# IYPT

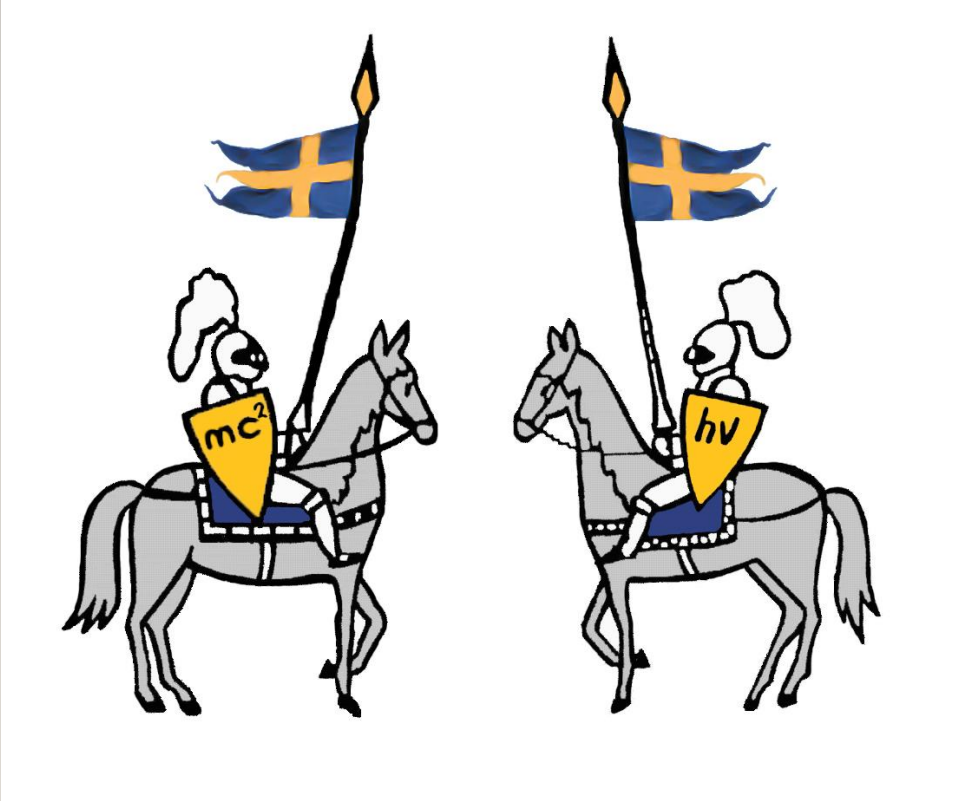
En unik möjlighet för gymnasiearbete!

# MÅLET MED DAGENS PRESENTATION: SVARA PÅ TRE FRÅGOR

- **Vad är IYPT?**
- **Varför IYPT?**
- **Hur gör man IYPT?**

# VAD ÄR IYPT?

# IYPT ?




**International Young Physics Tournament**

**Unga Fysikers Världstävling**

**En tävling för dig som går på gymnasiet**

# FYSIK VS TEKNIK?

- IYPT är formellt en fysiktävling: Vad har det med teknik att göra?
- Grovt uppdelat:
  - Fysik sysslar med varför saker är som det är.
  - Teknik sysslar med hur det kan användas.
- Mer semantik än egentlig ämnesskillnad.
- Fysiker tjänar ofta på att ha en mer teknisk infallsvinkel
- Tekniker förstår ofta systemet bättre om de förstår fysiken.

# BAKGRUNDEN TILL IYPT

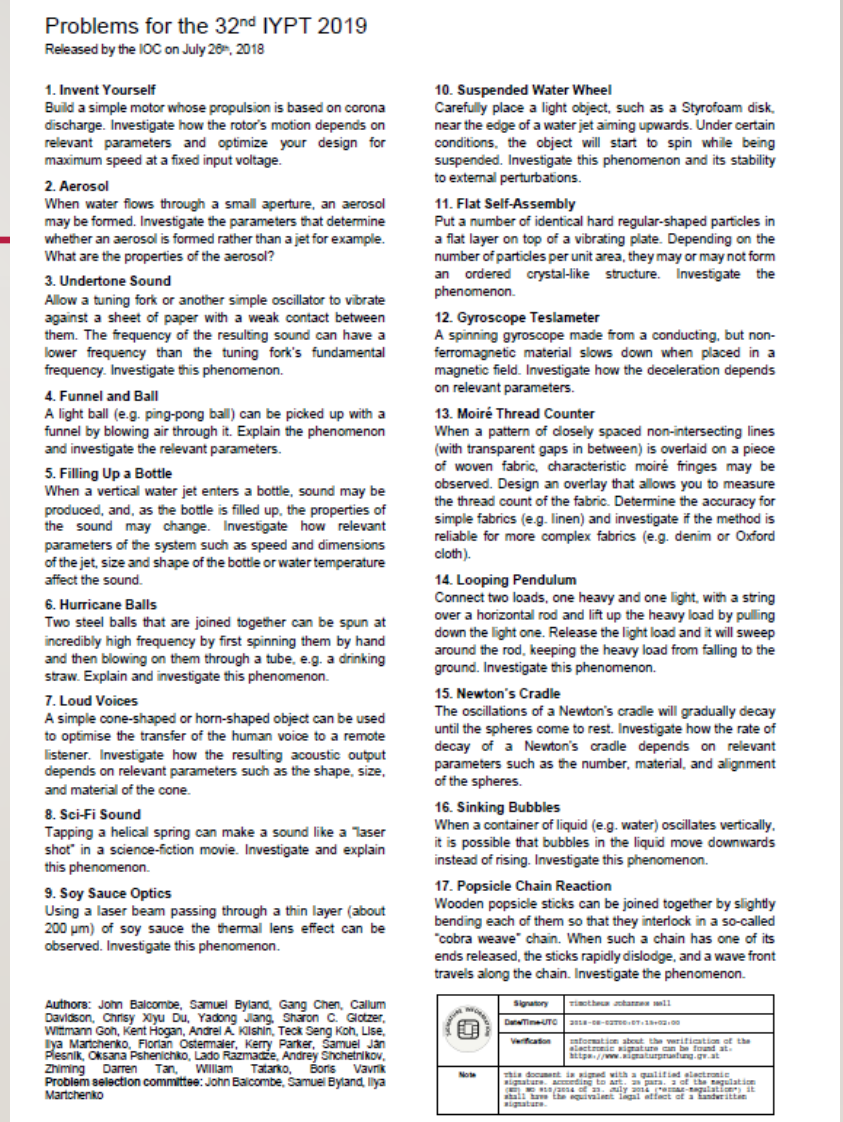
1979 ställde Evgeny Yunosov frågan:

**Vad skulle hända om elever på gymnasiet får riktiga forskningsproblem att arbeta med?**

<u>Kärnan inom IYPT:</u>

17 öppna, utmanande fysikproblem som i nuläget saknar fullständig lösning ska lösas under ett år

**Du fokuserar på ett av dem!**



Problems for the 32nd IYPT 2019

Released by the IOC on July 26th, 2018

**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.

**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?

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**12. Gyroscope Teslameter**
A spinning gyroscope made from a conducting, but non-ferromagnetic material slows down when placed in a magnetic field. Investigate how the deceleration depends on relevant parameters.

**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).

**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.

**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.

**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.

**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.

**Authors:** John Balcombe, Samuel Byland, Gang Chen, Callum Davidson, Chrisy Xiyu Du, Yadong Jiang, Sharon C. Glotzer, Wittmann Goh, Kent Hogan, Andrei A. Klishin, Teck Seng Koh, Lise, Ilya Martchenko, Florian Ostermaier, Kerry Parker, Samuel Ján Piesnik, Oksana Pshenichko, Lado Razmadze, Andrey Shchetnikov, Zhiming Darren Tan, William Tatarko, Boris Vavrik
**Problem selection committee:** John Balcombe, Samuel Byland, Ilya Martchenko

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| | Verification | information about the verification of the electronic signature can be found at: https://www.signaturpruefung.gv.at |
| Note | this document is signed with a qualified electronic signature, according to art. 25 para. 2 of the regulation (eu) no 910/2014 of 23. july 2014 ("eidas-regulation") it shall have the equivalent legal effect of a handwritten signature. | |

# EXEMPEL PÅ PROBLEM:

**10. Suspended Water Wheel**

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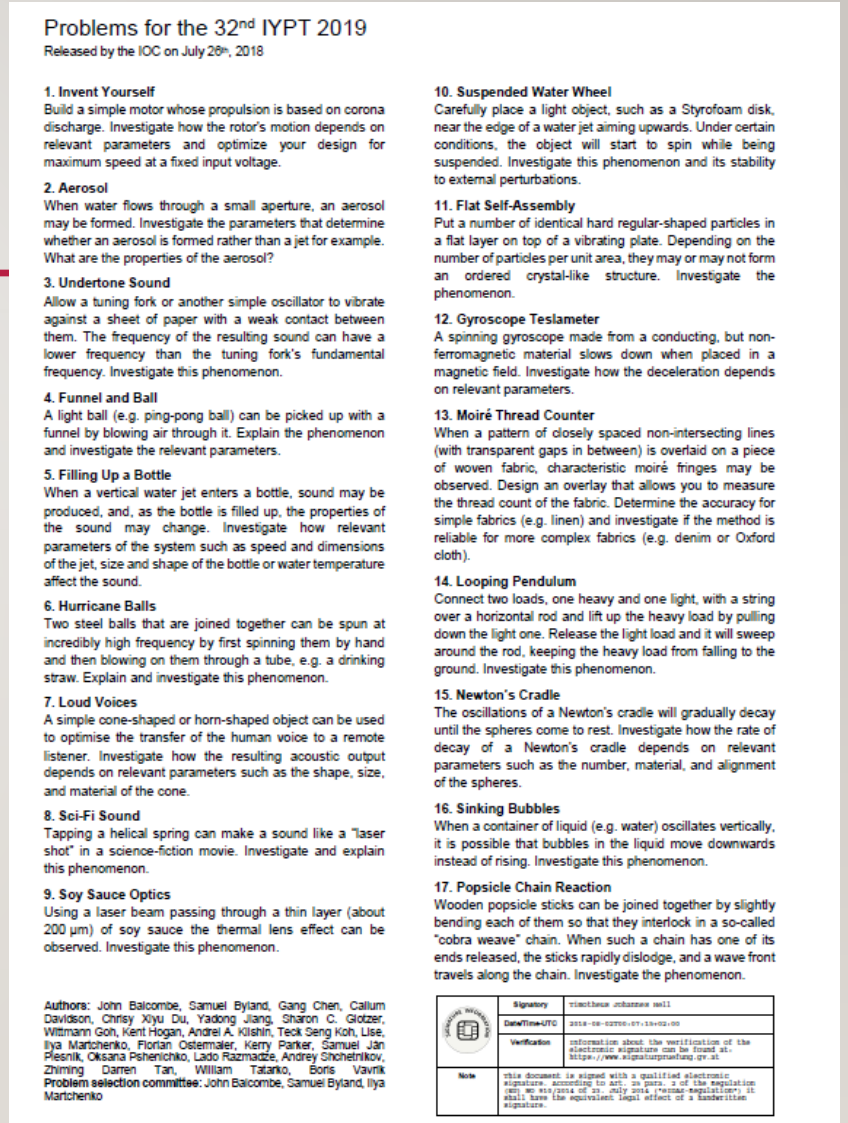
Under certain conditions, the object will start to spin while being suspended.

Investigate this phenomenon and its stability to external perturbations



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# FÖRSTA EXPERIMENTET

https://www.youtube.com/watch?v=mNHp8iyyIjo&t=50s

# MÖJLIGA FRÅGESTÄLLNINGAR

- Vilken vattenhastighet behövs?
- Finns det en maximal hastighet? Minimal?
- Vilken egenskaper hos bollen är viktig?
  - Radie?
  - Massa?
  - Ytegenskaper?
- Vilka egenskaper hos strålen?
  - Radie? Droppar?
- Kommer bollen att snurra för evigt?
  - Livstid?

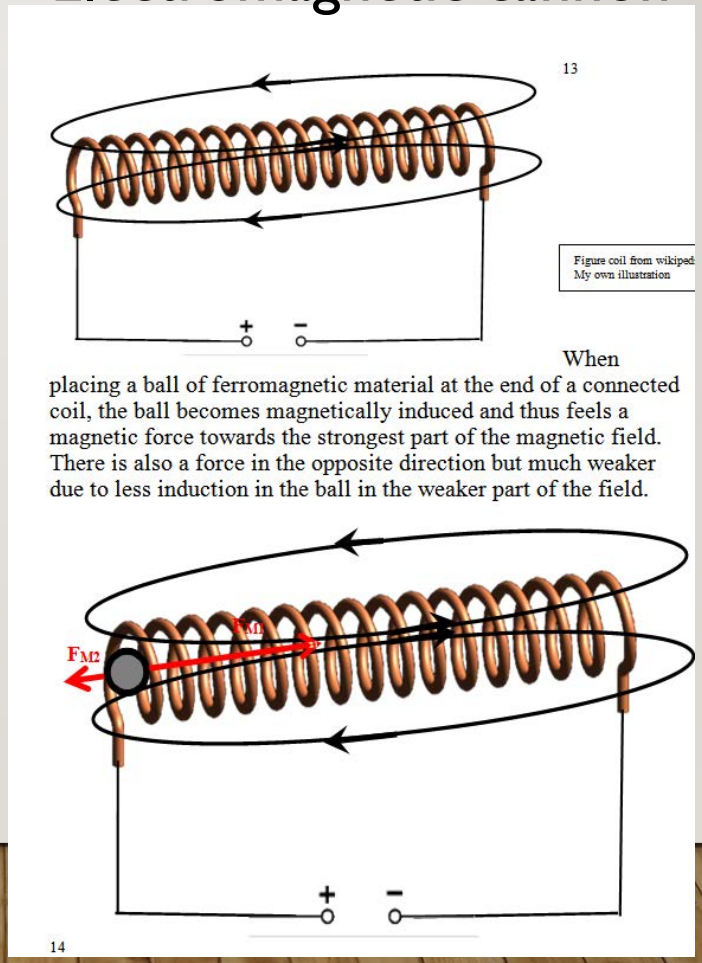
# ANDRA EXEMPEL OCH TIDIGARE DELTAGARE

Blanka Kesek, 2010

**1. Electromagnetic cannon**

A solenoid can be used to fire a small ball. A capacitor is used to energize the solenoid coil. Build a device with a capacitor charged to a maximum 50V. Investigate the relevant parameters and maximize the speed of the ball.

Electromagnetic cannon



# ANDRA EXEMPEL OCH TIDIGARE DELTAGARE

Jingcheng Zhao, 2012

**1. Adhesive tape**

Determine the force necessary to remove a piece of adhesive tape from a horizontal surface. Investigate the influence of relevant parameters.

Adhesive Tape


**[THE FORCE REQUIRED TO PULL OF A PIECE OF ADHESIVE TAPE FROM A HORIZONTAL SURFACE]**

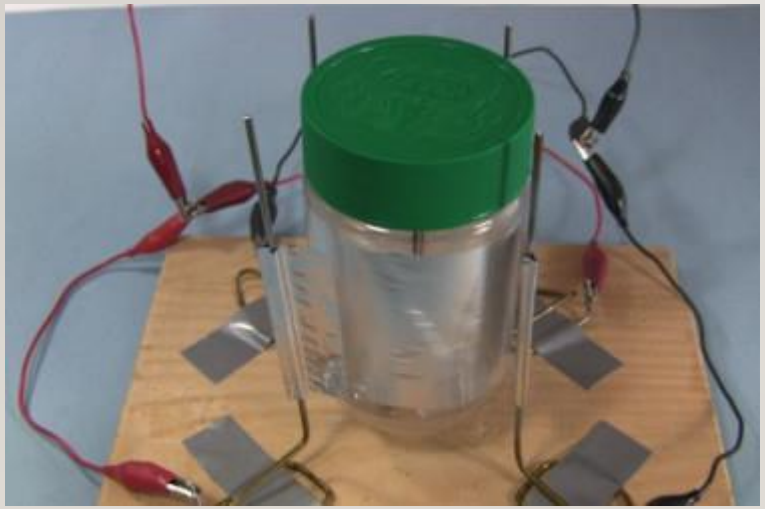
# MASSOR MED SPÄNNANDE PROBLEM!

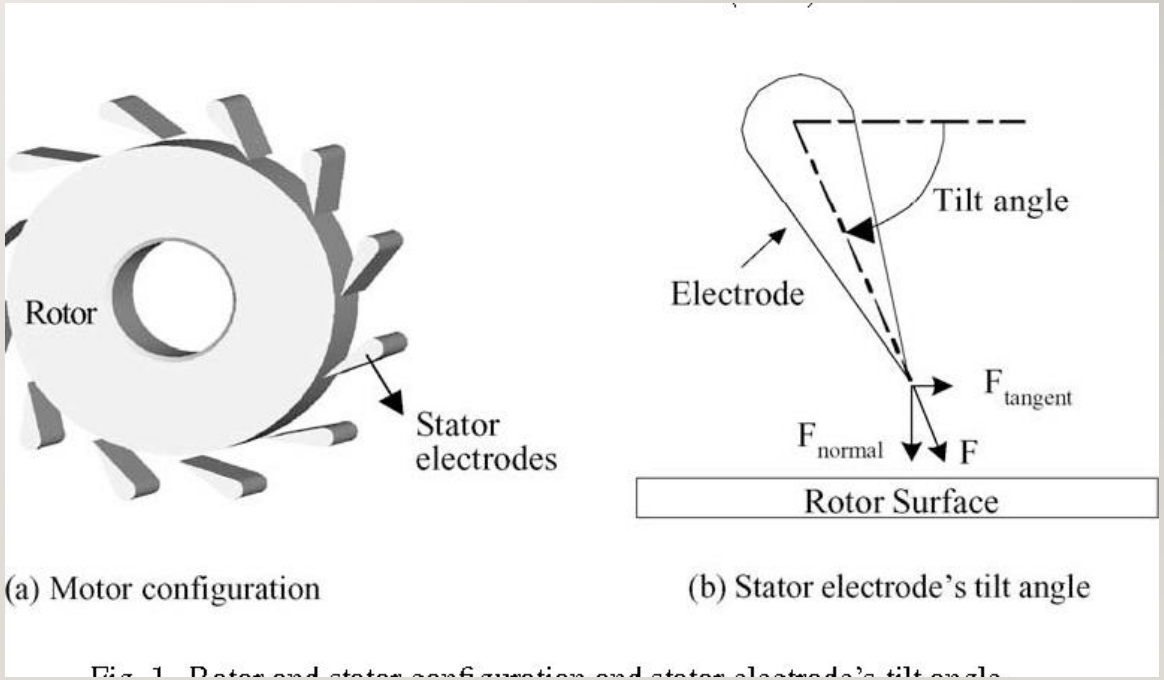
IYPT erbjuder 17 stycken problem varje år

# 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.





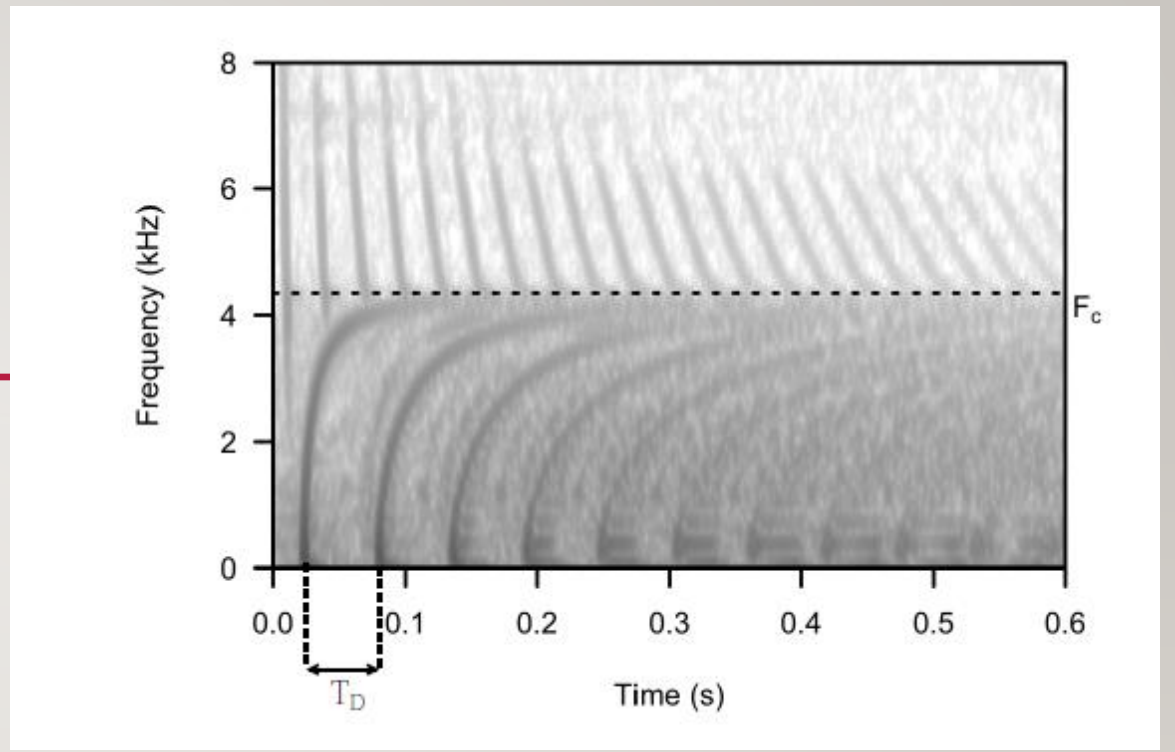

(a) Motor configuration

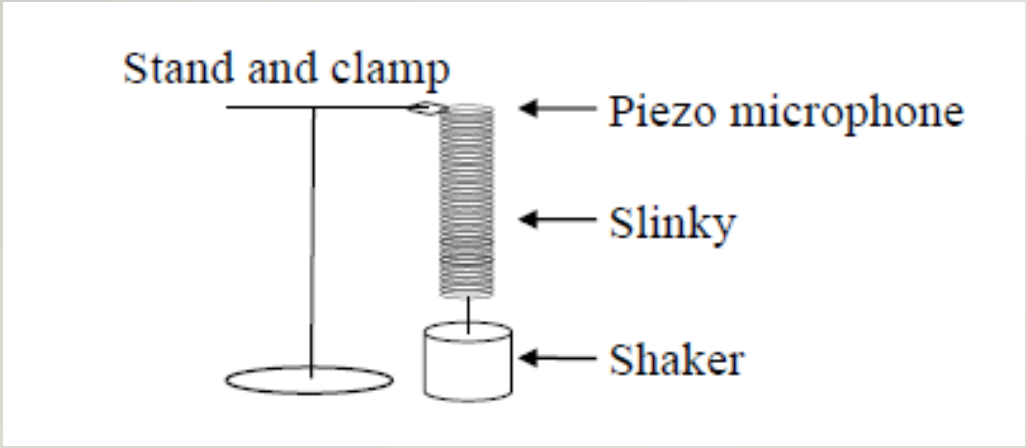
(b) Stator electrode's tilt angle

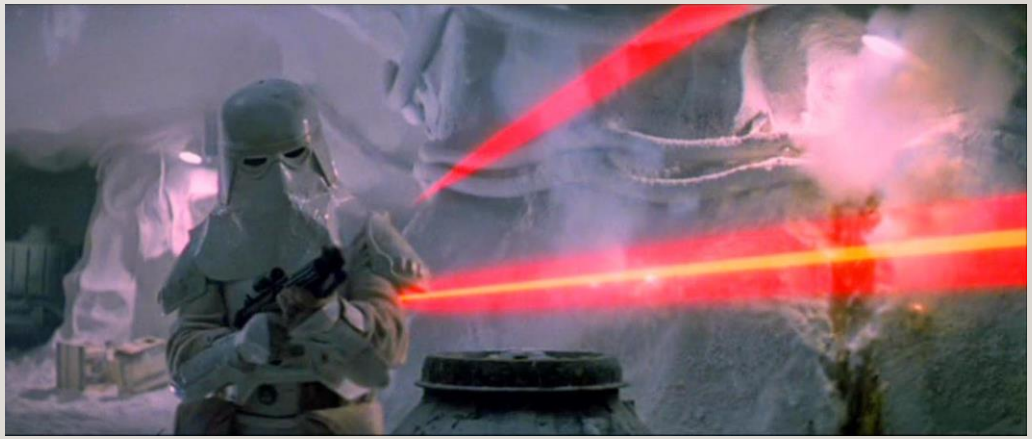
Fig. 1. Rotor and stator configuration and stator electrode's tilt angle

# 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.



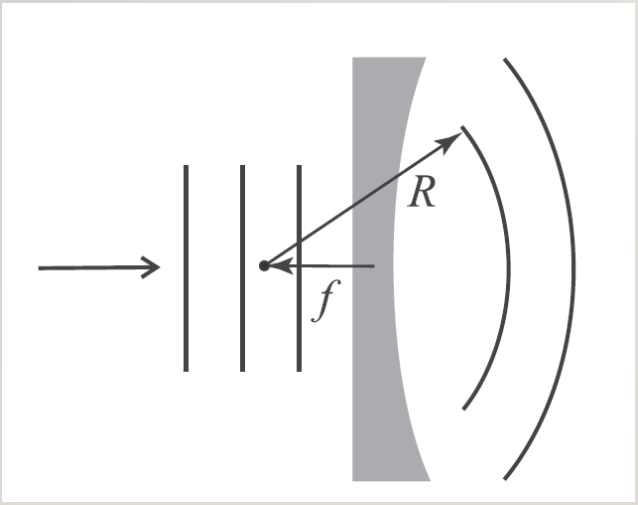



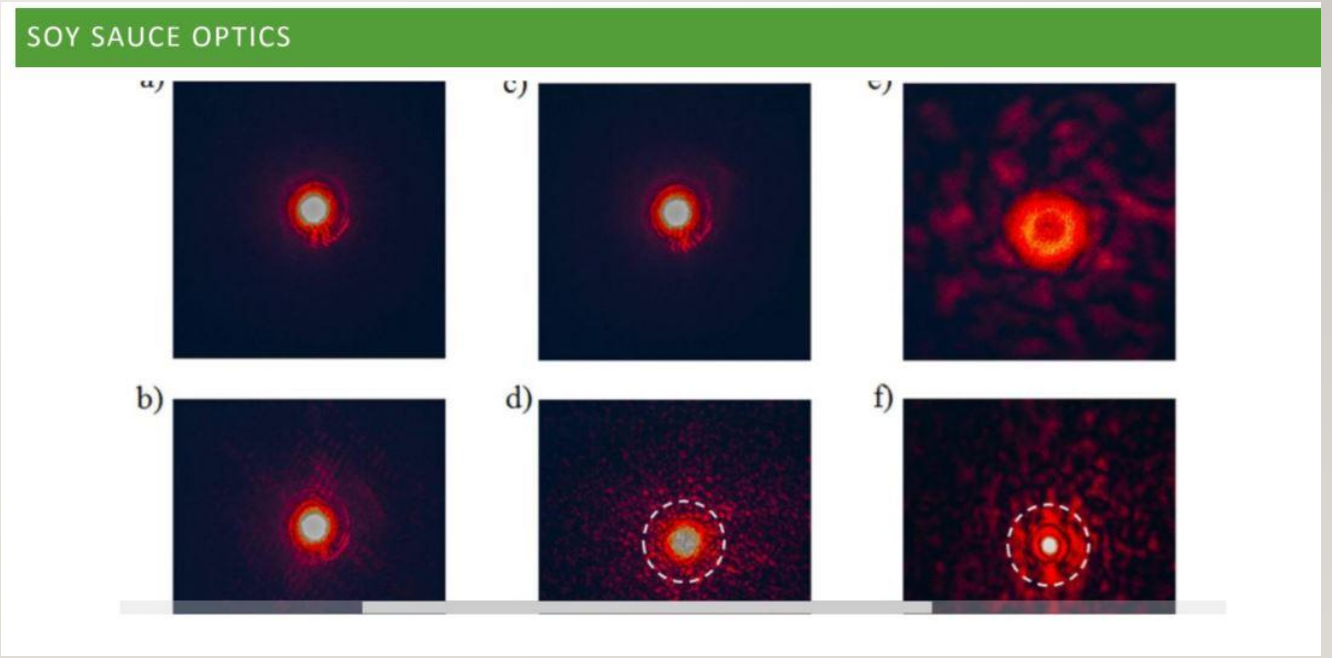



# 9. SOY SAUCE OPTICS


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.



# 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).

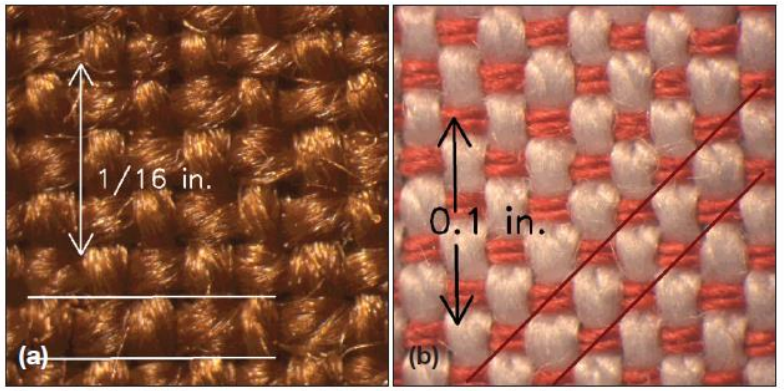
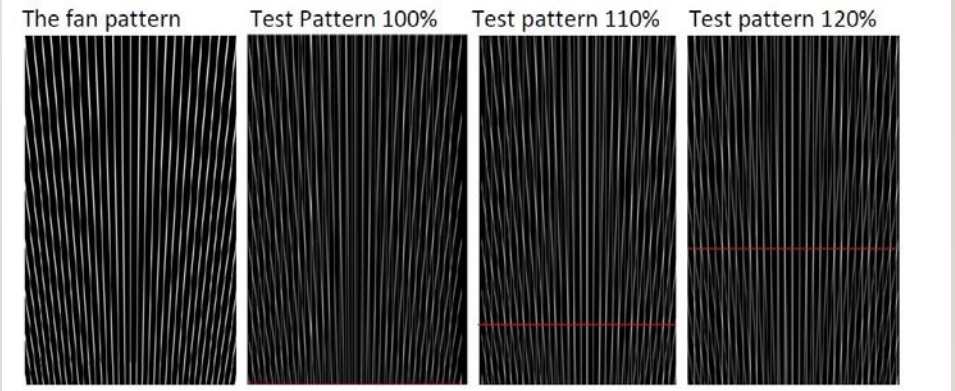


Fig. 7. (a) Plain weave fabric. (b) Oxford cloth.



# MÅLET MED DAGENS PRESENTATION: SVARA PÅ TRE FRÅGOR

- **Vad är IYPT?** ✓
- **Varför IYPT?**
- **Hur gör man IYPT?**

# VARFÖR IYPT?

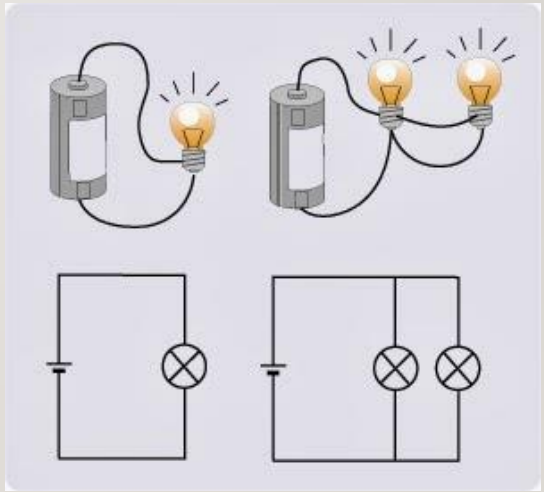
3 Argument

# 1. MÖJLIGHET ATT DELTA I FORSKNING

# ”VANLIG” UNDERVISNING

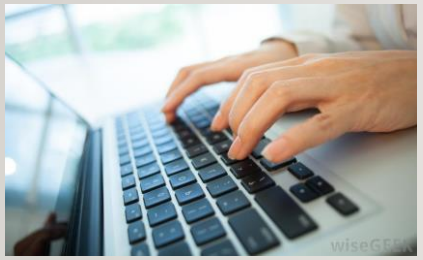
**Läs om begreppet i läroboken**


**Gör en laboration och kolla att det stämmer**



# HUR IYPT GÅR TILL

**Sök efter tidigare forskning**



**Testa fenomenet**

**Formulera teoretiska modeller**

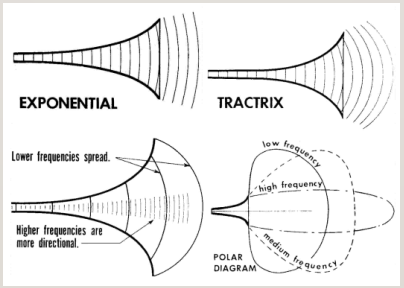
$$\iint_{\mathcal{A}} \nabla_{\perp}^2 p_1 + p_{0XX} + \kappa^2 p_0 \, d\sigma = \int_{\partial \mathcal{A}} \nabla_{\perp} p_1 \cdot \boldsymbol{n}_{\perp} \, d\ell + A(p_{0XX} + \kappa^2 p_0) =$$

$$p_{0X} \int_0^{2\pi} R R_X \, d\theta + A(p_{0XX} + \kappa^2 p_0) = A_X p_{0X} + A(p_{0XX} + \kappa^2 p_0) = 0.$$

**Få idéer**

**Upptäck nya fenomen**

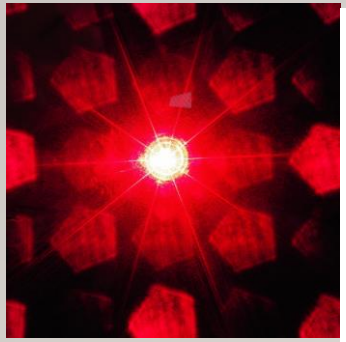
**Gör systematiska experiment**

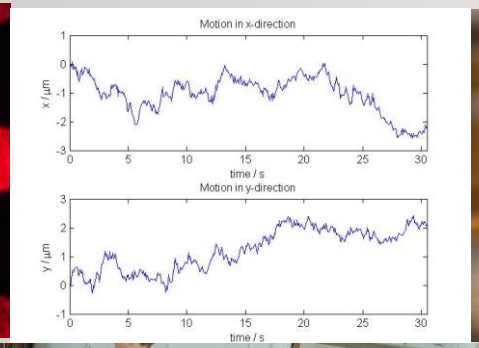


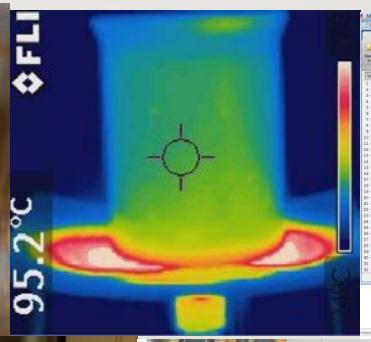

**Förutsägelser**

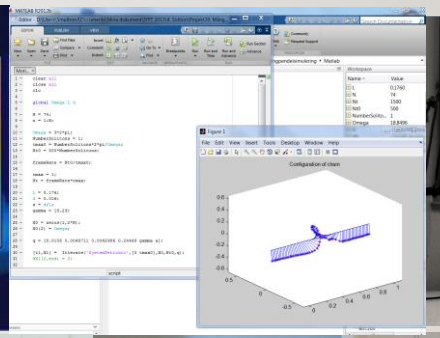
**Dataanalys**

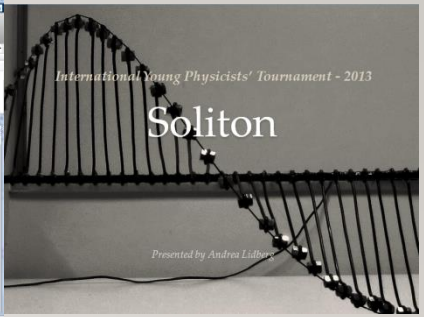
# IYPTS FORSKNINGSGRUPP

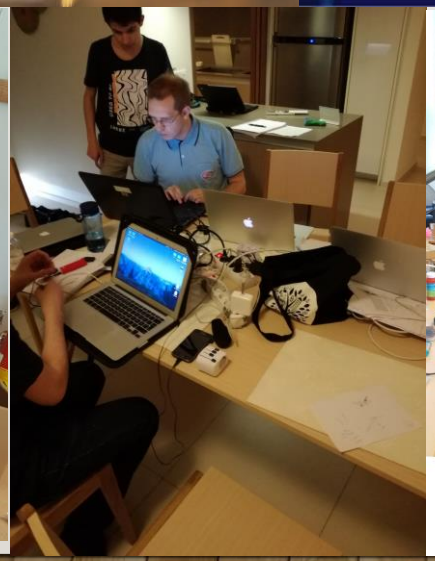






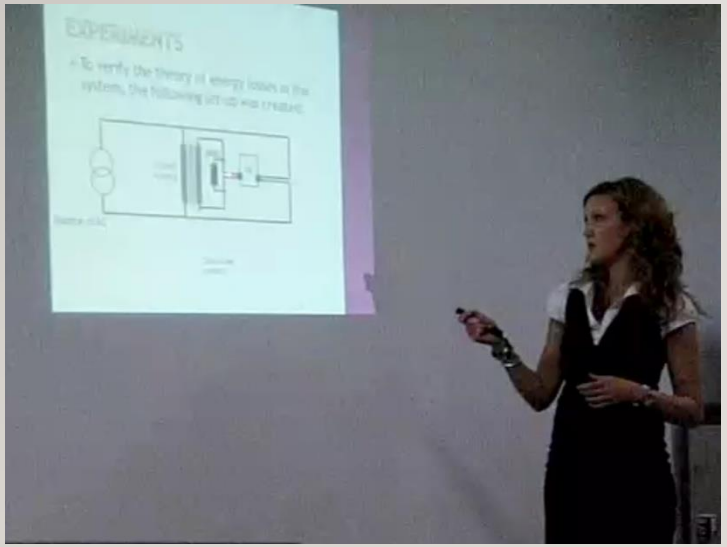



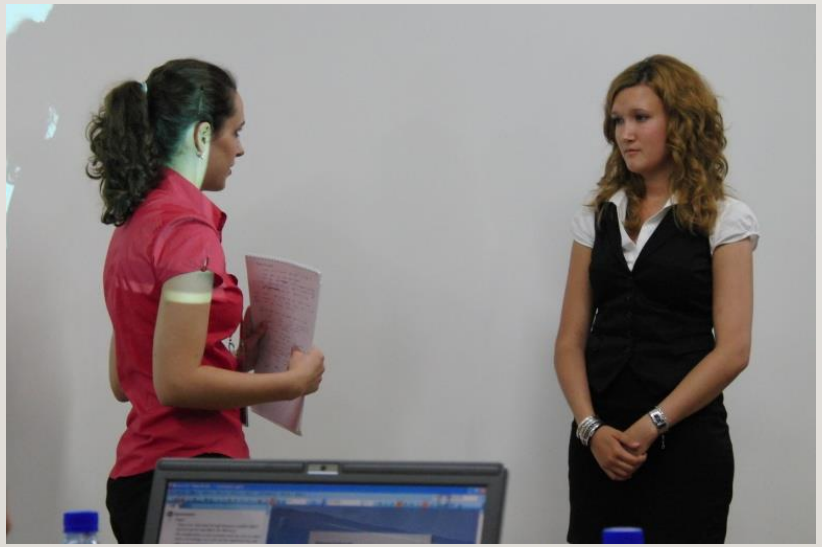
# 2.TÄVLA I FYSIK/TEKNIK

# FYSIKTÄVLING

- Använd din forskning för att tävla om en plats i svenska VM-laget i fysik

# BÅDE EN NATIONELL OCH INTERNATIONELL TÄVLING



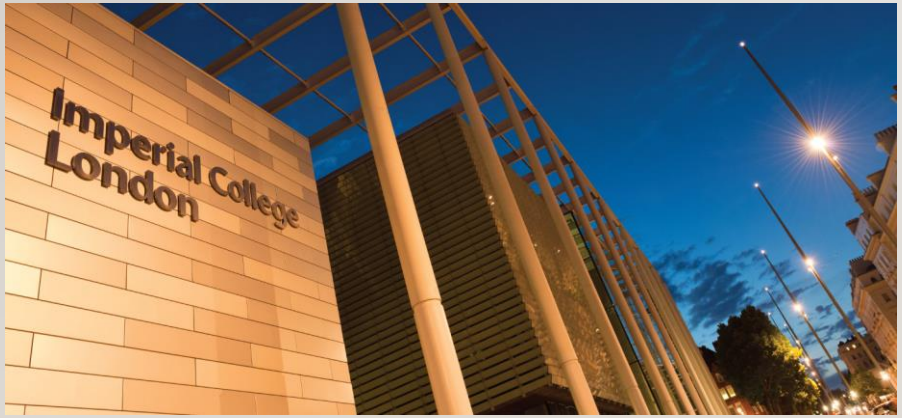
# RESULTATET!


Silver Medal
Sweden
Mikael Cognell
Tina Eslami
Maria Anghel
SWEDEN

# 3. FLYGANDE START PÅ UNIVERSITET!

# STUDERA UTOMLANDS?

- IYPT är en välkänd tävling bland universitet.
- Ses som en klar merit.
- IYPT Alumni runt hela världen

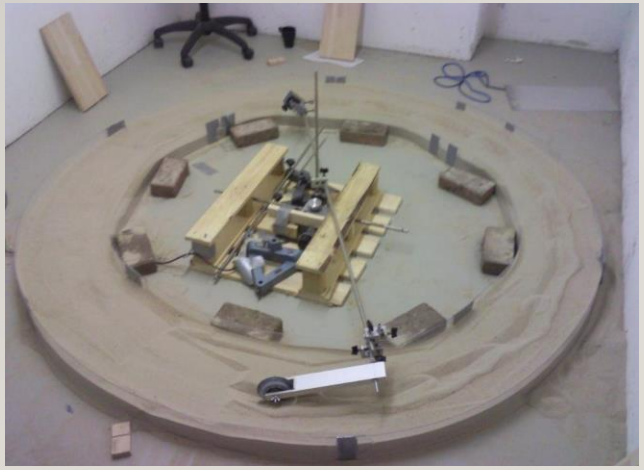


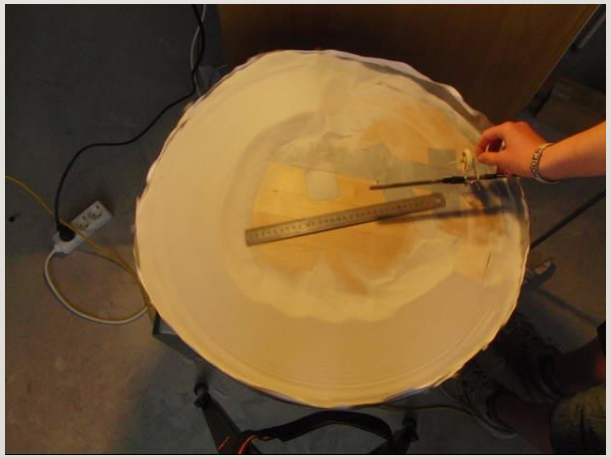

Yale University

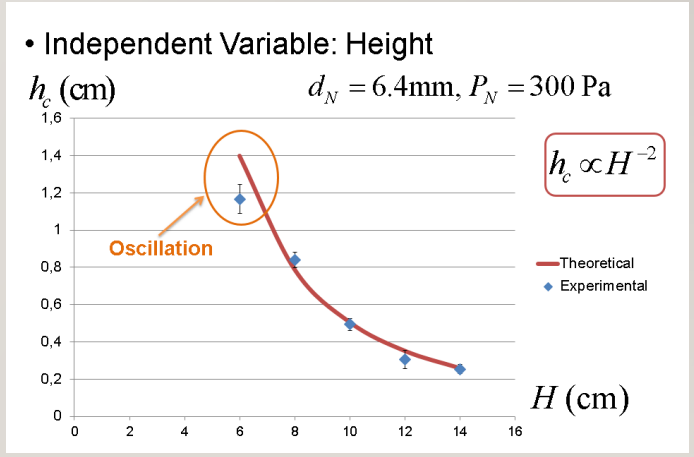
Massachusetts Institute of Technology

# STUDERA TILL INGENJÖR?

- IYPT tränar i att bygga smarta lösningar = ingenjörskunskap!
- Träna att hantera vad man gör när saker går snett!
- Hitta struktur

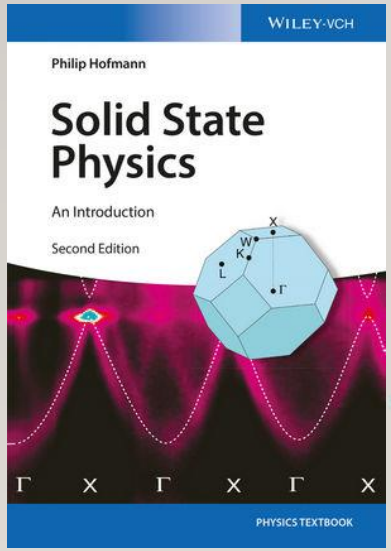


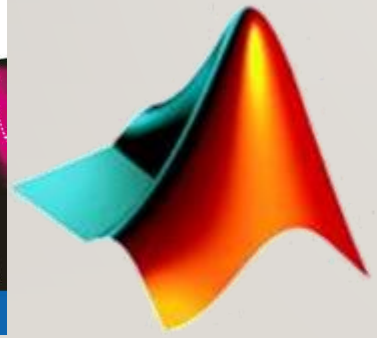


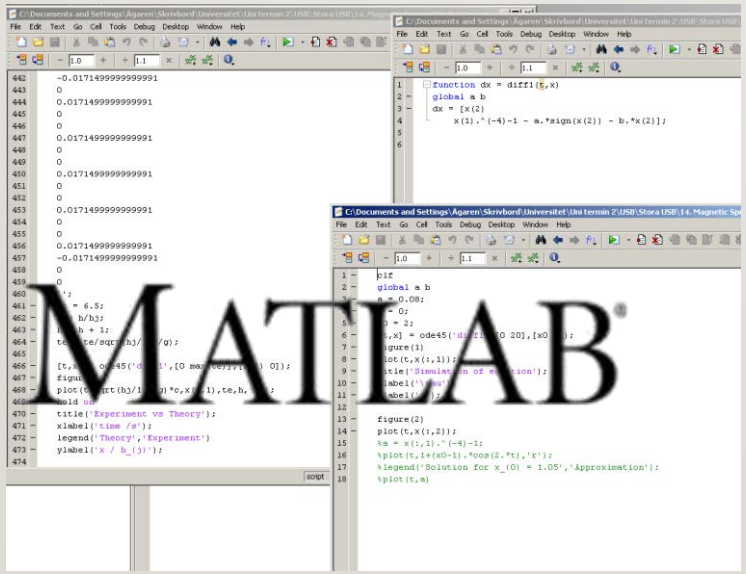


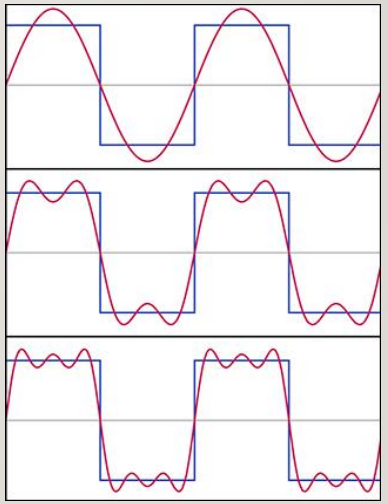
# STUDERA NATURVETENSKAP ELLER MATEMATIK?

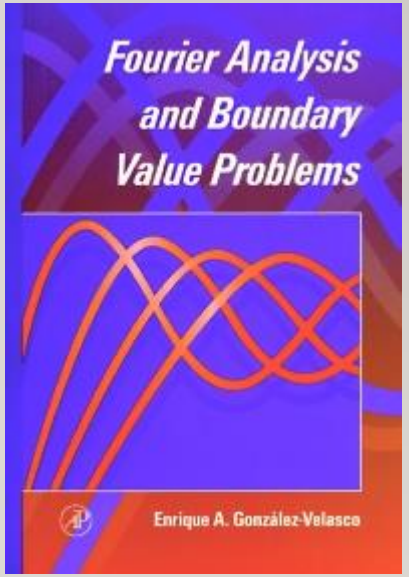
- Fysiken/Matematik inom IYPT ligger 2-3 år in på universitet!
- Elever som är med genomgår en enorm utveckling.



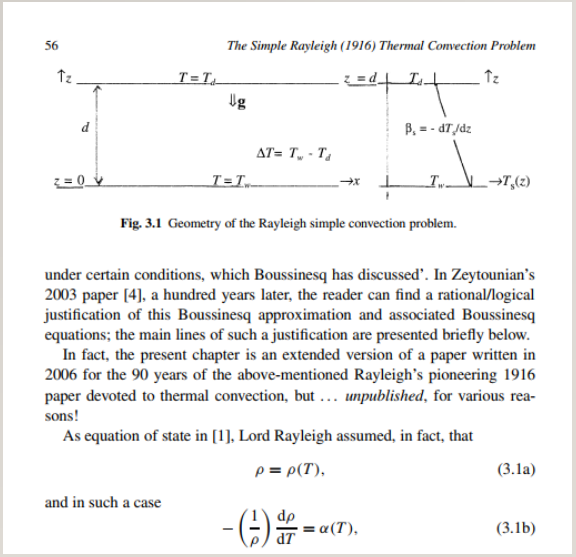




# ELLER NÅGOT ANNAT?

- **Tävlingen är på engelska**: Läs, skriv och tänk naturvetenskap på engelska
- **Resultatet presenteras:** Träna kommunicera och argumentera på ett effektivt sätt
- **En i ett Team:** Samarbetsförmåga och gruppdynamik



56 *The Simple Rayleigh (1916) Thermal Convection Problem*



**Fig. 3.1** Geometry of the Rayleigh simple convection problem.

under certain conditions, which Boussinesq has discussed'. In Zeytounian's 2003 paper [4], a hundred years later, the reader can find a rational/logical justification of this Boussinesq approximation and associated Boussinesq equations; the main lines of such a justification are presented briefly below.

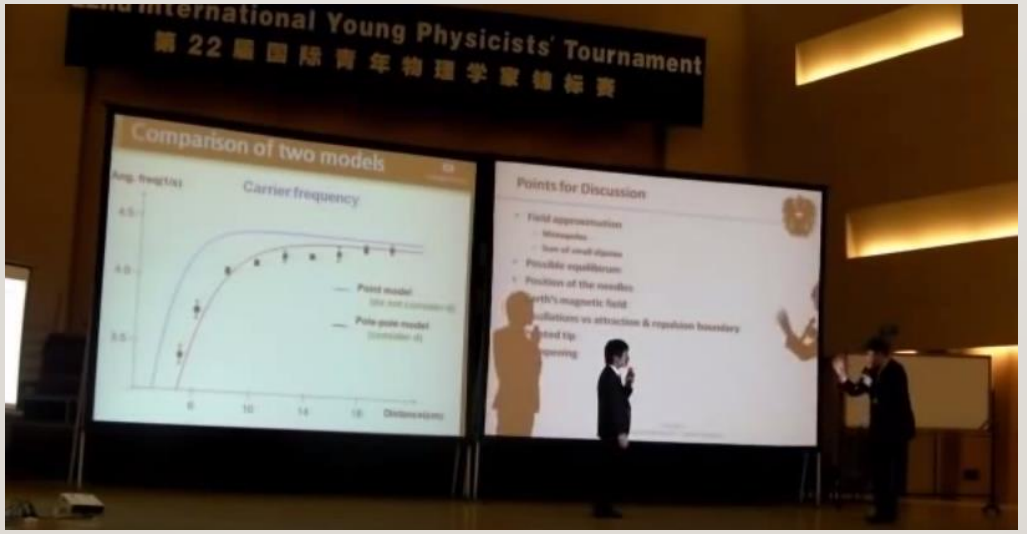
In fact, the present chapter is an extended version of a paper written in 2006 for the 90 years of the above-mentioned Rayleigh's pioneering 1916 paper devoted to thermal convection, but … *unpublished*, for various reasons!

As equation of state in [1], Lord Rayleigh assumed, in fact, that

$$\rho = \rho(T), \tag{3.1a}$$

and in such a case

$$-\left(\frac{1}{\rho}\right)\frac{\mathrm{d}\rho}{\mathrm{d}T} = \alpha(T), \tag{3.1b}$$




# MÅLET MED DAGENS PRESENTATION: SVARA PÅ TRE FRÅGOR

- **Vad är IYPT?** ✓
- **Varför IYPT?** ✓
- **Hur gör man IYPT?**

# HUR GÖR MAN IYPT?

# TRE OLIKA SÄTT ATT DELTA I IYPT

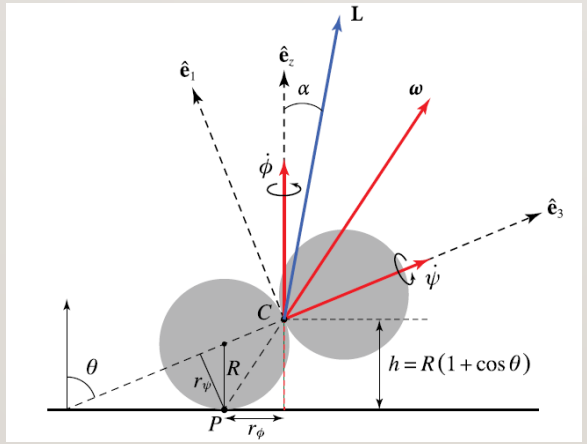
- IYPT som gymnasiearbete
- IYPT som oberoende projekt
- Delta på IYPT:s evenemang

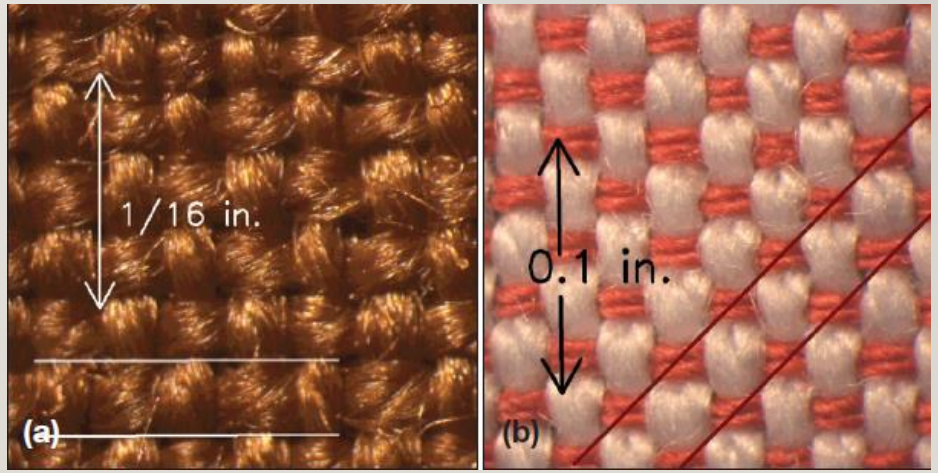
# IYPT SOM GYMNASIEARBETE

- Fungerar som ett vanligt gymnasiearbete:  Du väljer ett av problemen i slutet av sommaren.
- Finns dock några skillnader:
  - IYPT finns med och hjälper till med teoretisk och experimentell support
  - Vi kan hjälpa till att få kontakt med Universitet föra att få tag i bättre utrustning
  - Möjlighet att få tävla med sitt projekt nationellt som internationellt

# IYPT SOM OBEROENDE PROJEKT

- Du kan vara med redan från första året på gymnasiet
- Precis samma möjligheter att få tillgång till utrustning, tävla och utvecklas.
- Bra sätt att kunna fördjupa sig inom något område i fysik
- Möjlighet att komma igång redan under vårterminen



# DELTA PÅ IYPT:S EVENEMANG

- Vi anordnar även mycket annan spännande verksamhet under terminen
- Exempelvis:
  - Fysikläger: Labborera under en helg eller lov
  - Besök på Universitet och högskolor
  - Sommarforskarskola: Jobba tillsammans med landslaget för att lösa problemen

# MÅLET MED DAGENS PRESENTATION: SVARA PÅ TRE FRÅGOR

- **Vad är IYPT?** ✓
- **Varför IYPT?** ✓
- **Hur gör man IYPT?** ✓

# REDO FÖR ER OCH ERA ELEVERS ÄVENTYR? KONTAKTA OSS!

Jakob Lavröd
jakob@lavrod.se
Forskningsansvarig IYPT


**Teoretiska frågor**
Vilken fysik är viktig?
Vad ska jag mäta för något?
Finns det någon teoretisk modell?
Hur analyserar jag min mätdata?
…

**Praktiska frågor**
Vem handleder mig?
Var får jag tag i utrustning?
Hur bygger jag upp min setup?
….

# TACK FÖR ER TID!

Frågor?

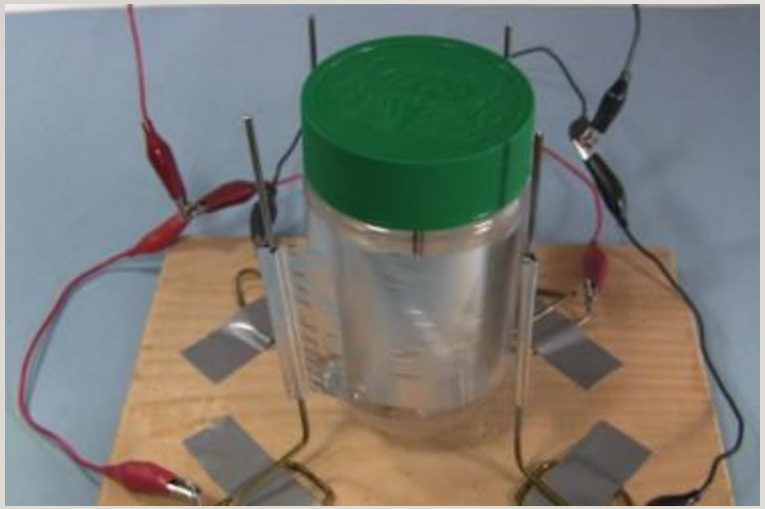
# VÄLJ MELLAN 17 SPÄNNANDE PROBLEM!

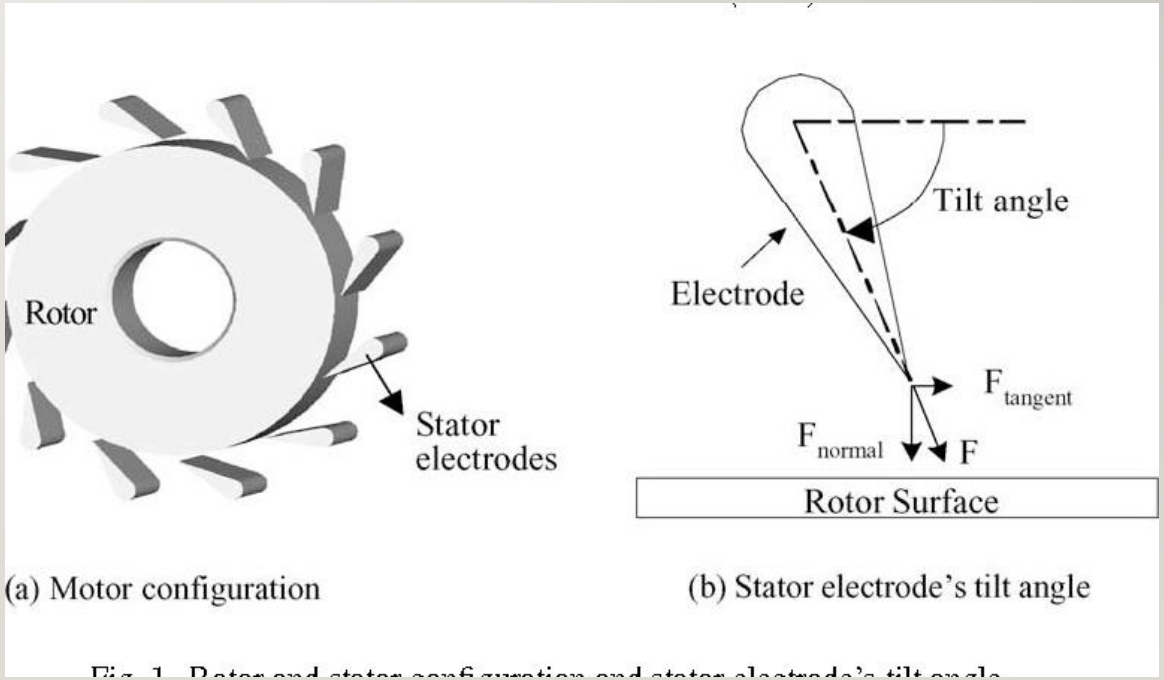
Genomgång av årets lista

# 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.






(a) Motor configuration

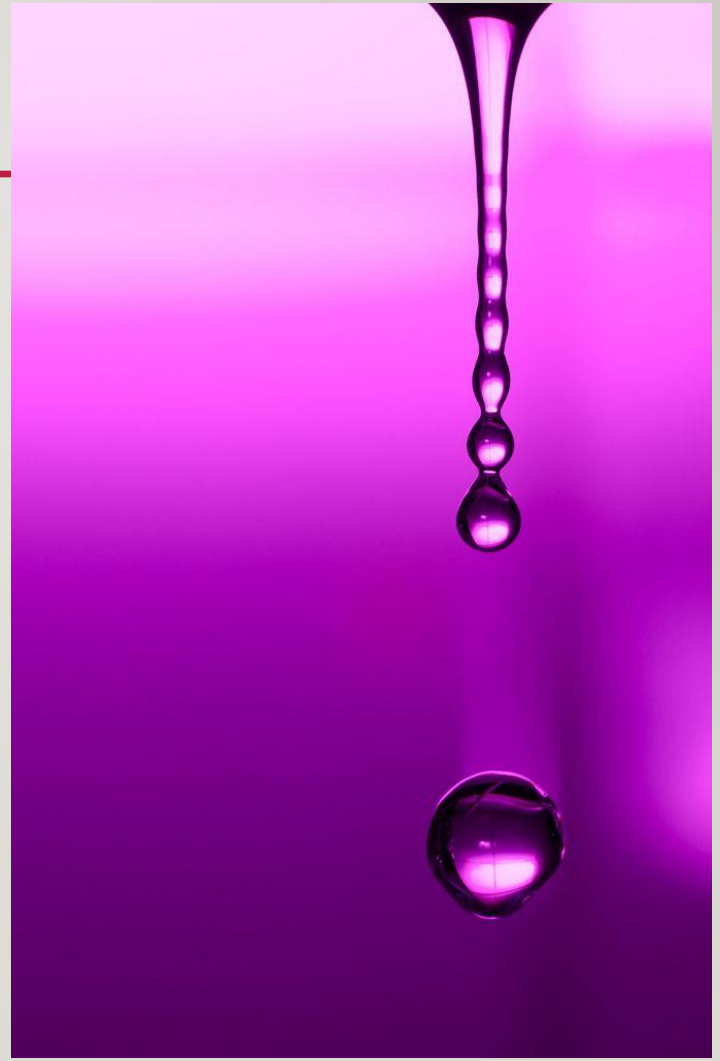
(b) Stator electrode's tilt angle

Fig. 1. Rotor and stator configuration and stator electrode's tilt angle

# 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?

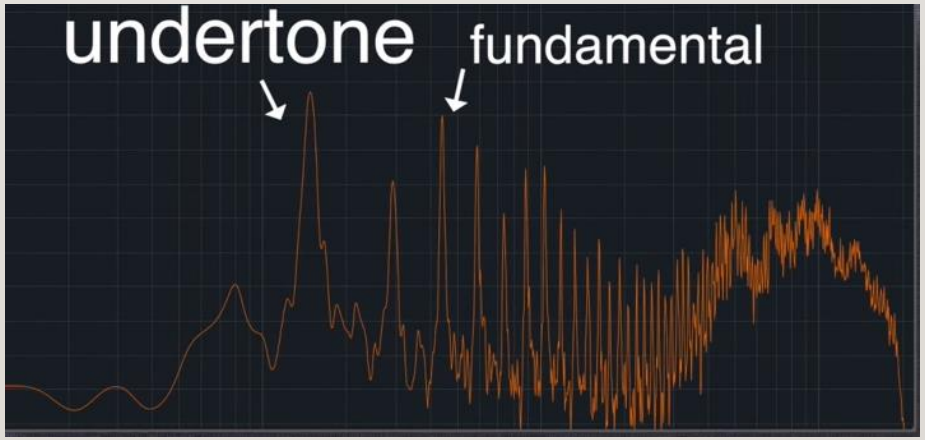


# 3. UNDERTONE SOUND

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.

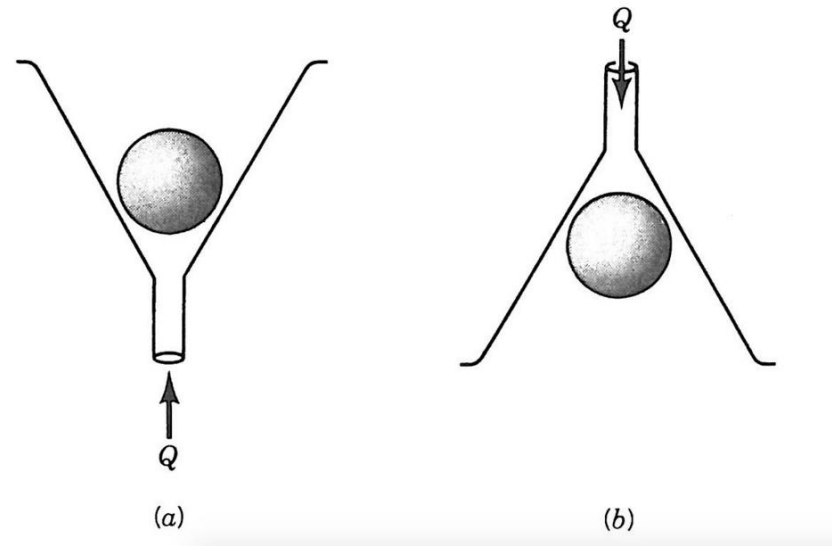
Investigate this phenomenon

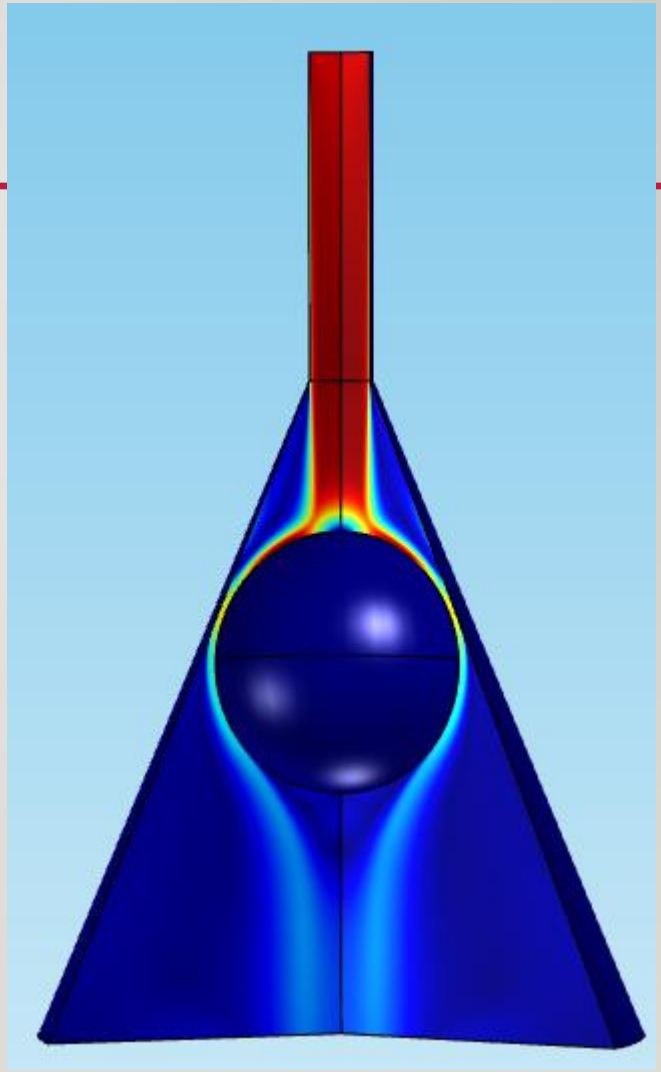



# 4. FUNNEL AND BALL

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.



# 5. FILLING UP A BOTTLE

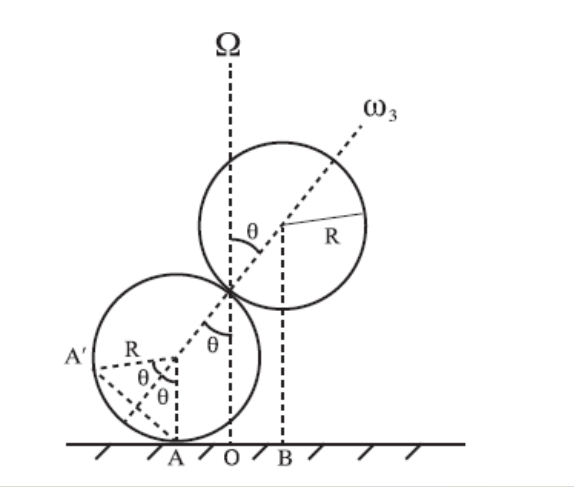
When a vertical water jet enters a bottle, sound may be produced, and, as the bottle is filled up, the properties of the sound may change.

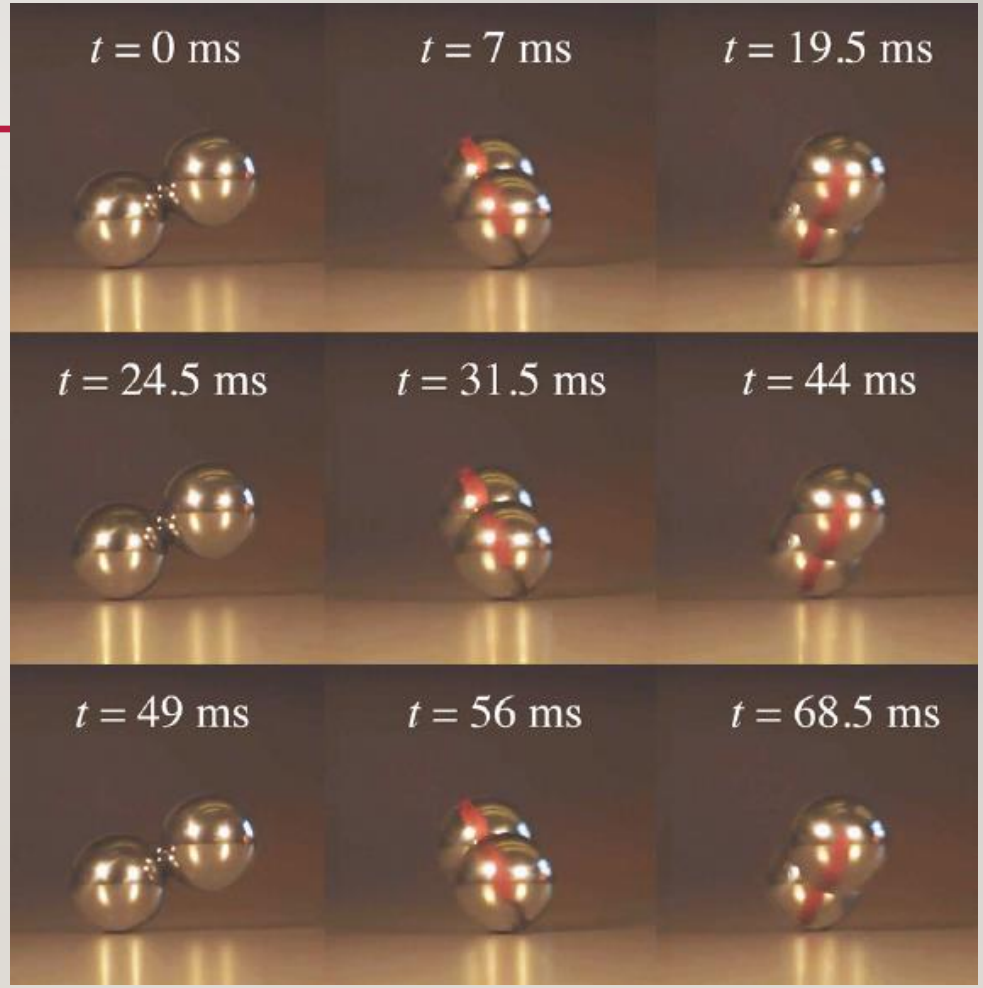
Investigate how relevant parameters of the system such as speed and dimensions of the jet, size and shape of the bottle or water temperature affect the sound.

# 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.

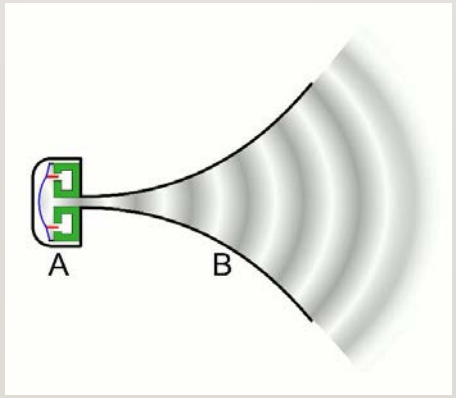


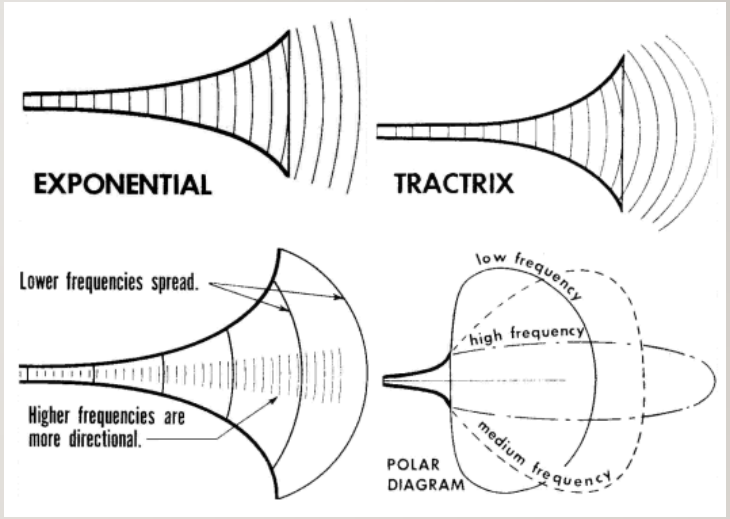



# 7. LOUD VOICES

A simple cone-shaped or horn-shaped object can be used to optimise the transfer of the human voice to a remote listener.

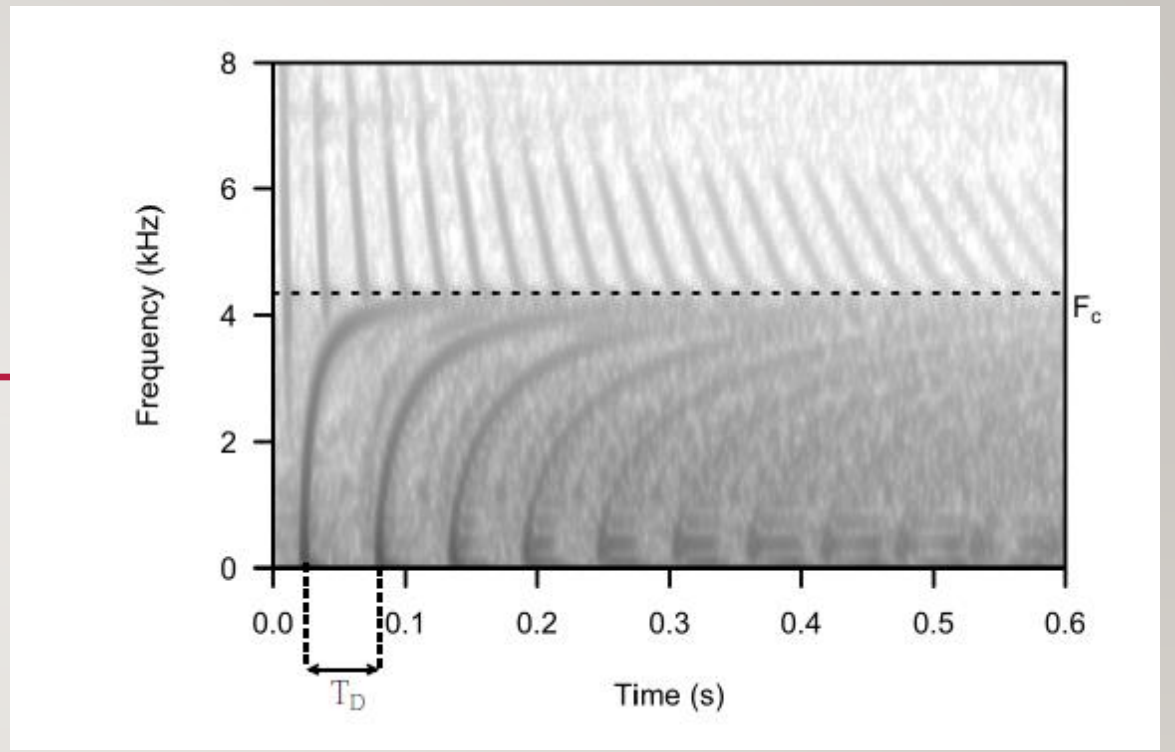
Investigate how the resulting acoustic output depends on relevant parameters such as the shape, size, and material of the cone.

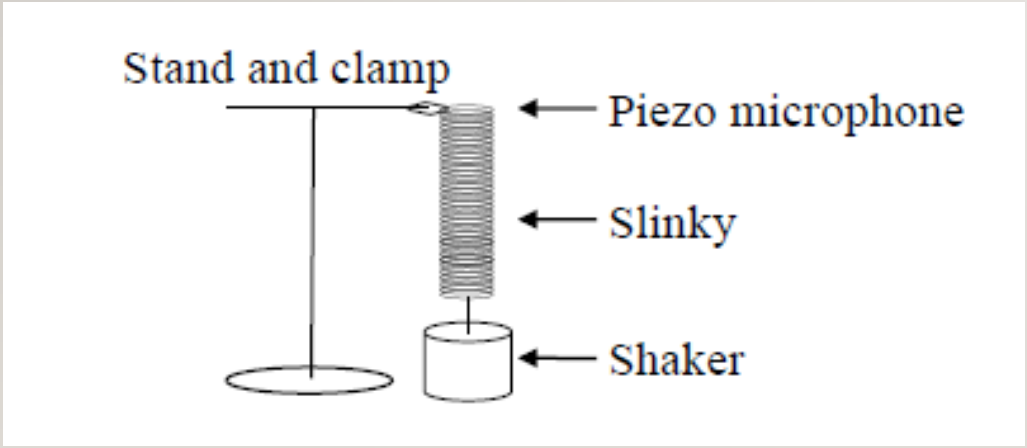


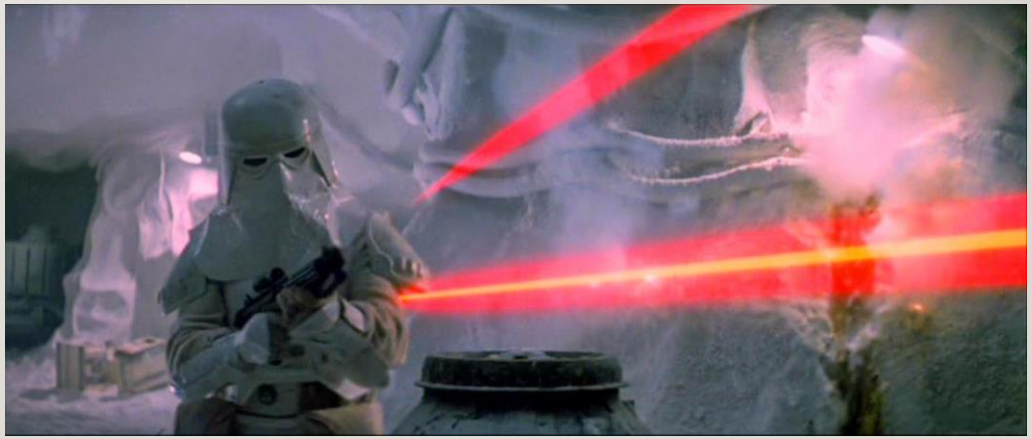



# 8. SCI-FI SOUND

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



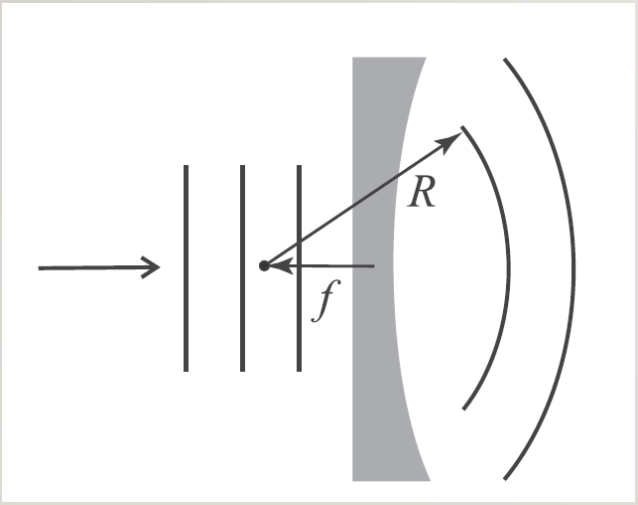



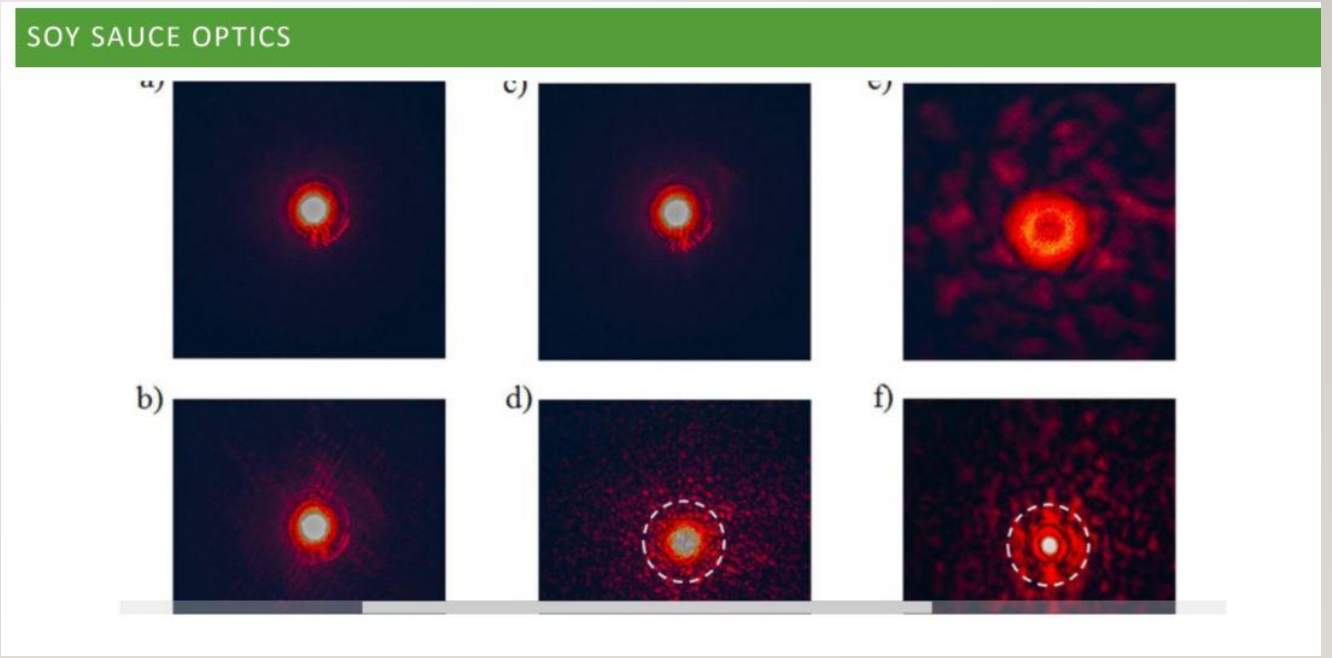



# 9. SOY SAUCE OPTICS


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.



# 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.

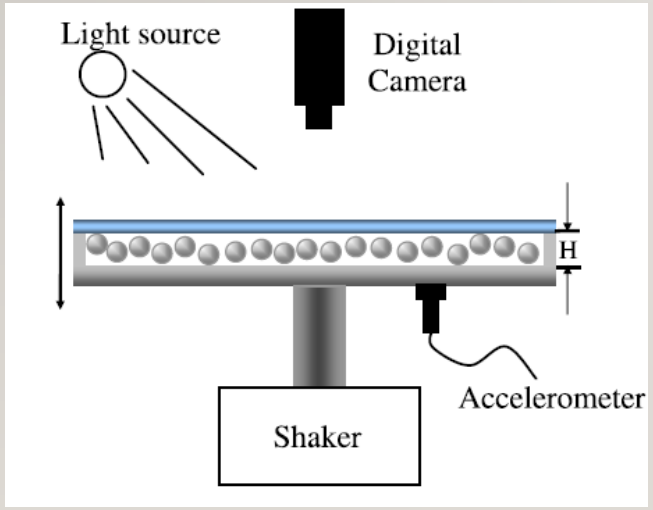
Investigate this phenomenon and its stability
to external perturbations.

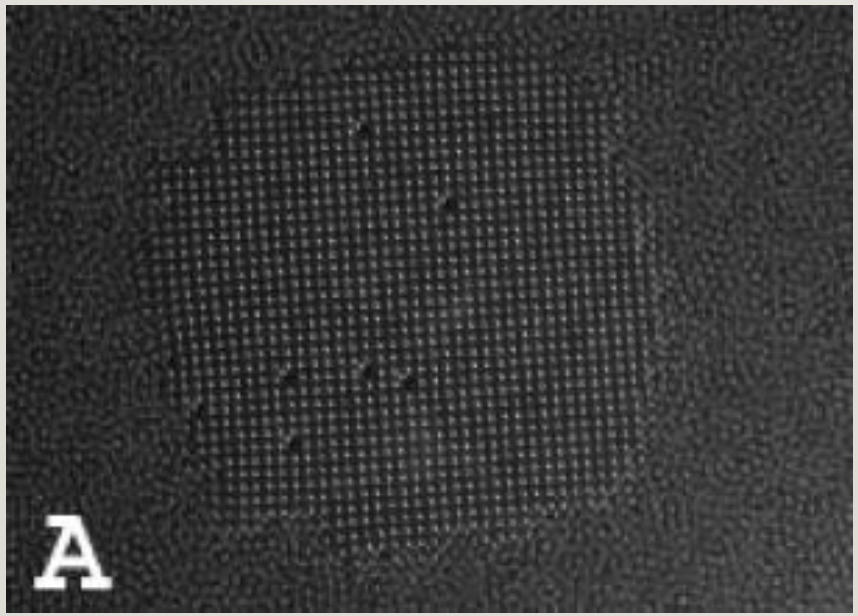
# 11. FLAT SELF-ASSEMBLY

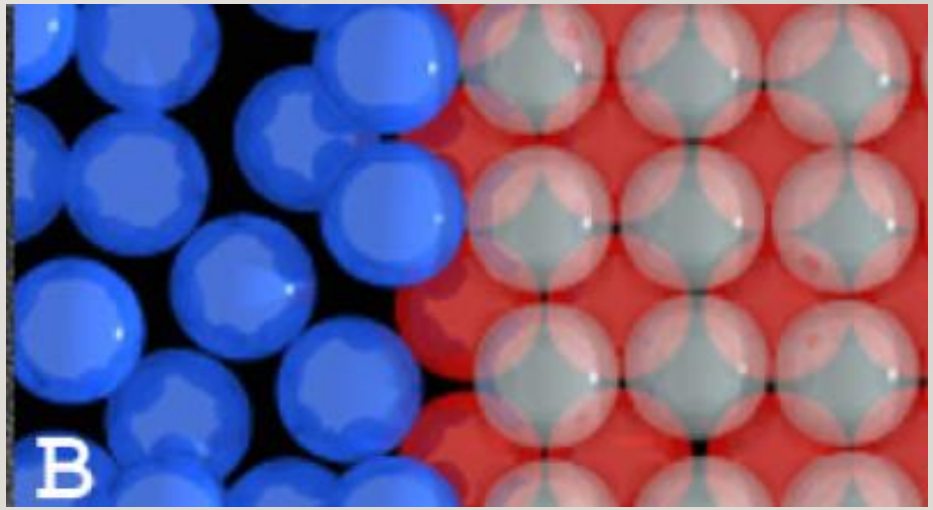
**The dynamics of thin vibrated granular layers**

P Melby[1], F Vega Reyes[1], A Prevost[2], R Robertson[1], P Kumar[1], D A Egolf[1] and J S Urbach[1,3]

- 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.



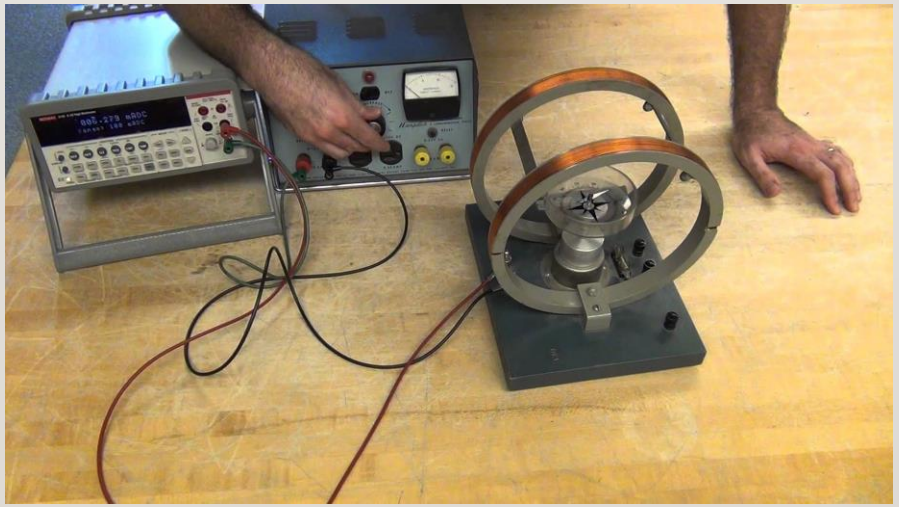



# 12. GYROSCOPE TESLAMETER

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.



# 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).

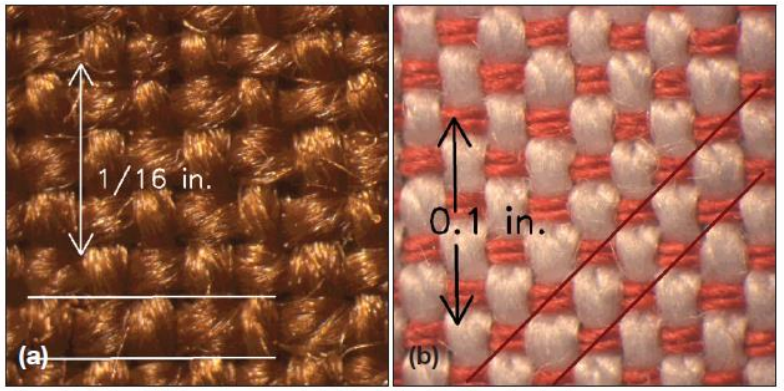
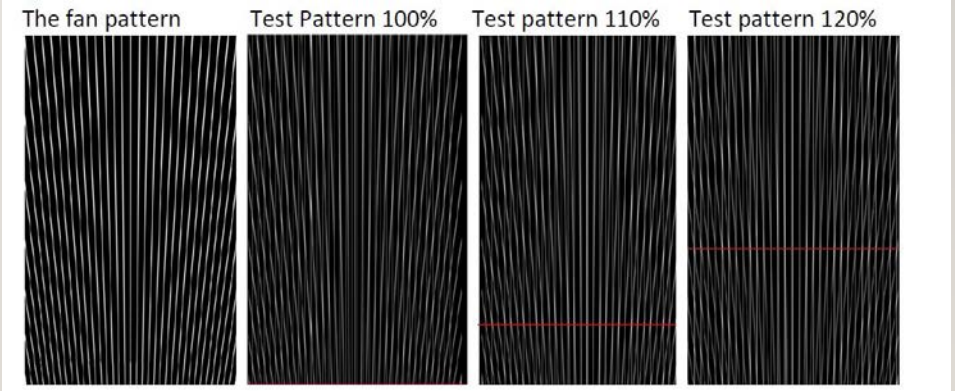
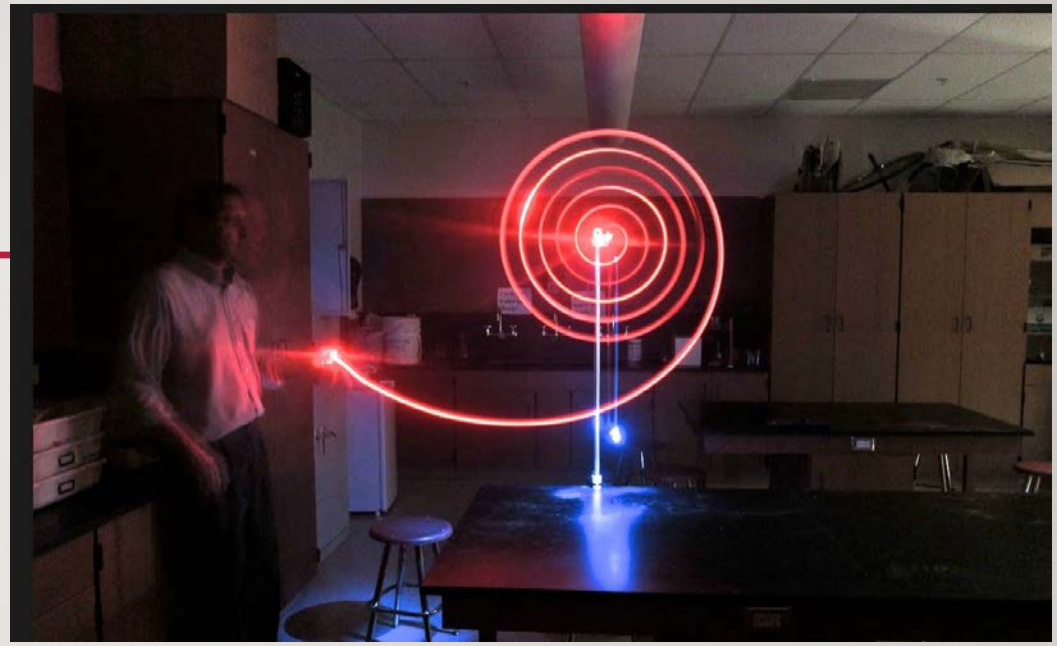


Fig. 7. (a) Plain weave fabric. (b) Oxford cloth.



# 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.

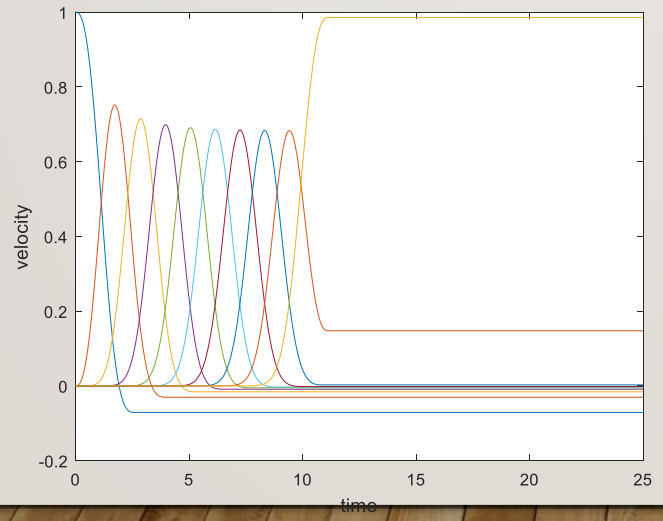
Release the light load and it will sweep
around the rod, keeping the heavy load from falling to the ground.

Investigate this phenomenon.

# 15. NEWTON'S CRADLE

The oscillations of a Newton's cradle will gradually decay until the spheres come to rest.

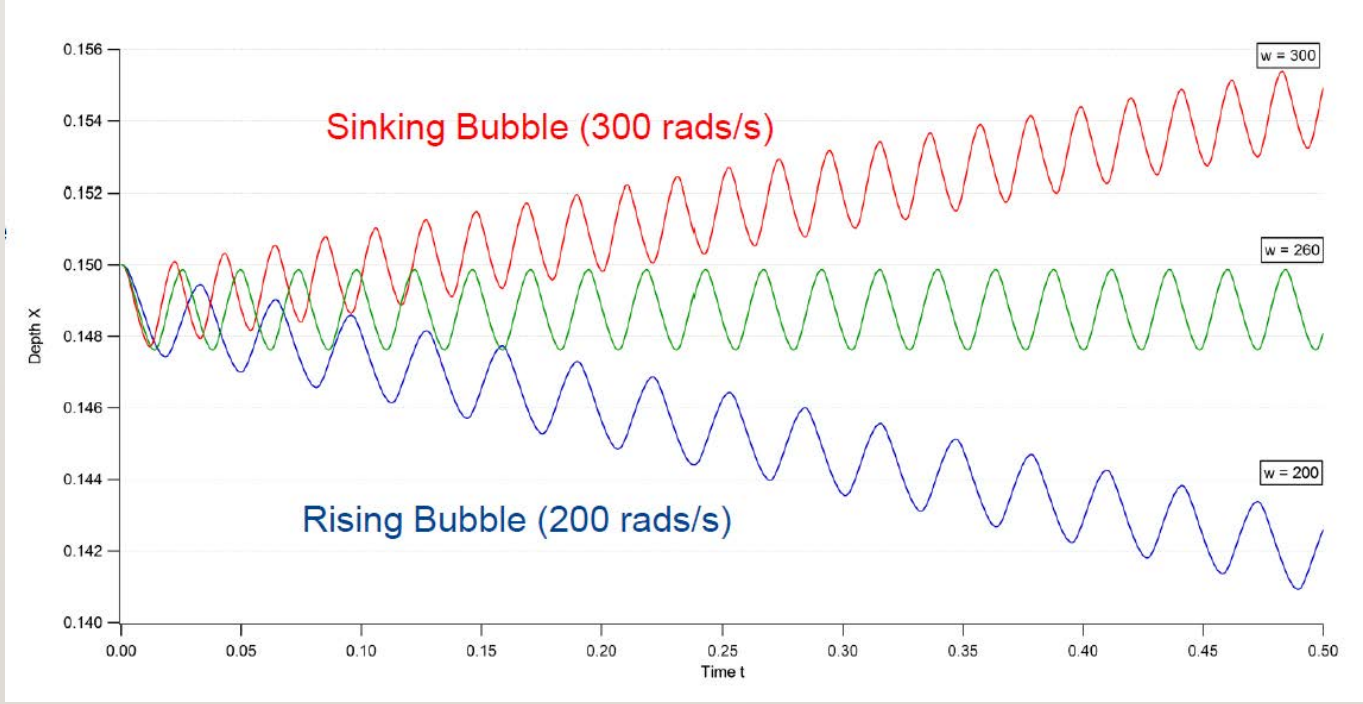
Investigate how the rate of decay of a Newton's cradle depends on relevant parameters such as the number, material, and alignment of the spheres.




# 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.

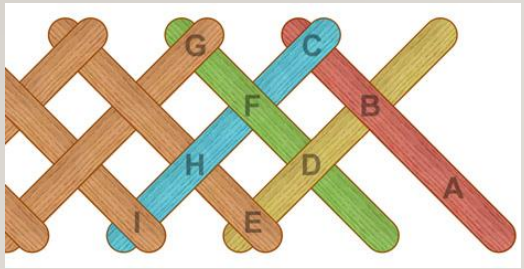


# 17. POPSICLE CHAIN REACTION

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.




# TACK FÖR ER TID!

Frågor?