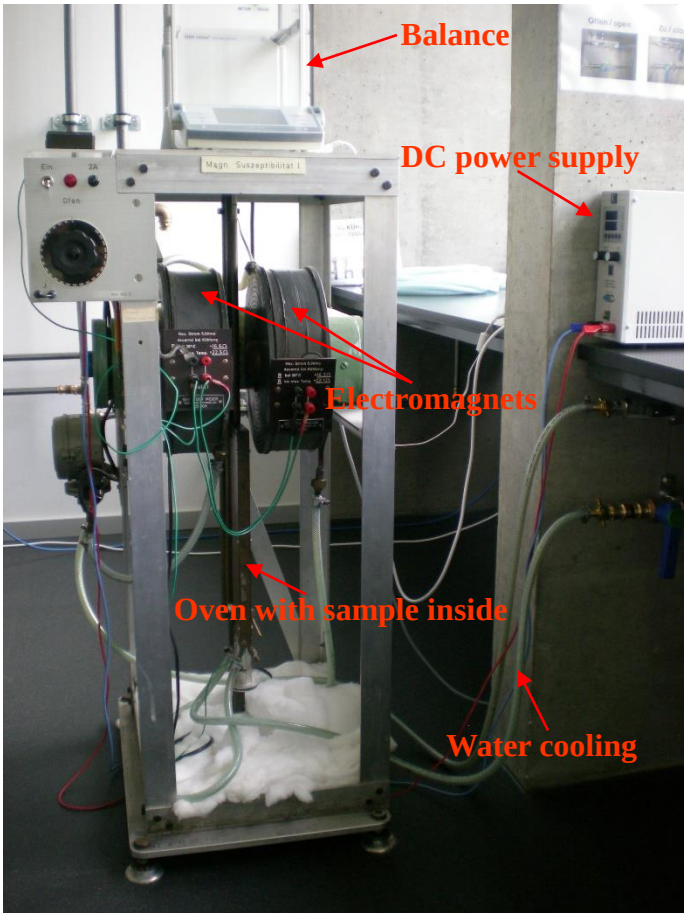
Physics Lab
ETH zürich

D PHYS

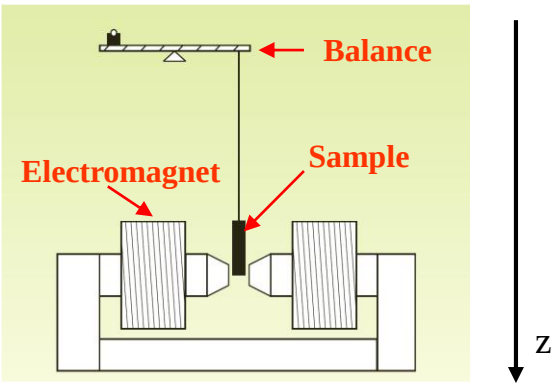
Magnetic Susceptibility

Abstract. The magnetic susceptibility χ is a characteristic property of magnetic materials that specifies, how they react to an externally applied magnetic field intensity H: $M = \chi H$. In *paramagnetic* materials, the induced magnetization M is parallel to H, i.e. $\chi > 0$. In diamagnetic materials, M is antiparallel to H and thus $\chi < 0$. The magnetic susceptibility is a function of temperature and for ferromagnets in the paramagnetic region over the Curie temperature Θ, χ_M can be described by the Curie-Weiss Law $\chi_M(T) = \mu_0(Np^2\mu_B{}^2/3k(T\text{-}\Theta) = C_M/T\text{-}\Theta$, where μ_0 is the magnetic field constant, N the number of magnetic atoms per kMol, μ_B the Bohr magneton, k the Boltzmann constant and p the effective Bohr magneton number. In the force method, the apparent change in the weight of the sample due to the application of a magnetic field, is measured by a sensitive balance and this weight change is directly proportional to the magnetic susceptibility.

Measurement of Magnetic Susceptibility Using the Gouy Method



Apparatus based on the Gouy method



Schematic drawing of the Gouy method

Experiment and Results. The tube with the compound under study is placed so that one end of the sample lies at the point of maximum magnetic flux in an electromagnetic field while the other end is at a point of low flux. Initially the magnet is switched off, but on applying a magnetic field, paramagnetic compounds are drawn into it by an amount that depends on their number of unpaired electrons. The apparent change in weight caused by the movement of the sample into the field is recorded, and from the associated force it is possible to calculate the magnetic susceptibility of the compound.

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