ESSAY 117: NEW TYPES OF ESR AND NMR

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Electron spin resonance (ESR) and nuclear magnetic resonance (NMR) make up about 60% of the whole of chemistry, which is three times bigger than physics as a subject. ECE2 theory was initiated in UFT313,written earlier in 2015, and is already being read 12,936 times a year off combined sites. One of the major discoveries of ECE2 is that all the equations of special relativity can be written in a space with identically non zero torsion and curvature. This includes the hamiltonian and lagrangian. Relativistic quantum mechanics is based on the hamiltonian and lagrangian of special relativity and ESR and NMR are manifestations of the hamiltonian modified by a vector potential, which in ECE2 becomes a type of curvature.

The theory of NMR and ESR is almost always based on a rough approximation to the ECE2 hamiltonian known as the Dirac approximation. Another major discovery of ECE2 theory is that the Dirac approximation is equivalent to assuming that the non relativistic, classical hamiltonian vanishes, an absurd result. Clearly, the classical hamiltonian is a constant of motion that in general takes values different from zero. All the theory of ESR and NMR is based on the Dirac approximation. When the latter is removed, recent papers of the ECE2 series such as UFT332 to UFT335 show that all types of ESR and NMR spectra are affected, another major discovery.

The most useful feature of NMR is called the chemical shift. This is due to the magnetic field generated by the nucleus of a molecule. This magnetic field changes the value of the applied magnetic field of an NMR spectrometer. The change in value is tiny and measured in parts per million, but is the essence of an NMR spectrum. By removing the Dirac approximation, chemical shift theory is modified, and the resulting changes in the spectrum ought to be observable in a Fourier transform (FT) NMR spectrometer. In ethanol or ethyl alcohol for example, CH3-CH2-OH, there are three different types of H, in the ratio 3:2:1, the H atoms belonging to CH3, CH2 and OH respectively. So the NMR spectrum consists of three lines in intensity ratio 3:2:1. So NMR can be used in an analytical laboratory to identify the presence of ethanol. The three lines are at different frequencies because the chemical shift is different for each type of H atom.

One of the major consequences of ECE2 theory and its use of a rigorous hamiltonian is to predict small but analytically useful changes in any NMR or ESR spectrum. Other phenomena of NMR include spin orbit and spin spin interaction, Fermi contact interaction, and so on. NMR relaxation can be used to study molecular dynamics through correlation times, there is NMR of different isotopes and so forth, for example carbon 13 NMR and oxygen 17 NMR. So a major discovery at the fundamental level will have a profound impact on a vast subject if properly exploited. A contemporary FT NMR spectrometer is fully computerized and there have been major advances in magnet technology in the past seventy years. Magnetic resonance imaging (MRI) is a variation of NMR that depends on the use of magnetic field gradients, and MRI has been routine in medicine for some years. So advances on the foundational level, such as ECE2, will again have major consequences if properly exploited. There is also two dimensional NMR and a myriad of advances in millions of papers since NMR was first demonstrated about seventy years ago.

ESR has also advanced tremendously in this time, its simplest occurrence is in an electron beam, and its best known feature is spin orbit Lande interaction in the anomalous Zeeman effect. The entire theory of ESR and the anomalous Zeeman was based prior to ECE2 on the Dirac approximation. The same is true of the theory of spin orbit interaction, which has also been changed on the foundational level in the ECE2 series of papers written in

2015, these are UFT313 - UFT320, UFT322 - UFT335 to date. Another major advance of ECE2 is its ability to explain the vector potential of ESR and NMR theory in terms of curvature.