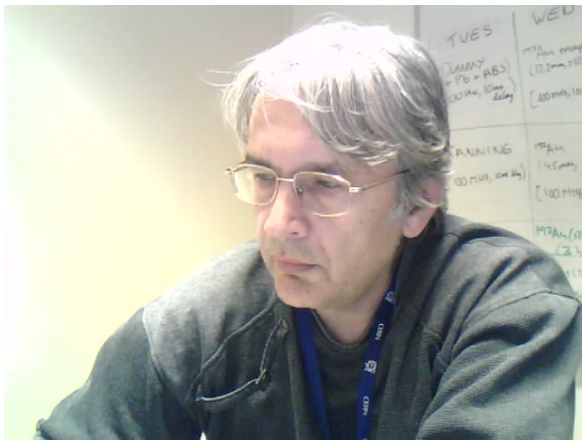
IN MEMORIAM:

MIHAIL DOLORIS MIREA

(9 February 1961 – 27 August 2020)



Mihail Doloris Mirea, senior researcher 1 in the Department of Theoretical Physics, "Horia Hulubei" National Institute of Physics and Nuclear Engineering (IFIN-HH), Măgurele, Romania, passed away, unexpectedly, on August 27th, 2020. He graduated the "Matei Basarab" High School in Bucharest (1980) and the Faculty of Physics, University of Bucharest (1985) as engineer physicist. Then, he was employed at the Institute for Nuclear Power Plants, Piteşti, Romania, until 1987, when he moved to "Horia Hulubei" National Institute of Physics and Nuclear Engineering. He defended his PhD thesis "Developments of Microscopic Macroscopic Models for Applications to Fission Processes with Very Large Mass-Asymmetries" in 1994, under supervision of Prof. D.N. Poenaru. Since 2004 he was senior researcher 1 in the Department of Theoretical Physics, "Horia Hulubei" National Institute of Physics and Nuclear Engineering, Măgurele, Romania. In 2014 Mihai Mirea was awarded the "Horia Hulubei" prize of the Romanian Academy. His scientific interests mainly concerned basic approaches in experimental and theoretical nuclear physics. In addition to his concrete research activity he has carried out significant managerial activities: Member of the Editorial Board of the Physics Section of Proceedings of the Romanian Academy, Series A (2014-2018), referee of several relevant international journals (Journal of Physics G, Nuclear Physics A, International Journal of Modern Physics E, Physical Review C, Romanian Journal of Physics, Romanian Reports in Physics, Advances in High Energy Physics,

Physica Scripta, European Physical Journal A, International Journal of Modern Physics A, etc.), director of many national and international research projects, Romanian spokesman in the IN2P3 (France)-IFIN-HH (Romania) collaboration, Romanian team leader in the n_TOF international collaboration at CERN (2007–2015), chairman of the International Workshop *New Applications of Nuclear Fission* (NANUF03), Bucharest, September 2003 (Proceedings edited by A.C. Mueller, M. Mirea, and L. Tassan-Got, in World Scientific, Singapore 2004). Mihail Mirea was elected in 2018 as a corresponding member of the Academy of Romanian Scientists, which was founded in 1935. His outstanding international scientific visibility significantly contributed to the important position (eighth place) among Romanian scientific institutions in the Elsevier-Scimago ranking.

Mihail Mirea has made many valuable original contributions in nuclear physics, embodied in over 200 articles published, as single author or in collaboration, in well ranked ISI journals such as Phys. Rev. Lett., Phys. Lett. B, Nucl. Data Sheets, Phys. Rev. C, J. Phys. G, European Phys. J. A, Nuclear Instruments and Methods B, etc., having over 2860 citations and a Hirsch factor of 30 (Google Academic). A short list of his main scientific contributions includes:

i) Developing of a Woods-Saxon super-asymmetric two center Shell Model and the associated computing code. The model is appropriate for the unitary treatment of the nuclear decays in a wide range of mass asymmetries, including fission, cluster, and alpha decay. It provides the possibility to investigate the nuclear processes dynamically, by following the rearrangement of the single particle levels from the ground state of an initial nucleus to the configuration given by two separated nuclei. It also provides a competitive explanation for the fine structure phenomenon in the heavy ions emission. Relevant articles on this topic include the following:

– M. Mirea, Superasymmetric Two-Center Shell Model for Spontaneous Heavy-Ion Emission, Phys. Rev. C **54** (1996).

– M. Mirea, Fine Structure in ^{14}C Cluster Emission from ^{225}Ac, European Phys. J. A **4**, 335 (1999).

– M. Mirea, Realistic Orbital Momentum Operators for the Superasymmetric Two Center Shell Model, Nucl. Phys. A **13** (2006).

– M. Mirea, Time-dependent Pairing Equations for Seniority-One Nuclear Systems, Phys. Rev. C **78**, 044618 (2008).

ii) Generalization of the time dependent pairing equations (formally similar to the time dependent Hartree-Fock-Bogoliubov equations) by including the Landau-Zener effect and the Coriolis coupling. The equations for independent particles and the time dependent pairing equations are particular cases of a new set of generalized equations. The system of equations was deduced first for seniority-1, and then for mixing between seniority-0 and seniority-2 configurations, highlighting a new dynamical pair breaking effect. Relevant articles on this topic include the following:

– M. Mirea, Landau-Zener Effect in superfluid Nuclear Systems, Mod. Phys. Lett. A **18**, 1809 (2003).

– M. Mirea, Time-dependent Pairing Equations for Seniority-One Nuclear Systems, Phys. Rev. C **78**, 044618 (2008).

– M. Mirea, New Dynamical Pair Breaking Effect, Phys. Lett. B **680**, 3164 (2009).

– M. Mirea, Microscopic Description of Energy Partition in Fission Fragments, Phys. Lett. B **717**, 252 (2012).

– M. Mirea, Microscopic Description of the Odd-Even Effect in Cold Fission, Phys. Rev. C **89**, 034623 (2014).

iii) Generalization of the cranking model formalism. The formulas for cranking mass parameters and for moments of inertia were deduced from the variational principle. The dynamical cranking masses include the dependence on the dissipated energies accumulated by the system in its way to scission. It was shown that the classical adiabatic cranking formula is a particular case, when no room for dissipated energy is allowed. Relevant articles on this topic include the following:

– M. Mirea, Cranking inertia of odd nuclei from time-dependent pairing equations: Application to Th cold fission, Phys. Rev. C **100**, 014607 (2019).

– M. Mirea, Nuclear inertia from the time dependent pairing equations, J. Phys. G **43,** 105103 (2016).

– M. Mirea and R.C. Bobulescu, Cranking mass parameters for fission, J. Phys. G **37**, 055106 (2010).

iv) Theoretical optimization for the modeling and the feasibility study for neutron rich nuclei source. Both the experimental assembly geometry and primary deuteron beam energy value that produces a secondary beam of neutrons were optimized, which in turn leads to the fission process. The results obtained in this context have been used to design the SPIRAL2 and ALTO installations. Relevant articles on this topic include the following:

– M. Mirea *et al.*, Modeling of Neutron Rich Nuclei Source, Eur. Phys. J. A **11**, 59 (2001).

– M. Mirea *et al*., Exploratory analysis of a neutron-rich nuclei source based on photo-fission, Nucl. Instr. Meth. B **201**, 433 (2003).

It is also worth mentioning that Mihail Mirea published in May 2020 a comprehensive and valuable review article, where the α decay half-lives and the fine structure phenomenon are investigated with fission-like models: M. Mirea, Fine structure of α decay from the time-dependent pairing equations, Eur. Phys. J. A **56**, 151 (2020).

v) Mihail Mirea's systematic improvements in the microscopic-macroscopic description of reaction dynamics lead to a powerful and a very competitive theoretical approach. The model put forward by Mirea is able to describe three different decay modes in a single nucleus associated to different paths in a common potential energy surface. The developed formalism is also transposable to the synthesis of superheavy nuclei, where in addition to identifying the most favorable fusion fragments, the quasi-fission phenomenon can also be studied. Relevant articles on

this topic were published by Mihail Mirea in collaboration with Aureliu Săndulescu (born: 11 February 1932, deceased: 21 April 2019) and Radu Budaca:

– R. Budaca, A. Sandulescu, and M. Mirea, Quasifission mass distributions in the synthesis of ^{274}Hs with ^{26}Mg and ^{36}S projectiles, Mod. Phys. Lett. A **30**, 1550129 (2015).

– M. Mirea, R. Budaca, and A. Sandulescu, Spontaneous fission, cluster emission and alpha decay of ^{222}Ra in a unified description, Ann. Phys. (NY) **380**, 154 (2017).

vi) In addition to the nuclear physics domain, Mihail Mirea has also worked in atomic physics, contributing to the development of a new, more precise method for calculating the kinematical factors relevant for beta and double beta decay processes (phase space factors, single and summed energy electron spectra, and angular correlations between electrons), which was used in more accurate predictions of beta and double beta decay lifetimes and in the investigation of Lorentz invariance violation. Relevant articles on these topics include the following:

– S. Stoica and M. Mirea, New Calculations for Phase Space Factors Involved in Double Beta Decay, Phys. Rev. C **88**, 037303 (2013).

– S. Stoica, M. Mirea, O. Nitescu, J. Un Nabi, and Z. Iftikhar, New phase space calculations for beta decay half-lives, Ad. High En. Phys. **2016**, ID8729893 (2016).

– M. Mirea and S. Stoica, Phase space factors for Double-beta decay, Frontiers in Physics **7**, 12 (2019).

As can be seen, Mihail Mirea was an outstanding researcher who brought significant theoretical contributions to the domains of nuclear and atomic physics.

Mihail Mirea was a noble, sincere and open person who possessed the virtue of integrity, eager any time to guide and help young students and researchers. The Romanian physics community is certainly losing one of its most valuable researchers. We, the colleagues from the Department of Theoretical Physics, IFIN-HH, Măgurele, will keep him an unforgettable memory.

Colleagues from the Department of Theoretical Physics,
IFIN-HH, Măgurele