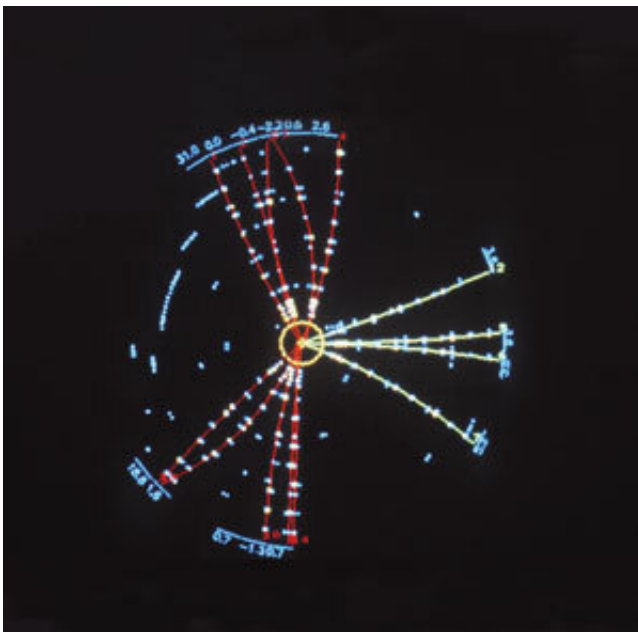


# How a walk through CERN's corridors helped lead to the discovery of the gluon 40 years ago

June 18 2019, by Ana Lopes

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A three-jet event detected by the TASSO detector at DESY. Credit: Oxford PPU

Forty years ago, in 1979, experiments at the DESY laboratory in Germany provided the first direct proof of the existence of gluons—the carriers of the strong force that "glue" quarks into protons, neutrons and other particles known collectively as hadrons. This discovery was a milestone in the history of particle physics, as it helped establish the theory of the strong force, known as quantum chromodynamics.

The results followed from an idea that struck theorist John Ellis while walking in CERN's corridors in 1976. As Ellis recounts, he was walking over the bridge from the CERN cafeteria back to his office, turning the corner by the library, when it occurred to him that "the simplest experimental situation to search directly for the gluon would be through production via bremsstrahlung in electron–positron annihilation." In this process, an electron and a positron (the electron's antiparticle) would annihilate and would occasionally produce three "jets" of particles, one of which being generated by a gluon radiated by a quark–antiquark pair.

Ellis and theorists Mary Gaillard and Graham Ross then went on to write a paper titled "Search for Gluons in  $e^+e^-$  Annihilation" in which they described a calculation of the process and showed how the PETRA collider at DESY and the PEP collider at SLAC would be able to observe it. Ellis then visited DESY, gave a seminar about the idea and talked to experimentalists preparing to work at PETRA.

A couple of years later, and following more papers by Ellis, Gaillard and other theorists, PETRA was being commissioned and getting into the energy range required to test this theory. Soon after, at the International Neutrino Conference in Bergen, Norway, on 18 June 1979, researchers presented a three-jet collision event that had just been detected by the TASSO experiment at PETRA.

At the European Physical Society conference at CERN a couple of weeks later, the TASSO collaboration presented several three-jet events and results of analyses that showed that the gluon had been discovered. One month later, in August 1979, three other experiments at PETRA showed similar events that lent support to TASSO's findings.

Find out more about the discovery in [DESY's coverage of the 40-year anniversary](#), in Ellis' account, and in [this 2004 CERN Courier article](#).

Provided by CERN

Citation: How a walk through CERN's corridors helped lead to the discovery of the gluon 40 years ago (2019, June 18) retrieved 25 April 2024 from <https://phys.org/news/2019-06-cern-corridors-discovery-gluon-years.html>

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