"THE GREATEST DAMN MYSTERY OF PHYSICS"

A. M. Chechelnitsky   Joint Institute for Nuclear Research,
Laboratory of Theoretical Physics,
141980 Dubna, Moscow Region.
E'mail: ach@thsun1.jinr.ru

ABSTRACT

Presented paper is the grateful reflection to the known brilliant, emotionally saturated lecture of outstanding physicist – theorist Richard Feynman, concerned, in particular, with the Fine Structure Constant (FSC - α). In the headline are Feynman's words.

Our answer to the question and problem, excited of Feynman, in the very brief form is following:
$$\alpha^{-1} = 2^{39/4}/2\pi = 137.0448088.$$
And it seems that this answer in it's simplicity not deceived intuitive expectations of Richard Feynman.

Customary Eternal Problems.

In science, as well as in life, the relation to arising problems is quite comparable: simple of them - are decided, complicated frequently, - are put aside " on then ", about coexisting of fundamental problems - try simply to forget. The tested method "sweeping under a carpet ", unconditionally, has the advantages – acts calmlingly, creates desired feel of a well-being. In result the calling actual problems at first become customary, and then, many from them is inconspicuous are transformed - in eternal. Quite often such forgetfulness severely revenges in the moments of by all means upcoming crises - eternal problems again and again resemble of itself. It would be possible to present whole commemorate list of such known problems.

Let's stay here only on one of the most fundamental problems of theoretical physics.

Magic Number.

Some time ago about coexisting a problem having more than semi-secular age, again was reminded with appropriute him by an expression outstanding American physicist, the Nobel prize winner, Richard Feynman.

The causing for revelations was granted him a non-routine situation – Alix Mautner Memorial Lectura, gived by Feynman at the of University California in 1983 [Feynman, 1985].

Fund of A. Mautner was set up, as the trustees point, - with purposes of carrying of "… an annual lecture series with the objective of communicating to an intelligent and interested public the spirit and achievements of science."

The dialogue with such a not ordinary audience has granted outstanding physicist a possibility to state, that is named, "plain text", not resorting to customary figures of default successfully masking sense happening of subjects by the usual "bird's" language, usually physicists-theorists resort in dialogue among themselves.

So, only one characteristic piece from this lecture [Feynman, 1985, p. 3-4]:

"... What I'd like to talk about is a part of physics that is *known*, rather than a part that is unknown. People are always asking for the latest developments in the unification of this theory with that theory, and they don't give us a chance to tell them anything about one of the theories that we known pretty well. They always want to known things that we don't known. So, rather than confound you with a lot of half-cooked, partially analyzed theories, I would like to tell you about subject that has been very thoroughly analyzed. I love this area of physics and I think it's wonderful: it is called quantum electrodynamics, or QED for short.

My main purpose in these lectures is to describe as accurately as I can the strange theory of light and matter – or more specifically, the interaction of light and electrons…

[Feunman, 1985, p. 129-130]:

There is a most profound and beautiful question associated with the observed coupling constant, *e* – the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to – 0.08542455. (My physicist friends won't recognize this number, because they like to remember it as the inverse of its square: about 137.03597 with an uncer-

tainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it.)

Immediately you would like to known where this number for a coupling comes from: is it related to pi, or perhaps to the base of natural logarithms? Nobody knows. It's one of the *greatest damn mysteries of physics*: a *magic number* that comes to us with no understanding by man. You might say the "hand of God" wrote that number, and "we don't know how He pushed His pencil." We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of a dance to do on a computer to make this number come out – without putting it in secretly!

A good theory would say that *e* is I over 2 pi times the square root of 3, or something. There have been, from time to time, suggestions as to what *e* is, but none of them has been useful. First, Arthur Eddington proved by pure logic that the number the physicists like had to be exactly 136, the experimental number at that time. Then, as more accurate experiments showed the number to be closer to 137, Eddington discovered a slight error in his earlier argument, and showed by pure logic again that the number had to be the integer 137! Every once in a while, someone notices that a certain combination of pi's and e's (the base of the natural logarithms), and 2's and 5's produces the mysterious coupling constant, but it is a fact not fully appreciated by people who play with arithmetic that you would be surprised how *many* numbers you can make out of pi's and e's and so on. Therefore, throughout the history of modern physics, there has been paper after paper by people who have produced an *e* to several decimal places, only to have the next round of improved experiments disagree with it."

What - behind the mystery?

Some time back - as a sequence of continuous researches of structure of actual physical systems – in framework of the Wave Universe Concept [Chechelnitsky, 1980-1999] - was, in particular, the unexpectedly simple result is obtained, which one in an extreme brief form can be set up as follows.

Proposition.

The numerical (theoretical) representation for a Fine Structure Constant (FSC) looks like
$$\alpha^{-1} = 2^{39/4}/2\pi = 137.044808(8).$$

The Fine Structure Constant (FSC) is not only *microparameter* (fundamental parameter of microworld - world of atoms and elementary particles) but also *megaparameter* (fundamental parameter of large astronomical systems).

The Comment.

Would be by fallacy to consider, that cited above extreme simple representation for a Fine Structure Constant grows out of a case - "games in numbers". It not so. There is a quite series correct conclusion within the framework of some concept and downlink system of representations doing it sufficiently natural and apparent.

But, saving a directivity of discussion - "for the intelligent and interested public" (i.e. for an extreme broad audience) would be, perhaps, inappropriate to enter here in a details of the concept and proofs.

Having in view the gnoseological aspects of the problem, it is necessary to take into consideration only following:

i) The mentioned above numerical representation of Fine Structure Constant is a *conclusion of the theory*.

ii)It concerns a *physically pithy situation*, i.e. essentially, is some statement about properties of a *reality*.

iii) For the mathematical statement the logical correctness of the proof, generally speaking, is considered self-sufficient - as criterion of justice of result it is considered mathematical, the formal - logical faultlessness of the conclusion. Brightest such samples of mathematical products follow at paradigma of "Geometry" of Euclid. In that case would be enough to cite itself proof to make a situation apparent. The mathematical correctness of the proof would do a problem depleted. The error in it would mean ending a controversy.

iv) For the *physical* statement it not so. Despite of, frequently, disarming cogency of the proofs many the contributors, learned bitter experience, prefer to consider each physical statement as *model representation* only to some extent adequate to a reality.

In this sense hardly it is necessary to do exception and for a quantum electrodynamics (QED) - without dependence from those epithets, by which one it now is deserved is awarded.

It is possible to understand and enthusiastic relation to it of R. Feynman - he was one of its creators. And still and the historical memory suggests - in science nowadays dominant or mod concept,

the theory, point of view, frequently, look attractively, correctly, convincingly, but also, as well as in life, our judgement rather often coincides judgement of the speaker appearing to last.

Without dependence from, whether our problems "by arm of the God " are written or represent "intrigues of a devil", there are no basis to be failed from that rather effective methodology of researches, which one has created modern science, and in times of Bacon and Newton was named as "Experimental Philosophy".

v) So, any conclusion of the *theory* should be *justified* by a *reality - observations and experiments*. The availability of the proofs of the theory yet does not mean a truth of its statements and justice of conclusions. The maximum judge can be *only experience* realized in a broad context. About it and words of the great theorist - A.Einstein: "... Only logically it is impossible to receive any knowledge of an actual world - any knowledge of a reality starts with experience and terminates with it."

The Data of Experiments and Imperative of the Theory.

Anticipating the becoming ripe detail, critical discussion of a situation combined in a range of definition of fundamental constants of the Universe we shall indicate only one fact relating definition of Fine Structure Constant.

The obtained theoretical value of a Fine Structure Constant

$$\alpha^{-1} = 137.0448088$$

in a full degree corresponds to the data of the most precision experiment of Wilkinson and Kreyn, connected with measurement of a magnetic moment of a free electron [see. Taylor, Parker, Langenberg (1972), p.196, Table 28]

$$\alpha^{-1} = 137.0467(36) \qquad (26 \cdot 10^{-4} \%)$$

Observable some difference of result from the theory

$$\alpha^{-1} = 137.0448088$$

from recommended now (Particle Data Group) "mean-statistical" on set of differed from each other experiments

$$\alpha^{-1} = 137.035989$$

merits special discussion.

Inevitably time comes of the critical analysis of the usual situation in the field of experimental definition of fundamental constants and Fine Structure Constant and of sequences connected with its.

The Theory and Experiment.

The problem, which one should arise in a similar situation, is obvious. As far the cited theoretical numerical value of Fine Structure Constant can be permissible by the data of experiments and justified by experience?

Having addressed this problem to the interested audience, it would be possible on the given stage to consider our mission depleted.

So or not so? The arising in that case situation, generally speaking, can be considered as some rather characteristic *model situation*, not so seldom arising in basic researches.

How to act if there are such on new orientating statements?

It is possible, simply, - to not believe.

In that case - Ex nihil nihil fit (From anything nothing it happens) and the further search at once is barred. Thus hardly it is necessary to hope on connected with search new unexpectedness. On the other hand, it is possible to say: " It is necessary to test " - and to be routed to a state- " I know and I realize " through further researches, observations, experiments.

It is already difficult to say, how would act in the given concrete situation, for example, itself Richard Feynman - the scientist has died - in 1988. Unique, that it is possible to approve is almost error-free – to many outstanding researchers it was peculiar all-absorbing feeling of inquisitiveness, they had that the psychologists could call as the tightened orientation reflex. Whether about it words of Feynman from the discussed lecture?:

"... We, physicists, always try to test, *whether all in the order with the theory*. The game is those, because, if something not so, becomes interesting! But till now we have not found anything incorrect in a quantum electrodynamics. Therefore I would say, what is it pearl of physics and subject of our greatest pride."

Causing for Reflections.

Without dependence from further destiny and significance of the mentioned above concrete representation for Fine Structure Constant, it is meaningful to consider the present reference to a problem, mainly, as a causing for some general cognitional reflections and connected with them of questions.

1. And still - whether "the pearl of physics and subject of our greatest pride " - the quantum electrodynamics now has reached perfection, having received final treatment within the framework of the usual formalism of the theory and dominant system of representations?

2. In this connection it is interesting and more concrete question- whether will undergo, in particular, some little changes and adopted now numerical value of Fine Structure Constant? Certainly, the possible reasons and arguments are not less interesting and are relevant, than the same answer to this question.

3 Whether the further evolution of fundamental representations of a quantum electrodynamics are possible?

4. It is doubtless, the greatest concern would be presented by independent separate opinions of the physicists-experimenters from their that population, in which one have not got used to consider most mod today statements of the theory - as true in the last resort.

5. Separate opinion, at least, one outstanding physicist - theorist - R. Feynman is already known from the same lecture [Feynman, 1985, p. 128-129]:

"Shwinger, Tomonoga and I independently invented ways to make definite calculations to confirm that it is true (we got prizes for that). People could finally calculate with the theory of quantum electrodynamics!

So it appears that the only things that depend on the small distances between coupling points are the values for n and j – *theoretical numbers that are not directly observable anyway*; everything else, which *can* be observed, seems not to be affected.

The shell game that we play to find n and j is technically called "renormalization". But no matter how clever the word, it is what I would call a dippy process! Having to resort to such hocus-pocus has prevented us from proving that the theory of quantum electrodynamics is mathematically self-consistent. It's surprising that the theory still hasn't been proved self-consistent one way or the other by now; I suspect that renormalization is not mathematically legitimate. What is certain is that we do not have a good mathematical way to describe the theory of quantum electrodynamics: such a bunch of words to describe the connection between n and j and m and e is not good mathematics."

It is infrequent on frankness the recognition comparable only with vivisection on oneself of the competent researcher, be can, more than someone feeling a doublemeaning and insufficiency of the usual situation.

Interestingly, such situation will how long be prolonged?

REFERENCES

Born, M. Mysterious number 137, "Uspekhi" (of Physical Sciences), 16, N6, p. 697, (1936).

Sommerfeld, A. Paths of Knowledge in Physics, Under edition J. A. Smorodinsky, M., Nauka, (1973).

Eddington, A.S. Fundamental Theory, Cambridge University Press, (1948).

Dirac P. A. M. Paths of Physics, Energoatomizdat, M., p. 86, (1983).

Weyl H. Selected Transactionses, M., Nauka, p. 347, (1984).

Feynman R.P. QED - The Strange Theory of Light and Matter, Alix G.Mautner Memorial Lectures Princeton University Press, Princeton, New Jersey, (1985).

Chechelnitsky A.M., Extremum, Stability, Resonance in Astrodynamics and Cosmonautics, M., Mashinostroyenie, 312 pp. (1980) (Monograph in Russian). (Monograph in Russian). (Library of Congress Control Number: 97121007; Name: Chechelnitskii A.M.).

Chechelnitsky A.M., Megawave Genesis of the Solar System's Rhythms, Variation of Neutrino Flux and Cosmic Rays, Proceedings of the All-State Conference, in: "Muons and Neutrino Research in Large Water Volumes", Alma-Ata, KazGV, pp.44-52, (1983) .

Chechelnitsky A.M., Wave Structure, Quantization, Megaspectroscopy of the Solar System; In the book:Spacecraft Dynamics and Space Research, M., Mashinostroyenie, pp. 56-76, (in Russian) (1986).

Chechelnitsky A.M., Uranus System, Solar System and Wave Astrodynamics; Prognosis of Theory and Voyager-2 Observations, Doklady AN SSSR, v.303, N5 pp.1082-1088, (1988).

Chechelnitsky, A.M., Neptune - Unexpected and Predicted: Prognosis of Theory and Voyager-2 Observations, Report (AF-92-0009) to the World Space Congress, Washington, DC, (Aug.22-Sept.5), (1992).

Chechelnitsky, A.M., Wave Structure of the Solar System, Report to the World Space Congress, Washington, DC, (Aug.22-Sept.5), (1992).

Chechelnitsky A.M., Wave Structure of the Solar System, (Monograph), Tandem-Press, (1992) (in Russian).

Chechelnitsky A.M., On the Way to Great Synthesis of XXI Century: Wave Universe Concept, Solar System, Rhythms Genesis, Quantization "In the Large", pp. 10-27: In book; Proceedings of International Conference "Systems Analysis on the Threshold of XXI Century: Theory and Practice", Moscow, 27-29 February 1996, v. 3, Intellect Publishing Hause, Moscow, (1997).

Chechelnitsky A.M., Mystery of the Fine Structure Constant: Universal Constant of Micro and Megaworld, Wave Genesis, Theoretical Representation, pp. 46-47: In the book: Proceedings of International Conference " Systems Analysis on the Threshold of XXI Century: Theory and Practice ", Intellect Publishing Hause, Moscow, (1996-1997); http:// arXiv.org/abs/physics/0011035.

Chechelnitsky A.M., Wave Astrodynamics Concept and It Consequences, In book: Search of Mathematical Laws of Universe: Physical Ideas, Approaches, Concepts, Selected Proceedings of II Siberian Conference on Mathematical Problem of Complex Systems Space – Time (PST – 98), Novosibirsk, 19-21 June 1998, Publishing House of Novosibirsk Mathematical Institute, p.74-91, (1999) (In Russian).

Taylor B.N. Parker W.H. Langenberg D.N. The Fundamental Constants and Quantum Electrodynamics, Academic Press, New York, London, (1969).

The Physical Encyclopaedic Dictionary, " the Soviet Encyclopedia ", M., p. 763, (1983).