Dialectical view on the particle structure

Part 1

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Dialectical philosophy and its logic (dialectics) [1], which we adhere to [2], is an integral part of the foundation of world philosophy. It is regarded as the logic of philosophy and all sciences, that is, recognized as the *logic* of *cognition* on the *whole*. Dialectics represents a synthesis of the best *achievements* of both *materialism* and *idealism* and is the ground for understanding of the *material-ideal essence* of the world.

In accordance with the *axiom* of dialectics, all *objects* and *phenomena* in the Universe have a *wave nature*, and the Universe is a *material-ideal* system. Wave processes have a *binary oscillatory-wave* character, they occur on two levels - *oscillatory* and *wave*. The above feature is *manifested*, in particular in the *binary structure* of *elementary particles* (described in the Dynamic Model [3]), in the existence in them of an inextricably bound *basis* and *superstructure*,

Dynamic Model (DM) of elementary particles (first put forward by the authors in 1996 [2]) is a *vivid example* of where the *axiom* of *dialectics* was taken into account when describing the structure of the particles. Various aspects of the DM are considered in a number of works of the authors and discussed at international conferences, such as in 2017 [4]. The DM was *designed* to *replace* the Standard Model (SM) (dominating in physics), which is *inadequate* to reality, since *based* on *subjective abstract-mathematical* postulates and *incompatible* with the *basic axioms* of dialectics.

Here we consider the *principal concepts* of *dialectical physics* [2] relating to the *individual peculiarities* of particles, as well as their *general classification*. The material in this article is an *updated version* of a part of the article *published* a quite long ago in 1998 by the authors in the book of collected papers [5]. For the reason of a small print run, this book is almost unknown for scientific community. Therefore, believing that the problem under consideration is now even more relevant for physics than before, the author (underlined above) decided to return to the issue raised in the article and publish its updated version.

1. Particle difference and general classification

Dialectics of recurrence-nonrecurrence, uniformity and difference, requires the *qualitative distinction* of *particles* of any level. In other words, *dialectics* of *quantity-quality* pierces both mega- and micro worlds of the Universe. It means that the *contradictory symmetry* of quantity-quality, material-ideal of the dialectical *material-ideal* Universe *excludes mechanical* principles of *identity* of any *particles* and indicates that they are *material-ideal* formations. We denote this feature ("*material-ideal*") by the symbol "^".

We call microparticles by the *general* name "$\hat{k}$*-particles*". Any particular $\hat{k}$*-particle* is a *definite* representative of $\hat{K}$*-class* particles that is symbolically indicated as $\hat{k} \in \hat{K}$.

The $\hat{e}$, $\hat{g}$, $\hat{\gamma}$, $\hat{\mu}$, $\hat{\pi}$,... -particles belong, correspondingly, to $\hat{E}, \hat{G}, \hat{\Gamma}, \hat{M}, \hat{\Pi}$,... -classes. Within each class, particle *masses differ*. Published particle mass tables show their *average* values.

The $\hat{k}$ -particles, belonging to any $\hat{K}$ -class, have a more or less *similar structure* at the level of *material basis*. This structure determines their approximate *quantitative equality*. But they have *distinct superstructures* reflecting their *qualitative difference*. Therefore, the symbol of any particle, strictly speaking, should be represented in the form of a *general symbol* of the *material-ideal field* of *measures*:

$$\hat{k} = k + ik, \qquad \hat{K} = K_\alpha + iK_\beta, \tag{1.1}$$

where K_α is the *basis* and iK_β is the *superstructure* of the $\hat{K}$ -class; α-*symbol* expresses an *insignificant* and unessential *distinction* at the *basis* level; β-*symbol* reflects, in a general case, an *essential qualitative distinction*, pointing to an existence of *qualitative subclasses* of iK_β-*substructure*; ***i*** is the *ideal unit* (the *unit* of *polar negation*) [5].

The *material k-basis* of $\hat{k}$ -particle forms the *quantitative* (*quantum*) *k-structure*, and the *ideal ik-superstructure* forms the *qualitative* (*qual*) *ik-structure*. The latter has its *fine superstructural field basis* consisting of objects by *some* orders *smaller* than particles of this class. Specifically these objects are *perceived* as the "*field level of matter*". For simplicity, we will (not infrequently) omit the symbol "^", expressing the material-ideal structure of objects.

According to the *wave equation* solutions, *atoms* are *neutron molecules* of a spherical form. The *nodal structure* of their *outer* wave *shells* determines the *physicochemical properties* (*quantitative-qualitative* features) of the atoms.

In the language of dialectics, *material-ideal neutrons* are the *material basis* of an atom, while a *certain* mutual *arrangement* of neutrons (structural *geometry* of the *superstructure*) is *properly* the *atom*. This means that an *atom* is an *ideal formation* from *neutrons* of the strictly *definite superstructure*. In addition, the *number of types* of *ideal subclasses* of *neutrons* iN_β determines the *number* of *neutron arrangement* forms, which is resulted in the definite atomic structures (atoms).

Thus, *atoms* are *ideal formations* of the material level of *neutrons*, where *proper neutrons*, e.g., carbon, aluminum, titanium, etc., *correspond* to *each* atomic formation; that is, *neutrons contain* the "*genetic code*" (at the level of *proper superstructure*) of those or other ideal atomic formations.

Masses of elementary particles M_n, whose classes are *above* $\hat{G}$ -class, but *below* classes of *isotopes* of the first elements of periodic table, are *approximately multiple* to an *average mass* of $\hat{g}$ *-particle*,

$$M_n = nm_g. \tag{1.2}$$

Therefore, we assume that the *main structural units* of such particles are *g-particles*, which *contain information* about *possible configurations* of "elementary" particles.

In view of the *fact* that *all formations* of "elementary" particles *above* $\hat{G}$ *-class*, up to the first elements of periodic table, are *unstable*, it should be recognized that at *present* in the Universe $\hat{g}$ *-particles* dominate with the *ideal code-information* capable of forming the *ideal superstructure* only of the *neutron level*. It means that these are mainly *neutron* $\hat{g}$ *-particles*.

The *g-nucleon* in a spectrum of elementary particles is called the *muon neutrino* ν_μ. As physicists *previously assumed*, its mass is equal to $68.5m_e$.

In the last few decades, the mass of *g-particle* has been accepted as *equal* to *zero*, which from viewpoint of *dialectical physics* (DM [2, 3, 5]) is *incorrect*. As follows from the latter, the *mean value* of mass m_g is approximately equal, *within* the *decimal scale*, to the *fundamental measure* in a *quarter* of the *fundamental period-quantum*, $\frac{1}{4}(2\pi\lg e) = 0.682188...$ [6], where *e* is the base of natural logarithms:

$$m_g = 68.22\, m_e \tag{1.3}$$

Actually, particles with mass (1.3) occupy a *specific place* in the *mass spectrum* of particles.

First, in 1931, Dirac *showed* [7, 8] that *field theory* can be built on the basis of *magnetic monopoles*, an *elementary charge* of which is

$$\mu_0 = \frac{\hbar c}{2e} = 68.5e \tag{1.4}$$

In the *Wave Model* (WM), consisting of *two* theories: *Dynamic Model* of elementary particles [3, 4] and *Shell-Nodal* model of atoms [9], $e = m_e\omega_e$; therefore, *dividing* the charge of the Dirac *monopole* μ_0 by the *fundamental frequency* ω_e (a *discovery* of the DM) leads to the following *mass* of μ_0,

$$m_{\mu_0} = 68.5\, m_e . \tag{1.5}$$

It is *evident* that the Dirac *monopole* μ_0 and the *g-lepton*, whose masses, (1.5) and (1.3), are approximately equal, are the *same particles*, that is, $\mu_0 \equiv$ g.

However, because the mass of the monopole was determined incorrectly, the *g-lepton* was not rendered its due attention in physics.

Secondly, according to the DM, the radius of the wave sphere of the g-*lepton*, or Dirac monopole, is

$$r_g = \left(\frac{m_g}{4\pi\varepsilon_0}\right)^{1/3} = 1.706\cdot 10^{-9}\ cm , \tag{1.6}$$

The *cardinal number* of the radius is very *close* to the rational *golden section* of the fundamental metrological *period-quantum* $\Delta = 2\pi\lg e$ of the Decimal Code of the Universe [6, 10],

$$r_g \approx \left(\frac{5}{8}2\pi\lg e\right)\cdot 10^{-9}\ cm . \tag{1.7}$$

For this reason, it can be assumed that *g-lepton* is a fairly *stable* particle, which, perhaps, *represents* at the level of *elementary particles* the *same* as the neutron represents for *atoms*.

If so, then based on *g-lepton* and the periodic law of space, it is possible to *compose* the *spectrum* of "elementary" particles, where the *g-lepton* is a *hydrogen analog*, γ-quantum is a deuterium analog, μ-meson is a tritium analog, π-meson is a helium analog, etc.

If a *quarter mass* of the π^+-meson is used as a *measure* of m_g , then we get

$$m_g = \frac{1}{4}m_{\pi^+} = 68.28158353m_e , \quad \text{where} \quad m_{\pi^+} = 273.1263341m_e \tag{1.8}$$

Introducing a *unit* of *mass* into one *hectoelectron* of mass, 1 *hem*=$100m_e$, we can write that

$$m_g = \frac{1}{4} m_{\pi^+} = 0.6828158353\, hem. \qquad (1.9)$$

The *mass* of π^+*-meson* in *hem* is on the level of the *fundamental quantum* $2\pi\lg e = 2.728752708$.

We will term the latter as the *reference measure* of mass of Π-*class* particles (π-*meson* class)

$$m_\pi = (2\pi\lg e)\, hem = 2.728752708\, hem \approx 2.7288\, hem\,. \qquad (1.10)$$

This mass *determines* the reference *mass* of *G-class* particles

$$m_g = \frac{1}{4}(2\pi\lg e)\, hem = \frac{\pi}{2}\lg e\, hem = \frac{\lg i}{i}\, hem = 0.6821881770\, hem \qquad (1.11)$$

where *i* is the *ideal unit*. The *G-class* is represented by *g-particles* with some difference in masses. In any experiment, we are dealing with *various representatives* of particles of this class.

A system of *two g-particles* forms a γ*-particle* (γ*-quantum*) with a *reference mass* of Γ*-class* equal to the *fundamental half-period* (half-quantum),

$$m_\gamma = \frac{1}{2}(2\pi\lg e)\, hem = 2\frac{\lg i}{i}\, hem = 1.364376354\, hem\,. \qquad (1.12)$$

A system of *three g-particles* represents a μ*-particle* (μ*-meson*) with a *reference mass* of *M-class* equal to *three quarters* of the fundamental quantum:

$$m_\mu = 3(\frac{\pi}{2}\lg e)\, hem = 3\frac{\lg i}{i}\, hem = 2.046564531\, hem \qquad (1.13)$$

A system of *four g-particles* forms a π*-meson*, which belongs to Π*-class* particles with the *reference mass* equal to one *fundamental quantum* (1.10), etc.

Thus, the *simplest decay reactions*, within specific qualities of elementary particles, take the following form (by the language of mass):

$$\begin{aligned}
&\pi \to \mu + g\,, && (2\pi\lg e)\, hem = \tfrac{3}{4}(2\pi\lg e)\, hem + \tfrac{1}{4}(2\pi\lg e)\, hem\,,\\
&\pi \to \gamma + \gamma\,, && (2\pi\lg e)\, hem = \tfrac{1}{2}(2\pi\lg e)\, hem + \tfrac{1}{2}(2\pi\lg e)\, hem\,,\\
&\mu \to \gamma + g\,, && \tfrac{3}{4}(2\pi\lg e)\, hem = \tfrac{1}{2}(2\pi\lg e)\, hem + \tfrac{1}{4}(2\pi\lg e)\, hem\,,\\
&\gamma \to g + g\,, && \tfrac{1}{2}(2\pi\lg e)\, hem = \tfrac{1}{4}(2\pi\lg e)\, hem + \tfrac{1}{4}(2\pi\lg e)\, hem\,.
\end{aligned} \qquad (A)$$

The *mass spectra* of the particles within the definite class will be considered in the second part of the paper. Let us agree to term the *quantitative* (i.e. *relative*) component A_r of an *arbitrary measure* A by the symbol *qnt*(A), then

$$qnt(\mathrm{A}) = \frac{\mathrm{A}}{dim(\mathrm{A})} = \mathrm{A}_r\,, \qquad (1.14)$$

where *dim*(A) is the dimensionality of A.

To demonstrate the *universality* of the *fundamental measure-quantum*, we supplement the above reactions (A) with the *metrological series* of *ancient measures* of mass.

For *example*, relying on the ancient *Rome ounce* of mass 2.7288 *dg*, which is equal to the *fundamental quantum* $m_o = (2\pi\lg e)\, dg$ (to within the fourth sign after comma), we get the following *series* for *comparison*:

1) π-meson	⇒	an ounce,	$qnt(m_\pi) = qnt(m_o)$;	
2) μ-meson	⇒	three quarters of an ounce:	$qnt(m_\mu) = qnt(\frac{3}{4}\, m_o)$;	(B)
3) γ-quantum	⇒	two quarters of an ounce:	$qnt(m_\gamma) = qnt(\frac{2}{4}\, m_o)$;	
4) *g*-particle	⇒	a quarter of an ounce	$qnt(m_g) = qnt(\frac{1}{4}\, m_o)$.	

The *second example* of the same series, but with the *Old Russian* measures, expressed in grams:

1) π-meson ⇒ 16 pochkas = 64 pirogs,
$qnt(m_\pi) = qnt(m_{16\ \text{pochkas}}) = qnt(m_{64\ \text{pirogs}}) = 2.7288$;

2) μ-meson ⇒ 12 pochkas = 48 pirogs,
$qnt(m_\mu) = qnt(m_{12\ \text{pochkas}}) = qnt(m_{48\ \text{pirogs}}) = 2.0466$; (C)

3) γ -quantum ⇒ 8 pochkas = 32 pirogs,
$qnt(m_\gamma) = qnt(m_{8\ \text{pochkas}}) = qnt(m_{32\ \text{pirogs}}) = 1.3644$;

4) *g*-particle ⇒ 4 pochkas = 16 pirogs,
$qnt(m_g) = qnt(m_{4\ \text{pochkas}}) = qnt(m_{16\ \text{pirogs}}) = 0.6822$.

One *pochka* was a small measure of weight of about 0.17 g. It was used when weighing precious stones, as well as when minting coins. The *pirog* is equal to a quarter of the pochka or about 43 *mg*.

The (A), (B), and (C) *spectra* of *measures* represent the *manifestation* of the *second kind law* – a non-physical (*non-material*) law – an *ideal law*, reflecting an *Ideal Beginning* of the *Universe* [6, 10], which we called the *law* of the *Decimal Code* of the *Universe*.

Physical laws are the *first kind* laws – the laws of *absolute necessity*, whereas the *second kind* laws are the laws of a *reasonable choice*; figuratively speaking, the latter are the *laws* of "*Cosmic Will*" (*Cosmic Reason*) caused by the *Ideal Beginning* of the *Universe*.

2. Fundamental quanta of exchange

2.1. ***Speed of exchange***

The *absolute speed* of each object in the Universe at all its levels is a multidimensional (multilevel) speed, which *does not depend* on *any reference frame*. Taking into account that the *speed of light is the beam speed of the wave process*, we will consider the dialectics of mutual transformations of the levels of the galactic field.

Let the *beam speed* of some *wave-basis* increases over a certain period of time. At that, the *total energy* of the wave system will *remain* equal to *zero* because the *field* of *rest* also *rises* by the *same value*, in the course of *rising* of the field of *motion*. Thus, an additional *increase* in *kinetic* energy is *compensated* by the *increase* in *potential* energy, equal in magnitude, but opposite in sign.

When the *beam speed*, having reached the speed of light, *exceeds* it, the *formation* of the *superstructure* begins. The latter is expressed in the *appearance* of *two* mutually perpendicular *longitudinal-transverse waves* of the *oscillatory* type. The speed of such a system consists of the

initial beam speed of light and the *additional speed* of the *superstructure*, forming a *spiral cylindrical* wave of the right or left torsion (Fig. 1).

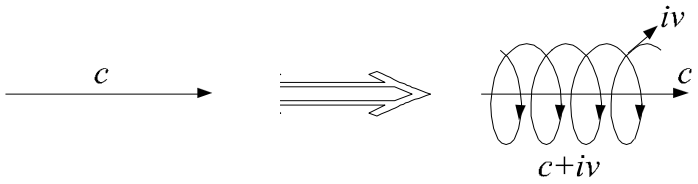

Fig. 1. Transformation of the beam speed *c*; *iv* is the circular frontal speed.

Thus, during the *superstructure's birth*, the *beam* speed of the wave is *transformed* into the *screw* speed.

Hence, the *absolute speed* of an *object-satellite* will be equal to

$$\hat{C} = c + iv, \tag{2.1}$$

and the *modulus* of speed is

$$\left|\hat{C}\right| = \sqrt{c^2 + v^2}\ , \tag{2.2}$$

where *iv* is the *frontal kinetic speed* of the *superstructure*, negating the speed of the basis.

In turn, when the *frontal speed iv*, as the *beam speed v*, exceeds the light speed *c*, the *wave* of *superstructure* becomes the *base wave*; thus, one more *superstructure* rises, etc.

As a result, the *absolute speed* of the *n-wave level* takes the following form

$$\hat{C} = nc + iv \tag{2.3}$$

All this allows us to state that the *speed* of *light* is the *fundamental period-quantum* of the *field* of *speed* of the *material-ideal exchange* of matter-space-time, and the *modulus* of speed of an *arbitrary* level of *basis-superstructure* is determined with *accuracy* up to *period c*, by the formula (2.2).

At considerable absolute speeds, the mutual speed of neighboring galaxies can reach speeds comparable to the period-quantum of the speed *c*. Astronomical observations confirm this. Apparently, the movement of galaxies with speeds, approaching the speed of light, partially closes to the wave motion of the basis of the microworld.

2.2. *Frequency of exchange*

The *fundamental frequency* of the atomic and subatomic levels (discovered thanks to the DM [4]) is equal to

$$\omega_e = \frac{e}{m_e} = 1.86916197 \cdot 10^{18}\ s^{-1} \tag{2.4}$$

where $e = m_e\omega_e = 1.702691627 \times 10^{-9}\ g \cdot s^{-1}$ is an elementary exchange charge or *elementary quantum* of the power (*rate*) of *mass exchange* (it is the *true physical meaning, magnitude* and *dimensionality* of the *electron charge*, which were also discovered thanks to the DM.

To explain the *quantitative meaning* of the *frequency*, we consider the wave motion of an electron in a uniform kinetic (magnetic) field of the subatomic level of matter (Fig. 2).

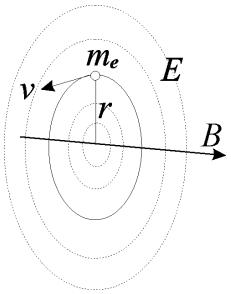

Fig. 2. A fragment of an electron wave of superstructure.

A *cylindrical kinetic* field is defined by the *kinetic B-vector*, a transverse *potential field* – by the *potential E-vector*; both fields represent the *longitudinal-transverse* field of matter-space-time of the *subatomic level*.

If the *longitudinal* wave of the *superstructure* is equal to *zero*, we have only the *transverse* wave of superstructure, which is represented by *circular motion* and described by the following tautological equation

$$\frac{m_e v^2}{r} = \frac{e}{\omega_e} v\omega = e\left(v\frac{\omega}{\omega_e}\right) = eE = \frac{v}{c}e\left(c\frac{\omega}{\omega_e}\right) = \frac{v}{c}eB\,, \qquad (2.5)$$

where $E = v\dfrac{\omega}{\omega_e}$ is the *potential* strength vector, the vector of *superstructure*; $B = c\dfrac{\omega}{\omega_e}$ is the *kinetic* strength vector of *basis*; at that $E = \dfrac{v}{c}B$; $e = m_e\omega_e$ (according to DM [3, 4]).

The *complex* vector of the field can be represented in two ways: $\hat{B} = E + iB$ or $\hat{B} = B + iE$. The second measure of the vector $\hat{B}$ is preferred because the *kinetic field B generates* its own negation – the *transverse potential field E*. More exactly, both fields always exist together.

With *increasing* field strength *B*, the electron *oscillation frequency* ω also increases *proportionally*, as follows from the equations (2.5):

$$m_e\omega = e\frac{B}{c} \qquad \text{or} \qquad \omega = \omega_e\frac{B}{c}\,. \qquad (2.6)$$

Hence, when $B \to c$, the electron oscillation *frequency* ω approaches the *limiting* value ω_e, $\omega \to \omega_e$, which is the *fundamental frequency* of the "*electrostatic*" field (and *electromagnetic field*), that is, of the *kinetic-potential field* of the *subatomic level* of matter-space-time.

Thus, the *fundamental frequency* ω_e is the *limiting frequency* of the *subatomic potential-kinetic (electromagnetic) field-space* of *basis*, which determines the corresponding *fundamental wave radius* of length $ƛ_e$ and the *quantum-period* of *time* T_e with the *time wave radius* T_{re}:

$$ƛ_e = \frac{c}{\omega_e}\,, \qquad T_e = \frac{2\pi}{\omega_e}\,, \qquad T_{re} = \frac{1}{\omega_e} = \frac{T_e}{2\pi}\,. \qquad (2.7)$$

The *fundamental wave radius* $ƛ_e$ of the field-space is *simultaneously* the *radius* of the *fundamental wave* of *atomic spaces*, which determines *half* the *average value* of the *interatomic distances* in crystals.

2.3. ***Power of exchange***

The first equation in (2.6) can be rewritten as follows

$$m_e\omega = e\frac{B}{c} \qquad \Rightarrow \qquad q_e = e\frac{B}{c}\,. \tag{2.8}$$

The product of the *electron mass* and the *oscillation frequency*,

$$q_e = m_e\omega\,, \tag{2.9}$$

is the *kinetic charge* of the *electron* in the wave of *superstructure* or, in other words, the *kinetic charge* of *wave motion*.

If $B \to c$, then as follows from (2.8), the *kinetic charge* of the electron q_e, increasing, *arrives* at the limiting *maximal value* equal to the *exchange electron charge e*:

$$q_e \;\; \to \;\; e = m_e\omega_e\,. \tag{2.10}$$

Consequently, the *electron charge e* should be considered as *one of the limiting quanta* by which microparticles can exchange.

Thus, the nature of the "*electron charge*" has now become understood. It is the "*elementary quantum of power (rate) of exchange*" or simply "*elementary quantum of exchange*".

Let us imagine, if possible, that the exchange does not occur; then the associated mass and the associated charge of the particles disappear, and they will not be physically detected.

Conclusion

Following dialectics, it is natural (and in principle very significant) to *abandon* the *mechanical principle* of *identity* of all *particles* of the same type, adopted in modern physics, and to *recognize* that all particles, having a *quantitatively*, approximately, *equal basis*, are *qualitatively different*, distinguishing by their *superstructures*.

G-*particles* with a mass of 68.28 m_e, which is multiple to a quarter of the *fundamental period-quantum* $(¼)2\pi\lg e$, *very likely* are one of the *main* structural units of "*elementary*" *particles*. This has been *quite convincingly* demonstrated here.

The universality of the *fundamental period-quantum* of the *decimal base* $\Delta = 2\pi\lg e$, determining the *fundamental measures-quanta*, including the *measures* of *elementary particles* discussed here, was confirmed by comparing the latter with some *ancient measures*.

The *period-quantum* Δ is the authors' *discovery*; it determines *harmony* in the Universe, *sets* a *strictly certain rhythm* for all processes in it [6, 10]. We called this discovery the *Law* of the *Decimal Base* (or *Decimal Code*) of the Universe, and referred it to the *second kind laws* (the laws of the *ideal* component of the *material-ideal* Universe). This is the concept of dialectical physics, which was first put forward by us in 1996 [2].

According to the Wave Model [3, 4, 9], the *speed of light c* is the fundamental *period-quantum* of the field of *speed* of the material-ideal exchange of matter-space-time.

The *fundamental frequency* ω_e (2.4) is the *limiting frequency* of the *subatomic* potential-kinetic ("electromagnetic") field-space of *basis*, and is the frequency of the so called "*electrostatic field*".

The *fundamental frequency* ω_e determines the *fundamental wave radius* $\lambda\!\!\!^{-}_e$ and the *quantum-period* of *time* T_e with the *time wave radius* T_{re} (2.7).

The wave radius $\lambda\!\!\!^{-}_e = \frac{\lambda_e}{2\pi} = \frac{c}{\omega_e} = 1.603886998 \times 10^{-8}\ cm$ is the characteristic parameter of atomic spaces; it determines the average *interatomic distance* in molecules and crystals, $2\lambda\!\!\!^{-}_e \approx 3.2\,\text{Å}$.

A particle of mass m_e, having an *exchange charge* $e = m_e\omega_e = 1.702691627 \times 10^{-9}\ g \cdot s^{-1}$, according to WM, is an *elementary quantum* of the *rate of mass exchange*. This is the *true meaning*, *magnitude* and *dimensionality* of a particle called an *electron*.

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