PROCEEDINGS OF SCIENCE

CERN's Education and Education Research Projects

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CERN's educational programmes offer a broad spectrum of opportunities from high-school students to professional and well experienced science teachers. In 2017 three new projects have been launched to complement these efforts. The High-School Students Internship Programme (HSSIP) offers a two-week national internship experience for students aged 16 to 19, enabling them to strengthen their understanding of science. The S'Cool LAB Summer Camp extends the S'Cool LAB offers by a two weeks residential programme enabling high-school students from around the world to experience hands-on science in an international research laboratory. The International Teacher Weeks is a two week programme that enables high-school teachers to develop further in the field of particle physics and exchange knowledge and experience among teachers from all over the world. CERN's Physics Education Research team and its projects and programmes will be presented.

The 39th International Conference on High Energy Physics (ICHEP2018)
4-11 July, 2018
Seoul, Korea

[1]Speaker

PoS(ICHEP2018)320

1.Introduction

Increasing awareness and building support for CERN and its mission are key mandates of CERNs Education, Communication and Outreach (ECO) group. The importance of increasing awareness of and support for CERNs activities lays not only in the increasing need to engage with the general public and explain what CERN does and why, but also to get support from decision makers and offer education and inspiration for schools and teachers.

To fulfil this mission, the varied activities of the ECO group targets different key audiences, including governments and policy makers, the general public, the scientific community, the CERN community, local communities and teachers and students.

2.Teacher and Student Programmes

Embedded in the ECO group, the Teacher and Student Programmes section offers a broad spectrum of educational opportunities from high-school students to professional and well experienced science teachers.

2.1. Teacher Programmes

Started as pilot-project for three weeks in summer 1998, the High-School Teacher Programmes [1] have evolved and became one of the most prestigious efforts of CERN's educational programmes. Nowadays, CERN offers various professional development programmes for teachers to keep up-to-date with the latest developments in particle physics and related areas, and experience a dynamic, international research environment. All programmes are facilitated by experts in the field of physics, engineering, and computing and include an extensive lecture and visit itinerary. To foster the exchange amongst colleagues and to increase the scientific experiences, the Teacher Programmes are either held in English or in one of the national languages of CERN's Member States and last between three days and three weeks.

Indeed, in addition to national teacher programmes, CERN offers two two-week international teacher programmes, namely the International High School Teacher (HST) Programme, which until 2018 lasted three weeks, and the International Teacher Weeks (ITW) Programme. Both programmes are delivered entirely in English and are open for in-service science teachers from around the world, to support their professional development in the field of particle physics and to promote the teaching of particle physics in high schools.

2.2. S'Cool LAB

S'Cool LAB [2] is a Physics Education Research facility at CERN. It offers high-school students and their teachers a unique chance to experience hands-on particle physics experiments on-site during their visit to CERN. High-school students get a glimpse of life and work in an international research facility by making discoveries independently, taking first steps to work scientifically and applying their gained knowledge in new settings. All learning activities in S'Cool LAB are facilitated by members of CERN's scientific community who accompany

students in their learning processes, discuss their observations and challenge their conceptual understanding.

Furthermore, S'Cool LAB serves as a testbed for physics education research projects, such as the iterative development of a new teaching concept on randomness and radioactivity, or the development of a test of students' conceptions of radiation.

The S'Cool LAB Summer Camp was introduced in 2017 as a two-week residential high-school student programme offering a rich programme including lectures and tutorial, hands-on workshops, student research projects and visits of CERN's research installations.

2.3. Beamline for Schools Competition

The Beamline for Schools Competition [3] is a contest for high-school students around the world. Since 2014, it invites teams of high-school students to team up and to propose a scientific experiment that they would like to perform at one of CERN's fully-equipped beamline facilities. Proposals are judged by a jury of scientific members of CERN and other related institutions. The winning teams are invited to CERN to carry out their experiment and experience the unique opportunity to be a scientist for two weeks.

So far, winning teams came from Canada, Greece, India, Italy, the Netherlands, Philippines, Poland, South Africa and the United Kingdom. The projects, proposed by the winning teams, span from "Proposing the Use of Pions for Cancer Therapy", over "Producing High-Energy Gamma Rays Using a Crystalline Undulator" to "Search for Elementary Particles with a Fractional Charge", just to name a few.

The Beamline for Schools Competition runs on a yearly basis. As CERN's accelerators will be under maintenance, the winning teams will be invited to another world-leading accelerator center, DESY (Deutsches Elektronen-Synchrotron) in Hamburg, Germany in 2019. For the competition in 2020, additional hosting beamline facilities for the winning teams are currently under discussion.

2.4. High-School Students Internship Programme

The High-School Students Internship Programme (HSSIP) [4] was introduced the first time in 2017 giving five pilot countries of CERN's member states the possibility to send up to 24 high-school students for a two-weeks residential internship to CERN.

The HSSIP Programme offers first hands-on opportunities in an international research laboratory. By instilling scientific curiosity, the participating high-school students shall be motivated to take on a career in science, engineering or another subject related to fundamental research. The selected students get the chance to work in pairs of two under supervision of scientific members of CERN on own projects to gain practical experience in science, technology and innovation.

Currently five HSSIP Programmes per year are foreseen. Until end of 2018 the following countries had already the chance to participate: Bulgaria, the Czech Republic, France, Hungary, Israel, the Netherlands, Norway, Poland, Portugal and Sweden. Until now 240 students took part in the HSSIP Programmes thus far and understood now better the relation between science,

especially particle physics and other disciplines. In 2019 the HSSIP Programmes will invite high-school students from Austria, Finland, Germany, Slovakia, and Spain.

2.5. Physics Education Research

Physics Education Research (PER) complements the communications, outreach and educational activities of CERN and its experimental collaborations. Since 2009 a team of CERN staff, fellows, and PhD students are developing not only the above mentioned programmes and corresponding material, but also conducting empirical research on the impact of these programmes, and providing consultancy for all actors in CERN's education and outreach efforts.

The research areas span from the continuing professional development of teachers to the impact of hands-on experiments in and out of the classroom as well as studies of students' and teachers' conceptions in physics.

Constant efforts are made to enrich the existing variety of activities. Since 2017 seminar speakers are invited to CERN to expand and share knowledge with external PER researchers from around the world. Those PER seminars are held on a monthly basis and are open to the interested public.

3.Summary

CERN's Teacher and Student Programmes section offers a variety of Physics Education Research activities to advance our current understanding of science education and offers educational development opportunities for high-school students and their teachers from around the world to contribute to the education of the next generation of scientists.

References

1. https://cern.ch/teachers
2. https://cern.ch/s-cool-lab
3. https://cern.ch/bl4s
4. https://cern.ch/hssip