FRANCK-HERTZ EXPERIMENT NOT A VERIFICATION OF THE EXISTENCE OF DEFINITE ENERGY QUANTA

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Abstract

Atoms absorb energy in precise and definite amounts because the atom is an oscillator with natural resonant frequencies. When frequencies of incident EM waves coincide with these natural frequencies, then the majority energy absorption takes place. Incident photon lumps cannot explain conceivably the energy absorption process. "Quantisation" means natural frequencies of an oscillator and not quantised energy packets.

The *Britannica guide to Nobel prizes* [brit] is a quasi-official announcement of commonly accepted theories. According to the authors, the Franck-Hertz experiment *confirmed the quantum theory that energy can be absorbed by an atom only in definite amounts and provided an important confirmation of the Bohr atomic model.*

This experiment *showed that when an electron strikes an atom of mercury vapour, the electron must possess a certain energy (4.0… eV, in this case) in order for that energy to be absorbed by the atom. Furthermore, this level of energy varies for different elements…*

This demonstrated that atoms absorb energy in precise and definite amounts, or quanta.

For details of the FH experiment see [hypfh]. The claim is that the Franck-Hertz experiment is an *experimentum crucis* for the existence of energy quanta. Hertz himself declares in his Nobel lecture: The *experiment provided a direct experimental proof of the basic assumptions of Bohr's theory of atoms*. [nobel]
The implication is that a physical cause with energy under a certain quantum level has no effect upon the atom. In science this is the first case for the claim that a cause is without effect! Furthermore, the claim is that a quantitative correspondence between experiment and theory is a verification of that theory. From an epistemological standpoint this is untenable. Let me illustrate this problem with a macroscopic example one. The collapse of the Tacoma Narrows suspension bridge due to a wind-induced resonance is well known. (Wind velocity 40 mph only!) At the collapse it was observed that there was a transition between purely vertical oscillations and torsional modes. Now assume two observers, one at the riverside, the other on the bridge. The observer at the riverside cannot see the weak vibrations due to moderate winds. The observer on the bridge does it probably too. Both observers may see elastic displacements due to passing heavy trucks. Obviously, both observers note the crash of the bridge in the resonance catastrophe when frequencies of winds reach the critical eigenfrequencies of the bridge. Nobody would argue that winds with other frequencies do not influence the bridge, there are elastic deformations! Nobody would argue that the bridge absorbs only an energy quantum $E = h\nu$, where h is some constant and ν is the resonance frequency of the bridge whereas the bridge rejects excitations with other frequencies.

But quantum theorists argue in this manner: The atom rejects the very most energy packets. Only if the energy quantum is in conformity with the energy levels of the Bohr atomic model the atom is ready to absorb the energy! For the excited atom there is the same line of arguments: In a certain range of excitations of the atom the effects are minute and we cannot observe them. Then at the first eigenfrequency (or natural frequency) of the atomic oscillator the effect becomes an observable fact. For hydrogen this is the level that corresponds to the red lines of the spectrum. And so on: For increasing excitation the next visible state of the atom is in the range of cyan.

In the case of hydrogen an excitation frequency of about 13.6 eV is equal to the resonance frequency of the atomic oscillator and causes therefore a resonance collapse: the hydrogen atom breaks in two, the proton and the electron. It is a conjecture that like in the Tacoma Bridge, resonance there is a cross over between longitudinal and torsional oscillations that causes the separation of the electron. So, energy levels have nothing to do with impossible energy quanta but are eigenfrequencies levels of the atomic oscillator.

By the way, the explanation of fine structure of spectra in terms of quantum theory must be very subtle: For the hydrogen red line doublet for example there is an alleged energy difference of only 0.000045 eV. Therefore the atom must be capable of distinguishing the incoming energy packets for an order of magnitude of 0.000045 eV. How does the atom measure the incoming energy to such a degree of precision in order to decide if an energy packet is to absorb or to reject?

References

[brit] www.**britannica**.com/**nobel**/bol**nobel**ists

[hyphf] Hertz/Frank http://hyperphysics.phy-astr.gsu.edu/hbase/FrHz.html