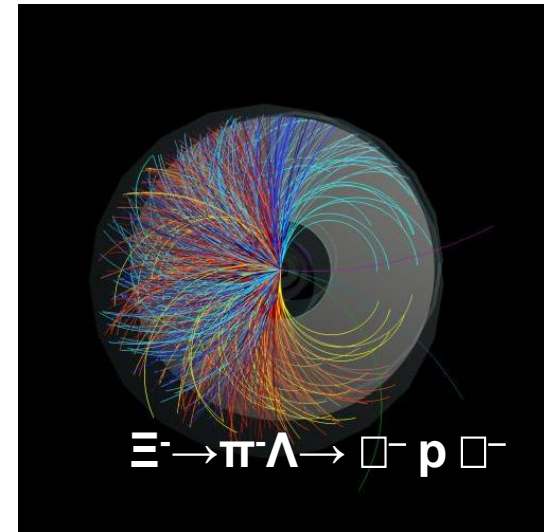
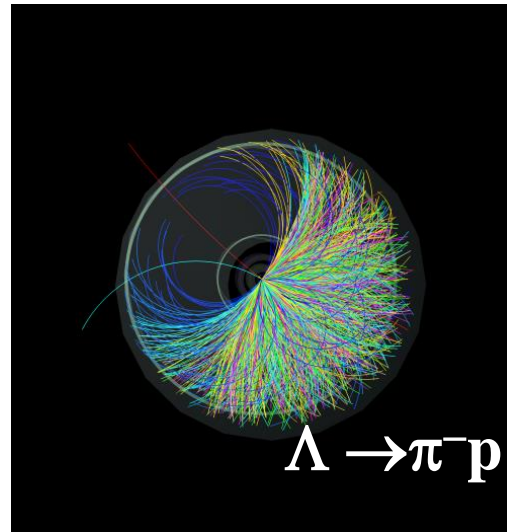
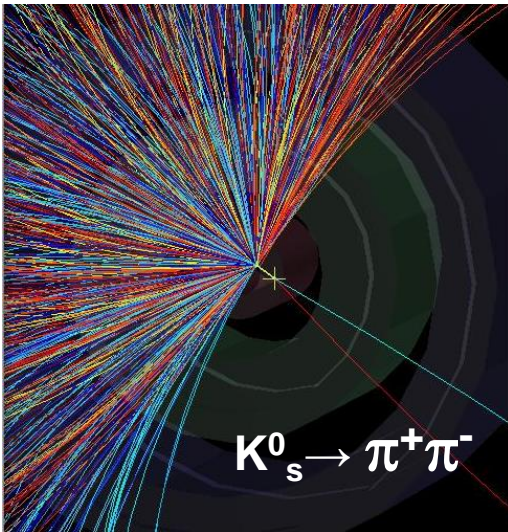
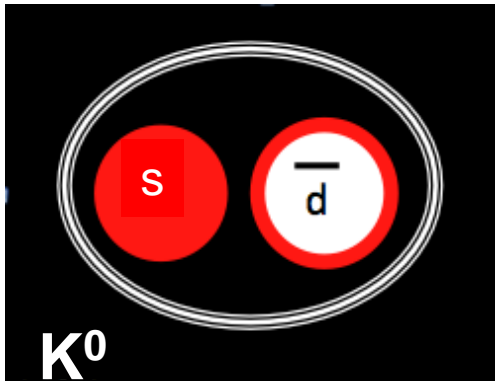


Looking for strange particles in ALICE



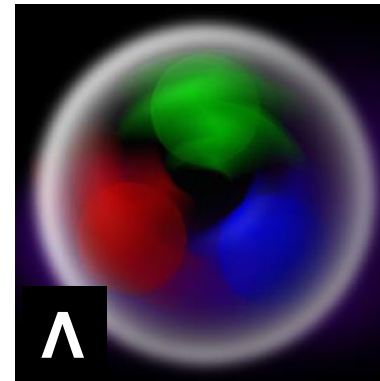
What are strange particles ?

meson



$\bar{d}s, ds$













baryon



uds

hadrons (baryons or mesons) containing **at least one strange (s) quark**

Today's periodic system of the fundamental building blocks

	<i>Quarks</i>		<i>Leptons</i>	
<i>Generation 3</i>	 t Top	 b Bottom	 τ Tau	 ν_τ Tau-neutrino
<i>Generation 2</i>	 c Charm	 s Strange	 μ Muon	 ν_μ Muon-neutrino
<i>Generation 1</i>	 u Up	 d Down	 e Electron	 ν_e Electron-neutrino

Quark Confinement

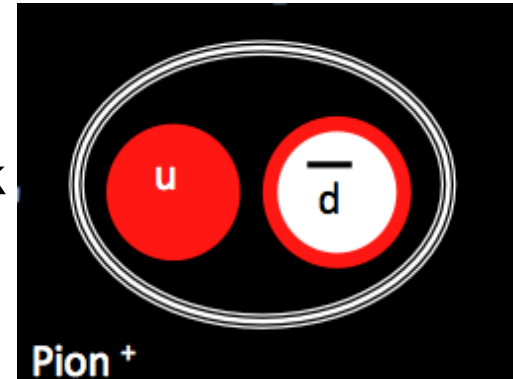
Quarks can not exist free in nature

They can only exist bound inside hadrons



baryons
consisting of
3 quarks

mesons
consisting of
a quark and
an anti-quark



Baryons qqq and Antibaryons $\bar{q}\bar{q}\bar{q}$

Baryons are fermionic hadrons.

These are a few of the many types of baryons.

Symbol	Name	Quark content	Electric charge	Mass GeV/c^2	Spin
\mathbf{p}	proton	\mathbf{uud}	1	0.938	1/2
$\bar{\mathbf{p}}$	antiproton	$\bar{\mathbf{u}}\bar{\mathbf{u}}\bar{\mathbf{d}}$	-1	0.938	1/2
\mathbf{n}	neutron	\mathbf{udd}	0	0.940	1/2
Λ	lambda	\mathbf{uds}	0	1.116	1/2
Ω^-	omega	\mathbf{sss}	-1	1.672	3/2

Mesons $q\bar{q}$

Mesons are bosonic hadrons

These are a few of the many types of mesons.

Symbol	Name	Quark content	Electric charge	Mass GeV/c^2	Spin
π^+	pion	$\mathbf{u}\bar{\mathbf{d}}$	+1	0.140	0
\mathbf{K}^-	kaon	$\mathbf{s}\bar{\mathbf{u}}$	-1	0.494	0
ρ^+	rho	$\mathbf{u}\bar{\mathbf{d}}$	+1	0.776	1
\mathbf{B}^0	B-zero	$\mathbf{d}\bar{\mathbf{b}}$	0	5.279	0
η_c	eta-c	$\mathbf{c}\bar{\mathbf{c}}$	0	2.980	0

We will be looking for **neutral** strange particles, which travel **some distance (mm or cm) from the point of production (collision point)** before they decay into **two oppositely charged particles**

$$K_s^0 \rightarrow \pi^+ \pi^- \quad \tau = 0.89 \times 10^{-10} \text{ s}$$

$$c\tau = 3 \times 10^{10} \text{ cm s}^{-1} \times 8.9 \times 10^{-11} \text{ s}$$

2.67 cm from the point of interaction

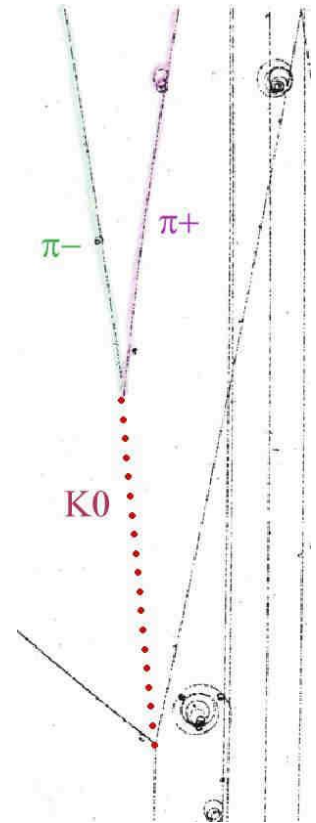
$$\Lambda \rightarrow \pi^- p \quad \tau = 2.6 \times 10^{-10} \text{ s}$$

$$c\tau = 3 \times 10^{10} \text{ cm s}^{-1} \times 2.6 \times 10^{-10} \text{ s}$$

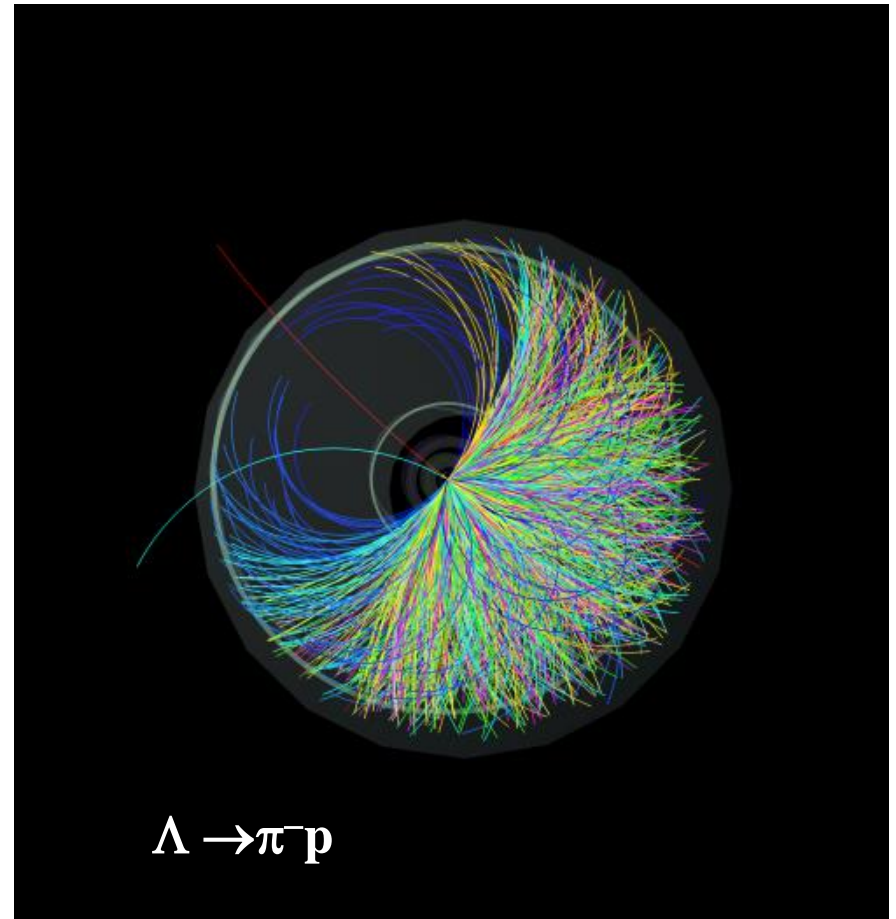
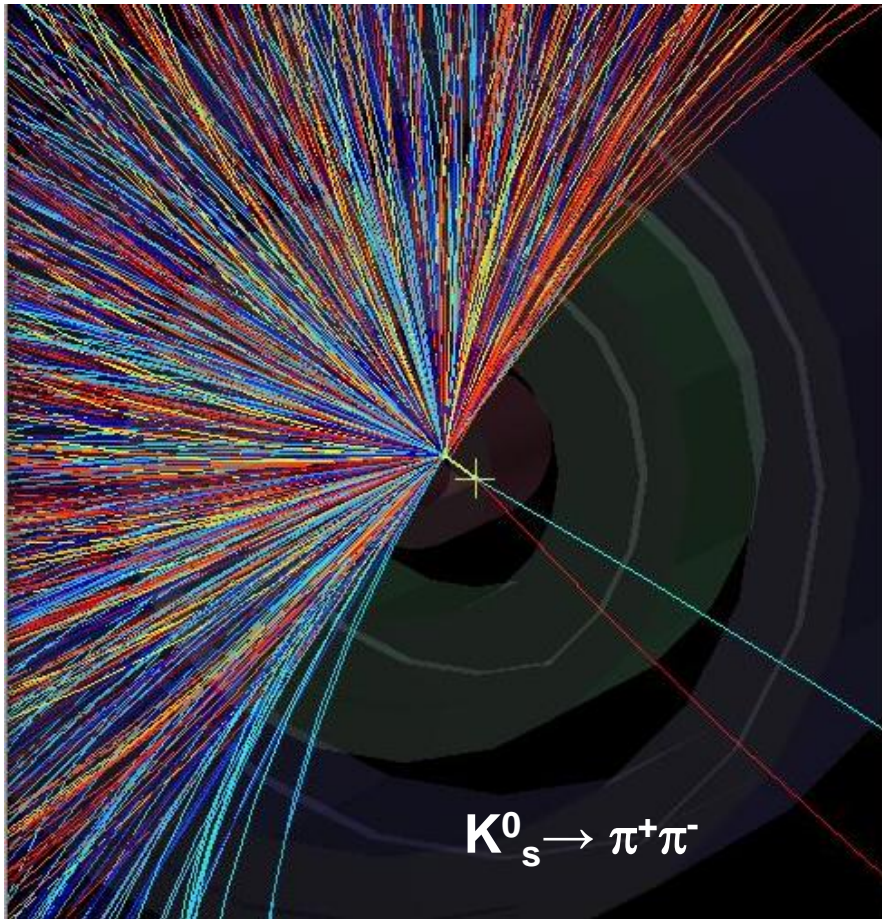
7.2 cm distance from the point of interaction

$$\bar{\Lambda} \rightarrow \pi^+ \bar{p}$$

Weak decays : strangeness is not conserved

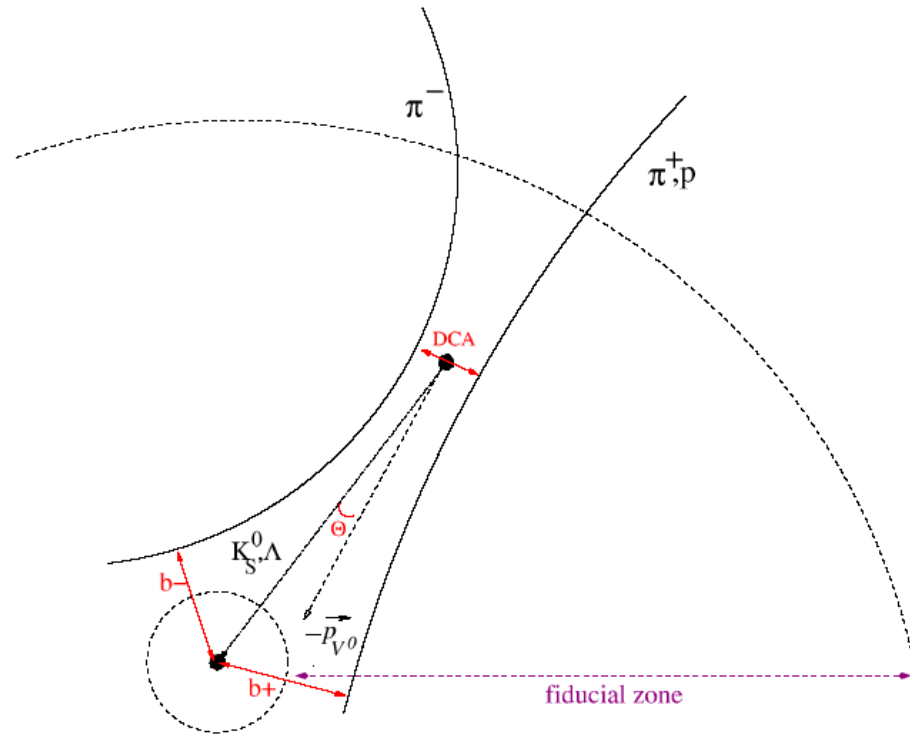


How do we find V0s ?



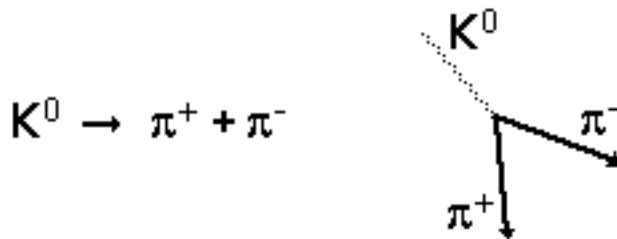
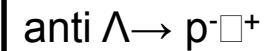
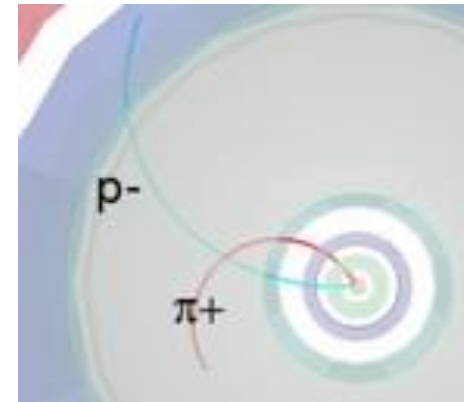
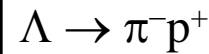
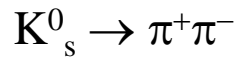
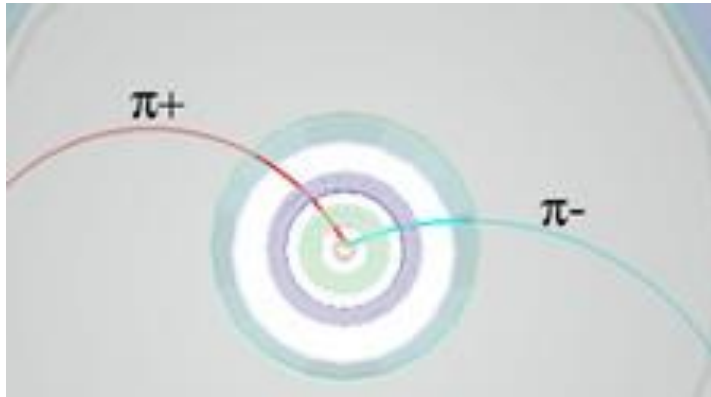
We look for two opposite tracks, having the same origin, which is not the interaction (collision) point

How do we find V0s ?



We look for two opposite tracks, having the same origin, which is not the interaction (collision) point

How do we identify each V0?



V0 decay :
a neutral particle (no track) gives suddenly two tracks

$$P = Q \cdot B \cdot R$$

P momentum

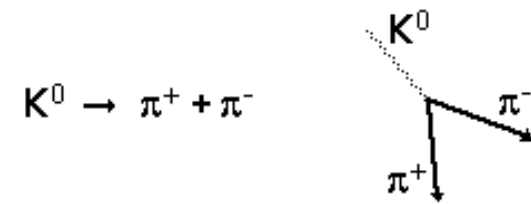
Q electric charge

B magnetic field

R radius of curvature

Identify V0s from the decay topology

How do we identify each V0?



Calculate the (invariant) mass

Energy conservation

$$E = E_1 + E_2$$

Momentum conservation

$$\mathbf{p} = \mathbf{p}_1 + \mathbf{p}_2$$

Total energy

$$E^2 = p^2 c^2 + m^2 c^4$$

$c=1$

$$E^2 = p^2 + m^2$$

$$E = E_1 + E_2 \quad E_1^2 = p_1^2 + m_1^2 \quad E_2^2 = p_2^2 + m_2^2$$

$$E^2 = p^2 + m^2 \quad m^2 = E^2 - p^2 = (E_1 + E_2)^2 - (p_1 + p_2)^2 = m_1^2 + m_2^2 + 2E_1 E_2 - 2\mathbf{p}_1 \cdot \mathbf{p}_2$$

Calculate the mass of the initial particle from the values of the mass and the momentum of the final particles

Particle Identification (done by a number of PID detectors) $\Rightarrow m_1 m_2$

Radius of curvature of the particle tracks due to magnetic field $\Rightarrow p_1 p_2$

$P=Q \cdot B \cdot R$ (P momentum, Q electric charge, R radius of curvature, B magnetic field)