Higgs Trumps Card Game

The game

Each card represents a real collision event recorded by either the ATLAS experiment or the CMS experiment at the CERN Large Hadron Collider. On each card there is an image representing the data recorded by the experiment together with a list of six properties of the event (see below). The aim of the game is to win all the cards from your fellow players.

How to play

1. The cards are shuffled and distributed equally between the players. Each player keeps their deck of cards hidden from the other players.
2. The first player takes the card from the top of their deck and chooses any one of the six listed event properties (e.g. 'number of leptons'). They state the event property they have chosen, and the value of that property that is written on their card (e.g. '4').
3. Each of the other players then reads out the value of that same event property from the card on the top of their deck.
4. The player with the largest value wins and collects the top card of each of the other players.
5. If the first player thinks that their event might contain a Higgs boson they can alternatively state at step 2 'I think I have found a Higgs boson!'. If they do this then the winner is the player with the card with 'event mass' closest to the value 125.6, which is our current best estimate of the mass of the Higgs boson (see below).
6. The player who won the last round places the cards they have won from the other players, together with their own winning card, on the bottom of their deck. They then take a new card from the top of their deck and repeat steps 2-5.
7. When a player has lost all their cards they drop out of the game. The game continues until only one player is left, who has collected all the cards and so wins the game.

Event properties

- 'Number of leptons': a lepton is a type of fundamental particle. The three kinds of lepton considered here are electrons (which are also found in atoms), muons

and tau leptons. One of the clearest signatures for the production of a Higgs boson is a collision event containing four leptons, which can be produced when the Higgs boson decays.

- 'Number of photons': a photon is a fundamental particle which transmits the electromagnetic force between other particles. Visible light consists of low energy photons, while high energy photons are known as 'gamma rays'. Another clear signature for the production of a Higgs boson is a collision event containing two gamma ray photons, which can be produced when the Higgs boson decays.
- 'Number of jets': When certain fundamental particles ('quarks' and 'gluons') are created in LHC collisions they generate sprays or 'jets' of lower energy particles inside the experiments. Jets can appear in events alongside other particles such as Higgs bosons.
- 'Number of vertices': Particle collisions happen so frequently at the LHC that often several occur inside an experiment at the same time, spread out in space along the LHC beam-pipe. The experiments record all the collisions together to create an 'event'. The experiments can detect each individual collision in an event by measuring the point where the particles created in the collision came from. This point is called a 'vertex'. Each event may contain many vertices, although usually only one corresponds to a high energy collision of interest to physicists.
- 'Missing transverse energy': Occasionally invisible particles such as neutrinos are created in the collisions. The experiments are not able to measure these particles directly because they do not interact with the recording equipment, however by looking for an imbalance in a property of the event called the 'transverse energy' physicists can infer that they were indeed created. This imbalance is called 'missing transverse energy'. It is measured in units of 'GeV'.
- 'Event mass': This can be calculated mathematically from the properties of the long-lived particles observed directly by the recording equipment in the experiment. When the long-lived particles are all created in the decay of a short-lived heavier particle, such as a Higgs boson, its value should be the same as the mass of that particle. It is measured in units of 'GeV/c^2'. For particles created in the decay of a Higgs boson this value should be about 125.6 GeV/c^2.

Credits:

- Images: ATLAS experiment, CMS experiment, CERN
- Design and production: University of Sheffield, University of Birmingham