Strangeness

INTRODUCTION

With the discovery of the pion (in photographic emulsion) in 1947, it might have seemed as if a great clarification of the sub-atomic world had been achieved: atoms consisted of negative electrons being held near nuclei by the 'exchange of virtual photon', while nuclei consisted of neutrons and protons ('nucleons') held together by the exchange of virtual pions.

Things were about to change. In the same year (see December 1947 issue of Nature), the first 'hadrons' (strongly interacting particles) outside the simple nucleon-pion scheme were discovered (in a cloud chamber), and named 'strange' particles. Others followed: K, Λ^0, Ξ^-, *etc.*

It was found that in interactions involving non-strange hadrons (p and n, π^+, $\pi^-$and π^0) these strange particles were produced in pairs; for example:

$$\pi^+ + p \longrightarrow K^0 + \Lambda^0$$

Processes such as $p + p \longrightarrow \Lambda^0 + p + \pi^0$ were NEVER observed.

A study of many interactions involving these particles led to the discovery of a new conservation law obeyed by the strong (also electromagnetic, but not the weak) interaction; the new conserved quantity - called 'strangeness' S - is additive like charge.

Here are the strangeness assignments of the 'stable' strange particles:

Particle	K^+	K^0	$\overline{K^0}$	K^-	Λ^0	Σ^+	Σ^0	Σ^-	Ξ^0	Ξ^-	Ω^-
Strangeness	+1	+1	-1	-1	-1	-1	-1	-1	-2	-2	-3

Antiparticles: to every hadron with a non-zero value for charge Q, baryon number B or strangeness S, there is a corresponding **antiparticle** with the opposite values.

Special (very odd) point about K^0s: K^0 particles that are seen in the detectors are mixtures of $K^0$and $\overline{K^0}$; so they can have either S=1 or S=-1.

(This is a very subtle issue - not for schools!?)

For a very good discussion of the K^0question, and many other topics, see *The Particle Hunters* by Yuval Ne'eman and Yoram Kirsh, Cambridge University Press, Second Edition, 1996.