Let the coordinates of the radius of the orbit are x, y, z . Then we have

$$a^2 = x^2 + y^2 + z^2$$

If Z – axis is chosen to be in the plane perpendicular to the applied field , then

$$a_1^2 = x^2 + y^2$$

The mean value of all possible radius is given by

$$a^2 = x^2 + y^2 + z^2 = 3x^2$$

$$= 2/3\ a^2 \qquad (13)$$

Using (13) in (12) ,

$$\Delta M = -(e^2 H /4m)(2/3\ a^2)$$

$$\Delta M = - (e^2 H /m)(1/6\ a^2)$$

For an atomic number Z , there are Z – electronic orbits and there orbits may lie in all possible directions in space , hence total induced magnetic moment .

$$M = -e^2 H / 6m \sum a^2 \qquad (14)$$

Let N = number of atoms per unit volume

Then the magnetic moment per unit volume or intensity of magnetisation ,

$$I = -e^2 H N / 6m \sum a^2$$

Hence the diamagnetic susceptibility

$$\chi = I / H = -e^2 N / 6m \sum a^2 \qquad (15)$$

This relation is independent of the temperature and field strength which agrees with experimental result .

This formulae is endorsed by quantum mechanics and the temperature - independency of this value may be understood from the evaluation of $\Sigma\, a^2$ using the wave functions.

The energy difference between the wave functions with different radial parts is approximates 10 eV.

The thermal energy k*T* at room temperature amounts to approximately 1/40 eV. Thus, diamagnetism exhibits no dependence on temperature.

Atomic diamagnetism usually is of the order of $\sim 10^{-6}$ emu, and increases in absolute magnitude for larger atoms with a bigger atomic number because they have a wider radial distribution function.