

## Scientific Activity of Professor M. Mateev (1940–2010)

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**Abstract.** The scientific activity of M.D. Mateev is the object of this report. The main topics of his research activity are considered. In a separate section the contributions of acad. Mateev both in the organization of science at national and international level, as well as in national and international scientific organizations have been analyzed.

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### 1 Introduction

The scientific activity of a scientist of the scale of Professor M. Mateev expresses his life from student years to the end. The discussion on this subject is much more difficult for me being in memory to a friend of mine.

The research activity of Professor M. Mateev is concentrated on various topics of contemporary physics as quantum field theory, neutrino physics and condensed matter physics. He initiated and was an important participant in many scientific projects and collaborations which included colleagues from the University of Sofia and from international scientific institutions like the International Center for Theoretical Physics – Trieste, JINR – Dubna, CERN and others.

The work of M. Mateev in organization of science and in national and international scientific organizations was also very important and successful. He manifested his clear understanding and concepts, and used his diplomatic art to solve both everyday and strategic problems of physics and physicists.

The analysis of the teaching, administrative and political activities of Professor M. Mateev is not an object of this report.

## 2 The Main Research Topics of M. Mateev

The analysis of the topics and results of the research activity of M. Mateev needs a special book, not a short report. Many features of his scientific work and its results are exposed in other lectures of this memorial session. Here we concern the scientific fields in which Professor M. Mateev made the most important contributions. We use his own List of publications, classified by himself.

This List includes 153 titles and the last two of them are the Theses from 1971 and 1980. The last decade publications are not so strictly arranged (obviously this is related with the tragic accident and death of Mateev). Nearly 20 papers are included two times in the List. So the approximate number of publications, including shortened version of some papers, is about 130.

The main scientific fields:

### A) *Quantum field theory*

More than 45 papers create the core of Mateev's contributions since the beginning of his scientific career (1963) till 1986 and the field of all of them is the Quantum field theory.

#### A.1) *Quasipotential approach to the relativistic two-body problem*

Quasipotential approach was very promising and fruitful in the 60s and 70s of the last century. The first publications of Mateev realized in University of Sofia, Trieste and Dubna as well as his first Thesis treated the two-body problem in the version of the quasipotential approach of Logunov, Tavheliidze and Kadyshesky. The cycle of papers on quasipotential approach, realized in Dubna, was awarded the First premium for research (1975) in JINR.

#### A.2) *Quantum field theory and the hypothesis of the fundamental length*

This big group of papers is divided in author's List in two Sections (the second part is devoted to the local quantum field theory and fundamental length). The second Thesis treats the concept of fundamental length in quantum field theory. The biggest part of this series of works is realized in the Laboratory for Theoretical Physics of JINR – Dubna during the 10-years stay of Mateev there (and after this stay) in the group of Kadyshevsky, in collaboration with A. Donkov, Mir-Kasimov and M. Chizhov in the 80s. The hypothesis of the fundamental length represents one possibility of development of Quantum field theory. According to the authors' hypothesis, the fundamental length is connected with non-Euclidean momentum space. The authors analyze the hypothesis of the fundamental length from any side, they consider many physical cases and consequences both experimental and theoretical.

In the papers published during the last years the problems of maximal mass model in the Quantum field theory has been treated (again in close collaboration with Kadyshevsky).

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### *B) Condensed matter physics*

Two cycles of research on condensed matter physics are connected with the activity of the University center for space research and technologies. This Center was inspired and organized in connection with the Bulgarian participation in the space programs. The role of M. Mateev in the Center was very significant.

#### *B.1) High temperature superconductivity*

At the very beginning of the study on high temperature superconductivity (1986, Bednortz and Muller) Mateev initiated the investigation on some new high  $T_c$  superconductors, synthesized and studied by the integrate group of researchers from the University of Sofia, Bulgarian Academy of Science, industrial and other institutions. In more than 10 papers Mateev and co-authors published the results of their technological, experimental and theoretical studies of several types of superconductors, which contain La, Bi, Ta, Ti and other.

#### *B.2) Microgravity experiment*

In the framework of the scientific programme of the second Bulgarian cosmic flight the experiment “Kliment – rubidium” has been planned and prepared by the group from the University Space Center. The crystal growth in microgravity conditions as well as the properties of the grown crystals have been studied and published in several papers from the beginning of the 90s.

### *C) Neutrino and astroparticle physics*

The problems of solar neutrino, neutrino oscillations and measurements of neutrino masses are the field of special scientific interest of Professor Mateev during the last 15 years and the results of his studies (with co-authors) are presented in several papers. The neutrino and astroparticle physics have been very attractive for Mateev and I remember with pleasure several lectures given by him since 2000.

### *D) Experiments Na-49, CERN*

In 1999 Bulgaria became a full member of CERN, and the research efforts of Mateev have been directed also in the collaboration Na-49, realized by the scientists of several countries in CERN. More than 60 publications of Mateev (2001–2010) present the different stages of that project and contain valuable results of the experiments Na-49.

In those experiments the collisions of heavy ions accelerated on CERN Super Proton Synchrotron (SPS) have been studied, especially Pb-Pb- collisions, Pb-p collisions and p-p collisions. The purpose of the experiment Na-49 is the investigations of the properties and the products of quark-gluon plasma. Professor Mateev provided the coordination of the Bulgarian participation in that experiment. The papers on the experiment Na-49 are well known and have high citation rate.

The scientific papers of Professor M. Mateev obtained more than 1000 independent citations by other authors.

### **3 Activity of Acad. M. Mateev in Scientific Organizations and Scientific Institutions**

It is difficult to graduate the importance of activity of Mateev in different institutions and thus I will follow a chronological order.

The first contact of Mateev with an international scientific institution has been established during his stay in ICTP – Trieste (1966) where he met many colleagues and put the beginning of long term connections with prominent physicists (and made his intensive research).

His collaboration with many physicists from JINR – Dubna who permanently or temporary worked there lasted more than 40 years. Very important and fruitful was his first stay in JINR in the 70s of the last century. For the bigger part of that period Mateev was Chairman of the Bulgarian group of scientists, technicians and members of their families (approximately 60–100 persons). This position is both scientific and administrative and M. Mateev invested systematic efforts for a quiet and fruitful stay of the group. Mateev made his own research which gave nice results and in the same time he took care for other Bulgarian people. The close collaboration with the colleagues from JINR – Dubna has been continued and developed during the next three decades. M. Mateev was an active member of the Scientific Council of JINR from 1993 till 2010 as representative of Bulgaria.

In the years 1986 -89 Mateev was the first vice-President of the Bulgarian Committee of Science (governmental body). The president was acad. B. Sendov. The most important contribution of Sendov and Mateev to the scientific activity in Bulgaria was the establishment of a National Fund for scientific research projects with state financing, based on the model of competition among the projects. Namely at that time a very intensive development of the University Center for Space Research and Technologies has been realized and M. Mateev was the “hero” of this institution, being its founder, leader and one of the main researchers.

In the year 1990 (after the beginning of the changes in Bulgaria) Abdus Salam – Nobel prize for 1979 – visited Bulgaria and obtained the honorable award “Doctor honoris causa of the University of Sofia”. Mateev has known him earlier (I think from his stay in Trieste) and was the host of the visit. Practically this year was the beginning of the active work for full membership of Bulgaria in CERN. Mateev was the motor of the efforts of the Bulgarian physicists, especially in nuclear and high energy physics, to convince the colleagues from Bulgaria and CERN, Bulgarian government and the scientific community in Bulgaria that our membership in CERN is a necessary and very productive step in the Bulgarian–European integration. Very important role had the visit in Bulgaria in the year 1995 of a big delegation of CERN, which estimated the qualification of Bulgarian scientists and their opportunity for successful work and integration with

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scientists from other countries – members of CERN. This delegation visited also the Rector's office of the University of Sofia (at that time I was the Rector of the Sofia University and the President of the Union of Physicists in Bulgaria). The very active position of Mateev during these visits and later on produced a brilliant result – in 1999 the Scientific Council of CERN, the Bulgarian government and the Bulgarian parliament approved the full membership of Bulgaria in CERN. In the years 1999–2000 Mateev was the representative of the Republic of Bulgaria in the Council of CERN. Even later the skeptical position of some Bulgarian scientific leaders (especially from the Bulg. Acad. Sci.) was the reason for additional explanations, directed to the Bulgarian society, what is CERN in fact and the significance of the Bulgarian membership in it. During the last decade Mateev had several long term stays in CERN with active research activity.

Professor Mateev worked very intensively in the Union of Physicists in Bulgaria (UPB) and for three terms he was its President (2001–2010). Mateev proposed in 1989 to declare the transformation of the Society of Physicists into the Union of Physicists as nongovernmental organization of Bulgarian scientists, teachers and applied physicists. In the time of deficiency of financing and of public understanding of the place of the physicists Mateev led the Union of Physicists following a quiet and realistic approach.

The European Physical Society (EPS) is also a nongovernmental institution and Mateev was its active member for more than two decades. He worked for the closer East – West connections in the framework of EPS and since 2001 he was the representative of the Union of Physicists in Bulgaria (UPB) in the Council of EPS. I stress on his special interest and efforts for the large propaganda of physics during the International Year of Physics (2005) declared as an important event of science and culture by UNESCO and by the United Nations. Those organizations supported the initiative of EPS and its President M. Ducloy (France). The integration of UPB in the European physics community and in EPS was a permanent care of Mateev.

The Balkan Physical Union (BPU) has been established in 1985 and due to the big social and political changes during the 90s it needed big transformations. The most critical moment was the collapse of the former Yugoslavia. BPU as an alliance of the societies of physicists of the Balkan countries needed new constitution and new rules. The very delicate relations between the countries influenced the relations inside BPU. Bulgarian physicists, and particularly M. Mateev, played the balancing role between the colleagues from other societies. I remember a two-days meeting in the Rector's office (1995) in which Mateev manifested again his diplomacy. The real transformations of BPU lasted several years and as a recognition of Mateev's efforts he was elected for vice-President of BPU (1997–2003). Bulgarian physicists hosted the 4th General Conference of BPU (2000, Velico Tirnovo). Professor M. Mateev was the main person in the organization of the Conference. Professor Mateev and myself established

new scientific forum with invited lectures of general interest given by prominent lecturers. We invited also the President of EPS sir Wolfandale. The next general conferences of BPU followed these new traditions.

Professor Mateev was the Editor-in-chief of the “Bulgarian Journal of Physics” during 1993–2010. This scientific journal has been established in 1973 and recognized by EPS in 1989. The care for financing and maintaining a high scientific level of the journal was personal responsibility of Professor Mateev for this period.

Mateev was a delegate of Republic of Bulgaria in the Consultative Council for Fusion CCE-FU, Euroatom (2006–2009) and a representative in the Governing body of European enterprise for ITER. He organized also the European Conference on Plasma Physics (Sofia, 2009).

#### **4 Conclusion**

This report represents a very schematic view on the scientific activity of Professor M. Mateev. It is impossible to give a complete review of the concepts, the ideas and the results of the scientific heritage of Mateev.

Even the short review of the scientific activity of Acad. Mateev exhibits his high intellectual level, his curiosity towards the news and problems of physics, his great energy in formulation and solving the problems and his talent in organization of research. The intensive work of Professor Mateev in the national and international organizations represents his essential contribution to life and professional activity of physicists and of other scientists. Without those institutions – professional, governmental and non-governmental – the success of science is impossible now and the existence and functioning of the institutions need the systematic work and the energy of people like M. Mateev.

Mateev was alive connection between these scientific institutions and the bulgarian physicists. His public lectures on the news in physics, as well as his teaching activity, lead the students and the scientists towards the frontiers of physics.

Professor Mateev demonstrated very high level of lecturing; he possessed the capability to expose the most complicated problems of physics using an understandable, profound and precise manner. The ability of contacting with the colleagues and the students is another very important feature of a scientist and Mateev manifested this quality during his whole life devoted to science.

The social, hierarchical and formal positions are and will be always full. Unfortunately the places among the community of brilliant individuals like Acad. M. Mateev are left empty and we feel all the time their loss.