

# Summary of 'stable' (lifetime $\gg 10^{-23}$ sec) particle properties

(Tailored to analysis of bubble chamber pictures.)

	Particle name	Mass in MeV/c <sup>2</sup>	Main decays	%	Mean life in seconds	$c\tau$ (cm)	Comment
$\gamma$	gamma	0	$e^+e^-$		stable		Strictly not a decay, but a 'materialisation' in the field of a nucleus.
$\nu$	neutrino	0			stable		Neutrinos show up in final states as unseen partners in decays: eg. of $\mu$ and $\pi$ .
$e^-$	electron	0.511	stable				Curls up characteristically in bubble chamber.
$e^+$	positron	0.511					<ul style="list-style-type: none"> <li>• Annihilates with electron.</li> <li>• Also curls up characteristically in bubble chamber</li> </ul>
$\mu^-$	mu minus	105.7	$e^- \bar{\nu}_e \nu_\mu$	100	$2.2 \times 10^{-6}$	$\sim 10^5$	Usually escapes; sometimes kinks.
$\mu^+$	mu plus	105.7	$e^+ \nu_e \bar{\nu}_\mu$	100	$2.2 \times 10^{-6}$	$\sim 10^5$	Usually escapes; sometimes kinks.
$\pi^-$	pi minus	139.6	$\mu^- \bar{\nu}_\mu$	100	$2.6 \times 10^{-8}$	780	May kink or 'pimue'
$\pi^+$	pi plus	139.6	$\mu^+ \nu_\mu$	100	$2.6 \times 10^{-8}$	780	May kink or 'pimue'
$\pi^0$	pi zero	135.0	$\gamma\gamma$ $\gamma e^+ e^-$	98.80 1.20	$8.4 \times 10^{-17}$		May give $e^+e^-$ pair(s) When $e^+e^-$ come directly from interaction, it is called a Dalitz pair.
$K^\pm$	kaon	493.7	$\mu\nu$ $\pi\pi^0$ $\pi^\pm\pi^+\pi^-$	63.51 21.16 5.59	$1.2 \times 10^{-8}$	371	May kink. May kink. May give 'trident'.
$K^0$	kay zero	497.7	$\pi^+\pi^-$	68.61	$0.9 \times 10^{-10}$	2.68	This is $K_S^0$ ; may give 'vee'.
$p$	proton	938.3	stable				Low energy $p$ often stops in bubble chamber - characteristic dark track.
$n$	neutron	939.6	$pe^- \bar{\nu}$	100	887		Sometimes identified via a proton it collides with.
$\Lambda$	lambda	1116	$p\pi^-$	63.9	$2.6 \times 10^{-10}$	7.89	May give 'vee'.
$\Sigma^+$	sigma plus	1189	$p\pi^0$ $n\pi^+$	52 48	$0.8 \times 10^{-10}$	2.4	May kink. May kink
$\Sigma^0$	sigma zero	1193	$\Lambda\gamma$	100	$7.4 \times 10^{-20}$		May give $\Lambda$ and $\gamma$ .
$\Sigma^-$	sigma minus	1197	$n\pi^-$	99.85	$1.5 \times 10^{-10}$	4.4	May kink
$\Xi^0$	xi zero	1315	$\Lambda\pi^0$	99.5	$2.9 \times 10^{-10}$	8.7	$\Lambda + \gamma$ s to downstream point
$\Xi^-$	xi minus	1321	$\Lambda\pi^-$	100	$1.6 \times 10^{-10}$	4.9	$\Lambda$ from kink possible.
$\Omega^-$	omega minus	1672	$\Lambda K^-$ $\Xi^0\pi^-$ $\Xi^-\pi^0$	67.8 23.6 8.6	$0.8 \times 10^{-10}$	2.5	$\Lambda$ from kink possible $\Lambda + \gamma$ s to downstream point $\Lambda$ to 2 <sup>nd</sup> kink possible.