

# Preface

Dear Reader,

Welcome to this special EPJ – Web of Conferences issue devoted to the publication of revised selected papers from the presentations made at the tenth International Conference in the series “Mathematical Modeling and Computational Physics”, MMCP 2019 (<http://mmcp.jinr.ru/2019>).

The MMCP 2019 was held during July 1–5, 2019 at the Congress Center Academia of the Slovak Academy of Sciences (SAS) in Stará Lesná, High Tatra Mountains, Slovakia. Together with the permanent organizer of the MMCP conferences, the Laboratory of Information Technologies (LIT) of the JINR, the co-organizers of the tenth MMCP edition have been the Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania, and four Institutions from Košice, Slovakia (the Institute of Experimental Physics (IEP) SAS, the Slovak Physical Society (SPS), the Technical University (TU), and the Pavol Jozef Šafárik University (PJŠU)).

In the tradition of the previous MMCP conferences, it was an open forum to exchange ideas, strengthen personal relations, find incentives for future cooperation, learn and communicate within a wide range of topics. On the one hand, the participants’ grasp of new research topics was enhanced by presentations of forerunner reports on challenges in the contemporary research; the excellent perspectives of the mathematical modeling and computational physics have been illustrated with topics generated by big science projects, cross-disciplinary research, the study of new systems and phenomena, the deep knowledge of special functions chapters. On the other hand, we are glad to notice that a significant fraction of the contributed original reports to this MMCP conference was presented by young authors.

For novices who have not finished their academic studies yet, a satellite event of the MMCP 2019 was the International IT-School “Machine Learning, Parallel and Hybrid Computations & Big Data Analytics”, attended by 26 students, using the ML/DL ecosystem of the HybriLIT heterogeneous computing platform (<http://hlit.jinr.ru/en/>).

The technical and organizational problems raised during MMCP 2019 have been overcome thanks to the abnegation of the Local Organizing Committee members and of several volunteers. We are grateful to all of them for the in-time and high-level solution of all the foreseen and unforeseen tasks.

The coverage of MMCP 2019 (involving plenary lectures and contributions in parallel sections) included: distributed and parallel computing in science and technology; mathematical methods and application software for complex systems; bioinformatics methods and computational biophysics; mathematical methods and software for experimental data processing; computer algebra and quantum computing.

Apart from the already made remarks, contributions to the success of the MMCP 2019 have been brought by a great many colleagues from various research institutions. Special mention is to be made of the role of the Conference Chairmen and all the members of the International Program Committee for their contribution to the definition of the basic aims and the scope of the conference, the proposal, selection, and promotion of invited lectures of the highest interest, the coverage of an important fraction of the reviewing process. The contribution of the 87 independent referees to the quality assessment of the submitted manuscripts is gratefully acknowledged.

The MMCP 2019 was attended by 104 participants from 12 countries. A number of 18 plenary lectures and 74 oral communications were presented. For the 57 manuscripts submitted for publication, a meticulously passed refereeing process was coordinated by the  $\text{\TeX}$  editor Ján Buša, who contacted 115 potential referees. Gheorghe Adam made the critical reading of each submitted manuscript (the authors of the accepted papers have had, however, the last word in deciding to accept

or not the proposed English corrections). All the three Editors contributed to the decisions concerning the manuscript acceptance or rejection.

To facilitate the lecture, we have found it useful to organize the content of this volume into three chapters: plenary lectures; mathematical modeling, numerical methods, and simulation; mathematical and computational support of the experiments, computing tools, and software services. Within each chapter, the papers are ordered alphabetically following the name of the first/single author.

There is a threefold message emerging from the lecture of these papers. First, the computing is pervasive in the modern physics research. Second, fine tuning of the software tools to the existing multi-core, many core, many-GPU hardware facilities is a must in the modern research. Third, the derivation of computing-based sound solutions needs the concurrence of three competences: grasp of rigorous mathematical methods, deep understanding of the underlying physics, flexibility in the use of the reality of the hardware and software environments.

The editors are convinced of the usefulness of the job done. The readers are warmly invited to explore this resource of valuable information for their current and future activity. We hope that the high standard of the MMCP conferences will be preserved in the future and that these conferences will remain a strong attractor of the worldwide scientific community.

This year marked anniversaries of cornerstone events for the fate of the contemporary physics research in Slovakia and Romania. The old University traditions, dating back to 1657, were renewed by foundation of Pavol Jozef Šafárik University in Košice in 1959<sup>1</sup>, which celebrated its 60-th anniversary in the modern times. The Institute of Experimental Physics of the Slovak Academy of Sciences (IEP SAS) in Košice, which was established by the SAS Presidium on January 1st, 1969<sup>2</sup>, celebrated its 50-th anniversary. The Faculty of Electrical Engineering and Informatics of the Technical University of Košice (FEEI TU), which has been set up by the Governmental Decree No. 79/1969, Coll., of July 21, 1969<sup>3</sup>, as a faculty originally entitled “Faculty of Electrical Engineering of the Technical College of Košice”, celebrated its 50-th anniversary. With its present name, established on 15th April 1994, the faculty celebrates its 25-th anniversary. Last but not least, the roots of the Horia Hulubei National Institute of Research and Development in Physics and Nuclear Engineering (IFIN-HH) in Măgurele, near Bucharest, date back to 1949<sup>4</sup>, when the first modern Institute of Physics was created in Bucharest by decision of the Romanian Academy. The 70-th anniversary of this event was celebrated at the Măgurele Campus in May this year. It is a great pleasure for us to devote the present MMCP 2019 Proceedings, to these four anniversaries. We take the opportunity of this event to warmly congratulate our Slovak and Romanian colleagues!

Gheorghe Adam (LIT JINR, IFIN-HH)  
Ján Buša (LIT JINR)  
Michal Hnatič (BLTP JINR, IEP SAS, PJŠU)

<sup>1</sup><https://www.upjs.sk/en/university/university/mission/history-of-the-university/>

<sup>2</sup><http://wwwnew.saske.sk/uef/en/about/history/>

<sup>3</sup><http://fei.tuke.sk/en/faculty/about-the-faculty>

<sup>4</sup><http://www.nipne.ro/about/history/>



# **MATHEMATICAL MODELING AND COMPUTATIONAL PHYSICS 2019**

**Stará Lesná, High Tatra  
Mountains, Slovakia  
July 1 – 5, 2019**

## **Organizers**

**Laboratory of Information Technologies of the JINR, Dubna, Russia**

**Institute of Experimental Physics SAS, Košice, Slovakia**

**Slovak Physical Society**

**Pavol Jozef Šafárik University, Košice, Slovakia**

**Technical University in Košice, Slovakia**

**IFIN-HH, Bucharest, Romania**

### **Organizing Committee**

#### **Chairmen and Vice-Chairmen**

V.V. Korenkov (LIT JINR), P. Sovák (PJŠU),  
Gh. Adam (LIT JINR, IFIN-HH), M. Hnatič (BLTP JINR, IEP, PJŠU)

S.–A. Adam (LIT, IFIN-HH), O.N. Belova (JINR), J. Buša (TU, LIT) – Scientific secretary,  
J. Buša Jr. (IEP, LIT), E. Hayryan (LIT), G. Hnatičová (IEP), M.Kh. Kirakosyan (LIT), P. Kopčan-  
ský (IEP), L. Mižišin (IEP, BLTP JINR), D.V. Podgainy (LIT), M. Reiffers (SPS, PU Prešov, IEP),  
O.Yu. Romyantseva (LIT), O.I. Streltsova (LIT), T.A. Strizh (LIT), Sh.G. Torosyan (LIT), P.V. Zrellov  
(LIT), M.I. Zuev (LIT) – Scientific secretary

#### **International Program Committee**

Gh. Adam (Romania/JINR), O.V. Belov (JINR), K. Borras (Germany/CERN), A. Bogdanov (Rus-  
sia), J. Buša (Slovakia/JINR), B.N. Chetverushkin (Russia), S. Dimova (Bulgaria), A. Feher (Slo-  
vakia), V. Friese (Germany), V. Gerdt (JINR), U.H.E. Hansmann (USA), M. Hnatič (Slovakia/JINR),  
J. Honkonen (Finland), A. Isar (Romania), V.V. Ivanov (JINR), F. Jakab (Slovakia), I. Kisel (Ger-  
many), A. Klimentov (USA/CERN), P. Kopčanský (Slovakia), V.D. Lakhno (Russia), R. Lazarov  
(USA), N. Mamedov (Azerbaijan), G. Maron (Italy), V.S. Melezhik (JINR), H. Safouhi (Canada),  
N.S. Scott (North Ireland), G. Semanišin (Slovakia), L.A. Sevastianov (Russia), T.A. Strizh (JINR),  
P.N. Vabishchevich (Russia), V.V. Voevodin (Russia), P.V. Zrellov (JINR)