

Proceedings of the LIV Zakopane School of Physics  
International Symposium  
Breaking Frontiers: Submicron Structures  
in Physics and Biology

Zakopane, Poland, May 21–25, 2019

*Editors of the Proceedings:*

Marta Marszałek  
Wojciech M. Kwiatek  
Janusz Lekki

WARSAW

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The Symposium was partially supported by:



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# LIV ZAKOPANE SCHOOL OF PHYSICS

*Breaking frontiers:  
submicron structures  
in physics and biology*

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## Preface

The Zakopane School of Physics, International Symposium “Breaking Frontiers: Submicron Structures in Physics and Biology” was held in Zakopane, Poland, from 21 to 25 of May, 2019. Our tradition of this meeting dates back to 1962 when a small group of students and professors decided to combine science appreciation with skiing, entertainment, and general merriment. Since then the meeting has been moved to spring, and since skiing is not quite possible in May in the Polish mountains, other activities took its place. Many ideas have been born during hiking trips across Tatra mountains. The School became a gathering where all our participants have the opportunity to learn, share their knowledge and experience, and discuss recent advances and new techniques in physics, chemistry, materials science, biology, and medicine.

Among 80 participants there were 19 excellent lecturers who are top specialists in the field of material science, biology, physics and chemistry and it was a real pleasure to listen to their talks. This year we focused on hot topics, such as topological semimetals and ultrafast spectroscopy at extreme light infrastructure, while these are the problems which determine the nearest future of research. All the different topics have been well represented: magnetism of low-dimensional systems, nanoscale X-ray imaging and spectroscopy at third generation synchrotron sources, shapeable magnetoelectronics, ion beam materials modifications, first results obtained at PEEM/XAS beamline at Polish synchrotron SOLARIS, and broad spectrum of research concerning anticancer studies of cells and tissues.

In addition to the scientific program of the Symposium, there was also time for informal meetings and discussions, the beginning of collaborations seeding new ideas and friendships. As with the case of previous schools, much fruitful conversation and exchange occurred during the scientific sessions, the mountain excursions, and over the meals, and coffee breaks that participants shared together.

The organization of the School was a team effort. First and foremost, we wish to acknowledge the International Advisory Board, whose members gave significant input and were always very helpful in their feedback. Special thanks goes to all speakers and chairpersons, who kept all sessions within schedule, while still allowing for the lively debates. A fundamental role in the conference preparation was played by the local organizing committee whose outstanding contribution mustn't be overlooked. THANK YOU for your determination, commitment, and patience!

The editors wish to thank all authors and referees for their effort in making these proceedings a good record of what was presented. Special acknowledgments are due to Editor-in-chief Prof. Jan Mostowski, Dr. Joanna Pietraszewicz and Marcin Staszewski for their understanding, help, and assistance in the preparation of these proceedings. The Office of International Relations of the Polish Academy of Sciences, as well as the Laserlab-Europe are acknowledged for their generous support which enabled participation of young students in this event.

The continuing success of this Symposium series leaves us full of hope and anticipation for the next event to be held in 2021. We hope the meeting made at least a small contribution to the relations in the community performing interdisciplinary research, beyond the borders of physics and biology.

Wojciech M. Kwiatek  
Marta Marszałek