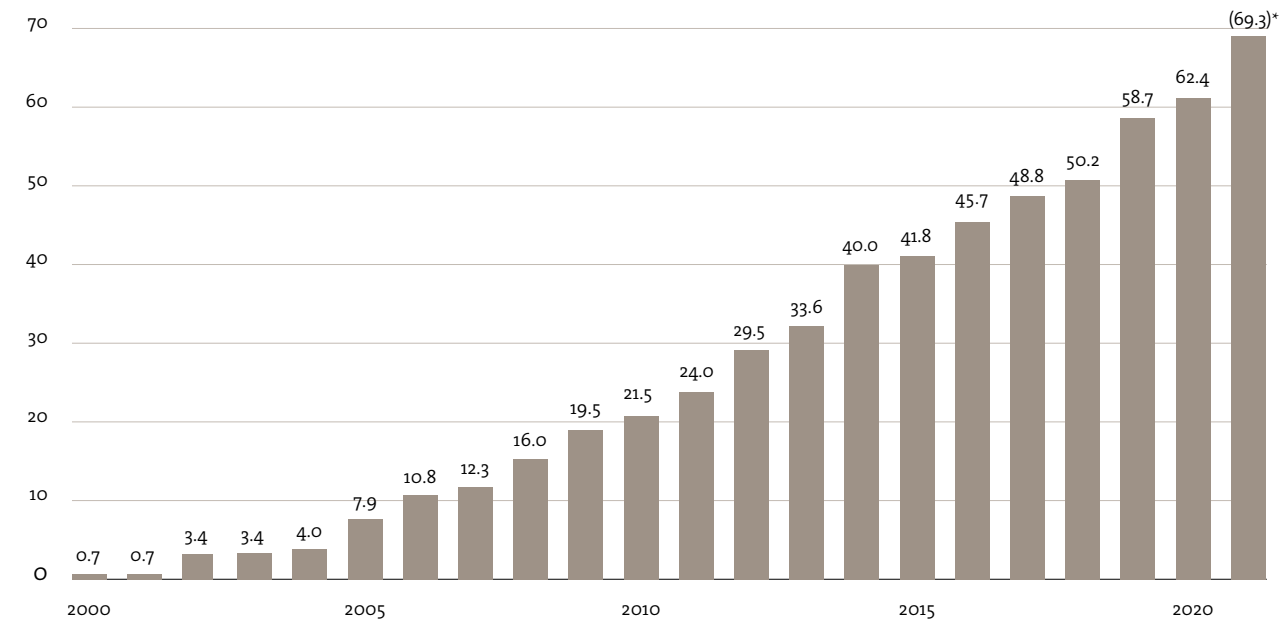
Like the history of the Lindau Meetings, the Foundation's success is very closely linked to the outstanding commitment of dedicated individuals. The Nobel Laureate Meetings and their concept are associated with their founders, but they would be equally inconceivable without the Nobel Laureates. They come to Lindau for no fee and make themselves available to the young scientists, not only through their lectures but also by offering their time to exchange ideas and to meet them in person. For 20 years, however, their enthusiasm has even gone far beyond that: neither the existence of the Foundation nor its further development are imaginable without the continued dedication of the Nobel Laureates.

In the year 2000, 50 Nobel Laureates broke the first ground for the Foundation on the occasion of the 50th Lindau Meeting. As initial founders they paved the way, also in honour of Count Lennart Bernadotte, the spiritus rector of the meetings since 1951, who convoyed the first

steps as Honorary President together with Roman Herzog, former President of the Federal Republic of Germany. The willingness of these Laureates to support the concept and to provide the Council's fundraising efforts with a Foundation and its endowment as a stabilising basis signalled the beginning of the Foundation. These beginnings just like the dedication of the Foundation's Board tipped the scales for success, in particular the Board's first Chairman Wolfgang Schürer. He made it his job to ensure that the internationalised meeting with its unique elan be firmly anchored within the heart of Europe.

Whereas the main focus during the early days was on German-speaking Europe, with the first participants coming from the countries neighbouring Lake Constance (Austria, Switzerland and Germany), by the year 2000, Sweden, France, the United Kingdom and other European countries as well as the United States had also gradually been incorporated. These days, top talents from around

Development of the Foundation's Endowment (in €m as per year's end)



Following its establishment in June 2000 – initial assets: €51,129.18 (100,000 DM)

*31.10.2021

100 countries take part in the meetings and all five continents are represented. This development is being further pursued through Memoranda of Understanding agreements with academic partners, a task for the Foundation also in the years to come.

Since Professor Jürgen Kluge assumed the chairmanship in 2015, the Foundation has been pursuing a 10-year strategy of self-sustainability with regard to its capital. The starting point at that time was €43m, which is to be doubled by 2025. The development so far is in line with this plan, despite the recent medical, societal, economic and financial challenges. A further goal is to reach an endowment of €100m in order to achieve complete financial independence for the Lindau Meetings. In addition to the further development of the pandemic, the issue of inflation is likely to play a role again in the medium term – possibly with higher interest rates on the capital markets again at a later date.

The increasing number of Nobel Laureates serving as members of the Founders' Assembly is mirrored by the increase in the Foundation's capital: 358 members in autumn 2021 mean on average 10% more Laureates each year since the Foundation was established. When so many have committed themselves and associate their impeccable names with the Foundation's work, it is

thanks to the great concept, its implementation and not least owing also to its continuous success and achievements.

In addition to the financial support for the meetings, the Foundation's work also includes concrete projects within the framework of the Lindau Outreach Programme and its Mission Education. The photo series 'Nobel Laureates in Portrait' and the Lindau Mediatheque with its over 1,000 audio and video recordings of lectures are worthy of particular mention in this regard. The most recent project made possible by the Foundation's network is the Mentoring Hub platform, which will further intensify cooperation in the Lindau Alumni community from autumn 2021 (see p. 104).

Each of the Foundation's activities is characterised by giving and taking. The reciprocal value of the work done by all those involved, whether they gave their personal time, provided financial resources or contributed ideas, can be measured in terms of the participants' enthusiasm as well as in the high levels of profound satisfaction, which regularly results in continuing involvement. This is how we can explain the 70 years of dedication of all previous and current individuals who are involved with the Lindau Meetings, dedication which will continue into the future.

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and the Friends of the Foundation

Founders' Assembly

The Foundation Lindau Nobel Laureate Meetings was established in 2000 by 50 Nobel Laureates.

Through their membership in the Founders' Assembly, Nobel Laureates demonstrate their strong support for the Lindau Meetings. As of October 2021, 359 Nobel Laureates constitute the assembly – these are the most recent additions:



Klaus Hasselmann
Nobel Laureate in Physics
2021



Andrea Ghez
Nobel Laureate in Physics
2020



Sir Roger Penrose
Nobel Laureate in Physics
2020



Charles M. Rice
Nobel Laureate in Physiology or Medicine
2020



Paul R. Milgrom
Laureate in Economic Sciences
2020



Robert B. Wilson
Laureate in Economic Sciences
2020

Honorary Senate

During the closing ceremony of the 70th Lindau Meeting, Dr Volkmar Denner, Chairman of the Board of Management, Robert Bosch GmbH, was appointed as Honorary Senator of the Foundation Lindau Nobel Laureate Meetings.

Members of the Honorary Senate – the most prestigious committee of the Foundation – function as advisors to the board and distinguished ambassadors for the cause of the Lindau Meetings. Each member of the Honorary Senate brings their formidable experience and expertise to bear on the goal of advancing the values and aims of Lindau's 'Mission Education', to which they are dedicated. Dr Denner epitomises this dedication to science, education as well as innovation through research, as Countess Bettina Bernadotte stated in her laudation:

“The Lindau Nobel Laureate Meetings have benefited for many years from Dr Denner’s love of science. Starting with the participation of the promising young scientist Volkmar Denner at the Physics Meeting in 1982, continuing with a regular and enriching exchange ever since, to his current generous support.”

In his acceptance speech, Dr Denner stressed the importance of open science and scientific progress, as well as his commitment to the meetings and their mission: “Being accepted into the Honorary Senate is a great honour for me and our company. Science becomes fruitful for the benefit of mankind when it does not remain in the ivory tower. That is why the appeals of the Nobel Laureate Meetings on climate protection, among others, are so important.”



Find all Members of the Honorary Senate on our website.



Preserving the Past for the Future

The Hein Family Archive

At the end of September 2021, a long-cherished wish came true for the Lindau Nobel Laureate Meetings: after deliberation, Piet Hein and Beate Hein Bennett bequeathed their father's working archive from the early years of the meetings to the Foundation.

Two dozen carefully prepared folders with valuable original documents from the founding years changed their location within Lindau and now have a place of honour in the office of the Executive Secretariat. "We are pleased to be able to include the children of the co-founder Franz Karl Hein in the circle of our benefactors in memory of their father", said Countess Bettina Bernadotte, President of the Council. "Once you start rummaging through the records, you don't like to stop."

The Council and the Foundation are curious to see what new insights into the history of the Lindau Nobel Laureate Meetings can be gained from correspondence, concepts and personal notes. Materials of overriding importance are to be digitised and made available in the Lindau Mediatheque. Similarly, selected documents can be made accessible to the public as part of the new exhibition on the Lindau Meetings after the renovation of the 'Cavazzen' Lindau City Museum.

The Donation of the Franz Karl Hein Work Archive 1950–1957

By Piet Hein and Beate Hein Bennett

Seventy years after the first meeting of Nobel Laureates in Medicine in June of 1951 in Lindau, we are pleased to donate our father's work archive to the Lindau Nobel Laureate Meetings. The archive contains his conceptual drafts of the organization of the meeting and his correspondence with all the major participants. We are very grateful to Nikolaus Turner, Member of the Board of the Foundation, who spearheaded the idea of the donation and the fulfillment of transferring this file of historical documents to the Foundation Lindau Nobel Laureate Meetings and appreciate the endorsement of Countess Bettina Bernadotte, President of the Council.

An important wish has been fulfilled: the archive stays in Lindau, the city where it all started and has remained. Being deposited in the Lennart-Bernadotte-Haus, it physically brings the names of two initiators together, Count Lennart Bernadotte and Dr Franz Karl Hein.

Professor Gustav Wilhelm Parade, medical colleague of our father and original co-planner with our father, remained involved with the meetings but at a distance since he left Lindau already in 1951.

The Hein archival documents are testimony to the remarkable courage, ingenuity, and far-sighted planning effort of the initiators to launch an international scientific meeting of such caliber six years after the ignominious collapse of Nazi Germany, the end of World War II and the Holocaust, and coinciding with the founding of the two republics of Germany in 1949 while under the occupation of the Allied Forces – and all this in the ancient small island town of Lindau that embraced this unique event (with some persuasion of our father as one of the city councilors), originally co-financed it, and ever since then has been host for one week every year to the scientific world.



Some of the files entailing historical treasures from the early years



Exhibition on the Lindau Meetings at the Lindau City Museum: Countess Bettina Bernadotte, Beate Hein Bennett and Piet Hein (2014)

Beate Hein Bennett and Piet Hein in the Video 'The Spirit of Lindau' (2012)



Council and Foundation

The Council

The non-profit Council for the Lindau Nobel Laureate Meetings was founded in 1954 to run the Lindau Meetings inaugurated in 1951. To organise the annual Lindau Meetings, the Council today maintains an executive secretariat based in the Lennart-Bernadotte-Haus on Lindau Island.

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Lennart-Bernadotte-Haus, Alfred-Nobel-Platz 1, Lindau

The Foundation

The non-profit Foundation Lindau Nobel Laureate Meetings was established under German law in the year 2000 by 50 Nobel Laureates. Its main purpose is to ensure the continuance and further development of the Lindau Meetings. As of now, 359 Nobel Laureates have agreed to serve as advocates for the Lindau Spirit in the Founders' Assembly.

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Preliminary Account 2021: Revenues

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Total Revenues 1,929,105.76

Please note: The calculated revenues refer to the meetings and selected outreach projects. Deficits have been covered by the Foundation Lindau Nobel Laureate Meetings as guaranteed to the Council for the Lindau Nobel Laureate Meetings.

Preliminary Account 2021: Expenditures

	(in Euro)
Travel	
Nobel Laureates	1,256.80
Young Scientists	0.00
Media	0.00
Others	6,871.60

Lodging	
Nobel Laureates	9,000.00
Young Scientists (Cancellation Fees)	2,464.00
Media	0.00
Others	22,939.50

Boarding	
Nobel Laureates	3,000.00
Young Scientists	0.00
Media	0.00
Others	19,582.04

Meeting Organisation	
Scientific Programme & Selection of Young Scientists	50,000.00
Rental Fees Locations	55,042.29
Technical Equipment	244,873.53
Utilities & Services	32,002.15
Supporting Programme	4,695.95
Printed Matter	44,029.34
Expendable Items	3,062.02
Audio, Video & Web Productions	54,501.48
Science & Media Services	21,690.07
Platforms (Mediatheque, Alumni)	265,585.41
Website	55,575.47

Further Expenses	
Telecommunications, Postage	43,193.83
IT Services, Hardware, Software	65,068.81
Accounting, Legal Advice, Insurances	23,010.87
Other Costs	13,363.62

Executive Secretariat	
Staff	784,176.72
Office Operating Costs	71,133.29
Office Supplies & Equipment	32,986.97

Expected Total Expenditures 1,929,105.76

Please note: The total expected costs include €515,780.13 of expected costs for September – December 2021. The budget does not include costs of the meeting covered directly by the Foundation.

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In Memoriam – Dearly Missed



Isamu Akasaki
1929 – 2021
Nobel Laureate in Physics 2014



Paul J. Crutzen
1933 – 2021
Nobel Laureate in Chemistry 1995



Richard R. Ernst
1933 – 2021
Nobel Laureate in Chemistry 1991



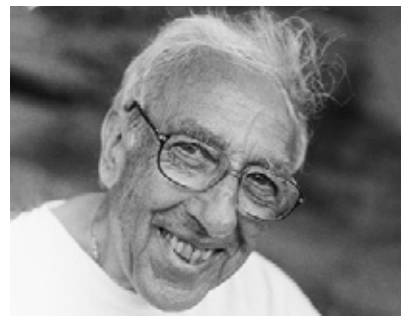
Toshihide Maskawa
1940 – 2021
Nobel Laureate in Physics 2008



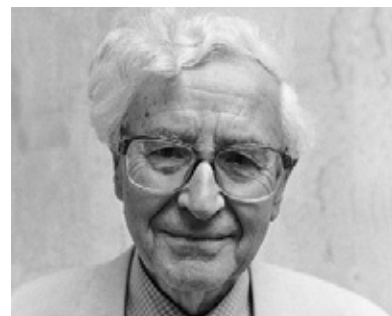
Robert A. Mundell
1932 – 2021
Laureate in Economic Science 1999



Ei-ichi Negishi
1935 – 2021
Nobel Laureate in Chemistry 2010



Edmond H. Fischer
1920 – 2021
Nobel Laureate in Physiology/Medicine 1992



Antony Hewish
1924 – 2021
Nobel Laureate in Physics 1974



Masatoshi Koshiya
1926 – 2020
Nobel Laureate in Physics 2002




Jack Steinberger
1921 – 2020
Nobel Laureate in Physics 1988



Martinus J. G. Veltman
1931 – 2021
Nobel Laureate in Physics 1999



Steven Weinberg
1933 – 2021
Nobel Laureate in Physics 1979

A person is seen from behind, holding a smartphone to take a photograph of a sunset over a body of water. The scene is dimly lit, with the sunset providing the main light source. In the background, another person is also taking a photo. The overall mood is serene and captures a beautiful natural moment.

71st Lindau
Nobel Laureate
Meeting
(Chemistry)
26 June – 1 July 2022

7th Lindau Meeting
on Economic Sciences
23 – 27 August 2022

72nd Lindau
Nobel Laureate
Meeting
(Physiology/Medicine)
25 – 30 June 2023

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