

# Rashco Zaycoff and theoretical physics in Bulgaria

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*Abstract:* - Rashco Zaycoff works in different areas of theoretical physics and applied mathematics under opposite political regimes in Bulgaria during the two halves of the 20th century. As a scientist with amazing mathematical talent, he has courage to do research in front of physics. This article celebrates his 120<sup>th</sup> anniversary.

*Key-Words:* - Rashco Zaycoff, theoretical physics, applied mathematics, Bulgaria

## 1 Introduction

Rashco Zaycoff is Bulgarian theoretical physicist. His work in theory of relativity marks beginning of this field in Bulgaria. Our documentary research begins three years ago when 140 anniversaries of Albert Einstein (14.03.1879–18.04.1955) has celebrated. Sofia University hosted seminar entitled „Einstein – the genius of the Century” (5 June 2019). New Bulgarian University German Study Department and Wolfgang Kraus Library organized this event.

Physicists Christow [1], Fakirov [2-3], Lazarova [4-5], and journalists Angelova [6], and Nikolova [7] based their articles onto R. Zaycoff's memories. Documentary research written by Zamfirov [8-11], Momchilov [12], Spassov [13], and Kamisheva [14-16] examine his biography and scientific contributions. There is nothing written for his wives and children as well as nothing about his political orientation. This work marks Zaycoff's 120<sup>th</sup> anniversary, and shows his scientific face via official documents in Bulgarian archives.

## 2 Biography

Rashco Gawrilow Zaycoff (10.12.1901–25.11.1982) was born in Burgas a town on the Black Sea coast. He came from two famous Bulgarian families. His father Gawril Zaycoff was the largest son of the priest of Yenikoy a village near Greek town Alexandroupoli (Dedeagach old name). Gawril Zaycoff studied natural history at the Sofia University and graduated forestry engineering in Lviv (Ukraine). Later on, he was a teacher, and foresters [17, s.22]. His wife, Velislava (Slavka) mother of Rashco Zaycoff, has been 16 years

younger than her husband has. She was a daughter of Christo Ivanov Tsarvulanov Captain, bearer of the St. George's cross. Christo Tsarvulanov was a friend and godfather of Hristo Botev's family in Bucharest. After the Liberation (1878), Christo Tsarvulanov was Commissioner of the Eastern Rumelia. His wife, Haritina Miljuva, the grandmother of Rashco Zaycoff, graduated school of Rada Kirkovich in Plovdiv. She has been a teacher in French language and sewed the flag of revolution together with Rayna (Princess) in 1876. Rashco Zaycoff mother attended communist lectures of Dimitar Blagoev when she studied the girls' secondary school in Plovdiv.

Many years later, Rashco Zaycoff wrote, “my mother helped some illegal communists between world wars first and second” [17, s. 22]. Probably, Zaycoff's fighting spirit came from his mother's family.

Rashco Zaycoff was a strange messy man with ingenious mathematical talent. When he was a baby, his mother met Italian professor who said, “Madam you are mother of a genius” [5]. Many years later, Bulgarian army used Zaycoff's capacity as a corporal in Skopje, North Macedonia from 10 April 1941 to 30 August 1941.

We find many types of spelling the name of Zaycoff (“Zaycov”, “Zaikov”, and “Zajkov”) in his publications: “Rashco”, “Raschco”, “Raschko”, and “Rashko” before and after the World War II. He had four marriages. He married first time during the period 1935–1938. He has a daughter Velislava born in 1939 from his second marriage (1938–1942). Professor Nicola Obreshkov wrote (1950): “His obvious weakness is a lack of firmness character.

He is third time married and this is due to easy way he enters into matrimony" [17, s. 88].

His third wife, Bonka Josifova Zaykova has been 9 years younger than her husband has. They met each other and married in Botevgrad where he was a teacher and she was a court secretary. Later on, Bonka Zaykova worked in Sofia Regional Court. They have a daughter Violeta (1946). Bonka passed away on 20 December 1960. In 1966, Milka Spassova Zaykova became his fourth wife.

Rashco Zaycoff chose physics for his research area independently. The reason is his international experience. He lived in Austria (1918–1919; 1926–1927), and Germany (1922–1924; 1926–1928; 1933–1935; 1942–1944). Zaycoff traveled to Netherlands (1924), North Macedonia (1924; 1941), Turkey (1925), Czech Republic (1927), Hungary (1927), Romania (1927), Serbia (1927), United Kingdom (1937), and France (1937) [17, s. 6]. He spoke seven languages: German and English good; French and Russian on average level; Turkish, Greek and Italian slightly.

Rashco Zaycoff was a member of Bulgarian Communist Party for a short time (1944–1945). He was a member of Bulgarian Physics and Mathematics Society from 1 January 1946, Union of Scientist from 27.11.1947, Common Workers Trade Union from 01.03.1947, Bulgaria-Russian Society (1947–1953), Voluntary Organization for Defense Assistants (1952), Bulgarian Red Cross (1952), and Fatherland Front in Sofia Kolarov Quarter (29.03.1948–01.09.1961), and Sofia Lenin Quarter from 01.09.1961. At that time, he headed a group and gave lectures about Russia [17, s. 5].

## 2.1 Education and specialization

Although, Rashco Zaycoff studied abroad one professional school and two prestigious universities, he graduated secondary school and university in Sofia. He studied primary school in his native town Burgas. After that, he was a student in a Moravian Military College with Austrian grant. Some years later (1918–1919), he returned in Sofia and finished secondary school (1921) [1].

Rashco Zaycoff wrote down mathematics and physics at the Sofia University and became a member of the students' academic society for physics and mathematics (1921–1922). From the next year, he studied mathematics at the universities of Gottingen (1922–1923) and Berlin (1923–1925). He was a member of National Student Organization (1923–1924), and Physics and Mathematics Society (1924–1925) in Berlin [17, s. 5].

Zaycoff met Albert Einstein in 1923. At the University of Berlin, he attended lectures of Einstein

about "Chosen chapters of theoretical physics". Einstein noticed youngest student and their friendship continued up to the World War Second.

May be, Zaycoff's mother helped communists because police arrested Rashco Zaycoff after the attack in the St. Sunday Church (16 April 1925). During the next months (01.06.1925–01.10.1925), Rashco Zaycoff and his father immigrated to Istanbul where he wrote his first article "Hilbert-Noether theorem application to the affine field theory". He sent it to Einstein for publication in the *Mathematische Annalen* (1926).

Einstein used this article to show talent of Bulgarian student. Humboldt foundation gave a grant to Rashco Zaycoff for theoretical physics specialization in Berlin (1926–1927). After that, Zaycoff returned to Sofia University and graduated physics (1928).

## 2.2 Zaycoff for Einstein

On the end of his life, Rashco Zaycoff wrote "Memories about Albert Einstein" [18]. In this book, Zaycoff said, "Einstein appreciated my scientific results best" [17, s. 59]. About the subject of his work at that time, Zaycoff wrote (1966): "I had a rare fortune to do research near Einstein in Berlin during 1926–1927. The problem I worked on is how to eliminate dualism ... [in] Riemann-Einstein four-dimensional space-time ... Theory of relativity has created by Einstein together with Grossman. It has developed by successors David Hilbert, Hermann Weyl, Arthur Eddington, Max von Laue, Max Born, Vladimir Fock, Dmitri Ivanenko, Leopold Infeld, Benesh Hoffman, Bartel Leendert van der Waerden, Luther Eisenhart, Aleksei Petrov, Hugo Tetrode, Cornelius Lanczos, and my modest person. This theory is far away to be finished yet" [19].

## 2.3 Sofia University assistant professor

Scientific carrier of Rashco Zaycoff started at the Physics Institute of the Sofia University. He was assistant professor of physics (31.03.1928–15.05.1930). A year later (12.11.1929), he made a request "to be appointed as a private professor on mathematical physics". All professors of physics and mathematics transferred between them responsibility to make a decision (like a hot potato). Faculty asks, "Is there any need similar private professorship to be created" [20, s. 36–36]. Institute of physics director, Alexandar Christoff, offers (03.12.1929): "Zaycoff publications to be reviewed by Professor Maneff (from physics point of view), and by some mathematician about their mathematical point of view" [20, s. 38]. Arkadi

Stoyanov, Institute of mathematics director, said: “It is Professor Maneff’s competency to review Zaycoff’s publications” [20, s. 39-40]. Faculty Counsel stick his old decision. Professor Ljubomir Tchakaloff has chosen “to give mathematical evaluation for Zaycoff’s publications” [20, s. 40]. His answer (16.01.1930) is, “Zaycoff’s publications are in an area far away from mine” [20, s. 41]. The question has been coming back in the Institute of physics. Its director, Alexandar Christoff reported (29.04.1930): “There is no need of similar private chair” [20, s. 57]. Historical reason for this decision is due to the University law. Every scientific area had only one chair and only one university professor from the Sofia University creation (1888) up to 1945. The request of assistant Zaycoff to be private professor of mathematical physics finished with his elimination from the Sofia University since 15 May 1930 [20, s. 76].

The next step of R. Zaycoff was to take part in the theoretical physics professorship competition. He attended two times in this competition (1930 and 1935). During the first competition, he filled and presented his documents, but took them back because his family was under pressure. Faculty Counsel reviewed Zaycoff’s publications nevertheless. Professor Kyrill Popoff and Nicola Obreshkov gave negative reviews for Rashco Zaycoff results.

## 2.4 Einstein for Zaycoff

Einstein said in a letter to Professor Obreshkov (6 January 1931): “Mr. Zaycoff has depth knowledge in mathematical physics. He shows independently developed ideas. His publications are little careless and uncritical. I would not give him a professorship in the beginning, but I will provide him possibility to work. May be, something will come out of him” [10].

## 2.5 Teacher

Rashco Zaycoff was a teacher in Sofia (16.05.1930–30.05.1933), Pavlikeni (04.11.1940–30.09.1942), and Botevgrad (15.09.1944–15.09.1946). He was a member of Bulgarian Teachers Society [17, s. 9].

## 2.6 Experience

In Germany, Rashco Zaycoff worked in Siemen’s factories two times (1933–1935, and 1942–1944). During the second of those periods, he wrote many review articles for Italian, German, and French magazines.

In Bulgaria, Rashco Zaycoff worked in the Institute for Economic Research (01.01.1935–22.02.1940). It was the Sofia University Institute

“headed by Professor Anderson – white guard” at that time [17, s. 101]. Nicola Obreshkov wrote (1950): “In Sofia, Rockefeller foundation and some banks created Institute for conjectural statistical research. Prof. Anderson became its director. He came from Russia, where he was professor of statistics in Sankt-Petersburg ... Zaycoff had appointment in this Institute. For a short time, he oriented in mathematical statistics due to his brightness, and became a competent researcher. Moreover, he published some scientific articles in the Institute journal. Soon, he has expelled from the Institute because of a women’s story. Zaycoff told me he would make a report against Anderson at the Police. After that, Professor Anderson went to Germany, and got a professorship position” [17, s. 88].

Police arrested Zaycoff for the second time (1940). The reason was that he charged espionage against Institute director Oskar Anderson (02.08.1887–12.02.1960).

After the World War Second, Rashco Zaycoff worked in the State Insurance Institute, economic management surveying section as an advisor instructor, first category (12.12.1946–02.12.1953). His boss Grozdanov wrote for him (05.12.1950), “he is suitable for the position he occupies, but he has intolerable character” [17, s. 97].

Magda Dimitrova Teneva, clerk in the same office, wrote (15.05.1950): “Zaycoff is an egoist, brutal, unscrupulous, and irresponsible in his actions. He put his ego in the foreground always. His discipline is lacking. In that reason, he has a separate room. He works independently and does not transfer his experience and knowledge. He uses foreign literature (German, French, and American). Recently, he starts to use Soviet authors as Konshin. His results are practically useless” [17, s. 87].

From 1 January 1951 to 31 May 1951, Rashco Zaycoff gave good “qualitative and quantitative” decisions for several transportation rates, insurance funds, and seismic risks [17, s. 97]. After that, State Insurance Institute evaluated him more positively: (1951) “It is difficult for him to work in collective” [17, s. 98]; (1952) “We find his discipline improved for some time. He makes endeavor but remains eccentric man yet” [17, s. 99]; (1953) “He has highly esteemed because of his huge theoretical knowledge in the area of mathematics and physics .... He has theoretical skills and apply them in insurance, but tasks have not elaborated practically. He is a poor organizer and manager. He has not communication skills to work with people” [17, s. 101]. Zaycoff leaved State Insurance Institute by order 2054 from 02.12.1953. In the same day,

Bulgarian Academy of Sciences appointed him as associate professor.

In the beginning of 1950s, Rashco Zaycoff became a member of editorial board at the Bulgarian Academy of Sciences. They must prepare tables of mortality in Bulgaria. The project stopped because Zaycoff has squabbled with another member (Michajlowski).

## 2.7 International cooperation

Bulgarian Statistical Institute sent Rashco Zaycoff for research in London (1937). On the return away, he stopped in France. He had scientific trips in Czech Republic for 17 day (from 21 November 1955), and Dubna for a specialization (1958) and to take part in a conference (1964).

## 2.8 Scientific positions

Georgi Nadjakov support has crucial role for Zaycoff's scientific career. Assen Datzeff became corresponding member of the Bulgarian Academy of Sciences (1951). He created a new theoretical section in the BAS Institute of Physics. Rashco Zaycoff (04.12.1953–01.09.1961) and Nikola Kalitzin (01.12.1918–10.08.1970) are first associate professors in this theoretical physics section. According Institute of Physics Bulletin, published from 1950 to 1973, Rashco Zaycoff wrote in the area of relativity in the beginning (1953–1955).

He worked together with Christo Yankow Christow (12.06.1915–20.03.1990), Vasil Christow (02.10.1922–05.08.1999), and Ivan Todorov in the theoretical physics section of BAS Institute of Physics (1955–1963). In 1958, Rashco Zaycoff, Vasil Christow, and Ivan Todorov specialized in Dubna (Russia). They worked on quantum field theory, theory of particle physics, and nuclear theory at the Russian Joint Institute for Nuclear Research.

Rashco Zaycoff became full professor of theoretical physics (01.09.1961). He was deputy director of the theoretical physics section from 1968 to 1971. He went on pension in 1972, but worked in the BAS Institute for Nuclear Research and Nuclear Energy during the next two years [21].

Vasil Christow, as a communist secretary at the BAS Institute of Physics wrote, Rashco Zaycoff "has not to be trusted politically. He is inconvenient for secret mission ... He is slave to his emotions and fall into extremes often" [17, s. 107]. Assen Datzeff gave the next evaluation (30 May 1950), Rashco Zaycoff "is in the clouds a little, he is unrealistic ... [and] ... unsuitable for practical leadership position ... He has quite good mathematical knowledge, and efficiency. His work has rather formal character"

[17, s. 91]. Director of BAS Institute of Physics Georgi Nadjakov determined (29 March 1960) Rashco Zaycoff as an "eminent authority in theoretical physics with excellent mathematical practice" [17, s. 107-107].

## 2.9 Awards

Rashco Zaycoff has six medals: 1) "Kirill and Methodius" first degree (1968); 2) "Bulgarian Academy of Sciences 100<sup>th</sup> anniversary" (1969); 3) "Soviet authority 25<sup>th</sup> anniversary" (1969); 4) "Red flag" (Decree 1059 from 9 December 1971); 5) "Bulgarian Academy of Sciences distinction" (1971); and 6) "Union of Scientists in Bulgaria distinction" (1971). The Scientific Counsel of the BAS Institute of Physics nominated Rashco Zaycoff for corresponding member without success (1956).

Rashco Zaycoff became scientist independently. In this paper, we will try to understand what his scientific results depend on.

## 3 Scientific results

Investigations of Rashco Zaycoff are in applied mathematics and theoretical physics. His publications are in four areas. 1) "Theory of general relativity and its application in the quantum theory" – 12 articles in Bulgaria and 21 abroad. 2) Quantum mechanics, quantum field theory and theory of nuclear physics – 20 articles in Bulgaria and 12 abroad. 3) "Astronomy, dynamical geology, demography and paleoanthropology, geochronology" – 9 articles in Bulgaria. 4) "Theory of probability, mathematical statistics and their applications" – 22 articles in Bulgaria. He gave 12 scientific reports and about 20 popular lectures in philosophy of physics [17, s. 113-114].

Rashco Zaycoff has 76 articles and 4 books [22-25]. He wrote in German language only (1925–1933). He wrote his articles in Bulgarian language in the second part of 20-century mainly. A very small number of his publications are in English and Russian language [1].

Together with Docho Fakirov, he edited the book "Multitemporal theory of relativity" [26]. Rashco Zaycoff mentioned, that he has two books in preparation 7 months before his death (20 March 1981), "Self-coordination mega cosmology" with volume 80 pages, and "Multidimensional distribution of Pearson" with volume 60 pages. No other sources have found for these books [17, s. 114].

Rashco Zaycoff wrote (20 March 1981) that he supervised 60 dissertations during the second half of 20<sup>th</sup> century. He pointed that he prepared "520

reviews in national competitions” [17, s. 114]. He “has 186 articles in theoretical physics and mechanics published in *Jahrbuch Über die Fortschritte der Mathematik* (1942–1943)” [17, s. 59].

### 3.1 Relativity (1925–1935)

Professor Kyrill Popoff wrote the next negative review (26 December 1930): “Mr. Zaycoff lack physics gesture. For him mathematical physics is a jugglery by some elemental transformations. Great name he calls his work as *Begründung* indicate that he has no clear concept about real problems. His publications are notes about theories he has studied. They touch: 1) Einstein theory on gravitational and electromagnetic field, and 2) Whittaker and Dirac publications about quantum theory and waves equations. [...] Mr. Zaycoff has full consciousness about what he makes and what the value of his results is but he needed new and new publication. [...] There are no clear and well-determined problems in his works. [...] Mr. Zaycoff calculates because loving calculation, but not to say something new” [27, s. 9-10].

Professor Nicola Obreshkov wrote the next review (26 December 1930): “Often, Mr. Zaycoff deviates from Einstein’s symbols. He put own symbols and his work is getting much complicated to read sometimes. Although, his work has no scientific interest they show his concentration in difficult problems of relativity. Character of his work is mathematically formal [...] Mr. Zaycoff uses original Whittaker work (1928). In it, he modifies Dirac theory with field theory. Zaycoff gives more symmetric formula of this theory, and express the covariant differentiation in detail. Received formulas give in first approximation Dirac wave equations I–II, and their theory of transformation depending of Whittaker’s wave equations [...] Mr. Zaycoff connects theory of remote parallelism with wave mechanics like of Mandel and Reichenbecher works. He introduces a new (fifth) dimension in four-dimensional world. He presents gravity, electromagnetic and Dirac wave equations by common covariant form using principle of Hamilton. Mr. Zaycoff generalizes mathematically known results. Often, his works suffer from unnecessary formulas. They show that he uses his good mathematical technique to solve modern problems. In that reason, I cannot recommend him for this professorship. I think we must give him a position in the University like an assistant for instance” [27, s. 25-30].

Rashco Zaycoff participated in third competition for theoretical physics professorship (1935) without

success. Reviewers (Ivan Tzenoff and Nicola Boneff) gave negative evaluations for him.

Ivan Tzenoff, analytical mechanics professor, wrote (8 July 1935): “Mr. Zaycoff’s scientific work has mathematical character. He aims to generalize mathematically various theories in relative and wave mechanics without taking into account their physical side. He put so many formulas in his articles as they are annoying to read even for a mathematician. He has a good mathematical technic. This is a reason why he cannot present us works with physical character according to me [...] He wrote many articles on the new wave mechanics, but there is no question about its principles or goals anywhere. In that reason, I cannot recommend Zaycoff for professor of theoretical physics” [28, s. 98-108].

Nicola Boneff, associate professor of astronomy, wrote (8 June 1935): “I find that Zaycoff has some understanding in these difficult fields of theoretical physics. He has good mathematical technics. Another positive aspect of his work is his choice of undecided questions in front of physics. However, he examines formal side of questions only. In that reason, his publications have overloaded with unnecessary transformations often. They are without physical significance. Although, theoretical physics is highly mathematical it is still physics. Zaycoff aspires to increase number of his publications, which prevent him to reach research in depth. He could not claim for a doctorate from a serious European university with any of these publications. Zaycoff illustrates brilliantly the fate of all wunderkinds in Bulgaria. Their talent has wasted by generous praises of parents and relatives instead to be bringing up by hard work and skillful leadership” [28, s. 108-114].

Some historians examine Zaycoff’s work later on. Goenner [29-30] analyses unified field theory in Zaycoff articles [31-36]. Biographical remarks have mentioned [29, s. 82]. According Goenner, Zaycoff criticized Einstein “for not having shown whether his constrains on the world metrics be permissible” [29, s. 91]. He “described the mathematical formalism of distant parallelism, and calculated the new curvature scalar in terms of the Ricci scalar and of torsion. He took a more general Lagrangian then Einstein and obtained the variation derivatives in linear and in a simple example in second approximation” [29, s. 91]. According Synge, information for Zaycoff’s publications [37-40] came from *Zentralblatt für Mathematik* [41, p. 490].

### 3.2 Mathematical Statistics (1935–1953)

Rashco Zaycoff has several articles in the area of mathematical statistics. He investigated “elimination

of the seasonal component by the method of Dr. A. Wald" [42], "decomposition statistical rows by time in three components" [43], "elimination of an accidental cumulative quantity by the variation difference method" [44], and "elimination the seasonal component from Bulgarian conjuncture rows" [45]. R. Zaycoff "analyzed conjuncture rows" [46], and "marketing indexes for volume and prices of export stocks" [47]. He published "table about mortality of population in Bulgaria 1927–1934" [48]. Docho Fakirov wrote that Rashco Zaycoff has significant contribution for creation the variation differences method. He "separates accidental fluctuations from regular tendency in a line of experimentally determined quantities" [49].

### 3.3 Nuclear Theory (1953–1972)

The interest of Rashco Zaycoff in nuclear physics started in Germany. Assen Datzeff wrote (30 May 1950): "During the last war ... Zaycoff was mathematician at the Siemens factories ... He told me, that he contributed to creation of important nuclear apparatus – betatron in Germany. Actually, he has only general information for it." [17, s. 90].

In the same time, Georgi Nadjakov initiated nuclear physics experimental research at the Bulgarian Academy of Sciences. We find his 10 pages document to creating three new nuclear physics laboratories in Bulgaria. Nadjakov supported Zaycoff's appointment and specialization in the area of particle physics theory.

During the second half of 20<sup>th</sup> Century, Rashco Zaycoff published 20 Bulgarian articles, and 12 articles abroad about "quantum mechanics, quantum field theory, and theory of particle physics".

### 3.4 Cosmogony

Rashco Zaycoff has nine Bulgarian publications in "astronomy, dynamic geology, demography, paleoanthropology, and geochronology". He has early publication [39] about theory of expanding universe and cosmological constant [50]. His monograph, "Expanding universe with moving inert matter, and light radiation" [25] has 96 pages. It has four chapters about "relativistic cosmology, elliptic cosmology, general theory of gravitation, [and] dependence between rotation of the Milky Way Galaxy and geological cycles. The book contains 22 new theoretical results and presents more precisely solutions for general theory of relativity in case of expanding universe" [17, s. 114].

## 4 Conclusion

Rashco Zaycoff is Bulgarian mathematical genius. He used his talent to do theoretical research in physics and applied mathematics. Role of Zaycoff's personal relationship for his scientific investigation is very important. Under the influence of Albert Einstein, he investigated five-dimensional space-time and unified field theory (1925–1935). His troubles in the Sofia University forced him to do research in the area of mathematical statistics (1936–1953). Georgi Nadjakov is the second eminent physicist influenced and supported Zaycoff scientific research in theoretical particle physics (1953–1982).

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