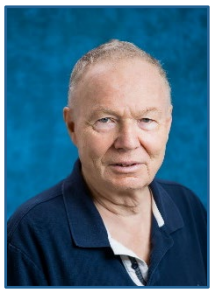
SUCCESSFUL PARTICIPATION OF CANADIAN STUDENTS IN THE 55TH INTERNATIONAL PHYSICS OLYMPIAD IN PARIS



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Our students did quite well in Paris, winning 5 medals while competing with the best physics students from 89 countries from all continents except Antarctica! It was great to participate in the International Physics Olympiad (IPhO) again after deciding against participating in the 2024 IPhO in Iran due to Canadian government travel restrictions. Fortunately, we were kindly invited to participate in the 2024 European Physics Olympics (EPhO) instead [1].

Our team was selected from among 1028 students from 146 schools participating in the 2025 CAP High School/CEGEP Prize Exam. This was almost twice as many students that participated in 2024 but still 50% below pre-COVID levels. The top 15 students were invited to the 8-day Canadian Physics Olympiad camp at the University of British Columbia. Only 14 participated as one student declined, at the last moment, due to health reasons.

This year the preparation of our students for the International Physics Olympiad was greatly improved by the amazing help of a group of our alumni led by Tristan Yan-Klassen. They organized an online camp with lectures and problem-solving sessions in April, before the in-person camp in May.

During the in-person Canadian Physics Olympiad camp we always introduce a large number of new subjects not covered in Canadian high schools, but that are part of the IPhO curriculum. Also, many schools are not equipped for teaching experimental work. Introducing these new subjects and experimental techniques before the in-person camp helped the students to master these new subjects and techniques.

Following an idea proposed by Prof. Silberman, the group also started training students not graduating from high school this year who participated in the 2025 CAP exam but were not selected for the final camp. The inaugural online Junior Physics Olympiad with lectures, theoretical and experimental examinations was held from August 3-9. Our alumni volunteers intend to continue supporting the Olympiad program by supporting the training of prospective team members and giving mentorship to talented young students.

At the end of the camp, five students with the highest scores in 2 experimental and 2 theoretical exams were chosen to represent Canada in the 55th IPhO in Paris. They were:

- He (Harry) Gong from St. George's School (BC), student of Nathan Moens
- Hongyi (Alex) Huang from Upper Canada College (ON), student of James Weekes
- Zander Li from Laurel Heights Secondary (ON), student of David Vrolyk
- Robert Yang from Walter Murray Collegiate (SK), student of Murray Guest
- Wuhua (Steven) Zhu from London International Academy (ON), student of Jeff Shen

The French IPhO organizers did a great job creating, presenting and marking Olympiad problems. The Academic Committee was composed of distinguished professors from top French universities, including the famous military École Polytechnique (founded in 1794), alma mater of many famous French scientists, politicians and military leaders. Like in Japan, 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.

There were six Nobel Prize winners on the IPhO honorary committee, two of which gave short, fascinating lectures, one during the opening and one during closing ceremonies.

All the International board meetings were hosted by École Polytechnique. One could even spot some French students in full dress uniform.

Apart from hard work during the experimental and theoretical exams the students had a chance to socialize with other participants and in many cases form new and lasting friendships. They were treated to a number of cultural events including a visit to Versailles, the Musée d'Orsay, the Science museum (Cité des sciences et de l'industrie) and a boat tour on the Seine.

EXPERIMENTAL AND THEORETICAL PROBLEMS

In the first experimental problem students were expected to measure the horizontal component of the Earth's magnetic field using a torque pendulum. The magnets, a hall sensor with an Arduino processor-based supply, amplifier and display, and a pair of coils in the anti-Helmholtz configurations were provided. Students were tasked to figure out the calibration and measurement method which would achieve the maximum accuracy of the measurement. It was interesting that, in order to ensure fair marking, the organizers had to measure the Earth's magnetic field at each of the student's booths. The magnetic field inside the building varied a lot due to the iron structures around the rooms.

The second experiment tested the students' ability to measure very accurately some surprisingly simple relations: the dependence of the size of an impact crater on the energy of the impacting ball and the dependence of the drag force acting on a ball rolling in sand on the ball's velocity.

Determining experimentally both of these dependencies required good experiment planning and execution to cover, in the first case, 5 orders of magnitude of energy by using various ball sizes and initial ball heights, and in the second case many repetitions for different ball energies. Statistical and graphic analysis of the results was essential.

The first theoretical problem reflected the methods used in analysing astronomical observations. First, students had to develop the model of hyperfine interactions in hydrogen atoms to obtain the hydrogen emission spectra. Next, they were given the original data describing the rotation curves for typical spiral galaxies and had to show that they indicated the existence of some hidden mass. Finally, students were introduced to some elements of the MOdified Newtonian Dynamics (MOND) theory and were then expected to use the given data to determine the Tully-Fischer exponent. All the calculations needed to solve this problem are available in textbooks, but not in the ones the IPhO contestants were likely to read.

The second theoretical problem was based on the design of a unique clock wound by atmospheric pressure changes. It was built in 1765 and nobody knows if and for how long it worked. The students had to analyse a simplified model of this contraption and calculate how much usable work it could provide.

The third problem was related to the famous French product, champagne. Students had to analyse the nucleation, growth and rise of the champagne bubbles, the sound of their bursting and the mechanics of extracting the champagne cork. To solve the problem, they needed knowledge of thermodynamics and acoustics as well as some mechanics. Personal experience of drinking champagne or opening the bottle was not needed. Some leaders who were strongly opposed to the idea of drinking alcohol were welcome to refer to any bubbly drink rather than champagne in their translation of the problem.

RESULTS

The problems were difficult. Figure 1 shows the distribution of points with the limits for gold, silver and

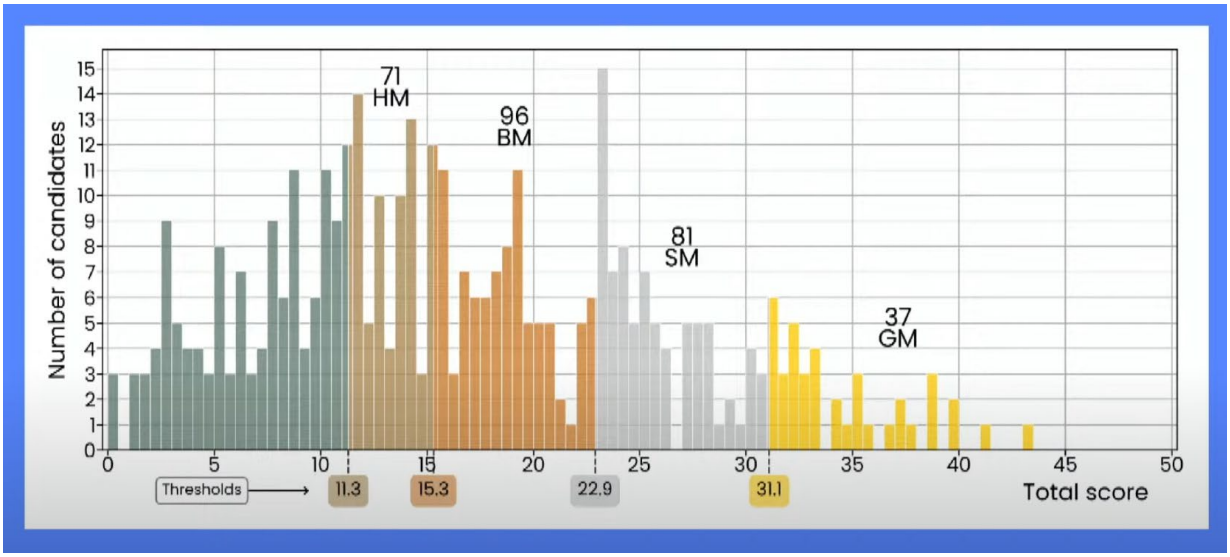

Figure 1. The distribution of the final scores showing thresholds for the different awards. Each problem was worth 10 points; 50 corresponds to 100%.

bronze medals and honorary mentions. Notice that only 2 students scored more than 80% (40 on the graph), and a large number of students scored less than 20% and some students scored 0 points. It seems that the theory clock problem was most difficult - see the points distribution for this problem in Fig. 2. Notice that almost 100 students did not receive any points for this problem!

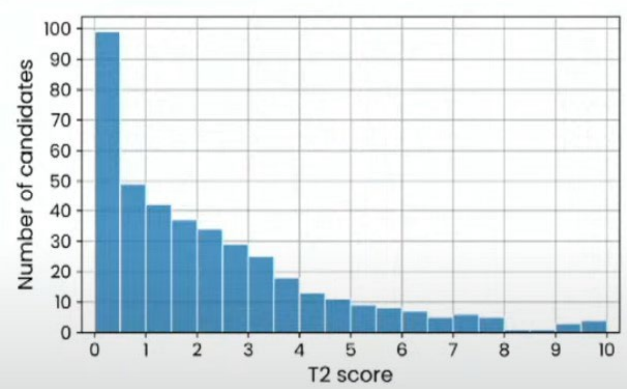

Figure 2. Grade distribution for theory problem 2.

Our students did very well, with the best results we've seen in the last few years: Zander Li, Robert Yang and Hongyi Huang received silver medals; He Gong and Wuhua Zhu earned bronze medals. Zander was very close to winning a gold medal; he received the top score amongst the silver medalists.

At the end of the closing ceremony the IPhO flag was formally transferred from France to Colombia. Colombian leader, Professor Elena Losada-Falk, invited all participating countries to participate in the 56th International Physics Olympiad in Bucaramanga, Colombia in 2026.

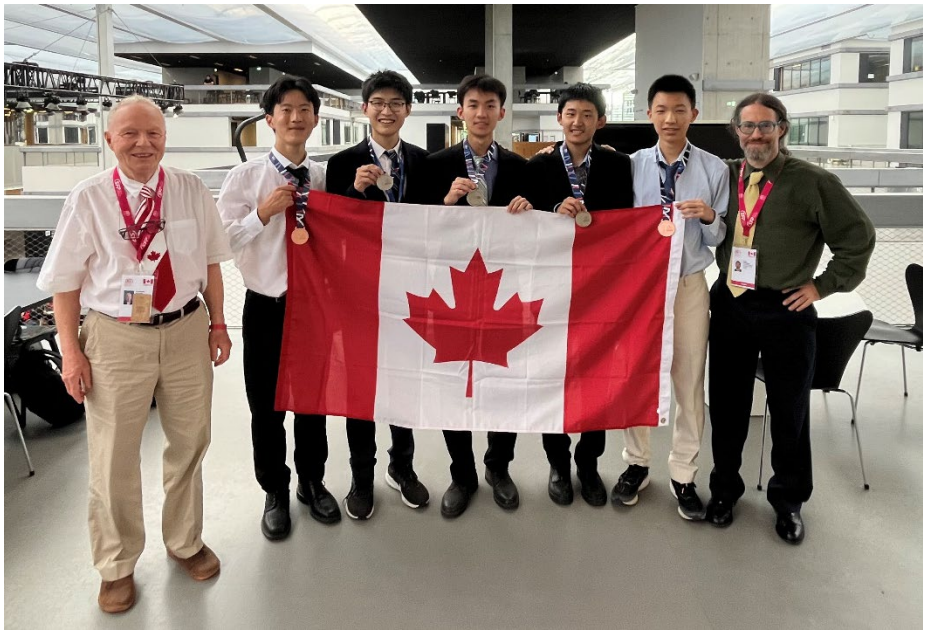

Figure 3. The members of the Canadian team with medals after the closing ceremony. From left to right: Team leader Dr. Andrzej Kotlicki (UBC), Director for the Canadian Physics Olympiad Program, He Gong, Hongyi Huang, Zander Li, Robert Yang, Wuhua Zhu, and Team leader Dr. Lior Silberman, Professor of Mathematics at UBC and past IPhO contestant (on the 1994 Israeli team).

ACKNOWLEDGEMENTS

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REFERENCES

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