



INTERNATIONAL YOUNG PHYSICISTS' TOURNAMENT

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Introduction

- Competition in physics for secondary school students
- Teams work on problems, discuss results in “Physics Fights”
- “Reporter”, “Opponent”, “Reviewer”
- Performance graded by int’l jurors
- Annual since 1988, own IOC and EC, seated with Eur. Phys. Soc.
- Not only a contest: a global platform for physics promotion





IYPT



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Concept



- Students are involved into a “simulation of real research”
- Experiments, theoretical description
- Many months of work into a 12 min presentation



Problems at the IYPT

- Experimental
- “No known answer”, intentionally left open-ended
- Research-oriented, no examination
- 17 problems each year (425 problems since 1988)
- Known to participants a year ahead
- **2. Cutting the air (2012)**
When a piece of thread (e.g., nylon) is whirled around with a small mass attached to its free end, a distinct noise is emitted. Study the origin of this noise and the relevant parameters.
- **4. Fluid bridge (2012)**
If a high voltage is applied to a fluid (e.g. deionized water) in two beakers, which are in contact, a fluid bridge may be formed. Investigate the phenomenon.



Problems at the IYPT

- “It is nonsense to search a solution if it does not exist”
- “No: it’s nonsense to search it, when it already exists”
- No known path for what to do
- No textbook solutions
- Topic for an independent research project
- A special role for the supervising teacher





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Exemplary problems for 2012



Magnetic Gaussian cannon



Quételet's rings on the glass



Fluid dynamics in a Hele-Shaw cell



Capillary-driven Cheerios effect



Ascent dynamics of Taylor bubbles



Dynamics of Newton's Beads



Formation of a granular jet



Interplay of impact and friction in a wooden toy



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Its is a bit difficult at first



Adhesive tape car



3-meter row of dominoes

- Feedback from Martin Malinowski (team member, IYPT 2011)

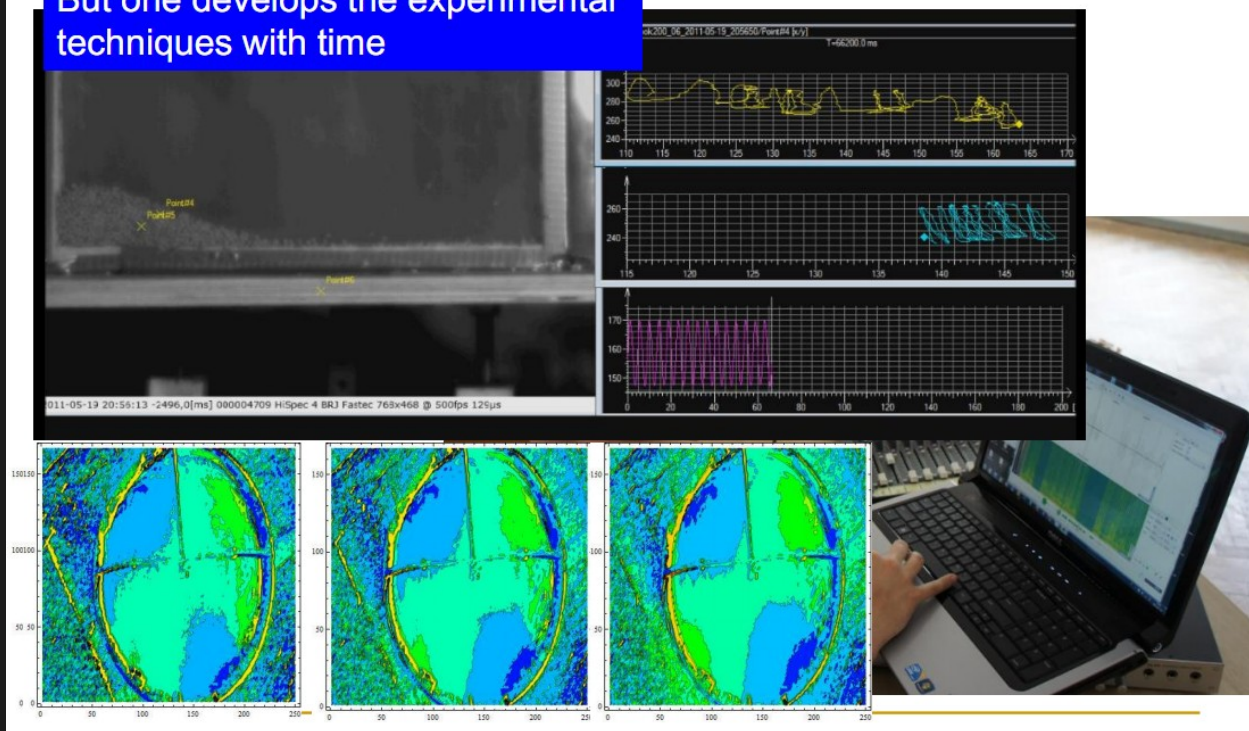


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But one develops the experimental techniques with time



- Feedback from Martin Malinowski (team member, IYPT 2011)

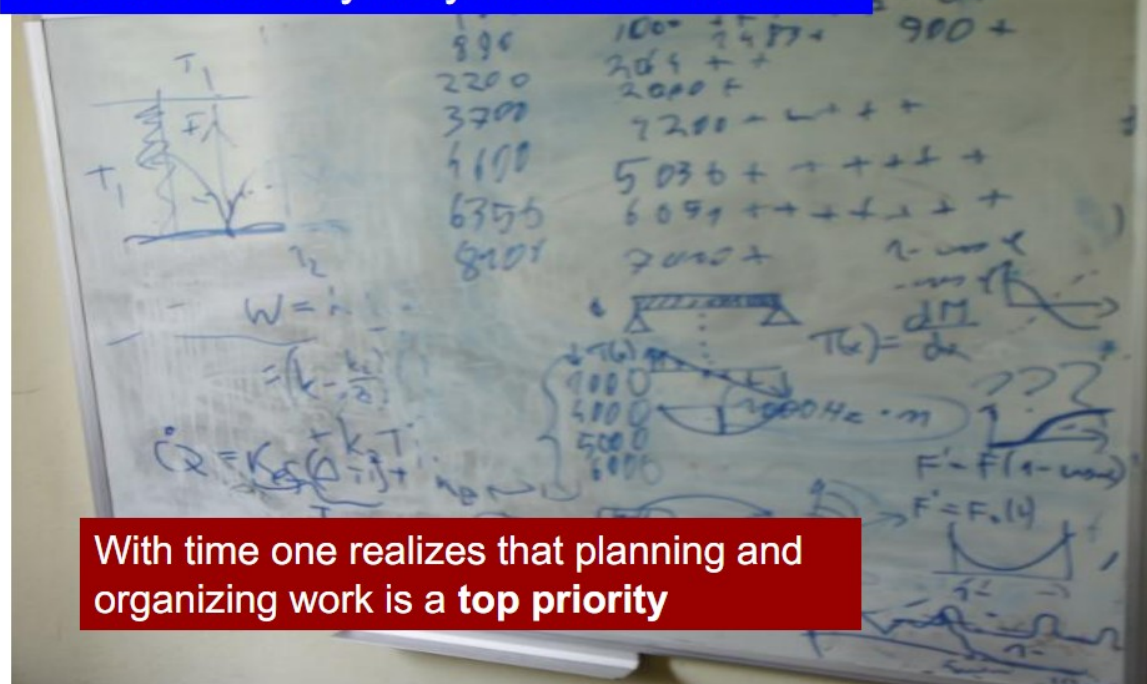


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There is actually very little time for work



With time one realizes that planning and organizing work is a **top priority**

- Feedback from Martin Malinowski (team member, IYPT 2011)

Good results via home made tools



Professional rheometer

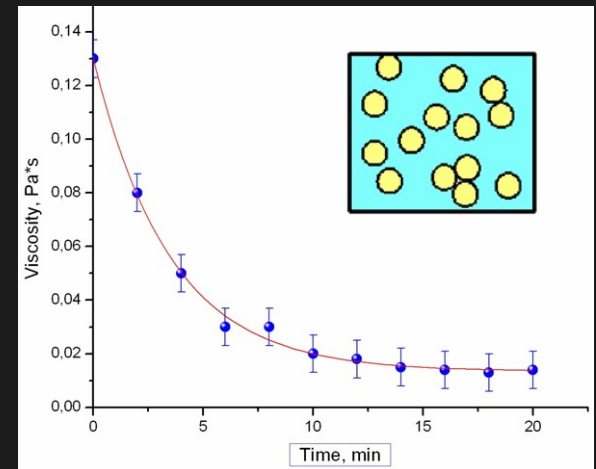


$$(I - I_0)U = k\omega^2$$

$$k \propto \eta$$

$$\eta = \frac{\omega_w^2 \eta_w (I - I_0)}{\omega^2 (I_w - I_0)}$$

$$\eta = \eta_0 \left(1 + \frac{5}{2} \Omega\right)$$



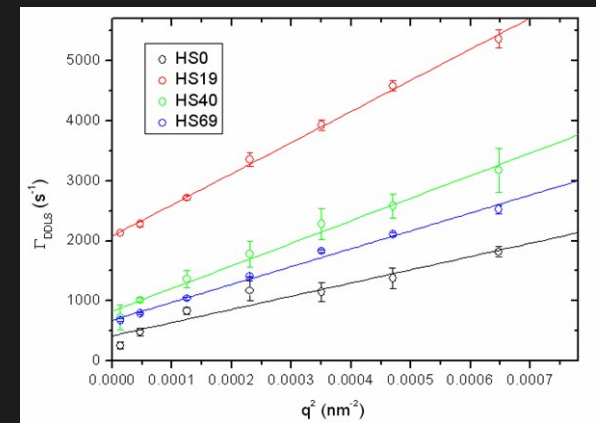
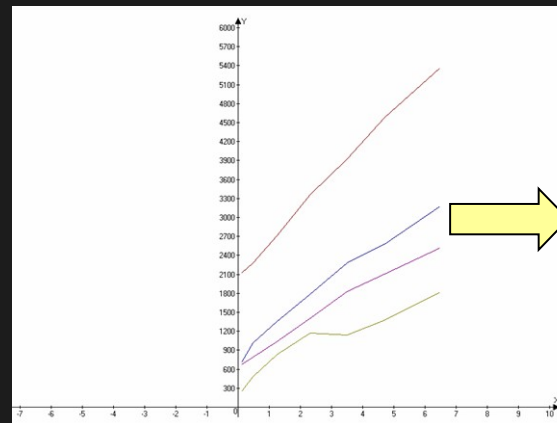
- IYPT: minimalist home-made rheometer

- η : sample viscosity
- η_0 : water viscosity
- Ω : volume fraction of particles

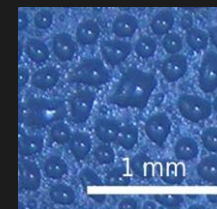
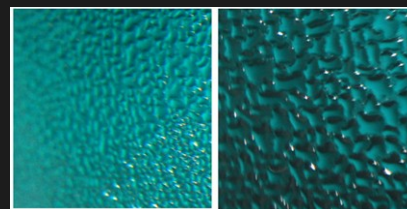
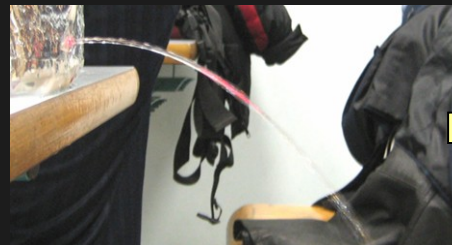


Relevant skills through practice

Plotting the data



Visualizing results





What skills are developed

- Solid knowledge in basic physics
- Collecting and analyzing experimental data
- Team work
- Making and defending a presentation
- Soft skills: holding a discussion, deadlines

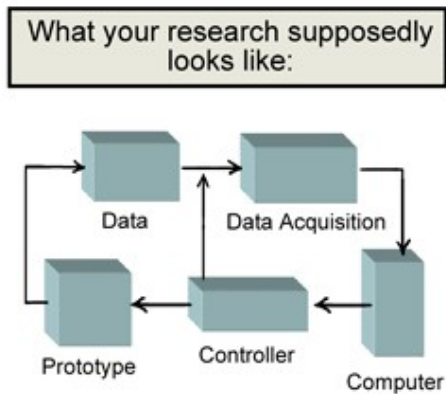


Figure 1. Experimental Diagram

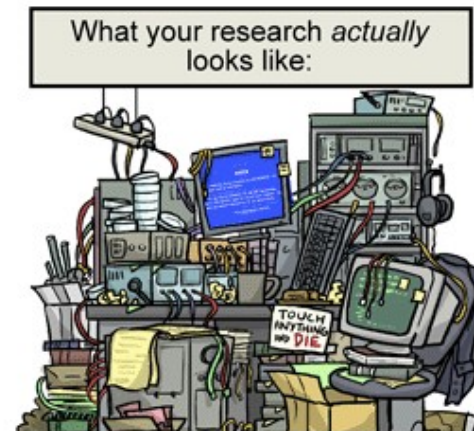


Figure 2. Experimental Mess



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What skills are developed

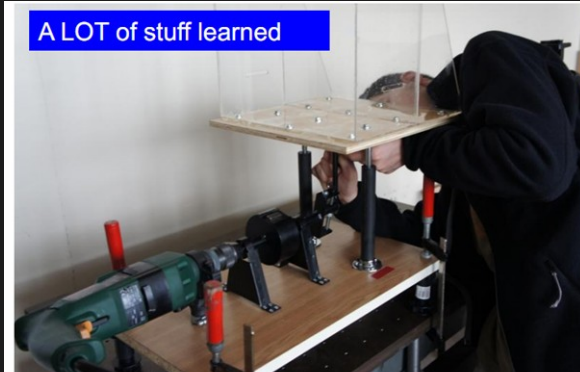
Further aspects

- Tactical thinking
- Visiting other countries
- Getting to know people from all over the world
- Opportunity to talk to experts in science
- Being proud of representing one's country

→ IYPT experiences are very useful!

■ Georg Hofferek

A LOT of stuff learned



- Ways of doing research
- General physics knowledge
- Finding literature
- Manual skills
- Electronics
- Computer programming
- Maths
- Presentation skills
- English language
- Patience
- ...

And a feeling of well-done job!

■ Maciej Malinowski

The Navier-Stokes equation in cylindrical coordinates

$$\left\{ \begin{array}{l} u \frac{\partial u}{\partial r} + w \frac{\partial u}{\partial z} = -\frac{1}{\rho} \frac{\partial p}{\partial r} + \nu \left(\frac{\partial^2 u}{\partial r^2} + \frac{1}{r} \frac{\partial u}{\partial r} - \frac{u}{r^2} + \frac{\partial^2 u}{\partial z^2} \right) \\ u \frac{\partial w}{\partial r} + w \frac{\partial w}{\partial z} = -\frac{1}{\rho} \frac{\partial p}{\partial z} - g + \nu \left(\frac{\partial^2 w}{\partial r^2} + \frac{1}{r} \frac{\partial w}{\partial r} + \frac{\partial^2 w}{\partial z^2} \right) \\ r \int_0^{h(r)} u(r, z) dz = q \quad \text{- integrated continuity equation} \end{array} \right.$$

$$u = v_r$$

$$w = v_z$$

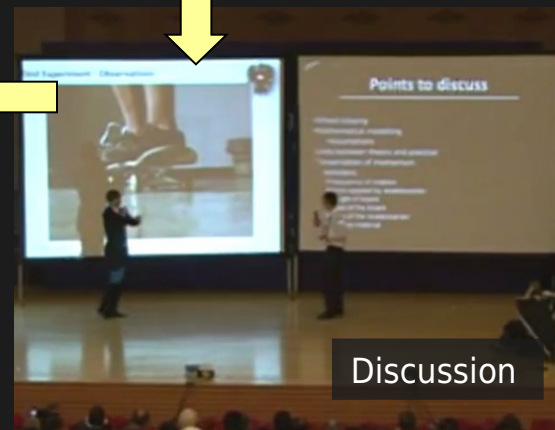
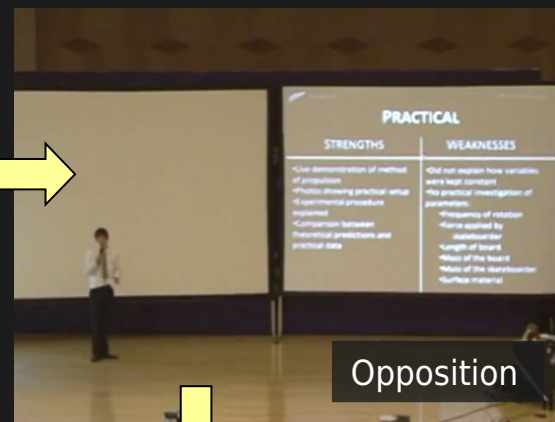
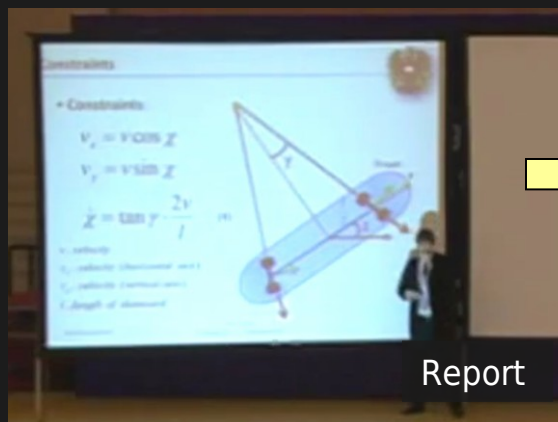
White Light and its Properties

- White light consist of three primary colours **Red**, **Blue** and **Green**.
- The seven principal colours that make up the visible spectrum are Red, Orange, Yellow, Green, Blue, Indigo and Violet.
- On one end of the scale Red light has the longest wavelength hence the lowest frequency and on the other end Violet has the shortest wavelength but the highest frequency.

“Physics Fight”

Three teams PF

Stage	1	2	3
Team			
1	Rep	Rev	Opp
2	Opp	Rep	Rev
3	Rev	Opp	Rep



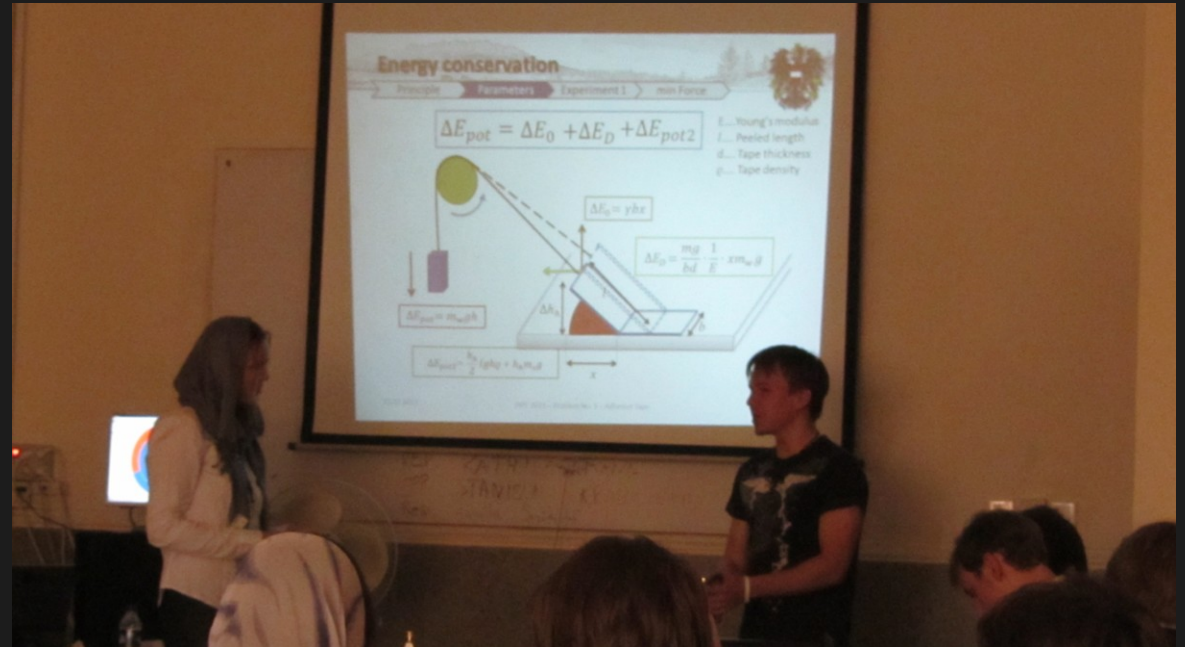
“Physics Fight”





Opponent

$$\sqrt{\frac{b}{g}} \sqrt{bg}$$



- Critical feedback to the presentation



Reviewer

- Evaluation of the discussion
- Not like a little Opponent but like a little jury
- Reviewer has no influence on challenge-rejection-procedure so the review cannot be prepared in advance

- Georg Hofferek



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IYPT problems as a source of ideas

- Gymnasiets projektarbete
- Science fairs, demonstrations
- Int'l Conf. Young Scientists, Jugend Forscht, ...

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Gorazd Planinsic 2009 *Eur. J. Phys.* **30** S133 doi:10.1088/0143-0807/30/6/S04

IYPT problems as an efficient source of ideas for first-year project laboratory tasks

FEATURED ARTICLE

Gorazd Planinsic
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Abstract **References** **Cited By**

In the project laboratory, a group of students are given a well-defined task but the path to the solution is entirely left to the students. The paper reports on some basic strategies in designing successful project tasks that are based on modified problems from International Young Physicists Tournament (IYPT). In addition, an integration of first-year project laboratory in in-service teacher training is also briefly presented.



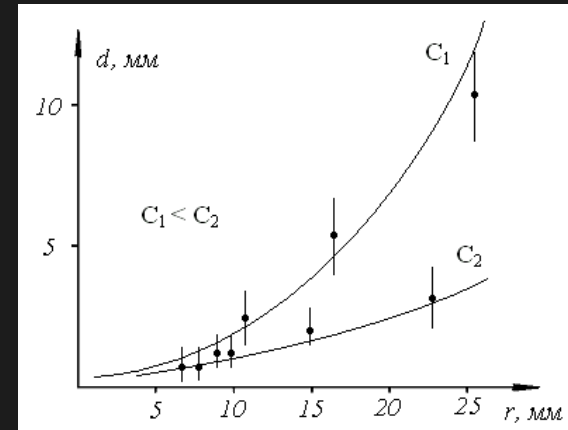
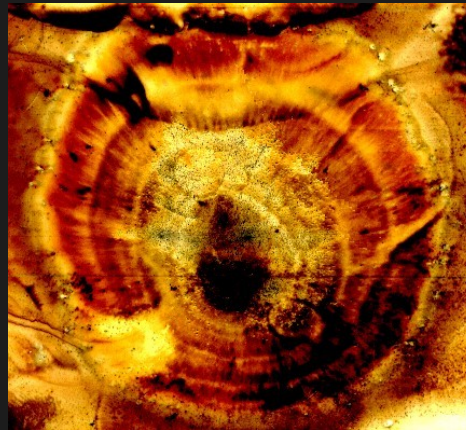
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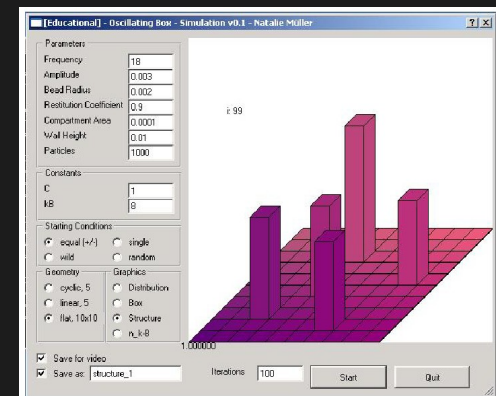
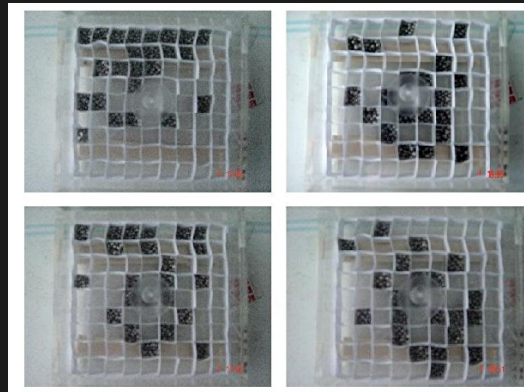
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Gymnasiets projektarbete

I. M.
No. 12 "Reaction"
14th IYPT (2001)



Natalie Müller
No. 7 "Oscillating box"
16th IYPT (2003)





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Official webpage

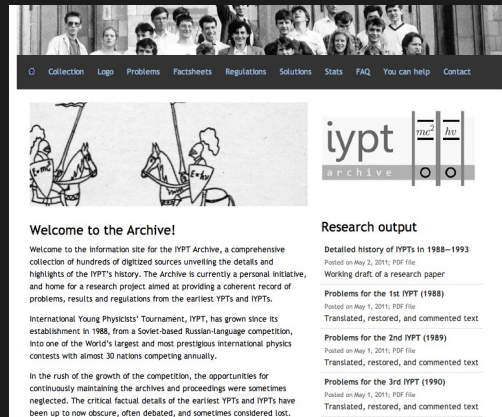
- Problems
- Regulations
- Official documents
- Contacts
- FAQ



<http://iypt.org>



IYPT Archive

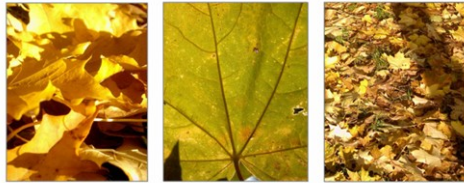


<http://archive.iypt.org>

- A collection of historical problems
- Solutions, ideas, expertise
- 550+ exemplary presentations (slides and videos)
- Bibliography in physics education, research focused on the IYPT
- Good for future participants: culture of citations, critical learning, “what those people have done”
- When, what, who, where

Reference kit

- Supporting reading material
- Bibliography on the phenomena related to the problems
- Practical tips and hints



Preparation to the Young Physicists' Tournaments' 2007 *

Ilya Martchenko, POISK Centre

* revised, updated, and translated from the Russian

<http://kit.ilyam.org>

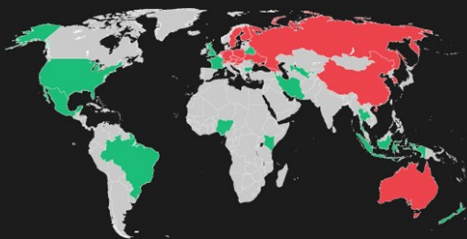
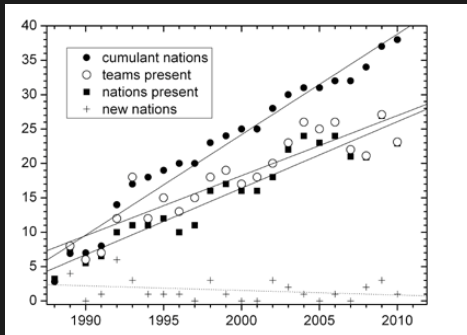


Getting work published

- Peer review by the editorial board
- IYPT Magazine: submissions from any student
- Proceedings of the IYPTs
- Professional journals



Attracting new teams

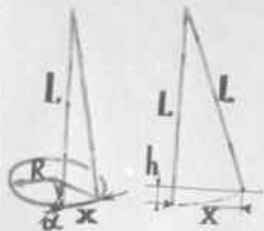


- Lars Gislén: Sweden first participated at the 7th IYPT (1994)
- Inflow of new nations is small
- Please: spread a word if you know interested people in Denmark, Norway

A national network around the IYPT?



- ca. 6 Austrian + **ca. 6 foreign teams**
 - all 17 IYPT problems
 - English language
 - regulations as at the IYPT
 - a formal association
 - fund raising is not easy, but well implemented
- ca. 15 Belarusian teams
 - **12 out of 17 IYPT problems**
 - Russian/Belarusian language
 - regulations as at the IYPT
 - group of enthusiasts, patronage from Ministry of Education
 - no centralized fund raising
- **German YPT yet in plans**
 - special center oversees preparatory work
 - enrolls teachers, advisors
 - fund raising from companies, foundations
 - patronage by German Phys. Soc.



$$h \approx \frac{d^2 R^2}{2L}$$

$$(x \ll L)$$

M - масса
платформы

m - груза

$$\frac{(M+m)h^2}{2} + (M+m)gh + \frac{I\omega^2}{2} = \text{const}$$



$$\dot{\alpha} = -\beta \dot{z}$$

$$\beta = \sqrt{\frac{M+m}{IL}}$$

$$\beta = \sqrt{\frac{1-m/L}{M/L}}$$

$$\frac{\partial}{\partial z} \left(\frac{1}{2} \frac{\partial}{\partial z} \left(\frac{\partial y}{\partial z} \right) \right) = \frac{\partial}{\partial z} \left(\frac{\partial y}{\partial z} \right) = \frac{\partial}{\partial z} \left(\frac{\partial y}{\partial z} \right)$$

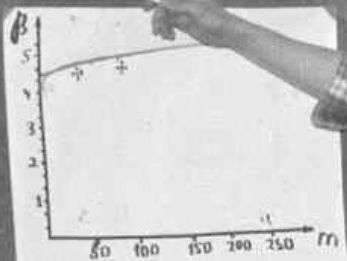
$$\frac{\partial \omega}{\partial t} = \frac{\partial^2 \omega}{\partial z^2} \quad \omega = \alpha \beta \sin$$

$$M = -\frac{1}{2} \pi R^2 \rho \sqrt{2g} \alpha_0 (\sin \phi \cos \phi)$$

$$M = \frac{1}{2} \pi R^2 \rho \frac{d\omega}{dt} \bigg|_{z=0} \quad \frac{dL}{dt} = -M\omega$$

$$L = M \cdot m \cdot g \frac{d^2 R^2}{2L} \quad \frac{dL}{dt} = -KE$$

$$K = \frac{\pi R^2}{L} \sqrt{\frac{g}{2L}} \sqrt{\frac{M+m}{L}} g, d > 1 \text{ mm}$$





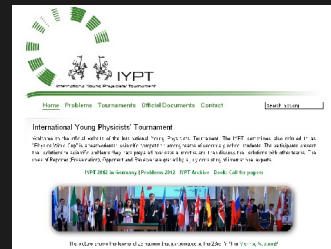
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Summary

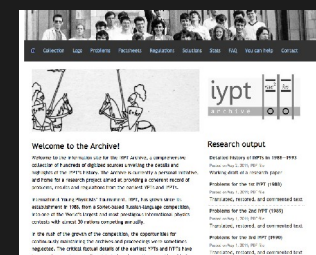
- IYPT is a (very) good tool to promote physics
- Helpful even if a student does not join a team
- Unusual problems, know-how, expertise
- Proven educational value, impact on future careers
- Spreading out the YPT to more schools (and more countries)



<http://iypt.org>



<http://iypt.de>



<http://archive.iypt.org>



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Acknowledgement

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