ELEMENTARY PARTICLE

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ABSTRACT

In this paper we review some elementary particle.They are very important part of standard model.Such as π,K.Mass, Width, Angular momentum, Parity, Isospin are our point.They may interact through the strong electromagnetic weak or through some unknown force.The purpose of this review is to provide a guide for future searches what is known, what is not known. This is very necessary for the beginner.

1 PARTICLE TREE

There are so many elementary particles, So the best way is classify them.All elementary particles are made up quarks.In this paper we just focus on the meson and baryon which composed of 2 or 3 quarks.

1. Light Unflavored Mesons
2. Strange Mesons
3. N Baryons
4. Δ Baryons
5. Λ Baryons
6. Σ Baryons
7. Ξ Baryons

1.1 Light Unflavored Mesons

What is light unflavored mesons? In the quantum mechanic, we can use some quantum numbers to describe a quantum system.For the elementary particles, we usually use S, C and B. Light unflavored mesons is $S = C = B = 0$.

Table 1: Light Unflavored Mesons

Particle	Mass(MeV)	Width	$I^G(J^{PC})$
$\pi^{\pm}$	139.57018 ± 0.00035	$(2.6033 \pm 0.0005) * 10^{-8}s$	$1^-(0^-)$
π^0	134.9766 ± 0.0006	$(8.52 \pm 0.18) * 10^{-17}s$	$1^-(0^{-+})$
η	547.862 ± 0.017	$1.31 \pm 0.05keV$	$0^+(0^{-+})$
$\eta^{'}$	957.78 ± 0.06	$0.197 \pm 0.009MeV$	$0^+(0^{-+})$
ρ	775.26 ± 0.25	$149.1 \pm 0.8MeV$	$1^+(1^{--})$
ω	782.65 ± 0.12	$8.49 \pm 0.08MeV$	$0^-(1^{--})$
ϕ	1019.461 ± 0.019	$4.266 \pm 0.031MeV$	$0^-(1^{--})$

Some particles are not the C eigenstate, such as $\pi^{\pm}$. We also could use lifetime to express the width, because we have $\Gamma = \frac{\hbar}{\tau}$.

1.2 Strange Mesons

Strange mesons are $C = B = 0, S = \pm 1$.
Koan is not G and C eigenstate. K^0 is not lifetime eigenstate, but K^0_L and K^0_S is.

1.3 N Baryons

N baryons are $I = \frac{1}{2}, S = 0$.
p and n are not G and C eigenstate.

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Table 2: Strange Mesons

Particle	Mass(MeV)	Width	$I(J^P)$
$K^{\pm}$	493.667 ± 0.016	$(1.2380 \pm 0.0020) * 10^{-8}s$	$\frac{1}{2}(0^-)$
K^0	497.611 ± 0.013	-	$\frac{1}{2}(0^-)$
$K^{*\pm}$	892.66 ± 0.26	$46.2 \pm 1.3MeV$	$\frac{1}{2}(1^-)$
K^{*0}	895.81 ± 0.19	$47.4 \pm 0.6MeV$	$\frac{1}{2}(1^-)$

Table 3: N Baryons

Particle	Mass(MeV)	Width	$I(J^P)$
p	938.272081 ± 0.000006	$2.1 * 10^{29}years$	$\frac{1}{2}(\frac{1}{2}^-)$
n	939.565413 ± 0.000006	$880.2 \pm 1.0s$	$\frac{1}{2}(\frac{1}{2}^-)$

1.4 Δ Baryons

Δ baryons are $I = \frac{3}{2}, S = 0$.

Table 4: Δ Baryons

Particle	Mass(MeV)	Width	$I(J^P)$
Δ^-	-	-	$\frac{3}{2}(\frac{3}{2}^-)$
Δ^0	-	-	$\frac{1}{2}(\frac{3}{2}^+)$
Δ^+	-	-	$\frac{1}{2}(\frac{3}{2}^+)$
Δ^{++}	-	-	$\frac{3}{2}(\frac{3}{2}^+)$

The pdg only give Breit-Wigner mass(mixed charges) = 1230 to 1234 MeV. And Breit-Wigner width(mixed charges) = 114 to 120 MeV.

1.5 Λ Baryons

Λ baryons are $I = 0, S = -1$.

1.6 Σ Baryons

Σ baryons are $I = 1, S = -1$.

1.7 Ξ Baryons

Ξ baryons are $I = \frac{1}{2}, S = -2$.

1.8 Born in Lab

PION was discovered by D. Perkins with nuclear capture in 1947[1].In the same year Powell's group announced the first observation of pion decay to a muon[2].

KAON was produced in proton-proton collisions $pp \to pK^+\Lambda$[3].

Definition 1 (Gauss)**.** To a mathematician it is obvious that $\int_{-\infty}^{+\infty} e^{-x^2}\, dx = \sqrt{\pi}$.

Table 5: Λ Baryons

Particle	Mass(MeV)	Width	$I^(J^P)$
Λ	1115.683 ± 0.006	$(2.632 \pm 0.020) * 10^{-10}$s	$0(\frac{1}{2}^+)$

Table 6: Σ Baryons

Particle	Mass(MeV)	Width	$I^(J^P)$
Σ^+	1189.37 ± 0.07	$(0.8018 \pm 0.0026) * 10^{-10}$s	$1(\frac{1}{2}^+)$
Σ^0	1192.642 ± 0.024	$(7.4 \pm 0.7) * 10^{-20}$s	$1(\frac{1}{2}^+)$
Σ^-	1197.449 ± 0.030	$(1.479 \pm 0.011) * 10^{-10}$s	$1(\frac{1}{2}^+)$
$\Sigma(1385)^+$	1382.80 ± 0.35	36.0 ± 0.7MeV	$1(\frac{3}{2}^+)$
$\Sigma(1385)^0$	1383.7 ± 1.0	36 ± 5MeV	$1(\frac{3}{2}^+)$
$\Sigma(1385)^-$	1387.2 ± 0.5	39.4 ± 2.1MeV	$1(\frac{3}{2}^+)$

Theorem 1 (Pythagoras). *The square of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other two sides.*

Proof. We have that $\log(1)^2 = 2\log(1)$. But we also have that $\log(-1)^2 = \log(1) = 0$. Then $2\log(-1) = 0$, from which the proof. □

2 DECAY MODEL

2.1 Strong Decay

2.2 Weak Decay

2.3 Electromagnetic Decay

3 PARTICLE IN THE DETECTOR

4 SUMMARY AND DISCUSSION

Reference to Figure 1 on the following page.

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Table 7: Ξ Baryons

Particle	Mass(MeV)	Width	$I(J^P)$
Ξ^0	1314.86 ± 0.20	$(2.90 \pm 0.09) * 10^{-10}$s	$\frac{1}{2}(\frac{1}{2}^+)$
Ξ^-	1321.71 ± 0.07	$(1.639 \pm 0.015) * 10^{-10}$s	$\frac{1}{2}(\frac{1}{2}^+)$
$\Xi(1530)^0$	1531.80 ± 0.32	9.1 ± 0.5MeV	$\frac{1}{2}(\frac{3}{2}^+)$
$\Xi(1530)^-$	1535.0 ± 0.6	$9.9^{+1.7}_{-1.9}$MeV	$\frac{1}{2}(\frac{3}{2}^+)$

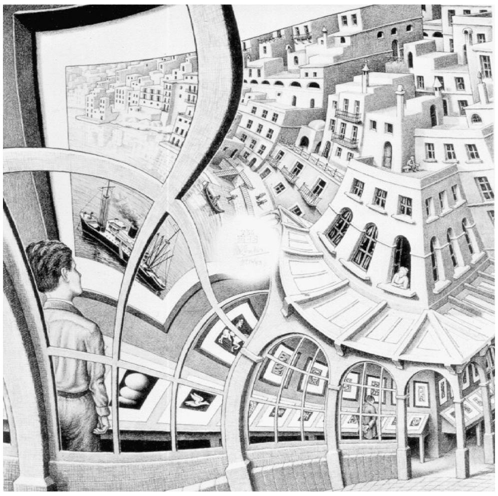

Figure 1: An example of a floating figure (a reproduction from the *Gallery of prints*, M. Escher, from http://www.mcescher.com/).

4.1 Subsection

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4.1.1 *Subsubsection*

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WORD Definition

CONCEPT Explanation

IDEA Text

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- First item in a list
- Second item in a list
- Third item in a list

4.1.2 *Table*

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Table 8: Table of Grades

Name		
First name	Last Name	Grade
John	Doe	7.5
Richard	Miles	2

Reference to Table 8.

4.2 Figure Composed of Subfigures

Reference the figure composed of multiple subfigures as Figure 2 on the following page. Reference one of the subfigures as Figure 2b on the next page.

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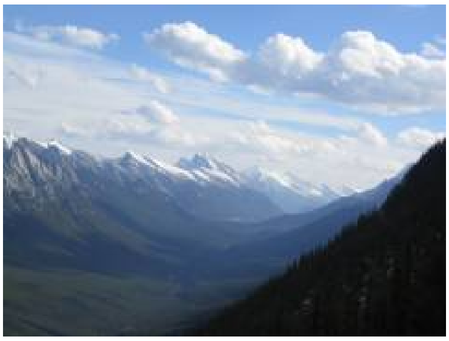
(a) A city market.

(b) Forest landscape.



(c) Mountain landscape.

(d) A tile decoration.

Figure 2: A number of pictures with no common theme.

5 REFERENCES

REFERENCES

[1] Nature 159 (1947), 126-127

[2] Nature 159 (1947), 186-190

[3] arXiv:nucl-ex/0302007

[4] Wikipedia