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Analysis for Science Librarians of the 2025 Nobel Prize in Physics: Macroscopic Quantum Observations

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In October 2025, the Royal Swedish Academy of Sciences awarded the Nobel Prize in Physics to John Clarke, Michel H. Devoret, and John M. Martinis 'for the discovery of macroscopic quantum mechanical tunneling and energy quantisation in an electric circuit.' This article includes a brief explanation of the science behind the experiment, an introduction to each laureate, and an analysis of each physicist's scholarly record using data from Web of Science.

Keywords: Nobel Prize in Physics, physics, quantum mechanics, quantum computing, John Clarke, Michel H. Devoret, John M. Martinis

Introduction

With 2025 being the International Year of Quantum Science and Technology to celebrate 100 years of quantum mechanics, it is only fitting that the 2025 Nobel Prize in Physics would be awarded to researchers whose experiments demonstrated fundamental characteristics of quantum physics at a macroscopic level. The results of these experiments were pivotal in physicists' ability to further observe quantum phenomena in macroscopic systems and laid the foundation for quantum computing research.

Emerging in the 20th century as scientists studied individual particles and found that classical mechanics laws were unable to explain all their behaviors, the field of quantum physics is young when compared to the long history of science. Compared to macroscopic objects (objects made up of many smaller particles), quantum effects are much harder to observe. One of the most famous stories in science history focuses on an observation of a macroscopic object. Isaac Newton was sitting under a tree contemplating the universe when he saw an apple fall. Based on this observed event, Newton drew the connection between the force making the apple fall straight to the earth and the orbit of the moon around the earth and developed his law of universal gravitation (Gefter 2010). This study of the motion of macroscopic objects is referred to as classical mechanics and unlike Newton's apple falling from the tree, quantum properties are not easily viewed by everyday humans due to their extremely small scale.

Since Newton's foundational works on classical mechanics in the 1600s, the field of physics has continued to develop new laws and theories to explain the world around us, both big and small. Some of the known characteristics exhibited by quantum particles are quantized energy levels, superposition, uncertainty, and particle-wave duality. To better explain quantum properties, physicists have needed to rely on other strategies such as thought experiments to explore quantum mechanical concepts. Erwin Schrödinger's 1935 thought experiment involving a cat sealed in a box with a vial of poison that will be released if a radioactive particle decays provides a macroscopic example of the limits of superposition (Schrödinger 1935). The cat is considered both alive and dead as long as the box is not opened but once the result is observed, the superposition of possible outcomes collapses. Though often used to explain the general concept of superposition, Schrödinger intended this thought experiment to depict the absurdity of observing quantum phenomena on a macroscopic scale as the experiment would be unethical to perform and the interactions with the outside environment would cause the superposition of possible outcomes to decay extremely fast (The Nobel Prize 2025a). So it may have surprised Schrödinger that the 2025 Nobel Prize in Physics was awarded to three scientists who were able to observe quantum mechanics at a macroscopic scale.

Synopsis of the science

Through a series of experiments conducted in 1984 and 1985, Clarke, Devoret, and Martinis were able to observe energy quantization and quantum tunneling in a centimeter-sized device you could hold in your hand. They built an electric circuit using two superconductors separated by a thin layer of non-conducting material to create a Josephson junction that exhibited quantum tunneling based on theoretical work done by Anthony J. Leggett, who was awarded a third of the 2003 Nobel Prize in Physics for work on superconductivity. Quantum tunneling is when a particle passes through a barrier that would not normally be possible when considered using classical physics laws. Classically, we would assume that a ball (an object made up of many particles) would not be able to pass through a wall. Every observation of the ball hitting the wall would result in the ball bouncing back and not passing through the barrier. However when viewed at a quantum level, a particle might hit a barrier and instead of bouncing back, appear on the other side (The Nobel Prize 2025b). The 1973 Nobel Prize in Physics was awarded to three scientists for early work on quantum tunneling. Leo Esaki and Ivar Giaever for their experimental discoveries regarding tunneling in semiconductors and superconductors and Brian Josephson for his theoretical predictions of the properties of a supercurrent through a tunnel barrier (The Nobel Prize, n.d.-b). In the experiments done by 2025's winners, the electric circuit mimics a quantum particle because all the charged particles in the system behave in unison and thus behave like a single particle rather than many. This effect happens in superconductors at very low temperatures because the electrons in the material form Cooper pairs. The nature of Cooper pairs brings the resistance in the material to zero unlike normal electrons and the pairs appear to be a single particle in the circuit. With these billions of Cooper pairs, the quantum effects in the system can be viewed macroscopically rather than microscopically like past experiments only involving a few particles (The Nobel Prize 2025b). The tunneling was observed by applying a weak current over the circuit. The Josephson junction causes the voltage of the system to start at zero since no current is flowing through the system. Eventually, the system starts to tunnel into a non-zero state and a voltage occurs within the system. By exposing the circuit to microwaves of different wavelengths, the scientists were also able to observe that the system had quantized energy levels. Quantization is when a particle has specific energy levels it can move into rather than a continuous range of energy. In the experiment, some of the microwaves would be absorbed and move the system into a higher energy state. In the higher energy state, the system would then have a shorter zero-voltage period and tunneling would be observed sooner.

So what implications do the results of Clarke, Devoret, and Martinis's experiments have on our lives today? Quantum physics is present in many everyday technologies from toasters to smartphones. The prize winners' work laid the foundation for quantum computing, allowing the subsequent creation of engineered quantum systems (Josephson et al. 2025). The experiments opened doors for the creation of artificial atoms and the applications of quantum properties in macroscopic systems. Since these experiments, significant advancements in quantum computers have been possible with the use of superconducting quantum bits or 'qubits.' Like the electric circuit made by the laureates, each superconducting qubit is an artificial atom that contains Josephson junctions and allows quantum properties to be applied to computing systems. Taking advantage of quantum phenomena, quantum computers reimagine modern computing to solve more complex problems faster. Current quantum computers remain in early development and have not reached mainstream production (SPINQ 2025). Research continues to test the constraints and precision of quantum computing in the hopes that future quantum computers can be used to further advance scientific research such as drug discovery, weather forecasts, and ultra-secure communications (U.S. National Science Foundation 2026).

John Clarke

John Clarke was born in Cambridge, England in 1942. His father was a carpenter turned construction administrator and his mother was a homemaker. Clarke's interest in building started young with building machines out of Meccano construction sets his parents gifted to him for Christmas. Clarke's initial education of mathematics and science came while attending the Perse School. In the summers, Clarke had a variety of jobs growing up including carpenter and plumber. His job at an electronic shop, where his supervisor taught him how to build a variety of equipment, taught him important skills applicable to his future career in physics (Clarke and Hellrigel 2016). The first in his family to go to college, Clarke attended Christ's College, Cambridge and received his Bachelor of Arts degree.

Despite applying to several other universities outside of Cambridge for graduate school, Clarke chose to stay close to home. In 1964, Clarke joined the Royal Society Mon Laboratory, located in Cambridge between his alma mater the Perse School and his grandfather's picture framing shop. Clarke felt 'it was a foregone conclusion that I would spend my career as a research student in a lab situated between two buildings that played such formative roles in my life' (Clarke 2020, 1587). Of the thesis topics suggested by his advisor Professor Brian Pippard (later Sir Brian), Clarke was most interested in measuring the resistance of superconducting-normal metal interfaces which required an unprecedented voltage sensitivity of 1 pV. As this had never been achieved, Clarke had difficulties getting started on creating such a design. In November of that year, Brian Josephson, another graduate student of Pippard, gave a seminar talk on Cooper pairs, his theory of pair tunneling, and recent work on the dc Superconducting QUantum Interference Devices (SQUID). Inspired by this talk, Pippard brought a new idea to Clarke, a digital voltmeter with a resolution of 2 x 10-15 volts per second.

Clarke was ‘very excited about [Pippard’s] idea and the opportunity to work on devices based on the Josephson effect’ (Clarke 2020, 1588). After many attempts, Clarke was able to build and demonstrate the first successful SQUID outside of the United States. Hoping to make a more reliable and practical voltmeter device, he eventually developed the Superconducting Low-inductance Undulatory Galvanometer (SLUG). The SLUG was the focus of his thesis research and one of the first big breakthroughs of his career as a SQUID research pioneer.

After completing his doctoral degree at Cambridge in 1968, Clarke started a postdoctoral position in the Department of Physics at University of California, Berkeley and a year later transitioned into a role as assistant professor. He also joined the Department of Energy’s Lawrence Berkeley National Laboratory (LBNL). Throughout his career, Clarke’s research has mainly centered on dc SQUIDs, SLUGs, and Josephson junctions. His work has crossed over with many other fields including astrophysics, cosmology, geophysics, medical physics, and quantum information. In his time at Berkeley, Clarke has advised over 100 graduate students and postdoctoral scholars, including his fellow prize winners Michel Devoret and John Martinis (Christ’s College University of Cambridge, n.d.).

In 2010, Clarke retired from the Materials Sciences Division of LBNL and transitioned into his current role as a professor emeritus of physics in the UC Berkeley Graduate School. He has continued to remain active in SQUID research. Clarke’s projects include work on SQUID applications in medical imaging, contributing to improvements in nuclear magnetic resonance technology. Recent work also includes his work with the Axion Dark Matter eXperiment to develop a Microstrip SQUID Amplifier for the detector, achieving an extremely low noise level and increasing chances of an axion detection.

Select Awards

- 2021 Micius Quantum Prize (with Michel H. Devoret and Yasunobu Nakamura)
- 2012 US National Academy of Sciences, Foreign Associate
- 2004 Royal Society, Hughes Medal
- 1999 National Academy of Sciences, Comstock Prize for Physics
- 1998 American Physical Society, Joseph F. Keithley Award For Advances in Measurement Science
- 1987 Fritz London Memorial Prize
- 1987 California Scientist of the Year
- 1986 Fellow of the Royal Society
- 1977 Guggenheim Fellowship
- 1970 Alfred P. Sloan Research Fellowship

Clarke in the scholarly record

John Clarke has 416 publications in Web of Science, the first of which is a *Physical Review Letters* article–on Josephson effects in superconductors of different materials–that was published in December of 1968, just after he graduated from Cambridge and began his postdoctoral work at Berkeley. Although Google Scholar indicates one journal article resulting from Clarke's doctoral work, from early 1968, the journal in which it was published, *Journal de Physique Colloques*, is not indexed by Web of Science (Clarke 1968).

Clarke's publications have, in aggregate, been cited by 17,071 documents (16,737 when excluding self-citing documents) and have accumulated 25,927 citations total, for an average of just over 62 citations per document. His h-index is 84.

The varied research areas to which Clarke has contributed over the course of his career are well represented in his 10 most highly cited papers, listed in Table 1. His top publication is on the subject for which he is now best known: His 2008 *Nature* paper on quantum information titled 'Superconducting quantum bits,' has garnered 1,644 citations, averaging over 90 per year since its publication. However, the second paper on the list already begins to reveal the breadth of Clarke's research output. This 1979

Geophysics paper, 'Magnetotellurics with a remote magnetics reference,' which discusses an application of SQUID magnetometers in geophysics, has accrued 704 citations. Also among these top 10 papers are two that discuss the application of SQUIDs to the search for dark matter axions and one that details a discovery related to the power spectrum of music. The latter, '1-F noise in music and speech,' was featured on the front page of a November 1975 issue of *Nature* (Clarke and Hellrigel 2016), and although it was hardly cited in the decade following its publication, it has since gained popularity and has consistently received over 10 citations per year for the past 20 years. Of these 10 papers, only one–the fifth most highly cited–resulted from his Nobel Prize-winning work with Devoret and Martinis. Figure 1 shows citations to all of Clarke's work over time. His yearly citations have climbed steadily over the course of his career and broke 1,000 for the first time in 2025.

Table 1: John Clarke's 10 most cited publications, as shown in Web of Science.

Publication	Web of Science Citations	Citations Per Year
Clarke, J., and F.K. Wilhelm. 2008. "Superconducting quantum bits." *Nature* 453 (7198): 1031–42.	1,644	91.3
Gamble, T.D., J. Clarke, and W.M. Goubau. 1979. "Magnetotellurics with a remote magnetics reference." *Geophysics* 44 (1): 53–68.	704	15.0
Tesche, C.D., and J. Clarke. 1977. "DC SQUID - Noise and optimization." *Journal of Low Temperature Physics* 29 (3–4): 301–31.	604	12.3
Asztalos, S.J., G. Carosi, C. Hagmann, D. Kinion, K. van Bibber, M. Hotz, L.J. Rosenberg, et al. 2010. "SQUID-based microwave cavity search for dark-matter axions." *Physical Review Letters* 104 (4).	578	36.1
Martinis, J.M., M.H. Devoret, and J. Clarke. 1987. "Experimental tests for the quantum behavior of a macroscopic degree of freedom - The phase difference across a Josephson junction." *Physical Review B* 35	507	13.0

(10): 4682–98.		
Du, N., N. Force, R. Khatiwada, E. Lentz, R. Ottens, L.J. Rosenberg, G. Rybka, et al. 2018. "Search for invisible axion dark matter with the axion dark matter experiment." *Physical Review Letters* 120 (15).	488	61.0
Voss, R.F., and J. Clarke. 1976. "Flicker (1-F) noise - Equilibrium temperature and resistance fluctuations." *Physical Review B* 13 (2): 556–73.	469	9.4
Yan, F., S. Gustavsson, A. Kamal, J. Birenbaum, A.P. Sears, D. Hover, T.J. Gudmundsen, et al. 2016. "The flux qubit revisited to enhance coherence and reproducibility." *Nature Communications* 7.	460	46.0
Voss, R.F., and J. Clarke. 1975. "1-F-noise in music and speech." *Nature* 258 (5533): 317–18.	436	8.5
Wellstood, F.C., C. Urbina, and J. Clarke. 1994. "Hot-electron effects in metals." *Physical Review B* 49 (9): 5942–55.	428	13.4

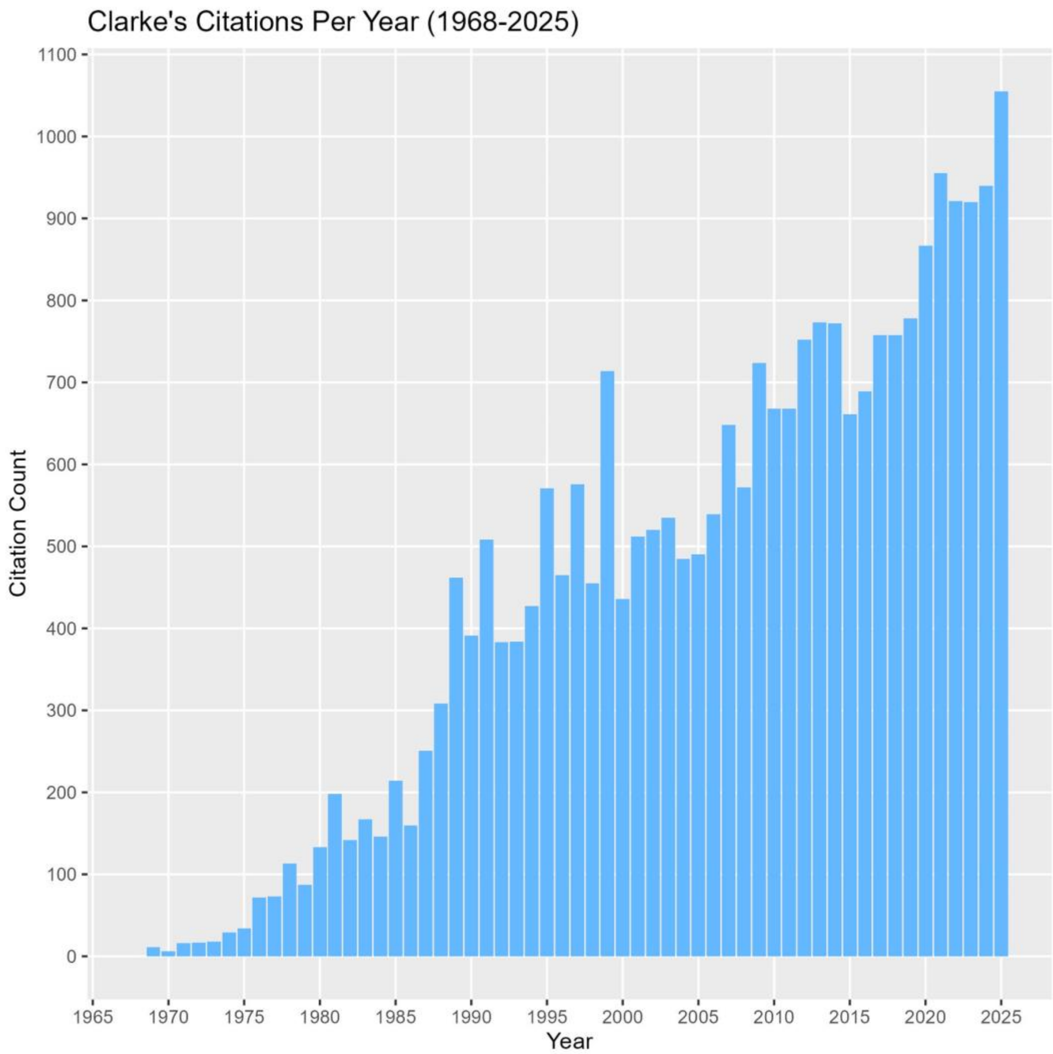

Figure 1: Clark's citations per year (1968-2025).

Of Clarke's 416 publications in Web of Science, the overwhelming majority, 329, are journal articles. They are accompanied by 22 proceeding papers, 22 meeting abstracts, eight review articles, two book chapters, and a smattering of other materials, including editorial pieces, biographical items, letters, notes and a correction. The biographical items are three obituaries published in the American Institute of Physics magazine *Physics Today*, detailing the lives of renowned low temperature physicists; one of these was of Alfred Brian Pippard, Clarke's own doctoral adviser at Cambridge, who died in 2008 (2009). Figure 2 shows Clarke's publications over time, which peaked in the mid-1990s (with a maximum of 17 publications in 1994) and have declined following his retirement in 2010 to roughly three or four publications per year.

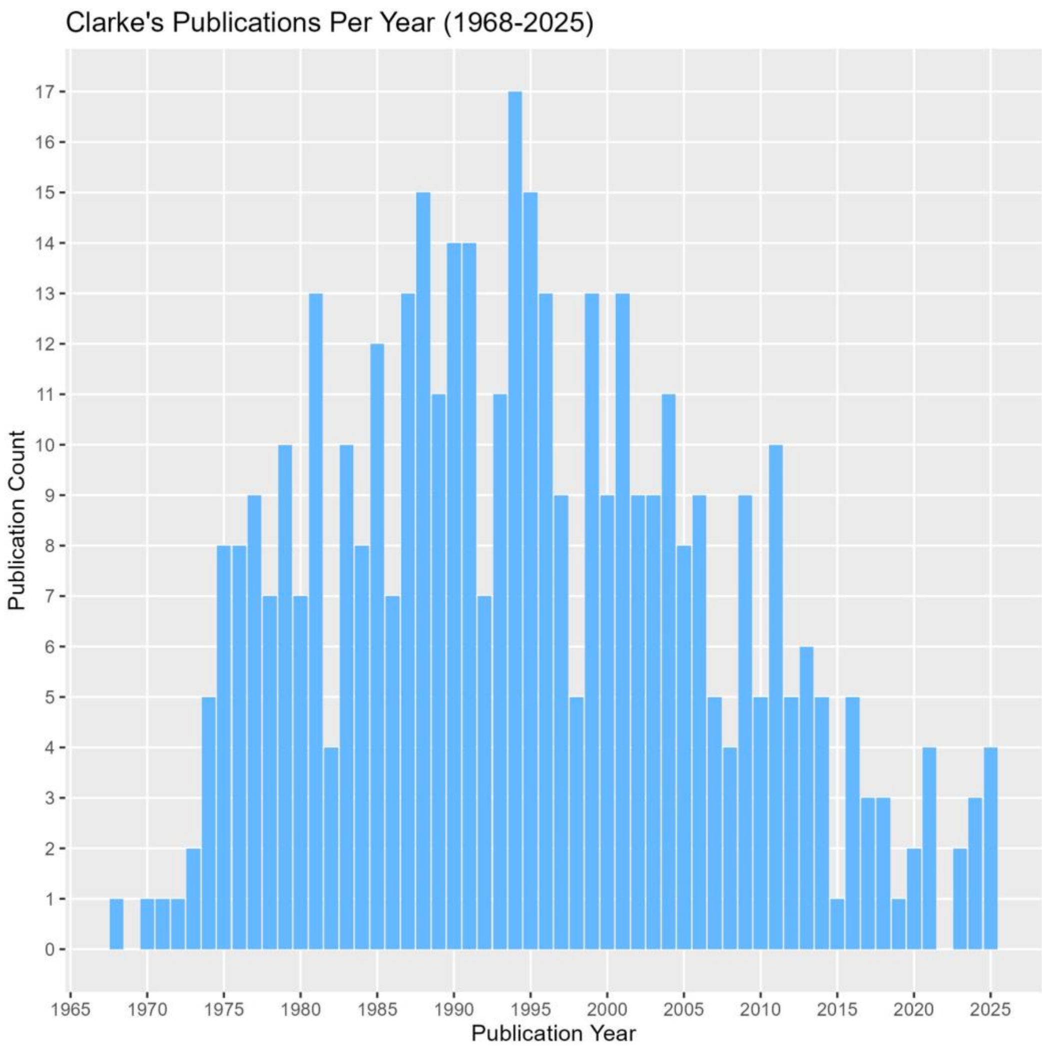

Figure 2: Clarke's publications per year (1968-2025).

Clarke's most frequent coauthor is Frederick C. Wellstood, who was a graduate student and postdoctoral fellow under Clarke at Berkeley for much of the 1980s, and who continued to collaborate with him after joining the faculty at the University of Maryland (Wellstood 2017). Forty-two of Clarke's publications in Web of Science–roughly 10 percent of his body of work–are shared with Wellstood. Clarke's next most frequent collaborators are E. Dantsker, with whom 32 publications are coauthored, and A. H. Miklich, with whom 28 are coauthored.

The journals in which Clarke has most frequently published are *Applied Physics Letters* (69 publications), *Physical Review Letters* (56 publications), *Physical Review B* (40 publications), *IEEE Transactions on Magnetics* (18 publications), and *Journal of Low Temperature Physics* (16 publications). Clarke's research output in these five journals is visualized in Figure 3. Remarkably, Clarke published in *Applied Physics Letters* every year for a 25-year period over the height of his career, from 1981 through 2005, and peaked at seven articles published in the journal in the year 1995. Although his output in *Physical Review Letters* has not been as consistent, his history with that journal is the longest, spanning from his first indexed publication in 1968 to the present day.

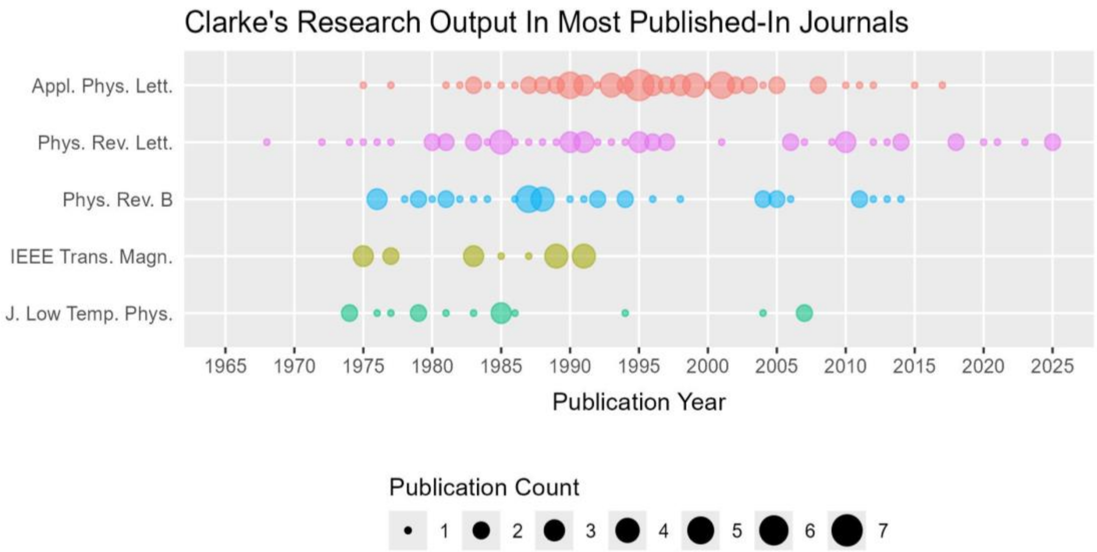

Figure 3: Clarke's research output in most published-in journals.

Michel H. Devoret

Michel H. Devoret was born in 1953 and raised in the suburbs of Paris (Fattaruso 2025). His mother was a kindergarten teacher and his father was a biologist who, although having taken only a few physics courses himself, was enthusiastic about physics and socialized with physicists, which gave Devoret a positive early impression of the field and the people in it (Devoret and Zierler 2021).

Although Devoret emphasized general science and mathematics over humanities as early as high school and through his undergraduate career in the grande école system, it wasn't until the beginning of his graduate studies that he was forced with choosing a specialization. Devoret has described physicists as being pessimistic around this time about the future of their field and warning prospective graduate students that physics–which had undergone a prolific post-World War II period–was now past its prime and would lead to few exciting discoveries. Despite this discouragement, Devoret chose to enter the field largely for the appeal of the physics laboratory work environment–the richness of its instrumentation and the sensory, hands-on experience of experimentation (Devoret and Zierler 2021).

Devoret first forayed into quantum mechanics research at the University of Orsay, where he completed over the course of two years what was known as a 'thèse de troisième' cycle. The first year of this graduate program–which he chose to complete in parallel to the last year of his undergraduate studies, as opposed to an internship at a company which was typical of his classmates–consisted mostly of coursework and culminated in a DEA diploma (Diplome d'Études Approfondies). For the second year, devoted entirely to research, he worked under the supervision of John Eland in the molecular physics laboratory directed by Sydney Leach (Devoret and Zierler 2021). And it was from this laboratory that Devoret left his first mark on the scholarly record, authoring a paper in 1976 on a new method for detecting molecular ion emissions and measuring their quantum yields and lifetimes (Eland, Devoret, and Leach 1976).

After wrapping up his project on the fluorescence of molecular ions, Devoret was forced to look elsewhere to pursue further graduate studies, as Leach's lab did not have the funds to support a doctoral student fellowship. For his Ph.D., he joined the lab of Anatole Abragam at CEA Saclay, a research center belonging to the French Commission for Atomic Energy. Devoret spent six years there, working under the direct supervision of Neil Sullivan and becoming familiar with techniques in nuclear magnetic resonance (NMR), on which Abragam had written what French physicists in the field considered to be 'The Bible' (Devoret and Zierler 2021). Applying NMR to solid helium and solid hydrogen, Devoret laid the foundation for a successful career in quantum physics research, and developed several skills that would prove complementary to those of Martinis and critical to their Nobel-winning work at Berkeley.

Although he was offered a permanent position at CEA Saclay upon his dissertation defense, as was typical for doctoral candidates in France, Devoret was given the unique opportunity by his lab director to complete postdoctoral work elsewhere and be guaranteed a position upon his return. Devoret has hypothesized that Abgram authorized this leave of absence because he himself had completed his doctoral studies in England, at the University of Oxford, and the knowledge he brought back with him (along with the knowledge brought back by Albert Messiah who studied in the United States) led to the resurgence of quantum mechanics education in France (Devoret and Zierler 2021).

With this sense of security, Devoret made the decision to pursue postdoctoral work in Clarke's lab at Berkeley, where he teamed up with Martinis, a graduate student at the time, to conduct the Leggett-inspired experiment demonstrating macroscopic quantum tunneling. In this endeavor, Devoret's knowledge of NMR and dilution refrigeration complemented Martinis's experience building superconducting devices (Devoret and Zierler 2021). Although they were not yet labeled as such, the artificial, macroscopic atoms created from these experiments marked the beginning of superconducting qubits.

Upon his return to France after two years in the United States, Devoret–along with other former Abragam students Daniel Estève and Cristian Urbina–was able to, at an early age, set up his own lab in the vacancy left by Sullivan. For a decade and a half, Devoret and his colleagues would lead the Quantronics Lab, as it came to be known, conducting experiments on quantum mechanical electronics. Among their accomplishments were the measurement of macroscopic quantum tunneling time (Martinis et al. 1988), the development of a new superconducting qubit known as a quantronium (Vion et al. 2002), and the design of a single-electron pump for counting electrons one-by-one (Pothier et al. 1992).

In 1999, Devoret visited Yale for a one-year sabbatical, drawn by the work of Daniel Prober and Robert Schoelkopf, who were trained in radio astronomy and blending techniques from that field with those of superconductivity. The sabbatical turned into a permanent post which he took up in 2002, around the same time the theorist Steven Girvin joined the Yale faculty (Devoret and Zierler 2021). Devoret would stay at Yale for 20 years, helping to found the Yale Quantum Institute in 2015. In 2007, Devoret, Girvin, Schoelkopf, and their team invented a new superconducting qubit called the transmon (Koch et al. 2007), whose scalability would make it the most popular qubit used in quantum processors today, and which is believed to be the building block of any practical quantum computer (Elsayyid 2025).

In 2024, Devoret left Yale to join the faculty at the University of California, Santa Barbara and to lead the hardware team at Google Quantum AI–a position previously held by his co-laureate John Martinis (UC Santa Barbara, n.d.-b).

Select Awards

- 2024 National Academy of Sciences, Comstock Prize in Physics (with Robert Schoelkopf)
- 2023 Elected to the National Academy of Sciences
- 2022 Micius Quantum Prize (with John Clarke and Yasunobu Nakamura)
- 2016 Olli V. Lounasmaa Memorial Prize
- 2014 Fritz London Memorial Prize (with Robert Schoelkopf and John Martinis)
- 2013 John Stewart Bell Prize (with Robert Schoelkopf)
- 2007 Elected to the French Academy of Sciences
- 2004 European Physical Society, Europhysics-Agilent Prize (with Daniel Esteve, Hans Moij and Yasunobu Nakamura)
- 2007 Elected to the French Academy of Sciences
- 2003 Elected to American Academy of Arts and Sciences
- 1996 Descartes-Huygens Prize
- 1991 Ampere Prize from the French Academy of Science (with Daniel Esteve)

Devoret in the scholarly record

Devoret has 302 publications in Web of Science. His scholarly output can be traced back to 1976, when results of his master's-level research on molecular ion emission detection at Orsay University were published in the Elsevier journal *Chemical Physics Letters*, in an article titled, 'Quantum yields and lifetimes of molecular ion fluorescence.'

Devoret's publications have, in aggregate, been cited by 22,670 documents (22,409 when excluding self-citing documents) and have accumulated 44,106 citations total, for an average of just over 146 citations per document. His h-index is 106.

Devoret's outsized research impact is illustrated by the fact that none of the articles directly resulting from his Nobel-winning postdoctoral work at Berkeley rank among his top 10 most highly cited publications, which are listed in Table 2. Indeed, the paper from this stage of his career with the highest number of citations comes in at number 13, with 506 citations for an average of roughly 13 per year since he authored it with Martinis and Clarke in 1987. Although the majority of these top 10 publications fall well within the field of superconducting qubits, to which Devoret has dedicated his career, his most highly cited paper represents a deviation from this primary research area. That paper, a 1997 *Nature* article demonstrating the electrical transport properties of carbon nanotubes, titled, ‘Individual single-wall carbon nanotubes as quantum wires,’ resulted from Devoret’s work during a brief sabbatical at Delft University of Technology in the Netherlands in 1996–just a few years before he returned to the United States. This paper built on the discovery of a form of carbon for which one of Devoret’s coauthors–Richard Smalley of Rice University in Houston–was awarded the Nobel Prize in Chemistry the year before (Mooij 2022; The Nobel Prize, n.d.-a). The paper has accrued 2,736 citations, averaging over 94 per year since its publication. Amassing citations at the highest rate is his 2007 *Physical Review A* paper, ‘Charge-insensitive qubit design derived from the Cooper pair box,’ which has steadily gained popularity and averaged almost 139 citations per year, receiving over 300 in both 2024 and 2025. Figure 4 shows citations to all of Devoret’s work over time. His yearly citations have grown at an increasing rate, hitting 1,000 for the first time in 2009 and 2,000 just eight years later. In both 2024 and 2025, Devoret was cited over 3,000 times.

Table 2: Michel H. Devoret’s 10 most cited publications, as shown in Web of Science.

Publication	Web of Science Citations	Citations Per Year
Tans, S.J., M.H. Devoret, H.J. Dai, A. Thess, R.E. Smalley, L.J. Geerligs, and C. Dekker. 1997. “Individual single-wall carbon nanotubes as quantum wires.” *Nature* 386 (6624): 474–77.	2,736	94.3
Koch, J., T.M. Yu, J. Gambetta, A.A. Houck, D.I. Schuster, J. Majer, A. Blais, M.H. Devoret, S.M. Girvin, and R.J. Schoelkopf. 2007. “Charge-insensitive qubit design derived from the Cooper pair box.” *Physical Review A* 76 (4).	2,632	138.5
Devoret, M.H., and R.J. Schoelkopf. 2013. “Superconducting circuits for quantum information: An outlook.” *Science* 339	1,678	129.1

(6124): 1169–74.		
Clerk, A.A., M.H. Devoret, S.M. Girvin, F. Marquardt, and R.J. Schoelkopf. 2010. "Introduction to quantum noise, measurement, and amplification." *Reviews of Modern Physics* 82 (2): 1155–208.	1,513	94.6
Vion, D., A. Aassime, A. Cottet, P. Joyez, H. Pothier, C. Urbina, D. Esteve, and M.H. Devoret. 2002. "Manipulating the quantum state of an electrical circuit." *Science* 296 (5569): 886–89.	1,397	58.2
Majer, J., J.M. Chow, J.M. Gambetta, J. Koch, B.R. Johnson, J.A. Schreier, L. Frunzio, et al. 2007. "Coupling superconducting qubits via a cavity bus." *Nature* 449 (7161): 443–47.	1,152	60.6
Paik, H., D.I. Schuster, L.S. Bishop, G. Kirchmair, G. Catelani, A.P. Sears, B.R. Johnson, et al. 2011. "Observation of high coherence in Josephson junction qubits measured in a three-dimensional circuit QED architecture." *Physical Review Letters* 107 (24).	876	58.4
Ofek, N., A. Petrenko, R. Heeres, P. Reinhold, Z. Leghtas, B. Vlastakis, Y.H. Liu, et al. 2016. "Extending the lifetime of a quantum bit with error correction in superconducting circuits." *Nature* 536 (7617): 441–45.	736	73.6
Schuster, D.I., A.A. Houck, J.A. Schreier, A. Wallraff, J.M. Gambetta, A. Blais, L. Frunzio, et al. 2007. "Resolving photon number states in a superconducting circuit." *Nature* 445 (7127): 515–18.	714	37.6
Blais, A., J. Gambetta, A. Wallraff, D.I. Schuster, S.M. Girvin, M.H. Devoret, and R.J. Schoelkopf. 2007. "Quantum-information processing with circuit quantum electrodynamics." *Physical Review A* 75 (3).	599	31.5

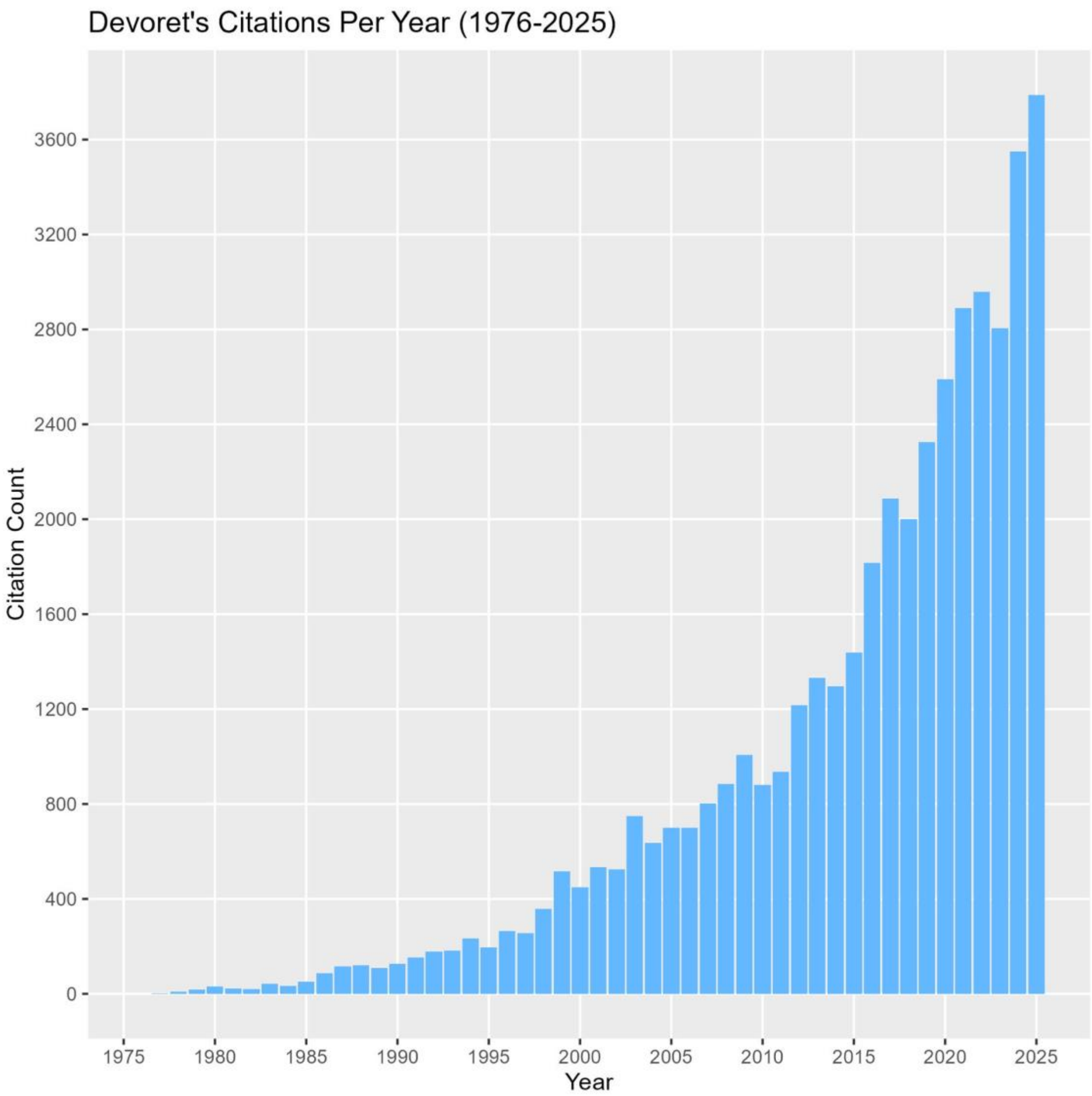

Figure 4: Devoret's citations per year (1976-2025).

Devoret's 302 publications in Web of Science consist mostly of journal articles, of which there are 261, and proceedings papers, of which there are 23. Also included are eight review articles and small numbers of other materials, including editorial pieces, notes, corrections, and a news item. That news item is a 2005 article published in the Institute of Physics magazine *Physics World*, in which Devoret communicates to a general audience the implications of techniques being developed to directly count electrons one by one as they pass through a point in an electrical circuit and an envisaged that such a capability 'could lead to a redefinition of the ampere' (Devoret

2005, 24). Figure 5 shows Devoret's publications over time. After peaking in the early 1990s–at about 11 publications per year–while he was leading the Quantronics group at CEA Saclay, Devoret's output dipped slightly in the early 2000s as he was getting settled at Yale. It then soared following the development of the transmon in 2007 and leading up to the formation of the Yale Quantum Institute in 2015 (Elsayyid 2025), peaking at 16 publications in 2013. In his oral history interview with AIP, Devoret discusses how his science suffered during the coronavirus pandemic, as social distancing measures made it difficult for lab members to train each other and collaborate (Devoret and Zierler 2021), and these challenges are indeed reflected by his reduced scholarly output in the early 2020s.

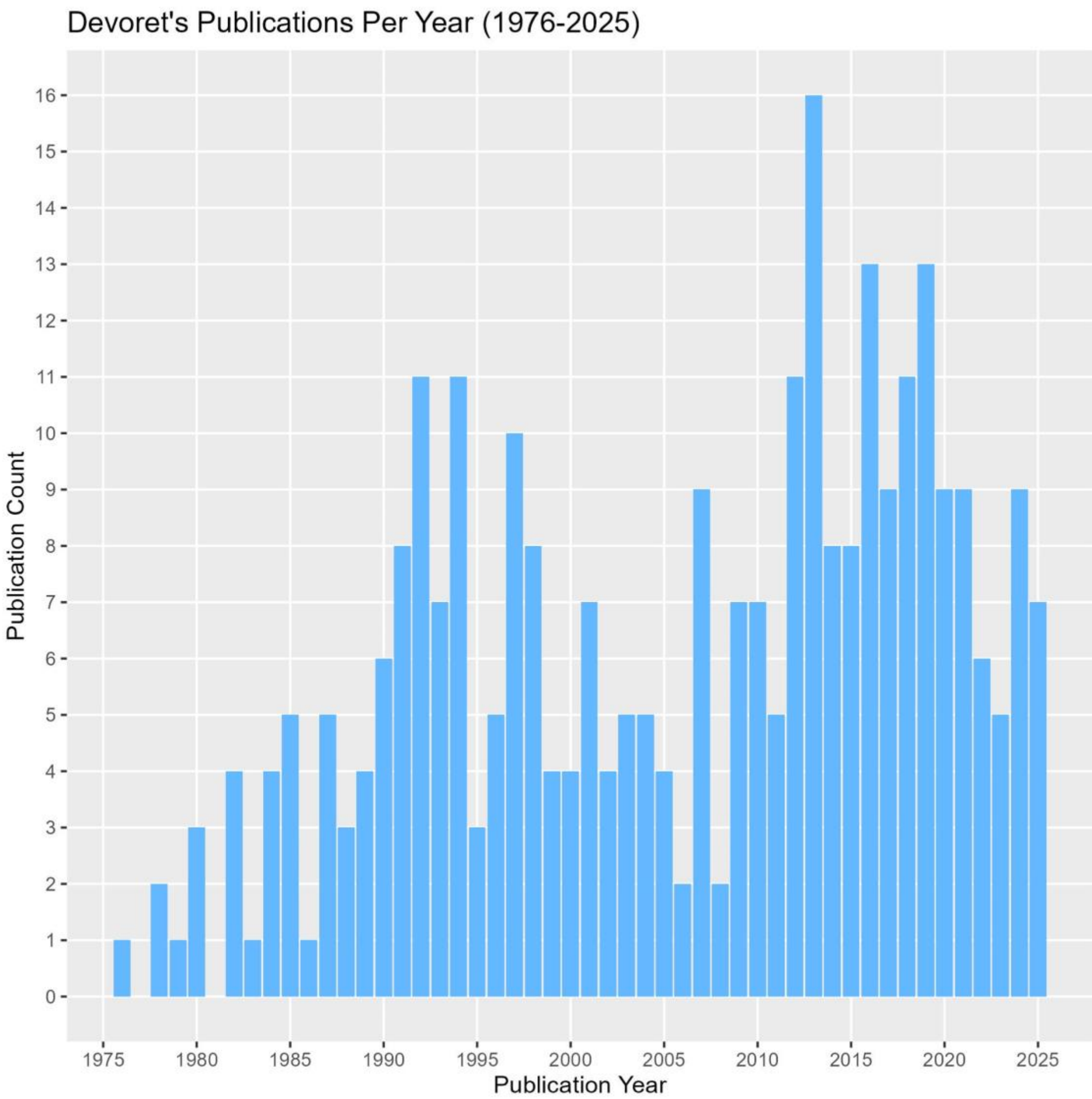

Figure 5: Devoret's publications per year (1976-2025).

Devoret's most frequent coauthor is Daniel Estève, who was a fellow doctoral student in Abragam's lab at CEA Saclay, and who later cofounded the Quantronics group at Saclay with Devoret. Ninety-seven of Devoret's publications in Web of Science–nearly a third of Devoret's body of work–are coauthored with Estève. Their collaborations span from 1980 through 2005. Devoret's next most frequent coauthors are R. J. Schoelkopf–his longtime collaborator at the Yale Quantum Institute–with whom he shares 82 publications, and L. Frunzio–a research scientist at Yale–with whom he shares 77.

The journals in which Devoret has most frequently published are *Physical Review Letters* (67 publications), *Physical Review B* (26 publications), *Nature* (23 publications), *Physical Review Applied* (16 publications), and *Applied Physics Letters* and *Physical Review X* (12 publications each). Devoret's research output in these six journals is visualized in Figure 6. Of these, Devoret has the longest history with *Physical Review B*, in which he published for the first time in 1978 while he was still a student. In recent years he has published most consistently in *Physical Review Letters*, peaking at six articles in the journal in 2012. There have been seven years in which Devoret has published multiple times in *Nature*, the most being three articles in 2007.

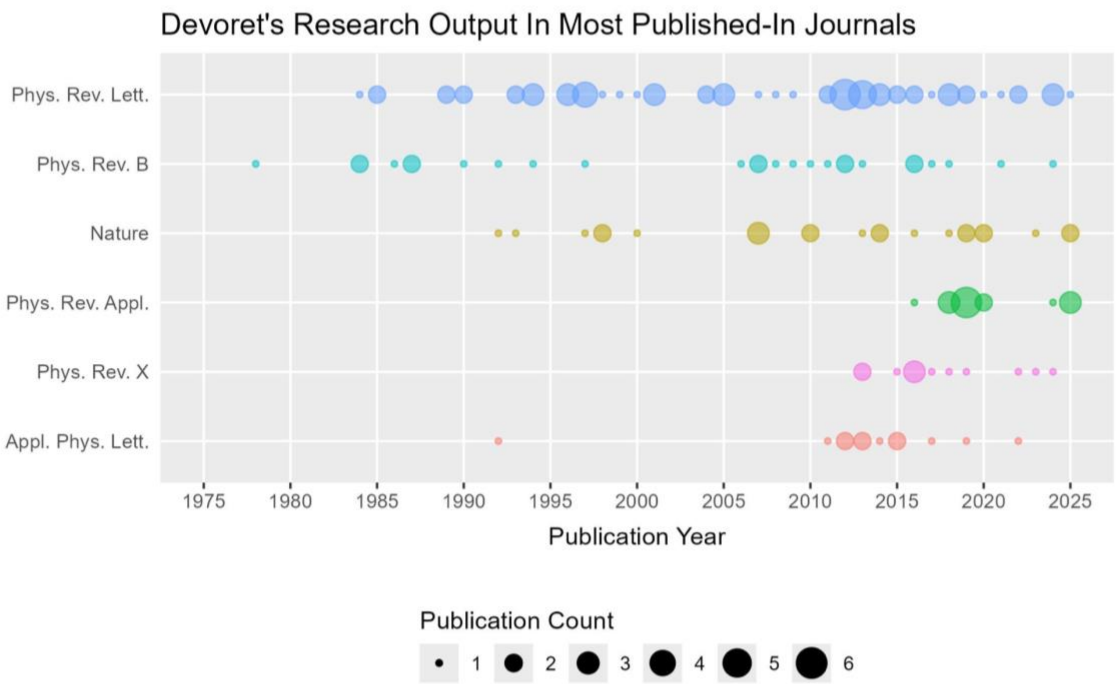

Figure 6: Devoret's research output in most published-in journals.

John M. Martinis

John M. Martinis was born in 1958 and raised in San Pedro, California–in the harbor region of Los Angeles (Fattaruso 2025). His mother was a homemaker and his father, who had fled communism in Yugoslavia, worked as a fisherman and then as a firefighter. As a child, Martinis would help his father build projects in their garage and developed a practical understanding of physics that would later serve as helpful context in his math and physics studies. A physics class senior year of high school hooked him on the subject and reassured him in his decision to pursue it as an undergraduate, at the University of California, Berkeley (Martinis and Zierler 2021).

For his undergraduate senior thesis, Martinis conducted nuclear physics research and built a detector called a Hadron calorimeter which he tested at Bevalac–a particle accelerator facility at LBNL (Stevenson et al. 1981). His senior year as an undergraduate was also when he had his first encounter with John Clarke, who was his instructor for a condensed matter course. Although at this time Martinis was still considering particle physics for graduate studies, he became very interested in experiments that Clarke was doing on quantum noise in superconducting devices, and discussed with Clarke the possibility of working for him as a graduate student (Martinis and Zierler 2021).

After earning his bachelor's degree, Martinis stayed at Berkeley and joined Clarke's lab for his doctoral studies. Although he started out working on a project on SQUID amplifiers, early on he was fascinated by a talk given by Anthony Leggett, who theorized the quantum tunneling of a macroscopic variable. Clarke agreed that this would be a good experiment for Martinis to do, and at just the right time, Devoret brought from France his knowledge of dilution refrigeration, which was critical for the experimental setup (Martinis and Zierler 2021).

Throughout this project, Devoret served as a mentor to Martinis, and after defending his thesis, Martinis went to do postdoctoral work under Devoret in his newly set up Quantronics Lab at Saclay. There, Martinis continued to research quantum devices, beginning with a project that served as a continuation of his thesis experiment, in which he measured the time of quantum tunneling under a barrier (Martinis et al. 1988).

Wanting to return to his home country, after a year and a half he took a job at the National Institute of Standards and Technology (NIST) in Boulder, Colorado, to lead an initiative in single electron counting. In this effort, he was able to build off the development of the single electron pump that was happening around the same time at Saclay (Martinis and Zierler 2021).

Although quantum computing had long been on Martinis's radar–since attending a conference presentation by Richard Feynman as a graduate student–it wasn't until well into his tenure at NIST that he began to explore it directly.

In 2004 he accepted an offer to join the faculty at UC Santa Barbara, where he brought new ideas about manipulating qubits with microwaves–and taking the first steps toward a scalable quantum computer. For 10 years he worked–alongside fellow former Clarke student Andrew Cleland–on improving qubit coherence and scaling up multi-qubit systems. His progressing results eventually attracted the attention of Hartmut Neven, head of Google Quantum Artificial Intelligence Lab, who offered Martinis the job of leading the lab's hardware team. In 2014, Martinis brought his team with him over to Google to set out on building a quantum computer (Martinis and Zierler 2021).

His effort reached a milestone in 2019 when his team produced evidence of quantum supremacy–a computational benchmark at which a quantum computer completes a task that the most powerful classical computer can't (Preskill 2019). Martinis and his team demonstrated that the 53-qubit Sycamore processor they designed–based on the transmon developed by Devoret and his team at Yale–completed in 200 seconds a task that they claimed would have taken a state-of-the-art classical supercomputer 10,000 years–though the claim was swiftly disputed by IBM (Arute et al. 2019; Pednault et al. 2019). In the wake of this success, however, intragroup tensions and a reorganization compelled Martinis to resign in early 2020 (Smith-Goodson 2020). Since his departure from Google, in addition to retaining his appointment at UC Santa Barbara, Martinis has been active in private industry, joining Australian start-up Silicon Quantum Computing as a consultant and cofounding a quantum computing company, Qolab (UC Santa Barbara, n.d.-a).

Select Awards

- 2021 John Stewart Bell Prize
- 2014 Fritz London Memorial Prize (with Michel Devoret and Robert Schoelkopf)
- 1997 American Physical Society, Division of Condensed Matter Physics Fellowship

Martinis in the scholarly record

Martinis has 316 publications in Web of Science. The earliest record of his scholarly output is a meeting abstract, published in 1981 in the *Bulletin of the American Physical Society*, that resulted from his dabbling in particle physics research as an undergraduate at Berkeley, titled, 'Measurement of the total energy of projectile fragments in relativistic heavy-ion collisions.'

Martinis's publications have, in aggregate, been cited by 25,313 documents (25,059 when excluding self-citing documents) and have accumulated 42,963 citations total, for an average of just under 136 citations per document. His h-index is 105.

Martinis's top 10 most highly cited publications, which are listed in Table 3, illustrate his devotion and immense contributions to quantum computing since the turn of the century. Despite doctoral work in the 1980s that would eventually earn him a Nobel Prize and a subsequent prolific period working on quantum devices at Saclay and NIST, his earliest paper among these 10 was published in 2002, after he began to tailor his research more directly toward the creation of a quantum computer. In that 2002 *Physical Review Letters* paper–his fifth-most cited–Martinis and his coauthors demonstrate the operability of a qubit circuit which they describe as ‘the basis of a scalable quantum computer’ (Martinis et al. 2002, 1). That paper has accrued 891 citations, averaging roughly 37 per year since its publication. Martinis's mostly highly cited paper–which is also the one that has accumulated citations at far and away the highest rate–presents the results of the effort he spearheaded, as the hardware lead at Google's Quantum AI Lab, to demonstrate quantum supremacy. This 2019 *Nature* paper announcing the groundbreaking performance of the Sycamore processor has 585 citations the year following its publication. It has since accrued 5,300 citations in Web of Science. Figure 7 shows citations to all of Martinis's work over time. His yearly citations have grown at an increasing rate, hitting 1,000 for the first time in 2012, 2,000 just seven years later, and 3,000 the following year. Since 2021, Martinis's citations have held relatively steady around 3,500 per year.

Table 3: John M. Martinis's 10 most cited publications, as shown in Web of Science.

Publication	Web of Science Citations	Citations Per Year
Arute, F., K. Arya, R. Babbush, D. Bacon, J.C. Bardin, R. Barends, R. Biswas, et al. 2019. “Quantum supremacy using a programmable superconducting processor.” *Nature* 574 (7779): 505–510.	5,300	757.1
Fowler, A.G., M. Mariantoni, J.M. Martinis, and A.N. Cleland. 2012. “Surface codes: Towards practical large-scale quantum computation.” *Physical Review A* 86 (3).	2,097	149.8
O'Connell, A.D., M. Hofheinz, M. Ansmann, R.C. Bialczak, M. Lenander, E. Lucero, M. Neeley, et al. 2010. “Quantum ground state and single-phonon control of a mechanical resonator.” *Nature* 464 (7289): 697–703.	1,691	105.7

Barends, R., J. Kelly, A. Megrant, A. Veitia, D. Sank, E. Jeffrey, T.C. White, et al. 2014. “Superconducting quantum circuits at the surface code threshold for fault tolerance.” *Nature* 508 (7497): 500–503.	1,389	115.8
Martinis, J.M., S. Nam, J. Aumentado, and C. Urbina. 2002. “Rabi oscillations in a large Josephson-junction qubit.” *Physical Review Letters* 89 (11).	891	37.1
O’Malley, P.J.J., R. Babbush, I.D. Kivlichan, J. Romero, J.R. McClean, R. Barends, J. Kelly, et al. 2016. “Scalable quantum simulation of molecular energies.” *Physical Review X* 6 (3).	888	88.8
Boixo, S., S.V. Isakov, V.N. Smelyanskiy, R. Babbush, N. Ding, Z. Jiang, M.J. Bremner, J.M. Martinis, and H. Neven. 2018. “Characterizing quantum supremacy in near-term devices.” *Nature Physics* 14 (6): 595–600.	833	104.1
Hofheinz, M., H. Wang, M. Ansmann, R.C. Bialczak, E. Lucero, M. Neeley, A.D. O’Connell, et al. 2009. “Synthesizing arbitrary quantum states in a superconducting resonator.” *Nature* 459 (7246): 546–49.	723	42.5
Kelly, J., R. Barends, A.G. Fowler, A. Megrant, E. Jeffrey, T.C. White, D. Sank, et al. 2015. “State preservation by repetitive error detection in a superconducting quantum circuit.” *Nature* 519 (7541): 66–69.	723	65.7
Martinis, J.M., K.B. Cooper, R. McDermott, M. Steffen, M. Ansmann, K.D. Osborn, K. Cicak, et al. 2005. “Decoherence in Josephson qubits from dielectric loss.” *Physical Review Letters* 95 (21).	687	32.7

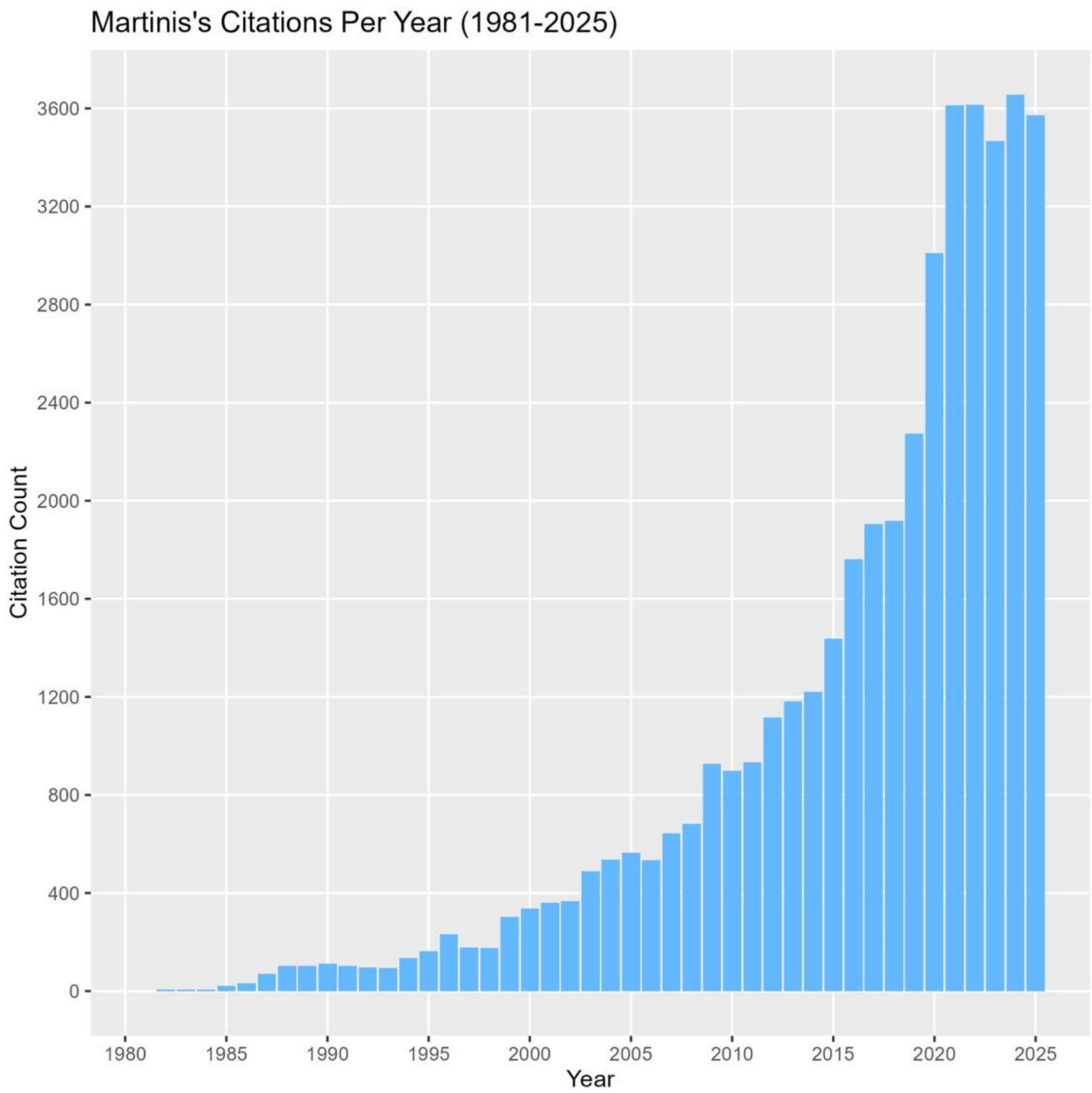

Figure 7: Martinis's citations per year (1981-2025).

Martinis's publications in Web of Science consist overwhelmingly of journal articles, of which there are 259. Also included are 33 proceedings papers, 13 book chapters, one review article, and a small collection of editorial materials, notes, a meeting abstract, and a correction. One of these editorial materials is a *Nature* opinion piece from 2017–just before Google's demonstration of quantum supremacy–in which he and several of his Google colleagues argue for the short-term commercial viability and investment returns of quantum technologies, and urge business stakeholders to adopt them (Mohseni et al. 2017). Figure 8 shows Martinis's publications over time, which form two clear peaks–one in the early 2000s, in the years leading up to his move from NIST to UCSB, and one in the mid 2010s, just as he moved his project to Google. During both periods, his maximum yearly output was 20 publications (in 2000 and 2014).

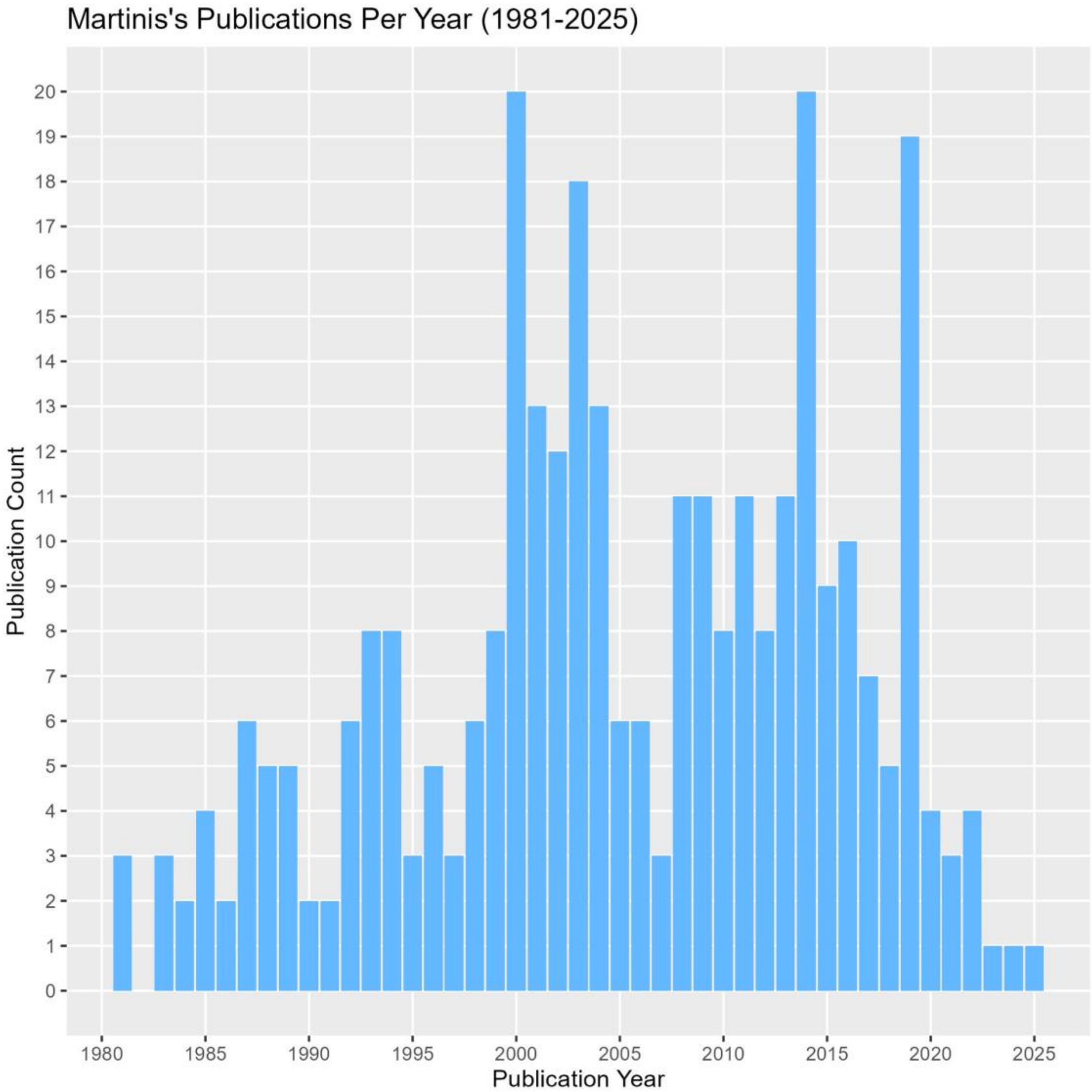

Figure 8: Martinis's publications per year (1981-2025).

Martinis's most frequent coauthor is Daniel T. Sank, who was a graduate student under Martinis at UCSB and followed him to Google upon graduating with his Ph.D (Sank 2014). Martinis and Sank have 72 coauthorships in Web of Science–roughly 23% of Martinis's publications. Martinis's next most frequent coauthor is J. Wenner, with whom he shares 64 indexed publications. Third most frequent is A. Cleland, who was a graduate student behind Martinis in Clarke's group at Berkeley, and with whom Martinis would later reunite on the UCSB faculty (Martinis and Zierler 2021). Martinis and Cleland have 61 coauthorships in Web of Science.

The journals in which Martinis has most frequently published are *Physical Review Letters* (51 publications), *Applied Physics Letters* (29 publications), *Physical Review B* (25 publications), *Physical Review A* (17 publications), and *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* (14 publications). Martinis's research output in these five journals is visualized in Figure 9. His history with *Physical Review Letters* dates back the furthest–to a 1981 paper resulting from his research as an undergraduate senior. Martinis's long histories with these American Physical Society journals begin to peter out around 2020, largely in favor of Springer Nature titles like *Nature*, *Nature Physics*, and *npj Quantum Information*.

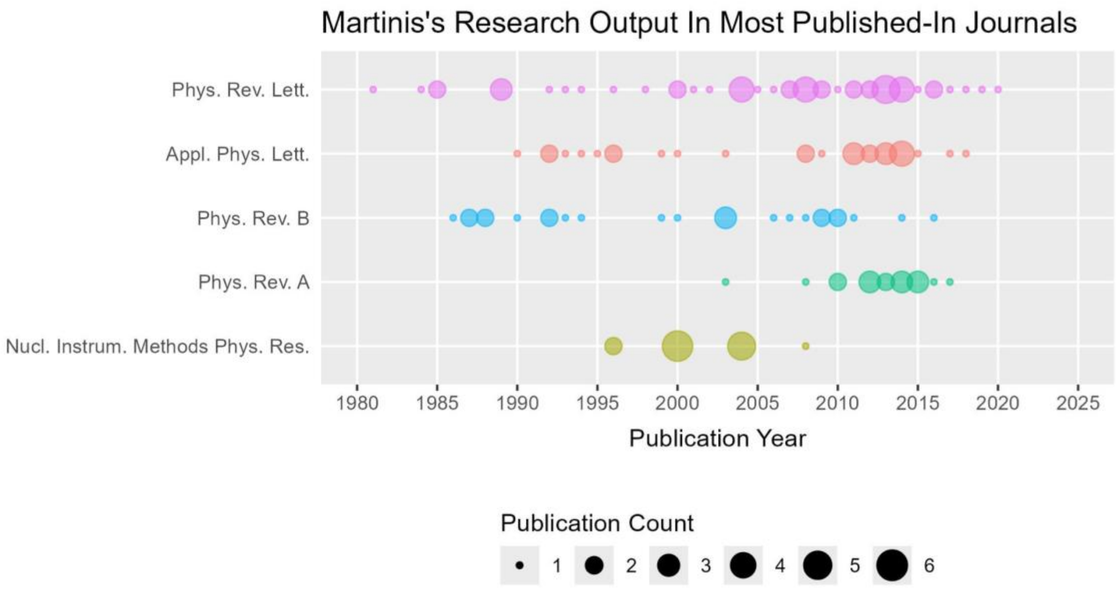

Figure 9: Martinis's research output in most published-in journals.

Conclusion

The 2025 Nobel Prize in physics highlights an important milestone in quantum physics history. Based on the outcomes of Clarke, Devoret, and Martinis's experiments, researchers have been able to make significant advancements in quantum computing and other quantum systems. Each laureate has continued to make major contributions to the field of physics and adjacent fields. Over the last 100 years of quantum physics, scientists have been able to uncover many secrets behind the unusual behavior of the quantum world. Yet there are still many unanswered questions out there for researchers to explore, whether that is how to create complex quantum computers or the discovery of dark matter particles.

Note on data collection

At the time of data compilation, the three laureates did not have robust trustworthy author records in Web of Science. For each laureate, publications were compiled by reviewing multiple erroneously fragmented, algorithmically generated author profiles, and by searching on name variants and institutional affiliations. Publication numbers reflect what was published through 2025 and indexed in Web of Science by the end of that calendar year, so it is likely that some publications from late 2025 are not accounted for. Citation data was exported from Web of Science in January 2026.

Web of Science often tags records with multiple document types. In analyzing document types, judgments were made by the authors so that breakdowns would not sum to over 100% of a laureate's publications. For example, any record tagged as both a proceeding paper and an article was treated as an article, and any record tagged as both an article and a book chapter was treated as a book chapter.

Disclosure Statement

The authors report there are no competing interests to declare.

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