

# Levitron – magnetic levitation

Margareta Pelesz

“Creative Group Quark” Youth Palace in Katowice, Poland, [ula@pm.katowice.pl](mailto:ula@pm.katowice.pl)

## The purpose of the investigation

My work concern mechanic of levitron – a toy, which consist in the levitation phenomenon. My objective was to present a theory explaining the operation of levitron, and execution of experiments to check the validity of the theories contained in publications and make the phenomenon of magnetic levitation more understandable.

## Method of the investigation

In my research I considered the levitating spinning top, and the specificity of the magnetic field generated by magnets placed in the magnetic base.

## Research of the magnetic field generated by the base magnet

In many publications It's said, that magnetic force from the base has the smallest value in the center of base. I decided to check it by visualization with ferromagnetic filings. My objective was to obtain cross sections of the magnetic field in two important heights: On the height on the top untwisting and on the height of the top's levitation. So far, I haven't seen any publication in witch ferromagnetic filings were used to investigate levitron's magnetic field.

## Research of the levitating top's rotary motion

To measure the rotational speed I've used the strobe effect. This method is commonly used for measuring the rotational speed of rapidly rotating objects.

I've made a strobe shield which has 18 black and white sections and I put it on the top. Then I was shining with flashing light on a stroboscopic disc. Flash frequency was regulated by a generator in the range of 50-2kHz.

## Results of the experiments

The results of my experiments are not explicitly to the theory contained in the publications.

## Result of the magnetic field's research

On the height of the top's untwisting magnetic field is inhomogeneous, but it has axial symmetry. In the center of the base there is a circular neutral place in magnetic field, where is no magnetic forces.

On the height of the top's levitation magnetic field is homogeneous and its lines are extending slightly up. There is no more neutral place in the field.

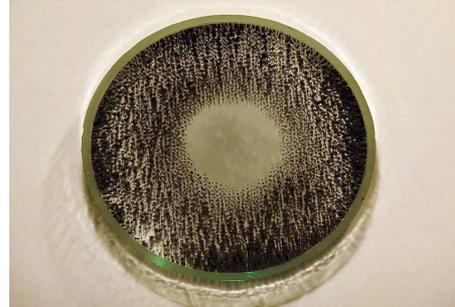


Fig.1 Magnetic field from base on the height of the top's untwisting.



Fig.2 Magnetic field from base on the height of the top's levitation

## Result of the top's rotary motion research

Measurement have shown that maximum frequency of the full representation of the strobe shield was 460Hz.

$$\Delta = k/18 T \quad (1)$$

Thanks to Eq.(1) I've count range of frequency and range of the rotational motion's angular speed, which are: 22-25 Hz, and 139-157 rad/s.

Thanks to many analysis I was able to determine the equilibrium position  $z_0$ , which for my toy is 58 millimetres.

$$z_0 = \sqrt[4]{\frac{3 \frac{\mu_0}{2\pi} \times \mu_l \times \mu_b}{mg}} \quad (2)$$

## Conclusion

I hope that my investigation made the phenomenon of magnetic levitation in levitron more understandable.