Prospects for Research on Biological Systems with THz Radiation.

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Life has evolved at room temperature and the energy available to develop the mechanisms of biological organisation, kT, is 6 THz. Consequently it is expected that modes of vibration in this wavelength range (1 THz ~ 300 microns ~ 0.004 eV) will play a key role in the activity of biological molecules such as DNA and proteins. Theoretical work indicates that THz modes of vibration are important in DNA replication and are the physical mechanism linking the informational and thermodynamic aspects of living things. This contribution will review the experimental evidence for the role of THz modes of vibration in the activity of DNA and in controlling the expression of genes [1-3].

The lecture will also described experiments designed to test the Frohlich hypothesis [1,4-6]. Many decades ago Herbert Frohlich hypothesised that long wavelength (THz) modes play an important role in biological self-organization and mediate the formation of a coherent state. Frohlich argued that the self-organization of living systems is maintained by a flow of free energy through a coherent exited state maintained by metabolic processes. He predicted that under appropriate conditions biological systems can support coherent excitations in the range 10^9 to 10^{12} Hz. This hypothesis is very relevant to the question as to whether or not quantum mechanics plays a non-trivial role in living systems an idea that has been discussed by physicists for decades and largely dismissed by biologists because there is no conclusive experimental evidence. This talk will present the results of a recent investigation of the Frohlich hypothesis using high intensity THz radiation from the ALICE [5].

References

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