Expériences : rotations

Mécanique, cours 8.exp

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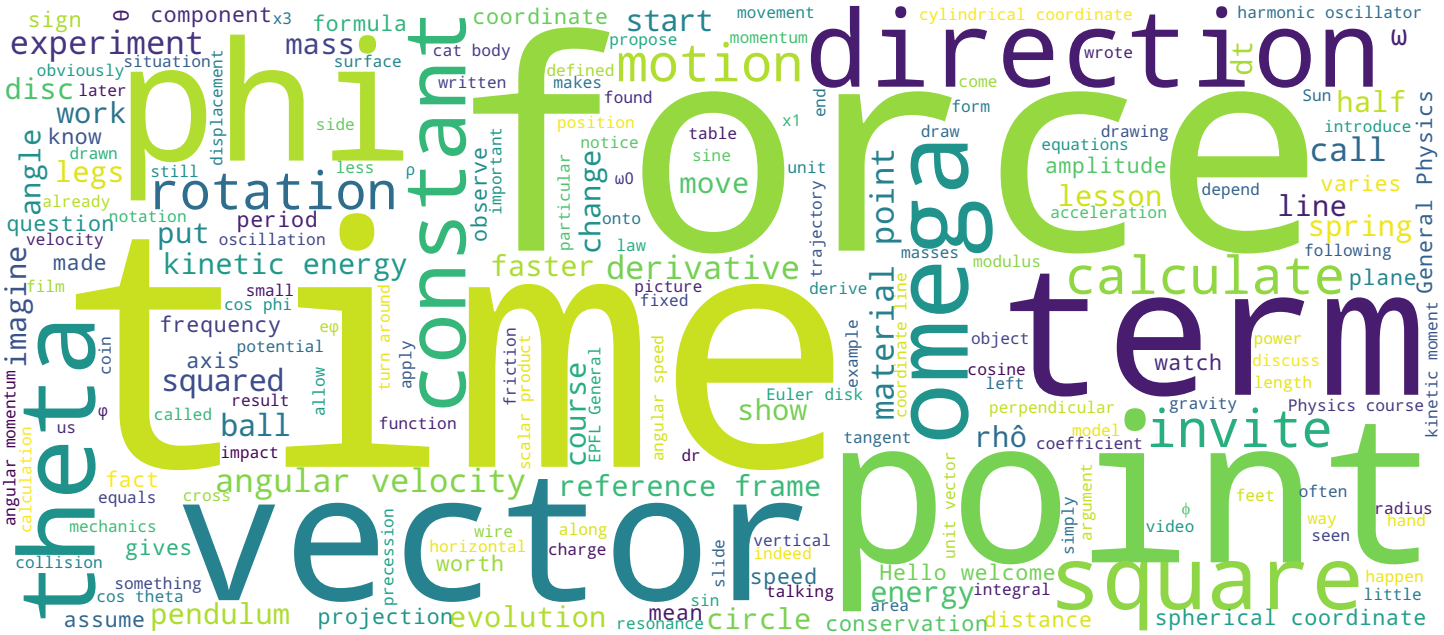


Expériences : rotations

- Le disque d'Euler
- Le chat retombe sur ses pattes

Hello, welcome to the EPFL General Physics course. In this lesson, I dealt with the mathematical representation of rotations. I know it's a difficult subject, but you can imagine that we can't do mechanics without talking about rotations. To counterbalance the arduousness of the course I've just given, I'm going to present you two amusing experiments: the first one is known as the Euler disk, it's a coin that rolls on a table, and the second one, the second experiment is the question of how a cat does to land on its feet.

Notes

Summary

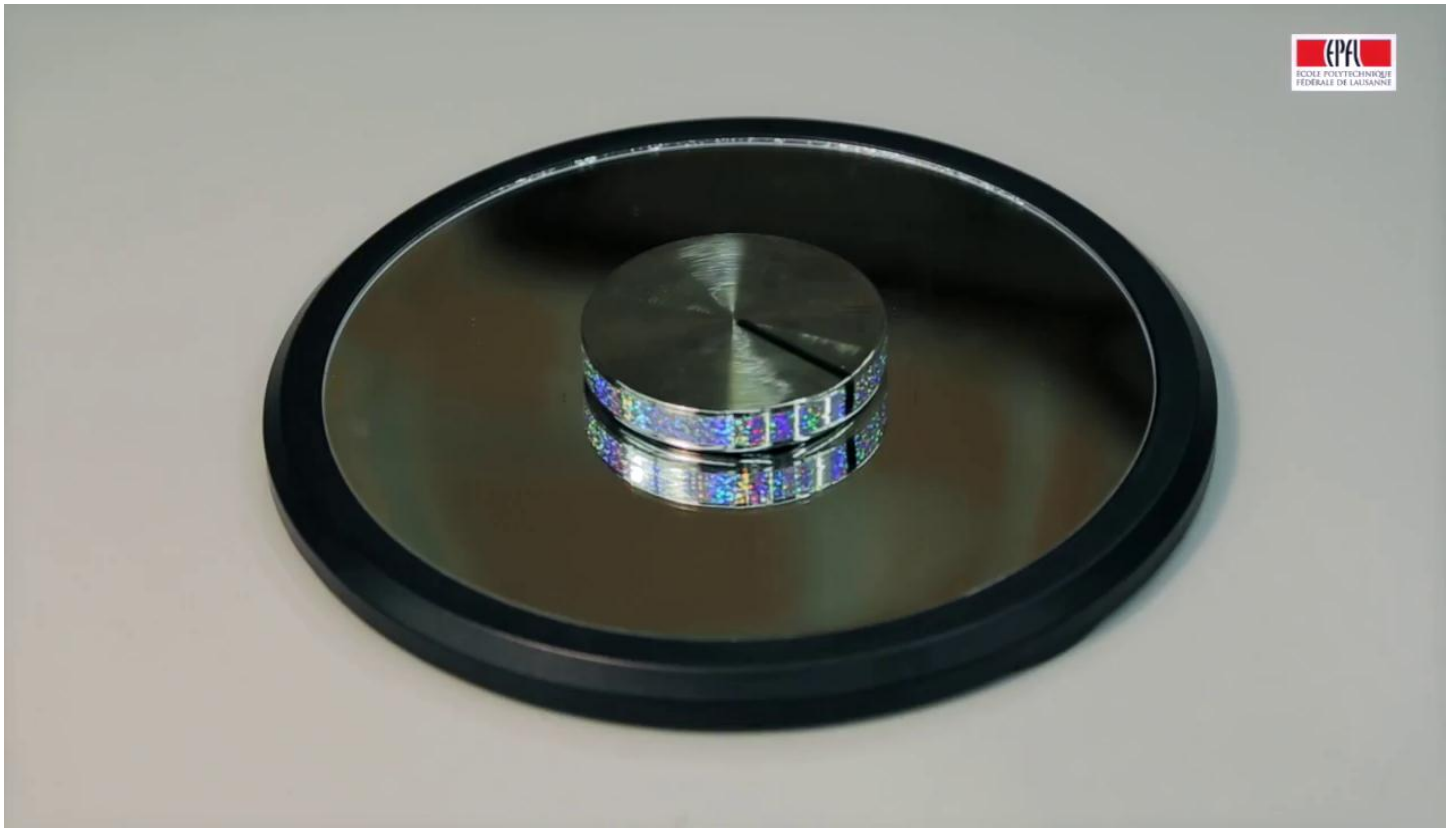
0m 04s

I start with the Euler disk; to do this experiment, instead of a coin we have a very dense disk, and which is put on a very smooth surface. I invite you to watch the experiment.

Notes

Summary

0m 43s



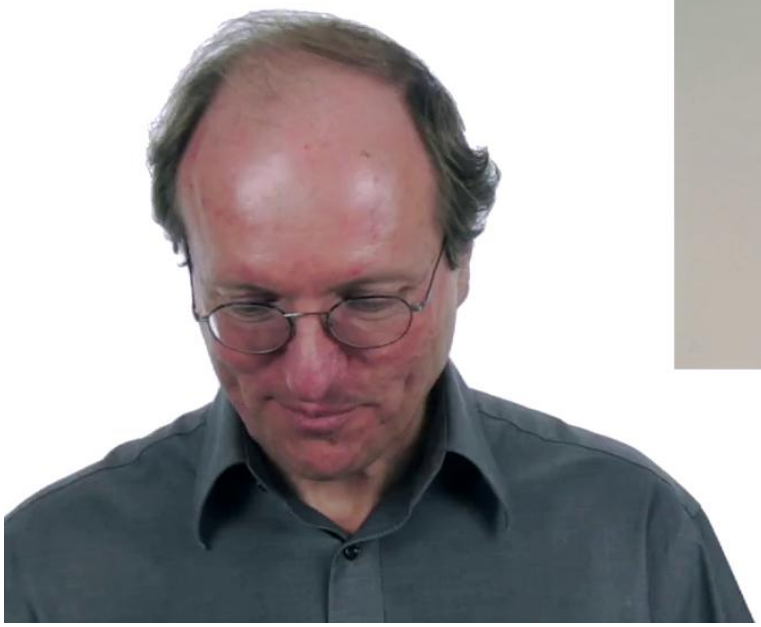
You will have noticed that the preparators have drawn a line on the surface of the disc. When you look at the evolution of this line, you see the angular speed of rotation of the disc on itself, and you notice that this angular speed is about constant. On the other hand, you notice that there is something that goes faster and faster. I would say like that, I would say that it's the reorientation of the disc which is going faster and faster. You might consider that it's the point of contact, actually, the technical term is precession, the angular velocity of precession is going faster and faster. What is beautiful in this video, is that we see that there are really two things happening, an angular velocity that doesn't change much, and one that changes a lot. I invite you to see the end of the film.

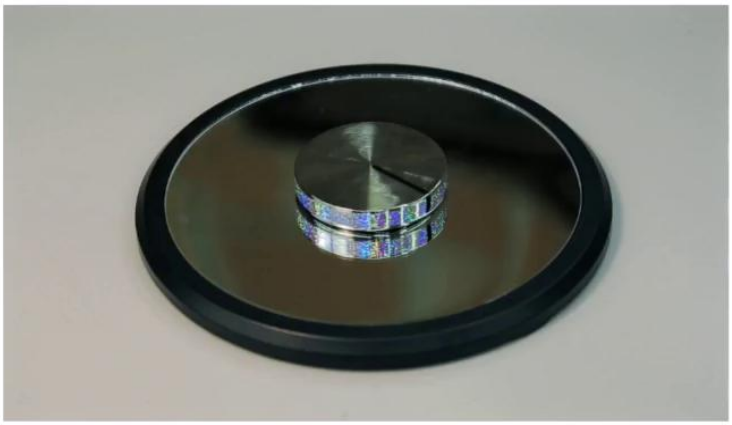
Notes

Summary

1m 13s

Le disque d'Euler





- Le disque tourne sans glisser, longtemps.
- Le point de contact parcourt un cercle de plus en plus vite, puis s'arrête d'un coup.
- Voir : Physical Review E **69**, 05660 (2004)

And there it is.

Notes

Summary

2m 28s

Le disque d'Euler

- Voir : Physical Review E **69**, 056610 (2004)
  Rolling and slipping motion of Euler's disk
  H. Caps, S. Dorbolo, S. Ponte, H. Croisier, N. Vandewalle

Well, uh, to see the movement a little better, we made a film in slow motion, which I invite you to watch now.

Notes

Summary

2m 33s

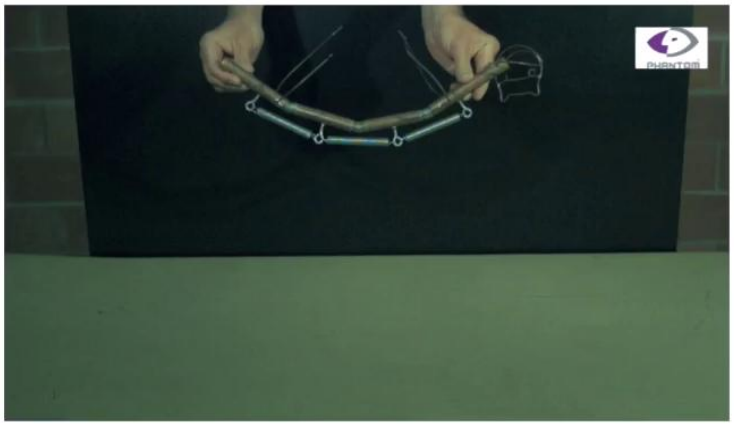
You can see, if you want, the evolution of the normal axis of the disc, and then the evolution of the line drawn on the disc. Try to imagine that.

Notes

Summary

2m 42s

Le chat retombe sur ses pattes



- Le chat tombant les pattes vers le haut combine trois rotations pour faire en sorte que ces pattes finissent vers le bas.

The second experiment analyses the question of how a cat can turn around and fall on its feet. I invite you to watch the experiment and we'll discuss it later.

Notes

Summary

3m 22s

It's a rehearsal, so you see, we have this mechanical cat made of rods and springs, and, in the initial position, the legs are up, and then, the two parts of the body, the front and the back turn around, here they are in the middle of flipping over, and, finally, at the moment of impact on the ground, the legs are down.

Notes

Summary

3m 44s

Le chat retombe sur ses pattes

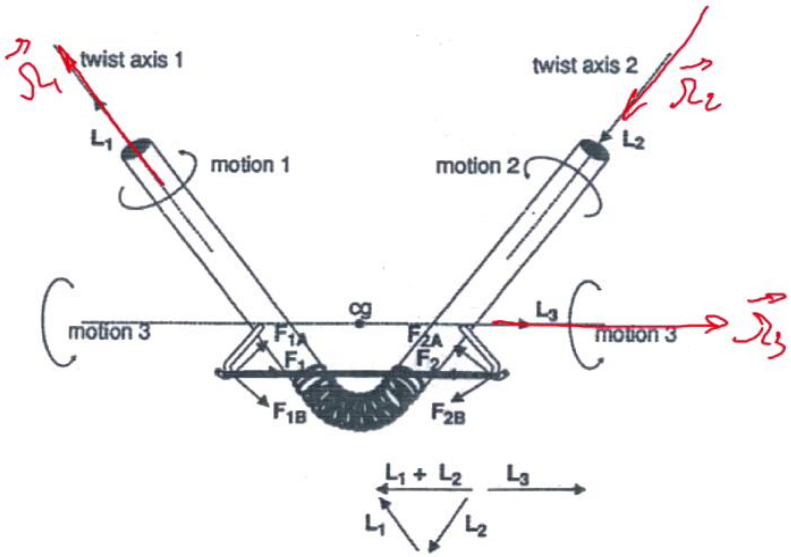
If you want to build such an object, I invite you to imitate our own construction, here: see some springs, the legs are obviously there just figuratively, the essential is in the three bars and the four springs. Why am I talking about this when I'm talking about rotation? I invite you to have a look at the drawing made by Mr.

Notes

Summary

4m 16s

Le chat retombe sur ses pattes



Voir : The Physics Teacher 33, 404 (1995) ou
http://physics.weber.edu/galli/Catflip.pdf

Galli, who published on this subject not so long ago. Here you have, let's say, half of the cat's body, here, the other half of the cat's body, you have an angular velocity corresponding to that arrow, so it's an angular velocity that I have to draw in that sense, (! I have an omega 1 like this, for this movement of the other legs, we have omega 2 which is in the other direction, and now, the fact that the cat's body turns around, corresponds to an angular velocity omega 3, like this. When we will have advanced in the course and we will do the mechanics of the indeformable solid, we will understand that these L represent kinetic moments, and the argument that is made by this author Galli, is that everything happens at zero kinetic moment.

Notes

Summary

4m 46s