g-2 measuring the muon

In the 1950s the muon was still a complete enigma. Physicists could not yet say with certainty whether it was simply a much heavier electron or whether it belonged to another species of particle. g-2 was set up to test quantum electrodynamics, which predicts, among other things, an anomalously high value for the muon's magnetic moment 'g', hence the name of the experiment.

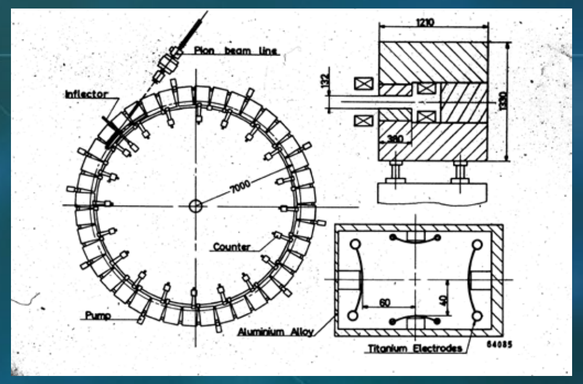
In 1959, six physicists joined forces to try to measure the muon's magnetic moment using CERN's first accelerator, the Synchrocyclotron. In 1961, the team published the first direct measurement of the muon's anomalous magnetic moment to a precision of 2% with respect to the theoretical value. By 1962, this precision had been whittled down to just 0.4%. This was a great success since it validated the theory of quantum electrodynamics. As predicted, the muon turned out to be a heavy electron.

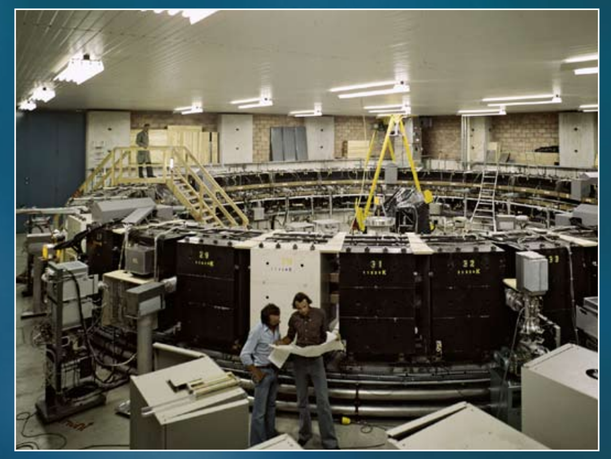
The first g-2 experiment at the SC, sitting on the experiment's 6 m long magnet. From right to left : A. Zichichi, Th. Muller, G. Charpak, J.C. Sens. Standing : F. Farley. The sixth person was R. Garwin.

The second g-2 experiment started in 1966 under the leadership of Francis Farley and it achieved a precision 25 times higher than the previous one. This allowed phenomena predicted by the theory of quantum electrodynamics to be observed with a much greater sensitivity — vacuum polarisation for instance, which is the momentary appearance of 'virtual' electron and antielectron pairs with very short lifetimes. The experiment also revealed a quantitative discrepancy with the theory and thus prompted theorists to re-calculate their predictions.

"g-2 is not an experiment: it is a way of life." John Adams

A third experiment, with a new technical approach, was launched in 1969, under the leadership of Emilio Picasso. The final results were published in 1979 and confirmed the theory to a precision of 0.0007%. They also allowed observation of a phenomenon contributing to the magnetic moment, namely the presence of 'virtual hadrons'. After 1984, the United States took up the mantle of investigating the muon's anomalous magnetic moment, applying the finishing touches to an edifice built at CERN.





The g-2 muon storage ring in 1974.

«The science I have experienced has been all about imagining and creating pioneering devices and observing entirely new phenomena, some of which have possibly never even been predicted by theory. That's what invention is all about and it's something quite extraordinary. CERN was marvellous for two reasons: it gave young people like me the opportunity to forge ahead in a new field and the chance to develop in an international environment.»

Francis Farley, Infinitely CERN, 2004