Proceedings of the All-Polish Seminar on Mössbauer Spectroscopy

Goniądz, Poland, June 17–20, 2018

Editors of the Proceedings:

Krystyna Perzyńska,
Krzysztof Szymański

WARSAW

POLISH ACADEMY OF SCIENCES
INSTITUTE OF PHYSICS

Honorary Patronate

Professor Robert W. Ciborowski — Rector of the University of Białystok

Scientific Committee

Artur Błachowski (Kraków)
Katarzyna Brzózka (Radom)
Mieczysław Budzyński (Lublin)
Jan Chojcan (Wrocław)
Jakub Cieślak (Kraków)
Józef Deniszczyk (Katowice)
Stanisław Dubiel (Kraków)
Aneta Hanc-Kuczkowska (Katowice)
Elżbieta Jartych (Lublin)
Józef Korecki (Kraków)
Kazimierz Łątka (Kraków)
Dariusz Malczewski (Katowice)
Jacek Olszewski (Częstochowa)
Antoni Pędziwiatr (Kraków)
Janusz Przewoźnik (Kraków)
Marek Przybylski (Kraków)
Krzysztof Ruebenbauer (Kraków)
Dariusz Satuła (Białystok)
Jan Stanek (Kraków)
Krzysztof Szymański (Białystok)
Tadeusz Szumiata (Radom)
Jan Świerczek (Częstochowa)

Organizing Committee

University of Bialystok

Chair: Krzysztof Szymański

Andrzej Andrejczuk
Maria Biernacka
Marek Brancewicz
Beata Kalska-Szostko
Urszula Klekotka
Krystyna Perzyńska
Katarzyna Rećko
Dariusz Satuła
Piotr Zaleski

PAS Branch in Olsztyn and Białystok

Anna Perłowska-Kurian

Preface

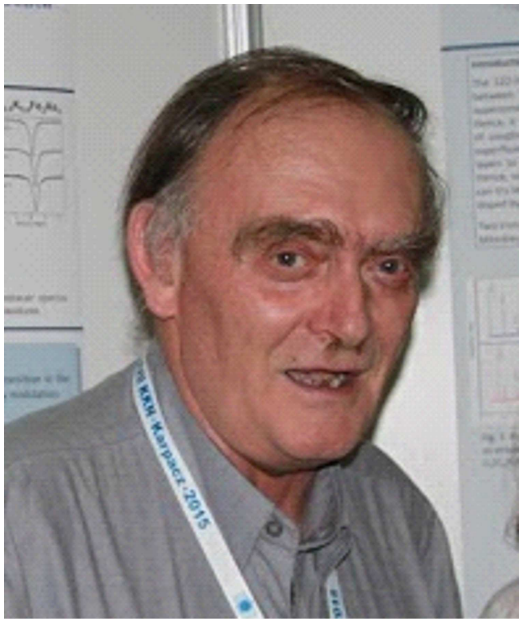
The meetings of the Polish Mössbauer community started in the late 60s and were organized by the Kraków group. After a dozen or so years of absence, the Lublin group renewed conference in 1996 with its Polish name Ogólnoposkie Seminarium Spektroskopii Mössbauerowskiej (OSSM). From that time on, the biennale meetings became a tradition and subsequent regional conferences were organized by groups from different centers in different places (Wrocław — Sobótka Górka, 1998; Radom — Zbożenna, 2000; Białystok — Goniądz, 2002; Katowice — Wisła, 2004; Częstochowa — Koszęcin, 2006; Kraków — Koninki, 2008; Warszawa, 2010; Lublin — Kazimierz Dolny, 2012; Wrocław — Pawłowice, 2014; Radom - Turno, 2016). This year's meeting was organized by the Białystok group and was held from 17th to 20st of June, 2018, again in Goniądz, a charming small town at the Biebrza river and on the outskirts of the Biebrza National Park. Special thanks are due to institutional contributions and help during the conference organization.

The OSSM 2018 meeting brought together 47 active participants. Two invited lectures were given by foreign guests. Content of the Proceedings is divided into 3 sections: nanomaterials; alloys, compounds and ceramics; geology, environmental and extra-terrestrial science.

It was announced that the next regional meeting of Polish Mössbauer community will be organized by the Katowice group in 2020.

Krzysztof Szymański
Guest Editor

In Memoriam
Professor Krzysztof Ruebenbauer (1947–2018)



The Polish and international Mössbauer community is deeply saddened by the death of our member, Professor Krzysztof Ruebenbauer.

Krzysztof Piotr Ruebenbauer was born on the 29$^{\text{th}}$ of August 1947 in Kraków, Poland. His father Tadeusz Ruebenbauer was a Professor of genetics and a Rector of the University of Agriculture in Kraków. Krzysztof Ruebenbauer studied technical nuclear physics at the AGH University of Science and Technology in Kraków and received a M.Sc. degree in 1971, then in 1975 he defended his Ph.D. thesis in the field of condensed matter physics at the Jagiellonian University in Kraków. His Ph.D. thesis supervisor was Professor Andrzej Hrynkiewicz who was a pioneer of Mössbauer spectroscopy in Poland. Krzysztof Ruebenbauer was employed in the Institute of Nuclear Physics of the Polish Academy of Science in the years 1976–1989, and then in the years 1989–2017 in the Pedagogical University in Kraków. His research experiences included long research visits at: the Institut für Angewandte Kernphysik, Karlsruhe, Germany; the Department of Chemistry, McMaster University, Hamilton, Ontario, Canada and the Department of Chemistry and Biochemistry, Concordia University, Montreal, Québec, Canada; The Department of Physics, Purdue University, West Lafayette, USA. In 1993 he received the Polish academic title of Professor of physics. He is an author or co-author of about 100 scientific papers.

His early scientific activity was concentrated on the investigation of the coexistence of ferromagnetism and superconductivity in magnetically diluted rare-earth systems. A region of coexistence of the magnetically soft ferromagnetic clusters embedded in a superconducting matrix was found in $Gd_xCe_{1-x}Ru_2$ Laves phase by means of ^{155}Gd Mössbauer spectroscopy [1]. A work on the highly sophisticated Mössbauer data processing software was started in 1979 [2]. This work was continued over many years resulting in the MOSGRAF package [3] being used in many Mössbauer laboratories. MOSGRAF contains many unique tools to deal with complicated Mössbauer spectra such as for example: the recoilless fraction anisotropy, the external magnetic field methods, the spectra obtained with split and eventually polarized source and to work with a field oriented at an arbitrary angle versus the beam. A series of papers were devoted to the investigation of the diffusional correlation functions in various lattices [4–7]. The Monte-Carlo method was extensively used to look upon mono- and divacancy mechanisms in cubic lattices [4]. Similar methods were applied to hexagonal lattices with a particular attention paid to maximizing the amount of information that can be extracted from the experimental data [5]. High temperature emission Mössbauer spectroscopy was mastered, resulting in the pioneering measurements of the cobalt/iron diffusivity in beryllium by means of emission Mössbauer spectroscopy [6]. Emission Mössbauer spectroscopy at high temperatures and under various atmospheres resulted in two Ph.D. theses supervised by Prof. Krzysztof Ruebenbauer: "Diffusion study by means of Mössbauer spectroscopy" — Ph.D. thesis by Bogdan Sepioł in 1989, and "Emission Mössbauer spectroscopy in rutile single crystals" — Ph.D. thesis by Urszula Wdowik in 1998 [7]. Detailed examinations of the anisotropy of the recoilless fraction were performed on the low–symmetry crystal of stannous fluoride by means of neutron diffraction and compared with the observed Goldanskii–Karyagin effect on random powder samples investigated by Mössbauer spectroscopy [8, 9]. A general theory describing the Goldanskii-Karyagin effect has been outlined [10]. A special method allowing to look upon recoilless fraction anisotropy in amorphous materials was invented [11]. It relies upon application of a strong external magnetic field parallel to the Mössbauer beam within the absorber volume. One of the latest topic of his scientific activity was the interplay between superconductivity and magnetism in iron-based superconductors [12] and charge modulations perturbations at the superconducting transition as seen by the Mössbauer spectroscopy [13]. At the International Conference on the Applications of the Mössbauer Effect ICAME-2017, Saint-Petersburg, Russia (2017) he presented his last invited lecture, about the dynamics of nanoparticles in organic ligands [14].

In addition to his outstanding scientific activities, Professor Krzysztof Ruebenbauer was a man with multiple interests. He liked particularly the outdoors, hiking in mountains being his favorite. Photography was also one of his passions. He was always ready to take pictures of anything unusual, or simply of the beauty of nature. He was passionate about history. He was very knowledgeable about everything, a real walking encyclopedia, and very much

willing to share his limitless knowledge. He enjoyed life, good food, and he always took great care to invite his guests to the best restaurants in Kraków. He was an excellent host and also a very pleasant guest to have. He had a great sense of humor.

Professor Krzysztof Ruebenbauer died on the 23rd of April 2018 and he was buried in the Rakowicki Cemetery in Kraków. He leaves behind his wife Ewa, who was a medical biologist before retiring, and their daughter Agnieszka, Ph.D. in biology.

Krzysztof, we are going to miss you, as you were kind, helpful and an outstanding scientist and an authority in the field of Mössbauer spectroscopy.

Artur Błachowski
Georges Dénès
July, 2018

References

[1] K. Ruebenbauer, J. Fink, H. Schmidt, G. Czjzek, K. Tomala, *Phys. Status Solidi B* **84**, 611 (1977).
[2] K. Ruebenbauer, T. Birchall, *Hyperfine Interact.* **7**, 125 (1979).
[3] K. Ruebenbauer, Ł. Duraj, MOSGRAF-2009.
[4] K. Ruebenbauer, B. Sepiol, *Hyperfine Interact.* **30**, 121 (1986).
[5] K. Ruebenbauer, B. Sepiol, B. Miczko, *Physica B* **168**, 80 (1991).
[6] B. Sepiol, K. Ruebenbauer, B. Miczko, T. Birchall, *Physica B* **168**, 159 (1991).
[7] U.D. Wdowik, K. Ruebenbauer, *Phys. Rev. B* **63**, 125101 (2001).
[8] T. Birchall, G. Dénès, K. Ruebenbauer, J. Pannetier, *J. Chem. Soc. Dalton Trans.* **1981**, 1831 (1981).
[9] T. Birchall, G. Dénès, K. Ruebenbauer, J. Pannetier, *Hyperfine Interact.* **30**, 167 (1986).
[10] K. Ruebenbauer, *Physica B* **172**, 346 (1991).
[11] K. Ruebenbauer, B. Sepiol, *Hyperfine Interact.* **23**, 351 (1985).
[12] A. Błachowski, K. Ruebenbauer, J. Żukrowski, K. Rogacki, Z. Bukowski, J. Karpinski, *Phys. Rev. B* **83**, 134410 (2011).
[13] A.K. Jasek, K. Komędera, A. Błachowski, K. Ruebenbauer, Z. Bukowski, J.G. Storey, J. Karpinski, *J. Alloys Comp.* **609**, 150 (2014).
[14] J. Żukrowski, A. Błachowski, K. Komędera, K. Ruebenbauer, G. Gabka, P. Bujak, A. Pron, M. Przybylski, *J. Phys. Chem. C* **121**, 6977 (2017).