

A game for which a deck of elementary particles can be used:

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THE EIGHTFOLD PATH

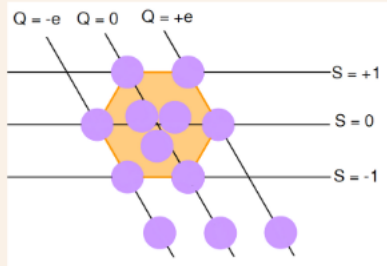
Introduction



- Games that use a deck of cards with elementary particles
- Proposition for a new game which utilises the concept of **The eightfold path**

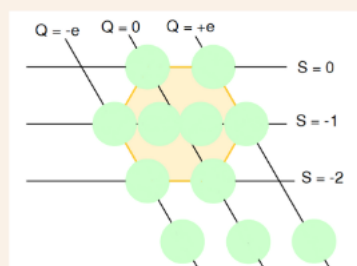


This is a board (card) game!



First board - Meson hexagon

- For the three mesons located in the center of the hexagon, their properties of total strangeness (S) and total electric charge (Q) are such as if they were at the very center of the hexagon, where $S = 0$ and $Q = 0$.



Second board - Baryon hexagon

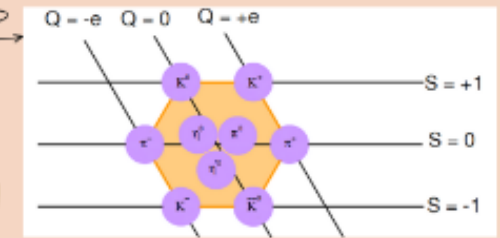
- For the two baryons located in the center of the hexagon, their properties of S and Q are such as if they were at the very center of the hexagon, where $S = -1$ and $Q = 0$.

- Boards correspond to the baryon and meson hexagons according to the eightfold path with **three additional circles** at the bottom.

What is the eightfold path in physics?

- Property of symmetry** in the representation of baryons and mesons
- It was independently observed by **Murray Gell-Mann** and **Yu'val Ne'eman** in 1961**
- Such grouping often results in **sets of eight** (or more) hadrons

EXAMPLE



Hadrons can be represented in suitable symmetric groups according to their charge (Q) and strangeness (S) properties



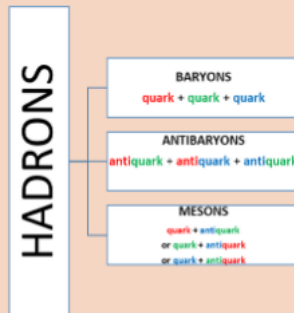
RULES AND COURSE OF THE GAME

What is the main goal?

To **fill** the designated circles in hexagons with the corresponding cards, so that within each circle, the total strangeness (**S**) and electrical charge (**Q**) are equal to the markings

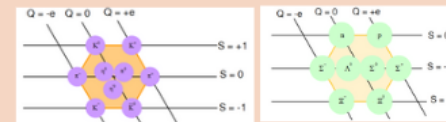


- Players are **arranging hadrons**
- The 3 lower circles (located outside the hexagon) must be filled with **4 lepton/anti-lepton cards** so that the total **Q** and **S** also correspond to the markings



Level 1: Beginner ★★☆☆☆

- Names of baryons and mesons **can** be **written on the boards**
- Players can use following tables:



Particle name	Strangeness (S)	Electrical charge (Q/e)
u	0	+2/3
d	0	-1/3
s	-1	-1/3
u	0	+2/3
d	0	-1/3
s	-1	-1/3
c	+1	+2/3
b	0	-1/3
c ⁺ , b ⁺	0	+1
c ⁻ , b ⁻	0	0
V _u , V _d , V _s , V _c , V _b	0	0

QUARK MATTER	BARYON	SYMBOL
uuu	Delta ++	Δ ⁺⁺
uud	proton	p
udd	Delta +	Δ ⁺
uud	nucleon	p ⁺
udd	Delta 0	Δ ⁰
udd	neutron	n
uds	Sigma +	Σ ⁺
uds	Lambda 0	Λ ⁰
dds	Sigma 0	Σ ⁰
dds	Sigma -	Σ ⁻
dds	Xi 0	Ξ ⁰
sss	Omega -	Ω ⁻

QUARK MATTER	MESON	SYMBOL
u d̄	Positive pion	π ⁺
u s̄	Positive kaon	K ⁺
d d̄	Negative pion	π ⁻
d s̄	Negative kaon	K ⁻
u s	Neutral kaon	K ⁰
d s	Neutral anti kaon	K̄ ⁰
u c̄	Positive charmed meson	D ⁺
d c̄	Neutral charmed meson	D ⁰



Level 2: Intermediate ★★★★★

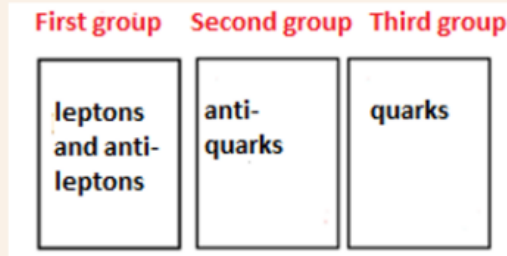
- Players **do not** have pre-written hadrons on the board
- Instead, they must place them on the board themselves based on their **Q** and **S**.
- It is important to be **fast** and skilled at recognizing potential **opportunities** to assemble the appropriate hadron that is left unfilled on the board.

Players need to be familiar with the individual **S** and **Q** of each **elementary particle** in the deck, as the total strangeness and electric charge of each hadron (or group of leptons) is equal to the **sum of S and Q** of all individual particles that make it up.

RULES AND COURSE OF THE GAME

Rules and course of the game

- The game is intended for **2 to 4 players**
- At the beginning, it is necessary to divide the cards from the deck into **three piles**
- Then, each player must take **two cards** from each pile
- Players hold their cards in their hands so that only they can see them.
- After that, the first part of the game begins!



The cards are shuffled and arranged according to the type of elementary particles, but they are faced down, so the players **cannot** see them

Part 1 - Assembling leptons, antileptons and mesons

- The game is played **in rounds** (for example, in clockwise order)
- In each round, each player has **two possible choices**:

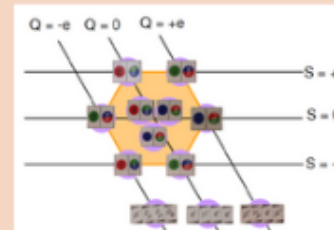
- To discard one of their own cards and draw a new card from one of the piles
- OR
- To place cards (correctly) in an empty circle within the hexagon!

- For a correctly filled circle, **1 point** is awarded...and there are also penalties!

Detailed explanations of the rules for the first part of the game can be found here



SCAN ME

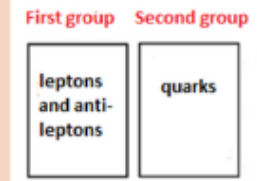


EXAMPLE

Correctly filled board at the end

Part 2 - Assembling leptons, antileptons and baryons

- After the first part is finished, players must **return** all the cards and make **two piles**:



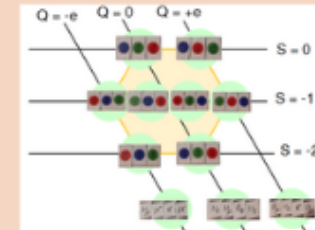
The cards are shuffled and arranged according to the type of elementary particles, face down. However, in this part of the game, the pile with antiquarks is **not** used

- Rules, choices and scoring are **very similar** to the first part of the game!

Detailed explanations of the rules for the second part of the game can be found here



SCAN ME



EXAMPLE

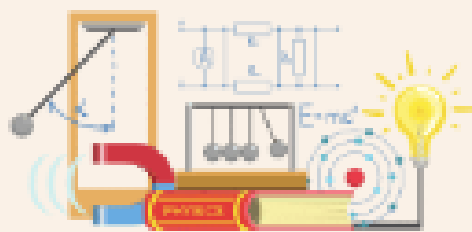
Correctly filled board at the end

Conclusion

For whom is the game intended, and what can we learn from it?



Workshop



Learning is Fun

- Various ideas and concepts of particle physics (which may seem very **complicated** at first), can be brought closer to players of different ages and backgrounds through **fun** and **social interactions**

- In addition to existing games, there is a particularly interesting and significant possibility of creating **new** and **diverse** games centered around the existing deck of cards
- As a result, these games can continue to be developed **in parallel with new physical discoveries** and theories