Christo Christov – a Remarkable Theoretical Physicist and Teacher Inventor and Organizer of Science

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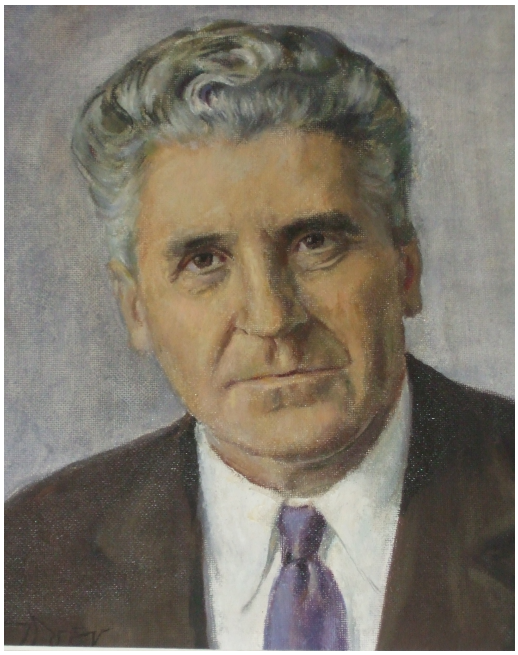
Abstract. Christo Y. Christov is an outstanding Bulgarian physicist who has contributions in the field of pure mathematics, quantum and classical physics, axiomatics, application of Lie groups in particle physics. He introduced the concepts of asymptotic numbers and functions. Christov is a co-author of an invention in the field of geology. He remains unforgettable for his students with his courses in *Mathematical methods of physics* and *Electrodynamics*. He was dean of the Faculty of Physics of Sofia University, deputy-rector and rector of the University, originator of theoretical physics at the Bulgarian Academy of Sciences, founder of the Institute for Nuclear Research and Nuclear Energy, its first director, vice-president of the Bulgarian Academy of Sciences, one of the creators of the Joint Institute for Nuclear Research, Dubna. He is an author of numerous popular articles in physics, head of the Bulgarian Physical Society, member of the European Physical Society.

Christo Christov was born in Varna on the 12 June 1915 in a family of teachers. He studied in the male high school "*Ferdinand I*" in Varna. There, he made his first steps in higher mathematics and published in the journal of the Physical and Mathematical Society the solution of two problems set by the Yugoslavian Mathematician Professor Karamata. His participation in a student's strike and his progressive way of thinking led to his expulsion from the school. He graduated from the secondary school in Razgrad in 1934 and became a student of the Faculty of Physics and Mathematics at the Sofia University, winning the only scholarship of the Ministry of Education for the year. He graduated in 1938 with distinctions in both mathematics and physics. His knowledge and talent were recognized. By Lubomir Chakalov and Kirille Popov recommendation, he received a scholarship to specialize at the Sorbonne. He started to work in Paris under the leadership of Francis Perrin (1901 – 1992) but the Second World War obstructed the completion of his specialization in quantum mechanics. In 1942, Christov became an assistant in the department of special physics, meteorology and geophysics in the Faculty of physics and mathematics at the Sofia University. Assistant, associate professor, professor, academician; dean of the Faculty of physics and mathematics, vice-director of the Joint Institute for Nuclear Research, Dubna, director of the Institute for Nuclear Research and Nuclear Energy, rector of the Sofia University, vice-president of the Bulgarian Academy of Sciences. His life was filled with intensive scientific and teaching work and a growing administrative activity.



The earlier papers of Christov are in the domain of pure mathematics. One of them, for example [1] was published with one of the most outstanding Bulgarian Mathematicians J. Tagamlitski. In the paper, convergence theorems in the sense of Lebesgue of certain type of integrals and their generalizations are proven. The paper shows that Christov had a deep knowledge of the most contemporary mathematical methods used in theoretical physics. Quantum mechanical state space is a Hilbert space and its elements – wave functions are quadratic integrable functions. Integration is in the sense of Lebesgue but not in the sense in Riemann. This is usually not explained to students and is barely touched upon in specialized courses in functional analysis for physicists. Back in those days, around sixty years ago, in Bulgaria there were neither courses in quantum mechanics, nor specialists on this topic, however Christo Christov who was making his first steps in science, knew quantum physics in detail.

Christov's papers are mainly dedicated to the problem of axiomatization of the physical theories and to applications of Lie groups in elementary particle physics. His views for axiomatization of physics are clearly presented in the paper "*The concept of energy in contemporary physics*":

"*At every stage of its evolution, just like any other science, physics has a more or less rigid structure where each physical term and each law have a place defined by the rule of logic. This systematic organization of physics rests on a certain number of concepts and variables, the meaning and method of measurement of which are evident from experiments and observations, and also on a certain number of propositions (axioms, principles and hypotheses), which are accepted without being questioned. Then based on these concepts and propositions, by the laws of deductive logic, the content and the method of measurement of all other concepts and variables are defined and all laws and consequences are deducted. This process characterizes the axiomatic method of define physics as well as any other science*" [2].

A very scientifically productive period for Christov was the fifties of the last century. He published a series of articles in Comptes Rendus of the Sovien Academy of Sciences [3-7] devoted to the interaction of the electromagnetic radiation with matter. These papers were recommended by the world famous M. A. Leontovich and Nikolay Nikolayevich Bogolyubov (1909 – 1992), members of the Russian Academy of Sciences. An interesting fact is that one of the articles [8], which is in the domain of pure mathematics, was recommended by K.T. Petrovsky and published in the mathematical division of the issue. During this time (1957), three consecutive articles devoted to the formation of air showers in cosmic rays were published in Journal of Experimental and Theoretical Physics [9-11]. The publication in Journal of Experimental and Theoretical Physics, one of the most prestigious journals at that time, is indisputable evidence for their excellence and approval of one of the most influential groups of theoretical physics, the Landau group. This is an extraordinary achievement, accomplished exclusively by Christov since he is the sole author of these papers and comes from a country with no traditions in theoretical physics.

A large number of Christov's latest papers deal with axiomatization of the quantum-mechanical theory of dispersion and its mathematical apparatus. The fields in quantum

theory are generalized functions, which cannot always be multiplied. This leads to uncertainties and although there are procedures for their elimination. They are not always applicable. Sequentially, Christov defined the so-called asymptotic functions and asymptotic numbers. The asymptotic number A is a polynomial function of a variable x:

$$A = \sum_{n=-\infty} \mu A_n x^n ,$$

with coefficients A_n, real numbers, from which only a finite number are different from zero. In the set of asymptotic numbers R_A all elementary algebraic operations are defined. They do not form a linear space but in respect to the sum and multiplication, R_A is a semi-group. The asymptotic function is an image of the set of real numbers in the set of asymptotic numbers. Between them, all arithmetic operations are defined including multiplication (unlike the generalized functions).

The universal approach in quantum theory is that fields are functions of all four coordinates of Minkowski space, which means that fields are functions of part of the parameters of the Poincaré group. Christov considered the fields as functions of all ten parameters of the Poincaré group [12] with the aim to find new non-conventional models in quantum theory of interaction fields. This activity led to finding non-linear representations of Lie groups and their classifications.

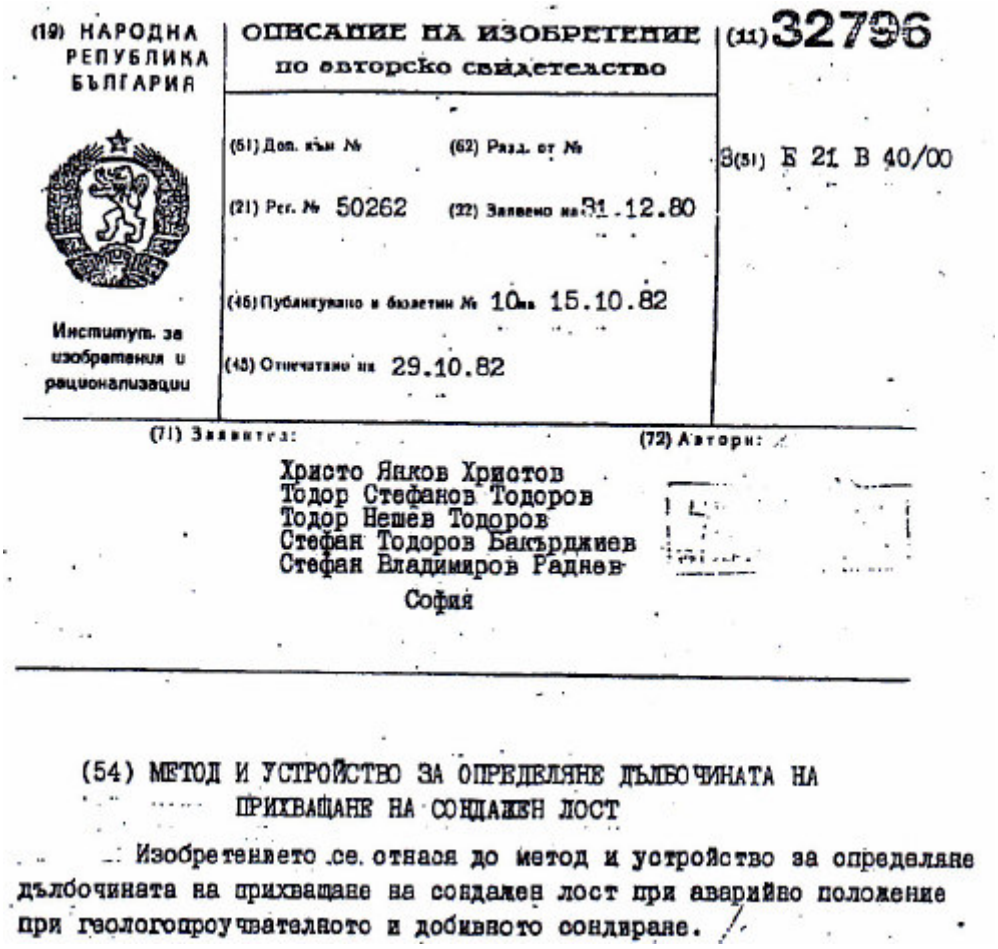
In a series of papers, Christov investigated the motion of molecules, ions and other micro particles using the methods of statistical physics. He found the exact coefficients of friction in the formula of Langevin in Brownian motion. In other papers, he studied a model with expanding air showers in non-homogenous and changing environment. The contributions of Christov are in most of the fields of contemporary physics: electronics, theory of solid states physics, nuclear physics, elementary particle physics, cosmology etc.

Christo Christov has always kept his interests to experimental and applied physics. This had started from the time when he was a high school student and did his first amateur chemistry experiments. He participated in an experiment and became a co-author of the invention "*Method and apparatus for finding the depth of soundings in different soils*" in the 80s of the 20 century. This invention [see the picture below] found applications in geology.

Christov was a remarkable lecturer and speaker who easily catched the attention of his audience. Here, we would like to cite I. Todorov about his lectures in electrodynamics:

"*This course was not a reproduction of a mathematical course, that could be readily formed based on the Maxwell-Hertz electrodynamics but a physics course that revealed the logic and beauty of a classical and lively field of theoretical physics. Initially, Professor Christov inductively derived the main laws of electricity and magnetism from experiments. At the same time, he showed us the details of the theoretical interpretation of experiments. For the first time we realized that Coulomb's law was used primarily for defining the physical concept of the electric charge. During the last lectures of the course, after deriving Maxwell's equations step by step, we obtained an original deduction of these equations and he demonstrated how from them (with certain assumptions and idealizations) the elementary and experimentally found laws were obtained. I would like to say confidently that no other*

physics course that I attended before or after that in Bulgaria or abroad impressed me to such a degree" [13].



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Изобретението се отнася до метод и устройство за определяне дълбочината на прихващане на сондажен лост при аварийно положение при геологопроучвателното и добивното сондиране.

The date of founding of the Joint Institute for Nuclear Research in Dubna is 26 March 1956. The Bulgarian government delegation consisted of Rumen Avramov – minister of education and culture, Georgi Nadjakov, Emil Djakov and Christo Christov. Since its establishment and later on, the Joint Institute hosts prominent scientists like the Nobel Prize Winner I. M. Frank, N. N. Bogolyubov, B. M. Pontecorvo, G. N. Flyorov, A. M. Baldin, D. I. Blokhintsev, and M. G. Meshcheryakov etc. Ch. Christov was a vice-director of the Joint Institute for Nuclear Research (1968 – 1970) and the official representative of Bulgaria in the Institute between 1972 and 1990.

Christov was a director of the Institute for Nuclear Research and Nuclear Energy since its founding in 1972 until his retirement in 1988. Christov was not only professionally involved but was also concerned with the daily issues and joys of its members.

Another activity that Christov pursued is the Union of Physicists in Bulgaria. He has elected as its president in 1971 after the Physical and Mathematical Society has split – an event that he did not approve very much. Christov has always been involved and initiated numerous activities of the Union of the Physicists in Bulgaria. Here we will only mention that he was the initiator of the first national educational conferences in physics that continue taking place until now.

Finally, we would like to cite T. D. Palev, member of the Bulgarian Academy of Sciences: "*Christov was a person with a well-rounded personality. He was an admired lecturer, a high conscious member of society, one of the founders of nuclear physics in Bulgaria and first director of the Institute for Nuclear Research and Nuclear Energy. He was a researcher after all …. Christov was a joyful man. He was joyful because he was in love all the time – unconditionally and boundlessly in love with science. In the morning of 20 March 1990, his last morning, he was passionately explaining about a new paper in general theory of relativity which was almost completed. He did not succeed to finish it. However, his enormous scientific heritage remains and will continue evolving and bringing benefits*" [13].

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