MATTER-WAVE TECHNOLOGIES, INC.

We reimagine chipmaking with the power of atom optics

Reigniting Moore's Law by exploiting the quantum nature of atoms

Zahir Alam, PhD
Founder, CEO

The incredible shrinking of transistors

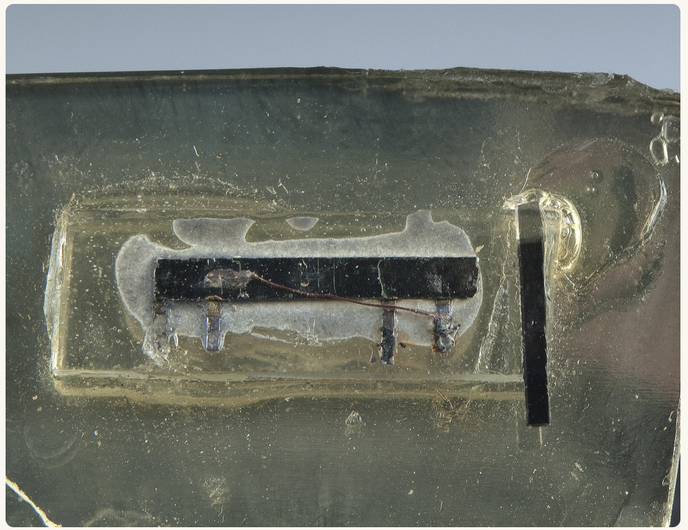
1947 · FIRST TRANSISTOR

≈ 13 mm

Point-contact germanium device, Bell Labs. About the size of a fingertip.

→

1958 · FIRST INTEGRATED CIRCUIT

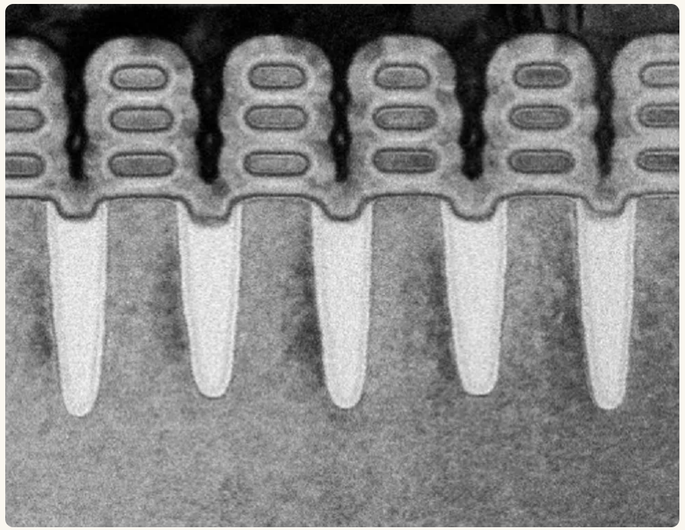


≈ 1 mm

Jack Kilby's germanium chip — one transistor on an 11 × 1.6 mm bar.

→

2026 · GAA NANOSHEET

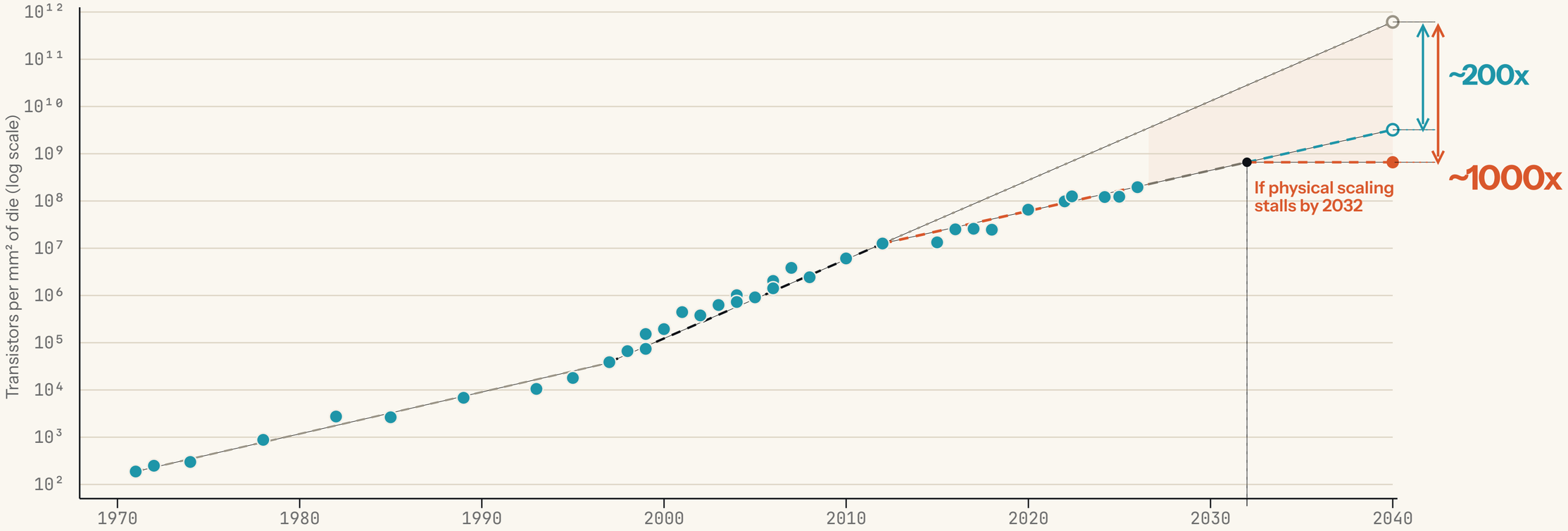


≈ 45 nm

Gate-all-around transistor at the 2 nm node — ~200 million transistors per mm².

Moore's Law has slowed down and is about to stall.

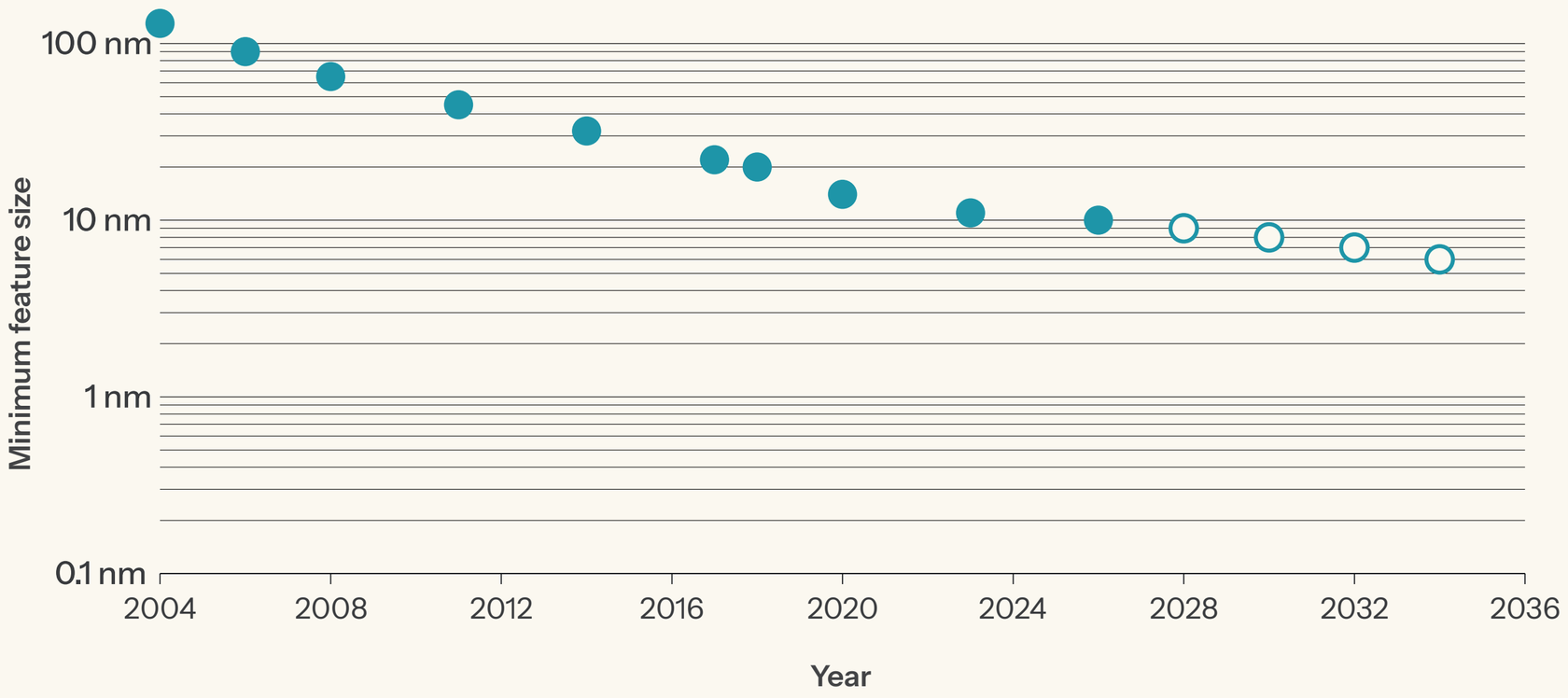
By 2040, matching the compute Moore's Law promised will take 1000x more silicon area — 20 years of missed progress.



Transistors per package = density × die area × dies per package

The global semiconductor market is set to pass $1.5 trillion by 2030.

Minimum feature size written on a chip is fundamentally limited by the wavelength of light used for lithography



$$\text{Minimum dimension} \propto k_1 \times \lambda / \text{NA}$$

At the leading edge, λ = 13.5 nm (EUV)

Where will the next 1000x density increase come from?

Minimum feature size is limited by the wavelength of EUV photons (13.5 nm).

Higher-energy photons are harder to manage

(98% of brightness is lost while travelling from the source to a wafer)

Electron and ion beam tools are too slow and resolution is limited by Coulomb repulsion.

Leading-edge EUV systems cost >$400M and each new fab build will cost ~$50B by 2030.

A new paradigm is needed.

Implications: fit Colossus 1 into a single rack

COLOSSUS 1 5 million gallons of water per day to cool. ~250 MW power draw

a single rack

THE NEXT 1000X IN DENSITY INCREASE

Atom Optics is here.

THE NEXT 1000X IN DENSITY INCREASE USING QUANTUM NATURE OF METASTABLE NEUTRAL ATOM

Atom Optics is here.

Neutral atom waves **write** → lithography
Neutral atom waves **measure** → metrology

FOR LIGHT

$$E = \frac{hc}{\lambda}$$

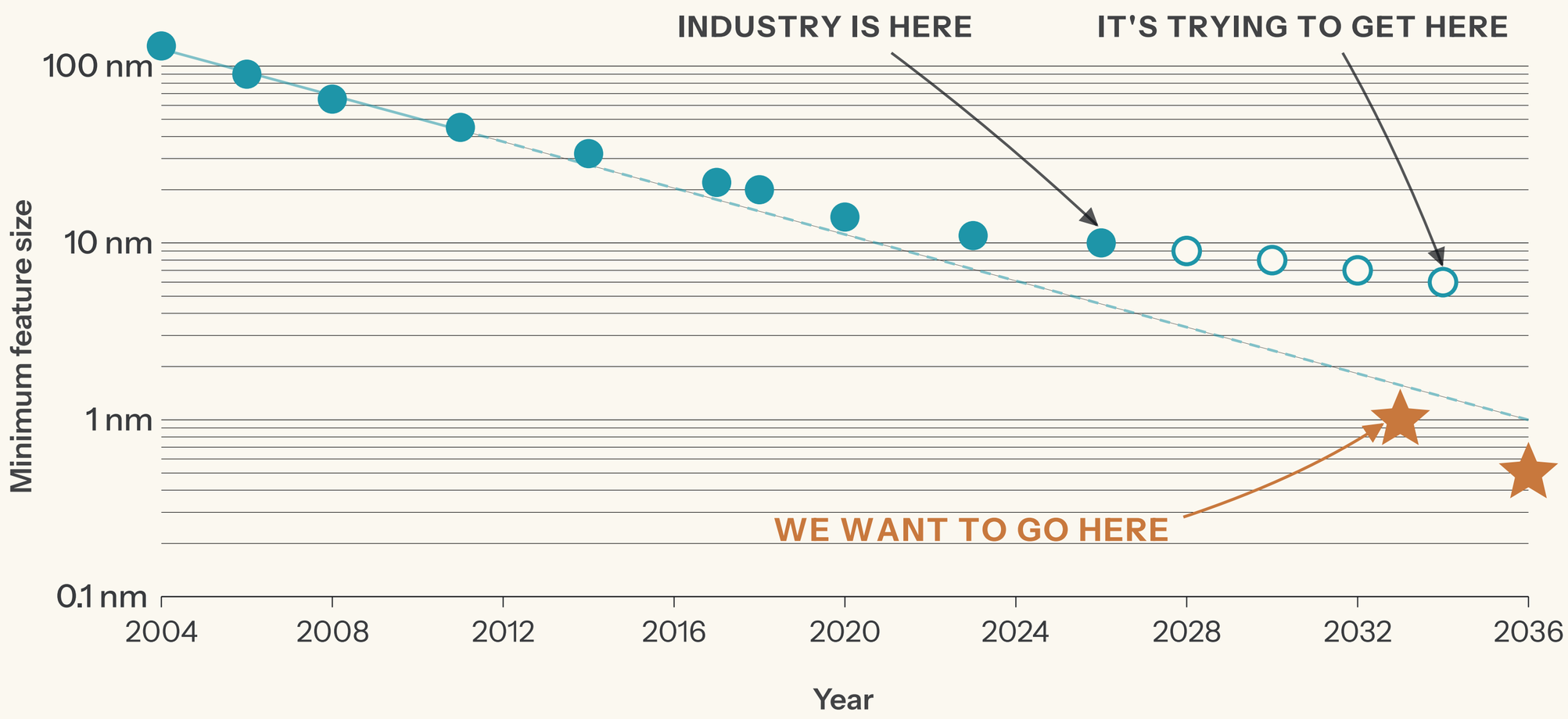
FOR ATOMS

$$KE = \frac{h^2}{2m\lambda^2}$$

Atomic wavelengths are **200× shorter** than EUV light.

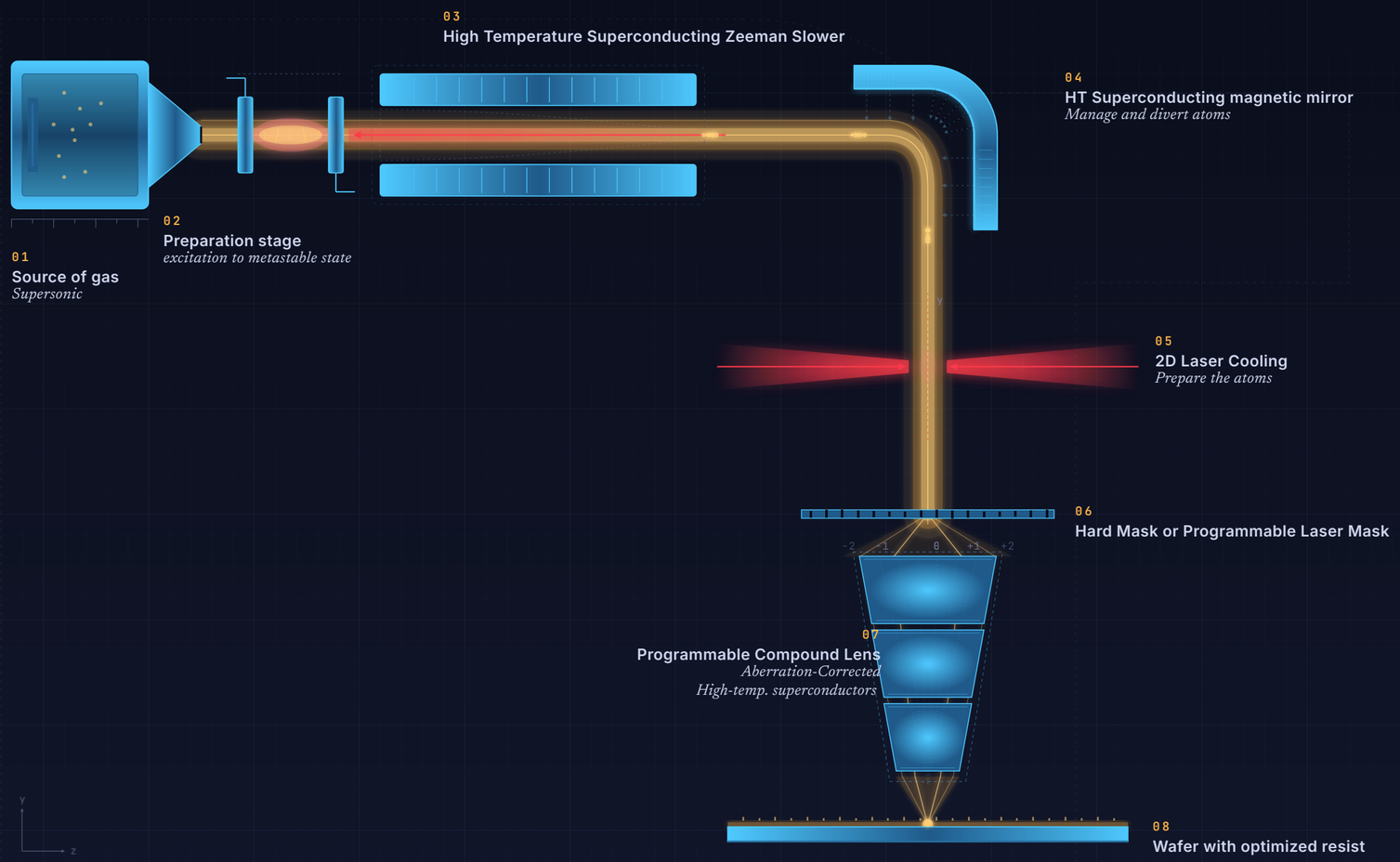
Metastable atoms carry energy in their internal quantum states and deliver that energy to a precise location of a wafer.

Reigniting Moore's law with atom optics



Product 1: 20 years of our breakthroughs make metastable atom lithography possible.

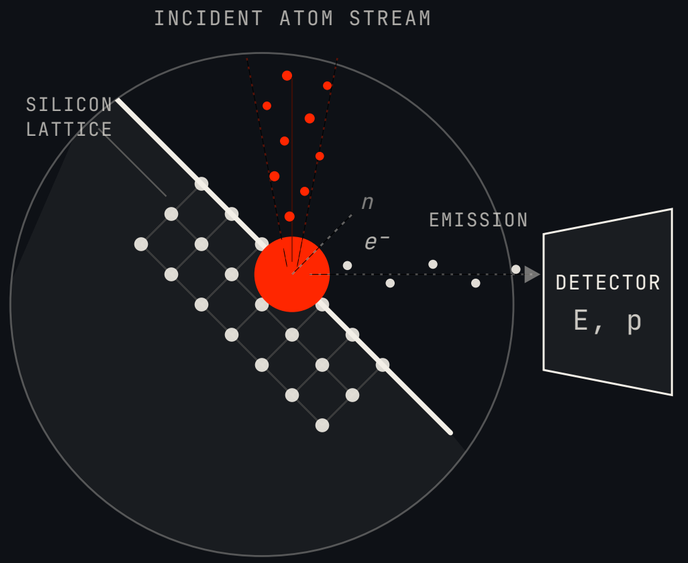
Neutral-atom **lithography** *with HT superconducting optics*



Product 2: Atom microscope and elemental analysis at true single-atomic-layer resolution.

Build an atom microscope to image the true surface — no other system can do that — and identify atomic defects, inclusions, atomic arrangements, topography.

Co-develop with the lithography system. Shares optical elements, source, beam manipulation techniques with the lithography machine.



INTERACTION ZONE

same column as the lithography tool

FOUNDERS

CHIEF EXECUTIVE OFFICER

Zahir Alam, PhD

Previously in the Office of the CTO at KLA, building next-generation DUV optical inspection tools for semiconductor metrology. Made pioneering contributions in nonlinear optics and nonlinear optical metamaterials. 70+ peer-reviewed articles, including in the Science and many Nature family journals.

CHIEF SCIENTIFIC OFFICER

Mark Raizen, PhD

Sid W. Richardson Chair Professor of physics at UT Austin. Experimental atomic physicist and expert in atom optics and the control of atoms. His group pioneered magnetic atom optics over the past 20 years — now ripe for commercialization in atom lithography and inspection.

HEAD OF ATOM OPTICS

Edvardas Narevicius, PhD

Alexander von Humboldt Professor of physics at TU Dortmund. Recently relocated his group from the Weizmann Institute. Expert in supersonic beams and the magnetic and laser control of atoms and molecules; pioneered cold collisions and atom diffraction with merged, decelerated supersonic beams.

MEMBERS OF TECHNICAL STAFF

AMO PHYSICS

Akbar Safari, PhD

Experimental AMO physicist (UW-Madison). Expert in neutral-atom quantum networks, nonlinear optics, and quantum optics.

THEORETICAL ATOM OPTICS

Enno Giese, PhD

Contributor to NASA's Cold Atom Lab on the ISS. DLR-funded for the QUANTUS atom-interferometry program. Assistant Professor of atom optics, TU Darmstadt.

FAB ENGINEER

Kashif Awan, PhD

Ex-faculty, Washington University in St. Louis. Senior nanofab engineer at Photonic Inc., Vancouver. 15 years in nanofabrication.

HIGH-ENERGY LASER SYSTEMS

Ahmed Helal, PhD

One of the world's handful of experts in high-energy lasers. Lead scientist managing the Texas Petawatt — the most powerful laser in the US at the time — for four years.

A TEAM THAT HAS DONE WHAT OTHERS CALL SCIENCE FICTION

We measured the instantaneous velocity of a Brownian particle — Einstein said it couldn't be done. We were the first to demonstrate atom lithography. We built a molecular collider to watch quantum mechanics steer chemistry at one thousandth of a degree above absolute zero. We created the first vortex beams of atoms and molecules by twisting matter waves. We routinely bring molecules travelling at 1000 mph to a complete stop. We flew an atom interferometer to the ISS with NASA to test Einstein's relativity in microgravity. We pioneered scalable neutral-atom qubits. We ran one of the most powerful lasers in the United States. We invented the most nonlinear optical material known to human. We made light cast a shadow. We built a system to separate isotopes to better than 99.95% purity.

INDUSTRY & TECHNICAL COUNSEL

Senior operators engaged for strategic and technical guidance

METROLOGY & INSPECTION · EX-KLA

John C. Robinson, PhD

✓ CONFIRMED

Senior Director of Product Development at Canon Nanotechnologies (nanoimprint lithography). SPIE Fellow. Ex-Senior Principal Scientist at KLA Corporation. 47+ SPIE publications; long-time program-committee member for SPIE Advanced Lithography & Metrology.

ACADEMIC ADVISORS

Prof. Joseph Thywissen

Canada Research Chair in Physics, University of Toronto; APS, Optica & CIFAR Fellow. Authority on ultracold-atom manipulation; the first to demonstrate lithography with atoms.

Prof. Mark Saffman

Professor of Physics, UW-Madison. A pioneer of maskless atom lithography and of neutral-atom quantum computing; authority on Rydberg-atom entanglement and scalable qubit architectures.

PARTNERSHIP AND DEEP ACCESS

We will build what the customers want, not what they need

TECHNOLOGY LICENSING · QUANTUM HARDWARE

Infleqtion (NYSE: INFQ)

LETTER OF SUPPORT · NON-BINDING

Letter of support from Infleqtion's CTO covering licensing and co-development of our atom-optics stack for neutral-atom quantum technologies, including quantum computing.

LITHOGRAPHY · EVALUATION & TESTING

Texas Instruments

IN DISCUSSION

Company-level technical discussions with a TI Fellow and lithography experts, working toward a letter of intent to develop R&D partnership and use around our early prototypes.

THE ASK

$20M

seed round · deployed over 18 months

TO BUILD

01

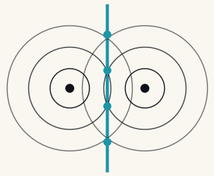
The first lithography prototype

02

The atom microscope prototype

03

AI-native physics models for engineering and lithography



Thank you.

Zahir Alam, PhD · www.matter-wave.co

Interested? Let's talk →