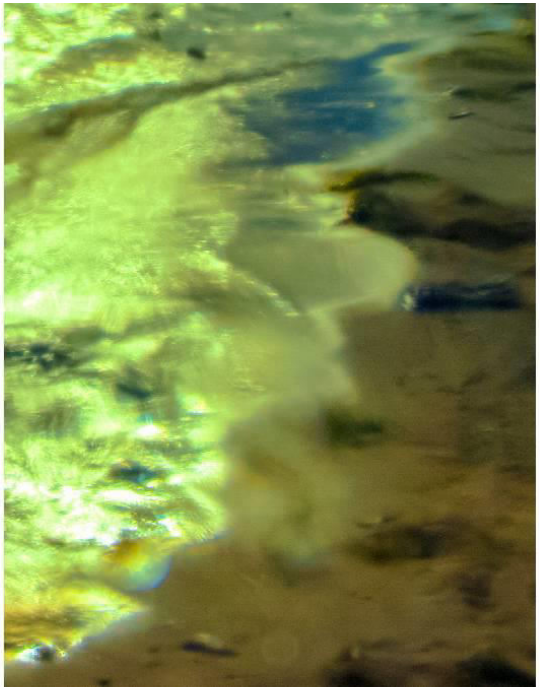
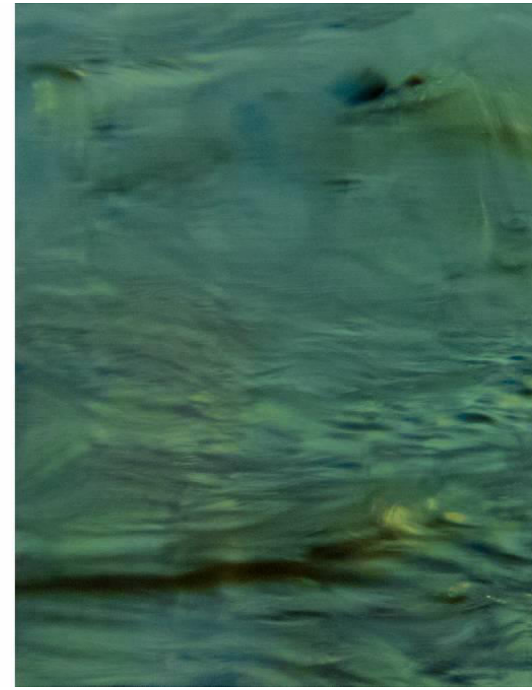
First day draft // July 16, 2026





Preparation to the Young Physicists’ Tournaments’ 2027

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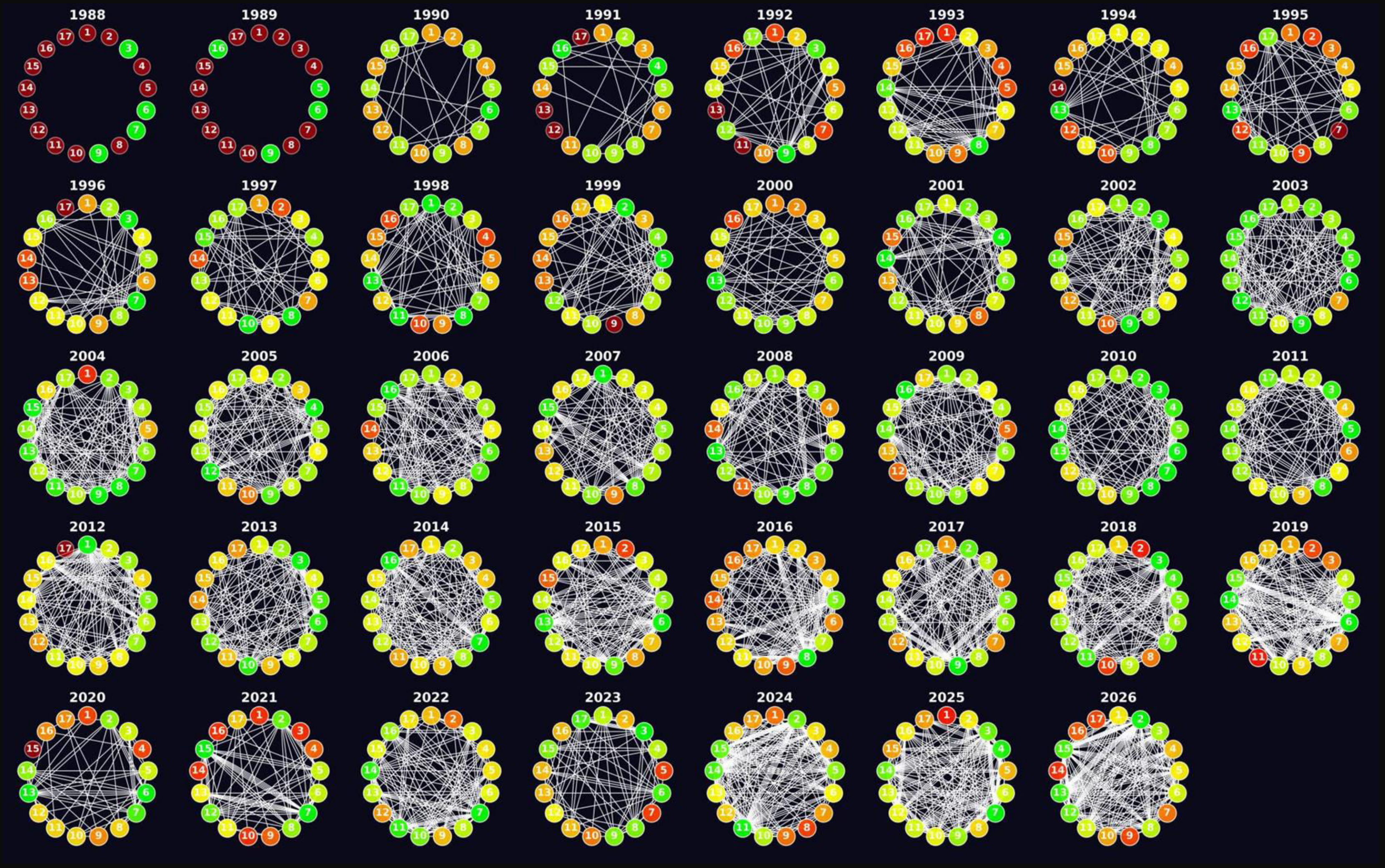
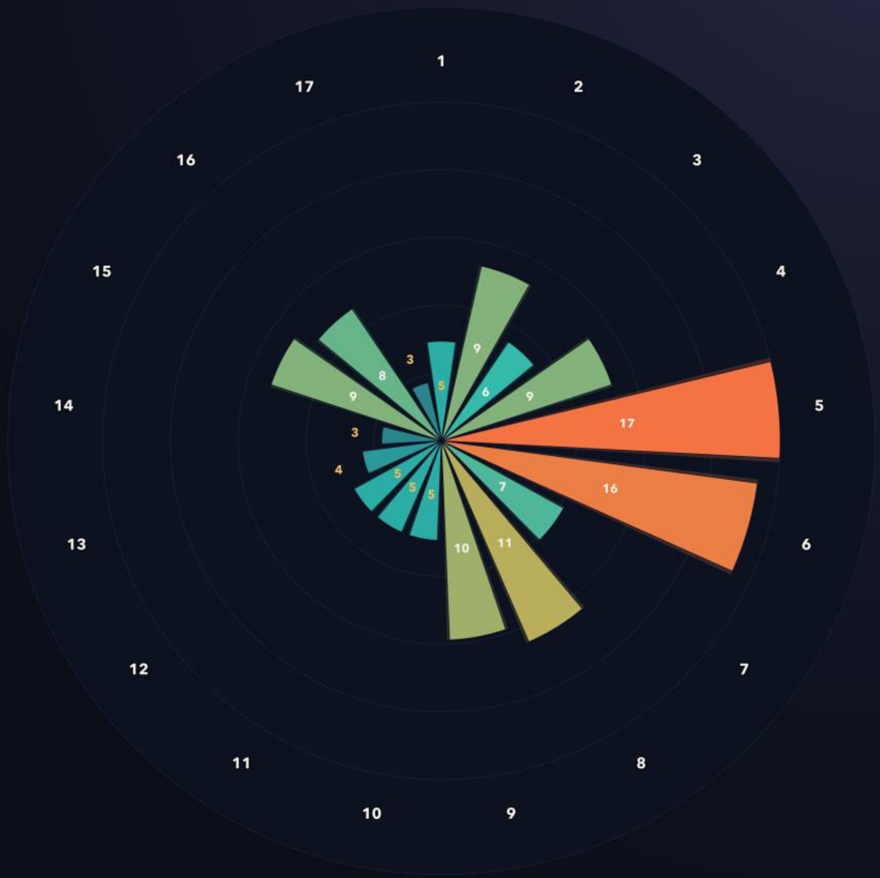
[1] Foundation for Youth Tournaments; [2] Novosibirsk State University; [3] Digital School

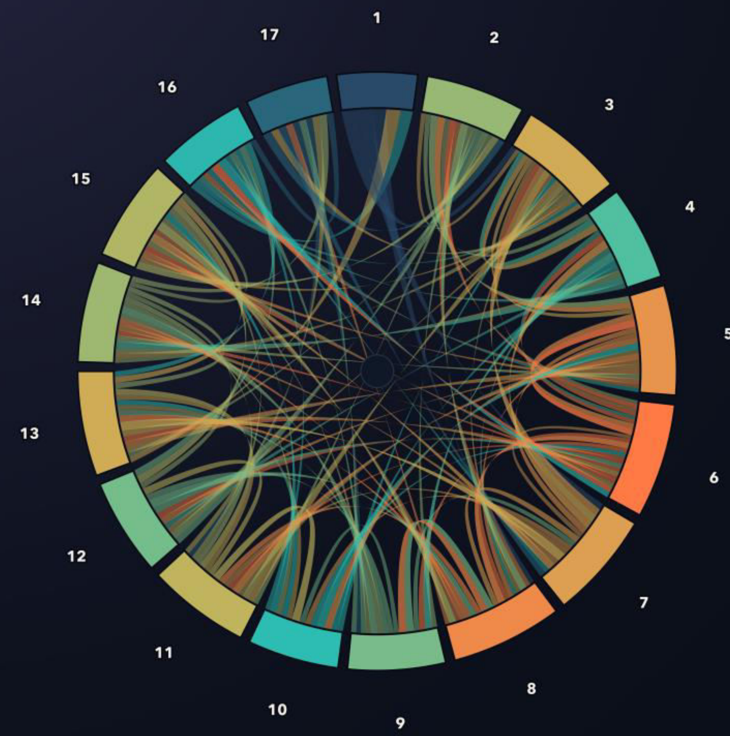


In 1988...2026, IYPT participants worked on 663+6 unique problems. The graph traces what problems Teams presented when advancing from one PF to the next PF in real-life IYPT stages

Problems in the Final



Problem-to-Problem Transitions




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

Important information

- The basic goal of this Kit is not in providing students with a start-to-finish manual or in limiting their creativity, but in encouraging them to
  - regard their work critically,
  - look deeper,
  - have a better background knowledge,
  - be skeptical in embedding their projects into the standards of professional research,
  - and, as of a first priority, be attentive in not “re-inventing the wheel”
- An early exposure to the culture of scientific citations, and developing a responsible attitude toward making own work truly novel and original, is assumed to be a helpful learning experience in developing necessary standards and attitudes
- Good examples are known when the Kit has been used as a concise supporting material for jurors and the external community; the benefits were in having the common knowledge structured and better visible
- Even if linked from iypt.org, this file is not an official, binding release of the IYPT, and should under no circumstances be considered as a collection of authoritative “musts” or “instructions” for whatever competition
- All suggestions, feedback, and criticism about the Kit are warmly appreciated

Problem No. 1 “Invent Yourself: Pinhole sunglasses”

Investigate the optimal arrangement of pinholes in an opaque film to produce sunglasses that reduce light intensity and help correct short-sightedness.

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- Дырчатые очки: между иллюзией и реальностью (factum-info.info), https://factum-info.net/ru/myths/miscellaneous/pinhole-glasses-myth-or-reality

Problem No. 2 “Disc spectrometer”

Data tracks on optical media (e.g. CDs / Blu-ray discs) behave as high-quality reflection-diffraction gratings. When illuminated, these discs can disperse light into its spectral components. Construct a spectrometer using a digital optical disc. Optimise the design to maximise the resolving power and minimise optical aberrations.

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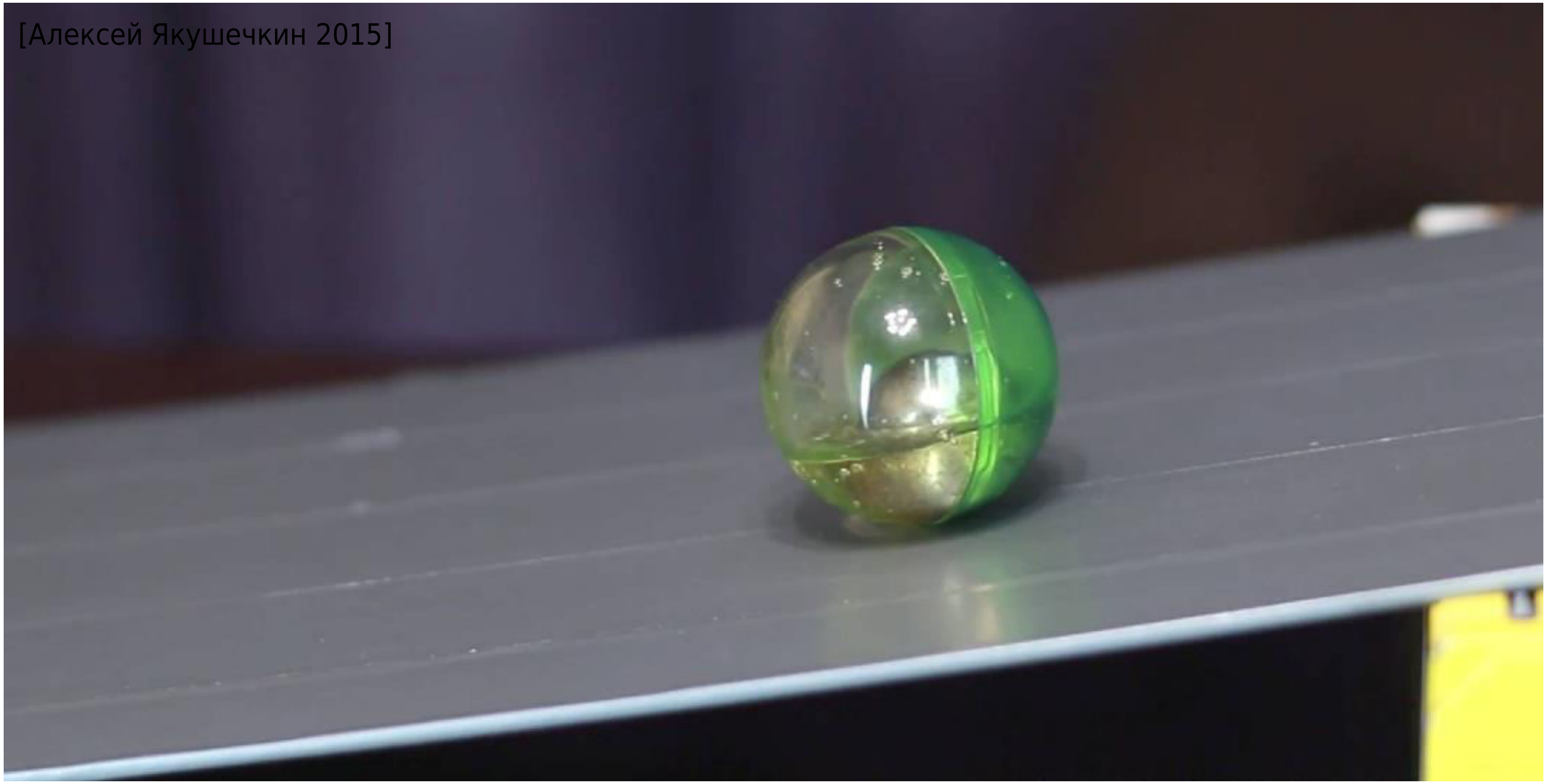

Problem No. 3 “Snail ball”

A hollow sphere contains a heavy ball and some viscous fluid. The rolling motion of such a sphere down an inclined plane is uneven and surprisingly slow. Explain and investigate this effect.


April 26, 2026

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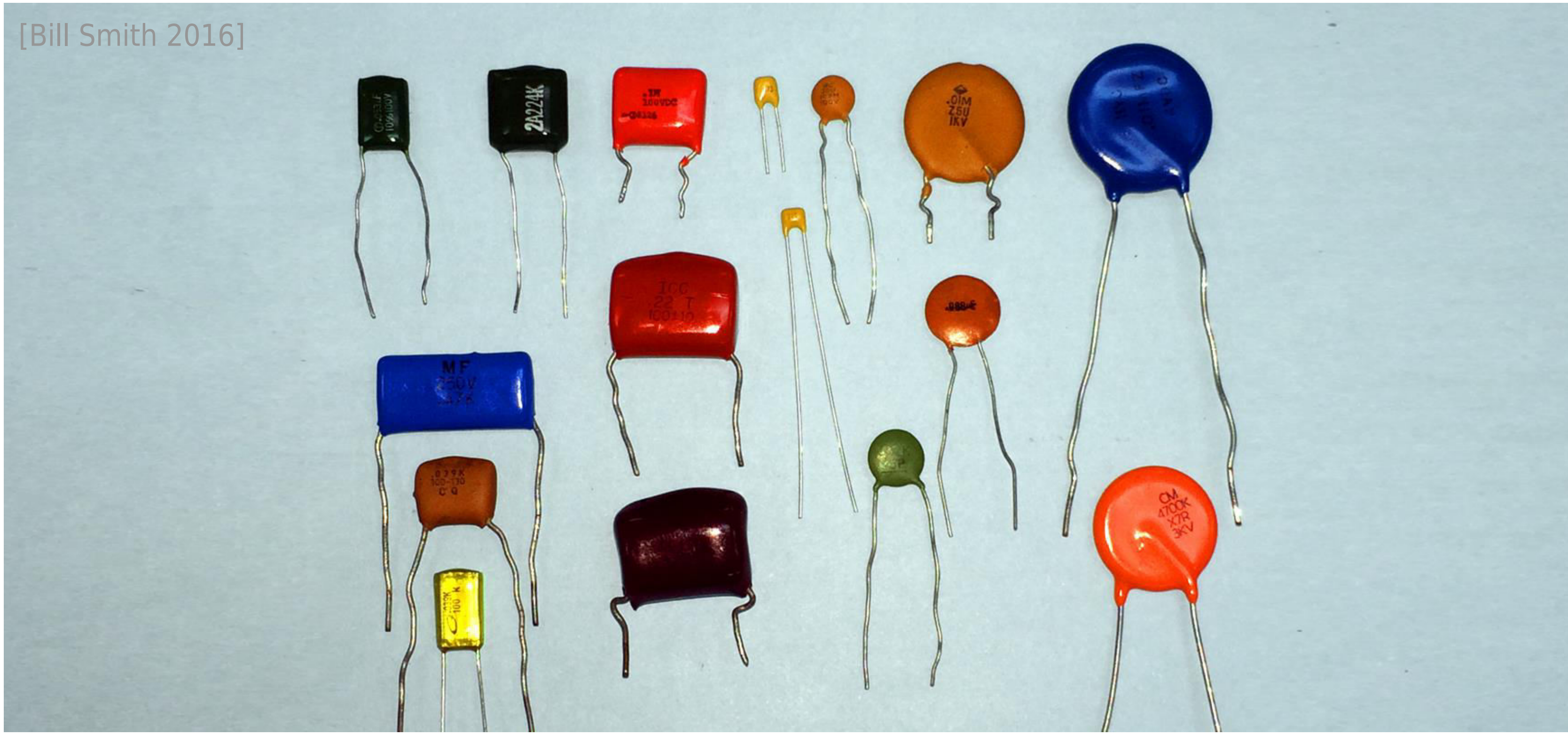

Problem No. 4 “Singing capacitor”

Certain types of ceramic capacitors emit an audible sound when an alternating voltage is applied across them. Investigate the characteristics of the sound produced and how they depend on relevant parameters, such as voltage, frequency, and capacitor properties.

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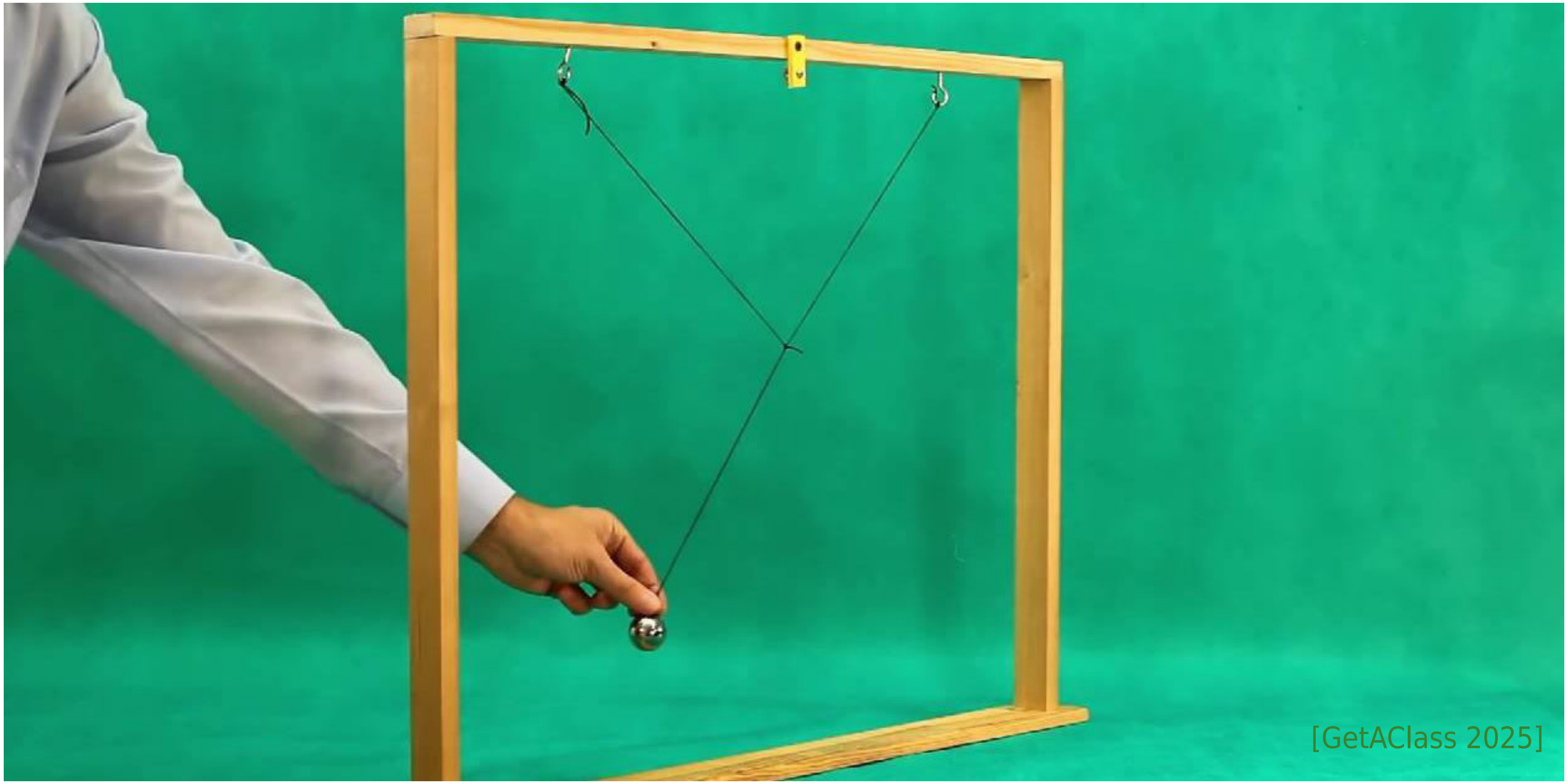

Problem No. 5 “Y-shaped pendulum”

Construct a Bowditch pendulum (a pendulum whose strings form a "Y" shape). Investigate how the Lissajous patterns generated by the bob depend on the relevant parameters.

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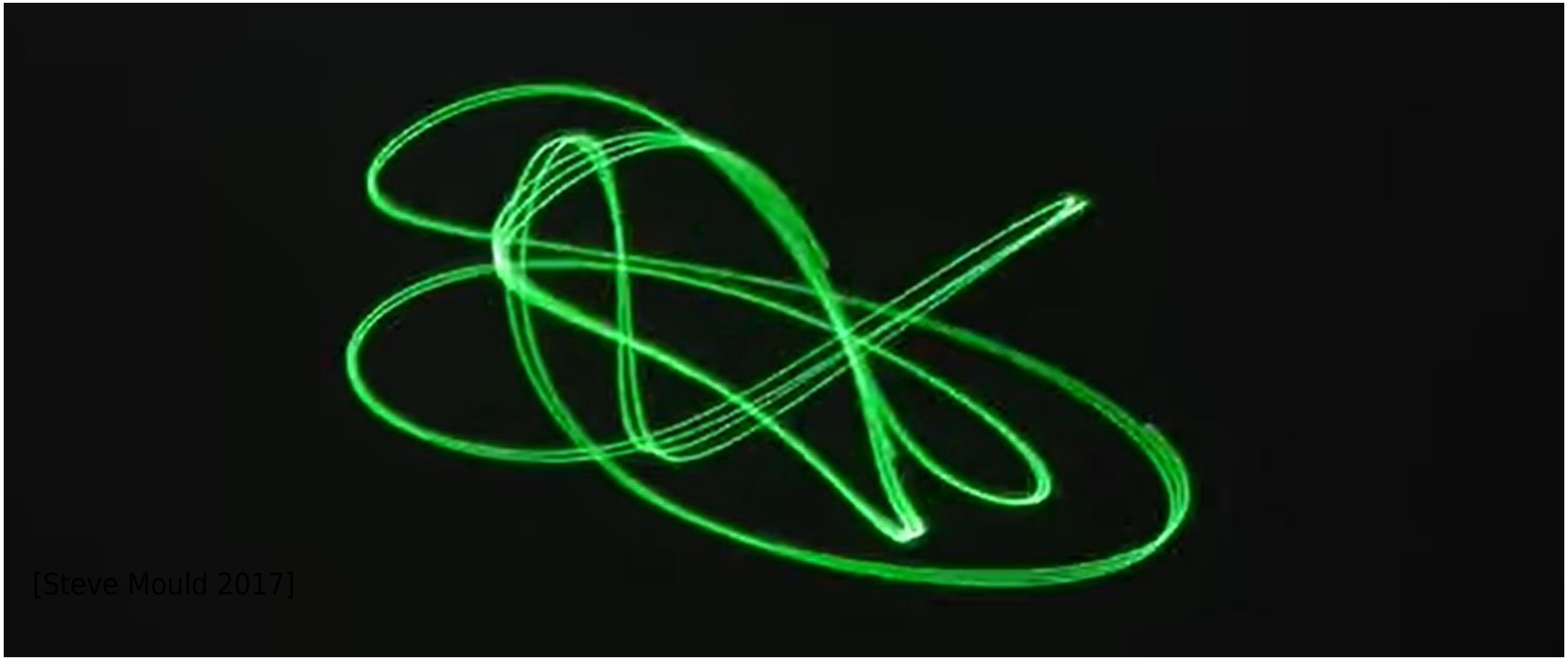

Problem No. 6 “Seeing sound”

A thin rubber membrane is stretched over a circular frame and driven into vibration by a loudspeaker. A small mirror is attached to the membrane, and a laser beam is reflected off it onto a distant screen. Under certain conditions, the laser spot traces out complex, steady, or evolving geometric patterns. Investigate the relationship between the driving parameters, the membrane’s properties, and the resulting light patterns.

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Problem No. 7 “Sinking funnel”

When a long-stemmed and sufficiently heavy funnel is released vertically into water with the stem pointing downward, it undergoes a series of damped vertical oscillations while gradually sinking. Investigate the motion and stability of the sinking funnel and the conditions under which the funnel tips over.

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Problem No. 8 “Upward-driven disc”

A circular disc is suspended from the point where it is sandwiched between two wheels, making it free to oscillate as a pendulum. One of the wheels is driven by a motor and thus exerts an upward driving force on the disc. Investigate the motion of the disc.

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Problem No. 9 “Photographic bokeh”

Bokeh is an effect observed in photographs that show objects at different distances from the camera and have both sharp and out-of-focus areas. If a slit is placed in front of the lens of the camera, the image may have unusual anisotropic distortions in out-of-focus areas, while in-focus areas remain undistorted and sharp. Investigate how the properties and sharpness of resulting images depend on relevant parameters.

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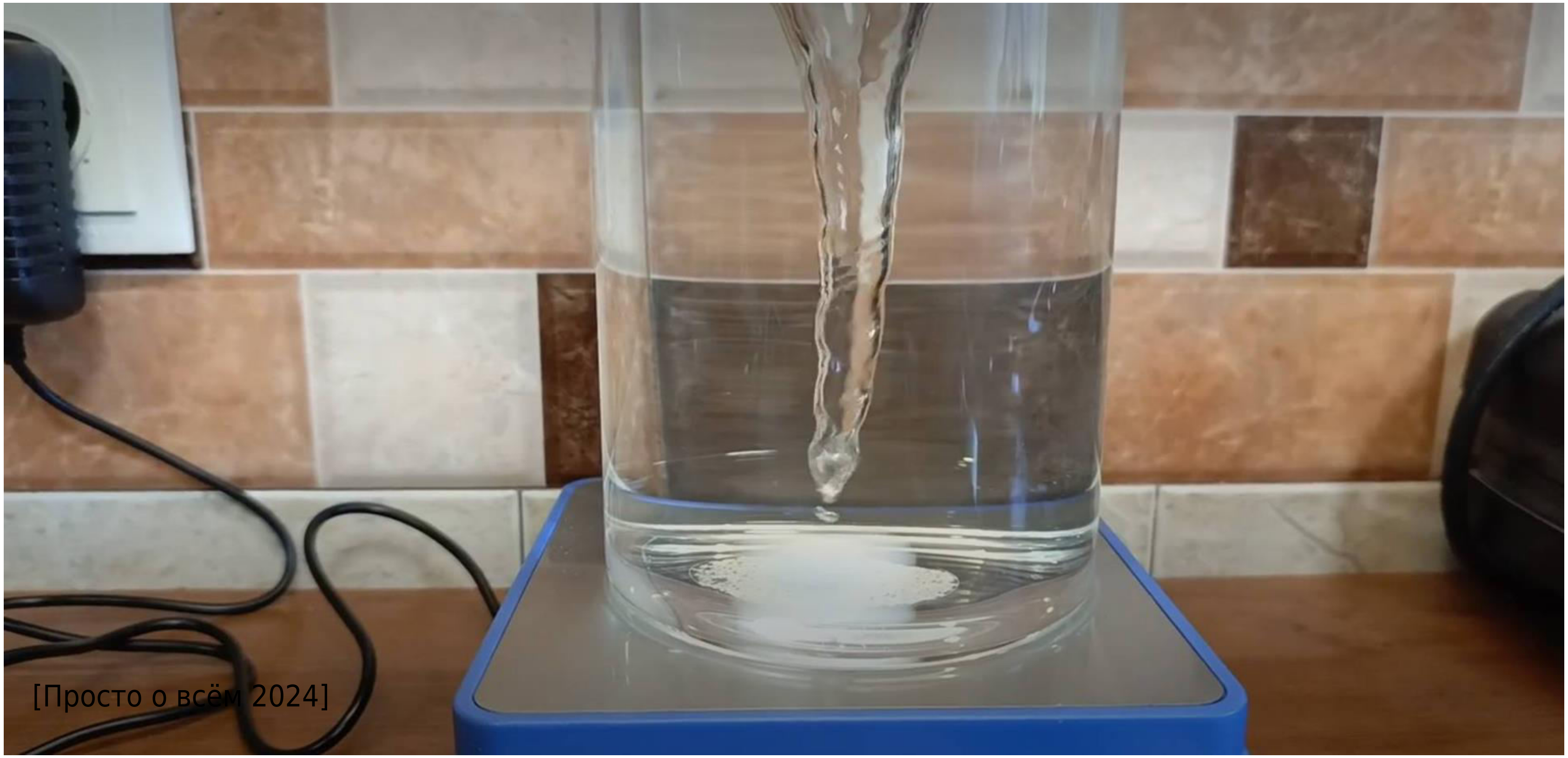

Problem No. 10 “Air vortex”

Place a small rod-shaped magnet on the bottom of a vessel filled with liquid and set it into rotation using a magnetic stirrer. Above a certain rotation speed, a thin air channel forms, extending from the liquid surface down to the rotating magnet itself. Investigate and explain this phenomenon.

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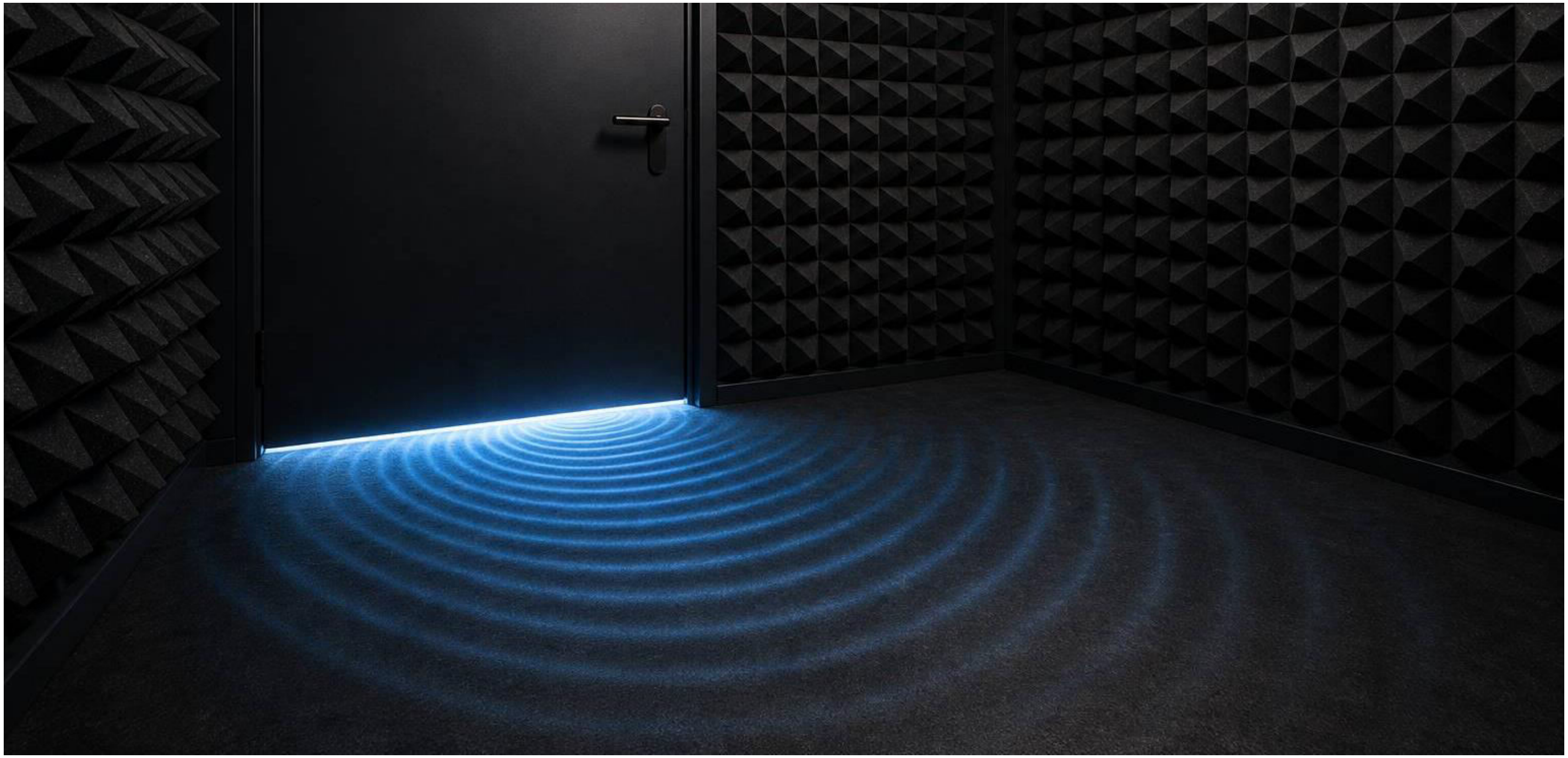

Problem No. 11 “Sound isolation”

The sound isolation of a room may become breached if the door is not shut properly, even if the gap is negligibly small. Investigate how the shape and size of a small opening affect the transmission of sound.

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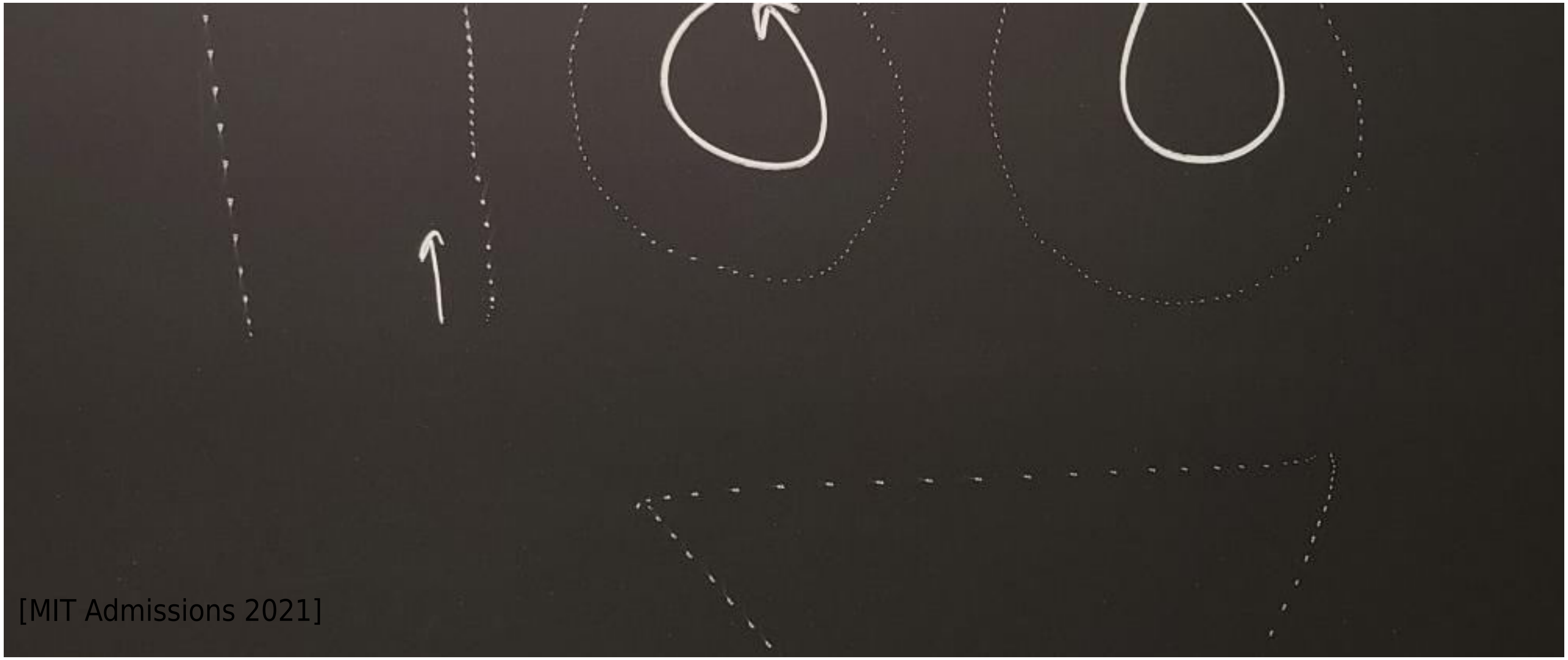

[MIT Admissions 2021]

Problem No. 12 “Dotted line trick”

Under certain conditions, when a piece of chalk is dragged across a blackboard, the resulting trace is not a continuous line but a periodic sequence of dots, even though the motion is uninterrupted. This can happen with other writing materials and surfaces. Investigate the physical parameters that govern this phenomenon.

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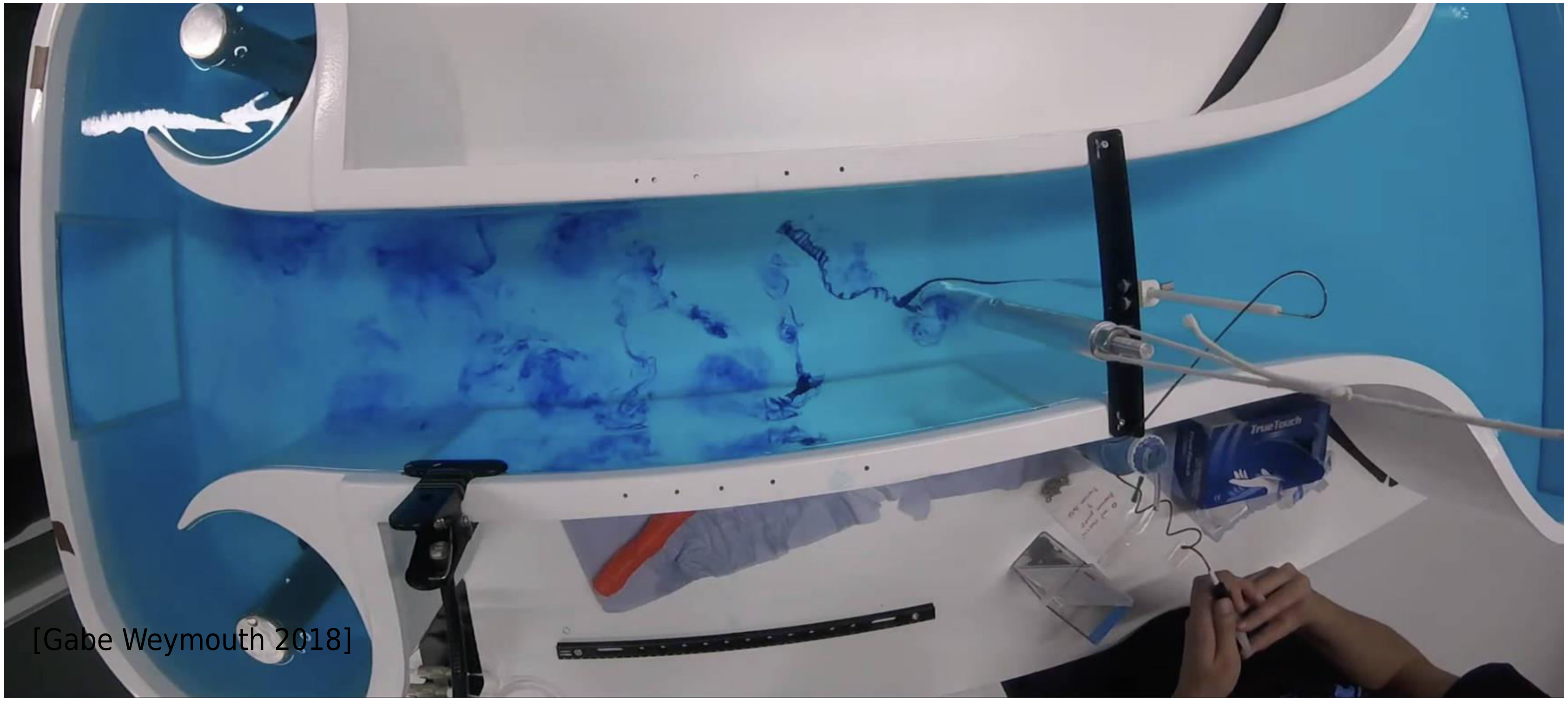

[Gabe Weymouth 2018]

Problem No. 13 “Vortex pendulum”

A pendulum with a vertically oriented cylindrical bob is suspended above a channel of flowing water. When the bob is partially submerged, the flow may cause the pendulum to oscillate in a direction perpendicular to the flow. Explain this phenomenon and determine how it depends on relevant parameters.

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Problem No. 14 “Non-Newtonian worms”

If a dilatant non-Newtonian fluid (e.g. a suspension of water and cornflour) is vibrated vertically in a reservoir. When certain conditions are met, wormlike structures that rise from the surface may form. Explain and investigate this phenomenon.

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Problem No. 15 “Cold drink”

A can or bottle of drink at room temperature can be cooled in a cooler containing ice. Adding salt and alcohol to the ice can increase the rate of cooling and affect the drink's final temperature. Investigate how the relevant parameters affect the lowest achievable temperature and the maximum cooling rate.

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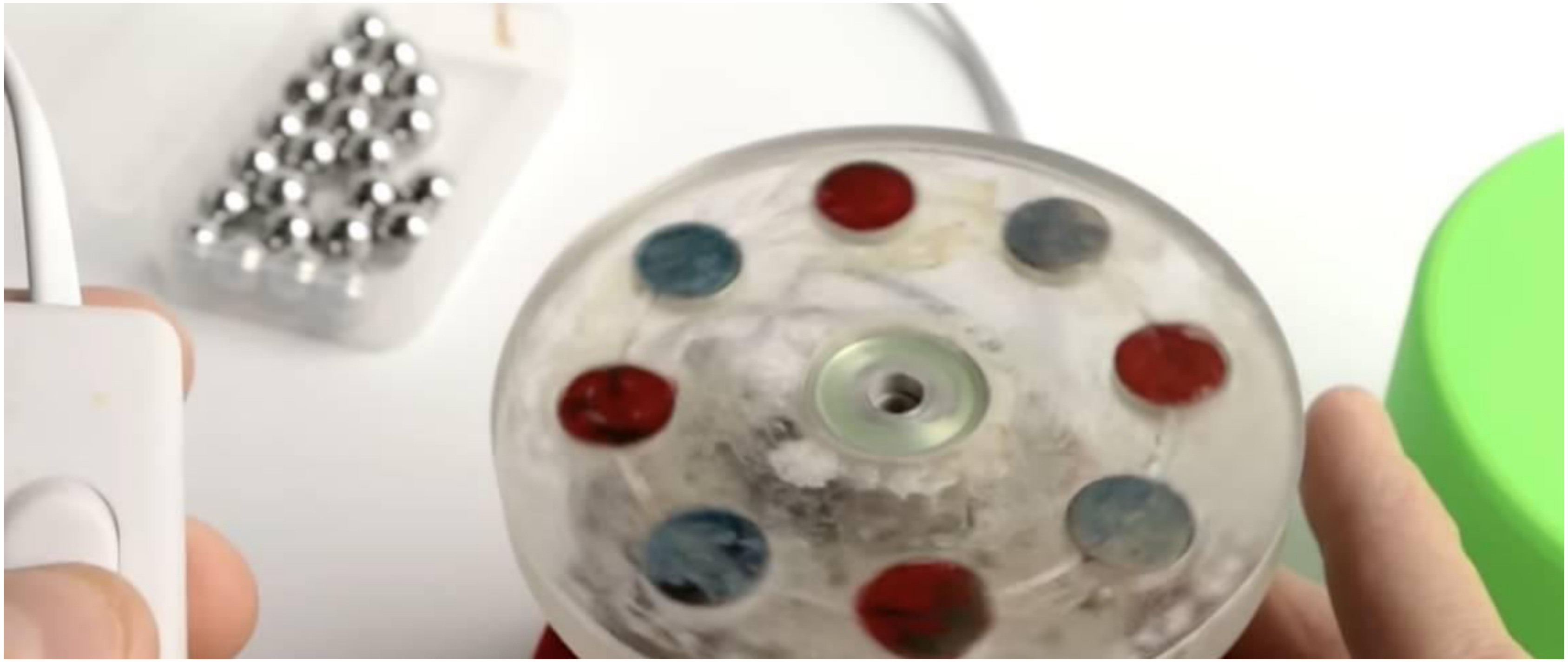

Problem No. 16 “Magnetic carousel”

Several neodymium magnets are attached to a horizontal disc, with adjacent magnets oriented in opposite directions. A fixed non-magnetic plate is placed horizontally above the disc. When the disc rotates about its vertical axis and a steel ball is placed on the plate, the ball may move either in the same direction as, or opposite to, the rotation of the disc. Investigate this phenomenon and determine how the motion depends on relevant parameters.

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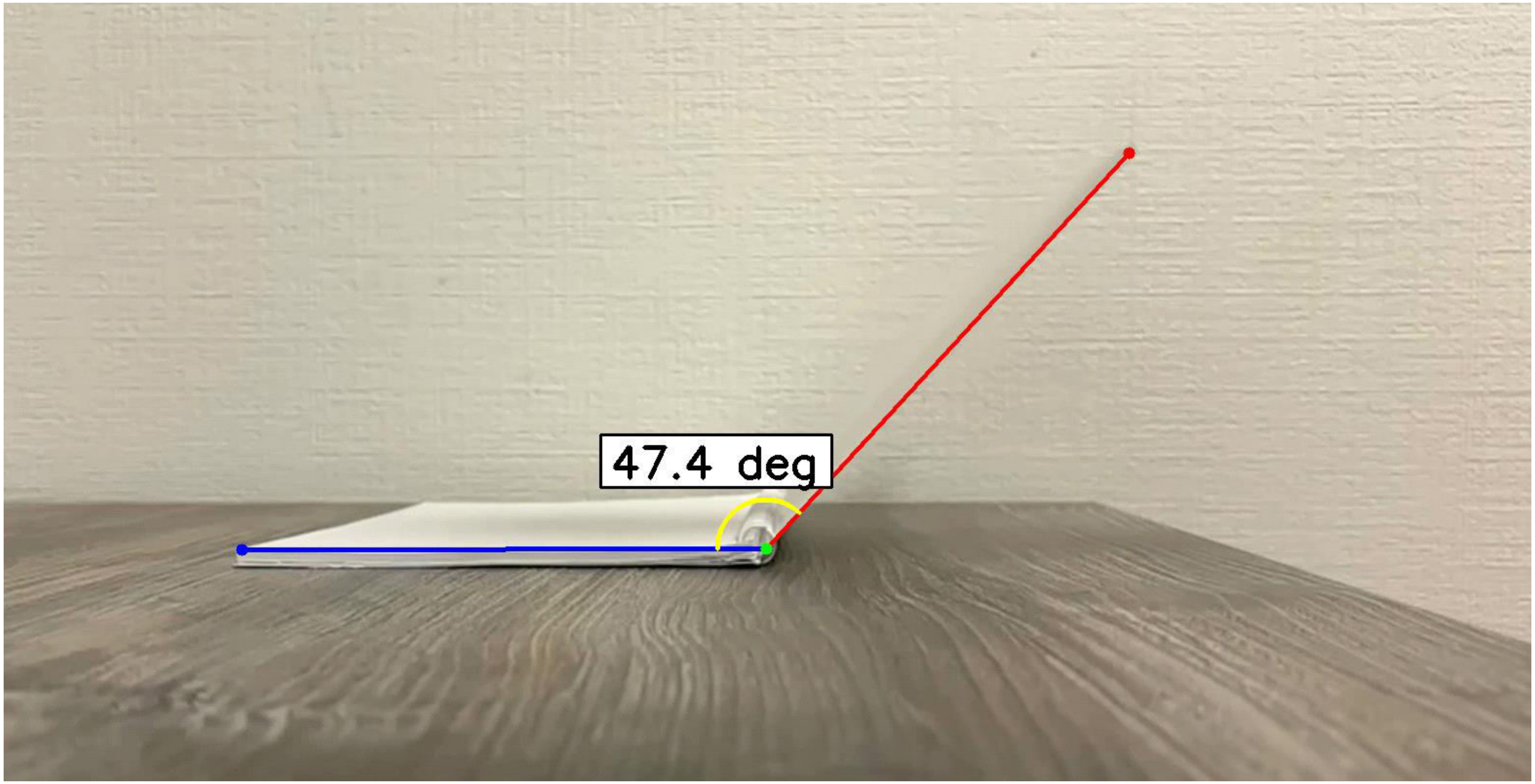

Problem No. 17 “Falling book cover”

A book is placed horizontally, and the partially open cover is allowed to fall. Investigate the motion of the falling book cover.

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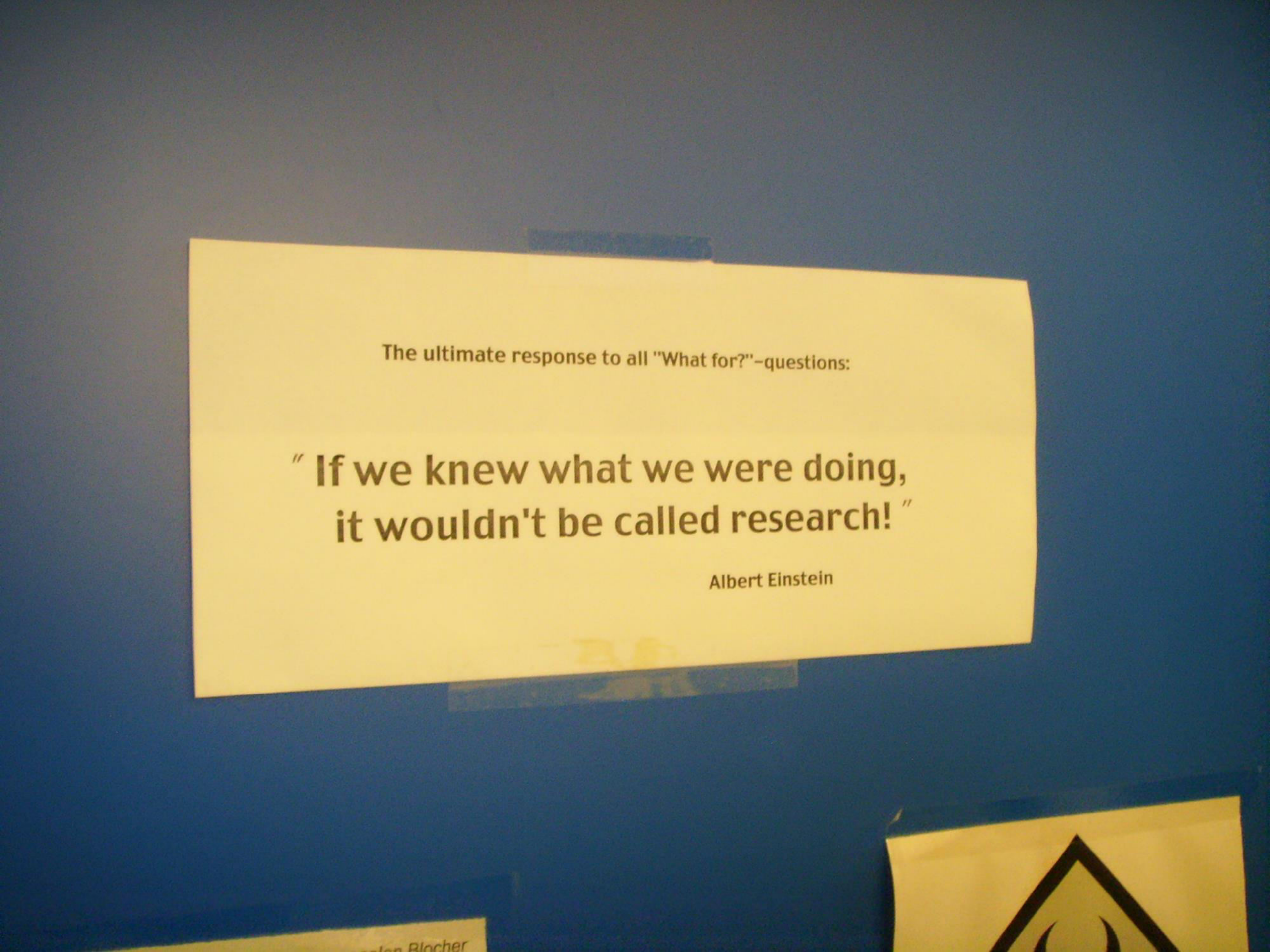

The ultimate response to all "What for?"-questions:
" If we knew what we were doing,
it wouldn't be called research! "
Albert Einstein

Habits and customs

- Originality and independence of your work is always considered as of a first priority
- There is no "correct answer" to any of the IYPT problems
- Having a deep background knowledge about earlier work is a must
- Taking ideas without citing is a serious misconduct
- Critically distinguishing between personal contribution and common knowledge is likely to be appreciated
- Reading more in a non-native language may be very helpful
- Local libraries and institutions can always help in getting access to paid articles in journals, books, and databases
- The IYPT is not about reinventing the wheel, or innovating, creating, discovering, and being able to contrast own work with earlier knowledge and the achievements of others?
- Is IYPT all about competing, or about developing professional personal standards?

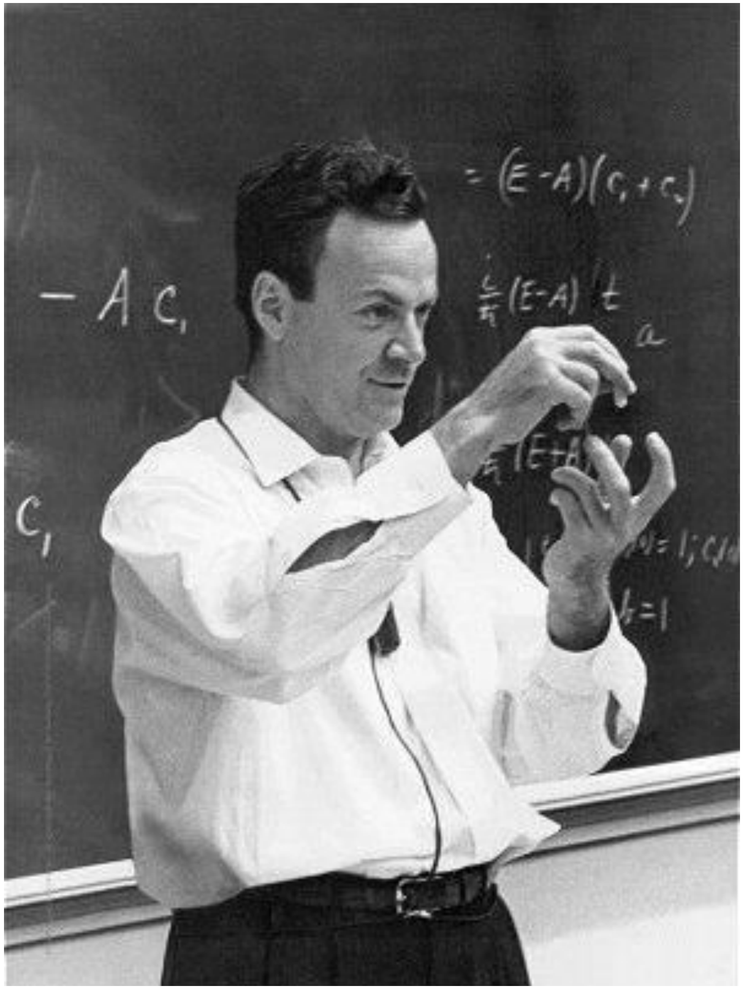
Requirements for a successful IYPT report

- Novel research, not a survey or a compilation of known facts
- Balance between experimental investigation and theoretical analysis
- Comprehensible, logical and interesting presentation, not a detailed description of everything-you-have-performed-and-thought-about
- Clear understanding of the validity of your experiments, and how exactly you analyzed the obtained data
- Clear understanding of what physical model is used, and why it is considered appropriate
- Clear understanding of what your theory relies upon, and in what limits it may be applied
- Comparison of your theory with your experiments
- Clear conclusions and clear answers to the raised questions, especially those in the task
- Clear understanding of what is your novel contribution, in comparison to previous studies
- Solid knowledge of relevant physics
- Proofread nice-looking slides
- An unexpected trick, such as a demonstration *in situ*, will always be a plus

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)

Expediting metadata extraction for the Kit

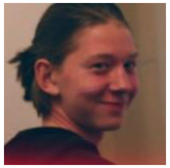
- **Each Kit includes extensive metadata for each reference as plain text**
  - Human-readable, comprehensible references (not just URL or DOI) to facilitate review and study
  - A well-documented reference will remain (more) usable in the future even if an exact URL goes dead

Finding a reference → Screening, immediate rejections → Accepting a valid reference → Metadata preparation → Final polishing → Added to the Kit

- Fetching metadata (e.g. publication dates for YouTube videos) is time consuming
  - However it must be done to keep the Kit usable and consistent now and in the remote future

- We acknowledge Sergey Bulykin and Artem Golomolzin for a custom-designed script that contributes to expedited metadata extraction

- Publication date, title, author etc. is retrieved automatically via API, in particular from YouTube, CrossRef, Semantic Scholar
- If the information cannot be found via API, a large language model (LLM) extracts details directly from the contents of the link

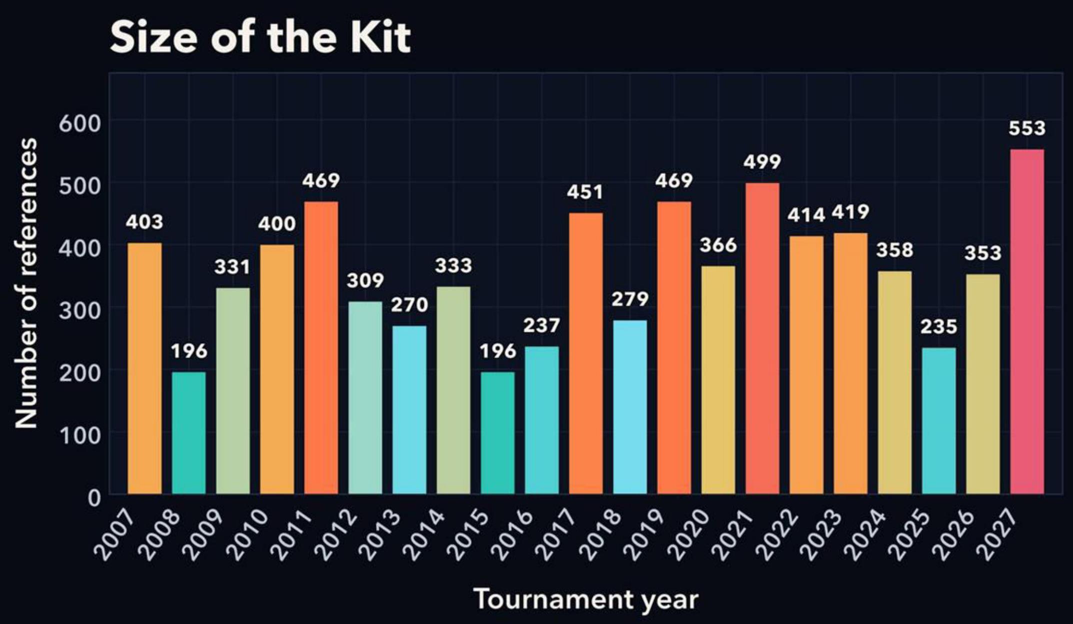


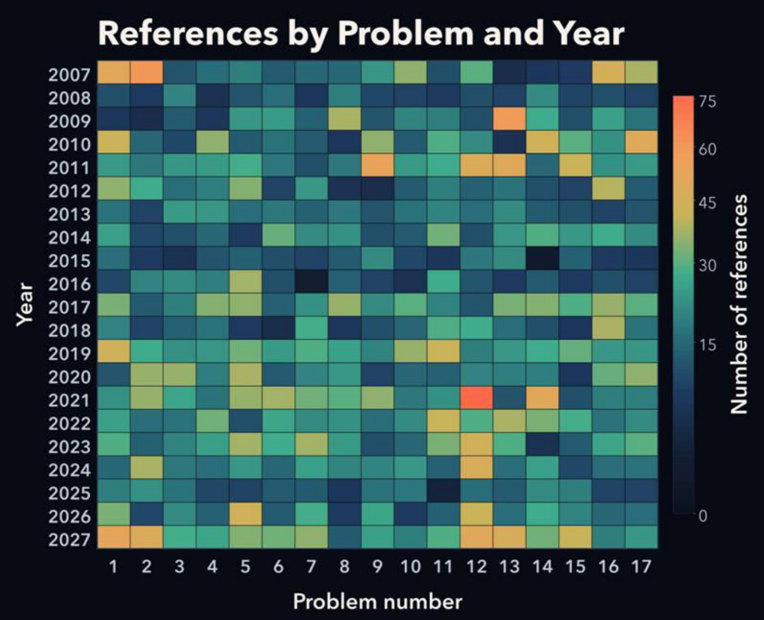
- We also acknowledge Anastasiya Litvinova for assistance with retrieving and preparing images and illustrations for the Kit

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 on the Kit for 2027, or plan bringing together the Kit for 2028, **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 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 may generate original, state-of-the-art research problems, widely used in other activities and at other events
  - and also the authors of the Kit, who could rapidly acquire a competence for the future activities and have a great learning experience

Stats on the Kit: Size

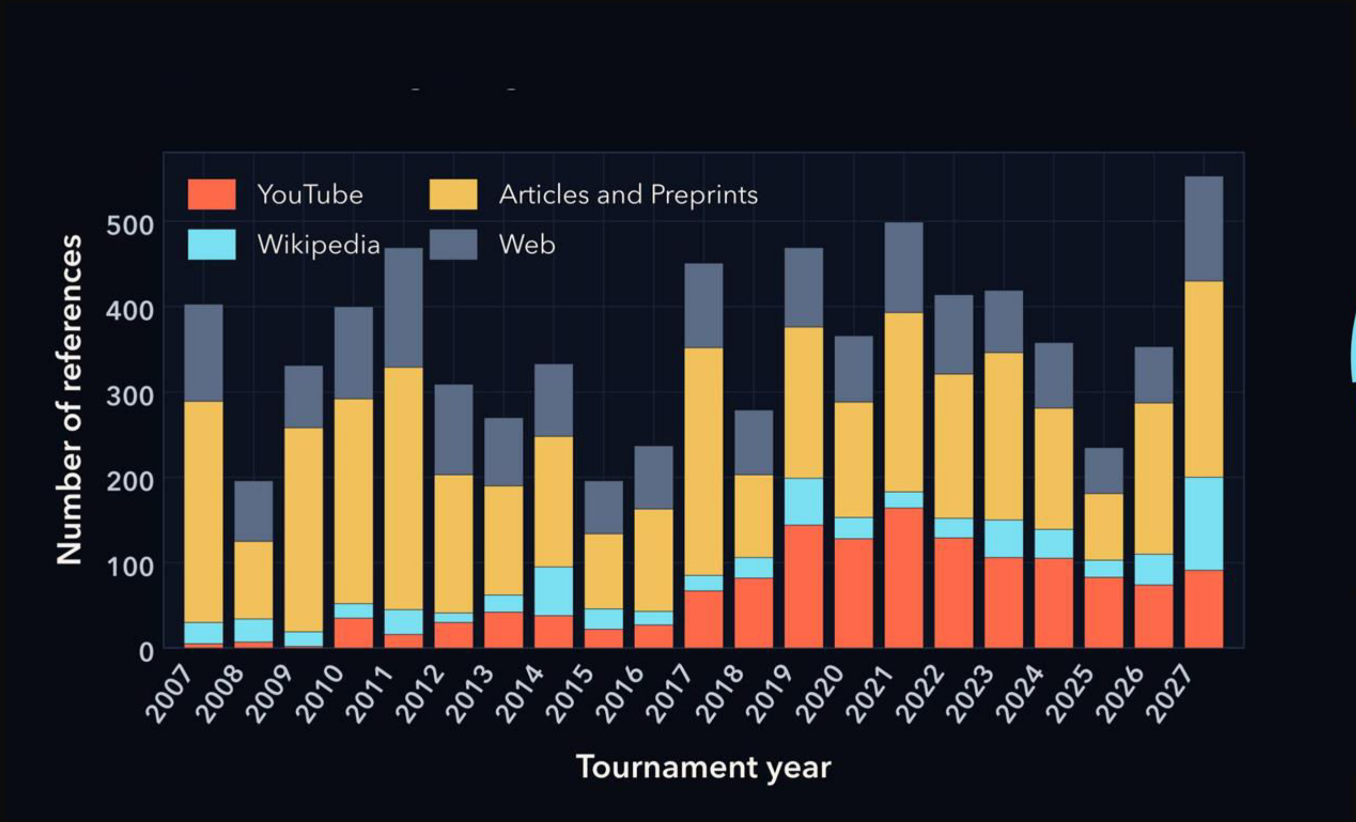


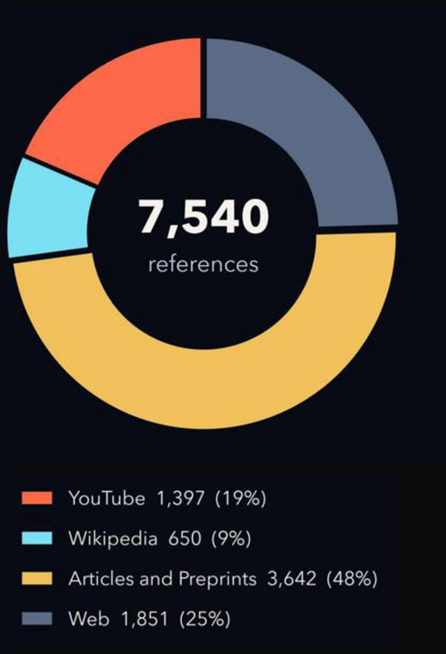


The present Kit for the IYPT 2027 (FDD) has attracted more references than any prior Kit in 2007…2027

No. 12 “Wilberforce Pendulum” (IYPT 2021) has attracted the maximum number of references

Stats on the Kit: Categories

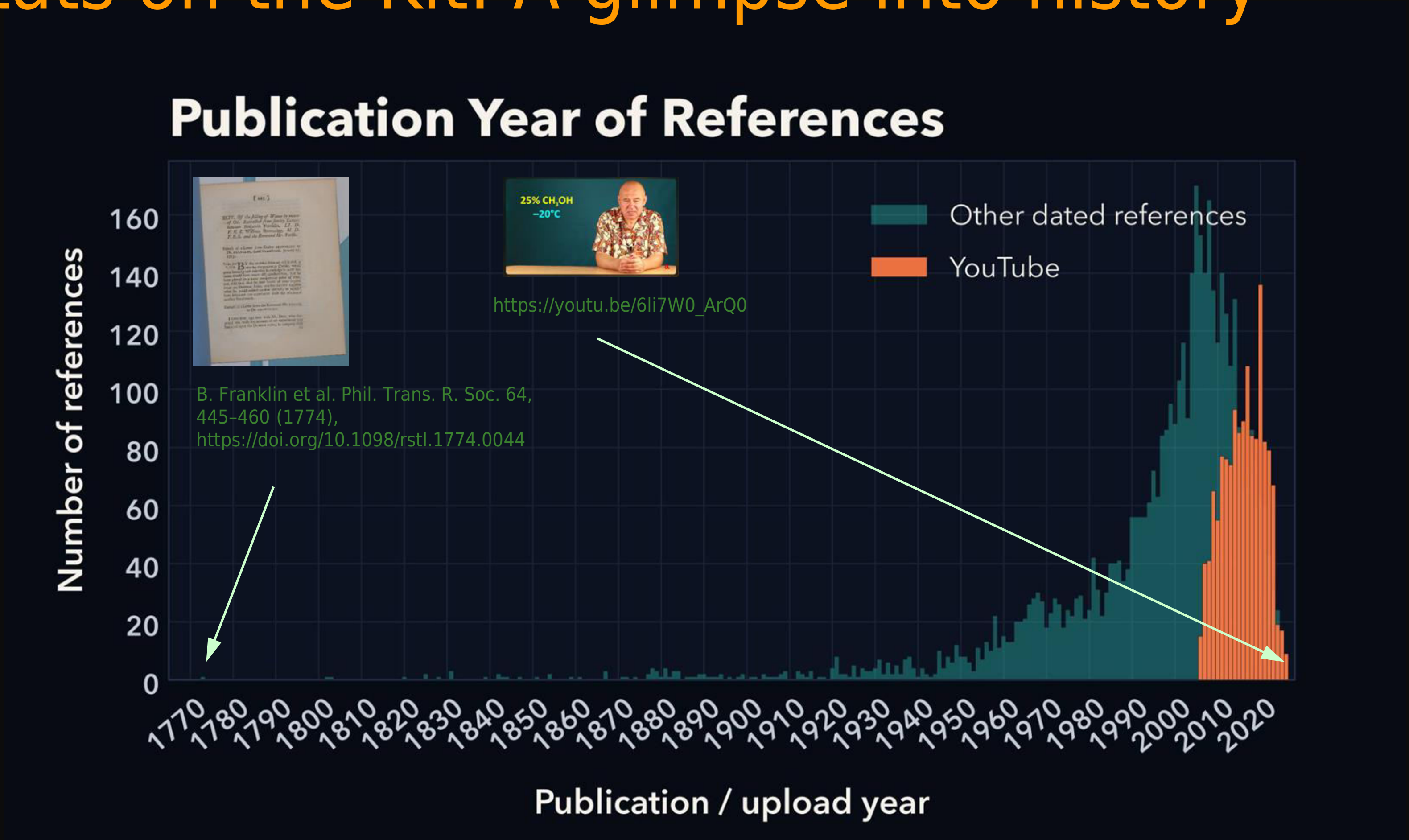




Wikipedia (est. 2001) and YouTube (est. 2005) proved to be useful resources that were not available in the 1980s and the 1990s when guidelines and practical tips for teams were prepared by Evgeny Yunosov

Peer-reviewed papers, preprints and academic textbooks now constitute ca. ½ of all references in the Kit

Stats on the Kit: A glimpse into history

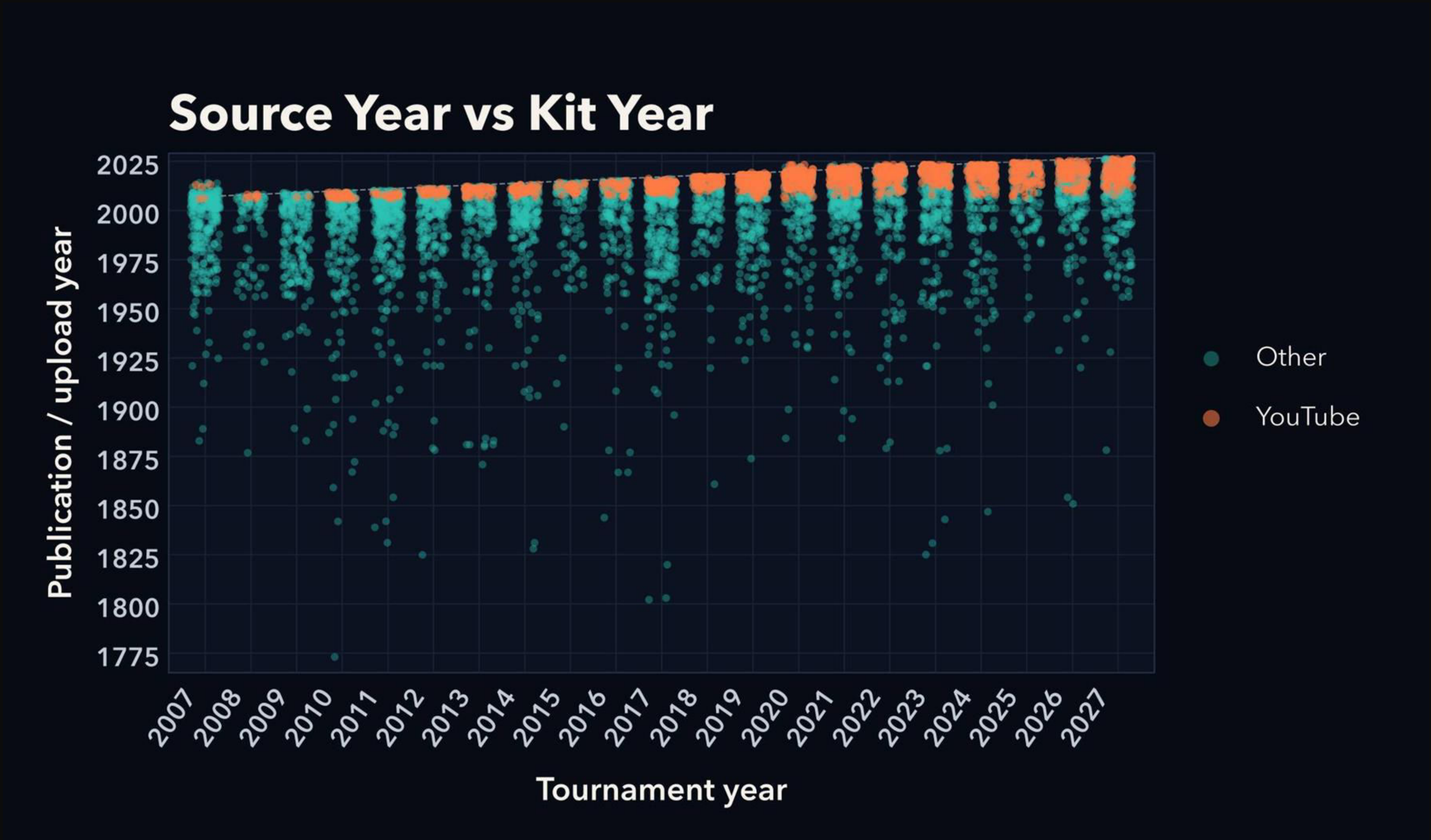


The laws of physics remain invariant as time passes, and one may argue that a good reference might have been published at any moment in the past. More recent references, i.e. after the 1960s, are inherently more frequent

The earliest reference seems to date back to Benjamin Franklin in 1773—1774 (No. 10 “Calm Surface”, IYPT 2010)

The most recent reference is a GetAClass video uploaded on July 14, 2026 (No. 15 “Cold drink”, IYPT 2027)

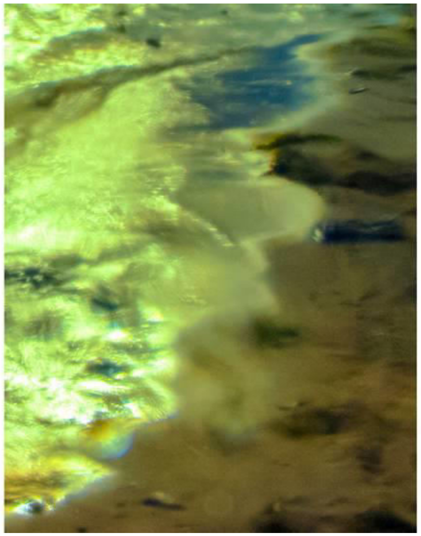
Stats on the Kit: A glimpse into history



The creation of YouTube (2005) is particularly well visible in the data on references in the Kit

The Kit for 2007 was substantially enhanced after 2006—2007 and includes more recent references

June 13, 1990



Fragmets of *Zhara* by T. M. used on the cover with kind permission

Preparation to 40th IYPT' 2027: references, questions and advices

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July 16, 2026

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