Supervisor's statement about the PhD thesis by **Mgr. Milan Berta**

Prague, September 20, 2010

Since 2005, Milan Berta has been working under my supervision as PhD student in the Institute of Physics. The topic of his PhD thesis, near-field imaging by using time-domain terahertz spectroscopy, is a modern subject also currently studied in other leading research groups.

During his PhD work, the candidate has gained a broad experience in several domains linked to terahertz imaging and microwave near-field techniques. At the beginning of his studies, he had to build up an experimental configuration able to meet our needs. At first, the imaging setup worked with a split-off portion of an amplified laser beam, which was far from ideal for the given purpose. The femtosecond oscillator was only purchased more than one year after the beginning of his thesis. Thus, building the whole setup took inevitably quite a long time.

Once the setup was operational, Milan has started to analyse the obtained first experimental data. Again, he was in a situation where he could not rely on earlier works, because the technique he was using had not been applied before. Facing the problem how to extract useful information from the data, he undertook by himself an initiative to apply mathematical methods of Singular Value Decomposition, which required to master the formalism, apply an appropriate software tool and get a deeper understanding of the data treatment. It proved to be an efficient approach, enabling us to discern the signal due to sensed structures from experimental noise and artifacts.

At the same time, in order to gain insight into the details of the near-field probe functioning, he performed a large amount of numerical simulations of electromagnetic wave propagation. To this purpose, he has mastered the Microwave Studio software, which is a complex environment including a real-time solver. In order to learn to use it efficiently, Milan visited the partnership laboratory in Jülich, Germany, which holds the software license, and where he also performed near-field experiments using continuous-wave microwave sources. Based on his knowledge of the simulations, he has been able to make a link to his experimental data. Specifically, he has performed an unprecedented work in near-field imaging of ferroelectric domains.

Finally, during the last year, he was active in developing a novel variant of the imaging technique, where a dual-material sensing probe is employed, with the aim to increase the signal-to-noise ratio. Among other things, he has developed a procedure of manufacturing of probes from plastics, and he has maintained his effort in order to make the technique work. He has then succeeded in acquiring first surface scans and demonstrating the functionality of this imaging approach.

To conclude, during his PhD studies, Milan Berta has proved a high level and a wide range of skills. He has succeeded in setting up the experiment, acquiring, for the first time by this technique, experimental data on various samples and, also thanks to the simulations, explaining the near-field operation of the probes. All his achievements are explained in a clear and detailed way in his thesis manuscript. Therefore, to my mind, his thesis deserves to be accepted for defence.

Dr. Filip Kadlec
Institute of Physics
Academy of Sciences of the Czech Republic
Na Slovance 2
182 21 Praha 8