

History of Atomic Models

Ancient Origins of Electronics

The earliest recording of electrical phenomenon was made by Thales of Miletus in around 600BC when it was found that after amber was rubbed, it attracted small objects. Our word for electricity and electron comes from the Greek word for amber, ἤλεκτρον (IPA pronunciation: /ɛː.lek.tron/).

Later, Democritus, an ancient Greek philosopher alive around 460BC to 370BC, made the argument that if you were to cut a piece of matter (such as gold) in half again and again, you must eventually reach a point where it can no longer be cut. He called this indivisible particle “atomos”, which means uncuttable or indivisible. His idea was largely rejected by other influential philosophers, such as Aristotle.

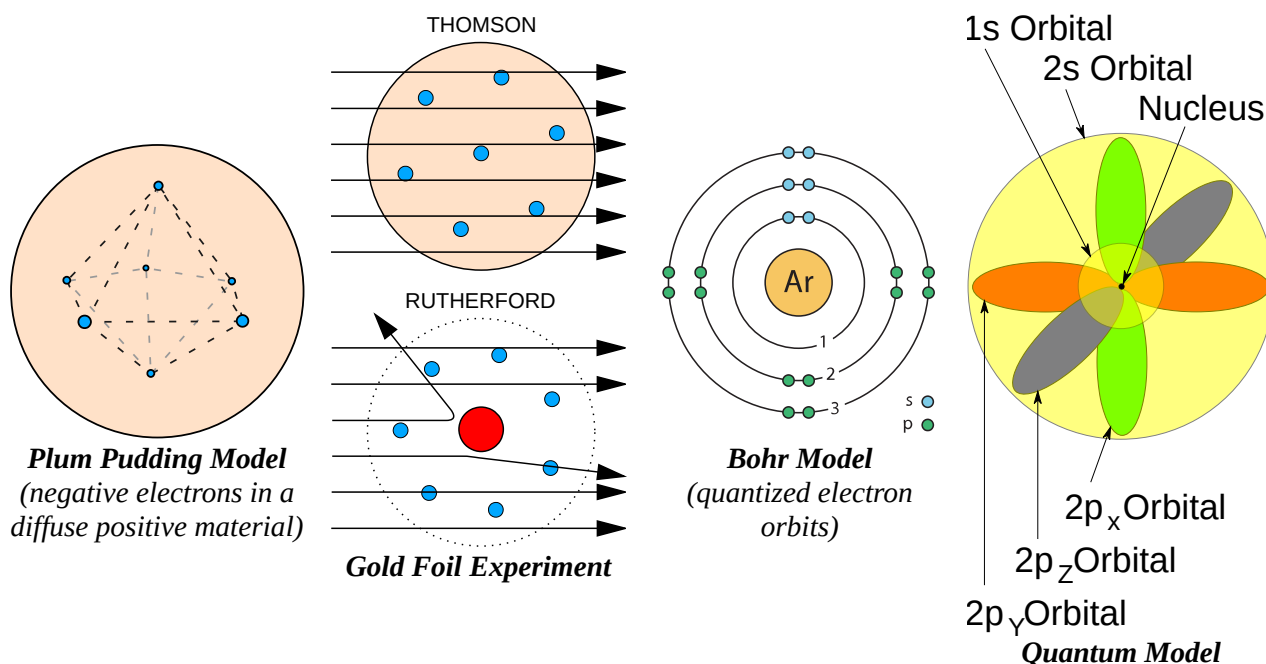
Modern Scientific Discovery

The modern *Scientific Revolution* started in the 16th century (1500s), and lead to rapid progress in the understanding of electronics. The following table gives an abridged timeline of some relevant advancements.

Year	Scientist	Publication name and description of advancement
1797	Joseph Proust	Law of Definite Proportions: chemical compounds always combine in constant proportions by mass, suggesting a discrete property of matter.
1808	John Dalton	A New System of Chemical Philosophy: a comprehensive and systematic atomic theory.
1897	Joseph John Thomson	Cathode Rays: provided experimental evidence from cathode rays for the electron, much smaller and lighter than an atom, proving that atoms are not the smallest possible division of matter.
1901	Max Planck	On the Law of Distribution of Energy in the Normal Spectrum: solved the <i>black body radiation problem</i> by making the assumption that energy is quantized. Energy can only be exchanged in discrete, indivisible packets, each with energy $E=h \cdot f$, where h is Planck’s constant, $h = 6.62607015 \times 10^{-34}$ joule-seconds (J·s). This idea was so unconventional that even Planck himself believed his solution was a mathematical trick rather than a real-world phenomenon
1904	Joseph John Thomson	On the Structure of the Atom: described what has become to be known as the <i>plum pudding model</i> of the atom (diagram below).
1905	Albert Einstein	On a Heuristic Point of View Concerning the Production and Transformation of Light: explained the photoelectric effect by proposing that light itself consists of particle-like <i>photons</i> , with energy $E= h \cdot f$, proving Planck’s concept was a real phenomenon.
1911	Ernest Rutherford	The scattering of alpha and beta particles by matter and the structure of the atom: disproved the <i>plum pudding model</i> by showing that the atom contains a nucleus that deflects alpha particles (He^{2+} nuclei). This lead to the <i>nuclear model</i> or <i>planetary model</i> of the atom.
1913	Niels Bohr	On the Constitution of Atoms and Molecules: explained that electrons could only occupy quantized orbits, and only absorb or emit radiation (energy) as they transition between lower and higher energy orbits.
1924	Louis de Broglie	Researches on the Quantum Theory: proposed not only light, but also matter exhibited wave-particle duality, providing a physical reason why electrons could only exist in fixed orbits – stable only if it were a whole number of the electron’s wavelength.
1926	Erwin Schrödinger	Quantization as an Eigenvalue Problem: presents what became known as the Schrödinger equation that describes the behavior of quantum particles, such as electrons, by treating them as waves. This lead to the most current and accepted <i>quantum mechanical model (orbital model)</i> of the atom.

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Exercise 1:

Write the approximate time of the advancement and the last name of the scientist (or philosopher) who is credited with each.

- the first record of electrical phenomenon
- the concept of an indivisible atom
- proposed an atomic theory and provided evidence based on mass ratios
- discovered the electron.
- the father of quantum mechanics who proposed energy was transferred in discrete packets
- proposed light itself consists of particle-like photons
- discovered the atomic nucleus leading to the *planetary model* of the atom
- proposed electrons exist only in quantized orbits
- proposed matter also exhibits wave-particle duality
- developed an equation that describes behavior of quantum particles, such as electrons, by treating them as waves

Year	Scientist