44 Electric Dipole

A "bound electron" orbits the atomic nucleus. It may be "paired" with a proton also "bound" within the nucleus. A "bound pair" (electron-proton) are assumed to form an electric dipole.

A magnetic dipole is associated with a quantum number (m_s) representing "spin magnetic moment". Evidence for a magnetic dipole within the atom is hinted at by "sets of groups" within the Periodic Table of Elements.

Evidence for an electric dipole within the atom is also hinted at by "sets of periods" within the Periodic Table.

Electric Dipole Moment:

The "electric dipole moment" ($\boldsymbol{p_1}$) is a vector: $\boldsymbol{p_1} = e_1\boldsymbol{r_1}$

Where: e_1 is the charge of the proton

e_2 is the charge of the electron

$\boldsymbol{r_1}$ is the vector distance between charges directed towards the proton

The opposite direction of $\boldsymbol{r}$ gives: $\boldsymbol{p_2} = e_2\boldsymbol{r_2}$

Vector magnitudes are: $|\boldsymbol{p_1}| = |\boldsymbol{p_2}| = p$

$|\boldsymbol{r_1}| = |\boldsymbol{r_2}| = r$

A dot product gives the electric dipole magnitude for undefined direction:

$$\boldsymbol{p_1} \bullet \boldsymbol{p_2} = e_1 e_2 \boldsymbol{r_1} \bullet \boldsymbol{r_2}$$

$$p^2 \text{Cos}(\theta_p) = e_1 e_2 r^2 \text{Cos}(\theta_r)$$

Where: $e_1 = -e_2$ and: $\text{Cos}(\theta_p) = -\text{Cos}(\theta_r)$

Giving: $p^2 = e_2^2 r^2$

$$p = \pm e_2 r$$

Electron Orbit:

If the electron orbit is circular, then the circumference (C_o) of the orbit is: $C_o = 2\pi r$

If the electron orbit is elliptical, then the circumference (C_e) of the orbit is: $C_e = 2\pi k_e r$

Where: k_e is a constant associated with the shape of the ellipse (eccentricity).

Quantization:

The “quantization rule” states that only an integer number (n) of wavelength (λ) may be imposed upon a circumference:

$$n\lambda = 2\pi k_e r$$

The quantized magnitude of electric dipole moment with undefined direction (p_Q) is:

$$p_Q = \pm e_2 r = \pm e_2(n\lambda/2\pi k_e) = \pm½(ne_2\lambda/\pi k_e) = p_n(ne_2\lambda/\pi k_e)$$

Where: p_n is the “quantum number” for “electric dipole”: $p_n = \pm½$

The Quantum Matrix:

If the “electric dipole number” (p_n) is included, then the quantum numbers may be arranged as a “quantum matrix”.

n	ℓ	s
p_n	mℓ	m_s

Where: the top row is the quantum representation of motion (radial, orbital, spin).

The bottom row is the representation of secondary characteristics

(electric dipole, orbital magnetic moment, magnetic dipole)

The four quantum numbers (n, ℓ, mℓ, m_s) are well defined in the literature, where;

n is the principal q. n. It is associated with radial distance from the nucleus; n = 1…8

ℓ is the q.n. for orbital momentum (angular momentum); ℓ = 0… (n-1)

mℓ is the q.n. for magnetic moment associated with orbital motion: mℓ = -ℓ …0…+ℓ

m_s is the q.n. for magnetic dipole associated with spin; $m_s = \pm½$ (spin up, spin down)

The two “quantum numbers” (s, p_n) are;

s represents the spin momentum of an electron; s = ½

Spin momentum has the same value for all leptons (including electrons). It is usually omitted.

p_n is the “assumed q.n.” for electric dipole and is associated with the principal q.n.

Evidence:

The Periodic Table of Elements has 18 "groups" and 7 "periods". Evidence for the existence of magnetic and electric dipoles are hinted at by the arrangement of groups and periods within the Periodic Table.

Evidence for the magnetic dipole within the atom is hinted at by the arrangement of groups within the Periodic Table. Some groups may be arranged into four "sets". The sets are determined by the value of spin magnetic moment (m_s):

	m_s = -½	m_s = +½
Set 1:	Group = 1	Group = 2
Set 2:	Groups = 13, 14, 15	Groups = 16, 17, 18
Set 3:	Groups = 3, 4, 5, 6, 7	Groups = 8, 9, 10, 11, 12
Set 4:	Groups = 3a,4a,5a,6a,7a,8a,9a	Groups = 10a,11a,12a,13a,14a,15a,16a

Evidence for the electric dipole within the atom is also hinted at by the Periodic Table. Some "periods" may be arranged into three "sets". Four sets may be determined from the Janet Periodic Table. The sets are determined by the value of p_n:

	p_n = -½	p_n = +½
Set 1:	Period = 3	Period = 2
Set 2:	Period = 5	Period = 4
Set 3:	Period = 7	Period = 6

"Period pairs" (2,3)(4,5)(6,7) appear to form sets of elements determined by "p_n".

Conclusion:

There may be some basis for experimental investigation of electric dipoles within the atom.