The Evolution of Particle Accelerators & Colliders

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WHEN J. J. THOMSON discovered the electron, he did not call the instrument he was using an accelerator, but an accelerator it certainly was. He accelerated particles between two electrodes to which he had applied a difference in electric potential. He manipulated the resulting beam with electric and magnetic fields to determine the charge-to-mass ratio of cathode rays. Thomson achieved his discovery by studying the properties of the beam itself—not its impact on a target or another beam, as we do today. Accelerators have since become indispensable in the quest to understand Nature at smaller and smaller scales. And although they are much bigger and far more complex, they still operate on much the same physical principles as Thomson's device.

It took another half century, however, before accelerators became entrenched as the key tools in the search for subatomic particles. Before that, experiments were largely based on natural radioactive sources and cosmic rays. Ernest Rutherford and his colleagues established the existence of the atomic nucleus—as well as of protons and neutrons—using radioactive sources. The positron, muon, charged pions and kaons were discovered in cosmic rays.

One might argue that the second subatomic particle discovered at an accelerator was the neutral pion, but even here the story is more complex. That it existed had already been surmised from the existence of charged pions, and the occurrence of gamma rays in cosmic rays gave preliminary evidence for such a particle. But it was an accelerator-based experiment that truly nailed down the existence of this elusive object.