Group report astroparticle physics – science fascinating people

We all want to learn more about our universe. This desire unites all human beings from all centuries, all cultures, and all ages. The card game aims to rewake that inner spark in everybody.

In a Socratic manner, the card game shows that if not a single person then the team knows enough to answer the questions with pure thinking. It sometimes also provokes questions (like Is there anything faster than light?), because wondering and being curious mark the beginning of science. To reach that goal and to tell a coherent story, the questions must be ordered (otherwise they could only test knowledge committed to memory). So we planned the game as a fictive conversation in class, where the pupils are lead to new insights through their ideas. Of course, as we did not want one person holding the complete „solution“ to be excluded from playing, the answers had to be definite. We wanted to enable everybody to be involved at the same time. We want the group to get into discussion while searching for the answer – that is also, what science is about. So there is no single winner, but every participant knows after the game more than before thanks to the groups' effort.

We created the game to be as accessible as possible

- it can be downloaded and printed from everywhere

- the manual is easy to understand

- it is for everybody who can read English, literally for 9 to 90 year old persons

- it can be played in groups of 3 as well as in school classes of 33

The aim of the game is to provoke everybody's desire for learning by showing some of the fascinating secrets astroparticle physics reveals combining the most interesting fields of astrophysics, high energy physics, and particle physics.

We strongly felt during the Sciathon against all cultural differences, despite the time shift, in spite of obligements like a wedding ceremony on Friday night in Pakistan and giving undergraduate classes on Saturday evening in Bangladesh and the face of the raging of the covid virus, that this desire for spreading knowledge unites us.

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Card game for 3 to 33 players aged 9 to 90 about astroparticle physics

Introduction

Astoparticle physics combines astrophysics, high energy physics and particle physics. In this game you will learn something about the fascinating science.

Preparation

Print the pages with the cards, fold it so that a black and a white side make the front and back of one card and cut along the horizontal lines.

Game manual

The cards are riffled and equally distributed among the players. (It does not matter whether one player has more cards than the others. If there are 33 players, everybody gets one card).
On each card is a question on one side.
On each card (except for the first) is an anwer to another question on the other side.
So the first player (the one without the answer) reads her/ his question aloud.
The other players turn their cards and look whether they have got the answer.
The one who has got the answer reads the answer. Then she/ he turns the card and reads the new question ...

Have fun!

How did humans get information about our universe in the past?	
What is the disadvantage of light here?	light from the stars
So particles that penetrate would be nice. What is matter made of?	it can be absorbed
What are atoms made of?	atoms
Protons and electrons also hit the atmosphere. Where and how can everybody observe that?	protons and neutrons in the nucleus, electrons in the atomic shell

Which characteristic of the earth leads to the fact, that polar lights are not straight lines?	polar light
Therefore one cannot find out, where the protons came from, but one can measure their energy: up to 10^{20} eV. What does the number 10^{20} mean?	the earth` magnetic field deviates charged particles
What does the unit eV mean?	a 10 with 20 zeros
The worlds biggest accelerator at CERN reaches very high energies, 7 TeV per particle – is this more or less than 10^{20} eV?	electron volt: that is the kinetic energy an electron gets, when it passes a voltage of 1V
Neutrino in a bar	Terra is 10^{12}, so it´s more than 10 Million times smaller

What qualifies neutrinos as messengers?	no charge
What is the difficulty when detecting neutrinos?	they show the direction where they came from
How can they be measured anyway?	they interact only weakly and mostly pass through matter
True or false? Neutrinos go into a charged muon, that moves faster than light in water or ice.	big detector => Km3NET in the mediteranean sea and IceCube in the Antartica
Why?	true

The moving muon makes a light cone in water or ice, which can be detected. The tracks show origins of the particles. Where do they originate?	maximum possible speed is $3 \cdot 10^8 \frac{m}{s}$, but this is light in vaccum, whereas light slows down in a medium
Why are they called active?	candidates are active galactic nuclei
Pictionary: Black Hole	they send a bright jet of light and particles in the universe
What is a black hole?	Black Hole – that is in the center
First image of Black Hole captured?	a region with very strong gravitation

Black Hole is bounded by?	10th April 2019 using Event Horizon Telescope in the center of M87 galaxy
What is Gravitational Collapse?	an event horizon, beyond that no light can escape the region because of gravity
What is the possible end state of a massive star?	death of a star
A light-year is the distance light travels in one Earth year. What is the equivalent distance of 1 light-year in km?	Neutron Star
1 Parsec is a length: When the apparent shift of a star during half a year in relation to active galactic nuclei is one arcsecond – how far away is the star?	9.46×10^{12} km

Pantomime: Big Bang	3.26 light years
How do we know our universe expands?	Big Bang – the assumed beginning of the universe
What might gravitational waves teach us about the universe?	there is background radiation of low temperature 2.7 K left: from the high temperature the universe cooled down due to expansion
Why are gravitational waves so hard to detect?	they could soon give us a measure of the expansion of the universe
What is Dark Energy? Why do we know it exists?	they only stretch spacetime a tiny amount

What is Dark Matter? Why do we know it exists?	anti-graviational force – the expansion of our universe is accelerated
Candidates are WIMPS “weakly interacting particles”. What have all astroparticles in common?	it has got strong gravitational forces which we can measure
	they are all messengers from the universe