

Magnets in External Magnetic Field: What We Can Learn from Simple Experiments (workshop)

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Abstract. The workshop will be a follow-up to the workshop “Magnets and Magnetic Field around Them: What We Can Learn from Simple Experiments” presented at GIREP-ICPE-EPEC 2017 conference in Dublin. The new workshop will concentrate mainly on experiments concerning torque on magnets in external field. It will offer its participants several simple experiments and teaching-learning sequences that can be used in active learning of the topic at upper-secondary and introductory university level.

1 Introduction

In the workshop presented at GIREP-ICPE-EPEC 2017 conference (see [1]), a series of simple experiments with neodymium magnets was presented that went from qualitative experiments to quantitative measurements enabling for example to find the value of magnetic field near a pole of a magnet (without using any magnetometers or similar instruments). The workshop was quite appreciated by its participants. Nevertheless, not all effects seen in the experiments could have been discussed and investigated in the last year’s workshop and some further interesting simple experiments had to be omitted. The proposed workshop should fill this gap.

As it was stressed in proposing the previous workshop, we all have much experience (since our early childhood) with how magnets behave and we learnt this topic in school physics. Despite of this, some relatively simple features of magnets and magnetic field are still not completely clear even to some physics teachers. Here, some simple experiments we do “in an inquiry-based style” can help. Small neodymium magnets are ideal cheap tools for this purpose. However, quite often simple experiments with magnets presented in various sources are just qualitative, see for example [2]. On the other hand, quantitative experiments described in literature usually require more sophisticated equipment, e.g. [3].

2 What will be presented in the proposed workshop

The experiments will use very cheap and simple tools, mostly made by participants themselves.

One experiment participants will do in the workshop concerns demonstration and measurement of inclination of Earth’s magnetic field. (People usually quite underestimate the angle Earth’s magnetic field forms with horizontal direction and an experiment showing its value is rather surprising to them.) Participants will make a simple tool (from two skewers, pieces of thread and four small magnets) and we will focus also to finding how to balance the magnets so that their weight would not spoil the measurement.

Largest part of the workshop will be devoted to oscillations of magnets in external magnetic field. The experiments will start from simple qualitative observations but arrive even to approximate measurement of the horizontal component of Earth’s magnetic field. For this measurement, the formula for period of torsion pendulum is necessary; in the proposed teaching-

learning sequence, a simple way how to arrive to it by means of experiments will be presented and discussed.

In the rest of the workshop (if time enables it), some further experiments will be presented and discussed, namely concerning the question how the field generated by small magnets decreases with distance. Of course, it can be done using magnetic field sensors in smartphones but we can also do it without any modern technology.

3 Where these experiments were already piloted with physics teachers

The series of experiments mentioned above was previously presented at a few workshops for Czech physics teachers [4] and was adapted according to gained experience. Some 50 to 60 teachers passed through the workshops. In an informal feedback, teachers stated that it helped them to understand some concepts and features concerning interaction of magnets with magnetic field.

4 Conclusion: the character of the proposed workshop

As it was already indicated above, the workshop will be aimed at active work of its participants and will be done in an inquiry based way. The participants will build several very simple tools for doing the experiments and measurements they can later use in their teaching, courses for physics teachers etc. However, the workshop will not be only “hands-on”; the “minds-on” component and detailed discussion of the experiments and features of tools will be equally important.

References

- [1] L. Dvořák, Magnets and magnetic field around them: what we can learn from simple experiments. In: *Proceedings of GIREP-ICPE-EPEC 2017 conference*. (Paper sent to editors.)
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