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73rd Lindau Nobel Laureate Meeting (Physics) Annual Report 2024

LINDAU
NOBEL LAUREATE
MEETINGS

73rd Lindau Nobel Laureate Meeting (Physics)

Annual Report 2024

There's a reason that the Laureates keep coming back. We enjoy ourselves here.
Donna Strickland
Nobel Laureate in Physics 2018

You do a wonderful job of selecting the Young Scientists. It was invigorating to interact with them.
Eric Betzig
Nobel Laureate in Chemistry 2014

I spent the best six days of my life on an island brimming with unfathomable knowledge and wisdom.
Garima Aggarwal
Lindau Alumna 2024

Thank you for your successful efforts to make the Lindau yearly Meeting a very significant event for many young scholars from around the world.
Dan Shechtman
Nobel Laureate in Chemistry 2011

The Lindau Meeting is the heaven of Physics.
Brian Gitahi
Lindau Alumnus 2024

Everything worked out very impressively and effectively.
Anton Zeilinger
Nobel Laureate in Physics 2022

LINDAU NOBEL LAUREATE MEETINGS

Annual Report 2024

73rd Lindau Nobel Laureate Meeting (Physics)

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Résumé and Outlook From Council and Foundation

The Common Ground

Countess Bettina Bernadotte and Jürgen Kluge welcoming HRH Princess Maha Chakri Sirindhorn of Thailand

Lindau is – and always has been – a place for the free flow of ideas and thoughts. For almost 75 years, the Lindau Nobel Laureate Meetings have offered the international scientific community a haven in which to meet, with the ambition of gathering excellence in research and of transcending differences of geography, gender, class, origin, and religion. At Lindau, scientists from all over the world talk to each other, learn from each other, and hopefully carry the "Lindau Spirit" back to their home countries, providing new impetus for tackling the urgent problems which assail humanity and which can only be solved through international cooperation.

In 2024, we followed this principle by assigning responsibility for a substantial part of the Meeting's core themes to the Young Scientists. Based on our conviction that today's Young Scientists – this time, representing 386 institutions and 91 countries – may be tomorrow's Nobel Laureates, we invited them to share insights into their cutting-edge research on how to employ artificial intelligence for physics; on physics-based solutions to the energy challenge; and on the potential for cross-disciplinary research in physics. And we have also continued our interest in the methods by which science can best be practiced, dedicating two workshops to the Lindau Guidelines, which foster new approaches to global, sustainable, cooperative, and, above all, open science.

We often evoke the "Lindau Spirit", and indeed, when you read reports about the Lindau Meetings from the 1950s and 1960s, you will find that one of the most-used terms to describe the atmosphere is "der heitere Geist von Lindau." Serenity, even cheerfulness, was the attribute associated with the picturesque, romantic island-city located on the lake. And yet, it was not only the city that inspired this sentiment.

We may think of our times as particularly difficult, even dire. But let us not assume that those years in post-World War II, Cold-War Europe were easy ones. Indeed, when the great physicists of their time met in the 1950s in Lindau, they were beset by one fear, that of humanity's self-destruction through nuclear war. Albert Schweitzer, the Nobel Peace Laureate of 1952 and great humanist, whose visit to Lindau we commemorated last year, probably acted as a catalyst to promote the 1955 Mainau Declaration – as well as the historic new declaration which we owe to the Laureates assembled on Mainau in 2024.

The serenity with which the Meeting was imbued did not merely arise because of the island, the sun, and the lake, it was also brought about by participants' lived experience of two ideas that remain at the core of the Lindau Meetings to the present day: One was the conviction that Science provides a common ground, a pure terrain where people from different backgrounds can meet. Following this logic, Lindau was a means to take a step back from the world with its seemingly insoluble conflicts and to unite the participants in their discussions of science, i.e. of something that is in itself valuable and moves in accordance with generally accepted, perhaps even timeless rules.

The other idea transcended science and revolved around the concept of "humanitas" or Humanity. It highlighted the fundamental interconnectedness that goes beyond the myriad divisions created by culture, nationality, and conflict. In nurturing these bonds, we can work toward a world where mutual respect and understanding prevail. These are also some of the core beliefs of our outgoing Vice President Wolfgang Lubitz, whose term ended in October 2024 and to whom we would like to express our profound thanks for his 20 years of service (see p. 114).

In looking forward to the coming Meetings – in 2025, we will have chemistry as well as the economic sciences on our agenda – we hope that these magnificent surroundings and the privilege of scientific exchange with Nobel Laureates and among the generations, continents, and subdisciplines can yield the same serenity as experienced by participants in times past. Surely, the more we focus on science, the more common ground we will find. At the same time, we firmly believe in the salutary effects of benevolence and goodwill. As renowned twentieth-century German philosopher, Hans-Georg Gadamer, himself an expert on the requirements and mechanisms of mutual understanding, once put it: "A proper conversation presupposes that the other person could be right." We hope you join us in seeing the great wisdom in these words.

Countess Bettina Bernadotte af Wisborg
President
Council for the Lindau Nobel Laureate Meetings

Jürgen Kluge
Chairman of the Board of Directors
Foundation Lindau Nobel Laureate Meetings

Welcome to the 73rd Lindau Nobel Laureate Meeting

Opening Day

A Moment for Celebration

A festive Opening Ceremony was the perfect kick-off for a week full of scientific and personal exchange. For the first time, a Young Scientist co-hosted the ceremony. Debatri Chattopadhyay from Cardiff University led participants through the programme together with Adam Smith of Nobel Prize Outreach. Later, a reception hosted by the Free State of Bavaria provided a perfect setting for personal encounters between Nobel Laureates, Young Scientists, and guests.

Opening Ceremony

A Welcome to Lindau
Countess Bettina Bernadotte, President of the Council

70 Years Ago – Albert Schweitzer in Lindau
Remembering a Pivotal Moment for the Meetings (Video)

Greetings from Stockholm
Astrid Söderbergh Widding, Chair of the Board, The Nobel Foundation, Sweden

Laureates' Greetings
Donna Strickland, University of Waterloo, Canada

Welcome Address
Bettina Stark-Watzinger, then German Federal Minister of Education and Research

Greetings from Austria
Martin Polaschek, Austrian Federal Minister of Education, Science, and Research

Current Key Topics in Physics – A Survey
Steven Chu, Stanford University, United States of America

Introducing the Scientific Programme
Scientific Chairs of the 73rd Lindau Nobel Laureate Meeting
Rainer Blatt, University of Innsbruck, Austria
Heiner Linke, Lund University, Sweden

A Welcome to Bavaria
Markus Blume, Bavarian State Minister of Science and the Arts, Germany

Musical Accompaniment
Ensemble of the Vienna Philharmonic

Masters of Ceremonies
Debatri Chattopadhyay, Cardiff University
Adam Smith, Nobel Prize Outreach

Reception

hosted by the Free State of Bavaria

For the #LINO24 Opening Ceremony, Young Scientist Debatri Chattopadhyay joined co-moderator Adam Smith in guiding participants through the speeches, greetings and musical pieces

Celebrating the Passion Behind Curiosity and the Joy of Knowledge

by Debatri Chattopadhyay

Being selected first by Cardiff University, then by the Royal Society, and finally by the Lindau Council was a dream realized. Little did I know that even greater surprises were in store. I was already on my way to the airport a week and a half before the event when I received the invitation to co-host the Opening Ceremony with Adam Smith – the first time a Young Scientist was given this role! Naturally, I said yes! My stage experience as a dancer since childhood may have helped with my later academic and public speaking, but this was an entirely new and daunting challenge – appearing in front of more than 30 Nobel Laureates and over 600 scientists from around the globe.

I arrived a day before the ceremony and was aptly and elegantly briefed by the organizers. Adam was incredibly patient and supported me both on and backstage throughout the appearance. After the ceremony, I had a surreal conversation with Saul Perlmutter and Brian Schmidt, who congratulated me on my hosting and inquired about my work!

The week was filled with unforgettable moments: Bill Phillips discussing fundamental constants at 22:00 outside, Steven Chu leading an impromptu science walk on Mainau Island, and one-on-one lessons from Saul Perlmutter on dark energy. Meeting icons like Didier Queloz, Anne L'Huillier, and John Mather was extraordinary. This experience was about more than recognition; it was about celebrating the passion behind curiosity and the joy of knowledge.

I will cherish the memory lifelong and carry the inspiration into my work, serving science to the best of my ability.

Advancing Our Mission to Educate – Inspire – Connect

Welcoming TRH Prince Ludwig von Bayern and Princess Sophie-Alexandra von Bayern

"Can't see you with the fascinator"

It gives me enormous joy to welcome you all here to Lindau for today's opening of the 73rd Lindau Nobel Laureate Meeting dedicated to Physics. Dear Laureates, you give us the possibility to take a glimpse into your extraordinary lives and learn from your success, often enough the result of overcoming seemingly unsurmountable obstacles. Thank you so much for taking the time and effort to come to Lindau: your dedication, support, enthusiasm, and commitment make these Meetings truly special!

We welcome you, 626 Young Scientists, representing 91 nationalities and 65 countries of university affiliation. 57% of you define as male, 42% as female and 1% as non-binary. I look forward to the day when diversity has become a lived normality in our societies, so that we talk less about its quotas and rejoice more in its value for us all.

Every year, we want to develop our formats in such a way that they serve you, the participants, and reflect wider societal developments and more closely embody our Mission to 'Educate – Inspire – Connect'. This is why we keep adding new elements to the Meetings – and we are very interested in your feedback.

One such ingredient is the new format 'Scientific Exchange Among Young Scientists'. We have invited contributions from all of you for all areas of physics not covered by the thematically focussed Next Gen Science sessions. Above all, we have asked you, the Young Scientists of this year's Meeting, to vote for your favourite abstracts among those submitted by your peers. Out of 249 applications, 14 abstracts have been selected for in-depth presentations.

We hope that you will enjoy these programme elements. They are so much more than poster sessions! This is also true of our 4th Lindau Online Sciathon, the 48-hour, hackathon-type competition to find great early-stage ideas on 'Physics as a Driver of a Sustainable World'. Finally, our alumni community has chosen the following two topics for this year's workshops: 'How to Remove Career Obstacles for the International Movement of Early-Career Scientists' and 'How to Create Bias-Free Review Procedures for Fellowships and Research Grants.'

I hope you will enjoy this week to the full! To all of you: a warm welcome to the 73rd Lindau Nobel Laureate Meeting.

Fostering Global Connections – Inspiring Future Generations

Donna Strickland greeting the audience on behalf of the participating Nobel Laureates

Astrid Söderbergh Widding, Chair of the Nobel Foundation Board, delivering the traditional Greetings from Stockholm

It is my privilege and pleasure to offer greetings on behalf of the 36 Nobel Laureates who are with us this week. We do bring a wealth of experience and are looking forward to interacting with the over 600 of the brightest young minds on the planet. Where we bring the experience, you bring the energy and the diversity.

When I first came to Lindau in 2019, I had just won the Nobel Prize, and much was being made of me being only the third woman to win a Physics Nobel Prize.

I have gone from being only the third woman to being one of three living women who are Nobel Physics Laureates. Anne L'Huillier is here. And joining us at Lindau is the woman who knows what it's like to be the only living woman with a Nobel Prize in Chemistry: Ada Yonath. I was inspired by her stories the first time I was at Lindau. Lindau is a place where students and postdocs can meet Laureates – where Laureates have the opportunity to meet and learn from each other.

One of the original aims of the Lindau Meetings was to reconcile people in post-war Europe – quite a different historical context. It is an aim which is more important than ever, perhaps in these times of increasing polarization in our world. And the role of science diplomacy cannot be underestimated.

Laureates meet new generations of Young Scientists under very, very favourable conditions, thus becoming great sources of inspiration for all of us gathered here. The Young Scientists indeed, you come from all over the world, and I think this is extremely important. It is very much in line with the vision of Alfred Nobel himself.

I'm convinced that Alfred Nobel would have been delighted. He wanted the prize in his name to really make a difference.

And what could be more beneficial than letting Laureates with great accomplishments meet and inspire, and also themselves, be inspired by promising Young Scientists?

Science, Freedom, and the Future

In her welcoming address, Bettina Stark-Watzinger, then German Federal Minister of Education and Research, conveyed a message of hope, emphasizing the importance of cooperation in tandem with freedom, the value of sharing knowledge and experience in fostering new achievements, and the essential role of science in addressing today's challenges.

“Peak performance in science is usually about something really big. It's about understanding the world. Peter Higgs like no other drew his motivation from this; his fascination, his craft focussed on the theory of the smallest building blocks of the universe. Particle physics is essentially about what holds the world together at its core. In the world we live in right now we are witnessing various types of centrifugal forces. So, what in fact holds our society together at its core?

Curiosity, courage, innovation, collaboration – all these aspects and characteristics are at the core of bringing humankind forward. But I would like to add another ingredient to that, and that is freedom. Science and scientific cooperation thrive from freedom. Freedom is the strength that we must bank on, particularly in eventful times like this.

You, dear Nobel Laureates, have my greatest respect for your scientific achievements, but also for being here, for sharing your knowledge, supporting young research talent and thereby sowing the seeds of new peak performances. That's what the Lindau Nobel Laureate Meeting is about. About lively discourse and the free exchange of ideas. And this is why I'm counting on the visibility which this meeting has: It is a lighthouse in times we are facing right now for science, for society as a whole.

Science is the unbreakable. It is a constant source of hope. And we are currently standing on an interesting threshold in terms of technology. One important factor is the growing use of artificial intelligence. AI will impact virtually all aspects of life and work. It will open new doors for you too, to new knowledge, which means progress for us all. Science sets the pace of this progress, and what I like about this is the openness.

Georg Christoph Lichtenberg once wrote: 'One has to do something new in order to see something new.' That is the way it is: to be open to new technologies, to be creative in finding new technologies. We see the opportunities in new technologies, but we also have to address the risks associated with that. So, it's good that you come together, you discuss what is going on, what our future will be like, and we find a common ground for maintaining humanitarian values. You as a young generation, you epitomize all of that. I've seen it time and time again. This is what Lindau thrives upon.”

Joined by Nobel Laureates and distinguished guests at the reception offered by the Foundation Lindau Nobel Laureate Meetings

In conversation with Young Scientists ...

... and with former Federal Minister of Education and Research, Annette Schavan

A Festival of Science and Hope

Bavarian State Minister of Science and the Arts Markus Blume did not conceal his delight about the Meeting's focus on physics and in particular on quantum computing. He went on to discuss the role of science in shaping society and concluded by inviting all participants to Bavaria's state reception.

"I can feel what is called the Lindau Spirit, what makes this event really special. We heard many things about the ingredients here of this Lindau Spirit.

You're not here for the wonderful weather, and you're not here for the beautiful landscape, and the Bavarian art of living. You're here because you can have a unique experience of meeting the brightest minds in the world. Thank you all for coming to Lindau, Ladies and Gentlemen. So this is a festival of great ideas, and we touched a little bit today on the history of this meeting. But it's also a festival that focusses on one discipline every year. This sounds for some pupils or students like a horror week. But I understand here in Lindau, a week of physics is pure pleasure.

As Minister of Science and the Arts, I'm very excited about the new possibilities, about the new technological developments, about the future of quantum computing, of fusion. So, thank you for making this the topic of this year's conference. And thank you especially, a warm thank you to the Nobel Laureates here for sharing your experience, your knowledge, your ideas with all of us. Thank you so much for this effort.

Finally, Lindau always is a festival of science and hope, because we are strong believers all together in the power of progress, in the power of new answers. And I strongly believe we need these new answers, because no doubt we live in a time of a paradigm shift, or maybe not even just one paradigm shift, but two or three or even more. So it's clear that we can only deal with all the new challenges with new answers and not just with a look back into the past.

This is the reason why we need you to manage the future, to shape the future basically. But there's even more behind this, because today, given the fact that in a neighbouring country in France we have elections today, I think, or I feel we may not allow for a world where people listen to the wrong people and follow the wrong ideas. They should listen to science, and they should follow your ideas."

Minister Blume addressing Lindau's international audience

Markus Blume with a group of Young Scientists ...

... and in conversation during the state reception

Political representatives abound:
Countess Bettina Bernadotte, two Bavarian State Ministers, the District Councillor, and the Mayor of Lindau

Nobel Laureate Saul Perlmutter surrounded by Young Scientists

Greetings From Austria

The Will to Do Research – Whatever It Takes

Austria was represented at this year's Meeting by Martin Polaschek, Federal Minister of Education, Science, and Research. In his address during the Opening Ceremony, the Minister emphasized the importance of international scientific exchange, particularly during periods of political turbulence. On a more joyful note, Polaschek reminded his listeners of how lucky they were to have found their calling as scientists. The entire ceremony was beautifully accompanied by an ensemble of the Vienna Philharmonic.

"

These annual meetings are simply unique and an exceptional opportunity for Young Scientists to meet and discuss their ideas with the most eminent scientists who have been honoured with the Nobel Prize. In order to promote young talent, we must also provide the opportunities. One example of this is the scholarships that allow talented young people to take part here in Lindau. Austria has one of the highest research quotas in the European Union, with 3.35%. This shows that the Austrian government has done a lot, making Austria an attractive place to do research and to compete internationally.

I am convinced by and fully share the Lindau Nobel Laureate Meetings' motto to 'Educate – Inspire – Connect' by promoting international exchange. The amazing enthusiasm of Young Scientists inspires and motivates others to explore their interests in understanding the fundamental principles of life and the universe.

However, we live in a time when the freedom of science and research is being challenged, and our liberal global standards, as well as trust in science and democracy, are under increasing pressure. As Minister, one of my priorities is to strengthen trust in science and democracy. I am a strong advocate of exchange and cooperation between trusted and like-minded partners to strengthen excellence in international research.

Lindau is a superb place to host such an exceptional international community of eminent as well as young researchers bringing together the best in an open setting. I am delighted that Austria is hosting a Panel Discussion as a Partner Event and an Academic Networking Dinner. And, as music is the universal language of the world, I'm very thankful that the Vienna Philharmonic is playing here again.

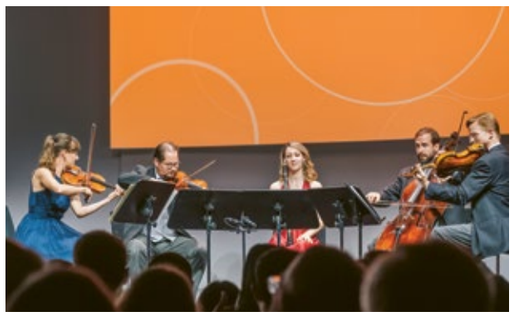
So, thank you everybody for coming here, for talking to each other, for thinking with each other, and carrying on the real spirit of Lindau into the future, which means curiosity and the will to do research, whatever it takes. Being a researcher – isn't that the greatest job one can do? Thinking about what you're interested in the whole day, creating ideas, bringing them to new people, and inspiring generations beyond us.

"

Martin Polaschek (r) with his Bavarian colleague Markus Blume

Austrian entrepreneur Hermann Hauser talking to Young Scientists

Enjoying a good meal and a profound discussion: at the Partner Breakfast ...



The Ensemble of the Vienna Philharmonic:
Andrea Götsch | Clarinet
Katharina Engelbrecht | Violin
Andreas Großbauer | Violin
Martin Lemberg | Viola
Jan Ryska | Cello

... and at an Academic Dinner, both hosted by the Austrian Federal Ministry of Education, Science, and Research

Calling for Evidence-Based Dialogue

The festive evening offered by the Foundation Lindau Nobel Laureate Meetings on the Meeting's opening Sunday has become a cherished tradition. At the reception, Jürgen Kluge, Chairman of the Board, reflected on current global challenges and advocated open discussions grounded in facts and evidence.

On behalf of the board of the Foundation, it is my pleasure and honour to welcome you to our traditional Sunday evening event. We are grateful to all of you for sharing your time with us here at the Lindau Nobel Laureate Meeting 2024, which will be about physics.

Indeed, it would be a mission impossible without the time, dedication, and commitment of the Nobel Laureates who pledge a week to Lindau, vitalizing the Lindau Spirit, and enabling interactions with the Young Scientists. In fact, 626 Young Scientists from about 90 countries are expecting intense exchange during the upcoming week leading to an unforgettable experience that motivates them for the future and will be kept forever.

Obviously, there would be no Lindau Meetings without Nobel Laureates; however, in exactly the same way we cannot do without our supporters. In this regard, it is our pleasure to welcome our Maecenates and Endowment Contributors of our Foundation as well as the Benefactors and Supporters of this year's Meeting. Likewise, a warm welcome to all representatives from international and national academies of sciences, academic institutions, ministries, and partners from all over the world. You are cornerstones on which the Meetings are built.

Despite – or perhaps even in view of – the countless crises in the world today, here in Lindau at our Meeting we want an open exchange of arguments, we want facts and evidence to carry the day in a win-win, collaborative atmosphere. That is what the Lindau Nobel Laureate Meetings are all about, since their beginnings. That is the Lindau Spirit.

I worked in a professional services organization for 25 years, and we had a simple rule: 'Client first, firm second, self third.' When we did not follow the rule, we always failed. I would like to see this rule adopted for the scientific world: 'Evidence first, institution second and self third!'

We still have it in our hands to save the world which is so beautiful, and life is so precious. Let's enjoy every moment and have an exciting Meeting!

Jürgen Kluge opening the reception

Wolfgang Schürer with Jean Holmes Chu

Carl-Thomas Epping with Hendrik Leber

Constanze and Steffen Metzger

Jasbir Singh signed the MoU for NRF Singapore

Christoph Philipp recently joined the Foundation's Board

Among the guests: Jutta Zülow and Patrick Cramer, President of the Max Planck Society

Pamela Mars and Olivier Greim

Responsibility Extending Beyond Science

Albert Schweitzer in Lindau 70 Years Ago

Remembering a Pivotal Moment for the Lindau Meetings

As a highlight of the Opening Ceremony, a newly produced documentary commemorated the 70th anniversary of the first visit of a Peace Nobel Laureate to a Lindau Meeting. Albert Schweitzer's visit in 1954 not only marked a new epoch for the Meetings but also had a profound impact on some of the 20th-century's leading physicists that were assembled in Lindau.

Using newly found letters and photographs from the 1950s, a short documentary film showcased the full story of Schweitzer's visit to Lindau. In the correspondence, Schweitzer reflects on his visit, expresses his admiration for the distinguished scientists, and voices his desire to return to Lindau one day.

In fact, soon after the first Lindau Meeting in 1951, co-founder Franz Karl Hein reached out to Schweitzer to explain the Meetings' origin and ambition. In 1954 an official invitation followed, endorsed by Count Bernadotte, who, in his letter, pointed out the Meetings' familiar and warm atmosphere, "distinct from official conferences".

Schweitzer accepted the invitation. He arrived by train on 30 June 1954, was welcomed by Mayor Walther Frisch, and listened to Nobel Laureate Butenandt's talk at Lindau's City Theatre, sitting next to Werner Heisenberg. That evening, Schweitzer gave an organ concert: much anticipated by the organizers but hidden from the public. He played alongside Heisenberg and indeed afterwards praised Heisenberg's organ skills.

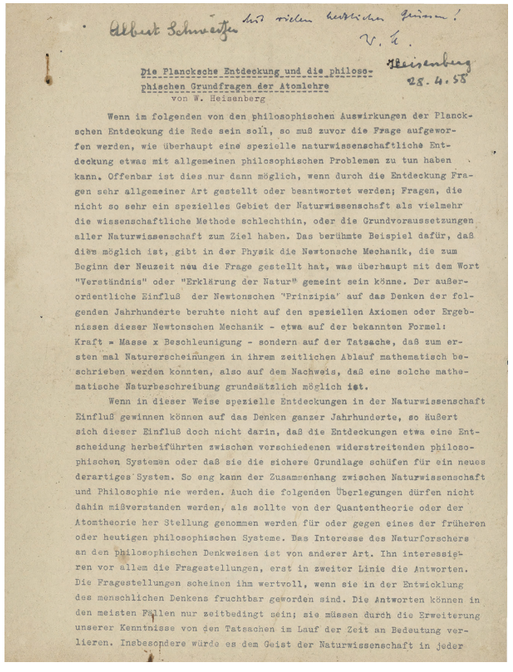
The 1954 Meeting was the first to see the participation of a substantial number of Young Scientists. Not surprisingly, 1954 has thus gone down as an iconic year that came to embody the Lindau Spirit like few others, radiating the enthusiasm and optimism that characterized Schweitzer's visit shortly after the Second World War.

However, the most enduring impact of Schweitzer's visit may have been in the dialogue he began with Heisenberg and Otto Hahn. Following their meeting in Lindau, Schweitzer corresponded with both men for the remainder of his life, discussing topics that included quantum physics but that, above all, were concerned with nuclear war.

In 1954, the issue of nuclear armaments could not be overlooked. That spring, Schweitzer published an article in the Daily Herald addressing the dangers of the hydrogen bomb. Otto Hahn publicly supported Schweitzer's stance against nuclear weapons, while Heisenberg later remarked that Schweitzer's presence at the 1954 Meeting led him and his colleagues to re-evaluate their humanitarian responsibilities as scientists. One year later, the 1955 Mainau Declaration, an appeal against nuclear war signed by eighteen Nobel Laureates, was spearheaded by Heisenberg and Hahn.

Remembering Schweitzer in 2024 was highly appropriate: not only because of the 70th anniversary of his visit, nor in anticipation of 2025's celebrations of Schweitzer's 150th birthday or the 70th anniversary of the Mainau Declaration. Commemorating his visit gave all of Lindau's participants the opportunity to reflect on the broader responsibilities shared by all scientists.

Albert Schweitzer amidst Young Scientists



Albert Schweitzer
mit vielen kollegialen Grüssen!
V. H.

Heisenberg
28.4.55

Die Plancksche Entdeckung und die philosophischen Grundfragen der Atomlehre
von W. Heisenberg

Wenn im folgenden von den philosophischen Auswirkungen der Planckschen Entdeckung die Rede sein soll, so muß zuvor die Frage aufgeworfen werden, wie überhaupt eine spezielle naturwissenschaftliche Entdeckung etwas mit allgemeinen philosophischen Problemen zu tun haben kann. Offenbar ist dies nur dann möglich, wenn durch die Entdeckung Fragen sehr allgemeiner Art gestellt oder beantwortet werden; Fragen, die nicht so sehr ein spezielles Gebiet der Naturwissenschaft als vielmehr die wissenschaftliche Methode schlechthin, oder die Grundvoraussetzungen aller Naturwissenschaft zum Ziel haben. Das berühmte Beispiel dafür, daß dies möglich ist, gibt in der Physik die Newtonsche Mechanik, die zum Beginn der Neuzeit neu die Frage gestellt hat, was überhaupt mit dem Wort "Verständnis" oder "Erklärung der Natur" gemeint sein könne. Der außerordentliche Einfluß der Newtonschen "Prinzipia" auf das Denken der folgenden Jahrhunderte beruhte nicht auf den speziellen Axiomen oder Ergebnissen dieser Newtonschen Mechanik – etwa auf der bekannten Formel: Kraft = Masse x Beschleunigung – sondern auf der Tatsache, daß zum ersten mal Naturerscheinungen in ihrem zeitlichen Ablauf mathematisch beschrieben werden konnten, also auf dem Nachweis, daß eine solche mathematische Naturbeschreibung grundsätzlich möglich ist.

Wenn in dieser Weise spezielle Entdeckungen in der Naturwissenschaft Einfluß gewinnen können auf das Denken ganzer Jahrhunderte, so äußert sich dieser Einfluß doch nicht darin, daß die Entdeckungen etwa eine Entscheidung herbeiführten zwischen verschiedenen widerstreitenden philosophischen Systemen oder daß sie die sichere Grundlage schüfen für ein neues derartiges System. So eng kann der Zusammenhang zwischen Naturwissenschaft und Philosophie nie werden. Auch die folgenden Überlegungen dürfen nicht dahin mißverstanden werden, als sollte von der Quantentheorie oder der Atomtheorie her Stellung genommen werden für oder gegen eines der früheren oder heutigen philosophischen Systeme. Das Interesse des Naturforschers an den philosophischen Denkweisen ist von anderer Art. Ihn interessieren vor allem die Fragestellungen, erst in zweiter Linie die Antworten. Die Fragestellungen scheinen ihm wertvoll, wenn sie in der Entwicklung des menschlichen Denkens fruchtbar geworden sind. Die Antworten können in den meisten Fällen nur zeitbedingt sein; sie müssen durch die Erweiterung unserer Kenntnisse von den Tatsachen im Lauf der Zeit an Bedeutung verlieren. Insbesondere würde es dem Geist der Naturwissenschaft in jeder

"Planck's Discovery and the Basic Philosophical Questions of Atomic Theory" by Werner Heisenberg – with a personal dedication to Albert Schweitzer

With Otto Hahn and Werner Heisenberg

Watch the Albert Schweitzer documentary in the Lindau Mediatheque:

An Appeal to Our Better Selves – From Hundreds of Nobel Laureates and Lindau Alumni

The Mainau Declaration 2024 on Nuclear Weapons

The bestowal of the 2024 Nobel Peace Prize to Nihon Hidankyo "for [...] demonstrating through witness testimony that nuclear weapons must never be used again" will have triggered a sense of déjà vu among the participants of the 73rd Lindau Nobel Laureate Meeting. Many of them had signed the Mainau Declaration 2024 on Nuclear Weapons in July 2024 – with a warning that the danger of nuclear war might be significantly higher today than in 1955.

Aptly in front of Mainau Palace: the symbol of peace inspired by the island's 2024 motto: "Flower Power"

David J. Gross in preparation of his address to an eager audience

On the closing day of the 73rd Lindau Meeting, exactly 30 Nobel Laureates in Physics and Chemistry signed the "Mainau Declaration 2024 on Nuclear Weapons". Since then, more than 100 Nobel Laureates all together have signed the appeal, while over 600 Lindau Alumni have also added their names, demonstrating how seriously the younger generation regard the threat from nuclear weapons.

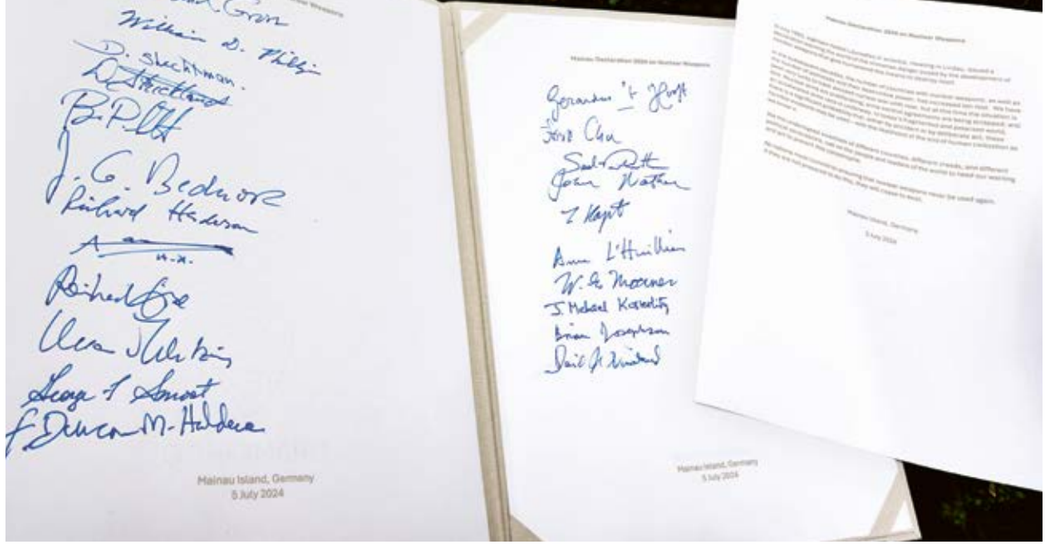
The signatories urgently warn that "in today's fragmented and polarized world, there is a significant probability that, either by accident or by deliberate act, these horrible weapons may be used – with the likelihood of the end of human civilization as we know it."

The declaration states: "In July 1955, eighteen Nobel Laureates in science, meeting in Lindau, issued a declaration warning the world of [...] nuclear weapons that give mankind the means to destroy itself. In the subsequent decades, the number of countries with nuclear weapons, as well as the number of warheads and their destructive power, has increased ten-fold."

30 Initial Signatories

First presented on the occasion of the 73rd Lindau Nobel Laureate Meeting on Mainau Island in Lake Constance, Germany, it was unanimously endorsed by all Laureates present.

Alain Aspect, Physics 2022
J. Georg Bednorz, Physics 1987
Steven Chu, Physics 1997
Johann Deisenhofer, Chemistry 1988
Reinhard Genzel, Physics 2020
Walter Gilbert, Chemistry 1980
David J. Gross, Physics 2004
F. Duncan M. Haldane, Physics 2016
Theodor W. Hänsch, Physics 2005
Serge Haroche, Physics 2012
Stefan W. Hell, Chemistry 2014
Richard Henderson, Chemistry 2017
Gerardus ´t Hooft, Physics 1999
Brian D. Josephson, Physics 1973
Takaaki Kajita, Physics 2015
Klaus von Klitzing, Physics 1985
J. Michael Kosterlitz, Physics 2016
Anne L'Huillier, Physics 2023
John C. Mather, Physics 2006
Hartmut Michel, Chemistry 1988
W. E. Moerner, Chemistry 2014
Saul Perlmutter, Physics 2011
William D. Phillips, Physics 1997
Didier Queloz, Physics 2019
Brian P. Schmidt, Physics 2011
Dan Shechtman, Chemistry 2011
George F. Smoot, Physics 2006
Donna Strickland, Physics 2018
David J. Wineland, Physics 2012
Kurt Wüthrich, Chemistry 2002



The Declaration's original copy, signed by 30 Nobel Laureates

Accompanied by standing ovations: the signing of the Declaration

Mainau Declaration 2024 on Nuclear Weapons

as signed

In July 1955, eighteen Nobel Laureates in science, meeting in Lindau, issued a declaration warning the world of the immense danger posed by the development of nuclear weapons that give humankind the means to destroy itself.

In the subsequent decades, the number of countries with nuclear weapons, as well as the number of warheads and their destructive power, has increased ten-fold. We have been very lucky to have avoided nuclear war until now, but at this time the situation is dire. Nuclear arms are proliferating; arms control agreements are being scrapped; and an accelerated arms race is underway. In today's fragmented and polarized world, there is a significant probability that, either by accident or by deliberate act, these horrible weapons may be used – with the likelihood of the end of human civilization as we know it.

We the undersigned scientists of different countries, different creeds, and different political persuasions, call on the people and leaders of the world to heed our warning and act to prevent this catastrophe.

All nations must commit to ensuring that nuclear weapons never be used again.

If they are not prepared to do this, they will cease to exist.

Nobel Laureate David J. Gross, speaking for the instigators of the declaration, said: "We initiated this declaration because 'there is a significant probability that, either by accident or by deliberate act, these horrible weapons may be used – with the likelihood of the end of human civilization.' We felt that we must alert the people and leaders of the world to this grave danger and urge them to heed our warning and act to prevent this catastrophe."

The Declaration evokes the first Mainau Declaration of 1955. Itself an appeal against the use of nuclear weapons, it had been initiated and drafted by the Nobel Prize-winning German nuclear scientists Otto Hahn and Max Born, circulated at the 5th Lindau Nobel Laureate Meeting (11–15 July 1955) and presented on Mainau Island on 15 July 1955. The declaration was initially signed by 18 Nobel Laureates. Within a year, the number of supporters rose to 52 Nobel Laureates. The second "Mainau Declaration 2015 on Climate Change" was initially signed by 36 Nobel Laureates on the closing day of the 65th Lindau Nobel Laureate Meeting, 3 July 2015, and handed over to the President of the French Republic during the United Nations Climate Change Conference (COP21) in Paris.

Additional Signatories

In the weeks and months since July 2024, many Laureates from all Nobel Prize disciplines have joined the initial signatories. Even more Lindau Alumni have added their names in support of the Mainau Declaration 2024, an initiative which began on the very day of the initial signing: "We, the undersigned Young Scientists of different countries, different creeds, and different political persuasions, urgently support the Laureates' call on the people and leaders of the world to heed our warning and act to prevent this catastrophe."

The following list shows those signing within 24 hours of its presentation (in chronological order) – altogether there were 625 supporting in December 2024.

Mincheol Park, Lindau Alumnus 2024
Jonas Fußangel, Lindau Alumnus 2024
Laura Šerkšnytė, Lindau Alumna 2024
Guillaume Bourdarot, Lindau Alumnus 2024
Shu Yang, Lindau Alumnus 2024
Miriam Gerharz, Lindau Alumna 2024
Johanna Lill, Lindau Alumna 2024
Gordian Edenhofer, Lindau Alumnus 2024
Mason Ng, Lindau Alumnus 2024
Ridha Eddhib, Lindau Alumnus 2024
Luana Olivieri, Lindau Alumna 2024
Yusuf Karli, Lindau Alumnus 2024
Anna Chrysostomou, Lindau Alumna 2024
Paul Cannon, Lindau Alumnus 2024
Mohan Muralikrishna Garlapati, Lindau Alumnus 2024
Maximilian Bachmaier, Lindau Alumnus 2024
Thomas Kirchner, Lindau Alumnus 2024
Julian Schwab, Lindau Alumnus 2024
Collins Okon Edet, Lindau Alumnus 2024
Hendrik David Reese, Lindau Alumnus 2024
Matteo Rosati, Lindau Alumnus 2024
Andrew Cameron, Lindau Alumnus 2021
Jonas Berx, Lindau Alumnus 2024
Anne-Kathrin Baczko, Lindau Alumna 2021
Brad D. Price, Lindau Alumnus 2024
Saikat Nandi, Lindau Alumnus 2024
Larissa Inácio, Lindau Alumna 2021
Denis Janković, Lindau Alumnus 2024
Simone Maria Stuenzi, Lindau Alumna 2024
Farsane Tabataba-Vakili, Lindau Alumna 2024
Sophie Kollatzsch, Lindau Alumna 2024
Julian Bonello, Lindau Alumnus 2021
Mirko Consiglio, Lindau Alumnus 2024
Yan Qi Huan, Lindau Alumnus 2021
Mirko Rossini, Lindau Alumnus 2024
Adam Kinos, Lindau Alumnus 2021
Shachar Gottlieb, Lindau Alumnus 2024
Stephan Amann, Lindau Alumnus 2024
Nicolás Bachi, Lindau Alumnus 2024

Current status of all signatories, both Nobel Laureates and Lindau Alumni:

Building Bridges With Music

Where words fail, it is often music that can best express our hopes and emotions. The Meeting's final day on Mainau Island offered one last highlight beyond the Scientific Programme: a concert by the West-Eastern Divan Ensemble led by Michael Barenboim.

Ever since the Mainau Declaration of 1955, the island of Mainau has been associated with international understanding and coexistence. On the final day of the Meeting, this tradition found expression in a concert given by the West-Eastern Divan Ensemble, whose origin and history, in itself, reflects a profound commitment to bridging divides through music.

The West-Eastern Divan Orchestra came to life 25 years ago as the result of ongoing conversations about music, culture, and humanity between renowned conductor Daniel Barenboim and critic Edward Said. Convinced that separation between peoples is not a solution for any of the problems that divide them, they identified music, particularly in the form of collaborative ensemble performance, as a means to promote coexistence and work against mutual ignorance. Thus, from a workshop held on the 250th anniversary of Goethe's birth in 1999, an orchestra named after his last great cycle of poetry was born.

Comprised mainly of Israeli, Palestinian, and other Arab members, the West-Eastern Divan Orchestra has become known to distinguished concert audiences across the globe. It has also demonstrated how – through music and based on the principle of equality – unexpected bridges can be built, and people can be encouraged to listen to each other's narrative.

Five years ago, Michael Barenboim decided to launch the West-Eastern Divan *Ensemble* in order to combine the orchestra's tradition and reputation with the more intimate chamber music format. In 2023, the Ensemble performed at the UN, and on Friday of the Lindau Meeting they were warmly welcomed to Mainau Island. Here, they played Beethoven's E-flat major, Op. 20 – a piece that the composer was particularly proud of and that expressed much of the Lindau Meetings' philosophy: joy and hope for togetherness.

Michael Barenboim | Violin
Katia Abdel-Kader | Viola
Sary Khalife | Cello
Omar Farjoun Bishara | Double Bass
Jussef Eisa | Clarinet
Zeynep Ayaydinli | Bassoon
Bar Zemach | Horn

The West-Eastern Divan Ensemble's concert on Mainau island

Michael Barenboim and Katia Abdel-Kader

Omar Farjoun Bishara and Zeynep Ayaydinli

Different Generations – Shared Experiences

Participants in #LINO24

Nobel Laureates in Lindau – Friends New and Old

Thirty-six Nobel Laureates took part in the
73rd Lindau Nobel Laureate Meeting dedicated to Physics.

Alain Aspect
Physics, 2022
"for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science"

J. Georg Bednorz
Physics, 1987
"for their important break-through in the discovery of supercon-ductivity in ceramic materials"

Eric Betzig
Chemistry, 2014
"for the development of super-resolved fluorescence microscopy"

Steven Chu
Physics, 1997
"for the development of methods to cool and trap atoms with laser light"

Johann Deisenhofer
Chemistry, 1988
"for the determination of the three-dimensional structure of a photosynthetic reaction centre"

Reinhard Genzel
Physics, 2020
"for the discovery of a supermassive compact object at the centre of our galaxy"

Walter Gilbert
Chemistry, 1980
"for their contributions concerning the determination of base sequences in nucleic acids"

David J. Gross
Physics, 2004
"for the discovery of asymptotic freedom in the theory of the strong interaction"

F. Duncan M. Haldane
Physics, 2016
"for theoretical discoveries of topological phase transitions and topological phases of matter"

Theodor W. Hänsch
Physics, 2005
"for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique"

Serge Haroche
Physics, 2012
"for ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems"

Stefan W. Hell
Chemistry, 2014
"for the development of super-resolved fluorescence microscopy"

Richard Henderson
Chemistry, 2017
"for developing cryo-electron microscopy for the high-resolution structure determination of biomolecules in solution"

Gerardus 't Hooft
Physics, 1999
"for elucidating the quantum structure of electroweak interactions in physics"

Robert Huber
Chemistry, 1988
"for the determination of the three-dimensional structure of a photosynthetic reaction centre"

Brian D. Josephson
Physics, 1973
"for his theoretical predictions of the properties of a supercurrent through a tunnel barrier, in particular those phenomena which are generally known as the Josephson effects"

Takaaki Kajita
Physics, 2015
"for the discovery of neutrino oscillations, which shows that neutrinos have mass"

Klaus von Klitzing
Physics, 1985
"for the discovery of the quantized Hall effect"

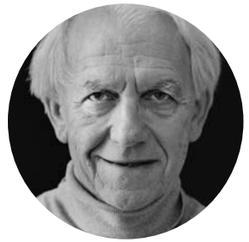
J. Michael Kosterlitz
Physics, 2016
"for theoretical discoveries of topological phase transitions and topological phases of matter"

Anne L'Huillier
Physics, 2023
"for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter"

John C. Mather
Physics, 2006
"for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation"

Hartmut Michel
Chemistry, 1988
"for the determination of the three-dimensional structure of a photosynthetic reaction centre"

W.E. Moerner
Chemistry, 2014
"for the development of super-resolved fluorescence microscopy"



Gérard A. Mourou
Physics, 2018
"for their method of generating high-intensity, ultra-short optical pulses"

Sir Konstantin S. Novoselov
Physics, 2010
"for groundbreaking experiments regarding the two-dimensional material graphene"

Saul Perlmutter
Physics, 2011
"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae"

William D. Phillips
Physics, 1997
"for the development of methods to cool and trap atoms with laser light"

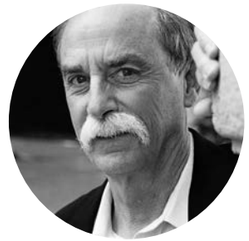
Didier Queloz
Physics, 2019
"for the discovery of an exoplanet orbiting a solar-type star"

Brian P. Schmidt
Physics, 2011
"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae"

Dan Shechtman
Chemistry, 2011
"for the discovery of quasicrystals"

George F. Smoot
Physics, 2006
"for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation"

Donna Strickland
Physics, 2018
"for their method of generating high-intensity, ultra-short optical pulses"



David J. Wineland
Physics, 2012
"for ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems"

Kurt Wüthrich
Chemistry, 2002
"for his development of nuclear magnetic resonance spectroscopy for determining the three-dimensional structure of biological macromolecules in solution"

Ada E. Yonath
Chemistry, 2009
"for studies of the structure and function of the ribosome"

Anton Zeilinger
Physics, 2022
"for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science"

Efim I. Zelmanov
Fields Medal (Mathematics), 1994
"for the solution of the restricted Burnside-Problem"
(Heidelberg Lecturer)

Find more information on the Nobel Laureates in the Lindau Mediatheque:

Laureates in Vibrant Colours …

… and in Concrete Figures

The Lindau Nobel Laureate Meetings are always delighted to welcome Laureates back to Lindau and were also particularly pleased to greet five Laureates who participated for the first time in 2024.

Disciplines

25
Physics

11
Chemistry

1
Mathematics

Records

First Participation
Alain Aspect
Richard Henderson
Anne L'Huillier
Didier Queloz
Anton Zeilinger

Most Participations: 27
Robert Huber
Hartmut Michel

Earliest Award: 1973
Brian D. Josephson – Physics

Most Recent Nobel Prize: 2023
Anne L'Huillier – Physics

Age

Youngest
49

Oldest
92

Average
75

Nationalities

United States 12
Germany 8
United Kingdom 5
France 4
Israel 2
Switzerland 2
Austria 1
Canada 1
Japan 1
Netherlands 1

Personal Impressions From #LINO24

The Best Thing About Lindau? Brilliant People. Period.

Professor Alain Aspect was awarded one third of the 2022 Nobel Prize in Physics for his work on quantum entanglement. So, it made perfect sense that he would play a starring role at the 2024 Meeting where quantum physics enjoyed pride of place. Here he looks back at what he most enjoyed about his visit to Lindau.

What is really special about Lindau is meeting the students. This is the most important thing about the whole meeting. What was really great were the organized opportunities, that is, situations in which spontaneity and informality can ensue, owing to good preparation. Of course, there should also be opportunities for complete spontaneity. It was extremely interesting to interact with Young Scientists over lunch in small groups, although any format in which a Laureate makes a short presentation of 10 or 15 minutes followed by a discussion is also rewarding. What I would say is critical for such interactions is that the groups remain small.

I also very much enjoyed the informal Open Exchange in which the room was full of students, and they put questions to me. These students have sharp minds, and they are extremely open. They are simply interesting and brilliant people. Period. What I like most is their enthusiasm: they love science. So, these sessions were very enriching – and very tiring I can tell you! You are under pressure: these young people are also demanding, and you have to give them what they expect.

In general, the programme is very busy, which meant that I really appreciated the fact that there was a dedicated room to which Laureates could retire and relax. As much I appreciated the brilliant Young Scientists, I also appreciated that there was a place where they didn't come in all the time to ask questions. I'm not a young man anymore!

Regarding my own lecture, this was in some respects a standard lecture akin to those that I give when I go to universities and give a colloquium. It's not then something that is unique to Lindau, but that doesn't mean of course that it's not important.

With respect to meeting the other Laureates, I always like to interact with people who are not in my subject or even discipline. You have the same feeling when you are in Stockholm for the Nobel Prize with the other Laureates, but here in Lindau the breadth is even larger because you have the people from all possible years – those in physics, but not from my area and those from other disciplines as well. So it was interesting talking to people where I knew the name but hadn't yet had the pleasure of meeting them in person.

F. Duncan M. Haldane and Alain Aspect on the way to their Laureate Lunches with Young Scientists

"I very much enjoyed the informal Q&A session."

The core of Lindau: Nobel Laureates in exchange with Young Scientists

Impressions

Young Scientists at #LINO24

The 73rd Lindau Meeting was the last Meeting to include early-career researchers who had to wait years to finally arrive in Lindau after their invitation in 2020. Here are a few more interesting figures on the 626 Young Scientists of #LINO24, also expressing the diversity of the participants:

Representing ...

91
Countries

386
Institutions

Gender Balance

Female **42%** Male **57%**

Age

Youngest **19**

Oldest **41**

Average **27.7**

Not Just Physics

18
Chemistry

5
Biology

1
Economics

Suraya Kazi's #LINO24 Story

One Precious Week of Questions and Inspiration

Suraya Kazi is a PhD student working on plasmonic and electrically tuneable nano-antennas in conducting polymers at Linköping University, Sweden. She gave the Young Scientist farewell address at the close of the 73rd Lindau Meeting.

I first came to know about the Lindau Nobel Laureate Meetings in 2018 during the last application period for a Physics Meeting. I was studying at the University of Dhaka in Bangladesh. I did not have the courage or qualifications to apply for such a special meeting. Still, I looked up more information, I watched all the videos of previous Young Scientists sharing their experiences of a Lindau Meeting. And I thought to myself, wow, that must have felt like a dream. Little did I know it will be my dream-come-true experience someday.

The next year, in 2019, another dream came true when Uppsala University offered me a scholarship to pursue a master's in physics in Sweden. There, I got to see my first Nobel Laureate in real life, Barry Barish, when he visited us for a lecture.

Once I met my first Nobel Laureate in person, I was keen to meet many more but sadly the pandemic intervened. Things were difficult in many ways, especially not being able to see my family for three years and surviving Swedish winters all by myself. In addition, I was particularly sad that there would be no Nobel Laureate visits anymore. Sometime during that time, I thought: What if I work hard, achieve everything, and join the next Lindau Physics Meeting in 2024 and meet all the Nobel Laureates? (Considering we all survive the pandemic first, of course.)

So, for the last four years, I looked for opportunities, grabbed them all, and made the best out of them. I applied to Lindau well-prepared, and it worked! Now that I have spent one precious week with all these genius minds, I can safely say that I have not met a single soul here who did not inspire me in one way or the other. I was amazed by the brilliant questions asked by the Young Scientists to the Nobel Laureates which the Nobel Laureates themselves found challenging to answer. I think we all will return home with this unique experience, more confidence, and a lot of stories to tell.

When asked if I would be interested in giving the farewell speech on behalf of the Young Scientists, I hesitated. Then I thought: Wait a minute, didn't I just make it all the way to Lindau? This should be easy! I will be repeating this to myself many times in my life when I need a bit of a push to keep going.

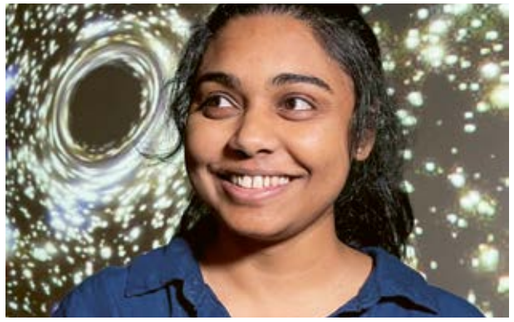
Suraya Kazi gives the farewell address on Mainau Island

At lunch with fellow Young Scientists

Passing the baton: Lindau Alumna Sibylle Anderl welcomes all #LINO24 Young Scientists to the alumni community

A Lasting Impact

As in previous years, science blogger and physicist Ulrike Böhm once again conducted a series of inspiring interviews with women participating in the Lindau Meeting. Together, these interviews showcase the diversity of female careers in science and illuminate what motivates these women in their research.



Gravitational-wave astrophysicist Shanika Galaudage studies the collisions between pairs of black holes and neutron stars

Giulia Lo Gerfo Morganti focuses on understanding the structure-function connection in materials used for renewable energy

Aneta Karpińska uses the Fluorescence Correlation Spectroscopy technique to study the internalization of anticancer drugs at the single-molecule level

Xuemei Gu seeks to uncover new physical phenomena in complex quantum systems and develop quantum-enhanced hardware for practical applications

What inspired you to pursue a career in science/in your discipline?

Shanika Galaudage, *postdoctoral researcher at the Observatoire de la Côte d'Azur (Lagrange laboratory) in Nice, France:* I was interested in astronomy from a young age, particularly fascinated by the planets in the solar system (back when Pluto was still classified as a planet). I continued this interest purely as a hobby because I thought the only thing I could do in astronomy was become an astronaut, and I definitely did not want to do that. I was content with my feet on the ground. It was only in my later years of high school that I realized my interest in astronomy and physics could become something more, thanks to my physics teacher. She helped me see that I could and should follow my passion.

What are you seeking to accomplish in your career?

Giulia Lo Gerfo Morganti, *PhD student at the ICFO – The Institute of Photonic Sciences in Barcelona, Spain:* I aim to be a perpetual learner, pushing myself slightly beyond my limits every single day. For me, it's not about reaching a specific goal but about the trajectory and growth. I do wish to maintain a harmonious balance between three fundamental pillars:

Exploration: I am drawn to activities like research that challenge my problem-solving skills and offer daily doses of variety and excitement.

Societal Impact: I am committed to making a positive difference in the world, whether through outreach initiatives, volunteering efforts, or even involvement in policy-making organizations.

Building: I seek opportunities that provide stability and allow me to invest in long-term projects, both professionally and personally.

By aligning these pillars, I hope to create a career path that fulfills me and leaves a lasting impact on the people around me.

What advice do you have for other women interested in science?

Aneta Karpińska, *PhD student at the Institute of Physical Chemistry at the Polish Academy of Sciences and Chief Operating Officer at Cell-IN:* Not to be afraid, to try. Do many internships in different disciplines so that, in the end, you choose the area of study that interests you the most. But most importantly, believe in yourself and your skills. And remember – doing science is fun.

What should be done to increase the number of female scientists and professors?

Xuemei Gu, *Alexander-von-Humboldt Postdoctoral Fellow at the Max Planck Institute for the Science of Light, Erlangen, Germany:* To increase the number of female scientists, it's important to spark their interest from an early age. Promoting STEM education for girls through targeted outreach programmes and engaging in educational materials is crucial. Creating supportive academic environments, including providing scholarships and grants specifically for women, is also essential. Additionally, implementing policies that support work-life balance, such as flexible working hours and parental leave, can help female scientists in their careers.

Don't miss the interviews with female participants in #LINO24!

Talking Physics That Matters

Nobel-Calibre Discoveries Relevant to Society at Large

Key Topics of #LINO24

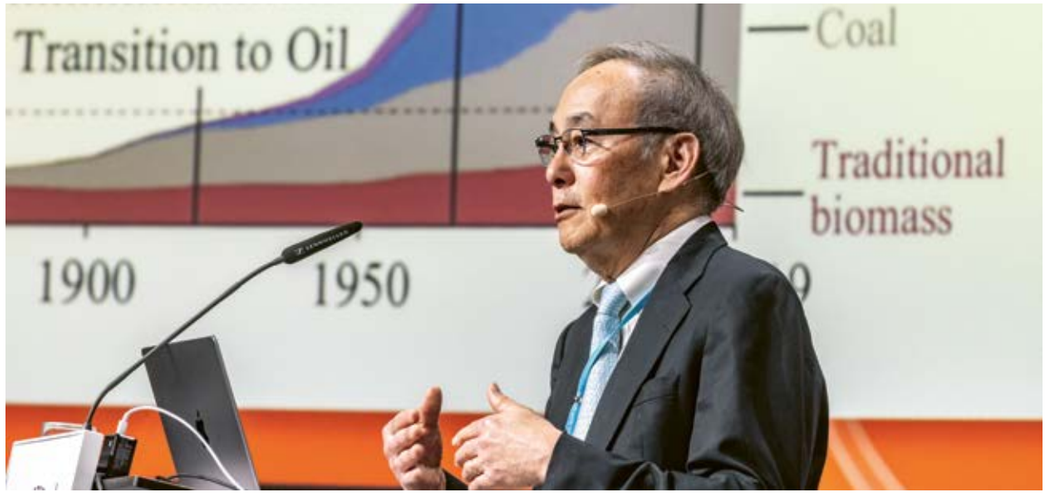
During the Opening Ceremony Nobel Laureate Steven Chu gave an overview of the science behind this year's key topics. He encouraged Young Scientists to aim for "Nobel-caliber discoveries" by exploring fields like quantum physics and artificial intelligence, while highlighting their potential to benefit society. The Programme had been developed by Scientific Chairs Rainer Blatt and Heiner Linke who stressed the importance of interdisciplinarity through interaction.

In his speech, Steven Chu addressed the young people in the audience, giving them advice on making "Nobel-calibre discoveries" by taking them on a journey through various fields of physics and the Nobel Prizes they inspired. The Prize, he stressed, is awarded to those who "have conferred the greatest benefit to humankind" – in the same spirit the 73rd Lindau Nobel Laureate Meeting dealt with topics in physics most relevant to society at large.

Basic and applied research on quantum physics was incorporated into the programme in various formats, among them a Panel Discussion. Professor Chu gave a brief introduction in this context, mentioning the usefulness of quantum mechanics in modern technologies as well as the current excitement about quantum computers. Despite the promise of increasingly efficient problem-solving, there are major challenges to be tackled in the field of quantum computing. Chu, for instance, talked about decoherence, the process of functionality loss in a quantum system caused by its interaction with the environment.

Artificial Intelligence and its potential in physics was another topic prominently featured during the Meeting. Scientific Chairs Rainer Blatt and Heiner Linke chose AI for one of the Next Gen Science Sessions convinced that it was the Young Scientists who would bring their unique perspectives and learnings, contributing to interesting discussions. Next to the new possibilities that AI usage opens in the natural sciences, problems like AI hallucinations were also discussed during the week – in his introduction Professor Chu gave an example of a nonsensical answer by ChatGPT and pointed out the unreliability of the tool.

Regarding the energy challenge, Chu who had served as US secretary of energy in the Obama administration emphasized the need for a transition to a carbon-free economy. He highlighted both the pace of scientific progress and the urgent work still required. In an impressive visualization, he explained that while the production of renewable energies has greatly increased, energy demand is so high that those new sources have simply been added to the old ones without a real transition. According to him, "we will need a 4th industrial revolution powered by carbon-free energy" – a topic with which many of the Young Scientists present were concerned as well and that inspired another Next Gen Session.



Steven Chu giving a scientific introduction to the Meeting's key topics

Scientific Chairs Rainer Blatt (r) ...

... and Heiner Linke (r) devised the Scientific Programme

Apart from these more concrete topics, Rainer Blatt and Heiner Linke emphasized the significance of cross-disciplinary science. Linke described how the impact of physics has always been palpable in all sciences and how the "language barrier" between various disciplines has been torn down during recent years, making interdisciplinary work increasingly natural. Blatt added that interdisciplinarity in its core "just means being open-minded" and advised the Young Scientists to "listen to everything, talk to everybody, listen to chemists, biologists, literally to everybody, and just absorb what you can".

Quantum Physics – Separating Hope From Hype

Redefining Reality

Rainer Blatt is a world expert in quantum physics and was thus the perfect Scientific Co-Chairperson for a meeting in which several sessions were dedicated to this hot topic. A few weeks later, he shared his observations from the Meeting as well as his own experience in the field and his expectations for the future.

A major theme during the Meeting was distinguishing between hope and hype in quantum technology – why is this timely and necessary?
After nearly a century of quantum physics, interest in advanced quantum technologies has surged in the last decade, driven by our ability to routinely create and manipulate "quantum entanglement", a phenomenon arising from quantum superpositions across spatial distances. Entanglement forms the foundation of emerging quantum communication technologies, sensors, simulations, and computers, which promise to revolutionize fields like chemistry, material science, and computing by solving previously unsolvable problems. Early demonstrations are promising, and significant investments are being made to scale these technologies for industrial use. While no fundamental barriers in physics exist, some expectations are overly optimistic. A panel discussion at this year's Meeting highlighted that the timeline for scalable quantum technology is often underestimated, and further basic research is essential, particularly on scalable platforms and more advanced quantum algorithms.

What were the most relevant messages from Lindau regarding quantum physics?
A key focus of this year's Meeting was quantum physics, including topics such as the generation and application of ultrashort pulses and fundamental studies of entanglement, which form the foundation for emerging quantum technologies. Quantum measurements play a crucial role in defining and realizing fundamental constants. As a result, quantum physics and its applications will remain a highly relevant pillar for future advancements in both industry and technology.

In which area do you think we will see significant breakthroughs in quantum technology in the next few years?
Quantum computing will see progress in error correction, scalability, and algorithms, unlocking applications in cryptography, optimization, and possibly, drug discovery. Quantum communication will advance with developments in Quantum Key Distribution (QKD) and quantum networks, enhancing secure global communication. Quantum sensing will revolutionize fields like navigation, medical diagnostics, and geophysics through ultra-sensitive measurements. Quantum simulation will lead to new discoveries in quantum materials and chemistry, aiding energy storage and pharmaceutical development. Early advances are expected in quantum communication and sensing, with longer-term impacts in computing and, potentially, in AI.

Quantum Technology: Potential or Hype? This question was discussed by Bill Phillips, Francesca Pietracaprina, Olivier Ezratty, Lene Oddershede, Serge Haroche, Heike E. Riel, and moderator Karl Ziemelis


Rainer Blatt in conversation with Bettina Stark-Watzinger, then German Federal Minister of Education and Research


Scientific Co-Chair Rainer Blatt introduced Alain Aspect's lecture

After so many years in this field: what is it that continues to fascinate you about quantum physics?
What fascinates me most about quantum physics is its ability to challenge and redefine our understanding of reality at the most fundamental level. The concepts of superposition, entanglement, and quantum measurement defy classical intuition, offering a glimpse into a world governed by probabilities rather than certainties. As an experimental physicist, the opportunity to manipulate individual quantum systems, such as trapped ions, and observe these effects firsthand is truly captivating. The potential applications of quantum physics, from revolutionary computing power to unbreakable cryptography, promise to transform our technological landscape in ways we are just beginning to comprehend. It's the combination of deep theoretical questions and practical, far-reaching implications that continues to inspire and drive my work in this field.

Lindau blogger Andrei Mihai reflects on the #LINO24 quantum sessions:

The Importance of Taking an Interdisciplinary Approach

Throughout his career, Heiner Linke has worked in nanoscience, a field on the boundary between chemistry and physics. As Scientific Co-Chairperson of the 73rd Lindau Meeting and Vice President of the Council, he was therefore the perfect interview partner with whom to explore the importance of interdisciplinarity in the Scientific Programme. For this annual report he summarizes his thoughts on the topic.

Different roles for Scientific Co-Chair Heiner Linke: outlining the week's agenda during the Opening Ceremony, ...

... welcoming guests at the Bavarian Evening, ...

... and moderating parts of the Scientific Programme

"Cross-Disciplinary Research in Physics" was one of the key themes of the 73rd Lindau Meeting – why did you decide to focus on this topic?

To say it in the words of one of the most recent Physics Nobel Laureates, John Hopfield: "My definition of physics is that physics is not what you're working on, but how you're working on it."

Concepts from physics find applications in many different areas of science and society, and physicists therefore also find work and build careers in many different areas of science. There are many examples. The properties of molecules and the nature of chemical bonds are understood using quantum physics. Data analysis methods developed in astronomy get applied in single-molecule biophysics. Machine learning is an invention that originated from physics and is now applied in almost any sector of science.

It is nice to highlight this multitude of uses of physics at a meeting like the Lindau Nobel Laureate Physics Meeting, where we celebrate great discoveries in physics and help educate and inspire a new generation of physicists.

Can you name some examples at Lindau of topical and interesting research that extends beyond the frontiers of physics?

The Young Scientists brought many examples of exciting, cross-disciplinary uses of physics to Lindau. Examples of application areas include consequences of climate change: research into turbulent fluid dynamics to improve models that predict Antarctic ice sheet melting; cell biology: extracting information on cellular signaling pathways from dynamical patterns of the signaling molecules; medical imaging: exploiting the quantum mechanical properties of x-rays to improve image quality; cancer treatment: improving pancreatic cancer therapy with carbon ion beams.

How should the research landscape be organized to support interdisciplinarity?

What seems most important to me is to continue building a culture where we as a scientific community are open to new insights and methods from outside our fields. For this to work, it is very helpful if there are many scientists at all career stages – from students to grant reviewers and members of faculty hiring committees – who have experience from working at the boundary between disciplines. A lot of mutual teaching and learning happens in collaborative, interdisciplinary projects; this learning is then transferred to research groups. I notice a clear difference in today's students compared to a couple of decades ago – there are many more who already during their training naturally learn concepts from what used to be multiple fields.

What in your opinion should society know about the interdisciplinary approach of science?

Perhaps that there is only one science. Similar concepts can have different names in different fields or disciplines, but the fundamentals of the scientific method – to observe, to establish and to test hypotheses, the importance of transparency, reproducibility, and falsifiability, are equally important in all sciences. Society, individuals, and decision-makers need to know that they can and should trust research results regardless of field.

Frontiers of physics were also elaborated on in the opening film:

The Energy Transition Challenge

From Fossil to Future

Ensuring that our energy supply becomes more sustainable is a huge challenge that concerns us all. Research in physics is closely entwined with the energy transition. At #LINO24, both Nobel Laureates and Young Scientists discussed recent findings and their implications for sustainable energy.

Global energy consumption has grown from around 7,000 terawatt-hours (TWh) in 1850 to over 28,000 TWh in 1950 to a stunning 183,000 TWh today. However, this energy largely comes from fossil fuels, which is posing unprecedented challenges for our society. If we truly want to achieve a sustainable future, an energy transition is essential.

This was the challenge addressed by Eric Betzig, who was awarded the Nobel Prize in Chemistry in 2014, in his joint Agora Talk. He began by highlighting the significant increase in life expectancy over the past century and a half. This is largely attributed to the Industrial Revolution, powered by fossil fuels – the same fossil fuels causing the ongoing climate crisis.

The harnessing of energy enabled unprecedented advancements in healthcare, sanitation, and overall quality of life. Betzig described how four pillars of modern civilization – steel, concrete, plastics, and ammonia – each come with substantial carbon footprints. Their production processes are deeply intertwined with fossil fuel use. Decarbonizing these sectors is no easy task.

Fossil fuel-derived energy has dominated the past century, largely because it was cheaper and easier to use than other forms of energy. The prices for renewable energy are already competitive with those of fossil fuels and sources of renewables are increasing every year. However, the Laureate reminded the audience that no change can happen overnight and that renewable energy comes with its own challenges.

Betzig emphasized that some of the solutions will be societal – implementing technologies like renewable energy and sustainable fuel that have already been developed. Other solutions, however, may require new technologies.

Nobel Laureate J. Georg Bednorz illustrated the role that superconductors can play in this transition. Superconductivity refers to the phenomenon where certain materials can conduct electricity without resistance at critical temperatures. Very low temperatures were thought to be necessary for this phenomenon to occur. Bednorz's work, however, which showed that some materials can become superconductors at significantly higher temperatures, has removed barriers to the widespread adoption of superconducting technology.

One of the primary advantages of superconductors is their ability to carry extremely high current densities – up to 500 times higher than copper. This characteristic allows for more power to be transmitted through smaller and more compact designs, reducing the need for materials and thus the overall environmental footprint. Superconducting components can be remarkably efficient, making them ideal for various applications in the energy sector.

Eric Betzig

J. Georg Bednorz

Joao Cunha at the Next Gen Science Session

Hariom Jani

Several researchers at #LINO24 are also working on the next generation of technologies for the energy transition, and they presented their work at the Next Gen Science Session "Physics-based Solutions to the Energy Challenge".

Joao Cunha, at the International Iberian Nanotechnology Laboratory, Portugal, discussed a novel approach for converting light into electricity. This differs from traditional solar cells, which are limited in efficiency at around 30%. The approach uses a rectifying antenna (or rectenna) to capture light and convert it into almost stable electrical currents.

Hariom Jani, meanwhile, is looking at ways to make computing more efficient. Computing is already producing around 2% of the world's CO_2 emissions, comparable to the airline industry – and shows no sign of slowing down. Jani is working on a system that would make computing more efficient by "marrying" memory and logic, achieving computation logic inside the memory and reducing the energy required for common computational processes.

Perhaps the clearest example of how important this energy transition is for many young researchers is an impromptu presentation that happened at the end of the session. This presentation referenced not only technological fixes, but also more direct approaches available to all researchers. For instance, one such approach would be incorporating it into grant or research applications.

The future of energy is both a daunting challenge and a remarkable opportunity for human ingenuity – but it is an urgent challenge for the present, not something that is coming sometime in the future. By fostering innovation and embracing cutting-edge technologies, we can build a more sustainable and equitable world, ensuring that the benefits of energy are accessible to all while safeguarding our planet for future generations.

Artificial Intelligence and Physics

How Do We Preserve Trust in Science in the Age of AI?

Recent advances in artificial intelligence (AI) are rapidly finding application in scientific research, not least in physics and related fields. While these advances hold great promise, they also raise serious questions. Two #LINO24 sessions discussed possible answers.

#LINO24's final Panel Discussion: Brian P. Schmidt, Jaryd Ricardo Christie, Donna Strickland, David J. Gross, and moderator Sibylle Anderl

The final Panel Discussion on Mainau Island was dedicated to trust and AI. It was therefore highly appropriate, if not, arguably, self-referential, that moderator Sibylle Anderl, Lindau Alumna 2010 and science journalist at DIE ZEIT, Germany, started by asking AI chatbot ChatGPT to briefly introduce the participants.

When presenting Nobel Laureate David J. Gross from the University of California, Santa Barbara, United States of America, ChatGPT accurately summarized his field of work and major achievements but simply made up a statement about Gross' opinion on AI. AI hallucination (the process by which an AI generates incorrect or nonsensical information that appears plausible or coherent) is a major problem not only with ChatGPT but with other generative models as well.

"I think AI models are inherently hard to trust because it's hard for people to understand what's going on," commented Jaryd Ricardo Christie, a medical physicist at the University of Western Ontario, Canada, who was also on the panel. "These models are kind of a black box. I think what we should do as AI scientists is always be sceptical of these models." Many generative models are essentially plausibility generators, but they have no real understanding of what they are generating. "AI models, especially large language models (LLMs), are trained to come up with things that sound good, but they don't know if it's true or not," Gross said. He continued that it would be great if AI could be trained to follow the scientific method, but until that happens, it's up to us humans to be sceptical of AI and ensure that what it turns out, or outputs in computing jargon, is factual and reliable.

Of course, members of the audience are very familiar with the scientific model and use it in day-to-day life as well as in their professional capacities. But for the general public, matters are different. It's one thing to ensure trust in AI in research; it's another to ensure it for society.

"I think LLMs are very useful, but we also have to worry about people not using this assistance as a crutch and not ever learning anything," said fellow panelist and Nobel Laureate Brian P. Schmidt of the Australian National University. He argued that the sense of accountability is crucial, and we as a society are still defining who is accountable for what.

Nobel Laureate Donna Strickland, University of Waterloo, Canada, echoed these ideas: "I think we have a growing distrust of science, especially in North America. Scientists from all fields can be part of the solution by engaging with the public, and not just the public that already loves science." For the general public, in the short term it will be more important to deal with the new deluge of content that will hit, and in some ways is already hitting, society.

"We're going to see a proliferation of generated false material in the next few years, to the point where you won't be able to tell if something is real or false unless there's a digital accountability [...] of what person or organization is behind it," said Schmidt. Any path to maintaining trust in AI and science should have two components: one where scientists continue to do a good job (whether using AI or not), and one where scientists engage with the public.

A Next Gen Session on "Artificial Intelligence in Physics" gave young researchers the opportunity to address this component. Ranging from quantum machine learning to medical physics and air flow prediction, there was no shortage of AI applications in physics. Young Scientist Anna Dawid-Łękowska works in a field of AI connected to trust: interpretable AI. Unlike "black box" models, interpretable AI provides clear insights into how certain results are achieved. The researcher presented work that aims to create a robust, automated system that can identify and optimize laser cooling schemes for various atoms and molecules. Different atoms and molecules have unique electronic structures, making it challenging to develop a one-size-fits-all approach to laser cooling. Each species may require a tailored cooling scheme to achieve optimal results, and this is where machine learning comes in (see p. 69).

Looking ahead, the integration of AI into scientific research holds great promise, yet it also demands careful consideration and proactive measures to maintain trust. The first step is to apply scientific standards to AI and to ensure that it is used reliably.

The second step is arguably much more pressing – maintaining public trust. This is a monumental challenge, the panel agreed, but also one that brings opportunities. The panel ended on a note of cautious optimism, while Schmidt concluded by reiterating the importance of accountability. "No matter what happens, we as humans are accountable for it, and we should accept that. If you start trusting a machine for accountability, that is the end."

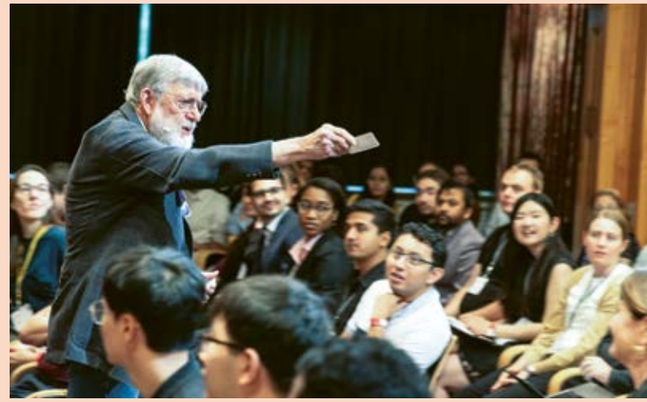
A Wide Range of Engaging Formats

The Programme at a Glance ...

	Sunday, 30 June	Monday, 1 July	Tuesday, 2 July	Wednesday, 3 July	Thursday, 4 July	Friday, 5 July
07		*Partner Breakfasts* • Austrian Federal Ministry of Education, Science, and Research • Texas A&M University	*Partner Breakfasts* • Mars, Incorporated • Rolex SA	*Break* Morning Workout	*Partner Breakfasts* • Heraeus Group • Human Frontier Science Program (HFSP)	*Break* Morning Workout
08		*Break* Morning Workout	*Break* Morning Workout			*Social Event* **Baden-Württemberg Boat Trip to Mainau Island** *hosted by the State of Baden-Württemberg*
09		*Lecture* L'Huillier	*Lecture* Aspect	*Next Gen Science* *presentations by Young Scientists* • Physics-Based Solutions to the Energy Challenge • Cross-Disciplinary Research in Physics	*Lecture* Genzel	
10		*Lecture* Zeilinger	*Lecture* Henderson		*Lecture* Queloz	
		Lecture Novoselov	*Lecture* Gross		*Agora Talks* • Smoot • Wüthrich	
11		*Agora Talks* • Chu, Hell • von Klitzing	*Agora Talks* • Bednorz, Betzig • Haldane, Kosterlitz	*Agora Talks* • Haroche, Wineland • Kajita	*Agora Talks* • Josephson • Phillips	*Panel Discussion* **How to Preserve Trust in Science in the Age of AI?** Christie, Gross, Schmidt, Strickland
12						
		Agora Talks • 't Hooft • Yonath	*Agora Talks* • Deisenhofer, Michel • Perlmutter	*Agora Talks* • Mather, Schmidt • Mourou, Strickland	*Agora Talks* • Moerner • Shechtman	*Closing Ceremony*
13						*Concert* **West-Eastern Divan Ensemble** Michael Barenboim
14		*Break* **Lunch Break** **City Reception**	*Break* **Lunch Break** **Laureate Lunches**	*Break* **Lunch Break** **Laureate Lunches**	*Break* **Lunch Break** **Laureate Lunches**	*Social Event* **Science Picnic on the Arboretum Lawn** *hosted by the Ministry of Science, Research, and Arts, State of Baden-Württemberg*
15	*Opening Ceremony* Countess Bettina Bernadotte Greetings Current Key Topics in Physics – A Survey by Steven Chu *Musical Accompaniment* Ensemble of the Vienna Philharmonic Orchestra	*Next Gen Science* *presentations by Young Scientists* • Artificial Intelligence in Physics	*Panel Discussion* **Potential and Hype in Quantum Technology: Where Are We Headed?** Ezratty, Haroche, Oddershede, Phillips, Pietracaprina, Riel	*Open Exchanges* Haroche, Kajita, Mather, Schmidt, Strickland, Wineland	*Open Exchanges* Genzel, Hänsch, Huber, Josephson, Moerner, Phillips, Queloz, Smoot, Wüthrich *Science Walks*	
16						*Social Event* **Baden-Württemberg Boat Trip to Lindau** *hosted by the State of Baden-Württemberg*
17	*Reception* *hosted by the Bavarian State Government*	*Open Exchanges* Chu, Hell, 't Hooft, von Klitzing, L'Huillier, Novoselov, Yonath, Zeilinger *Science Walks*	*Open Exchanges* Aspect, Bednorz, Betzig, Deisenhofer, Gross, Haldane, Henderson, Kosterlitz, Michel, Perlmutter	*Scientific Exchange Among Young Scientists* • Session 1 • Session 2	*Workshops* • How To Remove Obstacles for the International Movement of Early-Career Scientists • How To Create Bias-Free Review Procedures for Fellowships and Research Grants	
18						
19	*Social Events* **Dinner** *for Young Scientists*	*Social Event* **International Evening** *hosted by Texas A&M University*	*Social Events* **Partner Events** *hosted by Academic Partners & Supporters*	*Heidelberg Lecture* Zelmanov	*Social Event* **Bavarian Evening** *hosted by the Free State of Bavaria*	
20	**Foundation Dinner** *hosted by the Foundation Lindau Nobel Laureate Meetings*		**Grill & Chill** *hosted by the Lindau Nobel Laureate Meetings and supported by the City of Lindau*	*Social Events* **Partner Events** *hosted by Academic Partners & Supporters*		
21				**Dinner** *for Young Scientists*		

Browse the programme booklet:

... and in Action



A Week Overflowing With Physics

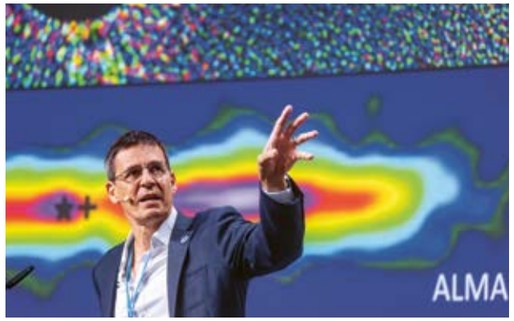
Lectures: Enriching, Memorable – and Inspirational

The Lectures held at the Lindau Meetings are not only educative but also highly inspirational. Taking centre stage, the Nobel Laureates address current research findings, elaborate on their own historical achievements, and raise awareness of fundamentally important issues.

Alain Aspect	From Einstein and Bell to Quantum Technologies: Quantum Non-Locality in Action
Reinhard Genzel	Experimental Studies of Black Holes: Status & Prospects
David J. Gross	Fifty Years of Quantum Chromodynamics (The Theory of The Strong Nuclear Force)
Richard Henderson	The Impact of Physics in Structural Biology
Anne L'Huillier	Attosecond Pulses of Light for the Study of Electron Dynamics
Sir Konstantin S. Novoselov	Materials for the Future
Didier Queloz	Exoplanet Revolution
Anton Zeilinger	A Voyage through Quantum Wonderland

Heidelberg Lecture

Every year, the programmes of both the Lindau Nobel Laureate Meetings and the Heidelberg Laureate Forum (HLF) reflect the close partnership of these two gatherings. At the HLF there is traditionally a Lindau Lecture, while the Heidelberg Lecture is a fixed part of every Lindau Meeting. For #LINO24, 1994 Fields Medalist Efim I. Zelmanov, known for solving the restricted Burnside problem in group theory, gave insights into the mind of a mathematician and the potential for art and beauty in mathematical concepts.



Didier Queloz

David J. Gross

Anton Zeilinger

Anne L'Huillier

Alain Aspect

Reinhard Genzel

Find all recordings of #LINO24 Lectures in the Lindau Mediatheque:

A Week Overflowing With Physics

Agora Talks: Fora for Questions

The Agora Talks feature one or two Nobel Laureates and a moderator, who join to discuss a topic of the Laureates' choosing. Participants are given the opportunity to ask questions in an open forum setting.

J. Georg Bednorz, Eric Betzig	Opportunities and Challenges for the Energy Transition
Steven Chu, Stefan W. Hell	Single Molecule Methods and a Physics Understanding of Biology | MINFLUX: A New Physical Principle To Resolve Position and Movements of (Bio)Molecules Down to Angströms
Johann Deisenhofer, Hartmut Michel	The Future of Structural Biology: Artificial Intelligence and in Situ Structures
F. Duncan M. Haldane, J. Michael Kosterlitz	Topology, Matter, and Quantum Information
Serge Haroche, David J. Wineland	Quantum Science With Trapped Ions and Rydberg Atoms
Gerardus 't Hooft	The Beauty of Mathematics in Science
Brian D. Josephson	Taking Into Account Organised Complexity Could Initiate a New Era in Physics
Takaaki Kajita	Experiments to Measure Neutrino Properties
Klaus von Klitzing	The Quantum Hall Effect and Our New SI Units
John C. Mather, Brian P. Schmidt	The Greatest Challenges in Cosmology, and How They Could Be Resolved
W.E. Moerner	Adventures With Single Molecules and SARS-CoV-2
Saul Perlmutter	The Other Way That Science Can Save the World: Scientific Thinking for All
William D. Phillips	The Quantum Reform of the Modern Metric System
Dan Shechtman	The Science and Aesthetics of Soap Bubbles
George F. Smoot	Cosmology Today and Tomorrow
Donna Strickland, Gérard A. Mourou	Extreme Light Laser and Its Societal Applications
Kurt Wüthrich	My Way to NMR and to a Nobel Prize
Ada E. Yonath	Physics for Underlying the Chemistry of Medical Biology

The Agora Talks were moderated by
Sibylle Anderl, DIE ZEIT, Germany
Rainer Blatt, University of Innsbruck, Austria
Klaus Blaum, Max Planck Institute for Nuclear Physics, Germany
Peter Brzezinski, Royal Swedish Academy of Sciences, Sweden
Günther Dissertori, ETH Zurich, Switzerland
Stefan H. E. Kaufmann, Max Planck Institute for Infection Biology, Germany
Anne L'Huillier, Lund University, Sweden
Heiner Linke, Lund University, Sweden
Wolfgang Lubitz, Max Planck Institute for Chemical Energy Conversion, Germany
Jürgen Mlynek, Wilhelm and Else Heraeus Foundation, Germany
Lene Oddershede, Novo Nordisk Fonden, Denmark
Achim Rosch, University of Cologne, Germany
Adam Smith, Nobel Prize Outreach, Sweden
Pernilla Wittung-Stafshede, Chalmers University of Technology, Sweden

George F. Smoot

Eric Betzig, Jürgen Mlynek, and J. Georg Bednorz

J. Michael Kosterlitz and F. Duncan M. Haldane

Dan Shechtman

Kurt Wüthrich

Ada E. Yonath

Recordings of all #LINO24 Agora Talks can be accessed in the Lindau Mediatheque:

A Week Overflowing With Physics

Open Exchanges: Intimate, Informal, and Frank

At the Lindau Meetings, most of the Laureates also conduct an Open Exchange, an unmoderated session exclusively accessible to our Young Scientists. The intimacy, informality, and openness that characterize the atmosphere of these discussions allows for personal questions, the airing of provocative ideas, and in-depth specialist analyses.

Alain Aspect	**Richard Henderson**	**Konstantin S. Novoselov**
J. Georg Bednorz	**Gerardus 't Hooft**	**Saul Perlmutter**
Eric Betzig	**Robert Huber**	**William D. Phillips**
Steven Chu	**Brian D. Josephson**	**Didier Queloz**
Johann Deisenhofer	**Takaaki Kajita**	**Brian P. Schmidt**
Reinhard Genzel	**Klaus von Klitzing**	**George F. Smoot**
David J. Gross	**J. Michael Kosterlitz**	**Donna Strickland**
F. Duncan M. Haldane	**Anne L'Huillier**	**David J. Wineland**
Theodor W. Hänsch	**John C. Mather**	**Kurt Wüthrich**
Serge Haroche	**Harmut Michel**	**Ada E. Yonath**
Stefan W. Hell	**W.E. Moerner**	**Anton Zeilinger**

Robert Huber

W.E. Moerner

John C. Mather

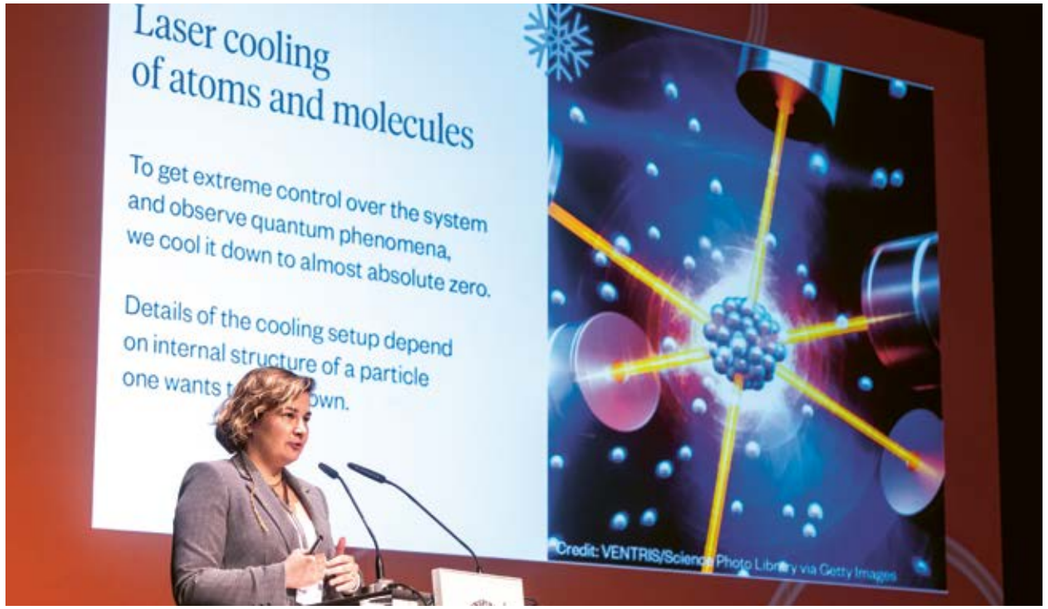
Sir Konstantin S. Novoselov

David J. Wineland

Theodor W. Hänsch

Great Snapshots of a Large Breadth of Cutting-Edge Research

In three sessions, 21 selected Young Scientists presented their current work to Nobel Laureates as well as their peers.



Anna Dawid-Łękowska during her presentation

Young Scientists invited to the 73rd Lindau Nobel Laureate Meeting had the opportunity to present their work in one of three Next Gen Science sessions. Each session was dedicated to one of the core topics of #LINO24. Continuing the successful cooperation of the past few years, Lindau Alumni once again contributed their time and expertise during the peer review process and evaluated the submitted abstracts.

Based on their rankings, the Scientific Chairpersons put together fascinating sessions that stood for the diversity of the Lindau Meetings' global community in several ways. The presenters represent almost 20 countries and work at 15 internationally renowned institutions, with an even gender balance.

The 7-minute presentations were great snapshots of the huge range of cutting-edge research carried out by the Young Scientists. Nobel Laureates and Young Scientists alike attended the sessions in Lindau's Inselhalle and City Theatre. The questions after each talk kicked off many fruitful discussions.

Artificial Intelligence in Physics

Session I moderated by Scientific Co-Chair Rainer Blatt, University of Innsbruck, Austria

Quantum Machine Learning in High-Energy Physics
Vasilis Belis, ETH Zurich, Switzerland

Thorax-Encompassing Multi-Modality PET/CT Deep Learning Model for Resected NSCLC Prognostication: A Retrospective Multi-Centre Study
Jaryd Christie, University of Western Ontario, Canada

Automated Detection of Laser Cooling Schemes for Ultracold Atoms and Molecules
Anna Dawid-Łękowska, Flatiron Institute, United States of America

Optimizing ARPES Experiments Through AI: Achieving Precise Photon Beam Polarization With Graphene Calibration
Ridha Eddhib, University of West Bohemia, Czech Republic

Inferring Heisenberg Hamiltonians From a Spin Spectral Function for a Quantum Spin Liquid With Machine Learning
Netta Karjalainen, University of Helsinki, Finland

Combination of Artificial Intelligence and Disordered Medium to Overcome Long-Standing Dilemma of Ultrasound Imaging
Wei Wang, Nanjing University, China

Towards Aerodynamic Flow Predictions With Physics-Informed Neural Networks and Quantum Circuits
Simon Wassing, German Aerospace Center – DLR, Germany

Samantha Grist taking centre stage during her presentation

Catch! Federico Vismarra throws the microphone to the audience

Cross-Disciplinary Research in Physics

Session II moderated by Council Member Stefan H.E. Kaufmann, Max Planck Institute for Infection Biology, Germany

Towards Robust, Portable, Point-of-Need Diagnostics Using Silicon Photonic Biosensors
Samantha Grist, University of California, Berkeley, United States of America

Time-dependent Biochemical Signaling: Mechanisms and Perspectives
Lauritz Hahn, École Normale Supérieure de Paris, France

Transforming Disease Detection: Simulated LAMP Results for HIV, COVID-19, and TB Diagnostics
Mosidi Mokoena, University of Cape Town, South Africa

Medical X-Ray Imaging: From Macroscopic Measurements to Quantum Imaging
Mats Persson, KTH Royal Institute of Technology, Sweden

Improving Pancreatic Cancer Therapy With Carbon Ion Mini-Beams
Christina Stengl, German Cancer Research Center, Germany

Overshooting Climate Targets – Increased Risks for Planetary Stability
Nico Wunderling, Potsdam Institute for Climate Impact Research, Germany

Turbulent Fluid Dynamics in Antarctic Ice Shelf Melt Predictions
Claire Yung, Australian National University, Australia

Physics-Based Solutions to the Energy Challenge

Session III moderated by former Vice President of the Council Wolfgang Lubitz, Max Planck Institute for Chemical Energy Conversion, Germany

Light Rectification for Conversion of Electromagnetic Energy Into Electrical Current
Joao Cunha, International Iberian Nanotechnology Laboratory, Portugal

Designing Magnetic Nano-Whirls to Enable Efficient Computing
Hariom Jani, University of Oxford, United Kingdom

Ultrafast Charge Transfer in Donor-Acceptor Molecules Unraveled With Attosecond Pump-Probe Spectroscopy
Federico Vismarra, ETH Zürich, Switzerland

Engineering Energy Transport in Bio-Inspired Materials: Does Nature Know Better?
Giulia Lo Gerfo Morganti, ICFO – The Institute of Photonic Sciences, Spain

A Good Candidate for Efficient Cooling and Energy Harvesting
Youri Nouchokgwe Kamgue, Luxembourg Institute of Science and Technology, Luxembourg

Ultrafast, Ultrathin, Ultratunable: Spintronics in 2D Materials
Nele Stetzuhn, Freie Universität Berlin, Germany

Enhancements in Stability and Efficiency of Perovskite Solar Cells Through P(VDF-TRFE) Additive Engineering
Grace Tabi, Australian National University, Australia

Scientific Exchange Among Young Scientists

Research by the Future, for the Future

In this updated format, 14 researchers presented their current work to the audience after initial votes by their fellow Young Scientists.

Besides the Next Gen Science sessions dedicated to the Meeting's three core topics (see p. 68), this year's Meeting offered an innovation: a Scientific Exchange Among Young Scientists whose application process was designed to let Young Scientists themselves decide what they wanted to hear about most. All Young Scientists were invited to submit short abstracts, without a predetermined topic, and the international #LINO24 community voted on the most promising submissions by their colleagues.

The two resulting sessions covered a wide range of cutting-edge topics in physics, including astrophysics, quantum technologies, and particle physics, with discussions on phenomena such as black holes, gravitational waves, and the quantum nature of gravity. Presentations also highlighted the role of physics in addressing sustainability and climate change, while one explored the state of physics education in Zambia and across Africa. The 14 presenters represented 13 countries and 14 internationally renowned institutions, with a balanced gender distribution. The talks sparked many scientific exchanges among Young Scientists throughout the week.

Luisa von Albedyll during her presentation

Session I

Presentations moderated by Scientific Co-Chair Heiner Linke, Lund University, Sweden

Extracting Energy From Black Holes
Arman Tursunov, Max Planck Institute for Radio Astronomy, Germany

Searching for New Physics in the Gravitational-Wave Era
Anna Chrysostomou, University of Johannesburg, South Africa

How Does the Proton Look From the Inside?
Juliane Haug, Eberhard Karls Universität Tübingen, Germany

The Big Bang in the Lab
Aleksas Mazeliauskas, Heidelberg University, Germany

Quantum Technologies: Out of the Lab and Into the Wild
Max Carey, University of Southampton, United Kingdom

Entanglement-Based Tests of the Quantum Nature of Gravity
Martine Schut, University of Groningen, Netherlands

Breaking the Ice – the Seasonal Pulse of Arctic Sea Ice
Luisa von Albedyll, Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Germany

Juan Del Águila Rodríguez on stage

Session II

Presentations moderated by Peter Brzezinski, Royal Swedish Academy of Sciences, Sweden

Building a Quantum Computer, One Atom at a Time
Adam Shaw, California Institute of Technology, United States of America

Wormholes and Curvature Singularities: A Peculiar Space-Time
Juan Del Águila Rodríguez, Universidad Autónoma Metropolitana, Mexico

Green Photonics
Dipa Ghindani, Harvard University, United States of America

A Look Into the Physics Education System in Africa, Zambia in Particular
Chilufya Mwewa, Brookhaven National Laboratory, United States of America

How Does a Quantum Particle Escape?
Takano Taira, The University of Tokyo, Japan

Strong Gravitational Lensing With James Webb Space Telescope
Barbora Bezděková, Charles University, Czech Republic

How Our Own Galaxy Really Looks Like and Why We Should Care
Gordian Edenhofer, Max Planck Institute for Astrophysics, Germany

Scientific Programme

Multifaceted Session Formats

8
Lectures
By Nobel Laureates
Free Choice of Topic

18
Agora Talks
Laureates Interact During Presentation
Moderator Leads Q&A from the Audience
Flexible and Interactive

2
Panel Discussions
Topical and Relevant Issues
High-Profile Panelists: Laureates, Young Scientists, Industry Specialists

33
Open Exchanges
Informal Discussions
Between a Laurate and Young Scientists Only
Time for Q&A

35
Presentations by Young Scientists
In two formats: "Next Gen Science Sessions" and "Scientific Exchange Among Young Scientists"
Nobel Laureates in the Audience During Next Gen

6
Partner Breakfasts
Discussions Hosted by Partners of the Lindau Meetings

Connecting Bright Minds and Sharing Enthusiasm

4th Lindau Online Sciathon

A Forum for New Ideas

In April 2024, ten teams comprised of Lindau Alumni and Young Scientists were given 48 hours to develop ideas for how physics can contribute to sustainability. Three of the groups with the most promising proposals workshopped their ideas during the Sciathon Forum at the 73rd Lindau Nobel Laureate Meeting.

The 4th Lindau Online Sciathon (19–21 April 2024) built on the successful hackathon-style events that have been organized by the Lindau Meetings since 2020. Once again, the group of participants was comprised of Lindau Alumni and Young Scientists who had been selected for the 73rd Lindau Nobel Laureate Meeting. In this way, Lindau Alumni could meet and mentor the newcomers who had the opportunity to participate in a Lindau Alumni event before even having attended the Meeting. The updated format of the Lindau Online Sciathon seeks to identify ingenious solutions to some of the most thorny problems currently facing humankind.

In early 2024, Lindau Alumni were invited to submit project ideas on the topic "Physics as a Driver of a Sustainable World". After a brief review, ten groups were accepted for the Sciathon. About 50 scientists from all over the world worked intensively in these groups led by Lindau Alumni. Opening and closing sessions moderated by Brian Malow bookended the weekend. The opening livestream featured a short interview with Lindau Alumnus Tilmann Herberger about the project Biosheets, which has been in development since the 3rd Sciathon.

After 48 hours, all groups successfully submitted a brief report summarizing their ideas. Together with a short video, these materials were the basis for the evaluation by an expert jury chaired by Council Vice President Heiner Linke. Three promising projects received the unique opportunity to workshop their ideas on issues ranging from sustainable open-source software to plastic pollution and safer pesticides during the 73rd Lindau Meeting.

The focus of the Sciathon Forum was on the discussion between the groups, an expert panel, and the audience on how to improve these ideas on their way to a viable (business) concept. After brief presentations on stage, each team received feedback from a panel comprised of prominent experts in the field. Afterwards, Lindau Alumni, Young Scientists, and guests had ample opportunity to continue the conversations. We would like to thank all participants for their input, in particular the expert jury and expert panel (see below and next page).

For more information on the projects and past Sciathon results, please see *sciathon.org*.

Physics as a Driver of a Sustainable World

Expert Jury

- Heiner Linke (Chair), Vice President of the Council and Scientific Co-Chair 73rd Lindau Meeting
- Kiana Aran, University of California, San Diego
- Jürgen Kluge, Chairman of the Board, Foundation Lindau Nobel Laureate Meetings
- Karl-Georg Schlesinger, Lindau Alumnus 1994, Co-Founder Marvel Fusion, BoS GmbH

Panelists Jürgen Kluge, Nici Bush, Kiana Aran, Jagdeep Bachher, and Heiner Linke (left to right) with the presenting groups

Robert Powell with Group Meißner

Group Zaidi in conversation with Felix Büchting

Sciathon Forum

Monday, 1 July 2024

Groups

Cleaning Up Our Planet – Through Physical Engineering of Bacterial Enzymes Capable of Degrading Plastics
Group Kandaswamy

Open-Source Software Efficiency Project
Group Meißner

Nanomaterial-Based Luminescent Pesticides (NBLPs)
Group Zaidi

Expert Panel

- Heiner Linke (Chair), Vice President of the Council and Scientific Co-Chair 73rd Lindau Meeting
- Kiana Aran, University of California, San Diego
- Jagdeep Bachher, University of California
- Nici Bush, Mars, Inc.
- Jürgen Kluge, Chairman of the Board, Foundation Lindau Nobel Laureate Meetings

How to Translate the Lindau Guidelines Into Action

In two workshops during the 73rd Lindau Meeting, participants were asked to collaborate on defining concrete goals based on the Lindau Guidelines and on sketching out core elements of an actionable path forward.

Young Scientists in conversation

The Lindau Guidelines 2020 owe their existence to Nobel Laureate Elizabeth Blackburn's initiative during the 68th Lindau Nobel Laureate Meeting in June 2018. Released after the Online Science Days in June 2020, the Guidelines are aimed at promoting an open, cooperative science community where data and knowledge are freely shared. While intended for all those engaged in scientific research, they are especially important for those embarking on independent careers. The successful implementation of the Lindau Guidelines relies on the commitment of the global community of scientists and researchers, including Lindau Alumni, Young Scientists, and partner institutions.

After the productive 2023 workshops, there was a realization that the focus should now be on implementation. Organizers and participants alike felt that three goals should be prioritized:

- the workshops should produce very concrete texts that move from protest to an actionable plan;
- while the commitment of Young Scientists and the Lindau Alumni community was key to the workshops' success, the perspective of more senior, tenured scientists should be added. Not only may they have more leverage regarding implementation, but they can also share useful insights into typical pitfalls and ways to surmount those obstacles;
- a strong element of democratic selection should be added to the prioritization process.

To this end, moderators Leonhard Möckl and Pernilla Wittung-Stafshede clustered the results of the 2023 workshop. In discussions with the Executive Secretariat, a list of six concrete items was prepared and put to the wider alumni community for a round of online voting. The two highest scoring topics formed the basis of the 2024 workshops. Participants discussed solutions in these areas, with input from Nobel Laureate W.E. Moerner, Adam Smith (Nobel Outreach) as well as Paul Krabat and Barbara Pauly (both Human Frontier Science Program Organization). Brief summaries are presented below, additional information is available on our website.

How to Create Bias-Free Review Procedures for Fellowships and Research Grants

Workshop moderated by Council Member Pernilla Wittung-Stafshede, Chalmers University of Technology, Sweden

Improving Applications

- Replacing conventional length CVs with a narrative CV focused on an applicant's scientific contributions, training of early researchers, collaborative experience and clarity of communication may help evaluations consider the scientific ideas and abilities with less emphasis on demographic factors.
- Adjust the order of evaluation such that biased information is revealed after the reviewers have formed an opinion of the candidate's research ideas and ability. For example, remove affiliation on the CV, and use initial for first name to not reveal the gender of the candidate.
- Dividing the application in two parts, where the first part is a short (perhaps 1 page) summary that should be anonymized so that the reviewers cannot figure out the identity or affiliation of the applicant. This first part can still contain key information about the applicant's merits in anonymized form.
- Introducing an anonymous selection process up to interview. Investigation regarding "accountability" as well as "feasibility" could be done later, e.g., after interview.
- Research proposals that are succinct, omitting extensive background, literature analysis, and speculation on broader impact of project. I.e., shorter proposal lengths.
- Effective first screening procedure using an anonymous narrative CV and short 1–2-page pitches of the research proposal.
- A two-step evaluation system that initially separates the assessment of scientific merit from the candidate's personal and professional information. First step: Reviewers assess scientific merit of short 1–2-page proposal. After that, CV and personal information reviewed. Proposals scoring above a certain threshold advance to second stage. The second step addresses administrative, technical, and detailed elements of the proposal. Here, all the project management details and a more detailed description of the scientific project (3–4 pages) should be included.
- Ask for the results of the targets mentioned in previous funded research to keep proposals more realistic.

Moderator Pernilla Wittung-Stafshede

Selecting and Training Reviewers

- Provide training sessions for reviewers on recognizing and mitigating unconscious bias. Nudge the reviewer: Reminder of common biases in proximity to marking grids.
- Explicitly outline priorities and expected outcomes of funding call to reviewers. Describe profiles of successful target candidates.
- Avoid using reviewers that have direct or indirect connections with the applicants. Recruiting international (foreign) reviewers to broaden the view and help ensure proposals are evaluated strictly on scientific merit.
- Increasing the number of potential reviewers invited to review to ensure suitable and matched reviewers for each proposal. To reduce work for expert reviewers and provide a broader perspective, introduce early-career expert reviewers on review panels.
- Strive for diversity (not only gender) among reviewers and review panel members.

Reviewing

- Reviewers' comments must be sufficiently precise so that the applicant can address them. The reasons for a low score should be provided.
- Require review panel members to document individual scores before group discussion to avoid dominance of a single member. Transparency in scores given by all panel members. Justify marks with a short explanation. A well-designed scoring grid of how/what to assess in each stage of the selection.
- Reviewers should be instructed not to assign undue importance to language errors in applications. Establish systematic, clear evaluation standards that prioritize research, relevance, and originality over language accuracy.
- Providing an opportunity for factual clarification or context from applicants could help ensure reviews are based on accurate understanding of the proposed work.
- Create a channel of communication between applicants and reviewers. The applicant should have a possibility to respond to criticism and, in return, the reviewer should have an opportunity to modify the review.
- As it is practically impossible to distinguish fundable projects within a small window around a hard cutoff, a certain percentage of applications below and above the cutoff point, that fall within the uncertainty/resolution, are chosen randomly.

Moderator Leonhard Möckl

- Use RRR (Review the Reviewers' Review), a feedback mechanism designed to enhance quality and fairness by rating the reviewers' assessments. Applicants who participate in RRR will review the evaluations provided by reviewers on other proposals. These "applicant reviewers" will assess the clarity, depth, constructiveness, and absence of bias in the original reviews. (They cannot review evaluations of their own proposals and will typically review proposals outside their area of expertise or with time delay.)
- Ratings given by "applicant reviewers" are recorded and monitored by granting agency for accountability and improvements. Perhaps use standardized questionnaire for applicant reviewers to collect feedback.
- The reviewers should be selected, assessed, and rewarded based on the quality of their expert opinions. Their contributions to science need to be properly acknowledged.
- Funding agencies should systematically collect data on misconduct regarding conflicts of interests, reviewers' performance etc., and set up metrics to follow up the effectiveness of newly implemented changes in procedure.

How to Remove Obstacles for the International Movement of Early-Career Scientists

Moderated by Lindau Alumnus Leonhard Möckl,
Max Planck Institute for the Science of Light, Germany

Visa Issues

- National institutions and universities should connect with immigration and local authorities and offer education on critical research projects and what to consider in visa applications.
- Universities should set up and expand frameworks that help early-career researchers to navigate visa application procedures.
- Universities should push for the establishment of a specific visa category for scholars, particularly for attending scientific events on short notice. In many countries, there is no dedicated visa for such events, necessitating the application for a tourist visa instead.
- A website listing all available fellowships and grant options by the university, national research foundations/EU funding and important foundations would help not just foreign early-career researchers but also provide early-career researchers with more guidance at

the national level. This website could also be developed on a national level and could expand on the European EURAXESS website.
- A database on the mobility challenges faced by scholars to provide statistical evidence should be created so that policymakers can be approached with data-driven arguments.
- Social media pressure, organizing email/phone call campaigns, and leveraging personal networks to advocate for policy changes could be employed by individuals.

Facilitating Movements and Family Planning
- Dual career offices should also provide contacts for accompanying parties looking for work in the area. Offices should at least compile a list of documents with guides, tips, and a list of companies and points of contact to provide support and guidance to incoming early-career researchers and their families.
- Hosting institutions should help with finding childcare and even offer emergency childcare services, which are especially relevant in the first weeks after moving to a different country.
- Hosting institutions should offer to pay the first salary upfront to reduce financial strain on early-career researchers when they move from one position to the next.
- Host institutions should eliminate short-term positions (less than two years) as much as possible, and positions with limited time frames should have a guarantee in place to account for visa delays.
- Funding agencies should be motivated by university representatives to establish dedicated funds for international movements.
- Research groups that hire early-career researchers from abroad should have a designated person who is responsible for welcoming new early-career researchers and helping them with bureaucracy, paperwork, and similar tasks.
- If an early-career researcher signs a contract in a country where they do not understand the language, a person native in the language should be available to check and explain the contract as the document in the native language is the binding one.

Young Scientist Isabella Rammala presents the results of her group

Re-integration of Returning Early-Career Researchers
- Institutions should provide clear guidance and tips for outgoing and returning early-career researchers, listing all challenges they might face and what they can do to mitigate their personal risk.
- Institutions within the EU should push for a European pension which would help scientists and other workers facing the challenge of moving frequently throughout their career.

Social Outreach
- Many early-career researchers in developing countries are unaware of international opportunities. Social media presence, collaboration of universities with local institutions, and visible online information platforms should be established.

Find the full-length results of both workshops and more on *lindau-nobel.org*.

Partner Breakfasts

For Curious Early Birds

The Lindau Meetings offer a variety of options for Partner Events, such as the Partner Breakfasts. Despite the fact that these take place early in the morning before the Scientific Programme starts, they are well attended and play host to insightful discussions.

From Quantum Foundations to Emerging Quantum Technologies

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

- Rainer Blatt, University of Innsbruck, Austria
- Serge Haroche, Collège de France
- Yusuf Karli, University of Innsbruck, Austria
- Anton Zeilinger, University of Vienna, Austria
- Moderator: Markus Arndt, University of Vienna

The Role of Physics in Solving Global Problems of the 21st Century

hosted by Texas A&M University, United States of America

- Tatiana Erukhimova, Texas A&M University
- William D. Phillips, National Institute of Standards and Technology (NIST), United States of America
- Sarah Vickers, University of North Carolina at Chapel Hill, United States of America
- Moderator: Adam Smith, Nobel Prize Outreach, Sweden

Complex Systems, Complex Challenges: How Can Physicists Unlock New Approaches?

hosted by Mars, Incorporated

- Ona Ambrozaite, The Johns Hopkins University, United States of America
- George F. Smoot, DIPC – Donostia International Physics Center, Spain
- Abigail Stevenson, Mars, Incorporated, United Kingdom
- Moderator: Adam Smith, Nobel Prize Outreach, Sweden

Perpetual Planet Initiative: Excellence in Science and Exploration

hosted by Rolex SA

- Tom Matthews, King's College London, United Kingdom
- Brian P. Schmidt, The Australian National University
- Moderator: Helen Czerski, University College London, United Kingdom

The Role of Enterprises in Our Society and How Scientists Can Help Shape Them

hosted by Heraeus Group

- Steven Chu, Stanford University, United States of America
- Sabrina Curtis, Khanjur R&D, LLC, United States of America
- Jürgen Kluge, Foundation Lindau Nobel Laureate Meetings, Germany
- Jan Rinnert, Heraeus Group, Germany
- Moderator: Martina Gieg, Heraeus Group

Physics Will Shape the Biology of the Future

hosted by the Human Frontier Science Program (HFSP)

- Hartmut Michel, Max Planck Institute of Biophysics, Germany
- Barbara Pauly, International Human Frontier Science Program Organization (HFSP), France
- Giorgio Tortarolo, École polytechnique fédérale de Lausanne EPFL, Switzerland
- Moderator: Pavel Kabat, Executive Director, International Human Frontier Science Program Organization (HFSP)

Partner Breakfasts: an entertaining format for the audience ...

... and panelists alike, here Jan Rinnert, CEO of the Heraeus Group

Supporting the Lindau Meetings

More and more of our partners follow the Klaus Tschira Foundation's example in supporting the Meetings.

Eighty Young Scientists, antipasti, and an entertaining Pub Quiz – these were the important elements of the informal get-together organized by the Klaus Tschira Foundation at this year's Meeting. The Foundation promotes natural sciences, mathematics, and computer science through its own projects as well as via support for other initiatives, organizations, and events – like the Lindau Meetings. At the get-together, the foundation provided German-speaking young scientists with information on funding opportunities, research projects, and science communication. To name one example, the Klar-Text Award for science communication recognizes postdocs that have done a particularly good job of explaining their doctoral research to non-scientists.

Finally, Anja Heinzelmann, Head of Communications, talked about the Heidelberg equivalent of the Lindau Meetings – the Heidelberg Laureate Forum, which connects 200 young researchers from all over the world with the most exceptional mathematicians and computer scientists, including those who have received the Abel Prize, ACM A.M. Turing Award, ACM Prize in Computing, Fields Medal, IMU Abacus Medal, and the Nevanlinna Prize. The quiz added excitement and a friendly competitive edge, with close results that made for a thrilling finish. Some awards ended up being shared among the top-performing teams. Let's see how the Young Scientists will do next year!

Anja Heinzelmann, Head of Communications, talking about the work of the Klaus Tschira Foundation

Young Scientists gathered at the restaurant 'Cantinetta' for an entertaining Pub Quiz

"Women in research" – at dinner with Carl-Thomas Epping

Julia Ollech representing Helmholtz

Stefan Jorda, Alain Aspect, Jürgen Mlynek, and Rolf-Dieter Heuer at the dinner by Wilhelm und Else Heraeus-Stiftung

Jörn Achterberg welcoming to the DFG dinner

Dinner hosted by Dieter Schwarz Stiftung

Anna Müller-Trimbusch and Phil-Alan Gärtig representing Carl-Zeiss-Stiftung

Partner Dinners

Hosts

- Bayer Foundation
- Bundesministerium für Bildung, Wissenschaft und Forschung (Austria)
- Carl-Thomas Epping
- Carl-Zeiss-Stiftung
- DAAD
- DFG (Deutsche Forschungsgemeinschaft)
- Dieter Schwarz Stiftung
- Helmholtz
- Lindau Perspectives
- Lindau Spirit
- Mars
- Max-Planck-Gesellschaft
- Ragnar Söderberg Foundation
- Wilhelm und Else Heraeus-Stiftung

Connecting Cultures

International Day
hosted by Texas A&M University, United States of America

Partner Breakfast
see p. 85

International Evening

Welcome
- Countess Bettina Bernadotte, President of the Council

Greetings
- Timothy E. Liston, Consul-General, U.S. Consulate-General Munich

Welcome Address
- Alan Sams, Executive Vice President and Provost, Texas A&M University

Cultural Performance and Dinner
- Aggie Wranglers, Texas A&M University

Dance & Music
- MaXin

Master of Ceremonies: Joerg Steiner, Texas A&M University

Alan Sams and Timothy E. Liston

Texas style dance performance

Steven Chu and Joerg Steiner

Minister Eric Beißwenger

Bavarian Evening
hosted by the Free State of Bavaria

Welcome
- Countess Bettina Bernadotte, President of the Council

Greetings on Behalf of the Free State of Bavaria
- Eric Beißwenger, Bavarian State Minister for European Affairs, Germany

“O’zapft is!” – Bavarian Dinner
- Traditional Tapping Ceremony
  Opening of the Beer Barrel and Bavarian Dinner Buffet

Folk Dance & Bavarian Music
- Trachtenverein “Koppachtaler” Altusried
- ScheinEilig

Trachtenverein “Koppachtaler” Altusried

ScheinEilig

Young Scientists posing for a selfie with George F. Smoot

#LINO24 participants in traditional festive attire

Celebrating With New Friends From All Around the World

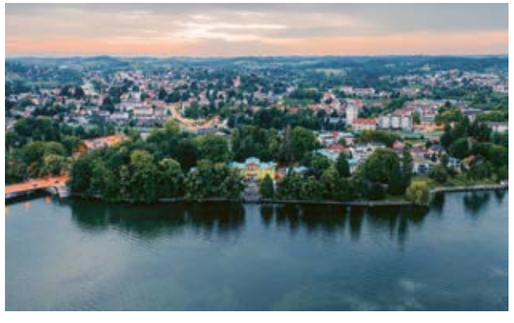
Grill & Chill

Hosted by the Lindau Nobel Laureate Meetings and supported by the City of Lindau, the event reaches out to Lindau's civic society and extends the invitation also to the local families hosting Young Scientists.

Welcome
- Countess Bettina Bernadotte, President of the Council
- Claudia Alfons, Mayor of Lindau

Donations of Our Guests
The proceeds and donations benefit Lindau's city museum "Cavazzen", projects with young people in Lindau and the surrounding area run by the Mentor Foundation Germany, the "Bayerische Polizeistiftung" as well as marshland renaturation projects.

Supporters
- City of Lindau
- Mineralbrunnen Krumbach GmbH
- TV Reutin 1905



Grill & Chill in the Toskanapark

Host families, Lindau citizens, Nobel Laureates, Young Scientists, and guests gathering under the umbrellas

Baden-Württemberg Boat Trip to Mainau Island

hosted by the State of Baden-Württemberg

Welcome Addresses
- Countess Bettina Bernadotte, President of the Council

Closing Panel Discussion
"How to Preserve Trust in Science in the Age of AI?"

Concert
by the West-Eastern Divan Ensemble

Conclusion & Farewell
- Suraya Kazi, Linköping University, Sweden
- William D. Phillips, National Institute of Standards and Technology (NIST), United States of America

Science Picnic
hosted by the Ministry of Science, Research, and Arts, State of Baden-Württemberg

Alumni Party
Music by Tamara Wirth

Brian P. Schmidt sharing ideas with Young Scientists during the Science Picnic

Lindau Alumni party

Additional Programme

Rendezvous With Galileo

"Thank you for sharing the fascinating history of the books by Kepler, Galileo, and others. It was a real treat to learn more about these great scientists and their original ideas." – Pratiksha B. Gaikwad, Dept. of Chemistry, University of Florida

Lindau's Old Town Hall houses the historic library

Guided tour by curator Burkhard Kümmerer

Careful handling required

Impressive even behind glass

The participants of the Lindau Meetings typically do not miss even a single item on the programme, which this time included an exhibition on "Wrathful Rods, Messengers of Terror, Objects From the Sky – From Aristotle to Newton."

In fact, the Old Town Hall houses an outstanding collection of books from the early years of modern science: The first editions of Copernicus' *De Revolutionibus*, Newton's *Principia Mathematica*, and Kepler's *Astronomia Nova*. Curator and Lindau Alumnus Burkhard Kümmerer as well as Director Markus Breitwieser were happy to offer a guided tour through this treasure trove on comets and their important role in the Copernican Revolution.

Vitaly Wirthl from the Max Planck Institute of Quantum Optics, Garching, expressed his excitement: "Professor Kümmerer was explaining the history of physics topics with such an impressive depth and background, along with great joy and passion. I very much hope for the future participants of the Meetings that this additional programme will be available again!"

Nobel Laureates @ School

Learning Science From a Living Physical Constant

"Be optimistic!" – Klaus von Klitzing

A highlight for the students: holding von Klitzing's Nobel Prize medal in their hands

The Nobel Laureate sharing his passion for Physics with high school students

#LINO24 and the Lindau Spirit weren't solely found at the Inselhalle and the venues on the island. On Wednesday of the Meeting week, Nobel Laureate Klaus von Klitzing was invited to the Bodensee-Gymnasium, a local school, where he discussed his Nobel Prize-winning discovery with German, Austrian, and Swiss high school students with a passion for Physics.

Von Klitzing received the 1985 Physics Nobel Prize "for the discovery of the quantized Hall effect" which made very precise measurements of electrical resistance possible through a universal constant which bears his name (RK). Von Klitzing's talk at the high school "From a Nobel Prize to the New Kilogram" addressed his discovery as well as the 2019 redefinitions of the SI base units as part of which the von Klitzing constant was also assigned an exact permanent value.

The format of the Student Talk with Nobel Laureates is a tradition that both actively involves regional students in the Lindau Meetings and inspires them to possibly follow their own scientific path one day. Once again, the participating students attentively listened to Klaus von Klitzing's engaging talk and their questions ran well over the allotted time. Despite naming the climate crisis as the most pressing issue in the natural sciences today, the Nobel Laureate urged the students to stay positive: "Be optimistic!"

Teaching Spirit

Rewarding and Stimulating Excellent Teachers

In total, 15 teachers from Germany and the region represented by the International Lake Constance Conference (IBK) took part in the two-day "Teaching Spirit 2.0" programme at #LINO24. With this outreach project, the Lindau Nobel Laureate Meetings aim to inspire those who are themselves seeking to galvanize the coming generation of STEM students.

Participation in the Teaching Spirit programme recognizes and rewards teachers who have made an outstanding contribution to the teaching of science at their schools – for example, by establishing or supervising project groups and similar measures beyond their general teaching obligations and over a longer period of time.

As part of the programme, supported for the first time by the Wilhelm and Else Heraeus Foundation, the teachers had the opportunity to attend the lectures held by Nobel Laureates in the Inselhalle, to mingle with Young Scientists, and experience the Bavarian Evening as well as the final day on Mainau Island. A lunch with Nobel Laureates who gladly devoted their time was another highlight of the programme.

However, the teachers not only gained an insight into the Lindau Meeting's programme, they also received valuable input for lesson planning. The curious participants had the opportunity to explore numerous hands-on experimental stations in detail. The work units' main topics were "nanotechnology and modern materials in physics lessons", "exploring physical phenomena by means of augmented reality", and "how does science work, e.g. in the context of climate modelling?". For the AR topic, selected online Nobel Labs 360° from the Lindau Mediatheque could be tested using virtual reality headsets. The afternoon session was enriched with a Q&A by Nobel Laureate Hartmut Michel, who spoke in an informal atmosphere about suitable approaches for sparking and nurturing interest in scientific research.

This year's candidates – mostly physics teachers, in accordance with this year's thematic focus – were nominated by the German Physical Society (DPG), the education ministries of the federal states, the EWE Foundation, the German Philologists Association (DPhV), the International Lake Constance Conference (IBK), the German Association for the Promotion of Mathematics and Science Education (MNU), the Siemens Foundation, the Jugend forscht Foundation, and Teach First Germany.

The didactical core content of the programme "Teaching Spirit 2.0" was developed in a collaborative project involving the University of Tübingen (Professor Stefan Schwarzer) and the University of Gießen (Professor Kerstin Kremer), supported by Ludwig-Maximilians-Universität Munich (Christoph Hoyer). Funding was provided by the Vector Foundation and the Siemens Foundation.

Q&A session with Nobel Laureate Hartmut Michel

Teachers discussing climate-simulation models

Measuring the film thickness of a soap bubble

Synthesis of gold nanoparticles

Demonstrating an atomic force microscopy for educational purposes

Gathering inspiration for the classroom

Lunch with Nobel Laureates – and a splendid view

Stefan Jorda, Wilhelm and Else Heraeus Foundation

Reaching out to Society Throughout the Year

Involving Our Global Community

From helping with our peer review to the challenge of safeguarding biodiversity or participating in the Falling Walls Science Summit, Lindau Alumni had manifold opportunities to get involved this year.

Alumni Peer Review
The Lindau Alumni community had a multifaceted and meaningful impact on the composition of the Lindau Meeting in 2024. A small team of selected Lindau Alumni from around the world once again supported our Scientific Chairs as reviewers in the nomination and application process. In addition, Lindau Alumni volunteered as part of the review process for the Next Gen Science sessions, evaluating a vast number of abstracts submitted by #LINO24 physicists. The collaboration is continuing during the selection process for the upcoming 74th Lindau Meeting. We would like to thank all Lindau Alumni reviewers for their involvement in this cooperative effort.

AuthentiSci at #LINO24
AuthentiSci is a tool that helps to combat misinformation and to verify scientific information in the media for scientists and non-scientists alike. Since the first Lindau Online Sciathon, it has been further developed by Lindau Alumni in collaboration with the Max Planck Institute for Gravitational Physics in Potsdam and the Foundation Lindau Nobel Laureate Meetings. After a relaunch with a workshop in Potsdam last May, 2019 Lindau Alumna Ana Alonso Serrano presented the tool during the Baden-Württemberg Boat Trip at #LINO24. Please find more information on *authentisci.com*.

Some Lindau Alumni were actively involved during the Meeting week, in activities such as the Sciathon Forum (see p. 78). Lindau Alumnus Leonhard Möckl moderated one of the Lindau Guidelines workshops (see p. 80). Lindau Alumna Sibylle Anderl, after moderating the panel discussion on Mainau Island, cordially welcomed this year's Young Scientists into the Lindau Alumni community.

Lindau Alumni Network
The Lindau Alumni Network has been the digital space for our alumni community since 2017. The platform includes tools that help users to find fellow alumni, share their work, swap stories, register for Lindau Alumni events, and stay connected to our growing global community. Members of the Lindau Alumni Network will always hear about new opportunities to extend the "Lindau Spirit" beyond the confines of a weeklong meeting. The Lindau Meetings express their sincere gratitude to the German Federal Ministry of Education and Research for supporting the project.

Lindau Alumnus Kamaljit Moirangthem at the Science Challenge with David Coomes, Michael Blank, and Nathalie Seddon (left to right)

Alumni party on the way back to Lindau

Lindau Alumni at the 2024 Falling Walls Science Summit

Lindau Mentoring Hub
The goal of the Lindau Mentoring Hub is to make sure that Lindau Alumni and Young Scientists have access to support and guidance. The platform was developed with Team Mentoring Hub, a group of Lindau Alumni who initiated the idea during the Sciathon in 2020. 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 at *lindau.mentoringhub.org*.

Lindau Science Challenge
A cooperation with the Families for Nature Foundation brought a new opportunity for Lindau Alumni and 2024 Young Scientists: The Science Challenge "A Quantum Leap for Biodiversity" aimed to identify and support scalable, revolutionary technologies and methods to enhance biodiversity conservation and to halt and reverse biodiversity loss and mitigate its impact on nature, climate, and local communities. After a two-stage selection process, six promising projects were invited to present their ideas at a roundtable event in Liechtenstein. Through this exclusive event, the selected Lindau Alumni gained valuable access to the networks of both the Families for Nature Foundation and the Founders & Funders Foundation to further accelerate their projects.

All Lindau Alumni are invited to join the online community at *lindau-alumni-network.org*.

Nobel Heroes Exhibitions

Revealing the Personality Behind the Accolades

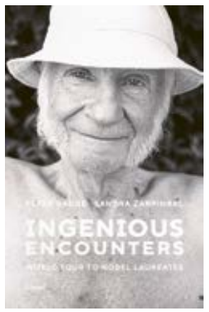
In 2024, the portraits of Nobel Laureates by artist Peter Badge were once again on tour around the world. One of the many locations where the photos were exhibited was East Timor, a full 12,673 kilometers away from Lindau. How did this come about?

The connection to the East Asian country came about through H.E. José Ramos-Horta, current President of the Democratic Republic of Timor-Leste and Nobel Peace Laureate 1996. Peter Badge first met Ramos-Horta in connection with the Nobel Heroes photo project, and the two have been on friendly terms ever since. Their cooperation became more concrete in 2010, when Badge organized the visit of other Nobel Laureates for a scientific programme in East Timor for the first time, visits which have taken place frequently since that time. Moreover, a Memorandum of Understanding with Lindau was signed under the leadership of the President some years ago.

The Nobel Heroes exhibition at Galeria Memória Via, a Museum of President Ramos-Horta's achievements, and at the East Timorese Ministry of Foreign Affairs since August 2024 is another milestone in their collaboration. In the accompanying catalogue, Ramos-Horta describes the importance of the exhibition in these words:

"In a world that often seems divided, this exhibition stands as a powerful reminder of what we can achieve when we dedicate ourselves to the betterment of humanity through science, literature, and peace. It is a celebration of the human spirit, of our endless capacity for innovation and our ability to positively impact the world around us."

Other Nobel Heroes exhibitions in 2024 took place in Munich in collaboration with TUM, where a scientific matinee programme also took place at the beginning of the year, Heiligendamm on the Baltic Sea and Guangzhou as contribution to the China-Singapore Guangzhou Knowledge City. Since the turn of the year and until the conclusion of the 74th Lindau Nobel Laureate Meeting at the beginning of July, the portraits have been on display in Bad Ragaz, Switzerland/south of Liechtenstein.



The exhibition is complemented by the book "Ingenious Encounters", also available in German: "Geniale Begegnungen – Weltreise zu Nobelpreisträgern". Both publications have recently been published in an updated, second edition – including all portraits of Peter Badge's project to date.
ISBN 978-3-95829-965-8 (EN)
and 978-3-95829-718-0 (DE)

An impressive exhibition venue ...

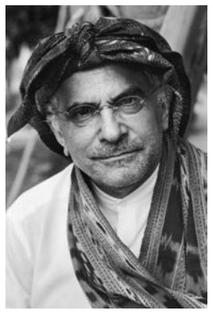
... recently built in Guangzhou

Full house during the vernissage ...

... of Nobel Heroes at TUM, Munich

Peter Badge next to José Ramos-Horta (r)

Visitors at Heiligendamm



Nobel Heroes portrait of José Ramos-Horta

The Opportunity of a Blank Page

The photo project “Sketches of Science” started as an idea, like most things. It wasn’t a spontaneous idea, rather it had been simmering with science photographer Volker Steger for some time before he turned it into reality. Here, he relates his simple yet profound strategy for capturing the diverse personalities of the Laureates and their Nobel Prize-winning concepts.

It is indeed interesting to get to know a person a little through traditional portrait photography. If it is done well, we see individuality, character, and personality. We can find a person likeable or not. And of course, this works just as well with Nobel Laureates as it does with other people.

And yet – a Nobel Laureate is no celebrity (with very few, mostly historical exceptions), but primarily a scientist who has won an award for his or her research. We are interested in these persons because of the discoveries they made.

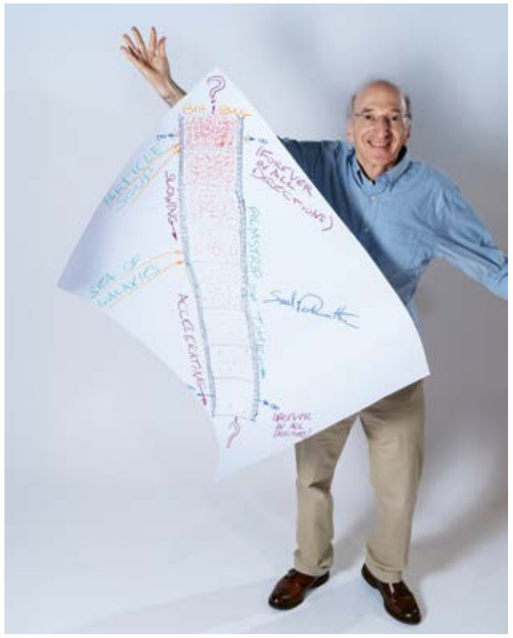
Visiting a Laureate’s lab with a camera brings you closer to their research. You may want to take a photograph of a Nobel Laureate in front of a complex instrument. There are great examples of this genre and many poor ones. One problem is that the technical equipment becomes simply a “scientific” backdrop and doesn’t really convey very much. As a part of a larger feature in a magazine, this is fine.

Sketches of Science is different. I aim to portray a Nobel Laureate’s personal side and to give the viewer the opportunity to get an idea of the concept that won them the prize – in a single image!

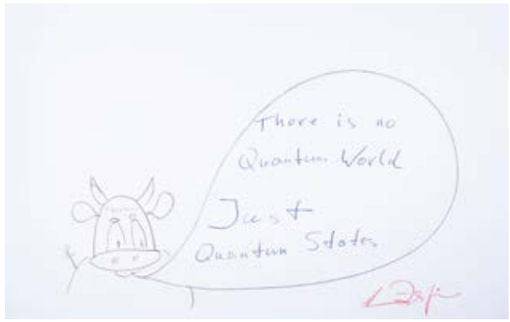
There are two ways of visualizing scientific concepts graphically: by writing and by drawing. When done by hand, both become very individual and personal. And more often spontaneous. A quick sketch is not a slide presentation. It is often better.

Both the sheet of paper I ask the Laureates to sketch on and my photo backdrop are plain white and empty. Anyone who has ever faced a blank page knows that this is both a challenge and an opportunity.

Sketches of Science provides a canvas for the participants, not much else. I try to leave it to the Nobel Laureates to fill it. This applies not only to the sketch but also to the subsequent photography. There is no fuss, no elaborate staging or posing – unless a participant explicitly asks for it. I try to create a relaxed and easy atmosphere, both for the sketching and the actual photo session that follows. I like to think of my white backdrop as a “stage”, and I see the photo session as an engaging, cooperative project – fun is strictly permitted!



Saul Perlmutter



A sketch by Anton Zeilinger

Volker Steger

Eric Betzig and his daughter Mia

Project Partner
Nobel Prize Museum, Stockholm

Principal Funder
Klaus Tschira Stiftung

Publisher of the Art Book “Sketches of Science”
Berliner Wissenschaftsverlag
ISBN 978-3-8305-5176-8

Find more information about the project:

Lindau Matinee

A Traditional Format Going on Tour

As per tradition, our year began with the Lindau Matinee – an event that is highly popular with Lindau's citizens. Council members and Lindau Alumni expounded on the research recently awarded with the Nobel Prize. On the day before and for the first time, the Matinee format had also been hosted by Technical University Munich.

Lindau's inhabitants need to act fast once registration opens for the Lindau Matinee – the available places for this Sunday morning event are always filled quickly. Even in busy Munich, the announcement of the Lindau Matinee was met with great interest. Four experts for the respective discipline presented the Nobel Prizes awarded in December. The lectures in German language about the 2023 awards were followed by a reception to invite all guests to exchange their thoughts about science and enjoy each other's company in the foyer of the Inselhalle. Once again, we were grateful to Hendrik Groth, Editor-at-Large, Schwäbische Zeitung, for moderating the programme.

The Nobel Prize in Chemistry:
Moungi G. Bawendi, Louis E. Brus, and **Aleksey Yekimov** for the discovery and synthesis of quantum dots

Explanation by **Heiner Linke**, Lindau's Vice President of the Council and Co-Chairperson for Physics – Member of the Nobel Committee for Chemistry, Royal Academy of Sciences, Professor of Nanophysics at Lund University, Sweden, and TUM Alumnus

The Nobel Prize in Physiology or Medicine:
Karolin Karikó and **Drew Weissman** for their discoveries concerning nucleoside base modifications that enabled the development of effective mRNA vaccines against COVID-19

Presentation by **Andreas Linder**, Lindau Alumnus 2015, Assistant Physician, Medical Clinic II, Clinic of the Ludwig-Maximilians-Universität Munich, Gene Center Munich

The new posters explaining the Nobel Prizes are presented to the audience

The Nobel Prize in Physics:
Pierre Agostini, Ferenc Krausz, and **Anne L'Huillier** for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter

Background by **Rainer Blatt**, Member of Lindau's Council and Scientific Co-Chairperson for Physics – Scientific Director at the Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences and Lindau Alumnus

Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel:
Claudia Goldin for having advanced our understanding of women's labour market outcomes

Introduction by **Andrea Doetsch**, Lindau Alumna 2017 (Economic Sciences), Global Equal Pay Lead, Allianz SE

Communications

Spreading the Word in 50 Different Languages

There is always a lot happening in Lindau – both during the Meetings and also outside of those special times. And we want the world to know about it! On the occasion of #LINO24, we engaged with a fantastic group of science journalists, bloggers, and media representatives in the Inselhalle.

Media power users of the #LINO24 press lounge

One out of many interviews with Young Scientists

For communications at Lindau, the last Meeting really ends when this annual report has made it into the hands of our esteemed readers. As a further important follow-up, we analyzed the media response to the 73rd Lindau Meeting. This time, we focused on quantity and found for instance that the Meeting was covered worldwide in 45 countries and 250 different (online) media – beginning with the announcement of the invited Young Scientists at the end of March, with numerous portraits of early career researchers.

Social media posts were published in 50 different languages, which we interpret to mean that the participants felt at home in Lindau. In this context, we included the activities of the Academic Partners in the social media channels in our monitoring. For our media travel grant programme, we received applications from 25 different countries from which we were able to invite about a dozen media representatives to Lindau.

In preparing for 2025 we updated our offer to journalists:

Media Accreditation
for onsite access to numerous sessions of the Scientific Programme, to partner events, and social functions – open from April at *lindau-nobel.org/media*.

Interview Arrangements
such as one-on-one or group talks with Nobel Laureates as well as Young Scientists.

Media Grants
to compensate for travel and accommodation expenses.

Resources
to support your coverage, including photos, audio, and video recordings.

Social Media

Connecting With the Lindau Community

In 2024, digital connections with our community – on various platforms – continued to play a crucial role in our mission of connecting people and sharing ideas.

#LINO24 and its audience

Participants and the public could engage with us during the 73rd Lindau Meeting using the hashtag #LINO24. Short clips produced by London-based Econ Films highlighted Nobel Laureates and Young Scientists. Longer interview pieces by science comedian Brian Malow with Young Scientists and Sciathon groups were streamed live on Facebook, X, and on YouTube. All together, these formats aimed to provide insights into the Lindau Spirit at work via social media.

In 2024, LinkedIn became a core part of the Lindau Meetings' social media strategy. Our presence on the networking site for professionals is a great way to create and maintain relationships. This is also true for our official Facebook page. We update our community on news from Lindau year-round.

Videos, visual highlights, and other digital content from the Lindau Meetings are also attracting a growing audience on Instagram. Young Scientists and Lindau Alumni engage with us, sharing snapshots and stories during #LINO24 and throughout the year. We're looking forward to more stories in the lead-up to both #LINO25 and #LINOecon.

Our YouTube channel is a growing resource of short-form interviews, additional material from Lindau and the Sciathon as well as Mini Lectures. High-quality pictures from the Lindau Meetings are available to everyone on Flickr. The images are free for editorial use, but the copyrights must be acknowledged accordingly.

Due to the significant changes to the platform X, formerly known as Twitter, the Lindau Meetings have decided to discontinue their presence on the platform. We would like to thank the more than 15,000 Lindau Alumni, Young Scientists, partners, and everyone who connected with @lindaunobel. We are looking forward to staying connected on the other platforms.

At Your Service: Lindau Institutions

Council and Foundation – Supporting Pillars of the Meetings

The Council

In 1954, three years after the first Meeting, the non-profit Council for the Lindau Nobel Laureate Meetings was founded in order to provide the Lindau Meetings with an institutional framework. Today, the annual Meetings are organized by the Executive Secretariat, based at the Lennart Bernadotte Haus on Lindau Island.

Honorary President
Count Lennart Bernadotte af Wisborg †

Board
Countess Bettina Bernadotte af Wisborg
President
Heiner Linke
Vice President
Wolfgang Lubitz
Vice President (until 10/2024)
Nikolaus Turner
Treasurer

Members
Rainer Blatt
Thomas Ellerbeck
Klas Kärre
Stefan H. E. Kaufmann
Jürgen Kluge
Hartmut Michel
Valeria Nicolosi
Torsten Persson
Klaus M. Schmidt
Pernilla Wittung-Stafshede

Corresponding Members
Astrid Gräslund
Hans Jörnvall
Thomas Perlmann
Christoph Philipp

Permanent Guests
Claudia Alfons
Christof Widmer

Executive Secretariat of the Council

Thomas Gruber
Director

Conference Management
Susanne Wieczorek
Head
Nelly Bolg
Diana Hagg
Sabrina Lummer
Karen Otto (03–07/2024)
Daniela Thiel
Valeria Wollenweber
(since 03/2024)

Young Scientist Support and Academic Partner Relations
Nadine Gärber
Head (until 08/2024)
Nora Dávila Flores
Saskia Flegler
Kai Lohbeck
Karen Otto (since 09/2024)
Fabio Staiti (04–07/2024)

Communications
Wolfgang Haaß
Head
Patricia Edema
Christoph Schumacher

Guests, Secretariat, and Accounting
Lisiane Clossmann
Anke Elben
Marion Möstel
(until 12/2024)
Evelyn Weishaupt-Wefing
(until 10/2024)

Data Projects
Wolfgang Huang
(until 07/2024)

Nadine Gärber (here with Thomas Ellerbeck and Jamal Bin Huwaireb) left the Executive Office in 2024 after 20 years of passionate commitment to the Lindau cause

Relief and pride at the end of the week: Countess Bettina Bernadotte thanks the Executive Secretariat team

The Foundation

In 2000, 50 Nobel Laureates helped to establish the non-profit Foundation Lindau Nobel Laureate Meetings under German law. Ensuring the continuity and further development of the Lindau Meetings is its core objective. As of December 2024, more than 380 Nobel Laureates have agreed to join the Founders' Assembly and thus serve as advocates of the Lindau Spirit (see p. 119).

Honorary Presidents
Count Lennart Bernadotte af Wisborg †
Roman Herzog †

Honorary Chairman
Wolfgang Schürer

Board of Directors
Jürgen Kluge
Chairman
Nikolaus Turner
Managing Director
Countess Bettina Bernadotte af Wisborg
Thomas Ellerbeck
Christoph Philipp

Foundation Office
Nikolaus Turner
Managing Director
Maximilian Benatar
Director International Benefactor Relations
(since 12/2024)
Franziska Castell
Director International Benefactor Relations
(until 06/2024)
Diana Grenz
Secretariat Boards and Management

Thomas Perlmann at his first Council Meeting

Klaus M. Schmidt and Torsten Persson, Scientific Chairs for the upcoming 2025 Meeting in Economic Sciences

Pernilla Wittung-Stafshede and Valeria Nicolosi, Scientific Chairs for the upcoming 2025 Meeting in Chemistry

Farewell to Vice President Wolfgang Lubitz

Contributing to the Careers of 12,000 Young Scientists

With the autumn 2024 Council Meeting, Professor Wolfgang Lubitz' Council membership and tenure as Vice President came to an end. On the occasion of his farewell, all remaining members of the Council expressed their gratitude for his support over a time span of two decades and 20 Meetings in the natural sciences.

The location chosen to honour Wolfgang Lubitz was appropriate: Countess Bettina and Count Björn Bernadotte welcomed the Council Members for a reception at Mainau Palace. While Countess Bettina regretted the end of Wolfgang Lubitz' roles as Vice President, Member of the Council, and Scientific Chairperson, she expressed her gratitude that he had offered his help in the future in the case of need. "The ties to his successors as Scientific Chairs in Chemistry have been firmly established", she emphasized: Professors Valeria Nicolosi, Trinity College Dublin, and Pernilla Wittung-Stafshede, Chalmers University of Technology in Gothenburg.

Looking back on their joint time on the Council, she pointed to his role as a vivid example of how the Lindau Meetings evolved: with him coming into office, the idea had materialized that each Lindau scientific discipline should be represented by Council Members both from Sweden and other countries, Germany in this case, and that these Council Members work on the scientific conferences together.

Wolfgang Lubitz joined the Council in 2004, 20 years ago. In 2014, he became Vice President, taking on even more duties. In his words of thanks, he expressed gratitude to Count Lennart Bernadotte and Countess Sonja whom he remembered from his first years connected with Lindau.

He derived great satisfaction from his work and saw himself as privileged to continuously learn from other Council Members, Nobel Laureates, and Young Scientists alike. Lubitz had calculated that the number of early career scientists who were invited to Lindau under his auspices came to about 12,000 – "quite a number", in fact representing one third of all documented Lindau Alumni. "They made their career also thanks to the Lindau Meetings."

During his term in office, Benjamin List received the 2021 Nobel Prize in Chemistry. This must have been a special moment for Lubitz as the two were practically neighbours at their institutes in Mülheim/Ruhr. The fact that the newly awarded Laureate found his way to Lindau already the following year may well have been due to Lubitz' gentle prodding.

In his closing remarks, Lubitz repeated his gratitude for being allowed to be part of the Lindau community. In reviewing the evolution of the Meetings and their increasing focus and professionalization, he also left his listeners in no doubt that the current Members of the Council were ideally placed to continue this positive trajectory.

The gathering was also a good opportunity to welcome Thomas Perlmann, Secretary of the Nobel Assembly at Karolinska Institutet and of the Nobel Committee for Physiology or Medicine, to the Lindau Council, where the Meetings in Physiology and Medicine will benefit from his expertise. In summing up, Countess Bettina remarked, "I am grateful for those who newly join us as well as for those who move on, united in the Lindau Nobel Laureate Meetings, bringing together wonderful people from different fields, different generations, and different parts of the world."

Wolfgang Lubitz with Countess Bettina Bernadotte, ...

... Valeria Nicolosi and Pernilla Wittung-Stafshede, ...

... Nobel Laureate Richard R. Schrock, ...

... Heiner Linke and Nobel Laureate Richard Henderson,

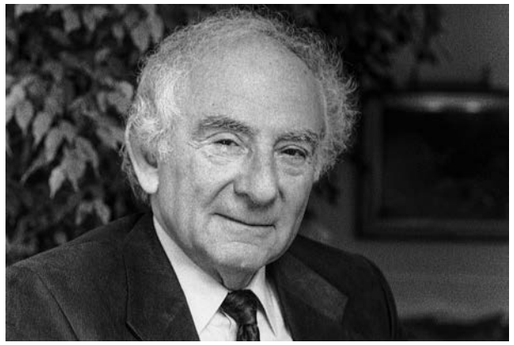
... Rafael Lang (Klaus Tschira Foundation), ...

... and former Council Vice President Burkhard Fricke

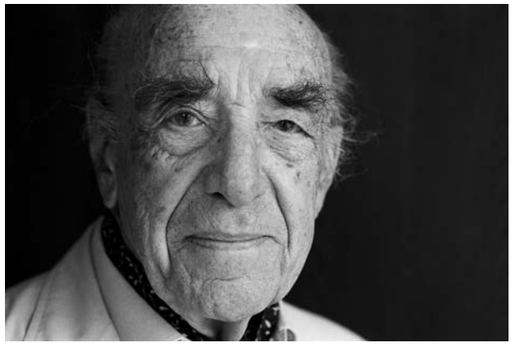
Opening the Online Science Days with Rainer Blatt ...

... and – among his favourites – giving guidance to Young Scientists

In Memoriam – Dearly Missed

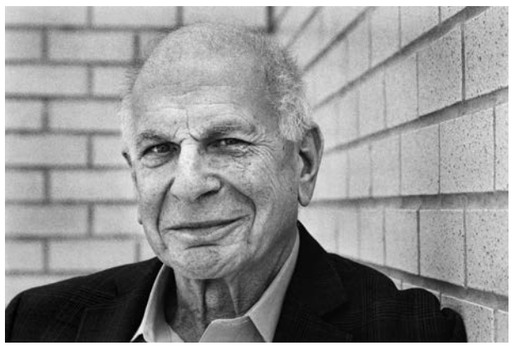


Leon N. Cooper
1930–2024
Nobel Laureate in Physics 1972



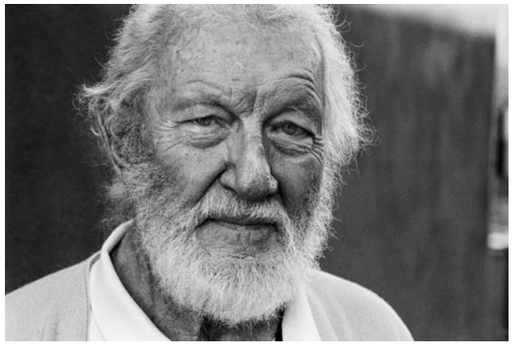
Roger C. L. Guillemin
1924–2024
Nobel Laureate in Physiology or Medicine 1977

Peter W. Higgs
1929–2024
Nobel Laureate in Physics 2013



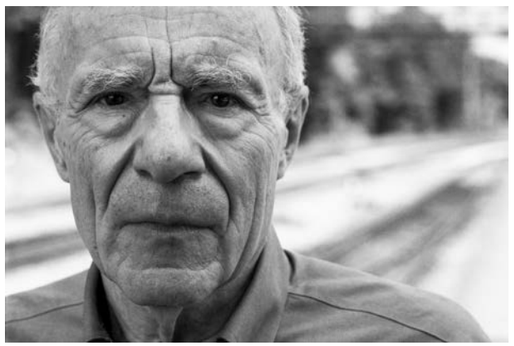
Daniel Kahneman
1934–2024
Laureate in Economic Sciences 2002

Henry A. Kissinger
1923–2023
Nobel Laureate in Peace 1973



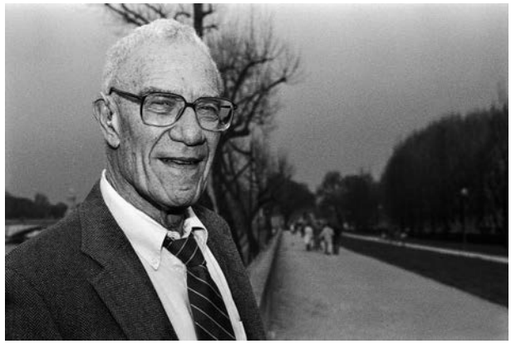
Herbert Kroemer
1928–2024
Nobel Laureate in Physics 2000

Tsung-Dao Lee
1926–2024
Nobel Laureate in Physics 1957

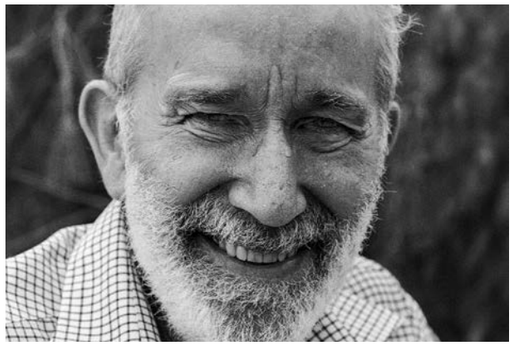


Arno A. Penzias
1933–2024
Nobel Laureate in Physics 1978

Bengt Samuelsson
1934–2024
Nobel Laureate in Physiology or Medicine 1982



Robert M. Solow
1924–2023
Laureate in Economic Sciences 1987



J. Robin Warren
1937–2024
Nobel Laureate in Physiology or Medicine 2005

Ludwig E. Feinendegen
1927–2024
Scientific Chairperson (Physiology/Medicine) for the first time at the 28th Lindau Nobel Laureate Meeting, 1978
Member of the Council (1979–2005)
Vice President of the Council (1999–2005)
Member of the Board of the Foundation (2000–2005)

The Council and Foundation were also saddened by the passing of Professor Ludwig E. Feinendegen, who, first alongside Count Lennart Bernadotte and later together with Countess Sonja Bernadotte, shaped the Meetings with great commitment and skill. Over more than 25 years in his roles as Council Member, later serving as Vice President, Feinendegen made outstanding contributions to the advancement of the Lindau Nobel Laureate Meetings, including the first steps towards an enhanced internationalization among the Young Scientists.

Founders' Assembly

Impressive Numbers – and Personalities

The Foundation Lindau Nobel Laureate Meetings was established in the year 2000 by 50 Nobel Laureates. Through their membership in the Founders' Assembly, Nobel Laureates demonstrate their strong support for the Lindau Meetings. As of November 2024, more than 380 members constitute this body – these are the latest additions:

Daron Acemoglu
Laureate in Economic Sciences
2024

Pierre Agostini
Nobel Laureate in Physics
2023

John Jumper
Nobel Laureate in Chemistry
2024

Katalin Karikó
Nobel Laureate in Physiology or Medicine
2023

Ferenc Krausz
Nobel Laureate in Physics
2023

Anne L'Huillier
Nobel Laureate in Physics
2023

Gary Ruvkun
Nobel Laureate in Physiology or Medicine
2024

Anton Zeilinger
Nobel Laureate in Physics
2022

Find all members of the Founders' Assembly on our website:

How Lindau Is Made Real

Bringing the World's Top Talents to Lindau

The Importance of Our Academic Partners

The Lindau Nobel Laureate Meetings maintain a global network of more than 200 Academic Partners that help ensure the scientific excellence of the attending Young Scientists.

Signing the Memorandum of Understanding with the National Research Foundation, Singapore

Reception for representatives of Lindau's Academic Partners during the 73rd Meeting

World-renowned scientific institutions both from the public and private sectors are entitled to nominate Young Scientists for participation in the Lindau Meetings. These institutions include academies of sciences, leading universities, research institutes, foundations, and innovative enterprises throughout the world. This support allows the Lindau Nobel Laureate Meetings to bring together the most gifted scientific talents worldwide.

For the 73rd Lindau Nobel Laureate Meeting (Physics) more than 130 institutions from around the globe nominated their most talented Young Scientists. Generally, Young Scientists apply to and are nominated by our Academic Partner institutions. In exceptional cases, applications can be submitted directly to the Council via Open Application, for example, when an applicant studies or works in a country where the Lindau Meetings do not yet have an Academic Partner. The Academic Partner network is continuously being expanded. The Lindau Meetings conclude memoranda of understanding with their Academic Partner institutions to commit themselves to the interconnection and promotion of aspiring Young Scientists and thus to spreading Lindau's "Mission: Education" worldwide.

For instance, in 2024, a Memorandum of Understanding with the National Research Foundation, Singapore, was renewed. This connection additionally resulted in a cooperation with the Royal Society for STEM, Bhutan. Finally, two Young Scientists from Bhutan participated in the Meeting, supported by the "Hans und Wolfgang Schleussner-Stiftung".

In their symbiotic relationship with the Lindau Nobel Laureate Meetings, Academic Partners act as vital nodes in a world-spanning network of progressive young minds for which the Lindau Meetings function as a hub. They foster a constant pursuit of excellence and are enablers of intergenerational and intercultural dialogue.

Application Process

Application for the 75th Lindau Meeting (Interdisciplinary – 28 June to 3 July 2026) starts this September (2025).

Requirements

Outstanding undergraduates, Master and PhD Students, and early-career Post-Docs

Application

Nomination by Academic Partners (Pre-selection by Academic Partner)

Open Application (Only available in Countries without an Academic Partner, pre-evaluation by scientific reviewers)

Evaluation and Selection

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

Pre-evaluation

Participation

Once Only

Lindau Alumni Community

About 36,000 former participants
Since 1951

Nominating Institutions for #LINO24

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)
Canadian Institutes of Health Research (CIHR)
Carl von Ossietzky University of Oldenburg, Germany
Carl-Zeiss-Stiftung
CERN, Switzerland
Charité – Universitätsmedizin Berlin, Germany
Chemnitz University of Technology, Germany
China-Singapore Guangzhou Knowledge City Investment and Development Co., Ltd
Clausthal University of Technology, Germany
Columbus Association
Constructor University, Germany
Croucher Foundation, Hong Kong
Czech Academy of Sciences
Department of Science & Technology, Government of India
Elite Network of Bavaria, Germany
Estonian Academy of Sciences
European Commission
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
German Academic Exchange Service
German Academic Scholarship Foundation
German Aerospace Center (DLR)
Global Young Academy
Göttingen Graduate Center for Neurosciences, Biophysics, and Molecular Biosciences, Germany
Heidelberg University, Germany
Helmholtz Association of German Research Centres, Germany
Honoris United Universities
Human Frontier Science Program, France
Hungarian Academy of Sciences
ICREA – Catalan Institution for Research and Advanced Studies, Spain
Independent Research Fund Denmark
Industrie-Club e.V. Düsseldorf, Germany
Irish Research Council
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
King Abdullah University of Science and Technology, Saudi Arabia
Klaus Tschira Stiftung gGmbH, Germany
Körber Foundation, Germany
Korea Foundation for Advanced Studies (KFAS)
Leibniz Association, Germany
Leibniz University Hannover, Germany
Leipzig University, Germany
Ludwig-Maximilians-Universität Munich, Germany
Luxembourg National Research Fund
Martin Luther University Halle-Wittenberg, Germany
Max Planck Society, Germany
Mexican Academy of Sciences
Ministry of Education, Tertiary Education, Science and Technology, Mauritius
Ministry of Higher Education, Research and Innovation, Oman
Ministry of Research, Technology and Higher Education of the Republic of Indonesia
Mongolian Academy of Sciences
Munich Quantum Valley, Germany
National Academy of Sciences of Uruguay
National Academy of Sciences, USA
National Institute of Materials Physics, Romania
National Research Foundation, Singapore
National Science and Technology Development Agency, Thailand
Otto von Guericke University Magdeburg, Germany
Paderborn University, Germany
Pakistan Institute of Engineering & Applied Sciences (PIEAS)
Philipps-Universität Marburg, Germany
Ragnar Söderberg Foundation, Sweden
Research Foundation – Flanders (FWO), Belgium
Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, Germany
Royal Netherlands Academy of Arts and Sciences
Royal Society for STEM (RSSTEM)
Ruhr-Universität Bochum, Germany
RWTH Aachen University, Germany
Sharif University of Technology, Iran
Sigma Xi, The Scientific Research Honor Society, USA
Sino-German Center for Research Promotion, China
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Preliminary Accounts 2024: Revenues

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Expected Total Revenues	€ 4,263,480

Preliminary Accounts 2024: Expenditures

Travel	(€)
Nobel Laureates	191,163
Young Scientists	45,900
Media	16,126
Others	21,190
Lodging	
Nobel Laureates	95,162
Young Scientists	433,529
Media	8,211
Others	80,094
Boarding	
Nobel Laureates	25,489
Young Scientists	396,846
Media	12,232
Others	80,235
Meeting Organization	
Scientific Programme & Selection of Young Scientists	2,500
Venue Rental Costs	152,010
Technical Equipment	269,452
Utilities & Services	32,766
Onsite Staff	200,421
Transfers (Buses, Limousines)	215,848
Supporting Programme	59,593
Accompanying Programme	45,489
Printed Matter	45,041
Expendable Items	8,703
Audio & Video Productions	97,868
Science & Media Services	34,031
Website	9,284
Telecommunications, Postage	10,969
IT Services, Hardware, Software	277,261
Accounting, Legal Advice, Insurances	54,026
Other Costs	2,570
Ongoing Outreach Activities	
Digital Archives (Lindau Mediatheque)	21,000
Alumni Activities	17,946
Events and Exhibitions	15,266
Further Outreach Activities	26,384
Executive Secretariat	
Staff	858,858
Office Operating Costs	77,060
Office Supplies & Equipment	14,957
Expected Additional Expenditure (Oct–Dec 2024)	308,000
Expected Total Expenditures (as of 1 December 2024)	4,263,480

Fellowships

Endowments Enable Participation

Special fellowships of the Foundation Lindau Nobel Laureate Meetings enable the participation of selected Young Scientists in the Meetings.

Lou Ignarro with Young Scientists at Lindau harbour

The Countess Sonja Bernadotte Fellowship enables female Young Scientists to participate in the Meetings

The Foundation Lindau Nobel Laureate Meetings was established in 2000 upon the initiative of 50 Nobel Laureates. Since then, more than 380 Laureates have joined the Founders' Assembly. To support the continuation of the Lindau Meetings in the long term and to safeguard their independence, the Foundation continues to pursue the goal of significantly increasing its assets.

To help generous donors achieve this, the Lindau Foundation has set up Fellowship Funds to enable Young Scientists to participate in the Lindau Meetings. For instance, we want to draw special attention to the fellowship named after Countess Sonja Bernadotte – this funding enables female Young Scientists to participate in the Meetings.

Another fellowship, called the "Lindau Spirit", describes the special atmosphere at the Meetings when Nobel Laureates and Young Scientists meet together in Lindau. The "Lindau Spirit Fellowship" was initiated by supporters during the pandemic and was awarded for the first time in 2022. In the meantime, several such fellowships have been created, including the "Sharon and Lou Ignarro Fellowship" which is funded from the proceeds of the German edition of the book "Dr. NO: The Discovery That Led to a Nobel Prize and Viagra".

In grateful and loving memory of Edmond H. Fischer, recipient of the Nobel Prize in Medicine 1992, the Vallee Foundation has also endowed an Eddy Fischer/Vallee Foundation Fellowship Fund. With this fellowship, every year a Young Scientist is invited in his name to the Meetings in Lindau.

Förderstiftung für die Lindau Nobel Laureate Meetings
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The circle of donors grows from year to year; some support the Meetings continuously, others contribute only for certain disciplines, while others still donate for a prescribed period of time or occasionally.

We would be delighted to welcome you into this circle. All donations are tax-deductible according to German law.

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Stefan W. Hell, Nobel Laureate in Chemistry 2014, with Young Scientists

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28 June – 3 July 2026

73rd Lindau Nobel Laureate Meeting (Physics)

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+49 8382 277 31 0
info@lindau-nobel.org
lindau-nobel.org

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Inspired by the 2023 Nobel Prize in Physics, awarded to Pierre Agostini, Ferenc Krausz, and Anne L'Huillier. Through a combination of various and shorter wavelengths of light, and by utilizing the overtones in laser light, one can create pulses of light that are short enough to depict the processes occurring inside atoms and molecules.
Credit: agsandrew/Shutterstock.com

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This was my best event of the summer for sure.
W. E. Moerner
Nobel Laureate in Chemistry 2014

Lindau really fits well into this interdisciplinarity and collaboration, you get new ideas from very different fields and you get a new perspective on your own projects by doing so.
Vanessa Nadig
Lindau Alumna 2024

I fully enjoyed my participation – please let me thank you for your friendly and very efficient efforts in organizing this wonderful Meeting.
Ada E. Yonath
Nobel Laureate in Chemistry 2009

It's the only meeting I've been to where I never felt imposter syndrome. Which is interesting because before coming here I thought I would have it, but during this Meeting, it's just amazing.
Etienne Palos
Lindau Alumnus 2024

Overall, an extraordinary accomplishment, thanks to the team, the leadership, the supporters, and the participants. One of the most inspiring events I have ever attended.
John C. Mather
Nobel Laureate in Physics 2006