

Annex 1

31st European Union Contest for Young Scientists, Sofia 2019

Core Prizes

Four first prizes (€7 000 per project)

Country: Ireland
Contestant: Adam Kelly (17),
Field: Computing
Project title: Optimised Simulation of General Quantum Circuits
Abstract: Quantum computers may tackle problems beyond the capabilities of current computers. However, only small scale quantum devices are currently available. This introduces a need for fast and accurate simulation methods and tools. In this work, a series of tools for simulating quantum computers are developed. Existing techniques are built upon, and new algorithms are developed. A classical preprocessing step is introduced, allowing for optimizations throughout the simulation process. These developments create a coherent approach towards the simulation of quantum circuits, that can be used by any researcher to improve the simulation process for any quantum circuit, allowing more qubits, more quantum gates and faster development times.

Country: Denmark
Contestant: Magnus Quaade Oddershede (19),
Field: Engineering
Project title: The wingtip's influence on the efficiency of airplane wings
Abstract: Aviation is one of the most important ways of transportation. However, it is highly energy consuming and has a substantial climate impact. In this project, I have designed and tested a new type of wingtip device called a New Raked Wingtip. The New Raked wingtip optimizes the three-dimensional flow around the wingtip in order to maximise the lift and minimise the drag on the wing. That is, maximising the wing's efficiency defined as the ratio between the lift and the drag. Experiments that I have designed and carried out show that the New Raked Wingtip not only increases the efficiency of the wing, but also increases the efficiency more significantly than currently used wingtip devices. Implementation of New Raked Wingtips has the potential of dramatically reducing aviation's climate impact.

Country: Germany
Contestant: Alex Korocencev (18), Felix Christian Sewing (18),
Field: Engineering
Project title: Hoverboard - a Magnetically Levitated Vehicle
Abstract: In the science-fiction classic "Back to the Future II," actor Michael J. Fox whizzes through the streets on a skateboard that has no wheels - it floats over the ground like a hovercraft. This is precisely the technology that Felix Sewing and Alex Korocencev have been puzzling over. Their vehicle is based on four rotating discs that can induce a powerful, repulsive magnetic field on a metal plate located beneath it. The load capacity of the board is impressive indeed: the prototype can lift a considerable weight. In addition, the rotor discs can be tilted individually, allowing the board to be purposefully steered. The technology functions so well by this point that the two young researchers have even been able to apply for a patent covering the new arrangement of the magnets.

Country: USA
Contestant: Leo Li Takemaru (17), Poojan Pandya (17),
Field: Biology
Project title: Investigating the Role of the Novel ESCRT-III Recruiter CCDC11 in HIV Budding: Identifying a Potential Target for Antiviral Therapy
Abstract: Infection with human immunodeficiency virus (HIV) causes acquired immunodeficiency syndrome (AIDS). Nearly 37 million people are infected with HIV worldwide, and 1 million people die of AIDS-related illnesses each year. As of today, there is no cure, and current medications are frequently associated with severe side effects. To discover a novel target for anti-HIV therapies, we studied the role of coiled-coil domain-containing 11 (CCDC11) in HIV formation. Our data suggest that CCDC11 is required for efficient release of HIV particles from the cell surface potentially through recruitment of the membrane scission machinery called ESCRT-III. Given the fact that CCDC11 is not present in the majority of adult human organs, it might be a viable target for potential antiviral therapeutics.

Four second prizes (€5 000 per project)

Country: Georgia
Contestant: Saba Gogichaishvili (18), Nia Gogokhia (18),
Field: Chemistry
Project title: Novel Biodegradable Polymer for Pharmaceutical Applications
Abstract: Chemotherapy has a bad reputation for severe side effects and this problem is one of the major challenges for modern medicine. Targeted drug delivery has become popular for its main advantage to differentiate between healthy cells and cancerous ones. However, targeted drug delivery still has problems to overcome and one of them is the need of new, promising materials for drug encapsulation. We present novel polymer, which forms micelles in aqueous solution and provides a hydrophobic reservoir for Water-Insoluble Drugs. We claim to achieve complete biodegradability and non-toxicity of micelles as well as high stability below CMC and long blood circulation time. We desire our project to play a role in the development of targeted

drug delivery systems and to bring socio-scientific benefits.

Country: Spain

Contestant: Claudia Lúdia Pubill Quintillà (17),

Field: Social sciences

Project title: With Death at His Heels. Chronicle of an Escape and Two Wars.

Abstract: Based on a recording made by the protagonist himself, I have tried to reconstruct Miguel Quintillà's biography. A member of the Republican Council of Purroy (Spain), he managed to escape execution by the Guardia Civil in 1938 and became a republican combatant in the Segre and Ebro battles. Prisoner by Franco, he managed to escape in the Navarre Pyrenees. He joined the French Légion étrangère and fought against Hitler during the 2WW in the battle of the Norwegian fjords. He was also a soldier of the NOSC of the British Army, which landed on the Normandy coast. My analysis it's an attempt at portraying a carpenter who became a fugitive, a prisoner and a soldier in two wars, but it may be as well a way of recognising the role played by anonymous people, the true heroes in our History.

Country: Finland

Contestant: Olli Järviemi (18),

Field: Mathematics

Project title: On the Common Prime Divisors of Polynomials

Abstract: We inspect those polynomials whose coefficients are integers. We say that an integer m is a divisor of a polynomial P if some value of P is divisible by m . Our main result is that the common divisors of any several polynomials are exactly the divisors of a single polynomial. This is extended to prove that the set of prime numbers for which a system of polynomial equations in multiple variables is solvable is exactly the set of prime divisors of some polynomial in one variable. In addition, we prove results on how often a prime number is a common prime divisor of some polynomials – we prove a tight lower bound for this so-called density, and under additional assumptions give a formula for this density. Our work generalizes previous results, and we propose several ideas for further research.

Country: South Korea

Contestant: Jaehyun Lee (17),

Field: Physics

Project title: Introduction of a Novel Diodicity Evaluation Criteria and 1-D Approximate Model for Multistaged NMP (No-Moving-Parts) Check Valves and Methods for Valve Stage Optimization

Abstract: A new diodicity evaluation criteria, Volumetric Diodicity (D_v), is introduced to analyze the diodicity of NMP (No-Moving-Parts) valves. Recent studies about the valve system are based on the pressure diodicity, defined as the ratio between the pressure drop in forward and reverse flow. However, existing evaluation criteria do not show discrete relationships with actual data. In this paper, an inelastic collision-based analytic turbulent model was designed to approximate the tendency of diodicity by stage number and was verified both experimentally and numerically with CFD (Computational Fluid Dynamics). The new diodicity criterion can be applied in numerous fields that require NMP valves which are operated in relatively low-pressure ranges.

Four third prizes (€3 500 per project)

Country: Switzerland
Contestant: Océane Zofia Adrienne Patiny (19),
Field: Engineering
Project title: Remote Controlled Cylinder
Abstract: This research work consists of the conception and open-source development of a robotic cylinder whose speed is remotely controlled through a web page. To induce the movement, an innovative approach has been developed, which uses the coordinate movement of three motors to move a mass inside the cylinder. As the mass is placed away from the center, an imbalance is induced, causing the cylinder to accelerate. This project is very transdisciplinary, which is what makes it especially interesting: mathematics, physics, mechanics, electronics and programming notions were necessary to build the final prototype. It weighs 1.4 kg, has a diameter of 32 cm, an autonomy of about 4 hours and a maximum speed of 1 m/s.

Country: Belarus
Contestant: Aliaksandr Piachonkin (17),
Field: Mathematics
Project title: On the number of points on an algebraic curve in a ring of residues
Abstract: In our paper we obtained the following results: 1. We introduce a new function $R(f, l)(n)$, which is the number of all possible combinations of giving coordinates of the solutions of the congruence $f(x_1, \dots, x_k) \equiv 0 \pmod{n}$, and proved that this function is multiplicative. 2. We obtain the exact number of points on a curve $x^m - y^k \equiv 0 \pmod{n}$. 3. We introduce a new definition m/k -power residue modulo n and found an exact formula for their number modulo n . From this formula as a corollary we obtained the full results about m -power residues. 4. We calculated the number of points on a curve $ax^2 + bxy + cy^2 \equiv 0 \pmod{a}$ prime number. 5. We found an exact formula for the number of all possible values of quadratic polynomial mod n . These results can be useful algebraic geometry and asymmetric cryptography.

Country: Austria
Contestant: Noah Scheiring (19), Andreas Ladner (19), Tobias Schauer (19),
Field: Engineering
Project title: Diffrec PRO
Abstract: The team developed a so-called differential pulley block for alpine lightweight synthetic fibre ropes, which will be easy and simple to handle. They calculated and compared different concepts and found a serrated differential roller with three differently sized grooves. The axle of the pulley is suspended from two side plates, which also provide a suspension point for a carabiner. A mechanism presses the rope into the serrations so that it doesn't just let go. They found a very smart solution for the improvement of pulley blocks for alpine applications.

Country: Poland
Contestant: Antoni Ignacy Lis (19),
Field: Chemistry

Project title: Nanoparticles in antitumor therapy

Abstract: One of the most common cause of deaths are various tumor diseases. Tumor cells often appears to be not vulnerable for some drugs. That is why developing therapies which includes many different mechanisms of work are very important. In my studies I was trying to synthesize iron oxide extrimelly small rounded shaped particles which could handle three different mechanisms of killing tumor cells. Firstly they have special magnetic properties which, allows us to local increasing temperature thanks to variable magnetic field. So we could in some way "boil" cells. Secondly I tried to admixture radioactive element. And thirdly I connected the particles with antitumor drug. In my project I was sythesizing those particles and investigated their properties and also how they interact with cells.

Honorary Awards

Stockholm International Youth Science Seminar 2019

Selected winners attend the 2019 Nobel Prize ceremonies, meet the Nobel Laureates and take part in a series of other scientific/cultural activities during the week.

Country: Germany
Contestant: Alex Korocencev (18), Felix Christian Sewing (18),
Field: Engineering
Project title: Hoverboard - a Magnetically Levitated Vehicle

London International Youth Science Forum 2020

Selected winners meet young scientists from around the world and take part in the annual two-week intensive summer science festival during July-August 2020.

Country: Ireland
Contestant: Adam Kelly (17),
Field: Computing
Project title: Optimised Simulation of General Quantum Circuits

Country: Denmark
Contestant: Magnus Quaade Oddershede (19),
Field: Engineering
Project title: The wingtip's influence on the efficiency of airplane wings

Country: Finland
Contestant: Olli Järviemi (18),
Field: Mathematics
Project title: On the Common Prime Divisors of Polynomials

Special donated Prizes

The following is a list of special donated prizes:

- JRC (Joint Research Centre): The European Commission's internal science service (4 prizes)
- EIROforum: a one-week stay at each of the eight members of EIROforum
 1. CERN - The European Laboratory for Particle Physics
 2. EUROfusion – JET
 3. EMBL - The European Molecular Biology Laboratory
 4. ESO - The European Southern Observatory
 5. ESA - The European Space Agency
 6. ESRF - The European Synchrotron Radiation Facility
 7. ILL - The Institute Laue-Langevin
 8. XFEL - the European X-Ray Free-Electron Laser Facility
- Bioeconomy prizes
 1. The BBI JU Biobased Industries Joint Undertaking prize
 2. The European Food and Drink Industry prize
 3. The Unilever prize
 4. The PepsiCo prize
- EuCheMS (The European Chemistry Society) prize
- Swiss international talent forum prize
- Host Country awards
 1. Bulgarian Mathematics Summer School Award
 2. International students of history prize
 3. National workshop on coding theory prize

JRC - Joint Research Centre

3 prizes: two-day stays at the JRC's Institutes in Ispra, Italy

Country	Contestants	Field	Project title
Spain	María Bouso Posada (18) Xiana Rego Fernández (17) Ana Rubal Sánchez (18)	Biology	O da la miúda. Distribution, ethology and phenology of the Iberian wolf.
Bulgaria	Andrey Evgeniev Gizdov (19)	Medicine	A novel method for skeletal age

			estimation based on cranial suture analysis
Switzerland	Jannik Lukas Wyss (19)	Biology	Gene regulation during development: The roles of the genes xbp1, creb3l1 and creb3l2 in axial mesoderm differentiation
Israel	Elias Elias (18)	Medicine	The effect of the E12 antibody on multiple sclerosis

EIROforum Prizes

CERN - The European Laboratory for Particle Physics

One week stay in Geneva, Switzerland

Country	Contestants	Field	Project title
Poland	Mateusz Leon Mazurkiewicz (18) Łukasz Bartłomiej Gałecki (19) Jan Marcin Struziński (19)	Engineering	High Altitude Micro Air Vehicle

EUROFusion - JET

One week stay at Culham, United Kingdom

Country	Contestants	Field	Project title
Canada	Manning Harrison Whitby (18)	Engineering	An Interpretation of Life Through Vibration Motors

EMBL - The European Molecular Biology Laboratory

One week in Heidelberg, Germany

Country	Contestants	Field	Project title
Sweden	Mattias Sven Anders Akke (19) Elsa Maja Greta Axby (19)	Chemistry	Catching the Bad Guys: Capturing Oligomers of the Amyloid-beta Peptides / Metod för framställning av

			amyloidogena oligomerer (Swedish title)
--	--	--	--

ESO - The European Southern Observatory

Visit to ESO site in Chile

Country	Contestants	Field	Project title
France	Sékolène Mosser (17) Louise Richard (18) Hugo Montan (18)	Physics	Advanced ARAGO, a "gravitational wave" detector

ESA - The European Space Agency

Participate at a major European space science conference under the sponsorship of the European Space Agency, including coverage of travel and accommodation costs.

Country	Contestants	Field	Project title
Switzerland	Océane Zofia Adrienne Patiny (19)	Engineering	Remote Controlled Cylinder

ESRF - The European Synchrotron Radiation Facility

One week stay in Grenoble, France

Country	Contestants	Field	Project title
Czech Republic	Alexandr Zarivnij (20)	Medicine	Inhibition of glutamate excitotoxicity in glaucoma by liposomes

ILL - The Institute Laue-Langevin

One week stay in Grenoble, France

Country	Contestants	Field	Project title
Spain	Nadia Weronika Brzostowicz (18)	Physics	Acoustic levitation. Building and analyzing two different acoustic levitators based on piezoelectric transducers, and exploring its current and possible future applications using simple physical and

			chemical experiments.
--	--	--	-----------------------

XFEL - the European X-Ray Free-Electron Laser Facility

One week stay in Hamburg, Germany

Country	Contestants	Field	Project title
Belarus	Roman Rouba (17)	Physics	Investigation of the Prince Rupert's drop properties

Bioeconomy Prizes

BBI JU – Biobased Industries Joint Undertaking

Study trip to biobased industry facilities

Country	Contestants	Field	Project title
Finland	Ronja Holopainen (19)	Materials	EcoMe: a reusable, ecological and affordable menstrual hygiene product for developing regions

The European Food and Drink Industry Prize

€2,000

Country	Contestants	Field	Project title
Denmark	Emma Weiss Nielsen (15)	Environment	MOOSIC: a mean for productivity optimisation

The PepsiCo Prize

Visit to PepsiCo's state of the art facilities at the Beaumont Park R&D Centre, UK

Country	Contestants	Field	Project title
Austria	Hannah Viktoria Schatz (19) Yasemin Hatice Gedik (19)	Environment	Microplastic on our doorstep

The Unilever Prize

Visit to Unilever's Global Foods Innovation Centre in Wageningen, the Netherlands

Country	Contestants	Field	Project title
Hungary	Miklós Zsigó (17)	Engineering	Moth.NET

EuCheMS

€1,000

Country	Contestants	Field	Project title
Egypt	Zeyad Bady (16)	Chemistry	High particulate matter filtration efficiency Nano-fibrous membrane

Swiss international talent forum

Country	Contestants	Field	Project title
Italy	Elisa Seghetti (19)	Social sciences	OnMind: an IoT wearable biofeedback system for the treatment of psychosomatic disorders

Host Organizer Prizes

Bulgarian Summer Research School Award

One student to attend this prestigious summer school

Country	Contestants	Field	Project title
Russia	Alexander Alexandrovich Sokko (17)	Engineering	Next generation of solid-fuel rocket engines
United Kingdom	Aalia Sellar (15) Brendan Michael Miralles (14) Grace Hannah Patricia Lord (15)	Computing	Music Splash

International Students of History Association

One student to attend and present results at ISHA Conference

Country	Contestants	Field	Project title
Spain	Claudia Lúdia Pubill Quintillà (17)	Social sciences	With Death at His Heels. Chronicle of an Escape and Two Wars.

National Workshop on Coding Theory Prize

Two students to be invited to participate at the next edition of the NWCT

Country	Contestants	Field	Project title
Slovakia	Ján Varga (19)	Computing	Prevention of Cheating in eSports
Germany	Constantin Tilman Schott (16)	Mathematics	Neural Network application to key-point-detection in radiographs