

# **International Young Physicists' Tournament (IYPT)**

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## **ABSTRACT**

The paper presents the history and development of the International Young Physicists' Tournament (IYPT) during 15 years of its existence. Format of the IYPT is described in details, as it is determined by the Regulations of the IYPT. Tournament's problems are characterized with the presentation of sample problems. Features of the IYPT are presented and compared with those of the International Physics Olympiad. Organizational structure of the IYPT is also involved in the paper. Finally, procedures of selection of students and formation of national teams to the IYPT are described. The national Young Physicists' Tournament in Poland is presented as an example of a national Young Physicists' Tournament.

The International Young Physicists' Tournament (IYPT) is one of the biggest international physics competitions for secondary school (high school) students after the International Physics Olympiad. In many aspects it can be regarded as complementary to the Physics Olympiad.

1. History and development of the International Young Physicists' Tournament

Young Physicists' Tournament was founded at the Physics Faculty of Moscow State University in 1979. At the beginning it was a competition for secondary school students from Moscow region, after few years it became opened for schools from the whole Soviet Union. In 1988 the first International Young Physicists' Tournament has been organized in Moscow. Next five IYPTs, until 1993 have been also organized in Russia (before 1992 – USSR). Since 1994 IYPTs are organized every year in different country. The Netherlands (1994), Poland (1995), Georgia (1996), Czech Republic (1997), Germany (1998), Austria (1999), Hungary (2000), Finland (2001) and Ukraine (2002) hosted the IYPT till now. The IYPT 2003 is going to be organized in Sweden.

During 15 years the number of countries participating in IYPTs increased from 3 to 18, involving countries from four continents – Asia, Australia, Europe and North America. As it can be seen from Fig. 1 (the same figure presents also number of participating teams), this growth is approximately linear in time with fluctuations not exceeding  $\pm 2$ : the number  $n$  of countries participating in an IYPT with subsequent number  $s$ , follows the formula:

$$n = s + 3 (\pm 2).$$

The Table 1 presents all countries, which were represented in subsequent IYPTs either by teams or by observers over the last 10 years. Countries that hosted the IYPT are also marked there.

## 2. Description of the IYPT

According to the Regulations of the IYPT “The International Young Physicists' Tournament (IYPT) is a competition among teams of secondary school students in their ability to solve complicated scientific problems, to present solutions to these problems in a convincing form and to defend them in scientific discussions, called Physics Fights (PF).”

Pre-university students of secondary schools (which in many countries are called high schools) coming from many countries and even from various continents meet at the Tournament, compete with each other, and also learn to collaborate in an international environment.

The IYPT is carried out in one-week period determined by the Local Organizing Committee from May to July.

### ***Format of the Tournament***

The tournament itself resembles a scientific conference: solutions to the given problems are presented in reports, which are followed by questions and discussion. Seventeen problems, to be solved by participants, are chosen and formulated (by the International Organizing Committee) during a special preparatory seminar held in October of a year preceding the IYPT. The problems are published, e.g. on the World Wide Web. Students interested in participating in the IYPT can work on these problems over nearly half a year. They mostly work in teams at schools, sometimes in special clubs or seminars.

Their activity is very similar to the work of a scientist. They have first to analyse the problem, to study the topics relevant for the problem, then make a theoretical model, sometimes also computer simulations, carry out experiments (often build an experimental set-up), discuss the experimental results, compare them with theoretical predictions, and finally prepare the presentation with their results – the report.

Teams consisting of five students participate in the IYPT. Each country is represented by one team. In particular cases, which are determined in the Regulations, there may be more than one team from a country.

Each team is headed by a captain (student member) and accompanied by two adult leaders (as a rule they are school teachers or university professors).

The main element of the IYPT is scientific discussion called **Physics Fight** (PF).

Three or four teams participate in a Physics Fight, which is carried out in three (or four)

Stages. In each Stage a team plays one of the three (four) roles: Reporter, Opponent, Reviewer (Observer).

In subsequent Stages of the PF, the teams change their roles according to the schemes:

	Stage	1	2	3		Stage	1	2	3	4
Team					Team					
A	Rep	Rev	Opp		A	Rep	Obs	Rev	Opp	
B	Opp	Rep	Rev		B	Opp	Rep	Obs	Rev	
C	Rev	Opp	Rep		C	Rev	Opp	Rep	Obs	
					D	Obs	Rev	Opp	Rep	

Abbreviations:

Rep – Reporter

Opp – Opponent

Rev – Reviewer

Obs – Observer

**The Reporter** presents the essence of the solution to the problem, attracting the attention of the audience to the main physical ideas and conclusions. Standard devices for presentation specified in the Regulations are blackboard, overhead and slide projectors. However, recently digital projectors (beamers) are used more and more frequently.

**The Opponent** puts questions to the Reporter and criticizes the report, pointing to possible in-accuracies and errors in the understanding of the problem and in the presented solution. The Opponent analyses the advantages and drawbacks of both the solution and the

presentation of the Reporter. The Opponent's speech is followed by a discussion between the Reporter and the Opponent.

**The Reviewer** presents a short estimation of the presentations of Reporter and Opponent, taking into account also the discussion between them.

**The Observer** does not participate actively in the PF.

Only one member of a team takes the floor as Reporter, Opponent or Reviewer; other members of the team are allowed to make brief remarks or to help with the presentation technically. There is limitation, how many times a particular member of a team may take the floor: twice during one PF and no more than three times as Reporter during all Selective PFs.

The official representative of a team during the PF is its captain.

***The performance order in the Stage of a PF***

is determined by the Regulations as follows:

	<i>Reserved time in minutes</i>	
	English	English/Russian
The Opponent challenges the Reporter for the problem . . . . .	1	1
The Reporter accepts or rejects the challenge . . . . .	1	1
Preparation of the Reporter . . . . .	5	5
Presentation of the report . . . . .	12	12
Questions of the Opponent to the Reporter and answers of the Reporter . . . . .	2	3
Preparation of the Opponent . . . . .	3	3
The Opponent's speech, maximum 5 min. (E) or 8 min. (E/R), and discussion between the Reporter and the Opponent . . . . .	15	20
Questions of the Reviewer to the Reporter and the Opponent and answers to the questions . . . . .	2	3
Preparation of the Reviewer . . . . .	2	2
The Reviewer takes the floor . . . . .	3	5
Concluding remarks of the Reporter . . . . .	2	3
Questions of the Jury and grading . . . . .	2	2

Total time of a Stage

50 min. 60 min.

The report has to be presented in English, which is the official language of the IYPT. In the subsequent parts, particularly in a discussion, teams can choose to use Russian. In such a case, that from year to year happens more and more seldom, Russian – English translation has to be provided.

Physics Fight is conducted by a chairperson, who (like a chairperson in a conference session) looks after that the IYPT Regulations, in particular the performance schedule, are obeyed. Technical staff equipped with a computer helps the chairperson, e.g. in measuring the time of particular action according to the above schedule.

## ***Grading***

After each stage Teams (their performances) are graded by the Jury, which consists of team leaders (leaders never grade their own teams) and so called independent jury members, invited by the Local Organizing Committee from various countries. The Jury takes into account all presentations of the members of the team – both the “physical content” as well as the form of presentation – questions and answers to the questions, and participation in the discussion. Each Jury member shows integer marks from 1 to 10. Normally the Jury consists of more than six persons, in that case the highest and the lowest marks are not taken into account at calculating the score. If the Jury consists of five or six persons, only the lowest mark is withdrawn in the evaluation of the mean mark. The mean marks are multiplied by various coefficients – 3.0 (or less in special cases) for the Reporter, 2.0 for the Opponent, 1.0 for the Reviewer – and then transformed into points. A measure of success is the sum of points (*SP*) which is the sum of mean marks, multiplied by the corresponding coefficients (and rounded to one decimal).

Problems to be reported are not chosen by a Reporter itself, but challenged by the Opponent. There are strict rules concerning the rejection of challenged problems. During all Selective PFs the Reporter may reject the challenge of three different problems in total without penalty. If this maximum number of allowed rejections is exceeded, the coefficient of the Reporter (normally equal to 3.0) is for every additional rejection decreased by 0.2.

## ***Agenda of the IYPT***

There are five Selective PFs and the Final PF during the IYPT. All teams participate in five Selective PFs. They are carried out according to a special schedule, following the rule that, if possible, no team meets another team more than once.

After the Selective PFs the total sum of points (*TSP*), equal the sum of *SP* of the team in all Selective PFs, is calculated for all teams. The three teams having the highest *TSP* in the Selective PFs participate in the Final. The Final PF is similar to the Selective PF. The only

difference is that the procedure of challenge is omitted in the Final. It means that teams participating in the final choose problems to be reported by themselves.

### ***Winners***

The winner of the Final obtains the 1<sup>st</sup> place. The other two teams participating in the Final share the 2<sup>nd</sup> place. For teams not participating in the Final, the Local Organizing Committee decides, according to the *TSP* obtained, which teams will share the 3<sup>rd</sup> place (e.g. in 2002 eight teams shared the 3<sup>rd</sup> place).

### **3. Problems**

The problems are often inspired with nature or with phenomena that can be observed in everyday life. Elements of chemistry or biology are involved in many of them. A common feature of the IYPT problems is that they can be solved on various ways. Therefore discussion during the Tournament (between the Reporter and the Opponent) is usually very lively.

Sample problems selected from the last three IYPTs are presented below.

#### ***Selected problems from the 13th IYPT***

##### **Plasma**

Investigate the electrical conductivity of the flame of a candle. Examine the relevant parameters, in particular, the shape and polarity of the electrodes. *The experiments should be carried out with a voltage not exceeding 150 V.*

##### **A strange sound**



Pour hot water into a cup containing some cappuccino or chocolate powder. Stir slightly. If you then knock the bottom of the cup with a teaspoon you will hear a sound of low pitch. Study how the pitch changes when you continue knocking. Explain the phenomenon.

### ***Selected problems from the 14th IYPT***

#### **Singing saw**

Some people can play music on a handsaw. How do they get different pitches? Give a quantitative description of the phenomenon.

#### **Rubber heat machine**

Investigate the conversion of energy in the process of deformation of rubber. Construct a heat machine, which uses rubber as the working element and demonstrate how it works.

### ***Selected problems from the 15th IYPT***

#### **Spider's web**

A spider's thread looks like a string of pearls. What is the reason for this? Make experiments to investigate the relevant parameters.

#### **Flying colours**

Why do flags flutter in the wind? Investigate experimentally the airflow pattern around a flag. Describe this behaviour.

#### **4. Features of the IYPT**

IYPT is in many aspects complementary to International Physics Olympiad. Problems to be solved by participants are usually “non-academic” problems, often of interdisciplinary character, that have no one exact solution, but can be solved on various ways and on various levels. Participants have to make reasonable assumptions or define conditions for the solution by themselves.

As Tournament is a competition between teams, long-term teamwork plays an important role here. This work involves studies of literature (Internet has growing importance as a source of information), development of theoretical models, planning and performing of experiments, in some cases computer simulations, preparation of a presentation. Various tasks can be shared between team members according to individual preferences and skills.

Public presentation of the results and interpersonal discussion (e.g. at defending of own solution) are particularly relevant in the IYPT. Those elements are quite absent in the Physics Olympiad. Last, but not least: the percentage of girls among participants of the IYPT is much higher than in the case of the Physics Olympiad. Particularly high percentage of girls can be observed among captains of successful teams.

Participation in the IYPT stimulates creativity and helps to acquire competencies in physics, especially the ability to use scientific methods and tools for solving complex problems. It develops the ability to work in a team, giving also possibility to develop leadership skills (team captains). Communication skills, which are especially important for public presentation and discussion, are developed here in a high degree. Additionally, knowledge of English, which is a foreign language for majority of the participants, is strongly stimulated.

The abilities acquired in connection with the IYPT and during the IYPT are rather universal and can be advantageous for the future career and life of the IYPT participants irrespective of profession they choose.

#### Organisational structure of the IYPT

Organizational rules of the IYPT are determined in the Regulations. The Regulations are decided (and can be changed) by International Organizing Committee (IOC), composed of the representatives of participating countries.

The **International Organizing Committee (IOC)** meets twice a year: during the Preparatory Seminar (in October) and during the IYPT (in May - July). It accepts host country for the next IYPT, formulates problems for the IYPT and elects the President, the Secretary General, and two members of the Executive Committee. Two other members of the Executive Committee are Chairpersons of the Local Organizing Committee (LOC) of the last and the next IYPT.

The **Local Organizing Committee (LOC)** organizes the IYPT and the Preparatory Seminar in the year preceding the IYPT.

The **Executive Committee**, if needed, acts on behalf of the International Organizing Committee between the meetings of the IOC.

#### **Executive Committee (2002/03)**

President of the IYPT      – Gunnar Tibell (*Sweden*)

Secretary General      – Andrzej Nadolny (*Poland*)

Members elected by the IOC

Rudolf Lehn (*Germany*)

Valentin Lobyshev (*Russia*)

Chairpersons of the LOC

Valery Koleboshin (*Ukraine - IYPT 2002*)

Sven Liungfelt (*Sweden - IYPT 2003*)

## 6. Procedures of students selection and formation of national teams to the IYPT

Selection procedures of IYPT teams are different in various countries. Many of them, e.g. Austria, Czech Republic, Georgia, Poland, Russia, Slovakia, Ukraine, organize their national Young Physicists' Tournaments.

One of the biggest national Young Physicists' Tournaments is organized in Poland. This Tournament involves three stages. In the first stage teams prepare their solutions to the 10 chosen by themselves problems (from the 17 IYPT problems) and send them to one of the two Tournament centres, that are in cities Katowice and Warsaw. About 30 teams from all over the country participate usually in this stage. These are mainly school teams, sometimes several teams from one school. After evaluation of solutions each centre selects four (sometimes five) teams and invites them to the next stage – a competition following similar rules as IYPT. The best teams from both centres – four together – meet about one month later in the final competition, which is organized in the Institute of Physics, Polish Academy of Sciences in Warsaw. Contrary to previous stages, obligatory language of all presentations and discussions during the final is English. The team – winner of the final represents Poland in the IYPT and its teacher accompanies his/her team as one of the team-leaders.

In certain countries (e.g. Hungary, The Netherlands) there is selection of individual students on the basis of their solutions (papers) which are sent to the Tournament organizers. In Hungary selected students are invited to work together for 2-3 weeks at the Faculty of Physics in Budapest University. They listen to the lectures offered especially for them, make experiments and prepare their reports there.

There are also countries, like Australia, Sweden or the United States, where no national selection is made but an enthusiastic teacher acts like the promoter for a team. It is however desirable that every student from a country has the possibility (at least theoretical) to come to the IYPT team.

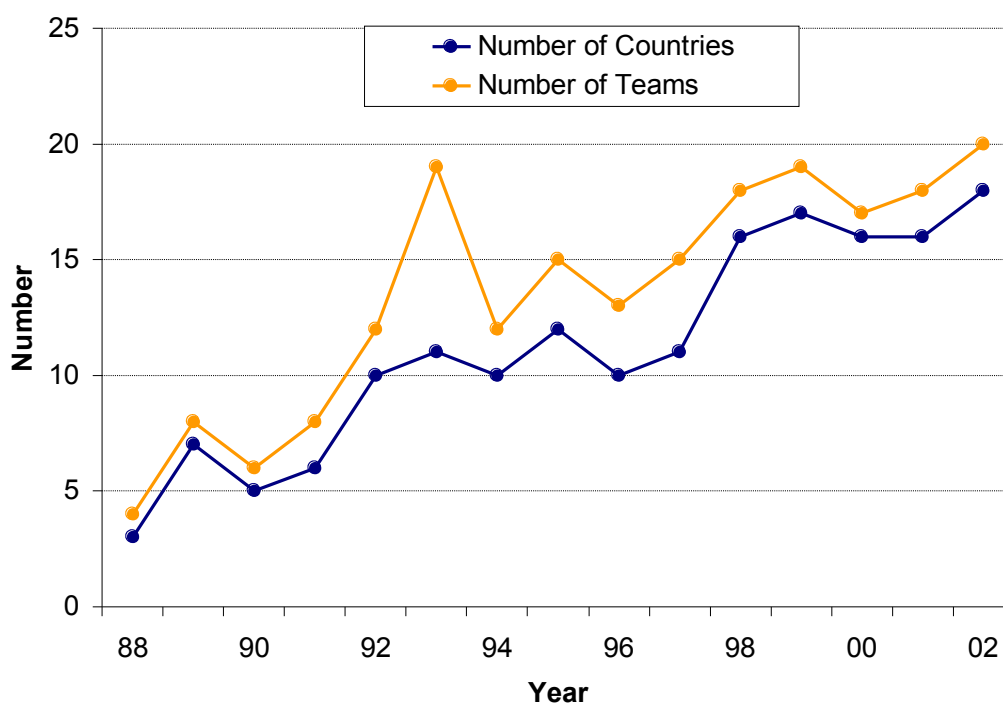


Fig. 1. Number of countries and number of teams participating in subsequent IYPTs

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Armenia	-	-	-	+	-	-	-	-	-	-
Australia	-	-	-	-	-	+	+	+	+	+
Austria	-	-	-	-	-	+	H	+	+	+
Belarus	+	+	+	+	+	+	+	+	+	+
Bulgaria	-	-	-	-	-	-	-	+	+	+
Croatia	-	-	-	-	-	-	-	-	O	+
Czech Republic	+	+	+	+	H	+	+	+	+	+
Finland	-	-	+	-	O	+	+	+	H	+
Georgia	+	+	+	H	+	+	+	+	+	+
Germany	-	-	+	+	+	H	+	+	+	+
Hungary	+	+	+	+	+	+	+	H	+	+
Republic of Korea	-	-	-	-	-	-	-	O	O	+
Moldavia	+	-	-	-	-	-	-	-	-	-
Mexico	-	-	-	-	-	+	+	+	-	+
The Netherlands	+	H	+	-	-	+	+	+	+	+
Poland	+	+	H	+	+	+	+	+	+	+
Russia	H	+	+	+	+	+	+	+	+	+
Slovakia	+	+	+	-	+	+	+	+	+	+
Sweden	-	+	O	-	+	+	+	+	+	O
Switzerland	-	-	-	-	O	-	-	O	O	+
USA	-	-	-	-	-	-	+	-	+	O
Ukraine	+	+	+	+	+	+	+	+	+	H
Uzbekistan	+	+	+	+	+	+	+	-	-	-

Table 1. Countries participating in IYPTs: H host country, + participating team, O observer