

Masaryk University	
Faculty	Faculty of Science
Procedure field	Condensed Matter Physics
Applicant	Ing. Jiří Orava, Ph.D.
Applicant's home unit, institution	J. E. Purkyně University
Habilitation thesis	What Drives the Lability of Glass-Forming Liquids to Crystallize? Applications in Electronic, Structural and Optical Materials
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Evaluation of the applicant's scholarly/artistic qualifications

Dr. Jiří Orava received his Master's degree in Materials Science, Chemistry and Technical Chemistry and his Ph.D. in Materials Science, Chemistry and Technology of Materials from the University of Pardubice in 2005 and 2009, respectively. Orava's doctoral research project was focused on the physical and chemical properties of bulk and thin films of chalcogenide glasses. Together with his PhD supervisor and coworkers, he has determined, using spectroscopic ellipsometry, the temperature dependence of the complex dielectric function and optical bandgap energy of thin films of the phase-change memory material Ge₂Sb₂Te₅. Importantly, the dependence covered the transition from the amorphous to the fcc phase, which is at the heart of the memory mechanism. The results were published in the Journal of Applied Physics in 2008, and they have been used by many authors and treated as a reliable standard. This period also marks the beginning of the collaboration with the Masaryk University because all ellipsometric measurements were done under the supervision of doc. Mgr. Jan Sik, Ph.D. (formerly at MU, now at On Semiconductor Czech Republic).

In 2009–2012 and 2013–2019, Orava worked as a postdoctoral research associate, later on as a postdoctoral research assistant at the University of Cambridge, in the Department of Materials Science and Metallurgy, in 2012–2013 as a research associate at the Tohoku University (Sendai, Japan), in 2018–2021 as a research fellow at the Leibnitz Institute for Solid State and Materials Research (Dresden, Germany). During these research stays, Orava significantly contributed to the current knowledge in the field of physical properties of amorphous materials, in particular to (i) understanding of structure and kinetics of thin-film phase-change and ionic-migration memory materials, (ii) general understanding of kinetics of phase transitions and diffusion in non-equilibrium (metastable) materials, (iii) development of methods for functionalizing metallic and chalcogenide glasses by tuning their structure and correlating it with on-demand macroscopic properties, (iv) understanding the mechanism of rejuvenation in metallic glasses, (v) in-situ synchrotron X-ray studies of structural changes and phase transformations in metallic-glass-forming systems and to (vi) studies of thermal properties of non-crystalline materials via ultra-fast-scanning calorimetry.

Since 2021, Orava has been an assistant professor at the Faculty of Environment of the Jan Evangelista Purkyně University in Usti nad Labem. His current research activities are manifold building on his expertise in materials science but also expanding to new areas of research, such as energy and environmental materials. Orava's results and publications testify to his creativity, diligence, ability to work in a team, and consistent and coherent research focus (later works build excellently on previous insights). They demonstrate that he is an original and creative researcher who can develop new ideas and solutions that provide important progress in research.

Jiří Orava has authored or coauthored 75 publications listed in the WOS database (journal papers and proceedings papers), some of them in top journals (1 in Nature Materials, 1 in Nature Communications, 2 in Advanced Functional Materials, 1 in Science Advances, 2 in Acta Materialia, etc., in most cases, Orava is the first or the corresponding author). The publications have been cited 1706 times, 1572 times excluding direct self-citations (as of February 4, 2023). The Nature Materials paper gained about 350 citations. Orava gave 12 invited talks at respected international conferences.

Conclusion: The applicant's scholarly/artistic capabilities **meet** the requirements expected of applicants participating in a habilitation appointment procedure in the field of Condensed Matter Physics.

Evaluation of the applicant's pedagogical experience

Jiří Orava has been involved in teaching since 2005. In 2005 and 2006 he was responsible for the laboratory course on inorganic chemistry at the University of Pardubice. In 2010–2017, except for 2012, he led practical classes on atomic force microscopy for master's students at the University of Cambridge; at Cambridge he also acted as "head of class" for the third-year undergraduate laboratory course on AFM and co-

supervised undergraduate group projects, and 3-month masters level projects focused on measuring mechanical properties by AFM. In 2014–2015, he contributed with several lectures on metallic glasses, AFM, etc., to the Solid State Chemistry course at the University of Pardubice. Since 2021, at the Jan Evangelista Purkyně University in Ústí nad Labem, Orava has been responsible for the course (lectures) Sustainable materials and technologies: Making more with less; since 2022, he has been a guarantor of two other courses: mandatory exam "Odborná zkouška z angličtiny" (Scientific English) for PhD students at the Faculty of Environment, and Materials and Technologies for Sustainable Society for PhD students at the Faculty of Science.

Orava also significantly contributed to the supervision of bachelor, master, and PhD students at the University of Pardubice and the University of Cambridge, as documented in the supporting letters by Professor Tomas Wagner from Pardubice and Professors Lindsay Greer and Zoe Barber from Cambridge. He currently supervises one doctoral candidate.

Conclusion: The applicant's pedagogical capabilities **meet** the requirements expected of applicants participating in a habilitation appointment procedure in the field of Condensed Matter Physics.

Habilitation thesis evaluation

Orava's habilitation thesis entitled "What Drives the Lability of Glass-Forming Liquids to Crystallize: Applications in Electronic, Structural and Optical Materials" is based on selected publications that originated in 2012–2021. It consists of an extensive introduction to the field (ca 70 pages) and a collection of 22 attached reprints starting with the Nature Materials paper "Characterization of supercooled liquid Ge₂Sb₂Te₅ and its crystallization by ultrafast-heating calorimetry".

The thesis has been reviewed by three experienced scientists: Professor Richard J Curry from the University of Manchester, Professor Bart J. Kooi from the University of Groningen, and Professor Jiří Málek from the University of Pardubice. All reviewers concluded that the habilitation thesis fulfils the requirements expected of a habilitation thesis in the field of Condensed Matter Physics. In their reports, they highlighted the high level of understanding, the ability to make connections across a wide range of glass families, the high quality of the underlying research and publications, and the coherence of the collection thereof, showing the systematic manner in which Orava worked on sequential research topics, and the focus on publishing high-quality research rather than on producing a large number of papers.

Conclusion: The applicant's habilitation thesis **meets** the requirements expected of habilitation theses in the field of Condensed Matter Physics.

Secret vote results

Voting took place: electronically

Number of board members		5
Number of votes cast		5
of which	in favour	5
	against	0

Board decision

Based on the outcome of the secret vote and following an evaluation of the applicant's scholarly or artistic qualifications, pedagogical experience and habilitation thesis, the board hereby submits a proposal to the Scientific Board of the Faculty of Science of Masaryk University to **appoint the applicant associate professor** of Condensed Matter Physics.

In Brno on 10.02.2023

prof. Mgr. Dominik Munzar, Dr.