

Didactical material – Millikan's experiment

Didactical analysis (why, for whom, how, ...)

The "Millikan experiment" is the only experiment, by which one can proof the quantization of the electric charge and can measure directly the size of the elementary charge at school level. This experiment is central and essential in the curriculum; many physical laws are applied here; therefore, it is a demanding experiment for students.

In general, the "Millikan experiment" produces a series of problems:

... for the teacher

- the preparation of the experimental setup with video transfer to monitor takes time,
- the number of individual measurements during teaching are too small to make unambiguous statements about the quantization of electric charges,
- series of measurements are not possible because the opening to inject oil droplets may be blocked after a while; in addition, the light source may heat up the capacitor chamber and oil droplets perform convective motion,
- after finishing long series of measurements the result is unsatisfying,
- performing measurements when watching the motion of oil droplets the experimenter is getting tired,
- during measurements only one observer is actively involved,

... for the students

- using the frictional force due to Stokes without derivation is problematic,
- the necessity for the Cunningham correction and its justification via thermodynamics is not straight forward,
- the concept of quantization of physical values at school level is intriguing.

We suggest the following implementation of the RCL Millikan's experiment in teaching environment: During lesson the theoretical background must be worked out with the students. Then the lab part of the RCL Millikan will be introduced to the students. The teacher may demonstrate qualitatively the RCL to inform the students how to perform the experimental steps. As homework each student is given the task to determine the charge of several oil droplets and to store digitally the measured and evaluated data.

In the following lesson all the results of students will be collected and analyzed by a suited spreadsheet program. According to the size of the class one is getting in a relatively short time period many results which can be statistically analyzed.

If the RCL Millikan may not work due to technical problems, one can evaluate measuring videos. A selection of 10 measuring videos is stored under the menu option „Material“.