

Electron paramagnetic resonance

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1 Motivation

The motivation of this Experiment is to determine the magnetic moment caused by the Spin of a free electron. Diphenylpicrylhydrazyl is a sample which offers free electrons. Methods of high frequency spectroscopy are used for this purpose: The experimental conditions are varied until a resonance absorption of the electrons occur. With the resonance condition it is possible to determine the magnetic moment.

2 Theory

Electrons without orbital angular momentum still have a magnetic moment. From this it can be concluded that the electrons have a spin. The connection between orbital angular momentum and magnetic momentum in of quantum mechanics, based on the consideration that the wave function for an atom in the one-electron approximation can be represented as

$$\psi_{n,l,m}(r, \vartheta, \varphi) = R_{n,l}(r)\theta_{l,m}(\vartheta)\phi(\varphi) = \frac{R_{n,l}(r)\theta_{l,m}e^{im\varphi}}{\sqrt{2\pi}}, \quad (1)$$

leading to the expression

$$\mu_z = -\frac{e_0\hbar m}{2m_0} \quad (2)$$

which describes the relationship between magnetic and the angular momentum. $m\hbar$ is the angular momentum l and the product of the natural constants is called Bohr magneton μ_B .