



SCIENCE

Slovenian scientists at the European Organization for Nuclear Research (CERN) were part of the team that discovered the Higgs boson, which was one of the greatest scientific breakthroughs of our time. Photo: CERN

HOW SLOVENIAN EXPERTISE HAS CHANGED THE WORLD

Meet the researchers who shape our everyday lives

TEXT BY PETRA PREŠEREN GOLOB

The law by which scientists determine the temperature of the Sun and other stars, the method that enabled the rapid development of organic chemistry, the vision that paved the way for the conquest of space and modern breakthroughs in medicine and pioneering research in the field of artificial intelligence. These are just a few of the achievements of Slovenian researchers, whose curiosity and knowledge have long transcended the borders of their homeland and the time in which they live.

Modern Slovenian scientists are involved in a wide range of international research projects, addressing some of the most pressing issues facing the world today.

In 2025 Slovenia became a Member State of the European Organization for Nuclear Research (CERN), where our physicists are helping to drive forward research into elementary particles.

Slovenian experts are also participating in the project to build the world's largest fusion reactor, ITER, which promises a new, sustainable source of energy.

From basic law to the stars

The path to Slovenian scientific excellence was paved by visionaries whose legacy is now documented in textbooks worldwide. Mathematician and physicist Jurij Vega (1754–1802) had a profound impact on mathematics, astronomy and technology for well over a century thanks to his logarithmic tables. As an exceptionally precise computational tool, they were indispensable to scientists and engineers around the world until the advent of the first computers. Vega is also the only Slovenian to have a lunar crater named after him.

Several decades later, physicist Jožef Stefan (1835–1893) laid the foundations of modern physics by formulating the law of black-body radiation.

Today it is known as Stefan-Boltzmann's law, and it is the only law of physics to be named after a Slovenian scientist. Slovenia's largest research institute is also named after him.

The field of chemistry was forever changed by Friderik Pregl (1869–1930). He received the Nobel Prize in Chemistry in 1923 for the development of a micromethod for the analysis of organic substances, and is the only Slovenian scientist to receive this award independently. His method required 50 times less research material and was much faster, which enabled rapid progress in organic chemistry.

When space travel still sounded like science fiction, Herman Potočnik Noordung (1892–1929), a Slovenian rocket engineer and aeronautics and astronautics pioneer, presented a plan for human habitation in space, the concept of a space station and the conditions of life in weightlessness in his book entitled *The Problem of Space Travel*. His vision laid the theoretical foundations for space exploration.

Slovenian researchers are participating in cutting-edge space projects in collaboration with both the European Space Agency (ESA) and NASA.

As a member of the James Webb Space Telescope team, astrophysicist Dr Maruša Bradač helped develop the telescope's key instruments. She now uses it to study the oldest galaxies. Astrophysicist Dr Andreja Gomboc is pushing the boundaries of our understanding of gravity through her research on black holes. She is also the leader of the Slovenian team working on the Vera C. Rubin Observatory project in Chile, currently the most powerful telescope in the world.



Jožef Stefan. Photo: The Jožef Stefan Institute archive



Friderik Pregl. Photo: Wikipedia



Aleksandra Kornhauser Frazer. Photo: Wikipedia



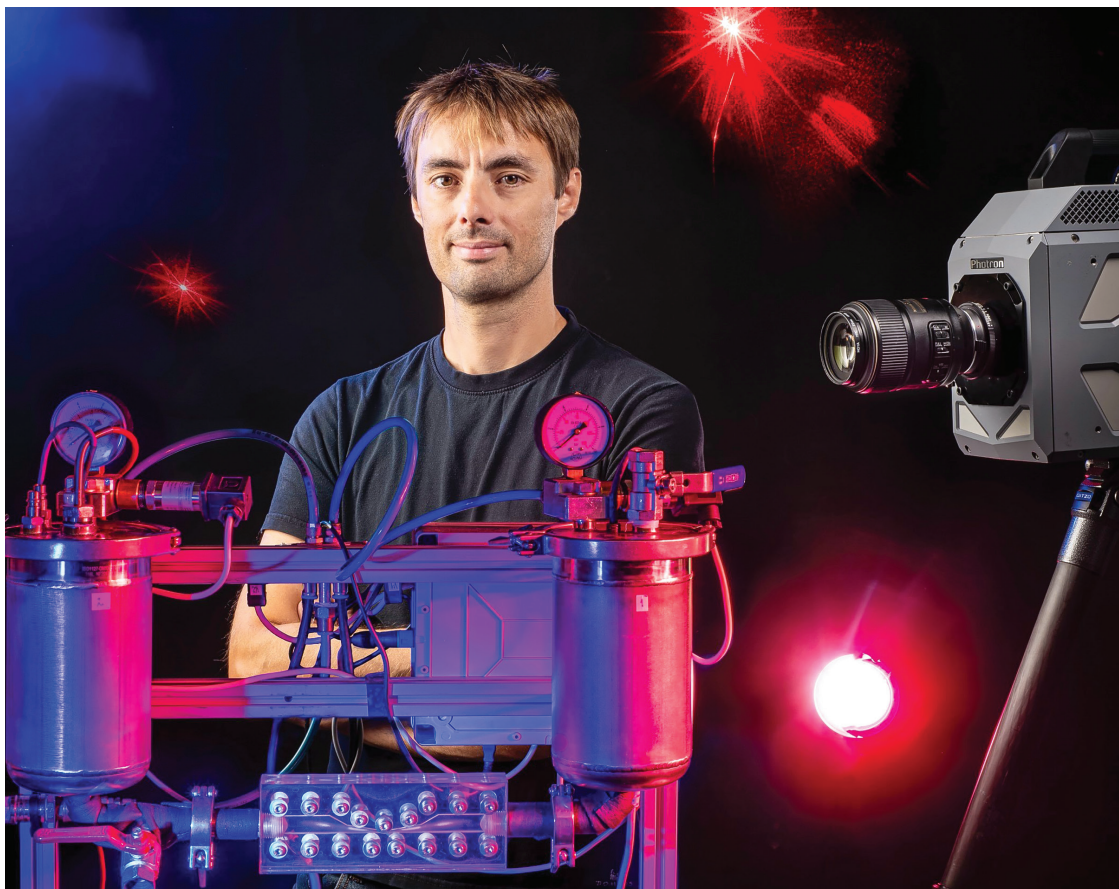
Roman Jerala. Photo: Bor Slana/STA

Innovations for health and a green future

One of the most important Slovenian researchers in the field of sustainable chemistry and environmentally friendly technologies was Dr Aleksandra Kornhauser Frazer (1926–2020). Today, her legacy is carried on by Dr Lučka Kajfež Bogataj, a climatologist and co-recipient of the Nobel Peace Prize, as well as researchers such as Dr Žiga Zaplotnik, who develops models for forecasting extreme weather at the European Centre for Medium-Range Weather Forecasts, and oceanographer Dr Matjaž Ličer, who studies the impact of climate change on the ocean and marine ecosystems.

In the fields of biotechnology and medicine, Dr Roman Jerala stands out for his work in synthetic biology, laying the groundwork for advanced treatments of the future, particularly in the areas of gene therapy and cancer. Slovenia's successes abroad are exemplified by Dr Marinka Žitnik, who is developing artificial intelligence models at Harvard University to diagnose rare diseases, and Dr Jure Leskovec of Stanford University, whose algorithms for network analysis influence the functioning of today's digital technologies and make him one of the most cited computer scientists in the world.

Under the leadership of Dr Rok Pestotnik and in collaboration with international partners, researchers at the Jožef Stefan Institute are developing a new generation of positron emission tomography (PET) scanners, one of the most important technologies for the early detection of cancer. Due to its high cost, this technology is currently available in less than half a percent of healthcare facilities worldwide. In collaboration with CERN and leading European and American institutions, researchers are applying knowledge from particle physics to develop a new generation of modular PET scanners that would enable more accurate, faster and more widely accessible cancer diagnostics.



The team from the Faculty of Mechanical Engineering of the University of Ljubljana, led by Dr. Matevž Dular, employ hydrodynamic cavitation to develop environmentally sound technologies for water treatment. Photo: Katja Bidovec and Arne Hodalič

Another internationally recognised field of Slovenian research is hydrodynamic cavitation.

This phenomenon occurs at waterfalls and when ship propellers are in operation. Tiny bubbles form in the water and release a tremendous amount of energy when they burst. Researchers from the Faculty of Mechanical Engineering, led by Dr. Matevž Dular, are among the leaders in Europe in using the destructive power of bubbles to develop environmentally friendly

technologies for water purification and the destruction of microorganisms without the use of harsh chemicals.

At the same faculty, Dr. Jaka Tušek and his team are developing elastocaloric cooling, one of the most promising green technologies of the future. Their new system enables cooling units to operate more efficiently and consume less energy without using environmentally harmful refrigerants, which could significantly reduce energy consumption and greenhouse gas emissions.

Slovenia among the pioneers of artificial intelligence

Not many people know that Slovenia has one of the longest traditions in artificial intelligence (AI). Development began as early as the 1970s, when local researchers were among the pioneers in this field. They were visionaries who, even back then, placed great emphasis on the logic and explainability of technology, as they believed that AI systems must be understandable to humans.

One of the most interesting projects of that time was the KARDIO system, developed in the 1980s by Dr. Ivan Bratko, Dr. Nada Lavrač and Dr. Igor Mozetič,

which was capable of identifying and explaining heart rhythm disturbances based on data.

This technology was so advanced and reliable that it was installed in the world's first AI-powered pacemaker.

Today, this rich tradition continues and is growing through the involvement of younger generations of researchers in international projects, which are helping to shape the digital future.

Ultimately, Slovenia's role in the digital future has also been recognised by UNESCO with the establishment of the International Research Centre on Artificial Intelligence (IRCAI) in Ljubljana.



As early as in the 1980s, Slovenian researchers developed the technology behind the world's first AI-powered pacemaker. Photo: The Computer History Museum

Did you know? World-class inventions born of Slovenian ingenuity.



Photo: Wikipedia

Janez Puh (1862–1914) was a pioneer of the automotive industry and the founder of the Puch company, which became one of Europe’s leading manufacturers of bicycles, motorcycles and automobiles in the late 19th and early 20th centuries. His technical innovations and manufacturing methods significantly impacted the development of the European automotive and motorcycle industries.

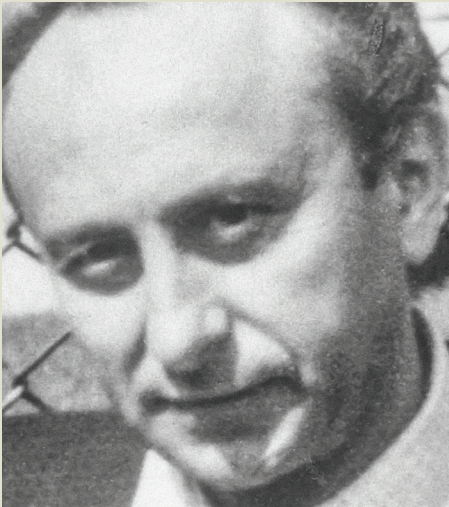


Photo: Personal archive

Engineer **Anton Banko** (1927–1986) developed the first successful phacoemulsification machine, a technology that revolutionised cataract surgery through the use of ultrasound and made it possible to perform significantly less invasive procedures. To this day, the Banko method is universally recognised as the gold standard and the bedrock of modern eye surgery.



Photo: Jure Eržen/Delo archive



HP-35 scientific pocket calculator.
Photo: Tamino Petelinšek/STA

Engineer **France Rode** (1934–2017) is best known for his work on the HP-35, the world’s first pocket electronic calculator. He played a key role in its development as one of the principal designers. His innovations in the field of microelectronics and later satellite navigation (GPS) were adopted by leading global companies.



Photo: Gregor Mlakar/STA

Peter Florjančič (1919–2020) was one of Slovenia’s most prolific inventors, holding more than 400 patents. Among these, the best known are slide frames, plastic parts for perfume atomisers and plastic zippers. His innovations have been adopted by numerous world-renowned companies, and his products have become part of everyday life around the world.