CERN High School Teacher Programme 2018

by Giselle Lawrence and Thana Rahim

This year we had the honour to be the recipients of the Canadian Association of Physicists (CAP) High School Teaching Award 2018 for British Columbia and the Yukon (Giselle), and the Northwest Territories and Prairies (Thana). Following the announcement, we were asked to submit a statement of why we would be interested in attending CERN High School Teacher Program 2018 (HST 2018) and how it would impact our teaching in the classroom. After this, CAP informed us that we were selected to be Canada's representatives for the HST 2018, what a great privilege! This was the most valuable professional development experience of our career.

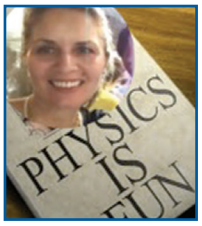
The CERN HST program in Geneva is a three week residential program for selected participants that has been taking place for the last 20 years. It consists of 100 hours of lectures given by many distinguished scientists, on-site visits, exhibitions, and hands-on workshops that introduce its participants to leading-edge particle physics. In addition to these activities, participants devote 20 hours to group work to prepare presentations on selected topics. The purpose of this work it to gain a deeper understanding of topics related to particle physics while working and exchanging knowledge in a collaborative way.

Our first week started with a social evening to allow us to get to know the 44 other participants, representing 32 other countries, and CERN organizers followed by the "Discover CERN Treasure Hunt" to get familiarized with the different locations where the program would take place. We then had an introduction to CERN and to the program prepared by the program manager, Dr. Jeff Wiener. After this, the technical lectures started right away.

The first lecture was an Introduction to Particle Physics by the renowned British physicist, Dr. John Ellis. During the week, we also had lectures on Particle Physics, Particle Accelerators and Particle Detectors. We looked into topics related to education and particle physics in a lecture on Elementary Particle Physics in Early Education by Dr. Wiener and a Cloud Chamber Workshop where we learned how to build a simple and affordable cloud chamber that can be used in the classroom. During this week we also had the opportunity to visit the Synchrocyclotron, the Cryogenic Test Facility Hall SM18 and the Alice Control and Exhibition rooms (Fig. 1).

We were divided into small working groups and we chose two topics: S'cool LAB Quadruple Ion Trap and Beam Optics, and Medical Applications. The S'cool LAB Quadruple Ion Trap and Beam Optics working group (Fig. 2) was in charge of building an astable multivibrator (Fig. 3) to simulate the functioning of a Quadrupole Ion Trap using spores instead of ions and performing an experiment to explore electric fields, charge distributions and frequency. This work enabled the group to gain a deeper understanding of how Quadrupole Ion Traps work while further developing their circuit construction and electronic skills, 3D printing skills and basic mechanical assembly skills. The group also worked on a beam optics lab.

The Medical Applications group was in charge of learning all about the recent CERN Medical Technology Hackathon (Medtech:Hack 2018) and exploring how to adapt the hackathon model to make it viable in a high school setting. CERN's MedTech:Hack 2018 was an innovation competition where teams came up with solutions to medical challenges. These solutions had to involve the use of CERN technologies. The group had the opportunity to work at IdeaSquare (Fig. 4), a unique innovative environment where people can get together to think, do and collaborate in order to generate new ideas and work on building prototypes. The working group came up with a series of recommendations on how to run a high school



Summary

Giselle Lawrence and Thana Rahim were selected from among the 2018 High School Teaching Award winners to attend the CERN High School Physics Teacher Program. The three-week program brings together teachers from around the world who attend lectures, facility tours, workgroup sessions, and lots of discussions.

Sponsors of the CAP-Perimeter Physics Education (CERN) Scholarship

Giselle Lawrence, <giselle.naranjo@icloud.com>, Brentwood College School, Mill Bay, BC

and

Thana Rahim, <thana.rahim@ycs.nt.ca>, Ecole St. Patrick High School, Yellowknife, NT

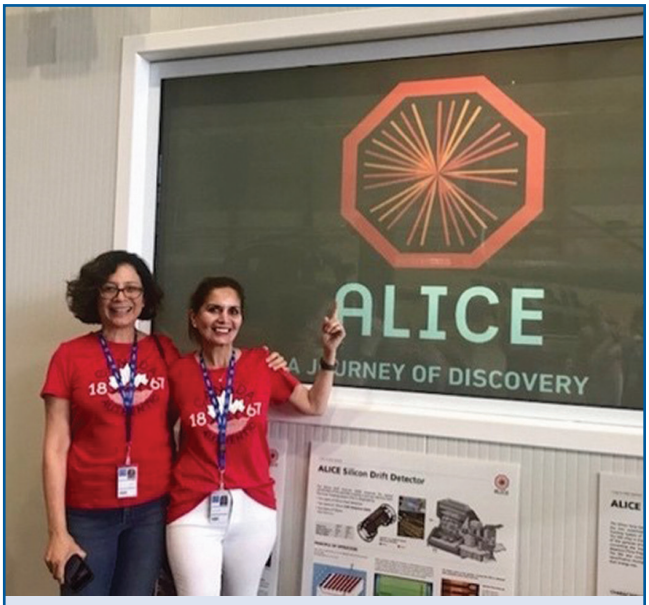


Fig. 1 Thana Rahim and Giselle Lawrence visiting ALICE Control and Exhibition rooms.

Fig. 2 Quadrupole Ion Trap and Beam Optics Working Group. From the left:Ayyaz Mehmood - Pakistan, Thana Rahim - Canada, Susanna Schort - Austria, Bahareh Azad - Iran, Kazuoki Ehara - Japan, Lidwina Felisima Tae - Indonesia.

hackathon and some examples of challenges that high school students could address. We ended the week with a "Discover Geneva Treasure Hunt" followed by the Official Dinner of the HST program at Hotel Edelweiss in Geneva.

During our second week at CERN, we had great lecturers sharing their knowledge on Data Analysis in Particle Physics, Computing at CERN, Neutrino Physics, Cosmology, Theoretical Physics, Engineering at CERN, Antimatter Research and Medical Applications of Particle Physics. This last lecture emphasized how CERN contributes to society and industry by

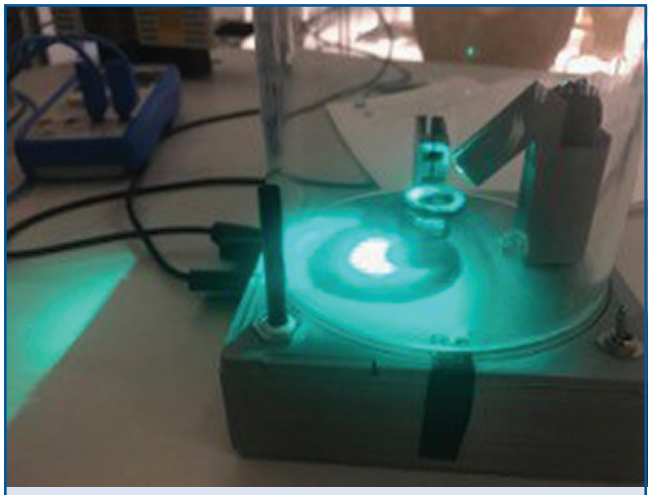


Fig. 3 Astable multivibrator simulating a Quadrupole Ion Trap.

Fig. 4 The Medical Applications group at IdeaSquare From the left: Oksana Zhyvotova - Ukraine, Natthawin Cho - Thailand, Giselle Lawrence - Canada, Marina Lici - Romania and Sarutaya Lunsakawong - Thailand.

transferring knowledge and new technology. During this lecture, it was very exciting to hear the announcement of the first 3D Colour X-Ray image obtained using technology developed at CERN (Fig. 5).

We also had the opportunity to visit the Data Centre, the Control Centre, the ISOLDE facility, the AMS POCC , the Large Magnet Facility and, the Low Energy Ion Ring and Antimatter Factory. Although all visits were truly amazing, the highlight of our week was the visit to the Large Magnet Facility (Fig. 6) where we learned how superconducting magnets that work at a temperature below 2 K are made. We also learned about the design of the new enhanced quadrupoles magnets that reach a magnetic field strength of 12 T and will be used in the High Luminosity LCH (HL-LHC) which is an upgrade of the LCH that will be operative in 2025. In addition, we were informed about the compact

superconducting crab cavities that have been funded by the Canadian government and will also be part of the HL-LHC. During this visit, it was very interesting to hear first-hand, from one of the engineers involved, the recount of the 2008 accident that happened just nine days after the LHC turned on for the first time. The engineer explained to us how a faulty wire connecting two of the magnets heated up, heating up the magnet, leaving the current to build up and boil the liquid helium that was supposed to keep the magnet cold, and how this generated an explosion. The engineer proceeded to explain the challenges they had to face to assess and fix the damage, how they replaced magnets along more that 600 m of the accelerator ring and how they have worked all these years to make sure nothing blows up again.

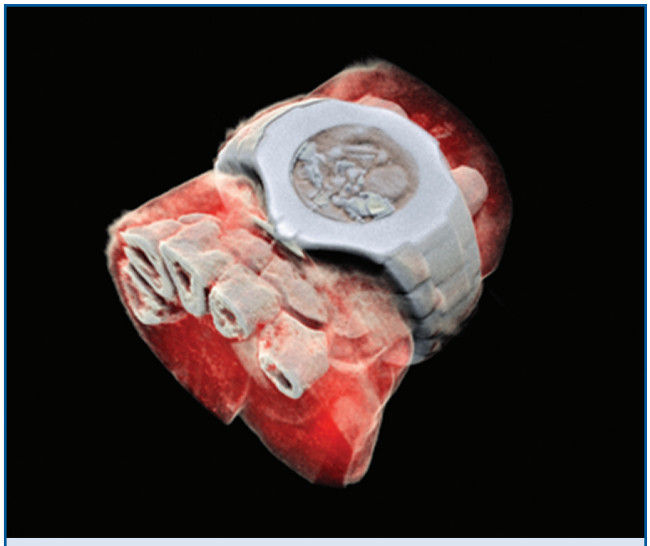


Fig. 5 A 3D Colour X-Ray image of a wrist with a watch. (Image: MARS Bioimaging Ltd).

Our third week at CERN started with a fantastic Perimeter Institute Workshop run by Dave Fish and Greg Dick (Fig. 7) where teachers learned how to incorporate uncomplicated activities for the study of dark matter and the expansion of the universe into the regular curriculum. All teachers were highly engaged and valued very much the ideas and resources that this Canadian organization shared with them. The night before the workshop, Greg and Dave organized a casual evening gathering where they kindly invited everybody in the program to share about their teaching context, philosophy and experience. It was very nice to have the opportunity to learn more about the teaching context of all the other participants.

The week continued with lectures on CERN's Teachers in Residence program, Gender Equality in Education, the AWAKE project, the Discovery of the Higgs Boson, and CERN Future Strategies and Technologies. We ended our lectures with a session called "Final questions, final answers" run by the Head of CERN's Education Group, Dr. Rolf Landua. The discussion centered on the role of the HST program in creating awareness about the research that takes place at CERN, how the LHC has started a journey of discovery that will extend for decades, how this journey will require new scientists and engineers that could

Fig. 6 Multiple images taken at the Large Magnet Facility.

Fig. 7 Greg Dick from Perimeter Institute introducing the workshop on Dark Matter.

be our current and future students, and our duty to instill in our students a greater appreciation for the scientific method and the role of scientists in society. This week we also had the opportunity to visit the University of Geneva to get familiarized with their outreach programs called Physiscope & Mathscope. Finally, the program ended with the Work Group presentations where all groups shared very interesting educational resources. All lectures and work group presentations can be found at: https://indico.cern.ch/event/651996/timetable/.

Wow, what intense, stimulating and memorable three weeks we had! Fascinating particle physics lectures, awe-inspiring visits to world renowned facilities and engaging workshops, all these while getting to know outstanding school teachers (Fig. 7), equally passionate about the teaching and learning of physics, from all continents in the world. What a great honour it was to represent Canada and to experience first-hand the peaceful collaboration and diversity that CERN stands for. We will be forever grateful to the Canadian Association of Physicists, Perimeter Institute, the Particle Physics Institute and CERN for this invaluable opportunity.

Official HST 2018 Group picture. Photo by Tony Valsamis/CERN.