



Nobel Prize in Physics goes to the Quantum Tunnelling Effect

John Clarke, Michel H. Devoret and John M. Martinis have won the Nobel Prize in Physics for the discovery of macroscopic quantum mechanical tunnelling and energy quantisation in an electric circuit.

October 08, 2025

Yesterday, the **2025 Nobel Prize in Physics** has been announced, and **John Clarke** (University of California, Berkeley), **Michel H. Devoret** (Yale University and UC Santa Barbara), and **John M. Martinis** (UC Santa Barbara) have been awarded for their groundbreaking discovery of **macroscopic quantum mechanical tunnelling and energy quantization in an electric circuit**. Their work revealed that quantum phenomena, usually confined to the microscopic world, can also be observed in systems large enough to hold in one's hand.

In 1984 and 1985, the awardees conducted a series of experiments which addressed one of the major questions in physics that still remain today: what is the maximum size of a system that can demonstrate quantum mechanical effects? or, how large can a system be and still display quantum behavior? Using a specially designed **superconducting circuit** separated by

a thin insulating layer-known as a **Josephson junction**-they showed that collective motion of electrons could act like a single quantum object. This allowed them to study quantum effects in a tangible, macroscopic setting.

Thanks to this electrical circuit built of superconductors, their experiments demonstrated **quantum tunnelling**, where the system could escape from a stable, zero-voltage state through a quantum process rather than a classical one. They also confirmed **energy quantization**, showing that the system could absorb or emit only discrete energy levels, exactly as predicted by quantum theory.

This pioneering research not only deepened our understanding of the quantum-to-classical boundary but also laid the foundation for **modern quantum technologies**, including superconducting qubits used in quantum computing. The work exemplifies how century-old quantum mechanics continues to surprise-and to power the technologies of the digital age.

ICFO was privileged to welcome John M. Martinis in 2018 as part of the ICFO Corporate Liaison Program (CLP) Day, where he delivered a talk titled *Quantum Supremacy: Checking a Quantum Computer with a Classical Supercomputer*. Then a Research Scientist at Google and Professor at UC Santa Barbara, Martinis shared insights from his pioneering work at the frontier of quantum computing, offering the ICFO community a first-hand glimpse into the dawn of quantum supremacy. As Oriol Romero-Isart, Director of ICFO, remarks, *This Nobel Prize honors John Clarke, Michel Devoret, John Martinis, and the wider community who pursued the bold quest to observe quantum effects in electronic circuits-a pursuit that, in the 1980s, few could have imagined would evolve into one of today's most promising platforms for quantum computation. It is a clear example of how curiosity-driven research lays the foundations for future technologies.*