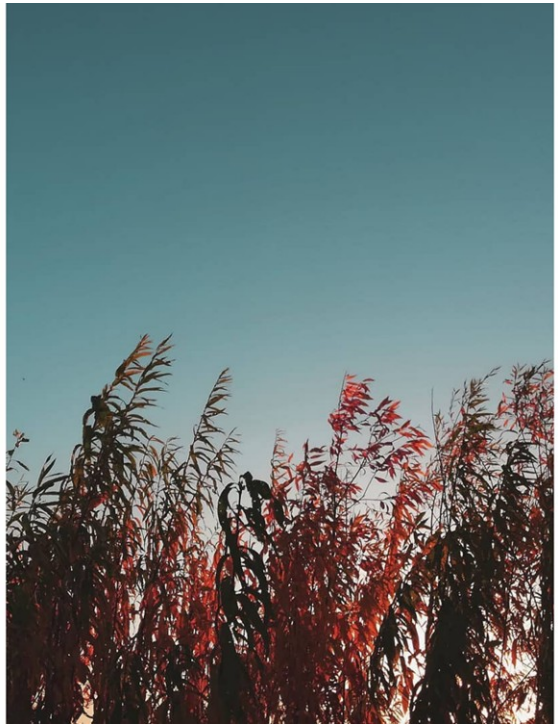
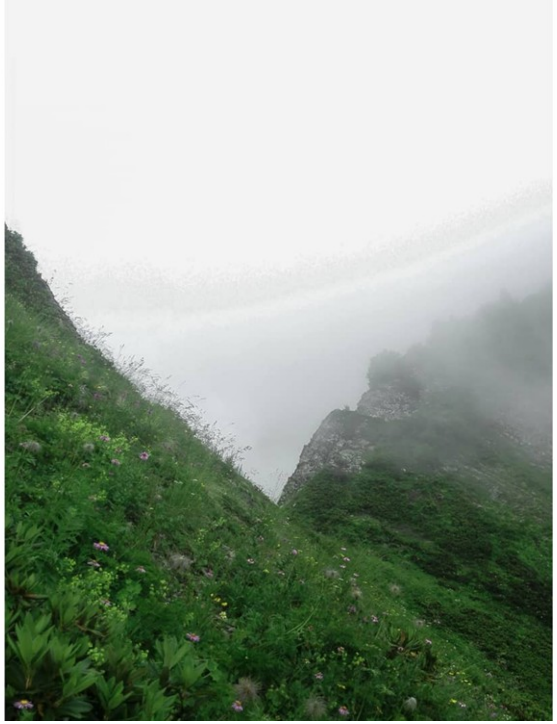




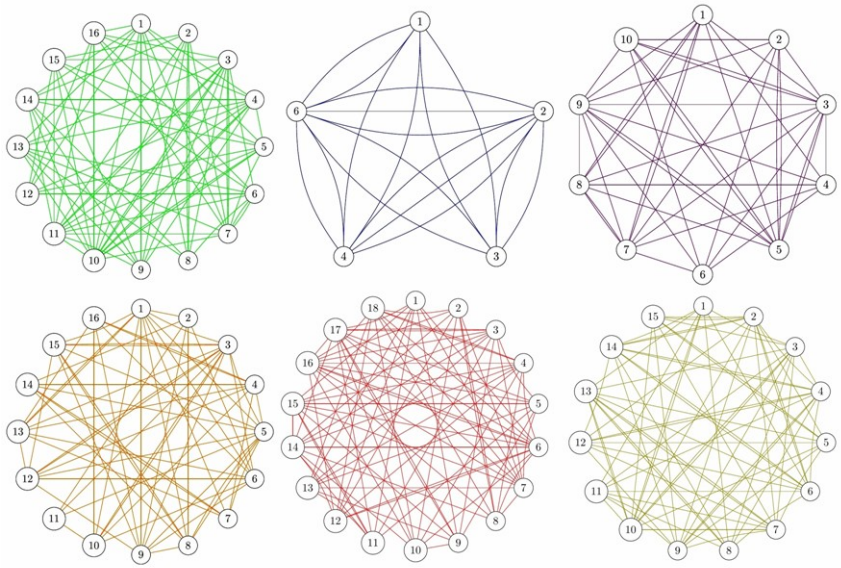
Preparation to the Young Physicists' Tournaments' 2019

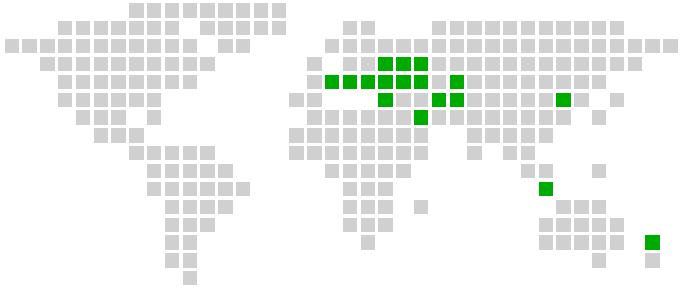
Ilya Martchenko,[1]* Hossein Salari,[2] Łukasz Gładczuk,[3] and Klim Sladkov[4]

[1] Foundation for Youth Tournaments; [2] Institute for Research in Fundamental Sciences; [3] University of Oxford; [4] Moscow State University

Welcome to the 7th IYNT 2019 in Minsk

- The International Young Naturalists' Tournament, IYNT, is a whole new competition with breathtaking problems, state-of-the-art grading standards, and an impressive momentum
- The IYNT bridges gaps between natural sciences and is focused on participants aged 12 through 16
- The IYNT has so far attracted 80 teams from 17 different countries from Switzerland in the West to China in the East and from Russia in the North to New Zealand in the South; has given 8157 grades in 375 stages; and has awarded 48 medals
- Do not hesitate and pre-register today





http://iynt.org

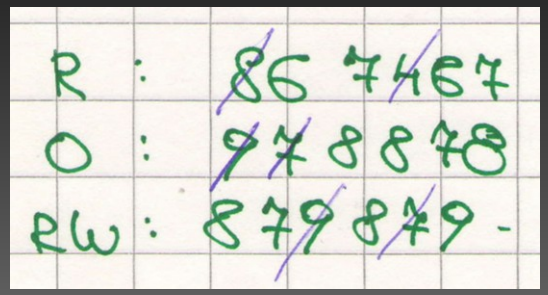
Call for cooperation

- If you are interested in the idea behind the Kit — to structure the existing knowledge about the physics behind the problems and to encourage students to contrast their personal contribution from the existing knowledge — your cooperation is welcome
- If more contributors join the work and plan bringing together the Kit for 2020, good editions may be completed earlier
- It would be of benefit for everybody,
  - students and team leaders, who would have an early reference (providing a first impetus to the work) and a strong warning that IYPT is all about appropriate, novel research, and not about “re-inventing the wheel”
  - jurors, who would have a brief, informal supporting material, possibly making them more skeptical and objective about the presentations
  - the audience outside the IYPT, who benefits from the structured references in e.g. physics popularization activities and physics teaching
  - the IYPT, as a community and a center of competence, that generates vibrant, state-of-the-art research problems, widely used in other activities and at other events
  - and also the author (-s) of the Kit, who could rapidly acquire a competence for the future activities and have a great learning experience

Is the novel research limited and discouraged by the existing common knowledge and the ongoing work of competing groups? :-)

In search for missing results

- Have you attended an IYPT marked in **red** and preserved Physics Fight results, e.g. by keeping printed rankings?
- Have you attended an IYPT marked in **orange** or **red**, and recorded grades from a Fight, e.g. by writing them down?



Thank you for helping us locate the missing results of past IYPTs

Green: each and every Juror's grade has been preserved
Orange: all Sums of Points (SP) are known, however Juror's grades are not
Red: some Sums of Points (SP) are missing

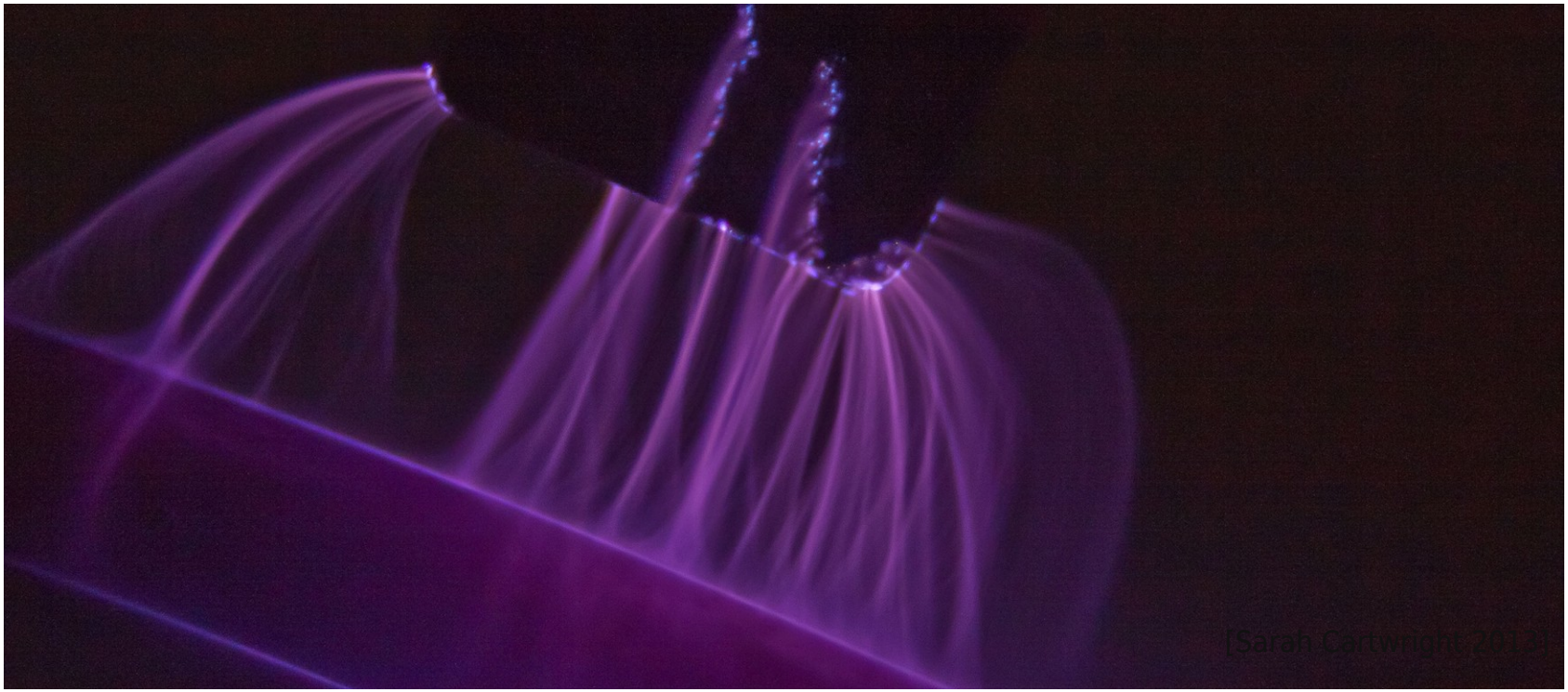
								1988	1989
1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2010	2011	2012	2013	2014	2015	2016	2017	2018	

iypt archive

How to tackle the IYPT problems?

- How to structure a report?
- What level is competitive?
- How to set the goals, fix the priorities, and set the direction of the work?
- How were people resolving particular issues in the past?

- Look through the historical solutions in the Archive
  - an opportunity for goal-oriented critical learning
  - examples, not guidelines
  - those solutions were good, but yours should be better!



Problem No. 1 “Invent yourself”

Build a simple motor whose propulsion is based on corona discharge. Investigate how the rotor's motion depends on relevant parameters and optimize your design for maximum speed at a fixed input voltage.

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- Electrostatic Motor (youtube, Ludic Science, Jun 12, 2015), https://youtu.be/WkmH2ECctzw
- Clear Disk Electrostatic Motor (youtube, Lidmotor, May 24, 2015), https://youtu.be/Hfj50Jixt0A
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- Corona and Arc Discharge (youtube, PHYSIERGE, Jan 4, 2015), https://youtu.be/2pLJ2ZX4By4

Background reading

- How to Make Corona Motor (v2) aka Electrostatic Motor/Atmospheric Motor (youtube, RimstarOrg, Aug 8, 2014), https://youtu.be/9uEjXsX1F14
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Problem No. 2 “Aerosol”

When water flows through a small aperture, an aerosol may be formed. Investigate the parameters that determine whether an aerosol is formed rather than a jet for example. What are the properties of the aerosol?

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- IYPT 2019 Problem 2 Aerosol Demonstration (youtube, Canadian Young Physicists' Tournament, Dec 14, 2018), https://youtu.be/MEhP5PnlZbo
- How to Make Simple Air Paint Spray Gun - Homemade (youtube, Creative Life, Oct 15, 2017), https://youtu.be/buLrAZBPETI
- Aerosol modelling - 1 (Nicolas Bellouin) (youtube, Atmosphere Copernicus, Sep 20, 2013), https://youtu.be/Y0CWLDcaRAM
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Problem No. 3 “Undertone sound”

Allow a tuning fork or another simple oscillator to vibrate against a sheet of paper with a weak contact between them. The frequency of the resulting sound can have a lower frequency than the tuning fork’s fundamental frequency. Investigate this phenomenon.

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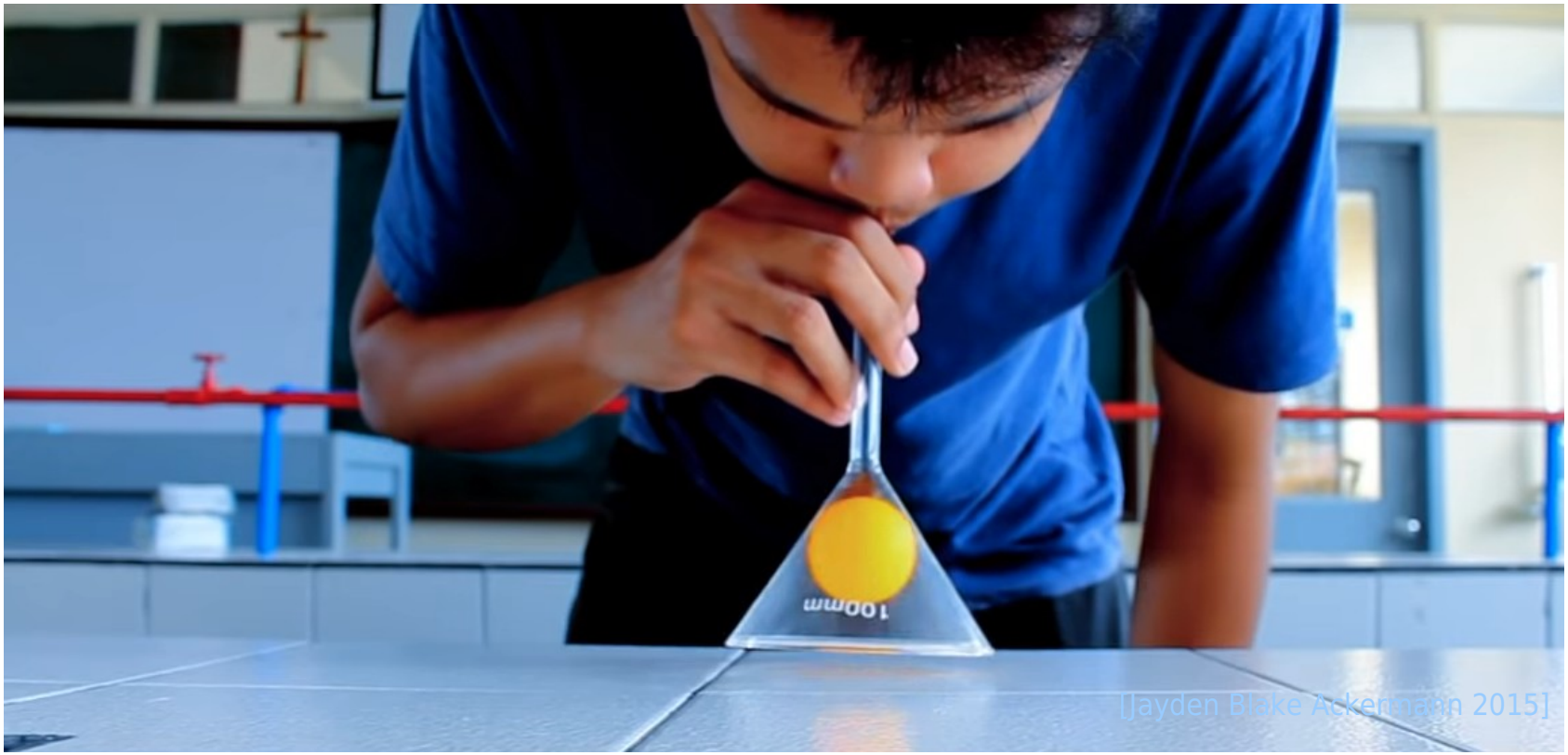

[Jayden Blake Ackermann 2015]

Problem No. 4 “Funnel and ball”

A light ball (e.g. ping-pong ball) can be picked up with a funnel by blowing air through it. Explain the phenomenon and investigate the relevant parameters.

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Problem No. 5 “Filling up a bottle”

When a vertical water jet enters a bottle, sound may be produced, and, as the bottle is filled up, the properties of the sound may change. Investigate how relevant parameters of the system such as speed and dimensions of the jet, size and shape of the bottle or water temperature affect the sound.

Background reading

- C. Velasco, R. Jones, S. King, and C. Spence. The sound of temperature: What information do pouring sounds convey concerning the temperature of a beverage. J. Sens. Studies 28, 5, 335-345 (2013)
- I. Lupea. Considerations on the Helmholtz resonator simulation and experiment. Proc. Romanian Acad. A 13, 2, 118-124 (2012), https://academiaromana.ro/sectii2002/proceedings/doc2012-2/05-Lupea.pdf
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- You Can Hear The Difference Between Hot and Cold Water (youtube, Tom Scott, Mar 6, 2017), https://youtu.be/Ri_4dDvcZeM
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- Filling a container with water: Listen! (youtube, Jeff Regester, May 19, 2010), https://youtu.be/83HLFKfof58
- Wikipedia: Helmholtz resonance, https://en.wikipedia.org/wiki/Helmholtz_resonance
- Wikipedia: Minnaert resonance, https://en.wikipedia.org/wiki/Minnaert_resonance
- Wikipedia: Acoustic resonance, https://en.wikipedia.org/wiki/Acoustic_resonance

Problem No. 6 “Hurricane balls”

Two steel balls that are joined together can be spun at incredibly high frequency by first spinning them by hand and then blowing on them through a tube, e.g. a drinking straw. Explain and investigate this phenomenon.

Background reading

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- W. L. Andersen. Corrigendum: The dynamics of hurricane balls (2015 Eur. J. Phys. 36 055013) Eur. J. Phys. 37, 2, 029501 (2016)
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[Thomas Quine 2014]

Problem No. 7 “Loud voices”

A simple cone-shaped or horn-shaped object can be used to optimise the transfer of the human voice to a remote listener. Investigate how the resulting acoustic output depends on relevant parameters such as the shape, size, and material of the cone.

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Problem No. 8 “Sci-Fi sound”

Tapping a helical spring can make a sound like a “laser shot” in a science-fiction movie. Investigate and explain this phenomenon.

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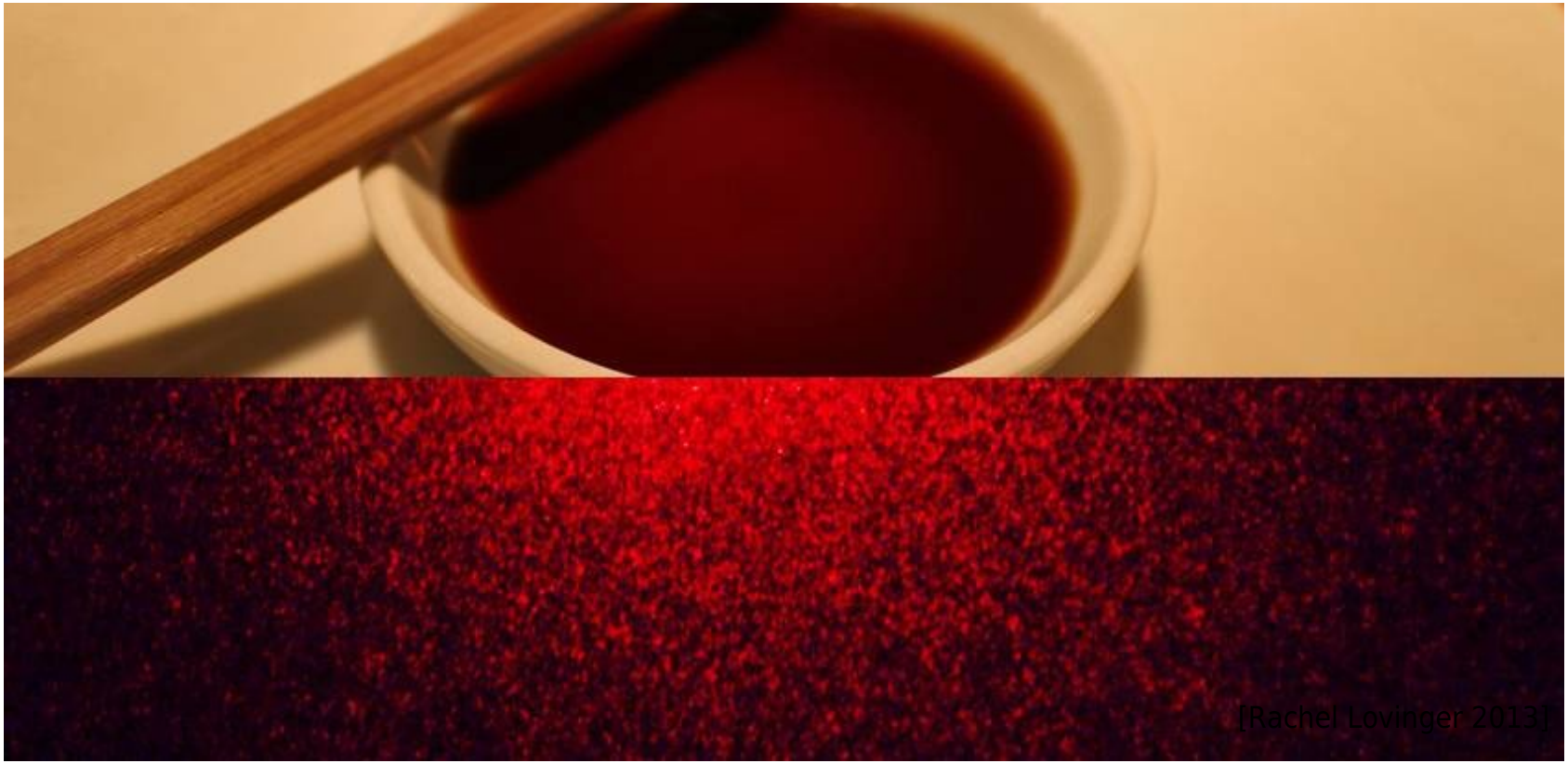

Problem No. 9 “Soy sauce optics”

Using a laser beam passing through a thin layer (about 200 µm) of soy sauce the thermal lens effect can be observed. Investigate this phenomenon.

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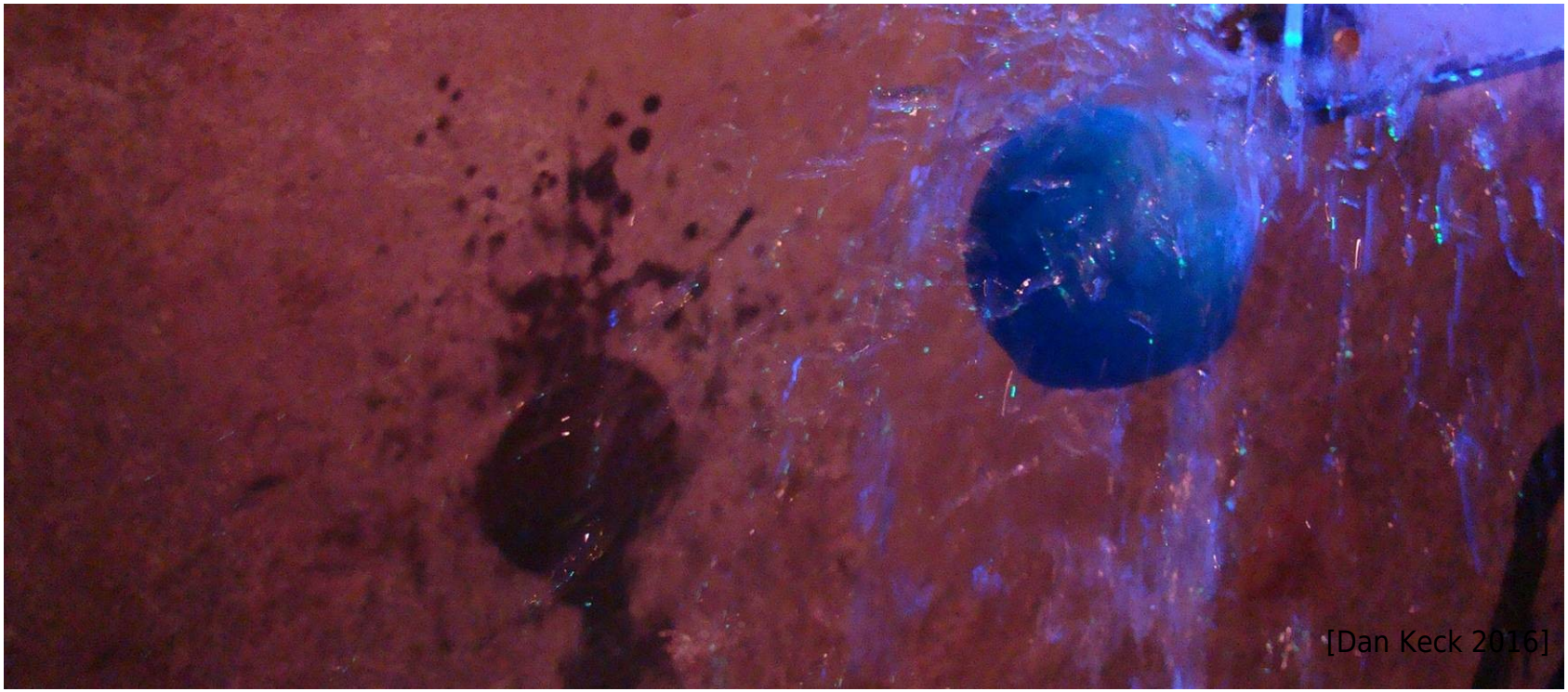

Problem No. 10 “Suspended water wheel”

Carefully place a light object, such as a Styrofoam disk, near the edge of a water jet aiming upwards. Under certain conditions, the object will start to spin while being suspended. Investigate this phenomenon and its stability to external perturbations.

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Problem No. 11 “Flat self-assembly”

Put a number of identical hard regular-shaped particles in a flat layer on top of a vibrating plate. Depending on the number of particles per unit area, they may or may not form an ordered crystal-like structure. Investigate the phenomenon.

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Problem No. 12 “Gyroscope teslameter”

A spinning gyroscope made from a conducting, but nonferromagnetic material slows down when placed in a magnetic field. Investigate how the deceleration depends on relevant parameters.

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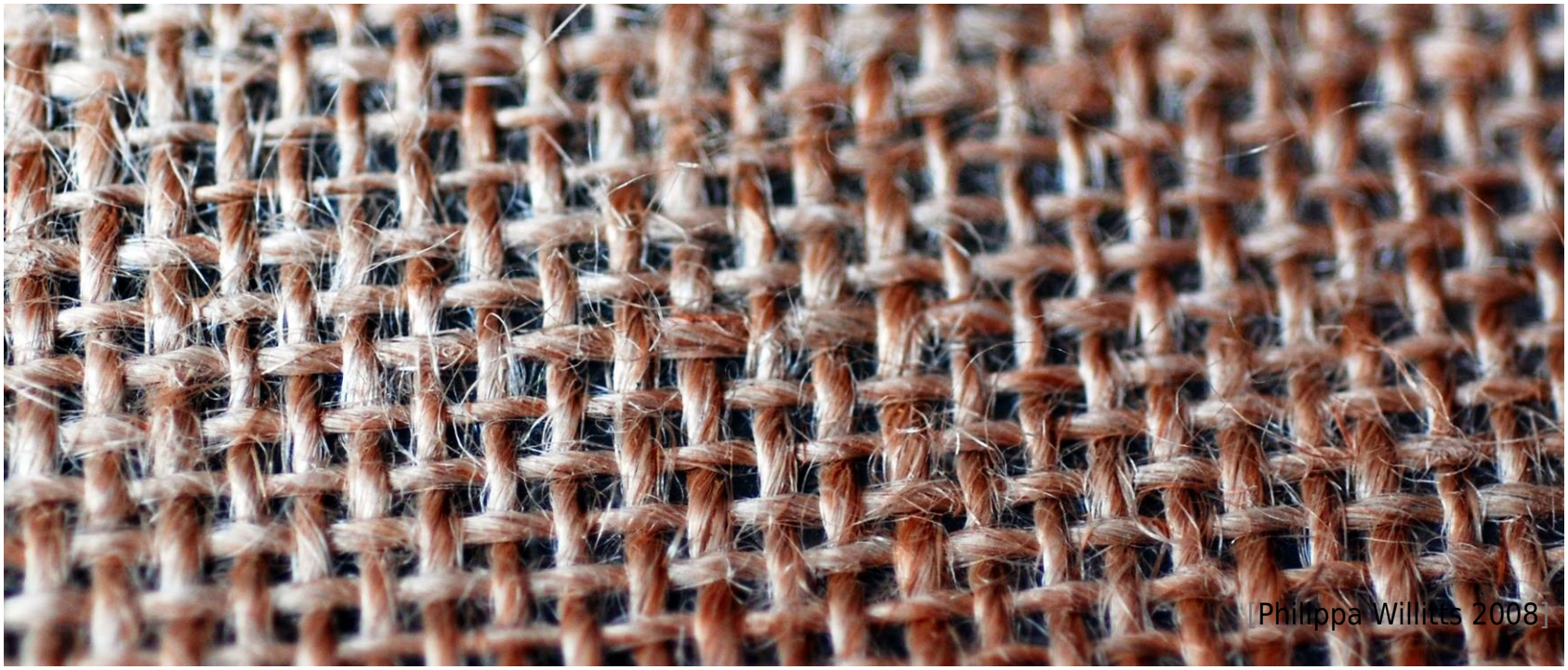

Problem No. 13 “Moiré thread counter”

When a pattern of closely spaced non-intersecting lines (with transparent gaps in between) is overlaid on a piece of woven fabric, characteristic moiré fringes may be observed. Design an overlay that allows you to measure the thread count of the fabric. Determine the accuracy for simple fabrics (e.g. linen) and investigate if the method is reliable for more complex fabrics (e.g. denim or Oxford cloth).

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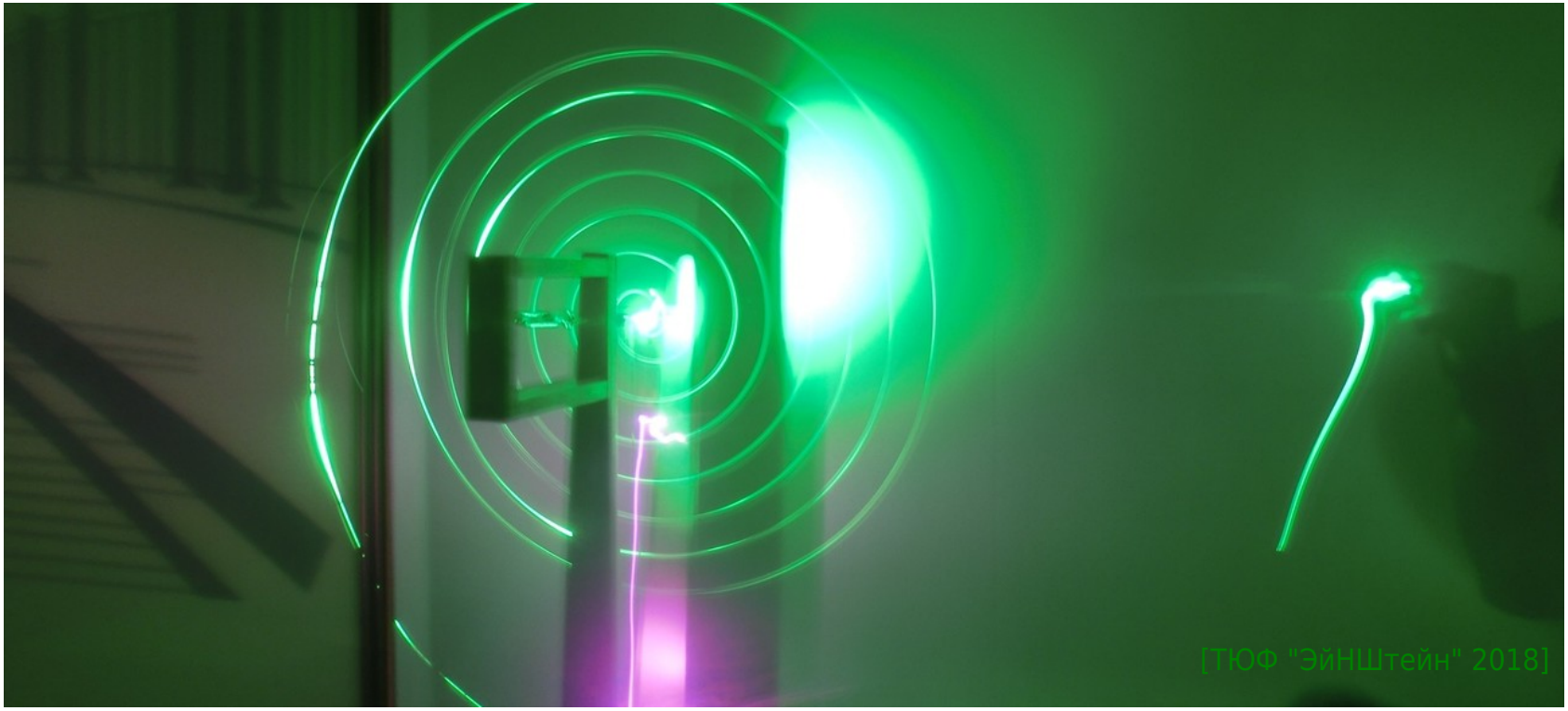

Problem No. 14 “Looping pendulum”

Connect two loads, one heavy and one light, with a string over a horizontal rod and lift up the heavy load by pulling down the light one. Release the light load and it will sweep around the rod, keeping the heavy load from falling to the ground. Investigate this phenomenon.

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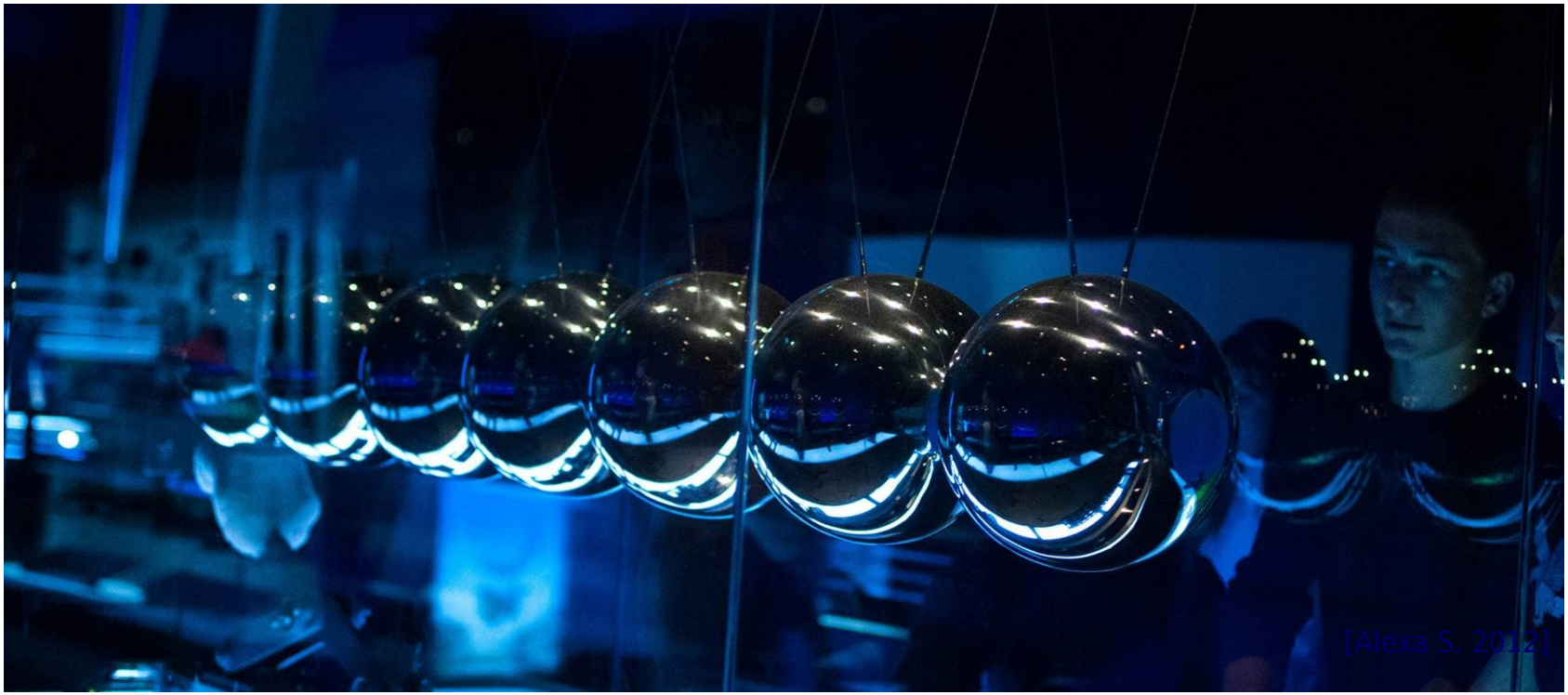

Problem No. 15 “Newton’s cradle”

The oscillations of a Newton's cradle will gradually decay until the spheres come to rest. Investigate how the rate of decay of a Newton's cradle depends on relevant parameters such as the number, material, and alignment of the spheres.

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Problem No. 16 “Sinking bubbles”

When a container of liquid (e.g. water) oscillates vertically, it is possible that bubbles in the liquid move downwards instead of rising. Investigate this phenomenon.

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Problem No. 17 “Popsicle chain reaction”

Wooden popsicle sticks can be joined together by slightly bending each of them so that they interlock in a so-called “cobra weave” chain. When such a chain has one of its ends released, the sticks rapidly dislodge, and a wave front travels along the chain. Investigate the phenomenon.

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IYPT 1989, Team Netherlands

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  - look deeper,
  - have a better background knowledge,
  - be skeptical in embedding their projects into the standards of professional research,
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- Clear understanding of the validity of your experiments, and how exactly you analyzed the obtained data
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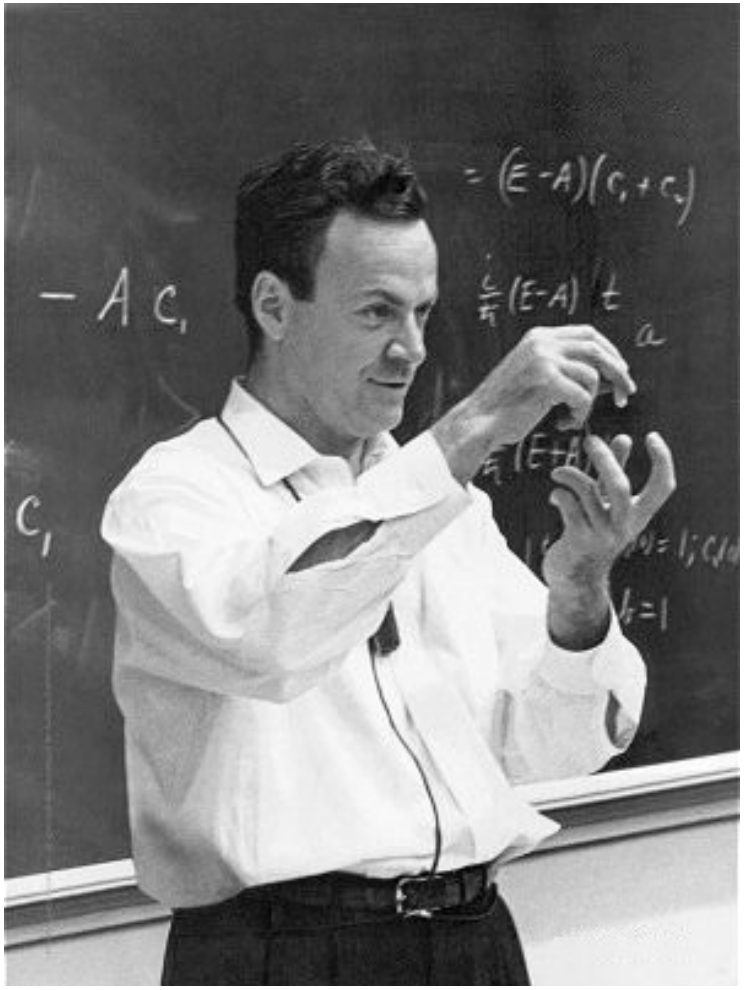
Feynman: to be self-confident?

- “I’ve very often made mistakes in my physics by thinking the theory isn’t as good as it really is, thinking that there are lots of complications that are going to spoil it
- — an attitude that anything can happen, in spite of what you’re pretty sure should happen.”



R. P. Feynman. Surely You’re Joking, Mr. Feynman (Norton, New York, NY, 1985)

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What is a Naturalist?

In their *Treatise on Natural Philosophy* (1867), Lord Kelvin and Tait give the definitions of matter

Introduction

The IYNT is an inclusive educational network and a prestigious international competition. The IYNT is focused on student participants aged 12 through 16, the

Preparation to 32nd IYPT' 2019:

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