

"We try to rethink the traditionally rather technical exercise class, inspiring TAs and their students to enjoy physics together!"



Engaging Physics Tutoring at ETH

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Motivation: Physics class...?



Why?

- TAs have no pedagogical background, basic teaching courses are too general
- Lack of time due to other duties
- Traditionally “old-style” physics teaching/ lack of engaging materials

Teaching physics at ETH

- ~14 introductory physics courses (for physicists, engineers, etc, ~3500students)
- Lectures are given by Professors
- Exercise sessions given by ~100 TAs / semester



We support TAs in their preparations of exercise classes



Materials
&
Interaction



Reflection
&
Feedback

EPT-hub



Training
events



Transferable skills
Socialization

Seven secrets of good teaching

What else is important besides disciplinary content and expertise?

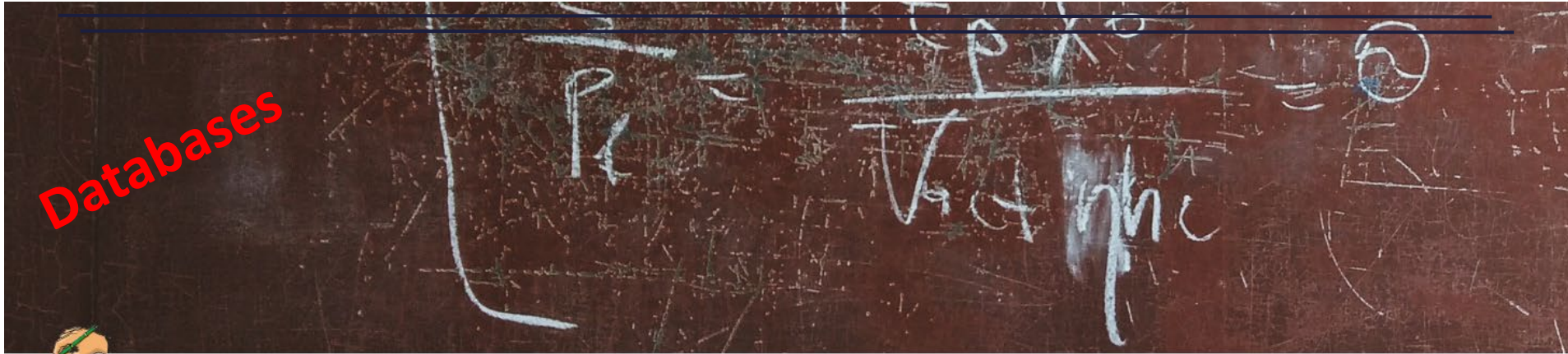
- Clear learning objectives & instructions
- Safe encouraging environment
- Communication & feedback
- Engaging techniques
- Work in team
- Good planning
- Teaching habits

**We have to prepare students
to real-world complexity**



Materials

Repository of personal TA's materials as social product



EPT Hub Database

Physics for PHYS/MATH

- 1 Physics I for PHYS/MATH
- 2 Physics II for PHYS/MATH

Physics for BIOL/PHARM

- 1 Physics I for BIOL/PHARM
- 2 Physics II for BIOL/PHARM

Physcis for MED/HEALTH

- 1 Physics I for MED/HEALTH
- 2 Physics II for MED/HEALTH

Physics for MAVT

- 1 Physics I for MAVT
- 2 Physics II for MAVT

Physics for BAUG

- 1 Physics for BAUG

Physics for Environmental and Agricultural Sciences

- 1 Physics I for ZEUS
- 2 Physics II for ZEUS

Physics for CHAB

- 1 Physics I for CHAB

Einführung in die Kern- und Teilchenphysik

- 1 KTP

Repository of personal TA's materials as social product

Databases

Feature: search by key-words/topics through all courses

Physics I for PHYS/MATH

Table

Teaching Materials

Subjects	Topics	Files	Type of Resource	Author	Professor
Classical Mechanics	Thermo Ideal Gas Isothermal Process Coulomb Force Newton's 2nd	PVK_Physik_Dis...	Latex Notes Theory Expl	Pedro Rosso Bibian	Prof. Dissertori
Thermodynamics	Isothermal Process Isochoric Process Isobaric Process Adia	Ü13_Slides.pptx	Slides Exercise Class	Viola Vogler-Neuling	Prof. Grange
Classical Mechanics	Rotation Moment of Inertia	SlidesÜ8.pptx	Slides Exercise Class	Viola Vogler-Neuling	Prof. Grange
Classical Mechanics	Newtonian Gravity Effective Gravitational Potential	Ü7_Slides.pptx	Slides Exercise Class	Viola Vogler-Neuling	Prof. Grange
Classical Mechanics	Work Energy	Ü5_Slides.pptx	Slides Exercise Class	Viola Vogler-Neuling	Prof. Grange
Classical Mechanics	Circular Motion Kinematics	Ü4_Slides.pptx	Slides Exercise Class	Viola Vogler-Neuling	Prof. Grange
Classical Mechanics	Kinematics Dynamics Collision Newton's 2nd Law	Ü3_Slides.pptx	Slides Exercise Class	Viola Vogler-Neuling	Prof. Grange
Classical Mechanics	Kinematics Dynamics Collision	SlidesÜ2.pptx	Slides Exercise Class	Viola Vogler-Neuling	Prof. Grange
Classical Mechanics	Coordinate Systems Kinematics	Übungstunde ...	Slides Exercise Class	Viola Vogler-Neuling	Prof. Grange
Thermodynamics	Carnot Engine pV-Diagram Entropy	NotesU14.pdf	Exercise Class Practical E	Benjamin Savinson	Prof. Ensslin
Thermodynamics	Heat Ideal Gas Isothermal Process Isochoric Process Isob	NotesU13.pdf	Exercise Class Practical E	Benjamin Savinson	Prof. Ensslin
Classical Mechanics	Damped Oscillation Driven Oscillator	NotesU12.pdf	Exercise Class Practical E	Benjamin Savinson	Prof. Ensslin
Classical Mechanics	Differential Equations Harmonic Oscillator	NotesU11.pdf	Exercise Class Practical E	Benjamin Savinson	Prof. Ensslin
Classical Mechanics	Newtonian Gravity Potential Moment of Inertia	NotesU10.pdf	Exercise Class Practical E	Benjamin Savinson	Prof. Ensslin
Classical Mechanics	Kepler's Laws Effective Gravitational Potential	NotesU9.pdf	Exercise Class Practical E	Benjamin Savinson	Prof. Ensslin
Classical Mechanics	Newton's 2nd Law Oscillations	NotesU8.pdf	Exercise Class Practical E	Benjamin Savinson	Prof. Ensslin

EPT Hub Database

Physics for PHYS/MATH

- 1 Physics I for PHYS/MATH
- 2 Physics II for PHYS/MATH

Physcis for MED/HEALTH

- 1 Physics I for MED/HEALTH
- 2 Physics II for MED/HEALTH

Physics for BAUG

- 1 Physics for BAUG

Physics for CHAB

- 1 Physics I for CHAB

Development of eBooks with complete lesson designs

For dedicated course, for every lesson

The image displays three overlapping screenshots of the EPT eBook website interface. The top-left screenshot shows the landing page for 'EPT didactical tool-box for your exercise class on physics I for MED/HEST students', listing authors Vira Bondar, Jonas Nuber, Manuel Zeyen, and Günther Dissertori, and consultant Guillaume Schiltz. The top-right screenshot shows the landing page for 'Engaging Physics Tutoring: Physics I for BIOL students', listing authors Vira Bondar, Jonas Nuber, Manuel Zeyen, Jesse Zhang, Oscar Lara Crosas, and Klaus Kirch, with consultant Guillaume Schiltz. The bottom screenshot shows the landing page for 'Engaging Physics Tutoring: Introduction to Nuclear and Particle Physics', listing authors Vira Bondar, Jonas Nuber, Manuel Zeyen, and Klaus Kirch, with consultant Guillaume Schiltz. Each page features the ETH zürich logo, navigation links (Home, Read, Admin, Sign out), and a 'Read Book' button. The interface is primarily dark blue with white text and images.

Examples of materials

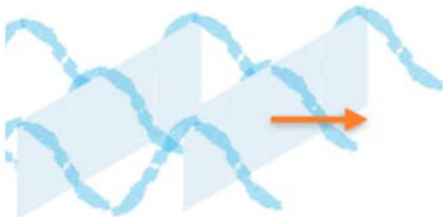
Little summaries

Mehrdimensionale Wellen

Alle Punkte auf einer Welle mit derselben Phase bilden eine Phasenfläche (auch: Wellenfront).

Beispiel: Punkte entlang eines Wellenkamms sind auf einer Wellenfront

Ebene Wellen (2D)



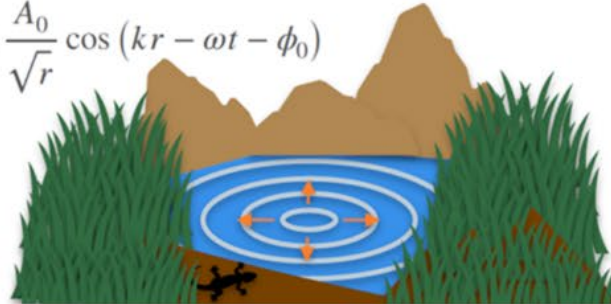
$$\Psi(x, t) = A \cos(kx - \omega t - \phi_0)$$

*Bewegen sich in eine Richtung,
Wellenfronten sind Ebenen*

Kreiswellen (2D)

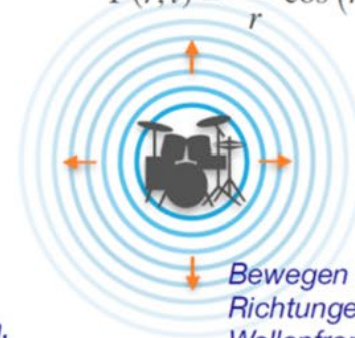
*Bewegen sich radial nach aussen,
Wellenfronten sind Kreise*

$$\Psi(r, t) = \frac{A_0}{\sqrt{r}} \cos(kr - \omega t - \phi_0)$$



Kugelwellen (3D)

$$\Psi(r, t) = \frac{A_0}{r} \cos(kr - \omega t - \phi_0)$$



*Bewegen sich in alle
Richtungen nach aussen,
Wellenfronten sind
Hohlkugeln*

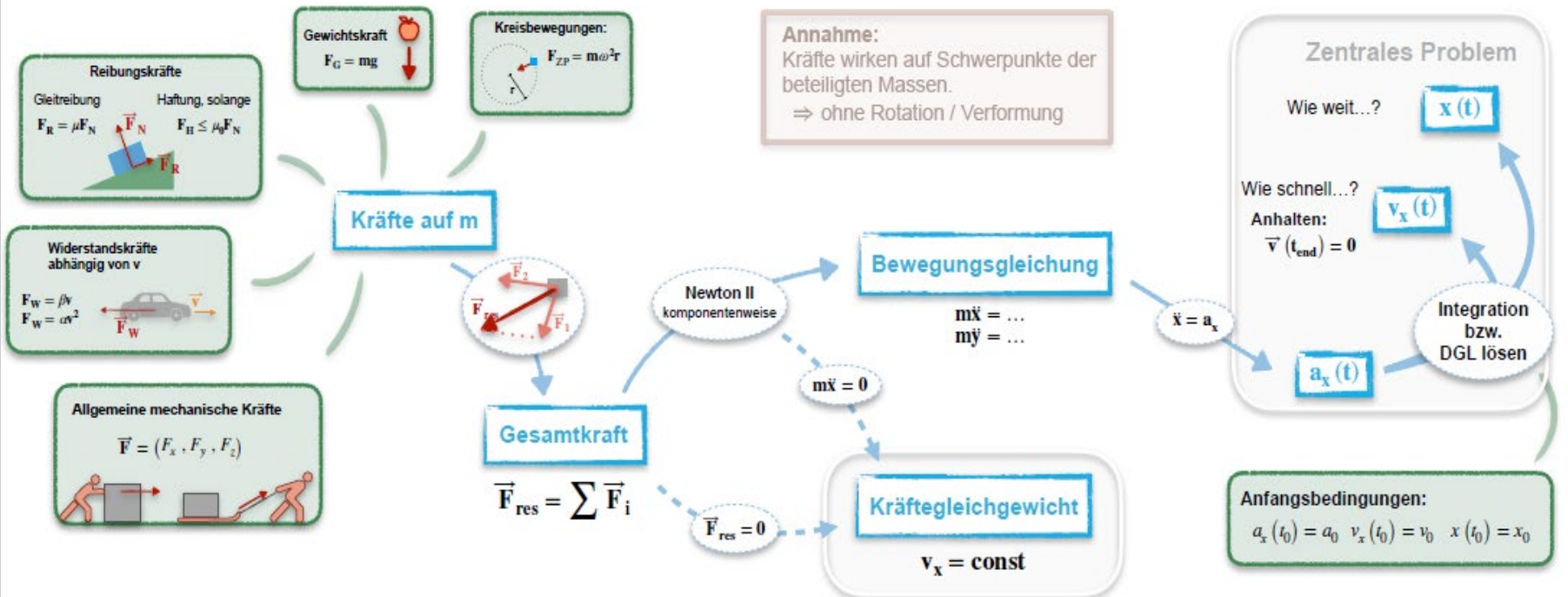
Theoretical organizer on mechanics: students get birdview on topical lessons and connections between them

Von der Kraft zur Position: Rechnen mit Massenschwerpunkten

Kräfte aufstellen



Problem lösen



Concept questions

How is it possible that the stone doesn't fall?

Wie kann es sein, dass der Felsen in dieser Position bleibt?

- a) Die Reibungskraft ist gerade genau so gross wie die Hangabtriebskraft.
- b) Die Reibungskraft ist viel grösser als die Hangabtriebskraft.
- c) Die Normalkraft kompensiert die Reibungskraft gerade so, dass die Hangabtriebskraft null wird.
- d) Die Normalkraft ist grösser als die Gravitationskraft, sodass die Hangabtriebskraft null wird.



Gamification

Newton of our life

“EVERYTHING that happens in our lives can be connected back to one of Newton’s 3 laws of motion since force is involved in everything...”

...lets play the cards with Newton;)...which Newton’s law?

(more than 1 answer is possible, explain the physics behind)





**THAT
SOUNDS
LIKE
A
CHALLENGE**



<https://www.youtube.com/watch?v=9WiGCfxA-UA>

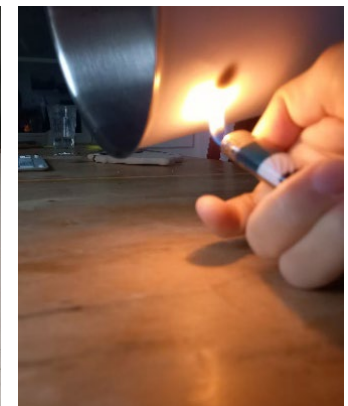
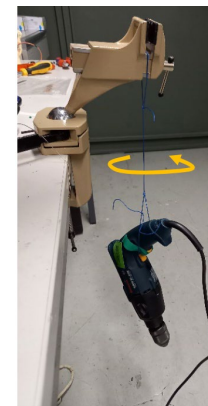
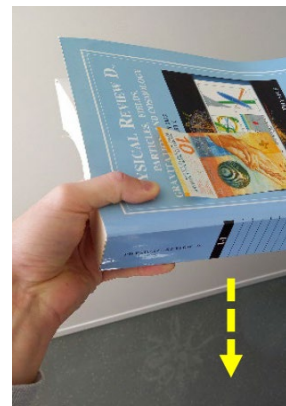
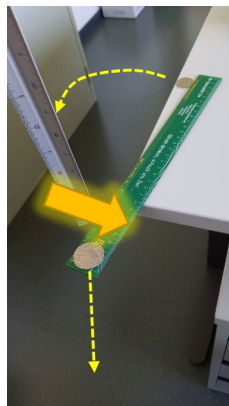
<https://ept.ethz.ch/#service>

Hands-On experiments for physics TAs

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PHYSICS
TUTORING **EPT**

Physics I

Kinematics, Newtonian dynamics, Thermodynamics and Optics



TA's Training

Examples of EPT events

"HANDS-ON" SEMINAR FOR PHYSICS TAs

HOW TO ACTIVATE MY STUDENTS: the "puzzle" method

Date: 11.11
Time: 16:00-16:45
Registration: ept@ethz.ch
Place/format: announcement upon registration



ENGAGING
PHYSICS
TUTORING **EPT**

Date/Time: 28.04.22 / 16.00-16.45
Registration: ept@ethz.ch
Format: online

ENGAGING
PHYSICS
TUTORING **EPT**

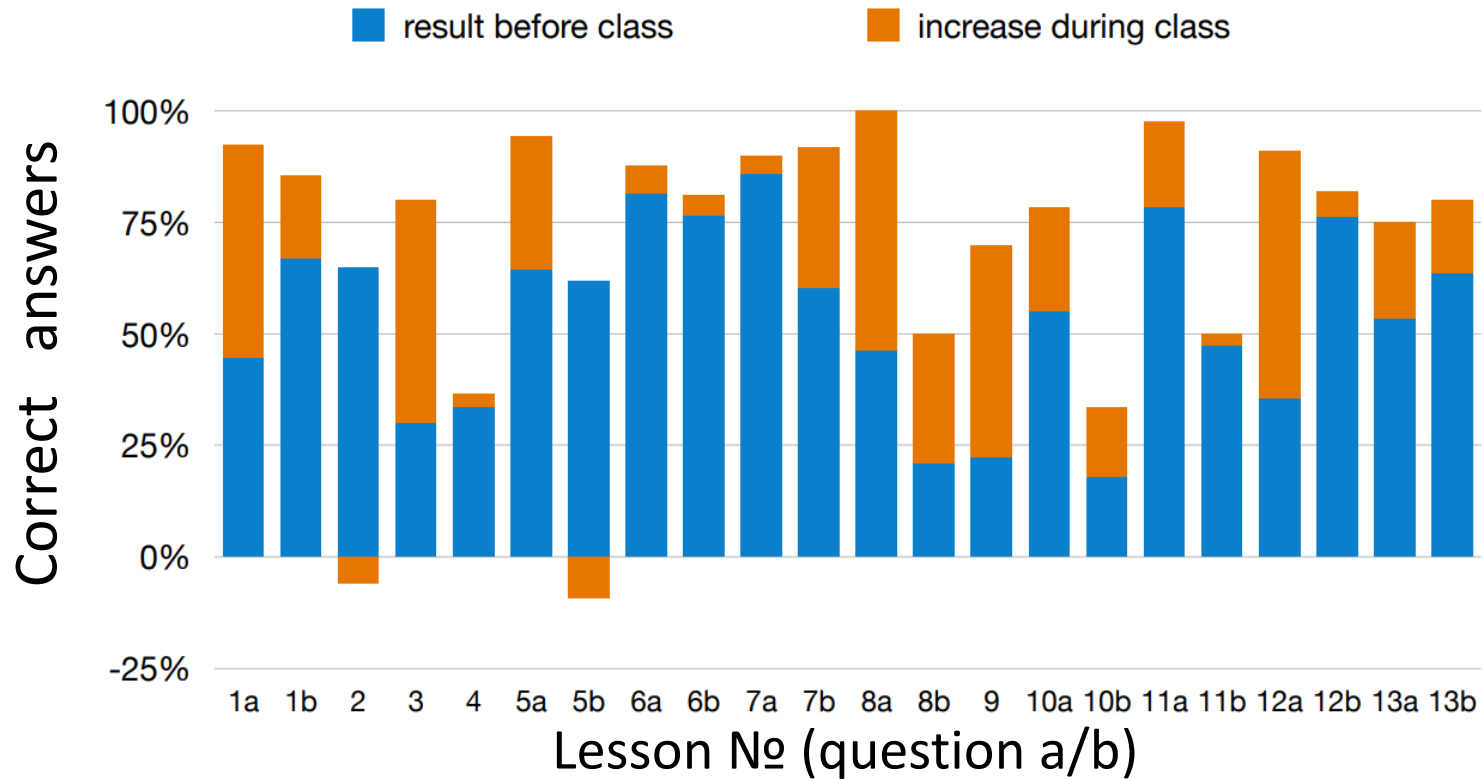
FOR PHYSICS TAs TIME MANAGEMENT

WORKSHOP WITH EMILY ALICEA-MUÑOZ (GEORGIA TECH)



Evaluation and feedback

Learning progress: MC question before and after the class

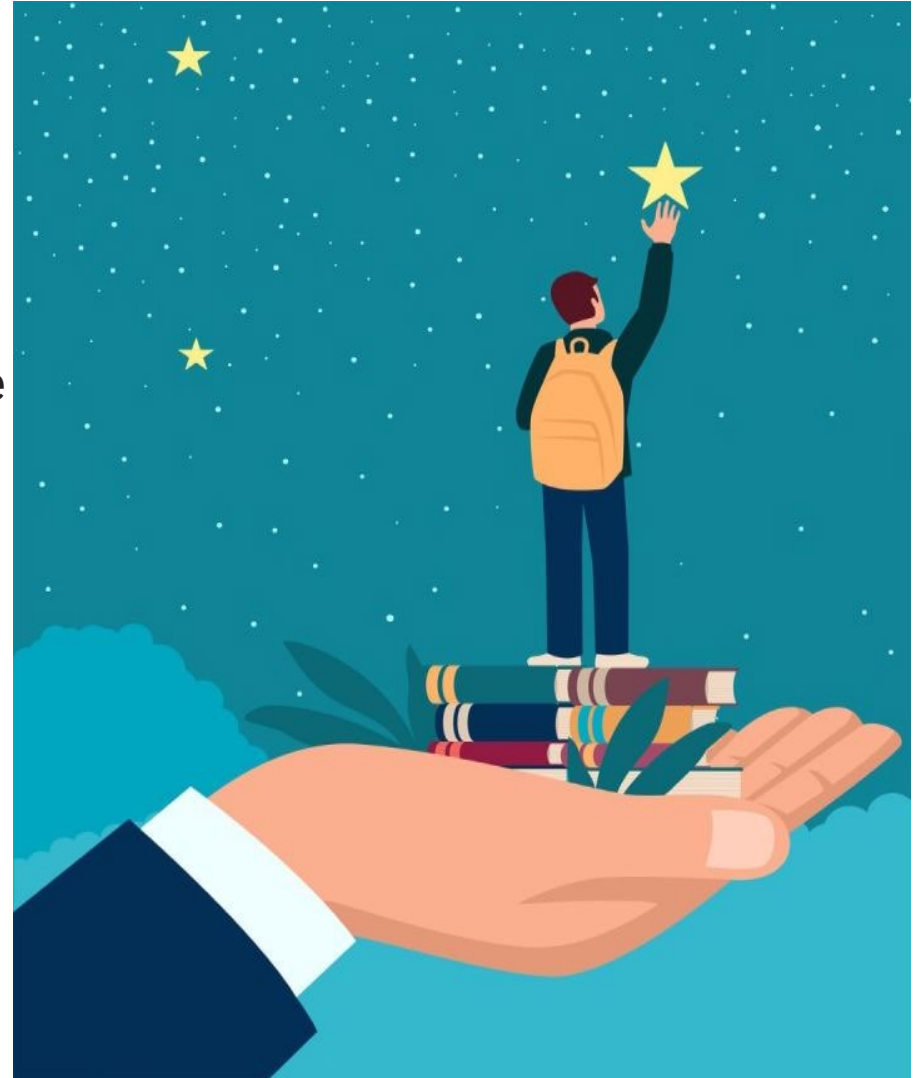


Further student's impressions

“This class is a great inspiration for me, my TA is great!”

“The activities bring the "personal" feel of the class and physics around us, I really like it”

“EPT resources make concepts much more clear. The level of interaction with others is nice, it motivates me a lot for learnings”

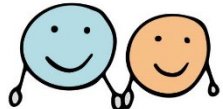

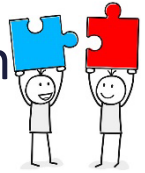




Lets try it!



Puzzle activity

Instruction

- You will do the activity with your neighbours in groups of 2 
- There is white cardboard with envelop under some seats – take it!
- Cardboard can be used as a “table” for puzzle.
- Open envelop, take out chocolate, enjoy it together 
- Take out components of the puzzle and complete it together 
- You have 3min for this task. 
- Consulting with other neighbours is allowed 



Electromagnetic waves

Interference

Superconductivity

Doppler effect

523 nm

Resonance



Doppler effect



Electromagnetic waves



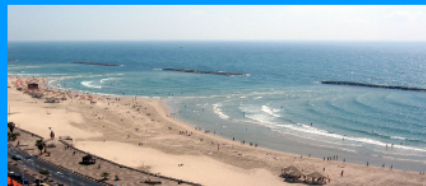
Superconductivity



523 nm



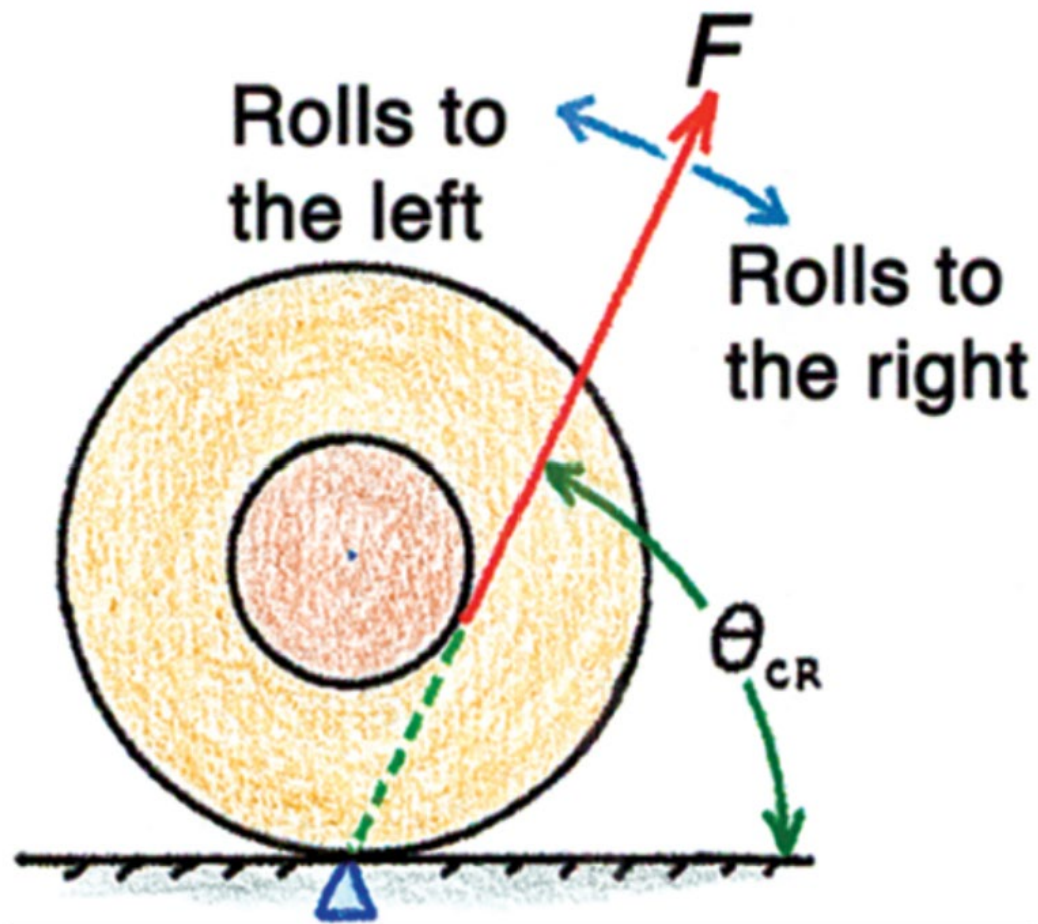
Resonance



Interference

Time for experiments





Waves...



Teaching habits



- Just DO it!
- In the beginning it feels uncomfortable
- Stick to it until it becomes a new normal

EPT summer camp

23-26 JUNE, 2024
MATTLI ANTONIUSHAUS
MORSCHACH

CONTACT: EPT@ETHZ.CH

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ept.ethz.ch

TOPICS:

Engaging teaching
Transferable skills
Equity and inclusion



Warmest welcome!

Impressions from the last camp..



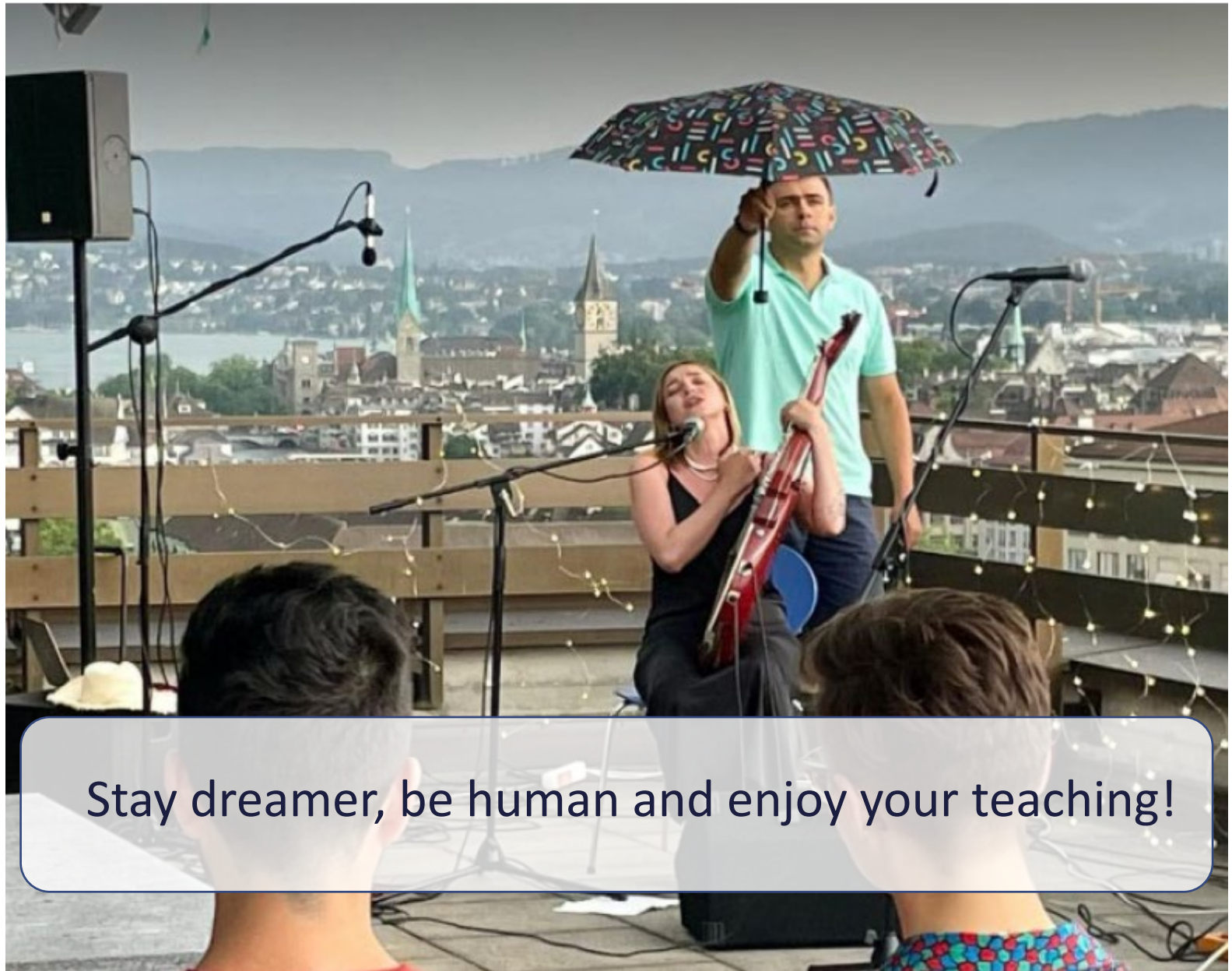
- 39 participants (PhD students & postdocs)
- Representatives from 4 Departments

Feedbacks:

“Broad mix of workshops was very useful for my self-improvement in teaching and PhD research.”
“I liked that camp was very inclusive, feeling of being welcomed was overwhelming.”
“After this camp I feel very excited and happy about teaching, and my life in general 😊”



<https://www.youtube.com/watch?v=AS9xx3zHcLg>



Stay dreamer, be human and enjoy your teaching!