

Report on Canada's participation in the 47th International Physics Olympiad in Zurich, Switzerland

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The 47th International Physics Olympiad (IPhO) was held from July 11th –17th, 2016 in Zurich, Switzerland. Due to the generosity of our sponsors, in particular one who requested anonymity, we were able to organize the Canadian Olympiad Finals in Vancouver. The students who were invited to the finals at our cost were the top scorers of the Canadian Association of Physicists (CAP) High School Exam. 846 students from 163 Canadian schools wrote the exam this year (an almost 6% increase compared to last year), and the top 15 students were invited to the National Finals in Vancouver. Only the student who placed 3rd in the CAP exam decided not to come. After 6 days of lectures, 2 theoretical exams, and 2 experimental exams, the Canadian Team for the International Physics Olympiad was selected. The National Final was organized with great help from UBC profs Mona Berciu and Bill Unruh, Canadian Physics Olympiad alumni Tout Wang, Brett Teeple, and Wilson Wu, a UBC TA Koosha Rezaiezadeh (a former IPhO gold medalist from Iran), and UBC COOP student Sophie Ebsary. The limited funding did not allow for any additional training for the full team before the trip to Switzerland, however, Dr Natalia Krasnopolskaia and Wilson Wu organized a daylong training session at UofT for the 4 students living in the Toronto area. It is worth mentioning that teams from other countries are given anywhere from 2 weeks to 2 years of additional training for this competition.

This year we were able to pay for the trip to the IPhO for all of the students but the two leaders had to pay their own way to Switzerland (about \$1700 per person). Many thanks to Run Ze Cao for committing his time and money to act as a co-leader. The Canadian Physics Olympiad (CPO) Program also paid the IPhO participation fee (3000 EU).

The members of the Canadian team this year were:

Yiqun Zhang the student of Henri Van Bemmelen from Marc Garneau C. I. grade 12

Stephen Liu the student of Bogdan Brkic from Bayview Secondary School grade 12

Noel Loo the student of David Karbushewski from Western Canada High School grade 12

Steven Mai the student of Shawn Brook from UofT Schools grade 9

Yuheng (Jack) Xu the student of Raymond Fung from Unionville High School grade 9

It was amazing to see the advanced knowledge and problem solving skills in the grade 9 students!

The team leaders were Dr. Andrzej Kotlicki (UBC), Director for the Canadian Physics Olympiad Program, and Run Ze Cao, an ex-participant of Canadian Physics Olympiad, who just graduated from the University of Pennsylvania.

This year's IPhO was hosted by the University of Zurich with its Department of Physics, Office for Education of the Principality of Liechtenstein, Association of Swiss Scientific Olympiads with its member and the Association of Swiss Physics Olympiad. The opening ceremony took place at the university and was accompanied by music from 6m long mountain horns. The closing ceremony took place at the famous Zürich Concert Hall: the Tonhalle and had amazing organ music between the speeches and the awarding of the medals.



Figure 1. The Canadian Team with medals after the Closing Ceremony. From the left: The Swiss guide Laurissa, Run Ze Cao, Yiqun Zhang, Yuheng (Jack) Xu, Noel Loo, Stephen Liu, Steven Mai, Dr Andrzej Kotlicki.

Eighty-six countries participated from all continents except Antarctica in this year's Olympiad. According to the IPhO's rules, roughly 67% of the participants were awarded Olympic medals or honorable mentions.

As usual, the competition had both theoretical and experimental parts that were meant to challenge students at a level more advanced than typical high school or even first year university physics exams. The competition consisted of 3 theoretical and 2 experimental problems which required some of the same equipment. All the problems were excellent, at a very appropriate level, and not only interesting to solve but also very educational for the students. One theoretical and one experimental problem in particular required students not only to apply known principles and do complex calculations but also to be able to analyze and figure out unknown processes.

The first theoretical problem was about the stability of a wooden cylinder with a metal disc hidden inside and about gravity in the space station. The second problem, in my view the most interesting and challenging problem, was about a linear model of a thyristor. The students were given explanations and a linear approximation of a voltage-current characteristic of this device and they had to find out how the system including such an element can oscillate or form a one shot univibrator. Only a few students completely solved this problem and it was nice to see that one of our students was included in this group. The third problem required students to analyze the principles governing the acceleration of the particle beams in Cern's Large Hadron Collider.

In experimental problem 1, students had to perform four probe resistance measurements of a silicon wafer coated with a thin chromium film and graphite coated conductive paper. They had to find out experimentally how the measured quantities related to the resistivity and determine the sheet resistivity of the material and how the size of the sample affects this relationship.

The second experiment, using some of the same equipment, required students to investigate a very clever model of a second order phase transition. This experiment can be used as a great demonstration for a high level thermodynamics course.

As usual to ensure the fairness and consistency of the marking, grading was done separately by organizers and team leaders and then moderated. Overall, marking was excellent. There were only a few minor changes resulting from the moderation for our students.

Our team did reasonably well in the competition considering the limited training. Everyone on the team received a bronze medal.



Figure 2. Our team during the mountain excursion.

In between and after the exams, the students enjoyed interesting excursions to Cern, Lichtenstein, and a local mountain (accessed by a cog railway and hiking). There was also a lot of socializing including a “midterm” party with a lot of typical Swiss competitions like mountain horn blowing, nail driving and artificial cow milking. There was even a set of enormous catapults to test the students’ ability to apply the theory of projectile motion with drag to the rubber chicken trajectory.

Next year, Indonesia will host the IPhO in Bali. Canada looks forward to participating in 2017.