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## Supervisor's review of the dissertation thesis

**Student:** Ing. Jana Matoušková  
**Thesis title:** Neutron Imaging at Very Low Power Research Reactors  
**Affiliation:** Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Department of Nuclear Reactors  
**Degree programme:** Application of Natural Science, sub-programme Nuclear Engineering

Ms Jana Matoušková has been my doctoral student since March 2020. The topic of Jana's doctoral research is the development of neutron imaging instrumentation for low-power research reactors and its use for education and research. Neutron imaging (i.e. neutron radiography and tomography) is a well-known and well-developed non-destructive nuclear analytical technique for strong neutron sources such as medium or high-power research reactors with the power of MW. However, neutron imaging at very low-power research reactors is challenging due to the lack of neutrons, long exposition time and many technological and operational limitations, which can be found at very low-power research reactors. As an academic staff, I have been dreaming of building a neutron imaging facility at our VR-1 reactor with a nominal power of 100 W for almost three decades. Finally, after thirty years, Jana, a very talented and hard-working doctoral student, fulfilled my dream.

The first neutron imaging instrumentation NIFFLER (Neutron Imaging Facility for Learning and Research) at the VR-1 reactor was developed in the complicated Covid-19 pandemic period in 2021-2022 in close collaboration with Heinz Maier-Leibnitz-Zentrum, Technische Universität München in Garching in Germany with the research group of Dr Burkhard Schillinger who also became Jana's co-supervisor. The first experiments in neutron radiography (2D imaging) were very promising and clearly showed that NIFFLER can be used not only for education but also for research purposes, as well as its capabilities in neutron tomography (3D imaging). In late 2021, the VR-1 reactor, due to Jana's research work, joined the group of the first five very low-power research reactors (at the power of hundreds of W or several kW) that can perform neutron radiography in the world. Due to Jana's hard work, we performed the first neutron tomography at a very low-power research reactor worldwide.

It should be emphasised that Jana started her doctoral study only in March 2020 and submitted her dissertation thesis on time in the eighth semester of her doctoral study. During this short period, she published five scientific papers, of which Jana is the first author of four papers and co-author with a significant contribution in the fifth paper. The dissertation thesis is written as a commented set of these five scientific papers. Comments are more extended than we can usually find in this form of the dissertation thesis. Still, together with the published paper, they made a comprehensive research publication that can be used as a crucial reference source for other students or researchers dealing with neutron imaging at low-power research reactors. In this context, the high level of English used in the dissertation thesis should be mentioned.

Even though five impacted papers clearly show Doctorand's impact on the scientific community worldwide, several additional non-metric Jana's impacts on the world neutron community should be emphasised. The neutron imaging community highly acknowledged this remarkable success, and we were invited to extend our collaboration with colleagues from MLZ Garching in Germany to collaborate with researchers from the Idaho National Laboratory and Oak Ridge National Laboratory in the USA and ILL Grenoble in France. The International Atomic Energy Agency (IAEA), as the most reputed international organisation in the peaceful use of nuclear energy, also highly appreciated the results which Ms Matoušková achieved with the NIFFLER imaging instrumentation:

1. In 2021, as an invited speaker, Jana was invited to share her experience in the IAEA AUNIRA 2021 workshop on the advanced use of neutron imaging for research and applications.
2. In 2022, IAEA asked Jana to join a group of neutron imaging upgrade developers at the research reactor RA-6 at CNEA in San Carlos de Bariloche, Argentina, to share her experience from the NIFFLER development and granted her a fellowship for four months to install and to commission new system on-site, at the RA-6 reactor.
3. In 2023, Jana got an invitation to deliver the keynote lecture at the IAEA international conference on research reactors, which was planned to be held in November 2023 in Jordan but, due to war in Israel, is postponed to 2024. Jana will be the youngest researcher worldwide who has the privilege of being the keynote lecturer in this IAEA topical conference of research reactors, which is held every four years.
4. In 2023, the IAEA published an article about Jana's story in the development of a neutron imaging system in the IAEA Bulletin (December 2023), the IAEA's flagship publication, highlighting IAEA's work in the peaceful uses of nuclear technology, nuclear safety and security and non-proliferation.
5. In 2023, the IAEA also invited Jana to contribute to the neutron imaging section of a new revision of the IAEA publication Application of Research Reactors.

Based on Jana's doctoral research results at the VR-1 reactor, we (Jana and I) are developing a new neutron imaging facility at 10 MW high-power research reactor LVR-15 in Research Centre Řež. In this context, we got very promising results from culture heritage preservation research (as described in the third paper - Annex A.3), and right now, a prestigious collaboration with the National Gallery Prague is already established and collaboration with the Institute of Archaeology of the Czech Academy of Sciences is under development.

As a supervisor, I can declare that Ing. Jana Matoušková is a hard-working, very talented and enthusiastic young lady who, during doctoral study, proved that she can provide scientific work. I am proud of her, and without any doubt, I can suggest that she deserves to obtain a scientific degree PhD.

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