Physics 410/510

Experiment G-10
Determination of Boltzmann's Constant
and Avogadro's Number

1. Make photographs at various depths (5 micron steps) in a thin volume of equilibrated particle suspension in water. Each student will make his or her own cell. From the photographs make particle counts and from the variations in depth and the law of atmospheres, determine Boltzmann's constant. Having this and the universal gas constant, Avogadro's number can be obtained. We assume the calibration of the fine focus of the microscope is as the dial indicates, but it could be checked by the student without difficulty.

2. Make approximately 100 determinations of particle x-displacement in a 30 second time interval. From the mean square value (check also the mean value), again determine Boltzmann's constant. (One can try this right after making up the cell but the particle density may be too high for easy tracking. It is easy to track particles near the top of the "particle atmosphere" after equilibrium is established, say after about a day's time.) The microscope optics need to be calibrated against a standard scale (.01mm least count), and various constants will have to be obtained. One could also repeat this for a time interval of say, 15 or 60 seconds.

Use care in focusing the microscopes so that the objectives do not come down against the top of the cell or against the calibrating standard mm scale. Necessary constants in the experiment are posted or may be obtained from tables and data on the bottle containing the suspension concentrate.

References:

Harnwell and Livingood, Experimental Atomic Physics (copies in reading room), pp. 82-95.

Trigg, Crucial Experiments of Modern Physics, pp.37-54.

Am. Jour. Phys., 41, 344 (1977).

Papers of Perrin, cited in these references, may also be utilized.

Physics 410-510
Experiment - G-10
Determination of Bolzmann's Constant and Avagadro's Number

1. Make photgraphs at various depths (5micron steps) in a thin volume of equilibrated particle suspension in water. Each student will make his (or her) own cell. From hte photographs make particle counts and from the variations in depth and the law of atmospheres, determine Boltzmann's constant. Having this and the universal gas constant, Avagadro's number can be obtained. We assume the calibration of the fine focus of the microscope is as the dial indicates, but it couls be checked by the student without difficutly.
2. Make approximately one hundred determinations of particle x-displacement in a 30 second time interval. From the mean square value (check also the mean value), again determine Boltzmann's constant. (One can try this right after making up the cell but the particle density may be too high for easy tracking, it is easy to track particles near the top of the "particle atmosphere" after equilibrium is established, say after about a day' time). The microscope optics needs to be calibrated against a standard scale, (.01mm least count) and various constants will have to be obtained. One could also repeat this for a time interval of, say, 15 or 60 seconds.

Use care in focussing the microscopes that the objectives do not come down against the top of the cell or against the calibrating standard mm scale. Necessary constants in the experiment are posted or may be obtained from tables and data on the bottle containing the suspension concentrate.

References:

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