



FORECASTING INNOVATION FROM TODAY'S NOBEL- QUALITY SCIENCE

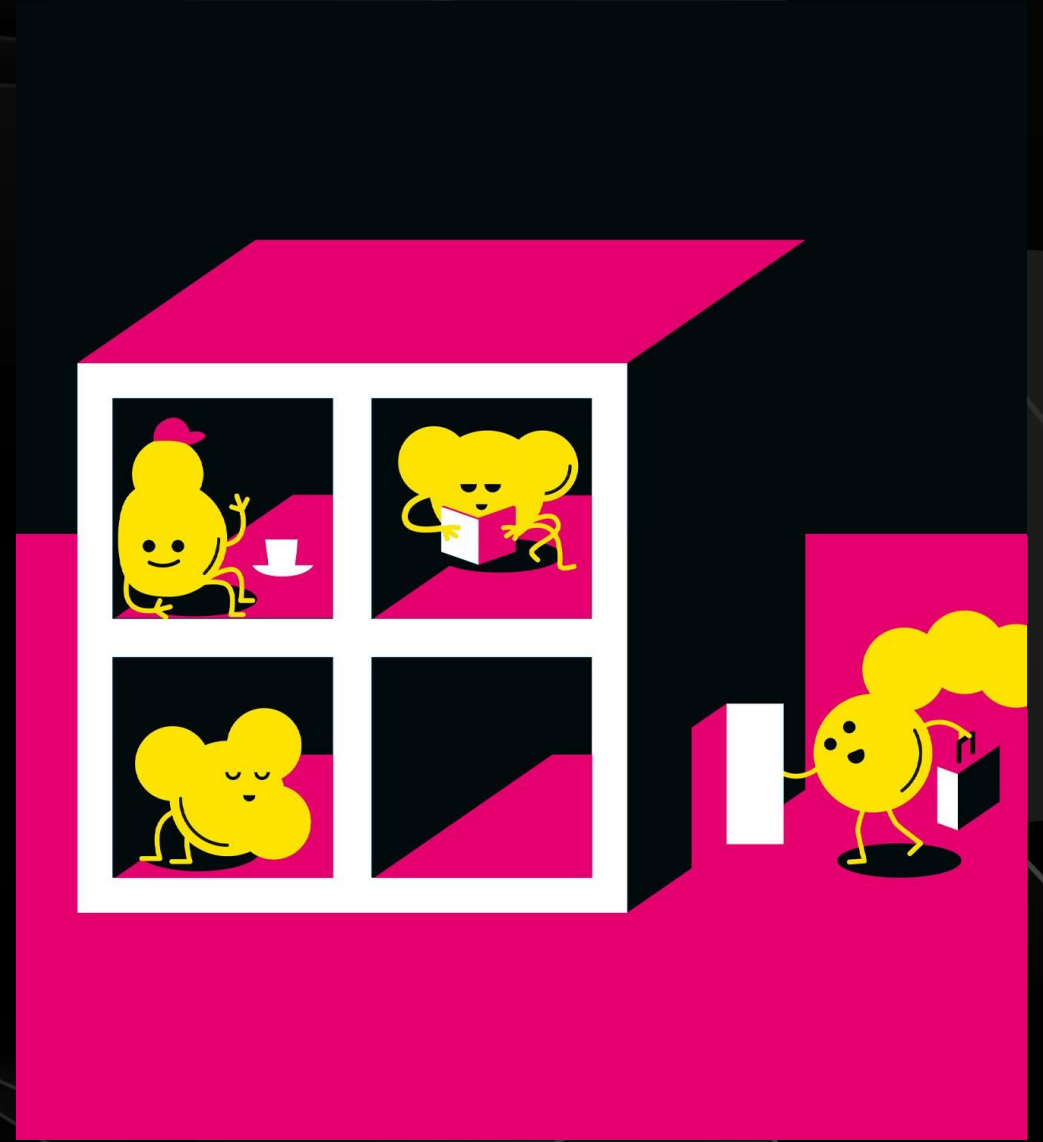


Arij van Berkel
Chief Product Officer

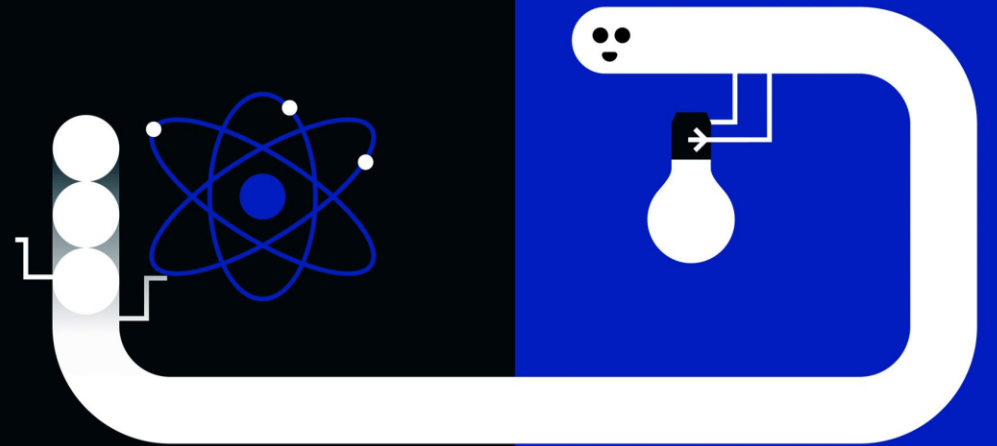
AGENDA

- 1 The Nobel Prize as an innovation tool
- 2 Understanding the 3 Ds of innovation
- 3 Predicting the next Nobel-quality innovation breakthrough

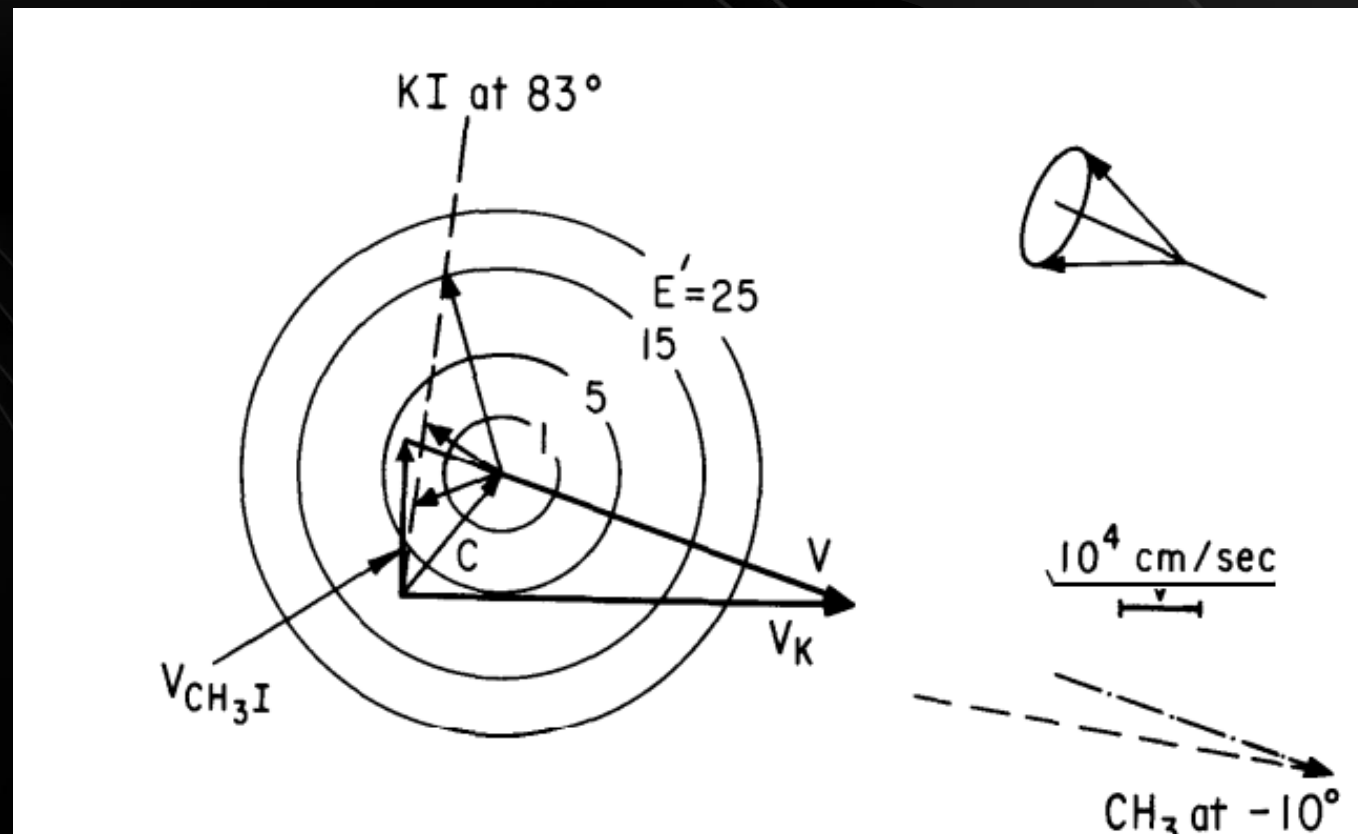
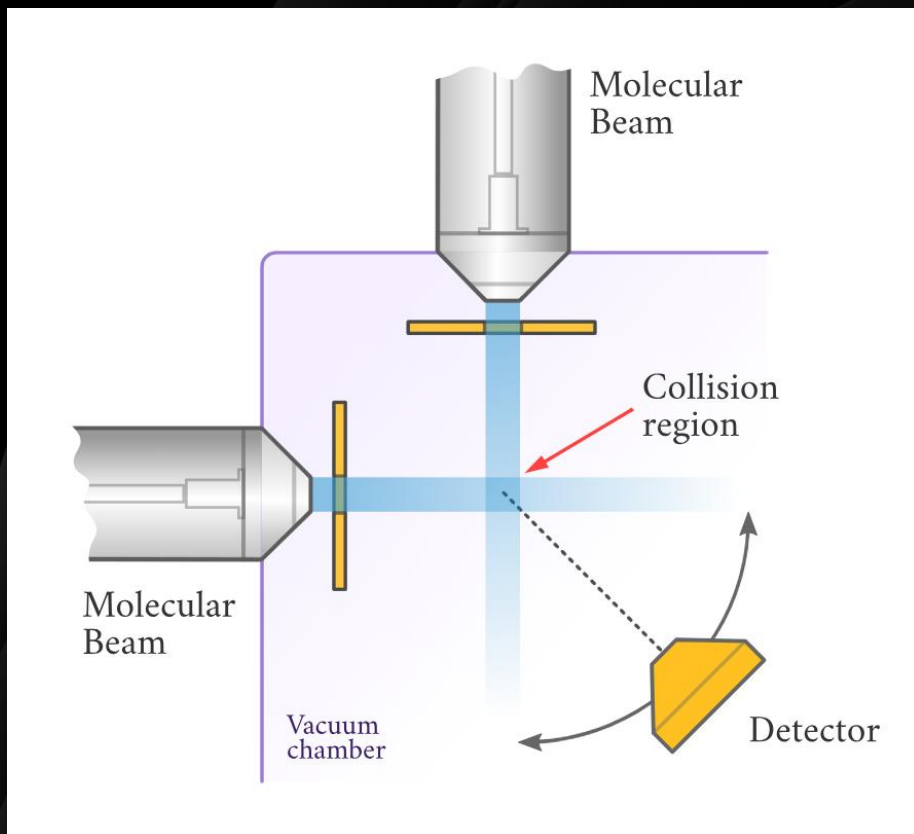
CONGRATULATIONS TO SUSUMU KITAGAWA, RICHARD ROBSON, AND OMAR YAGHI



**CONGRATULATIONS
TO JOHN CLARKE,
MICHEL DEVORET,
AND JOHN MARTINIS**



BERKELY IN THE 1950s AND 1960s



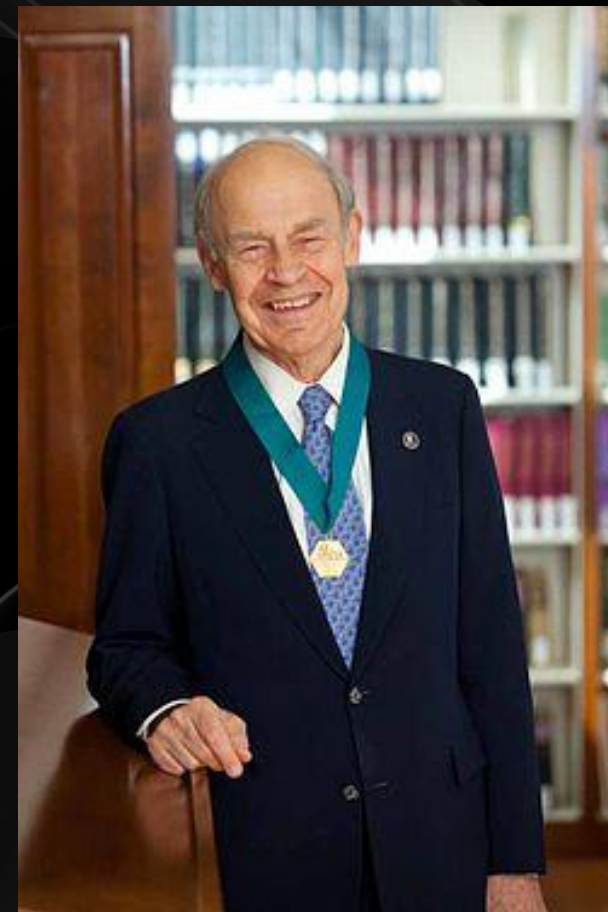
NOBEL PRIZE CHEMISTRY 1986



John Polanyi



Yuan Lee



Dudley Herschbach

THE EXCITEMENT THAT FOLLOWED

Engineering & Science
January-February 1980

Laser Selective Chemistry

A New Challenge for Chemists and Physicists

by Ahmed Zewail

How can molecules be cracked selectively with lasers, and what happens to them under heavy doses of laser radiation?

Laser Separation of Isotopes

The isotopes of an element, ordinarily indistinguishable, can be sorted out in the monochromatic light of a laser. The process may make isotopes plentiful for medicine, research and nuclear power

by Richard N. Zare



Chemical Physics Letters

Volume 126, Issue 6, 23 May 1986, Pages 541-546



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MOLECULAR BEAM SCATTERING FROM SOLID SURFACES

S. L. Bernasek and G. A. Somorjai

Department of Chemistry and Inorganic Materials Research Division,
Lawrence Berkeley Laboratory, University of California
Berkeley, California, U.S.A.

Control of unimolecular reactions using coherent light

Paul Brumer¹ , Moshe Shapiro

Department of Chemical Physics, The Weizmann Institute of Science, Rehovot 76100, Israel

Received 21 January 1986, Revised 3 March 1986, Available online 15 January 2002.

THE IMPACT IN INDUSTRY



“ ”

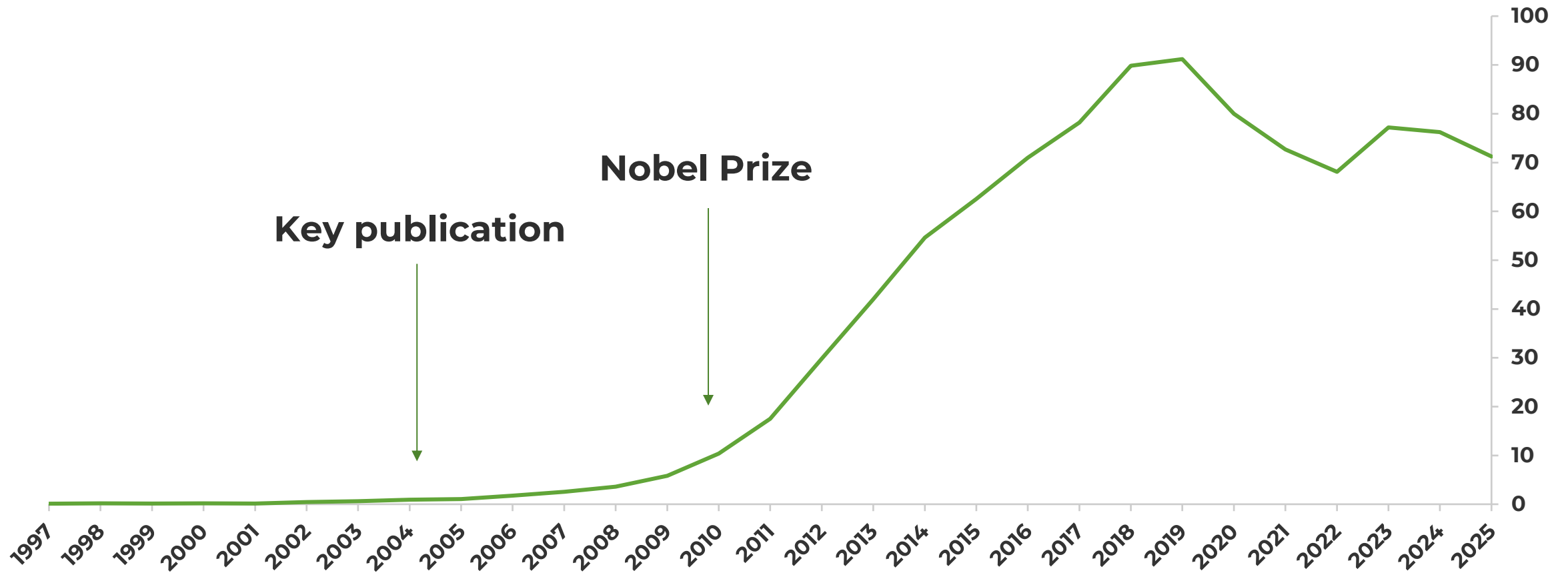
**Honestly, we funded
hundreds of
researchers...we had no
idea who we were
funding until they won
the prize.**

Corporate funder of Nobel Prize-winning
research, in conversation



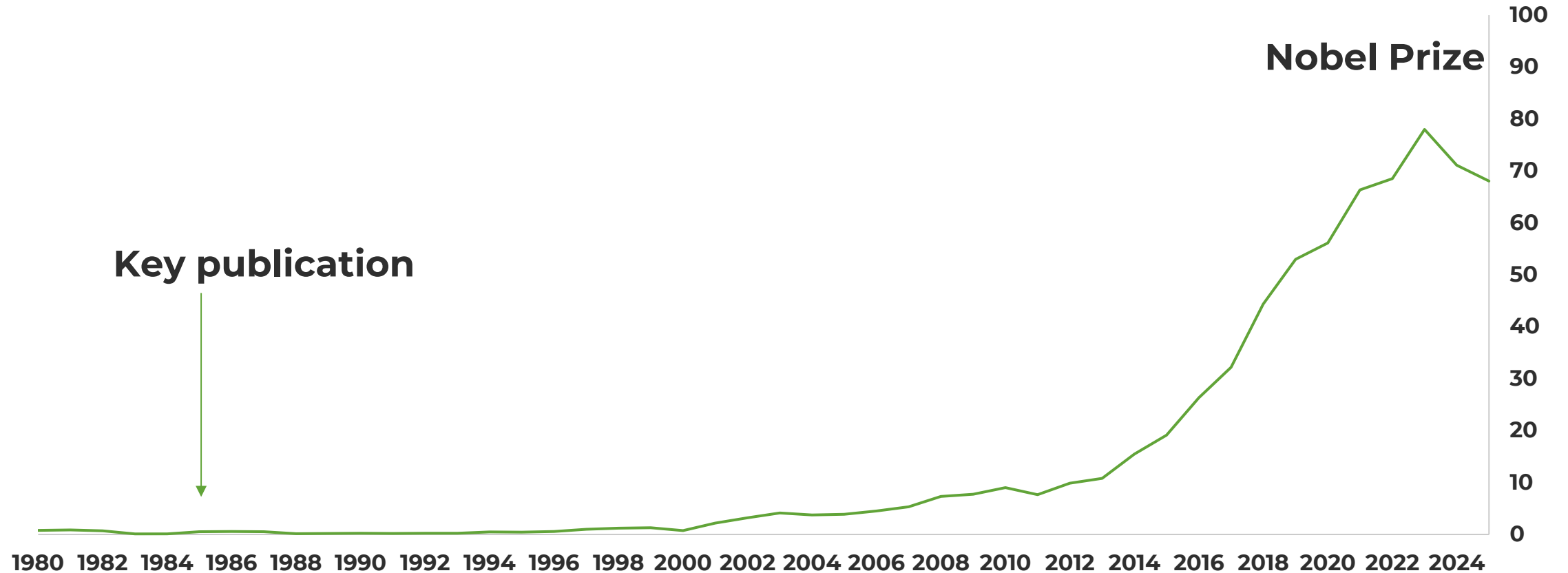
THE NOBEL PRIZE ISN'T A GREAT INDICATOR OF COMMERCIAL TIMING

Lux Tech Signal: Graphene



THE NOBEL PRIZE ISN'T A GREAT INDICATOR OF COMMERCIAL TIMING

Lux Tech Signal: MOFs



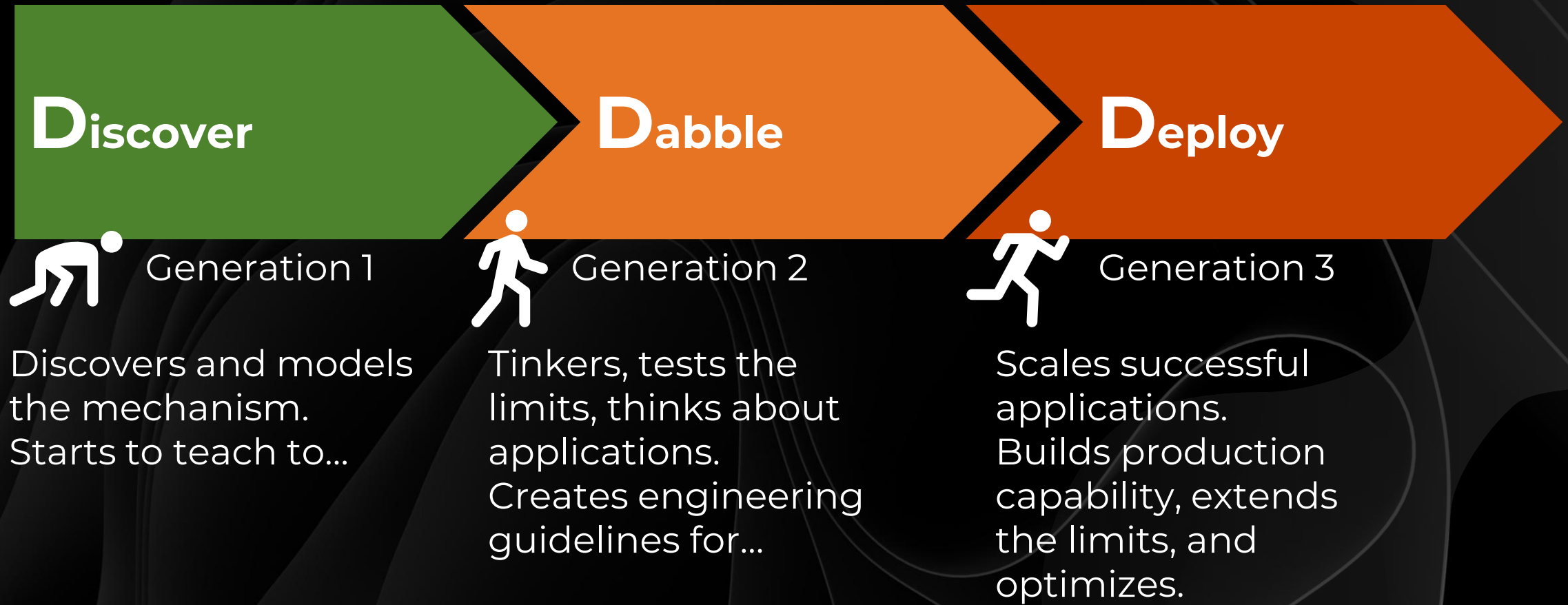


Scientific breakthroughs are hard to track and hard to understand.

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3 D OR RATHER... 3G



GIANT MAGNETORESISTANCE

PHYSICS 2007

Discover

1988



Showed that you can change electric conductivity by changing magnetization

Dabble

1991



Design rules: layer thickness, stability, manufacturing

Deploy

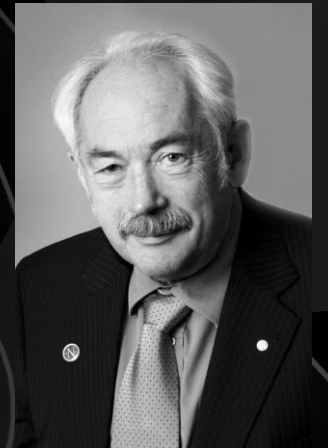
1997



IBM Deskstar hard drive is the first to use the effect in a commercial product



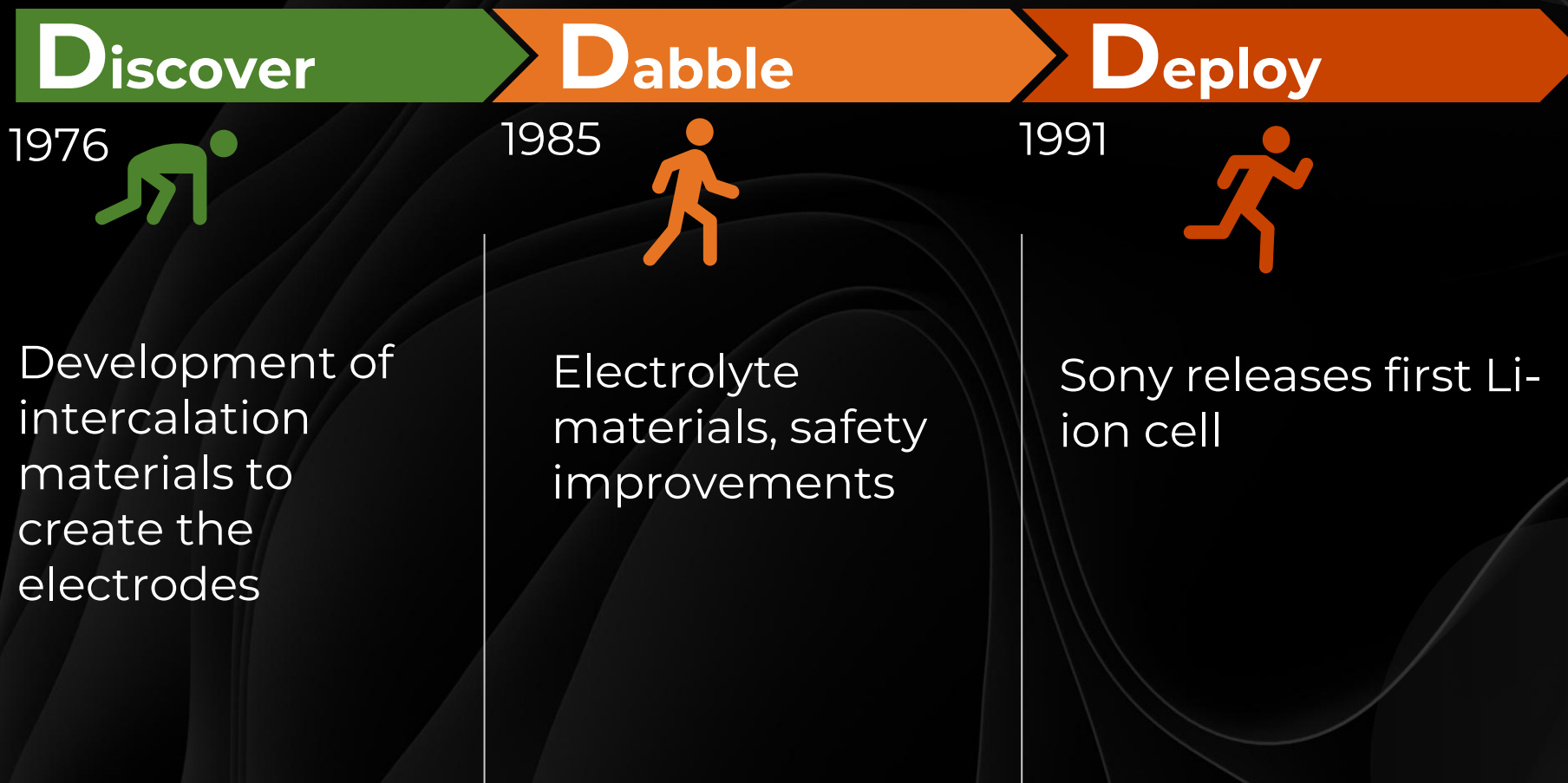
Albert Fert



Peter Grünberg

LITHIUM-ION BATTERIES

CHEMISTRY 2019



John Goodenough



Stanley Whittingham



Akira Yoshino

GRAPHENE

PHYSICS 2010

Discover

2004



Showed that you
can create 2D
layers of carbon
with simple
methods

Dabble

2007



Electronics,
composites,
sensors,
membranes

Deploy

Today?



....

Some niche
applications exist in
coatings and additive
materials



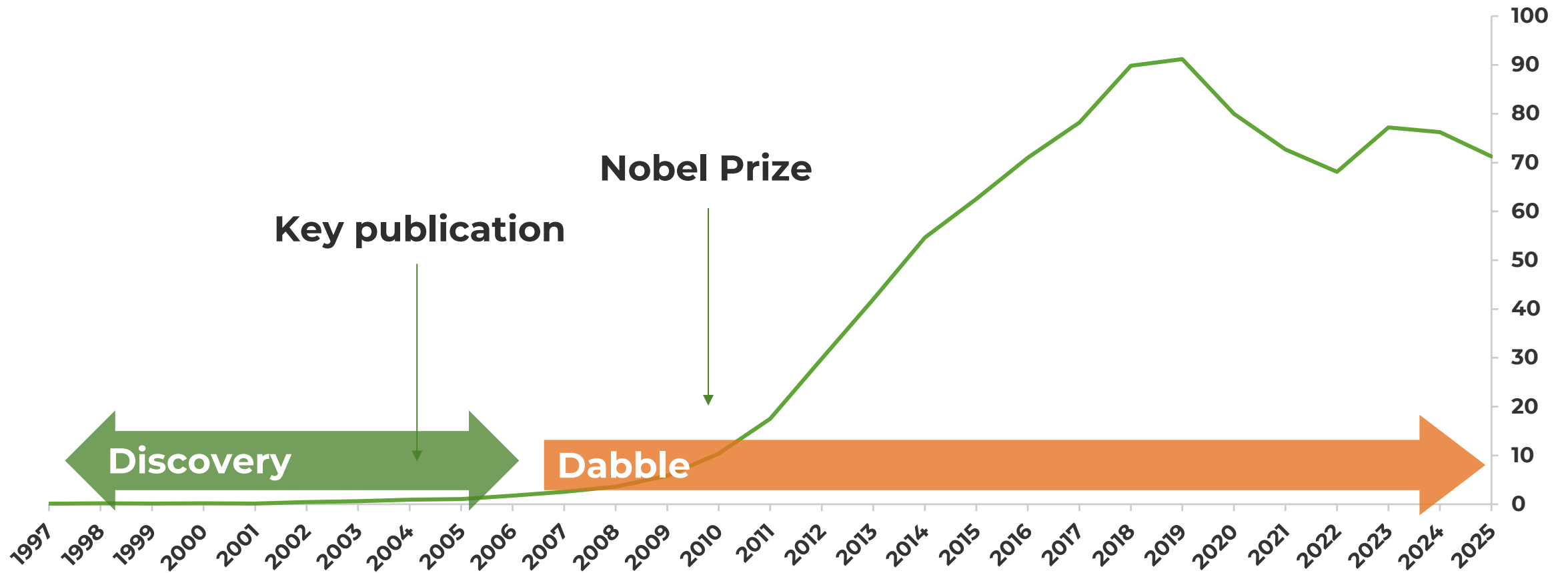
Andre Geim



Konstantin
Novoselov

THE LUX TECH SIGNAL TRACKS THE ONSET OF THE DABBLE STAGE

Lux Tech Signal: Graphene



FULLERENES

CHEMISTRY 1996

Discover

1985



Discovery of C₆₀ molecules

Dabble

1990



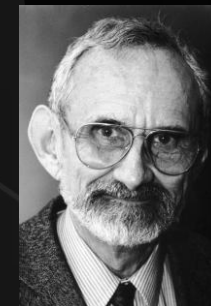
Drug delivery, solar cells, transistors, lubricants, composites, antioxidants

Deploy

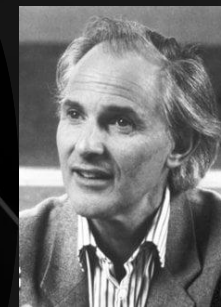
Today?



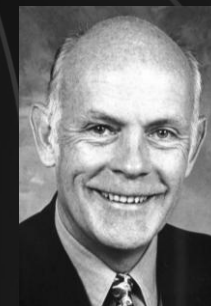
Limited use in photonics and some specialty materials



Robert Curl Jr.

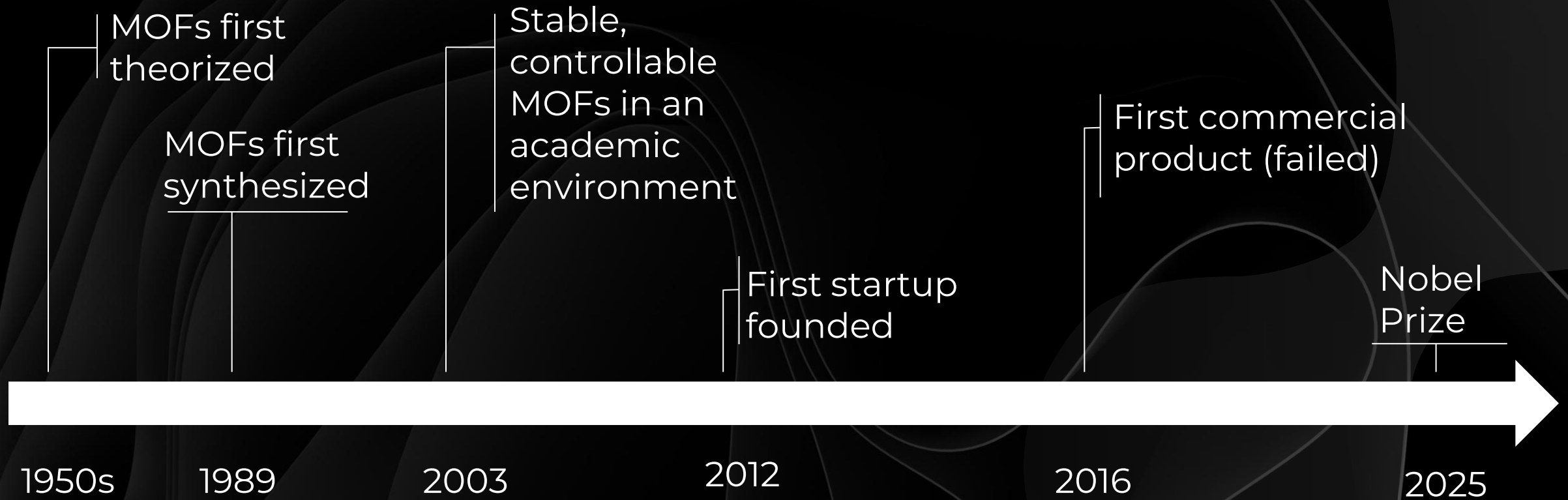


Sir Harold Kroto



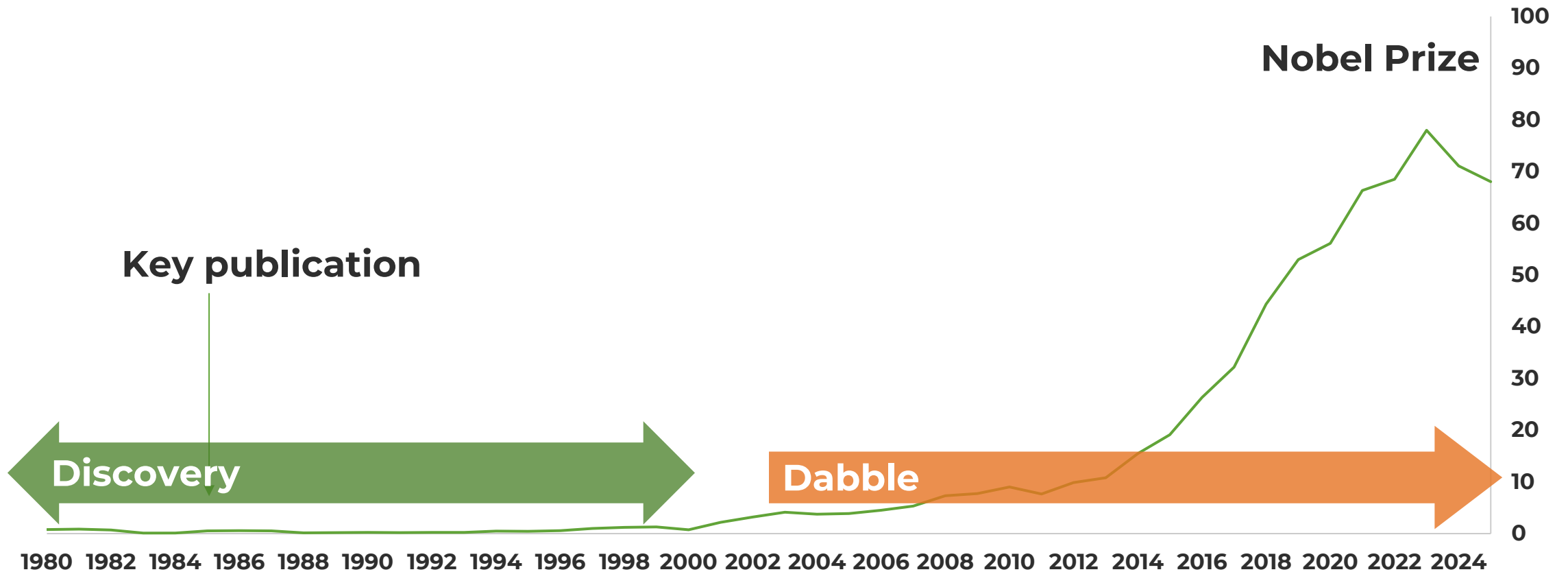
Richard Smalley

A QUICK HISTORY OF MOFS



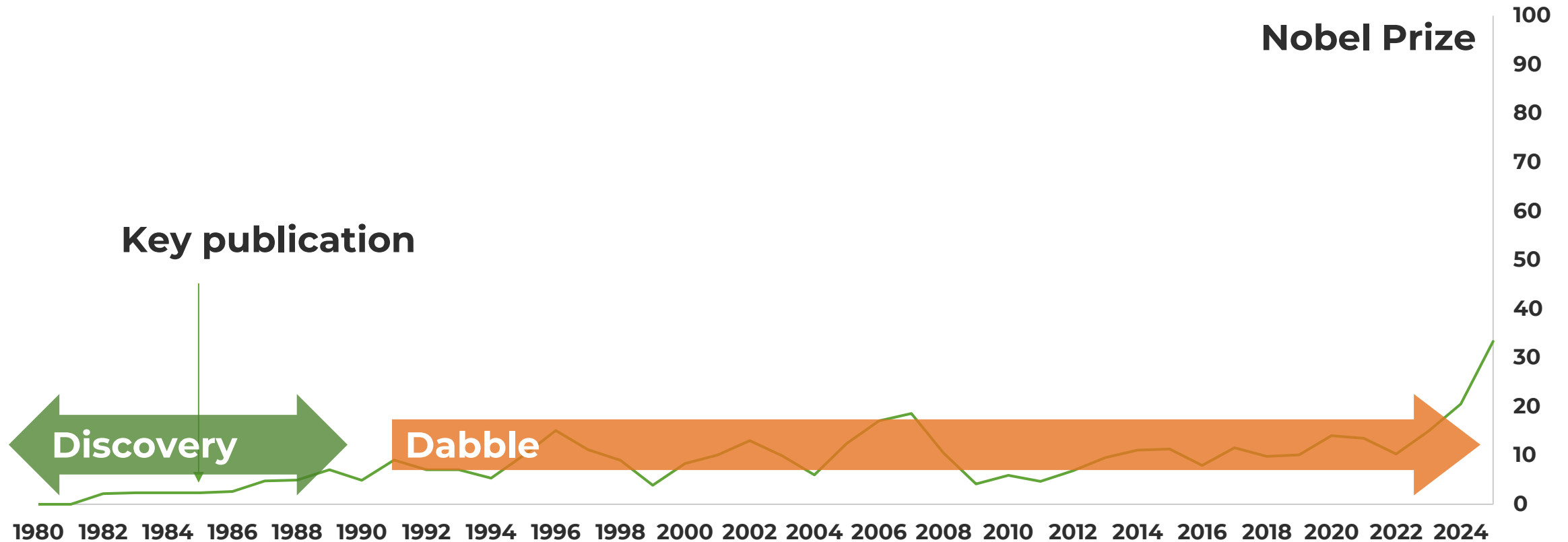
TECH SIGNAL TRACKS START OF DABBLING FOR MOFs

Lux Tech Signal: MOFs



PROLONGED DABBLING, JUST STARTING TO SCALE

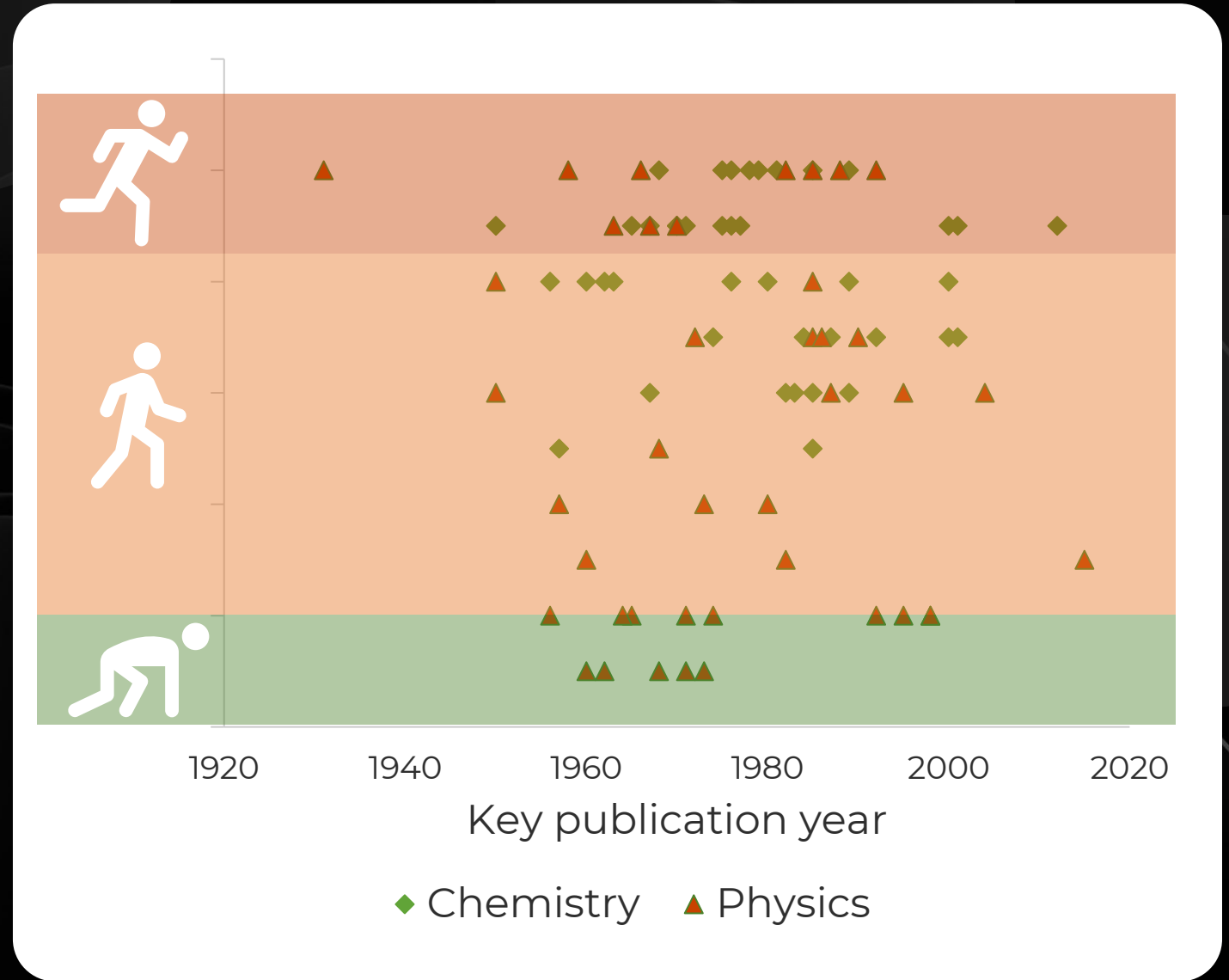
Lux Tech Signal: Macroscopic Quantum Tunneling



MAPPING ALL NOBEL PRIZES

All the physics and chemistry Nobel Prizes mapped on the 3D model show:

- Physics discoveries take longer to start dabbling and are harder to deploy.
- About 1/3 of the Nobel Prizes since 1985 are actively dabbling. This is your watch list.



OUR WATCHLIST OUT OF 40 YEARS NOBEL PRIZES

Nobel prize year	Research	Why watch
2016 chemistry	Molecular machines	Molecular elevators, switches, vehicles, and muscles
2011 chemistry	Quasi crystals	PFAS alternatives, low-friction coatings, novel catalysts, hydrogen storage
2001 physics	Bose-Einstein condensation	Photonics and quantum computing
1987 physics	High-temperature superconductivity	Power transmission, quantum computing
2012 physics	Control of individual quantum systems	Quantum sensors

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FORECASTING TOMORROW'S BREAKTHROUGHS

We scanned more than 3,000 Lux Tech Signals to find technologies with high growth, but low total signal, in the last two years. These technologies are likely to move from discovery to dabbling.

**YBCO
superconductors**

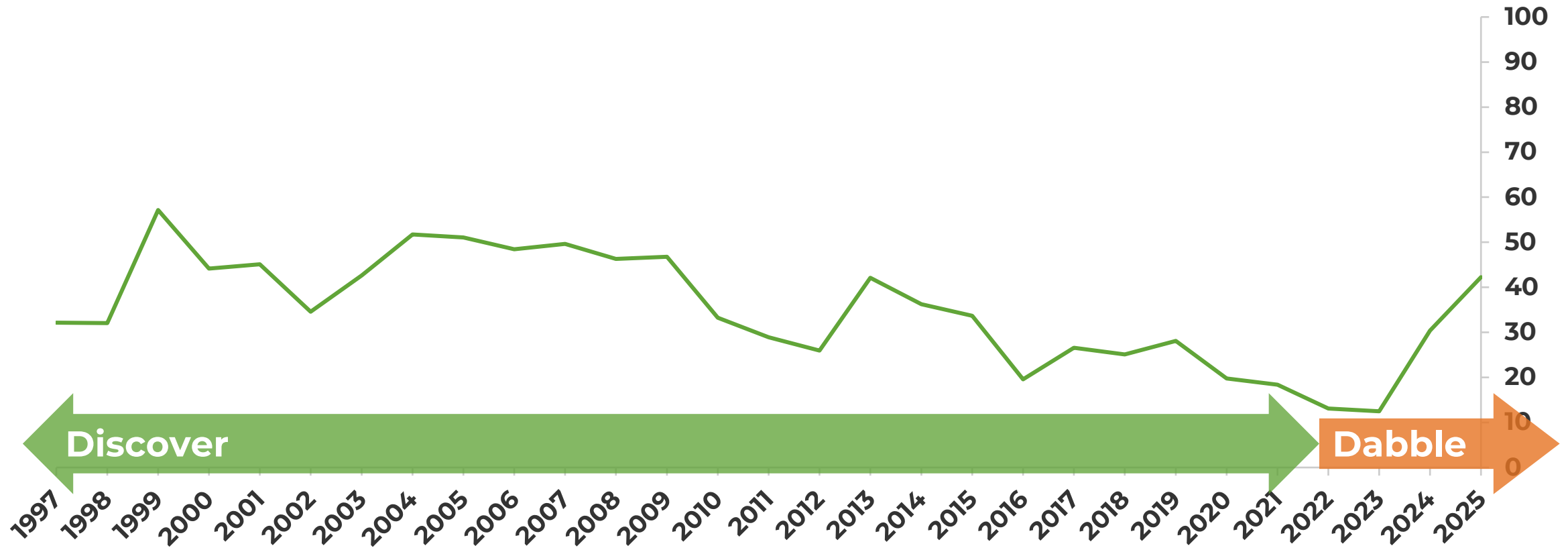
Recyclable curing agents

**Titanium-nitride
superlattices**

AlNiCo magnets

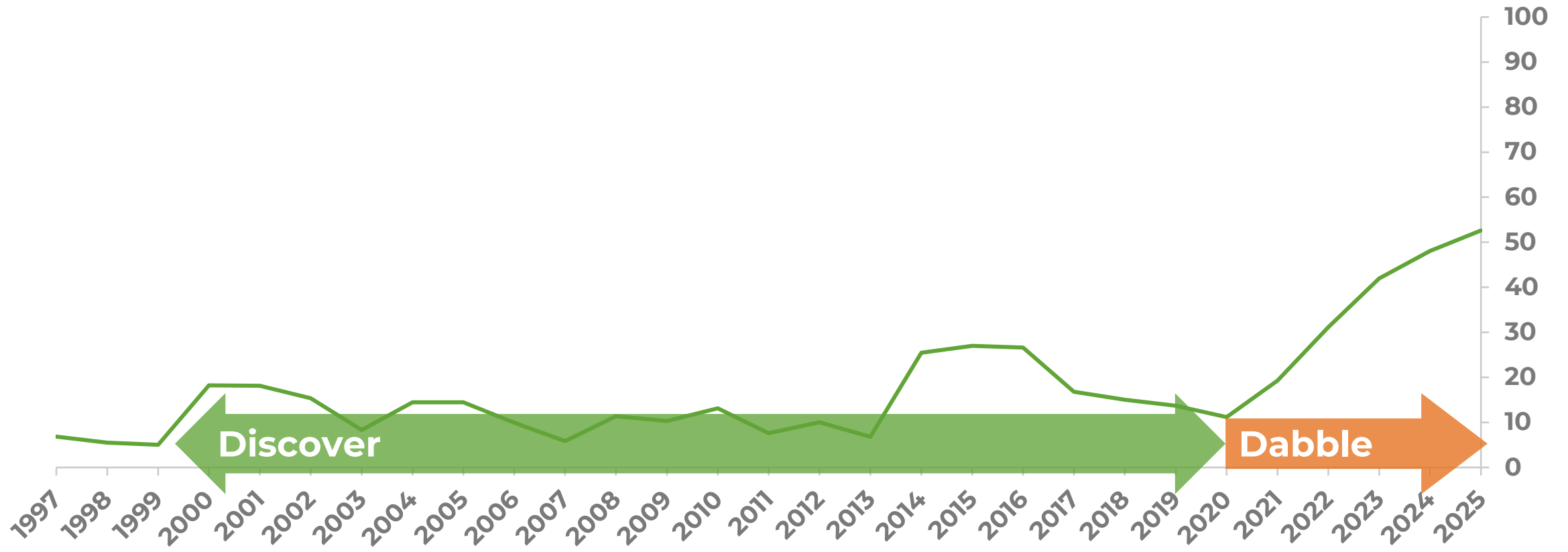
YCBO SUPERCONDUCTORS SUPPORT HIGH-POWER ELECTRONICS

Lux Tech Signal: YCBO Superconductors



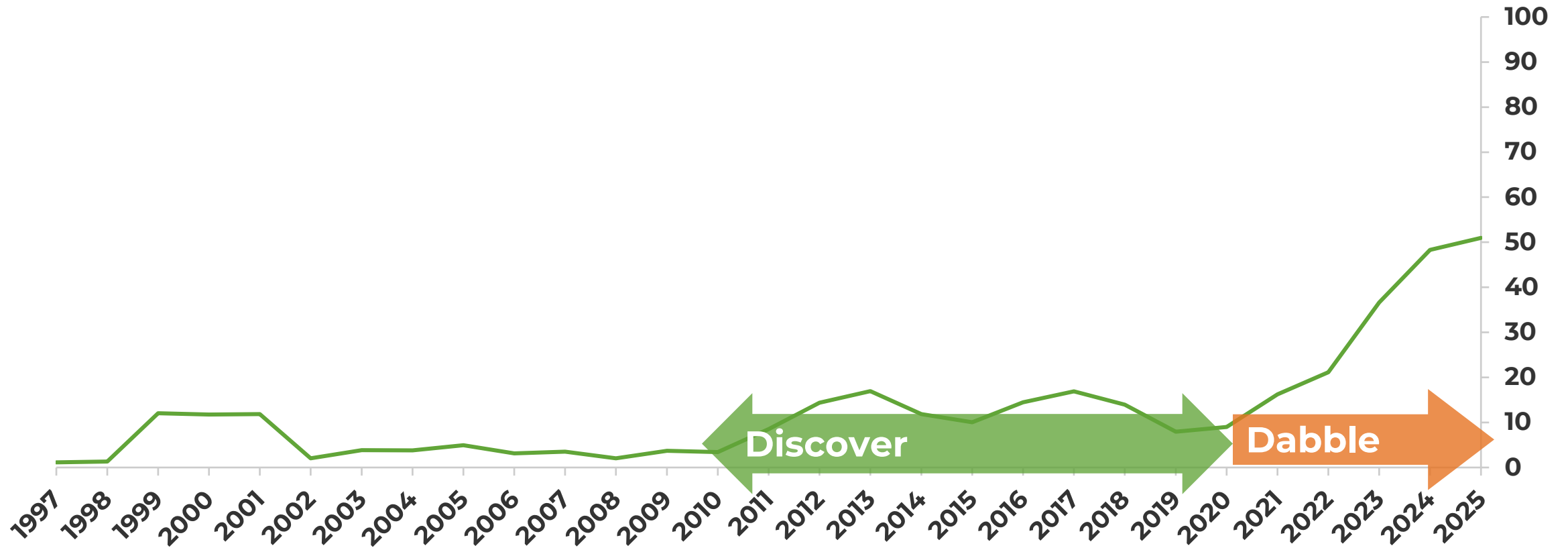
TITANIUM NITRIDE SUPERLATTICES: METAMATERIALS FOR ELECTRONICS

Lux Tech Signal: Titanium-Nitride Superlattices



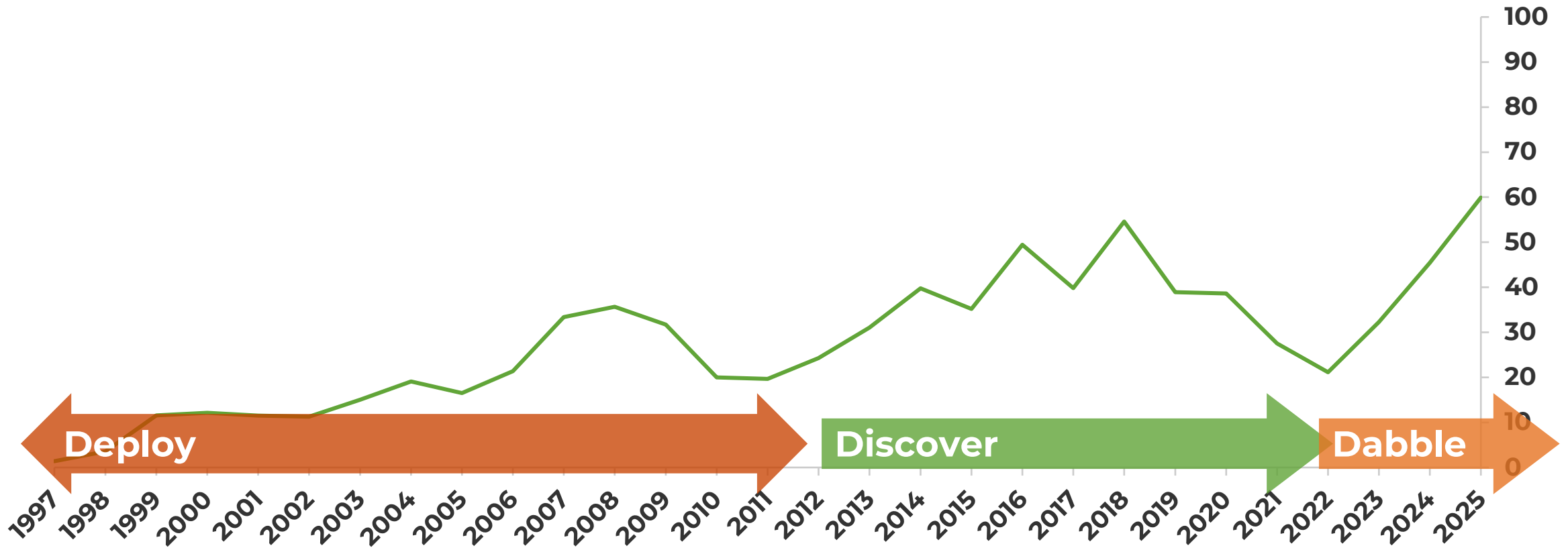
RECYCLABLE CURING AGENTS TACKLE TOUGH CIRCULARITY CHALLENGES

Lux Tech Signal: Recyclable Curing Agents



ALNICO MAGNETS: BACK TO DISCOVERY TO AVOID RARE EARTHS

Lux Tech Signal: AlNiCo Magnets



KEY TAKEAWAYS

1

Track the start of the conversion from science to invention.

The Lux Tech Signal provides an integrated signal of science, investment, and commercialization. This makes it uniquely suitable for tracking early scientific efforts and the moment when these get picked up by inventors and investors.

2

Analyze all breakthroughs you hear about.

Don't wait for an authority to label something a breakthrough. You can track developments using data science (aka the Lux Tech Signal) so you select based on the data rather than an authority.

3

Dabbling takes you in all directions, including unexpected ones.

You can't expect to predict the impact of a science breakthrough. Some are predictable, while others emerge in the dabbling phase. Keep an open mind and pick winners after dabbling, not before.



THANK YOU



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ABOUT LUX

Lux Research fuels innovators to not only imagine what's possible in the future but also operationalize innovation success in the near term. We deliver research and advisory services to inspire, illuminate, and ignite innovative thinking that reshapes and grows businesses. Using quality data derived from primary research, fact-based analysis, and opinions that challenge traditional thinking, our experts focus on finding truly disruptive innovations that are also realistic and make good business sense.



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The “Lux Take” is trusted by innovation leaders around the world, many of whom seek our advice directly before placing a bet on a startup or partner — our clients rely on Lux insights to make decisions that generate fantastic business outcomes. We pride ourselves on taking a rigorous, scientific approach to avoid the hype and generate unique perspectives and insights that innovation leaders can't live without.