Maths & Physics from Ireland

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William Rowan Hamilton

Dublin (1805-1865)

One of the most famous mathematical physicists of all time. He revolutionized physics and mechanics with the invention of the Principle of Least Action, and Hamiltonian mechanics. These are at the heart of modern fundamental physics. We use these for everything from studying the laws of motion that govern our solar system to the quantum mechanical laws that describe subatomic physics.

He is also well known for inventing the quaternion number system, an extension of the complex numbers. He had the idea while walking along the Royal Canal and immediately etched the famous formula into the Brougham Bridge.

He spent his career at Trinity College Dublin, where he was Professor at just 22 years old.

George Stokes

Skreen, Sligo (1819-1903)

Stokes did foundational work in fluid dynamics with the Navier–Stokes equations, which explain how liquids and gases flow. They are essential in many areas of engineering and physics: weather prediction, designing airplanes, modeling blood flow, and even understanding stars.

He was also well-known for his work in optics with notable research in understanding fluorescence (where some materials glow under ultraviolet light), and on the diffraction and polarization of light. His famous "Stokes' Theorem" is a cornerstone of modern mathematics and physics, relating line and surface integrals over a vector field.

The man from Sligo held the Lucasian Professorship of Mathematics in Cambridge for 54 years, the longest tenure in its history.

John Tyndall

(1820-1893)

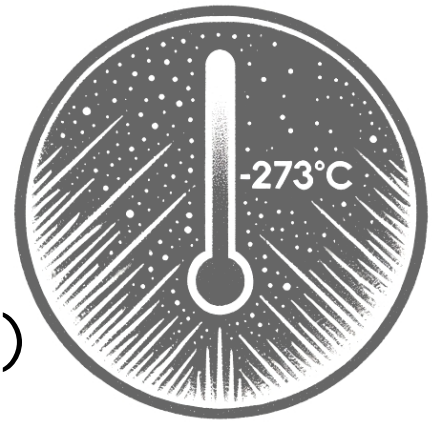
Leighlinbridge, Carlow

Tyndall was the first to understand that our sky is blue because blue light scatters more than other colours off particles in our atmosphere, and that sunsets and sunrises appear red because the blue light has already scattered off after traveling so far through the atmosphere. We now call this the Tyndall effect / scattering.

Although he first gained fame for his work on diamagnetism, in 1859 he was the first to prove the Greenhouse effect. Testing atmospheric gases in his lab he showed how some of them can trap infrared heat from the Sun, particularly with carbon dioxide and water vapour. This was a major contribution to what we now call climate science.

He was also a well-known popularizer of science, and the Tyndall Institutes in Ireland are named after him.

William Thompson



Belfast, Antrim (1824-1907)

Also known as Lord Kelvin, William Thompson made major contributions to the theory of thermodynamics. He was the first to figure out that the lowest temperature that can possibly be reached is approx -273.15 degrees Celsius. We now call this temperature Absolute Zero, or Zero Kelvin. Outer space is very close to being a perfect vacuum and so the temperature is very close to absolute zero, about -270.45 degrees, or 2.7 Kelvin. This Kelvin temperature scale was developed by him and is still used today.

Thompson also pioneered a theory that the atom is actually a vortex in an aether. The theory proved to be incorrect, but it did give birth to the branch of mathematics known today as Knot Theory. He became a professor at the University of Glasgow at age 22, and played an important role in the development of the transatlantic cables.

Joseph Larmor

(1857-1942)

Magheragall, Antrim

Joseph Larmor made major contributions to electricity, motion, and atomic theory. He predicted time dilation before Einstein and studied how charged particles lose energy when they accelerate.

Larmor explained how magnetic fields split light into different colors, an effect important to modern spectroscopy, and the Larmor frequency is named after him. He proposed an early atomic model and even suggested the existence of a 'positive electron', later known as the proton.

Although he believed in the outdated aether theory, his mathematical work helped shape modern physics, influencing relativity and quantum mechanics. Larmor held the Lucasian Chair of Mathematics at Cambridge, where he was succeeded by the famous physicist Paul Dirac.

John Campbell

Lisburn, Antrim (1862-1924)

John Campbell made major contributions to Lie algebras and differential geometry, areas that became crucial in quantum mechanics and particle physics.

His most famous result, the Baker-Campbell - Hausdorff theorem, gives a formula for combining exponentials of matrices using just their commutators. This is essential to describe how quantum systems evolve in time, and how symmetries are encoded into the equations of fundamental physics.

Campbell got his degree in Mathematics at Queens University Belfast, later worked at Oxford University, and was president of the London Mathematical Society. However, after losing his son in World War I he stopped mathematical research.

Annie (Russell) Maunder

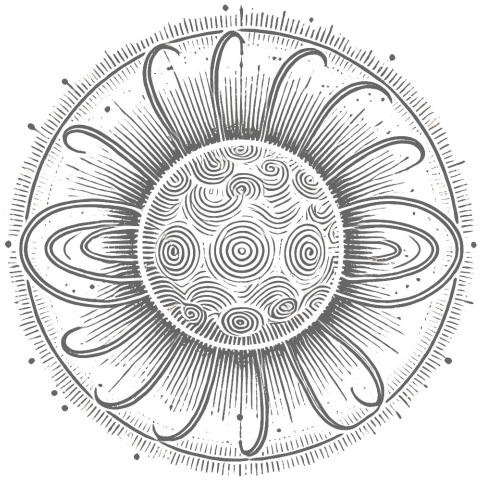
Strabane, Tyrone (1868-1947)

Annie Maunder was an astronomer who defied the gender restrictions of her time. Despite excelling in mathematics at Cambridge, she was denied a degree because she was a woman.

She worked as a mathematician (or `lady computer') at the Royal Observatory Greenwich, analyzing sunspots and photographing solar eclipses worldwide. After marriage forced her resignation, she continued groundbreaking research alongside her husband, Walter Maunder. A pioneering astrophotographer, she captured record-breaking coronal streamers.

Her legacy lives on in the Maunder Minimum, a crater on the moon named after her, and a Royal Astronomical Society medal also named in her honor.

John Sealy Townsend



Galway (1868-1957)

Known for his groundbreaking work in gas ionization and electrical conductivity, he studied mathematics at Trinity College Dublin before joining Cambridge, where he worked under J. J. Thomson.

Townsend developed the "Townsend discharge" theory, explaining how electrons ionize gases through collisions. His experiments helped determine the elementary electric charge, later refined by Millikan. Although he did not know it at the time, the electron charge is a fundamental constant of nature that plays a central role in fundamental physics today.

His work is still important today in plasma physics, which describes how mixtures of ions and electrons behave. Our sun, and most stars, are made of plasma.

John Synge

(1897-1995)

Dublin

Synge made many important contributions to theoretical physics, especially to Einstein's theory of relativity. He specialized in using geometry to study spacetime, black holes, and mechanics.

In 1950, he was the first to study the region inside a black hole event horizon, when most physicists did not believe black holes were real! His 1956 book introduced space-time diagrams, providing visual representations of relativistic systems. In his research Synge contributed to classical mechanics, optics, hydrodynamics, and electromagnetism. He even made an impact in pure mathematics, where Synge's theorem in topology is named after him.

Also, his uncle was the famous playwright John Millington Synge.

Ernest Walton

(1903-1995)

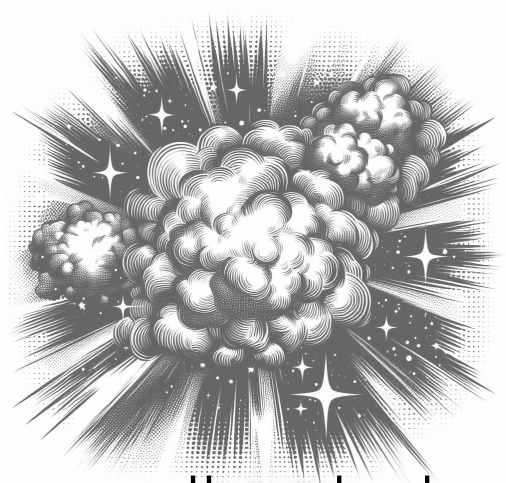
Dungarvan, Waterford

The first to split the atom in a controlled experiment and the only Irish winner of the Nobel Prize in Physics.

Walton excelled in mathematics and physics at Trinity College Dublin before joining Cambridge's Cavendish Laboratory under Ernest Rutherford.

Himself and John Cockroft built a particle accelerator in the 1930s, the Cockcroft-Walton generator. Their experiments accelerated protons and collided them with lithium atoms to break them into helium nuclei, confirming theories on nuclear structure. This was the first controlled nuclear transmutation, i.e. splitting the atom, and earned them the Nobel Prize in 1951. Their work is still important for many technologies used today, such as X-ray machines.

David Bates



(1916-1994)

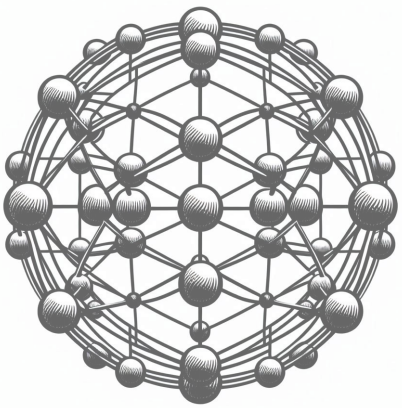
Omagh, Tyrone

Bates began his career working on the physics of the Earth's upper atmosphere, but during World War II he turned his skills in mathematical physics to figuring out ways to avoid the German magnetic mines. These mines detonated when they detected deviations in the magnetic field caused by passing ships.

After the war, Bates continued to make contributions in the field of atomic and molecular physics, focusing on processes in the upper atmosphere and on the composition of interstellar gas clouds. In 1950 he spent time in the US where he wrote his important paper `The density of molecules in interstellar space'.

He founded the Department of Applied Mathematics and Theoretical Physics at Queens University Belfast, and was a founding member of the Alliance Party.

Sheila Power



(1918-2010)

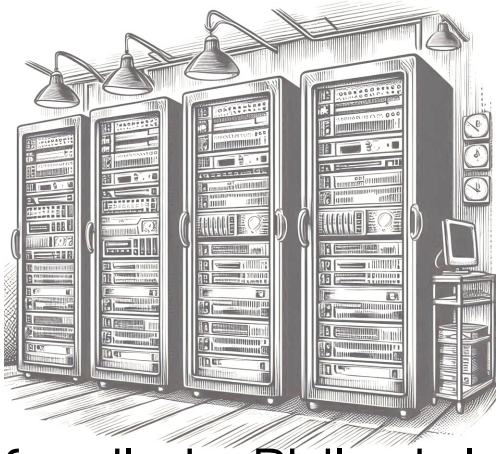
Galway

Power studied at University College Dublin and obtained her PhD in mathematics with renowned physicist Max Born at the University of Edinburgh, where she studied quantum theory and the stability of crystal lattices under vibrations.

She continued her research in nuclear physics, spending a year in Princeton at the same time as Einstein, Weyl, and Dyson. She also collaborated with Erwin Schrödinger, who described her as 'among the best equipped and most successful of the younger generation of theoretical physicists'.

In 1949 she returned to Ireland where she became one of the first women elected to the Royal Irish Academy. She was made Professor of Mathematical Physics and Quantum Theory at UCD, where she stayed until retirement.

Kay McNulty



(1921-2006)

Creeslough, Donegal

Kay McNulty moved with her family to Philadelphia in America when she was only a few years old. From a young age she excelled at mathematics, and during World War II she was employed as a mathematician at the Moore School of Engineering where she would calculate firing tables for artillery.

Through this, Kay became one of the first operators of the ENIAC computer – the first programmable, electronic, general-purpose computer, built in 1945. She became an expert in designing algorithms for solving differential equations using the computer. When the machines successors were built, the BINAC and UNIVAC computers, she continued designing programs for them.

Later in life she was a well-known public speaker on the topic of computing.

John S. Bell

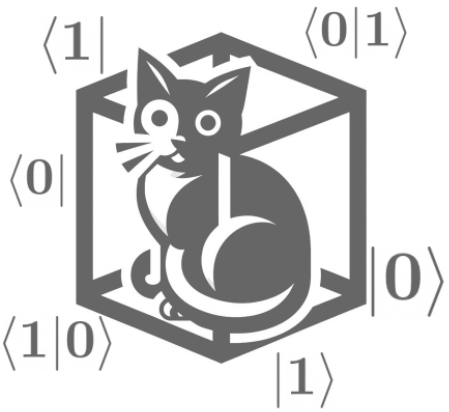
(1928-1990)

Belfast, Antrim

Best known for developing Bell's Theorem, which shows that quantum mechanics does not fit into a classical `local hidden variable' theory. Instead he showed that quantum mechanics, and so nature, is inherently non-local, something that even Einstein thought was not possible. In fact, Einstein called it 'spooky action at a distance'.

Experimental verification of Bell's Theorem was obtained in 1972 and 1982, work that received the 2022 Nobel Prize in Physics. Bell was in fact nominated for a Nobel Prize in 1990, but sadly passed away before a decision was made. He spent most of his career working at CERN making significant contributions to the physics of particle colliders. He was skeptical of the standard Copenhagen interpretation of quantum mechanics, believing that a deeper underlying theory should exist.

Boole and Schrödinger



Ireland was also host to some great mathematicians and physicists who were not born in the country. One of these was George Boole who worked on differential equations and algebraic logic. In 1849 he became Professor of Mathematics at Queen's College in Cork where he invented Boolean algebra, a crucial concept in modern computing and digital electronics.

In 1939 Erwin Schrödinger moved to Ireland to escape Nazi Germany after an offer from Éamon de Valera, who also had a degree in mathematics. Schrödinger won the Nobel Prize in Physics in 1933, and while in Ireland he worked at the Dublin Institute for Advanced Studies. He is famous for work in quantum mechanics, in particular the Schrödinger equation and the Schrödinger's Cat thought experiment. While in Ireland he published his book, 'What is life?'.

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