BIOGRAPHY OF Dmitry Yu. BARDIN (1945 - 2017)

born April 19, 1945, Moscow, Russia.
died June 30, 2017, Dubna, Russia.

Dmitry Yurievich Bardin (Russian: Дмитрий Юрьевич Бардин) (born 1945, Moscow - died 2017 Dubna) was an outstanding Russian (and former Soviet) theoretical physicist. He was Doctor of Physical and Mathematical Sciences (Dr.Sci.) and professor at the Moscow State University. Bardin worked at the Department of Colliding Beams of the Laboratory of Nuclear Problems of the Joint Institute for Nuclear Research (JINR), Dubna, Russia. He was the scientific leader of numerous international projects and collaborations. His notable results and contributions were recognized widely by the scientific community around the world. He was internationally known for his distinguished and highly original contribution in fundamental theoretical questions and techniques in the physics of elementary particles. The approach of his ground-breaking works to the theory of quantum electrodynamics, quantum chromodynamics, physics of colliders, quantum field theory, etc. was characterized by deep and systematic treatment of the problems under consideration. He belonged to persons whose works contributed substantially to all these scientific disciplines and led to creation of the new scientific directions. Mainly involved in fundamental issues in the foundation and confirmation of Standard Model, he contributed much to the experimental justification of that Model by creating the unvaluable codes for numerical modelling of the processes at highest energies. These his results penetrated at many areas of the physics of elementary particles. Many of his ideas and methods enriched the physics of elementary particles greatly and are now disseminated in hundred of publications of many authors. He was also active on the national and international scene, as chairman and editor of the

numerous Conference Proceedings and as a visiting professor at many Universities and Scientific Centers, especially at CERN, Geneve. He gave numerous invited talks at conferences and workshops and at colloquia and seminars. His list of publication includes 700 items. These works have a highest Index of Citation, some of them have Index of Citation in a few thousands of References.

Dmitry Yu. Bardin graduated with honors at Moscow State University in 1968 and started research work at JINR. His teachers were S. M. Bilenky and Bruno Pontecorvo. First scientific interests of D. Yu. Bardin were devoted to elastic pion-electron scattering and rare decays of pions and kaons. The results of his calculation of radiative corrections were used in the analysis of data of the Soviet-American collaboration for the study of the electromagnetic form factor of the pion. Based on these results, in 1974 Bardin defended his Ph.D. thesis under the guidance of Professor S. M. Bilenky.

Since 1975, all the scientific work of Bardin was devoted to the phenomenology of elementary particle physics, precision physics, calculation of electroweak and QCD radiative corrections in the framework of the Standard Model for experiments at LEP1, LEP2, ILC, HERA, SPS and LHC. From 1980 to 1986 Bardin together with N. M. Shumeiko and A. A. Akhundov developed a semi-analytical formalism for the calculation of QED corrections to deep inelastic scattering of charged leptons and neutrinos on nucleons and nuclei. At the same time, in co-authorship with O. Fedorenko and P. Christova he developed the pioneering approach to renormalization in the unitary gauge, which became classical. The applications of these complete radiative corrections in the Standard Model were done in close cooperation with deep-inelastic scattering experiments at CERN: BCDMS, NMC, CHARM-I, CDHSW, and later with CHARM-II in elastic nu e scattering. Since 1979 and throughout his further scientific career, Bardin collaborated with Pena Christova from the Academy of Sciences of the Republic of Bulgaria, and since 1983 with Tord Riemann from DESY in Germany (till 1989 at the Institute for High Energy Physics of the Academy of Sciences, Zeuthen).
In the nineteen eighties D. Yu. Bardin and T. Riemann laid the foundation for a long-term cooperation between JINR and the Zeuthen institute, which became known as the Dubna-Zeuthen Radiative Corrections Group -- DZRCG: D. Bardin, A. Akhundov, A. Arbuzov, M. Bilenky, P. Christova, L. Kalinovskaya, T. Riemann, J.

Biebel, M. Jack, D. Lehner, A. Leike, S.~Riemann, M.~Sachwitz. Bardin's scientific activity was devoted to the physics of LEP1. The DZRCG took part in the workshop "Z Physics at LEP1`` in 1989. Together with W. Hollik, B. Ward, T. Riemann and R. Kleiss Bardin gave a course of lectures on "Radiation corrections for experimentalists" at CERN. In 1994-1995 Bardin, together with W. Hollik and G.~Passarino coordinated, in the framework of the project LEP1, the work of the Precision Calculations Working Group at CERN. This group prepared and published a report on LEP1 physics for CERN, which contains an analysis of the accuracy of calculations for the Z boson resonance.

Between 1990 and 1994 Bardin created in collaboration with A. Akhundov, C. Burdik, L. Kalinovskaya, T. Riemann the code TERAD91, which later was used to analyze the data of the HERA detectors at Hamburg. At this time, Bardin worked for several months at DESY in Hamburg and Zeuthen, as well as in the Theoretical Physics Department of CERN. For three years, from 1991 to 1994, Bardin participated in the theoretical support for the DELPHI experiment at CERN. For LEP2 and NLC, together with J. Biebel, M. Bilenky, A. Leike, D. Lehner and T. Riemann, Bardin investigated four-fermion processes in e^+ e^- annihilation. They calculated QED corrections in a gauge-invariant manner for W^+ W^- and for other reactions. Dmitry Yurievich was a convener of the Working Group on Event Generators for Standard Model processes in LEP2 in 1995. In the nineteen nineties Bardin, in collaboration with C. Burdik, P. Christova and T. Riemann, calculated the complete semi-analytical electroweak corrections for deep inelastic $ ep $ scattering at HERA energies.

Together with A. Arbuzov, J. Blumlein, L. Kalinovskaya, P. Christova and T. Riemann, Bardin created in 1996 the software package HECTOR -- for the calculation of deep inelastic scattering cross-sections of electrons and protons at HERA. This project includes model-independent calculations of radiative corrections in various variables for neutral and charged current scattering with unpolarized and polarized electrons. The basis of the by now famous project ZFITTER was created from 1984 to 1986.

The classical results of Bardin on the realistic description of the Z peak (together with M. Bilenky, G.~Mitselmakher, T. Riemann and M. Sachwitz), on the description of electroweak one-loop corrections to the decay of the neutral vector boson (together with A. Akhundov and T. Riemann), and also the description of QED corrections in e^+ e^-

annihilation (together with M. Bilenky, A. Chizhov, A. Sazonov, O. Fedorenko, T. Riemann and M. Sachwitz) formed the basis of the project ZFITTER. The ZFITTER project was one of the main codes for the LEP1 and LEP2 data analysis, and it is state of the art until now. The authors of the main version D. Bardin and A. Arbuzov, P.~Christova, M. Jack, L. Kalinovskaya, A. Olshevsky, S. Riemann, T. Riemann created a unique, creative analysis tool. The leaders of the project were D. Yu. Bardin and T. Riemann.

A huge, invaluable, painstaking work of support, both in physics and in programming lay on the shoulders of the ZFITTER authors for more than 25 years. Together with P. Christova and L. Kalinovskaya, Bardin actively participated in the work of two LEP2MC Workshops. The theoretical support for predicting the mass of the top quark and the mass of the Higgs boson was done using ZFITTER . In Peter Higgs' Nobel lecture of 2013 a world data fit was shown, the blue band plot``. Its theoretical prediction of the mass of the Higgs boson relies on ZFITTER. So far ZFITTER is a basic software of the ATLAS and CMS collaborations for Z boson production. Bardin made a decisive contribution to the development of techniques for calculating complete electroweak radiative corrections in the framework of the Standard Model.

In 1999, together with G. Passarino, D. Yu. Bardin published the fundamental monograph:

``The Standard Model in the Making, Precision Study of the Electroweak Interactions (Clarendon Press, Oxford, 1999),

which became a classic textbook on the technique of calculating single-loop radiative corrections and their extensive analysis.

Since 2000 D. Yu. Bardin, in collaboration with P. Christova, C. Bondarenko, L. Kalinovskaya, A. Arbuzov, A. Andonov, G. Nanawa, V. Kolesnikov, R. Sadykov, L. Rumyantsev, A. Sapronov and E. Uglov, was creating the software system SANC for calculations of QCD and electroweak radiative corrections in the framework of the Standard Model. The results of the MC integrator MCSANC are actively used in the ATLAS collaboration at the LHC. Particularly successful is here the cooperation with S. Jadach , Z. Was, W. Placzek, M. Klein. Under the guidance of Bardin several by now classical software packages were created and are used until today: ZFITTER - a powerful package for data analysis LEP and LHC; muela - a package for theoretical support of experiments on elastic polarized $ \mu e $ scattering, GENTLE - a package for 4-fermion background to the signal processes W^+W^-, ZZ and ZH for the LEP2 data analysis.

Based on his vast experience Professor D. Yu. Bardin developed a course of lectures for students at the Lomonosov Moscow State University on ``Standard Theory and Precision Calculations".
From 2009 Bardin was professor at the Moscow State University and experienced great respect from colleagues and students. Under the guidance of Dmitry Yu. Bardin 12 Ph.D. theses were defended. Dmitry Yu. Bardin is on the list of the Top 100 most cited Russian scientists according to the RINC. According to the database INSPIRE D. Yu. Bardin is co-author of more than 700 scientific publications. He presented his work at numerous seminars at JINR, CERN/TH, CERN/PPE, DESY, IfH, Universities of Bielefeld, Lyon, Karlsruhe, and acted at numerous world-class conferences like ACAT, CALC, RADCOR, Loops and Legs. He gave main lectures at several schools jointly organized by CERN and JINR. Groups headed by Dmitry Yurievich were awarded six times with the prestigeous First Research Prize of the Joint Institute for Nuclear Research.
It is difficult to count here all the scientists with whom Dmitry Yu. Bardin actively collaborated. Let us name besides those mentioned Bruno Pontecorvo, Barbara Badelek, Konstantin Chetyrkin, Ansgar Denner, Stefan Dittmaier, Valya Dokuchaeva, Fred Jegerlehner, Martin Grunewald, Andrei Kataev, Johann Kuhn, Bernd Kniehl, Wolfgang Friedrich Lohmann, Lew Okun, Dorothee Schaile, Dmitri Shirkov, Alberto Sirlin, Hubert Spiesberger, Oleg Tarasov and other.

Bardin has authored or co-authored about 700 publications on physics of elementary particles and Standard model. Many of his results are discussed and cited in the numerous books and review articles. Some of them are listed below together with some works of D. Yu. Bardin and his co-authors.

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