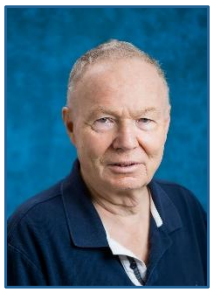
REPORT ON CANADA'S PARTICIPATION IN THE 53RD INTERNATIONAL PHYSICS OLYMPIAD IN TOKYO, JAPAN



By **ANDRZEJ KOTLICKI** (<kotlicki@phas.ubc.ca>, University of British Columbia)

The 53rd International Physics Olympiad (IPhO) took place from July 9 to July 17, 2023 in Tokyo, Japan. It was great to see the IPhO running in-person after a 3-year COVID break.

ACADEMIC PROGRAM

Japanese organizers did a fantastic job creating, analyzing and marking Olympiad problems. The Academic Committee worked perfectly with two Nobel prize winners and a large number of distinguished professors from various branches of physics who participated. The problems were very well designed not only to challenge the best high school physics students in the world but also to interest them in subjects of physics usually not taught in schools and to teach them some new skills. The International Board discussion resulted in very few significant changes to the problems.

It was amazing to realize how much support this high school competition had from leading Japanese physicists, universities and their educational authorities, as well as leading industrial companies that sponsored the event. Companies like Toshiba, Hitachi, Casio, Honda, Hamamatsu, Nikon and Toyota, just to name a few, were on the sponsor list.

The first experimental problem was loosely based on the Kibbel balance. It asked students to measure the mass of a cylindrical oscillator and the mass of additional weights by measuring the static and dynamic characteristics of the oscillating system.

The second experimental problem asked students to measure the thickness of a birefringent quartz crystal by measuring the light from the white (phosphor-based) LED propagating through the crystal at certain polarizations. The light from the LED was passed through a transmission diffraction grating, which could be rotated allowing the different wavelengths of the LED to pass through the crystal placed between 2 polarizers.

Both problems required a careful assembly of the experimental setup, making precise measurements, graphing them, calculating the results and analyzing the experimental errors. It was an excellent test of the students' experimental skills.

The first theoretical problem was related to analyzing the Brownian motion of colloidal particles, electrophoresis and coagulation of colloidal particles for the purification of water.

In the second theoretical problem students had to analyze the giant nucleus stability related to neutron stars and then to calculate the period of the pulsar (a neutron star in a binary system) including relativistic effects. They also had to analyze the gravitational waves produced by a binary system of neutron stars.

The third theoretical problem was related to phenomena arising from the interaction between water and objects due to surface tension. The merging of two droplets of water on a hydrophobic surface amazingly leads to a jump of the resulting bigger droplet. Students had to calculate the height of the jump and then analyze the general case of forces acting between the floating objects.

The problems were difficult, with a best overall score of 90.4%.

OUR TEAM

Olympiad participants representing Canada are drawn from the highest scoring students in the Canadian Association of Physicists (CAP) High School Prize Exam competition, held annually in spring across participating high schools in Canada. This national exam allows students to compete on physics problems reflecting the High School IB curriculum. This year, the CAP exam was written by 568 students from 100 schools. This number of participants was almost double the number who wrote the CAP exam last year, but we are still not up to pre-Covid numbers.

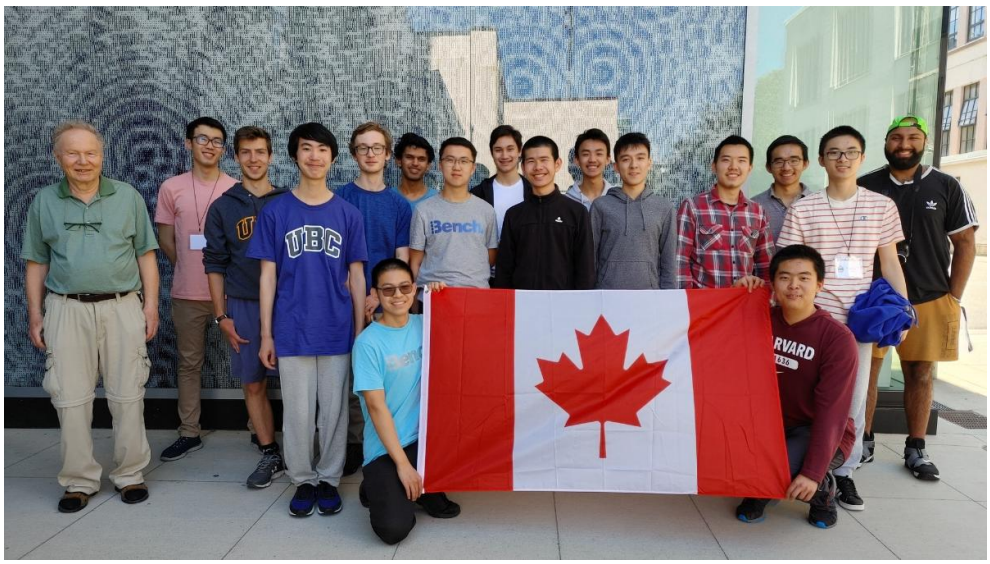


Figure 1. National Olympiad Training Camp participants. Back row from left to right: Team leader Andrzej Kotlicki, Dongli Tian, Parth Sheth, Tristan Yan-Klassen, Zander Li, Wenhe Zhang, staff Sajjan Grewal; middle row: Ryan Marshall, Vincent Millington, Qi Xuan Ding, Anthony Lu, Connor Wong, Yushan Wang; front row: Eric Shao, Tian Pu; front kneeling: Daniel Chane, Zichong Wang.

Students who have the top score nationally in this exam are personally invited to train at the National Olympiad Training camp, held on the UBC campus in Vancouver, as preparation for the selection of our national team who will compete in the IPhO World Physics finals. It is through the generosity of our sponsors that we are able to organize this 8-day Olympiad National Training Camp for the 15 top student placements from the CAP High School Exam. Over the week, participants worked, studied and tested with graduate students and faculty trainers, meeting UBC physics scientists and touring physics facilities.

It is worth mentioning that our National Training camp focused on desperately trying to fill the enormous gap between the IPhO syllabus and the scope of physics taught in Canadian schools. The lectures (covering in one hour the material usually presented in a few weeks of normal teaching) and labs introduced students to new concepts and skills. The camp tests were related to new subjects so we were not testing students' memorized knowledge but their ability to use new materials and skills to solve problems.

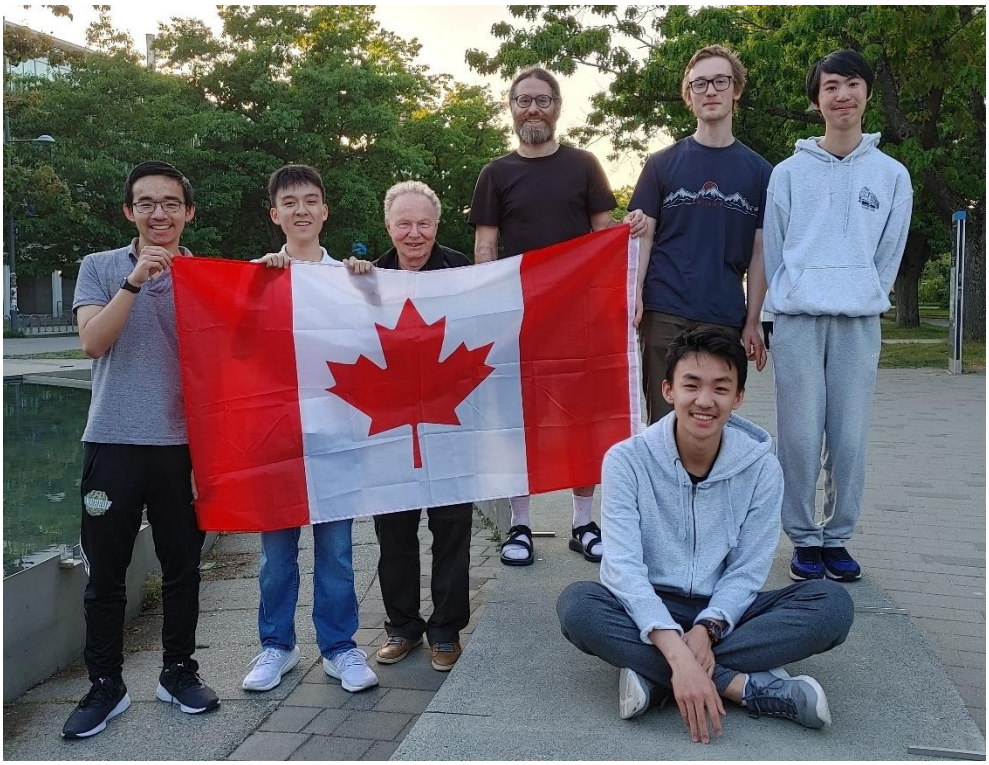


Figure 2: The members of the Canadian team. From left to right: Wenhe Zhang (Marianopolis College QC, student of Baharak Fatholahzadeh), Connor Wong (St. George's School BC, student of Nathan Moens), Team leader Dr. Andrzej Kotlicki (UBC, Director for the Canadian Physics Olympiad Program), Team leader Dr. Lior Silberman Professor of Mathematics at UBC and past IPhO contestant for the 1994 Israeli team), Vincent Millington (Cégep de Sainte-Foy QC, student of Maxime Verreault), Eric Shao (Semiahmoo Secondary School BC, student of Louay El Halabi). In front: Zander Li (Laurel Heights Secondary School ON, student of Nathan Zehr).

Over the week, our campers worked well together both in physics work and study to physics social time. We were impressed with their curiosity and determination to succeed.

At the end of the week, the top five scorers were selected as our IPhO National team.

ORGANIZATION AND RESULTS

The opening and closing ceremonies, as well as the exams, were held in the National Olympics Memorial Youth Center. At the opening ceremony, the formal speeches presented by the Japanese Minister of Education, the IPhO President, and the head of the organizing committee were welcoming and concise. The Japanize drum show and Karate demonstration were amazing.

During the time between and after the exams the participants had the pleasure of hearing two lectures by two Nobel prize winners: professors Kajita Takaaki on neutrinos and Amano Hiroshi on the discovery of blue diode. There were many excursions offered: around Tokyo, to Asakusa and Ueno, Odaiba, Hakone, Tsukuba, Nikko and Kamakura. The participants had a chance to visit some amazing temples, palaces and museums. The closing ceremony had again some short speeches and was illustrated by Koto music and a great juggling show.

86 teams participated in this year's Olympiad. There were 3 guest teams (first time participants) and one team of individual participants from Russia.

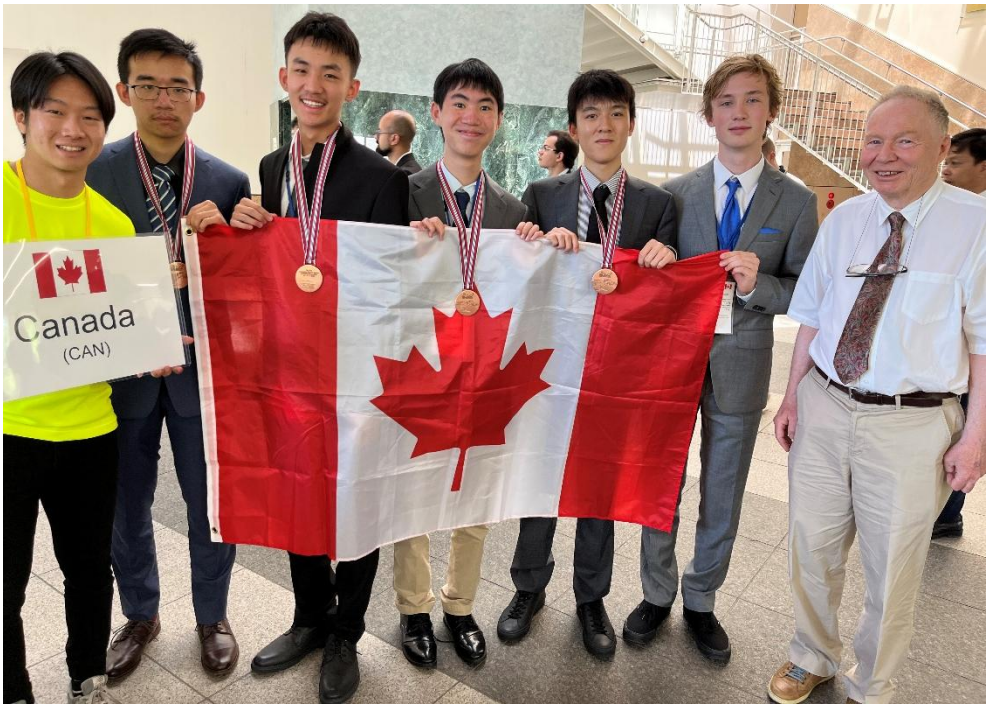


Figure 3. Our team with medals after the opening ceremony. From left: Japanese guide who took care of our team, Wenhe Zhang, Zender Li, Eric Shao, Connor Wong, Vincent Millington, and Team leader Andrzej Kotlicki.

Our students did fairly well, considering the limitations of a short training period (one intensive week as compared to countries holding multiple gold medalists, who train their teams for 1 to 2 years).

Connor Wong, Wenhe Zhang, Eric Shao and Zander Li received bronze medals and Vincent Millington honorary mention. Connor was very close to silver (received a top score amongst the bronze medalists) and Vincent was very close to bronze.

At the end of the closing ceremony the Iranian leader (in charge of the Iranian team since 1989), Professor Ahmad Shirzad, invited all participating countries to participate in the 54th International Physics Olympiad in 2024 to be held in Isfahan, Iran.

Participating in the Canadian Olympiad final camp and IPhO is a tremendous opportunity for high school students to meet others with similar skills and interests, and to build long-lasting friendships and connections with the brightest physics talents around the world.

ACKNOWLEDGEMENTS

Many thanks to our sponsors, whose support made Canadian student participation in this prestigious competition possible:

- The Department of Physics and Astronomy, UBC
- The Trottier Family Foundation
- Sonny Chan, IPhO alumnus (1998,1999) and medalist
- TRIUMF, Canada's Particle Accelerator
- The University of Toronto Schools