



Particles in Circle

Number of players: 2-4.

Object of the game:

To collect scores by quickly finding the earliest card that finishes a valid combination.

The course of the game:

The game consists of multiple rounds and lasts until there are no more cards by the dealer. After shuffling the deck of cards, the dealer places 22 cards in a circle and turn one arbitrarily chosen card face down. That will sign the starting point. The remaining 44 cards is given to the dealer, who take the uppermost card from the deck and quickly turns it and put it into the middle of the circle. It is important for the dealer to turn the card and put it into the middle as quickly as possible to make sure that all players can see it at almost the same time. The goal of the players now is to search – by inspecting but not touching the cards in the circle –, such cards that – together with the card in the middle –, will give a valid combination.

If the card in the middle is colored, i.e. quark/antiquark, then the search goes clockwise, while if it is black and white, i.e. lepton/antilepton, then the search goes anti-clockwise.

What are the valid combinations?

- If the card in the middle is colored (quark/antiquark), then a valid combination is a hadron. A player should point to the last quark/antiquark that finalizes the soonest the valence quark content of a hadron/antihadron -- searching in clockwise direction from the starting point.
- If the card in the middle is black and white (lepton/antilepton), then players should point to the antiparticle of that card that is found earliest going along the circle searching in anti-clockwise direction from the starting point.

Example:

If the card in the middle is a red quark, then we start searching from the card turned down going in clockwise direction along the circle and if we find an anti-red (green and blue) antiquark, then pointing on that first, we will get scores. However, if one finds for instance a green quark earlier than hitting the anti-red, it is not correct to point on the anti-red and one needs to search further until one finds a blue quark that finishes that baryon. This case, pointing to that blue quark earns scores.

Scoring

Scores are kept recorded by giving the cards that formed a valid combination to a player who earns scores in that round. This means that finding a baryon or antibaryon results in getting three scores (cards), finding a meson or an antimeson is worth two scores (cards), etc. The dealer then complete the circle from the deck at the end of that round. The **final winner** is the player with the **largest number of collected cards**, when there is no more cards by the dealer.

If one points to a **correct finalizing card before any other player**, then he or she will receive scores.

If one **can not find a card that results in a valid combination**, then one should shout 'None!' to tell the other players, that there is no such card to get a score in his view. If the other players also agree with this claim, then the first one who said 'None!' correctly, will get a single score and receive the card in the middle. Then the game goes on and the dealer turns another card from the top of the deck and put it into the middle.

If a player has pointed to a **wrong final card two times in a row before the other players** pointed to anything, then this player loses a score and has to give a card of his or her collected cards to the dealer. If this player has no scores, i.e. no cards that was given to him/her, and made the above mistake, then all other players will win a card from the deck of the dealer.

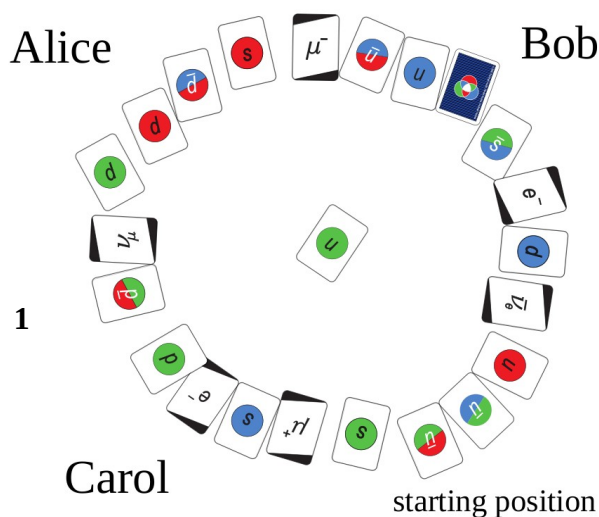
If **more players have made a mistake** at (approximately) the same time and there were **nobody** who **has pointed to the correct final card** (or said 'None'), then nothing happens. Nobody will receive or lose any scores and the game will be continued by inserting the card in the middle into the circle to an arbitrary place chosen by the dealer and then by placing a new card face up into the middle of the circle.

If **more players have made a mistake** at (approximately) the same time and there were **somebody** who **has pointed to the correct final card** or said 'None' correctly at (approximately) the same time, then he or she who was correct will receive scores.

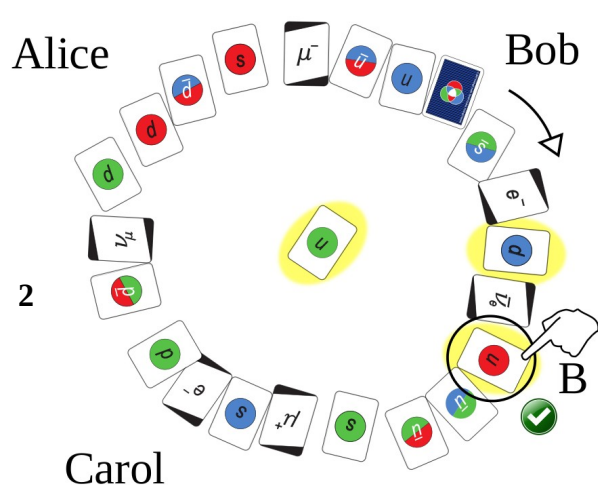
Identifying and deciding which player was the first in **less clear situations is the privilege of the dealer**. If he or she can not decide who was the first in an unclear situation, the dealer may also decide not to give scores to anybody and take the card in the middle and put it into the deck of cards. For beginners, we recommend that if there are more than two players playing, players to be dealers one after another in successive rounds and that the dealer to be left out from the round in which he or she is the dealer. This way the dealer could focus better on the decisions of other players.

Course of play

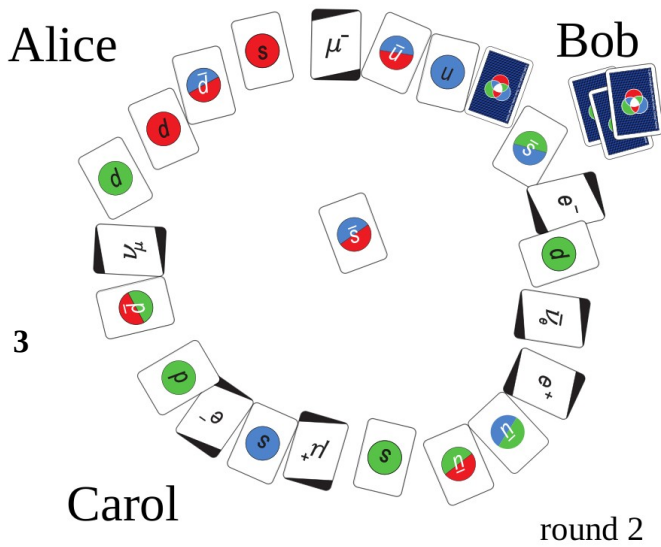
Important: keep in mind the direction of search, which is clockwise if the card in the middle is colored and anti-clockwise, if it is black and white.



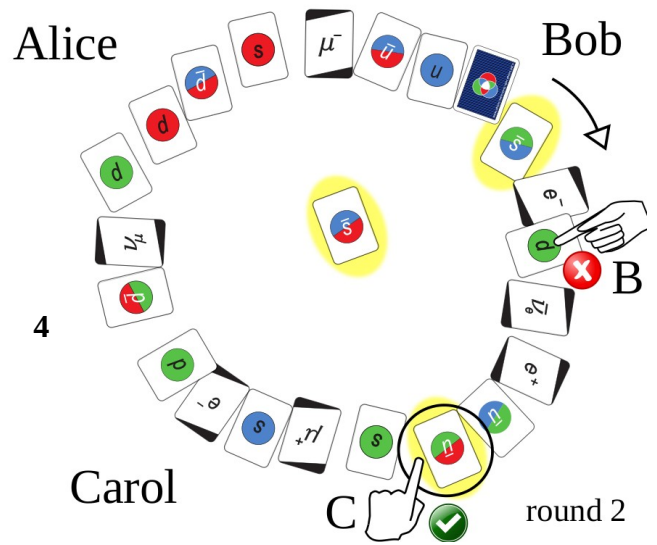
After forming a circle using 22 cards, the dealer places a card in the middle.



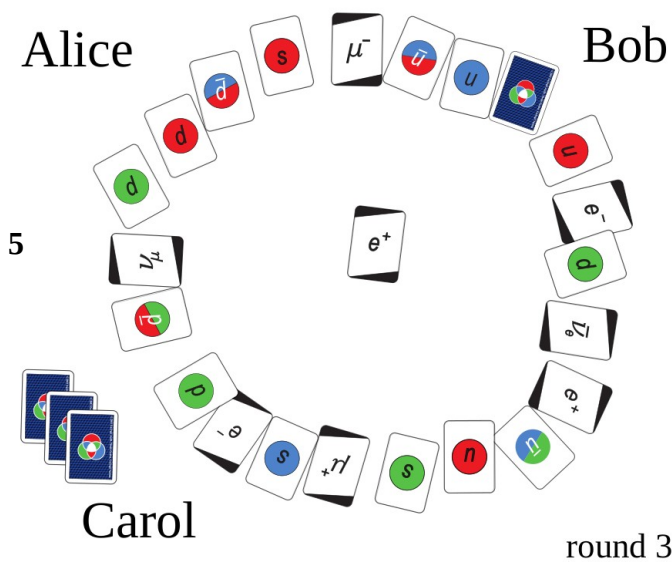
Bob points to the last quark that finalizes the hadron. This hadron consists of a green up quark (in the middle), a blue down quark and a red up quark: $u d u$.



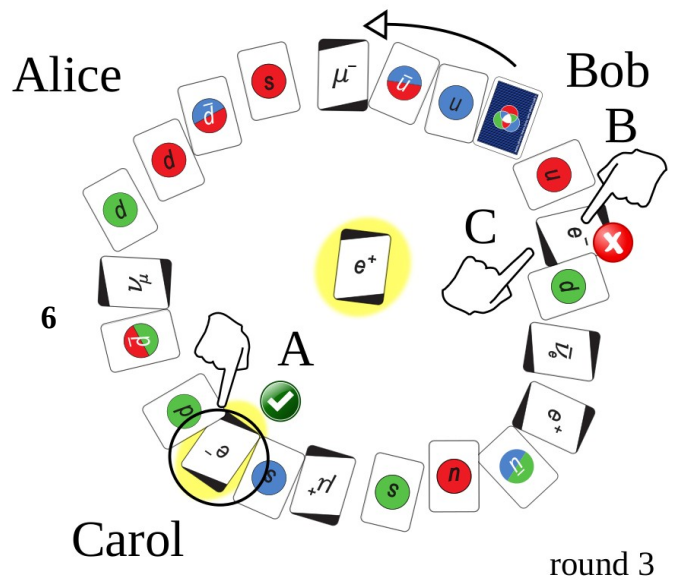
Bob receives the three cards, i.e. three scores. The dealer completes the circle then quickly turns on a new card and places it into the middle.



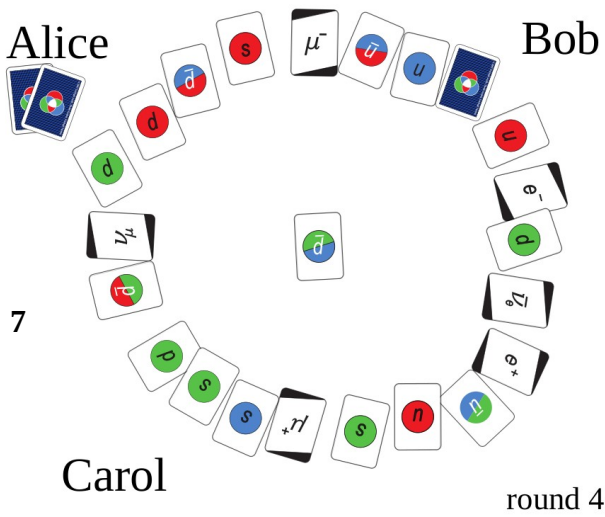
Bob points to a s which would give a meson together with the anti-green (red&blue) \bar{s} in the middle. But it is not correct now, because there was an anti-red (green&blue) \bar{s} earlier. Carol points to the correct antiquark that finishes the antihadron consisting of an anti-green, anti-red and an anti-blue (red&green) colored antiquark.



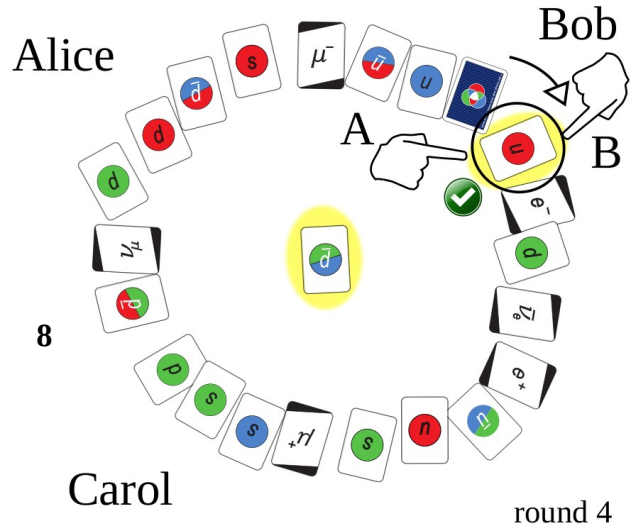
Carol receives three scores. The dealer completes the circle then quickly turns on a new card into the middle. It's a lepton, more precisely a positron!



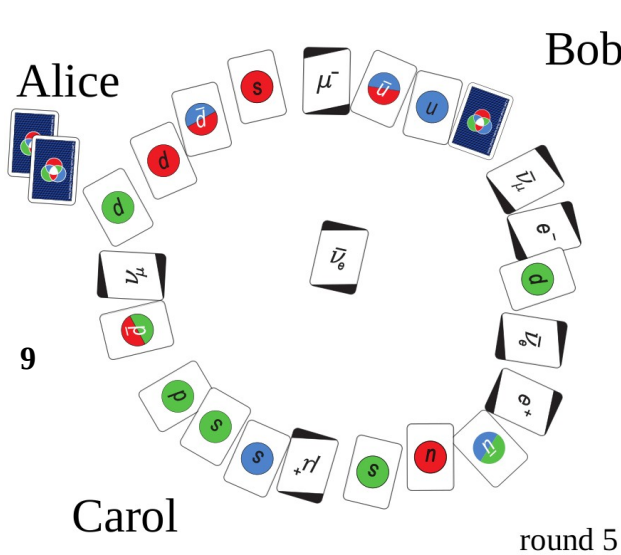
All three players point to an electron at approximately the same time, but only Alice wins in this round. Why? Because players have to search anti-clockwise when a lepton sits in the middle and the first electron along the circle is the one Alice points to.



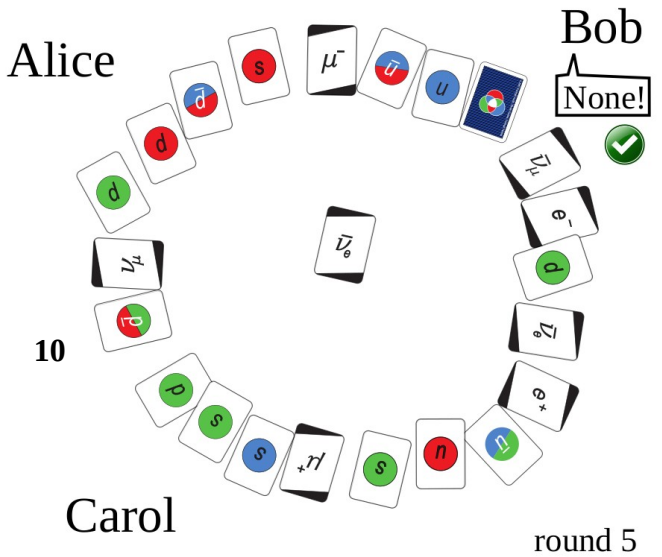
Alice receives the e^-e^+ pair (two scores). The dealer completes the circle then put an anti-red (green&blue) antiquark into the middle.



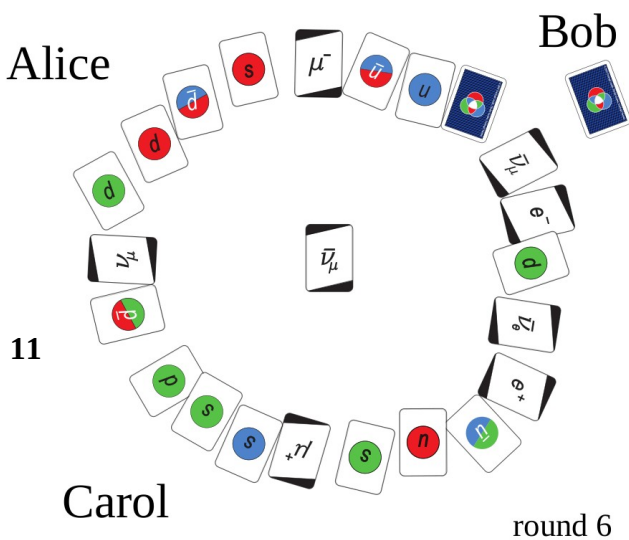
Alice and Bob point to the correct u card. Alice was slightly quicker so she receives two scores for that.



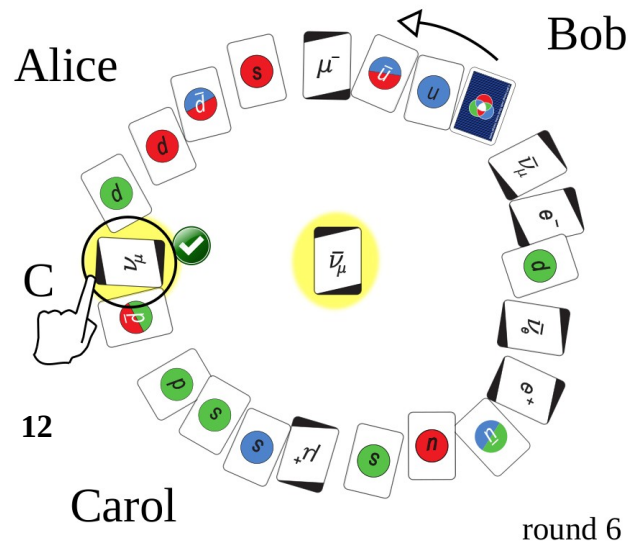
The dealer completes the circle then places a card into the middle.



Bob is the quickest to note that none of the cards is okay and he receives one score.



The dealer completes the circle then put a new card into the middle.



Alice finds the antiparticle (muon neutrino) of the lepton in the middle (muon antineutrino) and receives 2 scores.