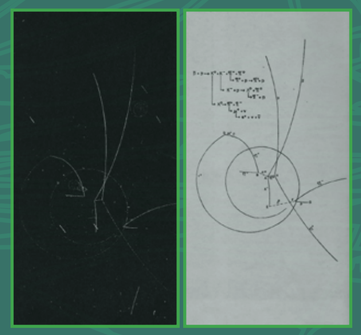
Exploring the *strong force with bubble chambers*

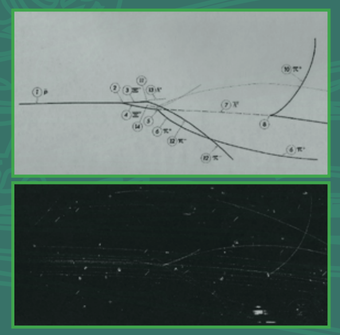
The beautiful, ephemeral trails of bubble chamber photographs became emblematic of an epoch. The tracks are lines of very small bubbles created by charged particles passing through a liquid that is very close to boiling point. A strong magnetic field bent the trajectories into arcs of circles, enabling the momentum and the charge of the particles to be measured and so the different types of particles to be identified.

The strong force is responsible for binding quarks and antiquarks to make hadrons, and gripping protons and neutrons in atomic nuclei.

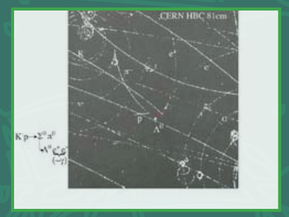
Bubble chamber physics at CERN made a brilliant start in hadron spectroscopy in 1961. This photo shows the Saclay 81 cm chamber.



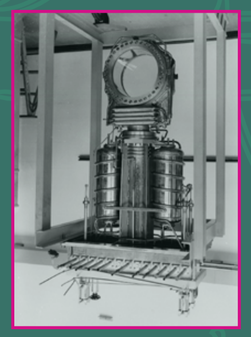
An antiproton annihilation in the 81 cm chamber.



Production of an antixi particle ($\bar{\Xi}^-$) in the 81 cm chamber.

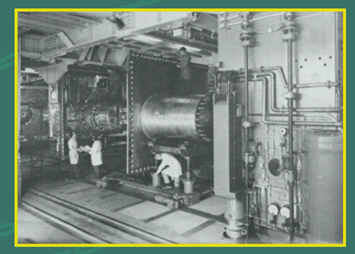


One of the events in the 81 cm chamber used to determine the sigma lambda parity.

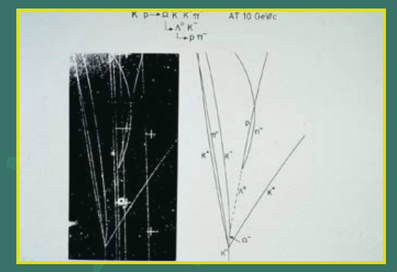


The 32 cm hydrogen chamber, the first bubble chamber built at CERN to do physics.

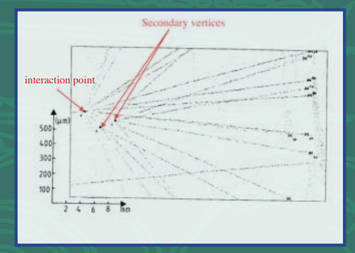
The interaction of a 24 GeV proton in the 32 cm chamber.



Of great importance was the evidence for multiplets of hadron resonant states which built up over several years. Since entering the field in 1961, CERN played a leading role in the study of more than thirty of these states, either establishing evidence for the resonance, or indeed determining its properties. This photo shows the 2 m bubble chamber which made a considerable contribution to this programme.



Particle tracks in the CERN 2 m liquid hydrogen bubble chamber. A negative kaon enters the chamber and interacts, giving rise to many particles, including an Omega minus.



In the second half of the 70's bubble chambers used beams from the SPS to determine the properties of particles carrying a new quantum number, poetically named « charm ». Big chambers, BEBC and Gargamelle, were used alone for this purpose, while a small but fast cycling chamber was associated to a downstream spectrometer in the European Hybrid Spectrometer (EHS). This image shows a charm event in the EHS's rapid cycling bubble chamber. The interaction vertex is indicated on the left, as are the secondary decay vertices of two charmed particles produced in the interaction.

"Bubble-chamber physics became a training ground for physicists, engineers, technicians, and for specialists in computers and data handling. A great number of new techniques were developed to improve particle identification both inside and outside the track-sensitive volume of the bubble chambers. […] Bubble chambers live on, not only through the many beautiful postcards and books showing bubble-chamber tracks, but also through many of the original ideas and the "bubble chamber philosophy" that continues to play an important role in physics today."

Horst Wenninger, CERN Courier, July / August 2004