Physics and Toys

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Content

10' 1) Some physics toys as an introduction (without a long explanation)

2) Three toys with a more detailed explanation

30'
- a) jumping animals and toys
- b) paper clip top
- c) 3D Chromadepth-Glasses

5' 3) Literature and links for physics toys

Σ 45'

Ladies and Gentleman,

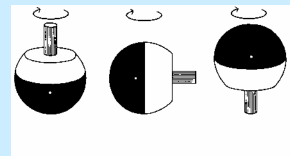
Thank you very much for the invitation to this conference. This is the first time that I am in Norway and I regret that I cannot welcome you in Norwegian.

I come from the Technical University of Munich. My regular job is to teach physics to students of medicine, biology and physics education. Physics toys are only my hobby for perhaps 20 years. But more and more people are interested in this sort of toys. Not only in German schools we have the problem that physics is not loved by the pupils. Toys are one way to stimulate interest.

At first I want to present some toys without a long explanation. Then I am going to show three toys with more detailed explanations. At the end I going to mention some sources about literature and links for physics toys. For almost all toys which I am going to show today you can find detailed publications on my homepage.

N. Bohr and **W. Pauli**
looking at a tippe-top
(= flip-over top)

University of Lund
31.05.1951

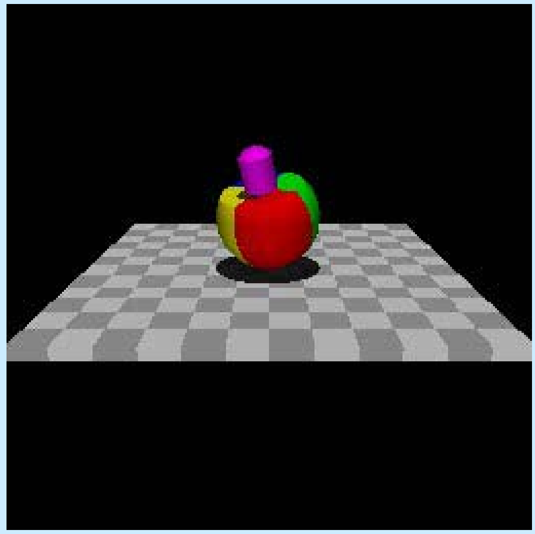


For an introduction, It is always good to have famous physicists as a support. Here two very famous physicists look at a tippe-top. It would be interesting to know their thoughts at this moment, but there is nothing passed down.

The construction of this top is very easy, as you can see from this picture. The physics background is very complicated. There have probably been more than 30 publications in the last 50 years. And it is important to know that there is no simple explanation of the flip-over phenomenon. You have to dive deeply into differential equations to solve the physics. This is of course not very satisfying, especially not for teachers.

I want to add only one remark: This tippe-top was patented 1891 in Germany by Miss Helene Sperl. Several examples were described in the patent. I have rebuilt these and it is interesting to know that none of these tops works as they should do. It is another story what the German patent office explained to me how it can happen that a patented object does not behave as described.

Calculated and animated behaviour of a tippe-top



It is nowadays possible to calculate the behaviour of a tippe-top. Here you see a calculated animation made by a German group of mathematicians and engineers at the university of Saarbrücken.

You can download this animation from the web.

Greek boy playing Yo-Yo

Vase decoration 450 B.C.
Antikenmuseum Berlin

Physicist playing Yo-Yo

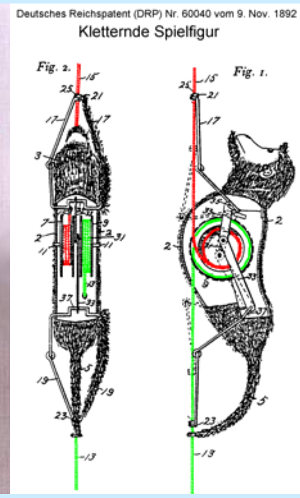
W. Bürger: Das Jojo,
ein physikalisches Spielzeug
Phys. Blätt. ***39*** *(1993), 401-404*

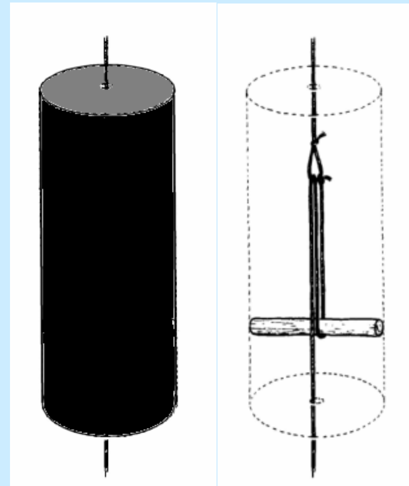
Another very popular toy is the Yo-yo. On the left a Greek boy plays Yo-Yo. Probably he could play this toy very well but knew nothing about the physics. The man on the other side knows the physics perfectly – the formula in the bubble correctly describes the movement of a Yo-Yo. Whether he could play a Yo-Yo is not so important.

The physics of the Yo-Yo is well known and not so complicated. There are publications for experiments in schools, especially for the so-called 'Maxwell wheel'.

Climbing monkey

The secret tube





I want to show now some toys that are not so complicated but illuminate some properties and possibilities for teachers. And I hope that not all of you know all my examples.

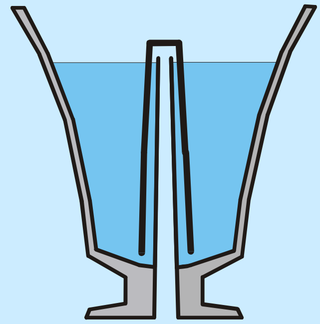
It is always interesting for children – and not only for children - if a toy has some surprise elements which can lead to discussions. On the left side is a monkey. It is a nice example for a mechanical toy made of sheet metal from the beginning of the last century. I pull on the bottom string and the monkey climbs up. How is this possible?

I have another object here where you can pull the string down and the cylinder goes up. If you look in the cylinder, there is almost nothing inside.

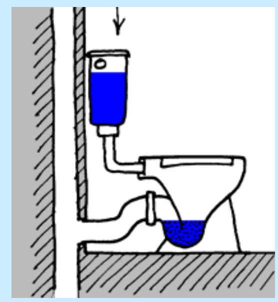
In both cases the solution is a pulley inside. The metal toy is not so easy to open, you may destroy it. I am not going zo explain the pulley in detail now. The cylinder is easy to open. But even if you have opened it, it is not so easy to recognize the pulley principle.

I have however, described this too fast.. You should not do this in front of your students.

You can have a look at these toys at the end of my talk or perhaps later if there is time.



principle of the siphon



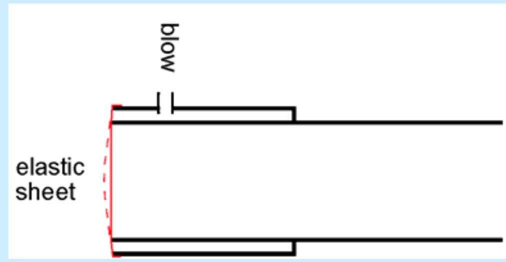
PYTHAGORA'S CUP

Pythagora created the design of this famous Cyp 2.500 years ago, for this desire to see every body drinking equal the same amount. So, by filling it up to the line, you will enjoy the maximum of your drink, but if you get gready, and overfill pass the line the penalty is to lose the lot, through the hole in the bottom of the Cup After all, fair is. That's why he named it dikea Koupa or fair drinking Cup.

At first sight this is not a toy. But again it is an example which produces discussions how it works. Here I am showing the original description coming from the Greek island of Samos. It contains no physical explanation.

The solution is the principle of the siphon. If the liquid goes over the inner border all the liquid will be pulled down through the inner tube. There are many examples for this siphon principle in the everyday world.

Funfare (fanfare)

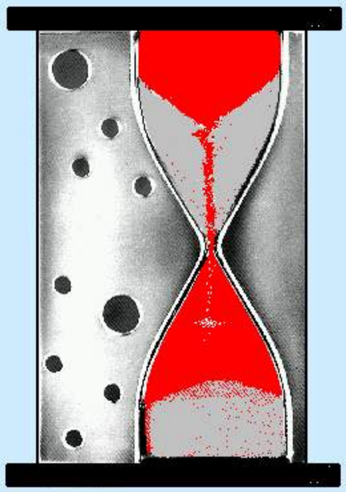


Most toys exist in mechanics but here is one from acoustics. Don't get frightened if I blow now, it is really very loud. I can change the frequency of the tone if I add another cylinder.

The construction is very simple: an elastic sheet will oscillate if I blow in the hole. The resonance tube amplifies the sound. The length of the tube is responsible for the main frequency.

You can make a nice frequency analysis with a computer.

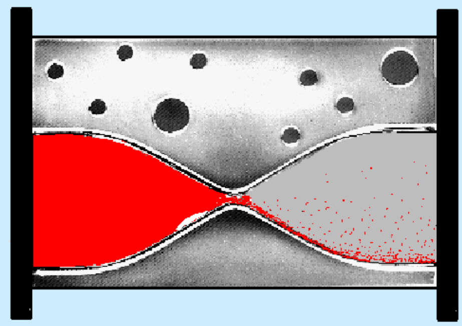
This instrument can be used as a foghorn. And also in football stadiums.



Paradoxical hourglass

liquid: saturated solution of $CaCl_2$ in water; $\rho \approx 1.35 g/cm^3$

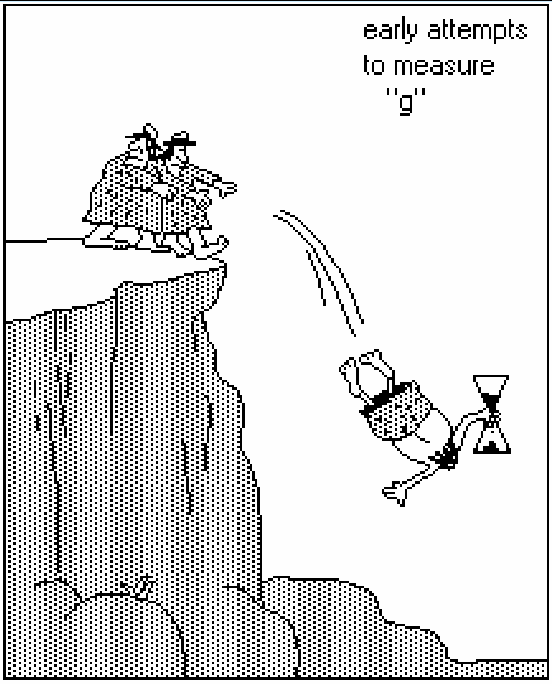
balls: polystyrol; $\rho \approx 1.05 g/cm^3$



My last example in this quick show is a paradoxical hourglass. The 'sand' runs up. How does it work?

There are smalls balls of Polystyrol in a liquid. The liquid is a saturated solution of calcium chloride in water. The density of the balls is lower than the density of the liquid.

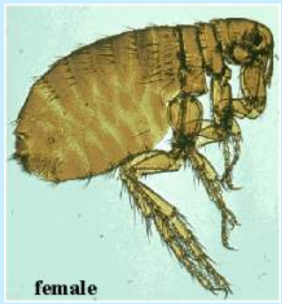
If you place the hourglass on the side you can even see single balls float upwards.



Don't forget to stop the timer when you get to the bottom of the cliff!

Paradoxical hourglass

jumping animals



≈ 2mm

Pulex irritans
(= human flea)

height of the jump h ≈ 0,5m

acceleration distance d ≈ 2mm

acceleration a = h·g/d = 2500ms^{-2}
≈ 250g

(uniform acceleration assumed g = 10ms^{-2})

From $v = \sqrt{2gh}$ *and* $v = \sqrt{2ad}$
results $a = hg / d$

A flea jumps up to a height of about *h = 0.5m*. It accelerates along a distance of about *d = 2mm*. This leads to an acceleration of *a = h·g/d = 0.5m·g/0.002m ≈ 250g* (g = 10ms^{-2}; uniform acceleration assumed).

Since the jumping height of a flea is strongly influenced by air resistance, it has, in reality, a greater initial acceleration. There are other animals with an even higher acceleration. The jumps of fleas and other animals are difficult to measure and not very reproducible. A man can only achieve up to 3g with a standing high jump.

jumping toy

height of the jump $h = 1.2m$ (±10%)

=> $E_{pot} = mgh = 0.0145kg \cdot 10ms^{-2} \cdot 1.2m = 0.17J$

compressing on a scale

$F \approx 19N$ (= 1.9kg); $d \approx 3.5cm$ (better 3.2cm)

spring stiffness $c = F/d \approx 543Nm^{-1}$ (better $570Nm^{-1}$)

=> $E_{spring} = 0.5 \cdot c \cdot d^2 = 0.5 \cdot 570Nm^{-1} \cdot 0.032^2 m^2 = 0.29J$

initial acceleration $a = F/m - g \approx 190g$

(m = head + rubber cup + 1/3spring)   *(a continuously decreasing!)*

A small toy known as jumping animal or pop-up makes some investigations easier and can illuminate the physics of jumping. The toy itself consists of a base, a spring, a rubber cup and a head. You have to press the cup onto the base and thus load the spring. After some time the cup will loosen itself and the toy will jump up.

The first simple experiment is to measure the jumping height and calculate the potential energy.

Another simple experiment is to compress the toy on a – kitchen - scale and to measure the weight and the compressing distance.

From that you can calculate the energy stored in the spring.

As you can see there is a great difference, which I will explain later.

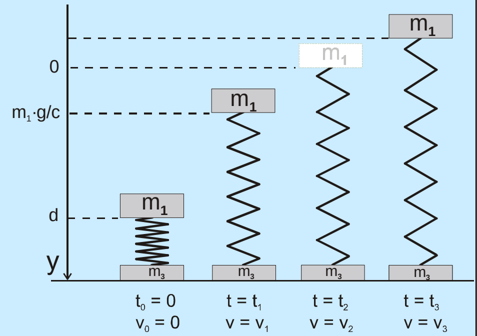
It is also simple to calculate the starting acceleration and as you can see it is remarkably high

jumping toy

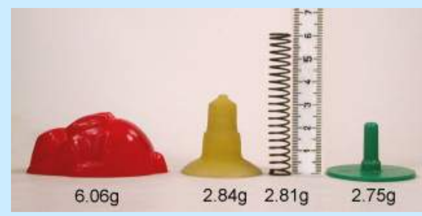
Maximum velocity of the head

$$\frac{c}{2}d^2-\frac{c}{2}\left(\frac{m_1 g}{c}\right)^2=m_1 g\left(d-\frac{m_1 g}{c}\right)+\frac{m_1}{2}v_1^2$$

spring energy *potential energy* *kinetic energy*



$$v_1=-\sqrt{\frac{c}{m_1}}\left(d-\frac{m_1 g}{c}\right)\approx 8ms^{-1}$$



The spring is compressed, and at the time $t_0 = 0$ the head starts with maximum acceleration. The time t_1 is when the mass m_1 (head + rubber cup) achieves the position where the head is in the equilibrium situation. Equilibrium means the situation, when the spring is not compressed and the head is in equilibrium with the spring. The time t_2 characterizes the position of the end of the spring without m_1; it is the equilibrium position of the spring without m_1. t_3 should be when the bottom mass m_3 leaves the floor.

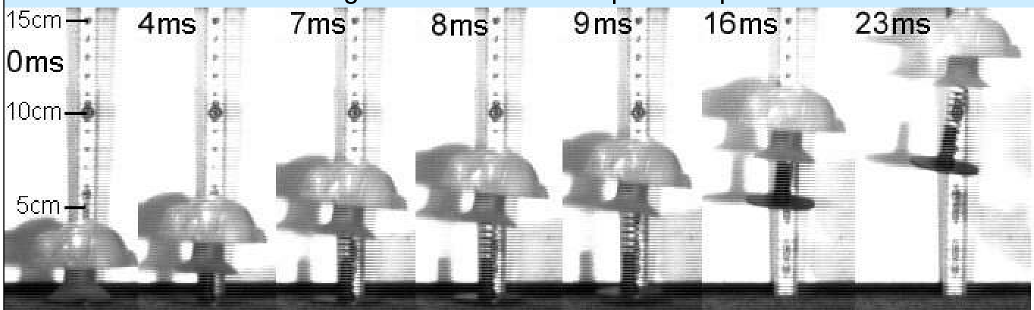
The head will achieve its maximum velocity v_1 at the time t_1. Conservation of energy leads to the following equation:

If you calculate the velocity results $v_1 = 8ms^{-1}$.

How can you measure that?

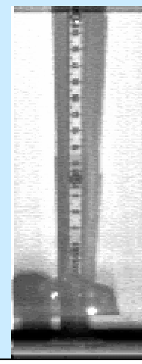
jumping toy

frames of a digital video with 1000 pictures per second



Video

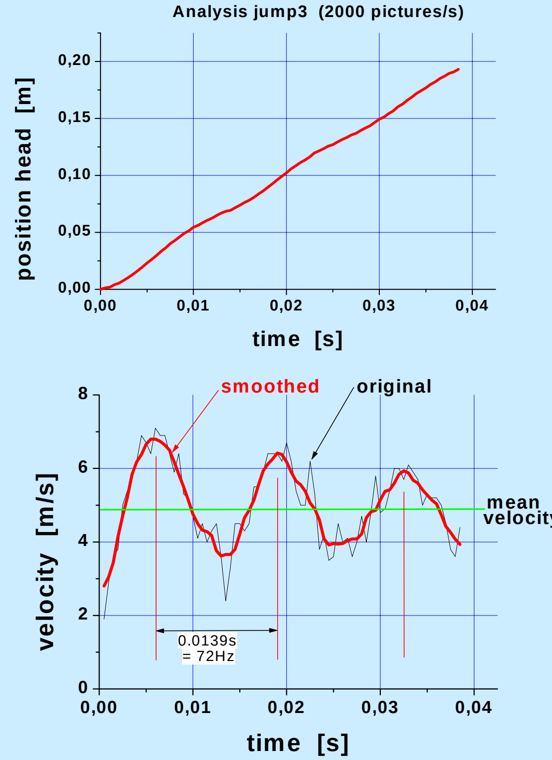
2000 pictures/second
146 pictures = 73 ms



Extract from a high speed video of the starting phase. At 0ms the toy starts; at 7ms the head of the toy reaches its maximum velocity; at 8ms the base leaves the floor; at 9ms the spring is stretched to its maximum; at 16ms the spring is maximally compressed; at 23ms the spring is again maximally stretched. The pictures are not sharp because the higher the speed of the video camera, the worse the resolution.

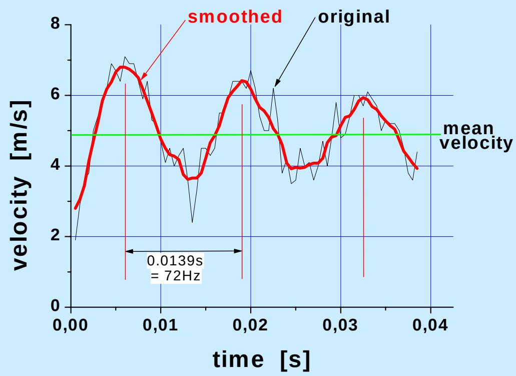
The spring oscillates. This can not be observed with the naked eye because the oscillating frequency is about 70Hz.

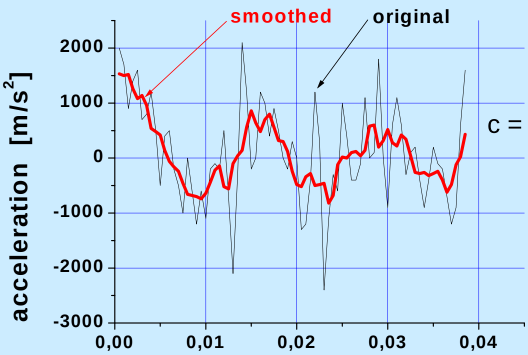
jumping toy
experimental results



By video analysis, the position of the toy’s head is extracted and shown in the left figure. This seems to be like a bad drawn straight line. But it contains much information. If you analyze this you get the bottom figure. It shows the velocity as a function of time. The maximum velocity of the head is about $7ms^{-1}$. This is comparable to the calculated value of $8ms^{-1}$

jumping toy





calculation of the initial acceleration:

c = 570Nm^{-1}; d = 0.032m; m = 0.0098kg; y = 0

$$a(y) = \frac{c(d-y)}{m} - g = 1851ms^{-2} = 185g$$

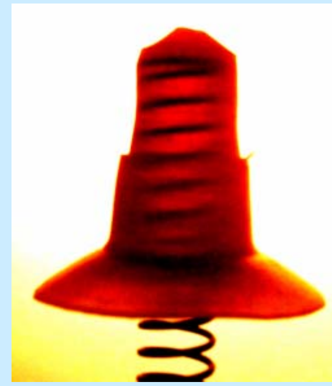
The acceleration continuously decreases

In the upper figure the velocity of the head is shown again as a function of time. The bottom figure is derived from that and shows the acceleration. The data are smoothed because the double derivation leads to large fluctuations. The measured acceleration of about 200g corresponds with the calculated value. One has to be careful with smoothing. Especially, the data near t = 0 are corrupted by this procedure.

jumping toy

Mechanical energy is lost in the rubber cup.

Several turns of the spring are compressed into the rubber cup;
This part of the spring can decompress only with strong friction.



A cause of the calculated energy differences is seen if you remove the plastic head from the rubber cup. The turns of the spring that are pressed into the top of the rubber cup can only move with great friction. The toy also performs oscillations between head and base. Furthermore, there are hardly predictable turns around several axes. These cost energy, thus reducing the height. These influences are almost impossible to measure quantitatively.

jumping toy

Using calculus you may write down the differential equation for the starting process. This is the well-known equation of an oscillating mass hanging on a spring (harmonic oscillator), where damping is neglected

$$m_1 \ddot{y} = m_1 g - c y$$

The solution with the initial conditions $\dot{y}(0) = 0$ and y(0) = -d is

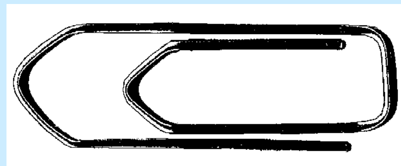
$$y(t) = \frac{m_1 g}{c} + \left(d - \frac{m_1 g}{c} \right) \cos\left(\sqrt{\frac{c}{m_1}} t \right)$$

and

$$\dot{y}(t) = \sqrt{\frac{c}{m_1}} \left(d - \frac{m_1 g}{c} \right) \sin\left(\sqrt{\frac{c}{m_1}} t \right)$$

For $t = \frac{\pi}{2} \sqrt{\frac{m_1}{c}}$ $(= 0.0062 s)$ you get the maximum velocity

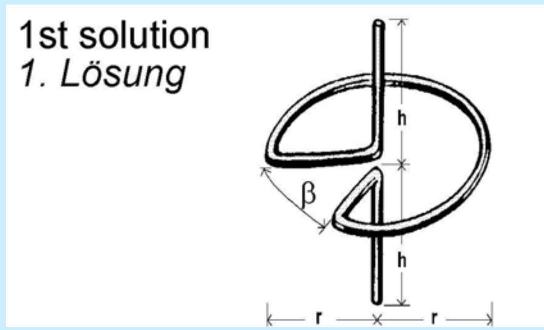
The paper-clip top (Sakai-top)



T. Sakai: Topics on tops which enable anyone to enjoy himself,
Mathematical Sciences (Surikagaki = 数理科学) **271**, 18-26 (1986)

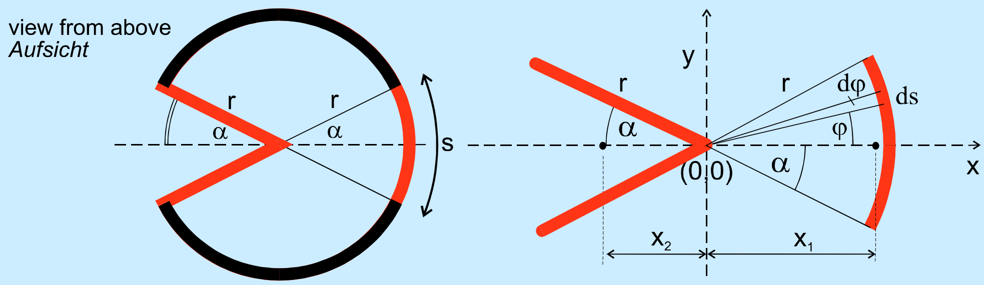
How can you make a top out of a paper clip. 'Paper clip' stands only for an easily available piece of wire. Professor Sakai from Japan proposed a nice idea. He used it as an exercise for students of mechanical engineering. I doubt that the students were amused.

The paper-clip top (Sakai-top)



This is the solution he proposed. This solution needs no soldering or gluing. One can recognize the axis of the top. To get a big moment of inertia the wire should have a large distance from the axis. But there also has to be a connection between the arc and the axis – the spokes. The interesting question is the size of the angle! If the angle is too big or too small, the center of gravity will be not in the axis.

The paper-clip top (Sakai-top)



center of gravity of the arc $x_1 = \frac{1}{s}\int x ds = \frac{1}{s}\int_{-\alpha}^{+\alpha} r\cdot\cos\varphi\cdot r\cdot d\varphi = \frac{2r^2}{s}\sin\alpha$

moment of the arc $M_1 = m_1\cdot x_1 = 2r^2\rho\cdot\sin\varphi$ ρ = density per unit length

center of gravity of the spokes $x_2 = \frac{r}{2}\cos\alpha$

moment of the spokes $M_2 = m_2\cdot x_2 = r^2\cdot\rho\cdot\cos\varphi$

$M_1 = M_2 \Rightarrow \tan\alpha = ½$ or $\alpha = 26.57^0$ or $ß = 2\alpha = 53.13^0$

This problem can be calculated. We disregard the two – black - arcs which are symmetrical to the center because their center of gravity lies in the axis. The center of gravity of the red arc can be calculated with the line integral as I have outlined here. Please don‘t try to take notes now. On my homepage you can download the whole equations.

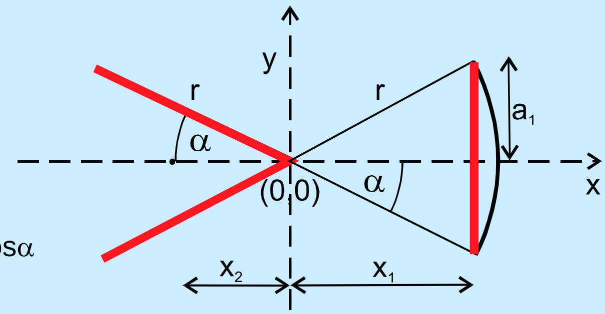
The moment of the arc results simply from the product of the mass with the distance x_1.

The center of gravity for the spokes and their moment is easily calculated. If you equate both moments it yields the simple equation tanα = 0.5 or α = 26.57^0 or ß = 53.13^0.

To make the tops in reality it is not so important to have exactly this angle. This would be difficult. It is also not so easy to make a perfect arc. It is important to have the center of gravity in the axis. After some tops you will get a feeling how to manufacture these tops, so that they will rotate well.

The paper-clip top (Sakai-top)

Approximation



$x_1 = r \cdot \cos\alpha$

$M_1 = m_1 \cdot x_1 = 2r^2 \cdot \rho \cdot \sin\alpha \cdot \cos\alpha$

$x_2 = r/2 \cdot \cos\alpha$

$M_2 = m_2 \cdot x_2 = r^2 \cdot \rho \cdot \cos\alpha$

$M_1 = M_2$ yields $\sin\alpha = ½ \Rightarrow \alpha = 30^0$ or $\beta = 60^0$

You can replace the arc by a chord. This approximation is easy to calculate and gives an angle of 60 degrees which is not very different from 53 degrees.

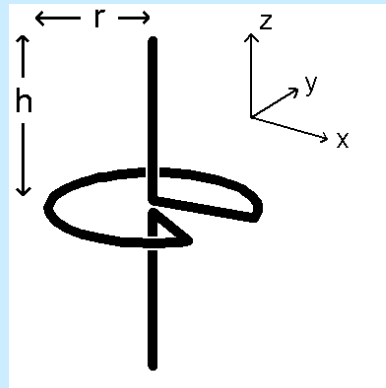
The paper-clip top (Sakai-top)

unstable top
for $h = 1.65 \cdot r$

$I_x < I_z < I_y$

I = moment of inertia;

I_z = moment of inertia relative to the z-axis etc.

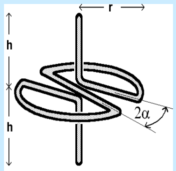


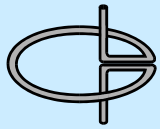
It is well known among engineers that a top can rotate stably only around the axes of maximum and minimum moment of inertia. If the axis of a top coincides with the middle moment of inertia, it is unstable.

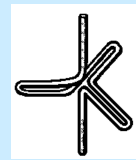
This is the case if the axis has just these proportions.

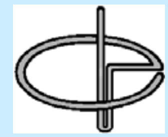
The paper-clip top (Sakai-top)

further possibilities









There are many further possibilities for constructing a top out of a paper clip.

Here I have special paper clips with a soft wire. These are not so good paper clips but they are perfect for making tops only with your fingers. Please take one sample later and try it. I have made these example tops by myself

My last example comes from optics. You need special glasses that I am going to give you here. Please give me these glasses back at the end. I need them for my next talks. You can order them through the internet and perhaps buy them also here in Norway?

Does everybody have a sample now?

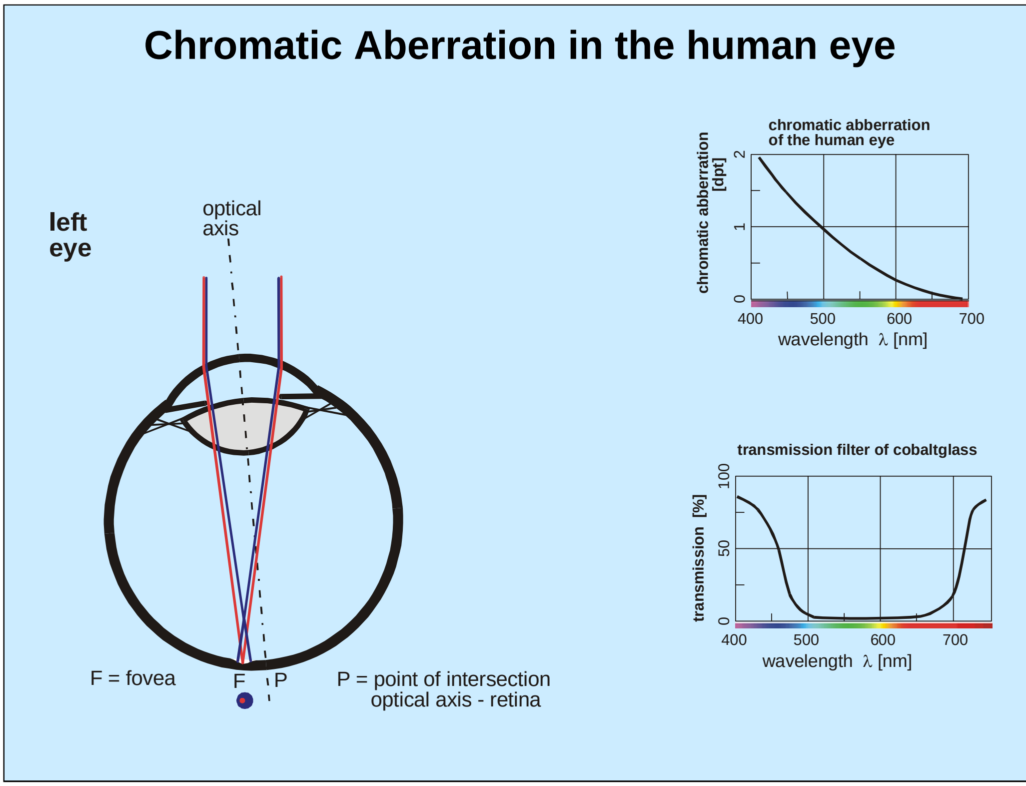
Please have a look at this text. You should normally see the red word in the foreground and the blue in the background. There may be some people who see just the red word in the background.

And probably some of you will not see a three-dimensional effect. Between 5 to 10% of the population has no three dimensional vision. And it is an interesting question to discuss the reasons in a class and to find out who does not have 3D-vision

The question is how to explain the 3D effect here? There are no polarizing glasses. There are also no red-green glasses. Furthermore you have only one picture here and not a stereoscopic pair of pictures.

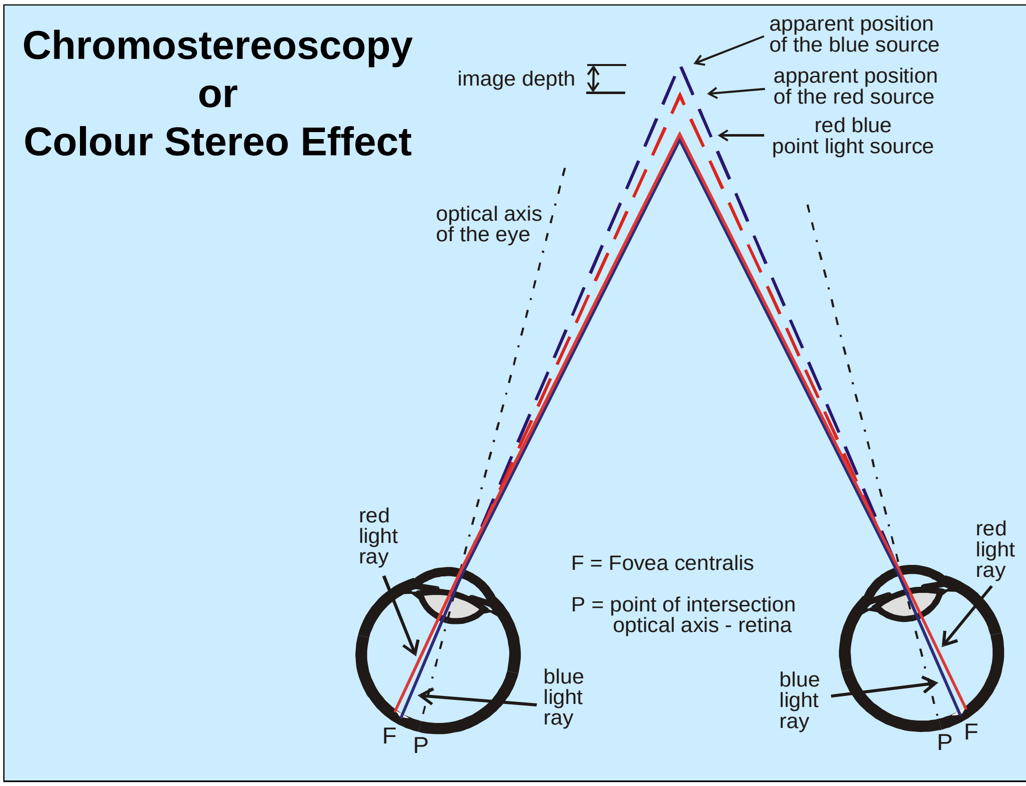
If you look through the glasses you will not recognize what goes on there.

There are several toys on the market in which these glasses are included. Here I have an example with which you can paint your own 3D pictures. I don‘t know whether you can buy this in Norway.



The explanation is surprising. In principle the human eye is a bad optical device. It is not an optically centered system. This means the fovea, that is that part of the retina with which we see sharp, lies not on the optical axis.

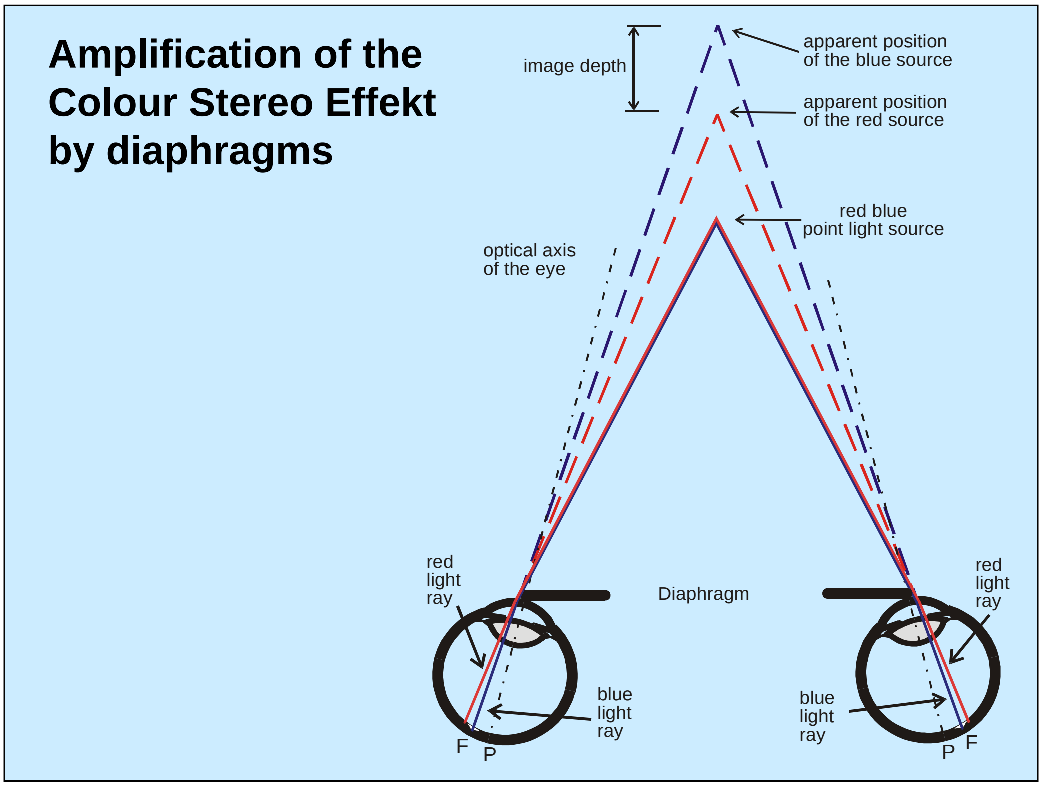
It has also a relatively large chromatic aberration. This means that if you look at a point light source which contains red and blue light, you will see either a red point with a blue blurred circle or vice versa. Furthermore the red point is not centered in the blue circle.



If you look with two eyes at such a red-blue point source, the red image of the source lies on another point of the retina than the blue image. In both eyes just in the opposite way. Your brain interpretes this as if there is an image depth between the red and the blue source. The dashed lines leads to the apparent image positions.

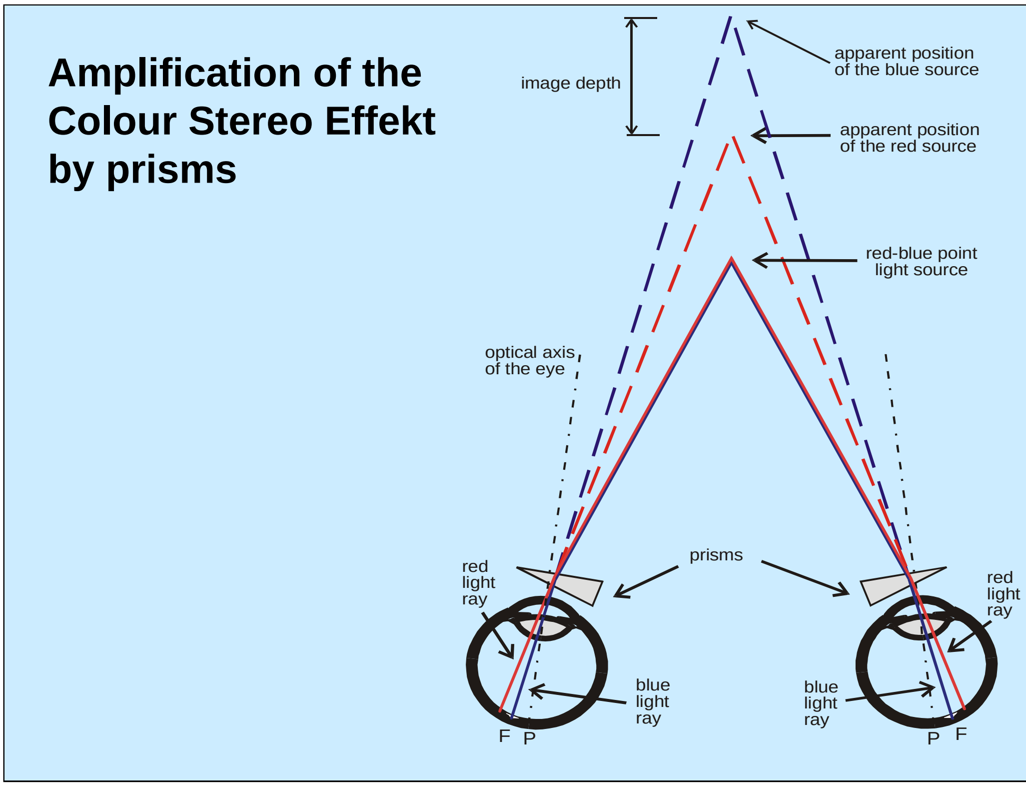
This is long known as Chromostereoscopy or Colour Stereo Effect. If you know this effect you can see it with appropiate pictures or situations.

The idea is now simple: If it were possible to amplify the chromatic aberration the colour stereo effect should be greater.



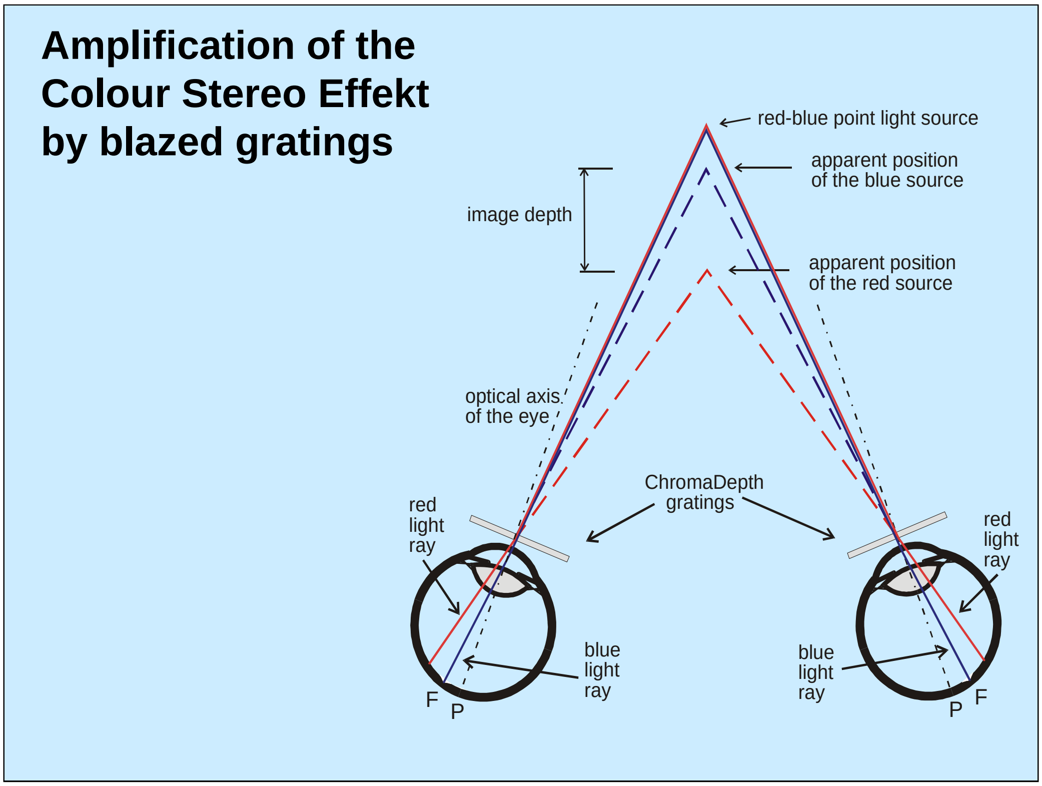
You can achieve this only with diaphragms in the right position. As diaphragms you can take your fingers. Or two pencils. Cover the inner (nasal) half of the cornea with the diaphragms. Now the light can pass only through the outer (temporal) parts of the cornea. And there, it is refracted stronger because the incidence angle is larger. This leads to a larger distance between the red and blue image on the retina and thus to a greater stereo effect.

This experiment needs some time and experience. If you are not successful now, try it later. Try also what will happen if you cover the temporal parts of your corneas.



But as physicists you know that you can get a larger dispersion with prisms. This is possible and was used by scientists. And the stereo effect is much greater.

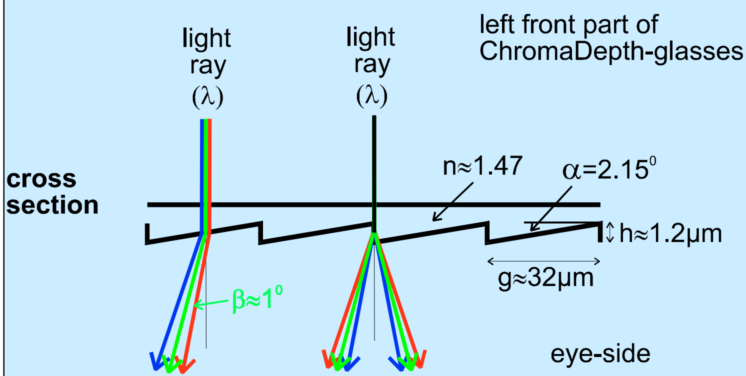
But prisms are relatively expensive and heavy. What other possibilities exist?



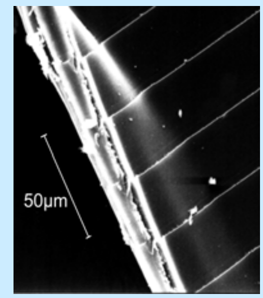
Another possibility to get a larger dispersion are gratings. But normal gratings have several diffraction orders. This would be not appropriate for our purposes. But for more than 100 years, astrophysicists have used so called blazed gratings. They have always had the problem to analyze the very weak light from stars. So they had to use all the light they could collect. They have done it with a combination of reflection gratings with etched prisms and these gratings are called blazed gratings.

About ten years ago, an American company developed a blazed transmission grating. This sounds simple but was technologically very difficult. And you find this product in these glasses. With the naked eye you cannot see the grating. I have asked the company to give me the physical data of their gratings but they refused to send me the details.

Blaze-Grating of the ChromaDepth-Glass



electron microscope picture



Blaze-conditions:
diffraction: $\lambda = g \cdot \sin\beta$ and refraction: $n \cdot \sin\alpha = \sin(\alpha+\beta)$

That is why I asked a colleague in my physics department to analyze the surface with a force microscope and an electron microscope. The result is this cross section. You can see the prisms through which the light is refracted. On the other hand, there is the grating by which the light is diffracted. The right combination of both leads to the fact that – for one wavelength – all the light is collected into the first order diffraction on one side only. In reality the prisms and grating are not perfect. Furthermore, you have several wavelengths. This means that the efficiency of the blazed grating is not perfect but sufficient

My last example comes from optics. You need special glasses that I will give you here. Please give me these glasses back at the end. I need them for my next talks. You can order them through the internet and perhaps buy them also here in Norway?

Does everybody have one sample now?

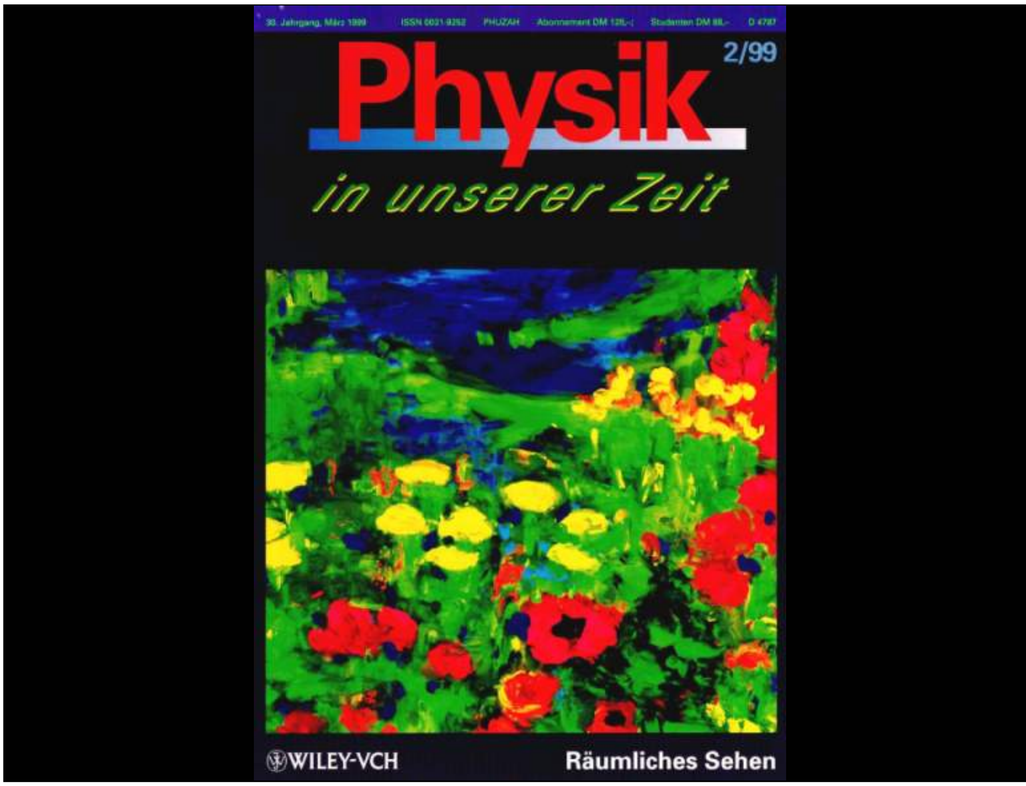
Please have a look at this text. You should see normally the red word in the foreground and the blue in the background. There may be some people who see just the red word in the background.

And probably some of you will not see a three-dimensional effect. Between 5 to 10% of the population has no three dimensional vision. And it is an interesting question to discuss the reasons in a class and to find out, which persons does not have 3D-vision

The question is how to explain the 3 D effect here? There are no polarizing glasses. There are also not red-green glasses. Furthermore you have only one picture here and not a stereoscopic pair of pictures.

If you look through the glasses you will not recognize what is made there.

Many further examples exist on the homepage of the company which manufactures these glasses. You can order these glasses directly through the internet.



This is the cover of a popular German physics journal where I published an article about the Colour Stereo effect. It is in German. But on my homepage you can also find an English version.

Artists have always made use of the colour stereo effect. Even without the Chromadepth-glasses, red will appear in the foreground and blue in the background.

URL: http://www.e20.physik.tu-muenchen.de/~cucke/

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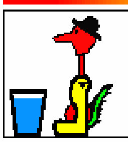


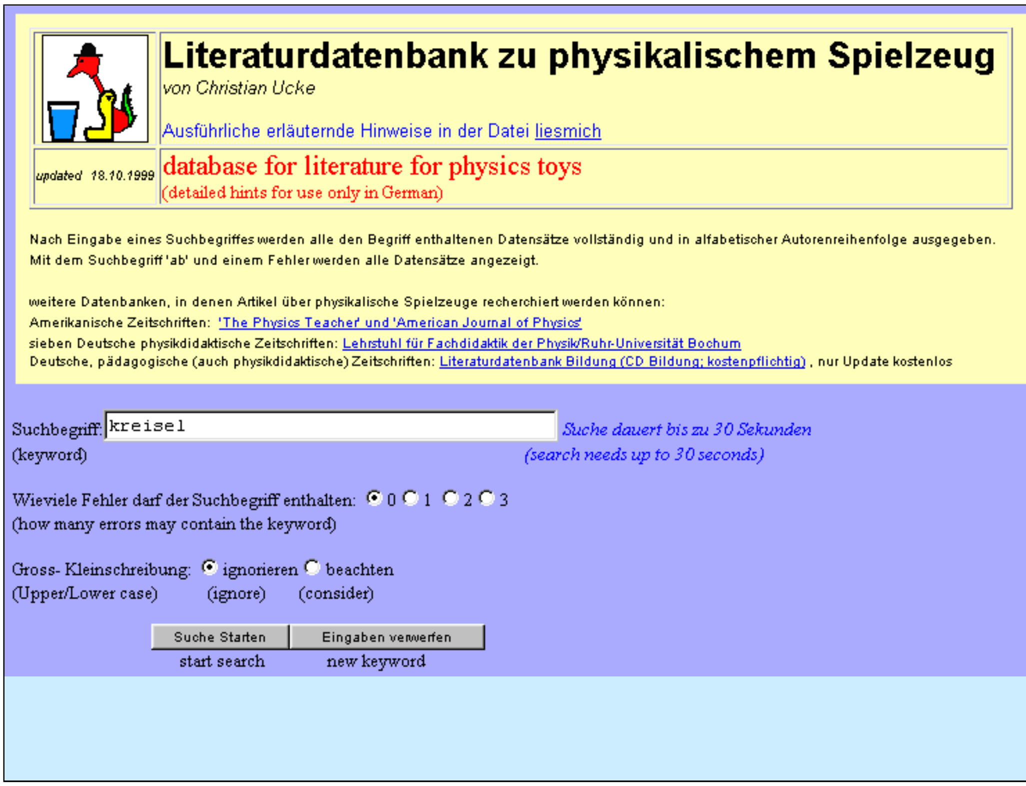
Activities

same page in German

- Head of Department of physics laboratory for life sciences; see Announcements resp. Description (both in German)
- Physics Toys (see Publications resp. files for Download ; some files in English, most in German)
- Physics Toys in the WEB
- Database for literature to physics toys (in German)

At the end, I am going to mention my own homepage, where you can find many references. My own publications, but also many links for other web pages related to physics toys.

There is also a database for literature about physics toys which I try to maintain.


Literaturdatenbank zu physikalischem Spielzeug
von Christian Ucke
Ausführliche erläuternde Hinweise in der Datei liesmich
updated 18.10.1999
database for literature for physics toys
(detailed hints for use only in German)

Nach Eingabe eines Suchbegriffes werden alle den Begriff enthaltenen Datensätze vollständig und in alfabetischer Autorenreihenfolge ausgegeben.
Mit dem Suchbegriff 'ab' und einem Fehler werden alle Datensätze angezeigt.

weitere Datenbanken, in denen Artikel über physikalische Spielzeuge recherchiert werden können:
Amerikanische Zeitschriften: 'The Physics Teacher' und 'American Journal of Physics'
sieben Deutsche physikdidaktische Zeitschriften: Lehrstuhl für Fachdidaktik der Physik/Ruhr-Universität Bochum
Deutsche, pädagogische (auch physikdidaktische) Zeitschriften: Literaturdatenbank Bildung (CD Bildung; kostenpflichtig), nur Update kostenlos

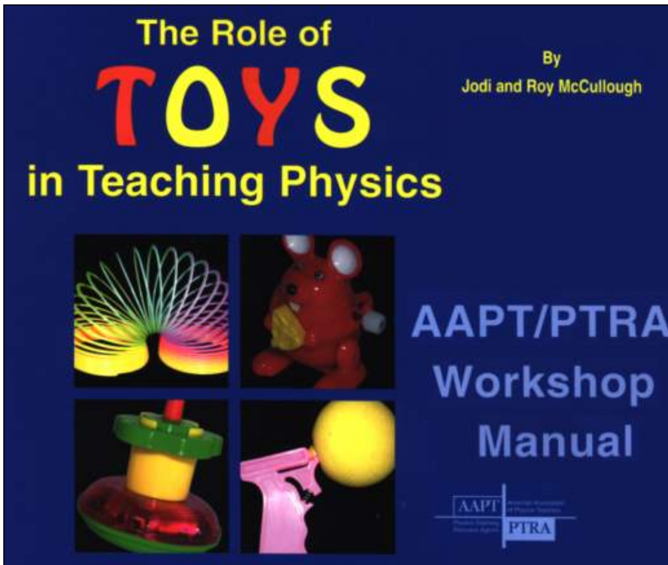
Suchbegriff: kreisel
(keyword)
Suche dauert bis zu 30 Sekunden
(search needs up to 30 seconds)

Wieviele Fehler darf der Suchbegriff enthalten: 0 1 2 3
(how many errors may contain the keyword)

Gross- Kleinschreibung: ignorieren beachten
(Upper/Lower case) (ignore) (consider)

Suche Starten | Eingaben verwerfen
start search | new keyword

Here is the page for the database. You enter a keyword and will find many references. The database contains now about 1000 references. Half of these are in English.



published by:
American Association
of Physics Teachers

June 2000

~$35

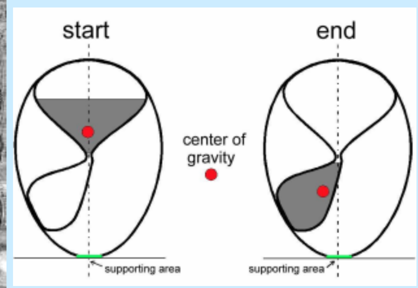
A brandnew book

Physics Toys and related topics in the web (see also the German page; better updated)

- Physics Toys and Resources: the American physicist Ray Hall has collected interesting links: Levitron (magnetic top), Tippe Top, pop-pop boat, Cartesian Diver, Dippy Bird (drinking duck); some vendors of physics toys.
- Grand Illusions: a collection of optical illusions, some physics toys and strange stories: Chinese magic mirror, Chinese singing fountain bowl, floating hourglass.
- Yippeee: a description of the history of toys including some physics toys: Yo-Yo, Slinky.
- Slinky: a description of the history of the invention of the Slinky; nice suggestions for experiments
- Slinky: 'slinky home page'; nice animations; suggestions for experiments; slinky songs; further slinky links
- Ligthmill an explanation to the ligthmill with good literature hints
- T.O.Y.S. to teach PHYSICS many hints for the use of toys for demonstrations and experiments (springs, drinking duck, Bungee Jumping Barbie, Dart Gun, Hovercraft); also chemical toys (slime, silly putty, love metre etc.)
- Levitron-Top: homepage of **fascination toys**, the manufacturer of the Levitron-Top
- Levitron-Top: an incredible history about the invention, developing and marketing of the Levitron-Top
- Levitron-Top: (German) the description, how you can build your own Levitron-Top
- Levitron-Top: where to buy the tops and frequently asked questions (FAQ) with answers by Michael Berry
- Stirling-Motor very good explanations; nice animation.
- magic tricks - science facts Tricks and Tips with a background in physics
- Kopfball (German) Description and explanation of the experiments, that were shown in the television 'Kopfball' (some toys also)

Here is the page with the links for physics toys in the web.

Magic Egg



Another magic object. Here you can see an egg. The task is to set it on the tip. It is often described that Columbus was the first person who had done this with a real egg. But this is not true. It is written that the Italian architect Brunelleschi has done this already in the year 1420. And perhaps there were earlier predecessors. It is not so important who it was. Important is, that I need some time to prepare the experiment. Now I will try to set it. You need calm hands.

Now you have seen that it is possible. If you will try it, you will have difficulties. This is another example that a physics teacher could take advantage from magic elements, but of course he is not a magician although some pupils may believe that.

The solution is very simple. There is an unsymmetrical hourglass inside. If I hold the egg long enough in my hands, all the sand will run into the symmetrical part of the egg. If I set it quick enough on the tip, the center of gravity is above the supporting area and the egg can stand stably. After a short time it will fall down. If you don't know the trick you will have no chance to set it on the tip.

Please try it later yourself.