M U N I

Annex No. 10 to the MU Directive on Habilitation Procedures and Professor Appointment Procedures

HABILITATION THESIS REVIEWER'S REPORT

Masaryk University	
Applicant	Mgr. Zdeněk Bonaventura, Ph.D.
Habilitation thesis	Modelling of Non-Equilibrium Electrical Discharges: Streamers and Determination of Electric Field from Optical Emissions
Reviewer	Claudiu Costin, Ph.D., Professor Habilitated
Reviewer's home unit, institution	Alexandru Ioan Cuza University of Iasi, Faculty of Physics, Iasi, Romania

The habilitation thesis of Dr. Zdeněk Bonaventura presents a coherent and scientifically significant research devoted to the modelling of non-equilibrium electrical discharges, with particular emphasis on streamer physics, numerical modelling techniques, photoionization processes, runaway electrons, and electric-field estimation from optical emission measurements.

The thesis is based on ten peer-reviewed scientific papers published in important international journals in plasma physics and computational physics; most of the articles appeared in *Plasma Sources Science and Technology*. Published in the last 15 years, these works demonstrate the candidate's continuous and significant contribution to the field of low-temperature plasma physics.

The thesis is organized into two chapters: numerical modelling of streamer discharges and theoretical foundations of electric-field determination from optical emission spectroscopy measurements. These topics are closely interconnected and together address fundamental questions concerning the physics and diagnostics of transient non-equilibrium plasmas.

The first chapter provides a comprehensive overview of fluid models of streamer propagation, including charged-particle transport, numerical treatment of Poisson's equation, surface processes, photoionization models, and numerical challenges associated with multiscale plasma simulations. The discussion demonstrates the candidate's deep understanding of both the physical and mathematical aspects of the problem. It worths mentioning the contributions to adaptive numerical methods and error-controlled simulations of streamer dynamics. The development of advanced computational approaches capable of resolving the strongly coupled and multiscale nature of streamer discharges represents an important contribution to computational plasma physics.

The second chapter is focused on electric-field determination using optical emission spectroscopy. Dr. Bonaventura contributed to the development of a methodology that links the experimental intensity-ratio method with a collisional-radiative model, enabling the determination of the electric field inside streamer discharges. The performed sensitivity

analyses and uncertainty assessments increase the reliability of deriving electric fields from experimental optical data and provide valuable guidance for future diagnostic applications. These contributions are of considerable importance for the plasma-physics community because they connect fundamental modelling with experimentally accessible observables.

The thesis provides evidence of the scientific independence and academic maturity gained by Dr. Bonaventura. He has been actively involved in defining research directions, supervising students and young researchers, and participating in competitive research projects. He evolved from 50% work contribution and n/a supervision in 2011 (paper A1) to 10% work contribution and 80% supervision in 2023 (paper B7).

The publications discussed in the thesis benefit of international recognition. According to Google Scholar, several of the selected papers have become widely cited references within their respective research areas: paper A1 has over 100 citations, A2 over 90, B6 over 70, A3 and B1 over 50. The reported results have contributed to a better understanding of transient plasma phenomena occurring both in laboratory and in atmospheric discharges. Dr. Bonaventura has grown an internationally visible research profile, as demonstrated by his publications and his long-standing collaborations with recognized international research groups, particularly in France and Denmark.

From the formal point of view, the thesis is well written and logically structured. The two chapters successfully place the selected publications into a broader scientific context and provide a coherent overview of the candidate's research achievements. The scientific arguments are clear, and the discussion reflects a good knowledge of the relevant literature.

In my opinion, the habilitation thesis written by Dr. Zdeněk Bonaventura fully demonstrates that he has achieved international recognition in the field of plasma physics and has established himself as an independent researcher capable of leading further scientific developments in this area.

Reviewer's questions for the habilitation thesis defence (number of questions up to the reviewer)

1. Which physical processes are currently the largest source of uncertainty in streamer simulations?
2. What do Dr. Bonaventura consider to be the most significant scientific contribution of his work to the understanding of streamer discharges?

Conclusion

The habilitation thesis entitled "*Modelling of Non-Equilibrium Electrical Discharges: Streamers and Determination of Electric Field from Optical Emissions*" by Zdeněk Bonaventura **fulfils** requirements expected of a habilitation thesis in the field of Physics of Plasma.

Date: June 9, 2026 Signature: