

HIGGS BOSON – ON YOUR OWN

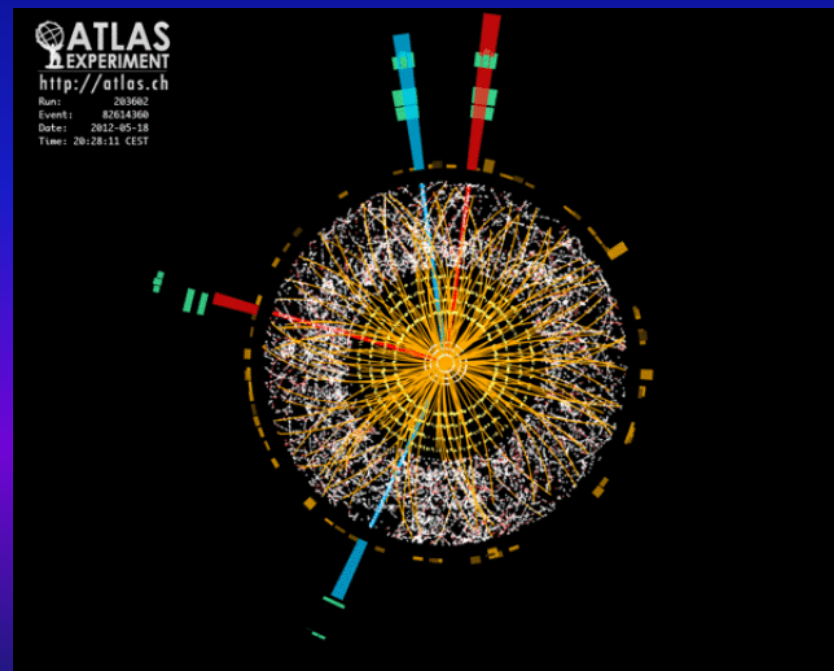
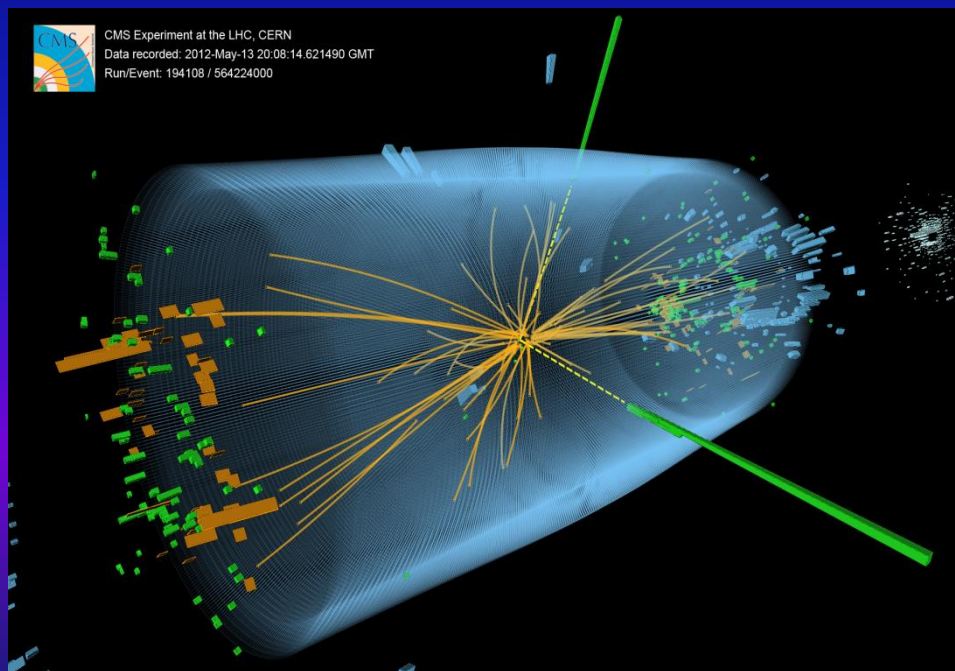
T. Csörgő

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[arXiv:1303.2732](https://arxiv.org/abs/1303.2732) [physics.pop-ph]

[arXiv:1303.2798](https://arxiv.org/abs/1303.2798) [physics.pop-ph]



HIGGS BOSON – ON YOUR OWN

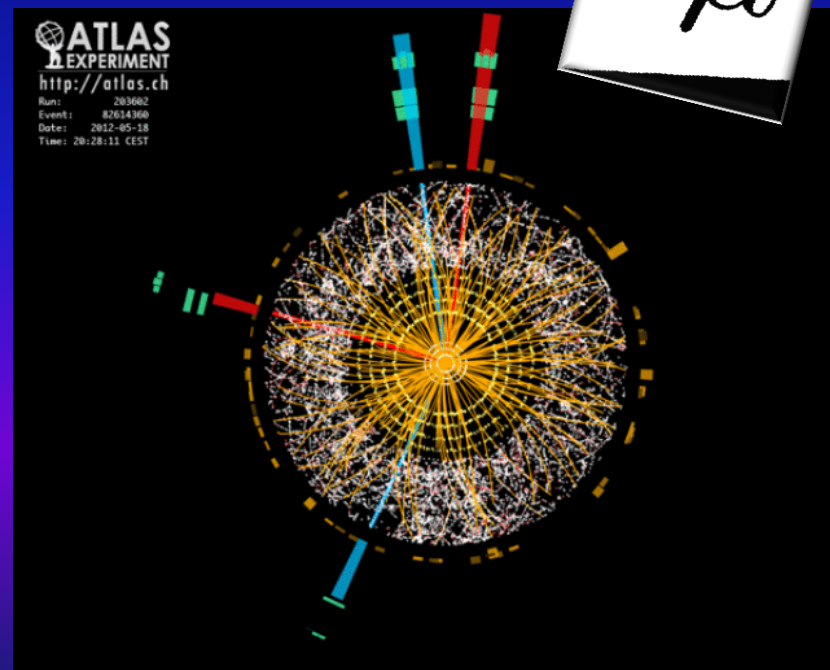
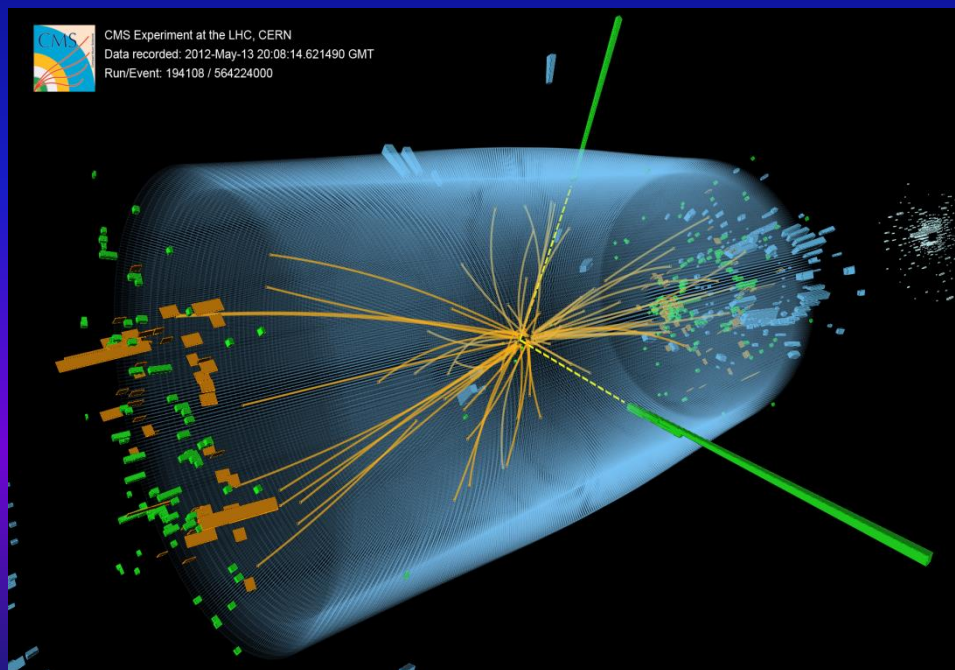
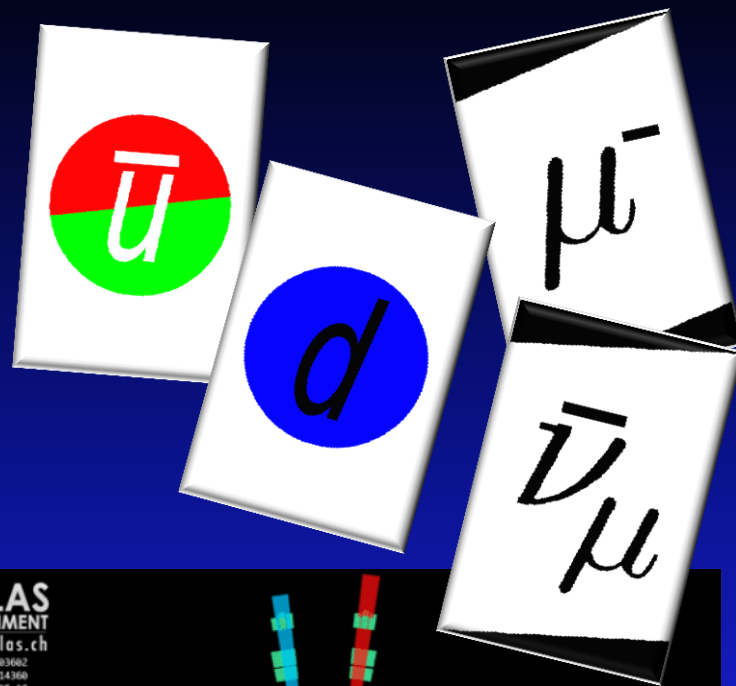
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ELEMENTARY PARTICLES

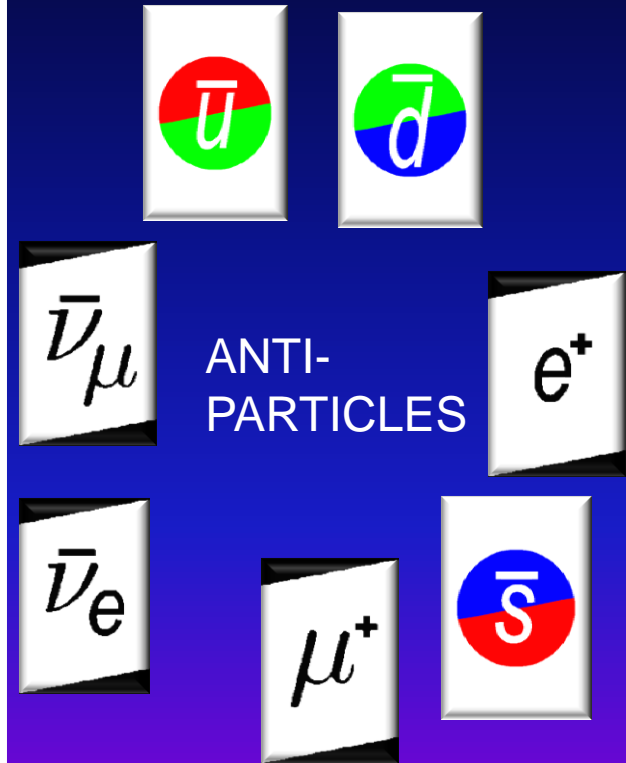
Three generations of matter (fermions)

	I	II	III		
mass →	2.4 MeV/c ²	1.27 GeV/c ²	171.2 GeV/c ²	0	? GeV/c ²
charge →	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	0	0
spin →	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	0
name →	u up	c charm	t top	γ photon	H Higgs boson
	4.8 MeV/c ²	104 MeV/c ²	4.2 GeV/c ²	0	
	$-\frac{1}{3}$	$-\frac{1}{3}$	$-\frac{1}{3}$	0	
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	
Quarks	d down	s strange	b bottom	g gluon	
	<2.2 eV/c ²	<0.17 MeV/c ²	<15.5 MeV/c ²	91.2 GeV/c ²	
	0	0	0	0	
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	
	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	Z⁰ Z boson	
	0.511 MeV/c ²	105.7 MeV/c ²	1.777 GeV/c ²	80.4 GeV/c ²	
	-1	-1	-1	± 1	
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	
Leptons	e electron	μ muon	τ tau	W[±] W boson	Gauge bosons

ELEMENTARY PARTICLES - PLAYFULLY

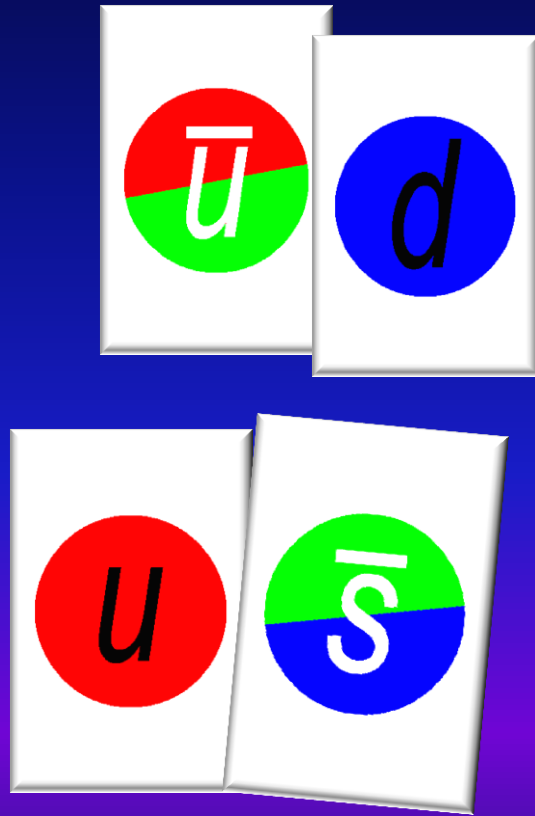
Three generations of matter (fermions)

	I	II	III		
mass →		1.27 GeV/c ²	171.2 GeV/c ²	0	? GeV/c ²
charge →		2/3	2/3	0	0
spin →		1/2	1/2	1	0
name →	u	c charm	t top	γ photon	H Higgs boson
	d	s	4.2 GeV/c ² -2/3 1/2 b bottom	0 0 1 g gluon	
Quarks					
	ν_e	ν_μ	<15.5 MeV/c ² 0 1/2 ν_τ tau neutrino	91.2 GeV/c ² 0 1 Z⁰ Z boson	
	e⁻	μ⁻	1.777 GeV/c ² -1 1/2 τ tau	80.4 GeV/c ² ±1 1 W[±] W boson	
Leptons					Gauge bosons

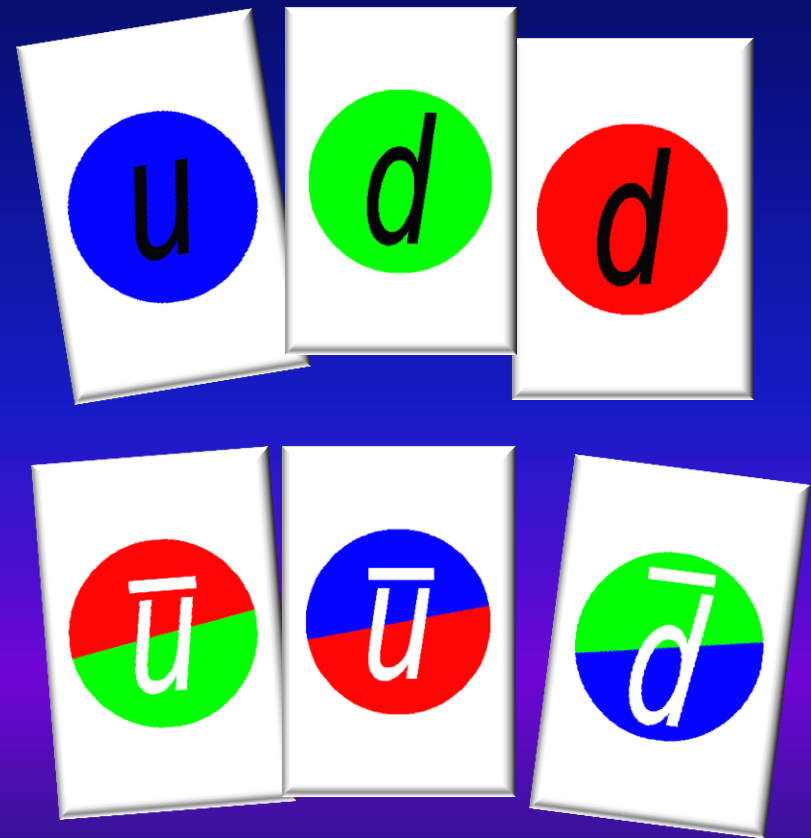


SU(3) COLOR vs OPTICAL COLOR

Mesons



Baryons



Student's idea: PARTICLE CARD GAME

By now:

invention, patent and product...

66 cards, 4 games:

- ANTI
- Let us detect!
- Quark Matter (BNL)
- Cosmic Showers

1st edition: an e-book for

„Meet the Scientist“ opening talk

Hungarian, online available

<http://www.lulu.com/>



International coverage, some examples

SUBATOMIC SHUFFLE

Prefer particle physics to poker? Pick up a deck of the Quark Matter Card both. Instead of kings and queens, the cards feature quarks (up, down, and trons, and their neutrinos; and antiparticles for all.

Hungarian high school students Csaba Török and Judit Csörgő invited their father, Tamás, a physicist at the KFKI Research Institute for Particle Physics Budapest. The simplest game is "Anti," in which players quickly identify combinations, bearing in mind a quantum-mechanical property called color of the card. It's an abstract concept, but "even children who cannot read," Tamás says. For adult players, he recommends "Quark Matter," which is piled to represent the quark-gluon plasmas physicists cook up at Brookhaven National Laboratory.



Relativistic Heavy Ion Collider (RHIC), and PHENIX experiments.

cards are available for purchase.

he and his daughter are known for their work on the subject.

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ncemag.org **SCIENCE** VOL 331 14 JANUARY 2011
Published by AAAS

2011.01.04.

Quark Matter at RHIC: It's in the Cards

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Quark Matter at RHIC: It's in the Cards

Students and RHIC physicist develop quark-gluon plasma card game

By Karen McNulty Walsh | January 4, 2011

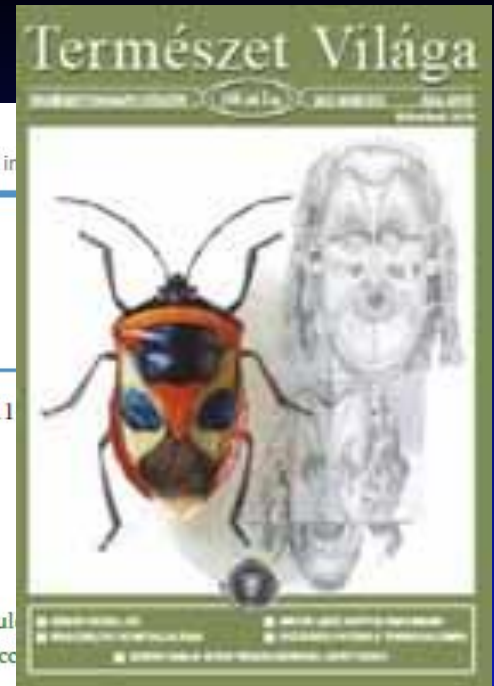
Happy New Year! Like the sprays of confetti and streamers exploding in Times Square at midnight on December 31, millions of subatomic particles will soon be streaming from heavy ion collisions at RHIC, Brookhaven Lab's Relativistic Heavy Ion Collider.

Linking subatomic particles with New Year's Eve celebrations may not be so strange: Two years ago, a group of Hungarian secondary school students rang in the New Year while playing with particles, literally. The group, which included Judit Csörgő, daughter of RHIC/PHENIX collaborator Tamás Csörgő, and her friend Csaba Török, were at a New Year's celebration, playing with the first edition of a set of cards invented by Csaba as an entertaining way to learn about subatomic particles and their interactions. The game, more formally developed and tested by the students with mentoring help from Tamás, won an honorable mention in a 2010 Hungarian competition for junior innovators. It is now available for purchase as an e-book, with cards included, on Lulu, currently with Hungarian directions. An English version is in the works.



RHIC/PHENIX collaborator Tamás Csörgő, Csaba Török and Judit Csörgő with their card game at the exhibition in the "Palace of Wonders" after the ceremony of the 19th Hungarian National Contest for Junior Innovators and Scientist (Budapest, Hungary, June 10, 2010).

Press coverage, awards, tests



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DESERTEC: energy for the planet

Playing with particles

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Entitlement to vote in the Canton of Geneva

PLAYING WITH PARTICLES

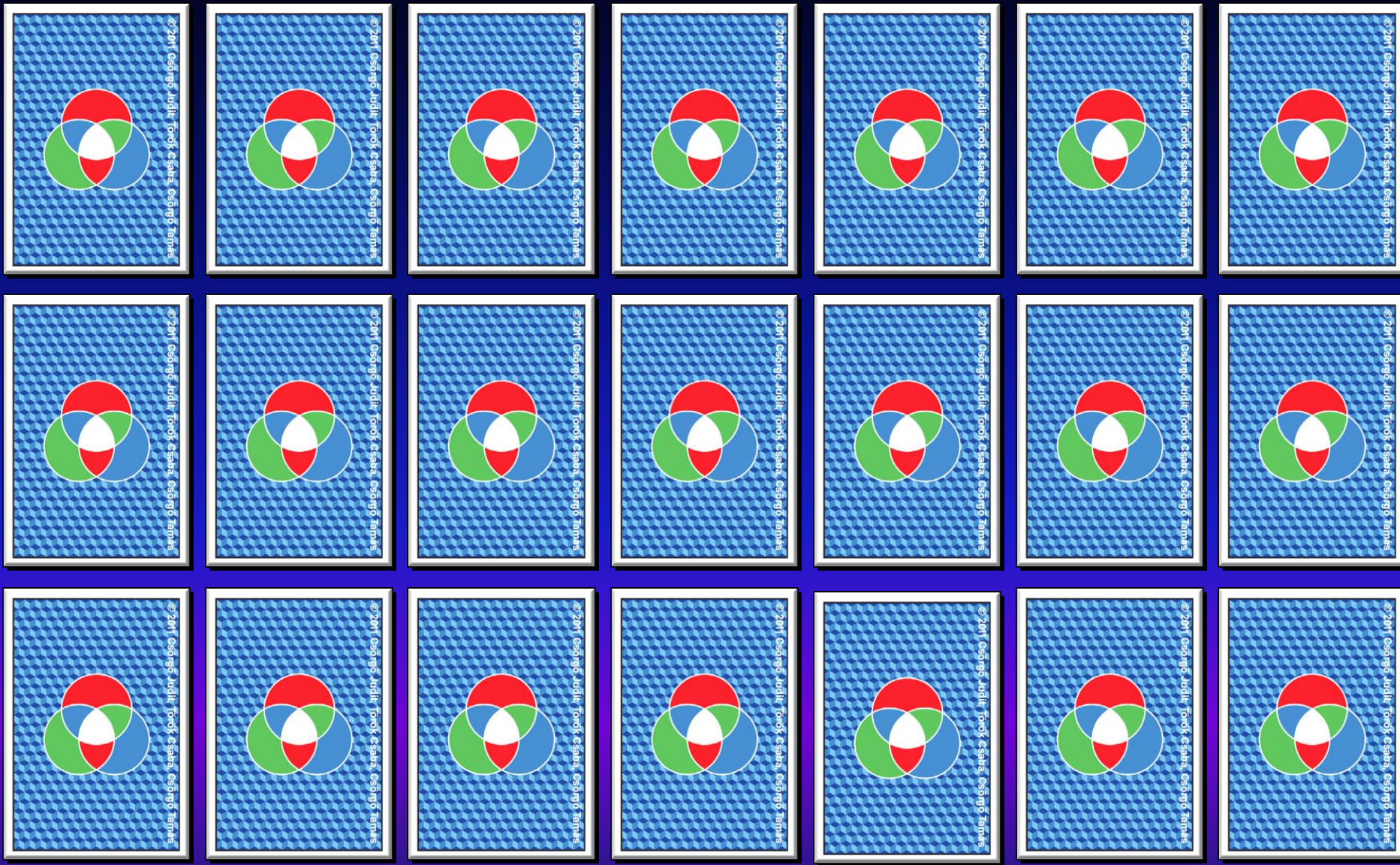
Could the principles of particle physics ever be explained by a game? Could we ever teach the Standard Model the way Monopoly teaches economics? According to the Quark Matter card game, the answer is an easy "yes!".



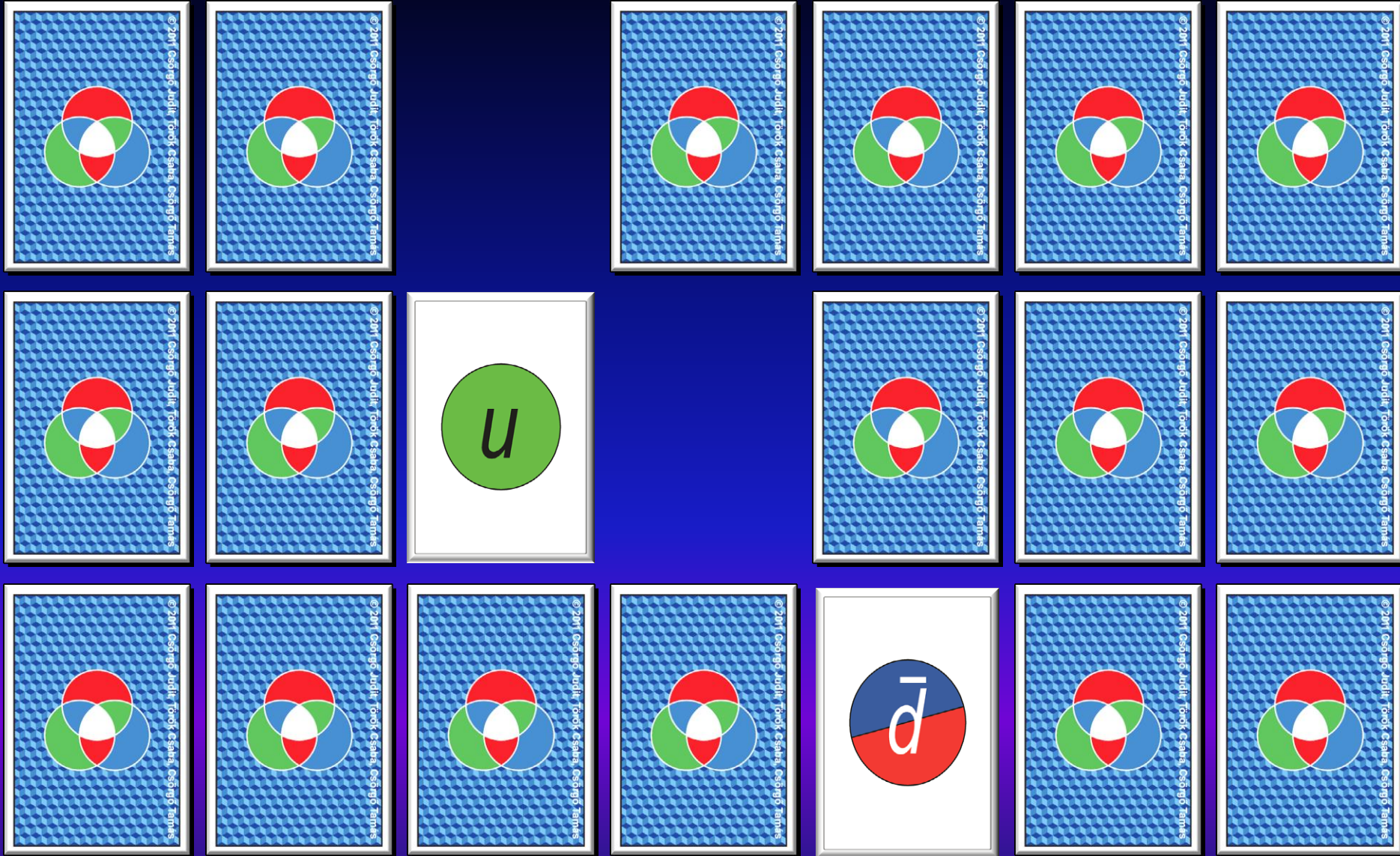
Csaba Török and Judit Csörgő (second and third from left) at the award ceremony for the Eötvös University Innovation Contest.

When he was only 17 years old, Hungarian student Csaba Török came up with the idea for the Quark Matter cards. "I wanted people to think of the Standard Model as fun – not just a serious, scientific theory," says Csaba. "The cards can turn everyone into a pseudo-physicist." He shared the idea with his friend Judit Csörgő and her physicist father, Tamás Csörgő, and together they went on to develop Quark Matter into the game it is today. Csaba and Judit were both members of the Science Club that Tamás re-organized and mentors at the Berze Secondary School in Gyöngyös, Hungary, and they are now both studying science at the ELTE University, Budapest.

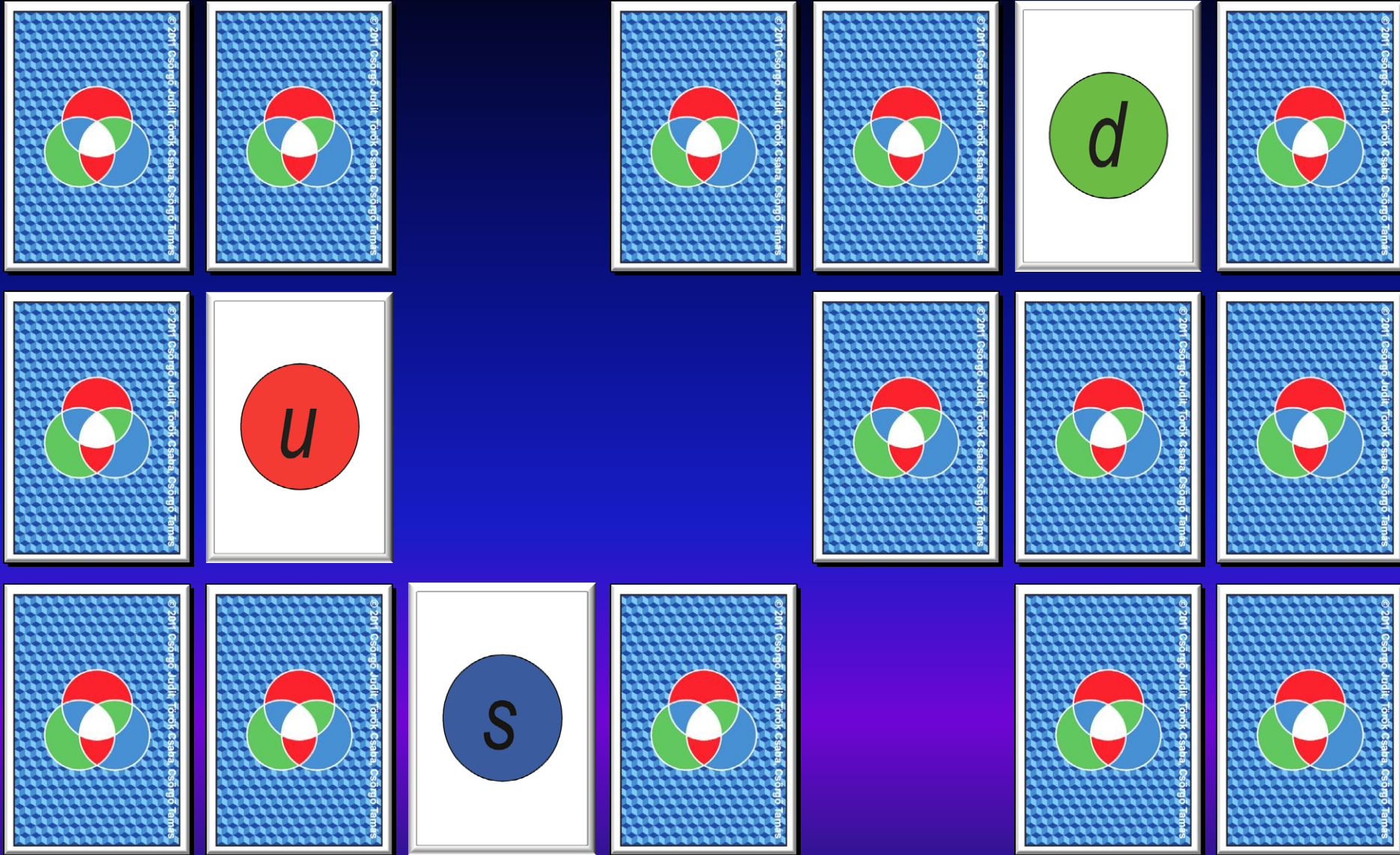
Higgs Card Game – Memory style



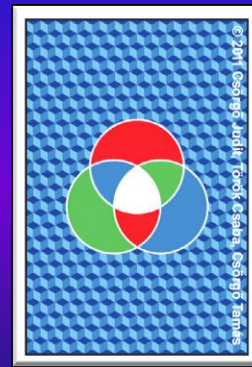
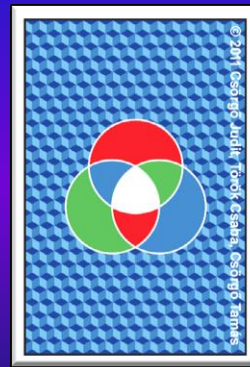
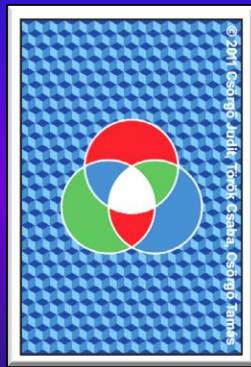
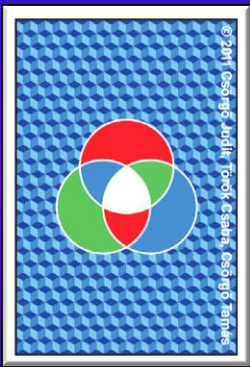
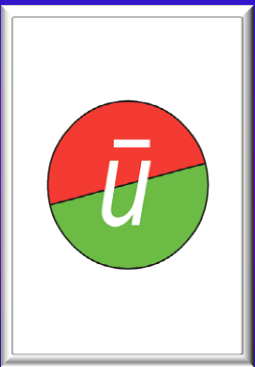
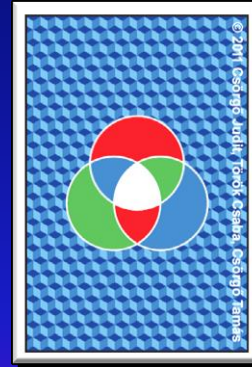
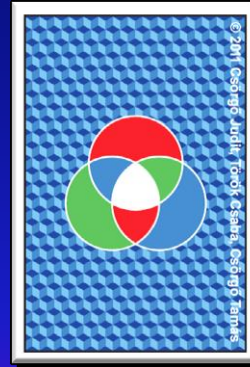
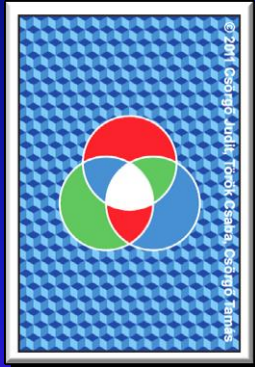
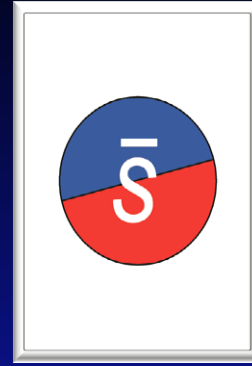
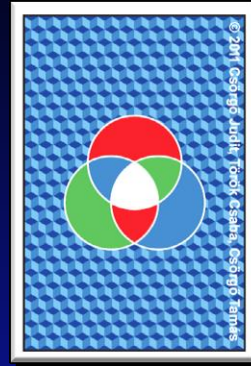
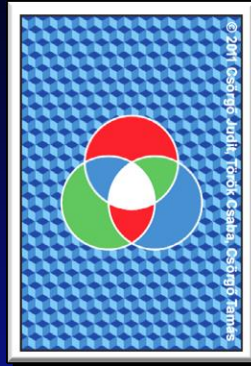
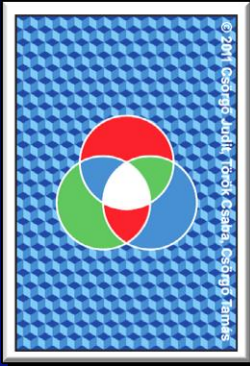
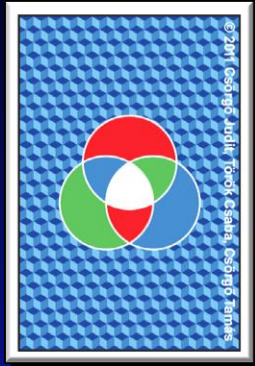
Higgs Card Game – valid meson



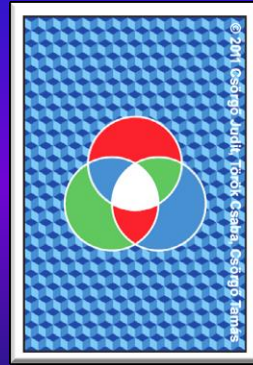
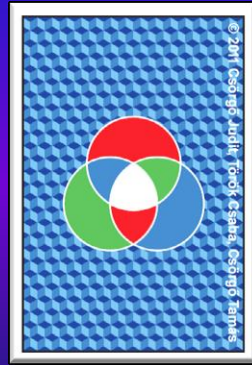
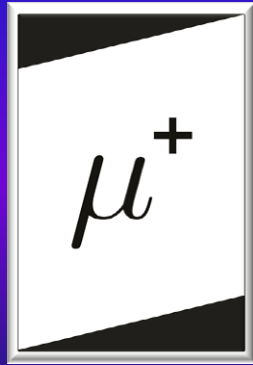
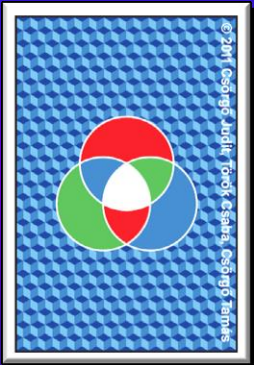
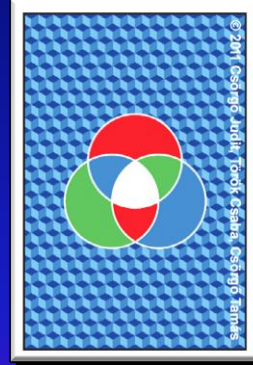
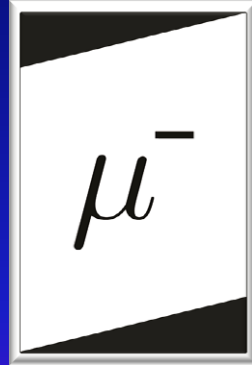
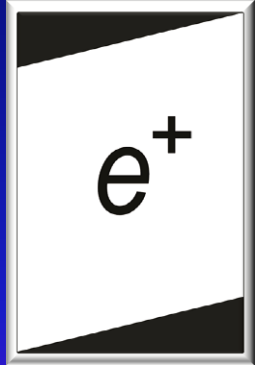
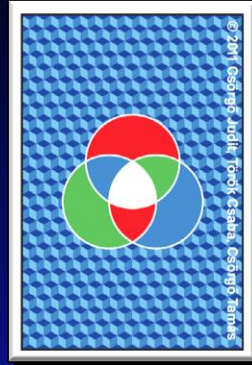
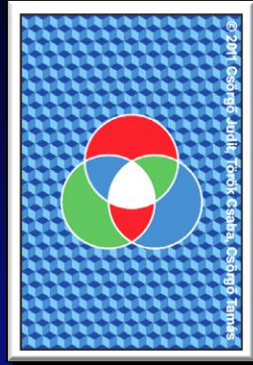
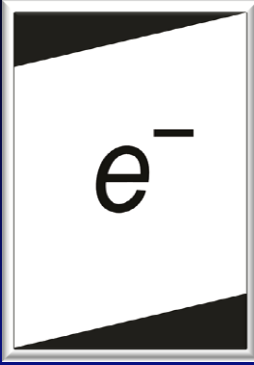
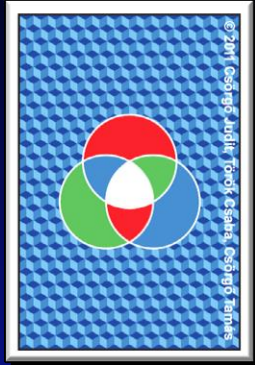
Higgs Card Game – a baryon



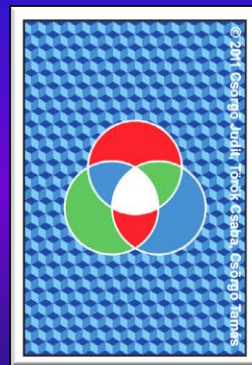
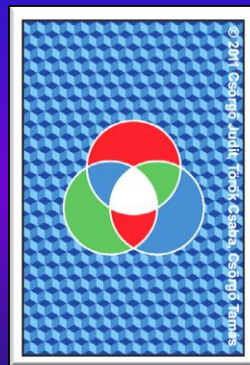
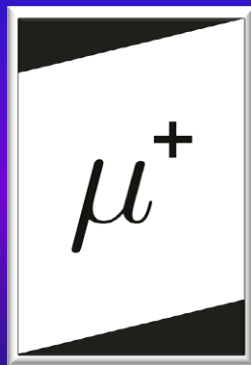
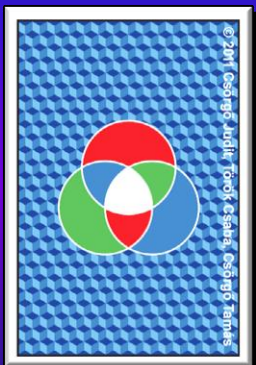
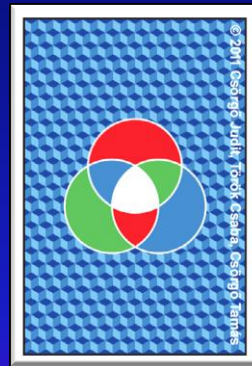
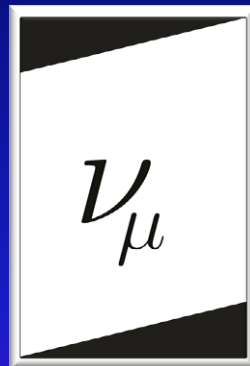
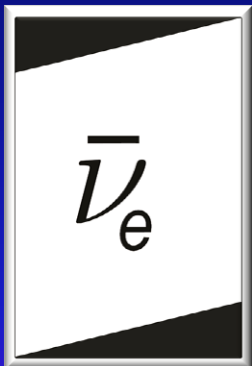
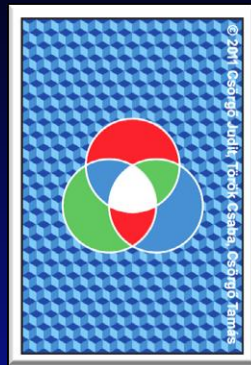
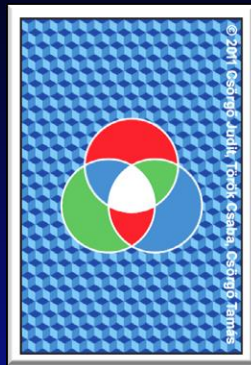
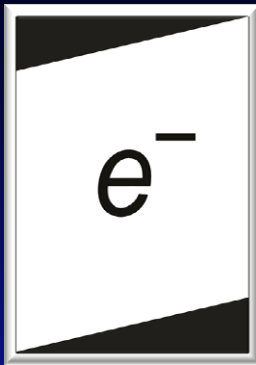
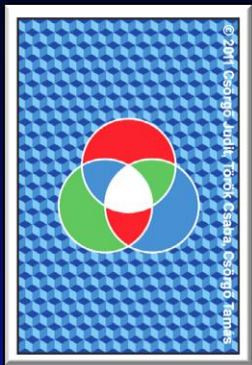
Higgs Card Game – an antibaryon



Higgs event: $H^0 \rightarrow Z^0 Z^0 \rightarrow \ell^+ \ell^- \ell^+ \ell^-$



Higgs-event: $H^0 \rightarrow W^+W^- \rightarrow \ell^+\nu \ell \nu$



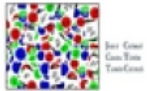
1st → 3rd English language edition: BNL's store

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QUARK MATTER
CARD GAME



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Quark Matter Card Game

By Judit Csörgő, Csaba Török,
Tamás Csörgő

Paperback: **\$27.94**

Ships in 3-5 business days

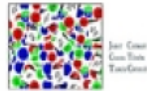


A new card game, attempting to make a bridge between elementary particles, quark matter, entertainment and self-education. The cards in these games represent the smallest known constituents of our...

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QUARK MATTER
CARD GAME



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Quark Matter Card Game

By Judit Csörgő, Csaba Török,
Tamás Csörgő

eBook (PDF): **\$8.99**

Download immediately.



A new card game, attempting to make a bridge between elementary particles, quark matter, entertainment and self-education. The cards in these games represent the smallest known constituents of our...

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SUMMARY

Science Club + PHENIX + TOTEM

Student and science outreach project:

[innováció](#), patent, [product](#)

Recently added: **2 open access science games**

[Memory of Quark Matter \(2011/05\)](#)

[Higgs-boson – on your own](#)

[2012/12/04, Zimányi School, Budapest](#)

Plans: Translation to national languages

Experiment specific games for

CERN Open Days (Sept 27-29,2013):

ATLAS, ALICE, CMS, LHCf, LHCb,

MoEDAL, PHENIX, STAR, TOTEM

YOUR outreach support requested

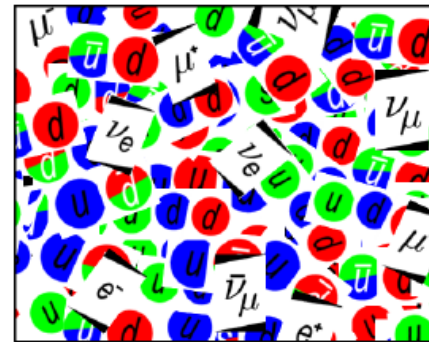
To reach out, really...

Thank you for your attention!

QUARK MATTER CARD GAME

ELEMENTARY PARTICLES ON YOUR OWN

THIRD, REVISED AND EXTENDED ENGLISH EDITION



JUDIT CSÖRGŐ
CSABA TÖRÖK
TAMÁS CSÖRGŐ

Bonus: with Science Club students

