Elementary: A Physics Game Use in Masterclasses

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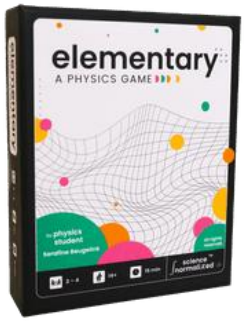
Introduction

Elementary is a physics-based card game, created by Serafine Beugelink during her Physics degree at Leiden University

The game has seen a great amount of success with various companies, events and institutions (they sell a special edition in the CERN gift shop) using the game

Rounds of the game are short and no knowledge of the Standard Model is required to play the game!

You can find more about the game at the url here: https://elementarythegame.com/

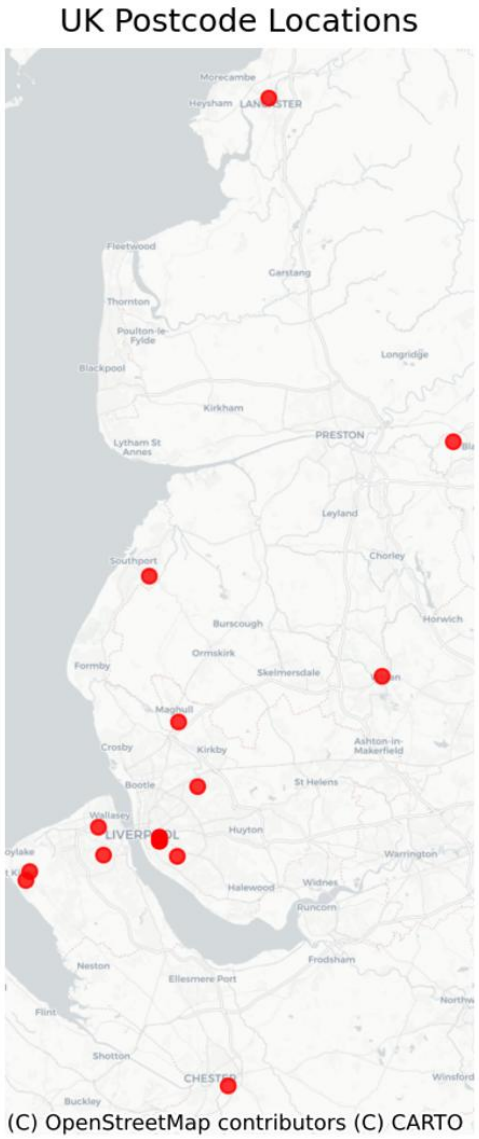


(N.B. we are not affiliated with the company, I saw the game online and thought it would be good to fill an activity slot)

Liverpool 2026 Masterclass (1)

We had 150 students attend our Masterclass in March, coming from around the Northwest area (see map).

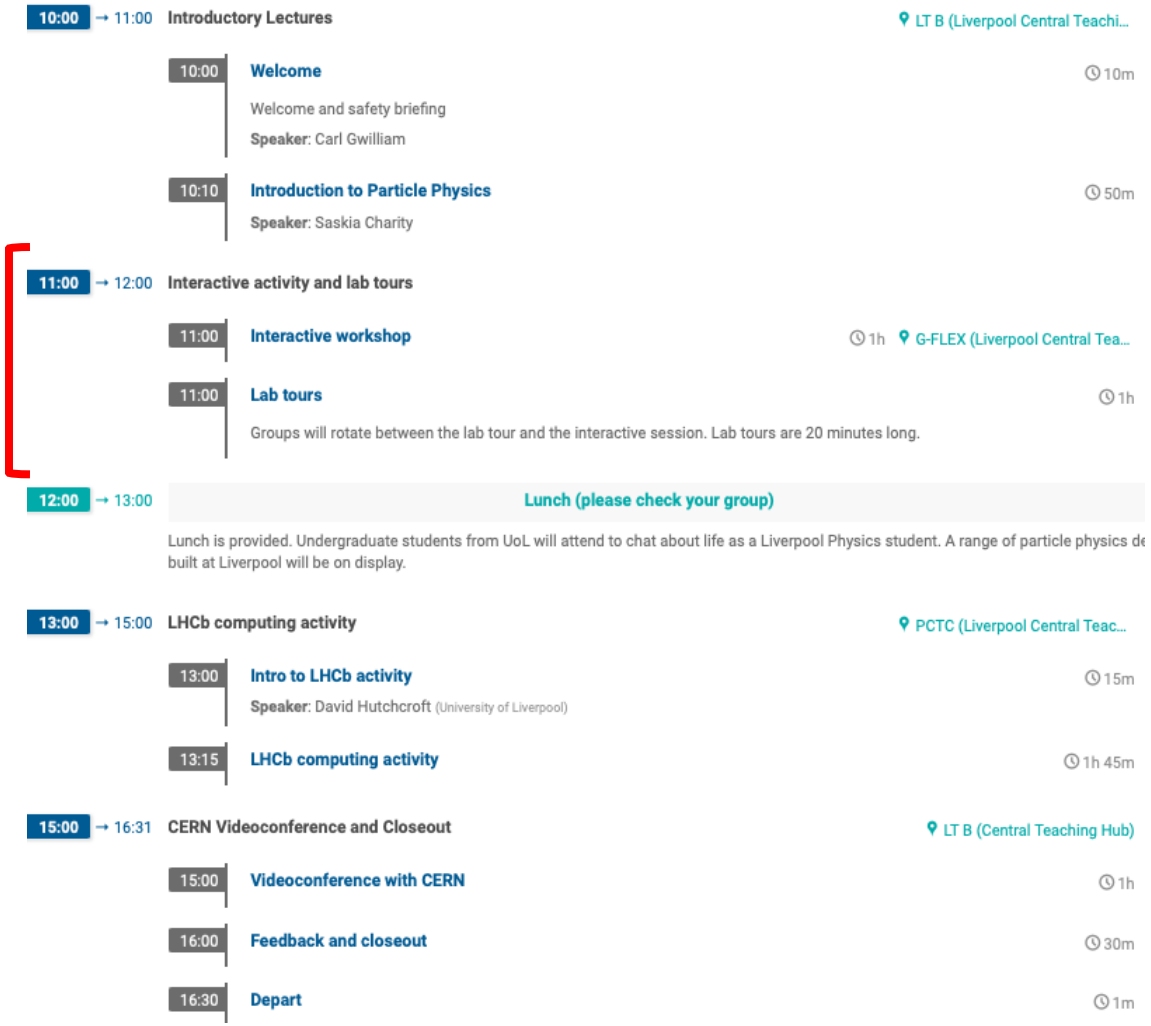
We do the LHCb masterclass, this is the second year we've run it and we tried to address previous feedback → students wanted more interaction; hence Elementary seemed like a good fit



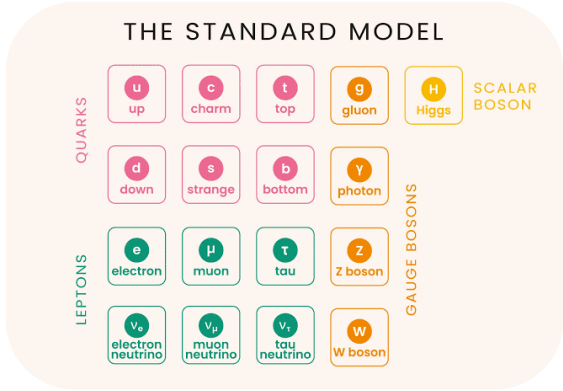
Liverpool 2026 Masterclass (2)

We played the game as our first activity after the morning lecture, in between rotating lab tours, to allow students to think about SM and consolidate lecture material

The timing worked quite well on this, each group managed to complete 2 games with demonstrators that explained how the game worked



The Game Itself:



The game features 33 cards, corresponding to the particles of the standard model, 2-4 players

In “easy mode” only the regular matter cards are used (17 cards)

In “classic mode” all cards and annihilation/energy token are used

I’ll briefly go over the game rules and and example turns for a player

Rules and images taken from: https://elementarythegame.com/wp-content/uploads/2023/07/EN-game-rules.pdf

Easy Mode

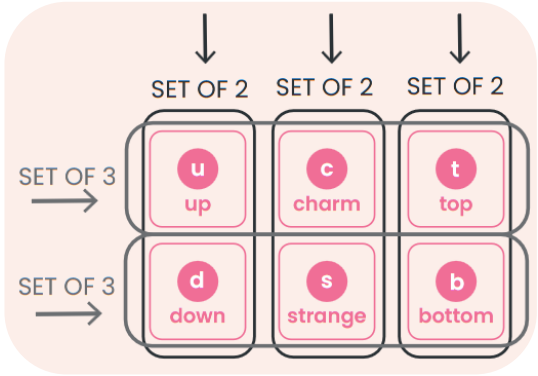
The main aim of the game is to create sets of particles

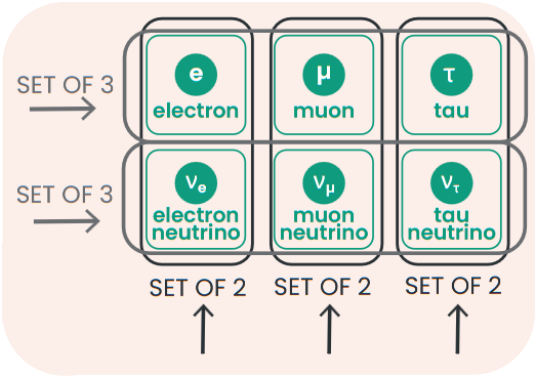
Gauge Bosons

One set, all 4 cards

Quarks

Either sets of same generation (2 cards) or same charge (3 cards)





Leptons

Either sets of correct partners (2 cards) or charged/neutral leptons (3 cards)

Scalar Bosons

Just the Higgs!

A set of 4 cards is worth 4 points, 3 cards is 3 points, etc.

Game ends after all cards have been placed into sets, winner is player with the most points

Classic Mode (1)

Classic mode has a few added mechanics, looking at antiparticles and energy conservation

Antiparticles can be combined in to sets the same way as regular quarks and electrons, **but** you cannot mix regular and anti-matter to make sets

<u>Annihilation:</u>

- Accidental: when a particle and it's antiparticle partner are in your hand they annihilate, you receive 1 energy chip (worth 1 point at the end)
- Sabotage: if you have a complete set in your hand and the opponent has the antimatter version of it already placed, you can sabotage their existing set, annihilating all pairs, **only you get energy chips for each pair!**

in both cases the cards are placed face-up on the table for the other feature

Classic Mode (2)

Classic mode has a few added mechanics, looking at antiparticles and energy conservation

Antiparticles can be combined in to sets the same way as regular quarks and electrons, **but** you cannot mix regular and anti-matter to make sets

<u>Creation:</u>

- On your turn you may hand in 1 energy chip to bring a particle/anti-particle pair that has already been annihilated **only if** they allow you to complete a set

What do students get out of it?

Learning:

- The game is scientifically correct
- Cards have some information about the particles, being their charges and masses → if they don't know why certain particles belong to a set they can look at this information to try and connect the dots
- Strengthens the student's knowledge of the constituents of the Standard Model and idea of symmetry and energy conservation in classic mode

Competitiveness:

- This was the first activity we did in the day, good icebreaker for students that may not know each other that well
- Mechanics like annhiliation sabotaging keep students engaged
- Need to pay attention so you know what cards people have been asking for so you can complete your sets.

Each group playing the game had (at least) one staff or PhD helper. This was the same helper that then guided the students through the computing activity in the afternoon → helped developed a good relationship with the demonstrators during the game. This contributed to them feeling more comfortable asking questions etc in the afternoon which was another target for us in this Masterclass.

Why did we decide this was suitable?

Accessibility:

- Many if not all the students will have seen the standard model in some capacity → no need for introduction of basic concepts, however you don't need any knowledge to play
- The game is simple, I played with some non-physicists and they got up to speed quickly with little explanation
- Variable player size accounts for any issues with uneven group sizes, we managed to play with groups of 5

Timing:

- The speed of the game allowed us to play two sessions of the game within a 40 minute window
- Comes in a small box with only a few cards and energy chips → fast set-up and pack away, and is easily portable

Cons

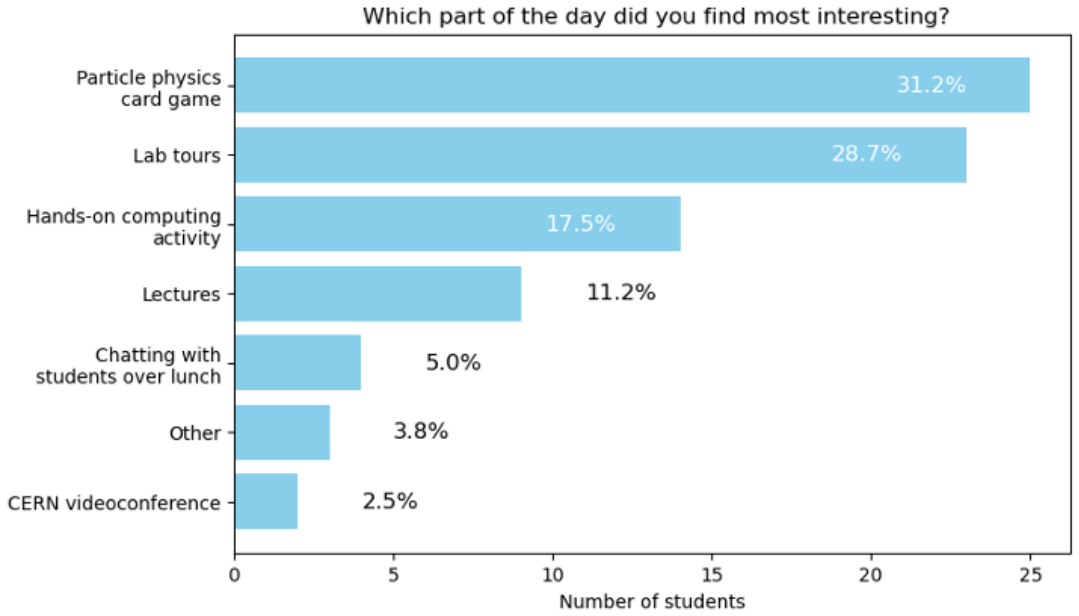
- The individual sets are quite expensive and need to be shipped (individually ~£20, can be discounted if bulk ordered from site) so for large groups, there's a significant price investment, however the cards are nice looking and well made
- Physical activity → can potentially run into loss of non-replaceable components, if one card goes missing then the game can't really be completed

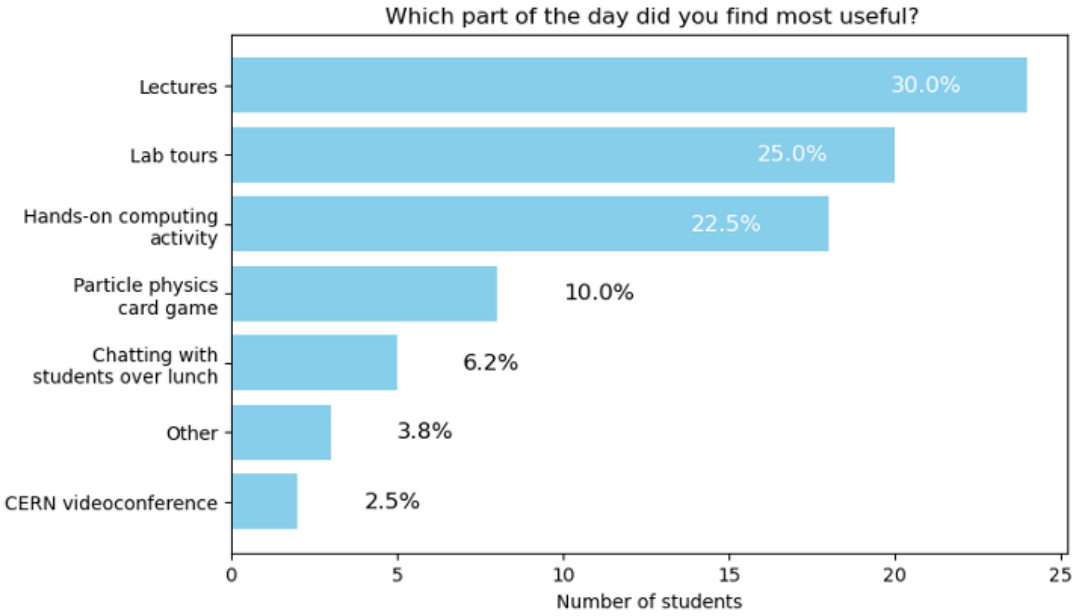
Feedback Survey Results/Plots

A lot of students found the card game the most interesting part of the event, however plots show not the most useful

We interpreted this as students not attributing consolidated knowledge from playing the game after the morning lecture as useful

Anecdotally, students were really interested, they enjoyed the commutative aspect of the classic version





Summary + Conclusion

Elementary was designed to bridge the gap between scientists and non-scientists, and shows non-scientists that physics isn't as scary and daunting as it seems.

Overall, we felt this activity was a great addition to our masterclass, and many students and teachers enjoyed the activity. We'd be interested to know if any other people try using this in their Masterclasses

We plan to continue using this activity for future masterclasses (not just because of the price investment)

If you are interested and want to try out the game, we'll have a few copies of it available over lunch

Thanks for listening!