Hands On vs. VR
Lectures in Times of the Pandemic

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Abstract: The implementation of physical and optical experiments in a VR environment will be presented. A comparison between the hands on and the digital VR experiments will be analyzed and presented.
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1. Hands On vs. VR

A change from face-to-face teaching to digital distance learning has never been more urgent than in the last two years due to corona pandemic. Thereby, we converted some experiments from the physics and optics labs into a digital respectively VR environment. A promising experiment for this implementation was measurement of specific charge (e/m) of electron Fig. 1. By setting the accelerating voltage U and current I in the coil of the magnetic field B, the specific charge (1) can be measured by reading the diameter d of the electron beam. In order to provide a versatile performance of the experiment, a corresponding application was developed. The calculated value is quite close to the theoretical value $1{,}759 \cdot 10^{11} \frac{C}{kg}$

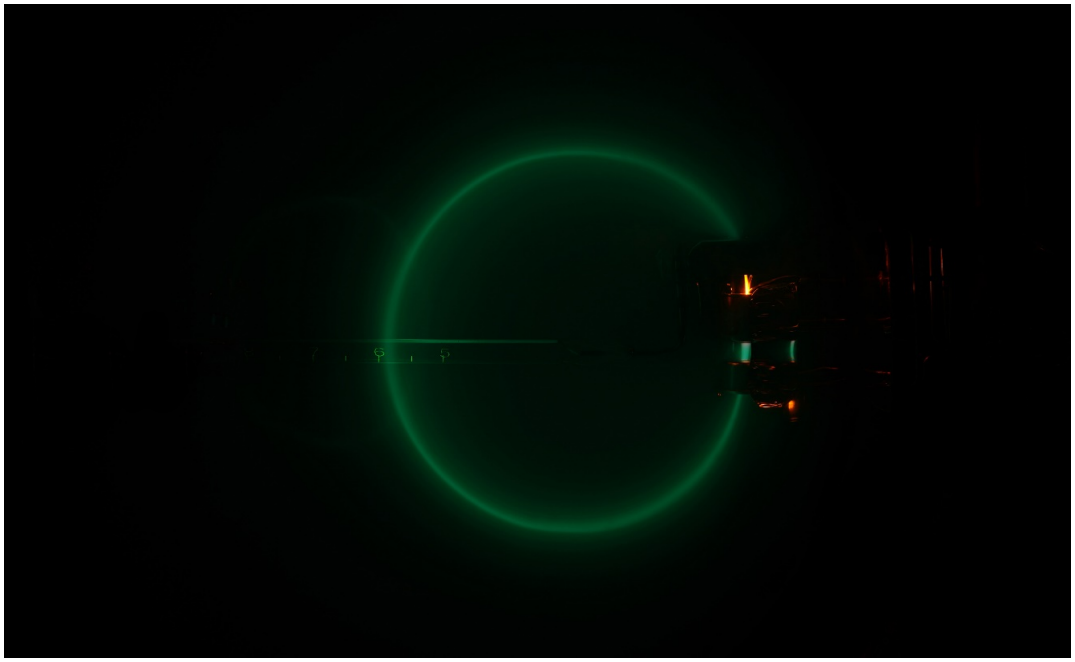

Fig. 1: Physical experiment: Specific charge (e/m) of electron. Photography by Dan Curticapean

$$\frac{e}{m} = \frac{8 \cdot U}{d^2 \cdot B^2} \tag{1}$$

where the magnetic field of the Helmholtz coils (2) is given by:

$$B \approx 7{,}84 \cdot 10^{-4} \frac{T}{A} \cdot I \tag{2}$$

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2. VR Environment

One of the crucial questions to be answered is how to design the VR experiments so that they also achieve the higher levels of Bloom's taxonomy [1] - [3]. We start with a simple measurement experiment in the electrical engineering.

Fig. 1. Real- vs. VR simulated measurement device

The simple measurement with a digital multimeter is to be supplemented and later replaced by a VR multimeter in a first step (Fig. 1). This allows students to test and compare the two multimeter in advance and perform some individual measurements according to the K3 (Application) level of knowledge. In a next step the authors extend the VR environment and simulate a VR laboratory implicating the use of the VR multimeter (Fig 2 – Fig. 3). By expanding the VR environment with additional measuring devices and electrical components, the experimental possibilities are significantly expanded, thus creating a big variety of new options. Higher educational levels can be achieved easily.

Fig. 2. Laboratory VR environment

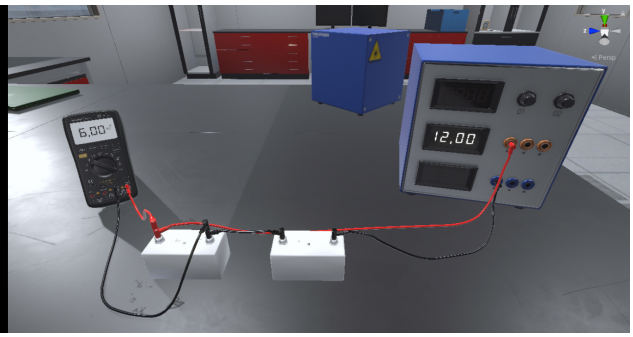

Fig. 3. VR experimental setup environment

An additional example from optics respectively colorimetry is shown in Fig. 4.

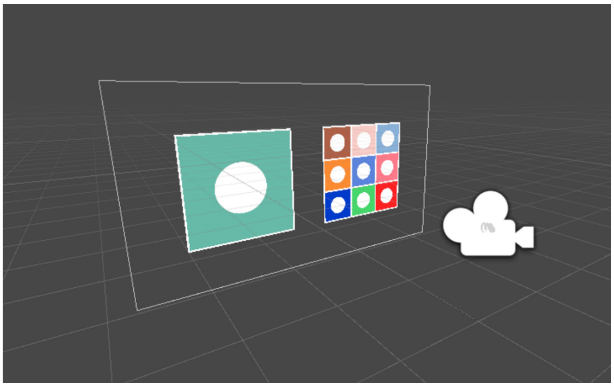

Fig. 4: Colorimetric experiment: a) real measure set-up; b) VR measurement environment

3. References

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