

Falling Walls Science Breakthrough of the Year 2024: These Groundbreaking Ideas Compete for the Title

- Since 2009 Falling Walls identifies Science Breakthroughs for humankind arising from academia.
- Today, the Falling Walls Foundation announces the shortlist for the Science Breakthrough of the Year 2024 title. The high-level jury reviewed over 1,000 entries from 52 countries.
- For the first time, the Women's Impact Award category (Female Science Talents) was part of the Global Call in 2024 to recognise women scientists who conduct visionary research while also engaging with issues of gender equity and equality science.
- The laureates will be announced on Thursday, 12 September, and will 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 2024 at falling-walls.com/science-summit/.

Berlin, 21 August 2024: The category **Life Sciences** includes groundbreaking research on identifying and modulating dysfunctional brain circuits to treat neurological disorders, redefining human genetic diversity through the human pangenome project, and pioneering vaccines targeting gliomas. Other research highlights include advanced imaging techniques for visualising cardiac health, and innovative approaches to drug delivery and tissue visualisation.

In **Physical Sciences**, the projects showcase remarkable achievements such as the first detection of X-ray signals from a single atom, quantum-level control of micro- and nanoscale objects at room temperature, and new materials enhancing X-ray imaging. Breakthroughs also include innovations in quantum communication and optomechanical metamaterials, as well as nuclear laser excitation that opens new possibilities in quantum nucleonics.

The winners in **Engineering & Technology** present novel solutions like bio-inspired robotics for real-world applications, energy-efficient AI systems, solar-driven water purification, and advanced capacitor technologies. Additionally, research on solid-state batteries, non-invasive thermal sensation for prosthetics, and semiconductor devices without wafers highlighted the transformative potential of engineering in addressing global challenges.

Among the topics in **Social Sciences & Humanities** are research on adolescent mental health in Sub-Saharan Africa, the psychological impact of identity fusion, neurorights in the age of neurotechnology, and innovative models to counteract misinformation. The category also features work on enhancing democratic inclusion, improving vision care accessibility, and leveraging technology for economic development in Africa.

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In **Art & Science**, the topics range from exploring the influence of algorithms on human autonomy and creating multisensory experiences from climate data, to reimagining microplastic pollution and developing sustainable cultural expressions. Projects also tackle the decolonisation of AI and proposed new forms of creative expression through the integration of cerebral organoids with robotic systems.

Selected in collaboration with the partners Elsevier Foundation and VolkswagenStiftung, the winning projects of the **Women's Impact Award** category (Female Science Talents) cover topics such as medical material innovation for women's health, gender-sensitive tuberculosis screening in remote areas, and holistic oncological care through biotech innovations.

Find the overview of all shortlisted projects below.

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About the Falling Walls Science Summit

Falling Walls Science Summit is the forum for global science leaders with focus on science driven 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, policy makers and media worldwide.

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

LIFE SCIENCES

ALI MAXIMILIAN ERTÜRK – HELMHOLTZ MUNICH

Breaking the Wall of Animal Use in Research

Ali Ertürk's innovative approach combines tissue clearing techniques with AI to visualise and analyse biological tissues at the cellular level. This method reduces the reliance on animal research, enhances data quality, and accelerates scientific discovery.

ANDREAS HORN – BRIGHAM & WOMEN'S HOSPITAL

Breaking the Wall of Dysfunctional Brain Circuits

Andreas Horn's research focuses on identifying and modulating dysfunctional brain circuits to treat neurological and psychiatric disorders. His work in Deep Brain Stimulation has broad implications for diseases such as Parkinson's, OCD, and depression.

BEN BLACK – UNIVERSITY OF PENNSYLVANIA

Breaking the Wall of Synthetic Human Chromosomes

Ben Black's research advances synthetic chromosome engineering, overcoming key barriers to create and deliver accurate synthetic human chromosomes. This breakthrough has potential applications in biotechnology, clinical treatments, and future genetic engineering.

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BENEDICT PATEN – UNIVERSITY OF CALIFORNIA, SANTA CRUZ

Breaking the Wall of Pangenomics

Benedict Paten's work on the human pangenome project is redefining our understanding of human genetic diversity by including a broader representation of global populations. This project is crucial for creating a more accurate and inclusive genetic reference.

ERICH JARVIS – ROCKEFELLER UNIVERSITY

Breaking the Wall of Understanding Language

Erich Jarvis's research reveals that advanced vocal learning in animals, like songbirds, is linked to greater cognitive abilities and brain size, challenging the notion that spoken language is uniquely human. His findings suggest that the cognitive skills underlying language are more widespread across species than previously believed.

GARRY DUFFY – UNIVERSITY OF GALWAY

Breaking the Wall of Implantable Drug Delivery

Garry Duffy's development of a dynamic soft reservoir for drug delivery overcomes the foreign body response, improving the long-term efficacy and integration of implantable devices. This technology ensures consistent drug dosing and reduces treatment interruptions.

MENGXING TANG – IMPERIAL COLLEGE LONDON

Breaking the Wall of Heart Vessel Mapping

Mengxing Tang has developed non-invasive super-resolution imaging techniques for visualising small blood vessels in the heart. This advancement offers new insights into cardiac health and has the potential to improve diagnosis and treatment of cardiovascular diseases.

MICHAEL FISCHBACH – STANFORD UNIVERSITY

Breaking the Wall of Commensal Vaccines

Michael Fischbach's research is transforming vaccine development by creating low-cost, easily distributable vaccines based on commensal bacteria. These vaccines aim to overcome current limitations, offering broader protection and accessibility, especially in low-resource settings.

MICHAEL PLATTEN – GERMAN CANCER RESEARCH CENTER

Breaking the Wall of Brain Tumor Vaccines

Michael Platten's pioneering work on vaccines targeting gliomas activates the immune system to fight cancer-causing mutations, offering new hope for treating these typically incurable brain tumours.

STEPHEN O'RAHILLY & MARLENA FEJZO – UNIVERSITY OF CAMBRIDGE & UNIVERSITY OF SOUTHERN CALIFORNIA

Breaking the Wall of Pregnancy Sickness

Marlena Fejzo and Stephen O'Rahilly have uncovered the genetic and hormonal causes of Hyperemesis Gravidarum, a severe pregnancy-related condition. Their research opens new avenues for prevention and treatment, improving maternal health outcomes.

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PHYSICAL SCIENCES

EWOLD VERHAGEN – AMOLF

Breaking the Wall of Programmable Metamaterials

Ewold Verhagen's research on optomechanical metamaterials allows the creation of novel photonic and phononic phases of matter with unique properties. This work has significant potential for future technologies in sensing, quantum devices, and information processing.

LIANG JIE WONG – NANYANG TECHNOLOGICAL UNIVERSITY

Breaking the Wall of Quantum X-ray Tech

Liang Jie Wong's research on quantum X-ray technology is set to revolutionize fields such as medical diagnostics, industrial inspection, and security scanning. By leveraging quantum science, he has developed more compact, safer, and effective X-ray solutions.

MARK LEVIN – UNIVERSITY OF CHICAGO

Breaking the Wall of Molecular Editing

Mark Levin's work in molecular editing introduces novel chemical reactions that allow precise modifications to molecules, akin to genetic editing. This innovation has the potential to transform fields like medicinal chemistry, enabling more efficient drug design.

MARTIN ZWIERLEIN – MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Breaking the Wall of Complex Quantum Matter

Martin Zwierlein uses ultracold quantum gases to explore complex quantum systems, revealing new states of matter. His work advances our understanding of phenomena like superfluidity and high-temperature superconductors.

NILS JOHAN ENGELSEN & TOBIAS KIPPENBERG – CHALMERS INSTITUTE OF TECHNOLOGY

Breaking the Wall of Quantum Drum Vibrations

Nils Johan Engelsen and Tobias Kippenbergs research has achieved quantum-level control of micro- and nanoscale objects at room temperature. This breakthrough opens new possibilities for advanced sensing technologies and tests of fundamental physics.

RICHARD TOWN – LAWRENCE LIVERMORE NATIONAL LABORATORY

Breaking the Wall of Fusion Gain

Richard Town played a pivotal role in achieving the first-ever controlled thermonuclear fusion reaction that generated more energy than the input laser energy, marking a significant milestone towards developing a nearly limitless low-carbon energy source.

SAW WAI HLA – OHIO UNIVERSITY AND ARGONNE NATIONAL LABORATORY

Breaking the Wall of 128 Years of X-ray History

Saw Wai Hla's team has achieved the first-ever detection of X-ray signals from a single atom, revolutionising the field of X-ray spectroscopy. This advancement enables unprecedented levels of material characterisation, impacting quantum technology and beyond.

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SIMON STORZ – ETH ZÜRICH

Breaking the Wall of Quantum Communication

Simon Storz has pioneered microwave-based quantum communication between quantum devices over long distances. His work establishes the foundation for future quantum interconnects, essential for the development of large-scale quantum computing systems.

THORSTEN SCHUMM & EKKEHARD PEIK – VIENNA UNIVERSITY OF TECHNOLOGY / TU WIEN & PTB GERMANY

Breaking the Wall of Light-Matter Interaction

Thorsten Schumm and Ekkegard Peik's successful nuclear laser excitation in Thorium-229 marks a new era in low-energy nuclear physics. This groundbreaking work opens new research opportunities in quantum nucleonics and beyond.

XIAOGANG LIU – NATIONAL UNIVERSITY OF SINGAPORE

Breaking the Wall of X-ray Imaging

Xiaogang Liu's research addresses the challenges of conventional X-ray imaging by developing novel optical nanomaterials. These materials enhance the efficiency, quality, and durability of scintillators, leading to improved medical diagnostics, space exploration, and environmental monitoring.

ENGINEERING & TECHNOLOGY

ANDREAS GÜNTNER – ETH ZÜRICH

Breaking the Wall of Electronic Scent Detection

Andreas Güntner introduces portable gas sensors that can be integrated into electronic devices, enabling non-invasive health diagnostics through breath analysis. This innovation has the potential to revolutionise healthcare by providing early disease detection and personalised treatment options.

CANAN DAGDEVIREN – MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Breaking the Wall of Breast Cancer Detection

Canan Dagdeviren innovates medical ultrasound imaging by developing flexible, wearable ultrasound devices capable of scanning curved body surfaces. Her research addresses critical gaps in current ultrasound technology, particularly in breast cancer screening, offering a new non-invasive method for early detection.

FRANCK RUFFIER – NATIONAL CENTRE FOR SCIENTIFIC RESEARCH (CNRS)

Breaking the Wall of Bio-Inspired Robotics

Franck Ruffier's research demystifies visual guidance in animals by introducing bio-inspired principles for robotics using optic flow and low-resolution vision. His work enhances understanding through real-world robotic applications, including drone stabilisation and seabird take-off behaviours, showing the broad applicability of optical flow regulation.

GUIHUA YU – UNIVERSITY OF TEXAS AT AUSTIN

Breaking the Wall of Solar Water Sustainability

Guihua Yu's research focuses on solar-driven water purification technologies, developing novel hydrogel materials that achieve record-high evaporation rates and efficient atmospheric water harvesting. His

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work offers sustainable solutions for clean water production, addressing critical environmental challenges.

JEEHWAN KIM – MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Breaking the Wall of Semiconductor 3D Integration

Jeehwan Kim has pioneered wafer-free 3D integration of semiconductor devices, significantly advancing the performance and efficiency of electronic and optoelectronic systems. His work eliminates the need for traditional wafer-based processes, reducing costs and complexity in semiconductor manufacturing.

SANG-HOON BAE – WASHINGTON UNIVERSITY

Breaking the Wall of Energy Density Limits

Sang-Hoon Bae has developed groundbreaking methods to enhance the energy density of capacitors, addressing the limitations of conventional materials. This innovation promises more efficient energy storage solutions, with significant implications for portable electronics and electric vehicles.

SOLAIMAN SHOKUR – CHUV: CENTRE HOSPITALIER UNIVERSITAIRE VAUDOIS

Breaking the Wall of Thermal Sensations in Amputees

Solaiman Shokur introduces a non-invasive technology that allows amputees to perceive thermal sensations through their prosthetic hands. This innovation enhances the sensory experience for prosthetic users, improving their quality of life and the embodiment of prostheses.

WALT DE HEER – GEORGIA INSTITUTE OF TECHNOLOGY

Breaking the Wall of Moore's Law

Walt de Heer's research on semiconducting graphene opens new possibilities for electronics beyond the limitations of silicon, potentially ushering in a new era of graphene-based semiconductors.

XIN LI – HARVARD UNIVERSITY

Breaking the Wall of Solid-State Battery Innovation

Xin Li's research revolutionises solid-state battery technology by unlocking new design opportunities that overcome the limitations of traditional batteries. His work on beneficial interface reactions within solid-state batteries promises safer, high-performance energy solutions.

YANG CHAI – THE HONG KONG POLYTECHNIC UNIVERSITY

Breaking the Wall of Efficient Sensory AI Systems

Yang Chai tackles the significant energy efficiency limitations of sensory AI, aiming to overcome the Power Consumption Wall, Latency Wall, and Memory Wall. His research paves the way for more energy-efficient, low-latency, and memory-optimised AI systems, making them more accessible for mobile and IoT applications.

SOCIAL SCIENCES & HUMANITIES

CHRISTIAN LEUZ – UNIVERSITY OF CHICAGO

Breaking the Wall of Intransparent Fracking Practices

Christian Leuz's research examines how transparency mandates, such as those for hydraulic fracturing, can reduce environmental impacts. His work combines natural and social sciences to provide evidence for effective policy interventions.

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EMMANUEL QUARSHIE – UNIVERSITY OF GHANA

Breaking the Wall of Adolescent Mental Health

Emmanuel Nii-Boye Quarshie's research addresses the high rates of adolescent suicide and self-harm in Sub-Saharan Africa. By exploring cultural understandings and providing interdisciplinary evidence, his work informs more effective mental health interventions and policies.

HARVEY WHITEHOUSE – UNIVERSITY OF OXFORD

Breaking the Wall of Climate Psychology

Harvey Whitehouse's research on identity fusion explores how deeply shared identities can motivate both conflict and cooperation. His work aims to harness this powerful psychological phenomenon to foster global unity and mitigate conflicts.

JON ROOZENBEEK – KING'S COLLEGE LONDON

Breaking the Wall of Propaganda

Jon Roozenbeek's project develops psychological "vaccines" against misinformation, exploring how propaganda influences public opinion. His work combines insights from psychology, sociology, and environmental science to counteract modern propaganda tactics.

KIMBERLY DOELL – UNIVERSITY OF VIENNA

Breaking the Wall of Climate Psychology

Kimberly Doell's project harnesses the expertise of diverse collaborators to test psychology-based interventions that boost climate awareness and action globally. Her work provides critical insights into the most effective strategies for promoting climate-conscious behaviour.

MICHAEL BRUTER – LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE (ELECTORAL PSYCHOLOGY OBSERVATORY)

Breaking the Wall of Democratic Exclusion

Michael Bruter redefines democratic inclusion by addressing the needs of underrepresented groups and how democratic processes can evolve to better serve diverse populations. His research has practical implications for improving participation and reducing political inequality.

NATHAN CONGDON – QUEEN'S UNIVERSITY BELFAST AND ORBIS INTERNATIONAL

Breaking the Wall of Vision-Driven Development

Nathan Congdon's research in low-cost vision care demonstrates how improved eyesight can enhance education and productivity in underserved communities. His work informs policy decisions that aim to make vision care more accessible globally.

RAFAEL PRIETO-CURIEL – COMPLEXITY SCIENCE HUB

Breaking the Wall of Drug Cartel Analysis

Rafael Prieto-Curiel's work uses mathematical models and limited available data to analyse the secretive nature of cartels in Latin America. His research aims to improve the effectiveness of policies targeting organised crime, reducing violence and fostering safer communities.

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RAFAEL YUSTE – COLUMBIA UNIVERSITY

Breaking the Wall of Neurorights Protection

Rafael Yuste advocates for "Neurorights" to safeguard brain activity in the age of neurotechnology. His work addresses the ethical challenges posed by brain-computer interfaces and neural augmentation, ensuring that human rights are preserved in the face of technological advancements.

YAW NYARKO – NEW YORK UNIVERSITY

Breaking the Wall of Rural Commodity Market Access

Yaw Nyarko's research leverages technology and market solutions to enhance the livelihoods of smallholder farmers in Africa. His initiatives, including mobile price alerts, nano commodity exchanges, and innovative credit schemes, aim to drive sustainable economic development in sub-Saharan Africa.

ART & SCIENCE

ANNA VERSHININA – KU LEUVEN

Breaking the Wall of 3D-Printed Eco-Habitats

Anna Vershinina's ExoGarden project offers resilient living solutions that integrate bioregenerative life support systems. This innovation supports both human and non-human life, addressing the urgent need for sustainable living in extreme, resource-scarce environments.

EGÓR KRAFT – UNIVERSITY OF ART & DESIGN LINZ, AT

Breaking the Wall of Disinformation

Ègor Kraft's work explores the concept of truth in digital ecosystems, developing tools that combat misinformation and engineered false narratives. His project leverages blockchain technology to create verifiable information ecologies, crucial for the integrity of digital communication.

FARA PELUSO – KARLSRUHE UNIVERSITY OF ARTS AND DESIGN

Breaking the Wall of Sustainable Sound Art

Fara Peluso's research focuses on creating circular LP records from algae-based bioplastics, challenging the carbon footprint of traditional music publishing. Her work bridges material innovation, cultural expression, and sustainable production methods.

GRÉGORY DARCY – DIETANZKOMPANIE

Breaking the Wall of Exclusion

Grégory Darcy's project aims to dismantle societal and technological barriers that create exclusion. His work envisions a world where diversity is celebrated, AI fosters inclusion, and interdisciplinary collaboration is embraced to address complex future challenges.

GUY BEN-ARY & NATHAN THOMPSON – SYMBIOTICA, UNIVERSITY OF WESTERN AUSTRALIA

Breaking the Wall of In-Vitro Intelligent Agents

Nathan Thompson and Guy Ben-Ary's work involves the embodiment of cerebral organoids with robotic bodies to create living artworks. This exploration of in-vitro intelligence challenges the boundaries of art and science, proposing new forms of creative expression and agency.

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JULIA JANSSEN – STUDIO JULIA JANSSEN

Breaking the Wall of Digital Heteronomy

Julia Janssen's installation, Mapping the Oblivion, critiques the influence of algorithms on human autonomy. Her work questions the extent to which data and AI should shape our choices, advocating for a reclaiming of human agency in the digital age.

KAT AUSTEN – STUDIO AUSTEN

Breaking the Wall of Plastic-Tree Coexistence

Kat Austen's project, Stranger to the Trees, shifts the perspective on microplastic pollution, examining its impact on trees and ecosystems. Her multimedia artwork redefines how we understand and interact with human-made materials in the natural environment.

MARCOS LUTYENS – INDEPENDENT ARTIST

Breaking the Wall of Reclaimed Oil Rigs

Marcos Lutyens' project challenges entrenched pro-oil and anti-ecology mindsets, using art to inspire a radical shift towards ecological sustainability. His work highlights the need for imaginative approaches to environmental decision-making.

TIANGE WANG – VLAB

Breaking the Wall of Multisensory Data

Tiange Wang's project, DataWagashi, transforms climate data into multisensory experiences using traditional Japanese confections. Her work makes complex information more accessible and relatable, fostering a deeper connection and understanding of climate issues.

RASHAAD NEWSOME – RASHAAD NEWSOME STUDIO

Breaking the Wall of Traditional Education

Rashaad Newsome's research focuses on decolonizing AI and data systems to overcome historical biases and inequalities. His work amplifies marginalized voices and reimagines education through interdisciplinary and participatory methods.

WOMEN'S IMPACT AWARD CATEGORY (FEMALE SCIENCE TALENTS)

INGE KATRIN HERRMANN – UNIVERSITY OF ZURICH

Breaking the Wall of W-HEALTH

Inge Katrin Herrmann is leading a transformative initiative to close the significant gap in women's health research. Through her W-HEALTH program, she is pioneering medical material innovations that address critical women's health issues, from endometriosis to gynecological cancers. Her work aims to overcome the systemic neglect of women's health, offering new hope for improved treatments and better health outcomes.

MARIANNA PROKOPI-DEMETRIADES – RSL REVOLUTIONARY LABS LTD, THERAMIR LTD, PROMED BIOSCIENCE LTD

Breaking the Wall of Holistic Oncological Care

Marianna Prokopi-Demetriades is breaking new ground in the field of cancer care through a holistic approach that prioritises patient well-being. Her work across three co-founded biotech companies—Theramir Ltd, Promed Bioscience Ltd, and RSL Revolutionary Labs Ltd—integrates cutting-edge research

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to deliver personalised cancer therapies and innovative dermaceuticals. Her efforts are reshaping oncological care, offering comprehensive solutions that enhance the quality of life for patients.

ANTONIA SAKTIAWATI – UNIVERSITAS GADJAH MADA

Breaking the Wall of Tuberculosis Screening in Indonesia

Antonia Saktiawati is driving a groundbreaking initiative to revolutionise tuberculosis screening in Indonesia, with a focus on gender equality and diversity in science. Her interdisciplinary approach brings together experts from various fields to tackle the TB epidemic, particularly in remote areas. By fostering collaboration with stakeholders and industry partners, Antonia's work not only advances scientific innovation but also empowers communities, making strides toward ending TB and promoting global health equity.