

For the 100th anniversary of the Russian Revolution, we chose an object representative of the nuclear program developed in Portugal in the context of the Cold War: the Cockroft-Walton Generator

Apparatus to accelerate particles allow us to study very small objects revealing the most intimate structure of matter found at the nuclei of the atoms. The accelerators are as important to particle physics as telescopes are to astronomy or microscopes to biology.

In 1929, John Cockroft and Ernest Walton began the construction of such an apparatus at the Cavendish Laboratory. The laboratory was led by Ernest Rutherford, who considered the main problem of physics, at the time, to be the lack of knowledge about the structure of the atomic nucleus. To overcome such problem, it was necessary to “breakdown the atom” causing particles to collide with each other, at high speed and therefore to design a machine that could produce very high electrical voltages in order to accelerate those particles.

Cockroft and Walton developed a device that allowed them to produce such voltages with relatively low currents. The particles thus accelerated reached energies of the order of 600 000 eV (electron-Volt) allowing Cockroft and Walton to develop sensational experiences! In 1932, they caused the first nuclear reactions with artificially accelerated particles. Using an auxiliary discharge tube, the scientists removed electrons from hydrogen atoms, obtaining a proton beam. From the shock between a proton beam and a lithium sheet the result was the absorption of protons by lithium and the detection of the so-called alfa particles.

Rutherford had already identified alfa particles early in his career as nuclei of helium atoms that lose their electrons and have four times the mass of the proton. The results of this experiment were fantastic: for the first time in history a

non-spontaneous disintegration of an atomic nucleus had occurred without the use of radioactive elements. Cockroft and Walton went even further: they measured the kinetic energy of alfa particles and experimentally confirmed Einstein’s famous formula, $E = mc^2$, of the equivalence between mass and energy!

The two scientists won the Nobel Prize for Physics in 1951 for their work. The research of Rutherford, Cockroft, Walton, and many others paved the way for particle physics and the construction of much more complex accelerators than the instrument displayed in the cloister. The goal remains the same since Rutherford’s experiments: to go deeper into the nature of matter and discover its secrets...

