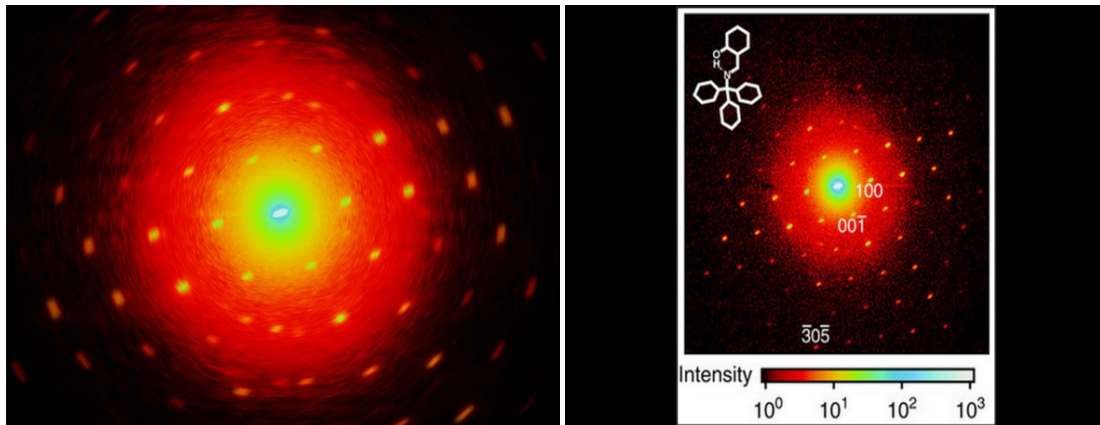# Atomic Structure

The Structure and the Causes-Mechanism of Energy Level Quantized of Atoms

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Abstract: this article shows a new atomic structure which has been proved by related and independent experiments; and, based on the atomic structure, put forwards a new causes and mechanism of the atomic energy levels quantization.

If ultrashort electron pulses hit a bimolecular crystal, they are diffracted from it. As a result, one obtains a characteristic diffraction image of the atomic structure.   Credit: Graphic: Alexander Gliserin [4][5]

Main viewpoints and conclusions:

Atom, from the Greek word *atomos*, which means indivisible, was first conceived around *2,400* years ago by a Greek man named Democritus. An atom is the smallest constituent unit of ordinary matter that has the properties of a chemical element. Every solid, liquid, gas, and plasma is composed of neutral or ionized atoms. [1]

Every atom is composed of a nucleus and one or more electrons being bounding together by the electric field(isn't electromagnetic field);[1]   and, the nucleus has positive electric charges, every electron has a unit negative electric charge.

Within an atom, further and however, the all electrons - the all extranuclear charge is one kind of soft matter which has the same and consistent of negatively charged ingredient; at and in an unified and complete whole which with a single basic structure; existing in and filling completely the space outside the nucleus of the atom; under the thermal effect, and by the mutual electromagnetic interaction with the nucleus and others related, Formed: the nucleus is the sphere center of atoms; different distribution of volume *extranuclear electric-charged matter* densities, energy levels at and in the discrete states(energy levels quantized); from higher to lower since the inner to the outer; a concentric and multi-layer spherical pattern of volume *extranuclear electric-charged matter* densities distribution structure and energy levels existence form. [2][3][4][5][6][7]

Moreover, the energy and energy levels distribution states of atoms is mainly refers to the energy and energy levels distribution states of the all extranuclear electrons - the all *extranuclear electric-charged matter*(hereinafter referred to as *"extranuclear matter"*)of the atoms.[8]

Inside atoms, the all extranuclear matter forming a sort of Hilbert spaces which could be infinitely discretized in theories; the all extranuclear matter existing in a different density distribution state-a concentric and multilayer spherical pattern; and the densities distribution ρ is the function of the charges amount, temperature, pressure and electromagnetic strength --- $\rho=F(Q, T, P, E, B)$. [9]

Since the volume mass densities (ρ; *divergences*) of any two distinct extranuclear matter layers are different, and by the $E=mc^2$, we know that the energy which contained in every unit volumes of any two distinct extranuclear matter layers are also different. That is the energy densities (energy levels) of any distinct extranuclear matter layers are all different from each other.

By the way, we get there should be $E/V = mc^2/V = \rho c^2 = h\upsilon$, and $\rho= h\upsilon/c^2$; but instead of $E = mc^2 = h\upsilon$, and $m = h\upsilon/c^2$. And this physical meaning shows us the relationship of the energy density ($E/V = mc^2/V = \rho c^2$) or called as energy level ($h\upsilon$) with to the volume mass density (ρ; *divergence*) of the same space or matter.

Further, the energy density (energy level) not only is the quantity and share of the energy which contained or combined in the unit volume of the matter, is also the quantity and share of the matter which contained or combined in the unit volume or called as the unit space. Same time, the volume mass density of the matter is proportional to its energy density (energy level), and the volume mass density of the matter is the characterization and the manifestation of its energy density state (energy level state).

An important physical fact which needs to be clear that the energy and the matter are can't mutual transformation. The matter is the carrier and habitat of the energy, is also the result of the effect and gather of the energy; and the energy is the guarantee and support of the matter can exist and keeping its density, is also the reason and driving force of the evolutions, phase transitions, and engender physical or chemical variations of the matter.

For instance, after a polyatomic system reached its Bose-Einstein condensate through the first-order and second-order of quantum phase transitions by loses the thermal energy and reduces the temperatures continues (*temperature - the scale and metric of the thermal energy density of a matter system*), then, the all atoms in the system would also reached the identical and consistent state, the all extranuclear matter forming an unified and complete whole that in an exactly the same volume mass density, no any cracks or electron-holes inside; and the energy level of this polyatomic system is also at an identical and consistent energy level which its lowest energy level state - the ground state. In the

state, all extranuclear matter is a non-volume mass density discretization system; is also a non-energy level quantization system. On the contrary, after obtained the thermal energy and temperature rose continue and enough, the all extranuclear matter of this polyatomic system would return into the normal state which the volume mass densities discretization (non-identical and consistent state that has multivariate volume mass densities) and the energy levels quantization(non-identical and consistent state that has multivariate energy levels, or said the system in a multivariate quantum state). And, there only existences the increase and decrease of the thermal energy, as well as the variations of the matter states and the volume mass densities; but no any increase and decrease of the ingredients and mass of the matter in the process. [10][11][12]

With regard to atoms, in particular, at their Bose-Einstein condensate, the extranuclear matter of an atom or a polyatomic system forming an unified and complete whole body that has no any cracks or electron-holes inside, and has an exactly the same volume mass density as well as an identical and consistent energy level; at the normal state, under the controls of thermal energy and the auxiliary roles of electromagnetic effect, the all extra-nuclear matter of an atom forming a non-identical and consistent distribution state which has multivariate mass densities, as well as a non-identical and consistent state which has multivariate energy levels - forming $k(\geq 2)$ matter layers that the volume mass densities and energy densities are different from each other at a concentric and multilayer spherec-al pattern. Based on them, some conclusions would be obtained as following:

1. M is the total mass of the all extranuclear matter of an atom; ρ_o is the volume mass density of the extranuclear matter of the atom which in its Bose-Einstein condensate; V_o is its total volume; v_o is its normal frequency (natural frequency); $\rho_o c^2 = hv_o$ is its energy density and energy level; and E_o is its total energy, then there be $E_o = \rho_o c^2 V_o = = hv_o V_o = Mc^2$.

2. ρ_i is the volume mass density of the i-th extranuclear matter layer; v_i is the normal frequency(natural frequency) of the i-th extranuclear matter layer; V_i is the volume of the i-th extranuclear matter layer; $i= 1, 2,...,k$.

3. E_{io} is the energy density or energy level of i-th extranuclear matter layer, and there be $E_{io} = \rho_i c^2 = hv_i$; $i =1,2,...,k$.

4. E_i is the energy of i-th extranuclear matter layer in the normal state, and then there be $E_i = \rho_i c^2 V_i = hv_i V_i$; $i = 1, 2,...,k$.

5. E is the total energy of the all extranuclear matter of the atom in the normal state, then $E = E_1 + E_2 + ... + E_k = hv_1 V_1 + hv_2 V_2 + ... + hv_k V_k = \rho_1 c^2 V1 + \rho_2 c^2 V_2 + ... + \rho_k c^2 V_k = Mc^2$. $E = Mc^2 = E_o = \rho_o c^2 V_o = hv_o V_o$; $V_1 + V_2 + ... + V_k < V_o$; $\rho_i > \rho_o, v_i > v_o, i = 1, 2,...,k$.

These above results shows that increase external energy can't change the innate energy of the all extranuclear matter, but can changes the distribution states of the volume mass densities and energy densities of the all extranuclear matter - making the all extranuclear matter is separated from a single complete and density consistent state into a concentric and multilayer pattern which having different volume mass densities and different energy densities; this is made the extranuclear matter into the state which matter distribution

diversification, volume mass densities discretization and energy levels quantization, and their degrees of quantities and levels both are proportional and synchronous to the intensity and level of the external energy.

Same time, every extranuclear matter layer, forming a fundamental field; k extranuclear mater layers formed k fundamental fields. All particles produced from the same extranuclear matter layer are absolutely identical particles which their energy levels are all $E_{io} = h v_i$ ($i=1,2,...,k$); or an identical energy flow which its energy level is $E_{io} = h v_i$ ($i=1,2,...,k$).

Every extranuclear mater layer uniquely corresponds to one spectral line; k extranuclear mater layers correspond to k spectral lines, and the frequency of the spectral line which corresponds to i-th extranuclear mater layer is v_i.

On the contrary, if there be k spectral lines, should corresponding to be the existence of k different extranuclear mater layers; if the frequency of a spectral line is v_i, then, the extranuclear mater layer which corresponding and emitting to the spectral line should be i-th extranuclear mater layer and its normal frequency (natural frequency) is v_i.

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*Music ..今夜无眠！.. **Sleepless Tonight!***

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