

# FALLING WALLS FOUNDATION

## Falling Walls Science Breakthrough of the Year 2023: These Groundbreaking Ideas Compete for The Title

- Today the Falling Walls Foundation has announced the shortlist for the Science Breakthrough of the Year 2023 title. The high-level jury reviewed over 1.000 entries.
- The laureates will be announced on Wednesday, 13 September and present their scientific breakthroughs at the Falling Walls Science Summit in Berlin on 9 November.
- The shortlist in the categories Science Start-Ups (Falling Walls Venture) and Science Engagement (Falling Walls Engage) will be announced later today.
- Find out more about the Science Summit 2023 at <https://falling-walls.com/science-summit/>

**Berlin, Germany, 16 August 2023:** The category **Life Sciences** included research on bioelectricity imaging, resilient crops, RNA-modifying ribozymes, cancer and neurodegenerative disease treatment, minimally invasive regenerative medicine, and others.

In **Physical Sciences** the projects showed breakthroughs in the first photonic circuit integrated Ti:Sa chip laser, multi-dimensional photoemission spectroscopy, magnetic quantum matter, CO2 “net zero” using black gold and more.

The winners in **Engineering and Technology** presented novel solutions used for non-invasive wearables, 3D nanofabrication, biodegradable seed carriers and organic batteries.

Among the topics in **Social Sciences and Humanities** were population health equity, a more humane criminal justice system, patriarchal policing, and violence against women\*, and cognitive liberty in the rapidly digitalised world.

In **Art and Science**, the topics ranged from music’s effect on the heart and xenotransplantation research to physical and cultural relationships with nature and women-centered community-based sci-art.

**Science and Innovation Management** included projects on scientific data organization for the UN SDGs, river fragmentation, AI democratization through open access, and awareness initiative to draw attention to mothers in academia.

*“We thank each participant for their scientific vigour and persistence to break the walls to new discoveries that we all will benefit from,”* says Jürgen Mlynek, Chairman of the Board of Trustees, Falling Walls Foundation.

See below for the complete shortlist.

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### About the Falling Walls Science Summit

Falling Walls Science Summit is the leading forum for global science leaders with focus on science breakthroughs. The summit takes place every year in Berlin from 7 – 9 November, the anniversary day of the fall of the Berlin Wall. This holistic approach of international, interdisciplinary and intersectoral discourse is globally unique and attracts leading researchers, CTOs, science strategists, sciences funders, and media worldwide.

More: <https://falling-walls.com/science-summit/>

### LIFE SCIENCES

#### ADAM COHEN – HARVARD UNIVERSITY

##### Breaking the Wall to Imaging Bioelectricity

By imaging the electrical activity in rodent and human neurons, as well as other cell types, Adam Cohen has developed tools to convert bioelectricity into light, thus deciphering rules of bioelectrical signaling in health and disease.

## **CHUAN HE – UNIVERSITY OF CHICAGO**

### Breaking the Wall of Food Insecurity

Chuan He's laboratory work on the functional roles of RNA chemical modifications in gene expression regulation aims to build resilient high-yielding crops.

## **CLAUDIA HÖBARTNER – UNIVERSITY OF WÜRZBURG**

### Breaking the Wall to the Molecular Evolution of RNA-modifying Ribozymes

Claudia Höbartner discovered the first methyltransferase ribozyme - a catalytically active RNA that site-specifically methylates another RNA and can be repurposed for targeting/labeling any RNA of interest.

## **FRANK WINKLER – UNIVERSITY OF HEIDELBERG**

### Breaking the Wall to a New Concept of Cancer Treatment

Frank Winkler discovered that tumor cells of incurable brain tumors interconnect with neuron-like processes to a communicating multicellular network that resists all standard therapies and can repair itself.

## **JEFFREY KELLY – THE SCRIPPS RESEARCH INSTITUTE**

### Breaking the Wall of Treating Neurodegenerative Diseases

Jeffery Kelly discovered the kinetic stabilizer drug Tafamidis to inhibit transthyretin aggregation; it's the first regulatory agency-approved drug to slow the progression of amyloid disease.

## **KAREN CHRISTMAN – THE UNIVERSITY OF CALIFORNIA SAN DIEGO**

### Breaking the Wall to Cost-Effective, Minimally Invasive Regenerative Medicine

Karen Christman developed the first pro-regenerative biomaterial therapy to target the microvasculature of injured or inflamed tissues, reduce vascular permeability and promote cell survival and tissue regeneration.

## **MARC DEWEY - CHARITÉ – UNIVERSITÄTSMEDIZIN BERLIN**

### Breaking the Wall to Noninvasive Imaging of Coronary Artery Disease

Mark Dewey made critical refinements to Computed Tomography as a highly accurate noninvasive clinical imaging test for coronary artery disease.

## **PIETER ROELFSEMA – NETHERLANDS INSTITUTE FOR NEUROSCIENCE**

### Breaking the Wall to a Visual Brain Prosthesis for Blind Users

Pieter Roelfsema aims to restore vision in blind individuals by the electrical activation of neurons in the visual brain.

## **ROBERT SEDER & PETER CROMPTON – NATIONAL INSTITUTES OF HEALTH**

### Breaking the Wall to Malaria Prevention with Monoclonal Antibodies

Peter Crompton and Robert Seder developed monoclonal antibodies as a potential tool to confer high-level protection against malaria in key vulnerable populations.

## **TOBIAS ERB – MAX PLANCK INSTITUTE FOR TERRESTRIAL MICROBIOLOGY**

### Breaking the Wall to Photosynthesis 2.0

Tobias Erb uses synthetic biology to develop photosynthesis 2.0 – a human-enabled version of the operating system of the global carbon cycle, providing novel solutions for improved carbon capture in agriculture, biotechnology, and chemistry.

## **PHYSICAL SCIENCES**

## **ARNE THOMAS – TECHNISCHE UNIVERSITÄT BERLIN**

### Breaking the Wall to Store the Energy of Sunlight

Arne Thomas investigated highly porous organic photocatalysts, prepared at ambient conditions, which allow to tailor their structure and optoelectronic properties.

## **HONG TANG – YALE UNIVERSITY**

### Breaking the Wall to the First Photonic Circuit Integrated Ti:Sa Laser

Hong Tang produced the first photonic circuit integrated Ti:Sa chip laser with an ultralow threshold, a breakthrough in solid-state laser technology, integrated photonics, ultrafast optics and spectroscopy.

## **KESHAV DANI – OKINAWA INSTITUTE OF SCIENCE AND TECHNOLOGY GRADUATE UNIVERSITY**

### Breaking the Wall to Imaging the Momentum-Forbidden Dark Excitons

Keshav Dani developed a novel class of instrumentation in multi-dimensional photoemission spectroscopy re-iterating its value for quantum technology applications.

## **LIBOR ŠMEJKAL – JOHANNES GUTENBERG UNIVERSITY MAINZ**

### Breaking the Wall to Magnetic Quantum Matter

By analysing all possible mathematical symmetries of the spin in magnetic crystals Libor Smejkal identified altermagnets and opened new routes toward sustainable nanoelectronics.

#### **LEO GROSS – IBM RESEARCH EUROPE - ZURICH**

##### Breaking the Wall to Resolving Single Molecules

By using a microscope with atomic resolution, Leo Gross discovered novel chemical reactions that reveal new molecule structure and can impact cleaner combustion, medical research, chemical synthesis and devising novel molecular machines.

#### **MIKHAIL LUKIN – HARVARD UNIVERSITY**

##### Breaking the Wall to Quantum Information Processing

Mikhail Lukin used neutral atom arrays trapped and transported by optical tweezers to realize the programmable generation of entangled graph states.

#### **PABLO JARILLO-HERRERO – MASSACHUSETTS INSTITUTE OF TECHNOLOGY**

##### Breaking the Wall to Twistronics

Pablo Jarillo-Herrero constituted the new platform 'Twistronics' which makes it possible to realize most of the quantum phases of matter known in physics.

#### **THOMAS KLINGER – MAX PLANCK INSTITUTE FOR PLASMA PHYSICS**

##### Breaking the Wall to Fusion Power with Wendelstein 7-X

Thomas Klinger used the stellarator "Wendelstein 7-X to deliver major breakthroughs in creating a fusion-relevant plasma that paves the way to make fusion power finally available to the world.

#### **VALENTINA EMILIANI – VISION INSTITUTE, CNRS**

##### Breaking the Wall to Neural Circuit Manipulation at Cellular Resolution

Valentina Emiliani proposed optical methods for precise control of individual neurons or ensembles of neurons in the brain mimicking specific patterns of brain activity and relating them to animal behavior.

#### **VIVEK POLSHETTIWAR – TATA INSTITUTE OF FUNDAMENTAL RESEARCH**

##### Breaking the Wall of CO<sub>2</sub> Net Zero Using Black Gold

To realise CO<sub>2</sub> "net zero", Vivek Polshettiwar's developed material "BLACK GOLD" absorbs the entire visible and near-infrared region of solar light and catalyzes CO<sub>2</sub> to fuel conversion at atmospheric pressure and temperature using solar energy.

#### **ENGINEERING AND TECHNOLOGY**

#### **CAO THANG DINH – QUEEN'S UNIVERSITY**

##### Breaking the Wall to Carbon Capture Technology

Cao Thang Dinh developed a novel system that integrates carbon capture and conversion in a single step, addressing the biggest challenge in carbon dioxide conversion technology — low energy efficiency.

#### **JODIE LUTKENHAUS – TEXAS M&A UNIVERSITY**

##### Breaking the Wall to Organic Batteries

Jodie Lutkenhaus pioneered organic batteries as an alternative to today's lithium-ion batteries, which are presently sourced from critical materials that will have limited availability in the coming years.

#### **LINING YAO – HUMAN-COMPUTER INTERACTION INSTITUTE**

##### Breaking the Wall to Autonomous Self-Burying Seed Carriers

Lining Yao engineered a wood-based, three-tailed, biodegradable seed carrier capable of self-drilling into the ground in response to moisture fluctuations. Her invention has a higher success rate than that of natural self-drilling seeds, making it a valuable solution for agriculture and reforestation purposes.

#### **PO-CHUN HSU – UNIVERSITY OF CHICAGO**

##### Breaking the Wall to Human-Building-Energy Nexus

Po-Chu Hsu devised a method to provide independent and active control over visible light, sunlight, and ambient thermal radiation to building envelopes and wearable devices, accomplishing thermal comfort with zero fossil fuel and carbon emissions.

#### **SHIH-CHI CHEN – CHINESE UNIVERSITY OF HONG KONG**

##### Breaking the Wall to Using Ultrafast Multi-Material 3D Nanofabrication

Shih-Chi Chen developed a revolutionary nanoscale 3D printing platform based on femtosecond projection that supports nanofabrication with 20 different materials and addresses critical fabrication challenges in nanotechnology, photonics, energy, and biotechnology.

#### **SHENG XU – THE UNIVERSITY OF CALIFORNIA SAN DIEGO**

#### Breaking the Wall to Sense Under the Skin

Sheng Xu and his team invented a wearable ultrasound technology to sense signals from deep tissues, introducing a new sensing dimension to existing wearables.

#### **STEVE ALBRECHT – HELMHOLTZ-ZENTRUM BERLIN FÜR MATERIALIEN UND ENERGIE**

##### Breaking the Wall to the Limitation of the Electricity Generation from Sunlight

Steve Albrecht and his team set several world records in perovskite-based tandem solar cell efficiencies, highlighting the crucial importance of new solar materials like halide perovskites for climate change mitigation, energy justice, and security.

#### **WEI GAO – CALIFORNIA INSTITUTE OF TECHNOLOGY**

##### Breaking the Wall to Autonomous Skin-Interfaced Personalized Healthcare

Wei Gao innovated wearable sweat biosensors, enabling them to continuously analyze a broad spectrum of biomarkers and provide insightful personalized information for a broad range of fundamental investigations and clinical applications.

#### **XIADONG CHENG – NANYAN TECHNOLOGICAL UNIVERSITY**

##### Breaking the Wall to Stretchable Devices Assembly

Xiaodong Chen developed a universal interface to assemble stretchable devices simply and quickly, effectively overcoming the challenge of fragile connections in such devices.

#### **ZUANKAI WANG – HONG KONG POLYTECHNIC UNIVERSITY**

##### Breaking the Wall to the Leidenfrost Effect

Zuankai Wang revolutionized thermal engineering with the heterogeneous integration of materials with opposite thermal properties and distinct topographies, resulting in a persistent contact between liquid, solid and enhanced heat transfer.

#### **SOCIAL SCIENCES AND HUMANITIES**

#### **ARLINE GERONIMUS - UNIVERSITY OF MICHIGAN**

##### Breaking the Wall to Population Health Equity

Arline T. Geronimus introduced an alternative model based on the weathering theory to guide how we understand health inequity.

#### **BEATRIZ MAGALONI – STANFORD UNIVERSITY**

##### Breaking the Wall of Police Brutality

Beatriz Magaloni's work highlights the factors that cause brutal policing practices in democratic societies and identifies institutional solutions.

#### **ILONA MAGDALENA OTTO – UNIVERSITY OF GRAZ**

##### Breaking the Wall of Climate Inaction

Ilona Otto proposed systemic solutions that help rewire our societies, change human resource and energy use patterns, and decrease the pressure on climate and natural systems.

#### **JONATHAN BIRCH – LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE**

##### Breaking the Wall to a Science of Animal Sentience

Jonathan Birch addresses the fundamental question of how we should treat invertebrates laying the foundations for a systematic and fully integrated science of animal sentience.

#### **LAURA MARTIN – WILLIAMS COLLEGE**

##### Breaking the Wall to Ecological Restoration

Laura Martin frames biodiversity restoration as a mode of collaboration with other species and shows how even in this era of rapid climate change, it is possible to manage for and design wildness.

#### **LOUISE AMOORE – DURHAM UNIVERSITY**

##### Breaking the Wall to Ethical Societies in the Age of Algorithms

Louise Amoore provides the rethinking of practical intervention in machine learning models that are urgently required to keep pace with the penetration of society by algorithmic systems.

#### **MATTHIAS BRAUN – UNIVERSITY OF BONN**

##### Breaking the Wall to Bodily Integrity in the Digital Age

Matthias Braun tackles the question of how we can think, understand, and protect bodily integrity in dealing with new technologies.

#### **NITA FARAHANY – DUKE UNIVERSITY**

##### Breaking the Wall to Thinking Freely in the Age of Neurotechnology

Nita Farahany's work addresses the protection of cognitive liberty in a world that is rapidly heading toward brain transparency, allowing us to track and hack our own brains but bars us from trespassing on other minds.

#### **PAUL BEHRENS – LEIDEN UNIVERSITY**

##### Breaking the Wall to Rethinking our Food System

Paul Behrens demonstrates why a transformation of our food system is essential to combat climate change and explains what role dietary changes in high-income countries play in this process.

#### **PUMLA DINEO GQOLA – NELSON MANDELA UNIVERSITY**

##### Breaking the Wall of the Female Fear Factory

Explaining how gender and fear intersect in public spaces, Pumla Gqola's "Female Fear Factory" is a theatrical and public performance of patriarchal policing of and violence towards women and others cast/read as female.

### **ART AND SCIENCE**

#### **ANA MARÍA GÓMEZ LÓPEZ – SANDBERG INSTITUTE, ROYAL ACADEMY OF FINE ART**

##### Breaking the Wall to Self-Experimentation

Using an ophthalmological prosthetic designed to collect tears, Ana María Gómez López carried out a self-experiment to achieve an intra-corporeal plant growth in her eyelid.

#### **CHRISTA SOMMERER & LAURENT MIGNON – INTERFACE CULTURES UNIVERSITY OF ART AND DESIGN LINZ**

##### Breaking the Wall to The Artwork as a Living System

Christa Sommerer & Laurent Mignonneau pioneered the art of interface, in which innovative technical interfaces enable the visitor to physically interact with the artwork.

#### **DIETMAR OFFENHUBER – NORTHEASTERN UNIVERSITY**

##### Breaking The Wall to Plant-Based Air Quality Monitoring

Dietmar Offenhuber developed „Ozone tattoo” as a plant-based visualisation system to detect harmful levels of ground-level ozone, a pollutant connected to both climate change and air pollution.

#### **ELAINE CHEW – KING'S COLLEGE LONDON**

##### Breaking the Wall to Understanding Music's Effect on the Heart

To see the effect of music on the heart, Elaine Chew creates models to characterise and visualise performed and composed music structures linking those to physiological signals from wearable sensors.

#### **HEATHER DEWEY-HAGBORG – INDEPENDENT ARTIST**

##### Breaking The Wall to Using Art To Reveal Xenotransplantation Research

Through her art installation, Heather Dewey-Hagborg confronts the viewer with the emerging science and medical reality of xenotransplantation research.

#### **HELENA NIKONOLE – INDEPENDENT ARTIST**

##### Breaking the Wall to Bio-Semiotic Innovations

Helena Nikonole developed DIY approaches for modifying human skin microbiome to produce smells that can be easily detected to self-diagnose or prevent diseases.

#### **JANET LAURENCE – UNIVERSITY OF NEW SOUTH WALES**

##### Breaking The Wall to An Experiential Interconnectedness Of Care For Our Nature

Janet Laurence explores human physical, cultural, and conflicting relationships with nature using evocative natural materials in her immersive installations.

#### **MARGARET WERTHEIM – INSTITUTE OF FIGURING**

##### Breaking the Wall to Women-Centered Community-Based Sci-Art

Margaret Wertheim works with communities worldwide to create complex sculptural installations that emulate coral reefs in a collective response to the devastation of living reefs by global warming and oceanic plastic trash.

#### **NATALIA RIVERA – UNIVERSITÄT DER KÜNSTE**

##### Breaking the Wall to Resist like Bacteria

Natalia Rivera developed the website BiOfilm.net, which aims to facilitate the connection to alternative networks and acknowledge the importance of seeking autonomy in modern communication technologies.

#### **SHEUNG YIU – AALTO UNIVERSITY**

##### Breaking the Wall to the Scale and Resolution Limit in Earth Observation

With her project “Ground Truth” Sheung Yiu explores cutting-edge imaging techniques, using meticulous on-site measurements of physical structures and spectral properties of trees.

## **SCIENCE AND INNOVATION MANAGEMENT**

### **ABDOULAYE DIABATE – INSTITUT DE RECHERCHE EN SCIENCES DE LA SANTE, BURKINA FASO**

#### Breaking the Wall to Ownership within Malaria Elimination

Abdoulaye Diabaté founded Target Malaria, a nonprofit research consortium that enables full community participation to ensure ownership and fill knowledge gaps.

### **CARLOS GARCIA DE LEANIZ – SWANSEA UNIVERSITY & BLUE RIVERS FOUNDATION, UK**

#### Breaking the Wall to Reconnecting Our Broken Rivers

Carlos Garcia de Leaniz created AMBER (“Adaptive Management of Barriers in European Rivers”) to provide the first comprehensive estimate of river fragmentation in Europe based on empirical and modeled barrier densities.

### **FERNANDA STANISCUASKI – FEDERAL UNIVERSITY OF RIO GRANDE DO SUL, BRAZIL**

#### Breaking the Wall to Equality in Science for Mothers

Fernanda Staniscuaski started the Parent in Science Movement to raise awareness of the barriers faced by academic mothers and how to dismantle them.

### **FLORIAN MONTEL – BOEHRINGER INGELHEIM, GERMANY**

#### Breaking the Wall to Democratize Life Science Innovation

With opnMe, Florian Montel shares well-characterized pre-clinical tool compounds with scientists from around the world who seek straightforward access to molecules of the highest quality.

### **HUADONG GUO – INTERNATIONAL RESEARCH CENTER OF BIG DATA FOR SUSTAINABLE DEVELOPMENT GOALS, CHINA**

#### Breaking the Wall to Big Data for SDGs

Huadong Guo established the International Research Center of Big Data for Sustainable Development Goals (CBAS) as a global platform to organize innovative data science research for the UN SDGs.

### **JOSHUA NICHOLSON – SCITE, USA**

#### Breaking the Wall to Next-Generation Citations

Joshua Nicholson created scite to help researchers better discover and understand research articles through Smart Citations.

### **MEHAK MUMTAZ - ILOF - INTELLIGENT LAB ON FIBER, UK**

#### Breaking the Wall to Personalized Medicine

Mehak Mumtaz developed iLoF, a digital AI-platform to accelerate the future of personalized drug discovery and development.

### **PATRICK STARKE & MARKUS ZLABINGER – TU WIEN INNOVATION INCUBATION CENTER, IMAGETWIN AI GMBH, AUSTRIA**

#### Breaking the Wall to Research Integrity

Patrick Starke and Markus Zlabinger created Imagetwin, a solution to detect manipulations and duplications in figures of scientific articles.

### **RAMON FLECHA – UNIVERSITY OF BARCELONA, SPAIN**

#### Breaking the Wall to the Diversification of Citizen Engagement in Science

Ramon Flecha created ALLINTERACT, an innovative platform to foster the dialogue between scientists and citizens about scientific evidence and social impact.

### **ROBERT KACZMARCZYK - LAION e.V., GERMANY**

#### Breaking the Wall to the Democratization of Large-Scale AI

Robert Kaczmarczyk founded LAION to democratize AI research by providing open access to advanced AI models, tools, and datasets, fostering public engagement and awareness, and promoting international collaboration to create a transparent and inclusive AI ecosystem that benefits everyone.

