165(1): The R Spectrum for Atomic and Molecular Absorption.

Start with eq. (29) of UFT 162, defining the new concept of scattering angle in atomic and molecular absorption

$$\cos\theta = \frac{E_1 E_2 - E_0^2}{(E_1^2 - E_0^2)^{1/2}(E_2^2 - E_0^2)^{1/2}} \quad -(1)$$

In the old physics:

$$E_0 = m_0 c^2 \quad -(2)$$

where m_0 is the mass of the electron as given in the tables for elementary particles. In the new physics:

$$E_0 = mc^2, \quad R = \left(\frac{mc}{\hbar}\right)^2. \quad -(3)$$

Therefore

$$\boxed{E_0 = \hbar c R^{1/2}} \quad -(4)$$

whenever the electron inside an atom or molecule interacts with a photon. The old rest energy (2) applies for the free electron. The free electron is an ideal because it cannot be observed in absorption scattering without interaction. In the old physics mass of the electron was determined from the Rydberg constant, but without consideration of conservation of linear momentum.

2) From the Schroedinger equation the Rydberg constant is

$$\hbar c R_{\infty} = \frac{m_0 e^4}{8\hbar^2 \epsilon_0^2} \quad -(5)$$

In the standard textbooks, m_0 was determined from experimental measurement of R_{∞}.

We now know from eq. (1) that E_0 varies, it is not $m_0 c^2$ if conservation of linear momentum is properly considered. The old physics used the h quantum number based on an approximation as shown in UFT 162.

Solving eq. (1) gives the R Spectrum for Atomic and Molecular Absorption:

$$\boxed{R = \frac{1}{2a\hbar^2 c^2}\left(-b \pm \left(b^2 - 4ac\right)^{1/2}\right)} \quad -(6)$$

where:

$$a = 1 - \cos^2\theta,$$

$$b = \left(E_1^2 + E_2^2\right)\cos^2\theta - 2E_1E_2,$$

$$c' = E_1^2 E_2^2\left(1 - \cos^2\theta\right)$$

In general there are two solutions: R_+ (positive b) and R_- (negative b).

3) The spectra can be defined as graphs of $R_\pm$ against θ for given E_1 and E_2. These are energy levels which can be measured experimentally from spectra. If R is complex valued then:

$$R := (RR^*)^{1/2} \quad -(7)$$

so

$$R_+(\theta) = (R_+R_+^*)^{1/2}, \quad -(8)$$

$$R_-(\theta) = (R_-R_-^*)^{1/2}. \quad -(9)$$

Since θ is unknown, choose θ in the range:

$$0^\circ \leq \theta \leq 180^\circ \quad -(10)$$

i.e

$$0 \leq \theta \leq \pi, \quad -(11)$$

increment θ by say 5°, and plot $R_+(\theta)$ and $R_-(\theta)$ from eqs. (8) and (9).